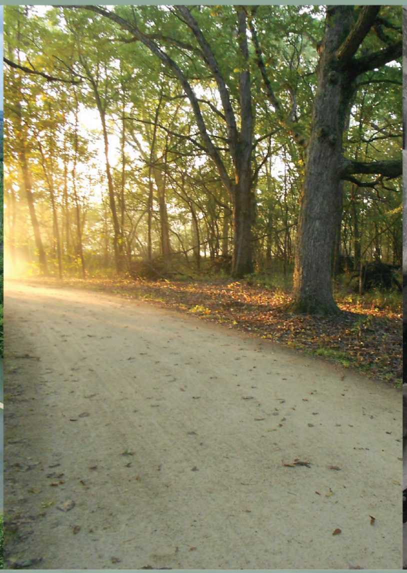
Des Plaines River Watershed-Based Plan






June 2018

Des Plaines River Watershed-Based Plan

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STORMWATER MANAGEMENT COMMISSION

Lake County Stormwater Management Commission
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Funding for this plan was provided by the United State Environmental Protection Agency under Section 319(h) of the Clean Water Act; distributed through the Illinois Environmental Protection Agency. The contents and recommendations in this document are not necessarily those of the funding agcenies.

STORMWATER MANAGEMENT COMMISSION

ACKNOWLEDGEMENTS

The Des Plaines River Watershed-Based Plan was funded in part through the United States Environmental Protection Agency Section 319(h) of the Clean Water Act program administered by the Illinois Environmental Protection Agency. The Lake County Stormwater Management Commission (SMC) also provided funds and in-kind services including project coordination and management, report authorship, geographical information systems support, consultant contract administration, stakeholder input coordination, education and outreach plan, and design layout services. The Des Plaines River Watershed Workgroup (DRWW) provided significant in-kind services towards the Des Plaines River watershed water quality monitoring strategy.

Several agencies and individuals provided significant contributions to this watershed-based plan including the Des Plaines River watershed (stakeholder) planning committee whose members include representatives from municipal, county, state and federal agencies, homeowner and lake associations, agricultural producers, and interested groups and individuals from the watershed. Of particular mention is Mike Warner, Mike Prusila, Patty Werner, Jeff Laramy, Ashley Warren, Ernesto Huaracha, Jacob Jozefowski, Sharon Osterby, and Neil Schindelar of SMC; and Mike Adam and staff of the Lake County Health Department. Jeff Boeckler and James Adamson of Northwater Consulting contributed significant support to SMC with analyzing data and writing sections of the plan report. Andi Dunn of Technical Communications Consulting performed editing and formatting on the watershed-based plan. SMC was the grant manager for this report. Strong partnerships with the DRWW and local subwatershed planning committees: Bull Creek – Bulls Brook Watershed Council and Buffalo Creek Clean Water Partnership created a more comprehensive watershed-based plan through outreach to the watershed and technical assistance.

In addition to those who were already mentioned, technical information was presented at watershed planning committee meetings by Lake County Health Department, DRWW, Libertyville Open Space District, Lake County Emergency Management Agency, North Shore Water Reclamation District, Village of Libertyville, Lake County Public Works, Village of Lindenhurst, Conserve Lake County, Lake County Forest Preserve District, Mundelein Park District, Tempel Farms, Diamond Lake Preservation Alliance, Loch Lomond Property Owners Association, Third Lake Management Committee, Gages Lake Lakes Committee, Libertyville-Mundelein Historical Society, Prairie Crossing Charter School, Lake County Department of Transportation, Northwater Consulting, Village of Buffalo Grove, Illinois Department of Transportation, Illinois Tollway Authority, Village of Gurnee, Bull Creek – Bulls Brook Watershed Council and the Buffalo Creek Clean Water Partnership.

The North Shore Water Reclamation District, Lake County Central Permitting Facility, Ryerson Woods Visitor Center, Mundelein Park District, Tempel Farms, Lake County Department of Transportation, Lake County Forest Preserve Operations & Public Safety Facility, Libertyville City Hall, Village of Buffalo Grove Council Chambers graciously supported the watershed planning effort by providing meeting spaces for the watershed planning committee. *Most of all we would like to recognize the project partners and watershed stakeholders whose interest in protecting, restoring, and enhancing the Des Plaines River watershed planning area has been critical to the success of this plan. The following individuals and organizations participated in watershed planning committee meetings from March 2016 – February 2018:*

Cover photos taken by SMC, LCDOT and Paul Klonowski

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Anderson	Ders	Openlands
Anderson	Jim	Lake County Forest Preserve District
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Benavides	Kristen	Resident
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Billington	Craig	Forest Preserve District of Cook County
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Buckardt	Nan	Lake County Forest Preserve District
Bundalo	Cindy	Wildwood Valley Lake
Bundalo	Dan	Wildwood Park District
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Lineham	Jack	Village of Gurnee
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Little	Barbara	Village of Deerfield
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Lofstrom	Michael	Vernon Township
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Marrs	Joseph	Cedar Crossing HOA
Martini	Judy	Lake County Board Dist.5
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Miceli	Tom	Sierra Club & Lake County Forest Preserve River Steward
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Papp	Kathy	Wetland Research Inc.
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Peterson	Maria	Resident
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Phillips	Katrina	Sierra Club
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Pippen	Scott	Village of Lincolnshire
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Popelle	Joe	Long Lake Improvement & Sanitation Assn.
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LAST NAME	FIRST NAME	ORGANIZATION/ENTITY
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Robinson	Joe	North Shore Water Reclamation District
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Rogers	Carol	Warren Township High School
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Ruscoe	Mark	City of Prospect Heights
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Sauter	Holly	Metropolitan Water Reclamation District of Greater Chicago
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Schneider	Fred	Resident
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LAST NAME	FIRST NAME	ORGANIZATION/ENTITY
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Urbanozo	Gerard	Lake County Health Department
Vancil	Susan	Lake County Stormwater Management Commission
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Warren	Ashley	Lake County Stormwater Management Commission
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Weik	Ken	Resident
Weinen	Kitty	Senator Mark Kirk Rep.
Weiss	Jeff	Buffalo Creek Clean Water Partnership
Werner	Patty	Resident
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Western	John	Audubon Society
Williams	Chris	Village of Lake Villa
Williamson	Nancy	Illinois Department of Natural Resources
Wilson	Donald	Resident and Volunteer Steward
Wittenberg	Bill	Resident
Witthuhn	Vern	Strand Associates
Wojcik	Thomas	Resident
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Wolfgram	Jeff	Village of Wheeling
Woolford	Kurt	Lake County Stormwater Management Commission
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Yoder	Chris	MBI
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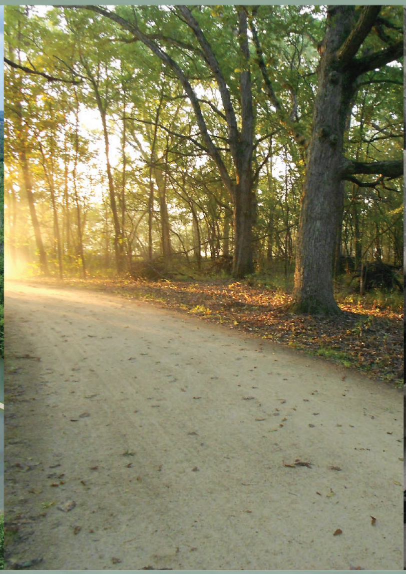
Zehner	Steve	Robinson Engineering
Zemaitis	Mike	Lake County Div. of Transportation
Zink	Sarah	Integrated Lakes Management

Des Plaines River Watershed-Based Plan






EXECUTIVE SUMMARY • June 2018

INTRODUCTION:

Why a Watershed-based Plan?

Water is elemental to our lives. Plants and animals, including humans, are largely composed of water, and generally require clean water to survive. Our communities, food systems, energy sources, and countless products that we consume everyday are dependent upon water. Despite this dependence, water is often taken for granted until it negatively affects us, usually due to short supply, inundation, or pollution.

Your actions help to:

- keep water in our rivers, streams, lakes and wetlands clean
- reduce the impacts of flooding
- protect and enhance natural resources
- maintain "green" and "grey" infrastructure
- increase awareness of watershed issues and opportunities

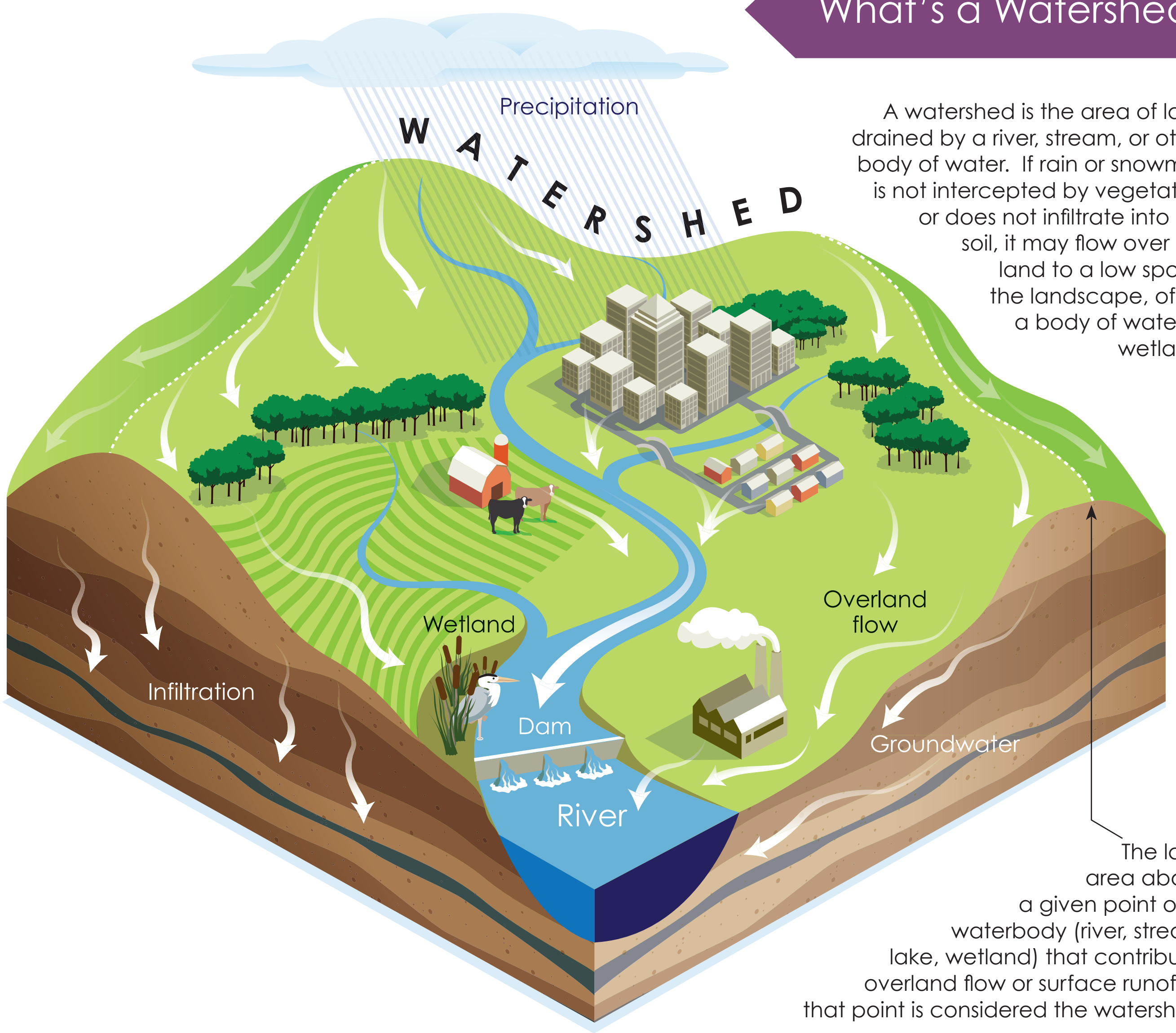
This watershed-based plan is important because it specifically addresses water-related issues in communities within the Des Plaines River Watershed Planning Area. Clean and abundant water, healthy streams and lakes, and safety from flooding are important to residents and business and therefore play a significant role in the quality of life, health and economic vitality of our communities. Clean and healthy watersheds are assets that make communities more desirable for residents and businesses; however, flooding can damage property and result in local economic impacts. Lakes, rivers, and streams in the planning area provide recreational destinations for watershed residents as well as tourists and are a highly visible indicator of watershed health. These waterbodies support a diverse variety of water-dependent plants and animals and are critical to local ecosystems.

Water does not generally flow according to political boundaries. Consequently, we recognize the watershed as the appropriate scale to address most water resource issues, which often involve multiple political jurisdictions. The Des Plaines River watershed planning process brought together numerous watershed stakeholders to provide input towards the management and enhancement of water resources in the planning area.

During this planning process, critical data was obtained from record flooding that occured in 2017, as well as a comprehensive water quality monitoring effort conducted on watershed streams.

This watershed-based plan utilizes these sources of up-to-date information as well as historical data to provide a comprehensive summary of existing watershed conditions and trends. It recommends actions stakeholders can take to protect resources that are in good condition and restore those that have been degraded. As a resident, landowner, business or community official, you make a difference.

What's a Watershed?



A watershed is the area of land drained by a river, stream, or other body of water. If rain or snowmelt is not intercepted by vegetation or does not infiltrate into the soil, it may flow over the land to a low spot in the landscape, often a body of water or wetland.

The land area above a given point on a waterbody (river, stream, lake, wetland) that contributes overland flow or surface runoff to that point is considered the watershed.

Des Plaines River Watershed Planning Area Vision Statement

The Des Plaines River watershed planning area will be a destination valued by residents, businesses, and governments that join together to actively engage in education and participate in improving water quality. Stakeholders will preserve and enhance regional green infrastructure, resulting in cleaner streams and lakes, better plant and animal biodiversity, and reduced flood damage – while balancing a sustainable native landscape with development and economic growth.

AT A GLANCE:

Des Plaines River Watershed Planning Area

The Land

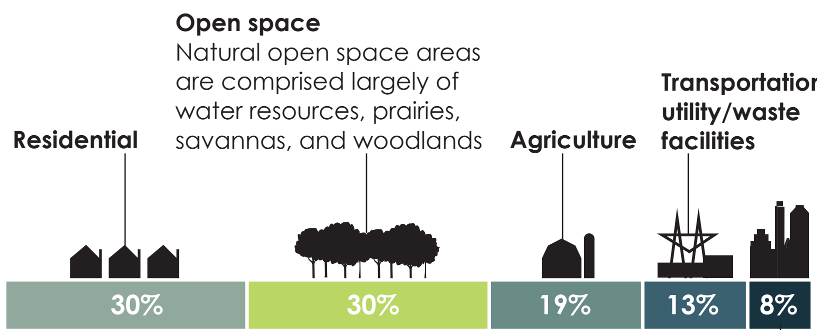
240 miles of rivers and streams

53 named lakes

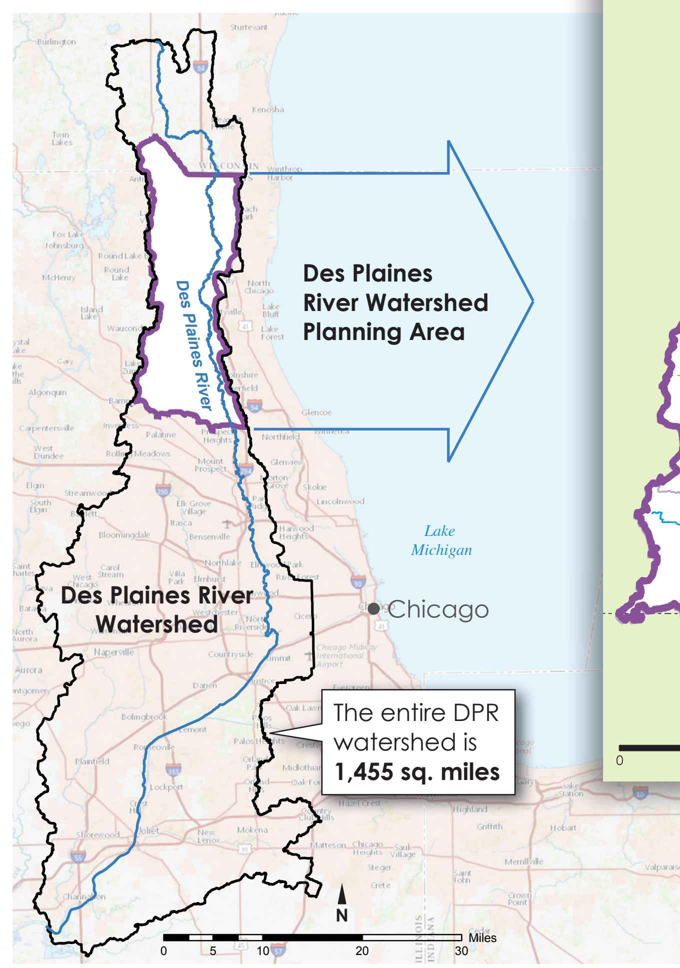
17,000 acres of wetlands

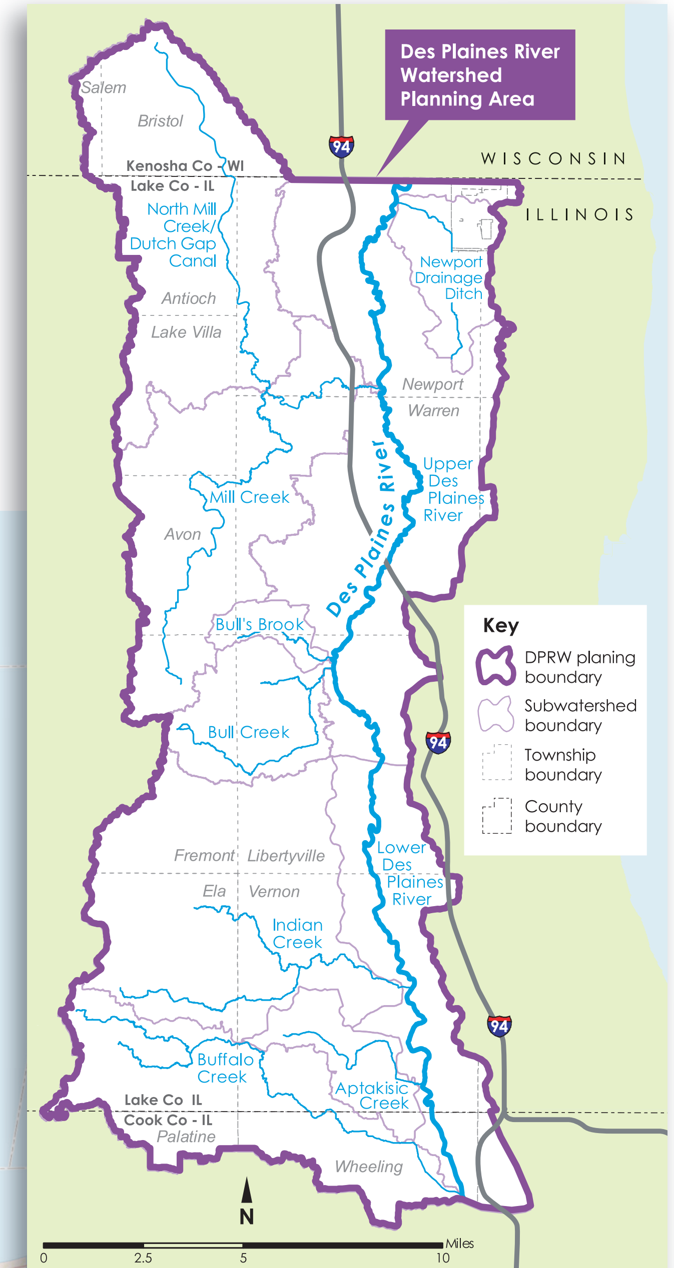
The Des Plaines River Watershed-Based Plan covers 235 square miles in Lake and Cook Counties in Illinois and Kenosha County in Wisconsin. This planning area is part of the much larger Des Plaines River watershed, which covers 1,455 square miles in Southeastern Wisconsin and Northeastern Illinois and is part of the Illinois and Mississippi River Basins. The planning area is divided into 10 smaller "subwatersheds": the Upper Des Plaines River, Lower Des Plaines River, Newport Drainage Ditch, North Mill Creek-Dutch Gap Canal, Mill Creek, Bull's Brook, Bull Creek, Indian Creek, Aptakisic Creek, and Buffalo Creek.

What's in the planning area:



Commercial, industrial, government/institutional, and office/research parks together encompass less than 10% of total watershed area but may have significant impacts on water resources, particularly where these uses are geographically concentrated.





The Des Plaines River Watershed-Based Plan is the first "umbrella" plan developed by SMC, in that it includes and updates five previous plans for smaller subwatersheds within the planning area: Bull Creek-Bull's Brook, Buffalo Creek, Indian Creek, Mill Creek, and North Mill Creek-Dutch Gap Canal, and completes planning for the remaining subwatershed areas with no previous watershed plans.

The People

400,000 approximate population in 2010

39 municipalities

15 townships

THE PLANNING AREA: A SPECIAL PLACE

The natural landscape of the planning area was formed by the retreat of a continental ice sheet more than 10,000 years ago. This process resulted in the low moraine ridges, kettle lakes and depressions, and outwash plains that give shape to the water resources and natural communities we see in the watershed today, including more than 50 lakes and 240 miles of river and streams. The planning area has a diverse mix of land uses with relatively large areas of natural and recreational open space interspersed with residential neighborhoods, commercial districts, and employment centers. Agriculture remains a major land use activity in the northern half of the planning area. The rural character in this part of the planning area has been identified as an important attribute by stakeholders.

Within the open space network are significant "ecological complexes" of more than 10,000 acres: one complex in the northern end of the planning area extending from Rollins Savanna to Red Wing Slough and one complex that runs along the Des Plaines River. These natural areas store and cleanse stormwater, provide important habitat for an array of plants and wildlife, and offer a myriad of recreational opportunities.

The Des Plaines River corridor is an archetype of "green infrastructure", providing an array of benefits including floodplain protection and flood damage reduction, open space and habitat preservation, and an unbroken recreational trail connection from north to south through the planning area. The planning area contains dozens of natural lakes and thousands of acres of wetlands resulting from the last glaciation. These lakes and wetlands often are a source of baseflow to streams, provide important habitat to native and threatened/endangered plants and wildlife and offer abundant recreational opportunities. The benefits of natural waterbodies are augmented by impounded and excavated lakes in the planning area that have been constructed over the years.

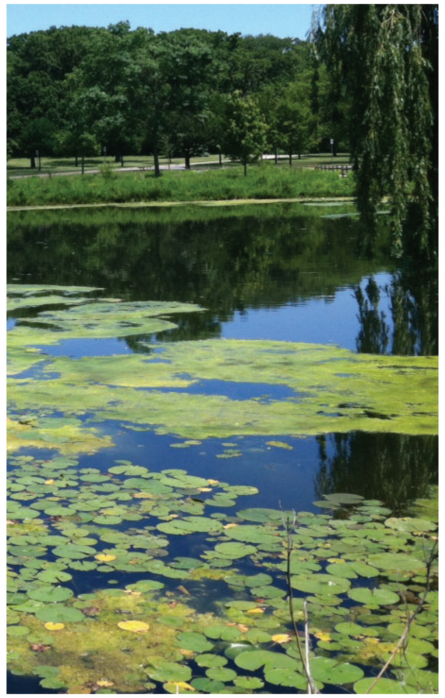
OUR FINDINGS:

A System Under Stress

Many rivers, streams and lakes in the planning area are impaired by nutrients, chloride, bacteria, and other forms of pollution. Pollution enters water bodies through stormwater runoff from urban and agricultural lands; from erosion of upland soils, streambanks, and lakeshores; and in permitted discharges of treated wastewater.

Fish and aquatic invertebrates found in rivers and streams indicate degraded water quality and aquatic habitat. Lakes have expanding populations of invasive aquatic plants and mussels, as well as high levels of nutrients, which can result in algae blooms. These algae blooms can produce harmful effects to people and aquatic life, limit recreational activities, and reduce the aesthetic quality of lakes.

Record flooding on the Des Plaines River in July of 2017 was accompanied by urban flooding in many areas outside of mapped flood hazard areas. Intense rainfall overwhelms older or undersized infrastructure. While wetland loss is not occurring at the rate it once did, wetland coverage is greatly reduced from its former extent. The capacity of wetlands to provide benefits such as flood water storage, uptake or retention of pollutants such as nutrients and sediment, and provision of baseflow to lakes and streams is correspondingly reduced.



Clockwise from top left: Algae bloom at Butter Lake; Watershed stakeholders providing feedback towards the plan; Fourth Lake Forest Preserve; volunteers cutting and pulling up sod to install native vegetation along Mill Creek.

WHAT'S AT RISK IN THE PLANNING AREA?

The amount of impervious surface in the planning area is projected to increase in the future. Increased imperviousness of the landscape results in a greater volume of stormwater runoff that must be detained or infiltrated in order to avoid an increase in downstream flood elevations. Additionally, impervious surfaces such as roads and parking lots are linked to urban pollutants such as chloride and polycyclic aromatic hydrocarbons (PAHs), which are becoming more prevalent in the planning area. Future pollutant loading scenarios based on municipal and county comprehensive plans suggest that nutrient and chloride pollution loads could increase dramatically in the future. If severe weather events such as those that resulted in the July 2017 flood become more frequent in the future, flooding in urban areas and along floodplains will be exacerbated.

Stressors

Specific watershed stressors include:

- **Nutrients, chloride, organic enrichment, and sedimentation/ siltation** are major causes of impairment in rivers and streams. Nutrients, sediment, and bacteria are major causes of water quality impairment in lakes.
- **Erosion** degrades water quality and aquatic habitat.
- **Chloride levels** are steadily rising in rivers, streams and lakes.
- There are **thousands of flood-prone structures**. Although 4,000+ structures are in mapped floodplains, many of the 2,000+ structures flooded in 2017 are outside mapped floodplains.
- Both **traditional and "green" stormwater infrastructure** may be insufficient for runoff volume or need repair.
- **More than half of the wetland acreage in the planning area has been los**t since European settlement.
- **Stakeholders** are generally unaware of the watershed stressors or do not have the experience or resources necessary to take action.
- **More collaboration** among jurisdictions is needed to address many of the watershed problems and take advantage of watershed opportunities.

ARE YOU A WATERSHED STAKEHOLDER?

Watershed stakeholders that contributed to the planning process include municipalities, townships, county agencies, wastewater treatment plant representatives, and the broader community of homeowner associations, businesses, non-profit organizations, institutions, and residents living, working or providing interest in the planning area.

Take Action!

10 in 10

TEN ACTIONS FOR STAKEHOLDERS TO TAKE IN THE NEXT TEN YEARS

1. **Adopt the watershed-based plan and implement high priority actions and/or projects,** including the allocation of funding for project implementation and maintenance.
2. **Determine a lead watershed organization to guide watershed plan implementation,** implement the education and outreach strategy, provide technical assistance to watershed stakeholders, and coordinate multi-partner projects.
3. **Municipalities and counties work collaboratively** and proactively to mitigate flood problem areas.
4. **Utilize low-impact development and stormwater best management practices** in new development and retrofit/maintain existing development to reduce and filter stormwater runoff from impervious areas.
5. **Restore wetlands,** particularly where they will provide additional flood storage and water quality benefits.
6. **Stabilize the worst "severe" eroding streambanks and lake shorelines** using techniques that provide water quality and aquatic habitat benefits.
7. **Stabilize eroding fields,** implementing nutrient management plans and implementing best farming practices to reduce soil loss.
8. **Reduce the amount of chloride in runoff** by implementing winter maintenance "de-icing" best practices and providing educational trainings and materials.
9. **Reduce phosphorus loads in runoff** through best management practices, projects, and programs.
10. **Use the results of watershed monitoring programs** to strategically target projects, develop programs, and update this watershed plan.

The Des Plaines River Watershed-Based Plan
was completed following guidance from the Illinois Environmental Protection Agency and U.S. Environmental Protection Agency. Funding for this plan was provided, in part, by the Illinois Environmental Protection Agency through Section 319 of the Clean Water Act and the Lake County Stormwater Management Commission.

LAKE COUNTY
STORMWATER MANAGEMENT COMMISSION

Cover photo taken by Paul Klonowski.
Other photos courtesy of Lake County Stormwater Management Commission and Lake County Department of Transportation

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COMMON ACRONYMS/ABBREVIATIONS USED IN CHAPTER 1

BCCWP – Buffalo Creek Clean Water Partnership

BMP – Best Management Practices

CMAP – Chicago Metropolitan Agency for Planning

CWA – Clean Water Act

DPR Planning Area – Des Plaines River Watershed Planning Area

DRWW – Des Plaines River Watershed Workgroup

HUC – Hydrologic Unit Codes

IDNR – Illinois Department of Natural Resources

Illinois EPA – Illinois Environmental Protection Agency

LCFPD – Lake County Forest Preserve District

LCHD – Lake County Health Department

SMC – Lake County Stormwater Management Commission

TMDL – Total Maximum Daily Load

UDPREP – Upper Des Plaines River Ecosystem Partnership

USACE – United States Army Corps of Engineers

USEPA – United States Environmental Protection Agency

USGS – United States Geological Survey

1 INTRODUCTION

1.1 WHAT IS A WATERSHED?

A **watershed** is the area of land drained by a river, stream, or other body of water (see Figure 1-1 for a diagram of a watershed system). Other common names given to watersheds include **drainage basins** and **catchments**.

As simple as the definition sounds, a watershed is actually a complex interaction between ground, climate, water, vegetation, and animals. In today's developed watersheds, other elements such as sewage, agricultural drainage, **impervious surfaces**, stormwater, and erosion can all be detrimental to the health of the watershed.

Figure 1-1: Diagram of a Watershed

The health of a waterbody is a direct reflection of how the land in the watershed is used and managed. Some of the benefits of a healthy watershed are: improved water quality, fewer flooding problems, enhanced wildlife habitat, recreational opportunities, and better quality of life.

WATERSHED: Land area that drains water to a given point, usually a river, stream or lake. The land area above a given point on a waterbody (river, stream, lake, wetland) that contributes runoff to that point is considered the watershed.

DRAINAGE BASIN: Synonymous with "watershed," though often used to describe the watersheds of larger rivers or hydrologic systems (e.g., the "Mississippi River drainage basin" or "Great Lakes drainage basin").

CATCHMENTS: 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 confounding pollutant sources, boundaries have fewer political jurisdictions, and monitoring/mapping assessments can be done in a relatively short amount of time. The 432 catchments in the DPR planning area have an average size of 0.5 square miles, with a range of 0.03 – 2.2 square miles.

SUBWATERSHED: A smaller basin within a larger drainage area that all drains to a central point of the larger watershed. The 10 subwatersheds in the DPR planning area have an average size of 23.5 square miles, with a range of 2.8 – 50.9 square miles. See Chapter 3, Section 3.4.1 for more information about the DPR planning area 10 subwatersheds.

IMPERVIOUS SURFACES: A surface that does not allow water to infiltrate to the soil layer, including pavement, rooftops, and roads.

1.1.1 Why A Watershed-Based Plan?

Water is elemental to our lives. Plants and animals, including humans, are largely composed of water, and generally require clean water to survive. Our communities, food systems, energy sources, and countless products that we consume everyday are dependent upon water. Despite this dependence, water is often taken for granted until it negatively affects us, usually due to short supply, inundation, or pollution.

This watershed-based plan is important because it specifically addresses water-related issues in communities within the Des Plaines River watershed planning area. Clean and abundant water, healthy streams and lakes, and safety from flooding are important to residents and business and therefore play a significant role in the quality of life, health and economic vitality of our communities. Clean and healthy watersheds are assets that make communities more desirable for residents and businesses; however, flooding can damage property and result in local economic impacts. Lakes, rivers, and streams in the planning area provide recreational destinations for watershed residents as well as tourists and are a highly visible indicator of watershed health. These waterbodies support a diverse variety of water-dependent plants and animals and are critical to local ecosystems.

Water does not generally flow according to political boundaries. Consequently, we recognize the watershed as the appropriate scale to address most water resource issues, which often involves multiple political jurisdictions. The Des Plaines River watershed planning process brought together numerous watershed stakeholders to provide input towards the management and enhancement of water resources in the planning area. During this planning process, critical data was obtained from record flooding that occured in 2017, as well as a comprehensive water quality monitoring effort conducted on watershed streams. This watershed-based plan utilizes these sources of up-to-date information as well as historical data to provide a comprehensive summary of existing watershed conditions and trends. It recommends actions stakeholders can take to protect resources that are in good condition and restore those that have been degraded. As a resident, landowner, business or community official, you make a difference.

1.2 DES PLAINES RIVER WATERSHED PLANNING AREA

1.2.1 Des Plaines River Watershed

The Des Plaines River watershed covers 1,455 square miles (or 931,489 acres) in northeastern Illinois and southeastern Wisconsin. The Des Plaines River begins near Union Grove, Wisconsin and flows south through Racine and Kenosha Counties in Wisconsin and Lake, Cook, and Will Counties in Illinois. The river joins the Chicago Sanitary and Ship Canal in Lockport, Illinois and flows west through Joliet, before converging with the Kankakee River to form the Illinois River. The Illinois River then flows into the Mississippi River, which flows south to the Gulf of Mexico. The drainage area of the Des Plaines River Watershed was increased by 673 square miles when there was a diversion of Lake Michigan water through the Chicago Sanitary and Ship Canal and the Cal-Sag Channel in the early 1900's (Pescitelli, 2013). Since January 17, 1900, there has been limited diversion of water from Lake Michigan through the Chicago Sanitary and Ship Canal to the Illinois River (Healy, 1979).

1.2.2 Des Plaines River Watershed Planning Area

The Des Plaines River Watershed-Based Plan covers 16% of the Des Plaines River watershed, or approximately 235 square miles (150,361 acres). Hereinafter referred to as the Des Plaines River (DPR) planning area, this area encompasses portions of central Lake County, Illinois; southern Kenosha County, Wisconsin; and northern Cook County, Illinois, with portions of 39 municipalities and 15 townships (see Figure 1-4), 240 miles of stream, 17,000 acres of wetland, and 53 named lakes. Figure 1-3 depicts the size and location of the Des Plaines River Watershed compared to the DPR planning area. The DPR planning area is comprised of eleven 12-digit HUCs (see Table 1-1).

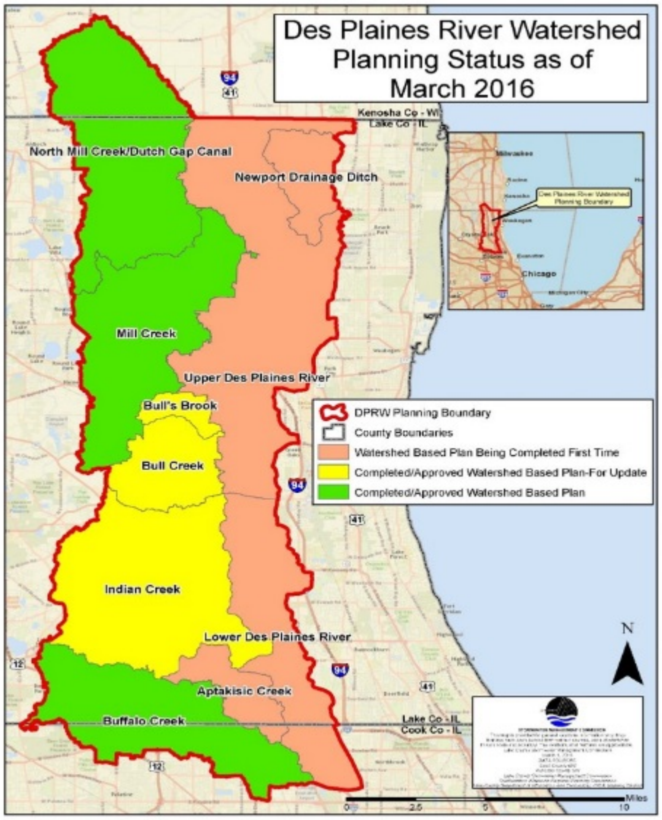

Figure 1-2: Des Plaines River Watershed Planning Status

The Des Plaines River Watershed-Based Plan is an "umbrella" watershed-based plan because the 235 square-mile planning area includes 10 subwatersheds. The following five watershed-based plans have been completed for six subwatersheds of the DPR planning area in Lake County: the Bull Creek/Bulls Brook Watershed Based Plan (2009), Indian Creek Watershed Based Plan (2009), North Mill Creek-Dutch Gap Canal Watershed-Based Plan (2013), Mill Creek Watershed and Flood Mitigation Plan (2014), and Buffalo Creek Watershed-Based Plan (2016).

Four subwatersheds do not have watershed-based plans completed: Newport Drainage Ditch, Upper Des Plaines, Lower Des Plaines, and Aptakisic Creek. This "umbrella" plan updates or completes watershed-based planning for all ten subwatersheds (see Figure 1-2 for the DPR planning area subwatersheds planning status as of March 2016). This umbrella plan also guides local stakeholders to implement best management practices (BMPs) that provide cost and pollution effective solutions to surface water quality impairments.

Noteworthy: Hydrologic unit code (HUC)

A hydrologic unit can accept surface water directly from upstream drainage areas, and indirectly from associated surface areas such as remnant, noncontributing, and diversions to form a drainage area with single or multiple outlet points. Hydrologic units are only synonymous with classic watersheds when their boundaries include all the source area contributing surface water to a single defined outlet point. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on the six levels of classification:

- 2-digit HUC first-level (region)
- 4-digit HUC second-level (subregion)
- 6-digit HUC third-level (accounting unit)
- 8-digit HUC fourth-level (cataloguing unit)
- 10-digit HUC fifth-level (watershed)
- 12-digit HUC sixth-level (subwatershed)

Table 1-1: Des Plaines River Subwatersheds & 12-digit HUCS

SUBWATERSHED	12-DIGIT HUC	HUC NAME
North Mill Creek	071200040201	North Mill Creek
Mill Creek	071200040202	Mill Creek
Buffalo Creek	071200040502	Wheeling Drainage Ditch
Indian Creek	071200040501	Indian Creek
Bulls Creek	071200040302	Bull Creek – Des Plaines River
Bulls Brook	071200040302	Bull Creek – Des Plaines River
Upper Des Plaines River	071200040302 071200040301	Bull Creek – Des Plaines River Sterling Lake – Des Plaines River
Lower Des Plaines River	071200040503	McDonald Creek – Des Plaines River
Newport Drainage Ditch	071200040301 *071200040104*	Sterling Lake – Des Plaines River *Jerome Creek-Des Plaines River (only part of this HUC is in the planning area)*
Aptakisic Creek	071200040503	McDonald Creek – Des Plaines River

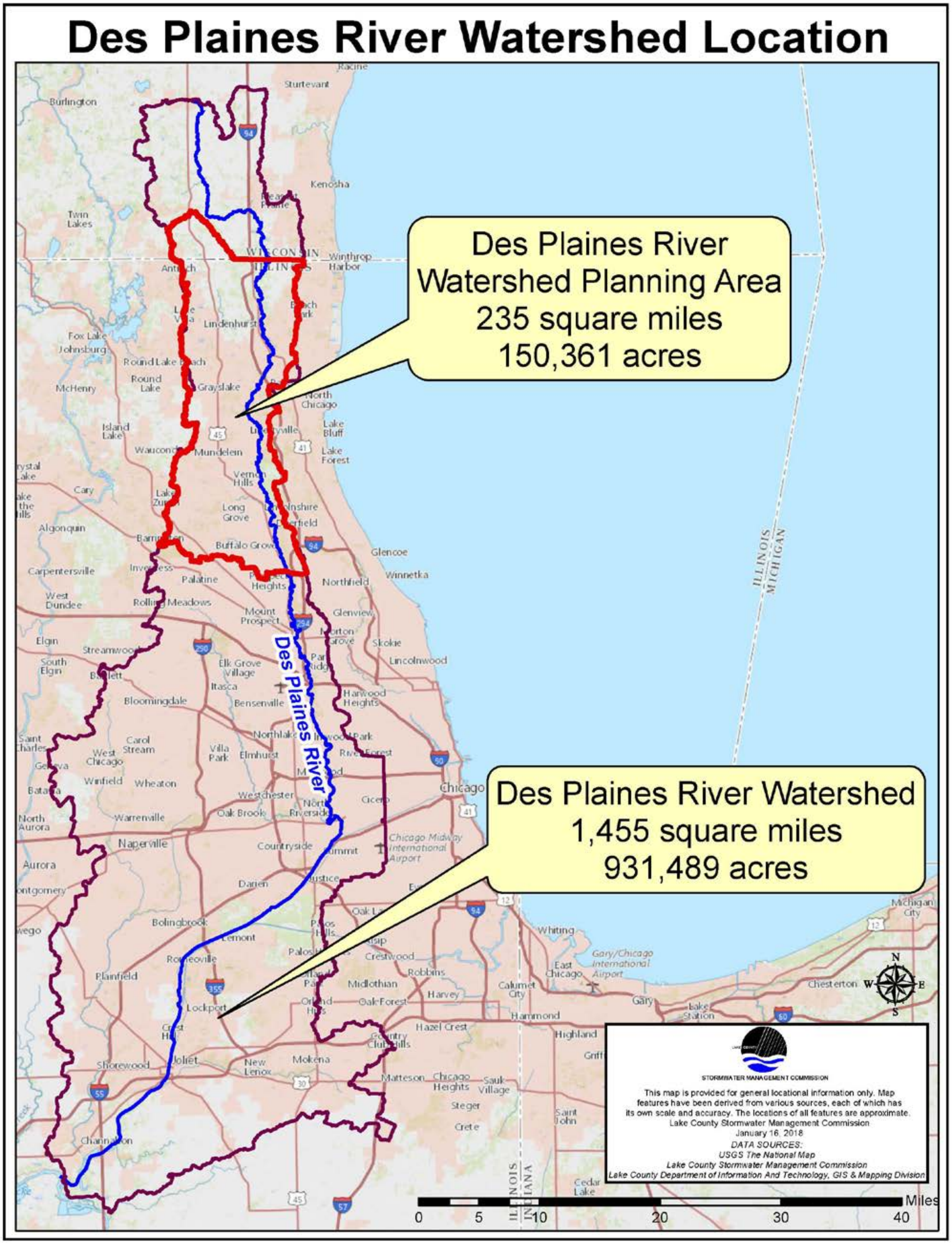

Figure 1-3: Des Plaines River Watershed Location Map

1.3 WATERSHED PLAN PURPOSE

Lake County Stormwater Management Commission (SMC) took the lead to develop a watershed-based plan for the DPR planning area. The purpose of this effort was to develop a plan to reduce the impacts of water pollution and flood damage; restore watershed lakes, streams, and wetlands to a healthy condition; and provide opportunities for watershed stakeholders to have a significant role in the process. This watershed-based plan does not address groundwater quality issues, focusing instead on stormwater and surface water runoff.

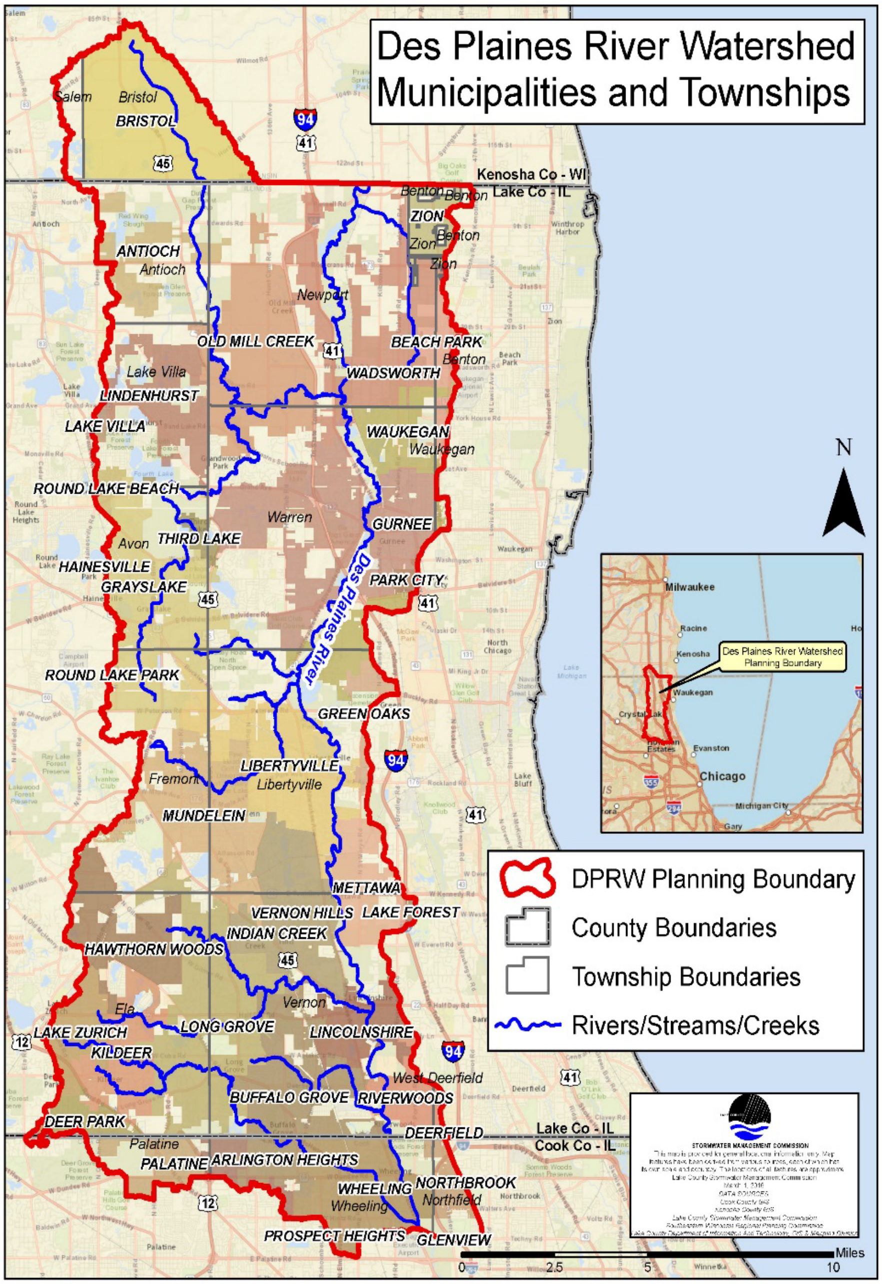

Figure 1-4: Des Plaines River Watershed & Des Plaines River Watershed Planning Area

A broad representation of watershed stakeholders participated in the planning process and developed and supported this plan. A significant objective of this planning effort and the implementation of the plan going forward is to return the 61 waterbodies in the DPR planning area that are listed as **impaired** on the 2016 Illinois 303(d) list of impaired waters to conditions that fully support their designated uses (Illinois EPA, 2016). Figure 1-5 depicts the waterbodies that are impaired in the DPR planning area.

This plan identifies BMPs to remedy or mitigate water quality impairment, flood damages, and the loss or degradation of natural resources.

The plan also recommends watershed stakeholders implement actions to preserve, manage, and restore natural resources, as well as prevent actions that will cause

IMPAIRED WATERS: The Clean Water Act requires states to identify waters that do not or are not expected to meet applicable water quality standards with current pollution control technologies alone.

or exacerbate unintended water quality and flood damage problems. Watersheds do not generally coincide with political boundaries, so watershed planning improves coordination and cooperation among communities and the land and water resources they share and impact.

1.4 WATERSHED PLAN REQUIREMENTS, PROCESS, AND ORGANIZATION

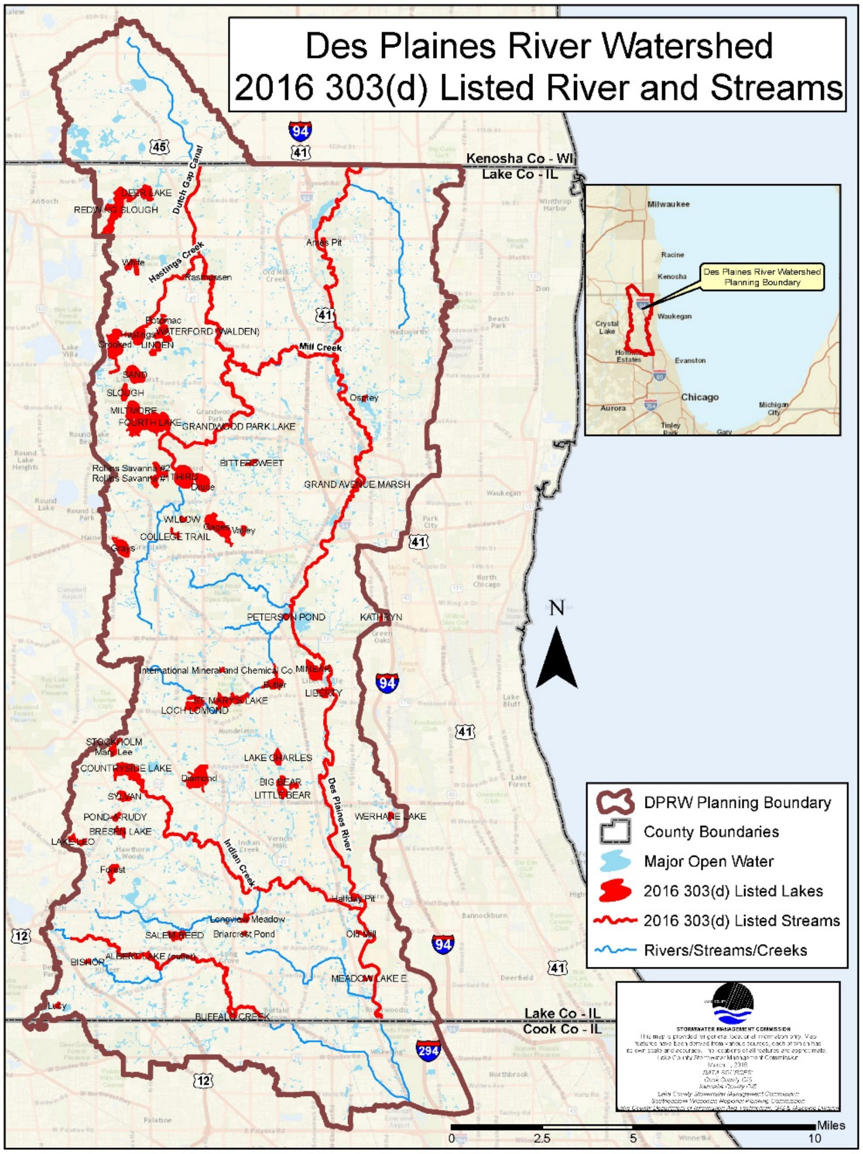

Figure 1-5: Des Plaines River Watershed 2014 303(d) Impaired Waters

The primary scope of this project is the development of a comprehensive watershed-based management plan for the 235-square mile DPR watershed planning area that identifies actions to improve water quality and reduce flood risks. The planning approach was designed to help stakeholders from multiple jurisdictions and with various interests to better understand and become engaged in the watershed. The desired planning outcome is to spur implementation of watershed improvement projects and programs that will accomplish the goals and objectives established in this plan. SMC worked with numerous stakeholders, including public agencies, local units of government, landowners, and private sector professionals with interests in the watershed. SMC engaged Northwater Consulting to assist in developing a watershed-based plan for the DPR planning area.

This Des Plaines River Watershed-Based Plan updated and incorporated the action plan recommendations of the five subwatershed watershed-based plans already completed. The most recent watershed-based plans for Mill Creek and Buffalo Creek are supplemented by this plan and contain new action recommendations within those watersheds. The Des Plaines River Watershed-Based Plan serves as a 10-year update to the three older watershed-based plans (North Mill-Dutch Gap Canal, Indian Creek, and Bull Creek-Bulls Brook) and satisfies the recommendations for periodic updates included in those watershed-based plans. These five watershed-based plan executive summaries and links to the watershed-based plans are included in the Appendices **(Appendix O)**.

Development of the Des Plaines River Watershed-Based Plan was funded, in part, by the Illinois EPA through Section 319 of the Clean Water Act (CWA). Section 319 grants are also awarded to projects to protect water quality in Illinois. Projects must address water quality issues relating directly to nonpoint source pollution. Funds can also be used for the implementation of watershed management plans including the development of information/education programs and for the installation of BMPS. Section 319 funds give higher priority to applications that are implementing a site-specific action plan recommendation (project) in an approved watershed-based plan or TMDL implementation plan that meets the watershed-based plan requirements. A portion of the Section 319 funds does fund projects that are not recommendations in an approved watershed-based plan, but higher priority is allocated to projects within the watershed-based plans. The Des Plaines River Watershed-Based Plan follows Illinois EPA guidance and is designed to meet the nine elements required by the USEPA for a watershed-based plan.

NOTEWORTHY – USEPA'S NINE ELEMENTS OF A WATERSHED –BASED PLAN

1. 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;
2. Estimate of the pollutant load reductions expected following implementation of the management measures described under number 3 below;
3. Description of the nonpoint source management measures that will need to be implemented to achieve the load reductions estimated under number 2 above, and an identification of the critical areas in which those measures will be needed to implement the plan;
4. 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;
5. Public information/education component that is designed to change social behavior;
6. Plan implementation schedule;
7. Description of interim, measurable milestones;
8. Set of criteria that can be used to determine whether pollutant loading reductions are being achieved over time;
9. Monitoring component to evaluate the effectiveness of the implementation efforts over time.

Pursuant to its mission and authority for stormwater management and watershed planning (55 ILCS 5/5-1062), SMC develops watershed-based plans and follows the adoption process outlined below (for Lake County portions of the planning area):

1. *Draft version of the watershed-based plan is submitted to the Illinois EPA, Illinois DNR-Office of Water Resources, and Chicago Metropolitan Agency for Planning (CMAP) for review*
2. *SMC Board approves a 30-day public comment through a public hearing and local publication*
3. *SMC revises the draft watershed-based plan based on comments received*
4. *Illinois EPA determines the plan meets the watershed-based planning guidance*
5. *The plan is brought before the Lake County Stormwater Management Commission & Lake County Board for adoption as an amendment to the Lake County Comprehensive Stormwater Management Plan.*
6. *SMC seeks community adoption of the watershed-based plan from the DPR planning area entities.*

1.5 PREVIOUS AND RELATED STUDIES AND PLANS

> **NOTEWORTHY – DRWW**
> The Des Plaines River Watershed Workgroup (DRRW) is a voluntary, dues-paying organization with a mission to bring together a diverse coalition of stakeholders to work together to preserve and enhance water quality in the Des Plaines River and its tributaries within Lake County, Illinois. The goal of the DRWW is to improve water quality in the Des Plaines River and its tributaries through monitoring, project and best practices implementation, and education and outreach that will achieve attainment of water quality standards and designated uses for the watershed. The DRWW officially formed in 2015 with the intent of improving water quality through a collaborative, locally led process.

Floodplain, biological, habitat, water quality, and demographic/geographic data for this plan were compiled from several previous and concurrent studies of the watershed. This information was collected, analyzed, summarized, and supplemented with newly collected field data, and was then used to reach conclusions regarding the condition of the resources in the watershed. Field studies completed in association with this planning effort include: detailed stream and detention basin inventories performed by SMC and an expansive biological and water quality monitoring of the DPR watershed performed by the DRWW and the Illinois EPA. References for previous reports and studies and summaries of field data collected and reports compiled specifically for this planning effort are listed below in Table 1-2.

Table 1-2: Previous Studies and Plans

PREVIOUS & RELATED STUDIES/PLANS	YEAR COMPLETED	AUTHOR/OWNER
Floodplain Studies	Newport Drainage Ditch (2003), Mill Creek (2014) & Bull Creek (2006)	Hey & Assoc., USGS, MWH Global, SMC, Bleck
Lake County Wetland Restoration and Preservation Plan	2018	SMC
Lake County All-Natural Hazards Plan	2017	SMC
Lake County Green Infrastructure Model and Strategy	2016	LCPFD
Lake County Flood Problem Areas Inventory	2016	SMC
Upper Des Plaines River & Tributaries (Des Plaines Phase II Report)	2015	USACE
Buffalo Creek Watershed-Based Plan	2015	SMC, BCCWP, Cardno, TRC Companies Inc., Bleck Engineering Company Inc. and Living Lands Conservation Company
Mill Creek Watershed and Flood Mitigation Plan	2014	SMC & Northwater Consultants
North Mill Creek-Dutch Gap Canal Watershed-Based Plan	2011	SMC & Northwater Consultants
Indian Creek Watershed-based Plan	2009	SMC, Applied Ecological Services, Inc. and Futurity, Inc.
Bull Creek-Brook Watershed-Based Plan	2009	SMC, Applied Ecological Services, Inc. and Depke Design
Des Plaines Strategic Subwatershed Implementation Plan	2004	IDNR/UDPREP

PREVIOUS & RELATED STUDIES/PLANS	YEAR COMPLETED	AUTHOR/OWNER
Des Plaines River Wetland Restoration Study	2001	Hey & Assoc., SMC
Lake County Lake Reports	2000	LCHD
Upper Des Plaines Flood Damage Reduction Study	1999	USACE
Upper Des Plaines River Area Assessment	1998	IDNR

1.6 USING THE PLAN

1.6.1 WHO SHOULD USE THIS PLAN?

This plan will be of limited use without the commitment of watershed stakeholders to improve, restore, manage, and steward watershed resources. Municipal and county agencies and elected officials, as the primary land use, development, and infrastructure authorities in the watershed, will have a significant amount of influence and responsibility for implementing this plan. These public agencies represent the interests of their constituents and are strongly influenced by every community resident or landowner. Therefore, each community member has the potential to influence the actions that occur in the DPR watershed through active participation.

State and federal agencies, elected officials, and private organizations, such as lake associations, homeowner associations, and private conservation organizations, will also play an important role. State and federal agencies can support the implementation of this plan by approving projects in a timely fashion, supporting projects with funding, and providing technical information, tools, and resources to assist local authorities and watershed organizations in their efforts. Private associations and organizations have the ear and influence of their members and can provide significant contributions to land and water protection. Individual watershed residents and landowners must also accept responsibility for managing their own land and water resources responsibly and for working with others to implement this plan.

All jurisdictions, organizations, businesses and institutions, private landowners, and residents will have to work together to successfully protect and restore the watershed. The power of water is immense, as anyone who has experienced flooding can attest. The flow of water also does not respect property lines or jurisdictional boundaries; therefore, everyone needs to share the long-term stewardship responsibility and the costs and benefits of watershed improvements.

The success of plan implementation will also be determined by the ability of stakeholders to organize to coordinate, communicate, and manage activities in the watershed. Watershed organizations are generally formed from the organizations and/or individuals who participated in the watershed planning process. Watershed organizations often become the drivers of implementing the watershed plan and provide educational outreach to the community. A watershed organization will be the primary mechanism to engage the general public in watershed activities, to support the implementation of the watershed plan, and to voice their concerns and celebrate their successes in restoring watershed resources.

1.6.2 How To Use This Plan

For those unfamiliar with watershed planning, this document may appear overwhelming. There are pages of information to navigate, containing numerous tables and maps reporting the condition of the watershed, and many costly recommendations that a lone individual cannot likely implement. These recommendations are for public agencies to consider. But there are also a number of straightforward actions that individuals can take to improve the watershed. Every action, no matter how small, when undertaken by many or key landowners can have a positive impact on improving the watershed. For a general understanding of what this plan is about, please read the Executive Summary, which also includes a list of top priority actions for the next ten years. For additional details, browse the table of contents and advance to the section you are interested in.

To find out…

- What this plan is intended to accomplish, read about the watershed issues, opportunities, goals, and objectives for improving watershed health and improving water quality in **Chapter 2**.
- Detailed information about watershed resources and conditions, read the section(s) of interest in **Chapter 3**.
- What the problems are facing the watershed, **Chapter 4** includes a summary and analysis of watershed problems that need to be addressed by the action plan.
- Detailed information about flooding, including the flood events, flood problem inventory, and strategies for flood damage reduction, turn to **Chapter 5**.
- What kind of actions can be taken to improve the watershed, the action plan in **Chapter 6 and Appendix N** includes a watershed-wide programmatic action plan that includes general recommendations; and a site-specific action plan directed to critical areas of the watershed that identifies actions that can improve water quality in specific areas. A web application has been created (https://tinyurl.com/ycthwx9x) that allows watershed stakeholders to access the site-specific action plan recommendations in the DPR planning area through a mapping tool.
- What kind of funding may be available to provide cost share for implementing watershed improvement projects, refer to the funding sources in **Chapter 7**.
- What sort of outreach and education is needed so that watershed stakeholders understand the watershed problems, their role in the watershed, and have the capability to implement the Action Plan, refer to **Chapter 8**. SMC will continue to coordinate the stormwater activities in the watershed planning area to improve water quality, reduce flood damage, and restore and enhance the natural drainage systems.

1.7 REFERENCES

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CHAPTER TWO: WATERSHED ISSUES, OPPORTUNITIES, GOALS, AND OBJECTIVES

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LIST OF FIGURES

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COMMON ACRONYMS/ABBREVIATIONS USED IN CHAPTER 2

APMP – Aquatic Plant Management Plan

BMP – Best Management Practices

CLC – College of Lake County

DPR planning area – Des Plaines River Watershed Planning Area

DRWW – Des Plaines River Watershed Workgroup

FEMA – Federal Emergency Management Agency

GSS – Grade Stabilization Structure

HOA – Homeowners Association

Illinois EPA – Illinois Environmental Protection Agency

PAH – Polycyclic Aromatic Hydrocarbons

RMP – Resource Management Plan

SMC – Lake County Stormwater Management Commission

SMU – Subwatershed Management Unit

TMDL – Total Maximum Daily Load

TSS – Total Suspended Solids

USGS – United States Geological Survey

VLM - Volunteer Lake Monitoring

WASCOB – Water and Sediment Control Basin

WI – Wisconsin

WRAPP – Wetlands Restoration and Preservation Plan

2 WATERSHED ISSUES, OPPORTUNITIES, GOALS, AND OBJECTIVES

2.1 WATERSHED ISSUES

One of the first tasks the Des Plaines River watershed committee (watershed planning committee) undertook was to identify issues that the Des Plaines River Watershed-Based Plan should address and opportunities or strategies to address those issues. Participants (watershed stakeholders) at the March 17, 2016 kick-off planning meeting (see **Appendix A** for stakeholder meeting minutes) identified issues and voted to determine priorities at the April 28, 2016 planning meeting. Watershed stakeholders received 10 votes each for watesrhed issues (multiple votes could be used on one topic/issue).

WATERSHED PLANNING COMMITTEE**:** A committee comprised of SMC staff and watershed stakeholders (including the Des Plaines River Watershed Workgroup), with a goal of creating an umbrella watershed-based plan for the DPR planning area and reducing nonpoint source pollution. See Section **2.4** compiled by previous watershed-based plans in the DPR planning area and watershed stakeholders.

Issues related to water quality received the most votes, followed by issues rela ted to regional green infrastructure and natural resources. Flood damamge reduction and stormwater infrastructure issues received a similar number of votes and when combined slightly exceeded water quality issues. A full list of the issues/concerns of watershed stakeholders is available in Table 2-1. Issues were grouped into categories by topic and later organizied into goal categories. It is important to note that although watershed stakeholders voted on issues in certain categories, many issues listed in Table 2-1 could apply to several of the categories.

Table 2-1: Specific Issues/Concerns Identified by Stakeholders

The "X" symbol indicates the Category the issue was voted on by the watershed stakeholders and the "*" symbol indicates other categories the issue can apply to as well.

# OF VOTES	WATERSHED ISSUES	GOAL CATEGORIES						
		WATER QUALITY IMPROVEMENTS	REGIONAL GREEN INFRASTRUCTURE & NATURAL RESOURCES	FLOOD DAMAGE REDUCTION	FUNDING, INSTALLING, & MAINTAINING STORMWATER INFRASTRUCTURE	COMMUNITY & AGENCY COORDINATION (NOT A VOTING CATEGORY)	SUSTAINABLE AGRICULTURE SYSTEMS (NOT A VOTING CATEGORY)	EDUCATION & OUTREACH
21	Not enough wetlands preserved and restored	*	X	*		*	*	
20	Road salt creating chloride pollution	X	*		*	*		*
15	Condition of stormwater infrastructure (pipes, detention basins, etc.), *Example: North Libertyville Estates*	*		*	X	*		
13	There is a disconnect for some public works agencies between improving stormwater conveyance and the negative impacts of stormwater on lakes and streams	X			*	*		*
13	Undesirable or invasive aquatic plants & animals	*	X			*	*	*
13	Damages from flooding and lack of flood control measures	*	*	X	*	*		*
13	Too much stormwater runoff from impervious surfaces	*	*	X	*	*		*
12	Phosphorus pollution	X	*		*	*	*	*
12	Lack of stream or river maintenance	*		*	X	*		*
9	Loss of old growth trees (oaks)	*	X			*	*	*

# OF VOTES	WATERSHED ISSUES	GOAL CATEGORIES						
		WATER QUALITY IMPROVEMENTS	REGIONAL GREEN INFRASTRUCTURE & NATURAL RESOURCES	FLOOD DAMAGE REDUCTION	FUNDING, INSTALLING, & MAINTAINING STORMWATER INFRASTRUCTURE	COMMUNITY & AGENCY COORDINATION (NOT A VOTING CATEGORY)	SUSTAINABLE AGRICULTURE SYSTEMS (NOT A VOTING CATEGORY)	EDUCATION & OUTREACH
8	Impacts of water quality on recreational opportunities (poor water quality limits recreational opportunities such as fishing)	X	*			*		*
8	Public does not understand the issues					*		X
6	Lake shoreline erosion	*	*		X	*		*
5	Coal tar sealant pollutants	X	*		*	*		*
5	Invasive plant issues (teasel)	*	X			*	*	*
5	Insufficient capacity of stormwater infrastructure for increasing growth	*	*	X	*	*		*
5	Dams and dam removal	*	*	*	X	*	*	*
5	Education of general public on invasive species and the water quality impacts of native fauna	*	*			*	*	X
3	Not enough volunteer efforts on rivers and adjacent forest preserve areas	*	X			*		*
3	Understanding conflicts and owner responsibilities (Social issues with fellow neighbors)	*	*			*		X
2	Lack of TMDL information - (*Wheeling drainage ditch/reach*)	X				*		*
2	Public understanding of agency roles					*		X

# OF VOTES	WATERSHED ISSUES	GOAL CATEGORIES						
		WATER QUALITY IMPROVEMENTS	REGIONAL GREEN INFRASTRUCTURE & NATURAL RESOURCES	FLOOD DAMAGE REDUCTION	FUNDING, INSTALLING, & MAINTAINING STORMWATER INFRASTRUCTURE	COMMUNITY & AGENCY COORDINATION (NOT A VOTING CATEGORY)	SUSTAINABLE AGRICULTURE SYSTEMS (NOT A VOTING CATEGORY)	EDUCATION & OUTREACH
2	Who to Call…for questions? Where is this located?					*		X
1	River flooding impacts on adjacent lakes (*east side of Lake Minear, invasive species impacts)*	X		*	*	*		
1	Not resilient to climate change	*	X	*	*	*	*	*
1	Need additional USGS stations	*		X	*			
1	Lack of understanding of impacts coming from leaching septic fields	*			*	*	*	X
0	Lack of coordination for mosquito abatement and improper drainage; stagnant water as a source of mosquitos	*	*	*	X	*		*
0	Recreational conflicts – canoeing vs. speedboats	*	*			X		*

2.2 WATERSHED OPPORTUNITIES

Following the identification of watershed issues, stakeholders provided input on what opportunities or strategies they thought would address watershed issues. Stakeholders also considered what was desirable about the watershed and identified these characteristics as opportunities for preserving for the future. Watershed stakeholders received 10 votes each for voting on watershed opportunities and strategies (multiple votes could be used on one topic).

Stakeholders voted most often for education and outreach and community and agency coordination as the opportunities and strategies to address watershed issues. Importantly, education and outreach to individual landowners on a variety of topics received the most votes of any single opportunity or strategy. Regional green infrastructure and natural resources and stormwater infrastructure also received a large number of votes. The opportunities and strategies identified by stakeholders are listed in Table 2-2. It is important to note that although watershed stakeholders voted on watershed opportunities in certain categories, many opportunities listed below could apply to several of the categories.

Table 2-2: Specific Opportunities and Strategies Identified by Stakeholders

The "X" symbol indicates the Category the issue was voted on by the watershed stakeholders and the "*" symbol indicates other categories the issue can apply to as well.

# OF VOTES	WATERSHED OPPORTUNITIES & STRATEGIES	GOAL CATEGORIES						
		WATER QUALITY IMPROVEMENT	REGIONAL GREEN INFRASTRUCTURE AND NATURAL RESOURCES	REDUCE FLOOD DAMAGE	FUNDING, INSTALLING & MAINTAINING STORMWATER INFRASTRUCTURE (GRAY AND GREEN)	COMMUNITY & AGENCY COORDINATION	SUSTAINABLE AGRICULTURE SYSTEMS	EDUCATION & OUTREACH
29	Educate individual landowners on: maintaining stormwater management systems best management practices yard waste management water quality and water resources flood damage reduction phosphorus reduction (countywide ban) stream erosion & lakes management ecosystems more (public) postings for resident participation in programs or projects technical references	*	*	*	*	*	*	X
18	Clearing debris and restoration of natural areas – *i.e. North Libertyville Estates retention: erosion, cattails, drainage*	*	*	X	*		*	

# OF VOTES	WATERSHED OPPORTUNITIES & STRATEGIES	GOAL CATEGORIES						
		WATER QUALITY IMPROVEMENT	REGIONAL GREEN INFRASTRUCTURE AND NATURAL RESOURCES	REDUCE FLOOD DAMAGE	FUNDING, INSTALLING & MAINTAINING STORMWATER INFRASTRUCTURE (GRAY AND GREEN)	COMMUNITY & AGENCY COORDINATION	SUSTAINABLE AGRICULTURE SYSTEMS	EDUCATION & OUTREACH
17	Restoring wetlands to a sustainable functional system	*	X	*	*		*	
14	Smarter management of stormwater runoff	*	*	*	X	*		*
13	Utilizing land along tributaries for storage and treatment of stormwater – (green infrastructure)	*	*	X	*		*	
13	Coordination/consistent efforts for future and current land use (green infrastructure planning tools)	*				X		*
12	Expand preserved open space, trees and plants (including old growth trees), wildlife (corridors), and habitat	*	X				*	*
11	Sustainable farm practices	*	*				X	*
10	Plant native plants in buffers along the Des Plaines River	*	X	*		*	*	*
10	Having more intense modeling of the impacts of planned land uses	*				X		*
9	Educate local public work departments on chloride (road salt) reduction practices	*	*		*	*		X

# OF VOTES	WATERSHED OPPORTUNITIES & STRATEGIES	GOAL CATEGORIES						
		WATER QUALITY IMPROVEMENT	REGIONAL GREEN INFRASTRUCTURE AND NATURAL RESOURCES	REDUCE FLOOD DAMAGE	FUNDING, INSTALLING & MAINTAINING STORMWATER INFRASTRUCTURE (GRAY AND GREEN)	COMMUNITY & AGENCY COORDINATION	SUSTAINABLE AGRICULTURE SYSTEMS	EDUCATION & OUTREACH
8	Manage invasive species: flora and fauna (i.e. teasels)	*	X			*	*	*
8	Need additional funding for restoration efforts	*	*		X	*		*
6	Determine pollutant contribution from wastewater treatment plants to streams	X			*	*		
6	Expand Lake County Forest Preserves	*	*			X	*	*
6	Better enforcement of existing regulations	*				X		*
6	Removing drain tiles to ditches upstream	*	*			*	X	*
5	Retrofitting of detention basins	*	*	*	X		*	
5	Better coordination and partnerships among agencies, municipalities and landowners for watershed projects *(i.e. Lincolnshire drive berm, Conservation @ Home, river management with adjacent landowners, multiple groups – bigger scope)*	*	*			X		*

# OF VOTES	WATERSHED OPPORTUNITIES & STRATEGIES	GOAL CATEGORIES						
		WATER QUALITY IMPROVEMENT	REGIONAL GREEN INFRASTRUCTURE AND NATURAL RESOURCES	REDUCE FLOOD DAMAGE	FUNDING, INSTALLING & MAINTAINING STORMWATER INFRASTRUCTURE (GRAY AND GREEN)	COMMUNITY & AGENCY COORDINATION	SUSTAINABLE AGRICULTURE SYSTEMS	EDUCATION & OUTREACH
5	Promote pollution prevention – (i.e. give a hoot, don't pollute)	*	*			*		X
4	Villages adopt ordinances to manage phosphorous	*	*			X		*
4	CLC or other institutions provide technical education	*	*	*	*	*	*	X
4	Use social media to educate corporations, agencies, the public, and municipalities to encourage the implementation of BMPs and participation in restoration efforts	*	*			*		X
3	Create a Stream Management Program – "Adopt a Stream"	*		*	X	*		*
3	Creating better standards for BMPs for roadways and drainage projects	*	*	*	X	*		*
3	Having enough resources to implement programs/services – new ways to fund and stormwater management as utility	*			X	*		*
3	Engage community action – stewardship and volunteering (having a bigger voice)	*	*			X	*	*

# OF VOTES	WATERSHED OPPORTUNITIES & STRATEGIES	GOAL CATEGORIES						
		WATER QUALITY IMPROVEMENT	REGIONAL GREEN INFRASTRUCTURE AND NATURAL RESOURCES	REDUCE FLOOD DAMAGE	FUNDING, INSTALLING & MAINTAINING STORMWATER INFRASTRUCTURE (GRAY AND GREEN)	COMMUNITY & AGENCY COORDINATION	SUSTAINABLE AGRICULTURE SYSTEMS	EDUCATION & OUTREACH
3	Expand and preserve small scale farming	*	*			*	X	*
2	Using permeable pavement in development and redevelopment (improving infiltration)	*	*		X			*
2	Work with nurseries to provide attractive designs for using native plants for stream buffer and bank stabilization	*	*	*	X		*	*
2	Expand stormwater infrastructure funding and technical assistance *(HOAs, etc…)*	*	*		X	*		*
2	Funding support for developing better regulations to control impervious surfaces	*		*	X	*		*
2	Watershed involvement with Illinois EPA on Nutrient Loss Strategy	*				X	*	
2	Educate students on flood reduction, restoration, recreational value *(i.e. Gowe Beach)*	*	*	*		*		X
2	Making public service a high school education requirement	*				*		X

# OF VOTES	WATERSHED OPPORTUNITIES & STRATEGIES	GOAL CATEGORIES						
		WATER QUALITY IMPROVEMENT	REGIONAL GREEN INFRASTRUCTURE AND NATURAL RESOURCES	REDUCE FLOOD DAMAGE	FUNDING, INSTALLING & MAINTAINING STORMWATER INFRASTRUCTURE (GRAY AND GREEN)	COMMUNITY & AGENCY COORDINATION	SUSTAINABLE AGRICULTURE SYSTEMS	EDUCATION & OUTREACH
1	Local communities and residents have a role in water quality improvements	*	*			X	*	*
1	Provide liaison to assist with permitting processes	*			*	X		
1	Identify watershed champions in each community	*				X		*
0	Better water quality would attract more wildlife *(more indicator species (i.e. eagles))*	X	*			*		*
0	Revise existing regulations and codes to create more uniformity	*				X		
0	Better access to headwaters – (*Wisconsin - different ways of doing things*)	*				X		

2.3 WATERSHED VISION

The watershed planning committee participated in an exercise to develop a vision statement for the watershed. The vision serves to focus the aim of the group. While different groups implementing the plan may have different goals and objectives, the achievement of all should fit under the overarching vision statement.

The vision statement exercise began by asking the following questions:

1. What matters to you most about where you live in the DPR planning area?
2. What positive changes would you like to see in the watershed?
3. What is your dream for our watershed community? (How would the watershed look if the watershed plan is successful?)
4. Who will be involved in helping achieve the watershed vision over the next 10 years?

The watershed planning committee (during this vision statement exercise) was divided into four facilitated breakout sessions to discuss the answers/phrases to the vision statement exercise; see Table 2-3 for voting results of the vision exercise. Each session voted on their preference of vision phrases to share with the overall watershed planning committee. The watershed planning committee was then able to vote on which group's (1-4) vision statement exercise phrases should be included (or combined) into the Des Plaines River Watershed-Based Plan vision statement.

Table 2-3: Des Plaines River Watershed Plan Stakeholder Vision Exercise Results

VOTE RESULT (%)	WHAT MATTERS TO YOU MOST ABOUT WHERE YOU LIVE IN THE DPR PLANNING AREA?	WHAT POSITIVE CHANGES WOULD YOU LIKE TO SEE IN THE WATERSHED?	WHAT IS YOUR DREAM FOR OUR WATERSHED COMMUNITY? (HOW WOULD THE WATERSHED LOOK IF THE WATERSHED PLAN IS SUCCESSFUL?)	WHO WILL BE INVOLVED IN HELPING ACHIEVE THE WATERSHED VISION OVER THE NEXT 10 YEARS?
0%	**Group 1:** My community (restoration of pond) – debris, sediment, erosion in rivers, lakes and streams	**Group 1:** Better water quality	**Group 1:** Unpolluted water and more natural areas	**Group 1:** Individual responsibility
21%	**Group 2:** Flood control measures to limit property damage	**Group 2:** Accommodate wetland restoration to establish native vegetation and improve habitat diversity.	**Group 2:** River as a destination	**Group 2:** Government, businesses, public and private entities, and residents.

VOTE RESULT (%)	WHAT MATTERS TO YOU MOST ABOUT WHERE YOU LIVE IN THE DPR PLANNING AREA?	WHAT POSITIVE CHANGES WOULD YOU LIKE TO SEE IN THE WATERSHED?	WHAT IS YOUR DREAM FOR OUR WATERSHED COMMUNITY? (HOW WOULD THE WATERSHED LOOK IF THE WATERSHED PLAN IS SUCCESSFUL?)	WHO WILL BE INVOLVED IN HELPING ACHIEVE THE WATERSHED VISION OVER THE NEXT 10 YEARS?
37%	**Group 3:** Protect and improve natural resources, water quality and habitat.	**Group 3:** Improved biodiversity	**Group 3:** Residents demand and value quality water resources and recreational opportunities	**Group 3:** Partnership between public and private stakeholders to improve education and planning
42%	**Group 4:** Sustainable planning and implementation for environmental health to achieve clean, healthy water, preservation of regional green infrastructure, etc.	**Group 4:** Comprehensive community education and outreach to foster support for and participation in improvements/changes.	**Group 4:** Sustainable landscaping with balance between built environment (development) and natural environment. Cleaner lakes, better streams, more secure biodiversity, and large sections of stream meeting aquatic life criteria	**Group 4:** Everyone

The participant responses to the exercise resulted in the following vision statement for the DPR planning area:

> ***The Des Plaines River watershed planning area will be a destination valued by residents, businesses, and governments that join together to actively engage in education and participate in improving water quality. Stakeholders will preserve and enhance regional green infrastructure, resulting in cleaner streams and lakes, better plant and animal biodiversity, and reduced flood damage – while balancing a sustainable native landscape with development and economic growth.***

2.4 WATERSHED GOALS AND OBJECTIVES

The watershed planning committee generated and prioritized seven (7) watershed goals to address watershed stakeholder issues/concerns. Establishing these watershed goals allowed the watershed planning committee to develop objectives and outcomes for each goal. The goals were central to the development of the watershed action plan (**Chapter 6**). The goals and objectives reflect watershed conditions, address watershed stakeholder priority issues, consider expected future changes, and meet current and possible future funders' expectations.

Over the period of the planning year, measurable indicators were assigned to each goal to help measure future progress toward meeting each goal as the watershed action plan is implemented. The action plan contains recommended:

- Programmatic actions that address flooding; water quality; stormwater management and drainage; natural resources; and education, outreach, coordination, and implementation goals; and
- Site-specific actions that recommend BMPs for specific problem locations identified during inventories and assessments.

Chapter 7 Plan Implementation and Evaluation and **Appendix M Evaluation Scorecards** examine the watershed plan goals by looking at their performance and progress. These sections evaluate milestones related to measurable indicators for the watershed goals and objectives.

NOTEWORTHY: WHAT ARE GOALS VERSUS OBJECTIVES?

GOALS:

- Mini vision statements or targets for the watershed plan.
- The desired change or outcome you wish to achieve.
- Driven by stakeholder issues and problems identified by the watershed assessment.
- Ideally will be clear, concise, and measurable.

OBJECTIVES:

- Specific, more precise steps needed to attain goals.
- Position reached or purpose achieved by some activity by a specific time.
- Objective outcomes should be measurable, attainable, relevant, and time-based.
- There may be multiple objectives to achieve a goal(s).

2.4.1 Watershed Goal #1: Water Quality Improvements

GOAL: Improve water quality and prevent future pollution impacts to streams, lakes, ponds, and wetlands within the DPR planning area.

OUTCOME: *Overall water quality is improved. Water bodies will fully support their designated uses (are not impaired).*

Figure 2-1: Butler Lake algae

OBJECTIVES:

a) Develop and implement a watershed monitoring program to collect and assess physical, chemical, and biological water quality data on streams and lakes on a regular basis.

   Indicator: Watershed stream annual monitoring program support. Implementation of watershed monitoring program for lakes.

b) Continue to monitor water quality in the DPR planning area and develop strategies to address water quality impairments and causes of impairments.

Indicator: Number of water bodies removed from the Illinois EPA's impairments list.
Number of causes of impairment removed.

c) Reduce the quantity of road salt (sodium chloride) needed for safe and cost-effective winter maintenance to reverse the current trend of rising chloride levels in water bodies.

Indicator: Winter Maintenance Program establishment including: policy and manual development, de-icing workshop attendance and certification.

d) Reduce phosphorus loads by:

- Using conservation practices on all agricultural fields to reduce soil loss;
- All municipalities and the County pass ordinances that restrict the use of lawn fertilizer with phosphorus;
- Implementing effective leaf cleanup and composting programs;
- Removing phosphorus from wastewater discharges;
- Upgrading poorly functioning septic systems; and
- Addressing re-suspension of phosphorus in lakes where feasible.

Indicator: Number of local units of government that adopt a phosphorous ordinance.
Number of exceedances of permitted phosphorus concentrations from wastewater treatment plant effluent.
Number of agricultural BMPs implemented that target phosphorous.
Number of upgraded septic systems.
Number of municipalities that have codes that allow or require green infrastructure for stormwater management.

e) Where appropriate, remove or retrofit impoundments, dams, and weirs in streams to support fish passage and migration, natural baseflow conditions, and to improve dissolved oxygen levels.

Indicator: Number of dams and impoundments removed or retrofitted.

f) Reduce sediment and excessive debris accumulation in surface waters by reducing streambank, shoreline, and construction-related erosion throughout the watershed.

Indicator: Reduction in concentrations of total suspended solids (TSS).
Linear feet of streambank and shoreline restored.

g) Reduce or eliminate harmful algae blooms in lakes.

Indicator: Number of algae blooms reported. See Figure 2-1 for an example of an algae bloom in Butler Lake.

h) Reduce fecal coliform pollution by regulating septic system construction and maintenance, requiring regular maintenance, and enforcing ordinances that require proper cleanup and disposal of pet waste.

Indicator: Percentage of identified sources of fecal coliform addressed.

i) Reduce the use of coal tar sealants for parking lots and driveways.

Indicator: Concentration of PAHs detected in water quality/sediment monitoring efforts.

j) Prepare pollution prevention plans to address emergency response for potential catastrophic environmental events, such as pipeline leaks and flooding.

Indicator: Number of MS4 communities maintaining a database of pollution prevention plans that address emergency response to catastrophic events.

k) Minimize runoff volumes, velocities, and pollutants to waterways by utilizing wetlands, natural landscapes, and stormwater BMPs such as infiltration and pollutant filtration systems.

Indicator: Number of action recommendations completed.

2.4.2 Watershed Goal #2: Regional Green Infrastructure and Natural Resources Improvements

GOAL: Protect, enhance, and restore natural resources (soil, water, plant communities, and fish and wildlife) by employing good natural resource management practices. Using green infrastructure on public and private properties to maintain, enhance, or restore natural hydrology, native plant and wildlife communities, provide buffers for streams, lakes, wetlands, and high-quality areas (see Figure 2-2). Expand environmental corridors to provide ecological, educational, and recreational benefits.

Figure 2-2: Parking lot bioswale with native vegetation

OUTCOME: *Natural resources are protected, establishing a series of interconnected hubs and corridors that work to preserve and enhance the high-quality natural areas of the watershed.*

OBJECTIVES:

a) Protect and expand ecological quality of aquatic and terrestrial resources by improving water quality and eradicating invasive species, while preserving and protecting threatened and endangered species and ecosystems.

Indicator: Number of water bodies removed from the Illinois EPA's impairments list.
Number of causes of impairment removed.
Area of open space identified and preserved for environmental and recreational natural areas.
Acres of invasive species removal/management projects.

b) Restore degraded terrestrial and aquatic (lakes, wetlands, and streams) resources using restoration best practices to improve habitat.

Indicator: Area of degraded natural communities restored.

c) Maintain, expand, or restore high-quality native plant buffers along rivers, streams, lakes, and wetlands.

Indicator: Length of native plant buffers along water bodies maintained, expanded, and/or restored.

d) Preserve, restore, and create wetlands areas with a target of a minimum 10% wetland land cover per subwatershed.

Indicator: Acres of wetlands enhanced and/or restored.

e) Identify and preserve natural areas that provide important ecological, environmental, educational, and recreational activities, such as swimming, hiking, fishing, biking, riding, canoeing, and bird watching.

Indicator: Area of open space identified and preserved for environmental and recreational natural areas.

f) Identify and connect environmental corridors across community, county and state lines, and create trail connections between new and existing parks and forest preserves where appropriate.

Indicator: Number of new trail connections.

g) Assess current fish population and reduce or eradicate common carp and other invasive aquatic species in lakes.

Indicator: Number of lake management plans developed to address aquatic resource trends based on lake reports.
Number of lake management plan project recommendations implemented

h) Develop an aquatic plant management plan (APMP) for lakes and streams that targets the reduction of invasive species and promotes native plant diversity.

Indicator: Number of lakes with Aquatic Plant Management Plans (APMP).

i) Reduce/eliminate presence of invasive species in the watershed, particularly in riparian and buffer areas.

Indicator: Acres of invasive species removal/management projects.

j) Reintroduction of extirpated native species as water resources or ecosystems improve (such as blanding turtles).

Indicator: Number of successful reintroductions of threatened and endangered native species into natural habitats.

2.4.3 Watershed Goal #3: Flood Damage Reduction

GOAL: Reduce current flood damage in the DPR planning area and prevent future flooding from worsening in the watershed and along the Des Plaines River downstream of Lake County.

OUTCOME: *Flood damages are reduced to the maximum extent achievable and impacts to residents, businesses, institutions, governments, and natural resources in the DPR planning area are minimal.*

Figure 2-3: Sandbagging efforts to reduce flooding

OBJECTIVES:

a) Create additional flood storage at regional wetland restoration or flood storage sites in Illinois and Wisconsin to reduce flooding and prevent downstream erosion.

Indicator: Area of new or restored flood storage sites.

b) Reduce existing flood damage and number of flood problem areas through the implementation of flood mitigation projects. See Figure 2-3 for sandbagging efforts at Gurnee Grade School during a flood event.

Indicator: Number of flood problem areas positively affected by flood mitigation projects implemented.

c) Residents protect themselves from the impacts of flood damage by obtaining flood insurance and installing individual property mitigation measures.

Indicator: Number of flood insurance policies in the watershed communities.
Number of Lake County Floodproofing Workshop attendees.

d) Use infiltration and evapotranspiration provided by green infrastructure to reduce volume of runoff and flood damage.

Indicator: Number of action recommendations completed.

e) Identify and install overland flow routes for all detention facilities and flood prone and depressional areas where needed.

Indicator: Number of mapped overland flow routes.

f) Require more specific/stringent maintenance and drainage easement requirements for stormwater features in new developments and re-developments.

Indicator: Number of municipalities that have codes that allow or require green infrastructure for stormwater management.

g) Maintain and increase local drainage system capacity to mitigate flood damage and improve resiliency for changing precipitation patterns.

Indicator: Number of local drainage system improvement projects implemented.

h) Remove excessive debris loads in channels to maintain conveyance and reduce streambank erosion.

Indicator: Number of communities with established stream maintenance programs.

i) Support updating of outdated floodplain maps to accurately identify current flood hazard areas.

Indicator: Number of updated FEMA floodplain maps (less than 10 years old).

j) Purchase and remove structures that are chronically damaged by flooding through the voluntary buyout program.

Indicator: Number of Voluntary Floodplain Buyouts.

k) Reduce the number of flood damage claims from major flood events.

Indicator: Number/value of claims filed each year per community in the watershed.

2.4.4 Watershed Goal #4: Funding, Installing, And Maintaining Stormwater Infrastructure

GOAL: Reduce the volume and improve the quality of stormwater runoff by installing appropriate gray or green stormwater infrastructure and improving the condition of existing stormwater infrastructure.

OUTCOME: *Reduce stormwater runoff volume and the pollution reaching and negatively impacting water bodies and natural resources and causing flood damage.*

Figure 2-4: Protected culvert
A trash rack reduces debris and stone riprap reduces erosion.

OBJECTIVES:

a) Reduce the rate and volume of stormwater runoff from developed areas and new developments by minimizing impervious cover and implementing stormwater green infrastructure practices that reduce runoff volumes, velocities, and pollutants to waterbodies – through infiltration, evapotranspiration, and storage of rainwater on-site.

Indicator: Number of action recommendations completed.

b) Expand funding opportunities, including alternative funding mechanisms, technical assistance, and maintenance resources, for improving stormwater green infrastructure and BMPs.

Indicator: Number of cost-sharing programs available in the DPR planning area
Amount of grant funding available for stormwater green infrastructure and BMPs.

c) Develop standards/guidelines for use of green infrastructure for stormwater management in site planning and design, including strategically connecting to off-site green infrastructure.

Indicator: Number of municipalities that have codes that allow or require green infrastructure for stormwater management.

d) Increase education and political desire to provide funding and technical analysis for improving local and countywide regulations pertaining to impervious surface stormwater runoff and BMPs.

Indicator: Number of local, county, and state representatives provided educational outreach materials for improving local and countywide regulations.

e) Increase funding committed for in-the-ground stormwater BMPs.

Indicator: Funding increase for in-the-ground stormwater BMPs.

f) Retrofit and maintain existing stormwater management structures, such as detention basins, to provide water quality, natural resource and flood prevention benefits, and ensure design standards for new basins incorporate multiple benefits. See Figure 2-4 for an example of a protected culvert with a trash rack which reduces debris and stone riprap that reduces erosion.

Indicator: Number of existing stormwater management structures retrofitted.
Number of developments built using conservation design principles and/or green infrastructure.

g) Clear, repair, or replace blocked, damaged, and failing culverts, outfall pipes, swales and ditches, and other stormwater conveyance infrastructure to maintain conveyance and reduce erosion.

Indicator: Potential maintenance needs identified in future stream and detention basin inventories.

h) Establish and implement a watershed-wide stream and river maintenance program using the American Fisheries Society standards as guidelines.

Indicator: Number of communities with established stream maintenance programs.

i) Design and install stormwater BMPs to capture and treat roadway stormwater runoff.

Indicator: Lane miles of roadway retrofitted or constructed with BMPs.

j) Identify who is responsible for maintenance activities for stormwater gray/green infrastructure practices.

Indicator: Number of informational guides on roles and responsibilities for stormwater gray/green infrastructure maintenance distributed.

k) Utilize modeling and monitoring to evaluate whether design predictions and the performance goals for stormwater infrastructure are being achieved.

Indicator: Number of compliant site inspections performed during the 10-year operation and maintenance period for Illinois EPA 319 grant funded projects.

2.4.5 Watershed Goal #5: Community And Agency Coordination

Figure 2-5: Multi-partnership project groundbreaking ceremony
Groundbreaking Ceremony for the Lake County Central Permit Facility and Consolidated Environmental Lab in Libertyville, Illinois.

GOAL: Improve coordination, research, and decision-making among public, private, and non-profit entities to help achieve watershed plan goals and objectives.

OUTCOME: *Watershed stakeholders coordinate and utilize all of their local resources to implement watershed improvement projects.*

OBJECTIVES:

a) Watershed communities adopt the Des Plaines River Watershed-Based Plan.

Indicator: Number of municipalities, counties, and natural resource agencies that adopt the Des Plaines River Watershed-Based Plan.

b) The DRWW will continue to monitor water quality and develop strategies to address water quality impairments in the DPR planning area.

Indicator: Watershed stream annual monitoring program support.

c) Establish a watershed organization or committee with funding and support to guide watershed plan implementation, provide technical assistance to watershed stakeholders, and coordinate multi-partner projects (see Figure 2-5 as an example of a multi-partnership project).

Indicator: Establishment of lead organization (watershed planning committee) with budget and executive committee.
Number of projects advanced/undertaken with the support of the watershed planning committee.

d) Communities and organizations will designate a representative and participate in the watershed committee.

Indicator: Communities and organizations have designated an individual or board member(s) representative to participate on the watershed planning committee.

e) Land use planning jurisdictions will consider the watershed plan recommendations when developing local comprehensive plans and making land use decisions.

Indicator: Number of municipalities implementing watershed site-specific and programmatic actions.

f) Strengthen and better enforce consistent regulations and standards intended to protect and preserve watershed natural resources.

Indicator: Number of communities that have ordinances and programs that protect and preserve watershed natural resource areas.
Number of municipalities that have codes that allow or require green infrastructure for stormwater management.

g) Increase citizen scientist monitoring through River Watch and VLM programs.

Indicator: Number of RiverWatch sites/lakes enrolled in volunteer/citizen scientist river and lake monitoring programs.

h) Watershed committee annually assesses progress on plan implementation and provides updates to the watershed-based plan every 10 years.

Indicator: Number of watershed stakeholders providing feedback for the watershed report cards.

2.4.6 Watershed Goal #6: Sustainable Agriculture Systems

GOAL: Watershed stakeholders participate in farmland preservation programs and implement sustainable agricultural practices to accomplish other watershed goals and objectives.

OUTCOME: *The plan encourages farmland preservation and sustainable agriculture practices in the watershed.*

Figure 2-6: Grassed waterway installed as an agriculture BMP
Photo Credit: NRCS New York Photo Gallery (https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/?cid=nrcs144p2_027319)

OBJECTIVES:

a) Install and expand agricultural BMPs, including drainage and tillage, to reduce sediment, chemical, and nutrient transport to water bodies in the DPR planning area.

Indicator: Number and area of agricultural BMPs installed.

b) Create and implement Resource Management Plans (RMPs) for all farms, equestrian facilities, and nurseries in the watershed.

Indicator: Number or percent of farms, equestrian facilities, and nurseries with RMPs.

c) Maintain BMPs to reduce sediment transport to water bodies and investigate opportunities for showcasing end-of-tile water quality BMPs at a demonstration site.

Indicator: Number of high priority sediment reduction agriculture BMPs installed.
Demonstration site established and monitored.
Length of drain tile removed or disabled.

d) Investigate opportunities for a farmland preservation program (Illinois and Wisconsin portions of the watershed may require separate programs), and partner with existing farmland protection groups to share knowledge and provide support.

Indicator: Number of county and municipal agencies that have adopted a farmland preservation program(s).

e) Conserve soils by using erosion control measures on farms and utilizing farming best practices to reduce erosion. See Figure 2-6 for an example of a grassed waterway BMP.

Indicator: Acres of cover crops or crop residue left on fall agricultural fields.

Acres of waterway, wetland, water and sediment control basin (WASCOB), field border, filter strip, grade stabilization structure (GSS) and other erosion control agriculture BMPs that are implemented, enhanced, or restored.

f) Expand sustainable local agricultural production, including small scale and local farming to preserve prime farmland (i.e., native plant nurseries and Farm to Table initiative).

Indicator: Number of prime farm acres in production.

2.4.7 WATERSHED GOAL #7: EDUCATION AND OUTREACH

GOAL: Provide watershed stakeholders with the knowledge, skills, and motivation needed to take action to implement the watershed plan. Watershed stakeholders include (but are not limited to): residents, property owners, property owner associations, government agencies, jurisdictions, and developers.

OUTCOME: *Stakeholders have adequate information and knowledge of resources to implement the watershed plan.*

Figure 2-7: Watershed planning committee
Stakeholders developed watershed goals and objectives.

OBJECTIVES:

a) Educate and provide information and training to riparian and lakeshore landowners on best practices for stream and lake shoreline restoration and maintenance that will reduce erosion and increase water quality.

Indicator: Number of landowners that receive information about best practices for stream and lake. shoreline restoration and maintenance.

b) Conduct a watershed outreach campaign to inform and engage the public about watershed issues, landowner responsibilities, and available resources. See Figure 2-7 watershed planning committee meeting.

Indicator: Number of people reached by watershed outreach campaign.

c) Educate local government officials and agencies, consultant and contractors working in the watershed, landscapers and nurseries, and landowners on road salt alternatives and application BMPs to minimize the use of road salt by public and private snow removal providers.

Indicator: Number of public agencies and local private contractors attending the annual Lake County De-icing Workshop.
Number of public agencies with winter maintenance responsibilities that use alternative de-icing products.

d) Educate the general public on the importance of watershed health (water quality, flood prevention, soil conservation and agricultural production, green infrastructure, and water-based recreation) to the economy, culture and quality of life in communities.

Indicator: Number of property owners that receive information about the importance of watershed health.

e) Utilize trainings, workshops, public meetings, newsletters, websites, media, campaigns, and stakeholder word of mouth to provide watershed stakeholders opportunities to participate in watershed programs and projects.

Indicator: Number of landowners that receive information about watershed programs and projects.
Number of workshops.
Number of action recommendations completed.
Continuous increase in number of contacts on the SMC Des Plaines River watershed contact database.

f) Develop and implement a pollution prevention campaign to educate residents, businesses, developers and homebuilders on source control and runoff reduction measures that may be used on their properties. These measures can be used to reduce or eliminate pollution inputs associated with landscape maintenance and agricultural production.

Indicator: Pollution prevention campaign established.

g) Facilitate public training and engage schools and youth groups (students), lake associations, and homeowner associations to volunteer for lake, stream, and natural area stewardship and maintenance.

Indicator: Number of volunteers for lake, stream, and natural area stewardship and maintenance.

h) Promote the use of native plants and the removal of invasive plants by establishing demonstration sites and training.

Indicator: Number of native plant demonstration sites established, and trainings held.

i) Provide communities with the tools they need to prevent flood damage from worsening by using the "no adverse impact standard" and maintaining floodplain as open space.

Indicator: Number of communities that adopt the "no adverse impact standard."

j) Provide outreach and workshops for the public affected by flood damage to educate them on the causes of flooding, flood mitigation practices, and what can be done to prevent local and regional flood damage.

Indicator: Number of educational flyers or mailings to high flood risk property owners about flood mitigation measures.
Number of clicks (overall activity) on SMC website flooding resources.

k) Install signs at each lake to educate riparian and lakeshore landowners and lake users on ways to reduce the spread of aquatic invasive species.

Indicator: Number of educational signs regarding aquatic invasive species installed.

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COMMON ACRONYMS/ABBREVIATIONS USED IN CHAPTER 3

ADID – Advance Identification
ALK – Alkalinity
BCCWP- Buffalo Creek Clean Water Partnership
BMP – Best Management Practices
BOD – Biological Oxygen Demand
CCDOT - Cook County Department of Transportation
CFU- Colony Forming Units
Cl^- Chloride
CMAP – Chicago Metropolitan Agency for Planning
COM - Commercial and Services
COND – Specific Conductivity
CWA – Clean Water Act
CWP – Center for Watershed Protection
DEM – Digital Elevation Models
DO - Dissolved Oxygen
DPR – Des Plaines River
DRWW- Des Plaines Watershed Workgroup
DST- Decision Support Tool
DTM - Digital Terrain Models
E. coli- Escherichia coli
fIBI- Fish Index of Biotic Integrity
FLU – Future Land Use
FPDCC - Forest Preserve District of Cook County
FQI – Floristic Quality Assessment
GIMS- Green Infrastructure Model and Strategy
GIS – Geological Information System
GPS – Global Positioning System
HOA - Homeowner Associations
HQAR- High Quality Aquatic Resources
HSG – Hydrologic Soil Groups
HUC - Hydrologic Unit Code
IDNR – Illinois Department of Natural Resources
IDOT – Illinois Department of Transportation
Illinois EPA – Illinois Environmental Protection Agency
INAI – Illinois Natural Areas Inventory
INT – Institutional
IPS- Identification and Prioritization System
IWLC- Isolated Waters of Lake County
IWW - Industrial, Warehousing and Wholesale
LCDOT – Lake County Department of Transportation
LCFPD – Lake County Forest Preserve District
LCHD-ES – Lake County Health Department – Ecological Services
LCWI- Lake County Wetland Inventory
LiDAR - Light Detection and Ranging
LRR- Lateral Recession Rate

MGD – Millions of Gallons Per Day

mIBI- Macroinvertebrate Index of Biotic Integrity

MS4s - Municipal Separate Storm Sewer Systems

MWRD- Metropolitan Water Reclamation District

NAVD88 – North American Vertical Datum of 1988

NH_3-N – Ammonia

NLCD – National Land Cover Database

NO_{2-} - Nitrite

NO_{3-} - Nitrate

NOI – Notice of Intent

NPDES - National Pollutant Discharge Elimination System

NPS – Nonpoint Source

NRCS – Natural Resource Conservation Service

NSWRD – North Shore Water Reclamation District

NWI- National Wetlands Inventory

PAH- Polycyclic Aromatic Hydrocarbons

PCB - Polychlorinated biphenyl

PRW- Potentially Restorable Wetlands

RAP-M - Rapid Assessment Point Method

RES - Residential

s.u. – Standard Unit

SCS- United States Department of Agriculture Soil Conservation Service

SECCHI - Secchi Disk Depth

SEWRPC - Southeastern Wisconsin Regional Planning Commission

SMC – Lake County Stormwater Management Commission

SMU – Subwatershed Management Unit

SRP – Soluble Reactive Phosphorous

SWPPP – Stormwater Pollution Prevention Plan

TAG- Technical Advisory Group

TCU - Transportation, Communication, and Utilities

TDS - Total Dissolved Solids

TKN – Total Kjeldahl Nitrogen

TMDL – Total Maximum Daily Load

Tollway – Illinois Tollway Authority

TP – Total Phosphorus

TS - Total Solids

TSS - Total Suspended Solids

TVS - Total Volatile Solids

USDA – United States Department of Agriculture

USEPA – United States Environmental Protection Agency

USFWS- U.S. Fish and Wildlife Service

USGS – United States Geological Survey

WDO – Lake County Watershed Development Ordinance

WI DNR - Wisconsin Department of Natural Resources

WISDOT - Wisconsin Department of Transportation

WOUS - Waters of the United States

WRAPP- Lake County Wetland Restoration and Preservation Plan

WWTP- Wastewater Treatment Plant

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3 WATERSHED CHARACTERISTICS ASSESSMENT

3.1 WATERSHED SETTING

The Des Plaines River watershed originates as a small prairie stream in southern Racine County, Wisconsin and flows southward for approximately 133 miles joining the Chicago Sanitary and Ship Canal in Lockport, Illinois and converging with the Kankakee River about 10 miles southwest of Joliet to form the Illinois River; a major tributary of the Mississippi River (Figure 3-1). The Illinois River flows about 334 miles through the State of Illinois and joins the Mississippi at Grafton, about 25 miles north of St. Louis, Missouri. The Mississippi flows another 1,169 miles to the Gulf of Mexico. The Des Plaines River is part of a historic water route linking the Great Lakes to the Mississippi River for travel and commercial trade.

Figure 3-1: Tributary Drainage Area to the Mississippi River Basin

This report focuses on the Des Plaines River Watershed-Based Plan planning area of the Upper Des Plaines River Watershed. The planning area includes the Dutch Gap Canal/North Mill Creek Watershed in Kenosha County, Wisconsin and the entire Des Plaines River watershed in Lake County, Illinois, to the confluence of the Des Plaines River and Buffalo Creek in Cook County, Illinois. All figures and tables focus only on this planning area within the Upper Des Plaines River Watershed, hereinafter referred to as "DPR planning area". The DPR planning area is approximately 235 square miles (150,361 acres). Fourteen square miles (8,717 acres) of the DPR planning area boundary are in Kenosha County, Wisconsin, 203 square miles (130,242 acres) are in Lake County, Illinois and 18 square miles (11,402 acres) are in Cook County, Illinois.

3.1.1 GEOLOGY- THE WATERSHED STAGE

> **LOESS:** Small sediment formed by the accumulation of wind-blown dust.
>
> **OUTWASH:** Deposits of sand and gravel carried by running water from the melting ice of a glacier and laid down in stratified deposits.
>
> **TILL:** Unsorted glacial sediment.

The Des Plaines River watershed is shaped by surficial geology formed during the most recent glacial period known as the Wisconsin stage of the Pleistocene Era or "Ice Age" that began approximately 85,000 years ago and ended 10,000-14,000 years ago. During this time, 80% of Illinois was covered with one or more sheets of glacial ice (Neely and Heister 1987). Although the DPR planning area was most likely glaciated repeatedly during the Ice Age, the retreat and re-advance of the Lake Michigan lobe of the North American ice sheet during the Wisconsin glaciation resulted in almost all the surficial geologic features present today (Figure 3-2) (Barnhardt et al., 2015). These features are composed of materials deposited less than 30,000 years ago and include **loess, outwash valley deposits,** and **till**. Glacial till deposits range from a few feet to more than 250 feet in thickness. Topographic features in the Des Plaines River Watershed are largely a result of the movement of the Lake Michigan lobe of

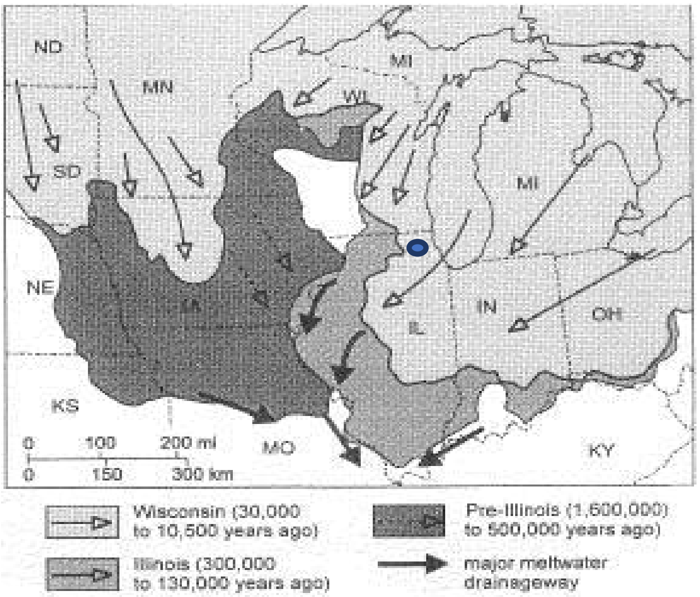


Figure 3-2: Geology of the Midwest
The blue circle represents the approximate location of the planning area. This area has been affected by all three phases of glaciation; most recently the Wisconsin Period (Fryxell 1927).

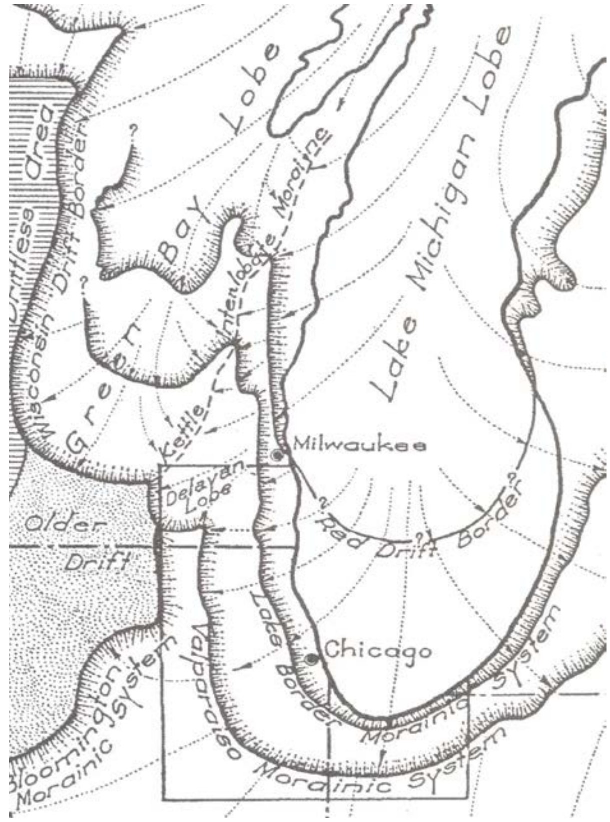


Figure 3-3: Moraine Deposits Developed from Advancing and Retreating Glaciers
The latest deposit is the Wisconsin glacier (Fryxell 1927). The red circle represents the approximate location of the planning area.

the ice sheet, which extended as far south as Shelbyville, Illinois. Its retreat resulted in the deposition of moraines and till plains. The recessional **moraines** that formed at the ice margin following stages of retreat and re-advance presently appear as concentric belts of low topographic ridges around southern Lake Michigan and the Chicago region and generally parallel to the modern Lake Michigan shoreline (Figure 3-3). Recessional moraines in the DPR planning area are oriented along north-south axes, resulting in the general pattern of north-to-south flow of major streams in the landscape today. These parallel ridges are known as the Valparaiso and Lake Border moraine systems. The unsorted till deposited by the glacier between the moraines ranges from relatively flat to **hummocky** and is pock-marked with depressions containing younger peat, muck, **marl**, and organic materials. The till west of the Des Plaines River tends to be clayey, resulting in less permeable soil.

MORAINE: Low ridge formed by till deposited at the margin of a stagnant or retreating glacier.

HUMMOCKY: Extremely irregular surface.

MARL: A loose or crumbling earthy deposit that contains a substantial amount of calcium carbonate.

Meltwater from the retreating glacier carved the valley in which the Des Plaines River flows today. This meltwater also carried and deposited tremendous amounts of outwash sand and gravel, partially filling the Des Plaines River valley. The numerous sand and gravel mining operations along the Des Plaines River and their remnant quarries are a reminder of the origin of this river valley sediment. Much of the surface of the landscape is or was covered by a relatively thin layer (<2 feet thick) of sediment called loess, which is material deposited on glacial landforms by the wind. The geologically-youngest natural landforms are formed by sedimentation on the floodplains of the Des Plaines River and its tributary streams.

The bedrock of the DPR planning area is composed primarily of dolomite, limestone, sandstone, shale, and coal. Fossils indicate that bedrock was formed during a geologic period known as the Silurian that began approximately 440 million years ago. Rock formed during this period is found at the surface only in the northern third of the state. Today, these rock formations are economically important because they yield limestone and other important minerals.

Figure 3-4: Mud Lake Excavation Site

3.1.2 The Watershed Over Time

Following the most recent glacial retreat, the Des Plaines River watershed was colonized by a succession of flora, fauna, and human cultures. There is paleontological evidence of Pleistocene megafauna and archaeological evidence of prehistoric human occupation in the watershed shortly after deglaciation, supported by the discovery of remains of a mammoth near Mud Lake in Bristol, Wisconsin (Figure 3-4). Marks on the mammoth bones, which date to 13,530 – 13,440 years before present, indicate the animal was butchered and provide an estimate of the temporal extent of human presence in the watershed (Milwaukee Public Museum, No date). In July 1992, mastodon bones were discovered in Wadsworth, Illinois. While digging a lake on their property, Van Zelst, Inc. Landscapers excavated mastodon bones, eastern elk bones and remnants of an ancient spruce forest. The find was identified by scientists from the Illinois State Museum, where the majority of the find was donated. One of the spruce logs was donated to and is on exhibit at the Lake County Discovery Museum.

Prior to European settlement of the area, Native American cultures including the Potawatomi, Sauk, Fox, Chippewa, and Ottawa occupied the region. The names of local Potawatomi leaders Aptakisic and Mettawa are still used as place names in the DPR planning area, and the names Half Day (a translation of "Aptakisic") and Indian Creek (named after the Potawatomi villages along the creek) are also a testament to their presence.

The Des Plaines River was called the "soft maple tree river" or "river of the tree from which water (sap) flows" by the Native American tribes encountered by the early French traders. This was rendered "She-shik-ma-o", "She-shick-ma-wish-sip-pe," or similar in early histories and gazetteers of the watershed (Lapham, 1846; Beckwith, 1884; White, 1911). The same tree was called "plaine" by the French, as it was apparently reminiscent of European plane trees. The name of the river was historically recorded as "Aux Plaines", "Au Plein", "O'Plain", and ultimately "Des Plaines". The older name is reflected in the name of O'Plain Road, which ended at O'Plain Bridge, the former name for the settlement that became Gurnee, Illinois. Over time, the meaning of the French "Plaines" became conflated with a similar word for "prairie/plain" giving rise to a folk

NATURAL COMMUNITY: An assemblage of plants and animals interacting with one another and their physical environment.

PRAIRIE: An extensive flat or rolling area dominated by grasses. Prairie grasslands once covered much of central North America.

SAVANNA: A type of woodland characterized by open spacing between trees and intervening grassland.

WETLAND: Low-lying land that is saturated or inundated with water to an extent that plants that are adapted to living in wet conditions grow there. Marshes, swamps, bogs, sloughs, wet prairie, rivers, streams, ponds and the edges of lakes are typically classified as wetlands.

MARSH: Low-lying land area that is usually saturated or inundated with surface or ground water that is dominated by herbaceous plants.

WOODLANDS: Land that is mostly covered with trees and shrubs.

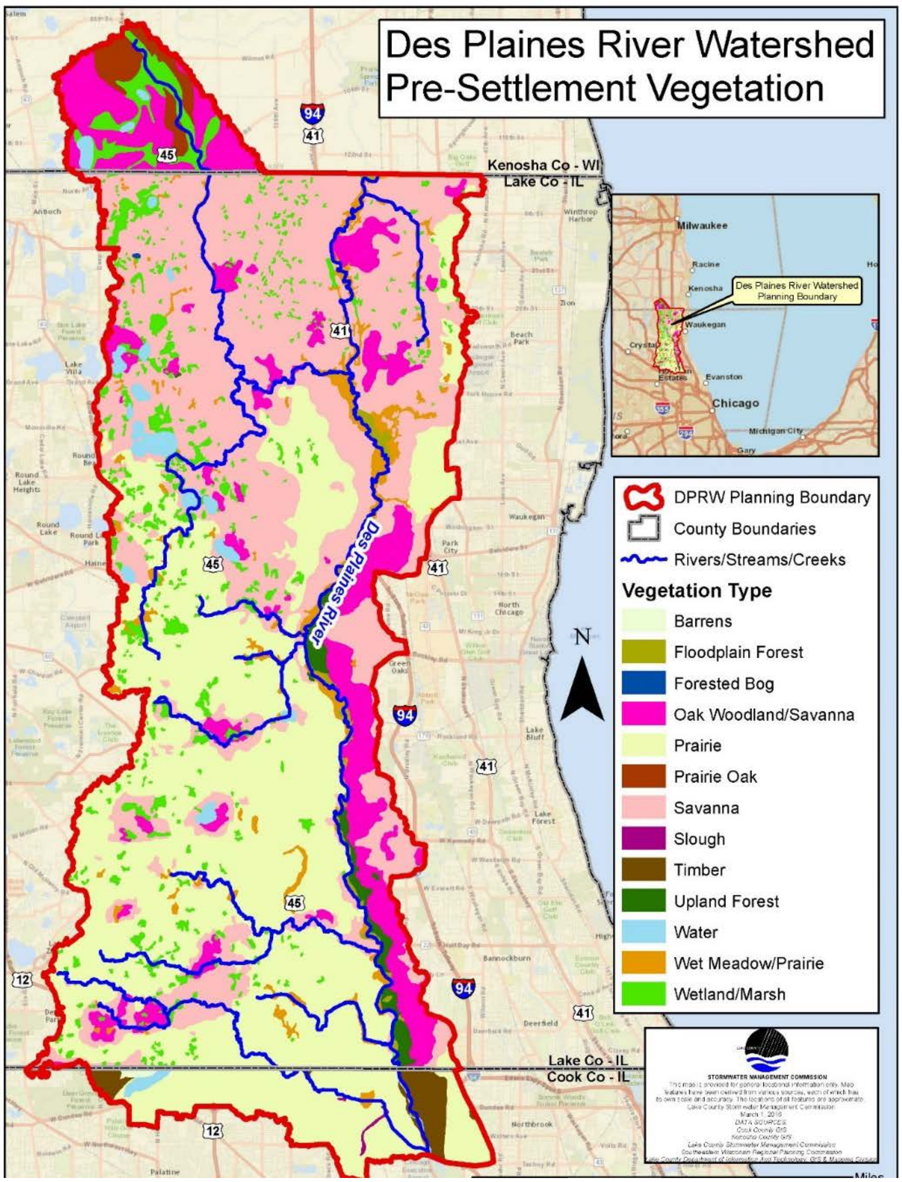


Figure 3-5: Pre-European Settlement Plant Communities

etymology that the name means "river of the prairie/plains", but historical sources are consistent in attributing the French name to the species of tree.

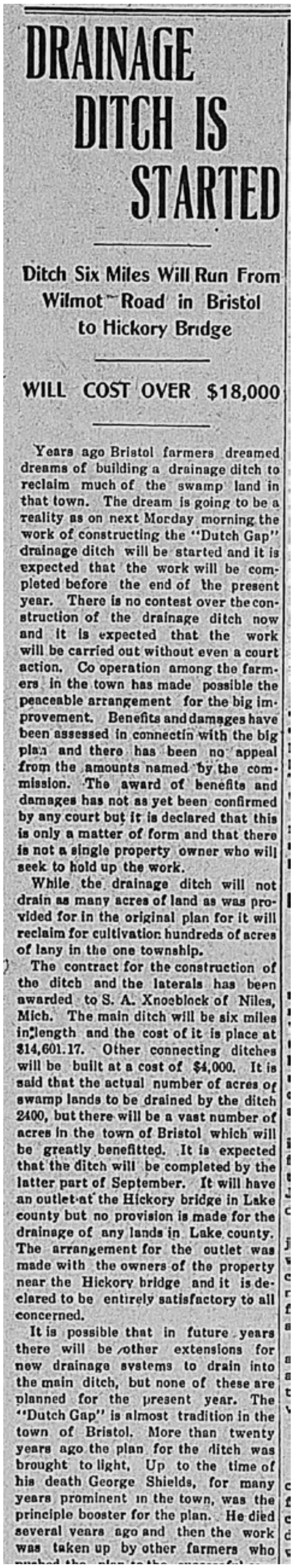
The landscape of the Des Plaines River watershed included numerous **natural communities** (ex. oak **savannas and prairies)**, some of which were adapted to periodic disturbance by fire. There is large body of literature on the fire ecology of these communities and it is likely that fires resulted from both natural causes (lightning) as well as being ignited by Native American peoples (Fahey et al., 2015). Vegetation maps of the Des Plaines River Watershed at the time of European settlement indicate there were natural communities such as savannas, **wetlands/marsh,** prairie, floodplain forest and oak **woodland** as shown in Figure 3-5. Most of the watershed at that time was a landscape of predominantly prairie and savanna with areas of oak woodlands and marshes. Savanna dominated the northern half of the watershed and prairie dominated the southern half. Oak woodlands lined the east side of the river and marshes and other wetlands were interspersed throughout. These natural communities likely worked in unison to infiltrate and treat precipitation, which minimized surface runoff leaving the watershed. The natural drainage system was largely composed of marsh/prairie rather than defined stream **channels**, with several glacial lakes dotting the moraine west of the Des Plaines River. Examples of Pre-European settlement landscapes in the DPR planning area are shown in Figure 3-6.

CHANNEL: Any river, stream, creek, brook, ditch, gully, ravine, swale or wash, into which surface or groundwater flows, either perennially or intermittently.

Following European settlement in the early 1800's, most of the DPR planning area was altered for agricultural purposes. This resulted in the clearing of woodlands and prairies and installation of drain tiles to convey water off the farmland and into natural and constructed stream channels to create farmland. Dutch Gap Canal, Hastings Creek, Avon-Fremont Drainage Ditch, Newport Ditch, Seavey Drainage Ditch and Aptakisic Creek are examples of excavated channels designed to drain wetlands and the surrounding uplands for farmland in the early 20th century.

The construction and cost of many of these ditches is documented in local newspaper articles from 1900-1920. An article documenting the construction of Dutch Gap Canal is included as Figure 3-7 (The Antioch News, 1916). Drainage districts were created to pay for these projects, some of which still exist today. The ditches usually followed the path of sloughs or elongated slow-moving wetlands with no defined stream channel. The ditches were excavated from these wetlands, lowering the water table and draining the surface soils for conversion to cropland. As urban and suburban development in the watershed increased, these ditches also became a component of the urban drainage system, conveying both stormwater and treated waste water through the landscape.

Figure 3-6: Pre-European Settlement Landscape



DRAINAGE DITCH IS STARTED

Ditch Six Miles Will Run From Wilmot Road in Bristol to Hickory Bridge

WILL COST OVER $18,000

Years ago Bristol farmers dreamed dreams of building a drainage ditch to reclaim much of the swamp land in that town. The dream is going to be a reality as on next Morday morning the work of constructing the "Dutch Gap" drainage ditch will be started and it is expected that the work will be completed before the end of the present year. There is no contest over the construction of the drainage ditch now and it is expected that the work will be carried out without even a court action. Co operation among the farmers in the town has made possible the peaceable arrangement for the big improvement. Benefits and damages have been assessed in connectin with the big plan and there has been no appeal from the amounts named by the commission. The award of benefits and damages has not as yet been confirmed by any court but it is declared that this is only a matter of form and that there is not a single property owner who will seek to hold up the work.

While the drainage ditch will not drain as many acres of land as was provided for in the original plan for it will reclaim for cultivation hundreds of acres of lany in the one township.

The contract for the construction of the ditch and the laterals has been awarded to S. A. Xnoebleck of Niles, Mich. The main ditch will be six miles in length and the cost of it is place at $14,601.17. Other connecting ditches will be built at a cost of $4,000. It is said that the actual number of acres of swamp lands to be drained by the ditch 2400, but there will be a vast number of acres in the town of Bristol which will be greatly benefitted. It is expected that the ditch will be completed by the latter part of September. It will have an outlet at the Hickory bridge in Lake county but no provision is made for the drainage of any lands in Lake county. The arrangement for the outlet was made with the owners of the property near the Hickory bridge and it is declared to be entirely satisfactory to all concerned.

It is possible that in future years there will be other extensions for new drainage systems to drain into the main ditch, but none of these are planned for the present year. The "Dutch Gap" is almost tradition in the town of Bristol. More than twenty years ago the plan for the ditch was brought to light. Up to the time of his death George Shields, for many years prominent in the town, was the principle booster for the plan. He died several years ago and then the work was taken up by other farmers who

Figure 3-7: The Antioch News newspaper article on the Dutch Gap Canal

While a significant portion of the northern part of the DPR planning area remains in farmland, many communities have expanded with primarily residential development since the mid-20th Century. Communities were established along the Chicago-Milwaukee Road (now Milwaukee Avenue) as European settlement began in the mid-1800s. Subdivisions of small, often seasonal cottages were constructed in the early 20th Century around the lakes in the watershed as tourist destinations and weekend getaways for people from Chicago as well as residents of the suburbs in eastern Lake County. Suburban development steadily increased after World War II, peaking in the 1990s and carried through much of the 2000 decade, resulting in newer suburban villages mixing with the older rural areas of the watershed.

The DPR planning area includes several high quality and remnant natural areas and is identified as a "Conservation Opportunity Area" in the Illinois Wildlife Action Plan. The restored Rollins Savanna Forest Preserve is a good example of the interspersion of prairie, savanna and wetland/marsh complexes that once existed in the watershed. Remnant oak woodlands can be found along the crests of the moraines on the eastern and western boundaries of the watershed, while excellent examples of Northern Flatwoods have been preserved east of the Des Plaines River in the southern end of the watershed. For more information on the DPR planning area natural communities see Section 3.10 Natural Areas.

3.1.3 WATERSHED SIZE

The Des Plaines River watershed stretches 1,455 square miles (or 931,489 acres) in northeastern Illinois and southeastern Wisconsin. The Des Plaines River begins near Union Grove, Wisconsin and flows south through Racine and Kenosha Counties in Wisconsin and Lake, Cook, and Will Counties in Illinois. The river joins the Sanitary and Ship Canal in Lockport, Illinois and flows west through Joliet, before converging with the Kankakee River to form the Illinois River. The Illinois River then flows into the Mississippi River, which flows south to the Gulf of Mexico. The drainage area of the Des Plaines River Watershed was increased by 673 square miles when there was a diversion of Lake Michigan water through the Chicago Sanitary and Ship Canal and the Cal-Sag Channel in the early 1900's (Pescitelli, 2013). Since January 17,1900, there has been limited diversion of water from Lake Michigan through the Chicago Sanitary and Ship Canal to the Illinois River (Healy, 1979). The area included in this watershed plan ("planning area") covers approximately 235 square miles (150,361 acres) in southern Kenosha County, Wisconsin and Lake and northern Cook Counties in Illinois (Figure 3-8).

3.1.4 Watershed Location

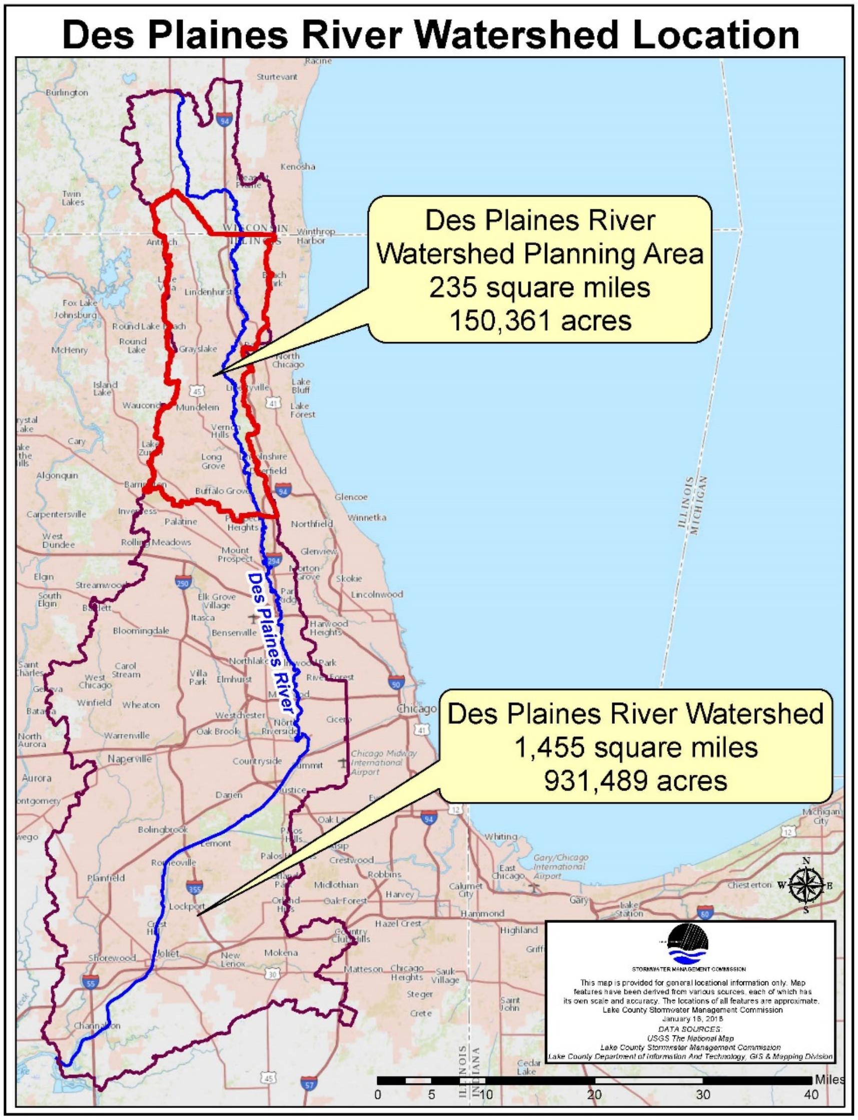


Figure 3-8: Des Plaines River Watershed Planning Area Subwatershed

The DPR planning area drains from north to south, with its headwaters in largely agricultural (rural) areas in Racine and Kenosha Counties in Wisconsin. The DPR planning area landscape becomes progressively more suburban and urban as the Des Plaines River flows south through Lake and Cook Counties in Illinois. The watershed planning area includes the North Mill Creek/Dutch Gap Canal Watershed in Wisconsin, defined subwatersheds in central Lake County, Illinois, and extends southward into northern Cook County, Illinois to the confluence of Buffalo Creek (Wheeling Ditch) with the Des Plaines River.

3.1.5 Geographic Boundaries

The boundaries of the DPR planning area are defined by topographic features formed by the retreat of the continental ice sheet during the Wisconsin glaciation and subsequent geologic processes. Additionally, the total area of the Des Plaines River watershed has increased due to drainage and diversion of runoff and streamflow from the Chicago and Calumet River watersheds, which historically drained to the Great Lakes. Because the Chicago and Calumet diversions are located downstream of the DPR planning area, they are not discussed further. The remainder of this section discusses the boundaries of the 235-square mile DPR planning arealocated in southern Kenosha County, Wisconsin, Lake County and northern Cook County, Illinois.

Generally, the DPR planning area and subwatershed boundaries used in this report are the same as those used for previous watershed-based plans or are unchanged from the Lake County subwatershed boundaries delineated by the SMC in the early 1990s. The western boundary of the DPR planning area is based on the boundaries used for the North Mill Creek/Dutch Gap Canal, Mill Creek, Bull Creek/Bull's Brook, Indian Creek, and Buffalo Creek watershed-based plans. The eastern boundary from the Illinois-Wisconsin state line to approximately Wadsworth Road is based on the boundaries used in the Kellogg Creek and Dead River watershed-based plans. The remaining eastern boundary is based on the Stormwater Management Commission watershed boundary delineation and the boundaries used for the 2008 North Branch of the Chicago River Watershed-Based Plan. The southern boundary west of the Des Plaines River is the southern boundary of the Buffalo Creek watershed; east of the Des Plaines River it was delineated as based on available topography for the catchment directly east of the confluence of the Des Plaines River and Buffalo Creek.

The most evident landscape features associated with the DPR planning area and subwatershed boundaries are recessional moraines, the crests of which define a significant portion of these boundaries. The eastern boundary of the DPR planning area is formed by different components of the Lake Border moraine system. North of Illinois Route 132 (Grand Avenue), the Highland Park moraine forms the boundary between the Des Plaines River watershed and the Lake Michigan watershed. Illinois Route 131 (Green Bay Road) generally marks the watershed divide, which is also a sub-continental watershed divide between the drainages of the St. Lawrence and Mississippi Rivers. South of Illinois 132, the watershed boundary crosses intermorainal lowlands, which are troughs between the Lake Border moraines running from Greenleaf Creek in the DPR planning area to the headwaters of the Skokie and Middle Forks of the North Branch of the Chicago River. From Illinois Route 120 (Belvidere Road) to Illinois Route 60 (Town Line Road), the Deerfield moraine forms the eastern boundary of the watershed. At Illinois Route 60, the boundary crosses another intermorainal trough, extending from an unnamed tributary to the Des Plaines River in Mettawa to the headwaters of the West Fork of the North Branch of the Chicago River in Lincolnshire. South of Illinois 60, the eastern watershed boundary is formed by the Park Ridge moraine. The western boundary of the watershed is formed by the crest of the Valparaiso moraine system. This moraine is larger and higher than the Lake Border moraines and is marked by numerous glacial “kettle” lakes. The southern boundary of the DPR planning area follows the southern boundary of the Buffalo Creek watershed through northern Cook County, Illinois to the confluence of Buffalo Creek (Wheeling Ditch) and the Des Plaines River in Wheeling, Illinois. Figure 3-9 depicts the DPR planning area glacial moraines.

The USGS has developed a coding system for hydrologic systems that is used throughout the United States by numerous federal, state, and local agencies and organizations. Each watershed unit is assigned a HUC, with the number of digits in each code dependent upon watershed size and its relationship to larger watersheds to which it belongs (if any). Table 3-1 includes the applicable HUCs for the DPR planning area and Figure 3-10 shows all of the HUC 12 watersheds in the DPR planning area.

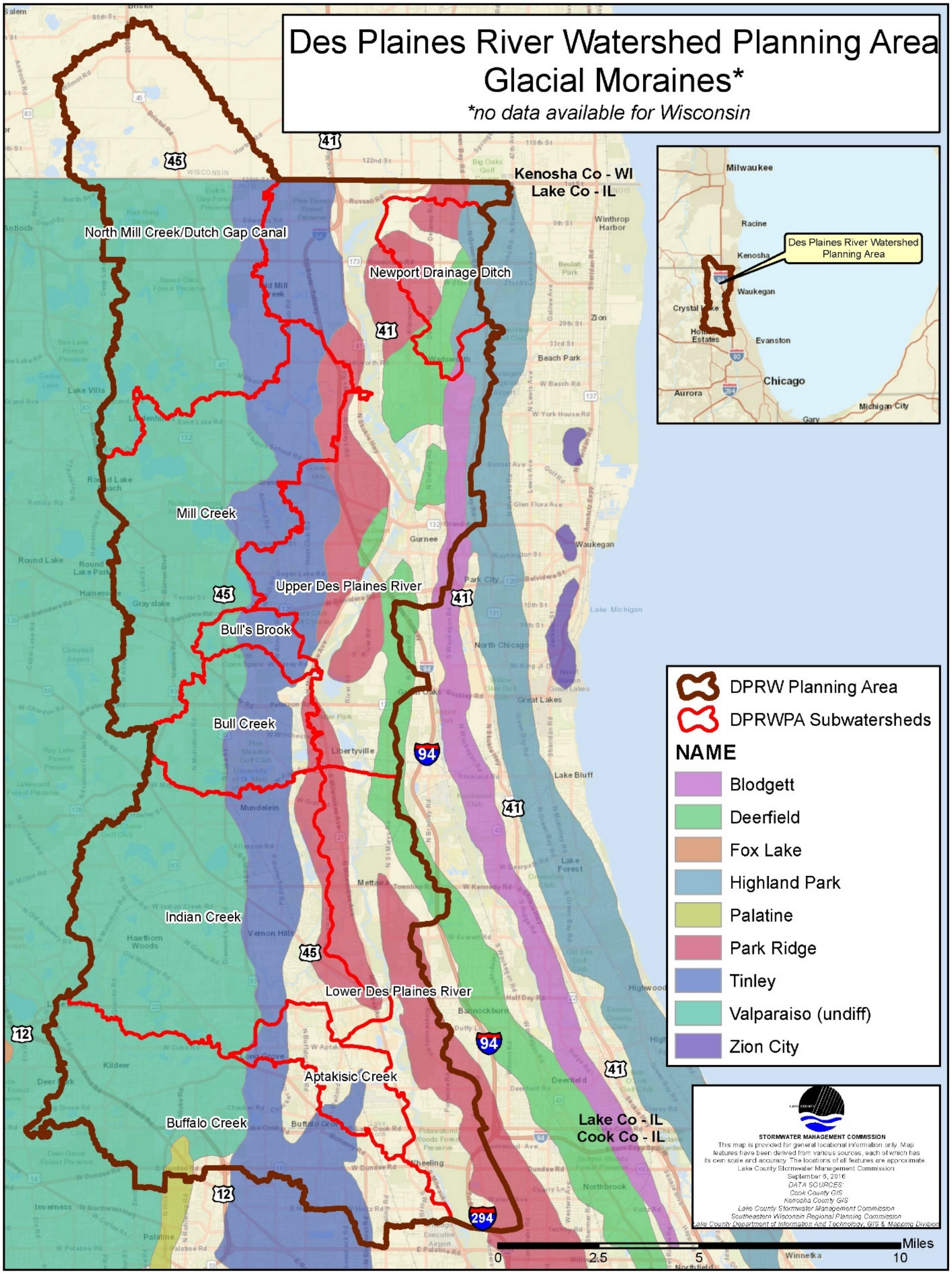


Figure 3-9: Des Plaines River Watershed Planning Area Glacial Moraines

Table 3-1: Hydrologic Units and HUC Designations for the Planning Area

HUC	HUC NAME	HUC LEVEL (NUMBER OF DIGITS)	CORRESPONDING PLANNING AREA SUBWATERSHED NAME(S)
07*	Upper Mississippi	HUC 2	All
0712*	Upper Illinois River	HUC 4	All
07120004*	Des Plaines	HUC 8	All
071200040104*	Jerome Creek-Des Plaines River	HUC 12	Upper Des Plaines River
071200040201	North Mill Creek	HUC 12	North Mill Creek/Dutch Gap Canal
071200040202	Mill Creek	HUC 12	Mill Creek
071200040301	Sterling Lake-Des Plaines River	HUC 12	Upper Des Plaines River, Newport Ditch
071200040302	Bull Creek-Des Plaines River	HUC 12	Upper Des Plaines River, Bull Creek-Bull's Brook
071200040501	Indian Creek	HUC 12	Indian Creek
071200040502	Wheeling Drainage Ditch	HUC 12	Buffalo Creek
071200040503*	McDonald Creek-Des Plaines River	HUC 12	Lower Des Plaines River, Aptakisic Creek

*The DPR planning area includes portion(s) of these hydrologic units

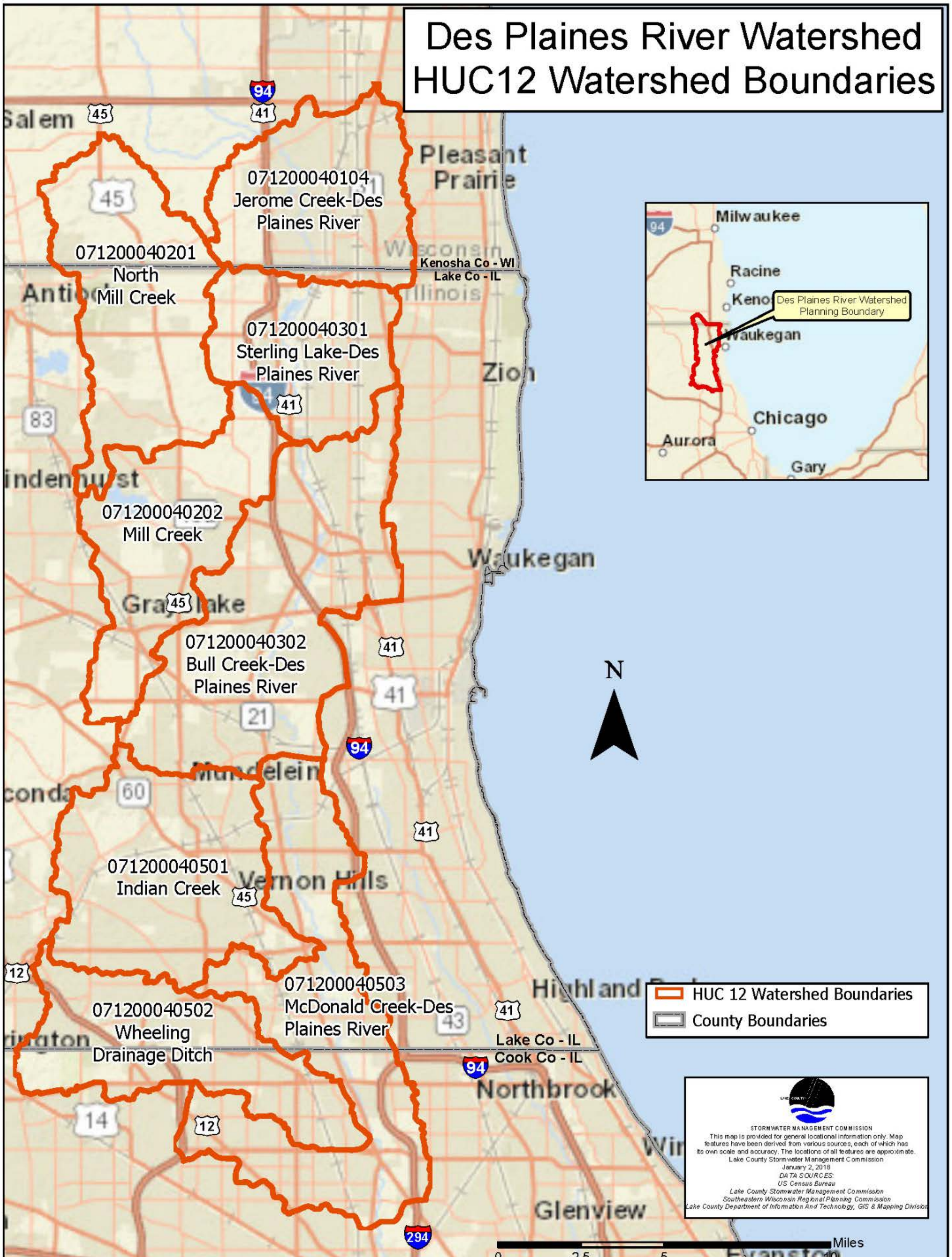


Figure 3-10: Des Plaines River Watershed Planning Area HUC 12 Watersheds

3.1.6 Climate and Precipitation

The DPR planning area is situated midway between the western Continental Divide and the Atlantic Ocean, and it is often underneath the polar jet-stream, which creates low pressure systems that bring clouds, wind and precipitation to the region. The DPR planning area's mid-latitude position results in seasonal variations in the regional solar energy input causing warm summers and cold winters.

The DPR planning area is classified as a warm continental climate, meaning the coldest month has an average temperature below freezing, the warmest month has an average temperature above 72 degrees Fahrenheit, and there is not a pronounced wet or dry season. The presence and density of buildings, roads, parking lots and industrial activities also influence the climate in comparison to surrounding rural areas, often increasing the temperature (National Climatic Data Center, 2009).

Lake Michigan influences the climate of the DPR planning area. Lake Michigan's large thermal mass moderates both the heat of the summer and the cold of the winter. Weather data also suggests that Lake Michigan increases general area cloudiness, decreases summer precipitation, and increases winter precipitation (National Climatic Data Center, 2009).

Climate Normals: 30-year averages of climatological variables including temperature and precipitation.

The Illinois State Climatologist Office tracks **climate normals** for numerous sites in Illinois. The monthly mean temperature normals and monthly precipitation normals for several sites in or near the DPR planning area are summarized in Table 3-2 and Table 3-3, respectively. As indicated by the climate classification for the region, winters are cold, with average temperatures below freezing while summers are relatively warm or hot. The influence of Lake Michigan on local climate is most evident at the Waukegan Regional Airport. Compared to the other stations in Table 3-2, Waukegan has among the warmest mean temperatures in December, January and February and the coolest mean temperatures in June, July, and August. The warmest site year-round appears to be Chicago Executive/Palwaukee.

Table 3-2: Mean Monthly Temperature Normals (Degrees Fahrenheit), 1981-2010

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN.
Antioch	21.5	25.2	35.3	47.3	57.7	67.7	72.3	71.0	63.4	50.9	39.0	25.9	48.2
Barrington	20.6	25.0	35.2	47.5	57.8	67.6	72.1	70.2	62.3	50.3	38.4	25.2	47.8
Chicago Executive/Palwaukee	23.7	27.8	37.5	47.8	58.3	68.4	73.6	72.3	64.3	52.2	40.0	28.0	49.6
Lake Villa	22.2	25.9	36.0	47.5	58.0	67.8	72.6	71.2	63.3	51.2	39.0	26.2	48.5
Mundelein	20.9	25.1	35.2	46.9	57.6	68.0	72.3	70.7	62.8	50.8	38.3	25.1	47.9
Waukegan Regional	23.0	25.9	35.2	46.1	55.7	65.7	71.3	69.9	62.2	51.0	39.1	27.5	47.8

(Illinois State Climatologist's Office & National Climatic Data Center, 2010) Data provided by the Illinois State Climatologist's Office, a part of the Illinois State Water Survey (ISWS) located in Champaign and Peoria, Illinois, and on the web at www.isws.illinois.edu/atmos/statecli.
Note: Mean monthly temperature normal data not available for Gurnee

Table 3-3: Mean Monthly Precipitation Normals (Inches), 1981-2010

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN.
Antioch	1.60	1.48	2.09	3.21	4.24	4.71	3.57	4.08	3.54	3.09	2.75	2.32	36.68
Barrington	1.90	1.89	2.29	3.56	4.24	3.85	3.78	4.86	3.40	3.10	3.04	2.26	38.17
Gurnee	1.80	1.82	2.35	3.59	3.96	3.69	3.79	2.90	3.29	2.85	2.90	2.28	35.22
Lake Villa	1.99	1.76	2.55	3.79	3.88	3.86	4.03	3.65	3.21	2.83	2.83	2.39	36.77
Mundelein	1.53	1.97	2.55	3.21	4.21	4.05	3.82	4.19	3.48	2.92	2.65	1.97	36.55

(Illinois State Climatologist's Office & National Climatic Data Center, 2010) Data provided by the Illinois State Climatologist's Office, a part of the Illinois State Water Survey (ISWS) located in Champaign and Peoria, Illinois, and on the web at www.isws.illinois.edu/atmos/statecli.

Note: Monthly precipitation normal data not available for Chicago Executive/Palwaukee or Waukegan Regional

Illinois exhibits wide variability in annual precipitation. Average annual precipitation varies by about 3 inches among sites in or near the DPR planning area. Despite the spatial variability of annual precipitation, seasonal variations in precipitation are similar between sites within or near the planning area, with comparatively wetter summers and drier winters. Annual snowfall totals are typically higher than annual precipitation, due to the low density of snow compared to liquid water. The wetter summer months are the result of thunderstorm-derived precipitation. These storm events tend to distribute rainfall variably and it is not uncommon for heavy rainfall to occur in some parts of the DPR planning area while other parts receive little to no precipitation. The spatial variability of this precipitation source may account for some of the overall variation in the normal rainfall amounts across the sites in Table 3-3.

The variety of climate and weather conditions creates diverse watershed conditions. For example, during winter months the watershed experiences precipitation in the form of snow, this precipitation may affect flooding if there is a sustained warm period following heavy snow accumulation. Likewise, rain on frozen ground or snow melt in spring combined with rain may also result in stream and localized flooding.

During spring, the DPR planning area will usually experience warming temperatures and wet weather conditions. In contrast, during fall, the watershed experiences cooling temperatures and precipitation frequency decreases. There have been prolonged "wet" periods of above-average annual precipitation, most recently during the 1970s and 1980s. There have also been major multi-year droughts in the 1930s and 1950s. Illinois has rainstorms which cause 40 or more flash-floods annually, each with several inches of rainfall in a few hours, in localized areas. In July 2017, this type of rainstorm delivered up to 8 inches of rainfall in less than 24 hours in some portions of the watershed planning area, resulting in localized flash flooding as well as a record flood crest elevation on the Des Plaines River.

3.1.7 Spatial Relationship of Water Resources

Water resources (streams, lakes, and wetlands) in the DPR planning area tend to be spatially distributed by the underlying surface topography and later anthropogenic influences (ditching, mining, impoundment, tile drainage, storm sewer networks, etc.). In general, tributary subwatersheds west of the Des Plaines River tend to have longer and more **dendritic stream systems** Figure 3-11). East of the Des Plaines River, stream systems tend to be shorter with fewer tributary branches. The north-south trending recessional moraines influence channel orientation in portions of North Mill Creek, Mill Creek, Bull Creek, Indian Creek, and Buffalo Creek. Wetland sloughs were common in the inter-morainal lowlands, prior to draining to increase cultivatable land. Newport Ditch, Dutch Gap Greenleaf Creek, and Seavey Drainage Ditch are examples of channels constructed to drain intermorainal lowlands.

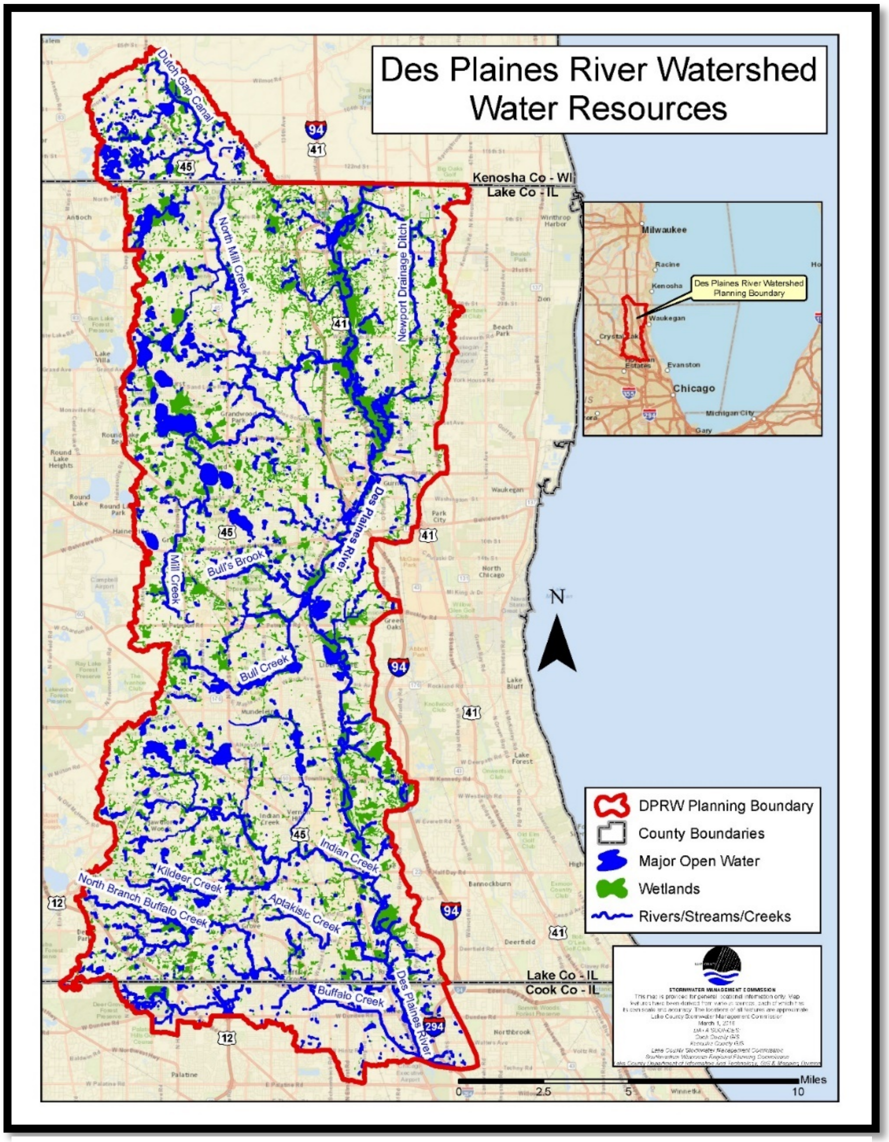


Figure 3-11: Water Resources in the DPR Watershed Planning Area

Several lakes in the DPR planning area are **kettle lakes** or **glacial sloughs**. These naturally-formed lakes are typically located higher in the moraines west of the Des Plaines River and are often near subwatershed boundaries. The hydrology of these lakes and their hydrologic connection to other water resources has been modified by humans. Many lakes have adjustable or fixed spillways, dams or culverts constructed at their outlets. Likewise, flow into the lakes has been modified by ditching and drainage projects as well as by storm

Dendritic Stream Systems: In a dendritic system, there are many contributing streams (similar appearance to the twigs of a tree), which are then joined together into the tributaries of the main river. They develop where the river channel follows the slope of the terrain.

Kettle Lakes: Shallow, glacial lakes that are formed when partially buried ice blocks from glaciers melt creating a depression that fills with water.

Glacial Sloughs: Shallow, wetland-type lakes that are formed during glacial retreat.

sewer networks that discharge to lakes. Many of the natural lakes in the watershed have a surface or culvert connection to another lake, stream, or wetland. Crooked, Hastings, Gages, Third, Fourth, and Diamond Lakes are examples of natural lakes in the planning area. Gray's Lake is unique because it is a natural lake of glacial origin that was historically part of the Fox River watershed, but overflow from the lake is now diverted through a storm sewer system to Mill Creek in the Des Plaines River watershed.

As discussed in section 3.1.1, the Des Plaines River is in a valley partially filled with glacial outwash sediment. Aggregate mining operations utilize this resource and have created numerous former quarry lakes near the Des Plaines River such as Lake Sterling, Lake Carina, Lake Minear and Independence Grove. Similarly, the construction of the Interstate Highway system through Lake County required large amounts of fill material, resulting in numerous borrow pits along its length. These borrow pits have filled with water and have become a component of the hydrologic system in the watershed.

Several additional lakes in the watershed were created for purposes other than quarrying: primarily aesthetic purposes, recreation, or stormwater management and flood control. These lakes were often constructed through a combination of excavation of low-lying areas near streams and wetlands and subsequent impoundment with construction of a dam or spillway. Lakes constructed directly on a stream system are sometimes referred to as "online" impoundments. Examples of online impoundments in the DPR planning area include Grandwood Park, St. Mary's, Loch Lomond, and Countryside Lakes. Buffalo Creek Reservoir is also an online impoundment that serves as a flood control reservoir. The dam on Rasmussen Lake, an online impoundment of North Mill and Hastings Creeks, is being removed (as of 2017) and the lake will revert to a free-flowing stream. Examples of other constructed lakes in the DPR planning area include Linden, Potomac, Valley, and Harvey Lakes.

Wetlands cover approximately 17,000 acres of the DPR planning area and can be found virtually throughout the watershed, except in locations where they have been drained, filled, or converted to another land cover type. While wetlands are typically lower in elevation than the immediately surrounding lands, they are found in a variety of topographic positions, ranging from isolated depressions on the crests of moraines to gently sloping drainageways across the landscape, to bottomlands in floodplains and along lake shores. Similarly, wetlands can be found throughout the hydrologic network of the watershed. Geographically isolated wetlands are located in depressions surrounded by uplands and do not have regular surface connections to other water bodies or wetlands. Headwater wetlands are located along the upper-most stream reaches, while larger wetland complexes often have larger tributary areas and may have more regular hydrologic connections to other water features. Rivers, streams, and lakes typically have wetlands of some form associated with them. Descriptions of more common wetland types can be found in Section 3.11.

Ponds and detention basins are the most numerous constructed water features in the DPR planning area and can be found throughout the landscape. Ponds have historically been constructed by excavation or impoundment for a variety of purposes in the DPR planning area including agriculture, borrow pits, wastewater treatment, wildlife management, fish/fishing, golf course features, and residential aesthetics. Constructed ponds are often associated with a natural source of hydrology such as a wetland or stream but may also be located in upland areas that would otherwise be dry. Detention basins, a specific type of pond, are associated with urban and suburban development beginning in the second half of the twentieth century. Detention basins can be wet (ponds), wetland-bottom, or dry and are specifically designed to reduce peak runoff discharges from developed sites. Prior to watershed development regulations, detention ponds were constructed in both upland and wetland locations. Regulations now discourage or prohibit the construction of stormwater detention facilities in wetlands, which are typically constructed in upland areas in more recent developments. Detention basins are a component of the designed drainage system and stormwater infrastructure, and typically have a direct or eventual hydrologic connection to rivers, streams, lakes, and wetlands through stormsewers, drainage ditches, and other detention basins. The stormsewer network and detention basin inventory are further described in sections 3.14 and 3.15, respectively.

3.2 TOPOGRAPHY

Topographic data is used in the planning process to develop floodplain maps, water quality models, flood mitigation recommendations, catchments, **DEMs** and regionally significant depressional storage areas.

> **DIGITAL ELEVATION MODELS (DEMs):**
> A digital cartographic/geographic dataset of elevations in xyz coordinates. DEMs are derived from hypsographic data (contour lines) and/or photogrammetric methods using USGS 7.5-minute, 15-minute, 2-arc-second (30- by 60-minute), and 1-degree (1:250,000-scale) topographic quadrangle maps.

Figure 3-12 represents the DPR planning area boundary and topography from a compilation of three data sets: the 2010 Kenosha County DTM, 2007 Lake County DTM, and 2008 Cook County DTM. The Dutch Gap Canal/North Mill Creek, Mill Creek, Bull Creek, Indian Creek, Aptakisic Creek, and Indian Creek tributaries all drain into the Des Plaines River main stem from the west. The Newport Drainage Ditch is the only major tributary draining into the main stem from the east. The lowest elevation in the DPR planning area is 630 feet (NAVD88) above mean sea level at the northwest corner of the confluence of Buffalo Creek and the Des Plaines River (just north of Chicago Executive Airport in the Village of Wheeling). The highest elevation in the DPR planning area is 919 feet (NAVD88) above mean sea level is the western edge of Hawthorn Woods County Club (just east of Old McHenry Road in the Village of Hawthorn Woods) on the western edge of the planning boundary.

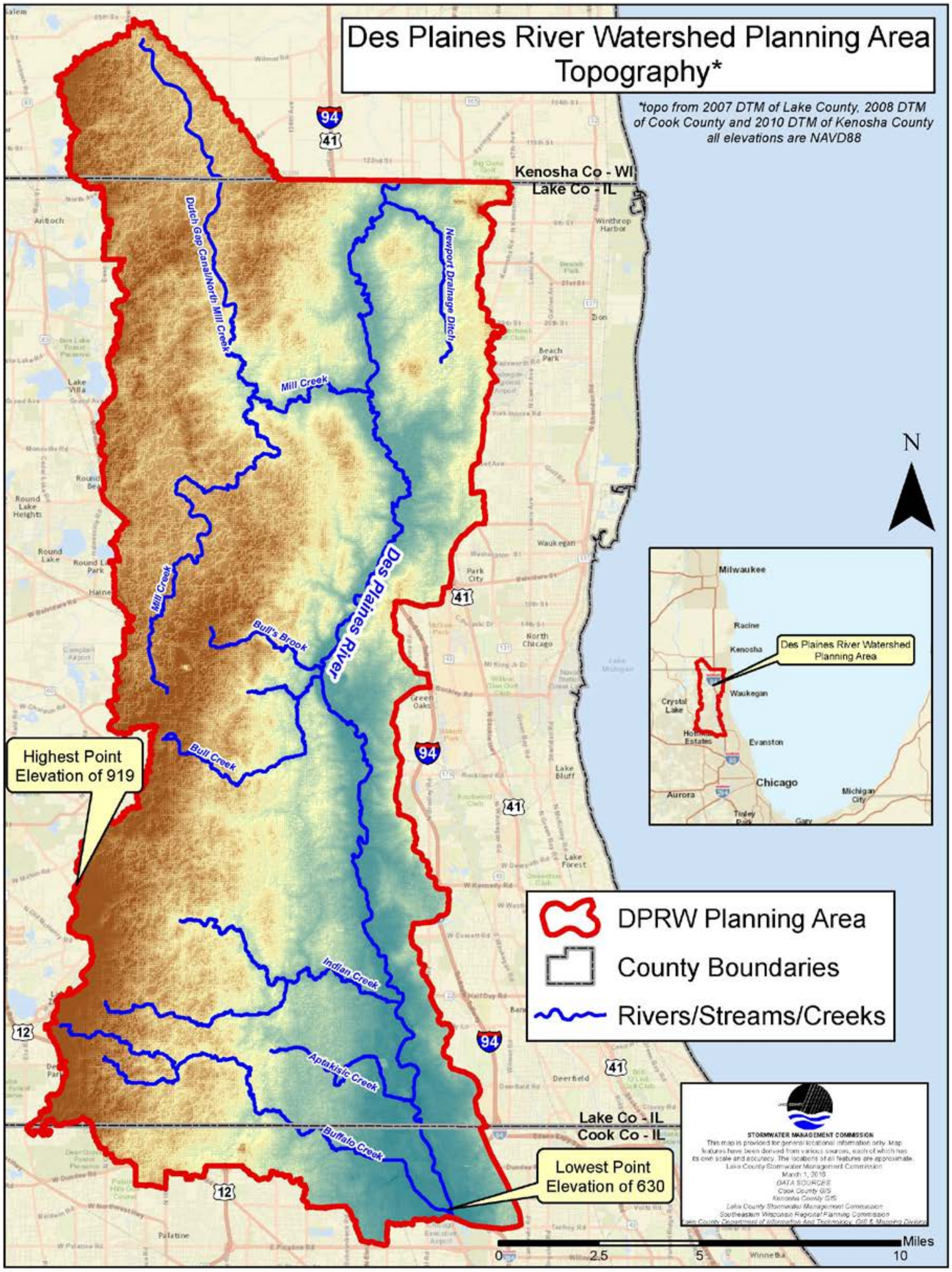


Figure 3-12: Des Plaines River Watershed Topography

3.3 SOIL

Deposits left during the last glacial period are the raw materials of present soil types in the DPR planning area. A combination of physical, biological and chemical variables, such as topography, drainage patterns, climate, erosion and vegetation, have interacted over centuries to form the variety of soils found in the watershed. These soils were formed under wetland, forest and prairie plant communities, and they are identified by a name associated with each series or class of soils with similar characteristics. A soil series name generally is derived from a town or landmark in or near the area where the soil series was first recognized, although naming conventions vary by county.

Soils determine the water-holding capacity and include both the erosion potential and **infiltration** capabilities. Soil characteristics indicate the way soils in an area will interact with water in the environment, and therefore are useful in watershed planning. These soil characteristics can help guide where restoration and BMPs are likely to be successful and where there may be constraints to project implementation.

INFILTRATION: That portion of rainfall or surface runoff that moves downward into the subsurface soil.

SOIL PHASE: A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

The USDA NRCS has produced a detailed (current) soil survey for Lake, Kenosha and Cook County. These soil surveys contain information regarding the physical and chemical properties, as well as, information regarding human use for each soil series and **soil phase** in the watershed. The soil surveys were utilized to extract detailed soil data for the DPR planning area. Table 3-4 includes the major soil series (more than 3% in the watershed) present in the DPR planning area and the amount of watershed occupied by each.

Table 3-4: Major Soil Types in the DPR Planning Area

SOIL SERIES	SOIL SERIES NAME	ACRES	HYDROLOGIC SOIL GROUP	HYDRIC RATING (Y/N/Partial)	% OF WATERSHED
Mzd(WI)/530	Ozaukee	28,293.80	C	N	18.82%
Me(WI)/531	Markham	14,656.23	C	N	9.75%
At(WI)/232	Ashkum	10,945.30	C/D	Y	7.28%
Ph(WI)/153	Pella	8,943.95	B/D	Y	5.95%
Et(WI)/146	Elliott	8,005.99	C/D	Partial	5.32%
Va(WI)/223	Varna	7,327.18	C	N	4.87%
W	Water	6,034.31	N/A	Y	4.01%
Bc(WI)/298	Beecher	5,940.64	C/D	Partial	3.95%
802/805	Orthents	4,989.41	C/D	N	3.32%
Ht(WI)103/1103/4103	Houghton muck	4,954.37	A/D	Y	3.29%
Other Soil Series (>3% of the watershed)		*50,269.83*	--	--	*33.43%*
	TOTAL:	**150,361**			**100%**

*Partial Hydric: At least some components of the soil are hydric.

3.3.1 Hydric Soils

Hydric soils form in areas of the landscape that are seasonally or permanently saturated with water. These conditions are conducive to the growth of hydrophytic vegetation; therefore, the presence of hydric soils is indicative of present or historical wetland conditions or may indicate areas of depression. Areas with hydric soils and drained hydric soils that do not presently contain wetlands may be utilized for wetland restoration.

> **Hydric Soils:** A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. These conditions alter the physical, biological and chemical characteristics of the soil, thereby influencing the species composition or growth, or both, of plants on those soils.
>
> **Hydrophytic Vegetation:** Plants that tolerate or require saturated soil or standing water

Figure 3-13 and Figure 3-14 map hydric soils in the DPR planning area. Hydric soils cover approximately 35,820 acres (24%), while non-hydric soils cover about 114,541 acres (76%) of the watershed. Most of the streams, lakes, and other surface waters in the watershed have hydric soils. Additionally, smaller pockets of hydric soils are well-distributed throughout the watershed.

3.3.2 Soil Erodibility

Soil erodibility is largely determined by the tendency of soil particles to become detached and mobilized by water and the ground slope. Highly erodible soils in the watershed are highly susceptible to erosion by water due to a combination of slope, particle size, and cohesion, but they are not prone to erosion by wind. Highly erodible soils are considered in the watershed-based plan because erosion from these soils can potentially end up in surface waters, contributing to high amounts of total suspended solids and sediment accumulation in streams and lakes.

> **NOTEWORTHY: Soil Erodibility and Pollution**
>
> Soil characteristics, especially the tendency of soil particles to become detached and mobilized by water runoff, have considerable impact on water quality. For instance, sandy soils are more prone to erosion than clayey soils, although pollutants are more likely to be attached to clay particles.
>
> It is important to map highly erodible soils because they represent areas that may contribute large amounts of total suspended solids (TSS) to streams and lakes. High TSS levels can result in stream degradation as a result of silt deposition and pollution. Some pollutants frequently attach to TSS particles and wash into lakes and streams, polluting the water and sediments and decreasing water clarity.

The movement or loss of soil resulting from erosion may also cause damage to property as buildings and infrastructure are undermined. The removal and disposal of sediment accumulated in lakes, ponds, detention ponds and the storm drainage system can be an expensive maintenance activity.

In the DPR planning area, 20,569 acres (14%) are classified by NRCS as highly erodible soil. This suggests that a substantial amount of the soils in the watershed have the potential to negatively impact water quality. Highly erodible soils do not include hydric soils and are represented by hydrologic soil groups “B” and “C”. Erodible soils along lakeshores, stream channels, and disturbed land surfaces (e.g. active croplands and construction sites) are most susceptible to erosion. A large portion of the highly erodible soils in the DPR planning area are associated with open water (Figure 3-15 and Figure 3-16). Stabilization practices near shorelines and stream channels could substantially reduce erosion. Additionally, land developers are required to follow the NPDES and the Lake County WDO regulations regarding soil erosion and sediment control measures during construction.

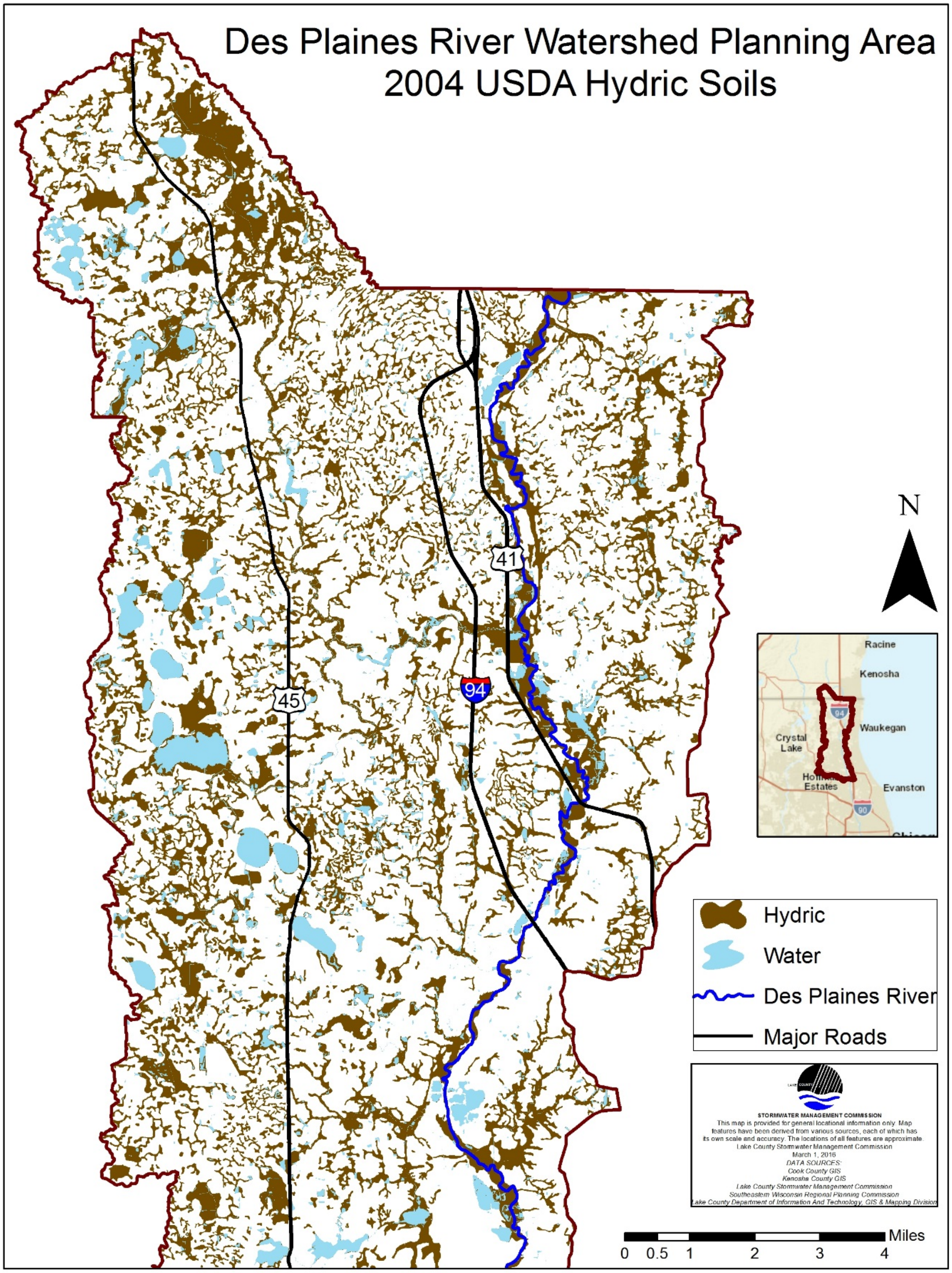


Figure 3-13: Hydric Soils – Northern Portion of the Des Plaines River Watershed Planning Area
NRCS 2012 Lake County Soil Survey, 2004 Kenosha County Soil Survey and 2011 Cook County Soil Survey

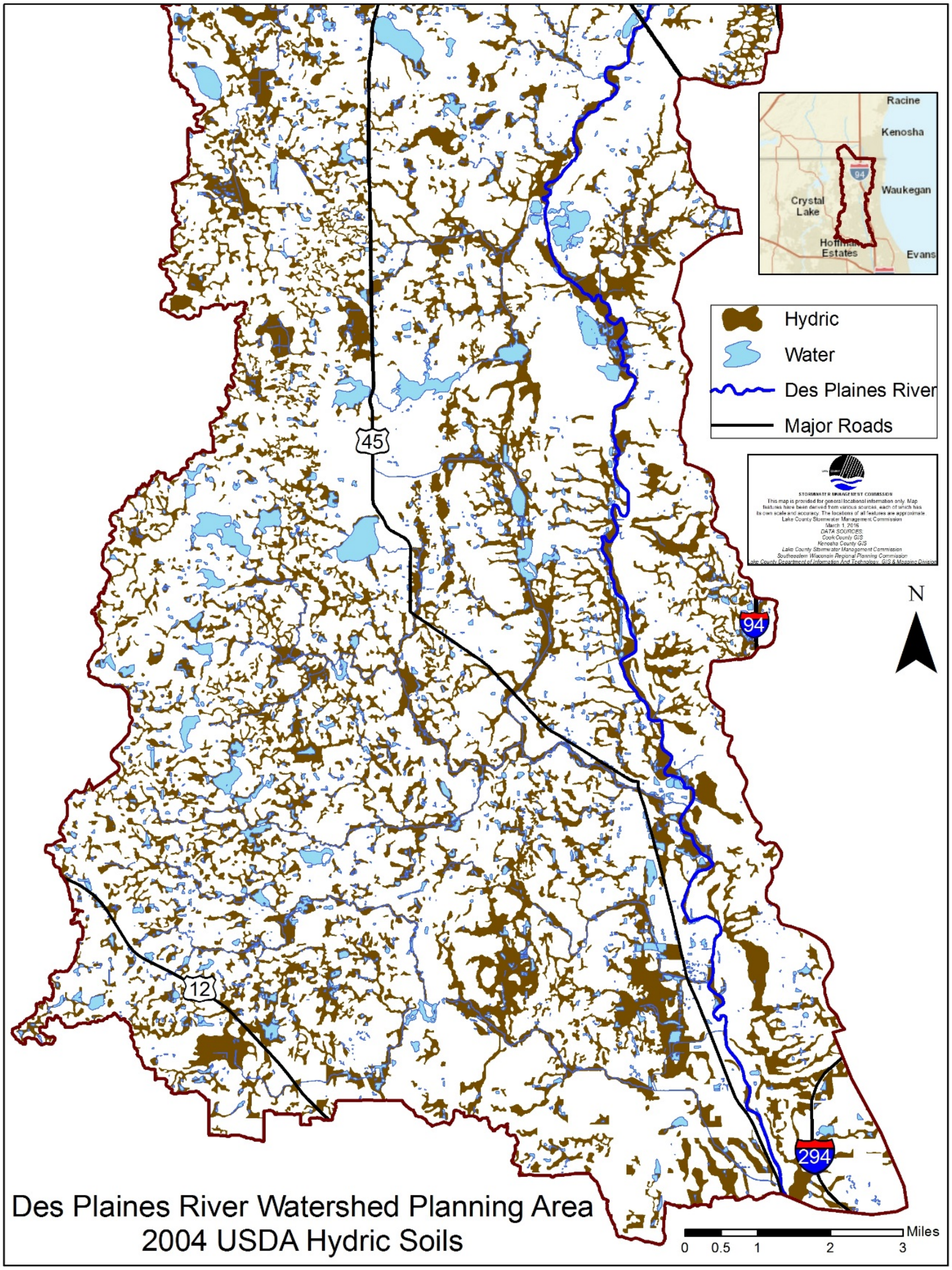


Figure 3-14: Hydric Soils – Southern Portion of the Des Plaines River Watershed

NRCS 2012 Lake County Soil Survey, 2004 Kenosha County Soil Survey and 2011 Cook County Soil Survey

3.3.3 Hydrologic Soil Groups

The NRCS broadly classifies soils based on their drainage characteristics into four different hydrologic soil groups (HSGs). The classification considers soil texture, drainage description, runoff potential, infiltration rate and transmission rate (permeability). Group A is comprised of the most permeable soil types (i.e., sandy soils) and has the least runoff potential while group D includes the most impermeable soil types (i.e. clay) and has the greatest runoff potential. HSGs should be considered when identifying potential stormwater best management practice and retrofit opportunities. The main HSGs are separated into four categories: A, B, C, and D; see Table 3-5 for HSG permeability and surface runoff characteristics.

Table 3-5: Hydrologic Soil Groups and Corresponding Attributes

HSG	SOIL TEXTURE	DRAINAGE DESCRIPTION	RUNOFF POTENTIAL	INFILTRATION RATE	TRANSMISSION RATE	SPATIAL PATTERN IN WATERSHED	ACRES (% OF WATERSHED)
A	Sands (and Gravels), Loamy Sand, or Sandy Loam	Well to Excessively Drained	Low	High	High (greater than 0.30 in/hour)	Typically adjacent to wetlands or open water	112 (<1%)
B	Silt Loam or Loam	Moderately Well to Well Drained	Moderate	Moderate	Moderate	Along larger streams and water bodies – riparian areas	2,850 (1.9%)
C	Sandy Clay Loam	Somewhat Poorly Drained	High	Low	Low	Upland areas	66,788 (44.4%)
D	Clay Loam, Silty Clay Loam, Sandy Clay Loam, Silty Clay, or Clay	Poorly Drained	High	Very Low	Very Low	Tops of moraines and ridges	11,271 (7.5%)
						Total:	81,021

There are also areas of the watershed with combined soil groups such as: HSG-A/D, HSG-B/D and HSG-C/D and N/A – water, landfills, urban areas, etc. (totaling 41.5% of the watershed). These combined soil groups are a combination of soil types and exhibit a combination of permeability and surface runoff characteristics. The soil characteristics can change depending on saturation, slope and time of year. If these soils can be adequately drained (with underground drain tiles or other techniques), then they are assigned to dual hydrologic soil groups based on their saturated hydraulic conductivity and the water table depth when drained. The first letter applies to the drained condition and the second to the un-drained condition.

Runoff curve numbers classify the runoff potential of different soil types with different types of land cover. The curve numbers are a function of HSGs, land cover or usage and antecedent soil moisture conditions. The curve number value ranges from 0 - 100. Lower runoff curve numbers indicate low runoff potential, while larger runoff curve numbers indicate increased runoff potential. Overall, soils in the DPR planning area are not well drained.

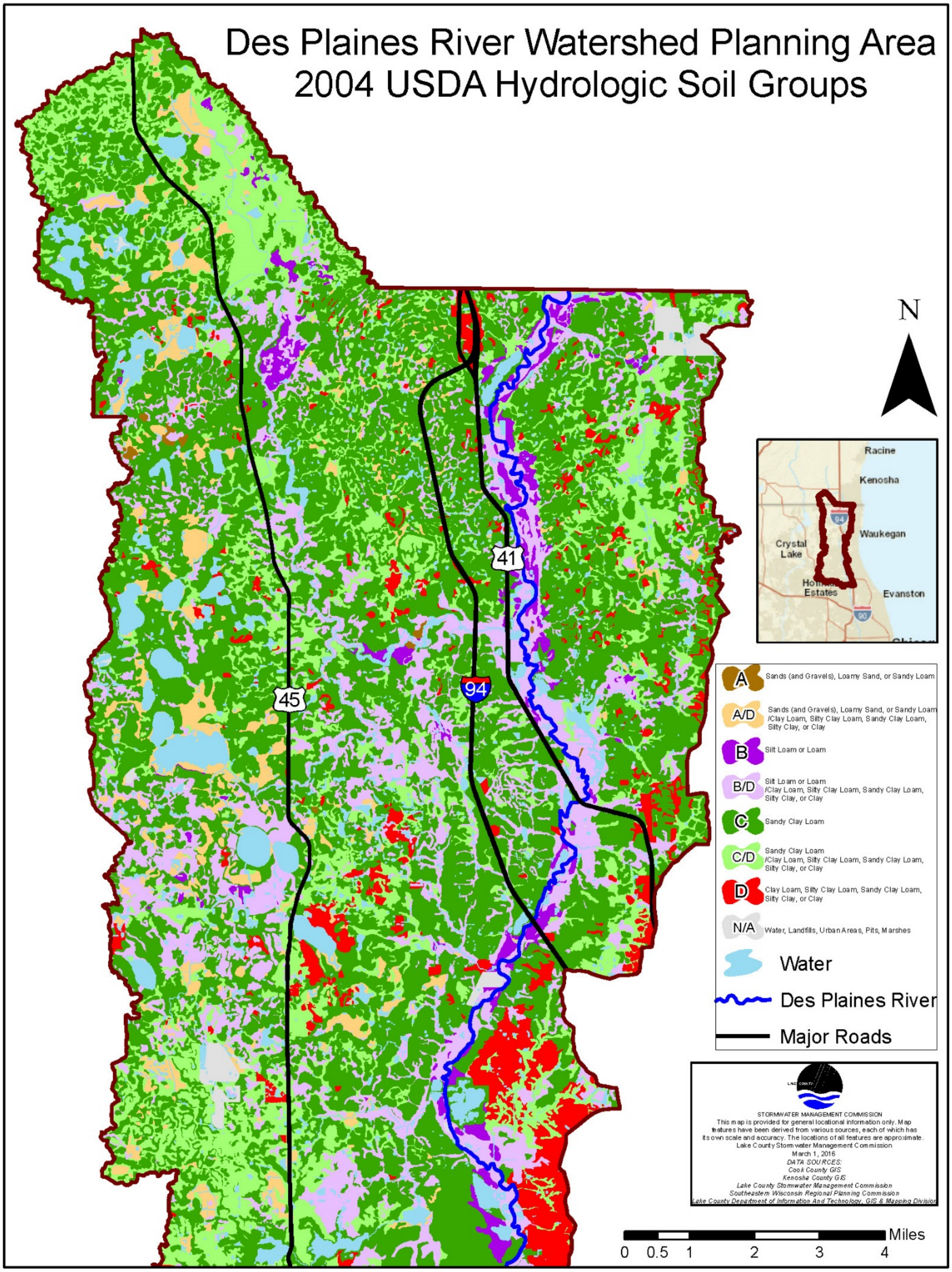


Figure 3-15: Hydrologic Soil Groups – Northern Portion Des Plaines River Watershed Planning Area

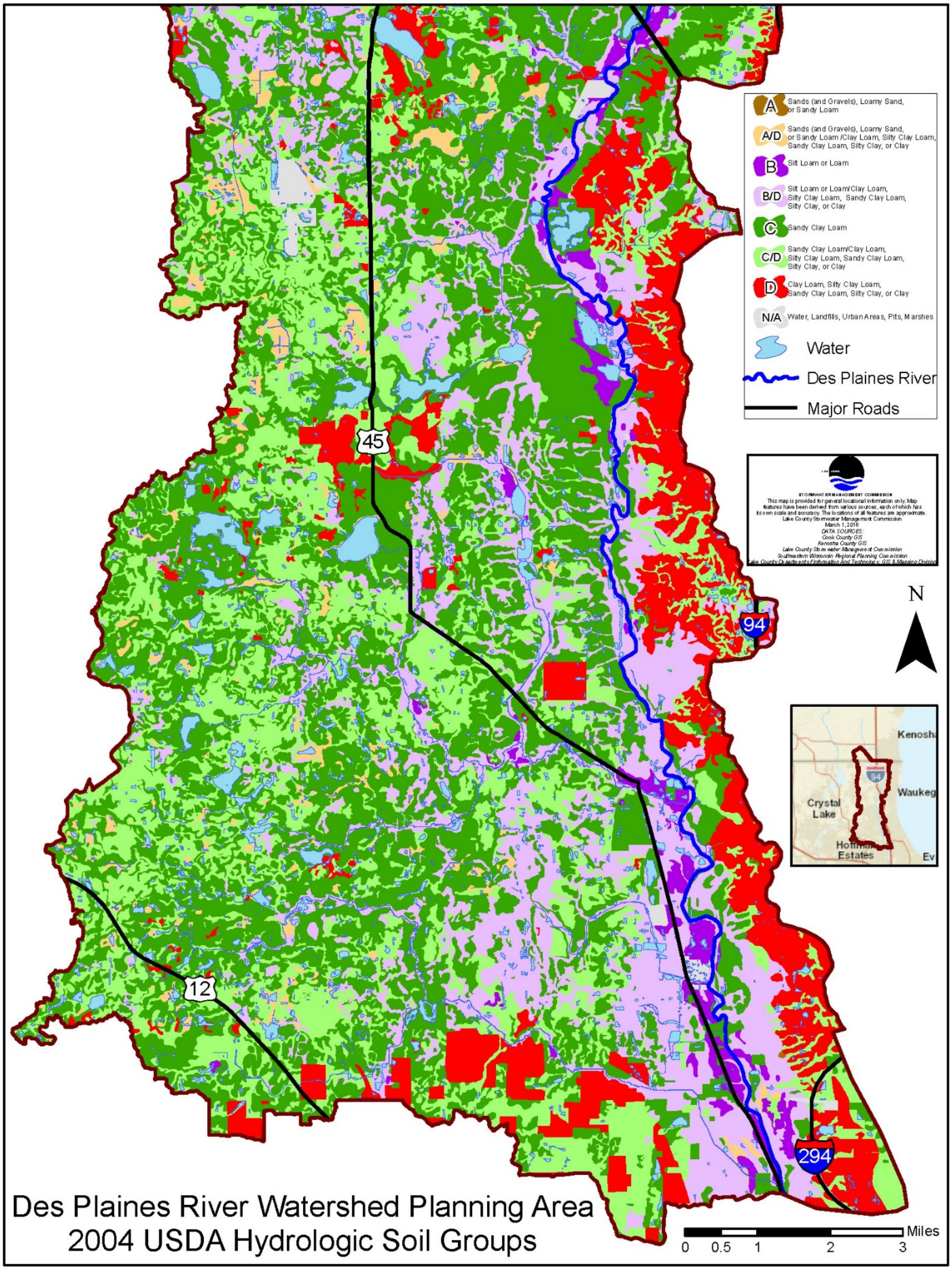


Figure 3-16: Hydrologic Soil Groups – Southern Portion Des Plaines River Watershed Planning Area

3.4 WATERSHED HYDROLOGY

Hydrology is the study of the occurrence, circulation, distribution, and properties (e.g., quality) of water. Earth's water is constantly being cycled between oceans, the atmosphere, and land through different pathways at different rates. The movement of the earth's water through these various pathways is called the hydrologic cycle. Although the hydrologic cycle is inherently complex, one can gain a general understanding of how it works by envisioning the following process. Clouds form over the ocean due to the evaporation of water. Wind carries the clouds ashore where they produce rain. Excess rainfall (i.e., stormwater runoff) flows into lakes, rivers, wetlands, and groundwater. Over time, water stored in the lakes, rivers, and wetlands, either evaporates back into the atmosphere or flows back into the ocean, beginning the cycle anew.

Primarily, hydrology involves studying the flow of water through the various hydrologic pathways that can be found within a geographical region or area. These pathways connect every component of the landscape and can generally be divided into surface and ground water hydrologic pathways. Surface water includes all hydrologic pathways at or above the earth's surface, including precipitation, evapotranspiration and surface water flow. Ground water includes all hydrologic pathways below the earth's surface including, infiltration, interflow, and groundwater flow. Hydrology is the study of surface water pathways, and hydrogeology is the study of ground water pathways. Primary areas of study within the science include developing methods for directly measuring flows through the various hydrologic pathways and developing and/or applying models for estimating flows through the various hydrologic pathways. When applied to a watershed, hydrology typically involves studying the flow of water between the surface water hydrologic pathways that connect the air, land, lakes, rivers, and wetlands found within the watershed.

NOTEWORTHY: HYDROLOGIC CYCLE

The hydrologic cycle describes the continuous movement of water on, above, and below the surface of the earth. The total mass of water on earth remains relatively constant over time, but the amount of water in each of its three primary states: solid (i.e., ice), liquid (i.e., water), and gas (i.e., water vapor), is variable depending on a wide range of climate-related variables. Water moves from one state to another through various hydrologic pathways, such as evaporation, transpiration, condensation, precipitation, infiltration, surface water flow, and interflow (i.e., shallow groundwater flow). As water moves between states, energy is exchanged, which affects temperatures on the surface of the earth. For example, when water evaporates, energy is absorbed, and the surface of the earth is cooled through the process of evaporative cooling. When water condenses, energy is released, and the surface of the earth is warmed. These energy exchanges, which occur on a global scale, powered by solar energy, have a significant influence on the earth's climate, as does water, in its three primary states (e.g., water vapor absorbs and emits energy back toward the surface of the earth; however, when water vapor forms into clouds, it reflects a significant amount of solar radiation back into space). Water and the hydrologic cycle are responsible for earth's mild climate and makes life possible on earth.

Hydrology and hydraulics are terms used to describe the effects of precipitation including infiltration, runoff, and evaporation on land surfaces that drain to streams and lakes. Hydrologic studies of watersheds usually typically determine how topography naturally delineates the land into watersheds, subwatersheds and smaller catchments. Hydraulics is the branch of science that deals with practical application of liquid in motion.

3.4.1 SUBWATERSHEDS

SUBWATERSHED: Topographic perimeter of the catchment area of a stream tributary. Watersheds are broken down into these smaller geographic units.

Table 3-6 and Figure 3-17 display the major **subwatersheds** in the DPR planning area. There are 10 subwatersheds ranging in size from approximately 3 square miles (Bull's Brook) to 51 square miles (Upper Des Plaines River) with an average size of 23 square miles.

The subwatersheds in the DPR planning area are roughly equivalent to USGS HUC 12 boundaries in size; however, the subwatersheds in the DPR planning area are not official USGS HUC boundaries. The subwatersheds in the DPR planning area were originally derived from HUC boundaries in the late 1980s. These boundaries have been altered as more detailed data, such as remapping from floodplain studies and higher resolution topographic data, has become available.

Table 3-6: Des Plaines River Subwatersheds

SUBWATERSHEDS	SQUARE MILES	ACRES	% OF WATERSHED
Aptakisic Creek	6.83	4,374.3	3%
Buffalo Creek	27.2	17,392.8	12%
Bull Creek	11.2	7,136.4	5%
Bull's Brook	2.84	1,816.8	1%
Indian Creek	37.7	24,151.4	16%
Lower Des Plaines River	22.8	14,607.2	10%
Mill Creek	30.9	19,783.0	13%
Newport Drainage Ditch	7.8	5,018.1	3%
North Mill – Dutch Gap Canal	36.8	23,532.3	16%
Upper Des Plaines River	50.9	32,548.6	22%
TOTALS:	**235**	**150,361**	

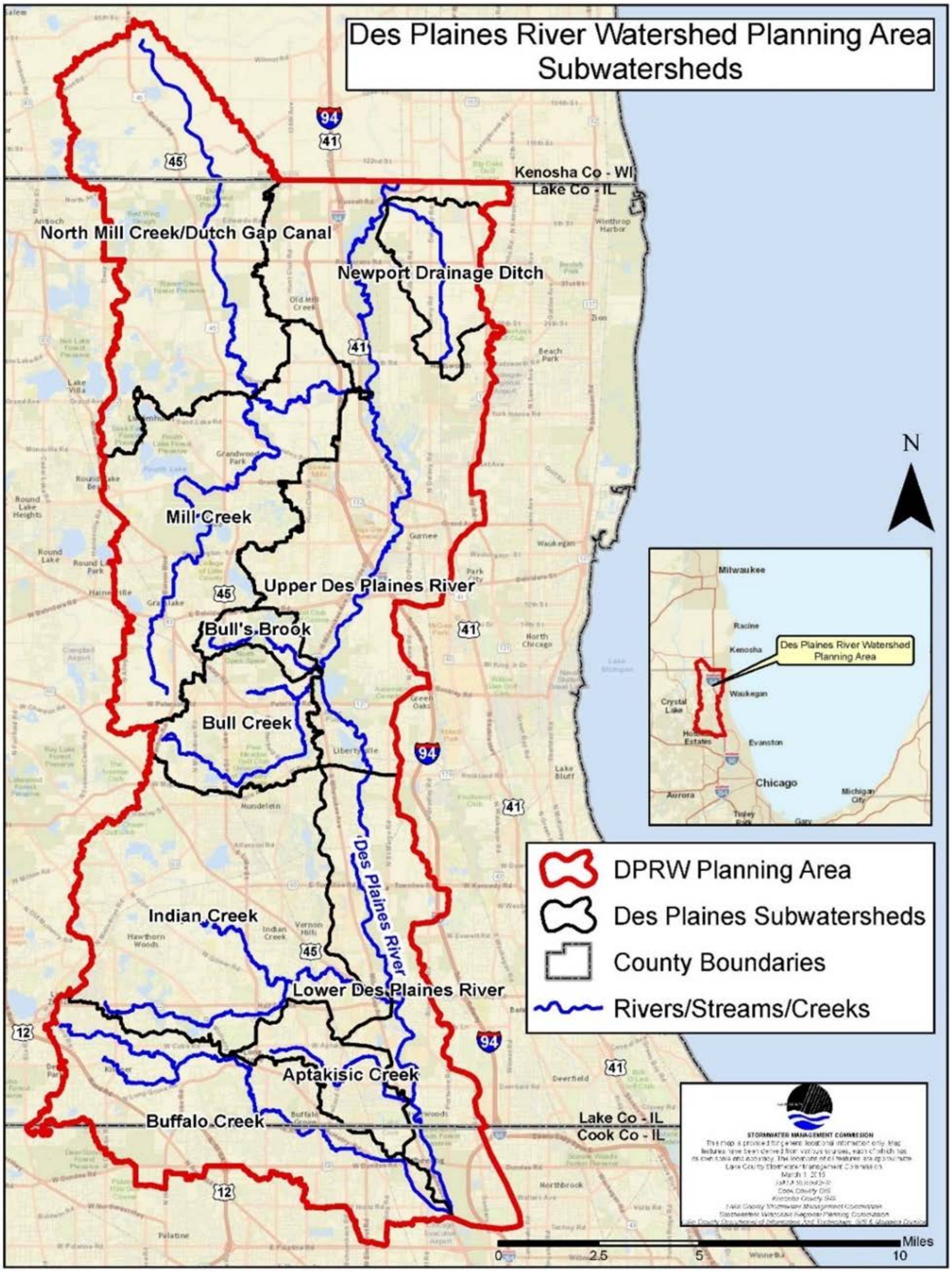


Figure 3-17: DPR Planning Area Subwatershed Map

3.4.2 CATCHMENT

CATCHMENTS: 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 confounding pollutant sources, boundaries have fewer political jurisdictions, and monitoring/mapping assessments can be done in a relatively short amount of time. See Figure 3-18.

The DPR planning area consists of 432 catchments ranging in size from 18 to 1,432 acres, with the average (mean) size of 348 acres. As part of the watershed delineation discussed in Section 3.4.1, the DPR planning area was further divided into 432 catchments using 2011 LiDAR data from Kenosha County, WI, 2007 LiDAR data from Lake County, IL, and 2008 LiDAR data from Cook County, IL. The LiDAR datasets were used to produce a seamless raster and basins were developed using models in ArcGIS. The boundaries developed in GIS were further augmented and refined using the latest aerial photography as well as other datasets such as water, roads, and culverts. Catchments of individual lakes ("lake-sheds") that were previously delineated by the LCHD were maintained as much as possible. The catchments represent surface drainage only and do not account for sub-surface (storm sewers or drain tile drainage) areas.

Table 3-7 and Figure 3-19 summarize the delineated catchments by subwatershed.

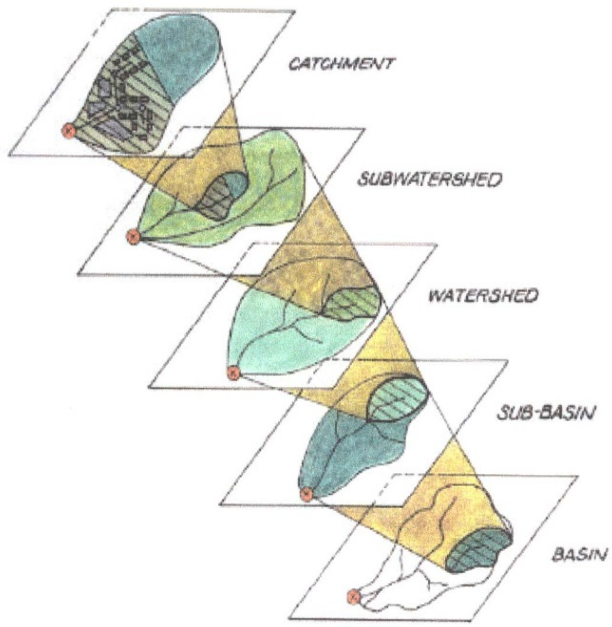


Figure 3-18: Defining Watershed, Subwatershed, and Catchment/Subwatershed Management Unit Boundaries

Table 3-7: Subwatershed Catchment Compilation Data

SUB-WATERSHEDS	NUMBER OF CATCH-MENTS	TOTAL ACRES	AVERAGE (MEAN) ACREAGE OF CATCH-MENTS
Aptakisic Creek	9	4,374	486
Buffalo Creek	43	17,393	404
Bull's Brook	6	1,817	303
Bull Creek	21	7,132	340
Dutch Gap/North Mill Creek	63	23,532	374
Indian Creek	64	24,152	377
Lower Des Plaines	58	14,607	252
Mill Creek	58	19,783	341
Newport Drainage Ditch	16	5,018	314
Upper Des Plaines	94	32,553	346
TOTAL:	**432**	**150,361**	

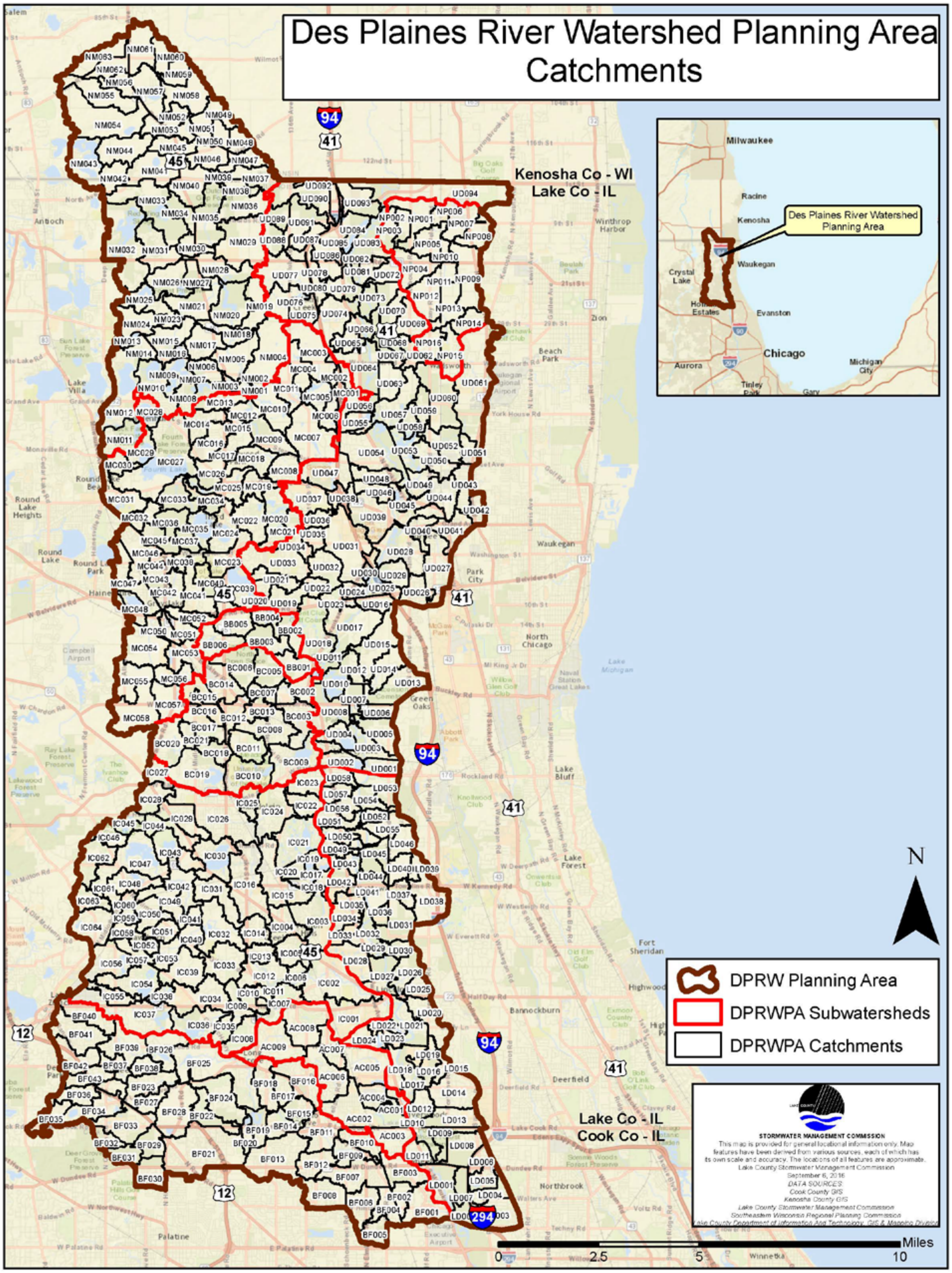


Figure 3-19: Des Plaines River Watershed SMU and Catchment Map

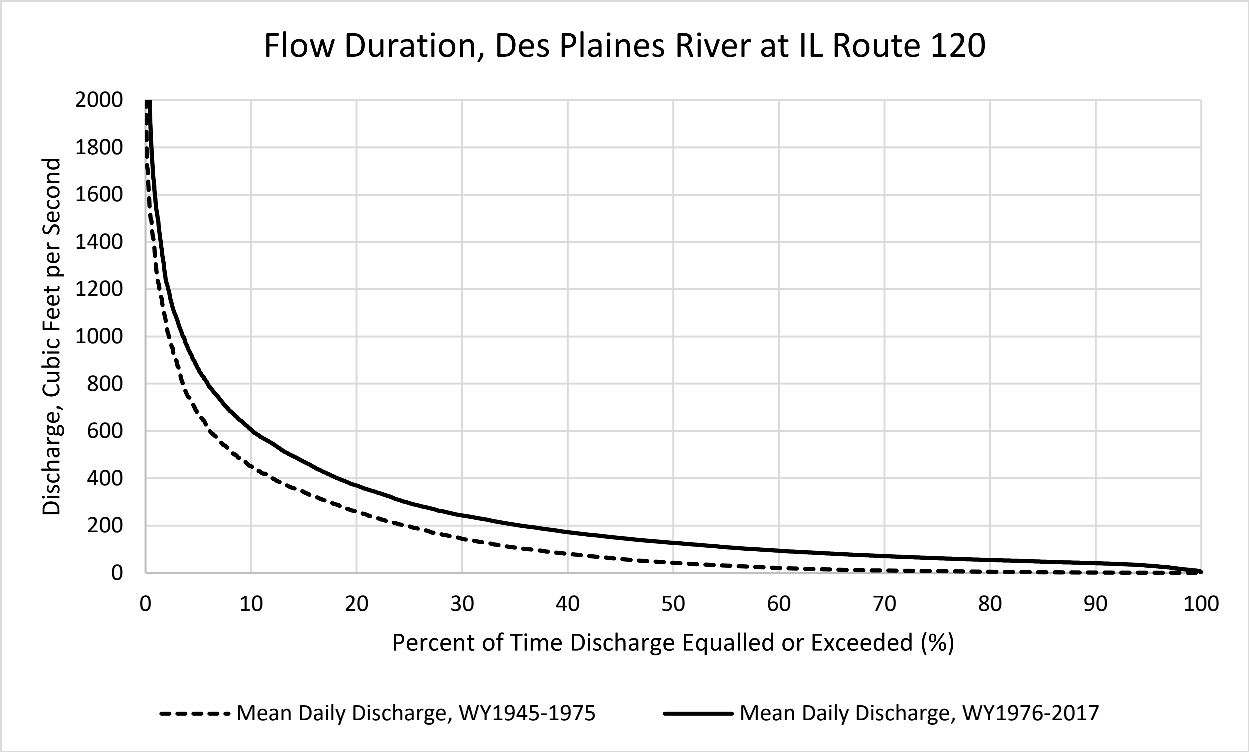
3.4.3 STREAM HYDROLOGY

Discharge (volume of flowing water) in the DPR planning area is derived from three general sources of flow:

- baseflow and interflow, the discharge of groundwater and shallow subsurface flow to lakes, streams, and wetlands.
- overland flow and surface runoff, discharge of water flowing over the ground surface as a result of direct precipitation, snowmelt, ground saturation, or other sources of water. Flow in streams, surface waters and wetlands is included in this category.
- treated effluent and return flow, discharge of water that has been used for some human activity such as treated wastewater from public water supplies or industrial uses, cooling and process water, and irrigation. Treated wastewater effluent is a significant source of overall streamflow in the planning area. Return flows from cooling, industrial processes, and irrigation are not significant.

Under pre-settlement landscape conditions, discharge during much of the year in all streams within the watershed was driven by baseflow, interflow, and tributary flow (runoff) from other water bodies. Runoff from precipitation had a less pronounced effect on stream discharge compared to present conditions. As the DPR planning area has developed, baseflow and interflow has almost certainly been reduced with surface runoff contributing a greater proportion of the volume of annual discharge (see Section 4.1). Tiling, channelization of streams, and ditching of wetlands and low-lying areas lowered shallow groundwater levels in some areas. Consequently, stream hydrology in the DPR planning area has been extensively altered since European settlement.

Additionally, the DPR planning area receives hydrologic inputs from the Great Lakes basin through public water supply systems that transport potable water from Lake Michigan to systems within the DPR planning area. Much of the wastewater that the WWTPs in the DPR planning area receives is derived from Lake Michigan, then is treated, and discharged to the Des Plaines River or its tributaries. Hastings Creek, Mill Creek, lower Aptakisic Creek, and the Des Plaines river receive significant flow inputs from WWTP discharges within the DPR planning area, while additional streams (but not all) receive relatively small inputs from WWTPs. These inputs are most noticeable during periods of baseflow or low flow, when “natural” sources of streamflow are augmented by flows from WWTP discharges. For example, Figure 3-20 depicts the flow duration curves for the Des Plaines River at Gurnee stream gage for water years 1945-1975 and 1976-2017, corresponding the periods before and after the introduction of two WWTP effluent discharges upstream of this location. The curves indicate an increase in discharges for both high and low flows after 1975. The 90% and 75% probability exceedance low flows increased 3900% (from 1 to 40 cubic feet/second) and 786% (7 to 62 cubic feet/second), respectively. The addition of WWTP effluent flows to the Des Plaines River is also discussed in section 3.17.



The

Figure 3-20: Flow duration curves for Des Plaines River at IL Route 120 for the periods water years 1945-1975 and water years 1976-2017
(Data from USGS).

cumulative effects of watershed hydrologic changes can also be discerned by comparing hydrographs (change in discharge over time) for different stream segments in the DPR planning area. Figure 3-21 shows the annual hydrograph for the 2014 water year (October 1, 2013-September 30, 2014) for three locations on the Des Plaines River (above) and three locations in the North Mill Creek/Dutch gap Canal subwatershed (below). The dashed lines represent locations that receive runoff from more rural, less developed watersheds (North Mill Creek at IL Route 173 and the Des Plaines River at Russell Road).

These locations tend to have less pronounced peaks in response to runoff. Also note in the lower hydrograph that North Mill Creek at IL Route 173, with a watershed of more than 20 square miles, tends to have very low baseflow during the first five months of the record (<1 cubic foot/second). Hastings Creek at Miller Road has a watershed of less than five square miles, but baseflow at this location is augmented by WWTP discharge and rarely dropped below 1 cubic foot/second. Following a runoff event in March, peak discharge in North Mill Creek at IL Route 173 was more than twice the peak in Hastings Creek, owning to the differing in watershed size.

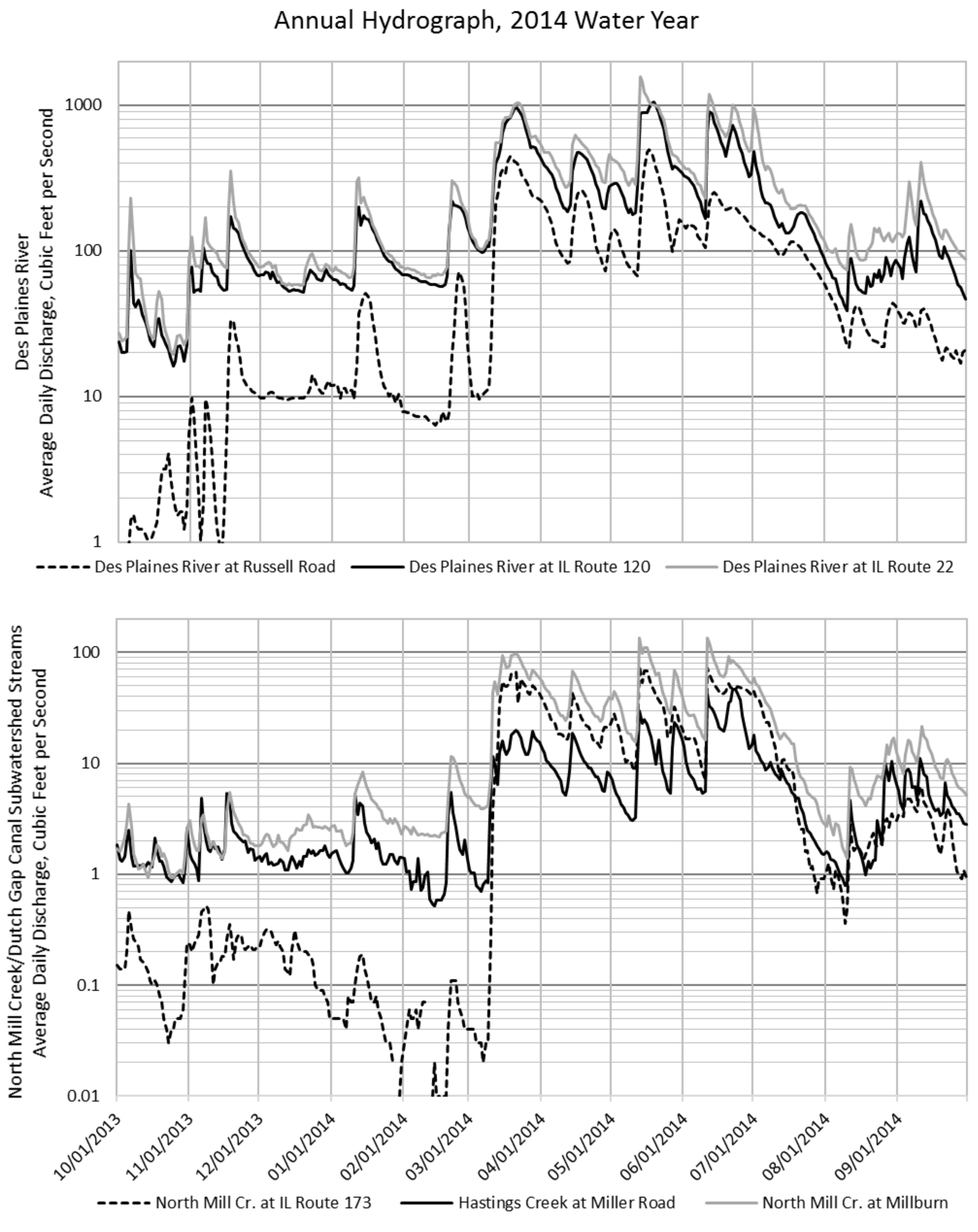


Figure 3-21: Annual hydrographs for water year 2014 at selected locations on the Des Plaines River (above) and in the North Mill Creek/Dutch Gap Canal watershed (below)
(Data from USGS).

Changes in stream hydrology are also evident over much shorter time periods. Figure 3-22 shows a comparison of 7-day hydrographs for the Des Plaines River at Russell Road and IL Route 120, Mill Creek at Hunt Club Road, and Hastings Creek at Miller Road over the period of August 1-8, 2014. The Des Plaines River at IL Route 120 and Hastings Creek at Miller Road are strongly influenced by upstream WWTP discharges, evidenced by the regular daily swings in discharge compared to the other locations with less or no WWTP effluent discharged upstream (Des Plaines River at Russell Road and Mill Creek at Hunt Club Road).

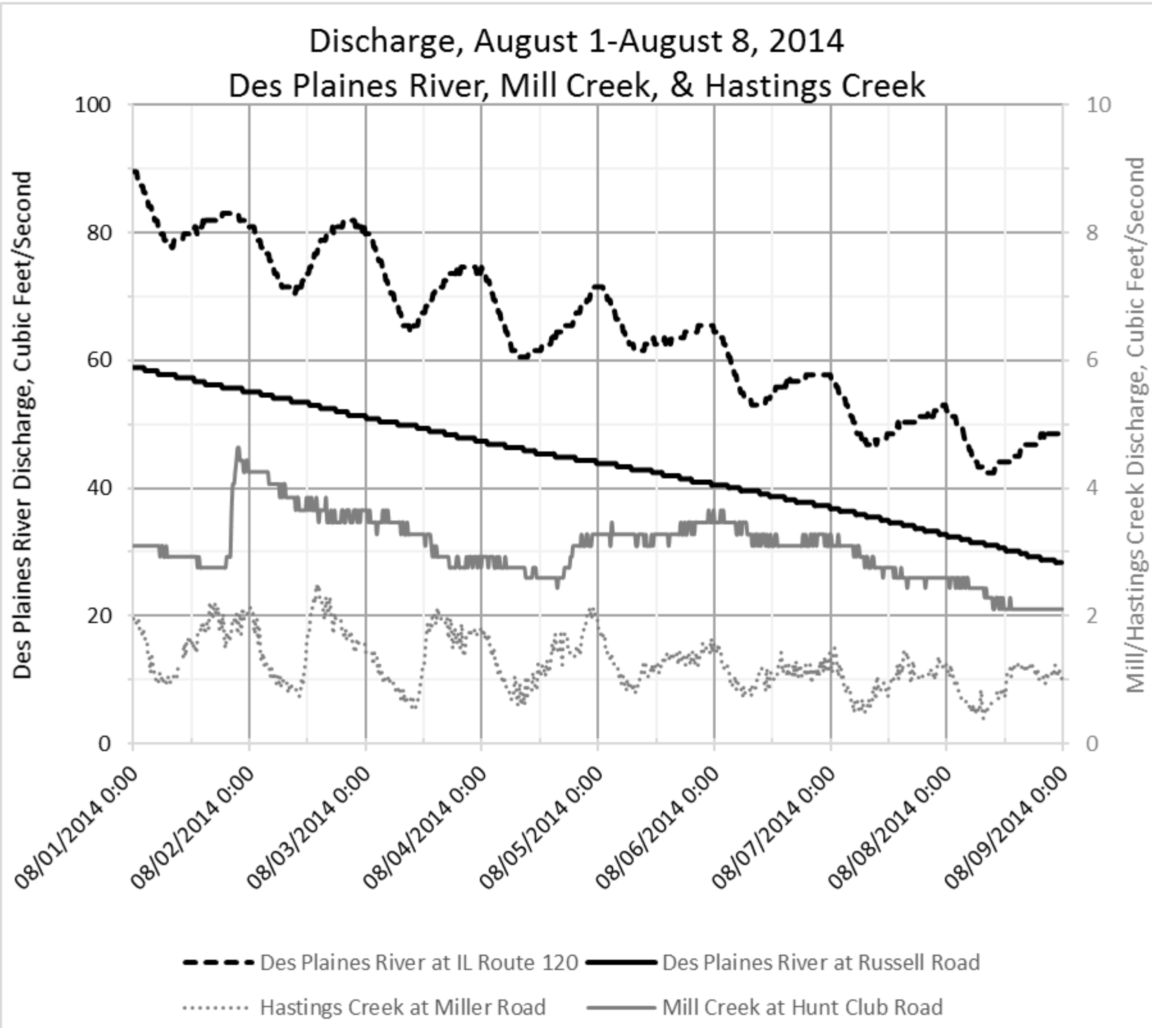


Figure 3-22: 7-day hydrograph for the Des Plaines River at Russell Road and IL Route 120, Mill Creek at Hunt Club Road, and Hastings Creek at Miller Road.
Note: Discharge values for Mill and Hastings Creeks are shown on the secondary vertical axis on the right-hand side of the chart (Data from USGS).

There are numerous **stream classification systems and characterization terms** in use by the community of engineers, watershed and natural resource managers, and researchers engaged in watershed planning. This plan recognizes the utility of these systems and terms but does not specify or apply them to streams in the planning area. In particular, the concepts of stream order and headwater streams are recognized as potentially significant to determining the feasibility of attaining certain water quality thresholds (such as indices of biotic integrity). The DPR planning area likely includes many streams that meet one or more definitions of “headwater”, specifically as headwaters of tributaries to the Des Plaines River. The spatial position of streams, permanence of flow, and the effect of anthropogenic changes to watershed and stream hydrology will require additional scrutiny and agreement among watershed managers, policy-makers, and regulators if these types of classifications are intended to define future watershed goals.

NOTEWORTHY: STREAM CLASSIFICATION

Numerous classification systems and characterizations for streams exist and are generally based on drainage area size, stream network pattern, stream channel morphology, spatial relationship to other streams, and discharge characteristics.

Stream order is a common method used to classify streams (usually hierarchically) within a drainage network but is dependent on underlying cartography. Similarly, it is generally agreed by hydrologists, ecologists, and watershed managers that “headwater” streams are of significance, though there is not a universal definition. Fritz, Johnson, and Walters (2006) have summarized the issue of stream order and headwater characterization well:

> “Stream order is a measure of stream position within a drainage network system (Horton 1932, Strahler 1945, Shreve 1966). Headwater streams are typically considered to be first- and second-order streams (Gomi et al. 2002, Meyer and Wallace 2001), meaning streams that have no upstream tributaries (i.e., “branches”) and those that have only first-order tributaries, respectively. Use of stream order to define headwater streams is problematic because stream-order designations vary depending upon the accuracy and resolution of the stream delineation (Mark 1983, Hanson 2001). Lack of agreement among maps with different mapping resolution is common when identifying headwater stream[s], determining stream order, and determining total stream [length]... The smallest headwater streams are not designated as channels on topographic maps and may be difficult to discern in aerial photographs. Thus, stream order designations based on maps are typically underestimated (Hughes and Omernik 1983), prompting some investigators to characterize such streams as zero-order streams (e.g., Brown et al. 1997). Most “blue line” designations on topographic maps are not based on field studies, but are “drawn to fit a rather personalized aesthetic” of the cartographer (Leopold 1994) or drawn with standards that exclude a proportion of headwater channels (Drummond 1974).”

3.5 WATERSHED JURISDICTIONS AND DEMOGRAPHICS

3.5.1 UNITS OF GOVERNMENT

The DPR planning area has numerous political jurisdictions; including municipal, township, and other local, state, and federal elective and agency jurisdictions. The boundaries of these jurisdictions are seldom drawn to coincide with watershed boundaries. Seventy one percent of the DPR planning area is incorporated, within 39 municipalities (totaling 106,577 acres). The Village of Gurnee is the largest municipality by area with 8,636 acres, or about 5.7% watershed coverage. The next largest municipality is Long Grove which occupies 8,036 acres, or about 5.3% of the watershed. Twenty nine percent of the DPR planning area is unincorporated, made up of fifteen townships (totaling 43,783 acres). Newport Township is the largest township by area with 8,951 acres, or about 6% watershed coverage. The next largest township is Warren Township with 8,290 acres, or about 5.5% of the watershed. Municipalities and townships in the DPR planning area are shown in Figure 3-23and Table 3-8**.**

Table 3-8: Municipalities and Townships in the DPR Planning Area

NAME	ACRES	% OF THE WATERSHED
Antioch	2,129.3	1.4%
Antioch Township	4,498.3	3.0%
Arlington Heights	954.2	0.6%
Avon Township	1,841.9	1.2%
Beach Park	1,363.9	0.9%
Benton Township	262.4	0.2%
Bristol	7,666.8	5.1%
Buffalo Grove	5,959.4	4.0%
Deer Park	1,169.7	0.8%
Deerfield	43.0	0.0%
Ela Township	2,351.9	1.6%
Fremont Township	3,644.2	2.4%
Glenview	1.9	0.0%
Grayslake	6,821.7	4.5%
Green Oaks	772.6	0.5%
Gurnee	8,636.4	5.7%
Hainesville	2.4	0.0%
Hawthorn Woods	3,558.4	2.4%
Indian Creek	170.7	0.1%
Kildeer	2,829.4	1.9%
Lake Forest	107.0	0.1%
Lake Villa	217.0	0.1%
Lake Villa Township	3,583.3	2.4%
Lake Zurich	2,023.3	1.3%
Libertyville	5,866.7	3.9%
Libertyville Township	4,600.9	3.1%
Lincolnshire	2,161.8	1.4%
Lindenhurst	3,118.5	2.1%
Long Grove	8,035.7	5.3%
Mettawa	2,705.5	1.8%
Mundelein	5,931.4	3.9%
Newport Township	8,950.8	6.0%
Northbrook	913.9	0.6%
Northfield Township	527.0	0.4%
Old Mill Creek	6,901.6	4.6%
Palatine	1,488.3	1.0%
Palatine Township	780.1	0.5%
Park City	259.7	0.2%
Prospect Heights	206.9	0.1%
Riverwoods	1,618.2	1.1%
Round Lake Beach	406.2	0.3%
Round Lake Park	37.3	0.0%
Salem Lakes	1,012.1	0.7%
Third Lake	551.0	0.4%
Vernon Hills	5,046.8	3.4%
Vernon Township	3,621.4	2.4%
Wadsworth	6,267.3	4.2%
Warren Township	8,289.8	5.5%
Waukegan	3,728.4	2.5%

NAME	ACRES	% OF THE WATERSHED
Waukegan Township	124.9	0.1%
West Deerfield Township	7.6	0.0%
Wheeling	4,606.8	3.1%
Wheeling Township	698.6	0.5%
Zion	1,285.6	0.9%
TOTAL:	150,361	100%

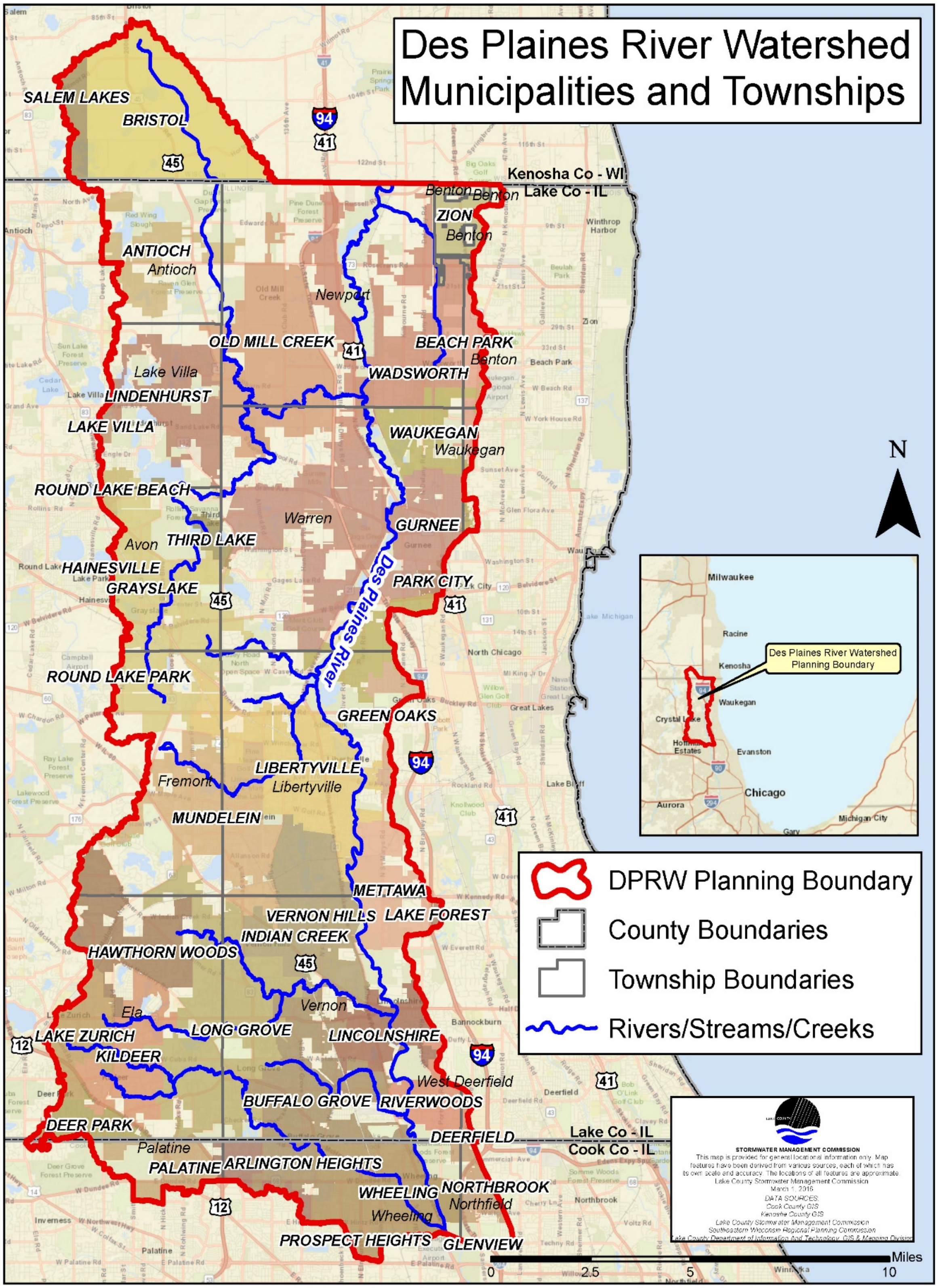


Figure 3-23: DPR Planning Area Municipalities and Townships

3.5.2 Roles and Responsibilities of Each Unit of Government

One of the challenges of creating and implementing watershed plans is that a watershed usually includes multiple jurisdictions that have varying interests, resources, and responsibilities. This variability can be beneficial if the jurisdictions actively work together to collaborate on policies, projects, and practices, but frequently it presents watershed coordination challenges for efficiently implementing BMP projects and for providing program, policy, and regulatory consistency. In some cases, independent actions by one community or jurisdiction can have a detrimental impact on watershed neighbors, or a good project may not be as effective as it could have been if resources had been pooled to expand the scope of the project to cover a broader area of the watershed, thereby providing economies of scale.

Watershed planning brings communities together to protect and improve the land and water resources that they share and impact. Watershed activities and projects offer many opportunities for communities and other government agencies to operate outside of their traditional "silos." When communities meet regularly as a watershed group, it provides opportunities to share information and coordinate activities. For instance, when a community or agency develops or updates a comprehensive plan, disagreement and costly competition among agencies/jurisdictions can be averted if the watershed plan and the plans of neighboring communities and sister agencies (such as parks departments or districts) are considered. This level of coordination benefits the watershed. As an example, a municipality may receive a development proposal for a land parcel that the local parks department has identified as environmentally sensitive and has included in their long-term conservation plan. Although the underlying zoning for the land may allow the proposed development, both the community and the developer are likely going to face challenges from competing interests, and with land development standards so that it does not negatively impact the features that made it environmentally sensitive. Sharing information about the land during the comprehensive planning process can prevent these kinds of problems.

3.5.3 POPULATION

Based on the 2010 decennial census, the total population within the DPR planning area is approximately 399,207 as shown in Figure 3-24.

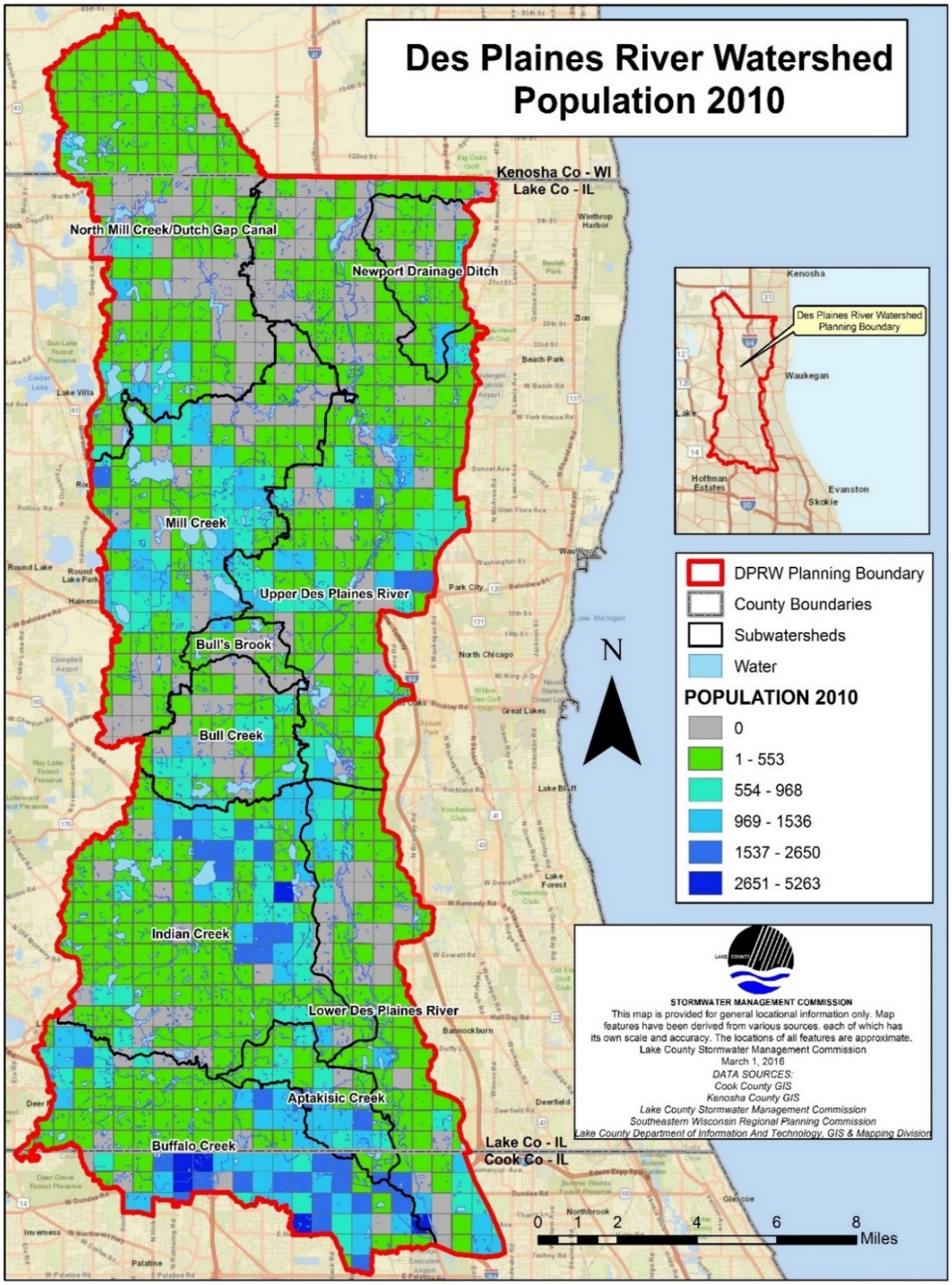


Figure 3-24: Population in the DPR Planning Area (2010)

Note: Each "square" on the map represents a quarter section of the Public Land Survey System. The data sources of CMAP and SEWRPC represent this data in quarter sections.

3.5.4 POPULATION CHANGE

Population is forecasted to increase from 399,207 to 506,234 (21%) by 2040 (Figure 3-25).

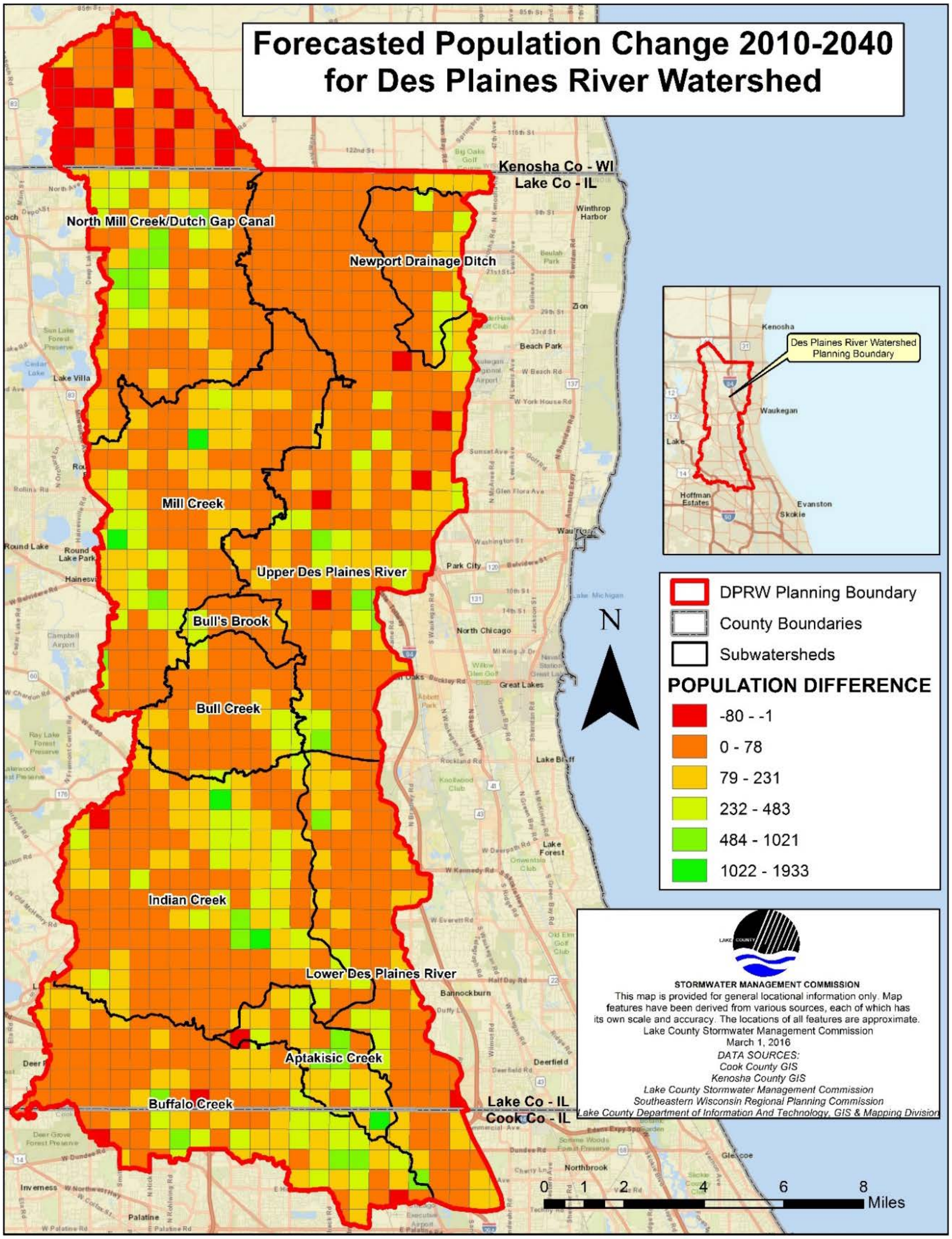


Figure 3-25: Population Change in the DPR Planning Area (2010-2040)

Note: Each "square" on the map represents a quarter section of the Public Land Survey System. The data sources of CMAP and SEWRPC represent this data in quarter sections

3.5.5 Growth Forecasts

The population change that is described in Section 3.5.4 is expected to increase the number of homes in the watershed, especially in those areas where population growth is expected to increase the most (see Figure 3-25 and Figure 3-26). There is a 37,038 (20%) increase in the number of households predicted within the watershed. As of 2010, there were approximately 195,067 jobs in the DPR planning area, but CMAP forecasts employment to increase by 23% by the year 2040 (Figure 3-27). The CMAP population and employment forecast is based on a model that accounts for local future development and land use plans, as well as other land use, demographic, and economic variables and trends. Due to the DPR planning area incorporating only a small portion of the entire CMAP population forecast area, the results should be considered as an example or indicator of how the watershed could develop over the next few decades. This plan does not draw conclusions or recommendations from any single evaluation unit (square) in the forecast map. No forecast data for household and employment was available for the Wisconsin portion of the DPR planning area.

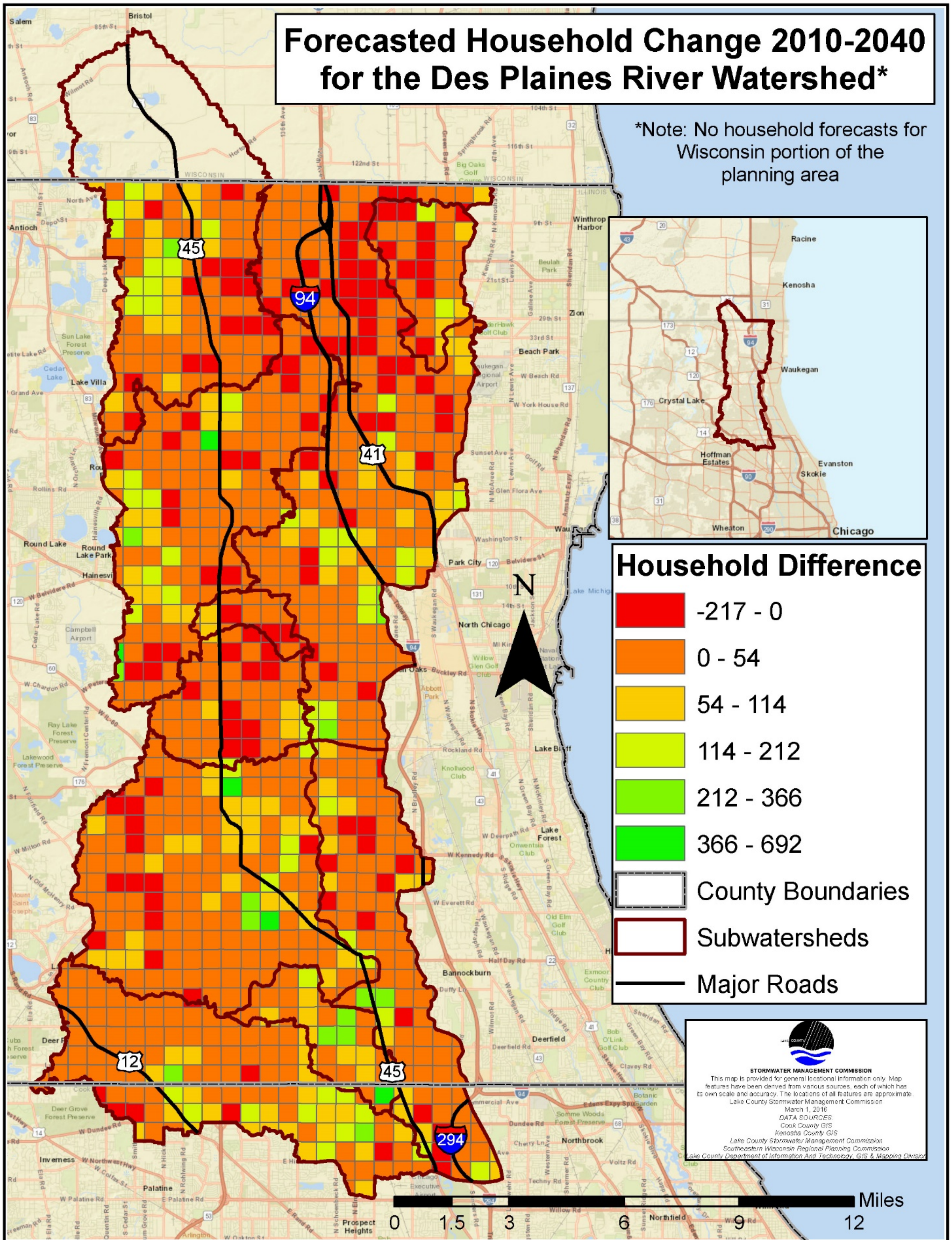


Figure 3-26: Forecasted Household Change in the DPR Planning Area (2010)

Note: Each "square" on the map represents a quarter section of the Public Land Survey System. The data sources of CMAP and SEWRPC represent this data in quarter sections.

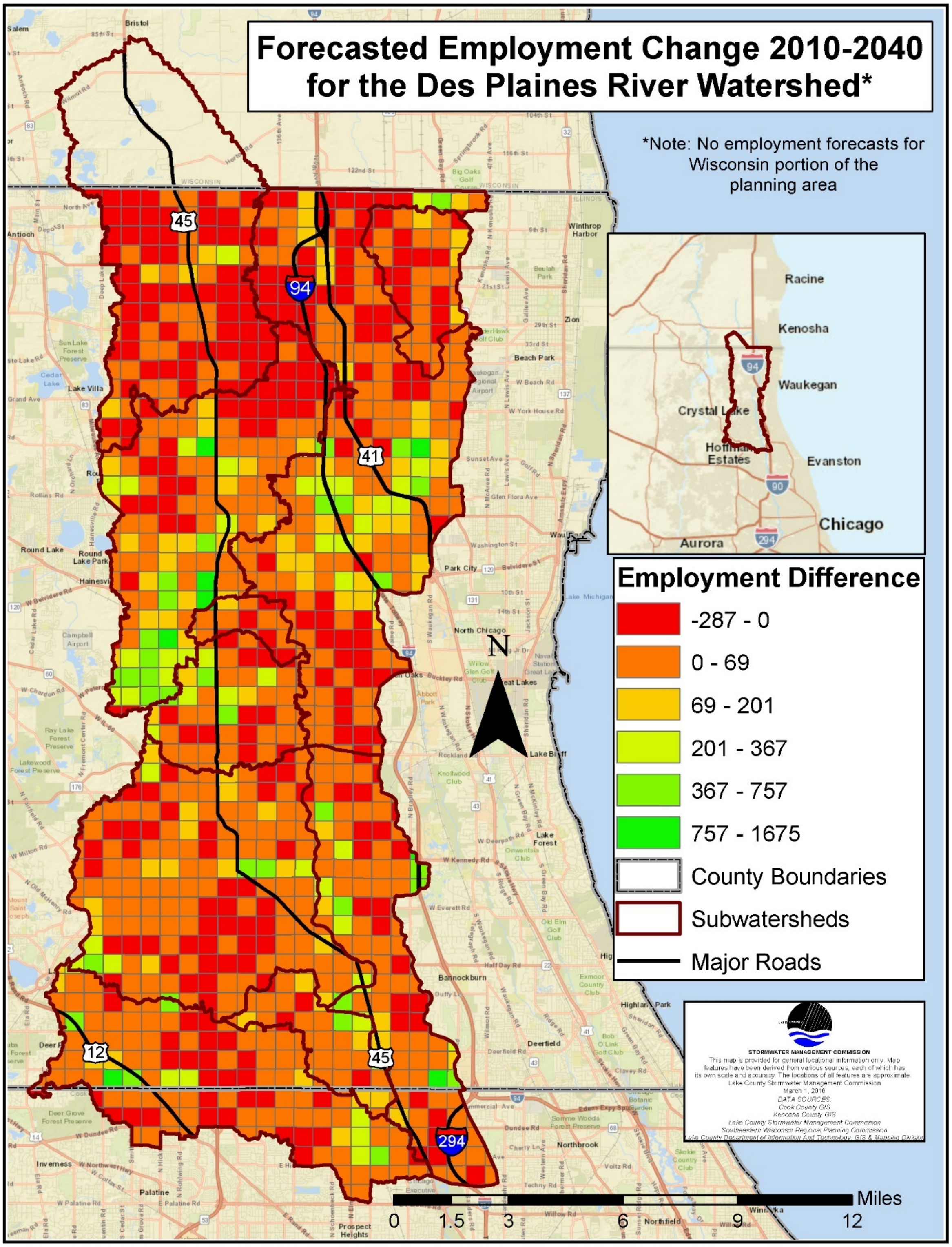


Figure 3-27: Forecasted Employment Change in the Des Plaines River Watershed

Note: Each "square" on the map represents a quarter section of the DPR planning area. The data sources of CMAP and SEWRPC represent this data in quarter sections.

3.5.6 MEDIAN AGE

Median age is a statistic that provides information on the age distribution of a population. When considered with other factors this information can inform estimates of future consumption, mobility, and development patterns, which impact water resources. The median age in the DPR planning area in 2010 was 41.7, compared to the median age of 37.4 from the 2016 census data for the State of Illinois (U.S. Census Bureau, 2010). Median census block age ranged from 0.0 (no population) to 87.9 in the planning area. The 2010 median age by census block is displayed in Figure 3-28.

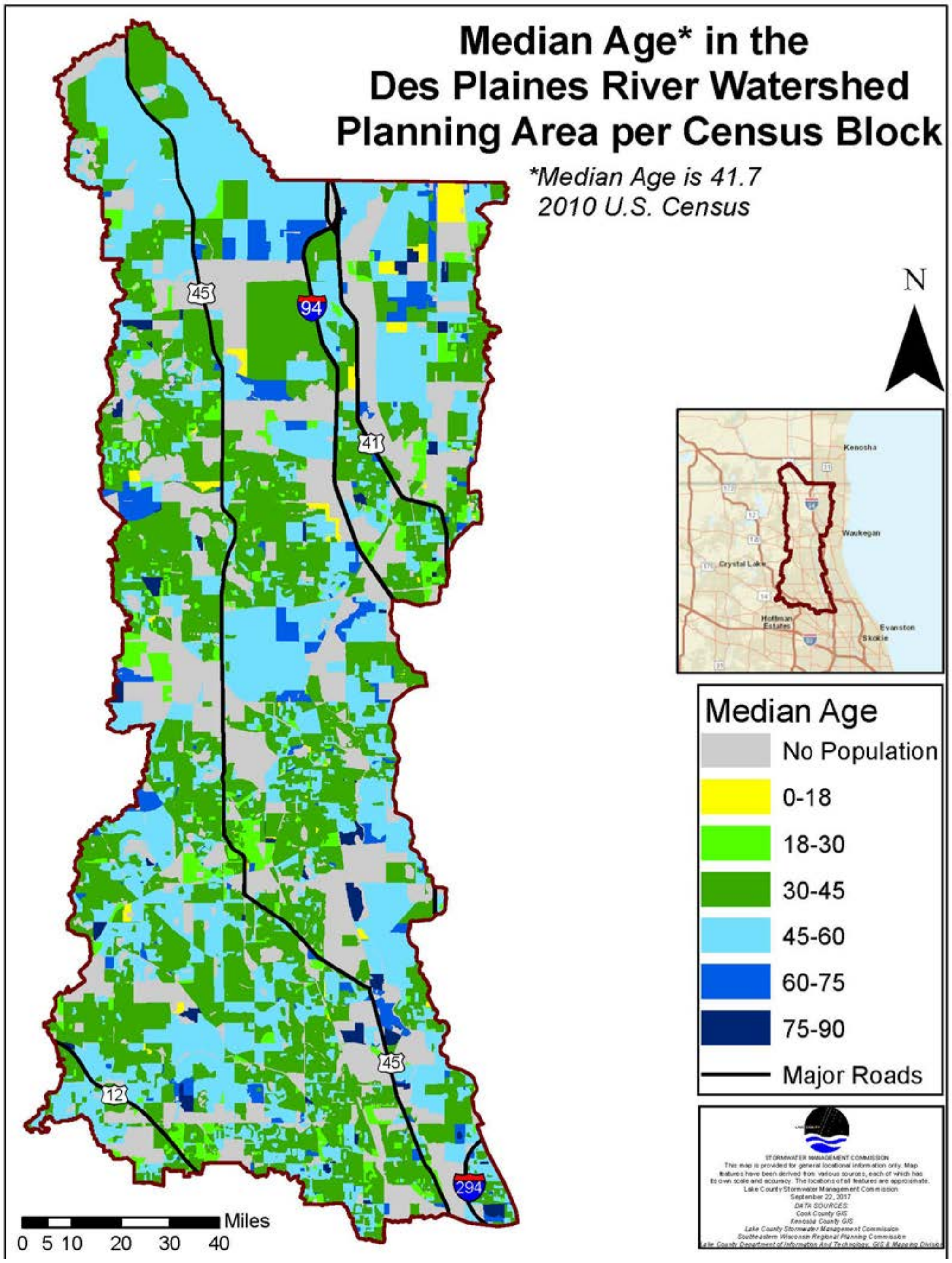


Figure 3-28: Median Age in 2010 in the DPR Planning Area

3.5.7 Median Income

According to the U.S. Census Bureau's 2007-2011 American Community Survey, the median household income for the DPR planning area is $85,536 (Figure 3-29) compared to $59,196 which was the median household income for the State of Illinois in 2016 (U.S. Census Bureau, 2016). The Census Bureau includes incomes of people 15 or older in income calulations. Median incomes are used as measures because the values are less skewed by extremely high or low outliers.

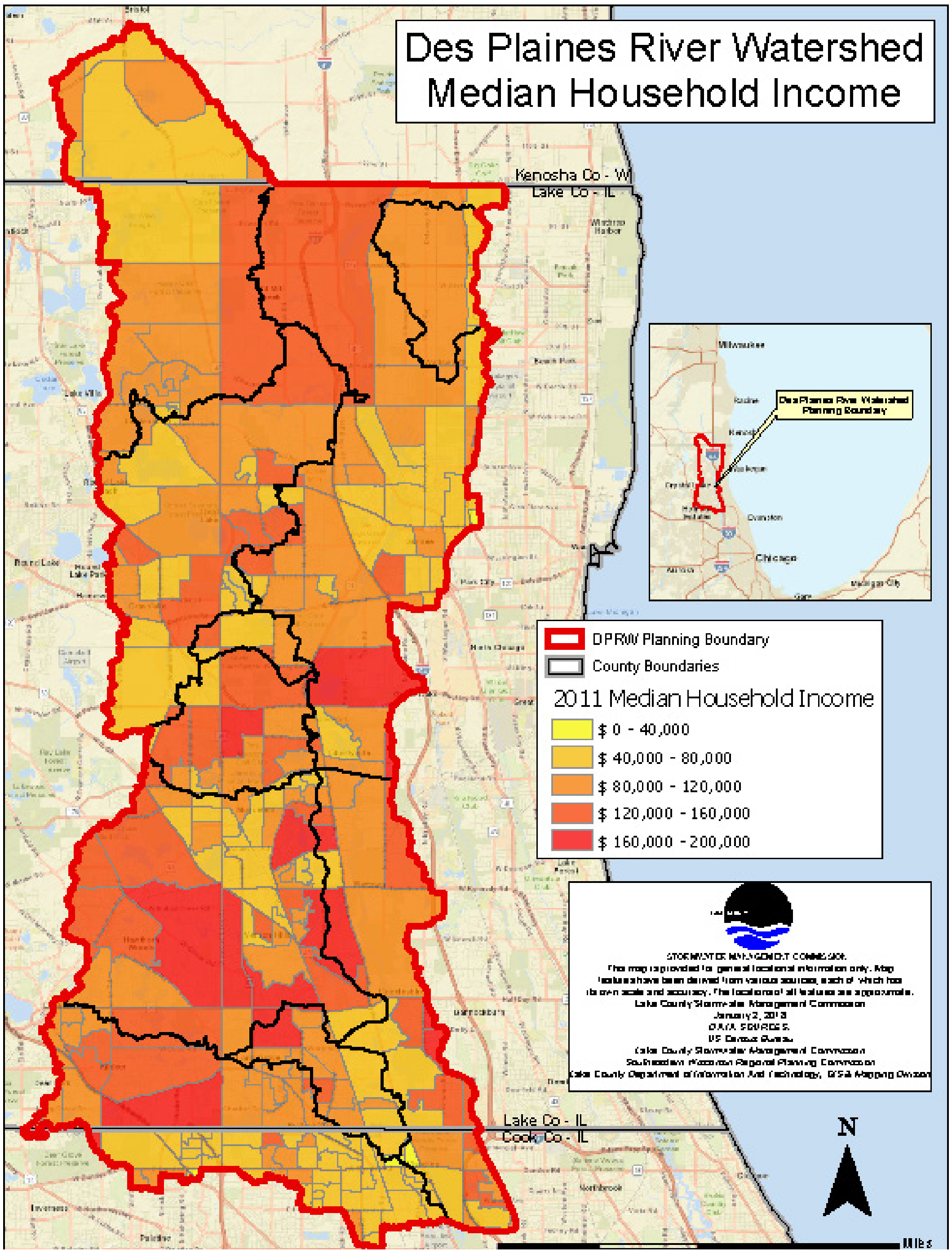


Figure 3-29: Median Income from 2007-2011 in the DPR Planning Area

3.5.8 EMPLOYMENT

The number of employed people per census block is closely related to the population. As with population, there is a higher density on average in the southern part of the watershed. The number of employed people per block in the DPR planning area ranges from 0 to 7,586 with an average of 187. The distribution of employed people in the DPR planning area is shown in Figure 3-30.

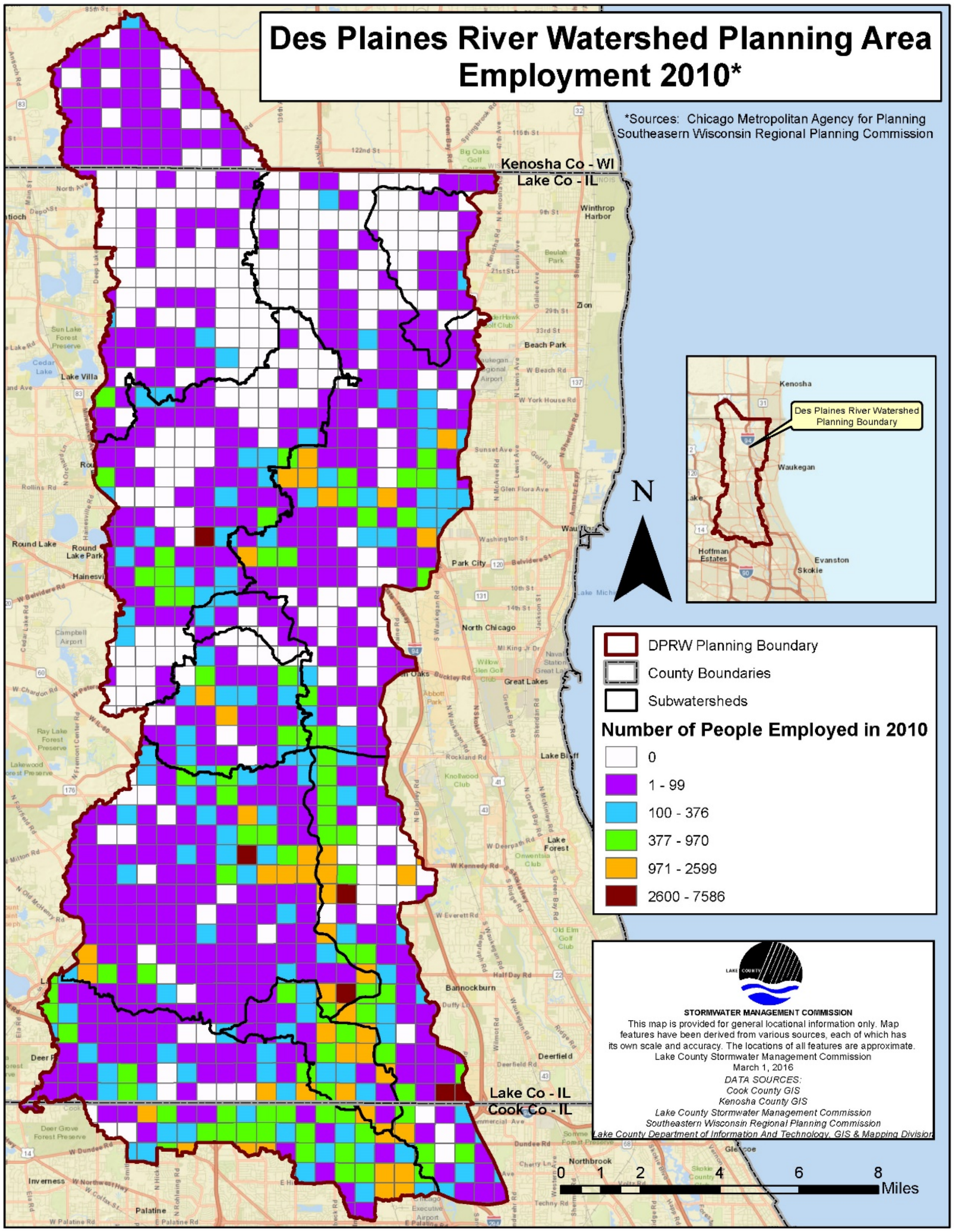


Figure 3-30: Employment in 2010 in the Des Plaines River Watershed

3.6 LAND USE AND LAND COVER

3.6.1 HISTORIC LAND COVER

Pre-settlement vegetation within the DPR planning area was evaluated in the Final Report Region 5 Wetland Management Opportunities and Marketing Plan, using CMAP's Green Infrastructure Vision dataset and the Illinois Natural History Survey's Historic Vegetation database.

Prior to European settlement, the land cover was predominately savanna and oak savanna in the northern portion of the watershed and prairie in the southern portion of the watershed. Based on this analysis, pre-European settlement land cover included approximately 12,873 acres of wetland (indicated below as marsh, wet meadow/prairie and wetland) within the DPR planning area. The pre-European settlement land cover is listed on Table 3-9 and shown in Error! Reference source not found.. Following European settlement, most of this land was converted to agricultural uses, followed by residential and commercial land uses.

Table 3-9: Historical Land Cover

VEGETATION TYPE	ACRES	% OF WATERSHED
Prairie	60,841	40.46
Oak Savanna / Savanna	55,820	37.13
Oak Woodlands	11,795	7.84
Marsh	6,119	4.07
Wet Meadow/Prairie	4,612	3.07
Water	2,436	1.62
Wetland	2,025	1.35
Prairie Oak	1,811	1.20
Timber	1,644	1.09
Upland Forest	1,453	0.97
Floodplain Forest	756	0.50
Oak Forest	347	0.23
Pond/Lake	223	0.15
Barrens	133	0.09
Scattering Timber	108	0.07
Wet Prairie	101	0.07
Slough	80	0.05
River/Creek	39	0.03
Forested Bog	15	0.01
TOTAL	**150,361**	**100**

SLOUGH: A swamp or shallow lake system, usually a backwater to a larger body of water.

BARRENS: An area with vegetation that is scattered with stunted woody growth and an exposed infertile substrate that supports species adapted to fire and drought and occurs in areas climatically suitable for forest growth of large trees.

LAND USE: The type of human activity that takes place on a particular area of land.

LAND COVER: The physical material that covers the surface of the Earth. Such categories include forest, urban, water, prairie, etc.

3.6.2 EXISTING LAND USE IN THE DPR PLANNING AREA

Existing **land use** of the DPR planning area was determined using land use data from CMAP (Cook County), Lake County GIS (Lake County), and SEWRPC (Kenosha County). To ensure land use and **land cover** represented the most recent watershed conditions, this layer was updated by interpreting aerial imagery. Any observed discrepancies between the imagery and the land use/cover data, such as where development has recently occurred, were noted and corrected. Additionally, land use categories were simplified by grouping and re-naming similar land use codes and by extracting land cover designations from land use (i.e., cropland in a forest preserve was separated into row crops and open space conservation). Open water and wetland areas were excluded from analysis to allow for comparison to future land use projections. Table 3-10 includes land use/cover categories, including acreage and overall percentage, and Figure 3-31 illustrates land use in map format.

The residential (single-family and multi-family) land use class accounts for the greatest area of the watershed with 38,861 acres (28.7%). Total open space, including all open land (agricultural, private/public open space, forest/grassland/beach) comprises 41,416 acres or 30.6% of the watershed. Total developed land, including residential, commercial/retail/mixed use, government/institutional, industrial, office and research parks, transportation, and utilities accounts for 68,707 acres or 50.8% of the watershed. The developed land uses in the watershed contain varying degrees of impervious cover.

Table 3-10: Land Use Type

LAND USE TYPE	TOTAL AREA (ACRES)	PERCENT OF WATERSHED
Agriculture	25,236	18.6%
Residential	38,861	28.7%
Transportation/Utility/Waste Facility	18,013	13.3%
Government/Institutional	3,047	2.3%
Industrial	3,710	2.7%
Office and Research Parks	1,230	0.9%
Retail/Commercial/Mixed Use	3,845	2.8%
Public/Private Open Space	41,416	30.6%
Total:	135,358*	100.0%

*Total watershed acres differ from previously stated values because open water was excluded in this analysis.

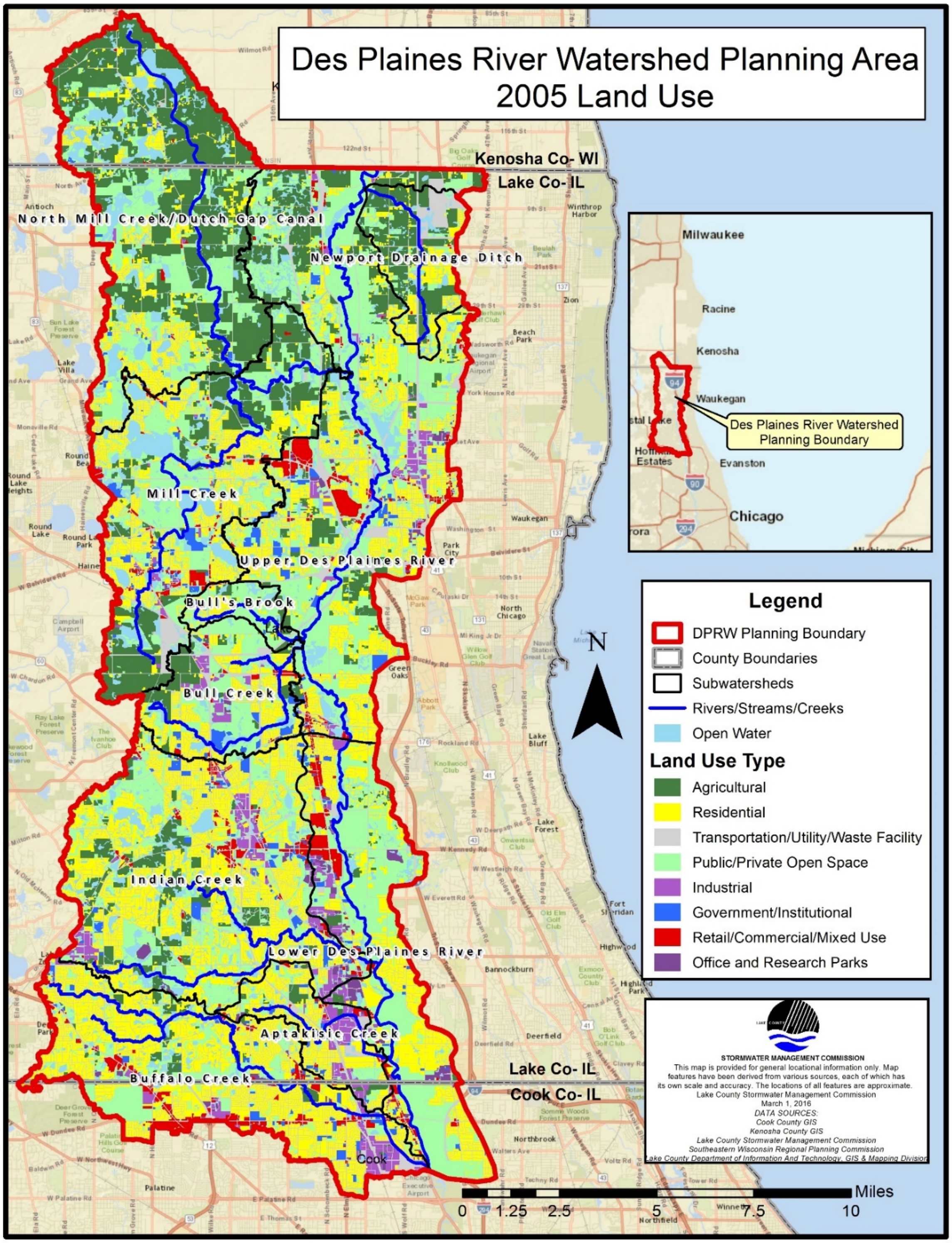


Figure 3-31: Current Land Use in the DPR Planning Area

3.6.3 Existing and Projected Future Percent Imperviousness

3.6.3.1 Existing Imperviousness

Impervious cover is the direct result of altering a native soil's permeability by replacing natural surfaces with impermeable/impervious surfaces. Impervious surfaces such as buildings, roads, parking lots, sidewalks, and compacted open space, which are common in urban areas, prevent precipitation from infiltrating into the ground. This increases direct storm water runoff and **nonpoint source pollution** stressors into wetlands, ponds, streams, and rivers, thereby impacting local water quality (USEPA Impervious Surface Growth Model, 2017).

NONPOINT SOURCE POLLUTION: The cumulative effect of rainfall runoff that flows over or through the land and collects pollutants and nutrients prior to entering waterways. The cumulative effect of this pollution throughout the watershed represents the contribution of nonpoint source pollution.

Analysis of impervious surface impacts in the DPR planning areawas conducted using planimetric GIS datasets that were derived and interpreted from LiDAR acquired data. These datasets delineated the measured area or constructed footprint of major contributors to impervious surfaces including buildings, roads, and parking lots. Impacts of construction and development that were not included in the planimetric datasets include driveways, private roads, sidewalks, gravel surfaces (trails, parking lots, road shoulders), railroad right of ways and embankments, select built structures, and compaction of soils. Planimetric data used in this analysis was developed by Lake County GIS, Cook County GIS, Kenosha County GIS and SMC. The results of the planimetric impervious cover analysis are summarized in Table 3-11 and Table 3-12 and displayed in Figure 3-32.

Table 3-11: Building footprints by subwatershed

SUBWATERSHED	SQUARE FEET	ACRES	% of SUBWATERSHED
Aptakisic Creek	22,981,641	528	12.06%
Buffalo Creek	71,670,733	1,645	9.46%
Bull's Brook	1,473,228	34	1.87%
Bull Creek	19,540,266	449	6.29%
Indian Creek	75,491,315	1,733	7.18%
Lower Des Plaines River	41,593,383	955	6.54%
Mill Creek	39,279,318	902	4.56%
Newport Drainage Ditch	4,895,433	112	2.24%
North Mill Creek/Dutch Gap Canal	17,710,571	407	1.73%
Upper Des Plaines River	63,340,225	1,454	4.47%
TOTAL:	**357,976,113**	**8,219**	**5.47% of Planning Area**

Table 3-12: Edge of pavement footprints by subwatershed

SUBWATERSHED	SQUARE FEET	ACRES	% of SUBWATERSHED
Aptakisic Creek	28,500,470	654	14.96%
Buffalo Creek	74,864,556	1,719	9.88%
Bull's Brook	2,756,199	63	3.47%
Bull Creek	30,035,119	690	9.67%
Indian Creek	101,700,324	2,335	9.67%
Lower Des Plaines River	66,380,027	1,524	10.43%
Mill Creek	60,257,147	1,383	6.99%

SUBWATERSHED	SQUARE FEET	ACRES	% of SUBWATERSHED
Newport Drainage Ditch	7,350,135	169	3.36%
North Mill Creek/Dutch Gap Canal	23,708,618	544	2.31%
Upper Des Plaines River	117,261,840	2,692	8.27%
TOTAL:	**512,814,435**	**11,773**	**7.83% of Planning Area**

Impervious surface coverage was also determined from the 2011 NLCD impervious cover model (https://www.mrlc.gov/nlcd2011.php). The data used to develop the NLCD impervious cover model was derived from Landsat Enhanced Thematic Mapper+ and classified land use data. The percentage of impervious cover was calculated in 30 meter 2-pixel units of geography. This is measured by multiplying the watershed area classified as: urban (i.e. low, medium, and high density residential; commercial; industrial; etc.) by the appropriate impervious surface coefficient for each land use type, then averaging the value of imperviousness within a 30 meter 2-pixel unit of geography, ranging from 0-100% impervious cover. The NLCD impervious surface data set is an aggregated total impervious area value for each pixel rather than individual impervious features. Results of the NCLD impervious cover model in the DPR watershed are shown in Figure 3-33.

Research conducted in many geographic areas, concentrating on many different variables, and employing widely different methods, has yielded a similar conclusion - stream degradation occurs at relatively low levels of imperviousness, with 10% imperviousness impacting water quality and greater than 30% imperviousness severely degrading water quality (Schueler, 1994). The impervious cover data is presented as a percentage of impervious surfaces within the DPR planning area in three categories (Table 3-13):

- 0.0-9.0 % (Open Space with little to no development)
- 10-29% (Residential and small scale development) and
- 30-100% (medium to large scale development).

Table 3-13: Breakdown of NLCD Percent Impervious Cover within each Subwatershed

SUBWATERSHED	NLCD PERCENTAGE (0-9%)		NLCD PERCENTAGE (10-29%)		NLCD PERCENTAGE (30-100%)	
	ACRES	% of Subwatershed	ACRES	% of Subwatershed	ACRES	% of Subwatershed
Aptakisic Creek	495	11.3%	1,044	23.9%	2,645	60.5%
Buffalo Creek	3,362	19.3%	4,697	27.0%	8,729	50.2%
Bull's Brook	1,256	69.1%	260	14.3%	211	11.6%
Bull Creek	2,751	38.6%	1,704	23.9%	2,291	32.1%
Indian Creek	6,494	26.9%	7,606	31.5%	8,612	35.7%
Lower Des Plaines River	6,939	47.5%	2,71	18.6%	4,377	30.0%
Mill Creek	9,966	50.4%	2,856	14.4%	5,374	27.217%
Newport Drainage Ditch	3,569	71.1%	669	13.33%	688	13.7%
North Mill Creek/Dutch Gap Canal	18,608	79.1%	1,574	6.7%	1,860	7.9%
Upper Des Plaines River	17,387	53.4%	5,503	16.9%	8,167	25.1%
Total	**70,828**	**47 % of DPR Planning Area**	**28,624**	**19 % of DPR Planning Area**	**42,954**	**29% of DPR Planning Area**

(open water not included in acre totals)

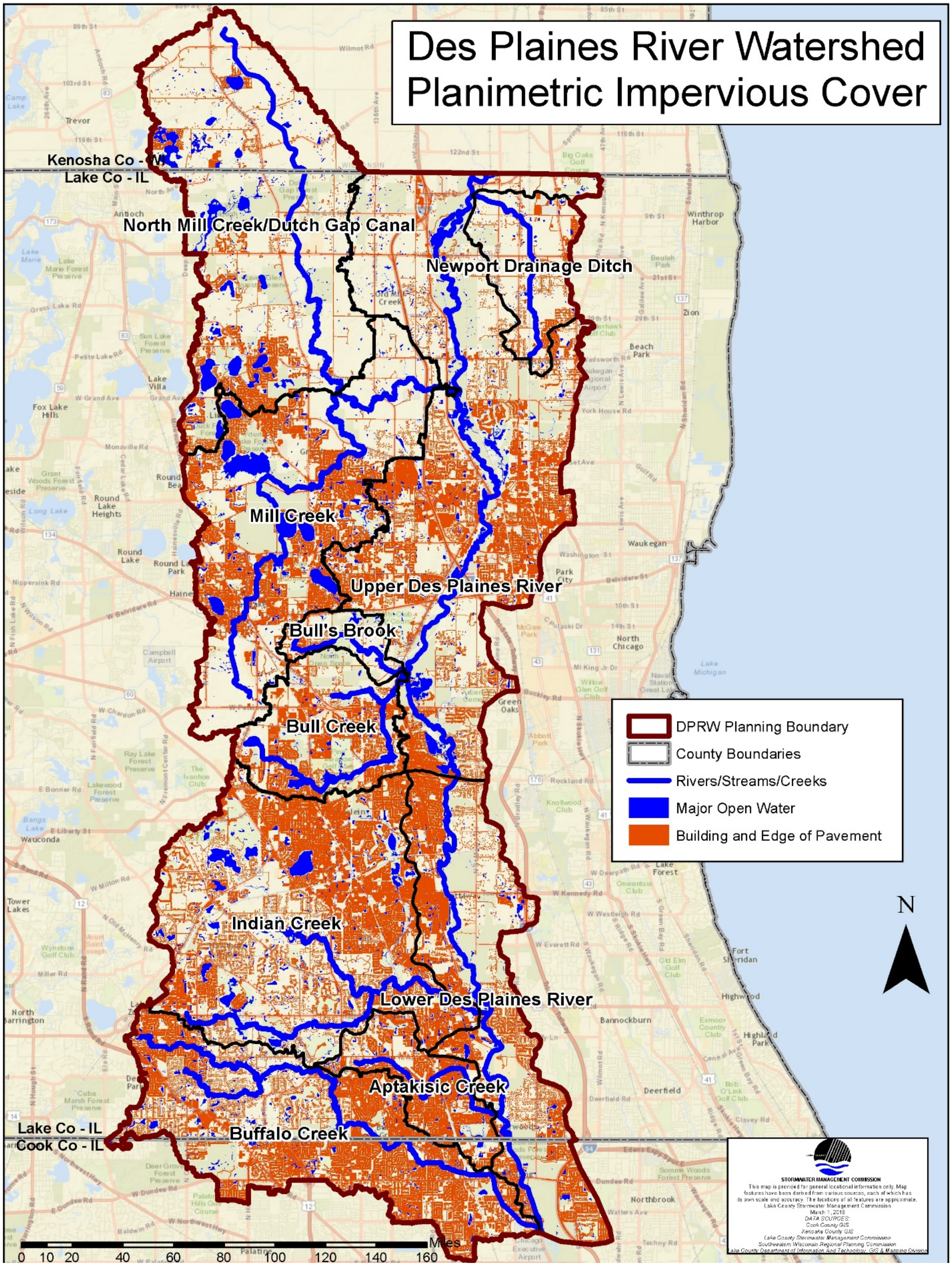


Figure 3-32: Planimetric Imperviousness of Table 3-11 and Table 3-12

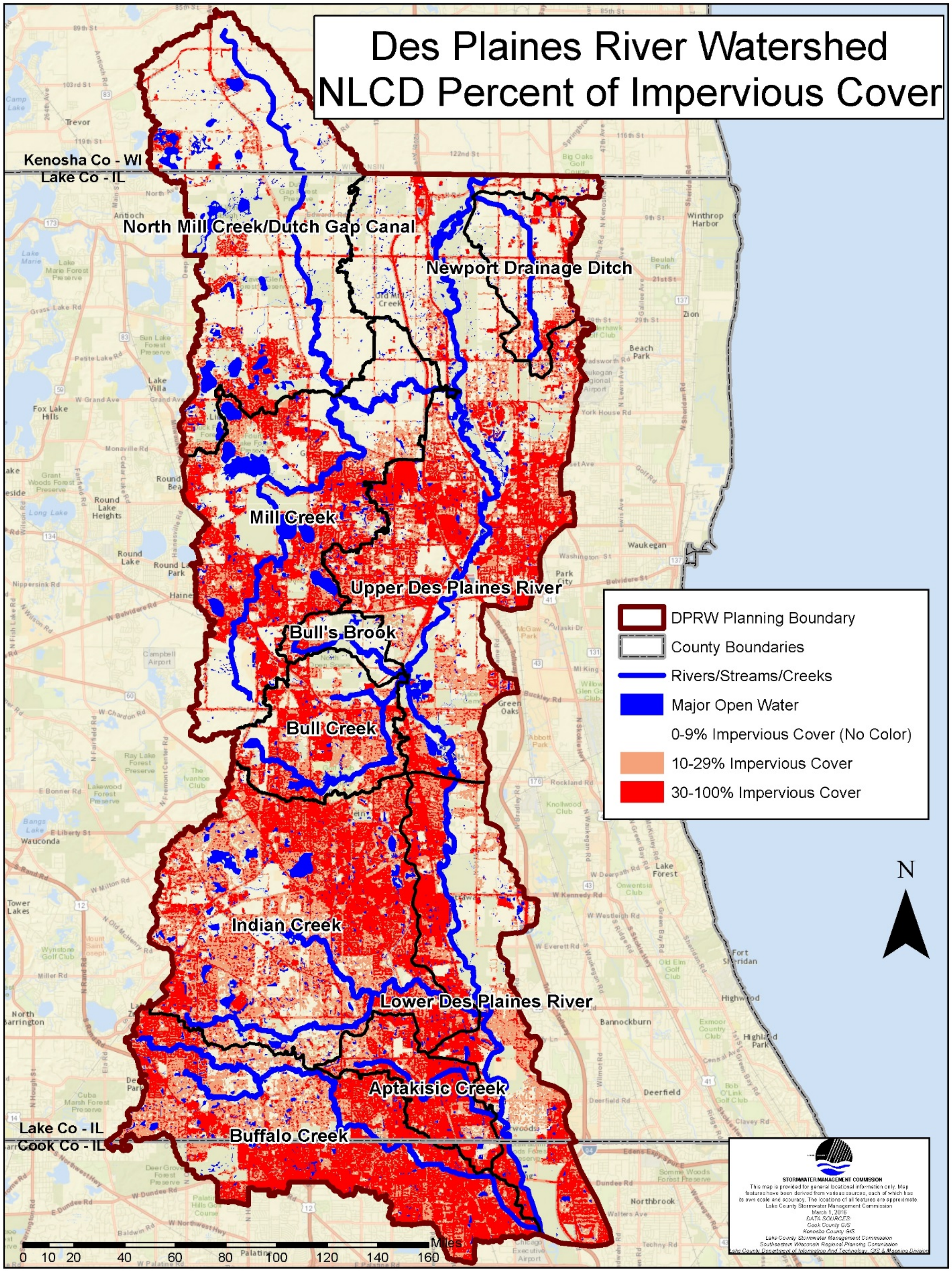


Figure 3-33: NLCD 2011 Imperviousness of Table 3-13 Data

3.6.3.2 Projected Future Land Use Imperviousness

The analysis and summation of existing impervious cover within the DPR planning area addressed the known current extent of impervious cover. To understand how potential future urbanization and land use expectations will impact water quality and overall watershed impervious cover, the analysis on current land use was used to characterize future land use impacts on impervious cover. Water quality can be improved by reducing impervious surfaces, promoting subsurface water absorption in future development, and decreasing existing impervious surfaces.

This assessment of future impervious cover used the following general land use categories: Industrial; Warehousing and Wholesale; Commercial and Services; Institutional; Residential; Agricultural Land; Forest, Grassland and Wetlands; Open Space; and Transportation, Communication, and Utilities. FLU parcels that are projected to change from low to high percentage of impervious cover are summarized in Table 3-14. The correlation of impervious cover to land use was analyzed based on the current percent impervious cover and current land use data. Based on the analysis from the existing impervious cover, the value of impact was used to determine the FLU impervious cover. Chapter 4 will have additional detail of impervious cover impacts, Table 3-15 and Figure 3-34 represent the geospatial analysis of the combined imperviousness data in relationship to current land use general categories. The data presented in Table 3-15 aligns with other research in that undeveloped land uses have less impervious cover (agriculture, naturally vegetated areas, and open space) and more developed areas have more impervious cover (Commercial, Industrial, and Transportation). Institutional land uses tend to have more campus setting environments with a mix of development and open space, which the data supports.

Table 3-14: Proposed Acreage of Future Land Use Changes Known to Impact Impervious Cover

SUB-WATER-SHED	AGRICULTURAL LAND					FOREST, GRASSLAND, AND WETLANDS					OPEN SPACE				
	COM	IWW	INT	RES	TCU	COM	IWW	INT	RES	TCU	COM	IWW	INT	RES	TCU
Aptakisic Creek	0	17	0	44	0	46	46	5	96	26	9	19	0	29	0
Buffalo Creek	147	3	3	247	0	257	5	8	758	11	27	0	2	222	0
Bull Creek	49	344	176	82	81	68	189	312	328	46	3	3	328	28	0
Bull's Brook	22	0	0	83	19	45	0	3	40	26	0	0	2	14	0
Indian Creek	431	47	0	1,531	4	542	254	80	2,016	112	58	22	8	782	0
Lower Des Plaines River	95	31	0	126	0	425	15	52	1,176	11	171	0	3	36	0
Mill Creek	559	511	37	1,856	173	575	195	193	1,175	117	14	6	36	233	0
Newport Drainage Ditch	252	106	0	1,224	3	132	44	0	605	34	9	0	0	17	0
North Mill Creek/Dutch Gap Canal	822	153	166	3,346	8	213	3	43	1,315	19	1	2	16	271	0
Upper Des Plaines River	1,277	86	129	1,440	11	1,311	371	224	2,494	203	45	5	25	276	0
Study Area	3,655	1,297	511	9,977	301	3,615	1,122	921	10,002	606	336	58	420	1,907	0

Note: Excluded from the Future Land Use Imperviousness Analysis are developed parcels that have a future land use zoning change. Developed parcels will be considered impaired or degraded in terms of impervious cover and therefore are not included in the analysis. Values in table represent acres of impervious cover. COM = Commercial & Services, IWW = Industrial, Warehousing and Wholesale, INT = Institutional, RES = Residential & TCU = Transportation, Communication, and Utilities

Table 3-15: Anticipated Future Land Use Impervious Cover Acreage by Subwatershed

SUBWATERSHED	LAND USE ACERAGE					
	COMMERCIAL AND SERVICES	INDUSTRIAL, WAREHOUSING, AND WHOLESALE	INSTITUTIONAL	RESIDENTIAL	TRANSPORTATION, COMMUNICATION, AND UTILITIES	TOTAL ACRES IN SUBWATERSHED
Aptakisic Creek	43.5	18.4	4.6	130.3	18.2	215.0
Buffalo Creek	295.0	36.8	4.3	1,128.0	8.1	16,790.1
Bull's Brook	55.3	0.0	3.0	161.4	44.7	264.3
Bull Creek	89.8	404.3	684.9	385.1	112.1	1,676.3
Indian Creek	798.9	177.5	66.7	3,678.6	89.7	4,811.4
Lower Des Plaines River	471.6	28.4	39.5	1,181.5	6.3	1,727.4
Mill Creek	974.8	653.7	216.9	3,197.7	265.5	5,308.6
Newport Drainage Ditch	345.5	104.9	0.0	1,844.1	35.5	2,330.0
North Mill Creek/Dutch Gap Canal	1,001.6	153.3	219.8	4,746.1	23.7	22,046.0
Upper Des Plaines River	2,412.0	290.3	315.5	3,940.7	186.5	7,144.9
Total Land Use Acres	6,487.9	1,867.5	1,555.1	20,393.5	790.4	62,313.9

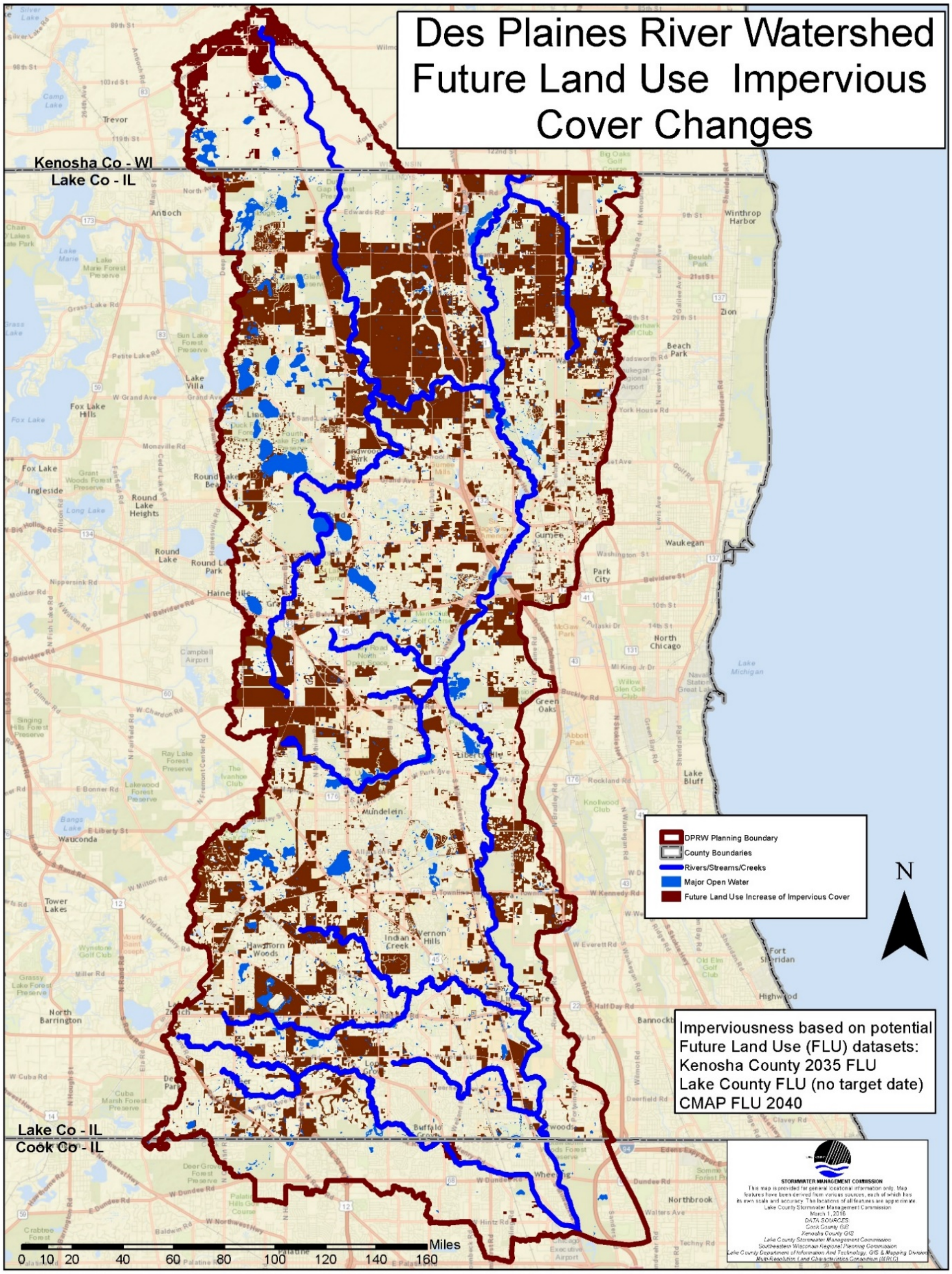


Figure 3-34: FLU Imperviousness increase, Table 3-14 and Table 3-15 Data

3.6.4 FUTURE LAND USE PROJECTIONS

FLU projections were based on a review of municipal, county, and regional future land use maps. The FLU datasets utilized in this study have varying projected future uses (by parcel): Lake County has no projected date, CMAP projections are to 2040 and Kenosha County projections are to 2035, generally FLU plans have a 20-year basis. Table 3-16 shows projected changes in land use by land use type and Figure 3-35 maps future land use predicted for build-out conditions in the watershed. The data indicates a substantial decrease in area for Agriculture and Public/Private Open Space land uses and a substantial increase in area for Residential, Government/Institutional, Industrial, Office and Research Parks, and Retail/Commercial/Mixed Use land uses, with a total change of 25,566 acres (21%) from undeveloped lands (Agriculture and Public/Private Open Space) to developed lands predicted.

Table 3-16: Projected Land Use Change by Land Use Type in the DPR Planning Area

FUTURE LAND USE TYPE	TOTAL AREA (ACRES)	PERCENT OF WATERSHED	PERCENT CHANGE FROM CURRENT TO FUTURE
Agriculture	9,056	6.7%	-64.1%
Residential	57,508	42.5%	48.0%
Transportation/Utility/Waste Facility	15,778	11.7%	-12.4%
Government/Institutional	4,259	3.1%	39.8%
Industrial	7,067	5.2%	90.5%
Office and Research Parks	3,988	2.9%	224.2%
Retail/Commercial/Mixed Use	8,672	6.4%	125.5%
Public/Private Open Space	29,006	21.4%	-30.0%

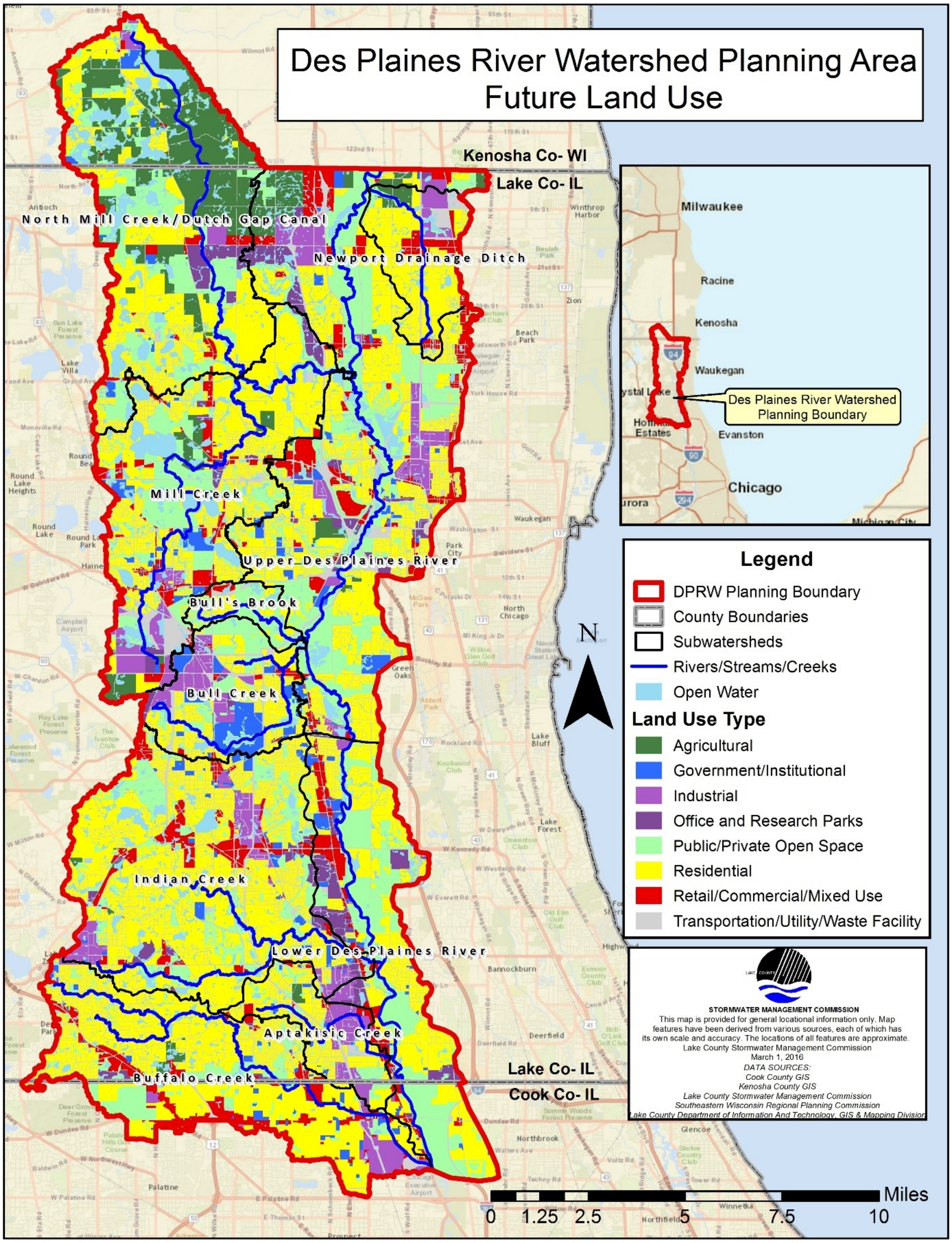


Figure 3-35: Future Land Use Projections in the DPR Planning Area

3.7 TRANSPORTATION

The DPR planning area includes 1,886 miles of roads and 442 miles of trails that make up the existing network of transportation corridors. Although not analyzed in detail in this section, other important components of the transportation network include the commuter rail lines, public bus transit system, parking lots, rail stations, and the public works and transportation maintenance yards that support the roads, trails and railroads in the watershed.

3.7.1 TRANSPORTATION AND NONPOINT SOURCE POLLUTION

Transportation corridors in the DPR planning area connect residents to points within and outside of the watershed. "Car habitat"; the combined area of roads, parking lots, driveways and garages is significant in the watershed. Parking lots and roads are the largest components of car habitat and can have a significant influence on stormwater runoff and water quality.

Studies have shown that streets are a major source of nonpoint source pollution in urban settings. Several factors contribute to high pollutant loading from streets. Streets are most often connected to the drainage system and tend to be the collector of stormwater runoff and pollution from sidewalks, driveways, lawns and rooftops as well as from emissions and leaks from vehicles, atmospheric deposition and winter road maintenance practices. The design, construction, and maintenance of transportation facilities and corridors can have substantial beneficial and detrimental impacts on human and watershed health.

3.7.1.1 Winter Maintenance Activities

Large quantities of road salt (mainly sodium chloride) are used for winter maintenance by public and private entities to remove snow and ice from the roads, parking lots and sidewalks. The proliferating use of road salt for winter deicing measures is a significant contributor to increasing trends in chloride pollution in waterbodies. Utilizing BMP's when storing, transporting, and applying de-icing chemicals is an essential step in reducing chloride pollution.

To assess the current winter maintenance practices in the watershed, SMC conducted a winter maintenance survey of jurisdictions within the DPR planning area through personal communications, website research and collected questionnaire data from 2016-2017. This data was used to identify current transportation policies and winter maintenance BMPs being used within the watershed. SMC collected information from 56 jurisdictions in the DPR planning area (information obtained pertains to the entire jurisdiction, including areas outside of the DPR planning boundary). The winter maintenance survey indicated that 50% of the jurisdictions have a winter maintenance policy, 30% of jurisdictions have a winter maintenance manual, and 73% of the jurisdictions have attended Lake County's Annual De-icing Workshop. Appendix B Des Plaines River Snow & Ice Removal Policies & Procedures summarizes transportation policies and winter maintenance BMPs for the assessed jurisdictions.

NOTEWORTHY: LAKE COUNTY DEICING WORKSHOP

A Lake County winter maintenance education & training program for public and private winter maintenance entities and their employees winter road maintenance best practices. Since 2009, the de-icing workshop has totalled over 1,200 attendees.

3.7.2 Transportation Infrastructure

There are multiple arterial roads, highways, railways and a trail system in the DPR planning area (Figure 3-36 and Figure 3-37). U.S. Highway 45 is the main north-south highway bisecting the watershed. Several major highways such as State Highways 173, 132, 120 and 22 run roughly east-west between the watershed boundaries.

The Metra North Central Service, Milwaukee District North lines bisect the watershed, with multiple stations located throughout the watershed, providing an alternative mode of transportation for commuters to and from downtown Chicago.

Figure 3-36: Lake Street, from Illinois Route 83 to Shorewood Road; Grayslake, Illinois

3.7.2.1 Roads

Multiple local and state entities manage the approximately 1,886 miles of roadway within the DPR planning area, as shown in Figure 3-38. The transportation network in the DPR planning area is composed of several main thoroughfares that are maintained by multiple agencies in two states. The roadway network includes local roads, township roads, county roads, and state highways. The largest stretches of existing major roadways in the DPR planning area are U.S. Route 45, which is 37.6 miles long and Interstate 94, which is 24.4 miles long.

Figure 3-37: Hawley St. between Midlothian Road and Seymour Avenue; Mundelein Illinois

Roadway Jurisdictions:

- *Lake County, Illinois: Roads and roadway planning are the responsibility of multiples entities including the LCDOT, IDOT, Tollway, LCFPD and individual townships and municipalities.*
- *Cook County, Illinois: Roads and roadway planning are the responsibility of multiples entities including the CCDOT, IDOT, Tollway, FPDCC and individual townships and municipalities.*
- *Kenosha County, Wisconsin: Roads and roadway planning are the responsibility of multiples entities including WISDOT, Kenosha County Division of Highways and individual townships and municipalities.*

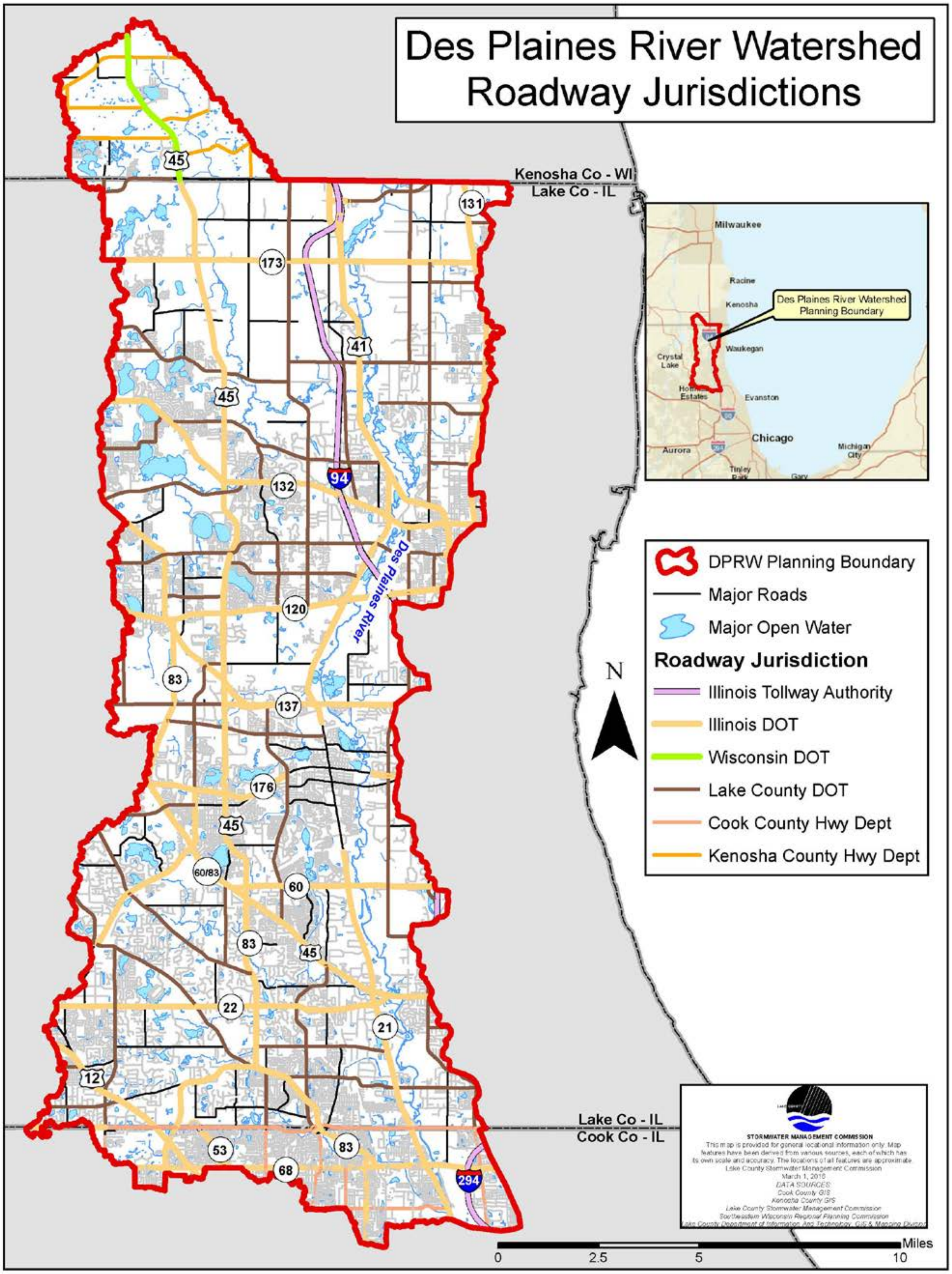


Figure 3-38: Des Plaines River Watershed Roadway Jurisdictions

3.7.2.2 Trails

There are currently approximately 442 miles of pedestrian and bicycle trails in the DPR planning area, including mowed footpaths and gravel, concrete, and asphalt trails. These trails are in various forms ranging from mowed footpaths to concrete or asphalt and are designed for single or multiple purpose users. The largest existing trail systems in the DPR planning area are the Des Plaines River Trail (31.4 miles) (Figure 3-39) and Millennium Trail and Greenway Trail (11.8 miles) (Figure 3-40).

Figure 3-39: Des Plaines River Trail System - LCFPD

Several jurisdictions develop and manage trails in the watershed including the Forest Preserve Districts, Park Districts, Municipalities, Townships, HOAs, CCDOT and LCDOT. Several villages and townships support trail systems along and across roadways within their jurisdiction. Park Districts also provide and maintain a trail network to connect people to parks and other community centers. The Forest Preserves provide a large trail network within and connecting forest preserves. HOAs provide neighborhood trails within the subdivision which connect to community trail systems and neighborhood parks. Additionally, there are short segments of connector trails constructed and maintained by the LCDOT and townships.

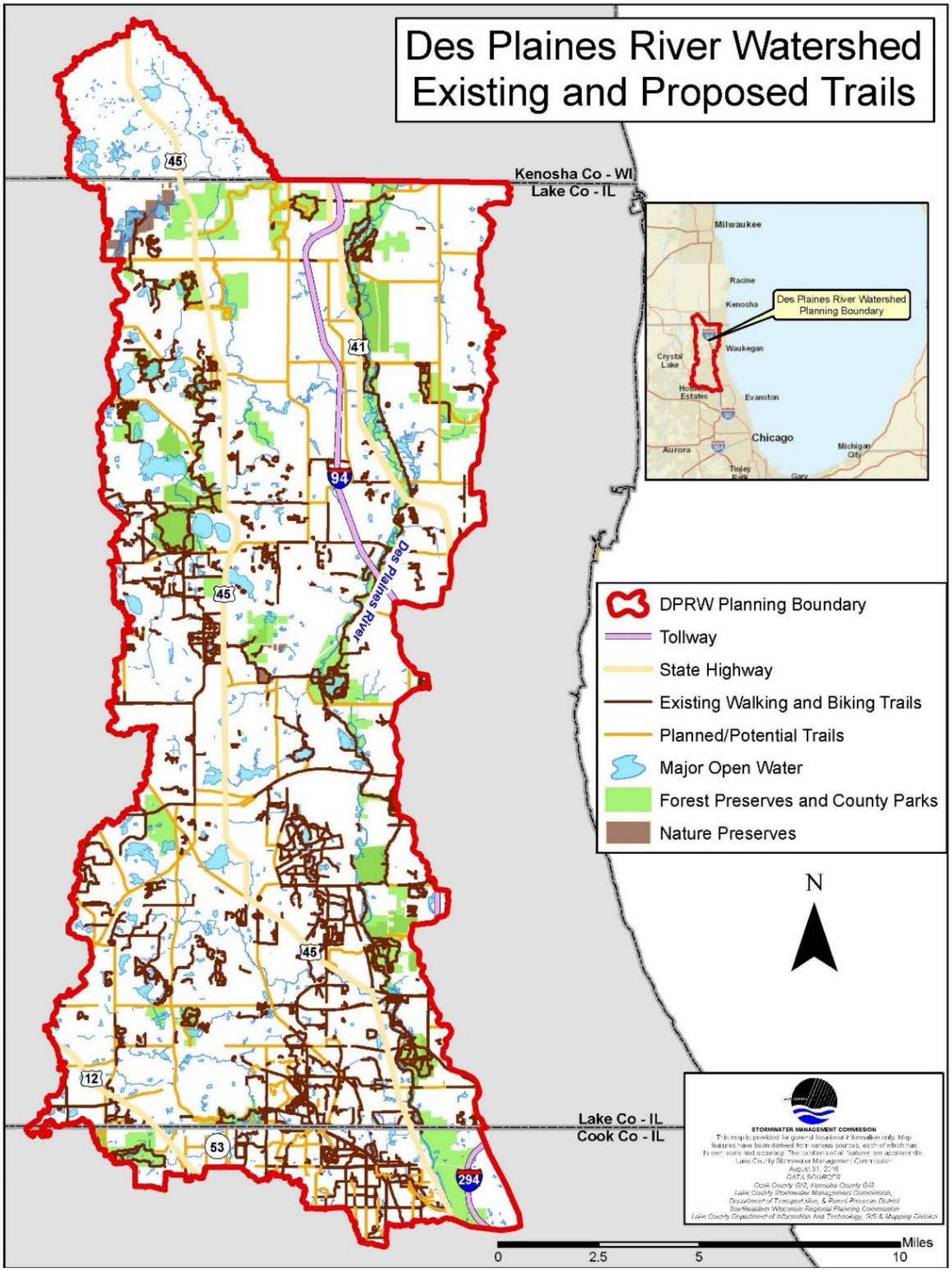


Figure 3-40: Des Plaines River Watershed Existing and Proposed Trails

3.7.3 Planned Transportation Projects

In the year 2020, Lake County will have a development pattern and transportation system that provides a variety of living and transportation choices, meets the mobility needs of all residents, and minimizes adverse environmental impacts.
LCDOT Regional Framework Plan 2004

Information about planned roadway improvements in the watershed was gathered through local, regional, and state transportation contacts and from available road planning reports. The compiled list of planned roadway improvements includes all major county, regional, and state planned projects; however, this is not an exhaustive list of all planned roadway projects in the planning area. There are likely additional local roadway improvement plans that were not captured in this analysis.

An example of roadway improvements is shown in Figure 3-41. Roadway improvement projects are intended to benefit watershed and county residents and the local economy by providing better transportation access. The design of rights-of-way has a substantial impact on the livability of communities' health, safety and welfare of residents, and the quality of aquatic resources. Transportation agencies face several challenges in addressing the volume of runoff from roadways and the pollutants typical in roadway runoff. A transportation jurisdiction frequently has limited control of the pollutants entering its right of way (including pollutants generated from atmospheric deposition, vehicle operation, litter, organic debris, and surrounding land uses).

3.7.3.1 Roads

There are 39 miles of proposed roadway, which includes roadway widening, new roadway, re-alignment of roads and bypass over the next five to ten years (Figure 3-42). The largest stretches of proposed major roadways in the DPR planning area are Route 53/120 (approximately 19.7 miles) and Route 22 from Quentin Road to Route 83 (approximately 3.51 miles within the DPR planning area). Traffic congestion on the highways and roads in Lake County negatively impacts the local economy and quality of life. Traffic congestion was amongst the issues most frequently mentioned by participants at the Regional Framework Plan Public Forums. "Less traffic congestion" was identified as the second most important quality of life factor in a Lake County Resident Transportation Survey conducted by the Department of Communications in 2000.

Road improvement and construction projects are vital to economic stability and growth but can result in negative impacts to the surrounding environment if not constructed using the appropriate BMPs. Road construction and road widening increase the amount of impervious surface and reduces open space in the watershed, resulting in increased runoff and potential for water quality degradation if not mitigated. Road construction also greatly increases the potential for soil erosion to nearby streams and lakes if soil erosion control measures are not properly installed before, during and after construction.

As described earlier in this section, "car habitat" is a substantial portion of the impervious cover in the watershed. Stormwater runoff increases as impervious surfaces increase, which results in additional pollutants in the stormwater runoff and ultimately local waterbodies. Collecting and minimizing the mobilization of this material from streets and highways where pollutants tend to accumulate is the goal of successful roadway runoff management. Table 3-17 lists common pollutants in stormwater runoff from “car habitat”.

Figure 3-41: Roadway Reconstruction of Peterson Road from Route 83 west through Atkinson Road

3.7.3.2 Trails

There are 183 miles of proposed trail and bikeway systems over the next five to twenty-four years (Figure 3-40) (Lake County 2040 Non-Motorized Plan). If constructed, many of the proposed trails would connect the network of existing trails within and outside the watershed such as the Des Plaines River Trail, Millennium Trail, Prairie Crossing Trail, Pine Dunes Forest Preserve Trail, North Shore Trail, Buffalo Creek Forest Preserve Trail, Quentin Road, Lake Cook Road, Rand Road and Long Grove Road to the Deer Grove Forest Preserve and Deer Park Mall. The longest stretches of proposed trail systems in the DPR planning area are the Multi-Preserve Connection from Hawley Road to Lake-Cook Road (8.1 miles) and Millennium Trail and Greenway Trail Extension (8.4 miles). Section 3.8 Green Infrastructure Inventory examines open and partially open space parcels and ownership necessary to design and connect proposed trails to the existing system.

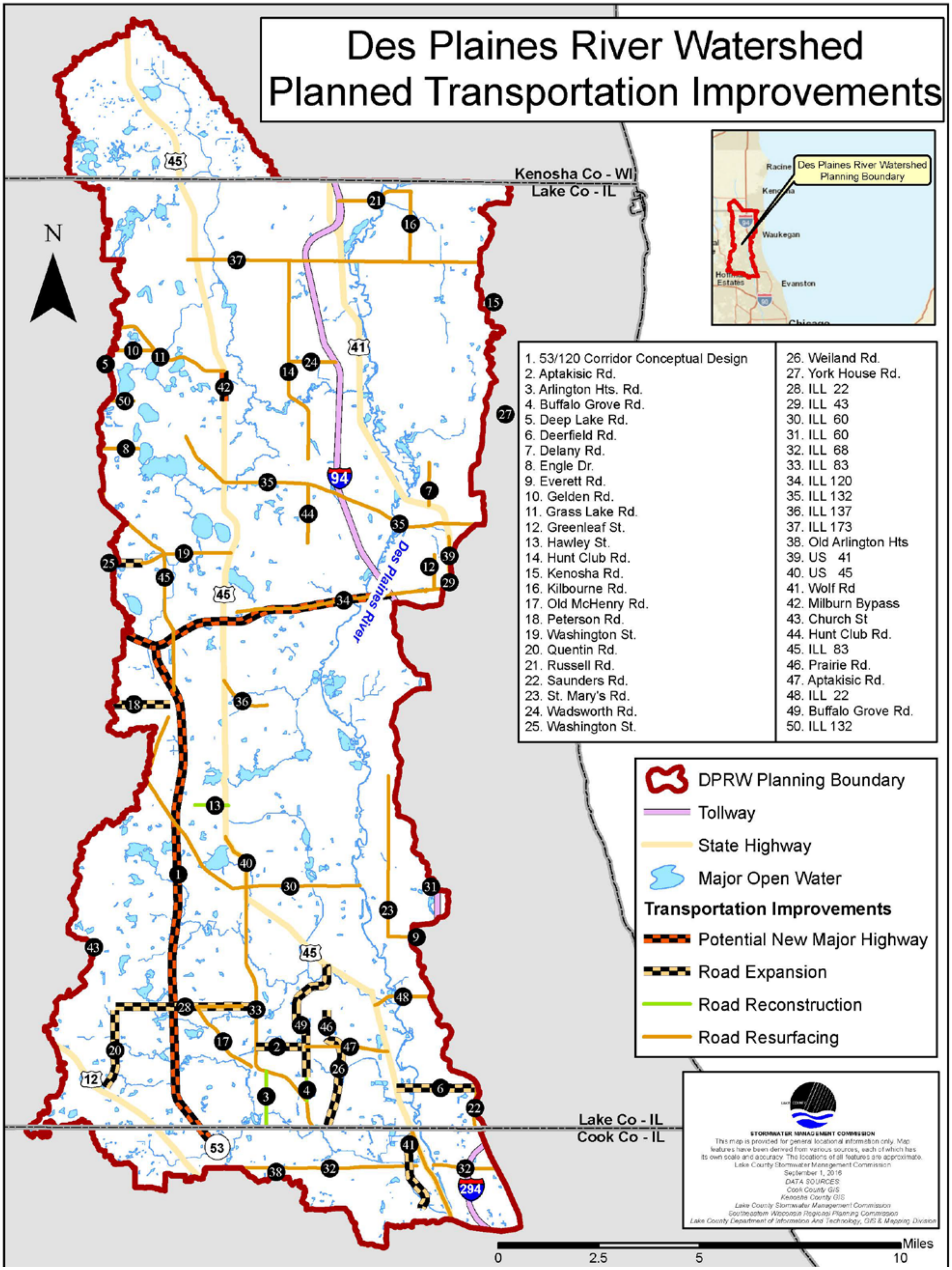


Figure 3-42: Planned and Potential Roadway Improvements in the DPR Planning Area

Table 3-17: Highway Runoff Constituents and Their Primary Sources

CONSTITUENTS	PRIMARY SOURCES
Particulates	Pavement wear, vehicles, atmosphere, maintenance
Nitrogen, Phosphorus	Atmosphere, roadside fertilizer application
Lead	Leaded gasoline (auto exhaust), tire wear (lead oxide filler material, lubricating oil and grease, bearing wear)
Zinc	Tire wear (filler material), motor oil (stabilizing additive), grease
Iron	Auto body rust, steel highway structures (guard rails etc.), moving engine parts
Copper	Metal plating, bearing and bushing wear, moving engine parts, brake lining wear, fungicides and insecticides
Cadmium	Tire wear (filler material), insecticide application
Chromium	Metal plating, moving engine parts, brake lining wear
Nickel	Diesel fuel and gasoline (exhaust), lubricating oil, metal plating, bushing wear, brake lining wear, asphalt paving
Manganese	Moving engine parts
Cyanide	Anti-cake compound (ferric ferrocyanide, sodium ferrocyanide, yellow prussiate of soda) used to keep deicing salt granular
Sodium, Calcium, Chloride	Deicing salts
Sulphate	Roadway beds, fuel, deicing salts
Petroleum	Spills, leaks or blow-by motor lubricants, antifreeze and hydraulic fluids, asphalt surface leachate
PCB	Spraying of highway rights-of-way, background atmospheric deposition, PCB catalyst in synthetic tires

Source: US DOT, FHWA, Report No. FHWA/RD-84/057-060, June, 1987; USEPA 1993.

3.8 GREEN INFRASTRUCTURE

3.8.1 Green Infrastructure Model and Strategy for Lake County, Illinois

The Lake County Green Infrastructure Model and Strategy (GIMS) encapsulates facets of green infrastructure beyond those related to just stormwater. Many of the green infrastructure datasets related to water used in the GIMS were also used in the watershed-based plan green infrastructure prioritization criteria, in order to eliminate "double counting" datasets. The GIMS provides a more comprehensive assessment of the overall green infrastructure values in our stormwater-based assessment. The GIMs following text is taken directly from the Project Summary (page 5) of the Lake County GIMS "Technical Report" (2017):

> ***The Lake County GIMS builds on the previous efforts of the Chicago Wilderness Regional Green Infrastructure Vision through building a more refined infrastructure network model with higher resolution and more up-to-date GIS data. The GIMS also builds on the efforts of The Conservation Fund's (the Fund) support to the Chicago Metropolitan Agency for Planning (CMAP) to access ecosystem service valuation in Lake and six other Illinois counties in its planning area. The Lake County GIMS provides a framework for identifying land conservation and restoration opportunities for the county's major native landscape types: woodland/forest. Prairie/grassland/savanna, wetlands, and freshwater aquatic systems. The primary products of the Lake County GIMS are derived GIS datasets and models, which describe and characterize the regional green infrastructure network, restoration opportunities, and ecosystem service values of this network. The derived GIS datasets include core***

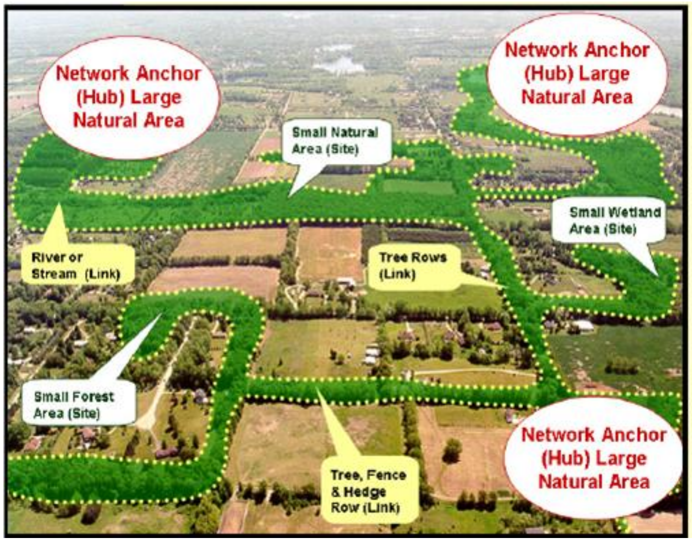
areas, functional connections, restoration building blocks, and composite layers that combine the science-based, data driven ecological network with the inventory of protected and managed lands. Included in the functional connections are corridor linkages for woodland/forest, prairie/grassland/savanna, wetlands, and steam buffers, as well as functional connectivity within Lake County's trail network.

For more information on the Green Infrastructure Model and Strategy for Lake County, Illinois, please visit http://www.lcfpd.org/conservation/greenstrategy/

3.8.2 GREEN INFRASTRUCTURE

Green Infrastructure is a stormwater management approach that saves money, supports sustainability, and more efficiently uses limited financial and natural resources. It is achieved by capturing raindrops where they fall reducing runoff volumes, and recharging groundwater supplies. By integrating natural processes into the built environment, green infrastructure provides stormwater management, flood mitigation, economic benefits, air quality management, and much more. Green infrastructure can be planned and implemented on local and regional scales:

- *Local scale:* Green infrastructure on a local scale consists of site-specific BMPs (such as naturalized detention facilities, vegetated swales, porous pavement, rain gardens, and green roofs) that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls.
- *Regional Scale:* Green infrastructure at the regional scale consists of the interconnected network of open spaces and natural areas that mitigate stormwater runoff, naturally recharge aquifers, and improve water quality while providing recreational opportunities and wildlife habitat (Figure 3-43)
    - o Regional scale green infrastructure aims to create an unbroken chain of natural areas and encourages planers to design interconnected hubs of natural space. This connection enhances the health of open spaces and promotes species diversity.



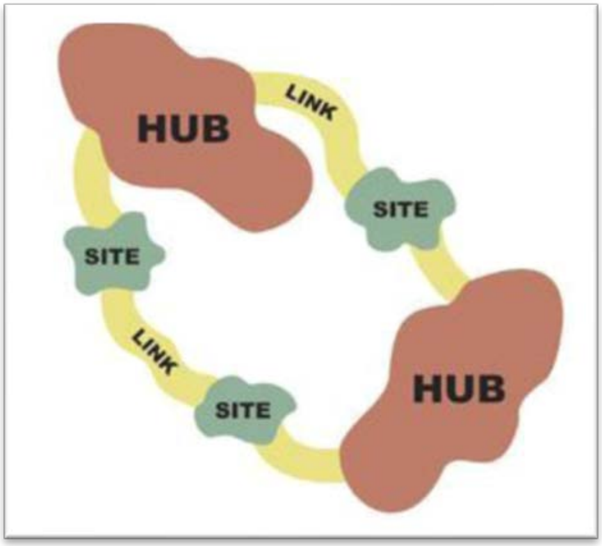


Figure 3-43: Diagram of Regional Scale Green Infrastructure

The Des Plaines River Watershed-Based Plan addresses the condition and quality of water resources and flood damage in the DPR planning area. Stormwater runoff is a major cause of water pollution and flooding in developed and semi-developed watersheds like the DPR planning area. Impervious surfaces such as rooftops, driveways, parking lots, and streets generate stormwater runoff that conveys pollutants to components of the natural drainage or green infrastructure system (ex. wetlands, lakes, and streams). Higher flows of stormwater can also cause erosion and flooding in urban streams, damaging habitat, property, and infrastructure. Since green infrastructure substantially influences how water moves in and on the landscape, it is an important element in the Des Plaines River Watershed-Based Plan for assessing current and planning for future conditions. *There are four goals that can be met by increasing the green infrastructure in the DPR planning area.*

1. *Water quality improvement: Minimize runoff volumes, velocities, and pollutants to waterways utilizing wetlands, natural landscapes, and stormwater BMPs as infiltration and pollutant filtration systems.*
2. *Regional green infrastructure and natural resources: Utilize good natural resource management practices and green infrastructure on private and public property to protect, enhance, and restore natural resources. This maintains and enhances native plant and wildlife communities, natural hydrology, and buffers for streams, lakes, and wetlands while expanding environmental corridors that provide ecological, educational, and recreational benefits.*
3. *Reduce current flood damage and prevent future flooding from worsening: Use infiltration and evapotranspiration provided by green infrastructure to reduce volume of runoff and flood damage.*
4. *Funding, installing and maintaining stormwater infrastructure: Reduce the rate and volume of stormwater runoff by minimizing impervious cover and implementing stormwater green infrastructure practices that reduce runoff volumes, velocities, and pollutants to waterbodies. Funding should be sought to implement green infrastructure practices wherever feasible. Appendix L describes potential funding sources for green infrastructure practices.*

Local and regional scale green infrastructure work in concert to infiltrate and store precipitation, thereby reducing the amount of stormwater runoff and the need to treat the water. Green infrastructure also brings many other environmental, social, and economic benefits. These benefits promote urban livability by improving the environment and preserving open space, which supports sustainable communities.

3.8.3 Public and Private Ownership

Most developed and partially open land in the DPR planning area is privately owned (see Table 3-18 and Figure 3-44). Approximately 44% of open space in the DPR planning area is publicly owned, most of which is within the Upper Des Plaines River, North Mill- Dutch Gap Canal, Mill Creek, and Lower Des Plaines River subwatersheds. Approximately 56% of open space in the DPR planning area is privately owned, most of which is located in the Upper Des Plaines River, North Mill- Dutch Gap Canal, and Mill Creek subwatersheds.

OPEN PARCELS: Parcels with no built structures or impervious cover (including open water).

PARTIALLY OPEN PARCELS: Parcels that have a small structure (building, parking lot) relative to the parcel, allowing for the potential implementation of BMPs.

DEVELOPED PARCELS: Parcels that are mostly occupied by structures and/or impervious cover.

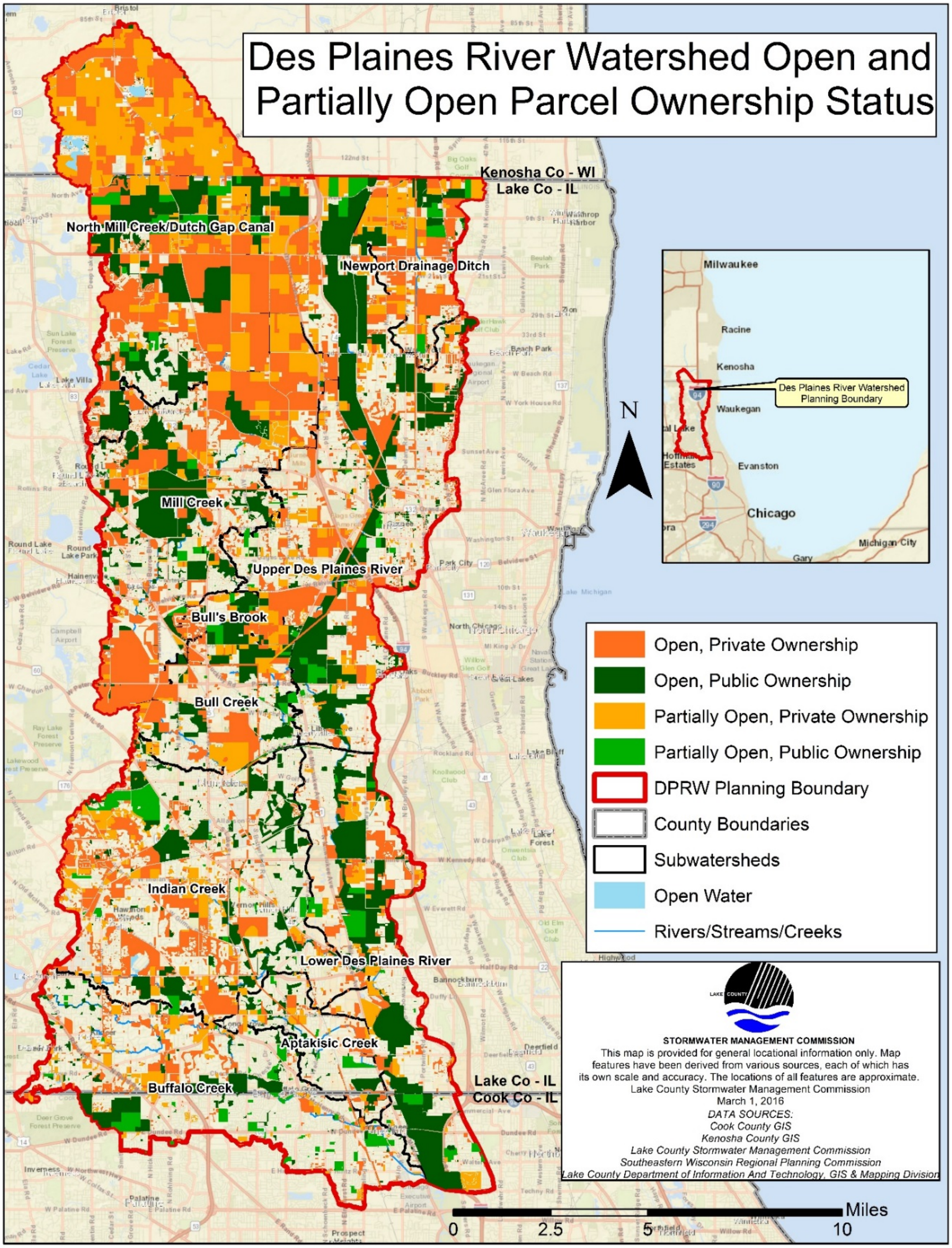


Figure 3-44: Public and Privately Owned Open and Partially Open Parcels in the DPR planning area

Table 3-18: Ownership of Open, Partially Open and Developed Parcels in the DPR planning area

	OPEN PARCELS				PARTIALLY OPEN PARCELS				DEVELOPED PARCELS			
	ACRES PUBLIC	% OF OPEN PARCELS (ACRES) IN SUBSHED	ACRES PRIVATE	% OF OPEN PARCELS (ACRES) IN SUBSHED	ACRES PUBLIC	% OF PARTIALLY OPEN PARCELS (ACRES) IN SUBSHED	ACRES PRIVATE	% OF PARTIALLY OPEN PARCELS (ACRES) IN SUBSHED	ACRES PUBLIC	% OF DEVELOPE D PARCELS (ACRES) IN SUBSHED	ACRES PRIVATE	% OF DEVELOPED PARCELS (ACRES) IN SUBSHED
Aptakisic Creek	406	48.1	438	51.9	129	36.3	226	63.7	126	4.9	2,427	95.1
Buffalo Creek	1,417	49.0	1,473	51.0	785	43.3	1,027	56.7	224	2.2	9,913	97.8
Bull Creek	1,151	44.7	1,422	55.3	137	15.7	736	84.3	464	16.1	2,419	83.9
Bull's Brook	449	47.7	491	52.3	85	19.4	354	80.6	7	2.6	248	97.4
Indian Creek	2,744	38.0	4,473	62.0	773	29.0	1,897	71.1	542	4.7	10,883	95.30
Lower Des Plaines River	3,796	73.2	1,393	26.8	554	35.0	1,030	65.0	250	3.8	6,346	96.2
Mill Creek	3,728	37.8	6,139	62.2	203	9.4	1,947	90.6	633	11.1	5,074	88.9
Newport Drainage Ditch	357	17.5	1,681	82.5	238	17.6	1,114	82.4	17	1.3	1,271	98.7
North Mill – Dutch Gap Canal	3,894	32.4	8,128	67.6	782	10.5	6,664	89.5	84	2.9	2,785	96.7
Upper Des Plaines River	7,058	50.9	6,810	49.1	871	21.4	3,197	78.6	706	6.4	10,403	93.7
DPR planning area Total	**25,000**	**43.5**	**32,448**	**56.5**	**4,557**	**20.0**	**18,192**	**80.0**	**3,053**	**5.57**	**51,769**	**94.4**

3.8.4 PROTECTION STATUS

Protected open space differs from unprotected open space because it can't be utilized for developed land uses. The land is either permanently chartered as open land or in a permanent deed restriction such as a conservation easement. Publicly protected areas include forest preserve districts, state nature preserves, and park districts. Privately protected areas include homeowners/business association-owned land with deed restrictions or conservation easements, and land owned by land trusts and other conservation organizations. The conversion of open space to other uses reduces the watershed benefits provided by open land. Conversion of open space to traditionally developed land uses increases runoff, water quality degradation, and loss of wildlife habitat area and connectivity.

The green infrastructure inventory identified the number and size of protected parcels within the DPR planning area. All protected and unprotected parcels were then sorted as open parcels, partially open parcels or developed parcels. Approximately 46% of open and 22% of partial parcels were protected (Table 3-19). Open and partially open unprotected parcels located near protected areas or along areas stream corridors (Figure 3-45) will be key parcels for the development of a *Green Infrastructure network*.

Table 3-19: Protection Status Summary of Open and Partially Open Parcels in the DPR planning area

SUBWATERSHED	OPEN PARCELS				PARTIALLY OPEN PARCELS			
	ACRES PROTECTED	% OF OPEN PARCELS (ACRES) IN SUBWATERSHED	ACRES UNPROTECTED	% OF OPEN PARCELS (ACRES) IN SUBWATERSHED	ACRES PROTECTED	% OF PARTIALLY OPEN PARCELS (ACRES) IN SUBWATERSHED	ACRES UNPROTECTED	% OF PARTIALLY OPEN PARCELS (ACRES) IN SUBWATERSHED
Aptakisic Creek	415	49.1	430	50.9	129	36.3	226	63.7
Buffalo Creek	1,439	49.8	1,452	50.2	785	43.3	1,027	56.7
Bull Creek	1,212	47.1	1,362	52.9	177	20.3	696	79.7
Bull's Brook	684	72.8	256	27.2	254	57.7	186	42.3
Indian Creek	2,744	38.5	4,440	61.5	787	29.5	1,883	70.5
Lower Des Plaines River	4,076	78.6	1,113	21.5	730	46.1	854	53.9
Mill Creek	3,741	37.9	6,125	62.1	203	9.4	1,947	90.6
Newport Drainage Ditch	349	17.1	1,689	82.9	238	17.6	1,114	82.4
North Mill – Dutch Gap Canal	3,918	32.6	8,104	67.4	821	11.0	6,625	89.0
Upper Des Plaines River	7,617	54.9	6,252	45.1	923	22.7	3,144	77.3
DPR planning area Total	**26,195**	**45.6**	**31,223**	**54.4**	**5,047**	**22.2**	**17,702**	**77.8**

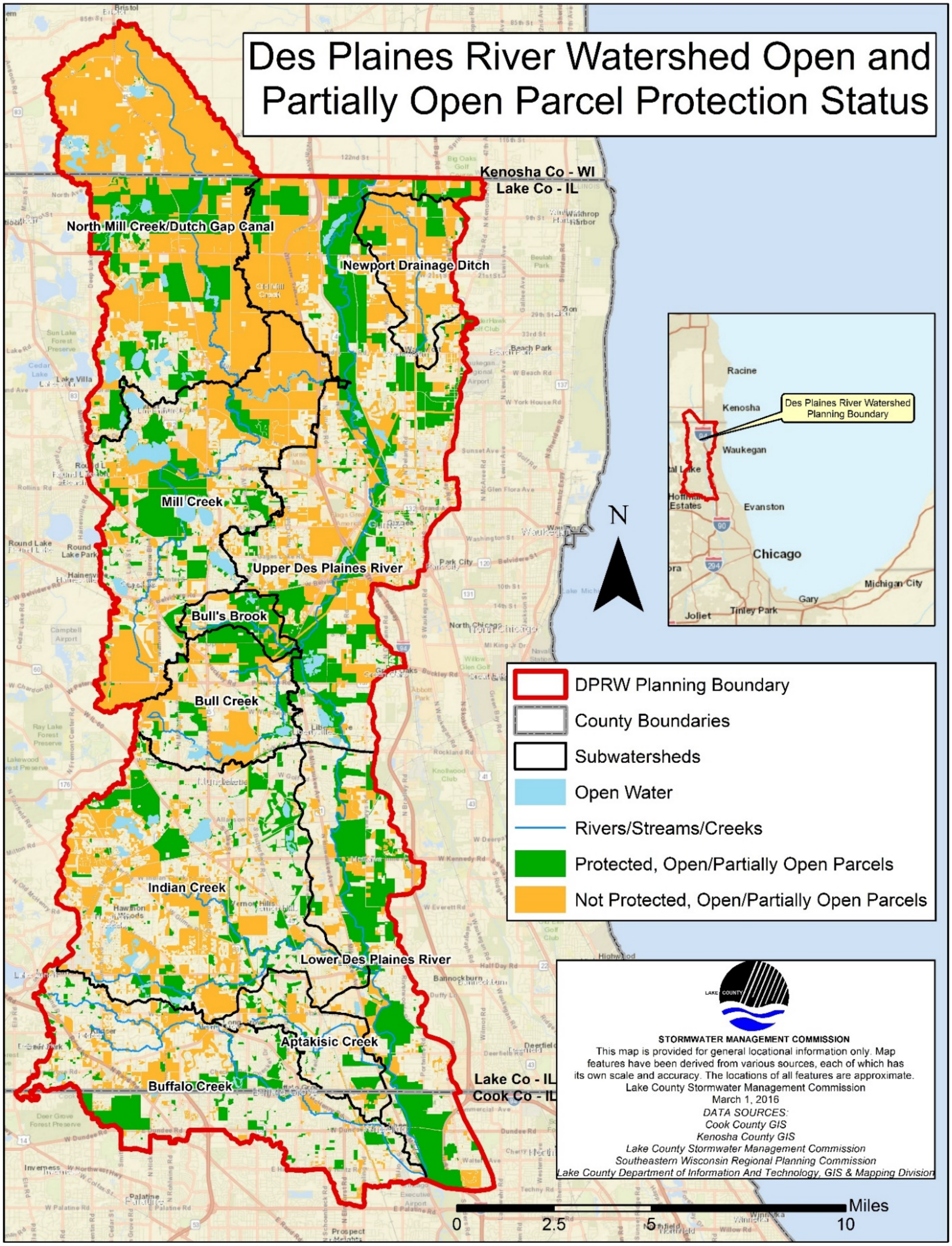


Figure 3-45: Protections Status of Parcels in the DPR Planning Area

3.9 PARKS AND RECREATION

3.9.1 PARKS AND OPEN SPACE

Figure 3-46: Buffalo Grove Farrington Ditch at Buffalo Skate Park

Three hundred and eighty-five (381) parks totaling approximately 5,982 acres were identified within the DPR planning area. For the purposes of this plan, "parks" are defined as publicly-owned open space not owned by a Forest Preserve District, including all open space owned by park districts, municipalities, townships, and the State of Illinois. Management, programming, and use of these lands is varied, and includes active and passive recreation, wildlife management, hunting and fishing, and nature preserves. This plan does not include golf courses in this definition. The average mean park size is approximately 15 acres. The number of parks per county and jurisdiction is presented in Table 3-20 and Table 3-21, respectively. Figure 3-46 displays an example of a park in the DPR planning area and all of the park locations are displayed in Figure 3-47.

Table 3-20: Distribution of Parks within the DPR Planning Area

PARK LOCATION (COUNTY)	NUMBER OF PARKS	SIZE (ACRES)	% OF THE WATERSHED
KENOSHA	11	14	0.01%
COOK	30	282	0.19%
LAKE	344	5,686	3.78%
TOTAL	**385**	**5,982**	**3.98%**

Table 3-21: Distribution of Parks within the DPR Planning Area by Jurisdiction

PARK LOCATION (JURISDICTION)	NUMBER OF PARKS	SIZE (ACRES)	% OF THE WATERSHED
City of Park City	1	1.9	0.001%
City of Prospect Heights	2	13.1	0.01%
City of Waukegan	6	274.5	0.18%
City of Zion	3	18.1	0.01%
Ela Township	1	2.3	0.002%
Fremont Township	3	4.2	0.003%
Lake Villa Township	4	2.4	0.002%
Libertyville Township	10	885.5	0.59%
State of Illinois	1	1,001.6	0.67%
Village of Salem Lakes	7	2.2	0.001%
Village of Antioch	6	79.2	0.05%
Village of Arlington Heights	4	56.7	0.04%
Village of Beach Park	2	6.6	0.004%
Village of Bristol	4	11.8	0.01%
Village of Buffalo Grove	49	460.2	0.31%
Village of Deer Park	8	52.6	0.03%
Village of Grayslake	39	396.7	0.26%
Village of Green Oaks	1	15.5	0.01%
Village of Gurnee	30	330.0	0.22%
Village of Hawthorn Woods	11	120.7	0.08%
Village of Lake Villa	2	12.6	0.01%
Village of Lake Zurich	15	125.4	0.08%
Village of Libertyville	21	392.8	0.26%
Village of Lincolnshire	7	36.4	0.02%
Village of Lindenhurst	31	187.9	0.12%
Village of Long Grove	19	418.8	0.28%
Village of Mettawa	1	9.2	0.01%
Village of Mundelein	33	403.3	0.27%
Village of Old Mill Creek	1	5.1	0.003%
Village of Palatine	4	29.5	0.02%
Village of Round Lake Beach	3	16.1	0.01%
Village of Vernon Hills	21	355.2	0.24%
Village of Wadsworth	2	17.1	0.01%
Village of Wheeling	8	106.7	0.07%
Warren Township	25	130.2	0.09%
TOTAL	381	5,982.1	3.98%

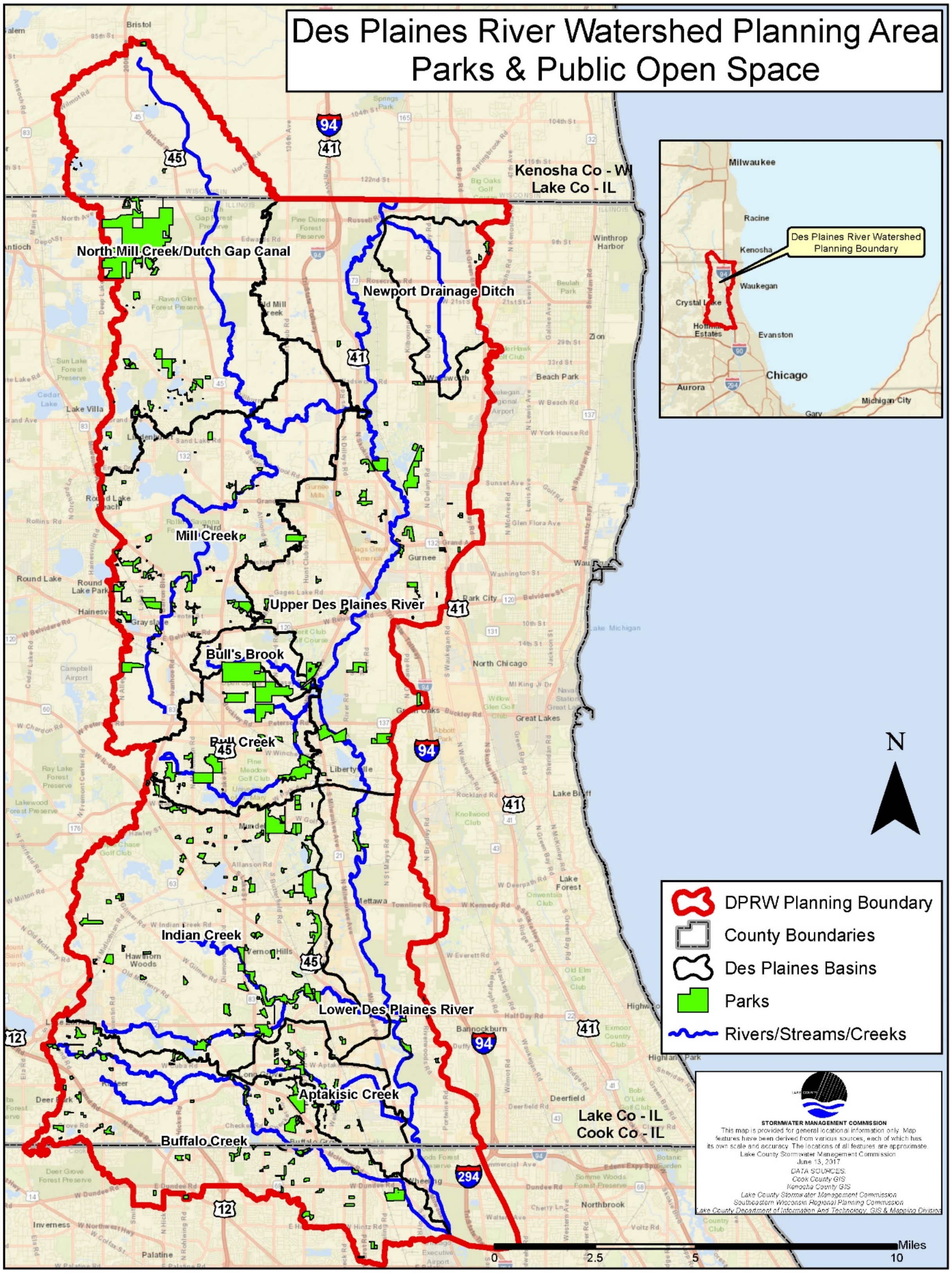


Figure 3-47: Location of Parks in DPR Planning Area

3.9.2 GOLF COURSES

Twenty-nine golf courses totaling approximately 4,319 acres are located within the DPR planning area. The distribution of golf courses by jurisdiction is summarized in Table 3-22, and graphically displayed in Figure 3-48**.**

Table 3-22: Distribution of Golf Courses within the DPR Planning Area

GOLF COURSE LOCATION (JURISDICTION)	NUMBER OF GOLF COURSES	SIZE (ACRES)	% OF THE WATERSHED
Avon Township	1	99.3	0.07%
City of Waukegan	1	249.9	0.17%
City of Zion	1	152.3	0.10%
Fremont Township	1	442.6	0.29%
Northfield Township	1	87.1	0.06%
Vernon Township	2	366.8	0.24%
Village of Arlington Heights	1	46.0	0.03%
Village of Beach Park	1	53.8	0.04%
Village of Buffalo Grove	2	247.4	0.16%
Village of Grays Lake	1	19.2	0.01%
Village of Gurnee	3	597.3	0.40%
Village of Hawthorn Woods	1	176.7	0.12%
Village of Kildeer	1	228.4	0.15%
Village of Libertyville	1	26.8	0.02%
Village of Lincolnshire	1	159.8	0.11%
Village of Long Grove	2	329.0	0.22%
Village of Mundelein	3	537.0	0.36%
Village of Northbrook	1	38.2	0.03%
Village of Riverwoods	1	1.4	0.00%
Village of Vernon Hills	2	332.7	0.22%
Village of Wheeling	1	127.0	0.08%
TOTAL	**29**	**4,319**	**2.87%**

Stormwater runoff from many of these golf courses flows directly into the Des Plaines River. Landscaping and maintenance practices at golf courses directly impact the watershed. While fertilizers and pesticides maximize productivity and performance of turf grass, the DPR planning area may be at risk from spills of concentrated chemicals used to mix fertilizers and pesticides for application. Of the many nutrients applied to golf turf and the primary contaminants of concern in fertilizers are nitrogen and phosphorus, which contribute to algal growth, weeds, and the impairment of water.

Pesticides may be toxic to aquatic and terrestrial systems depending on their solubility, toxicity, and chemical breakdown rate. Other potentially hazardous materials, such as fuels and paints that are used in everyday operation and maintenance, can contaminate water quality accidentally. Golf course BMPs should be followed for maintenance operations to prevent contamination from accidental releases.

Another significant source of pollution from golf courses are waterfowl. Shallow ponds surrounded by mowed turf grass attract significant populations of waterfowl. Deposits of fecal matter by resident and migrating waterfowl (primarily Canada geese) may contribute to high levels of fecal coliform in the watershed (Figure 3-49).

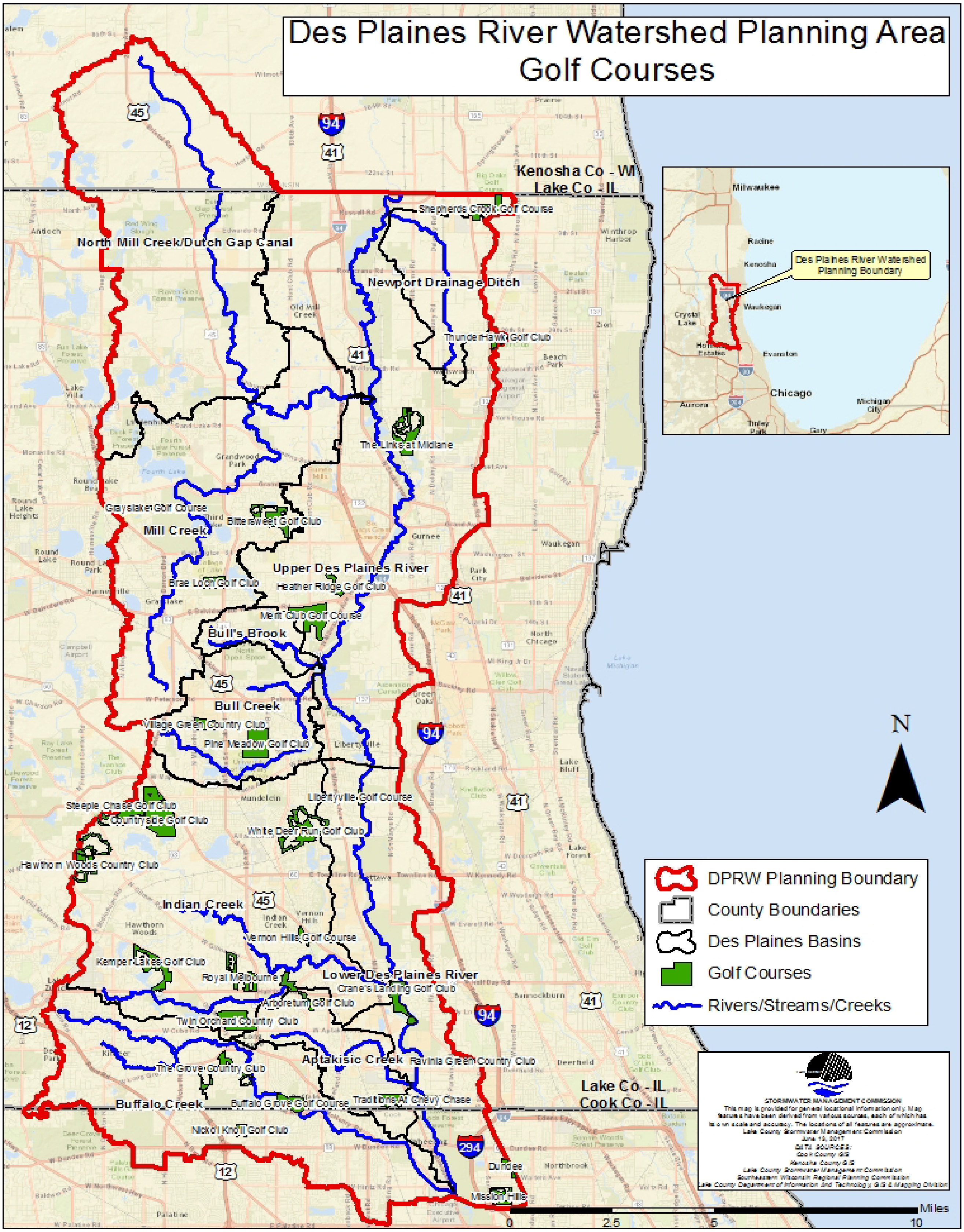


Figure 3-48: Golf Courses in Des Plaines River Watershed

Recommended BMPs for golf courses (Cornell University, 2014) include:

Figure 3-49: Photo of geese on a golf course

- *Maintain a 100-foot buffer around waterways for chemical storage and mixing. Storage areas should have a raised berm on all sides and an impervious surface for containment. Facilities should be equipped with "spill containment material".*
- *Grass clippings and debris removed from equipment should be disposed of properly and not released into waterways.*
- *Determine accurate supplemental nutrient needs based on soil chemical and physical analysis.*
- *Assess nutrient application efficiency through regular equipment calibration.*
- *Maintain turf with high shoot density to minimize runoff and maximize infiltration.*
- *Manage the surface accumulation of organic matter to maintain a permeable system that minimizes runoff and maximizes subsurface retention.*
- *Select turf that is well adapted to site conditions. Well adapted species require reduced amounts of fertilizer and pesticides, and if selected for drought tolerance, requires less water to survive and maintain playability.*
- *Minimize the amount of fertilizer and chemicals used during the establishment phase as establishing turf does not provide the needed uptake to prevent runoff and leaching.*
- *Implement methods such as core cultivation, deep slicing and water injection to alleviate soil compaction and remove organic material, resulting in increased infiltration and reduced runoff.*
- *Utilize proper topdressing material to maintain permeable turf.*
- *Utilize a combination of preventative and reactive strategies to manage pest problems. Select management options according to site conditions instead of the calendar.*
- *Establish wetland fringes around ponds to reduce populations of geese (geese prefer open water with closely mowed, visible banks to they can see predators approaching).*

3.10 NATURAL AREAS

3.10.1 Nature Preserves, Forest Preserves, and High Quality Natural Areas

Several dedicated Illinois Nature Preserves, County Parks, and Lake County Forest Preserves are in the watershed. There are 40 forest preserve and county park areas totaling 18,532 acres in the DPR planning area (3 acres in Kenosha County, 16,652 acres in Lake County and 1,877 acres in Cook County) (See Figure 3-50 for an example of forest preserves within the DPR planning area). Thirty-nine of the approximately 128 miles of major tributaries and 27 of the approximately 37 miles of the mainstem in the DPR planning area flow through forest preserves. The Lake County Forest Preserve District owns the most land of any single landowner in the watershed. Forest preserves are a key component of the system of hubs and links creating the regional green infrastructure system in the DPR planning area. In particular, the network of forest preserves along the Des Plaines River in Lake and Cook Counties provides significant flood damage reduction, water quality, habitat, and quality of life benefits to the planning area. Forest preserve districts are therefore key partners in successful implementation of this plan. Forest preserve properties within the DPR planning area are listed in Table 3-23, acres of forest preserve in each subwatershed is listed in Table 3-24, and forest and nature preserve properties are mapped in Figure 3-51. There are 19 nature preserve properties totaling 4,775 acres in the DPR planning area, as listed in Table 3-25. Six of these properties are entirely within a forest preserve property, five are partially within a forest preserve property, and five are located outside of forest preserve properties.

Figure 3-50: Almond Marsh Forest Preserve in Grayslake Illinois

Table 3-23: Forest Preserve and County Parks in the DPR Planning Area

SITE	ACRES	SITE	ACRES
Almond Marsh	502.2	Hastings Lake	268.4
Brae Loch Golf Club	154.0	Heron Creek	240.8
Bristol Woods	3.1	Independence Grove	1,140.5
Buffalo Creek	397.7	Lake Carina	473.5
Cahokia Flatwoods	221.4	Lyons Woods	2.0
Captain Daniel Wright Woods	682.9	MacArthur Woods	495.0
Casey Trail & Greenway	33.0	McDonald Woods	305.3
Countryside Golf Club	488.0	Mill Creek	276.8
Dam No. 1 Woods	668.4	Oak-Hickory	224.0
Deer Grove	92.2	Old School	272.2
Deer Grove East	558.9	Pine Dunes	862.5
Duck Farm	350.9	Potawatomi Woods	557.6
Dutch Gap	785.8	Prairie Stream	331.4
Edward L. Ryerson Conservation Area	561.1	Raven Glen	535.9
Egret Marsh	119.2	Rollins Savanna	1,236.9
Ethel's Woods	495.5	Sedge Meadow	793.2
Fourth Lake	622.1	ThunderHawk Golf Club	53.8
General Offices	6.6	Van Patten Woods	969.4
Grainger Woods Conservation Preserve	314.3	Wadsworth Savanna	1,960.6
Half Day	231.8	Wilmot Woods	243.9
		TOTAL:	18,533

Table 3-24: Forest Preserve and County Parks Acreages in the DPR Planning Area

SUBWATERSHED NAME	FOREST PRESERVE ACRES	% OF SUBWATSHED
Aptakisic Creek	1.8	0.04%
Buffalo Creek	1,072.3	6.17%
Bull's Brook	409.5	22.54%
Bull Creek	195.4	2.74%
Indian Creek	831.4	3.44%
Lower Des Plaines River	3,995.7	27.35%
Mill Creek	2,389.6	12.08%
Newport Drainage Ditch	188.0	3.75%
North Mill Creek/Dutch Gap Canal	3,113.2	13.23%
Upper Des Plaines River	6,335.6	19.47%
TOTALS	**18,532.5**	**Percent of Planning Area 12.33**

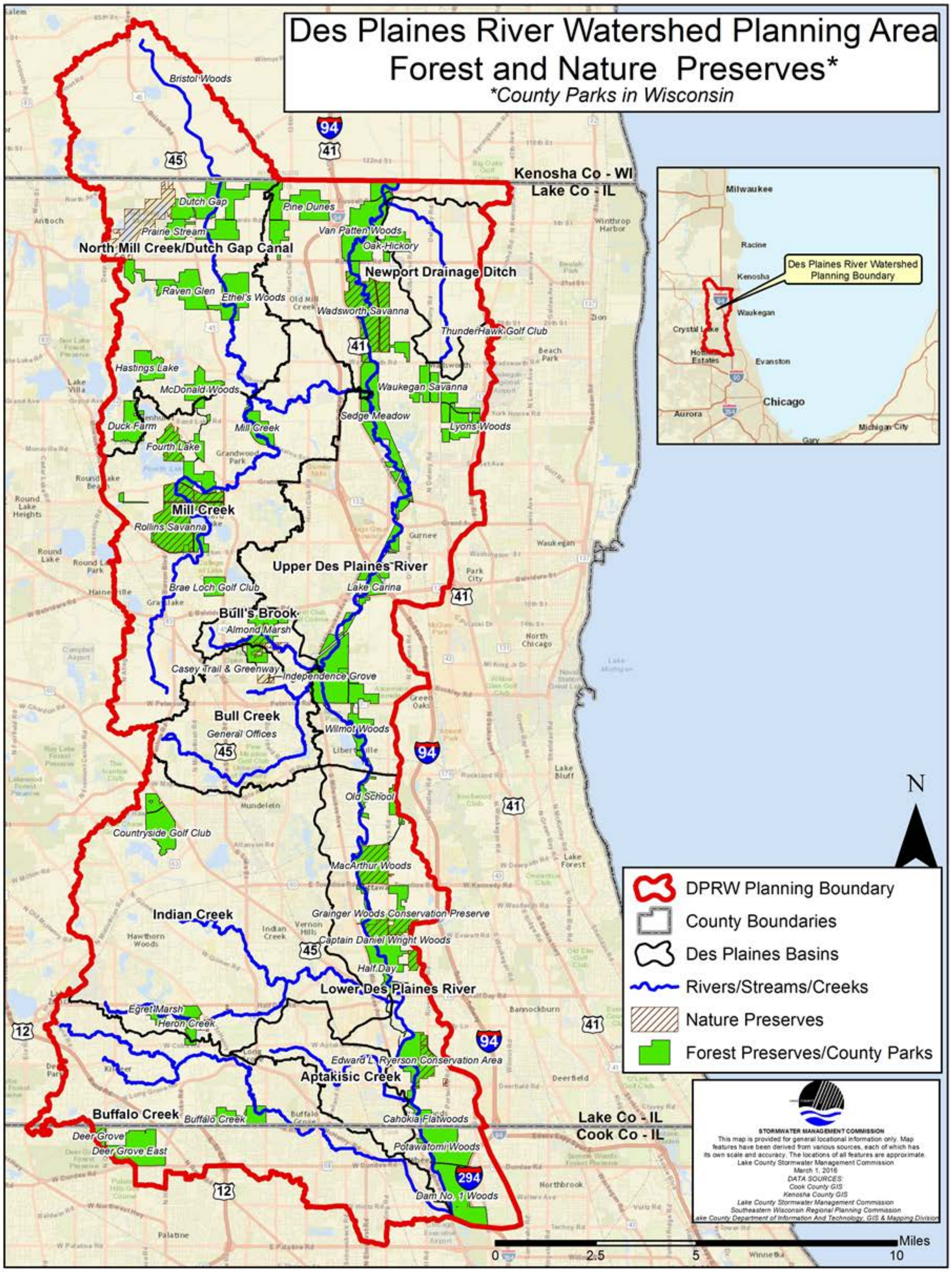


Figure 3-51: Des Plaines River Watershed Planning Area Forest and Nature Preserves

Table 3-25: Nature Preserves in the DPR Planning Area

SITE	ACRES	ACRES IN FOREST PRESERVE
Deer Grove West Woodland and Wetland Nature Preserve	78.5	78.5
Rhyan Tract Land and Water Reserve	13.6	13.6
Brooklands Wood Land and Water Reserve	10.7	0.0
Webber Wildlife Refuge Land and Water Reserve	17.2	0.0
Almond Marsh Nature Preserve	154.9	109.6
Oak Openings Nature Preserve	73.5	27.3
Liberty Prairie Nature Preserve	75.0	2.9
Eastern Prairie Fringed Orchid Nature Preserve	3.7	0.0
Red Wing Slough/Deer Lake Land and Water Reserve	734.8	0.0
Grainger Woods Nature Preserve	183.6	183.6
Lloyd's Woods Nature Preserve	142.8	142.8
MacArthur Woods Nature Preserve	469.6	466.4
Reed-Turner Woodland Nature Preserve	45.9	0.0
Edward L. Ryerson Nature Preserve	282.2	273.6
Wadsworth Prairie Nature Preserve	1,035.8	1,035.8
Fourth Lake Fen Nature Preserve	251.6	251.6
Kildeer Creek and Woodland Land and Water Reserve	63.4	63.4
Rollins Savanna Nature Preserve	1,059.3	1,059.3
Elm Road Woods Nature Preserve	78.9	78.9
TOTAL:	4,775.0	3,787.3

3.10.2 Threatened and Endangered Species

High quality natural resources in the DPR planning area include **threatened** and **endangered** species and communities, rare habitats, and important natural areas, including natural area inventory sites, forest preserves, nature preserves, and high quality **ADID** wetlands. No Federally endangered species have been observed in the watershed.

ENDANGERED SPECIES: A species in danger of extinction throughout all or a substantial portion of its range.

THREATENED SPECIES: A species likely to become endangered in the near future.

ADID SITES: Aquatic sites that have been determined to provide biological value by the USACE, Chicago District and the USEPA.

As of 2015, 58 Illinois listed threatened and endangered species were listed in the watershed including 32 vascular plant species, 17 vertebrate animal species, and 9 bird species. According to the WDNR and Wisconsin Natural Heritage Inventory program, the threatened and endangered species observed in the Kenosha County portion of the DPR planning area include 3 vertebrate animal species, 3 vascular plant species, and 2 natural communities. These include 5 species of special concern (not yet listed as threatened or endangered) and 1 state-listed endangered species. No formal status is assigned to natural communities by the WDNR.

Table 3-26 includes the Illinois listed threatened or endangered species in the DPR planning area and provides additional information, including status and type, and Table 3-27 lists the number of Illinois threatened and endangered species in each subwatershed. Ecologically significant and protected areas in the watershed provide habitat for threatened or endangered species and contain examples of high-quality natural communities. These areas include ADID (high quality) wetlands, five INAI sites, nine forest preserves, and ten nature preserves

Noteworthy: Identifying High Quality Natural Resources

The Illinois Natural Heritage Database provides information on the presence of the state's threatened and endangered plants and animals, INAI sites, Illinois Nature Preserves, and Forest Preserve lands. The database's information was gathered from the INAI inventory (conducted in the mid 1970's), as well as by IDNR biologists, resource managers, and volunteers. Lake County threatened and endangered species information was also assembled during LCHD-ES water quality and plant sampling of the lakes, in addition to 20 years of threatened and endangered species data from the LCFPD queried through the IDNR Element Occurrence Records reports.

Table 3-26: Illinois Listed Threatened and Endangered Species within the DPR planning area

COMMON NAME	SCIENTIFIC NAME	TYPE	STATUS
American Bittern	*Botaurus lentiginosus*	Bird	Endangered
American Orpine	*Sedum telephioides*	Vascular Plant	Threatened
Banded Killifish	*Fundulus diaphanus*	Vertebrate Animal	Threatened
Black Tern	*Chlidonias niger*	Vertebrate Animal	Endangered
Blackchin Shiner	*Notropis heterodon*	Vertebrate Animal	Threatened
Black-crowned Night-heron	*Nycticorax*	Bird	Endangered
Blacknose Shiner	*Notropis heterolepis*	Vertebrate Animal	Endangered
Blanding's Turtle	*Emydoidea blandingii*	Vertebrate Animal	Endangered
Buckbean	*Menyanthes trifoliata*	Vascular Plant	Threatened
Bulrush	*Scirpus hattorianus*	Vascular Plant	Threatened
Cerulean Warbler	*Dendroica cerulea*	Vertebrate Animal	Threatened
Common Bog Arrow Grass	*Triglochin maritima*	Vascular Plant	Threatened
Common Gallinule	*Gallinula galeata*	Vertebrate Animal	Endangered
Common Moorhen	*Gallinula chloropus*	Bird	Endangered
Common Tern	*Sterna hirundo*	Bird	Endangered
Downy Solomon's Seal	*Polygonatum pubescens*	Vascular Plant	Endangered
Downy Willow-herb	*Epilobium strictum*	Vascular Plant	Threatened
Dwarf Raspberry	*Rubus pubescens*	Vascular Plant	Threatened
Eastern Massasauga	*Sistrurus catenatus*	Vertebrate Animal	Endangered
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	Vascular Plant	Endangered
Forked Aster	*Aster furcatus*	Vascular Plant	Threatened
Forster's Tern	*Sterna forsteri*	Vertebrate Animal	Endangered
Grass-leaved Pondweed	*Potamogeton gramineus*	Vascular Plant	Threatened
Grove Bluegrass	*Poa alsodes*	Vascular Plant	Endangered
Hairy White Violet	*Viola blanda*	Vascular Plant	Endangered
Iowa Darter	*Etheostoma exile*	Vertebrate Animal	Threatened
King Rail	*Rallus elegans*	Vertebrate Animal	Endangered

COMMON NAME	SCIENTIFIC NAME	TYPE	STATUS
Least Bittern	*Ixobrychus exilis*	Vertebrate Animal	Threatened
Little Green Sedge	*Carex viridula*	Vascular Plant	Threatened
Marsh Speedwell	*Veronica scutellata*	Vascular Plant	Threatened
Mountain Blue-eyed Grass	*Sisyrinchium montanum*	Vascular Plant	Endangered
Northern Cranesbill	*Geranium bicknellii*	Vascular Plant	Endangered
Northern Harrier	*Circus cyaneus*	Bird	Endangered
Northern Long-eared Myotis	*Myotis septentrionalis*	Vertebrate Animal	Threatened
Osprey	*Pandion haliaetus*	Bird	Endangered
Pale Vetchling	*Lathyrus ochroleucus*	Vascular Plant	Threatened
Pied-billed Grebe	*Podilymbus podiceps*	Bird	Threatened
Pretty Sedge	*Carex woodii*	Vascular Plant	Threatened
Pugnose Shiner	*Notropis anogenus*	Vertebrate Animal	Threatened
Purple Fringed Orchid	*Platanthera psycodes*	Vascular Plant	Endangered
Queen-of-the-prairie	*Filipendula rubra*	Vascular Plant	Endangered
Reflexed Trillium	*Trillium recurvatum*	Vascular Plant	Threatened
Richardson's Rush	*Juncus alpinus*	Vascular Plant	Threatened
Sedge	*Carex bromoides*	Vascular Plant	Threatened
Sedge	*Carex formosa*	Vascular Plant	Endangered
Slender Bog Arrow Grass	*Triglochin palustris*	Vascular Plant	Threatened
Small Sundrops	*Oenothera perennis*	Vascular Plant	Threatened
Small Yellow Sedge	*Carex cryptolepis*	Vascular Plant	Endangered
Snowy Egret	*Egretta thula*	Bird	Endangered
Starhead Topminnow	*Fundulus dispar*	Vertebrate Animal	Threatened
Swollen Sedge	*Carex intumescens*	Vascular Plant	Threatened
Tamarack	*Larix laricina*	Vascular Plant	Threatened
Tubercled Orchid	*Platanthera flava var. herbiola*	Vascular Plant	Endangered
Tuckerman's Sedge	*Carex tuckermanii*	Vascular Plant	Endangered
Water Marigold	*Megalodonta beckii*	Vascular Plant	Endangered
Western Meadowlark	*Sturnella neglecta*	Bird	Threatened
Wilson's Phalarope	*Phalaropus tricolor*	Vertebrate Animal	Endangered
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	Vertebrate Animal	Endangered

Table 3-27: Number of Species that are State-Threatened or Endangered by Subwatershed

SUBWATERSHED	NUMBER OF SPECIES THAT ARE STATE-THREATENED OR ENDANGERED
North Mill Creek/Dutch Gap Canal	12
Mill Creek	17
Newport Drainage Ditch	0
Upper Des Plaines River	14
Bull's Brook	13
Bull Creek	6
Indian Creek	6
Lower Des Plaines River	19
Buffalo Creek	9
Aptakisic Creek	0

3.11 WETLAND INVENTORY

European settlers to the region altered much of the DPR planning area's natural hydrology and wetland processes. They drained wet areas, channelized streams, plowed prairie land, and cleared forests to farm the rich soils. Even after these alterations, the underlying soil retains clues to its prior condition. Hydric soils (soils that remain wet for an extended period) can help identify the locations of pre-settlement wetlands.

Many wetland types exist in the DPR planning area. These wetlands are characterized based on the location in the landscape, soil, vegetation, and hydrology. Marshes, often a mix of emergent vegetation and open water, are probably the most recognizable wetland type in the watershed and form in many different landscapes, including in isolated depressions, along stream corridors and lakes, and in low-lying floodplain areas along the

NOTEWORTHY: LAKE COUNTY WETLAND INVENTORY

The *Lake County Wetland Inventory (LCWI)* was originally developed in 1993 by a multi-agency team using a combination of information sources, including wetland inventory maps and the 1970 Soil Survey of Lake County by the USDA-Soil Conservation Service (SCS), National Wetland Inventory (NWI) maps by the USFWS, and various years of aerial photography. The LCWI was updated in 2002 using high resolution aerial photography and enhanced with Lake County GIS topographic information (elevation contours). The updated 2002 LCWI maps identify five different wetland types: *wetlands, farmed wetlands*, *artificial wetlands*, *converted wetlands*, and *Advance Identification wetlands (ADID)*. The LCWI is intended to improve the understanding and management of the County's wetland resources.

WETLANDS: Areas with a high potential for exhibiting hydric soil, hydrophytic vegetation, and required hydrologic conditions.

FARMED WETLANDS: Agricultural cropped areas on hydric soil that have been cleared, partially drained, or filled.

ARTIFICIAL WETLANDS: Man-made water features typically constructed on non-hydric soil.

Des Plaines River. Wet meadows (areas with saturated soil conditions for much of the year) were once a common wetland type in the watershed but have been reduced since the time of European settlement because of drainage and agriculture. Flatwoods, a forested wetland type that is relatively uncommon in northern Illinois, are found along the Des Plaines River in the southern half of the planning area. Vernal pools (forested wetland pockets that hold standing water during spring and early summer) are in the woodlands along the crests of the moraines that form the perimeter of the watershed. Other wetland types in the DPR planning area of which there are few examples still in existence or which have a more limited geographic distribution include bogs, fens, seeps, and lake fringes.

The first comprehensive effort to inventory and map wetland resources in the DPR planning area was the National Wetlands Inventory (NWI), undertaken by the U.S. Fish and Wildlife Service (USFWS) in the mid-1980s. NWI maps initially were developed by interpreting high-altitude aerial photographs using stereoscope, pen, and ink. Image interpretation for the NWI has evolved to now use geospatial software. In 1990 a countywide wetland mapping effort was undertaken. The Lake County Wetland Inventory (LCWI) was initially published in 1993, comprehensively updated in 2002, and the current version has a publication date of 2009. By way of comparison, the LCWI reflects approximately nearly twice the acreage of wetland resources for Lake County as the NWI and more than twice the acreage for the planning area. For the best indication of historic wetland locations prior to drainage and/or development there is the hydric soil mapping in the Soil Survey of Lake County, initially published by the Natural Resource Conservation Service (NRCS, formerly the Soil Conservation Service) in 1970 and updated in 2005. While the NWI offers a classification of wetland areas based on vegetation and hydrology, in 1992, the U.S. Environmental Protection Agency (USEPA) completed an Advanced Identification (ADID) study of high-function wetlands in Lake County

CONVERTED WETLANDS: Areas that have been drained or filled and no longer exhibit Wetland or Farmed Wetland characteristics

ADID WETLANDS: _High functional wetlands identified by USEPA and others, based on biological, hydrological and water quality functions.

HYDROGEOMORPHIC DESCRIPTORS: Characteristics that emphasize geomorphic and hydrologic attributes such as the landscape position, landform, water flow path, and waterbody type of a wetland or water body rather than biological characteristics.

WATER FLOW PATH: Descriptors that characterize the direction of water flow (inflow, outflow, throughflow, bidirectional flow, etc.)

LANDSCAPE POSITION: The physical setting of a wetland relative to a water body, if present (e.g., a wetland associated with a lake, a river, or a depression surrounded by uplands).

LANDFORM: The large-scale landscape features that affect the physical shape of a wetland or water feature (e.g., basin, flat, slope, island, or fringe).

WATERBODY TYPE: A distinction in the underlying nature of the wetland based on size and shape of the associated water component: Lake, Pond, River, or Stream.

POTENTIALLY RESTORABLE WETLANDS: Areas with predominantly hydric soils that are not mapped as wetlands on the LCWI and have not been converted to urban land use.

WETLAND ENHANCEMENT: Augmenting wetland functions beyond the current conditions; enhancement of one function sometimes can occur at the expense of other functions.

NOTEWORTHY: HIGH FUNCTIONALITY (ADID) WETLANDS

In 1992, Lake County implemented the *Advanced Identification (ADID)* process to identify high functionality wetlands that should be protected. The ADID program is a USEPA program developed to shorten permit processing time and provide information to local governments to aid in zoning, permitting and land acquisition decisions. Three primary functions were used by the USEPA and U.S. Army Corps of Engineers (USACE) to evaluate wetlands during the ADID process: biological functions (i.e., threatened or endangered species, wildlife habitat, and plant species diversity), hydrologic functions (i.e., stormwater storage), and water quality mitigation functions (i.e., sediment and toxicant retention,

Noteworthy: Wetland Restoration and Preservation Plan

The Wetland Restoration and Preservation Plan (WRAPP) was developed by SMC in 2018, with input from a 13-member Technical Advisory Group (TAG). Its dataset reflects enhancements of the 2002 LCWI maps using high resolution aerial photography and LiDAR collected since 2002, as well as existing information from the Lake County ADID study, soil surveys, and other available mapping products. Each WRAPP polygon was enhanced with descriptors associated with the NWI classification system and *hydrogeomorphology*. Using this combined information, the WRAPP estimates the functions (services) of mapped wetland and water resources for both existing and pre-settlement conditions within Lake County. The WRAPP will support watershed-based assessments of wetland function, identify locations of *potentially restorable wetlands (PRWs),* and identify opportunities for *wetland enhancement* and *preservation*. The WRAPP will include an on-line decision support tool (DST) to help users prioritize restoration and preservation opportunities based on acreage, wetland function or functional loss. This will allow the user to make informed decisions on wetland restoration and preservation options targeted to user-specific goals and objectives.

using the LCWI as a base. The ADID study identified about 200 wetland complexes in the county that were predicted to have high ecological, stormwater management, and water quality enhancement functionality.

The Lake County Wetland Restoration and Preservation Plan (WRAPP), which builds on these previous studies, provides the most current iteration of wetland resources and their functionality within the county. According to the WRAPP, approximately 17,000 acres or 40% of the pre-settlement wetlands remain in the watershed. Of this, 430 acres are classified as farmed wetlands. *Approximately* 1,530 acres of constructed wetlands, drainage, and stormwater features also have been created in the watershed, although this is likely an under-estimate resulting from mapping constraints. Figure 3-52depicts the location of wetlands, as documented in the WRAPP.

3.11.1 Wetland Function and Type

Wetlands filter sediments and nutrients from runoff, provide wildlife habitat, reduce flooding, and help maintain water levels in streams. They also provide areas where groundwater is recharged by surface water. By performing these functions, wetlands improve the water quality and biological health of streams and lakes located downstream and protect public safety.

The WRAPP evaluated thirteen wetland functions, which fall under three general groups: hydrologic functions, biodiversity functions, and water quality functions. As indicated in Table 3-28, not all wetlands within the Des Plaines River Watershed perform all functions, and they also do not perform all functions equally well.

Table 3-28: Wetland Functions and Acreages Rating for the Des Plaines River Watershed

CATEGORY	FUNCTION	HIGH	
		#	AC
Hydrologic Functions	Flood Water Storage	4,798	12,830
	Stream Baseflow Maintenance	935	3,000
Biodiversity Functions	Native Fish Habitat	88	1,180
	Waterfowl Habitat	974	4,870
	Other Wetland-dependent Bird Habitat	2,306	7,120
	Woodland Amphibian Habitat	232	550
	Unique Wetland Resources	1,589	5,720
	Stream Shading	1,224	2,550
	Wildlife Movement Corridors	6,147	14,786
Water Quality Functions	Nutrient Transformation (P-focus)	4,281	11,540
	Sediment and Other Particulate Retention	3,170	7,250
	Shoreline/Stream Bank Stabilization	1,894	5,120
	Carbon Sequestration	3,564	11,080

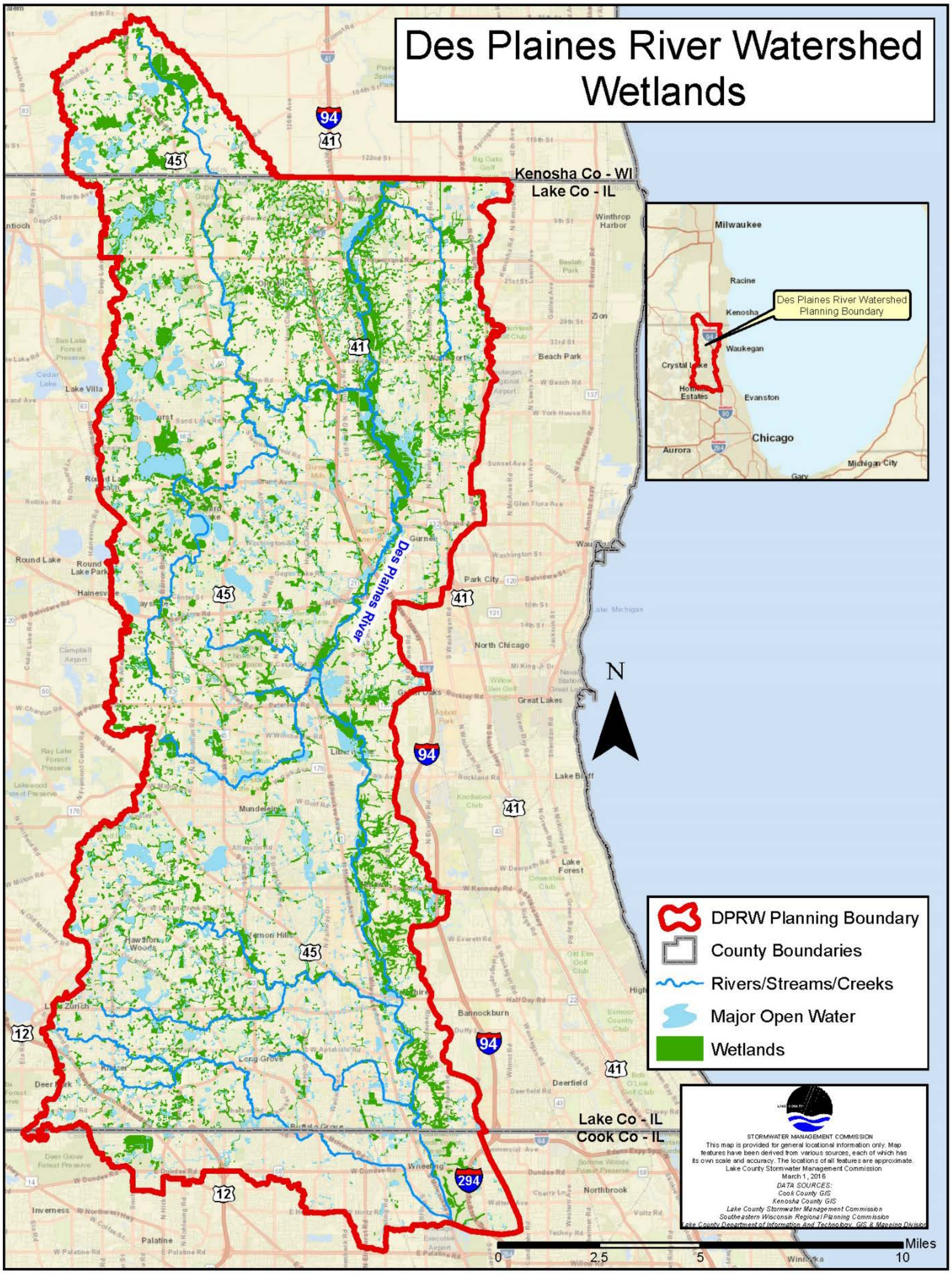


Figure 3-52: DPR Planning Area Wetland Locations

3.11.2 Approaches to and Tools for Wetland Management

Within a watershed, wetlands are managed using multiple approaches and various tools, including planning efforts, regulations, and voluntary activities. Advanced planning efforts can help identify wetland needs and potential locations. Countywide planning efforts include the WRAPP, the LCWI, and the ADID wetland studies previously described. Other efforts target specific areas of the county (e.g., select creeks in Fox River Watershed and the North Branch Chicago River watersheds, per Hey 2001a). Specific to the DPR planning area, is the *Des Plaines River Wetland Restoration Study*, which was developed by SMC with grant assistance from the USEPA to "advance the concept that wetland restoration can play an important role in helping to reduce flood flow volumes and rates" (Hey and Associates 2001). The study focused in identifying potential ***wetland restoration*** sites in the Upper Des Plaines watershed having more than 16 acres of drained hydric soil within open space on the Lake County's GIS.

Wetland Restoration: The re-establishment of wetlands in areas where they previously existed and were altered by drainage activities or landscape modifications.

Mitigation Banking: A system of credits and debits to offset environmental impacts associated with site development and achieve no net loss, typically accomplished via restoration, creation, enhancement, or preservation of similar wetland, stream, or natural habitats near the area of impact with the specific goal of compensating for unavoidable impacts to aquatic resources.

Wetland Preservation: Actions taken to maintain the size and functions of an existing wetland or water body.

Regulation of wetland impacts by agencies and municipalities is arguably the most visible approach for wetland management. This typically involves permits and may require mitigation which can occur at the national (USACE), state, county, and local (municipal) level. At the county level, Lake and Cook county regulate wetlands through the WDO and WMO, respectively. In Lake County, the WDO establishes a no-net-loss policy for wetland impact, with a goal of net gain in function. The WDO sets the minimum requirements for the county, including the need for a permit to approve wetland impacts and requirement for mitigation if impacts will exceed the minimum threshold. Wetland impacts within Lake County are to be mitigated within the county on a watershed basis. Wetland mitigation can take the form of mitigation banking, or a site-specific mitigation project involving wetland restoration, enhancement or, in rare cases, preservation. In Cook County, the WMO discourages wetland impacts, but allows for wetland mitigation in some cases. The WMO states the preferred wetland mitigation method is payment to mitigation banks. At the state level, the WI DNR regulates wetland Impacts in Kenosha County through a variety of state statues. For the most up to date information on WI DNR regulatory authority, visit the WI DNR's website.

Voluntary wetland restoration and management efforts are performed not as a required activity adjunct to a regulatory action but in response to a desire to restore or manage a target wetland for a specific purpose (e.g., duck habitat, flood water storage, etc.). Typical approaches include wetland preservation and wetland restoration or enhancement through on-the-ground activities that may include, but are not limited to, tile disablement, selective herbicide application, prescribe d burning, on-line flow restriction, and water level control.

NOTEWORTHY: WETLANDS PROTECTION IN LAKE COUNTY

Wetlands protection is provided under existing regulatory programs, including federal and state floodplain development restrictions, the USACE's Section 404 Clean Water Act wetland permit program, and the WDO.

A permit/approval is required for any development that will impact wetlands in Lake County. The USACE Chicago District issues permits for impacts to federal *Waters of the U.S.* (WOUS), while Lake County issues written approvals for impacts to *Isolated Waters of Lake County* (IWLC). The USACE-Chicago District normally issues regional permits for impacts to less than 1.0 acre of non-high quality WOUS and compensatory mitigation typically is required at a minimum 1.5:1 replacement ratio for impacts over 0.1 acre to these wetlands. An individual permit from the USACE usually is required for proposed impacts to federal ADID sites, as ADID sites are generally considered unsuitable for filling activities. The individual permit process requires permit applicants to identify and assess practicable alternatives for avoiding and minimizing impacts to the federal ADID sites. In cases where an IP is issued for impacts to federal ADID sites, the USACE usually requires mitigation at a 3:1 or higher ratio.

Lake County issues written approvals for IWLC impacts as part of the Watershed Development Permit process, in accordance with the WDO regulations. Compensatory mitigation is required at a 1.5:1 ratio for impacts to 0.1 acre or more of non-high quality IWLC and 3:1 or higher for impacts to high quality IWLC. The USACE-Chicago District's regulatory program and the WDO also require buffers of native vegetation around preserved wetlands to provide a natural transition between wetlands and developed upland areas and help treat stormwater runoff by filtering sediments and pollutants before the runoff reaches the wetlands. Required buffer widths vary depending on the size, type (linear vs. water body), and quality of the wetlands. For *High Quality Aquatic Resources* (HQAR), which include ADID sites, a 100-foot-wide buffer is required under both the USACE-Chicago District's regulatory program and the WDO. A 30- to 50-foot-wide buffer typically is required around all other wetland areas, depending on wetland size and type.

3.12 STREAM INVENTORY

3.12.1 INTRODUCTION AND METHODS

The SMC conducted stream inventories for each of the subwatersheds and the main stem of the Des Plaines River in the DPR planning area (Table 3-29). These assessments recorded qualitative information on several easily observed and measured parameters that provide information on the "baseline" conditions of the stream channel and riparian area. The results provide a framework for prioritizing and implementing watershed management strategies in the watershed-based plan.

The stream assessment includes the geomorphic characterization of the channel; identifying erosion, evaluating discharge points and hydraulic structures, obstructions, areas of deficient buffer zones, and areas with significant detrimental impact on the stream. Visual observations include vegetation, water quality conditions, habitat assessments, and aquatic and terrestrial life. This allows for a more comprehensive assessment of the stream conditions. Also, information captured during the inventory process includes notes and comments about the stream not represented in the other forms, such as specific restrictions to stream, restoration efforts or conversations with residents. A copy of the Stream Inventory Methodology and Inventory Report Form is in Appendix C.

The DPR planning area stream network is divided within each subwatershed into reaches; smaller geographically-defined stream segments, for which data is aggregated and evaluated. A team of two observers wade the entire length of each reach to collect data. At representative points within each reach, the observers measure the channel dimensions and relative velocity at the surface of the stream. The observers photograph and document all areas of moderate to severe ***erosion***, significant ***sediment deposition***, debris jams, ***hydraulic structures,*** and ***discharge points***. Equipment to collect photographs utilizes a ***GPS*** which provides geographic coordinates that translate point locations into GIS for analysis and mapping of data collected in the field. For determining bank erosion (lateral recession) additional measurements obtained include bank height, lateral recession rate, severity, and lateral recession characteristics. The stream inventory only assesses reaches which can be safely waded and have a ***"defined" channel***. Reaches excluded from assessments are: open-water ponds, lakes, impoundments, wetland complexes (without defined channel), roadside swales, small minor tributaries, or areas with restricted access or that create a hazard for the observer(s): depth of water, unstable substrate, or both.

EROSION: The process by which the surface of the earth is worn away by the action of water, glaciers, winds, waves

SEDIMENT DEPOSITION: The geological process in which sediments, soil and rocks are added to a landform or land mass.

HYDRAULIC STRUCTURES: Bridges, culverts, dams, weirs, or other structures spanning or crossing the stream channel.

DISCHARGE POINTS: The location where all sanitary, storm sewer and agricultural drainpipes surface or stormwater flows back into a lake or stream channel. Discharge points also include open channels, swales, gullies and other significant tributaries.

GLOBAL POSITIONING SYSTEM (GPS): A system of earth-orbiting satellites, transmitting signals continuously towards the earth that enables the position of a receiving device on or near the earth's surface to be accurately estimated from the difference in arrival times of the signals.

DEFINED CHANNEL: Clearly discernable bed and banks of a flowing watercourse

The following types of data were collect during the inventory and summarized in the following section:

- Channel conditions (dimensions of the banks and bed)
- Channelization
- Pool-Riffle Development
- Bank Erosion
- Sediment Accumulation and Debris Loading
- Hydraulic Structures (bridges, culverts, dams, etc.)
- Discharge Points (storm sewers, pipes and overland flow draining to the stream)
- Riparian Corridor (vegetated buffer along the stream)

The following characteristics of the DPR planning area stream reaches are summarized by subwatershed and reach and are available in Appendix C:

1. In-stream and Over-bank debris loads
2. Substrate Composition
3. Channelization and Sinuosity
4. Bank Erosion
5. Channel Dimensions

3.12.2 Stream Network Description/Stream Reaches

The DPR planning area stream inventory is comprised of nine subwatersheds and the main stem of the Des Plaines River (Figure 3-1). For the purposes of the inventory, the Bull Creek and Bull's Brook subwatersheds are combined and the Des Plaines River mainstem is identified separately because the inventory methodology was altered to facilitate the use of canoes. The DPR planning area stream network has 269.7 miles of flow path through streams, wetlands, and lakes. The stream inventories assessed 229.2 miles of stream channel as shown in Table 3-29 and Figure 3-53, and detailed information on the stream reaches in Appendix C. Each of the subwatersheds in the DPR planning areaare described below:

1. **North Mill Creek/Dutch Gap Canal Subwatershed:** The North Mill Creek/Dutch Gap Canal subwatershed encompasses 22.55 square miles (14,432 acres) of northern Lake County, Illinois and 13.61 square miles (8,713 acres) of southern Kenosha County, Wisconsin. The North Mill Creek/Dutch Gap subwatershed includes tributary drainage from Deer Lake Drain in the northwest and Hastings Creek from the west to the North Mill Creek, the main stem, which drains southeast and converges with the main stem of Mill Creek.
2. **Mill Creek Subwatershed:** The Mill Creek subwatershed encompasses 30.9 square miles (19,783 acres) of north central Lake County, Illinois. The Mill Creek subwatershed includes tributary drainage from the Avon-Freemont Drainage Ditch which flows north and Lambs Corner Creek which flows northwest both joining the Mill Creek. The Mill Creek flows east from the mouth of the North Mill Creek into the Des Plaines River.
3. **Newport Drainage Ditch Subwatershed:** Newport Drainage Ditch **sub**watershed encompasses 7.84 square miles (5,018 acres) of north east Lake County, Illinois. The Newport Drainage Ditch flows north/northwest to the Des Plaines River.
4. **Upper Des Plaines River Subwatershed:** The Upper Des Plaines River subwatershed encompasses 50.9 square miles (32,549 acres) of north central and north east Lake County, Illinois. The Des Plaines River

flows south from Wisconsin into this subwatershed to Route 176 in Libertyville and includes drainage from many smaller tributaries.

5. **Bull Creek/Bull's Brook Subwatershed:** The Bull Creek and Bull's Brook subwatersheds encompass 13.9 square miles (8,952 acres) in central Lake County, Illinois. Two branches of Bull Creek join north of Route 137 in Libertyville and flow east to the Des Plaines River. Bull's Brook flows east from Prairie Crossing to the Des Plaines River in Libertyville Township.
6. **Indian Creek Subwatershed:** The Indian Creek subwatershed encompasses 37.7 square miles (24,151 acres) of south central Lake County, Illinois. Seavey Ditch, Kildeer Creek (South Branch Indian Creek) and several other tributaries join Indian Creek, which enters the Des Plaines River just south of Route 22 in Lincolnshire.
7. **Lower Des Plaines River Subwatershed:** The Lower Des Plaines River subwatershed encompasses 22.8 square miles (14,607 acres) of south-central and south-east Lake County and 4.7 square miles (2,975 acres) of northern Cook County. The Des Plaines River flows from Route 176 in Libertyville south through this subwatershed to the confluence with Buffalo Creek at the southern end of the planning area.
8. **Buffalo Creek Subwatershed:** The Buffalo Creek subwatershed encompasses 27.2 square miles (17,392 acres) of south central Lake County and 12.5 square miles (8,023 acres) of northern Cook County. Two tributaries feed Buffalo Creek, which flows southeast from the Buffalo Creek Reservoir, into the Wheeling Drainage Ditch, and ultimately to the Des Plaines River in Wheeling.
9. **Aptakisic Creek Subwatershed:** The Aptakisic Creek subwatershed encompasses 6.83 square miles (4,374 acres) of south central Lake County and 0.7 square miles (421 acres) of northern Cook County. Two channelized streams join to form the main branch of Aptakisic Creek, which flows east through Buffalo Grove and Vernon Township to the Des Plaines River.
10. **Des Plains River Main Stem**: The Des Plaines River main stem flows south from Kenosha County in Wisconsin through Lake County, Illinois and into Cook County, Illinois. Within the DPR planning area, the Des Plaines main stem flows south through the Upper and Lower Des Plaines River subwatersheds.

Table 3-29: Stream Inventory Miles in the DPR Planning Area

SUBWATERSHED	12-DIGIT HUC(s)	NUMBER OF REACHES	ASSESSED MILES	YEAR ASSESSED
NORTH MILL CREEK	071200040201	34	23.8	2007
MILL CREEK	071200040202	28	11.5	2013
NEWPORT DRAINAGE DITCH	071200040301 *071200040104*	26	9.5	2015
UPPER DES PLAINES	071200040302 071200040301	70	45.1	2016
BULL CREEK - BULLS BROOK	071200040302 071200040302	35	16.0	2015
INDIAN CREEK	071200040501	53	37.3	2015
LOWER DES PLAINES	071200040503	25	11.1	2016
BUFFALO CREEK	071200040502	59	23.2	2013
APTAKISIC CREEK	071200040503	30	14.6	2015
DES PLAINES RIVER-MAIN STEM	071200040302 071200040301 071200040503	19	37.0	2016
WATERSHED TOTAL		**379**	**229.1**	

Figure 3-53: DPR Planning Area Stream Inventory Reaches

3.12.2.1Channel Conditions

Measurements of the physical dimensions of the stream channel reflect the shape of the channel and the amount of water that it can transport under **low or high flow conditions**. A summary of channel conditions by subwatershed is shown in Table 3-30. The channels in the DPR planning area have narrow, shallow headwater streams that gradually drain into wider, deeper main stem streams, a common feature in stream hydrology.

LOW OR HIGH FLOW CONDITIONS: Typically measured as a 7-day average of the lowest or highest water flow rates annually.

Table 3-30: Channel Conditions in the DPR Planning Area

SUBWATERSHED	BANK HEIGHT (FT.)		CHANNEL WIDTH TOP (FT.)		CHANNEL WIDTH BOTTOM (FT.)	
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
Dutch Gap/ North Mill Creek	1.5	3.8	12.4	20.0	7.5	13.4
Mill Creek	2.1	5.5	25.0	43.5	14.2	21.7
Newport Drainage Ditch	1.2	2.8	8.8	54.7	4.0	10.6
Upper Des Plaines River	1.1	3.7	8.7	15.2	5.0	9.4
Bull Creek-Bull's Brook	1.0	4.7	7.7	85.3	3.9	21.8
Indian Creek	1.6	6.6	15.5	38.3	9.5	27.2
Lower Des Plaines River	1.3	3.9	7.4	13.4	3.4	7.2
Buffalo Creek	1.2	3.7	21.7	42.9	9.9	18.4
Aptakisic Creek	1.3	5.5	11.3	35.8	7.0	27.0
Des Plaines Mainstem	1.9	5.5	78.1	197.1	53.1	118.3

3.12.2.2Channelization

Stream channelization describes any activity that moves straightens, shortens, cuts off, diverts, or fills in a stream channel (Figure 3-54). These activities, which include widening, narrowing, or lining a stream channel, alter the discharge and increase the velocity of water flowing through the streams. In natural meandering streams, channelization decreases the length of the stream and increases the gradient of the channel. Because it is the nature of concentrated, flowing water to create meandering channels with overbank floodplains that dissipate the energy of the flowing water, channelized streams may be susceptible to bank instability and erosion. Modifications in one area of the watershed or stream channel affect other areas upstream, downstream or within the immediate area. Table 3-31 and Figure 3-55 illustrate the degree of channelization of assessed reaches in each subwatershed within the DPR planning area.

Figure 3-54: Channelization in the Newport Drainage Ditch

The degree of channelization is ranked based on the percentage of channelization. Reaches with channelization of 1%-33% ranks “low”, 33%-66% ranks “moderate”, and >66% of a reach channelized ranks “high”. Reaches ranked as “None” have no indication of channelization.

Table 3-31: Degree of Channelization in the DPR planning area

SUBWATERSHED	DEGREE (# OF REACHES)				
	NONE	LOW	MODERATE	HIGH	TOTAL
North Mill Creek	5	10	9	10	**34**
Mill Creek	8	2	6	12	**28**
Newport Drainage Ditch	19	1	4	2	**26**
Upper Des Plaines River	12	29	22	7	**70**
Bull Creek-Bull’s Brook	10	20	3	2	**35**
Indian Creek	14	33	4	2	**53**
Lower Des Plaines River	7	16	2	0	**25**
Buffalo Creek	9	25	16	9	**59**
Aptakisic Creek	6	9	8	7	**30**
Des Plaines Mainstem	1	17	1	0	**19**
TOTAL	**91.0**	**162.0**	**75.0**	**51.0**	**379**

The majority (67%) of stream reaches assessed in the DPR planning area had "none" or a "low" degree of channelization, 20% were moderately channelized and 13% were highly channelized. The North Mill and Mill Creek subwatersheds stream reaches exhibited the highest percentages of channelization with 35% of their stream reaches ranked highly channelized. The subwatersheds with moderate to high degree of channelization have constructed ditches and channelized streams surrounded by turf grass and/or agricultural crops with very little buffer. As a result, these moderate to high channelized streams have reduced ***instream habitat*** and streambank stability.

INSTREAM HABITAT: Within a stream, the environment in which an animal or plant normally lives or grows

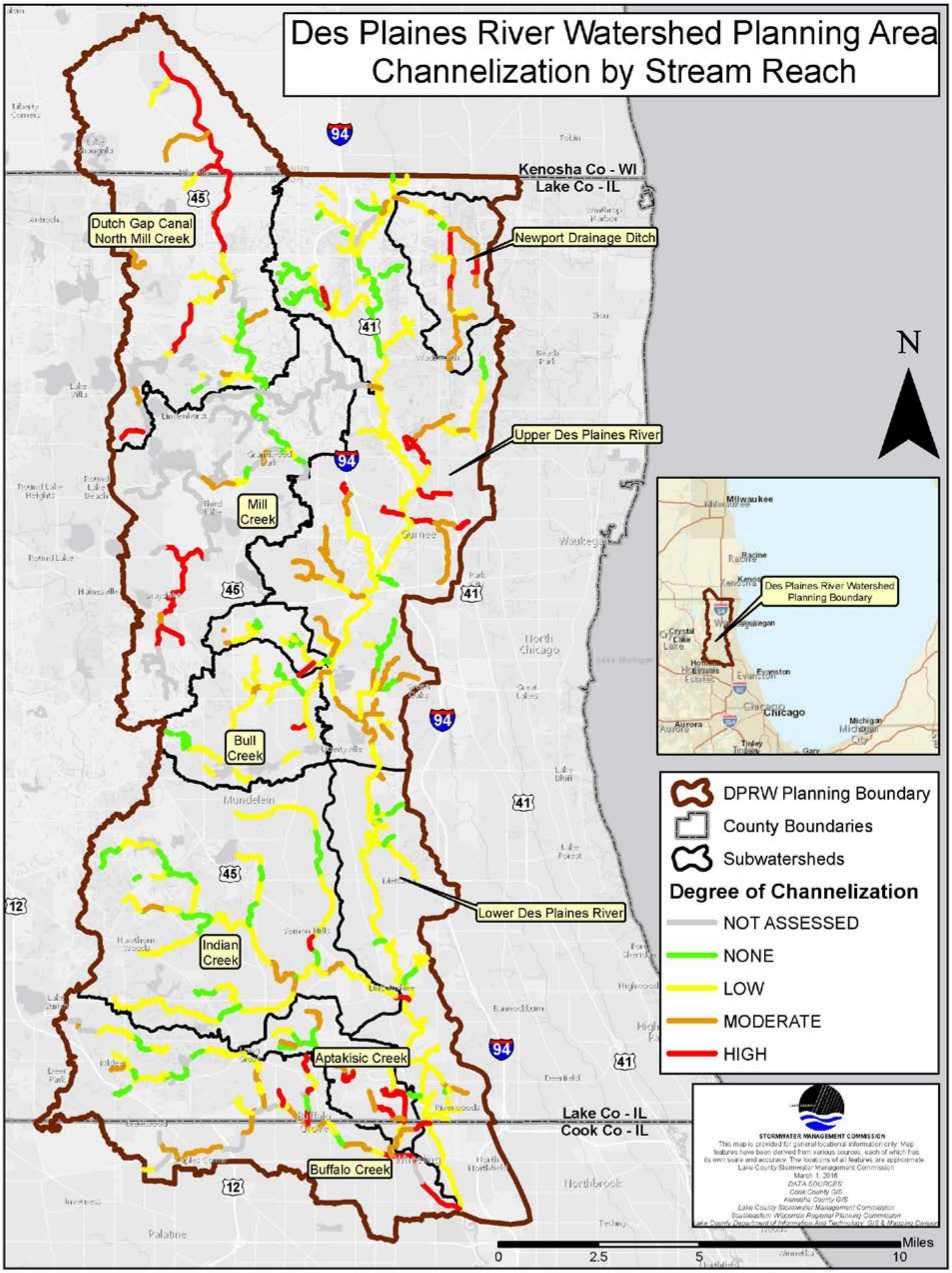


Figure 3-55: DPR Planning Area Channelization by Stream Reach

3.12.2.3Pool-Riffle Development

Under baseflow conditions, pools are low-gradient areas of deeper water with slower velocity and riffles are high-gradient areas of shallow water with higher velocity. During baseflow conditions, sediment erodes from riffles and is deposited into pools. During bankfull conditions, the relationship of relative velocity in riffles and pools is reversed and sediments along with substrate material are scoured from pools and the channel bed and deposited on riffles or bars. During periods of elevated flow when the velocity in pools exceeds that over riffles, deposition and bar formation tend to occur in areas adjacent to pools (Figure 3-56).

THALWEG: the line of lowest elevation within a valley or watercourse.

In a single-**thalweg** meandering channel, pools are typically associated with the outer portions of meander bends while riffles are typically located above or below pools. Bars typically form alongside pools or runs. Because pools and riffles exhibit very different physical conditions and are often adjacent to one another in the channel, they are important to the ecological health of the stream channel. Because of their typically shallow depth, increased gradient and large sediment size, riffles cause turbulence throughout the water column which aerates the stream, causing oxygen to dissolve from the air into the water. Pools have slower velocities and increased depth, offering habitat to a wide range of aquatic species for a variety of uses. Channelization often reduces the extent of pool-riffle sequences in a stream. Most stream channels in the watershed exhibit some degree of pool-riffle development as shown in Table 3-32.

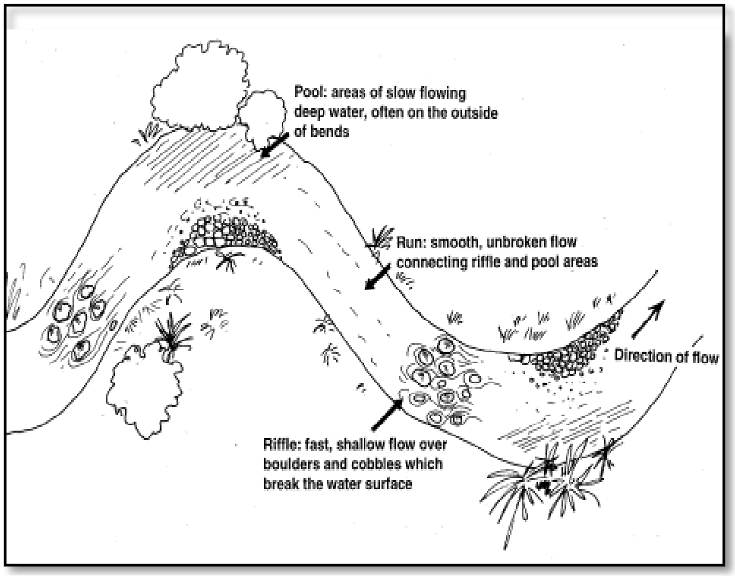


Figure 3-56: Pool/Riffle Sequence

Source: National Institute of Water and Atmospheric Research

A majority (62%) of stream reaches in the DPR planning area exhibited “none” or “low” pool/riffle development. The main stem of the Des Plaines River and the Buffalo Creek subwatersheds both contain substantial portions of natural stream channel and have more pool-riffle development than the constructed and channelized areas. The direct correlation between highly channelized streams and low pool/riffle development is evident in the North Mill and Mill Creek subwatersheds where 60% of stream reaches exhibited high channelization and 40% exhibited none to low (40%) pool/riffle development.

Table 3-32: Percent of Stream Reaches with Pool/Riffle Development in the DPR planning area

	NONE (<5%)	LOW (5-33%)	MODERATE (34-66%)	HIGH
Aptakisic Creek	33%	27%	20%	20%
Buffalo Creek	41%	42%	8%	8%
Bull Creek-Bull's Brook	23%	51%	20%	6%
Des Plaines River-Main Stem	0%	47%	53%	0%
Indian Creek	13%	57%	19%	11%
Lower Des Plaines	24%	24%	48%	4%
Mill Creek	57%	25%	14%	4%
Newport Drainage Ditch	54%	23%	15%	8%
North Mill Creek	13%	61%	27%	0%
Upper Des Plaines	11%	16%	56%	17%
WATERSHED TOTAL	**25%**	**37%**	**28%**	**9%**

3.12.2.4Streambank Erosion

The Rapid Assessment Point Method (RAP-M) assesses lateral recession and provides the degree of streambank erosion in the Des Plaines River watershed (Windhorn, 2000). Lateral recession rates (LRR) evaluates streambanks along the right and left bank (facing upstream) for each assessed reach. Segments with LRR characteristics were photo documented and measurements of left and right bank height and length were collected. The combined analysis allows for an overall assessment regarding the severity of the entire reach, including review of photographs, and repeatable measurements taken in the field. The methodology for lateral recession can be found in Appendix C (Windhorn, 2000).

Figure 3-57: Streambank Erosion in North Mill Creek Subwatershed

Streams are dynamic systems, in a perpetual state of flux, therefore, all banks exhibit some form of erosion (Figure 3-57). Streambank erosion in the DPR planning area tends to occur in developed areas, particularly residential neighborhoods, and urban areas. Surface runoff to streams contributes to streambank erosion and is dependent upon key factors such as the duration, timing, and amount of precipitation; the type and condition of soil within watershed; and land use and vegetative buffers.

The DPR planning area stream inventory assessed the degree of streambank erosion for each stream reach. The description of qualitative assessment criterion for streambank erosion is shown in Table 3-33 and the results of the streambank erosion assessment are summarized below in Table 3-34.

Table 3-33: Bank Erosion Criteria in the DPR planning area

CATEGORY	DESCRIPTION
Slight	Some bare bank but active erosion not apparent. Some rills but no vegetative overhang. No exposed tree roots.
Moderate	Bank is predominantly bare, with some rills and vegetative overhang.
Severe	Bank is bare, with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross-section becomes more U-shaped as opposed to V-shaped.

Table 3-34: Percent of Stream Reaches with Streambank Erosion in the DPR planning area

EXTENT OF EROSION	NONE (% OF MILES ASSESSED)	SLIGHT (% OF MILES ASSESSED)	MODERATE (% OF MILES ASSESSED)	SEVERE (% OF MILES ASSESSED)
Aptakisic Creek	60%	0%	37%	3%
Buffalo Creek	12%	2%	68%	19%
Bull Creek-Bull's Brook	38%	0%	53%	9%
Des Plaines River-Main Stem	0%	0%	84%	16%
Indian Creek	40%	0%	58%	2%
Lower Des Plaines	0%	0%	100%	0%
Mill Creek	4%	7%	43%	46%
Newport Drainage Ditch	77%	0%	23%	0%
North Mill Creek	3%	29%	59%	9%
Upper Des Plaines	14%	0%	81%	4%
PERCENT OF WATERSHED	**24%**	**3%**	**62%**	**10%**

The results of the stream inventory indicate most stream reaches (62%) were moderately eroded, and 10% of stream reaches were severely eroded. The Lower Des Plaines had moderate erosion in 100% of the stream reaches assessed. In some reaches, streambank erosion was severe suggesting that the stream channels were responding to changes in watershed hydrology. While some stream reaches exhibited severe cases of localized bank erosion, no reach exhibited high erosion over its entire length. Some stream reaches assessed and exhibiting "slight" bank erosion had substantial portions of the flow path through wetland complexes.

3.12.2.5Sediment Accumulation

Sediment erosion, transport and deposition are naturally occurring processes in stream systems. Land use changes and anthropogenic modifications within the watershed can amplify the magnitude of these processes.

Typically, a stream generates, suspends, and transports sediment through high-gradient reaches and deposits sediment in low gradient reaches and/or in areas where velocity decreases (Figure 3-58). These low-velocity areas may be naturally occurring areas such as pools or sloughs. They may also occur behind debris jams or beaver dams or upstream of channel constrictions (such as culverts) or dams. Fluctuations in discharge rate results in a stepwise movement of deposition and storage of sediment within stream network. Increased sediment transported during storm events will increase sedimentation rates in downstream channels. Excessive sediment deposition affects fish and the benthic community in several ways including: the suspended sediment can interfere with food gathering or filtering organisms; decrease light levels which impact productivity and reproduction; and sediment accumulation on the bottom of channels can bury organisms to the point of starvation or death. Once sediment has entered waterways it is difficult and expensive to remove, requiring engineering solutions and heavy equipment. Preventative measures such as the revegetation of riparian areas and stream banks can help reduce sediment transport and bank erosion.

Figure 3-58: Sediment Accumulation in North Mill Creek

Most reaches in the DPR planning area had “Low” or “Moderate” sediment accumulation (Table 3-35). Of the assessed reaches for the main stem of the Des Plaines River, 84% exhibited moderate sediment accumulation. Also, a considerable number of reaches (68%) in the North Mill Creek reaches exhibited moderate sediment accumulation. North Mill Creek has moderate or high debris loading (Table 3-36) and a considerable number of problem hydraulic structures (Table 3-37) which can contribute to sediment accumulation. The sediment accumulation is likely due to local and upstream increases in runoff and/or erosion, especially in areas with highly erodible soils, such as those on agricultural lands. Conversely, Aptakisic Creek did not have any reaches exhibiting moderate or high degrees of sediment accumulation. The lack of sediment accumulation and the slight-to-moderate (60%) bank erosion in Aptakisic Creek are likely related.

Table 3-35: Percent of Sediment Accumulation in the DPR planning area

SUBWATERSHEDS	SLIGHT (% OF REACHES)	LOW (% OF REACHES)	MODERATE (% OF REACHES)	HIGH (% OF REACHES)
Aptakisic Creek	43%	57%	0%	0%
Buffalo Creek	15%	32%	31%	22%
Bull Creek-Bull's Brook	23%	66%	9%	3%
Des Plaines River-Main Stem	0%	16%	84%	0%
Indian Creek	15%	60%	23%	2%
Lower Des Plaines	0%	29%	71%	0%
Mill Creek	7%	32%	39%	21%
Newport Drainage Ditch	38%	42%	15%	4%
North Mill Creek	2%	18%	68%	12%
Upper Des Plaines	13%	36%	46%	4%
PERCENT OF WATERSHED	**16%**	**40%**	**36%**	**8%**

Slight: < 5%, Low: 5-33%, Moderate: 34-66%, High: 67-100%

3.12.2.6 Debris Loading

In addition to sediment, most streams transport some amount of debris (organic material typically originating outside the stream itself, such as tree limbs, brush, and leaves). Because debris transport is a naturally-occurring stream process, some debris can provide habitat and contribute to a diverse instream environment. However, too much debris can be problematic and may result in large debris jams, causing backwater flooding and sediment deposition (Figure 3-59). Debris jams can also cause erosion of the stream banks which can damage riparian lands and property.

Figure 3-59: Debris Jam in Mill Creek

In the DPR planning area, reaches having a moderate or high debris load are considered to have the potential to be problematic. In some cases, these reaches may be in natural or open space areas and no action is needed or warranted. In other cases, moderate or high debris loads may be problematic, and, for example, debris jams may warrant removal. Table 3-36 summarizes the reaches with moderate or high instream and/or overbank debris loads. These reaches exhibit multiple debris jams, beaver dams, or overhanging debris obstructions extending across all or significant portions of the channel and/or onto the banks. In DPR planning area, 129 reaches (34.3% of reaches assessed) exhibited moderate to high debris loads. While beaver activity contributed to the debris load in some of these reaches, it did not account for the moderate or high debris loads in all reaches. Several reaches are also located in forested areas and therefore the debris loads from the adjacent riparian areas may be higher. Conversely, reaches located in open space areas may not have debris loading that affects the water levels. In such cases, it is up to the land manager or owner to determine if the debris loading constitutes a true "problem."

Table 3-36: Percent of Debris Loading in the DPR planning area

SUBWATERSHEDS	INSTREAM DEBRIS	OVERBANK DEBRIS
Aptakisic creek	7%	7%
Buffalo Creek	53%	44%
Bull Creek-Bull's Brook	42%	40%
Des Plaines River-Main Stem	37%	47%
Indian Creek	40%	35%
Lower Des Plaines	8%	12%
Mill Creek	54%	57%
Newport Drainage Ditch	15%	8%
North Mill Creek	50%	27%
Upper Des Plaines	23%	33%
WATERSHED TOTAL	**35%**	**33%**

3.12.2.7Hydraulic Structures

Hydraulic structures are bridges, culverts, dams, weirs, or other structures spanning or crossing the stream channel Figure 3-60 and Figure 3-61). These structures modify or have the potential to modify the pattern or amount of flow in the stream channel and may act as constriction points under certain flow conditions (such as heavy rainfall events), leading to backwater flooding. Additionally, dams and weirs can impede the movement of fish and other aquatic organisms within the stream network. Culverts may create temporary or permanent barriers if scour causes the bottom of the culvert to become elevated above the water level of the stream. Problem hydraulic structures include: obstructed culverts and bridges, culverts that are undermined or collapsed, bridges, culverts, dams and weirs that have been washed out, and beaver dams that are causing severe bank erosion or impounding a significant volume of water or length of stream channel. Structures listed as "problem" structures were identified as needing further inspection; however, this designation is not a definitive determination that the structure is defective.

Figure 3-60: Beaver Dam in the Mill Creek Subwatershed

Figure 3-61: Culvert in Buffalo Creek Subwatershed

Many areas of the DPR planning area were modified by channelization and the construction of hydraulic structures. These changes result in a decreased quantity of pool-riffle complexes, increased sediment accumulation, increased debris loads, habitat alteration and decreased biological productivity. Bridges were present in all nine subwatersheds. The number of bridges per subwatershed ranged from 16 – 87 and the number of culverts per subwatershed ranged from 0 – 95. Higher concentrations of bridges and culverts may be related to urbanization and development of areas in a subwatershed. Constructed ditches and the main stem of the Des Plaines River did not have dams constructed on them; however, the North Mill Creek subwatershed had 27 dams, the highest number of dams in the DPR planning area. Table 3-37**Error! Reference source not found.** contains a summary of hydraulic structures in the DPR planning area. Note: Dams located on reaches not assessed were not included in the stream inventory.

"Problem Hydraulic Structures," defined as structures that may require further inspection or repair, are found in every subwatershed of the DPR planning area. The North Mill Creek had the most problem structures. Conversely, the Lower Des Plaines, Aptakisic Creek and main stem had the lowest number of problem hydraulic structures. Appendix C contains the complete summary of the 1,124 hydraulic structures recorded in the Des Plaines River Stream Inventory. Figure 3-62 maps the problem hydraulic structures identified in the Des Plaines River Stream Inventory.

Table 3-37: Problem Hydraulic Structures in the DPR planning area

PROBLEM HYDRAULIC STRUCTURES	BRIDGE	CULVERT	DAM	OTHER	TOTAL STRUCTURES	PROBLEM STRUCTURES	% OF STRUCTURES IDENTIFIED AS PROBLEM STRUCTURES
APTAKISIC CREEK	29	66	1	3	99	4	4%
BUFFALO CREEK	26	40	8	67	141	10	7%
BULL CREEK -BULL'S BROOK	34	64	5	6	109	18	16%
DES PLAINES RIVER-MAIN STEM	37	0	5	6	48	2	4%
INDIAN CREEK	87	95	7	19	208	29	14%
LOWER DES PLAINES	30	6	0	43	79	4	5%
MILL CREEK	16	25	11	0	52	12	23%
NEWPORT DRAINAGE DITCH	31	40	0	0	71	7	10%
NORTH MILL CREEK	29	44	27	19	119	44	37%
UPPER DES PLAINES	71	35	0	92	198	24	12%
WATERSHED TOTAL	**390**	**415**	**64**	**255**	**1,124**	**154**	**12%**

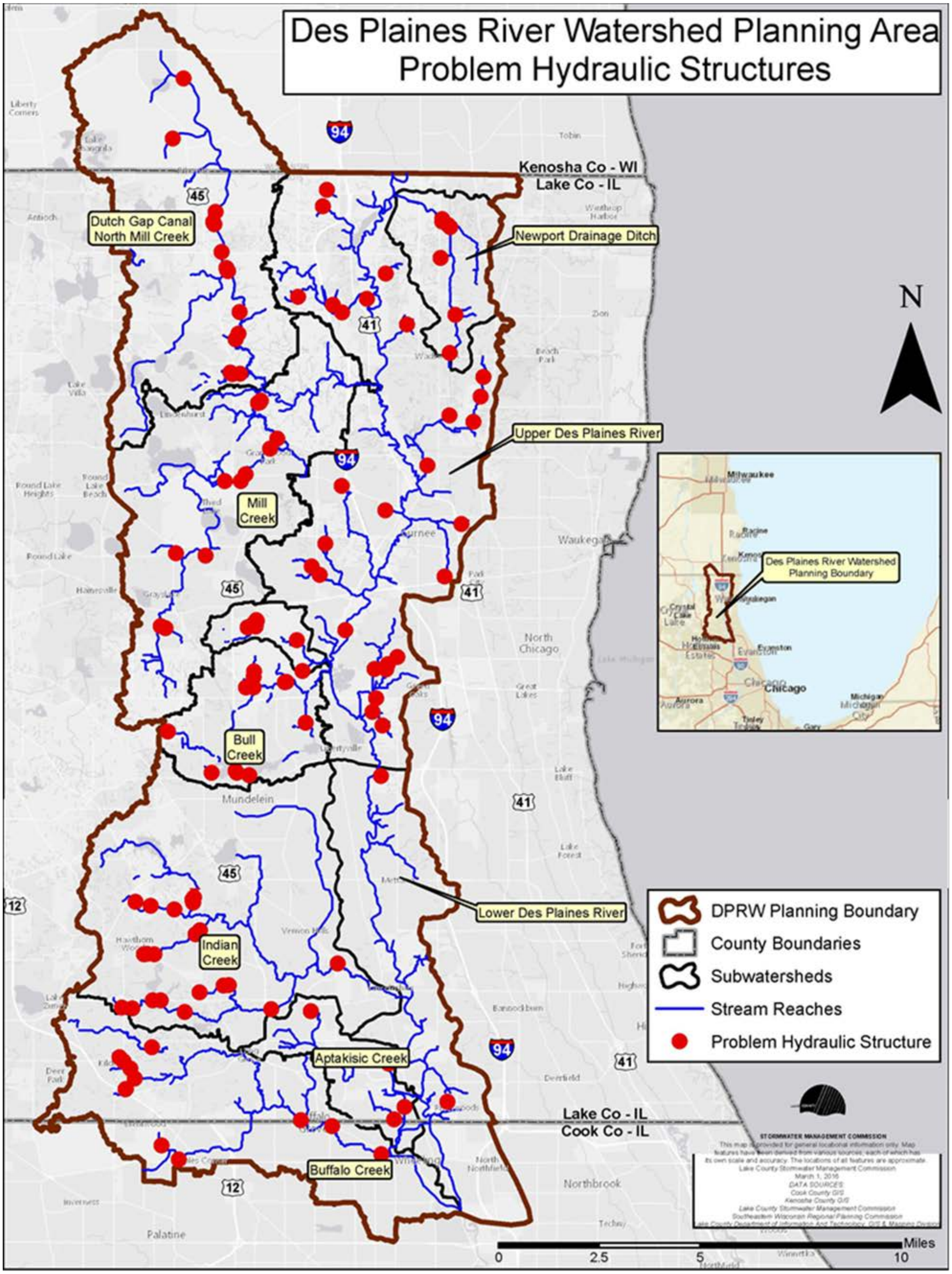


Figure 3-62: DPR Planning Area Problem Hydraulic Structures

3.12.2.8Discharge Points

Discharge points are identified as outfalls that discharge into streams including "pipes" such as drain tile outlets, sump pump discharges, storm sewers and "open channel" discharges such as drainage swales, gullies, and small tributaries (Figure 3-63). The stream inventory documented 2,310 discharge points into the stream network. Discharge points were most common in urban and residential areas where sump pump and stormsewer outfalls are numerous. Indian Creek watershed contained the largest number of discharge points, but the Buffalo Creek watershed had the highest density of discharge points per stream mile where a substantial portion of the watershed is suburban and residential development.

Figure 3-63: Example of a discharge point

Problem discharge points in the DPR planning area contribute to streambank erosion and the transport of excess sediment and associated nutrients to the stream channel. The location of these points is summarized in Table 3-38 and shown in Figure 3-64. Pipes commonly cause erosion below the end of the pipe, resulting in a positive feedback loop of bank erosion near the pipe, which may result in pipe, end section, apron, or supporting structure failure. Gullies and other open channels can also result in bank erosion, as they deliver concentrated flow to the stream channel. Pipes that appeared to have discolored discharge, substances other than water, or substantial damage were noted in the inventory.

Table 3-38: Problem Discharge Points in the DPR Planning Area

DISCHARGE POINTS	SWALES, GULLIES, & TRIBUTARIES	PIPES, STORM SEWERS, & CULVERTS	TOTAL DISCHARGE POINTS	PROBLEM DISCHARGE POINTS	DISCHARGE POINTS PER STREAM MILE
APTAKISIC CREEK	20	177	197	14	13.45
BUFFALO CREEK	65	240	305	52	13.15
BULL CREEK-BULL'S BROOK	70	101	171	27	10.69
DES PLAINES RIVER-MAIN STEM	75	102	177	27	4.78
INDIAN CREEK	134	294	428	25	11.46
LOWER DES PLAINES	15	61	76	9	6.87
MILL CREEK	47	113	160	35	13.91
NEWPORT DRAINAGE DITCH	22	16	38	3	3.99
NORTH MILL CREEK	62	52	114	35	4.79
UPPER DES PLAINES	92	261	353	64	7.83
WATERSHED TOTAL	602	1417	2,019	291	8.81

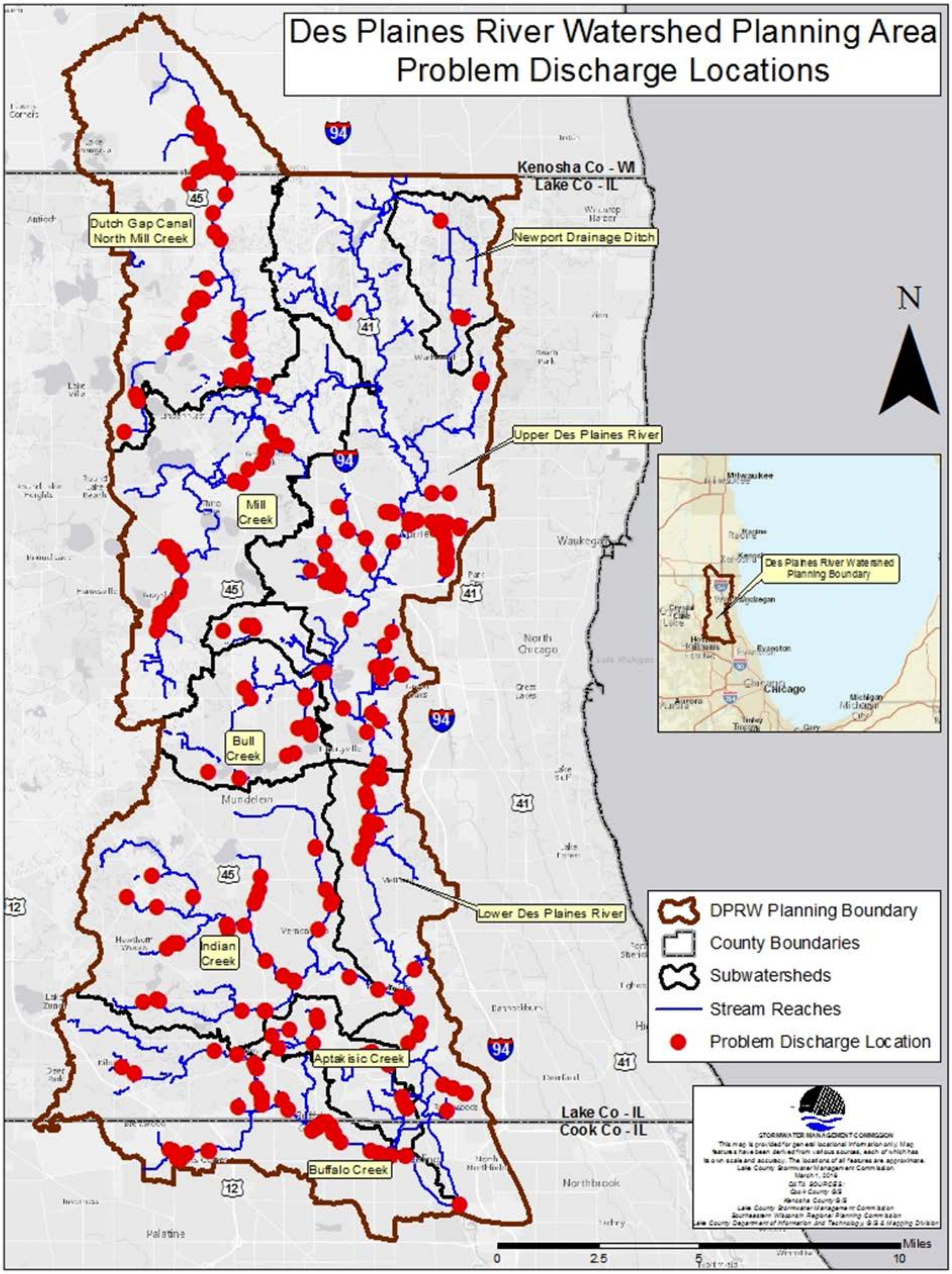


Figure 3-64: Problem Discharge Locations in the DPR Planning Area

3.12.2.9Riparian Buffers

The riparian zone is the area extending 100 feet from the left and right side of the stream channel (Figure 3-65). Vegetated riparian buffers are of interest because riparian vegetation can make streambanks more resistant to erosion, buffers act as filters for runoff and pollutants, and riparian areas offer habitat for wildlife and can be important links in the watershed green infrastructure network. Riparian vegetation also provides beneficial shading to streams and lakes which helps to avoid temperature stress on fish and aquatic organisms. The width and quality of vegetated riparian buffers were visually assessed while walking the stream channel throughout the inventory and checked with aerial photography of the watershed for each reach, including several reaches that were not otherwise assessed in the inventory.

Figure 3-65: Example of a riparian buffer

Table 3-39 summarizes the assessment criterion for buffer width, while Figure 3-66 maps the observed vegetated riparian buffer quality in 2013. Throughout the watershed, riparian buffer width was related to riparian land use, with wide riparian buffers ("High" buffer width) in locations where the stream flows through open space areas and narrow buffers ("Low" buffer width) in locations where the stream flows through developed areas. Generally, less urbanized areas had wider riparian buffers and flows through more open space areas. Urban areas had narrower buffers. There were only a few reaches in the watershed with riparian buffer.

RIPARIAN ZONES

NONE: <20 feet buffer width and zone contains little or no riparian vegetation due to human activities.

LOW: 20-40 foot buffer width and zone is impacted a great deal by human activities

MODERATE: 40-60-foot buffer width and zone is impacted minimally by human activities.

HIGH: >60-foot buffer width and zone is not impacted by human activities (i.e., no parking lots, roadbeds, lawns, crops.

Table 3-39: Riparian Buffer Widths in the DPR planning area

SUBWATERSHED	STREAM REACH RIPARIAN BUFFER WIDTH CONDITIONS *(based on stream inventory data)*			
	NONE (miles)	LOW (miles)	MODERATE (miles)	HIGH (miles)
APTAKISIC CREEK	4.98	5.88	2.55	1.23
BUFFALO CREEK	4.49	13.00	7.88	2.37
BULL CREEK-BULL'S BROOK	1.46	4.63	6.70	4.06
INDIAN CREEK	5.08	14.54	11.00	6.73
LOWER DES PLAINES	--	3.59	13.11	9.77
MILL CREEK	6.66	8.38	13.49	9.56
NEWPORT DRAINAGE DITCH	1.51	2.80	0.93	4.60
NORTH MILL CREEK	3.39	9.26	10.84	3.70
UPPER DES PLAINES	---	14.02	25.69	22.44
TOTALS:	**27.57**	**76.1**	**92.19**	**64.46**

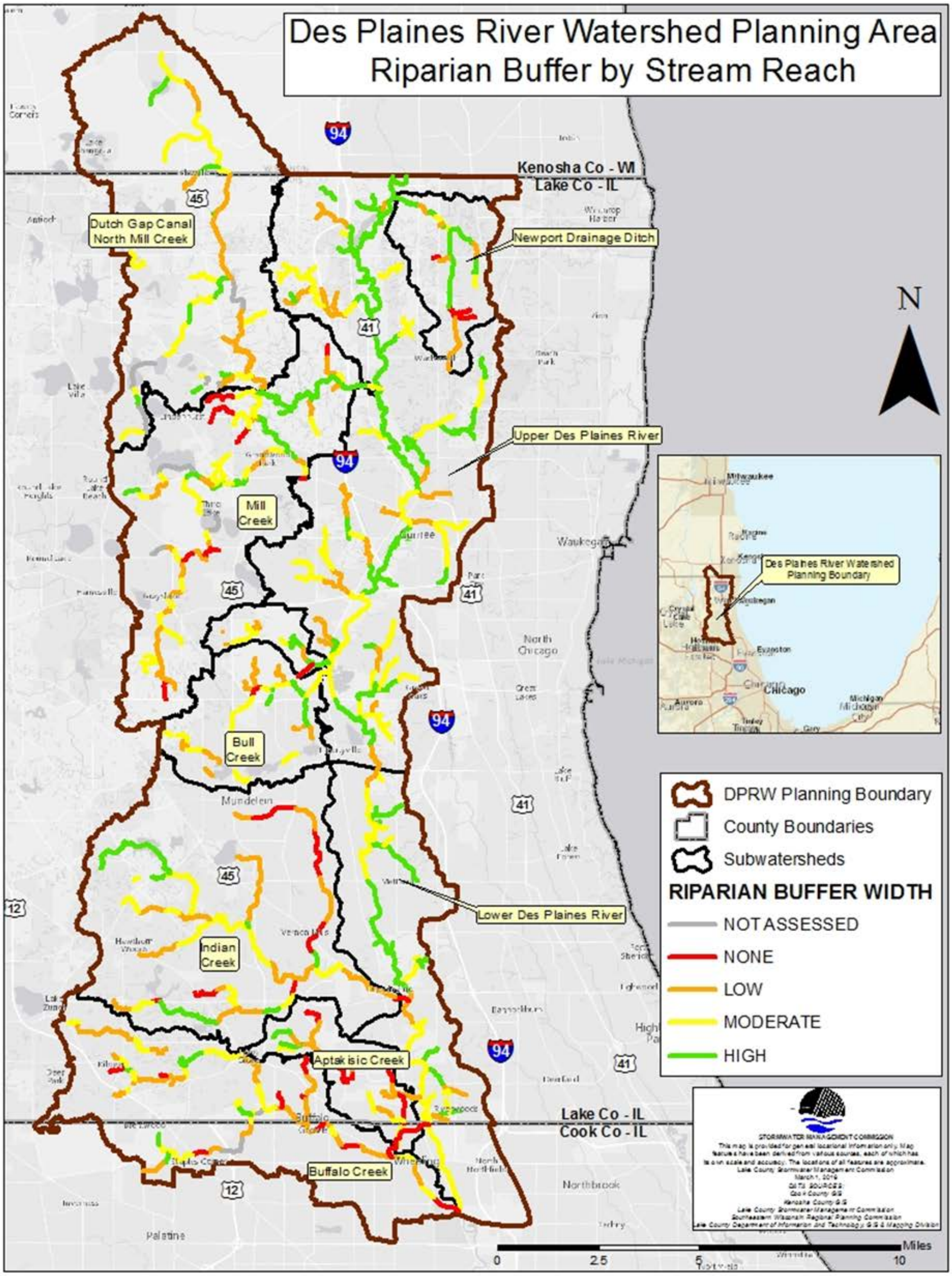


Figure 3-66: Riparian Buffers by Stream Reach in the DPR Planning Area

3.13 LAKE INVENTORY

3.13.1 INTRODUCTION AND METHODS

A lake inventory was conducted to assess the health of lakes within the watershed and provide information on natural and anthropogenic impacts to lake systems. Physical properties of lakes such as depth, area, shoreline length, and shoreline erosion were measured to determine lake morphology, which influences ecosystem function. Additionally, water quality parameters were assessed by the LCHD-ES, Illinois EPA, IDNR and the WI DNR to measure chemical, physical, and biological aspects of water quality. The parameters assessed at each lake are summarized in Table 3-40. Collectively this data provides essential information for watershed planning and management.

There are approximately 7,975 acres of open water in the DPR planning area. Open water includes all lakes, ponds, streams, and wetlands with open water surfaces. The Illinois EPA defines lakes as open bodies of water greater than 6 acres. For the purposes of this plan, lakes 20 acres or greater were considered for more detailed inventory and assessment. There are approximately 52 lakes (greater than 20 acres in size) in the DPR planning area (Figure 3-66). The LCHD-ES, Illinois EPA and IDNR has collected water quality data at 43 of these lakes within Lake County, and the WI DNR has collected data at two of these lakes within Kenosha County. Lakes assessed by LCHD-ES and the WI DNR will be summarized separately, because differences in sampling programs between organizations prevents the comparison of values.

Threats to the lakes can be described as coming from both external and internal sources. External sources include pollutants and nutrients entering the lake such as stormwater runoff, fertilizers, and erosion. Once introduced, many of these pollutants and nutrients remain in the lake and are recycled by internal processes. For example, growing aquatic vegetation consumes and accumulates nutrients from the lake, and decaying aquatic vegetation releases accumulated nutrients back into the lake. Additionally, sedimentation can remove nutrients and contaminates from the water column and deposit them into lake bottom sediment. These nutrients and contaminates may be reintroduced into the water column when anoxic conditions (< 1 mg/L dissolved oxygen) are present. Thus, lake management must consider both external and internal processes that impact lakes, and lake restoration objectives should be included in a lakes management plan.

Table 3-40: Parameters Assessed by Lake

SUBBASIN	LAKE	SHORELINE EROSION	NATIVE FISH	NATIVE PLANTS	FQI	WATER QUALITY MONITORING	MONITORING AGENCY
Buffalo Creek	Buffalo Creek Reservoir 1	X		X	X	X	LCHD-ES
	Buffalo Creek Reservoir 2	X		X	X	X	LCHD-ES
Bull Creek	Butler Lake	X	X	X	X	X	LCHD-ES, IDNR
	Loch Lomond	X	X	X	X	X	LCHD-ES, IDNR
	St. Mary's Lake	X		X	X	X	LCHD-ES
Indian Creek	Big Bear Lake	X		X	X	X	LCHD-ES
	Bresen Lake	X		X	X	X	LCHD-ES
	Countryside Lake	X	X	X	X	X	LCHD-ES, IDNR
	Diamond Lake	X	X	X	X	X	LCHD-ES, IDNR
	Forest Lake	X	X	X	X	X	LCHD-ES, IDNR
	Kemper Lake 1		X	X	X	X	LCHD-ES, IDNR
	Kemper Lake 2				X	X	LCHD-ES
	Lake Charles	X		X	X	X	LCHD-ES
	Little Bear Lake	X		X	X	X	LCHD-ES
	Salem Lake	X		X	X	X	LCHD-ES
	Sylvan Lake	X	X	X	X	X	LCHD-ES, IDNR
	Central Slough						
Lower Des Plaines	Stone Quarry Lake	X		X	X	X	LCHD-ES
Mill Creek	Druce Lake	X	X	X	X	X	LCHD-ES, IDNR
	Gages Lake	X	X	X	X	X	LCHD-ES, IDNR
	Gray's Lake	X	X	X	X	X	LCHD-ES, IDNR
	Lake Miltmore	X	X	X	X	X	LCHD-ES, IDNR
	Rollins Savanna Pond 2	X	X	X	X	X	LCHD-ES, IDNR

SUBBASIN	LAKE	SHORELINE EROSION	NATIVE FISH	NATIVE PLANTS	FQI	WATER QUALITY MONITORING	MONITORING AGENCY
	Sand Lake	X	X	X	X	X	LCHD-ES, IDNR
	Third Lake	X	X	X	X	X	LCHD-ES, IDNR
	Fourth Lake					X	LCHD-ES
	Tempel Farms Lake #2						
North Mill Creek	Crooked Lake	X	X	X	X	X	LCHD-ES, IDNR
	Deer Lake	X		X	X	X	LCHD-ES
	Hastings Lake	X	X	X	X	X	LCHD-ES, IDNR
	Lake Linden	X		X	X	X	LCHD-ES
	McDonald Lakes 2	X		X	X	X	LCHD-ES
	Slough Lake	X		X	X	X	LCHD-ES
	Timber Lake (north)	X	X	X	X	X	LCHD-ES, IDNR
	Waterford Lake	X	X	X	X	X	LCHD-ES, IDNR
	White Lake	X		X	X	X	LCHD-ES
	Rasmussen Lake					X	LCHD-ES
	Redwing Slough					X	LCHD-ES
	George Lake	X	X	X	X	X	WI DNR
	Paasch Lake						
	Benet Lake/Lake Shangrila					X	WI DNR
	Pollock Lake						
Upper Des Plaines	Independence Grove Lake	X	X	X	X	X	LCHD-ES, IDNR
	Lake Carina	X	X	X	X	X	LCHD-ES, IDNR
	Lake Minear	X			X	X	LCHD-ES
	Liberty Lake	X	X	X	X	X	LCHD-ES, IDNR
	Sterling Lake	X	X	X	X	X	LCHD-ES, IDNR

SUBBASIN	LAKE	SHORELINE EROSION	NATIVE FISH	NATIVE PLANTS	FQI	WATER QUALITY MONITORING	MONITORING AGENCY
	Almond Marsh					X	LCHD-ES
	Des Plaines Lake					X	LCHD-ES
	Osprey Lake					X	LCHD-ES
	Wadsworth Sand & Gravel						
	Leopold Lake						

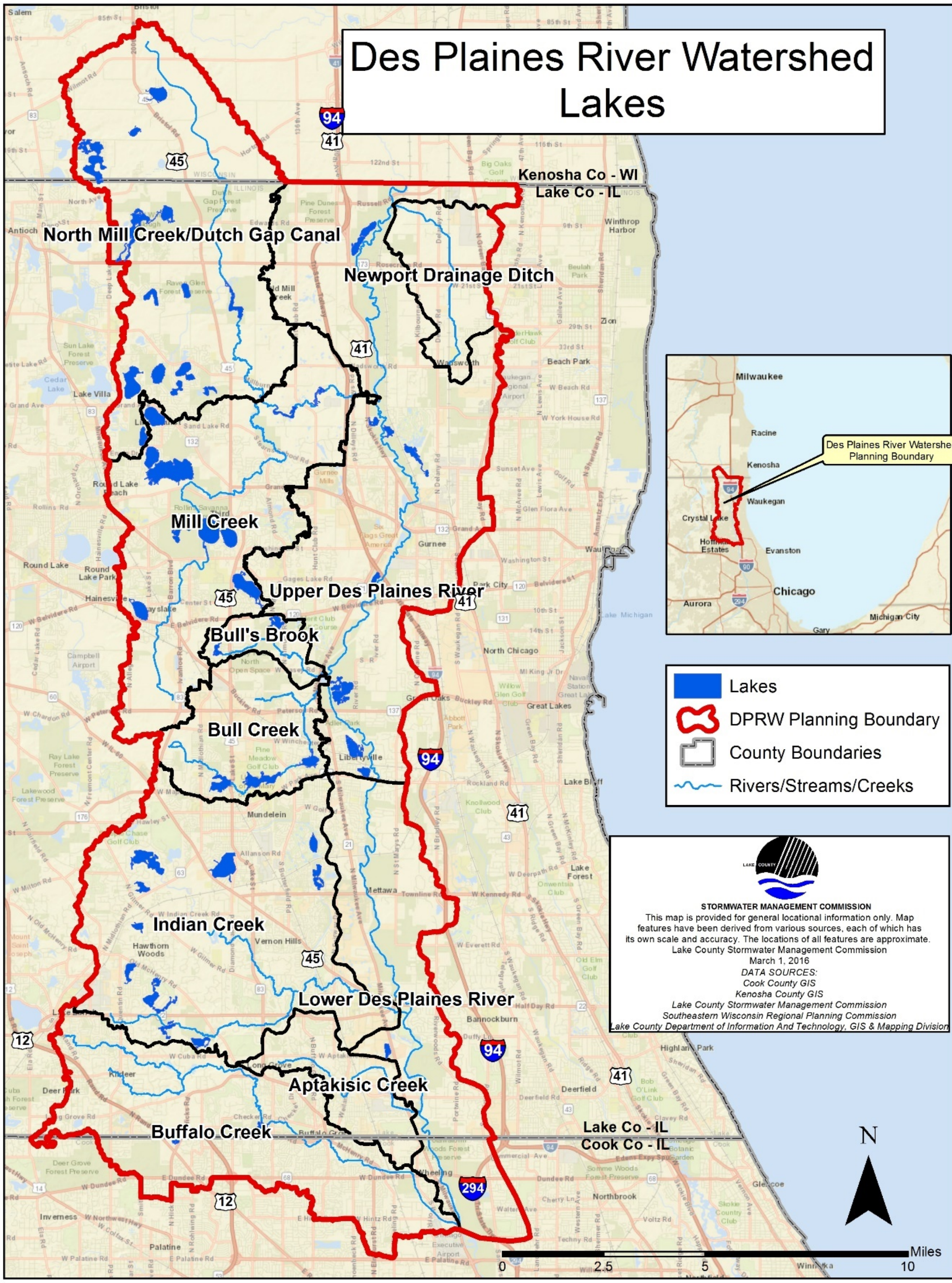


Figure 3-67: Lakes Greater than 20 Acres in the DPR Planning Area

3.13.2 Shoreline Erosion

Shoreline erosion is a natural process which results in the loss of sediment from a shoreline. Shoreline erosion occurs gradually; however, anthropogenic influences such as clearing of vegetation or rocks and increased stormwater runoff can substantially accelerate this process. Sediments eroded from shorelines are transferred to the lake's water column, which increases turbidity and introduces nutrients and contaminates which are attached to the sediment. This sediment is mostly deposited on the lake bed, which can result in degraded habitat for fish and aquatic life. Of the 36 lakes in the DPR planning area assessed by LCHD-ES from 2000-2015, 33 had eroded shorelines and 26 had severely eroded shorelines as shown in Table 3-41. This lake shoreline assessment identified visible erosion which may warrant implementation of erosion control practices; however, further site investigation is needed to determine if remedial action is necessary.

ALL SHORE EROSION: Total amount of eroded shoreline.

MODERATE SHORE EROSION: Recession is characterized by past or recently eroded banks, may exhibit some exposed roots, fallen vegetation, or minor slumping of soil.

SEVERE SHORE EROSION: Recession is characterized by eroding of exposed soil on nearly vertical bans, exposed roots, fallen vegetation, or extensive slumping of bank material, undercutting, washouts, or fence posts exhibiting realignment.

Table 3-41: Erosion of Lake Shorelines

LAKE NAME	LAST ASSESSED	SUBBASIN	% ALL SHORE EROSION	% MODERATE SHORE EROSION	% SEVERE SHORE EROSION
Buffalo Creek Reservoir 1	2013	Buffalo Creek	60	26	17
Buffalo Creek Reservoir 2	2013	Buffalo Creek	60	26	17
Butler Lake	2015	Bull Creek	39	14	0
Loch Lomond	2015	Bull Creek	23	1	3
St. Mary's Lake	2015	Bull Creek	78	30	22
Big Bear Lake	2002	Indian Creek	87	30	19
Bresen Lake	2000	Indian Creek	43	16	0
Countryside Lake	2010	Indian Creek	55	20	16
Diamond Lake	2002	Indian Creek	13	3	0
Forest Lake	2010	Indian Creek	41	12	9
Lake Charles	2000	Indian Creek	100	45	5
Little Bear Lake	2002	Indian Creek	85	43	26
Salem Lake	2000	Indian Creek	81	9	23
Sylvan Lake	2012	Indian Creek	10	4	0
Stone Quarry Lake	2004	Lower Des Plaines	39	6	0
Druce Lake	2011	Mill Creek	40	8	5
Gages Lake	2011	Mill Creek	41	9`	11
Gray's Lake	2011	Mill Creek	19	6	7
Lake Miltmore	2011	Mill Creek	52	7	1
Rollins Savanna Pond 2	2011	Mill Creek	0	0	0
Sand Lake	2011	Mill Creek	44	3	12
Third Lake	2010	Mill Creek	32	12	8
Crooked Lake	2010	North Mill Creek	42	9	6
Deer Lake	2010	North Mill Creek	0	0	0

LAKE NAME	LAST ASSESSED	SUBBASIN	% ALL SHORE EROSION	% MODERATE SHORE EROSION	% SEVERE SHORE EROSION
Hastings Lake	2010	North Mill Creek	10	1	5
Lake Linden	2010	North Mill Creek	16	0	0
McDonald Lakes2	2010	North Mill Creek	70	50	5
Slough Lake	2010	North Mill Creek	30	11	10
Timber Lake (north)	2010	North Mill Creek	0	0	0
Waterford Lake	2010	North Mill Creek	25	9	5
White Lake	2010	North Mill Creek	5	1	0
Independence Grove Lake	2007	Upper Des Plaines	38	15	8
Lake Carina	2007	Upper Des Plaines	63	15	8
Lake Minear	2007	Upper Des Plaines	67	14	39
Liberty Lake	2001	Upper Des Plaines	55	9	14
Sterling Lake	2007	Upper Des Plaines	22	5	9

3.14 STORMSEWER NETWORK

The natural drainage system of the DPR planning area has changed where residential, commercial, and industrial land uses replaced open lands. These land use/cover changes limit the land's capacity to infiltrate and store precipitation and runoff. In these portions of the planning area, a stormsewer network or **stormsewersheds** drains runoff directly to a stream or lake, or into a detention basin, which collects water before discharging it into a stream or lake.

STORMSEWERSHED: The land area drained by a stormsewer or stormsewer network.

Stormsewersheds were delineated in the watershed by reviewing municipal and stormsewer maps and analyzing aerial photography. The DPR planning area contains 83,620 acres (56% of DPR planning area) of stormsewersheds (see Table 3-42 and Figure 3-67). The stormsewersheds are mostly located in the central and southern portion of the DPR planning area (most developed portion of the watershed) and are less common in the northern portion of the DPR planning area.

Undeveloped areas, lands used for agriculture, and many older residential developments do not have stormwater detention facilities as they were built before detention basins were required by ordinances. The northern portion of the DPR planning area is dominantly an agriculture land cover and does not contain stormsewersheds. Although not mapped these agriculture areas utilize drain tiles in the agriculture fields to transport stormwater runoff; these drain tiles act as rural stormsewersheds.

Table 3-42: Stormsewersheds in the DPR planning area

SUBWATERSHEDS	TOTAL ACRES	ACRES OF SEWERED AREA	PERCENT OF SUBWATERSHED SEWERED
Aptakisic Creek	4,374.3	4,234	97%
Buffalo Creek	17,392.8	15,685	90%
Bull Creek	7,136.4	4,022	56%
Bull's Brook	1,816.8	555	31%
Indian Creek	24,151.4	22,217	92%
Lower Des Plaines River	14,607.2	9,435	65%
Mill Creek	19,783.0	10,285	52%
Newport Drainage Ditch	5,018.1	319	6%
North Mill – Dutch Gap Canal	23,532.3	2,153	9%
Upper Des Plaines River	32,548.6	14,714	45%
TOTALS:	**150,361**	**83,619**	**Total % of Watershed: 56%**

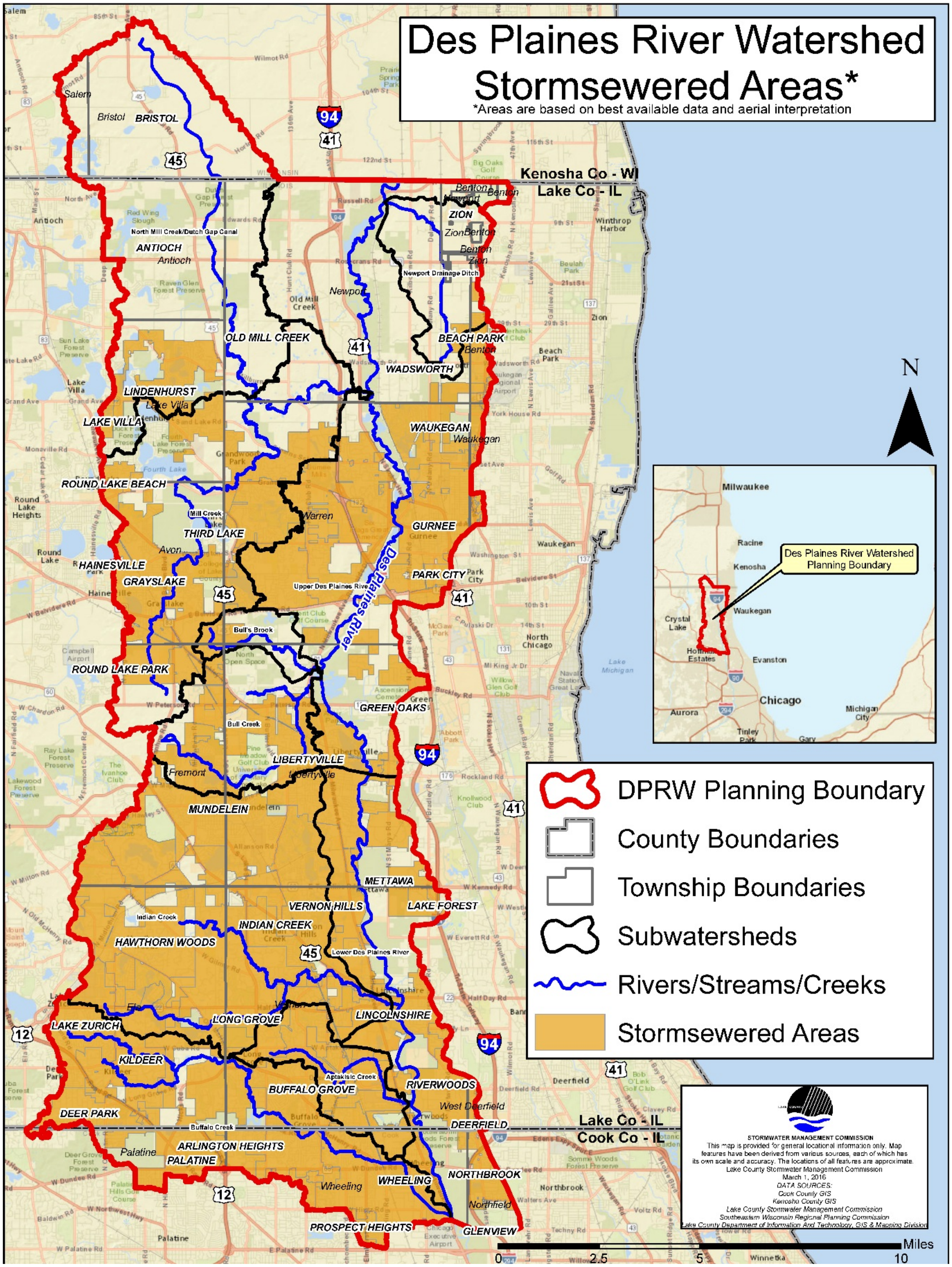


Figure 3-68: Stormsewered areas in the Des Plaines River Watershed Planning Area

3.15 DETENTION BASIN INVENTORY

In 2016, SMC conducted a detention basin inventory for all known areas being used for detention in the DPR planning area. The inventory was conducted by combining data from the 2003 Newport Drainage Ditch, 2013 Buffalo Creek, 2009 North Mill Creek, 2003 Indian Creek, 2013 Mill Creek, and 2004 Bull Creek detention basin inventories, and conducting field assessments at basins that were not previously inventoried. These locations were identified using aerial imagery analysis and field inspections. Basins were assessed for location (latitude/longitude), design features, maintenance and design needs, potential safety problems, and retrofit opportunities. Assessments were conducted at 2,303 detention basins (Table 3-43 and Figure 3-68). Appendix D summarizes the detention basin inventory results.

WET DETENTION BASINS: A stormwater control structure that provides both retention and treatment of contaminated stormwater runoff. It contains a perennial pool of water, which holds runoff from one rainfall event until displaced by a new rainfall event.

DRY DETENTION BASINS: - Basins that temporarily stores water before discharging to river or lake and usually dry up following large rainstorms or snow melt events. Typically, not effective at removing pollutants.

ONSTREAM (OR ONLINE) BASINS: Basins that are connected to a "natural" surface waterway (creek, stream, river etc.) , whether that waterway flows in and/or out of the pond..

3.15.1 Constructed Basins, Pre and Post 1992

In 1992, the Lake County Watershed Development Ordinance (WDO) restricted stormwater release rates for all new development within Lake County. The WDO was generally more restrictive than the municipal ordinances it superseded. The WDO limited release rates from the 2-year recurrence interval design storm to 0.04 cfs per acre of development area and limited release rates from the 100-year recurrence interval design storm to 0.15 cfs per development acre. Basins built after the adoption of the WDO are required to meet these discharge rates.

Basins within Cook and Kenosha county were included in this analysis; however, these counties did not implement regulation on stormwater release rates in 1992, so the results are not indicative of substantial changes in detention basin design in these counties. Of the assessed basins, 903 were built before 1992 and 1,400 were built after 1992. Most of the basins (78%) in Buffalo Creek were built before 1992. Most of the basins in North Mill Creek (83%), the Newport Drainage Ditch (85%), and the Lower Des Plaines River (73%) were built after 1992. The number of detention basins built pre and post 1992 by subwatershed is summarized in Table 3-44.

3.15.2 Basin Type, Location, and Maintenance/Retrofit Needs

A total of 2,303 basins were inventoried during this assessment. Of these, 1,691 basins were classified as **wet**, 424 were classified as **dry**, 184 were classified as wetland, and four were classified as **onstream** or **online**. Indian Creek and the Upper Des Plaines River subwatersheds had the most detention basins. The inventory assessed 1,947 basins for maintenance and retrofit needs. This assessment identified 1,271 (65 %) basins that could benefit from maintenance or improvement including the addition of aerators, native vegetation, and riprap, and the removal of woody vegetation, invasive vegetation, and debris.

Table 3-43: Number and Type of Detention Basins Inventoried by Subwatershed

SUBWATERSHED	NUMBER OF BASINS	NUMBER OF WET BASINS	NUMBER OF DRY BASINS	NUMBER OF WETLAND BASINS	NUMBER OF ONSTREAM BASINS
North Mill Creek	101	55	10	36	0
Mill Creek	248	199	33	16	0
Newport Drainage Ditch	75	55	11	9	0
Upper Des Plaines River	467	330	85	50	2
Bull Creek-Bull's Brook	137	84	46	7	0
Indian Creek	713	485	180	46	2
Lower Des Plaines River	166	144	13	9	0
Buffalo Creek	262	233	29	0	0
Aptakisic Creek	134	106	17	11	0
Total	**2,303**	**1,691**	**424**	**184**	**4**

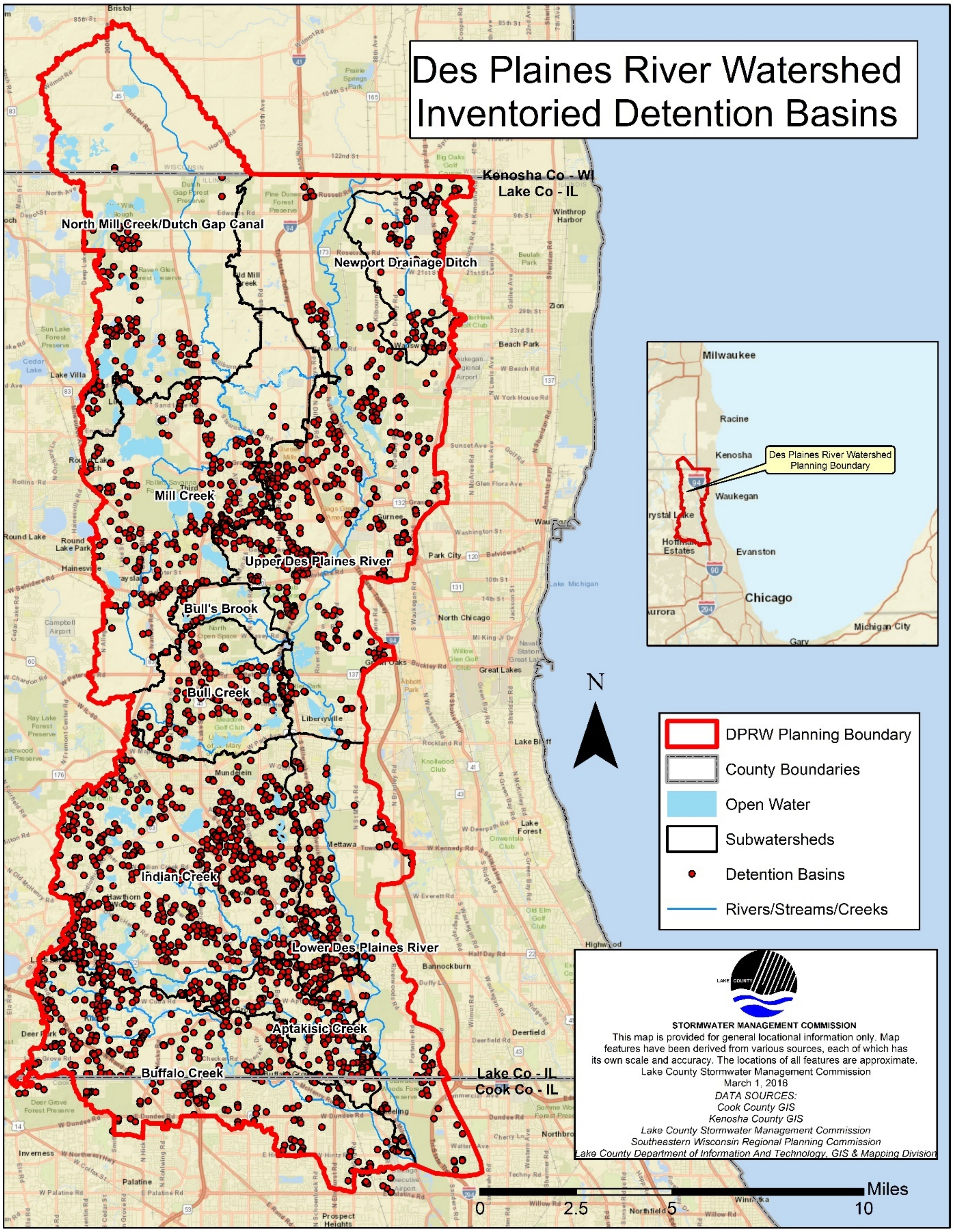


Figure 3-69: Inventoried Detention Basin in the Des Plaines River Watershed Planning Area

Table 3-44: Pre and Post 1992 Detention Basins by Subwatershed

SUBWATERSHED	NUMBER OF BASINS	NUMBER OF BASINS BUILT PRE 1992	NUMBER OF BASINS BUILT POST 1992
North Mill Creek	101	17	84
Mill Creek	248	79	169
Newport Drainage Ditch	75	11	64
Upper Des Plaines River	467	186	281
Bull Creek-Bull's Brook	137	42	95
Indian Creek	713	191	522
Lower Des Plaines River	166	88	78
Buffalo Creek	262	205	57
Aptakisic Creek	134	84	50
Total	**2,303**	**903**	**1,400**

3.16 LAKE AND STREAM WATER QUALITY

Water quality refers to a waterbody's ability to support a variety of aquatic life and recreational uses such as swimming, fishing, boating, and drinking. Water quality assessments also incorporate the aesthetic value of the water body. Water pollution reduces the health of aquatic ecosystems and may be harmful to human health. Water quality is impacted by pollutants from multiple point and nonpoint sources. During storms, pollutants on the landscape are washed from the ground and impervious surfaces into storm sewers, roadside drainage ditches, and natural drainageways and ultimately into the watershed's receiving streams and lakes.

Physical changes in the watershed, such as stream channelization and the loss of riparian vegetation and wetlands, reduce the ability of the natural drainage system to filter pollutants and infiltrate water into the ground, and contribute sediment and other pollutants to the stream and lakes, thereby reducing the quality of aquatic habitat. Water quality problems can be a result of many years of modification of the watershed landscape. These changes include modification of the stream channel, floodplain, wetlands, and other water resource-related landscape features.

Water quality degradation is also caused by an increase in watershed impervious cover (e.g., paving, concrete, rooftops) that has led to an increase in the volume and rate of runoff in the watershed. The increased quantity of runoff causes problems such as excessive stream bank erosion and the deepening of the stream channel due to in-stream erosion. In addition to increasing surface runoff, impervious surfaces reduce the amount of rainwater that infiltrates into the ground to recharge groundwater sources. This water quality summary includes information from water quality reports, data from stream inventories and recent water quality monitoring. Figure 3-69 shows the DPR planning area 2016 303(d) listed streams and lakes.

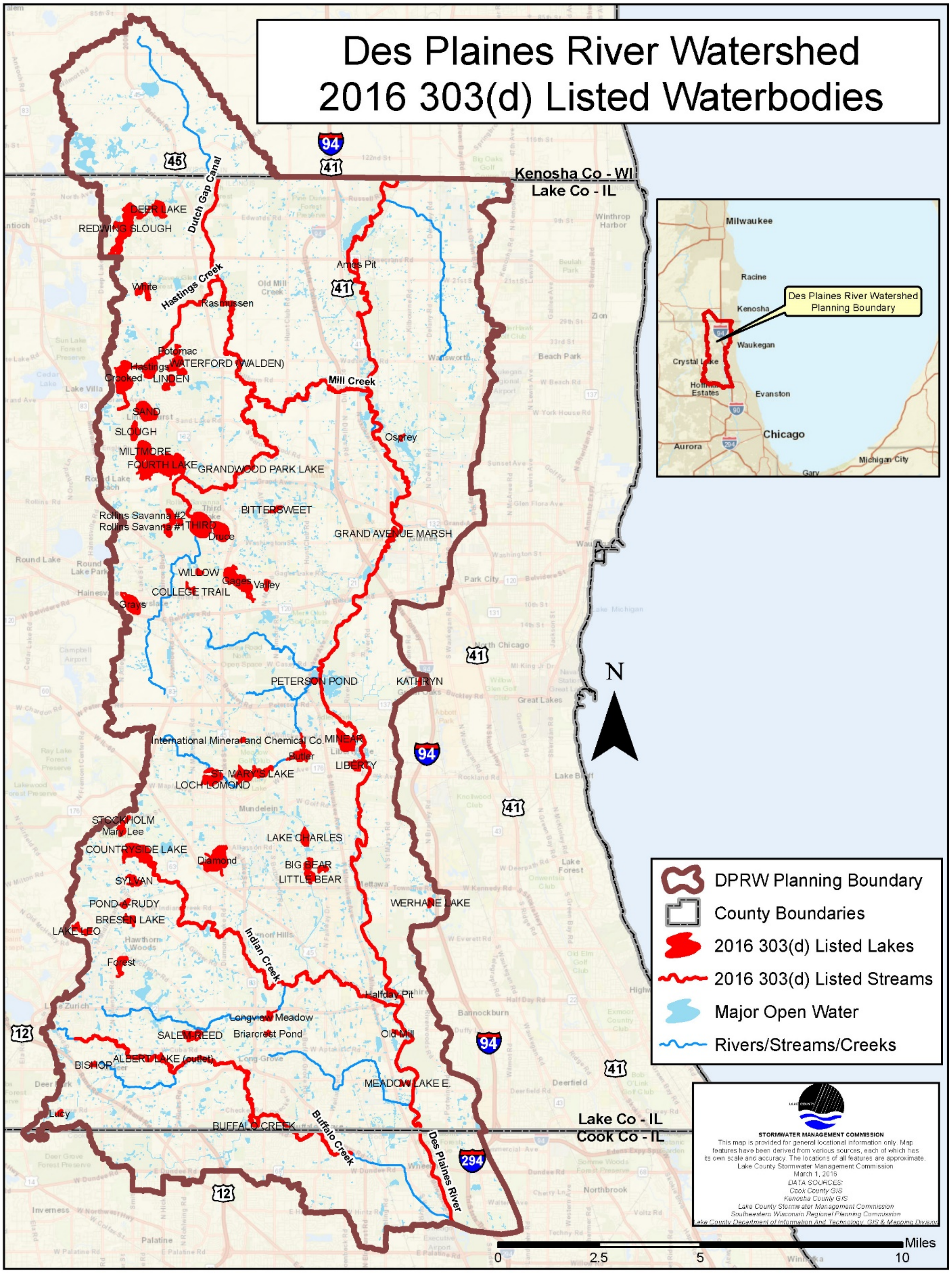


Figure 3-70: Des Plaines River Planning Area 2016 303(d) listed Streams and Lakes

3.16.1 Status of Designated Use Support

The Illinois EPA produces a biennial report on the water quality of surface waters and groundwater in Illinois. The “Integrated Water Quality Report and Section 303(d) List” (“Integrated Report”) is based on federal guidance for meeting the requirements of Sections 305(b), 303(d) and 314 of the Clean Water Act. Discussion of the Integrated Report in this section is specifically related to surface water (lakes and streams) in the 2016 Integrated Report. Assessment of water quality for an individual water body or stream segment is expressed in terms of support of “designated uses”. Designated uses assessed in the 2016 Integrated Report applicable to lakes and streams in the DPR planning area include Aquatic Life, Fish Consumption, Primary Contact (swimming), Secondary Contact (boating), and Aesthetic Quality. These uses are determined to be fully supported, not supported, not assessed, or to have insufficient information to make a determination. There are no specific assessment guidelines for Secondary Contact in Illinois. In any water where the Primary Contact use is assessed as “full support”, Secondary Contact is also assessed as “full support”. In all other cases, Secondary Contact is not assessed.

Illinois EPA evaluates physical, biological, and chemical monitoring data to make these assessments of designated use support. For some uses, monitoring data may indicate non-support or “impairment”. For example, depauperate fish or invertebrate taxa may indicate impairment of the aquatic life designated use. In these cases, physical and/or chemical monitoring data are compared to numeric water quality standards to determine if pollutants are present in sufficient quantities to cause an impairment of one or more designated uses. In other cases, exceedance or violation of the water quality standard is sufficient to list the use as not supported and the water as “impaired”. For example, exceedance of the fecal coliform standard results in non-support of the Primary Contact designated use, if it is an assessed use for a given water. Waters with one or more pollutants identified as the cause of impairment are added to the “303(d) list” of impaired waters and put onto a schedule for development of a Total Maximum Daily Load study for the pollutant(s) of concern (see Section 3.16.2 below). In some cases, “non-pollutants” are identified as the cause of non-support. Non-pollutants are typically non-chemical causes of impairment such as modification of flows in a stream by dams, alteration of habitat, or the presence of non-native invasive species. Once a surface water assessment is made, it typically remains unchanged in subsequent editions of the Integrated Report unless new data is obtained by Illinois EPA. Changes from previous editions are reported by Illinois EPA in an appendix to the report.

3.16.1.1Streams

Thirteen stream segments in the DPR planning area are assessed by Illinois EPA for support of designated uses as indicated by applicable water quality standards. These segments consist of 85 miles of rivers and streams. Of these, six are segments of the Des Plaines River (37 total miles), and two are segments of North Mill Creek (“Dutch Gap Canal” and “North Mill Creek”). The 2016 Integrated Report identified twelve of the assessed segments as impaired for one or more designated uses, all twelve of which did not support the aquatic life use. All six segments of the Des Plaines River in Lake County, accounting for the entire length of the Des Plaines River in Lake County, did not support the aquatic life and fish consumption uses (although water quality standards for several individual causes of impairment identified in 2014 were achieved in 2016). Buffalo Creek and three segments of the Des Plaines River did not support the primary contact (swimming) use. Bull Creek was the only segment in the Lake County portion of the DPR planning area found to support all designated uses, which is a change from 2014, when the aquatic life use was not supported. Indian and Mill Creek did not support the aquatic life designated use in 2016, which is a change from 2014, when both segments fully supported all designated uses. Dutch Gap Canal, the channelized section of North Mill Creek upstream of Rasmussen Lake, was assessed for the first time in 2016 and did not support the aquatic life designated use.

Table 3-45: Causes of Stream Impairments in the DPR Planning Area

CAUSE OF IMPAIRMENT	SEGMENTS AFFECTED
Phosphorus*	6
Mercury	6
Arsenic**	5
Low Dissolved Oxygen	5
Fecal coliform	4
Other Flow Regime Alterations	4
Polychlorinated Biphenyls (PCBs)	4
Sedimentation/Siltation	4
Total Suspended Solids*	3
Chloride	2
Manganese**	2
Changes in Stream Depth and Velocity Patterns	2
Alterations in Streamside or Littoral Vegetative Covers	2
Unknown Cause(s)	2
Aquatic Algae	1
pH	1

*Phosphorus and total suspended solids used to identify causes prior to 2012
**Arsenic and manganese in sediment samples used to identify non-standard based causes of aquatic life impairment prior to 2012

Table 3-46: Sources of Stream Impairments in the DPR Planning Area

SOURCE OF POLLUTION	SEGMENTS AFFECTED
Unknown Source(s)	9
Atmospheric Deposition	6
Contaminated Sediment	5
Urban Runoff/Stormsewers	4
Municipal-Point Source Discharges	4
Dam or Impoundment	3
Site Clearance (Land Development or Redevelopment)	2
Crop Production (Crop Land or Dry Land)	2
Impacts from Hydrostructure Flow Regulation/Modification	2
Streambank Modifications/Destabilization	1
Agriculture	2
Channelization	1
Upstream Impoundments	1

Sixteen causes of impairment are identified and multiple causes may affect a single stream segment. Causes of impairment and sources of pollution are summarized in Table 3-45 and Table 3-46, respectively. Phosphorus and total suspended solids are no longer used by Illinois EPA to assess aquatic life use attainment in streams, but any listings prior to 2012 will not be removed unless new data indicates full support of the use. Similarly, five segments impaired by arsenic and two impaired by manganese are based on sediment chemistry data and first appeared as a cause of the aquatic life use impairment in 2010. Non-standard based sediment data is no longer used as the basis for assessment, but these causes will not be removed unless new data indicates full support of the aquatic life use. The mercury and polychlorinated biphenyls causes are related to non-support of the fish consumption use for the Des Plaines River. The fecal coliform cause is related to non-support of the primary contact designated use in Buffalo Creek and three segments of the Des Plaines River. Sources of pollution fall into thirteen categories and multiple sources may affect a single segment. Sources are identified for each assessed segment in Table 3-47. Atmospheric deposition-toxics (6 segments) is related to mercury and PCB causes of non-support of the fish consumption use for the Des Plaines River. "Municipal-point source discharges" refers to wastewater treatment plants, although not all wastewater discharges upstream of affected segments are municipally-owned.

Table 3-47: Stream Impairments List in the DPR Planning Area

Bold font indicates the Designated Use and cause(s) of impairment for which the water appears on the 303(d) list. Bold underlining indicates waters for which a TMDL has been developed for one or more pollutants. Asterisks (*) indicate pollutant causes of impairment for which a TMDL has been developed.

STREAM	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
<u>Buffalo Cr.</u>	IL_GST	**Aquatic Life-Non Support** **Primary Contact-Non Support**	**Total Suspended Solids, Chloride*, Dissolved Oxygen*, Fecal Coliform***	Urban Runoff/Stormsewers; Unknown
Bull Cr.	IL_GV-01	Aquatic Life-Full Support Aesthetic Quality-Full Support	N/A	N/A
Des Plaines R.	IL_G-25	**Aquatic Life-Non Support** **Fish Consumption-Non Support** Aesthetic Quality-Full Support	**Arsenic, Sedimentation/Siltation, Total Suspended Solids, Dissolved Oxygen, Mercury**	Contaminated sediment, Site Clearance (Land Development or Redevelopment), Urban Runoff/Stormsewers, Atmospheric Deposition-Toxics, Unknown
Des Plaines R.	IL_G-35	**Aquatic Life-Non Support** **Fish Consumption-Non Support** Aesthetic Quality-Full Support	**Unknown, Phosphorus, Mercury, Polychlorinated biphenyls**	Municipal Point-Source Discharges, Unknown, Atmospheric Deposition-Toxics

STREAM	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
Des Plaines R.	IL_G-08	**Aquatic Life-Non Support** **Fish Consumption-Non Support, Primary Contact-Non Support** Aesthetic Quality-Full Support	**Dissolved Oxygen, Total Suspended Solids, Mercury, Fecal Coliform**	Unknown, Crop Production (Crop Land or Dry Land), Atmospheric Deposition-Toxics
Des Plaines R.	IL_G-26	**Aquatic Life-Non Support, Fish Consumption-Non Support**	**Unknown, Mercury, Polychlorinated biphenyls**	Unknown, Atmospheric Deposition-Toxics
Des Plaines R.	IL_G-36	**Aquatic Life-Non Support, Fish Consumption-Non Support, Primary Contact-Non Support**	**Phosphorus, Other flow regime alterations, Aquatic Algae, Mercury, Polychlorinated biphenyls, Fecal Coliform**	Impacts from hydrostructure Flow Regulation/modification, Dam or impoundment, Municipal Point-source discharges, Atmospheric Deposition-Toxics, Unknown
Des Plaines R.	IL_G-07	**Aquatic Life-Non Support,** **Fish Consumption-Non Support, Primary Contact-Non Support** Aesthetic Quality-Full Support	**Arsenic, Chloride, Phosphorus, Alteration in stream-side or littoral vegetative covers, Mercury, Polychlorinated biphenyls, Fecal Coliform**	Streambank modifications/destabilization, Contaminated Sediment, Municipal Point-source discharges, Urban Runoff/Stormsewers, Atmospheric Deposition-Toxics, Unknown
Dutch Gap Canal	IL_GWAB	**Aquatic Life-Non Support**	**Arsenic, Manganese, Phosphorus, Sedimentation/Siltation, Other flow regime alterations, Changes in stream depth and velocity patterns**	Contaminated Sediments, Dam or Impoundment, Agriculture

STREAM	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
Hastings Cr.	IL_GWAA	**Aquatic Life-Non Support**	**Arsenic, Phosphorus, Sedimentation/Siltation, Alteration in stream-side or littoral vegetative covers, Other flow regime alterations**	Channelization, Upstream Impoundments, Contaminated Sediments, Impacts from hydrostructure flow regulation/modification, Municipal Point-source discharges, Urban Runoff/Stormsewers, Site Clearance (land Development or Redevelopment), Crop Production (Crop Land or Dry Land)
Indian Cr.	IL_GU-02	**Aquatic Life-Non Support**	**Dissolved Oxygen**	Unknown
Mill Cr.	IL_GW-02	**Aquatic Life-Non Support,** Aesthetic Quality-Full Support	**Dissolved Oxygen, pH**	Unknown
North Mill Cr.	IL_GWA	**Aquatic Life-Non Support**	**Arsenic, Manganese, Phosphorus, Sedimentation/Siltation, Other flow regime alterations, Changes in stream depth and velocity patterns**	Contaminated Sediments, Dam or impoundment, Agriculture

Table 3-48: Causes of Impairment for Impaired Lakes

CAUSE OF IMPAIRMENT	LAKES AFFECTED
Phosphorus	52
Total Suspended Solids	43
Aquatic Plants	33
Low Dissolved Oxygen	9
Unknown Causes	8
Fecal coliform	4
Non-Native Aquatic Plants	1

3.16.1.2Lakes

Eighty-one lakes in the DPR planning area appear on Illinois EPA's list of assessed waters for 2016. Of these, 13 lakes do not have an assessed designated use. Of the remaining 68 lakes with designated uses, seven fully support all their respective designated uses. Of the seven lakes, four lakes are former gravel pits (Dog Training Pond, Independence Grove, Carina, and Sterling), two lakes are natural glacial lakes (Miltmore and Timber (North)), and one lake is a modified oxbow (Windward). Two lakes have "insufficient data" to conclude whether the lake supports or does not support designated uses (Green & Westchester II). Fifty-nine lakes do not support the aesthetic quality designated use, making it the most common designated use impairment for lakes in the planning area. Ten of these 59 lakes do not support the aquatic life designated use and four do not support the primary contact (swimming) designated use.

Seven causes of impairment were identified and multiple causes may affect a single lake. Causes of impairment for the 59 impaired lakes are summarized in Table 3-48. Phosphorus (52 lakes), total suspended solids (43 lakes), and aquatic plants (33 lakes), are the most common causes of impairment. Sources of pollution fall into twenty-two categories and multiple sources may affect a single lake. Sources of pollution are summarized in Table 3-49. Causes of impairment and sources of pollution are detailed for each lake in Table 3-50.

Table 3-49: Sources of Pollution for Impaired Lakes

SOURCE OF POLLUTION	LAKES AFFECTED
Unknown	33
Rural (residential areas)	19
Runoff from Forest/Grassland/Parkland	18
Agriculture	14
Urban Runoff/Stormsewers	12
Waterfowl	7
Littoral/Shore Area Modifications (non-riverine)	6
Yard Maintenance	6
Internal Nutrient Recycling	4
Streambank Modifications/Destabilization	3
Other Recreational Pollution Sources	3
Golf Courses	2
Natural Sources	2
Wildlife other than Waterfowl	2
Residential Districts	2
Site Clearance (Land Development or Redevelopment)	2
Contaminated Sediments	1
Impervious Surface/Parking Lot Runoff	1
On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)	1
Sediment Resuspension (Clean Sediment)	1
Pesticide Application	1
Highway/Road/Bridge Runoff (Non-Construction Related)	1

Table 3-50: Causes of impairment and source of pollution by lake

LAKE	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
ACORN	IL_WGD	None Assessed	N/A	N/A
ALBERT (outlet)	IL_VGG	**Aquatic Life-Non Support, Aesthetic Quality-Non Support**	**Dissolved Oxygen*, Total Suspended Solids, Phosphorus***	Unknown
AMES PIT	IL_VGA	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Phosphorus, Aquatic Plants**	Unknown
BENET	IL_UGW	None Assessed	N/A	N/A
BIG BEAR	IL_WGZU	**Aquatic Life-Non Support, Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus*, Aquatic Plants**	Unknown
BISHOP	IL_UGJ	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Rural (Residential Areas)
BITTERSWEET	IL_SGQ	**Aquatic Life-Non Support, Aesthetic Quality-Non Support**	**Dissolved Oxygen, Total Suspended Solids, Phosphorus**	Pesticide Application, Rural (Residential Areas), Runoff from Forest/Grassland/Parkland
BRESEN LAKE	IL_UGN	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus*, Aquatic Plants**	Unknown
BRIARCREST POND	IL_SGZ	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	Cause Unknown	Unknown
BROWN’S	IL_RGZY	None Assessed	N/A	N/A
BUFFALO CREEK	IL_SGC	**Aquatic Life-Non Support, Aesthetic Quality-Non Support**	**Dissolved Oxygen*, Total Suspended Solids, Phosphorus***	Unknown

LAKE	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
BUTLER	IL_RGJ	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Highway/Road/Bridge Runoff (Non-Construction Related), Littoral/shore Area Modifications (Non-Riverine), Streambank Modifications/Destabilization, Unknown, Waterfowl, Urban Runoff/Storm Sewers, Runoff from Forest/Grassland/Parkland
COLLEGE TRAIL	IL_VGO	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Agriculture, Rural (Residential Areas), Runoff from Forest/Grassland/Parkland
<u>COUNTRYSIDE LAKE</u>	IL_RGQ	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus*, Aquatic Plants**	Rural (Residential Areas), Runoff from Forest/Grassland/Parkland, Natural Sources
CROOKED	IL_RGZA	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Wildlife other than Waterfowl, Agriculture, Rural (Residential Areas)
DEER	IL_RGX	None Assessed	N/A	N/A
DEER LAKE	IL_WGZF	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Phosphorus, Aquatic Plants**	Rural (Residential Areas), Runoff from Forest/Grassland/Parkland
<u>DIAMOND</u>	IL_RGB	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus*, Aquatic Plants**	Littoral/shore Area Modifications (Non-Riverine), Sediment Resuspension (Clean Sediment), Internal Nutrient Recycling, On-site Treatment Systems (Septic Systems and Similar Decentralized Systems), Yard Maintenance, Unknown

LAKE	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
DOG TRAINING POND	IL_UGH	Aquatic Life-Full Support, Aesthetic Quality-Full Support	N/A	N/A
DRUCE	IL_RGV	Aquatic Life-Full Support, **Primary Contact-Non Support, Aesthetic Quality-Non Support**	**Fecal Coliform, Aquatic Plants**	Unknown
FARMINGTON	IL_UGK	None Assessed	N/A	N/A
FOREST	IL_RGZG	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus***	Unknown, Agriculture, Urban Runoff/Storm Sewers
FOURTH LAKE	IL_RGZC	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	Cause Unknown, **Aquatic Plants**	Unknown
GAGES	IL_RGI	Aquatic Life-Full Support, Primary Contact-Full Support, Secondary Contact-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Unknown, Internal Nutrient Recycling, Waterfowl, Yard Maintenance
GRAND AVENUE MARSH	IL_SGR	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Impervious Surface/Parking Lot Runoff, Yard Maintenance, Agriculture, Rural (Residential Areas)
GRANDWOOD PARK LAKE	IL_UGC	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Unknown
GRAYS	IL_RGK	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Phosphorus**	Internal Nutrient Recycling, Yard Maintenance

LAKE	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
GREEN	IL_SGE	Aquatic Life-Insufficient Information, Aesthetic Quality-Insufficient Information	Cause Unknown	N/A
HALFDAY PIT	IL_UGB	**Aquatic Life-Non Support, Aesthetic Quality-Non Support**	**Dissolved Oxygen*, Total Suspended Solids, Phosphorus***	Unknown
HARVEY LAKE	IL_VGJ	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Unknown
HASTINGS	IL_RGZB	Aquatic Life-Full Support, **Primary Contact-Non Support, Aesthetic Quality-Non Support**	**Fecal Coliform, Total Suspended Solids, Phosphorus**	Other Recreational Pollution Sources, Agriculture, Rural (Residential Areas), Runoff from Forest/Grassland/Parkland
HENDRICK	IL_UGU	None Assessed	N/A	N/A
HIDDEN VALLEY	IL_WGE	None Assessed	N/A	N/A
INDEPENDENCE GROVE	IL_SGH	Aquatic Life-Full Support, Aesthetic Quality-Full Support	N/A	N/A
INTERNATIONAL MINING AND CHEMICAL	IL_VGF	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Unknown, Urban Runoff/Storm Sewers
LAKE CARINA	IL_VGC	Aquatic Life-Full Support, Aesthetic Quality-Full Support	N/A	N/A
LAKE CHARLES	IL_RGZJ	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus*, Aquatic Plants**	Unknown
LAKE LEO	IL_UGL	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	Cause Unknown, **Aquatic Plants**	Unknown

LAKE	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
LAKE NAOMI	IL_UGM	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Unknown
LEOPOLD	IL_VGI	None Assessed	N/A	N/A
LIBERTY	IL_RGT	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Unknown
LINDEN	IL_RGC	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Phosphorus, Aquatic Plants**	Residential Districts, Runoff from Forest/Grassland/Parkland
LITTLE BEAR	IL_WGZV	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus*, Aquatic Plants**	Unknown
LOCH LOMOND	IL_RGU	Aquatic Life-Full Support, **Primary Contact-Non Support, Aesthetic Quality-Non Support**	**Fecal Coliform, Total Suspended Solids, Phosphorus**	Littoral/shore Area Modifications (Non-Riverine), Other Recreational Pollution Sources, Streambank Modifications/Destabilization, Unknown, Agriculture, Rural (Residential Areas), Urban Runoff/Storm Sewers, Waterfowl
LONGVIEW MEADOW	IL_SGU	**Aquatic Life-Non Support, Aesthetic Quality-Non Support**	**Dissolved Oxygen, Total Suspended Solids, Phosphorus**	Rural (Residential Areas), Runoff from Forest/Grassland/Parkland
LUCY LAKE	IL_SGT	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Rural (Residential Areas), Runoff from Forest/Grassland/Parkland
MANNING SLOUGH	IL_UGQ	None Assessed	N/A	N/A
MARY LEE	IL_UGR	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Phosphorus, Aquatic Plants**	Golf Courses, Agriculture

LAKE	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
MEADOW LAKE E.	IL_WGL	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Rural (Residential Areas), Urban Runoff/Storm Sewers, Runoff from Forest/Grassland/Parkland
MEADOW LAKE W.	IL_WGF	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Urban Runoff/Storm Sewers, Rural (Residential Areas), Runoff from Forest/Grassland/Parkland
MILTMORE	IL_RGZD	Aquatic Life-Full Support, Primary Contact-Full Support, Secondary Contact-Full Support, Aesthetic Quality-Full Support	N/A	N/A
MINEAR	IL_RGP	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	Cause Unknown, **Aquatic Plants**	Residential Districts, Yard Maintenance, Natural Sources, Runoff from Forest/Grassland/Parkland
NORTH ECONOMY GRAVEL PIT	IL_UGE	None Assessed	N/A	N/A
OLD MILL	IL_WGU	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Site Clearance (Land Development or Redevelopment), Wildlife other than Waterfowl, Urban Runoff/Storm Sewers, Waterfowl, Runoff from Forest/Grassland/Parkland
OSPREY	IL_SGY	**Aquatic Life-Non Support, Aesthetic Quality-Non Support**	**Non-Native Aquatic Plants, Dissolved Oxygen, Total Suspended Solids, Phosphorus, Aquatic Plants**	Unknown

LAKE	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
PETERSON POND	IL_UGI	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	Cause Unknown, **Aquatic Plants**	Unknown
POND-A-RUDY	IL_UGP	**Aquatic Life-Non Support, Aesthetic Quality-Non Support**	**Dissolved Oxygen*, Total Suspended Solids, Phosphorus*, Aquatic Plants**	Unknown
POTOMAC LAKE	IL_RGZK	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Phosphorus, Aquatic Plants**	Rural (Residential Areas), Urban Runoff/Storm Sewers
RASMUSSEN LAKE	IL_UGY	**Aquatic Life-Non Support, Aesthetic Quality-Non Support**	**Dissolved Oxygen, Phosphorus, Total Suspended Solids**	Unknown
REDWING SLOUGH	IL_VGD	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Agriculture, Runoff from Forest/Grassland/Parkland
ROBINSON PIT	IL_UGD	None Assessed	N/A	N/A
ROLLINS SAVANNA #1	IL_VGW	**Aesthetic Quality-Non Support**	Cause Unknown	Unknown
ROLLINS SAVANNA #2	IL_VGX	**Aesthetic Quality-Non Support**	**Phosphorus**	Internal Nutrient Recycling
SALEM-REED	IL_WGK	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus*, Aquatic Plants**	Unknown
SANCTUARY POND	IL_SGX	None Assessed	N/A	N/A
SAND	IL_RGM	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	Cause Unknown, **Aquatic Plants**	Rural (Residential Areas), Urban Runoff/Storm Sewers, Runoff from Forest/Grassland/Parkland
SCHERMERVILLE	IL_WGZT	None Assessed	N/A	N/A

LAKE	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
SLOUGH	IL_RGZE	**Aquatic Life-Non Support, Aesthetic Quality-Non Support**	**Dissolved Oxygen, Total Suspended Solids, Phosphorus**	Agriculture, Rural (Residential Areas), Runoff from Forest/Grassland/Parkland
ST. MARY'S LAKE	IL_UGF	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Contaminated Sediments, Littoral/shore Area Modifications (Non-Riverine), Streambank Modifications/Destabilization, Unknown, Urban Runoff/Storm Sewers, Runoff from Forest/Grassland/Parkland
STERLING	IL_WGZJ	Aquatic Life-Full Support, Aesthetic Quality-Full Support	N/A	N/A
STOCKHOLM	IL_UGS	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Golf Courses, Agriculture
SYLVAN	IL_RGZF	Aquatic Life-Full Support, **Primary Contact-Non Support, Aesthetic Quality-Non Support**	**Fecal Coliform*, Total Suspended Solids, Phosphorus***	Littoral/shore Area Modifications (Non-Riverine), Unknown
THIRD	IL_RGW	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Littoral/shore Area Modifications (Non-Riverine), Yard Maintenance, Agriculture, Rural (Residential Areas)
TIMBER LAKE (NORTH)	IL_UGZ	Aquatic Life-Full Support, Aesthetic Quality-Full Support	N/A	N/A
VALLEY	IL_RGZM	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Unknown

LAKE	ILLINOIS EPA ASSESSMENT UNIT ID	DESIGNATED USE(S) AND LEVEL OF SUPPORT	CAUSE(S)	SOURCE(S)
WATERFORD (WALDEN)	IL_WGS	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Other Recreational Pollution Sources, Urban Runoff/Storm Sewers, Rural (Residential Areas)
WERHANE LAKE	IL_VGH	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus, Aquatic Plants**	Unknown
WESTCHESTER II	IL_SGD	Aquatic Life-Insufficient Information, Aesthetic Quality-Insufficient Information	Phosphorus, Aquatic Algae	Waterfowl, Urban Runoff/Storm Sewers
WHITE LAKE	IL_UGX	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Phosphorus**	Site Clearance (Land Development or Redevelopment), Agriculture, Rural (Residential Areas), Runoff from Forest/Grassland/Parkland
WILLOW	IL_UGT	Aquatic Life-Full Support, **Aesthetic Quality-Non Support**	**Total Suspended Solids, Phosphorus**	Unknown
WINDWARD LAKE	IL_VGL	Aquatic Life-Full Support, Aesthetic Quality-Full Support	N/A	N/A

3.16.2 Total Maximum Daily Load for Des Plaines River/Higgins Creek

Total Maximum Daily Load (TMDL): An estimation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. It assesses contributing point and nonpoint sources and identifies pollution reductions necessary for designated use attainment.

Section 303(d) of the Clean Water Act requires Illinois EPA to identify all waters that do not meet water quality standards. For waters impaired by pollutants, Section 303(d) requires the development of a **TMDL**.

Illinois EPA developed the Des Plaines River/Higgins Creek Watershed TMDL Report in 2013, covering 18 lakes and stream segments, 14 of which are in the DPR planning area. The report directly addresses the pollutants phosphorus, fecal coliform, chloride. Dissolved oxygen impairment resulting from nutrient enrichment was addressed by developing a TMDL for phosphorus, carbonaceous biochemical oxygen demand and/or ammonia. The results of the report are summarized in Table 3-51. For all pollutants and all water bodies, the pollutant load reductions needed to achieve the water quality standard are achieved by subtracting the permitted load from point sources and a factor of safety from the modeled TMDL, and dividing the remaining load ("waste load allocation") among the municipal MS4 permit holders in the tributary area based on relative acreage.

Table 3-51: Load reductions needed to attain water quality standards for Total Maximum Daily Load pollutants as reported in the Des Plaines/Higgins Creek Watershed TMDL Report. Source: Illinois EPA 2013

WATERBODY	TMDL POLLUTANT	LOAD REDUCTION NEEDED TO ATTAIN WATER QUALITY STANDARD	MUNICIPAL MS4S TRIBUTARY TO TMDL WATER BODY AND ASSIGNED WASTELOAD ALLOCATION TO ACHIEVE LOAD REDUCTION, BASED ON AREA IN TRIBUTARY WATERSHED
Buffalo Creek	Fecal Coliform	12-85%*	Long Grove, Lake Zurich, Buffalo Grove, Kildeer, Deer Park, Barrington, Palatine, Inverness, and Arlington Heights
Buffalo Creek	Chloride	11-46%*	Long Grove, Lake Zurich, Buffalo Grove, Kildeer, Deer Park, Barrington, Palatine, Inverness, and Arlington Heights
Buffalo Creek	Carbonaceous biochemical oxygen demand**	39%	Long Grove, Lake Zurich, Buffalo Grove, Kildeer, Deer Park, Barrington, Palatine, Inverness, and Arlington Heights
Buffalo Creek	Ammonia**	30%	Long Grove, Lake Zurich, Buffalo Grove, Kildeer, Deer Park, Barrington, Palatine, Inverness, and Arlington Heights
Albert Lake	Total phosphorus**	89%	Lake Zurich, Long Grove, and Kildeer
Big Bear Lake	Total phosphorus	33%	Libertyville, Mundelein, and Vernon Hills
Bresen Lake	Total phosphorus	59%	Hawthorn Woods
Buffalo Creek Reservoir	Total phosphorus**	65%	Arlington Heights, Barrington, Buffalo Grove, Deer Park, Inverness, Kildeer, Lake Zurich, Long Grove, and Palatine
Countryside Lake	Total phosphorus	51%	Hawthorn Woods, Long Grove, and Mundelein
Diamond Lake	Total phosphorus	9%	Long Grove and Mundelein

WATERBODY	TMDL POLLUTANT	LOAD REDUCTION NEEDED TO ATTAIN WATER QUALITY STANDARD	MUNICIPAL MS4S TRIBUTARY TO TMDL WATER BODY AND ASSIGNED WASTELOAD ALLOCATION TO ACHIEVE LOAD REDUCTION, BASED ON AREA IN TRIBUTARY WATERSHED
Forest Lake	Total phosphorus	63%	Hawthorn Woods and Lake Zurich
Half Day Pit	Total phosphorus**	80%	Lincolnshire
Lake Charles	Total phosphorus	13%	Libertyville, Mundelein, and Vernon Hills
Little Bear Lake	Total phosphorus	7%	Libertyville, Mundelein, and Vernon Hills
Pond-A-Rudy	Total phosphorus**	67%	Hawthorn Woods
Salem Lake	Total phosphorus	69%	Long Grove
Sylvan Lake	Fecal Coliform	80%	Hawthorn Woods and Long Grove
Sylvan Lake	Total phosphorus	35%	Hawthorn Woods and Long Grove

*Percent reduction needed to achieve water quality standards changes based on flow conditions. **Also addresses dissolved oxygen impairment

For the TMDL models, wastewater dischargers were assumed to be operating within NPDES permit limits and were not assigned a load reduction. The excess chloride load in Buffalo Creek is attributed to winter de-icing activities. For Sylvan Lake, nonpoint sources, including agricultural practices, such as grazing livestock, and septic system failure were indicated as potential sources of fecal coliform loading and are included in the load allocation.

3.16.3 Summary of previous studies and DRWW monitoring program

In the last two decades, dozens of efforts to monitor, sample, and collect field data on chemical, physical, and biological parameters related to water quality have been undertaken in the planning area. Data of at least one type (physical/chemical or biological) are available for more than 70 specific locations throughout the planning area. Data have been gathered by various investigators for different purposes and reasons and therefore are not always directly comparable. While it is beyond the scope of this plan to provide an exhaustive review of all sources of water quality data available across the planning area, a list of studies and datasets that have been generated in the last 20 years is included for reference (see Table 3-52), and the results are summarized in the following pages. Generally, these data fall into one or more of the following categories: 1) data were collected by a public agency; 2) data are available publicly; 3) data/study is cited or referenced in previous watershed-based plans.

In 2015, the Des Plaines River Watershed Workgroup (DRWW) began collecting water column chemistry, streambed sediment, and biological community data at 40 sites in the planning area. In 2016, DRWW collected water chemistry, fish and macroinvertebrate data at 69 sites, sediment data at 50 sites and flow monitoring at 21 sites within the planning area. Currently 70 monitoring sites are located on the Des Plaines River and on tributary streams, including several not previously studied. The results of that data collection effort are discussed relative to previous data collection and monitoring efforts below. The findings of their baseline report (MBI, 2017) indicate similar trends to those identified in previous studies. None of the sites achieved full support for the aquatic life use/general use category. While no sites achieved the support criteria for fish assemblage, 34 of 70 sites achieved the criteria for aquatic macroinvertebrate assemblage. Major causes associated with impairment include siltation, chlorides, habitat degradation, organic enrichment/nutrients/dissolved oxygen, and Polycyclic Aromatic Hydrocarbons (PAHs)/Manganese. Sources to which these causes are attributed are urban runoff, habitat and hydrologic alterations, and wastewater treatment plant effluent. Excessive siltation and embeddedness of substrates was identified as the most pervasive cause of aquatic life impairment in the study. The increasing concentration of dissolved materials, markedly chloride, is noted as a trend across the entire study area and is consistent with data from previous studies. Organic enrichment from multiple sources was also prevalent across sites. Streambed sediment sampling indicated that PAHs are present throughout the DPR planning area and are correlated to urban land use (MBI, 2017).

Table 3-52: Summary of relevant recent stream water quality studies and monitoring efforts for the Des Plaines River and tributaries within the planning area

STREAM (STATION LOCATION)	YEAR	INVESTIGATOR(S)	NOTES
Des Plaines River (Wadsworth Rd., US Rt. 41, Washington St., IL Rt. 120, Oak Spring Rd., IL Rt. 60, Deerfield Rd.)	1986-2015	North Shore Water Reclamation District (formerly North Shore Sanitary District)	Chemical/physical parameters, aquatic macroinvertebrates, fish
Des Plaines River (IL Rt. 60, Benjamin Dr.)	2011-2015	Lake County Department of Public Works	Chemical/physical parameters
Des Plaines River (Russell Rd., Wadsworth Rd., Oak Spring Rd., IL Rt. 120, Benjamin Dr.)	1999-2015	Illinois Environmental Protection Agency	Chemical/physical parameters
Des Plaines River (Russell Rd.), Mill Creek (Wadsworth), Bull Creek (IL Rt. 21)	2000-2001	United States Geological Survey	Chemical/physical parameters, aquatic macroinvertebrates, fish (part of National Water Quality Assessment)
Aptakisic Creek (Pekara Dr., Aspen Dr.)	2003-2015	Lake County Department of Public Works	Chemical/physical parameters

STREAM (STATION LOCATION)	YEAR	INVESTIGATOR(S)	NOTES
Bull Creek (IL Rt. 21)	2003, 2008, 2013	Illinois Environmental Protection Agency & Illinois Department of Natural Resources	Chemical/physical parameters, aquatic macroinvertebrates, fish
Bull Creek (IL Rt. 21, Cass Park)	2001	Illinois Natural History Survey	Fish
Bull Creek, Bull's Brook (multiple)	2005	Integrated Lakes Management	Chemical/physical parameters (reported in Bull Creek/Bull's Brook Watershed-Based Plan)
Bull Creek, Bull's Brook (multiple)		Applied Ecological Services	Chemical/physical parameters (reported in Bull Creek/Bull's Brook Watershed-Based Plan)
Bull Creek, Bull's Brook (5 sites)	1997-2003	Riverwatch	Aquatic macroinvertebrates
Buffalo Creek (15 sites)	2013-2015	Buffalo Creek Clean Water Partnership	Chemical/physical parameters
Buffalo Creek	1996-2014	Riverwatch	Aquatic macroinvertebrates
Buffalo Creek	2012-2014	Buffalo Creek Clean Water Partnership	Aquatic macroinvertebrates
Indian Creek (Vernon Twp. Park)	2003, 2008, 2013	Illinois Environmental Protection Agency & Illinois Department of Natural Resources	Chemical/physical parameters, aquatic macroinvertebrates, fish
Seavey Ditch (Vernon Hills Golf Course)	2008	Village of Vernon Hills/Living Waters Consultants	Fish
Sylvan Lake Drain (above former WWTP, Washitay Ave.)	2006-2014	Lake County Department of Public Works	Chemical/physical parameters
Mill Creek (upstream of water reclamation facility, facility outfall, Dilley's Rd.)	2007, 2013	Lake County Department of Public Works, Hey & Associates	Chemical/physical parameters, aquatic macroinvertebrates, fish
Mill Creek (upstream of water reclamation facility, Dilley's Rd.)	2007-2015	Lake County Department of Public Works	Chemical/physical parameters
Mill Creek (Dilley's Rd.)	1999-2015	North Shore Water Reclamation District	Chemical/physical parameters

STREAM (STATION LOCATION)	YEAR	INVESTIGATOR(S)	NOTES
Mill Creek (Dilley's Rd.)	1999	Illinois Natural History Survey	Fish
Mill Creek (Il Rt. 83)	2012	Illinois Natural History Survey	Fish
Mill Creek (US Rt. 41, below Grandwood Park Dam)	2013	Illinois Environmental Protection Agency & Illinois Department of Natural Resources	Chemical/physical parameters, aquatic macroinvertebrates, fish
North Mill Creek (Millburn Rd., Old Kelly Rd.)	1998	Illinois Natural History Survey	Fish
Dutch Gap Canal (IL Rt. 173)	2010	Illinois Natural History Survey	Fish
North Mill Creek (Old Kelly Rd.), Hastings Creek (Miller Rd.), Dutch Gap Canal (IL Rt. 173), Dutch Gap Canal (Edwards Rd.)	2010	Lake County Health Department, Lake County Stormwater Management Commission/Living Waters Consultants	Chemical/physical parameters, aquatic macroinvertebrates, fish
North Mill Creek (Old Kelly Rd.), Hastings Creek (Miller Rd.), Dutch Gap Canal (IL Rt. 173)	2008, 2013	Illinois Environmental Protection Agency & Illinois Department of Natural Resources	Chemical/physical parameters, aquatic macroinvertebrates, fish
Dutch Gap Canal (Kenosha Co.)	2003, 2005	Wisconsin Department of Natural Resources	Aquatic macroinvertebrates, fish
Newport Ditch (Kilbourne Rd.)	1998	Illinois Natural History Survey	Fish
MacArthur Woods Tributary (Forest Preserve)	1997	Illinois Natural History Survey	Fish
Belvidere Road Tributary (IL Rts. 21 & 120)	2004, 2013	Illinois Natural History Survey	Fish
Watershed-wide	2002-2004	U.S. Army Corps of Engineers, Illinois Department of Natural Resources, Southeastern	Fish; 21 sites in DPR planning area(49 total sites in study)

STREAM (STATION LOCATION)	YEAR	INVESTIGATOR(S)	NOTES
		Wisconsin Regional Planning Commission	
Watershed-wide	2015-Present	Des Plaines River Watershed Workgroup	Chemical/physical parameters, aquatic macroinvertebrates, fish; 70 sites within planning area
Watershed-wide	1995-present	Lake County Forest Preserve District	Fish; fishery surveys at Forest Preserve properties

3.16.3.1Des Plaines River Mainstem

Several agencies have gathered water quality data for the Des Plaines River over the past two decades, including the United States Geological Survey (USGS), Illinois EPA, Illinois Department of Natural Resources, US Army Corps of Engineers, North Shore Water Reclamation District (NSWRD), and Lake County Public Works Department, the last two in conjunction with the discharge of effluent from wastewater treatment plants. The USGS gathered data from three sites in the DPR planning area (Des Plaines River at Russell Road, Mill Creek at Wadsworth, and Bull Creek at Libertyville) as part of its study of the effect of urbanization on the Des Plaines and Fox River watersheds (Harris, et al., 2005). Illinois EPA and Illinois DNR gather data from several sites in the DPR planning area every five years as part of the intensive basin survey. The Des Plaines River Watershed Workgroup began an intensive and comprehensive water quality monitoring effort throughout the DPR planning area in 2015 and findings through 2016 are discussed below.

3.16.3.2Dissolved Oxygen

Data from all sources indicated that dissolved oxygen fell below the water quality standard in 2.77% of samples for all sites (17 of 613 samples). In any body of water, dissolved oxygen generally decreases as water temperature rises, and dissolved oxygen data for the Des Plaines River displays a strong negative correlation to water temperature. Of all samples that fell below 5.0 mg/L (the higher of the two date-specific water quality standards), only one occurred when measured water temperature was below 60° F. The data also indicate that dissolved oxygen *increased* from upstream to downstream (i.e., low dissolved oxygen was more common upstream), as shown in Figure 3-70. It is unknown if this is a result of the nature of the river channel in northern Lake County or the result of oxygenated inputs (mainly treated wastewater effluent) south of Wadsworth Road. Of note, dissolved oxygen is listed as a cause of impairment in assessment units G-08 and G-25, the reaches containing the Russell Road and Wadsworth Road sample points.

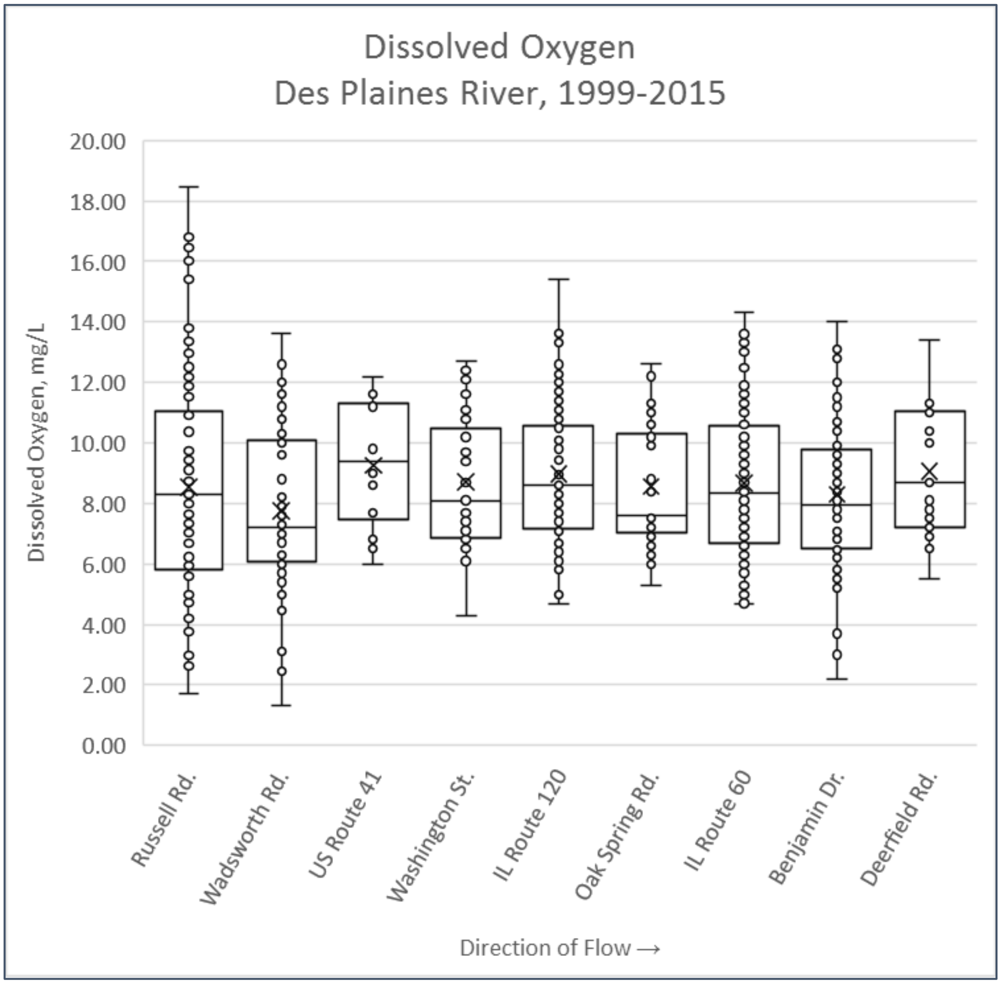


Figure 3-71: Upstream to downstream trend in dissolved oxygen from sample data on the Des Plaines River mainstem, 1999-2015
Mean for each location is indicated by the "X" marker.

DRWW baseline monitoring did not indicate any exceedances of the of the Illinois ambient water quality standards for dissolved oxygen in the Des Plaines River mainstem. Lower concentrations at the northern end of the DPR planning area are attributed to sluggish flows and prevalence of duckweed.

3.16.3.3Chloride

Chloride concentrations exceeded the USEPA chronic threshold for aquatic life of 230 mg/L in 10% of samples and exceeded the Illinois water quality standard (acute threshold) of 500 mg/L in 0.9% of samples. Chloride concentration increased slightly in the downstream direction. Data from all sites indicate that chloride concentration has increased over time, particularly from 2010-2015, as shown in Figure 3-71 The proportion of samples with chloride concentrations below 100 mg/L decreases markedly during this time frame. These trends are consistent with the baseline findings of the DRWW monitoring effort.

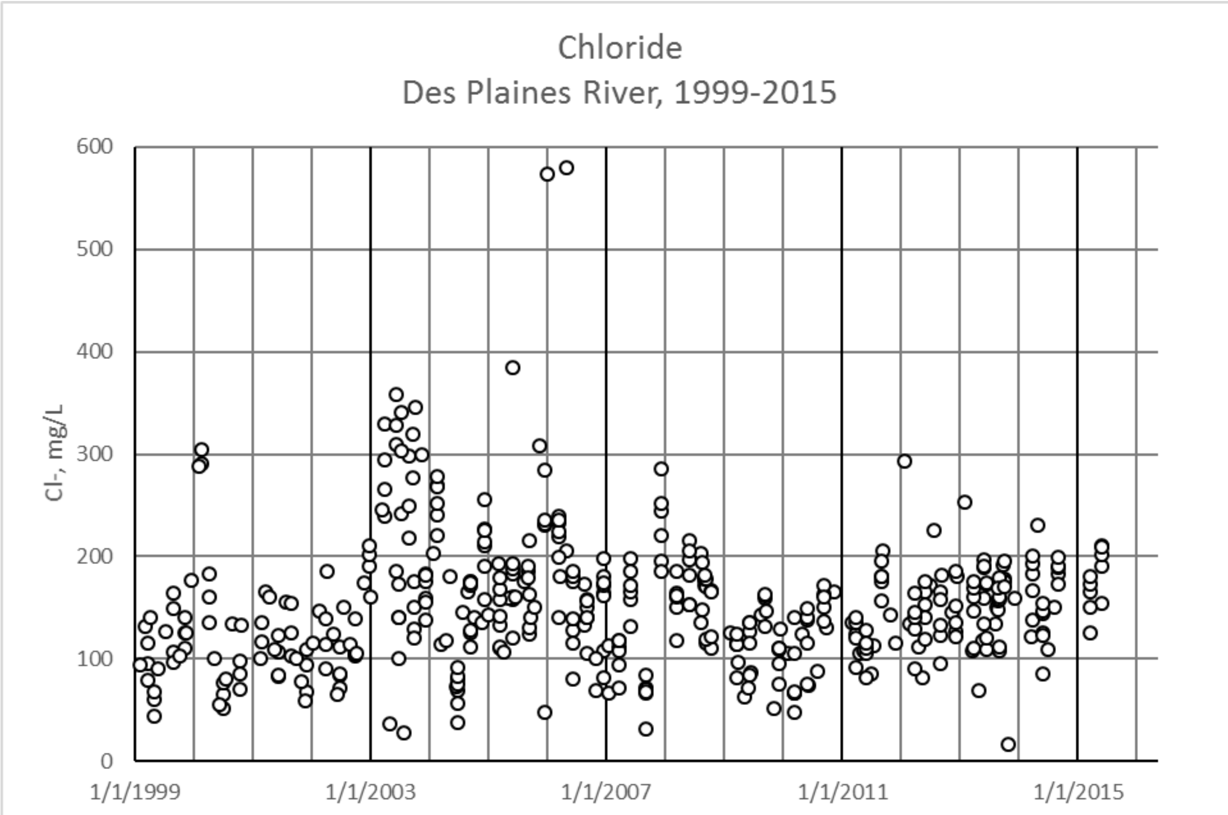


Figure 3-72: Chloride concentration in the Des Plaines River mainstem, 1999-2015, for all sample locations in the planning area

3.16.3.4 USEPA National Rivers and Streams Assessment

The USEPA National Rivers and Streams Assessment is compiled from data collected from 2008-2009 at more than 1,900 sampling locations nationwide using uniform field collection methods. The data were used to assess the condition of the nation's streams using biological, physical, and chemical data. Sampling sites were further divided into 11 geographical regions to develop thresholds for key pollutants (acidity, salinity as conductivity, total nitrogen, and total phosphorus) indicating the level of disturbance, based on all sites sampled in that region. The DPR planning area is in the "temperate plains region" and is compared to the thresholds developed for that region. The National Rivers and Streams Assessment used "good," to describe the chemical condition at the least disturbed sites (i.e., lowest levels of pollution) and "poor" to describe the condition at the most disturbed sites (i.e., highest levels of pollution). "Fair" describes the sites that fall between the "good" and "poor" thresholds for a given pollutant.

The DRWW baseline monitoring indicates elevated chloride levels throughout the Des Plaines River mainstem within the planning area. Figure 3-72 displays the 2015 and 2016 chloride trends from upstream to downstream, indicating a continuation of the recent historical trend, with the preponderance of concentration values above 100 mg/L. Additionally, the figure indicates the relation of chloride values to the USEPA chronic threshold as well as thresholds derived for fish and macroinvertbrates in the DuPage River system in northeastern Illinois.

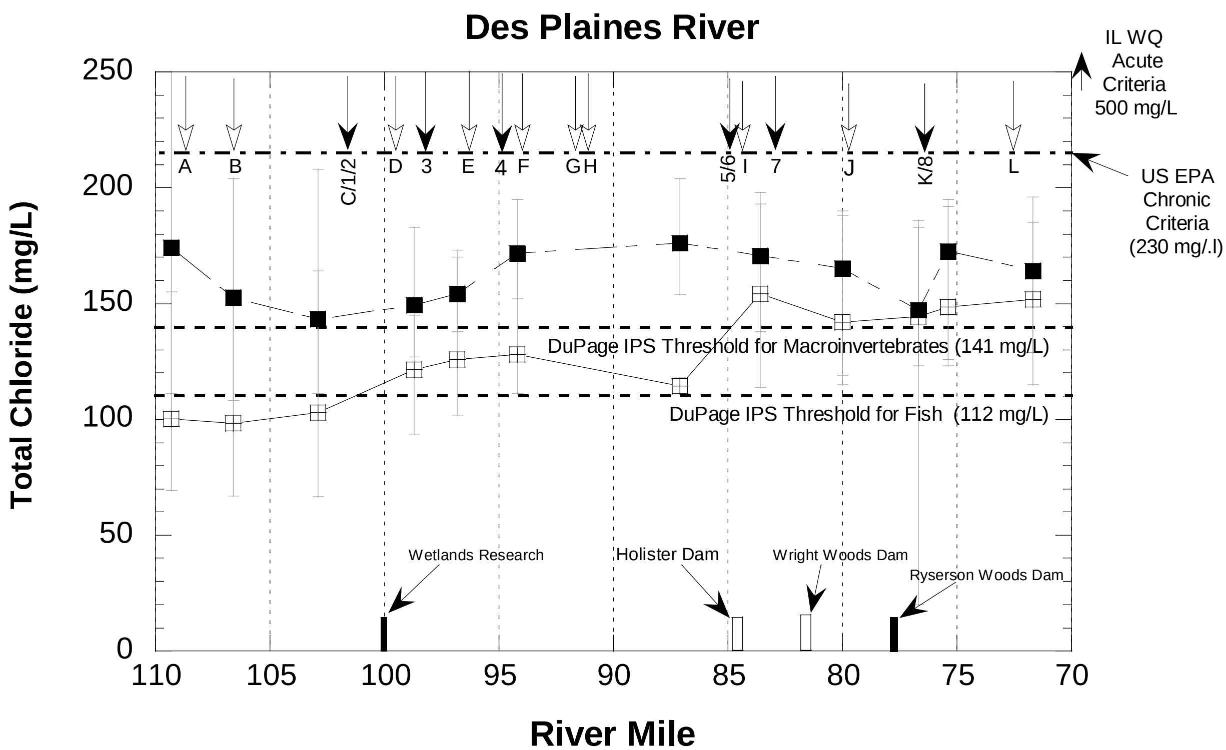


Figure 3-73: Concentrations of Total Chlorides in the Des Plaines River Mainstem

(From MBI, 2017). Mean, maximum, and minimum concentrations of total chlorides (upper panel) in the Des Plaines River mainstem in 2015 and 2016 in relation to municipal WWTP discharges and tributaries. Mainstem dams or weirs (black bars for dams that impede fish passage) are indicated by bars along the lower x-axis. The Illinois water quality criterion (500 mg/L), the USEPA national criterion (230 mg/L), and the DuPage IPS thresholds for fish (141 mg/L) and macroinvertebrates (112 mg/L) are indicated by dotted lines. The top arrows pointing downwards with letters signify tributary streams flowing into the Des Plaines River mainstem and that numbers indicate POTW discharges.

3.16.3.5Nitrogen

The only water quality standards in Illinois for nitrogen apply to public and food processing water supply (10mg/L for nitrate + nitrite, 10 mg/L for nitrate, 1 mg/L for nitrite) and therefore are not applicable to this DPR planning areafor the determination of designated use impairments under the State's water quality standards. More broadly, however, nitrogen is of concern throughout the Mississippi River basin as it, along with phosphorus, is one of the main contributors to seasonal hypoxia in the Gulf of Mexico. The USEPA National Rivers and Streams Assessment (USEPA, 2016) developed thresholds for total nitrogen, the sum of total Kjeldahl nitrogen (TKN), nitrate (NO_3), and nitrite (NO_2). The thresholds are not water quality standards but indicate the level of disturbance relative to a reference condition. Based on these thresholds, total nitrogen levels in the Des Plaines River are elevated above reference conditions, resulting in 88% of samples falling into the NRSA's "poor" condition, with total nitrogen concentrations above 1.274 mg/L. Available data indicate that the elements comprising total nitrogen are elevated where the Des Plaines River enters the DPR planning areafrom Wisconsin, and remain high or increase through the DPR planning area(Figure 3-73 and Figure 3-74). The range of TKN concentrations are relatively stable from upstream to downstream while nitrate-nitrite nitrogen concentrations increase in the downstream direction, resulting in a corresponding up- to downstream increase in total nitrogen through the planning area. These trends are consistent with the findings of the DRWW baseline monitoring study.

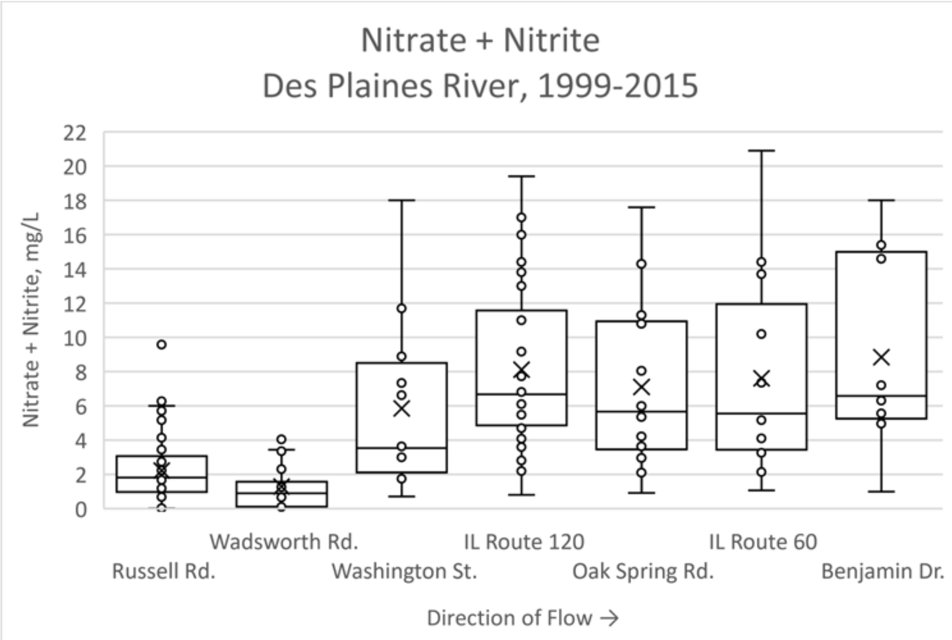


Figure 3-74: Upstream to downstream trend in nitrate/nitrite nitrogen on the Des Plaines River mainstem
Mean for each location is indicated by the “X” marker. Nitrate/Nitrite nitrogen sample data on the Des Plaines River mainstem, 1999-2015.

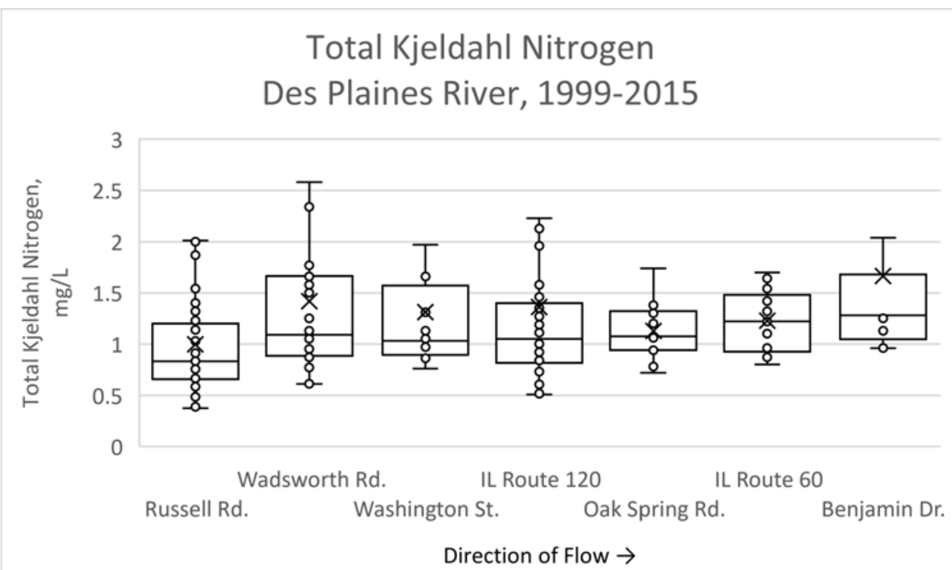


Figure 3-75: Upstream to downstream trend in total Kjeldahl nitrogen from Des Plaines River mainstem
Mean for each location is indicated by the “X” marker, outliers removed. Total Kjeldahl nitrogen from sample data on the Des Plaines River mainstem, 1999-2015.

The DRWW monitoring data did not indicate exceedances of water quality criteria for ammonia-N at any site in the planning area. Total Kjeldahl nitrogen exhibited elevated levels at upstream and mid-stream sites as well as a consistent upstream to downstream pattern from 2015 to 2016 (Figure 3-75). Nitrate concentrations increased from upstream to downstream in association with the addition of treated wastewater effluent. Nitrate levels approached or exceeded non-standard benchmarks and were well above the USEPA ecoregional reference background value of 1.798 mg/L Figure 3-76) (MBI, 2017).

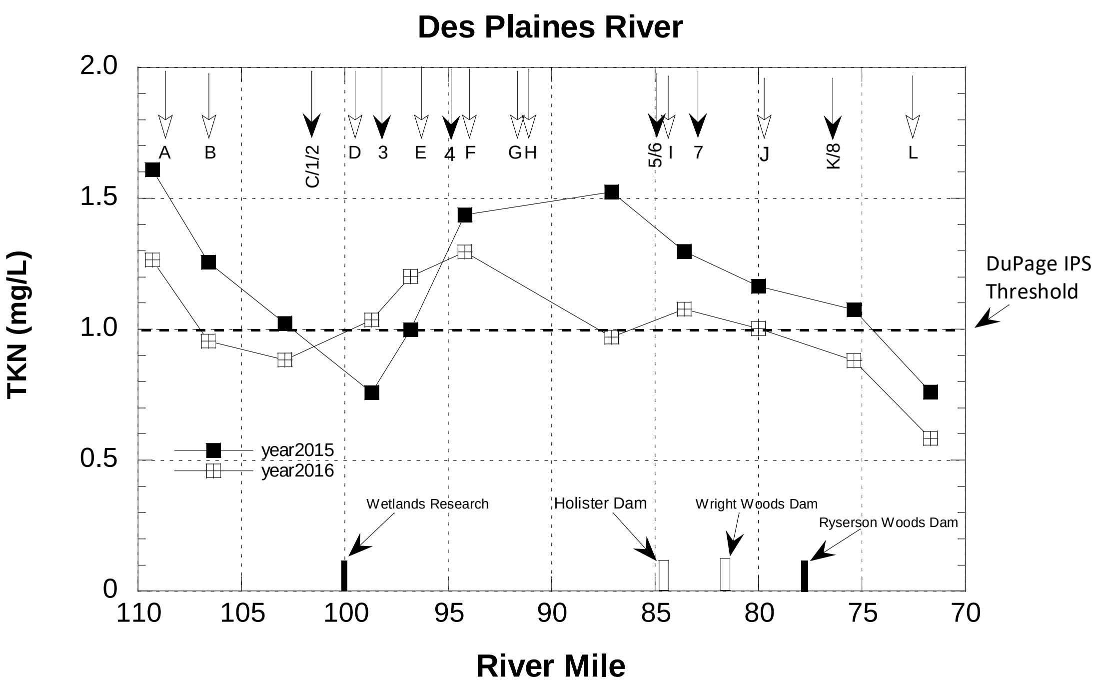


Figure 3-76: Concentrations of TKN in the Des Plaines River mainstem in 2015 and 2016 in relation to municipal WWTP discharges and tributaries

(From MBI, 2017). Mainstem dams or weirs (black bars for dams that impede fish passage) are indicated by bars along the lower x-axis. A dashed line represents effect levels correlated with impaired biota in the DuPage River-Salt Creek IPS study (1.0 mg/L). The top arrows pointing downwards with letters signify tributary streams flowing into the Des Plaines River mainstem and that numbers indicate POTW discharges.

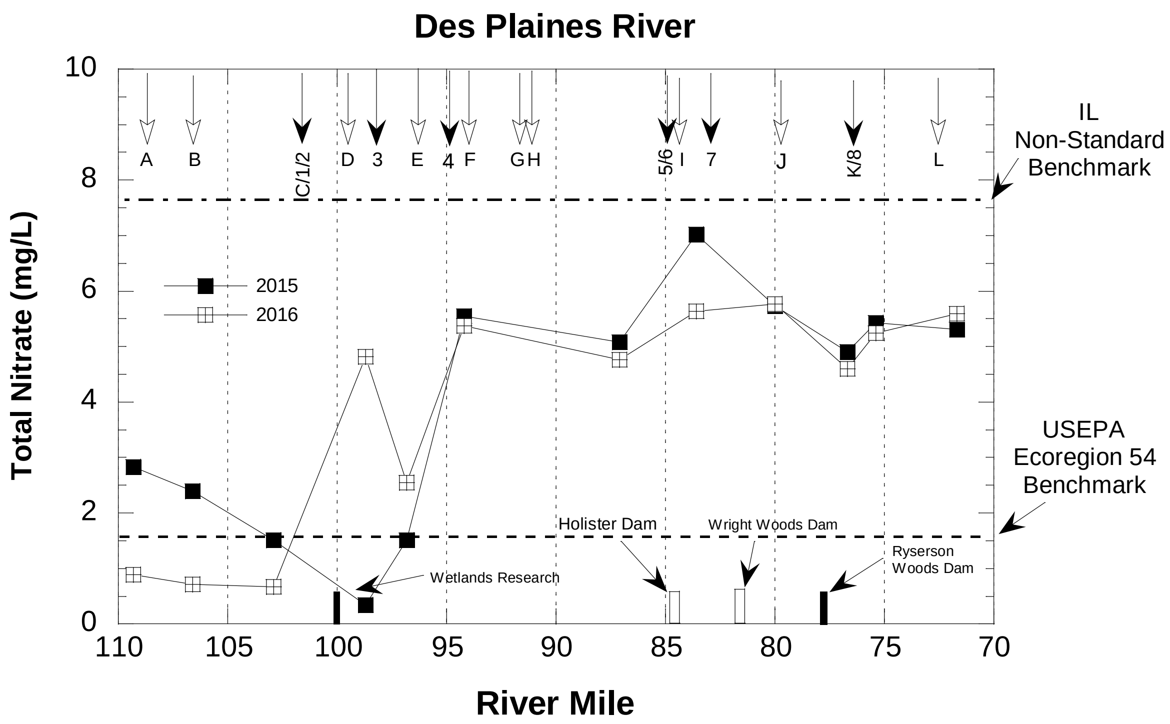


Figure 3-77: Concentrations of total nitrate-N in the Des Plaines River mainstem in 2015 and 2016 in relation to municipal WWTP discharges and tributaries.

(From MBI, 2017). Mainstem dams or weirs (black bars for dams that impede fish passage) are indicated by bars along the lower x-axis. The lower dashed line represents the USEPA Ecoregion 54 background reference site concentration (1.8 mg/L) and the upper dashed line the IL non-standard benchmark (7.8 mg/L). The top arrows pointing downwards with letters signify tributary streams flowing into the Des Plaines River mainstem and that numbers indicate POTW discharges.

3.16.3.6Phosphorus

Phosphorus standards do not exist for streams in Illinois, however lakes over 20 acres have a total phosphorus standard of 0.05 mg/L. Prior to 2012, Illinois EPA used a non-standard based criterion of 0.61mg/L to determine whether total phosphorus was a potential cause of aquatic life impairment in streams, resulting in the identification of phosphorus as such for 3 assessment units of the Des Plaines River in the planning area. The listing as a potential cause of impairment will remain until new data indicate that the segment fully supports the aquatic life use. In monitoring data from 1999-2015 for the Des Plaines River, about 3% of samples had non-flow-weighted concentrations below 0.05 mg/L and about 55% of samples were below 0.61 mg/L. The middle 50% of samples ranged from 0.176-1.18 mg/L. The USEPA National Rivers and Streams Assessment developed thresholds for total phosphorus as an indicator of the level of disturbance. Based on the USEPA thresholds for the region, 79% of the samples for the Des Plaines River fall into the "poor" or most disturbed condition (>0.143 mg/L). Like nitrogen, phosphorus levels in the Des Plaines River are elevated when the river enters the DPR planning area and increase downstream within the planning area, particularly south of Wadsworth Road (Figure 3-77). These trends are consistent with the findings of the DRWW baseline monitoring study.

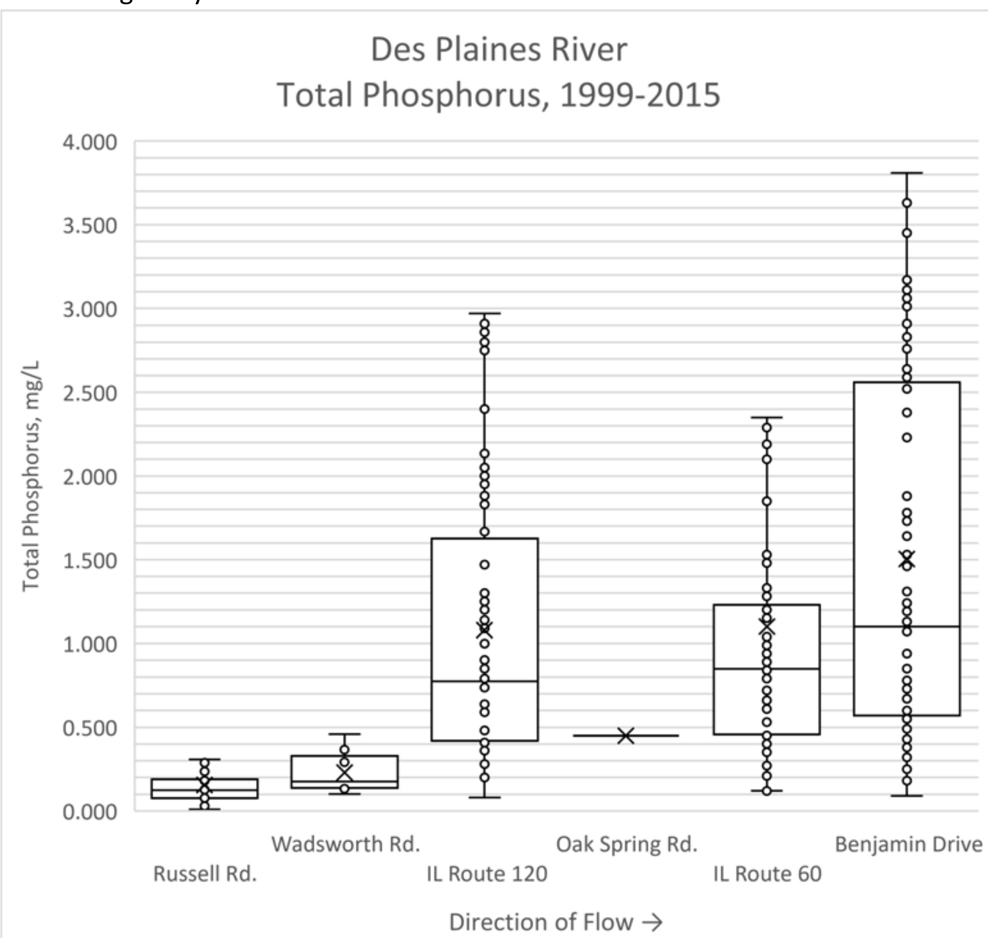


Figure 3-78: Upstream to downstream trend in total Phosphorus from sample data on the Des Plaines River mainstem, 1999-2015

Mean for each location is indicated by the "X" marker, outliers removed.

The DRWW monitoring data from 2015 and 2016 are consistent with trends identified in other sources of data from the past two decades, mainly in the upstream to downstream increase in phosphorus concentrations along the Des Plaines River mainstem within the DPR planning area (Figure 3-78**)**. Monitoring sites are consistently above the USEPA background levels for ecoregion 54 as well as above the "poor" condition phosphorus threshold for the National Rivers and Streams Assessment (>0.143 mg/L).

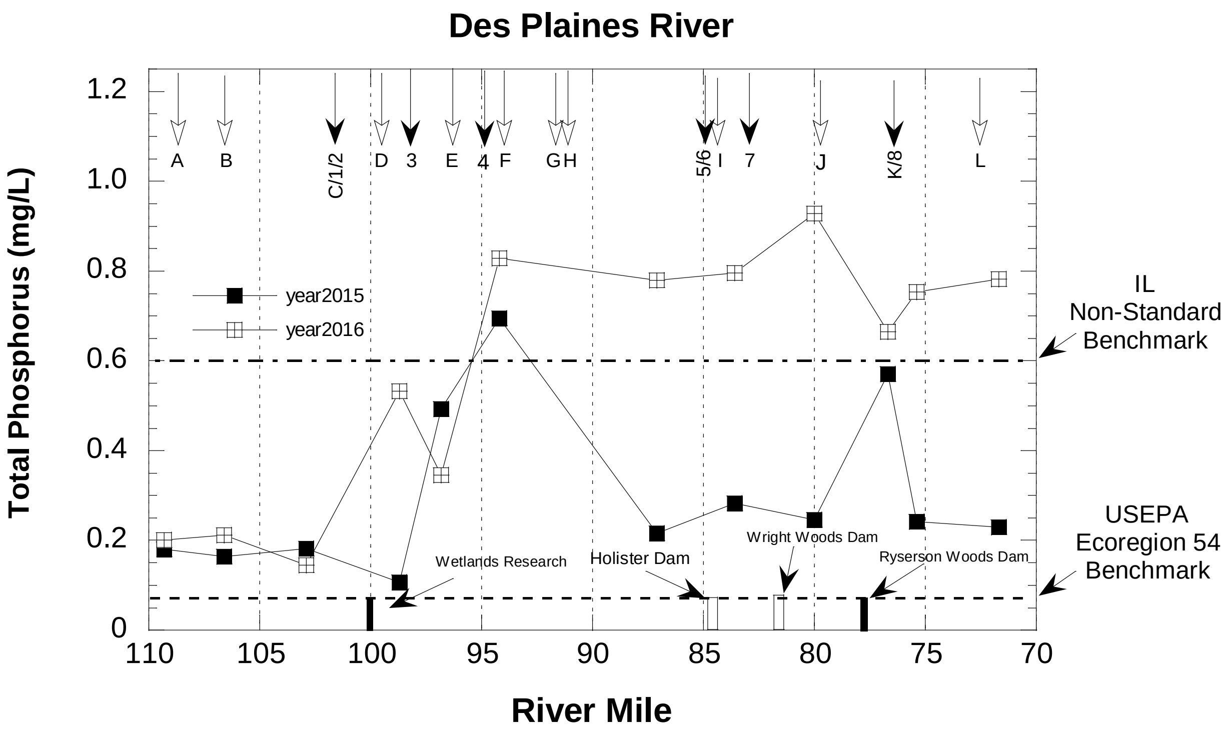


Figure 3-79: Concentrations of total phosphorus in the Des Plaines River mainstem in 2015 and 2016 in relation to municipal WWTP discharges and tributaries

(from MBI, 2017). Mainstem dams or weirs (black bars for dams that impede fish passage) are indicated by bars along the lower x-axis. The lower dashed line represents the USEPA Ecoregion 54 background reference site concentration (0.07 mg/L) and the upper dashed line the IL non-standard benchmark (0.61 mg/L).

3.16.3.7 Total Suspended Solids (TSS)

Currently, no water quality standard exists for TSS in Illinois streams. Prior to 2012, the Illinois EPA used a non-water quality standard-based criterion of 116 mg/L to determine whether TSS was a potential cause of aquatic life impairment in streams. As a result, TSS was listed as a cause of impairment for 2 assessment units of the Des Plaines River in the planning area. TSS will continue to be identified as a potential cause of impairment in these segments until new data indicate full support of the aquatic life use. Elevated TSS in streams can result from several natural and anthropogenic sources. Natural sources include erosion of stream banks and bed materials and resuspension of sediment and organic material, TSS inputs from tributary streams, and particulates carried into streams from the surrounding landscape by runoff. Anthropogenic sources of TSS include erosion from human activities that result in vegetation and soil disturbance such as agriculture, forestry, and site development or redevelopment, perturbation of the stream channel such as dredging, and rill, gully, and stream channel erosion resulting from concentrated or increased runoff caused by land use and land cover changes. Available monitoring data from 1999-2015 do not indicate a clear relationship between TSS and streamflow (discharge), so it is likely that several variables influence measured TSS levels in the Des

Plaines River. Data from the DRWW baseline monitoring study indicated some upstream to downstream increase of TSS in the Des Plaines River mainstem, however the levels did not exceed other published threshold levels (MBI, 2017).

3.16.3.8Metals

Arsenic is identified as a potential cause of impairment of aquatic life in 2 assessment units of the Des Plaines River within the planning area, based on sediment chemistry data. Neither the historical monitoring data nor the DRWW study data indicate violations of the acute or chronic water quality standards for dissolved arsenic in the Des Plaines River. Sediment samples from the DRWW study did not indicate arsenic levels elevated above the commonly referenced threshold effect levels. The listing as a potential cause of impairment will remain until new data indicate the segment fully supports the aquatic life use. Manganese is not listed as a cause of impairment for any portion of the Des Plaines River mainstem, however DRWW sediment sampling indicates elevated levels of manganese in 9 of 11 mainstem monitoring sites. Mercury is listed as a cause of impairment of the fish consumption beneficial use in all six assessment units of the Des Plaines River mainstem based on fish tissue samples from 1985-2011. Channel catfish (Ictalurus punctatus) and largemouth bass (Micropterus salmoides) tissues indicated elevated levels of mercury. The Illinois EPA Integrated Report identifies atmospheric deposition as the main source of mercury, as does a recent TMDL report for the nearshore Illinois waters of Lake Michigan (USEPA et al., 2015).

3.16.3.9Organic Compounds

PCBs are identified as a cause of impairment of the fish consumption beneficial use in four of the six assessment units of the Des Plaines River mainstem based on fish tissue samples from 1985-2011. Common carp (Cyprinus carpio) and largemouth bass (Micropterus salmoides) tissues indicated elevated levels of PCBs. The source identified in the Illinois EPA Integrated Report is atmospheric deposition, unknown sources, and contaminated sediment.

PAHs are not identified as a cause of impairment for any beneficial uses by Illinois EPA. Sediment chemistry monitoring data from the DRWW indicates that elevated levels of numerous PAHs are present in sediment throughout the Des Plaines River mainstem (MBI, 2017). PAHs are the product of hydrocarbon combustion and their geographic distribution has been linked to urban and transportation related land uses (such as coal tar sealants) (Baldwin et al., 2016).

3.16.3.10 Fecal coliform/Escherichia coli bacteria

Fecal coliform bacteria are listed as a cause of impairment of primary contact use in 3 assessment units of the Des Plaines River in the planning area. The water quality standard for fecal coliform is based on the average of samples above 200 colony-forming units (cfu)/100mL or the number of exceedances of 400 cfu/100mL over 30-day or five-year time periods. This assessment method is limited, and a monitoring station may or may not exceed water quality standards depending on the temporal range of data selected. Additionally, it is not known how much fecal coliform is from natural and anthropogenic sources. Additional assessment is needed to determine the origin of elevated levels and cause of elevated levels. The DRWW baseline monitoring study measured *E. coli* bacteria rather than fecal coliform, so data were compared to the USEPA recommended national water quality criteria (geometric mean of 126 cfu/100 mL or exceendance of 410 cfu/100 mL). Numerous exceedances of these thresholds occurred in the Des Plaines River mainstem, almost entirely downstream of the addition of treated effluent (MBI, 2017).

3.16.3.11 Biological Monitoring

Biological monitoring data related to the aquatic macroinvertebrate and fish communities of the Des Plaines River mainstem within the DPR planning area indicate that the fishery is degraded while the results of sampling the aquatic macroinvertebrate community is more variable.

Macroinvertebrate species assemblages at some sites are indicative of water quality sufficient to fully support aquatic life while other sites are indicative of some level of water quality impairment. Generally, sample locations north of U.S. Route 41 frequently contain macroinvertebrate assemblages indicative of impairment, while samples downstream typically indicate conditions that fully support aquatic life. This pattern is consistent with the initial findings of the DRWW baseline monitoring study (MBI, 2017). The DRWW data are a comprehensive "snapshot" of the macroinvertebrate community along the Des Plaines River at a point in time. In 2016, 103 taxa were collected across the Des Plaines River mainstem sites with the predominant types largely indicative of lentic habitats and moderate to heavy siltation. Three upstream sites (all north of U.S. Route 41) did not meet the Illinois macroinvertebrate criterion for full support of the aquatic life use while the criterion was met at all remaining Des Plaines River mainstem monitoring sites. The mIBI, the metric used to determine aquatic life use support, generally increased (improved) in the downstream direction (Figure 3-79) (MBI, 2017).

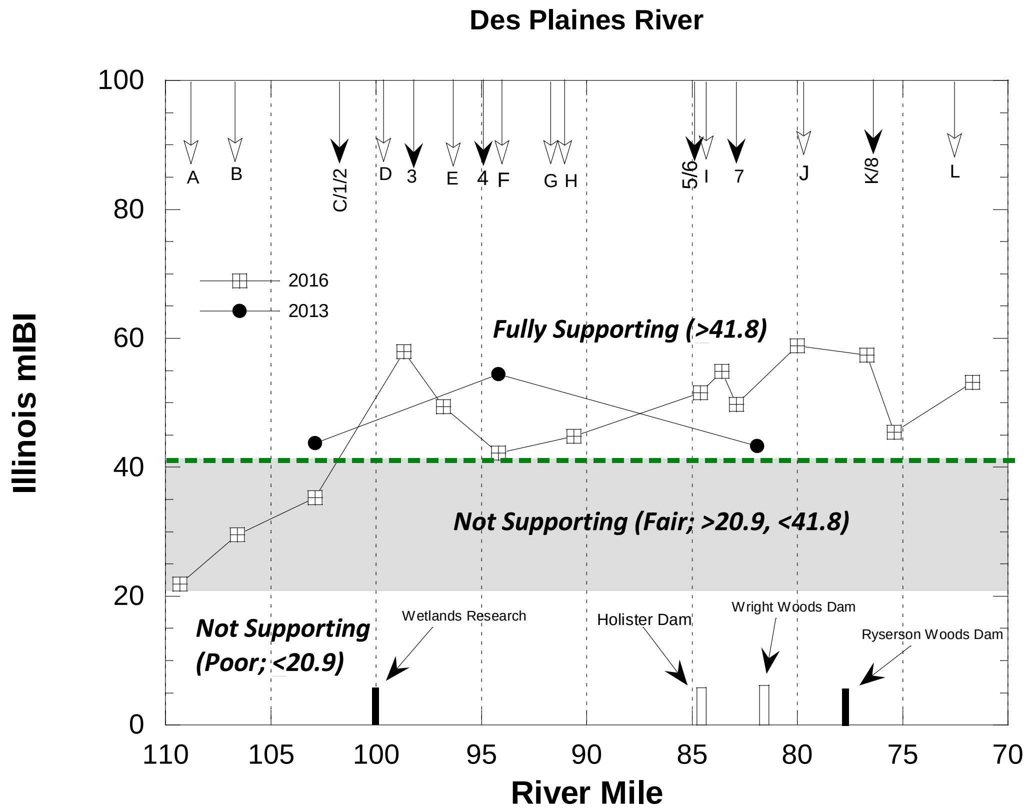


Figure 3-80: Illinois mIBI scores for samples in the Des Plaines River in 2013 and 2016 in relation to municipal WWTP discharges and tributaries.

MBI, 2017 Illinois mIBI scores for samples in the Des Plaines River mainstem in 2013 (from Illinois Intensive Basin Survey) and 2016 (DRWW) in relation to municipal WWTP discharges and tributaries. Mainstem dams or weirs (black bars for dams that impede fish passage) are indicated by bars along the lower x-axis. Thresholds for full and non-support fair and non-support-poor are indicated. The top arrows pointing downwards with letters signify tributary streams flowing into the Des Plaines River mainstem and that numbers indicate POTW discharges.

Community monitoring data for the last two decades is relatively robust for the Des Plaines River mainstem, with at least 12 sites sampled by various agencies from 1995-2015. Approximately 40 total native fish species occur across all the data reviewed, while the range for an individual sample was 11-24 native species. Currently, no sites on the Des Plaines River mainstem within the DPR planning area contain fish communities indicative of water quality fully supportive of aquatic life. Fish communities are generally depauperate in the number of sucker species (Catostomidae) as well as species that fill the following ecological niches: benthic invertivores (feed on bottom-dwelling invertebrates), lithophilic spawners (spawn on mineral substrates), and species known to be intolerant of water pollution. Sunfish (Centrarchidae) and minnows (Cyprinidae) are well represented in the fishery. A recent study by the Illinois DNR analyzing 30 years of data in the Des Plaines River watershed similarly found that while the diversity of the fishery has improved, the entire river is still lacking in the above species and niches. Likewise, while the relative abundance of pollution-tolerant species has declined, the relative abundance of intolerant species hasn't substantially increased (Pescitelli, 2016).

The DRWW baseline monitoring study provides a comprehensive "snapshot" of the Des Plaines River mainstem fish community at a point in time. In 2016, 36 total species and 34 native species of fish were collected across 14 sites on the mainstem. Consistent with other recent monitoring data, all sites failed to achieve the Illinois fish criterion for support of the aquatic life use. With a couple exceptions, the three upstream sites on the Des Plaines River mainstem had the lowest scores for the fIBI, the metric used to determine support of the aquatic life use based on the stream fishery (Figure 3-80). Species composition was associated with heavy siltation of substrates at all sites. The 15 most commonly collected species were all predominantly tolerant, moderately tolerant, or intermediately tolerant of disturbed conditions. As in previous collections, sucker species were lacking while sunfish and minnows were well-represented and among the most commonly collected species at all sites (MBI, 2017).

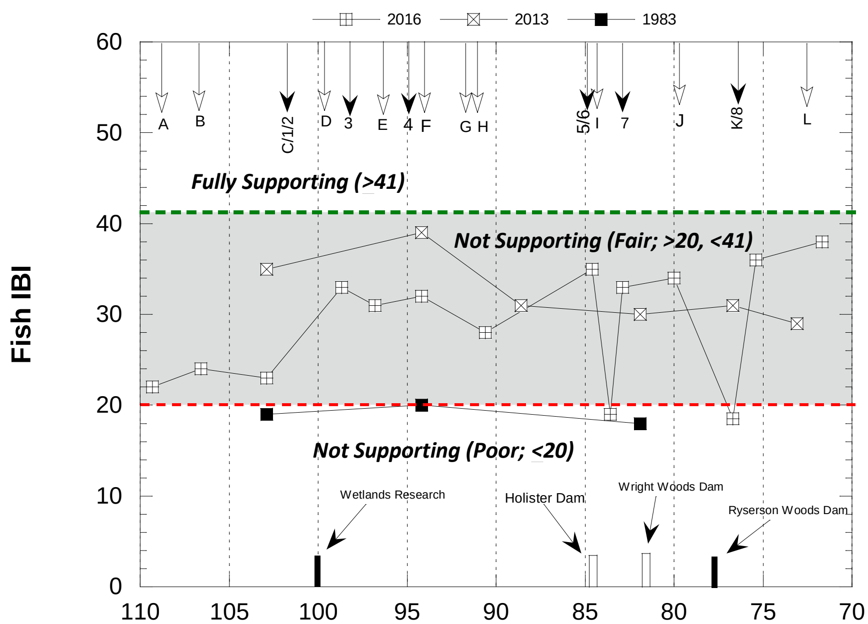


Figure 3-81: Illinois fIBI scores for samples in the Des Plaines River mainstem in 1983, 2013, and 2016 in relation to municipal WWTP discharges and tributaries.

(from MBI, 2017). Mainstem dams or weirs (black bars for dams that impede fish passage) are indicated by bars along the lower x-axis. Thresholds for full and non-support fair and non-support-poor are indicated. The top arrows pointing downwards with letters signify tributary streams flowing into the Des Plaines River mainstem and that numbers indicate POTW discharges.

3.16.3.12 Tributary & Sub-Watershed Water Quality Studies

The major and minor tributaries to the Des Plaines River within the DPR planning area have variable amounts of monitoring data available. Some tributaries only had a few data points for a stream over the last two decades, while other streams had more robust data sets, and many streams had no monitoring data prior to the study undertaken by the DRWW. More robust data sets are typically the result of specific studies (e.g., focused monitoring projects in the watersheds of North Mill and Buffalo Creeks) or facility-related monitoring (e.g., data for Aptakisic and Mill Creeks). The Illinois EPA and Illinois DNR intensive basin surveys have generated more sporadic data points for monitoring sites on tributary streams, as not all established tributary monitoring stations are sampled during each five-year survey. While it is important to consider this data within the watershed plan it is also important to be aware of such limitations. Findings of the DRWW baseline monitoring study are included in each section of the discussion below.

3.16.3.13 Dissolved Oxygen

Dissolved Oxygen is listed as a cause of impairment in Buffalo, Indian, and Mill Creeks, and a TMDL has been developed for constituents determined to contribute to the dissolved oxygen impairment of Buffalo Creek. Available monitoring data for dissolved oxygen in Indian Creek below its confluence with Kildeer Creek (South Branch Indian Creek) is probably too limited to draw any conclusions beyond those used by Illinois EPA to make its determination of impairment. The BCCWP began monitoring water quality at fifteen sites in 2013 and MWRD has monitored water quality at Lake-Cook Road since the 1970s. Data collected by the BCCWP and reported in the Buffalo Creek Watershed-Based Plan indicate that dissolved oxygen and biochemical oxygen demand fall below or exceed acceptable limits at several locations. Lake County Public Works periodically sampled the Sylvan Lake Drain branch of Indian Creek up and downstream of the Sylvan Diamond Lake wastewater treatment plant outfall (above the plant discharge on a wetland tributary to Sylvan Lake Drain and at Washitay Avenue downstream) (LCPWD, 2016). Data from grab samples from 2006-2014 indicated that dissolved oxygen routinely fell below the general use standard (5.0 mg/L March-July or 3.5 mg/L August-February) at the upstream sampling point (58.6% of samples). Dissolved oxygen at the downstream site fell below the standard 14.8% of the time (12 of 81 samples). All recorded dissolved oxygen concentrations outside of acceptable ranges occurred between May and August, and all but one occurred while water temperatures were above 18° C (64.4° F). Lake County Public Works also periodically samples Mill Creek up- and downstream of the WRF outfall (below the first dam upstream of the WRF and at Dilleys Road downstream), and North Shore Water Reclamation District samples Mill Creek at Dilleys Road (LCPWD, 2016; NSWRD, 2016). Data from grab samples from 1999-2015 indicate dissolved oxygen fell below the general use standard (5.0 mg/L March-July or 3.5 mg/L August-February) in 6.25% of upstream samples (5 of 80) and 4.6% of downstream samples (6 of 131). In about half the cases, the sub-standard values occurred on the same day, suggesting that upstream or local environmental conditions (such as ambient water temperature) may contribute to low dissolved oxygen.

The LCHD-ES monitored water quality at three sites in the North Mill Creek watershed from March to November 2010 in conjunction with the development of the North Mill Creek watershed-based plan (Table 3-52). Dissolved oxygen violated the water quality standard at each site during the study, but for relatively brief periods and was largely attributed to low flow conditions and high summer water temperatures (LCHD, 2011). The DRWW monitoring data recorded relatively few instances of failure to meet the minimum water quality standards for dissolved oxygen. The report indicated that the prevalence of high daytime concentrations (>10 mg/L) likely indicate a need for continuous monitoring to determine if excessive diel swings occur, indicative of increased algal conditions.

3.16.3.14 Chloride

Chloride is listed as a cause of aquatic life use impairment in Buffalo Creek and is included in the Des Plaines/Higgins Creek TMDL report. MWRD data indicates that chloride levels in Buffalo Creek have increased since the 1970s, BCCWP monitoring data from 2013-2015 confirms that chloride exceeds desirable levels, and chloride was identified as a primary pollutant of concern in the Buffalo Creek Watershed-Based Plan. Bull Creek and Bull's Brook, Integrated Lakes Management (2003) noted that chloride concentrations were typical for urban streams. A previous study by Applied Ecological Services found high chloride concentrations at 7 of 12 sample locations in the watersheds. Of 10 grab samples from Illinois EPA for Bull Creek at Illinois Route 21 from 2003-2013, all exceeded the USEPA chronic threshold of 230 mg/L for aquatic life and none exceeded the acute water quality standard of 500 mg/L for chloride.

Available data (Figure 3-81) indicate a recent historic trend similar to the mainstem Des Plaines River, with many samples indicating elevated chloride concentrations above 100 mg/L and several above the USEPA chronic threshold of 230 mg/L. However, the results of a 2010 study of the North Mill Creek watershed include several data points with chloride concentrations below 100 mg/L. This suggests that chloride levels may be lower in the North Mill Creek watershed than other tributary streams. This trend is evident in Figure 3-81 in the numerous data points collected in 2010 that fall below 100 mg/L and is consistent with data from the DRWW baseline study, which also found lower chloride concentrations in the North Mill Creek subwatershed than in other tributaries and subwatersheds.

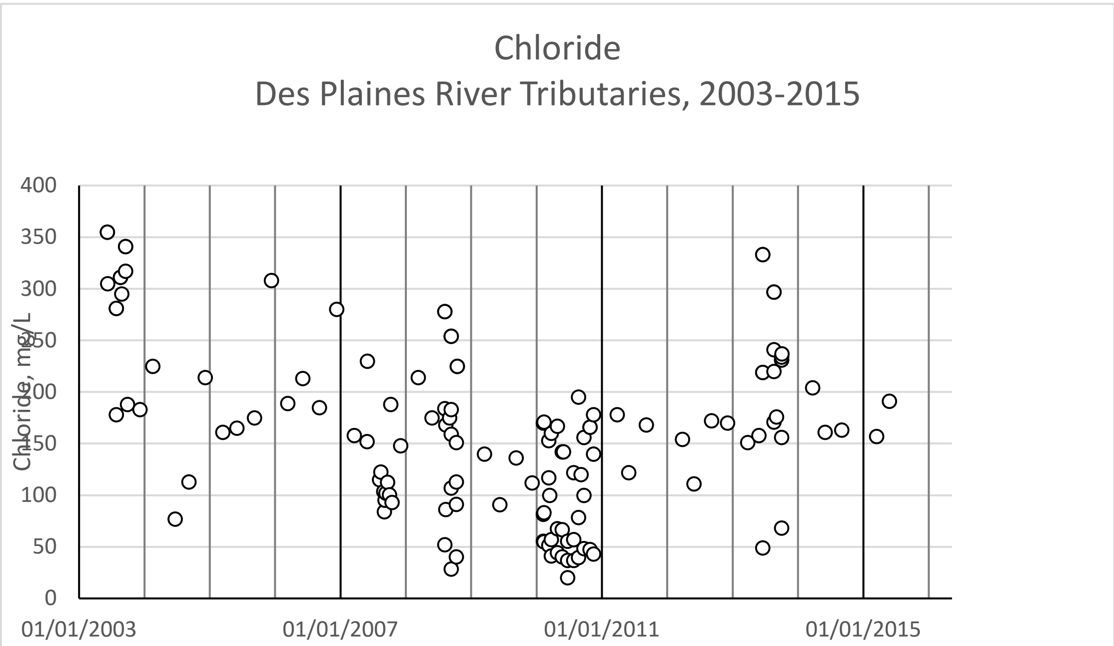


Figure 3-82: Chloride concentration across all monitored tributary sites, 2003-2015

DRWW monitoring data from 2016 indicated elevated chloride in all subwatershed streams, but higher concentrations tended to be associated with more urbanized drainage areas (Figure 3-82). The North Mill Creek subwatershed had the lowest chloride levels while Aptakisic Creek and some of the Des Plaines River Tributaries (Stoneroller Creek, Belvidere Road Tributary) had the highest chloride levels (MBI, 2017).

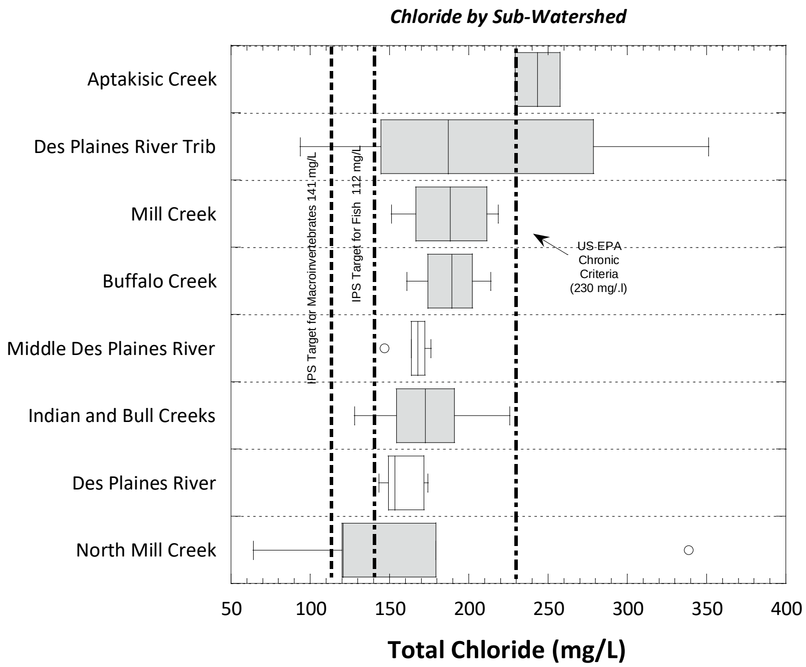


Figure 3-83: Mean, maximum, and minimum concentrations of total chlorides in tributary subwatersheds

The Illinois water quality criterion (500 mg/L), the USEPA national criterion (230 mg/L), and the DuPage IPS thresholds for fish (141 mg/L) and macroinvertebrates (112 mg/L) are indicated.

3.16.3.15 Nutrients (Nitrogen and Phosphorus)

Nutrient concentrations in tributary streams tend to be elevated or high. Lake County Public Works periodically sampled Aptakisic Creek up and downstream of the Des Plaines River wastewater treatment plant outfall (above the plant discharge at the Pekara Drive and at Aspen Court downstream) (LCPWD, 2016). Based on the USEPA thresholds for the region for phosphorus, 52% of the samples at Pekara Drive (45 of 86) fall into the “good” or least disturbed condition (<0.0.086 mg/L), while 26% (22 of 86) fall into the “poor” or least disturbed condition (>0.143 mg/L). At Aspen Drive, 2% of samples (2 of 88) fall into the USEPA’s “good” condition while 98% (86 of 88) fall into the “poor” condition. Consistent with data from the previous two decades, the DRWW monitoring report found that nitrate and phosphorus increased below the wastewater treatment plant on Aptakisic Creek, resulting the highest values for each constituent among tributaries throughout the DPR planning area (see Figure 3-83 and Figure 3-84) (MBI, 2017).

In Bull Creek and Bull’s Brook, Integrated Lakes Management (2005) found that several sites near agricultural fields tested high for nitrate and phosphorus, among other parameters. The DRWW monitoring data indicated relatively low levels of nitrate and phosphorus relative to other tributary stream systems in the DPR planning area (MBI, 2017).

In Buffalo Creek, ammonia was determined to be a contributing factor to the dissolved oxygen cause of impairment and an ammonia TMDL was developed. MWRD data indicate that phosphorus levels have decreased since the 1970s, but BCCWP data from 2013-2015 indicated that phosphorus levels were still elevated and it was identified as one of the main pollutants of concern in the Buffalo Creek Watershed-Based Plan. DRWW monitoring data indicated elevated levels of phosphorus, although those were relatively low compared to other subwatersheds (MBI, 2017).

The Indian Creek Watershed-Based Plan (LCSMC, 2008) summarizes the results of water quality monitoring performed in 1997 by Illinois EPA. Nutrient levels were high in both August and December of 1997. Ammonia-nitrogen and total phosphorus levels exceeded the standards set by the state. In August of 1997, ammonia-nitrogen levels exceeded the indigenous (aquatic) life support level of 0.22 mg/L. Total phosphorus levels exceeded state standards during both sampling events. In fact, phosphorus levels were nearly three times the "General Use" standard in August and twice the standard in December. Algal blooms documented in the streams and lakes of the watershed were attributed to high nutrient levels. At the time, Illinois EPA attributed the source of elevated nutrient levels to municipal point sources (wastewater treatment plants), construction sites, urban runoff/stormwater sewers, and contaminated sediments. DRWW monitoring data from 2016 indicate elevated phosphorus levels in Indian Creek and Kildeer Creek (South Br. Indian Creek), although they are relatively low compared to other subwatersheds (MBI, 2017).

Lake County Public Works periodically sampled Mill Creek upstream and downstream of its Mill Creek water reclamation facility. Based on the USEPA National Rivers and Streams thresholds for the region, most samples both upstream (80% or 63 of 79 samples) and downstream (79% or 59 of 75 samples) of the Lake County Public Works facility fall into the "poor" condition (>0.143 mg/L) indicating disturbed conditions relative to reference conditions for the region. Phosphorus levels upstream and downstream of the facility discharge appeared to be similar, based on grab samples. DRWW monitoring data were consistent with these trends, as phosphorus levels both upstream and downstream of the facility continue to be elevated (MBI, 2017).

Phosphorus is listed as a cause of impairment in North Mill Creek, Hastings Creek, and Dutch Gap Canal. Three sites monitored by the Lake County Health Department in the North Mill Creek watershed in 2010 and by Illinois EPA in 2008 and 2013 had high concentrations of nutrients, particularly nitrate-nitrite nitrogen and phosphorus. Hastings Creek consistently had extremely high concentrations of these nutrients. The watershed areas tributary to North Mill Creek and Dutch Gap Canal are still largely agricultural, which may correlate to elevated nutrient levels at those two sites. Hastings Creek is affected by the Lindenhurst sewage treatment plant, which is the most likely source of the higher nutrient concentrations found at that site during the study (LCHD, 2010). DRWW monitoring data from 2016 are consistent with these trends. Sites on North Mill Creek/Dutch Gap Canal had elevated nutrient levels, while nutrient levels increased downstream of the wastewater treatment plant on Hastings Creek (MBI, 2017).

Other tributary streams were identified as having elevated phosphorus levels (e.g., Slocum Corners Creek and Newport Ditch), but were relatively low compared to other tributary streams (MBI, 2017).

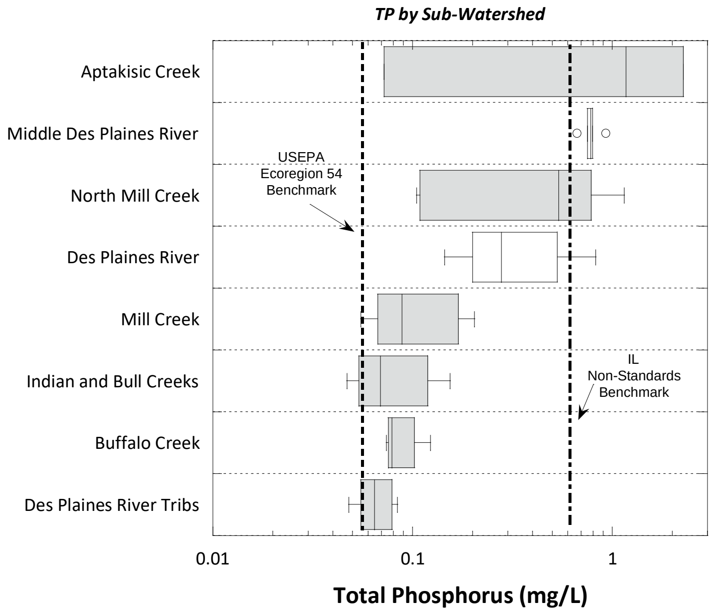


Figure 3-84: Concentrations of total phosphorus in tributary

(from MBI, 2017) The left dashed line represents the U.S. EPA Ecoregion 54 background reference site concentration (0.07 mg/L) and the right dashed line the IL non-standard benchmark (0.61 mg/L).

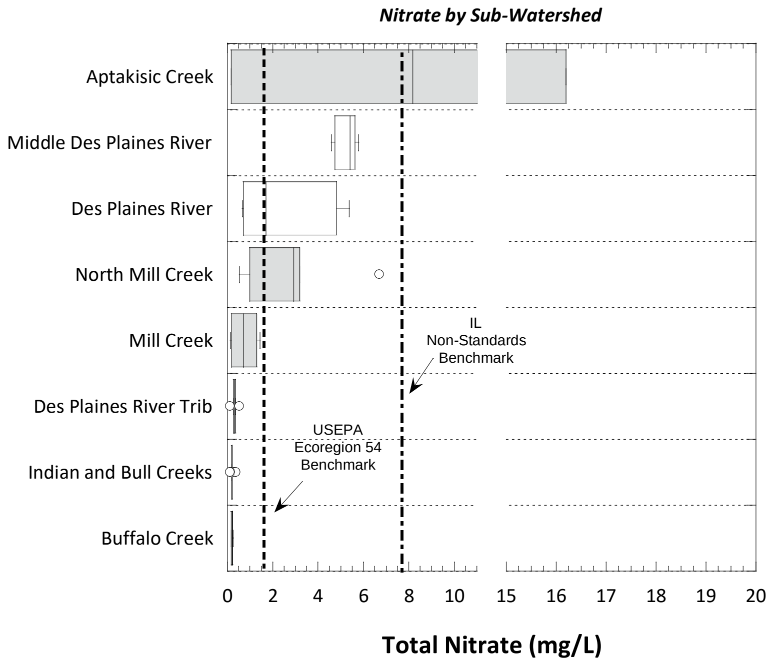


Figure 3-85: Concentrations of total nitrate-N in tributary subwatersheds

(from MBI, 2017) The left dashed line represents the USEPA Ecoregion 54 background reference site concentration (1.8 mg/L) and the right dashed line the IL non-standard benchmark (7.8 mg/L).

3.16.3.16 Metals

Arsenic is listed as a cause of impairment in North Mill Creek, Hastings Creek, and Dutch Gap Canal, and was previously listed as a cause of impairment in Bull Creek prior to its removal from the impaired waters list. These listings are based on sediment samples from these streams and none of the historical monitoring data indicate violations of the acute or chronic water quality standards for dissolved arsenic in the water column of these streams. The listing as a potential cause of impairment will remain until new data indicate a segment fully supports the aquatic life use. The DRWW data indicates elevated levels of arsenic in sediment at multiple sites in the watersheds of Bull and Indian Creeks, and at individual sites on Stoneroller and Buffalo Creek (MBI, 2017).

Manganese is listed as a cause of impairment in North Mill Creek and Dutch Gap Canal, and was previously listed as a cause of impairment in Bull Creek prior to its removal from the impaired waters list. These listings are/were based on sediment samples from these streams, as none of the historical monitoring data indicate violations of the acute or chronic water quality standards for dissolved manganese in the water column of these streams. Sediment sampling performed by the DRWW indicates that manganese is present at elevated levels in all subwatershed stream systems and most small mainstem tributaries (Suburban Country Club Tributary being the exception) where sediment sampling was performed (MBI, 2017).

3.16.3.17 Organic Compounds

PAHs are not identified as a cause of impairment for any beneficial uses by Illinois EPA. Sediment chemistry monitoring data from the DRWW indicates that elevated levels of numerous PAHs are present in sediment throughout the tributary stream systems in the planning area. Multiple sites exhibiting elevated or highly elevated sediment PAH levels are present in the subwatersheds of Mill, Bull, Indian, Aptakisic, and Buffalo Creeks (MBI, 2017).

3.16.3.18 Biological Monitoring

3.16.3.18.1 Aquatic Macroinvertebrates

Several watershed plans and existing study reports summarize conditions of the aquatic macroinvertebrate communities in tributary streams within the planning area. The 2016 DRWW monitoring program sampled macroinvertebrate communities at more than 50 tributary sites and offers a comprehensive “snapshot” of the macroinvertebrate community in tributary streams within the DPR planning areaat a point in time. In general, results indicate that aquatic macroinvertebrate assemblages vary by watershed and by watershed size (MBI, 2017). Figure 3-85 shows the relationship between mIBI scores and watershed size for the DRWW monitoring study. Figure 3-86 shows the range of mIBI values by subwatershed.

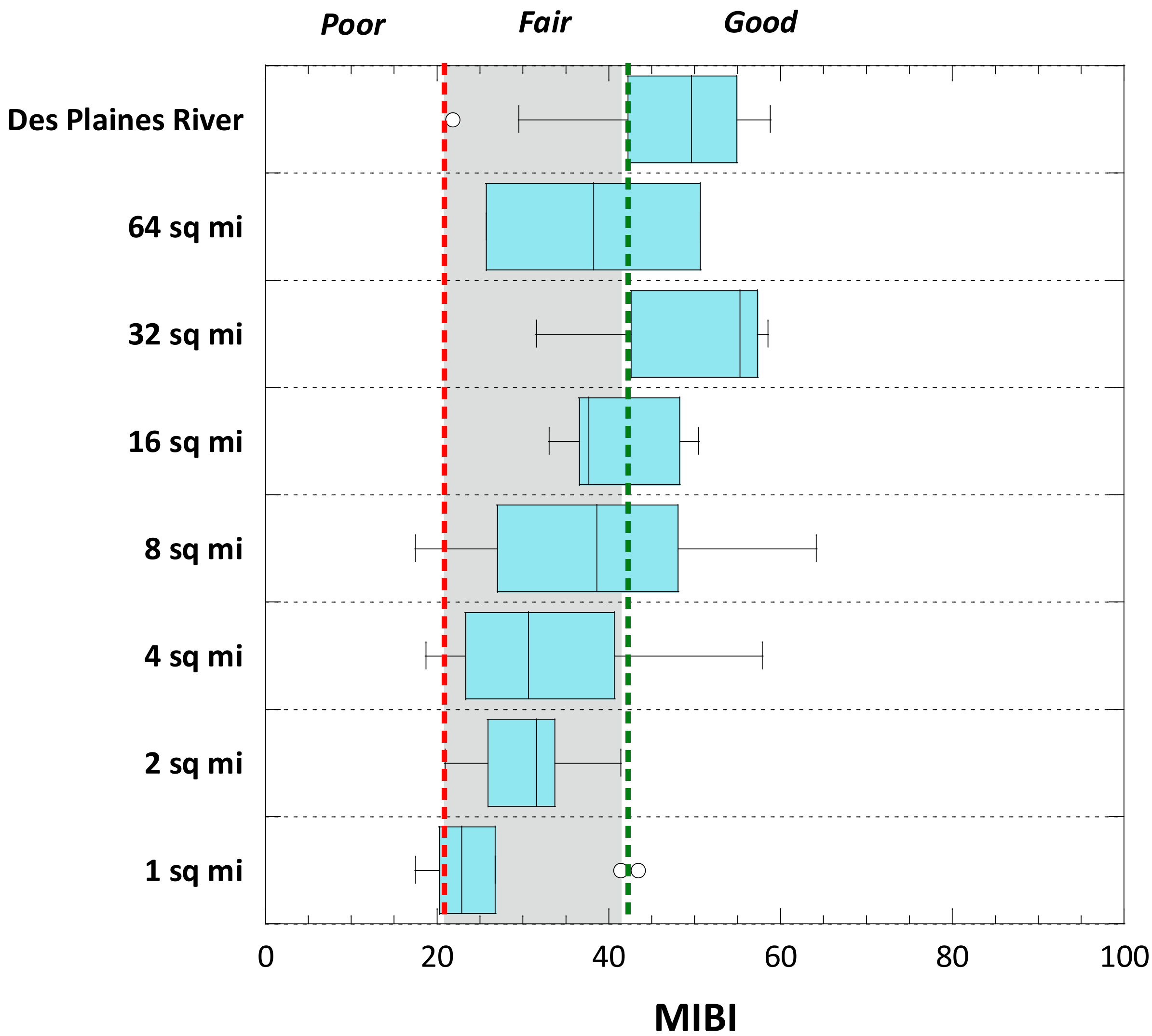


Figure 3-86: Macroinvertebrate IBI scores for the Des Plaines River mainstem and subwatersheds
from MBI, 2017). Box and whisker plot of macroinvertebrate IBI scores for the Des Plaines River mainstem and subwatersheds arranged by drainage size panels for samples collected in the 2016. The gray shaded area on the plot demarcate the non-support fair range from full support and non-support-poor.

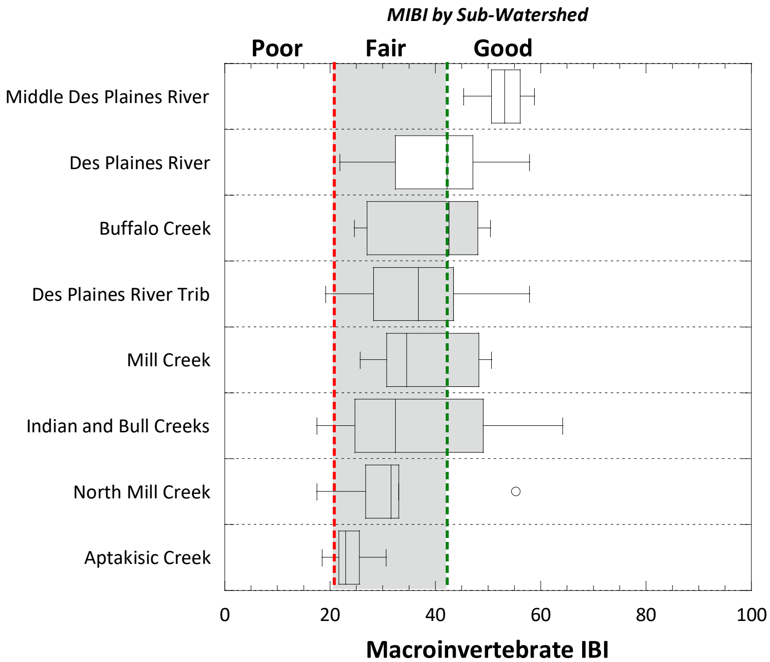


Figure 3-87: Illinois macroinvertebrate IBI scores for samples in tributary subwatersheds

Thresholds for full and non-support fair and non-support-poor are indicated.

The Bull Creek-Bull's Brook Watershed-Based Plan (LCSMC, 2008) summarizes the results of RiverWatch and Illinois EPA macroinvertebrate monitoring at five locations in the watersheds from 1997-2003. The data measure aquatic macroinvertebrate diversity and assign a qualitative descriptor based on the relative tolerance of the identified species to pollutants and aquatic habitat disturbance. Data from both sources indicated "good" water quality in both streams. DRWW monitoring data indicated varying levels of quality throughout the watershed. While poor sites indicated organic enrichment and low dissolved oxygen, sites with the highest mIBI scores reflected larger watershed size and included the highest scores in the entire survey (MBI, 2017).

The Buffalo Creek watershed plan summarizes data from the IDNR Riverwatch program from 1996-2014 and includes data from BCCWP collected from 2012-2014. The data measure aquatic macroinvertebrate diversity and assign a qualitative descriptor based on the relative tolerance of the identified species to pollutants and aquatic habitat disturbance. The results across 8 stream sites in the watershed range from "very poor" to "fair" in their qualitative description of water quality based on macroinvertebrate taxa present (BCCWP and LCSMC, 2015; BCCWP, 2015). The DRWW data indicated that three sites on the lower reaches of Buffalo Creek were in "good" condition while an upstream site and a site on the Buffalo Creek Tributary rated "fair." The upstream site on Buffalo Creek also indicated organic enrichment (MBI, 2017).

In the North Mill Creek subwatershed, aquatic macroinvertebrates were collected at four sites in 2010: North Mill Creek/Dutch Gap Canal at Edwards Road, North Mill Creek/Dutch Gap Canal at Highway 173, North Mill Creek at Kelly Road (below Rasmussen Lake dam), and Hastings Creek at Miller Road. Sample results were used to calculate the mIBI with results ranging from 33.7 to 51.6, indicating "fair" to "good" species composition. However, no taxa considered intolerant of pollution were collected at any sites, and the species composition suggests the sites are turbid and subject to siltation. The results were similar to those of the Illinois EPA collections in 2008, with the exception that the mIBI at North Mill Creek/Dutch Gap Canal at Highway 173 increased from 37.1 (“fair”) to 51.6 (“good”). There is no readily abundant reason for the increase in score between collections. Two common mussel species (giant floater and white heelsplitter) were identified below the Rasmussen Lake dam (Living Waters Consultants, Inc., 2010). Limited recent data exists for streams in the portion of the DPR planning areain Wisconsin, however, in 2003 and 2005, the Wisconsin DNR conducted a study on the Dutch Gap Canal at one sample location that shows the same degraded macroinvertebrate as in the IEPA study in 2008. In 2005, they also evaluated the macroinvertebtes and found an HBI of 7.4, which is considered to be “fairly poor” due to significant organic pollution. The DRWW monitoring data indicated “good” mIBI values at lower reaches and “fair” values at upstream sites. Values on Hastings Creek declined below the wastewater treatment plant, with assemblages at both sites indicating organic enrichment (MBI, 2017).

The DRWW monitoring data for Indian Creek yielded “good” mIBI values at downstream sites on Indian and Kildeer Creeks, while upstream sites with smaller drainage areas as well as sites on West Fork Indian Creek, Seavey Drainage Ditch, and Forest Lake Drain yielded “fair” values (MBI, 2017).

DRWW monitoring data for the Aptakisic Creek subwatershed yielded sites with mIBI values that rated “fair” to “poor,” with larger drainage areas being associated with better values. While the mIBI value at the site downstream of the wastewater treatment plant discharge rated “fair”, the taxa assemblage indicated a toxic biological response, the only such macroinvertebrate signature among the sample sites (MBI, 2017).

DRWW monitoring data for other tributary streams ranged from poor to good and mIBI values generally increased with watershed size, although there were some exceptions. For example, both the lowest mIBI value (downstream site on Suburban Country Club Tributary) and the highest mIBI value (Stoneroller Creek) were yielded by sites with just over 4 square miles of tributary drainage area. A site on Werhane Lake Drain had the smallest drainage area of these remaining tributary sites and a “good” mIBI value. The downstream site on Newport Ditch had the largest drainage area of the remaining tributary sites and a “good” mIBI value. The West Fork Belvidere Road Tributary also had a “good” mIBI value. All remaining sites had “fair” mIBI values (MBI, 2017).

3.16.3.18.2 Fish

Numerous fishery surveys have been completed for tributary streams in the planning area, with various goals. Some surveys, such as those conducted by the Illinois DNR in concert with Illinois EPA for the Intensive Basin Survey program are used to determine aquatic life use attainment in streams. Other fishery surveys have been conducted to determine the presence of rare or endangered species or to inventory the fish community at specific sites (Willink et al., 2016; LCFPD, 2016). The DRWW monitoring program sampled fish communities at more than 50 tributary sites and offers a comprehensive “snapshot” of the fishery in tributary streams within the DPR planning areaat a point in time. The results of previous surveys to assess aquatic life use as well as the results of the 2016 DRWW monitoring effort are discussed below. Figure 3-87 and Figure 3-88 display the fIBI values for tributary sites in the DRWW survey from 2016 and Error! Reference source not found. displays the relationship between fIBI and drainage area from the same survey.

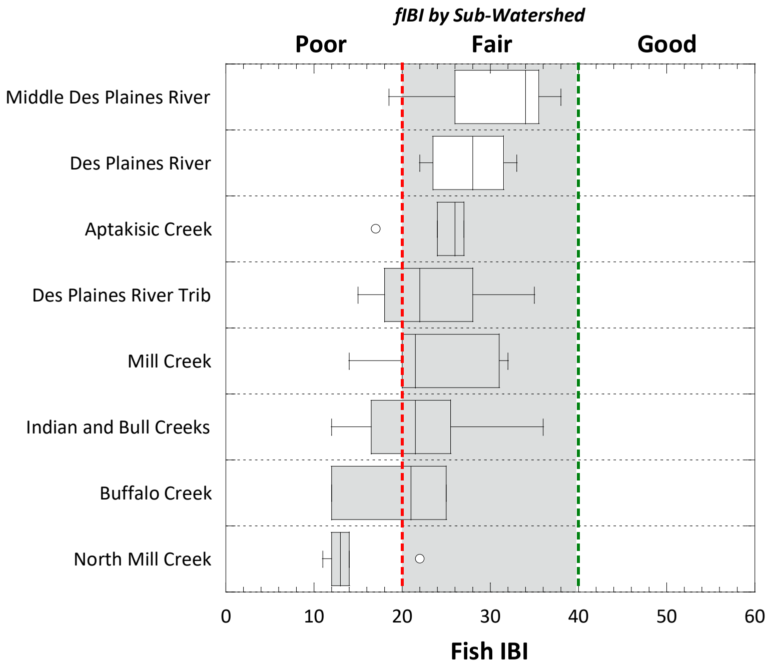


Figure 3-88: Illinois fIBI scores for samples in tributary subwatersheds

Thresholds for full and non-support fair and non-support-poor are indicated.

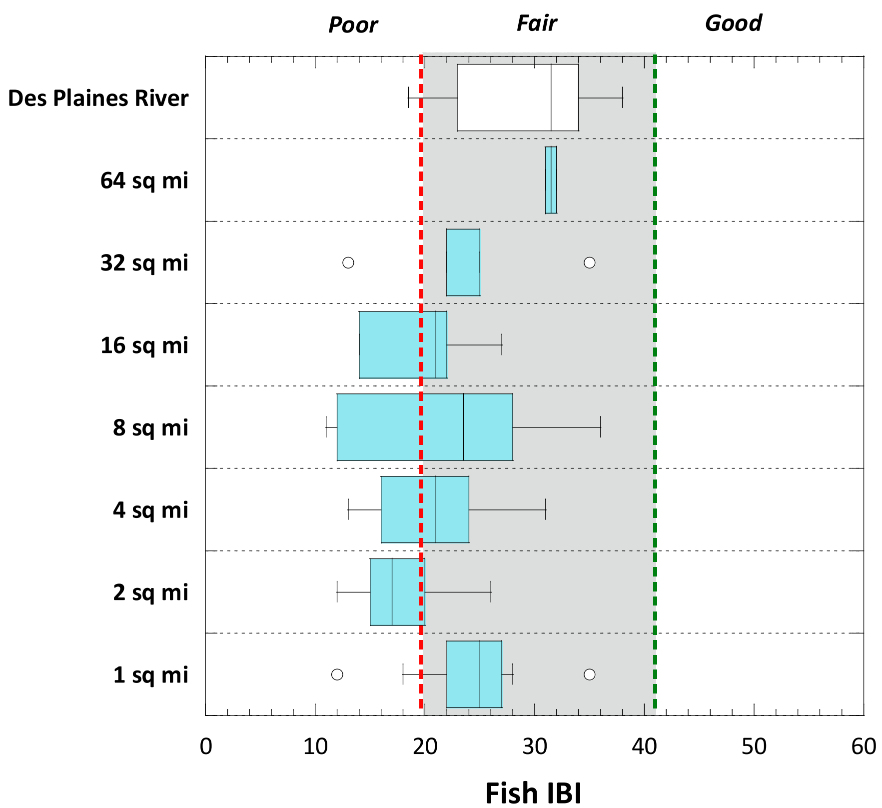


Figure 3-89: Box-and-whisker plot of fIBI scores for the Des Plaines River mainstem and subwatersheds

Box-and-whisker plot of fIBI scores for the Des Plaines River mainstem and subwatersheds arranged by drainage size panels for samples collected in the 2016. The gray shaded area on each plot demarcate the non-support fair range from full support and non-support-poor.

Living Waters Consultants sampled four sites in the North Mill Creek watershed for fish in 2010: North Mill Creek/Dutch Gap Canal at Edwards Road, North Mill Creek/Dutch Gap Canal at Highway 173, North Mill Creek at Kelly Road (below Rasmussen Lake dam), and Hastings Creek at Miller Road. Sample results were used to calculate the fIBI, which ranged from 19 to 23, indicating poor or impaired fish communities at all four sites (the highest possible f-IBI score is 60). Number of species encountered generally increased downstream and diversity of sunfish genera (centrarchidae) was relatively high throughout the watershed. Results of the fish collection resulted in more species and slightly increased fIBI values from the IDNR collection in 2008. A 2002-2004 fishery survey of 49 Des Plaines River mainstem and tributary sites by the Army Corps of Engineers, Illinois DNR, and Southeastern Wisconsin Regional Planning Commission included four sites in the North Mill Creek watershed. Both the number of native species (range 2-13) and fIBI (range 0-25) improved downstream of the Rasmussen Lake dam (being removed as of 2018) (Veraldi et al., 2005). Lake County Forest Preserve District has sampled the fisheries of streams within forest preserves in the North Mill Creek subwatershed, including Hastings Creek within Raven Glen Forest Preserve (2002-2005) collecting 9-12 native species, North Mill Creek at Ethel's Woods Forest Preserve (2002-2005) collecting between 3 and 12 native species, and Millburn Creek (Unnamed Tributary to North Mill Creek) at McDonald Woods Forest Preserve (1997) collecting 3-5 native species (LCFPD, 2016).

Comparison of sample data to fish habitat quality at each site suggested that factors other than habitat availability influence fish diversity in the North Mill Creek watershed (Living Waters Consultants, Inc., 2010). Limited recent data exists for streams in the portion of the DPR planning areain Wisconsin, however, in 2003 and 2005, the Wisconsin DNR also conducted a study on the Dutch Gap Canal at one sample location that shows the same degraded fish communities as in the Illinois EPA study in 2008. In 2003, they determined that the fish assemblage was "very poor" (IBI rating of 5). In 2005, the IBI rating for fish decreased to 3, within the classification of "too low to calculate". The 2016 DRWW fishery survey included 6 sites in the North Mill Creek watershed in Illinois. Number of native species ranged from 1 to 13, and five sites had "poor" fIBI values (<20), while only the downstream site (North Mill Creek at Millburn Road) had a "fair" fIBI value. North Mill Creek watershed sites had low species richness relative to its size and a high proportion of species tolerant to disturbance and pollution (MBI, 2017).

Since 2000, several fish surveys have been conducted on Mill Creek, with the resulting fIBI scores ranging from 15 to 39, indicating moderate to severe impairment of the fish community. Thirty-two native species are represented across all surveys. The lowest score (fIBI = 15) was from a sample taken below Third Lake Dam, while a sample below Grandwood Park Lake dam was also low (fIBI = 18). All other samples for which fIBI scores were computed were collected at sites downstream of the first dam on Mill Creek, and ranged from 27 to 39. Among other Lake County streams in the Des Plaines River basin, the fIBI values for downstream samples are comparable to the results of recent fish surveys from sites in the Indian and Bull Creek Watersheds with uninterrupted connections to the Des Plaines River. In samples from Mill Creek, the greatest number of species encountered in any single sample was 26, from a site below the first dam upstream of the Des Plaines River. Nineteen (19) species were encountered in each of the other recent samples taken downstream of the first dam on Mill Creek. Samples taken at four locations upstream of the first dam on Mill Creek yielded 15 or fewer species. Samples from Lake County Forest Preserve sites yielded 7 native species at

Mill Creek Forest Preserve (2012), 8 native species at Fourth Lake Forest Preserve (2003), and 6 to 15 native species at Rollins Savanna Forest Preserve (1999-2014) (LCFPD, 2016). The highest fIBI scores in the Mill Creek Watershed and from other similar Des Plaines River tributaries tend to come from sampling locations on downstream, barrier-free reaches where fish can migrate to and from the Des Plaines River. Other factors that may affect the decrease in species diversity in upstream reaches of the watershed are modification of habitat and degradation of water quality (LCSMC, 2014). The DRWW monitoring program sampled 6 sites in the Mill Creek watershed in 2016. The number of native species ranged from 6 to 25 and fIBI ranged from 14 to 32. The only site with a "poor" fIBI (fIBI = 14) was at Stearns School Road. Although there was a decrease in the number of native species and fIBI score from the site upstream of the Mill Creek water reclamation facility to the site downstream of the facility, the biological signatures were similar and indicated influence from nonpoint sources related to urban runoff and siltation (MBI, 2017).

Bull Creek is not listed as impaired for the aquatic life use and the fishery has been sampled relatively frequently in the last two decades at Illinois Route 21 north of Libertyville. This location typically yields among the highest fIBI values relative to other tributaries in the DPR planning area(range 34-40). Other sites further upstream in the subwatershed have yielded lower species richness and fIBI values (Veraldi, et al., 2005). The DRWW monitoring program surveyed the fishery of Bull Creek at 6 locations in the subwatershed in 2016. Native species abundance ranged from 1-21 across all sites, while fIBI values ranged correspondingly, from 12-36, indicating "poor" to "fair" conditions. While the monitoring station at Illinois Route 21 yielded the greatest species richness and highest fIBI value, it was below the criteria for aquatic life use attainment (fIBI >40). This site also had the best-rated habitat conditions in the subwatershed. Other sites were "fair" while upstream sites rated "poor" based on fIBI values and had heavy silt cover and substrate embeddedness (MBI, 2017).

Indian Creek is currently listed by Illinois EPA as impaired for aquatic life use, although it was previously identified as achieving aquatic life use support (Illinois EPA, 2011). Similar to Bull Creek, a monitoring site at Port Clinton Road located near the downstream end of the subwatershed, has been monitored relatively frequently in the past, and typically yields among the highest fIBI values relative to other tributaries in the DPR planning area(range 31-39). The Lake County Forest Preserve District has sampled the fishery at a restored section of Kildeer Creek in Heron Creek Forest Preserve (upstream of Old McHenry Road), identifying up to 16 native species in recent samples (LCPFD, 2016). A site on Seavey Drainage Ditch was surveyed by Living Waters Consultants and the Village of Vernon Hills in conjunction with the removal of a low-head dam and stream channel naturalization at the Vernon Hills Golf Course in 2006 and 2008. Species richness and fIBI values upstream and downstream of the former dam improved following dam removal, with the number of native species increasing from 10 (above and below dam) to 16 and fIBI increasing from 20 (above dam) and 25 (below dam) to 32. A fishery survey in 2016 at an adjacent site downstream yielded 15 native species (Willink et al., 2016). Species richness and fIBI values tended to decrease at sites further upstream (Veraldi et al., 2005; Pescitelli, 2016). The DRWW monitoring program sampled the fishery at 13 sites in the Indian Creek subwatershed in 2016. Streams sampled included Indian Creek, Seavey Drainage Ditch, West Fork Indian Creek, Kildeer Creek (South Branch Indian Creek), and Forest Lake Drain. Native species richness ranged from 2-15 and fIBI values ranged from 13 ("poor") to 35 ("fair"). The highest number of native species was collected at Oakwood Road while the highest fIBI value occurred at the site at Port Clinton Road (which also had the second-highest native species richness value at 14). Habitat ranged from fair to excellent, although all sites had moderate to heavy siltation and substrate embeddedness. Fish assemblages had high proportions of tolerant species although more sensitive species were collected at some of the sites with larger drainage areas. In general, fish species were indicative of the degraded habitat and low gradient stream conditions found at the sampling locations (MBI, 2017).

The DRWW monitoring program sampled the fishery at 5 sites in the Aptakisic Creek subwatershed in2016. The fish assemblage was dominated by tolerant species and lacked sensitive species and mineral substrate spawners. Native species abundance ranged from 5-18 while fIBI values ranged from 17 (“poor”) to 27 (“fair”). Similar to the sites up and downstream of the Mill Creek water reclamation facility, native species richness and fIBI declined below the wastewater treatment plant on Aptakisic Creek (native species from 18 to 12 and fIBI from 26 to 24). While the fish community response is detectable, it appears that the macroinvertebrate response is greater (MBI, 2017).

The Buffalo Creek fishery was previously sampled at two locations (Illinois Route 83 and Coffin Road) in 2002-2004 as part of a basin-wide survey led by the Army Corps of Engineers, Illinois DNR, and Southeastern Wisconsin Regional Planning Commission and in 1997 and 2002 at Buffalo Creek Forest Preserve by the Lake County Forest Preserve District (Veraldi et al., 2005; LCFPD, 2016). At that time, both native species abundance (8 or 9 at all sites) and fIBI values (10-14, “poor”) indicated impairment of the fish community. In 2008, the monitoring station at Lake-Cook Road yielded 10 species and an fIBI of 32 (“fair”). The DRWW monitoring program sampled the fishery at 5 sites in the Buffalo Creek subwatershed in 2016. Native species abundance ranged from 6 to 15 while fIBI values ranged from 12 (“poor”) to 25 (“fair”). Upstream sites were dominated by tolerant species while more sensitive species were present in downstream samples.

Other tributaries within the DPR planning area were sampled infrequently or not at all during the two decades preceding the DRWW monitoring program fishery survey in 2016. The Lake County Forest Preserve District has sampled the fishery at Stoneroller Creek at Lake Carina Forest Preserve (2000-2014), Werhane Lake Drain at MacArthur Woods Forest Preserve (2002, 2012), and Bull’s Brook at Almond Marsh Forest Preserve (1997, 2002); the Army Corps of Engineers, Illinois DNR, and Southeastern Wisconsin Regional Planning Commission fishery survey of 2002-2004 included a site on Newport Ditch at Kilbourne Road; and Illinois DNR sampled Bull’s Brook between Casey Road and Illinois Route 21 in 2004 (LCFPD, 2016; Veraldi et al., 2005, LCMSC, 2008). In the limited data from those previous surveys, native species abundance ranged from 3 (Bull’s Brook) to 16 (Stoneroller Creek and Newport Ditch) and generally increased with tributary drainage area and proximity to the Des Plaines River. The DRWW monitoring program surveyed 12 sites in the remaining tributary streams within the DPR planning area. Native species abundance ranged from 1 to 15 and fIBI values ranged from 15 (poor) to 35 (fair). Illinois DNR had previously collected two state-listed species (blackchin shiner and Iowa darter) from Bull’s Brook in 2004 (LCSMC, 2008). The DRWW survey did not collect either species from Bull’s Brook in 2016, despite sampling more sites on that stream (MBI, 2017). Scores for fIBI were generally related to tributary watershed size with fIBI increasing with drainage area. Despite good overall habitat quality at several locations, all sites were impacted by siltation and substrate embeddedness (MBI, 2017).

Fish surveys conducted on numerous tributary sites over the past two decades by multiple investigators including the DRWW in 2016 indicate that the fisheries of tributary streams in the DPR planning area are largely impaired and dominated by tolerant species characteristic of lentic habitats. The sites with the greatest native species abundance and highest values for biological integrity are typically at or just below the threshold indicative of impairment of the aquatic life beneficial use. These sites typically have larger tributary watersheds and better connectivity to the Des Plaines River. Previous studies have indicated that dams have a strong influence on fish species assemblage in Des Plaines River tributaries, with habitat degradation and urban land cover exerting a secondary influence (Slawski et al., 2008). The DRWW monitoring report identified changes to fishery composition associated with heavy siltation and substrate embeddedness, urban runoff, and the addition of treated wastewater effluent (MBI, 2017).

3.16.4 Summary of Previous Lake Studies And Data

The majority of historical physical and chemical data for lakes in the DPR planning area has been gathered by the Lake County Health Department-Lakes Management Unit. These data are reported in detailed lake reports, available from the LCHD-ES website. Pertinent findings of that monitoring effort are summarized here. Additionally, a subset of 10 of those lakes monitored by LCHD-ES have also been monitored by the Illinois EPA since 1999. Those data are also summarized where they augment or depart from the pertinent findings.

3.16.4.1Native Fish and Plant Species

The LCHD-ES surveyed 22 lakes in the DPR planning area for the number of native fish species present, and 36 lakes for the number of native plant species as summarized in Table 3-53. The number of native fish species observed ranged from 0 – 27 and the number of native plant species observed ranged from 0 – 13. These counts can be utilized to identify lakes that would benefit from habitat restoration.

Table 3-53: Number of Native Fish and Plant Species Identified in Assessed Lakes

LAKE NAME	LAST ASSESSED	SUBWATERSHED	NATIVE FISH SPECIES	NATIVE PLANT SPECIES
Buffalo Creek Reservoir 1	2013	Buffalo Creek	-	5
Buffalo Creek Reservoir 2	2013	Buffalo Creek	-	5
Butler Lake	2015	Bull Creek	10	8
Loch Lomond	2015	Bull Creek	9	2
St. Mary's Lake	2015	Bull Creek	-	0
Big Bear Lake	2012	Indian Creek	-	1
Bresen Lake	2016	Indian Creek	-	8
Countryside Lake	2013	Indian Creek	10	3
Diamond Lake	2012	Indian Creek	11	5
Forest Lake	2012	Indian Creek	18	8
Kemper Lake 1	2012	Indian Creek	0	5
Lake Charles	2012	Indian Creek	-	5
Little Bear Lake	2012	Indian Creek	-	2
Salem Lake	2000	Indian Creek	-	10
Sylvan Lake	2012	Indian Creek	5	2
Stone Quarry Lake	2004	Lower Des Plaines	-	4
Druce Lake	2011	Mill Creek	16	13
Gages Lake	2011	Mill Creek	19	4
Gray's Lake	2011	Mill Creek	13	5
Lake Miltmore	2011	Mill Creek	21	8
Rollins Savanna Pond 2	2011	Mill Creek	0	8
Sand Lake	2011	Mill Creek	9	3

LAKE NAME	LAST ASSESSED	SUBWATERSHED	NATIVE FISH SPECIES	NATIVE PLANT SPECIES
Third Lake	2012	Mill Creek	27	12
Crooked Lake	2006	North Mill Creek	8	4
Deer Lake	2010	North Mill Creek	-	13
Hastings Lake	2006	North Mill Creek	6	7
Lake Linden	2010	North Mill Creek	-	1
McDonald Lakes 2	2010	North Mill Creek	-	4
Slough Lake	2013	North Mill Creek	-	3
Timber Lake (north)	2010	North Mill Creek	8	12
Waterford Lake	2010	North Mill Creek	8	3
White Lake	2010	North Mill Creek	-	9
Independence Grove Lake	2016	Upper Des Plaines	10	18
Lake Carina	2016	Upper Des Plaines	10	6
Liberty Lake	2001	Upper Des Plaines	11	1
Sterling Lake	2016	Upper Des Plaines	13	15

3.16.4.2Floristic Quality Index

Floristic quality index (FQI) is a metric that evaluates how close the flora of an area is to undisturbed conditions. It can be used to identify natural areas, compare floristic quality between or within lakes, monitor long-term changes in floristic quality, or monitor habitat restoration efforts. To determine FQI, each floating and submerged plant species is assigned a number based on its sensitivity to disturbance, and the average of the assigned numbers is multiplied by the square root of the number of plant species found in the lake. FQI scores between 1-19 indicate low vegetative quality, scores between 20-35 indicate high vegetative quality, and scores >35 indicate undisturbed vegetative quality. The LCHD-ES surveyed 38 lakes in Lake County for FQI (Table 3-54)**.** These assessments determined FQI scores both including (FQI Native) and excluding (FQI w/ Adventives) invasive species. Of the 38 lakes assessed for FQI Native, 31 had low vegetative quality and 7 had high vegetative quality. When invasive species were included in the FQI scores (FQI w/ Adventives), 33 lakes had low vegetative quality and 5 had high vegetative quality.

Table 3-54: FQI of Assessed Lakes Without and With Adventives

LAKE NAME	LAST ASSESSED	SUBBASIN	FQI NATIVE	FQI W/ ADVENTIVES
Buffalo Creek Reservoir 1	2013	Buffalo Creek	12.5	11.4
Buffalo Creek Reservoir 2	2013	Buffalo Creek	12.5	11.4
Butler Lake	2015	Bull Creek	6.4	16.1
Loch Lomond	2015	Bull Creek	8.5	8.5
St. Mary's Lake	2015	Bull Creek	0.0	0.0
Big Bear Lake	2012	Indian Creek	5.0	3.5
Bresen Lake	2016	Indian Creek	17.8	16.6
Countryside Lake	2014	Indian Creek	7.7	11.5
Diamond Lake	2012	Indian Creek	5.5	3.7
Forest Lake	2012	Indian Creek	15.9	14.8
Kemper Lake 1	2012	Indian Creek	13.4	12.2
Kemper Lake 2	2012	Indian Creek	9.8	8.5
Lake Charles	2012	Indian Creek	11.0	9.0

LAKE NAME	LAST ASSESSED	SUBBASIN	FQI NATIVE	FQI W/ ADVENTIVES
Little Bear Lake	2012	Indian Creek	7.5	5.8
Salem Lake	2000	Indian Creek	20.2	18.5
Sylvan Lake	2012	Indian Creek	10.6	10.6
Stone Quarry Lake	2004	Lower Des Plaines	12.5	12.5
Druce Lake	2011	Mill Creek	21.8	19.1
Gages Lake	2011	Mill Creek	12.5	10.2
Gray's Lake	2011	Mill Creek	16.1	16.1
Lake Miltmore	2011	Mill Creek	18.7	16.8
Rollins Savanna Pond 2	2011	Mill Creek	17.7	17.7
Sand Lake	2011	Mill Creek	10.4	8.0
Third Lake	2014	Mill Creek	25.1	22.5
Crooked Lake	2010	North Mill Creek	16.0	14.0
Deer Lake	2010	North Mill Creek	24.4	23.5
Hastings Lake	2010	North Mill Creek	17.0	15.0
Lake Linden	2010	North Mill Creek	8.0	8.0
McDonald Lakes 2	2010	North Mill Creek	12.5	12.5
Slough Lake	2013	North Mill Creek	5.0	5.0
Timber Lake (north)	2010	North Mill Creek	23.4	20.9
Waterford Lake	2010	North Mill Creek	9.2	9.2
White Lake	2010	North Mill Creek	17.0	16.0
Independence Grove Lake	2016	Upper Des Plaines	27.5	24.6
Lake Carina	2007	Upper Des Plaines	14.3	12.1
Lake Minear	2015	Upper Des Plaines	13.9	11.0
Liberty Lake	2001	Upper Des Plaines	5.0	5.0
Sterling Lake	2016	Upper Des Plaines	26.9	24.5

3.16.4.3Water Quality

The water quality of 44 lakes in the DPR planning area was assessed utilizing multiple parameters including total phosphorus (TP), soluble reactive phosphorus (SRP), total Kjeldahl nitrogen (TKN), ammonia (NH_3-N), nitrate (NO_{3-}), secchi disk depth (SECCHI), total solids (TS), total dissolved solids (TDS), total volatile solids (TVS), total suspended solids (TSS), chloride (Cl^-), alkalinity (ALK), specific conductivity (COND), pH, and dissolved oxygen (DO). The most recent year of water quality data was used for each lake, which ranged from 2000 – 2016. Water quality data that is older than 10 years may not be representative of the current lake conditions and should be interpreted carefully. This lake inventory offers a summary of water quality for all assessed lakes in the DPR planning area. In depth analysis and reports for individual lakes within Lake County can be accessed at http://www.lakecountyil.gov/2400 /Lake-Reports. Table 3-55 summarizes the arithmetic mean of the most recent year of data for each parameter assessed at each lake.

Table 3-55: Water Quality in Lakes for Most Recent Year Assessed

Value for each parameter is the arithmetic mean of all samples for most recent assessment year. If most recent assessment was > 10 years before this lake inventory summary (2017), results may not be representative of the current lake conditions.

LAKE NAME	YEAR LAST ASSESSED	SUBBASIN	TP (mg/L)	SRP (mg/L)	TKN (mg/L)	NH3-N (mg/L)	NO3-N (mg/L)	SECCHI (ft)	TS (mg/L)	TDS (mg/L)	TSS (mg/L)	TVS (mg/L)	ALK (mg/L CaCO3)	COND (mS/cm)	Cl- (mg/L)	pH (s.u.)	DO (mg/L)
Buffalo Creek Reservoir 1	2013	Buffalo Creek	0.068	0.010	1.10	<0.10	<0.05	2.2	668	654	7.2	106	169	1.206	210	8.38	8.73
Buffalo Creek Reservoir 2	2013	Buffalo Creek	0.096	0.089	1.18	<0.10	<0.05	2.3	677	660	19.2	112	168	1.219	210	8.28	9.06
Butler Lake	2015	Bull Creek	0.032	<0.005	0.80	<0.10	0.08	6.5	620	-	2.3	125	159	0.995	205	8.14	7.38
Loch Lomond	2015	Bull Creek	0.196	0.188	1.54	<0.10	0.06	2.2	486	-	11.0	103	174	0.774	134	8.42	7.51
St. Mary's Lake	2015	Bull Creek	0.061	0.009	1.02	<0.10	<0.05	3.0	609	549	8.5	114	158	0.998	198	8.25	8.33
Big Bear Lake	2012	Indian Creek	0.096	0.006	1.17	0.10	0.05	1.3	616	557	18.1	118	156	0.987	193	8.04	7.77
Bresen Lake	2016	Indian Creek	0.158	0.020	2.06	<0.10	<0.05	2.7	547	464	14.8	135	179	0.828	145	8.68	8.78
Countryside Lake	2014	Indian Creek	0.080	0.005	1.38	0.14	0.05	2.6	440	405	8.1	95	134	0.710	139	8.55	8.14
Diamond Lake	2012	Indian Creek	0.039	0.037	0.84	<0.10	<0.05	3.2	514	466	6.5	90	153	0.833	165	8.37	8.26
Forest Lake	2012	Indian Creek	0.154	0.006	1.23	<0.10	0.03	2.5	621	-	13.5	121	152	1.245	214	8.60	8.42
Kemper Lake 1	2012	Indian Creek	0.222	0.015	1.95	<0.10	0.25	2.6	611	-	11.6	132	173	0.959	184	8.23	5.90
Kemper Lake 2	2012	Indian Creek	0.110	0.090	1.18	<0.10	<0.05	1.8	559	-	18.0	109	138	0.930	189	8.05	7.03
Lake Charles	2012	Indian Creek	0.093	0.010	1.07	0.13	0.17	2.2	501	436	15.1	97	131	0.785	153	8.26	7.75
Little Bear Lake	2012	Indian Creek	0.068	<0.005	1.06	0.10	0.05	2.4	624	614	11.4	111	153	1.022	205	8.06	7.75
Salem Lake*	2000	Indian Creek	0.165	0.060	1.64	0.18	0.06	1.6	422	379	16.5	134	142	0.617	-	8.73	7.47
Sylvan Lake	2012	Indian Creek	0.100	<0.005	1.58	<0.10	<0.05	2.0	573	478	17.0	137	160	0.856	150	8.49	10.72
Stone Quarry Lake*	2004	Lower Des Plaines	0.023	0.005	1.34	0.43	0.76	8.8	862	773	3.5	138	104	1.527	228	8.25	8.87
Druce Lake	2011	Mill Creek	0.014	<0.005	0.60	0.10	0.12	12.3	702	-	1.7	117	138	1.165	276	8.47	10.85
Fourth Lake	2011	Mill Creek	0.037	<0.005	1.05	<0.10	<0.05	2.4	638	568	6.3	125	196	1.035	202	7.95	8.67
Gages Lake	2011	Mill Creek	0.020	<0.005	0.97	<0.10	0.10	5.4	613	-	4.8	103	117	1.022	246	8.52	8.91
Gray's Lake	2011	Mill Creek	0.031	<0.005	0.89	<0.10	0.06	4.1	459	-	6.2	96	135	0.762	147	8.40	11.58
Lake Miltmore	2011	Mill Creek	0.021	<0.005	0.82	<0.10	0.06	7.4	567	536	3.6	111	137	0.971	208	8.83	9.11

LAKE NAME	YEAR LAST ASSESSED	SUBBASIN	TP (mg/L)	SRP (mg/L)	TKN (mg/L)	NH3-N (mg/L)	NO3-N (mg/L)	SECCHI (ft)	TS (mg/L)	TDS (mg/L)	TSS (mg/L)	TVS (mg/L)	ALK (mg/L CaCO3)	COND (mS/cm)	Cl- (mg/L)	pH (s.u.)	DO (mg/L)
Rollins Savanna Pond 2	2011	Mill Creek	0.587	0.029	6.47	<0.05	<0.10	1.0	359	227	72.0	171	185	0.357	3	8.32	6.48
Sand Lake	2011	Mill Creek	0.038	<0.005	1.23	<0.10	<0.05	7.5	409	-	5.0	114	124	0.725	129	8.89	8.66
Third Lake	2014	Mill Creek	0.038	0.000	1.03	0.00	0.49	1.2	731	708	5.0	122	164	1.181	254	9.77	10.14
Crooked Lake	2010	North Mill Creek	0.070	<0.008	1.26	0.12	0.17	4.3	526	492	7.3	123	162	0.884	173	8.69	10.24
Deer Lake	2010	North Mill Creek	0.094	<0.005	0.84	<0.10	<0.05	8.1	636	-	7.8	132	143	0.465	232	8.61	8.96
Hastings Lake	2010	North Mill Creek	0.052	<0.005	1.18	<0.10	<0.05	3.5	506	474	5.2	118	164	0.849	160	8.68	9.43
Lake Linden	2010	North Mill Creek	0.057	<0.005	1.02	<0.10	0.05	4.6	413	-	4.2	77	149	0.729	134	8.15	7.13
McDonald Lakes 2	2010	North Mill Creek	0.225	0.027	2.32	0.46	0.58	0.5	518	-	77.0	106	159	0.788	136	8.29	7.18
Rasmussen Lake	2012	North Mill Creek	0.486	0.237	2.31	0.10	1.24	1.6	530	-	22.6	114	219	0.785	115	9.14	13.91
Redwing Slough	2010	North Mill Creek	0.082	0.053	1.41	0.38	0.48	-	635	-	11.0	145	272	0.375	231	7.82	4.16
Slough Lake	2013	North Mill Creek	0.216	0.171	2.05	<0.10	<0.05	1.6	692	-	17.0	140	238	1.104	202	8.51	8.64
Timber Lake (north)	2010	North Mill Creek	0.021	<0.005	0.81	<0.10	<0.05	7.4	352	-	2.5	114	209	0.560	38	8.32	8.04
Waterford Lake	2010	North Mill Creek	0.040	<0.005	0.85	<0.10	0.09	4.7	480	-	3.9	80	142	0.854	175	8.32	7.31
White Lake	2010	North Mill Creek	0.086	0.046	1.41	0.11	0.06	4.0	239	-	7.3	91	125	0.373	37	8.66	7.38
Almond Marsh	2011	Upper Des Plaines	0.621	0.019	3.34	<0.05	<0.05	-	442	267	77.0	136	147	0.508	97	7.77	-
Independence Grove Lake	2016	Upper Des Plaines	0.013	<0.005	0.47	<0.10	<0.05	10.3	523	426	1.6	151	141	0.753	84	8.25	9.04
Des Plaines Lake	2016	Upper Des Plaines	0.109	0.025	1.26	<0.10	1.26	2.1	611	518	12.0	140	214	0.936	149	8.24	9.32
Lake Carina	2016	Upper Des Plaines	0.011	<0.005	0.40	<0.10	<0.05	17.0	797	717	1.4	138	133	1.331	328	8.44	9.16
Lake Minear	2015	Upper Des Plaines	0.016	<0.005	0.48	<0.10	<0.05	13.8	409	380	0.0	99	120	0.661	122	8.42	8.74
Liberty Lake*	2001	Upper Des Plaines	0.063	0.013	1.21	0.12	<0.05	3.2	539	506	8.3	114	121	0.902	-	8.21	8.50
Osprey Lake	2007	Upper Des Plaines	0.111	0.010	1.28	<0.10	<0.05	1.0	495	-	34.2	108	189	0.786	104	8.04	7.90
Sterling Lake	2016	Upper Des Plaines	0.011	0.008	0.47	0.13	<0.05	13.8	536	380	1.5	148	164	0.661	146	8.42	8.74

- = Data not collected

3.16.4.4Nutrients

Plants and algae require nutrients from their environment to grow. The primary nutrients necessary for plant and algal growth in lakes are nitrogen and phosphorus. Aquatic vegetative growth in DPR planning area lakes is typically phosphorus limited. This means that any contributions of phosphorus to the water column directly affects plant and algal growth. The LCHD-ES analyzed TP and SRP at lakes within the DPR planning area. TP is a measure of all organic and inorganic phosphorus in the water column. Lakes with TP concentrations greater than 0.05 mg/L are classified as impaired by the Illinois EPA, because they can support excessive algal growth. The most recent yearly average of TP for the assessed lakes ranged from 0.011 – 0.621 mg/L, as shown in Figure 3-89. The yearly average of TP concentration exceeded Illinois EPA's 0.05 mg/L TP standard in 28 (63.6%) of the assessed lakes.

SRP is a measure of phosphorus in the dissolved form that is readily available for plant and algal growth. The most recent yearly average of SRP for the assessed lakes ranged from 0 – 0.237 mg/L, as shown in Figure 3-90. Nitrogen is also needed for plant and algal growth, and is present in both organic and inorganic forms. The LCHD-ES analyzed TKN, NH_3-N, and NO_3 at lakes in the DPR planning area. TKN is a measure of organic nitrogen, which is typical bound by aquatic vegetation. The most recent yearly average of TKN for the assessed lakes ranged from 0.397 – 6.474 mg/L, as shown in Figure 3-91. NH_3-N and NO_3-N are measures of inorganic nitrogen, which can support seasonal algal blooms if present in sufficient quantities. The most recent yearly average of NH_3-N ranged from 0 - 0.462 mg/L, as shown in Figure 3-92**.** The most recent yearly average of $N0_3$-N ranged from 0.030 – 1.260 mg/L, as shown in Figure 3-93**.**

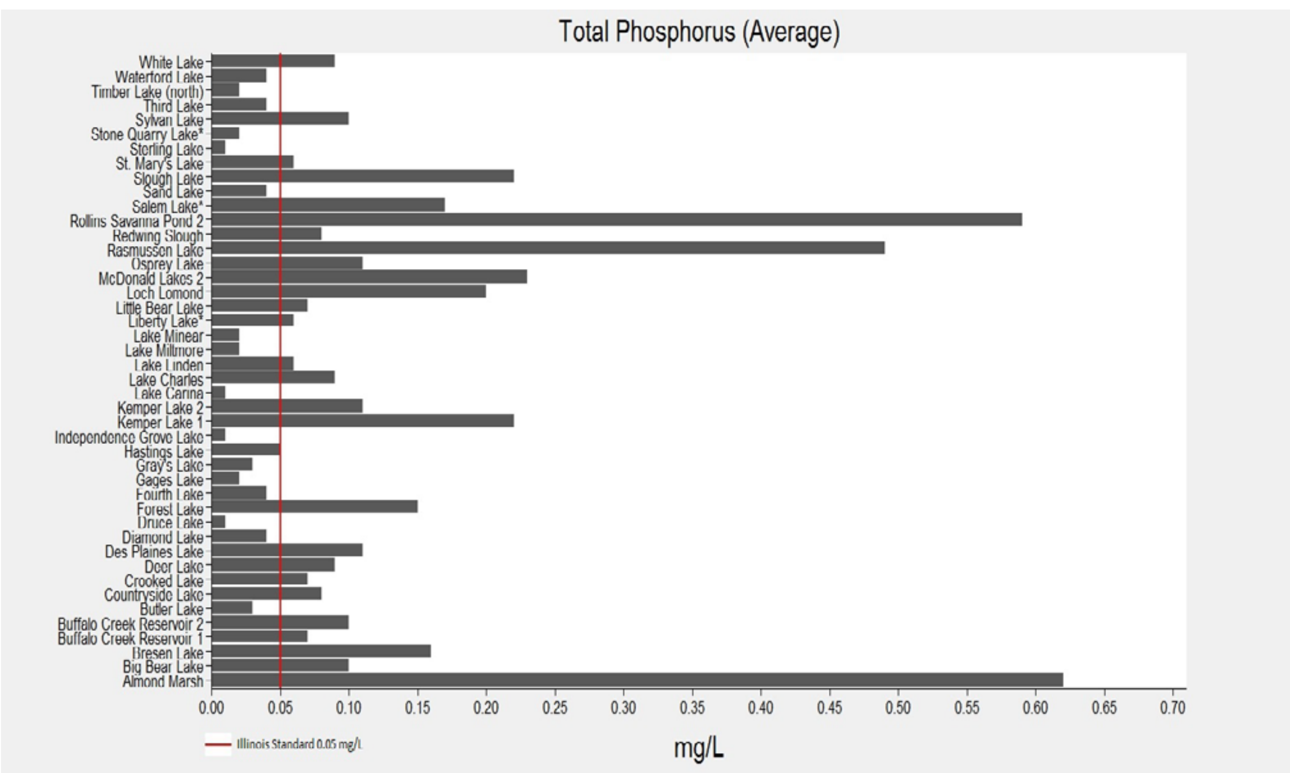


Figure 3-90: Most Recent Yearly Total Phosphorus Average by Lake

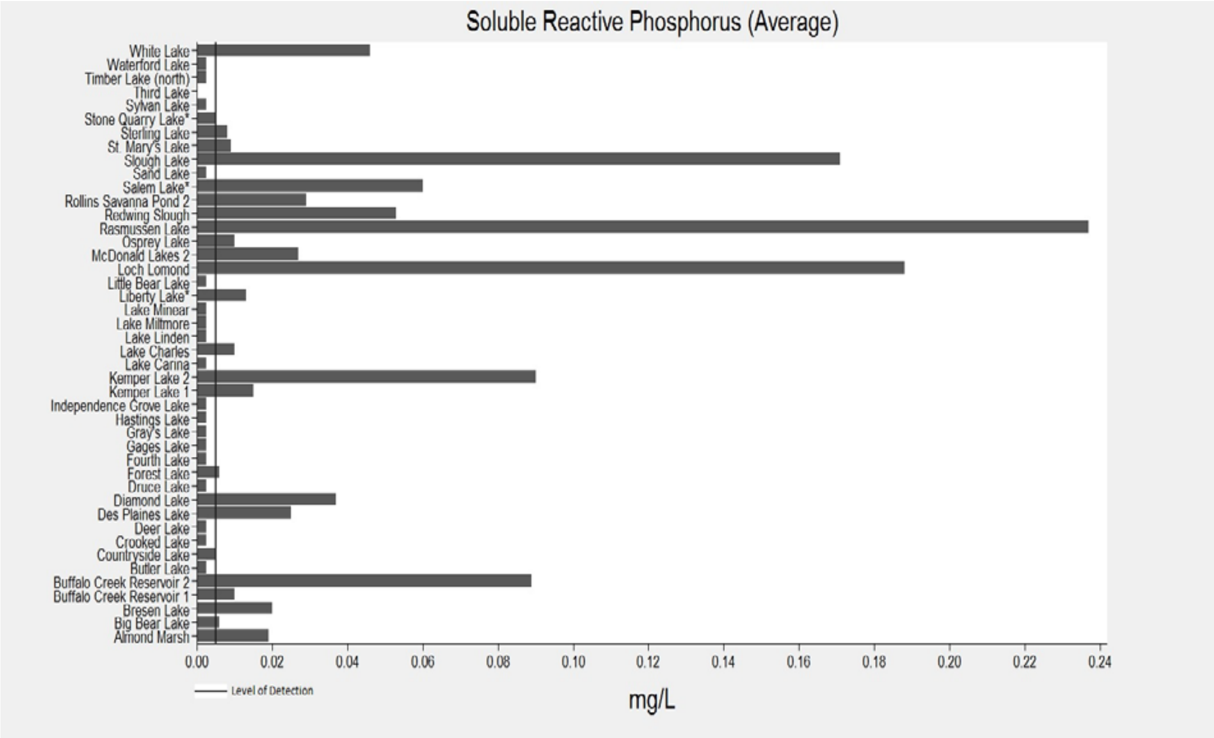


Figure 3-91: Most Recent Yearly SRP Average by Lake

Note: Values below the limit of detection are displayed as half of the limit of detection and represent concentrations between 0 – 0.1 mg/L.

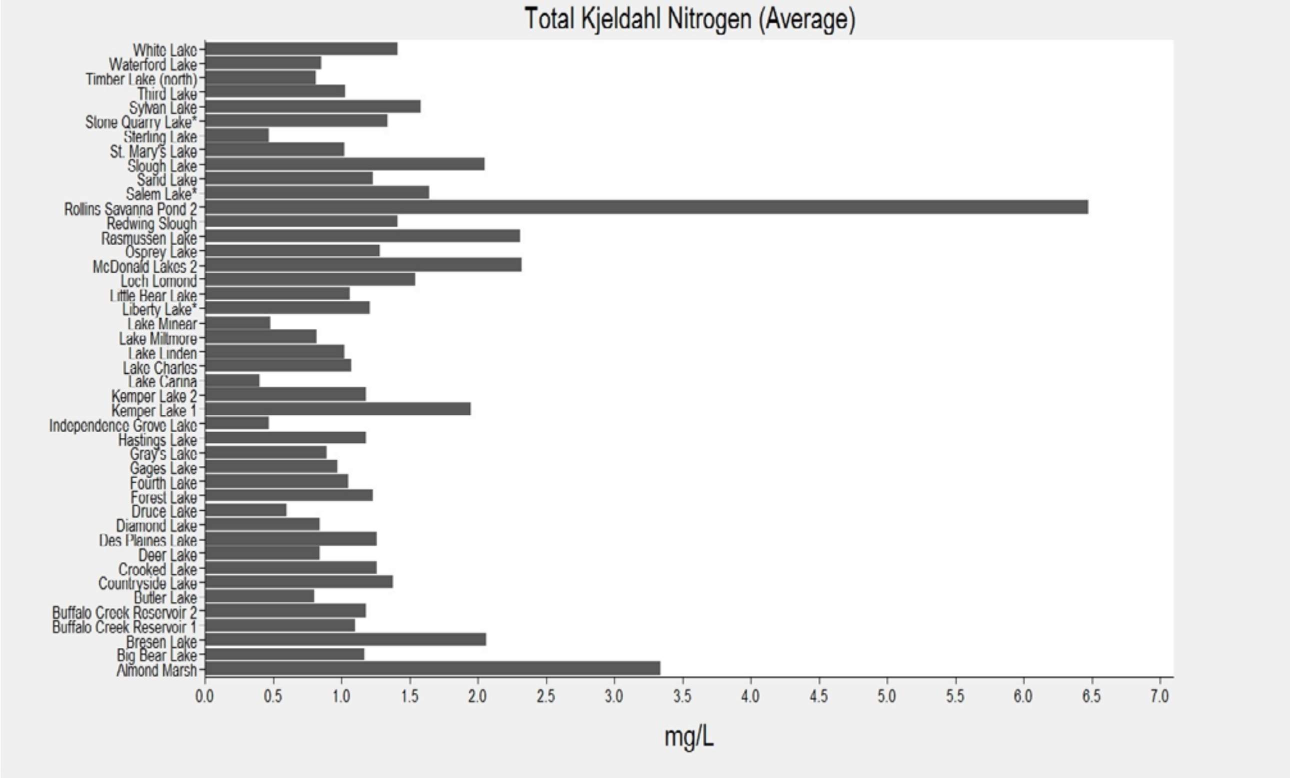


Figure 3-92: Most Recent Yearly TKN Average by Lake

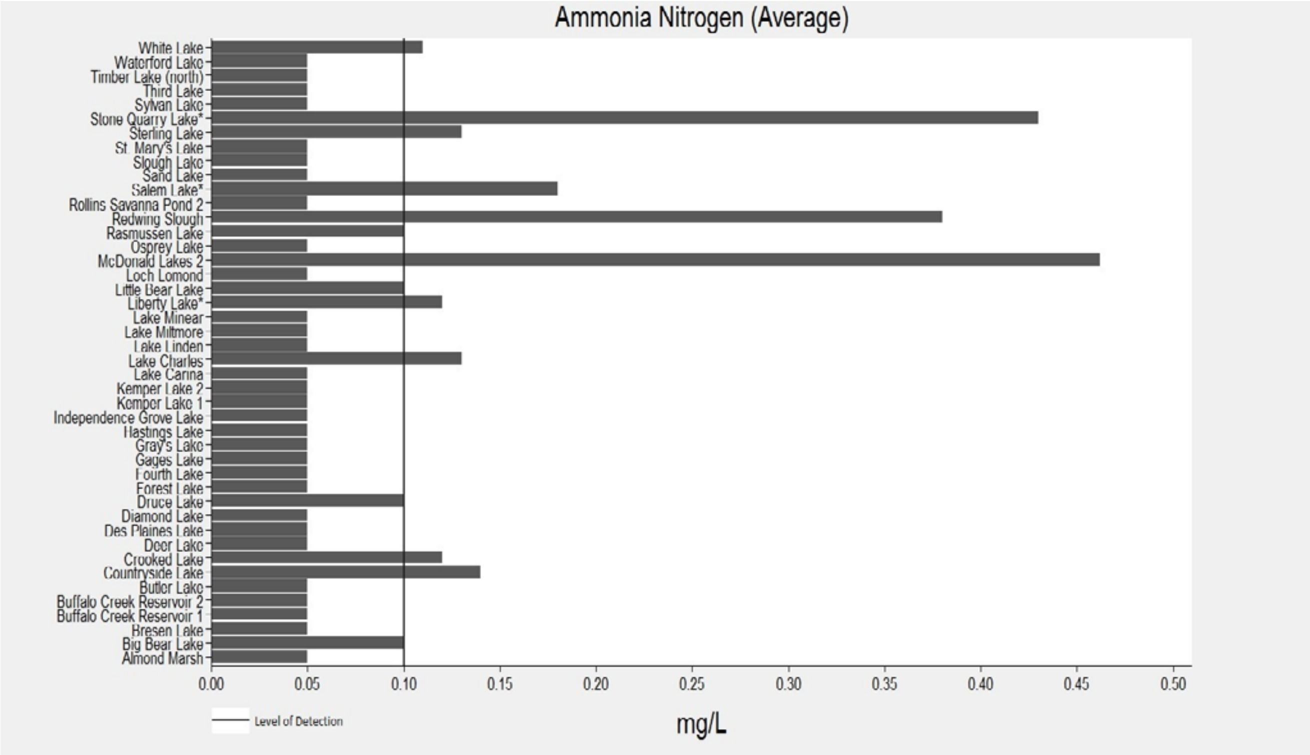


Figure 3-93: Most Recent Yearly Average of NH3-N by Lake

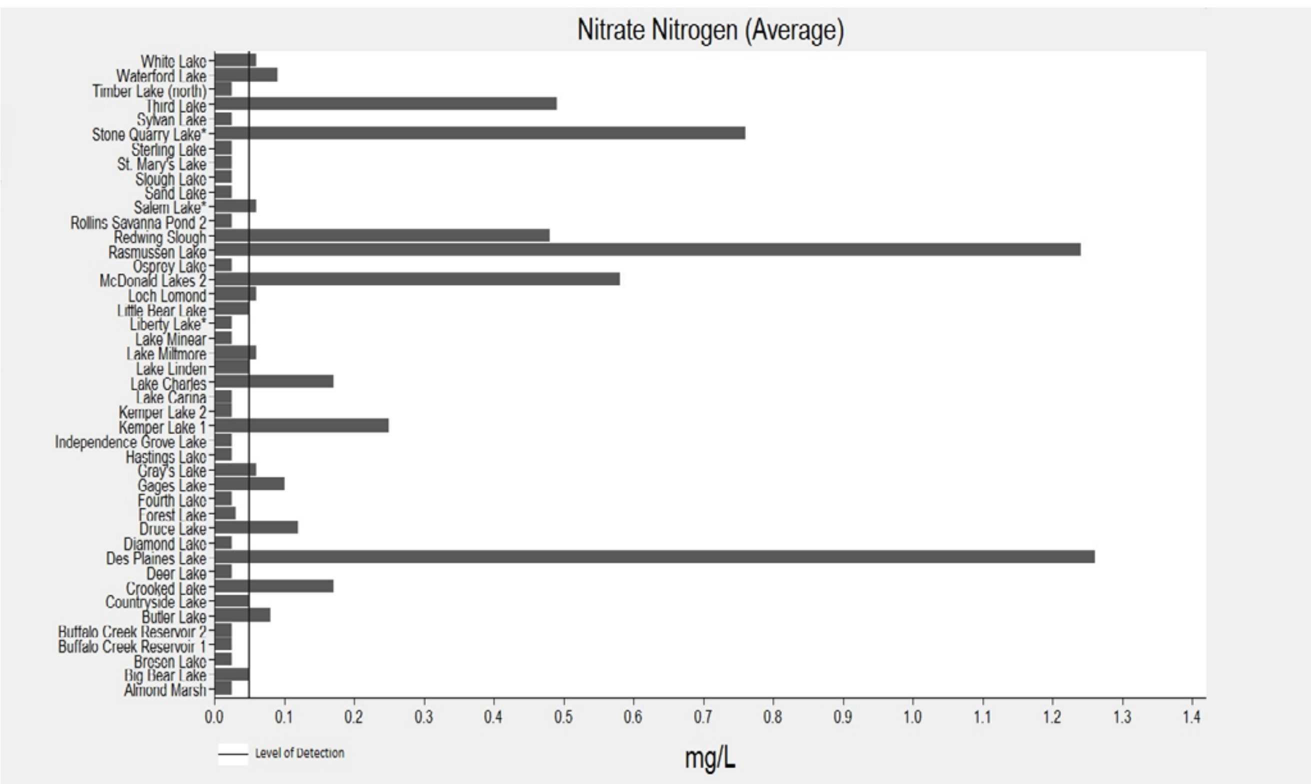


Figure 3-94: Most Recent Yearly Average of NO3-N by Lake

3.16.4.5 Water Clarity

Water clarity, or water transparency, is a measurement of the depth that light penetrates through the water column. A Secchi disk is typically utilized to measure this parameter (Figure 3-94). Briefly, a disk, with alternating black and white patterns, is lowered into the water column until it can't be seen by the observer. The depth at which this occurs is known as the Secchi depth. Secchi depth can be used as a proxy to estimate the amount of suspended and dissolved material in a lake such as algae, plankton, and sediment. Since suspended and dissolved material scatters light that enters the water column, increases in suspended sediments result in decreases in secchi depth. The most recent yearly average of secchi depth for the assessed lakes ranged from 0.5 – 17.0 feet, as summarized in Figure 3-95.

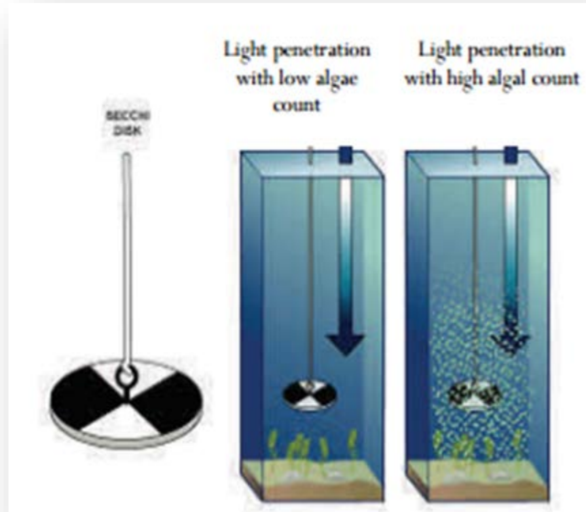


Figure 3-95: Illustration of a water clarity measurement utilizing a Secchi disk

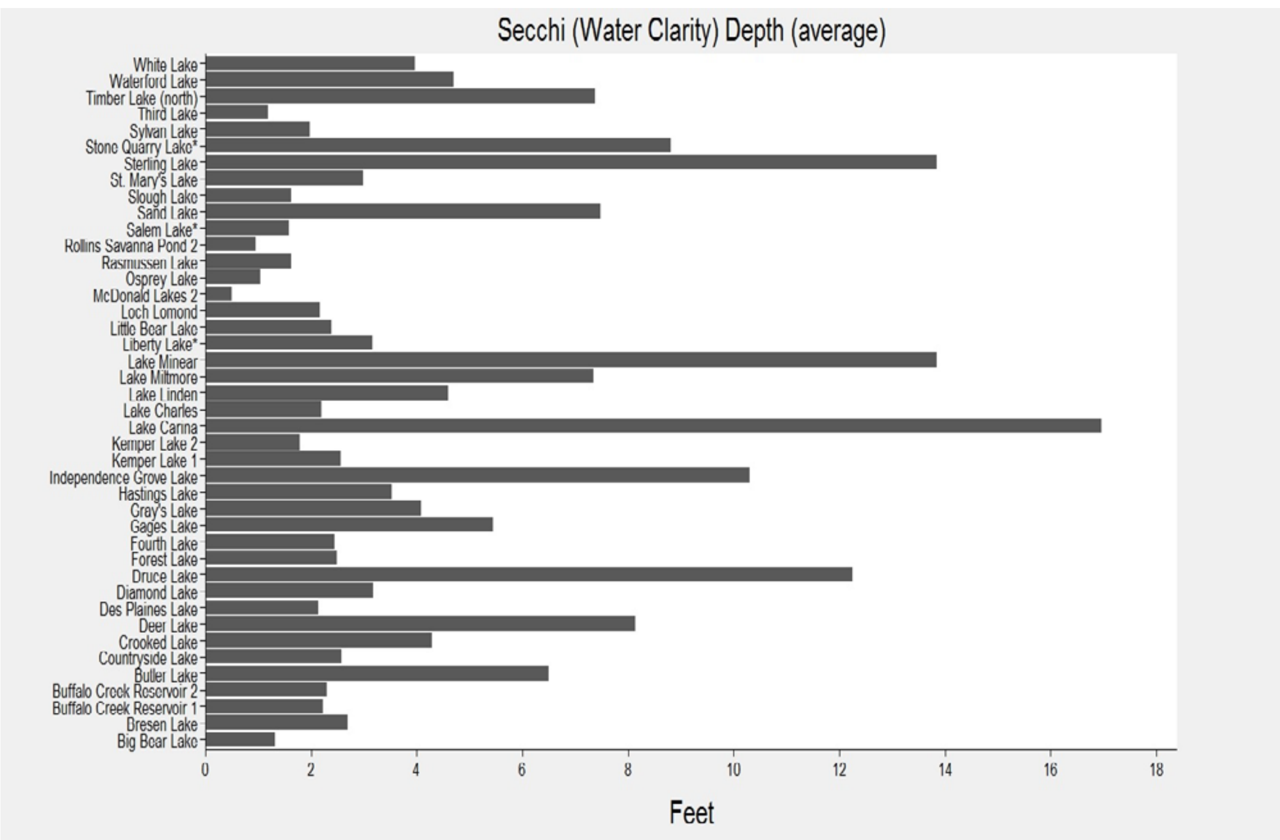


Figure 3-96: Most Recent Yearly Average of Secchi Depth by Lake

3.16.4.6Solids

Solids in the water column of a lake consists of suspended and dissolved material. TS is a measure of all suspended and dissolved solids in the water column. The most recent yearly average of TS for the assessed lakes ranged from 239 – 862 mg/L, as summarized in Figure 3-96. TDS is a measure of all the dissolved solids in a water column. The most recent yearly average of TDS for the assessed lakes ranged from 227 – 773 mg/L, as summarized in Figure 3-97**.** TSS is a measure of all organic and inorganic solids suspended in the water column including algae and sediment. High TSS concentrations can negatively impact many aspects of lake ecosystems and are typically associated with high phosphorus and low water clarity in DPR planning area lakes. The most recent yearly average of TSS for the assessed lakes ranged from 0.0 – 77.0 mg/L, as summarized in Figure 3-98. TVS is a measure of organic solids in the water column, including algae, plant material, and zooplankton. Lakes with high TVS typically have large quantities of aquatic plants and algae. The most recent yearly average of TVS for the assessed lakes ranged from 77.2 – 171.0 mg/L, as summarized in Figure 3-99.

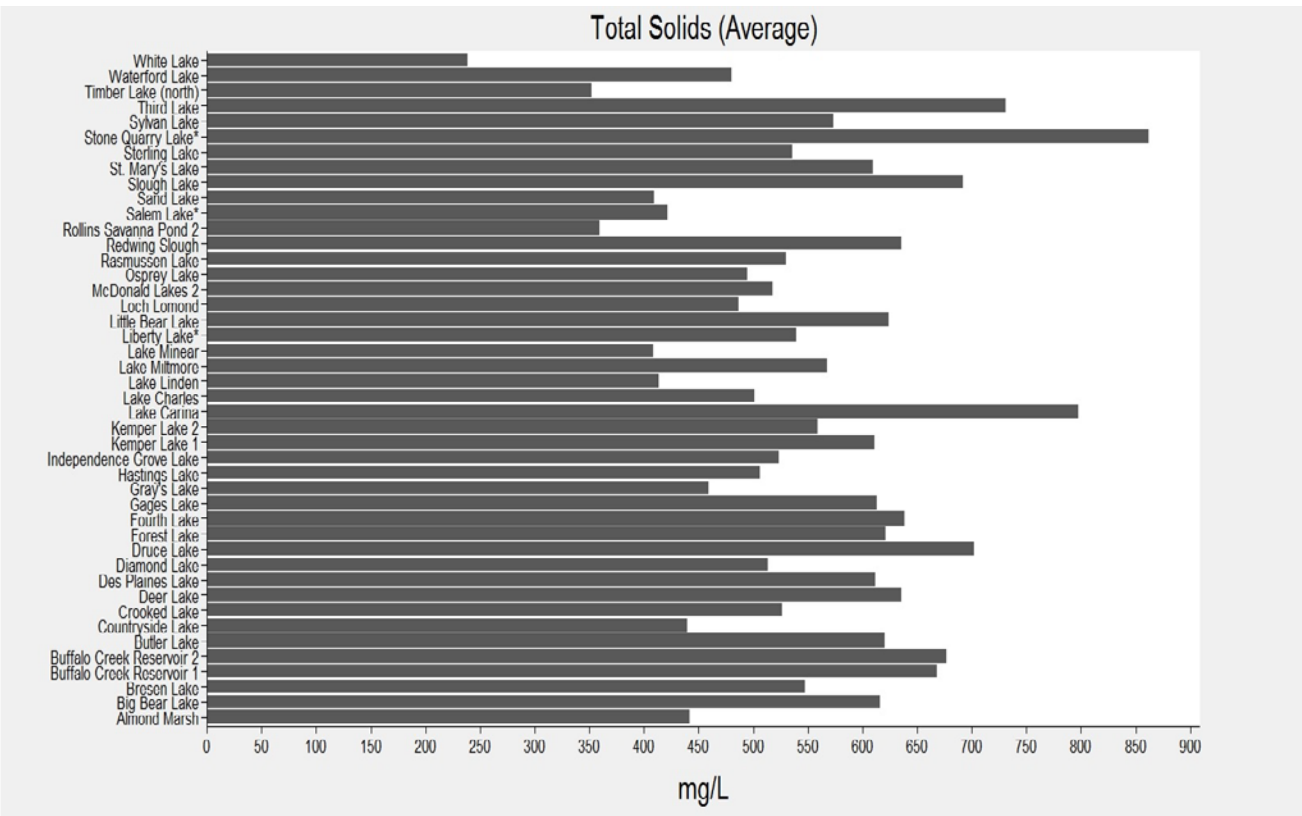


Figure 3-97: Most Recent Yearly Average of Total Solids by Lake

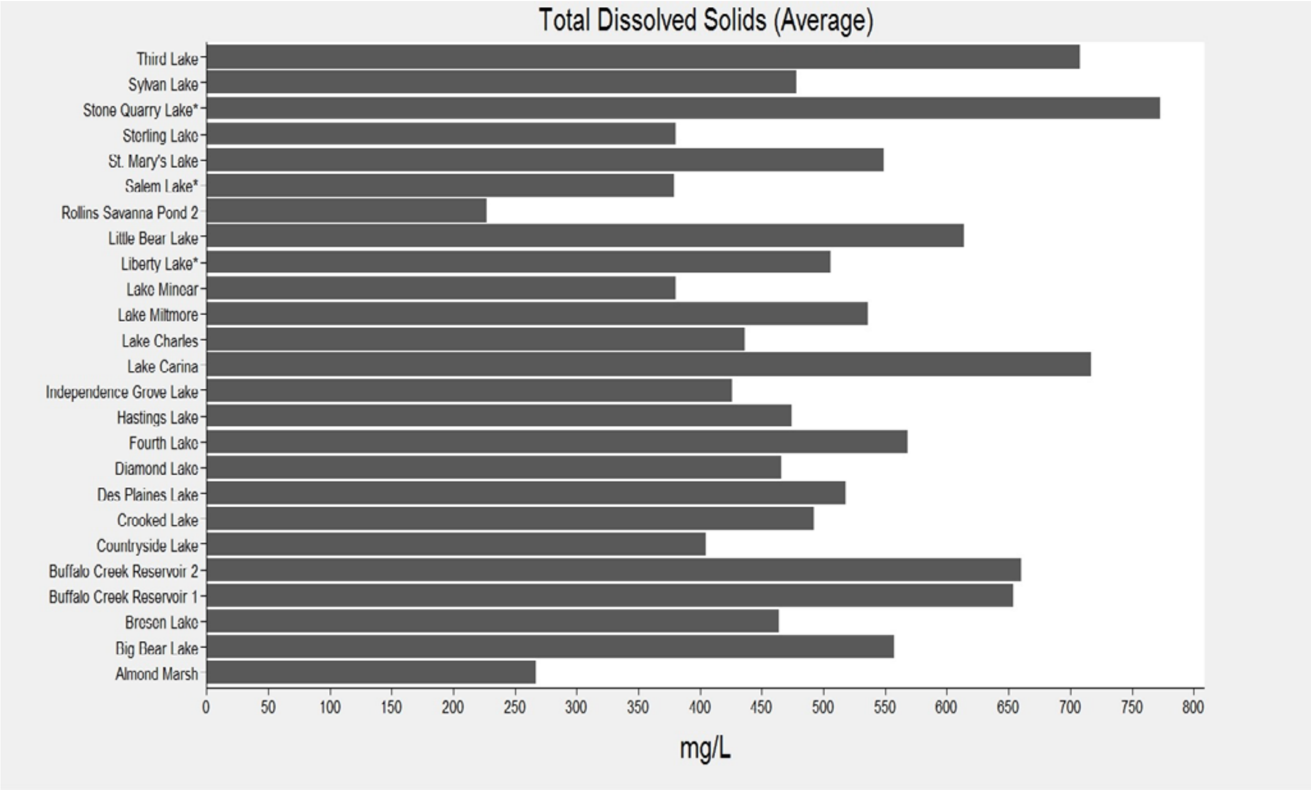


Figure 3-98: Most Recent Yearly Average of Total Dissolved Solids by Lake

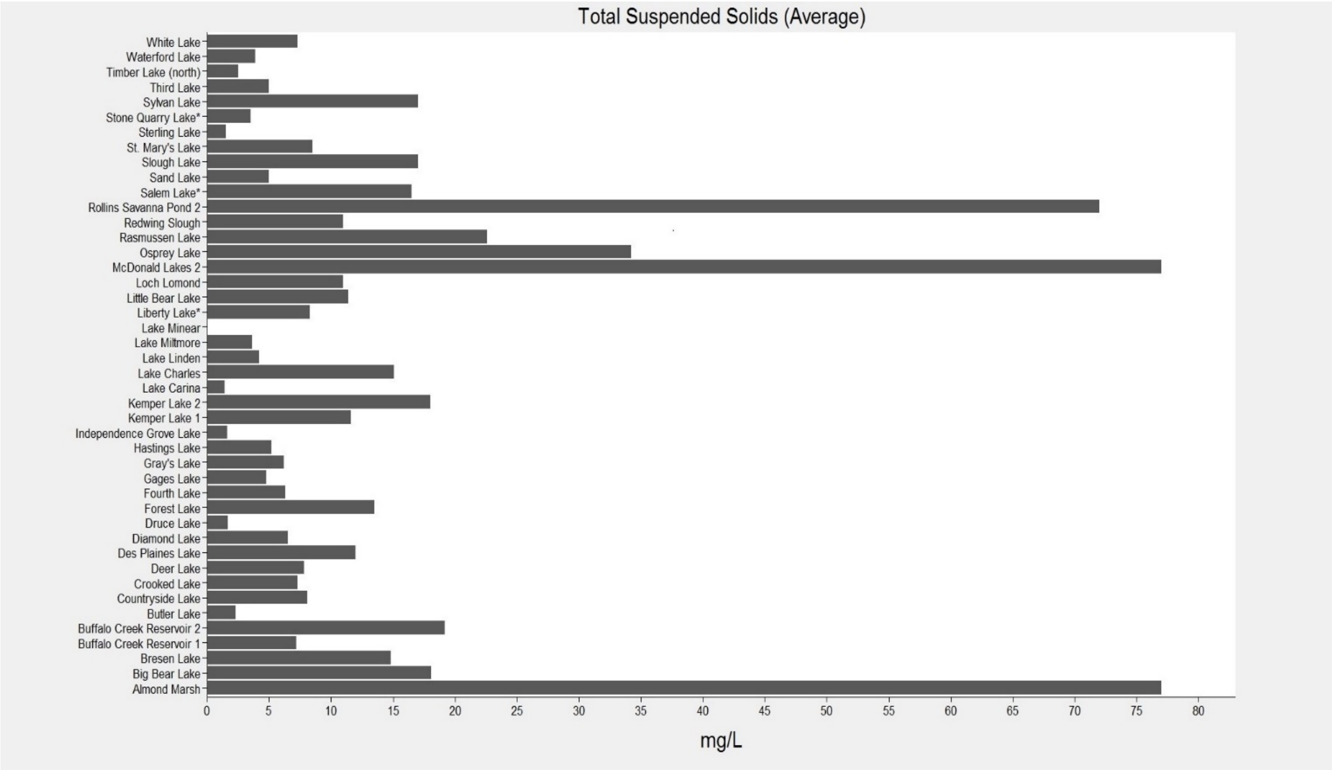


Figure 3-99: Most Recent Yearly Average of Total Suspended Solids by Lake

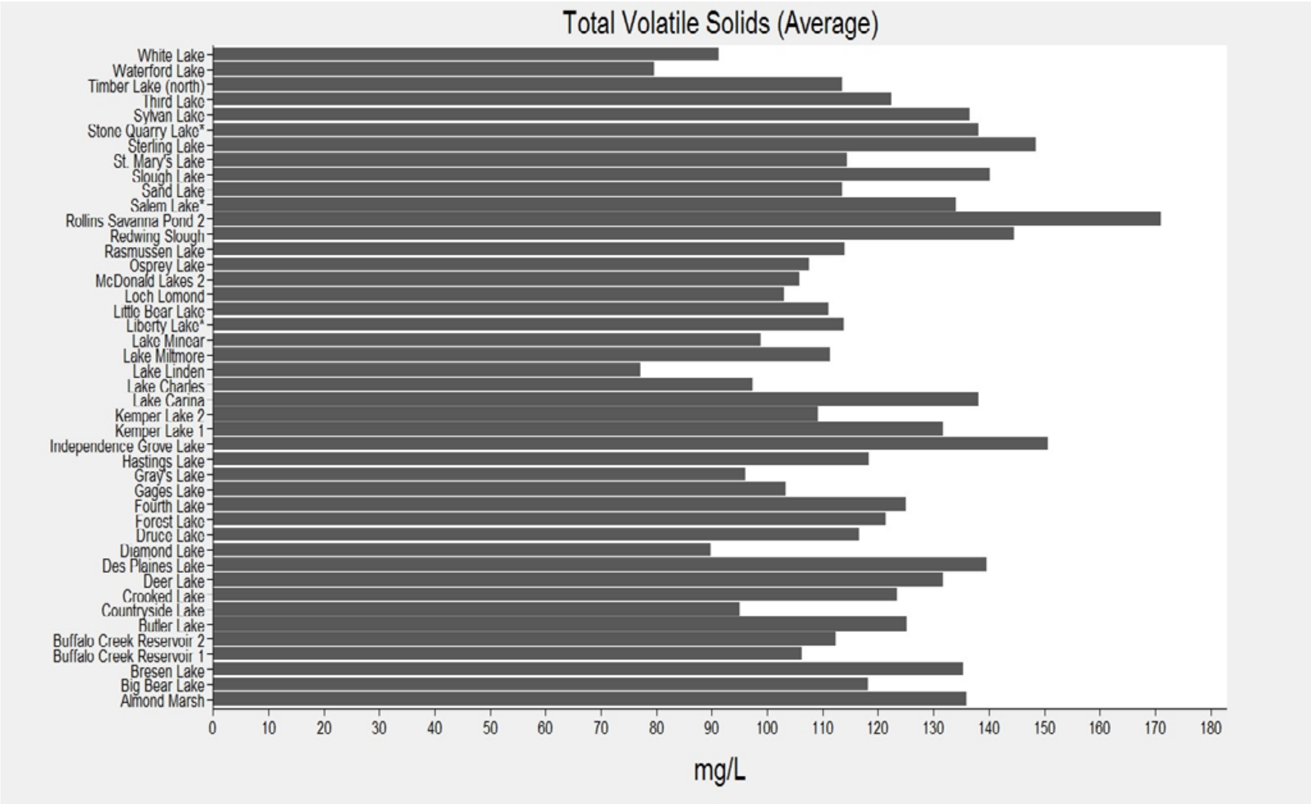


Figure 3-100: Most Recent Yearly Average of Total Volatile Solids by Lake

3.16.4.7Alkalinity, Specific Conductivity, and Chloride

Alkalinity is a measure of the buffering capacity of water, which is influenced by the minerals in surrounding sediment and bedrock. Lakes with high alkalinity have greater buffering capacities than lakes with lower alkalinity. The most recent yearly average for assessed lakes ranged from 104 – 272 mg/L, as summarized in Figure 3-100. Specific conductivity is measured to approximate the quantity of dissolved ions in a solution. Specific conductivity is closely related to chloride concentrations and TDS in DPR planning area lakes. Yearly average specific conductivity values ranged from 0.357 – 1.527 mS/cm in assessed DPR planning area lakes, as summarized in Figure 3-101**.** The concentration of chloride ions has been increasing in DPR planning area lakes over time. This increase is caused by the utilization of road salt for deicing. Road salt applied to surfaces within the watershed is incorporated into stormwater runoff, which drains into lakes. Increased chloride concentrations can cause detrimental impacts to aquatic life. The USEPA national recommended water criteria for chronic toxicity of chlorides is 230 mg/L. Yearly average chloride concentrations ranged from 3 - 327 mg/L in assessed DPR planning area lakes, as summarized in Figure 3-102. The yearly average chloride concentration exceeded Illinois EPA's 230 mg/L standard in 6 (14.3%) of the assessed lakes in the DPR planning area. These chloride concentrations assessments were conducted between May and September. Chloride concentrations in DPR planning area lakes are likely higher during times when road salt is typically applied.

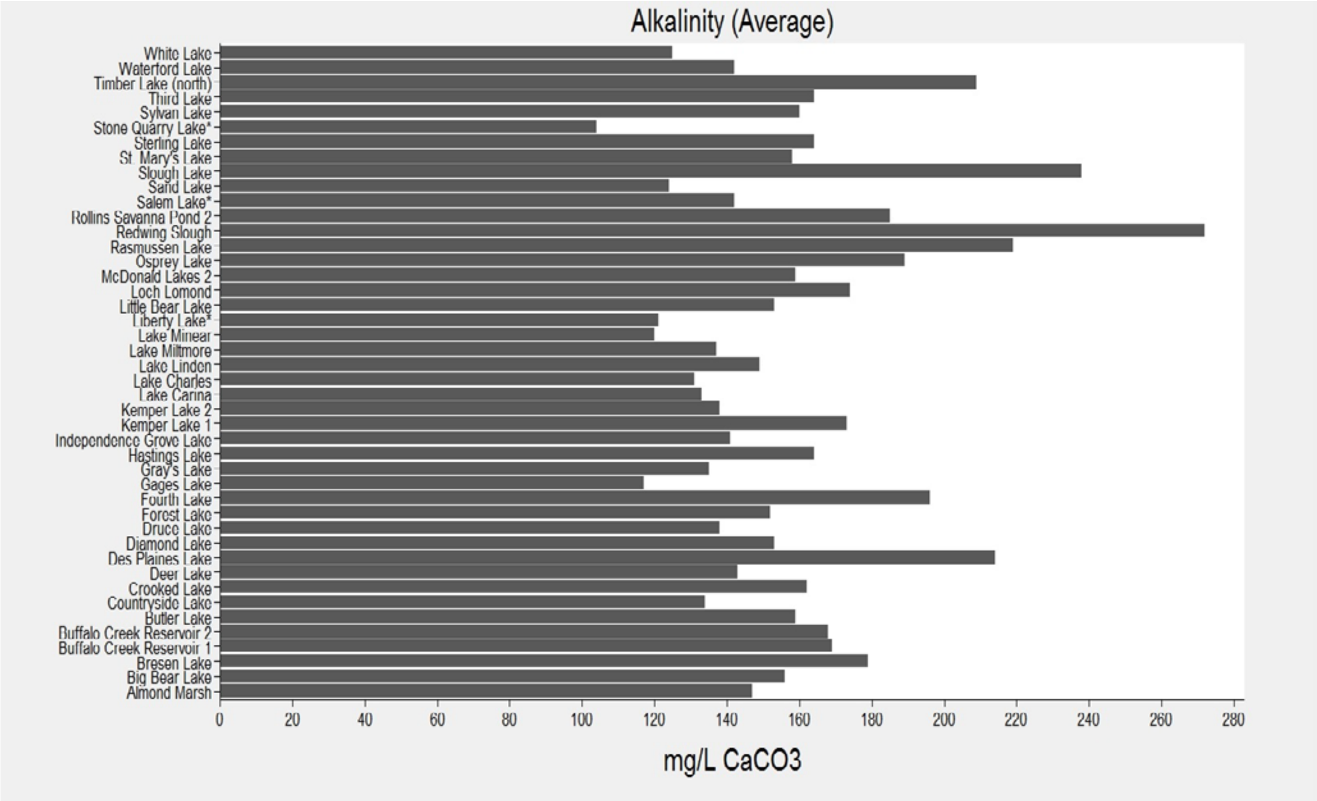


Figure 3-101: Most Recent Yearly Average Alkalinity by Lake

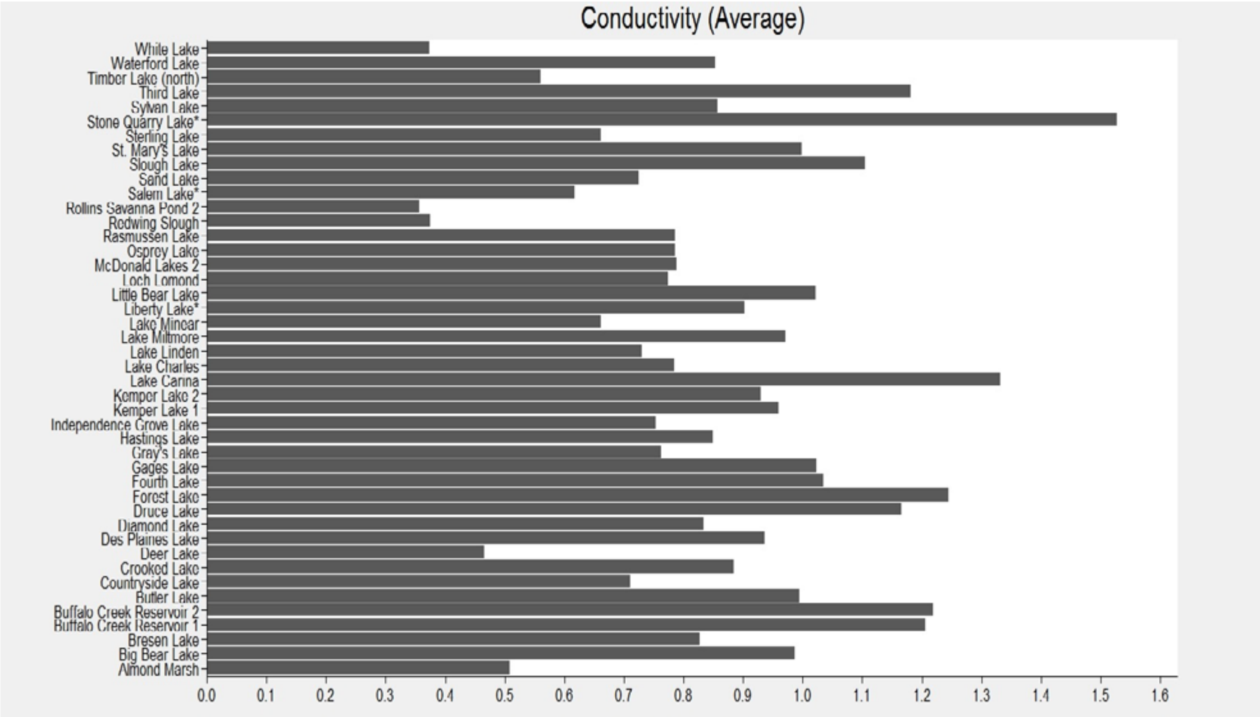


Figure 3-102: Most Recent Yearly Average Specific Conductivity by Lake

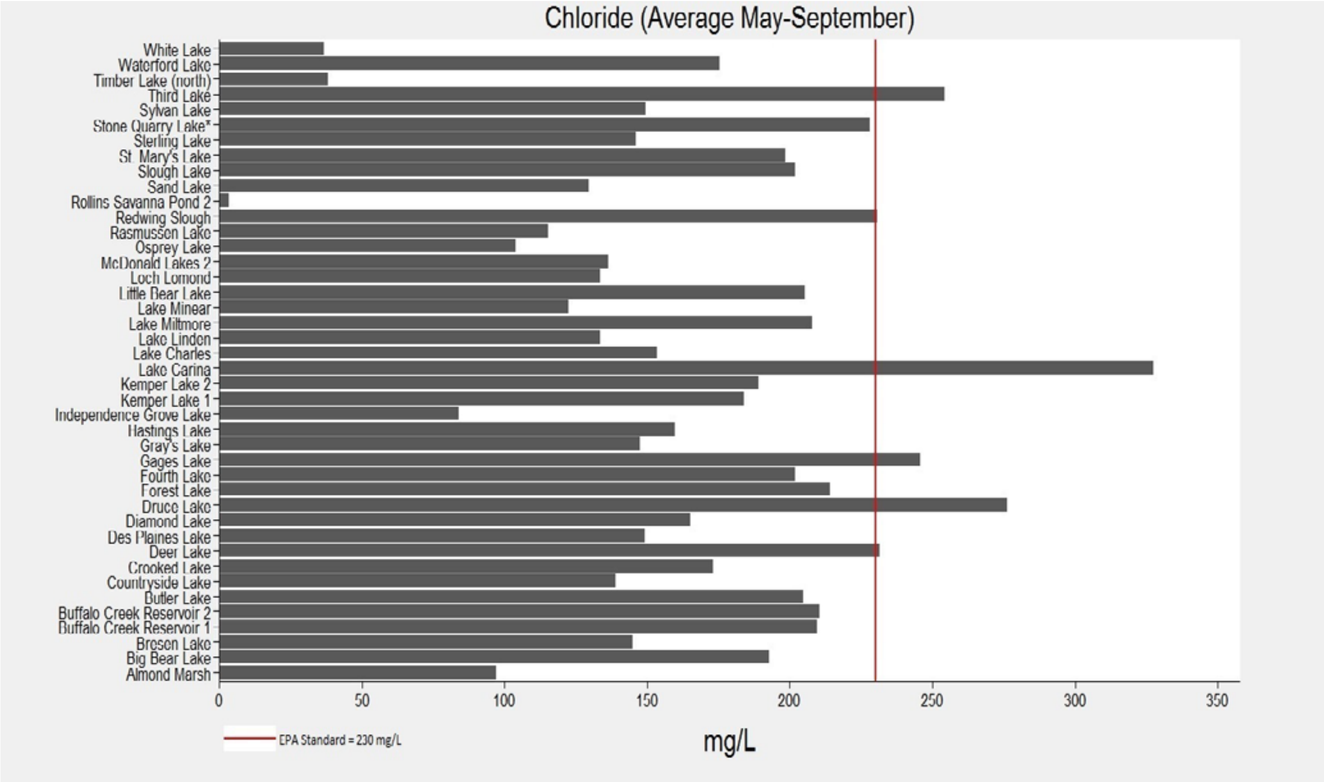


Figure 3-103: Most Recent Yearly Average Chloride Concentration by Lake

3.16.4.8pH and Dissolved Oxygen

pH is a measure of the concentration of the hydrogen ion in water, which affects multiple chemical processes within a lake such as the carbonate equilibrium cycle. The range of pH that is supportive of aquatic life is 5 – 9 standard units (s.u.). Values outside of this range can be harmful to aquatic life. Yearly average pH values ranged from 7.77 – 9.77 s.u. in assessed DPR planning area lakes. Rasmussen Lake and Third Lake had yearly averages of pH outside of the range recommended for aquatic life.

Dissolved oxygen is a measure of the concentration of gaseous oxygen in water. DO concentrations vary spatially and temporally on multiple scales. In stratified lakes, dissolved oxygen is generally higher in the epilimnion than the hypolimnion. DO concentrations fluctuate daily, with increases occurring in daytime hours when photosynthesizing plants are releasing oxygen into the water columns, and decreases occurring in nighttime hours when minimal photosynthesis is occurring. DO concentrations also vary seasonally because the solubility of oxygen in water decreases as water temperature increases. Additionally, lakes with substantial amounts of aquatic vegetation may experience sharp declines in DO, due to decaying plants and algae consuming water. Fish may experience oxygen stress if DO concentrations are below 5 mg/L for prolonged periods of time. Lakes with large amounts of aquatic vegetation may have high DO concentrations during daylight, and experience sharp decreases in DO at night. Yearly average DO values ranged from 4.16 – 13.91 mg/L in assessed DPR planning area lakes, as summarized in Figure 3-103. Redwing Slough had a yearly average DO below concentrations recommended for aquatic life. DO measurements were conducted during day light hours and likely represent the high end of growing season DO levels. Continuous overnight monitoring of DO in lakes is necessary to determine if diurnal fluctuations are sufficient to negatively impact aquatic life.

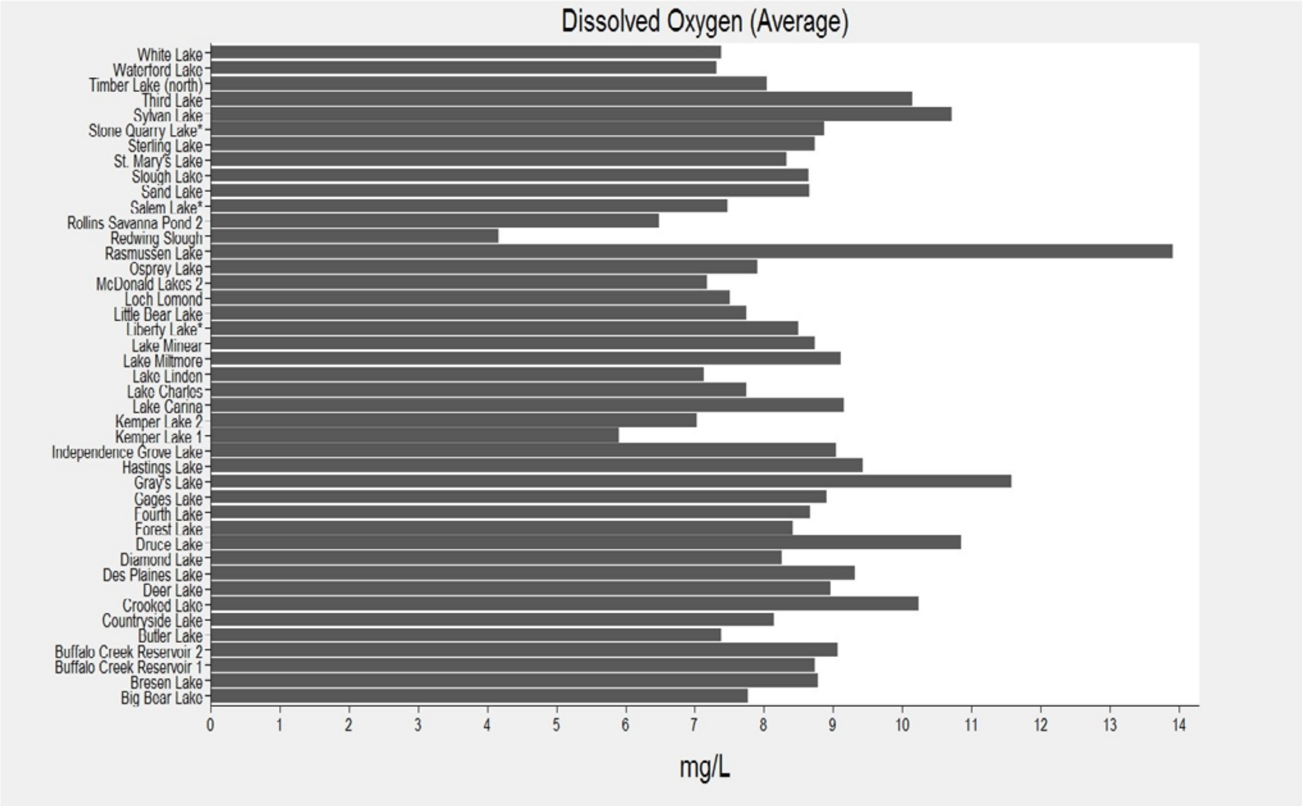


Figure 3-104: Most Recent Yearly Average Dissolved Oxygen Concentration by Lake

3.16.4.9Other Parameters/Studies

BCCWP and the Lake County Health Department also collected sediment samples at Albert Lake and two sites at Buffalo Creek Reservoir (one in each basin). Samples were analyzed for 136 parameters. Published guidelines (MacDonald, et al. 2000; Mitzelfelt, 1996) were exceeded for 7 parameters in Albert Lake and 10 parameters in Buffalo Creek Reservoir. In Albert Lake, copper and nickel are above a “threshold effect” concentration, indicating that they may have some effect on benthic organisms. Silver was considered highly elevated relative to mean concentrations from samples from 63 Illinois lakes. Mercury was above the “probable effect” concentration and considered elevated relative to concentrations from samples from 63 Illinois lakes, but may be bound to sediment, posing minimal risk. One suspected source of metals is the former Lake Zurich treatment plant that discharged to Buffalo Creek upstream of Albert Lake, which closed in 1993. In Buffalo Creek Reservoir, copper was found to be above the “threshold effect” concentration in the east basin. In the west basin, silver was considered highly elevated and mercury was above the “threshold effect” concentration and considered elevated relative to samples from 63 Illinois lakes (BCCWP and LCSMC 2015). Additionally, 5 organic compounds, all PAHs, were detected above the “threshold effect” level in Buffalo Creek Reservoir: pyrene, fluoranthene, chrysene, benzo(a)pyrene, and benzo(a)anthracene (BCCWP, 2015).

3.16.4.10 Kenosha County Lake Assessments

George Lake and Benet Lake/Lake Shangrila are lakes within the DPR planning area that are in Kenosha County, Wisconsin. George Lake is a 59-acre glacial lake located in Kenosha County, Wisconsin that is fed by two intermittent unnamed tributary streams. George Lake has a maximum depth of 16 ft, an average depth of 7 ft, 1.2 miles of shoreline, and a watershed area of 2,187 acres. The lake has one outlet, a fixed crest spillway/ dam, that is a major tributary of North Mill Creek / Dutch Gap Canal. There has been a gradual change in land use within the George Lake subwatershed from agricultural to urban since the 1950's. This trend is expected to continue in the future. Water quality data is provided by the 2007 lake management plan for George Lake, which was written by SEWRPC using data collected by the WI DNR's citizen lake monitoring network. George Lake is considered productive, nutrient rich, and visual assessments indicate an increase in algal blooms and a decrease in water clarity. George Lake has an average secchi depth of 4.83 ft, an average chloride concentration of 36 mg/L, and an average TP concentration of 0.05 mg/L. The lake is phosphorus limited and eutrophic. SEWRPC determined that stormwater runoff is the most likely source of phosphorus to the lake. George Lake has high quality habitat, with high numbers of plant and animal species. There is minimal shoreline erosion at George Lake.

Benet Lake is a 95.14-acre glacial lake located primarily in Wisconsin (93.5%) with a small portion (6.5%) on the south side extending into Lake County in Illinois. Benet Lake is connected by a shallow channel to Lake Shangrila and is sometimes considered part of the same lake with a total of size of 185.9 acres. The Illinois portion of the lake lies in the extreme northwest corner of the North Mill Creek / Dutch Gap Canal watershed. Benet Lake is not connected directly to North Mill Creek and is an isolated water body. Benet Lake has an average secchi depth of 1.4 ft, and an average TP concentration of 0.046 mg/L. Lake Shangrila has an average secchi depth of 1.0 ft, and an average TP concentration of 0.046 mg/L. Both lakes TP concentrations exceed Wisconsin state limits. Lake Benet is slightly hypereutrophic and has heavy algal blooms, dense aquatic vegetation beds, blue green algae blooms, and Eurasian Watermilfoil present along the shoreline.

3.17 NPDES POINT SOURCE PERMITS

The USEPA under the Federal Water Pollution Control Act Amendments of 1972, regulates and monitors point source industrial and wastewater pollutant discharges into the nation's waterways (Public Law 92-500; 33 U.S.C. 1251 et seq.). Authorized under amendments made to the 1977 CWA in 1987 and implemented in 1990, the USEPA developed a two-phased NPDES permit program to address industrial and MS4s, serving populations of greater than 100,000, requiring a permit to discharge stormwater from their outfalls into waterways. NPDES Phase 2, enacted into law in 1999 and implemented in 2003, builds upon the existing Phase I program by regulating stormwater discharges from small MS4s located in urbanized areas (as defined by the latest decennial census) and construction sites that disturb one to five acres obtain a permit to discharge stormwater from their outfalls into waterways. Additional information regarding the NPDES program and specifically permit basics and definitions are available from USEPA NPDES website (USEPA WMPD, 2012; USEPA, 2017, December 21). See section 3.18.1 for more information on DPR planning area NPDES permits that are currently active at the time of compiling this report.

Point sources are defined as discrete conveyances including but not limited to any pipe, ditch, channel, or conduit from which pollutants are or may be discharged into waterways. Point source regulation through NPDES includes wastewater treatment plants, industrial discharges, concentrated animal feeding operations, combined sewer overflows, sanitary sewer overflows, urban stormwater runoff and MS4 urban stormwater discharges. The NPDES program plays a key role in restoring water quality since it sets discharge limits, requires monitoring and reporting requirements, and limits discharge of specific pollutants including BOD, TSS, ammonia nitrogen, fecal coliform, DO, and phosphorus.

3.17.1 Wastewater Treatment Plants

WWTP's are vital to public health. Sewers collect sewage and wastewater from homes, businesses, and industries and deliver it to wastewater treatment facilities to remove pollutants from water impacted by human waste which can be either discharged to water bodies or land, or reused.

Sewage treatment processes typically use a series of processes to treat wastewater prior to discharge. The typical series of unit processes includes:

- preliminary treatment or screening to remove large solids,
- primary clarification (or preliminary sedimentation) to remove floating and settleable solids,
- biological treatment (also referred to as secondary treatment) to remove biodegradable organic pollutants and suspended solids, and
- disinfection to deactivate pathogens.

Some facilities also provide more advanced treatment which is designed to reduce constituents, such as nitrogen and phosphorus, that are not removed in any significant quantity by traditional biological treatment processes. Some municipalities currently experience high peak influent flows during periods of increased wet weather that exceed the treatment capacity of existing biological or advanced treatment units.

Under these 'peak flow conditions,' in order to prevent damage to the wastewater treatment plant, some plant operators divert a portion of the flow around biological or advanced treatment units. The diverted flow is then either recombined with flows from the biological treatment units or discharged directly into waterways" (*USEPA,* 2016).

Within the DPR planning area, there are 18 active WWTPs of varying capacity, function and treatment capabilities based on the USEPA Facility Registry System database (Table 3-56 and Figure 3-104) (USEPA, 2017). Of the 18 WWTPs identified, nine are operated by a public government body and service a population range of 2,860 -126,629 per facility, or a total population of 395,928. Based on the available data from current NPDES permits, the WWTPs in the DPR planning area contribute an actual average of 80.80 MGD of treated water into the Des Plaines River system through various waterbodies (20.19 MGD) or via direct discharge (60.61 MGD) into the main stem of the Des Plaines river. Table 3-57 lists Wastewater Treatment Plants in the DPR planning area Direct Discharges & Violations. The 18 WWTPs within the DPR planning area have the capacity to process 197.758 MGD of treated water into the Des Plaines River system.

Of the 18 WWTP's, 17 are located within the DPR planning area with the exception of the NSWRD Waukegan Facility which is located in the Lake Michigan Watershed. The Waukegan NSWRD facility discharges into the DPR planning area with an average of 22 MGD of treated water. The IDNR Upper Des Plaines River Area Assessment Volume 2: Water Resources concludes that 25% of water flow in the Upper Des Plaines River Watershed originates from wastewater treatment plants, with most of the WWTP water discharge having originated and been withdrawn from Lake Michigan for use in public water supply via the Central Lake County Joint Action Water Agency water supply (Illinois Department of Natural Resources, 1998). Treated Wastewater makes up 50% and 95% of Des Plaines River flows during medium to low flow situations, respectively.

Table 3-56: Wastewater Treatment Plants in the DPR Planning Area

PERMIT NO.	WASTEWATER TREATMENT PLANT	ACTUAL AVERAGE FACILITY FLOW (MGD)	FACILITY DESIGN FLOW (MGD)	RESIDENTS SERVED	SITE FUNCTION
IL0051934	Alden Long Grove Rehabilitation Center STP	0.015	0.037	Varies	Private Healthcare Facility
IL0049930	Fox Point Mobile Home Park STP - Wheeling	0.016	0.04	Varies	Private Mobile Home Site
IL0022055	Lake County Public Works Des Plaines River	16	51.8	80,132	County WWTP
IL0071366	Lake County Public Works Mill Creek STP	2.1	7.8	2,860	County WWTP
IL0022071	Lake County Public Works New Century Town STP	6	18	12,800	County WWTP
IL0020796	Lindenhurst Sanitary District STP	2	5.7	14,861	Municipal WWTP
IL0072966	Lou Perrine's Gas & Groceries STP	0.015	0.022	Varies	Fuel Station
IL0078093	Mobil Oil Service Gas Station WWTP	0.0043	0.011	Varies	Fuel Station
IL0035092	North Shore Water Reclamation District Gurnee STP	23.6	47.2	105,208	Municipal WWTP
IL0030244	North Shore Water Reclamation District Waukegan STP	22	44	126,629	Municipal WWTP
WI0030481	Paramski Mobile Homes Rainbow	0.04		Varies	Private Mobile Home Site
IL0024350	St. Mary's of the Lake Seminary - STP	0.03	0.075	Varies	Private WWTP
IL0073431	Toor Car & Truck Plaza STP	0.0075	0.011	Varies	Private Fuel Station
IL0071722	Tristar Gas and Food _ Wadsworth Plaza	0.012	0.02	Varies	Fuel Station
IL0029530	Village of Libertyville STP	4	8	22,503	Municipal WWTP
IL0022501	Village of Mundelein STP	4.95	15	30,935	Municipal WWTP
IL0074535	Wadsworth Crossing STP	0.008	0.032	Varies	Fuel Station/ Business Complex
IL0047619	Wadsworth Marathon STP	0.004	0.01	Varies	Fuel Station
	Total:	**80.8017**	**197.758**		

Table 3-57: Wastewater Treatment Plants in the DPR planning area Direct Discharges and Violations

PERMIT NO.	WASTEWATER TREATMENT PLANT	ACTUAL AVERAGE FACILITY FLOW (MGD)	DIRECT DISCHARGES TO…	VIOLATION ISSUES 2013-2016*[1]
IL0051934	Alden Long Grove Rehabilitation Center STP	0.015	Unnamed Trib of Buffalo Creek	Chlorine
IL0049930	Fox Point MHP STP - Wheeling	0.016	Des Plaines River	No Issues
IL0022055	Lake County Public Works Des Plaines River	16	Aptakisic Creek	No Issues
IL0071366	Lake County Public Works Mill Creek STP	2.1	Mill Creek	No Issues
IL0022071	Lake County Public Works New Century Town STP	6	Des Plaines River	No Issues
IL0020796	Lindenhurst Sanitary District STP	2	Hastings Creek/Mill Creek	No Issues
IL0072966	Lou Perrine's Gas & Groceries STP	0.015	Des Plaines River	Nitrogen, ammonia total [as N] Coliform; Fecal general
IL0078093	Mobil Oil Service Gas Station WWTP	0.0043	Des Plaines River	Ammonia as N; Solids, total suspended; BOD, carbonaceous, 05 day, 20 C
IL0035092	North Shore Water Reclamation District Gurnee STP	23.6	Des Plaines River	No Issues
IL0030244	North Shore Water Reclamation District Waukegan STP	22	Des Plaines River	No Issues
WI0030481	Paramski Mobile Homes Rainbow	0.04	Unnamed Tributary	No Issues
IL0024350	St. Mary's of the Lake Seminary - STP	0.03	St. Mary's Lake	Ammonia as N
IL0073431	Toor Car & Truck Plaza STP	0.0075	Unnamed Tributary (via storm sewer) to the Des Plaines River	Ammonia as N; Solids, total suspended
IL0071722	Tristar Gas and Food _ Wadsworth Plaza	0.012	Des Plaines River	BOD, carbonaceous, 05 day, 20 C; Solids, total suspended; Ammonia as N;
IL0029530	Village of Libertyville STP	4	Des Plaines River	Ammonia as N; BOD, carbonaceous, 05 day, 20 C
IL0022501	Village of Mundelein STP	4.95	Des Plaines River	No Issues
IL0074535	Wadsworth Crossing STP	0.008	Des Plaines River	No Issues
IL0047619	Wadsworth Marathon STP	0.004	Des Plaines River	Ammonia as N; Solids, total suspended; Oil and grease;
	TOTAL:	**80.8018**		

* A violation is noted as per the EPA Discharge Monitoring Report Pollutant Loading Tool as one or more exceedances of permit effluent limits for this pollutant sometime during the year recorded.

Figure 3-105: DPR Planning Area Active WWTPs

3.17.2 Other Point Sources

3.17.2.1Pesticide Point Source Discharge

Pesticide Application Point Source Discharges regulates point source discharges of biological pesticides and chemical pesticides that leave a residue over or into waters of the U.S. and requires a permit under the USEPA NPDES pesticides general permit (Illinois EPA, 2011). The USEPA's pesticides general permit authorizes discharges to waters of the U.S. from the application of biological pesticides and chemical pesticides that leave a residue for mosquito and other flying insect pest control, aquatic weed and algae control, aquatic nuisance animal control and forest canopy pest control.

Agricultural runoff and/or irrigation return flows that contain pesticides are exempt from NPDES permitting requirements as authorized by Congress in 1987 with an amendment to the CWA for the exemption. In Illinois, the Pesticide Application Point Source Discharges permit is NPDES Permit No. ILG87. In Wisconsin the Pesticide Application Point Source Discharges permits are: Aquatic Plants, Algae and Bacteria - Permit No. WI0064556, Detrimental or Invasive Aquatic Animals - Permit No. WI0064564, Forest Canopy Pests - Permit No. WI-0064572, or Mosquitoes or Other Flying Insects - Permit No. WI-0064581.

Within the study area are 26 NPDES Pesticide Application Point Source Discharge permits (USEPA, 2017, January 4), all located in Illinois within the DPR planning area or within a municipality that comprises some percentage of the land jurisdiction within the DPR planning area, see Table 3-58 and Figure 3-105 for individual NPDES pesticide permits. There may be additional commercial organizations with an NPDES pesticides general permit performing work on public and private property within the study area but are not included within this inventory as their activities cannot be determined at this time.

Table 3-58: ILG87 Permits Issued to Organizations located within a Municipality with Jurisdiction in the DPR Planning Area

PERMITTEE	NPDES PERMIT NO.	CITY	PERMITTEE	NPDES PERMIT NO.	CITY
Apex Landscaping	ILG870764	Hawthorn Woods	**Michael Gowe**	ILG870196	Gurnee
Ela Township	ILG870500	Lake Zurich	**Northern Illinois Lake and Pond Management**	ILG870080	Palatine
Fremont Township	ILG870748	Mundelein	**Northwest Mosquito Abatement**	ILG870138	Wheeling
Glenview, Village of	ILG870649	Glenview	**Palatine Park District**	ILG870105	Palatine
Integrated Lakes Management	ILG870013	Waukegan	**Palatine, Village of**	ILG870698	Palatine
John Weatherton	ILG870782	Buffalo Grove	**Royal Melbourne Country Club**	ILG870102	Long Grove
Lake County Forest Preserve District	ILG870192	Libertyville	**Skeeter Beater, LLC**	ILG870889	Hawthorn Woods
Lake County Health Department	ILG870262	Libertyville	**Teresa Jane Thornton**	ILG870726	Wadsworth
Lake Villa Township Office Daycare-Treatment Plant	ILG870348	Lake Villa	**Vernon Hills Park District**	ILG870104	Vernon Hills
Libertyville, Village of	ILG870890	Libertyville	**Village of Buffalo Grove Dept. PW**	ILG870678	Buffalo Grove
Lincolnshire Dept. PW	ILG870473	Lincolnshire	**Warren Township Highway Dept.**	ILG870360	Gurnee
McGinty Bros Inc	ILG870369	Long Grove	**Woodland CCSD 50**	ILG870788	Gurnee

Data Source: USEPA Facility Registry Service (FRS)

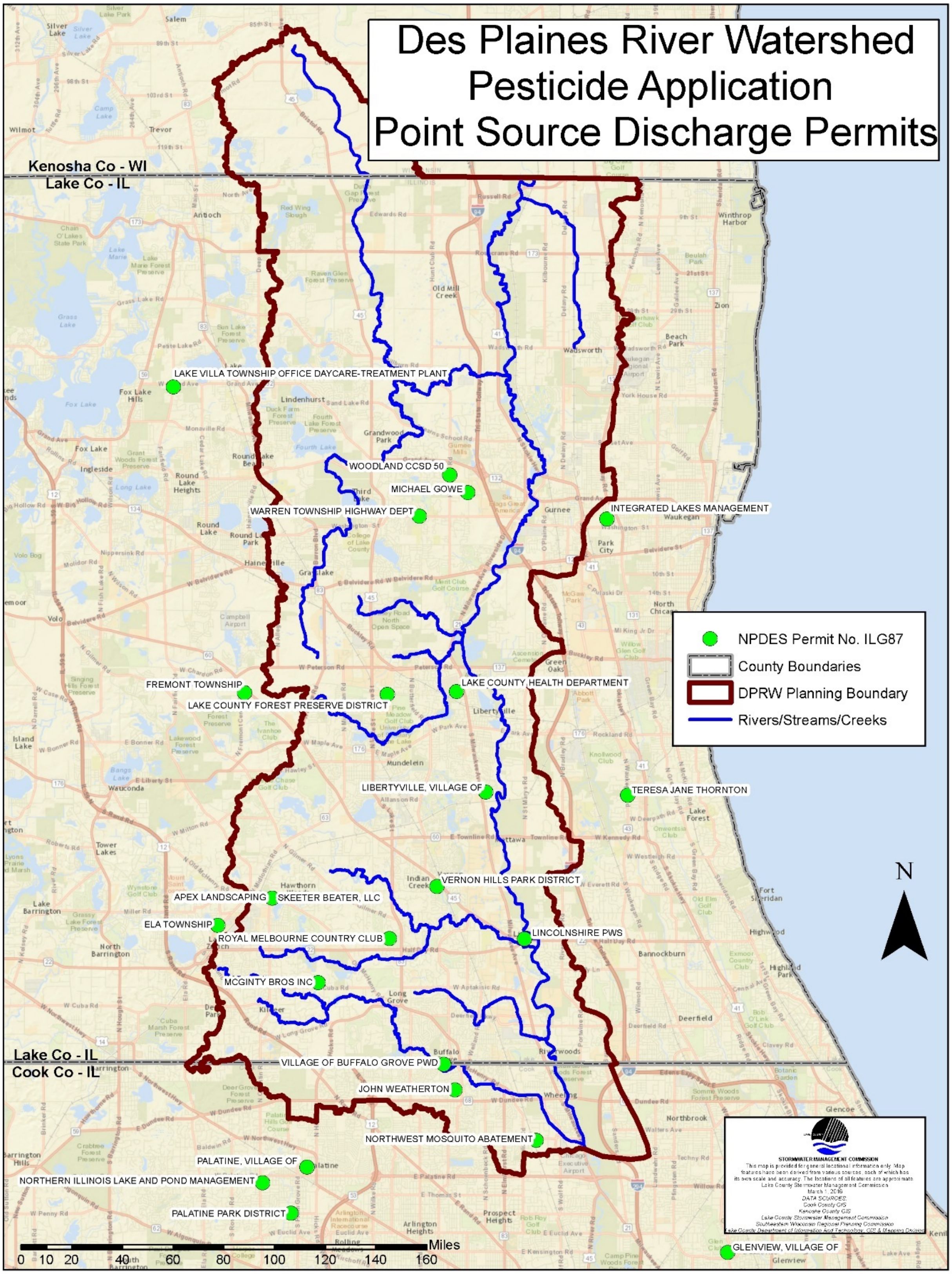


Figure 3-106: DPR Planning Area Pesticide Application Point Source Discharge Permit

3.18 NPDES PHASE II STORMWATER PERMITS

The NPDES Phase II Program regulates stormwater discharges from small MS4s, industrial and construction site activities. Stormwater runoff is identified as a key method of conveying pollutants from impervious surfaces into local rivers and streams causing, untreated water to degrade water quality. Polluted runoff or nonpoint source (NPS) pollution substantially impacts water quality. Polluted runoff is caused by rainfall or snowmelt moving over and through the ground picking up natural and human–made pollutants, depositing them into rivers, lakes, wetlands and groundwater.

Under the permitting requirements of the NPDES Phase II, permittees are required to implement certain practices that control pollution in stormwater runoff. They are required to prevent the contamination of stormwater runoff and develop a SWPPP. NPDES Phase II, is intended to reduce negative impacts to water quality and aquatic habitats by preventing and controlling unregulated sources of storm water discharge, educating communities about water quality and improving water quality.

3.18.1 Industrial Activity Storm Water Point Source Discharge (Stormwater Discharges from Industrial Activities, 2009)

Storm Water Discharges from Industrial Activities into WOUS require a permit under the USEPA NPDES. This permit is applicable to storm water discharges associated with industrial activity from areas where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water in the state of Illinois. Runoff from rainfall or snowmelt that comes in contact with these industrial activities can pick up pollutants and transport them directly to a nearby river or lake coastal water or indirectly via a storm sewer and degrades water quality. The permit provides a list of facilities that are included and excluded under a General NPDES Permit for Industrial Storm Water Discharge into WOUS.

In Illinois, the Industrial Activity Storm Water Point Source Discharge is NPDES Permit No. ILR00 (Illinois EPA, 2016). In Wisconsin, there are 6 individual permits for Industrial Activity Storm Water Point Source Discharges: Tier 1 Permit No. S067849; Tier 2 Permit No. S067857; Non-metallic Mining Operations Permit No. A046515 or B046515; Auto Recycling Permit No. S059145 or Permit No. S058831 (WI DNR, 2016).

There are 50 NPDES Industrial Activity Storm Water Point Source Discharge permits located within the DPR planning area (USEPA, 2017). No permittees were observed in Wisconsin.

Table 3-59 and Figure 3-106 identifies individual NPDES industrial storm water discharge permits.

Table 3-59: ILR00 Permits Issued to Organizations located within the DPR Planning Area

PERMITTEE	NPDES PERMIT NO.	CITY	PERMITTEE	NPDES PERMIT NO.	CITY
Aptar	ILR007086	Libertyville	Nichols Aluminum LLC-Lincolnshire Operations	ILR000454	Lincolnshire
Campanella & Sons, Inc.	ILR004465	Wadsworth	Northfield Block Co	ILR002622	Mundelein
Carter-Hoffmann, LLC	ILR006361	Mundelein	Nu-Pro Polymers	ILR000922	Wheeling
Chicago Executive Airport	ILR002970	Wheeling	Onyx Waste Svcs	ILR002927	Waukegan
Clavey Rd Sewage Treatment PLT	ILR004380	Gurnee	Orange Crush LLC	ILR004268	Wheeling
Clavey Rd Sewage Treatment PLT	ILR004379	Gurnee	Pactiv Corp	ILR001122	Wheeling
Clavey Rd Sewage Treatment PLT	ILR004381	Gurnee	Penray Cos Inc	ILR001445	Wheeling
Conway Central Express	ILR001361	Mundelein	PQ Corp Gurnee	ILR007190	Gurnee
Countryside Landfill	ILR000152	Grayslake	PQ Corporation	ILR005547	Gurnee
Degussa Construction Chemicals	ILR000512	Gurnee	Rexam Medical Packaging	ILR000036	Mundelein
Dist Tech	ILR003946	Gurnee	Roquette America Inc	ILR000528	Gurnee
Fedex Freight Inc	ILR006624	Zion	Signode Svc Business	ILR005975	Arlington Heights
Fedex Ground	ILR007009	Grayslake	Solo Cup Co	ILR006120	Wheeling
Gallagher Corp	ILR000225	Gurnee	Spectrum Mfg Inc (D/B/A Lake Region Medical)	ILR005969	Wheeling
HV Manufacturing Co	ILR001136	Wheeling	Taubensee Steel & Wire Co.	ILR000968	Wheeling
Inland Die Casting	ILR002937	Wheeling	Tempel Steel Co	ILR001252	Libertyville
Kirschhoffer Truck Service Inc	ILR002118	Zion	Tomoegawa	ILR000207	Wheeling
Laidlaw Transit Inc	ILR004388	Wheeling	Tredegar Film Products - Lake Zurich Inc	ILR000255	Lake Zurich
Land & Lakes Wheeling	ILR001840	Deerfield	United Parcel Service	ILR003127	Palatine
Maclean-Fogg Component Systems	ILR003992	Mundelein	Vantage Specialties	ILR001027	Gurnee
Maclean Molded Products	ILR000265	Wheeling	VCNA Prairie Illinois Inc Yard 1024	ILR002515	Vernon Hills
Meyer Material-N. Chicago 21	ILR003680	Lake Bluff	Village of Mundelein-Waste Water Treatment Plant	ILR006234	Libertyville

PERMITTEE	NPDES PERMIT NO.	CITY	PERMITTEE	NPDES PERMIT NO.	CITY
MHS Automation	ILR005423	Round Lk Bch	Vulcan Construction Materials LP	ILR006844	Grayslake
Mike Kallas	ILR005436	Gurnee	YRC Inc	ILR001987	Wheeling
Newport Township Landfill	ILR004382	Gurnee	Zeller Plastik Inc	ILR006977	Libertyville

Data Source: USEPA Facility Registry Service (FRS)

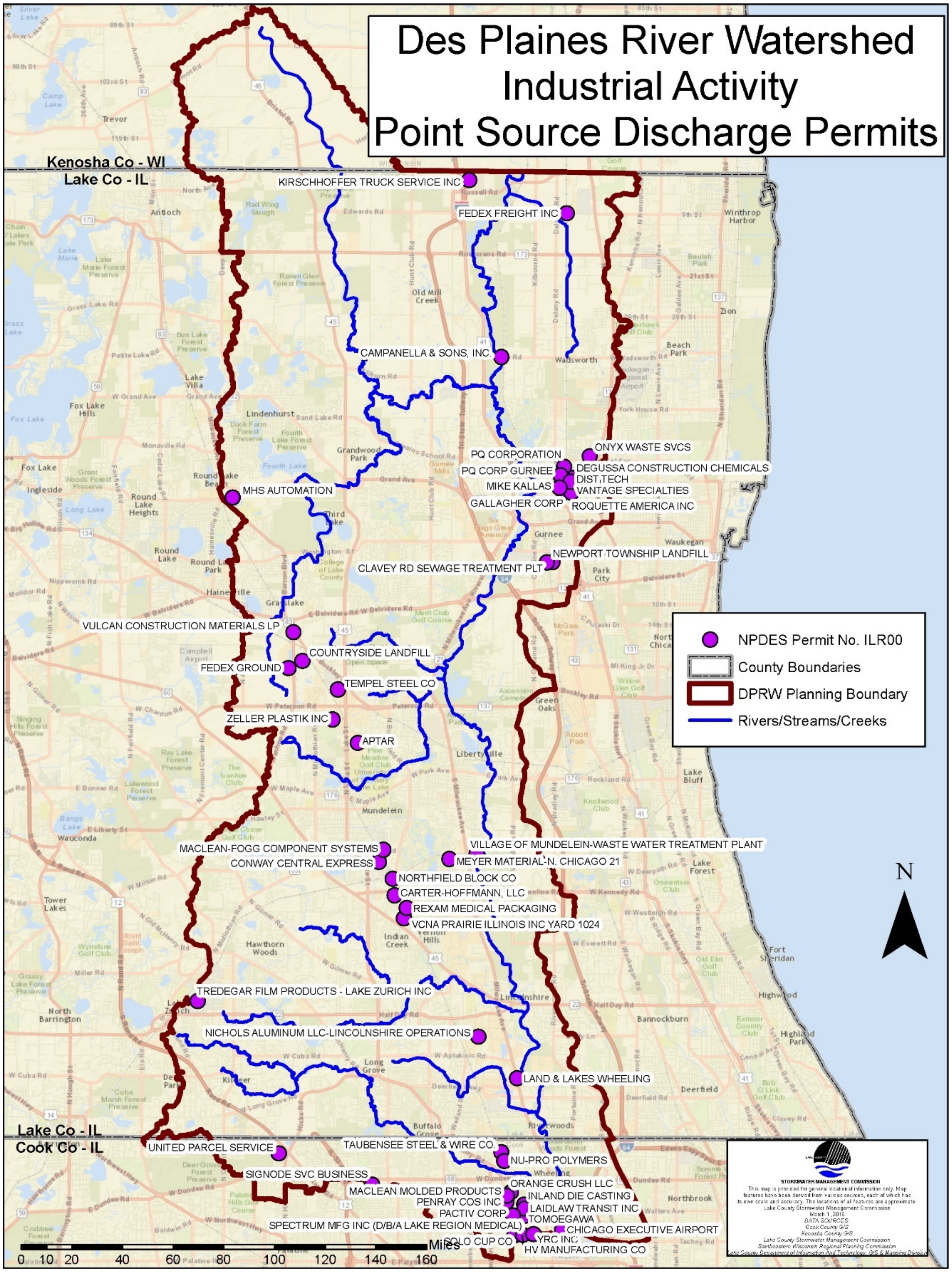


Figure 3-107: DPR Planning Area Industrial Activity Point Source Discharge Permits

3.18.2 Construction Site Activities Storm Water Discharge ("General Stormwater NPDES Permit for Construction Activities," 2010)

A USEPA NPDES permit is required for stormwater discharges into WOUS from construction sites where one or more acres of land is disturbed. Smaller sites within a larger construction project or development must consider the total disturbance of the project when determining if a USEPA NPDES permit is required. Many permittees in Illinois obtain permit coverage for their construction projects under the State's General Storm Water NPDES Permit for Construction Activities. In order for storm water discharges from construction sites to be authorized under this General Permit, the owner must submit a NOI in accordance with the requirements of the general permit. Permittees must develop and implement a SWPPP to effectively manage the discharge of pollutants from the site.

In Illinois, the Construction Site Activities Storm Water Discharge is Permit No. ILR10 *(*Illinois EPA, 2014). In Wisconsin, the construction site activities storm water discharge permit is Permit No. WI-S067831 (WI DNR, 2012).

Within the study area 86 NPDES ILR10 permits are identified as being located within the DPR planning area (USEPA, 2017). No permittees were observed in Wisconsin. Table 3-60 and Figure 3-107 identify individual NPDES construction site activity storm water point source discharge permits.

Table 3-60: ILR10 Permits Issued to Organizations located within the DPR Planning Area

PERMITTEE	NPDES PERMIT NO.	CITY	PERMITTEE	NPDES PERMIT NO.	CITY
Adler Square-Libertyville	ILR10J353	Libertyville	Hope Presbyterian Church	ILR10J181	Grayslake
Affinity Processing Serv Inc	ILR10C930	Lake Zurich	Independence Grove Parking Lot	ILR10H391	Libertyville
Almond Marsh Preserve	ILR10D489	Grayslake	Ired Lake Co-Mill Creek Estate	ILR10J611	Oak Brook
Amcore Bank-Antioch	ILR10J584	Antioch	Jacobs Way	ILR10I929	Mundelein
Amcore Bank-Vernon Hills Lt 3	ILR10J536	Vernon Hills	Katie's' Subdivision	ILR10H479	Wheeling
Apachi Day Camp	ILR10H930	Lake Zurich	Kemper Lakes Club	ILR10H332	Kildeer
Arlington Heights Nissan	ILR10D867	Arlington Heights	Keylime Cove	ILR10D881	Gurnee
Autozone Auto Parts	ILR10H372	Gurnee	Lake Co-Galt Offsite Wm Ext	ILR10J431	Oak Mill Creek
Autumn Leaves-Vernon Hills	ILR10H770	Vernon Hills	Lake Co Forest Preserve-Heron	ILR10I429	Libertyville
Berenesa Plaza Shopping Center	ILR10I878	Buffalo Grove	Lake County Hs Tech Campus	ILR10I153	Grayslake
Bridgeview Commons	ILR10J289	Lincolnshire	Lake Forest Oasis	ILR10A760	Lake Forest
Castillo Single Family Home	ILR10H281	Wadsworth	LCFPD Ryerson Visitors Center	ILR10A409	Deerfield
Centerpoint Business Ctr-1&3	ILR10I916	Gurnee	Lehman Manufactured Homes	ILR10I202	Zion
Chase Bank	ILR10H422	Waukegan	Life Time Fitness	ILR10H957	Vernon Hills
City Limits Harley Davidson	ILR10J419	Palatine	Lowe's - Vernon Hills	ILR10H661	Vernon Hills

PERMITTEE	NPDES PERMIT NO.	CITY	PERMITTEE	NPDES PERMIT NO.	CITY
Clubland Commons	ILR10I283	Antioch	Majestic Pines of Indian Creek	ILR10J688	Indian Creek
Cobblestone Land Comm Bldgs.	ILR10I933	Schaumburg	Marling-Delany Rd Buildings	ILR10J637	Waukegan
Coe-Butler Lake-Libertyville	ILR10E479	Libertyville	Menards Il 53 Rd Imprv-Long Gr	ILR10H987	Long Grove
Coletta Single Family Home	ILR10I385	Wadsworth	Midlane Club-Waukegan	ILR10J370	Waukegan
College of Lake County	ILR10I904	Grayslake	Millbrook Pointe (lg#7006)	ILR10J440	Wheeling
Columbus Centre	ILR10I573	Lake Zurich	Mobil Oil WWTP	ILR10H385	Wadsworth
Compx International Inc	ILR10H366	Grayslake	Multi-Tenant Bldg. Lot 4	ILR10H485	Lake Zurich
Condell Medical Ctr Emerg Exp	ILR10I474	Libertyville	Mundelein Town Center	ILR10I124	Mundelein
Congregation or Shalom	ILR10J684	Vernon Hills	Normandy Woods Subdivision	ILR10I119	Gurnee
Deer Park Estates	ILR10F521	Deer Park	Northfield Block Co	ILR10I999	Mundelein
Eastgate Estates Subdivision	ILR10H538	Long Grove	Oaks of Lincolnshire Subd	ILR10H686	Lincolnshire
Edward R. James Homes	ILR10C932	Buffalo	Offices & Deer Park Town Ctr	ILR10I942	Deer Park
Eleanor Lane Subd	ILR10J139	Kildeer	Pond View Estates	ILR10H605	Wadsworth
Estates at Churchill Hunt Ph. 2	ILR10C868	Gurnee	Retail Strip Mall-Long Grove	ILR10J283	Long Grove
Evergreen Point of Kildeer	ILR10C390	Kildeer	Safco	ILR108338	Buffalo Grove
Falling Waters Way-L 22-26	ILR10I597	Lindenhurst	Sonday Property Warehouse	ILR10J601	Zion
Forest Avenue Retail Ctr	ILR10I394	Mundelein	Springhill Suite Hotel	ILR10I120	Waukegan
Fox Chase Center LLC	ILR10I475	Round Lake Beach	Stone Creek Crossing	ILR10I788	Grayslake
Gates of Deer Grove Grading	ILR10J171	Palatine	Stone Creek Crossing	ILR10H695	Grayslake
Grand Gurnee Plaza	ILR10I672	Gurnee	Sunrise Senior Living	ILR10H512	Mundelein
Grants Grove	ILR10A360	Lindenhurst	Superdawg Drive-In	ILR10J743	Wheeling
Grayslake Side Track	ILR10A543	Grayslake	Tore & Lukes Restaurant	ILR10J633	Palatine
Great Lakes Crossing Comm Dev	ILR10H582	Zion	Tri-State Venture One	ILR10I831	Gurnee
Gross Property Warehouse	ILR10J589	Zion	Triangle Corporate Park	ILR10I918	Gurnee
Gurnee Community Bank	ILR10C696	Gurnee	Trumpet Park Subdivision	ILR10H269	Zion
Gurnee Fuel Stop	ILR10D878	Gurnee	Walmart #1668-03	ILR10I337	Gurnee
Hampton Inn & Ste.-Libertyville	ILR10I674	Libertyville	Wanish Park Townhomes/Condos	ILR10H953	Libertyville
Heritage Trails Subdivision	ILR10J230	Zion	Wheeling Animal Hospital	ILR10D982	Wheeling

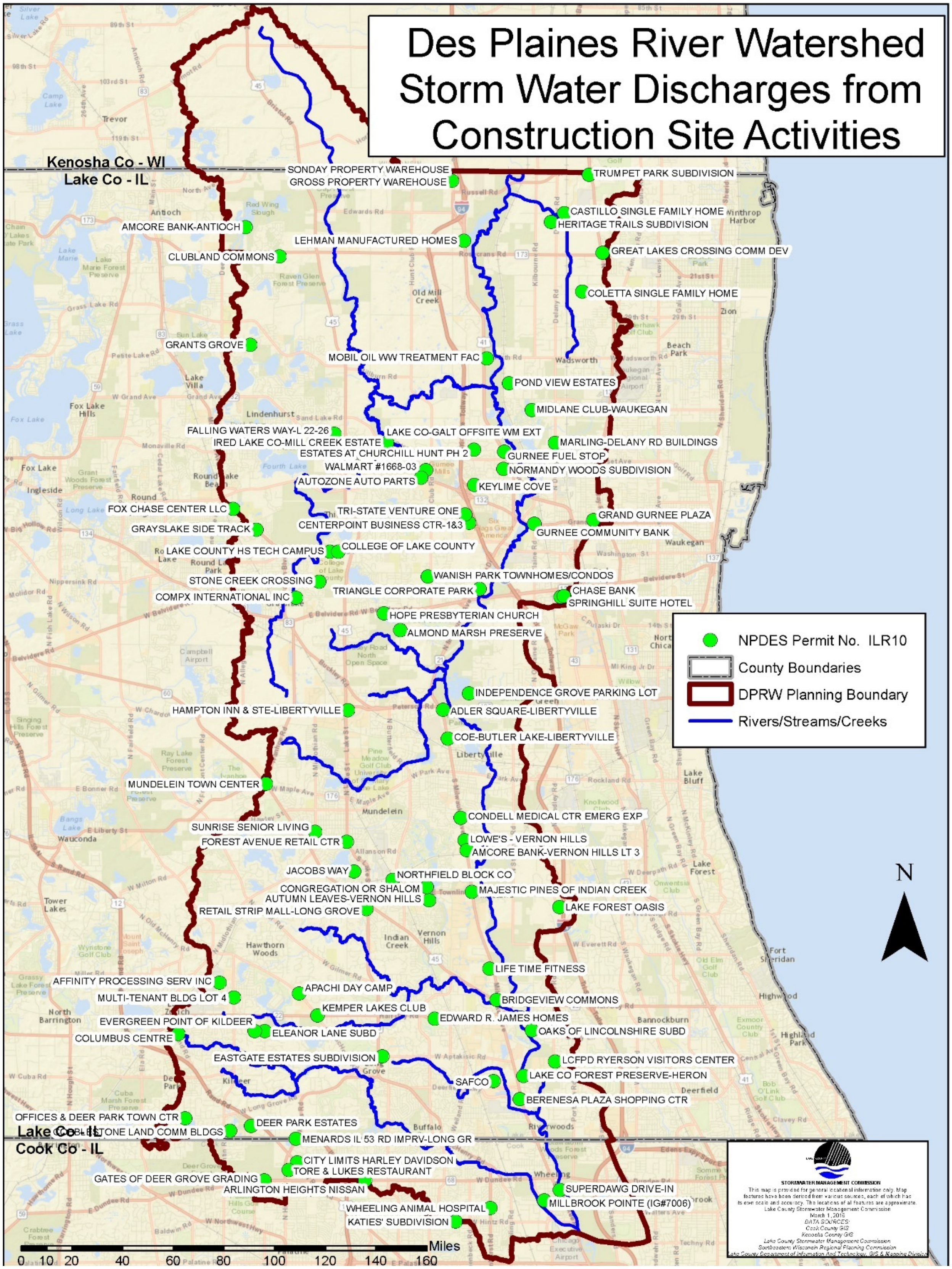


Figure 3-108: DPR Planning Area Storm Water Discharges from Construction Site Activities

3.18.3 ILR40, Discharges from Small Municipal Separate Storm Sewer Systems

Per Permit No. *ILR40 (Illinois EPA,* 2016), Storm Water Discharges from Small MS4s into WOUS require a permit under the USEPA NPDES program as many units of government have distinct roles and responsibilities related to water quality and nonpoint source pollution control. Discharges from small MS4s in USEPA Region 5 states are regulated under each state's general NPDES Permit No. ILR40 (Illinois) and WI-S050075-2 (Wisconsin) (USEPA, 2016). In the DPR planning area, the state NPDES program administrators are the Illinois EPA and the WI DNR.

The permit requires that MS4 operators develop, implement, and enforce a stormwater management program to reduce the discharge of pollutants. A permittee's stormwater management program must include six minimum control measures:

1. Public education and outreach on storm water impacts
2. Public involvement and participation
3. Illicit discharge detection and elimination
4. Construction site storm water runoff control
5. Post construction storm water management in new development and redevelopment
6. Pollution prevention / good housekeeping for municipal operations

To define its storm water management program, a permittee must define BMPs and measurable goals for each of the six minimum control measures.

In the DPR planning area, there are 3 units of county government, 15 units of township government, 37 units of municipal government and 2 drainage districts operating as MS4's with distinct roles and responsibilities related to activities and water quality control (Figure 3-108).

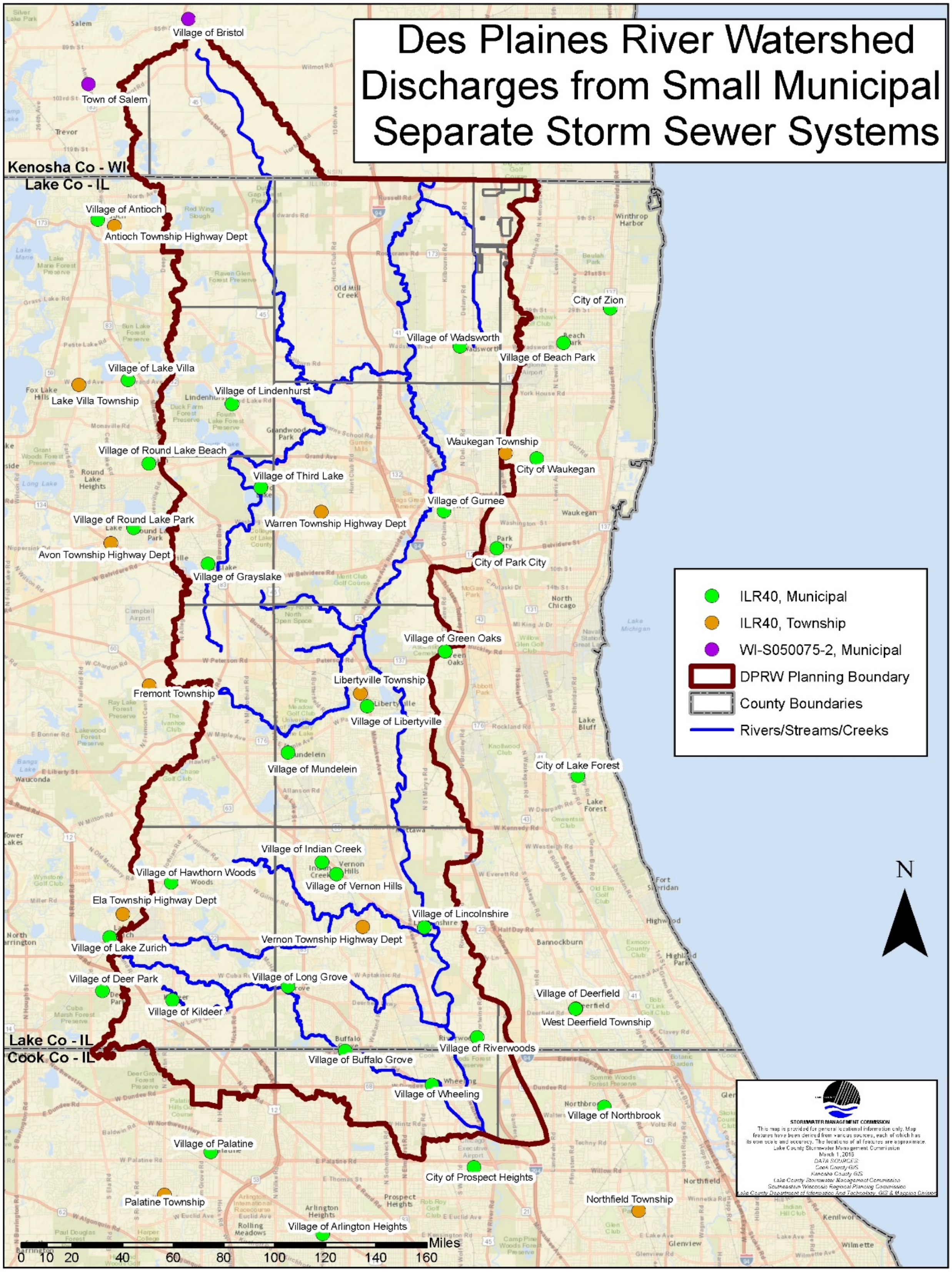


Figure 3-109: DPR Planning Area Small Municipal Separate Storm Sewer Systems

3.18.3.1 Municipal

In the DPR planning area, there are 37 units of municipal government, located within 2 states and 3 counties. The following NPDES MS4 tables' detail the municipality by name, the NPDES MS4 permit number, the number of acres the municipality has jurisdiction of within the DPR planning area and a percentage of their municipality. Each table is separated based on its County affiliation in either Wisconsin or Illinois.

There are 27 municipal units of government with NPDES MS4 permits within the DPR planning area in Lake County, IL (Table 3-61). Contributing acres by municipal units of government in Lake County ranges from 37-8,639 acres.

Table 3-61: ILR10 Permits Issued to Organizations located within the DPR Planning Area

PERMITTEE	PERMIT NO.	ACRES IN DPR PLANNING AREA	PERCENT	PERMITTEE	PERMIT NO.	ACRES IN DPR PLANNING AREA	PERCENT
City of Lake Forest	ILR400367	107.03	1.0%	Village of Libertyville	ILR400374	5,866.38	100.0%
City of Park City	ILR400420	259.71	34.8%	Village of Lincolnshire	ILR400375	2,204.70	73.7%
City of Waukegan	ILR400465	3,728.32	23.7%	Village of Lindenhurst	ILR400276	3,119.38	99.9%
City of Zion	ILR400482	1,285.57	20.5%	Village of Long Grove	ILR400219	8,035.64	100.0%
Village of Antioch	ILR400281	2,128.89	39.2%	Village of Mettawa	No Active Permit	2,705.42	79.6%
Village of Beach Park	ILR400164	1,365.34	30.2%	Village of Mundelein	ILR400395	5,935.05	92.8%
Village of Grayslake	ILR400202	6,821.86	95.0%	Village of Old Mill Creek	No Active Permit	6,901.73	100.0%
Village of Green Oaks	ILR400203	772.78	29.3%	Village of Riverwoods	ILR400431	1,618.31	63.1%
Village of Gurnee	ILR400204	8,639.04	98.7%	Village of Round Lake Beach	ILR400439	406.20	12.2%
Village of Hawthorn Woods	ILR400209	3,558.19	67.0%	Village of Round Lake Park	ILR400242	37.28	2.6%
Village of Indian Creek	ILR400212	170.68	100.0%	Village of Third Lake	ILR400654	551.03	100.0%
Village of Kildeer	ILR400215	2,838.87	100.0%	Village of Vernon Hills	ILR400252	5,047.22	100.0%
Village of Lake Villa	ILR400369	216.43	4.6%	Village of Wadsworth	ILR400492	6,266.59	100.0%
Village of Lake Zurich	ILR400370	2,023.66	43.6%				

There are 7 municipal units of government that are located in both Lake and Cook County, IL (Table 3-62). Contributing acres by municipal units of government in Lake and Cook County ranges from 42 - 5,962 acres.

Table 3-62: NPDES Permits Issued to Municipalities located within the DPR planning area and located within Lake and Cook Counties, IL

PERMITTEE	PERMIT NO.	ACRES IN DPR PLANNING AREA	PERCENT OF MUNICIPAL ACRES WITHIN THE DPR PLANNING AREA
Village of Arlington Heights	ILR400282	954.18	8.8%
Village of Buffalo Grove	ILR400303	5,961.58	98.3%
Village of Deer Park	ILR400323	1,169.83	48.3%
Village of Deerfield	ILR400324	42.96	1.2%
Village of Northbrook	ILR400404	911.04	10.7%
Village of Palatine	ILR400416	1,487.36	16.9%
Village of Wheeling	ILR400471	4,606.72	81.9%

There is one municipal unit of government that is located in Cook County, IL which encompasses a percentage of municipal acres in the DPR planning area (Table 3-63**)**.

Table 3-63: NPDES Permits Issued to Municipalities located within the DPR planning area and located completely within Cook County, IL

PERMITTEE	PERMIT NO.	ACRES IN DPR PLANNING AREA	PERCENT OF MUNICIPAL ACRES WITHIN THE DPR PLANNING AREA
City of Prospect Heights	ILR400427	206.87	7.5%

There are two municipal units of government that are located in Kenosha County, WI (Table 3-64). The municipalities contribute 1,037.23 and 7,634.43 acres to the DPR planning area.

Table 3-64: NPDES Permits Issued to Municipalities located within the DPR planning area and located completely within Kenosha County, WI

PERMITTEE	PERMIT NO.	ACRES IN DPR PLANNING AREA	PERCENT OF MUNICIPAL ACRES WITHIN THE DPR PLANNING AREA
Town of Salem	WI-S050075-2, FIN: 31153	1,037.23	5.1%
Village of Bristol	WI-S050075-2, FIN: 31150	7,634.43	35.9%

3.18.3.2 Townships

There are 15 townships located in Lake and Cook County, IL (Table 3-65). Twelve of the townships have active NPDES permits and 3 townships did have an NPDES permit.

Table 3-65: ILR40 Permits Issued to Drainage Districts located within the DPR planning area

PERMITTEE	NPDES PERMIT NO.	COUNTY
Antioch Township Highway Dept.	ILR400003	Lake
Avon Township Highway Dept.	ILR400006	Lake
Benton Township	No Active Permit	Lake
Ela Township Highway Dept.	ILR400046	Lake
Fremont Township	ILR400054	Lake
Lake Villa Township	ILR400074	Lake
Libertyville Township	ILR400077	Lake
Newport Township	No Active Permit	Lake
Northfield Township	ILR400098	Cook
Palatine Township	ILR400107	Cook
Vernon Township Highway Dept.	ILR400144	Lake
Warren Township Highway Dept.	ILR400145	Lake
Waukegan Township	ILR400148	Lake
West Deerfield Township	ILR400150	Lake
Wheeling Township	No Active Permit	Cook

Data Source: USEPA Facility Registry Service (FRS)[i]

3.18.3.3 Drainage Districts

There are two drainage districts in the DPR planning area (Avon Fremont and Grubb School). Neither district has an active NPDES permit.

3.18.3.4 Counties

There are 3 units of county government, located within 2 states in the DPR planning area that require a NPDES permit (Table 3-66).

Table 3-66: ILR40 Permits Issued to Counties located within the DPR Planning Area

PERMITTEE	NPDES PERMIT NO.
Lake County	ILR400517
Cook County Highway Department	ILR400485
Kenosha County	S050075, FIN (Facility ID): 33645

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COMMON ACRONYMS/ABBREVIATIONS USED IN CHAPTER 4

AC- ACRE

ADID – Advance Identification

BMP – Best Management Practices

CCFPD - Cook County Forest Preserve District

CFU - Colony Forming Unit

Ch- Chapter

CLC – College of Lake County

CMAP – Chicago Metropolitan Agency for Planning

CWP – Center for Watershed Protection

DPR Planning Area – Des Plaines River Watershed Planning Area

DRWW – Des Plaines River Watershed Workgroup

E. coli - Escherichia coli

EMC - Event Mean Concentration

FLU – Future Land Use

FPDCC - Forest Preserve District of Cook County

GI - Green Infrastructure

GIMS – Green Infrastructure Model and Strategy

GIS- Geographic Information System

GIV- Green Infrastructure Vision

I-Last^{TM} - Illinois- Livable and Sustainable Transportation Rating System and Guide

IC – Impervious Cover

IDNR – Illinois Department of Natural Resources

IDOT- Illinois Department of Transportation

IGA – Intergovernmental Agreement

Illinois EPA – Illinois Environmental Protection Agency

Lbs- Pounds

LCDOT- Lake County Department of Transportation

LCFPD- Lake County Forest Preserve District

LCHD- Lake County Health Department

LCHD-ES- Lake County Health Department- Ecological Services

LID- Low Impact Development

LRR- Lateral Recession Rates

MBI - Midwest Biodiversity Institute

MG- Million Gallons

MGD- Million Gallons per Day

MLSWCD – McHenry-Lake Soil & Water Conservation District

MRLC - Multi-Resolution Land Characteristics Consortium

Mun.- Municipal

MWRD – Metropolitan Water Reclamation District of Greater Chicago

NA- Not Applicable

NCSWCD – North Cook Soil & Water Conservation District

ND- No Data

NLCD - National Land Cover Database

NPDES- National Pollutant Discharge Elimination System

NPDES II- National Pollutant Discharge Elimination System Phase Two

NRCS- Natural Resources Conservation Service

NSWRD – North Shore Water Reclamation District

PAH – Polycyclic Aromatic Hydrocarbons

PB&D –Planning, Building and Development

PCBs – Polychlorinated Biphenyl

PEC- Probable Effect Concentration

SEWRPC - Southeastern Wisconsin Regional Planning Commission

SMC – Lake County Stormwater Management Commission

SSURGO- Soil Survey Geographic Database

STEPL- Spreadsheet Tool for Estimating Pollutant Load

SWAMM^{TM}- Spatial Watershed Assessment and Management Model

SWCD - Soil & Water Conservation District

TEC- Threshold Effect Concentration

TMDL – Total Maximum Daily Load

TSS – Total Suspended Solids

U of IL Extension- University of Illinois Extension

UDO – Unified Development Ordinance

USACE- United Stated Army Corps of Engineers

USEPA- United States Environmental Protection Agency

USLE- Universal Soil Loss Equation

WASCB- Water and Sediment Control Basin

WOUS – Waters of the United States

WDO – Watershed Development Ordinance

WI DNR- Wisconsin Department of Natural Resources

WMO – Watershed Management Ordinance

WWTP- Wastewater Treatment Plant

Yr.- Year

4 WATERSHED PROBLEM ASSESSMENT

This chapter assesses in detail the problems identified in Chapter 3 Watershed Characteristics Assessment. The Watershed Problem Assessment chapter sections describe the effect of land use and land cover change on water resources in the DPR planning area; estimate the most prevalent causes and sources of pollution in rivers, streams and lakes; estimate nonpoint source pollutant loading in the DPR planning area; and identify critical areas where programmatic or site-specific actions or projects are likely to result in nonpoint source pollutant reductions. This chapter also assesses how jurisdictional roles, including regulatory oversight, can be better coordinated to improve the condition of water resources. Finally, a green infrastructure analysis identifies locations that provide important stormwater functions.

4.1 LAND USE IMPACTS AND IC CHANGES

As discussed in Chapter 3, impervious cover (IC) is the result of altering or replacing native soil permeability through various land use functions. IC produces an increase in direct storm water runoff and nonpoint source pollution stressors into wetlands, ponds, streams, and rivers thereby impacting local water quality. Stressors increase pollutant loads in stormwater runoff, alter stream flow, decrease bank stability, increase water temperatures, and reduce wetland capacity and function. These impacts affect terrestrial and aquatic wildlife, plant establishment, habitat function, recreational opportunities, environmental health, and property use and value.

As discussed in Chapter 3, research also shows that IC impacts water quality at relatively low levels of development and land use (0-9% IC or **Low IC**). Symptoms of water quality impact from land use stressors have been observed at 10-29% IC (or **Medium IC**) of a watershed, and research has quantified and observed degradation of natural water bodies when IC is between 30-100% (**High IC**) of the watershed. Figure 4-1 visualizes percent imperviousness based on impacted land use (Chabaeva, 2007).

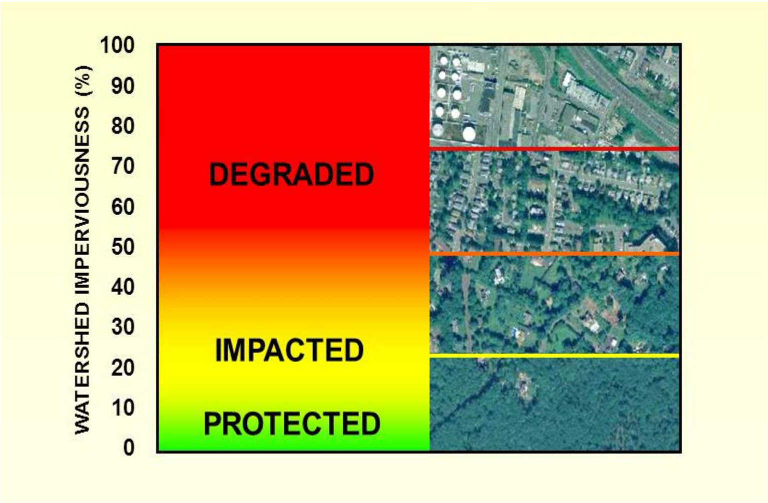


Figure 4-1: Comparison of percent imperviousness to land use

IMPERVIOUS COVER (IC) CLASSIFICATION: As mentioned in section 3.6.3 Existing and Projected Future Percent Imperviousness, water quality is impacted at 10% and degradation of water quality is consistent at greater than 30% impervious cover. The impervious cover is analyzed by impacts:

Low IC – Land use changes increase impervious cover to 0-9% of the watershed with minimal impact to water quality.

Medium IC – Land use changes increase impervious cover to 10-29% of the watershed with water quality impacts noticeable.

High IC – Land use changes increase impervious cover to 30-100% of the watershed with water quality degradation expected.

4.1.1 Effects of Land Use Change on Water Quantity

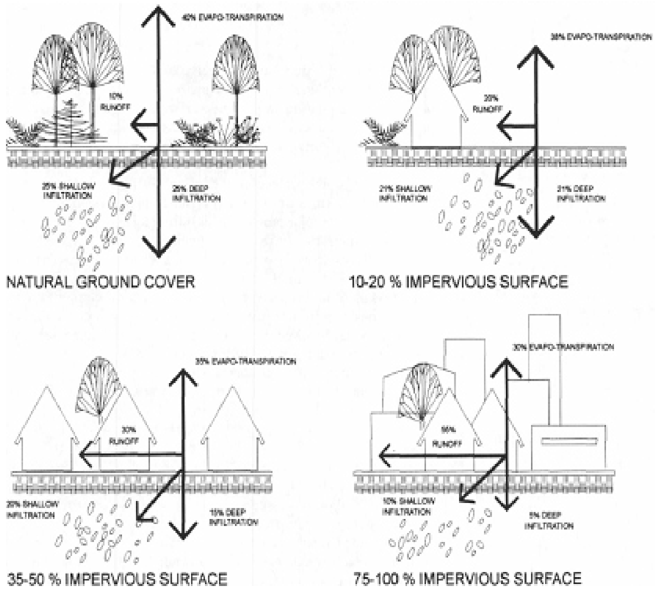
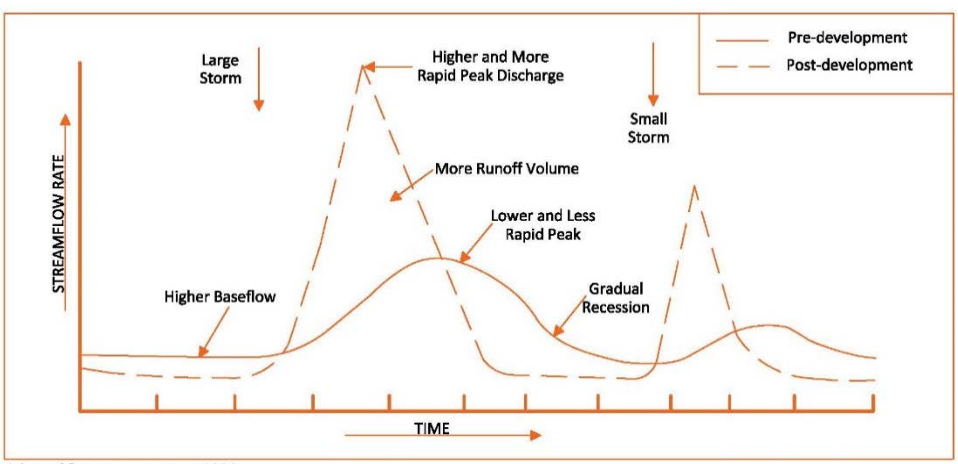


Figure 4-2: Influence of impervious surface on the fate of precipitation

Land disturbance associated with land use modification has a direct effect on stormwater quantity. When a natural site is disturbed, its hydrology is essentially altered due to impacts to the native soils and vegetation. Plowing, clearing, and tree removal eliminate vegetation that reduces stormwater runoff volumes through the hydrologic processes of interception, evaporation, and transpiration. Earthwork and grading disturb native soils and may remove areas with natural depressions that collect, infiltrate, and retain rainfall and stormwater runoff onsite. Soil compaction resulting from the operation of heavy machinery over and across the site reduces the infiltration capacity of underlying soil. Land use changes that increase impervious surfaces, such as roads, parking lots, and rooftops, further reduce the infiltration capacity of an area and increase stormwater runoff volume and velocity.

The installation of drainage improvements (e.g., channelization, dredging, or artificial drainage systems) further reduces a site's ability to retain rainfall. Collectively these impacts result in substantially increased stormwater runoff volumes and velocities (Figure 4-2) and reductions in groundwater recharge (Pitt, 1994; Shueler, 1987; Thompson, 2009). Increased stormwater runoff volumes and velocities result in increased peak discharge rates, which can be at least two to five times higher on developed sites than undeveloped sites, resulting in increased flooding risk (Figure 4-3). Reduced groundwater recharge decreases baseflow to aquatic resources, including streams and wetlands.



Adapted from Schueler, T. R., 1994

Figure 4-3: Pertinent impacts of urbanization on hydrology at the catchment scale

4.1.2 EFFECTS OF LAND USE CHANGE ON WATER QUALITY

Land use change also affects stormwater quality. Impervious and compacted surfaces, such as farm fields, lawns, parks, and athletic fields, accumulate pollutants including sediment, nutrients, trash, and debris during dry weather. These pollutants are quickly transferred to receiving waters during precipitation events, often through artificial drainage systems, resulting in increased pollutant loads to aquatic resources (Figure 4-4). Tables in sections 3.16.1 Status of Designated Use Support, 3.16.3 Summary of Previous Studies and DRWW Monitoring Program, and 3.16.4.3 Water Quality, characterize water quality impacts, causes and sources to lakes and streams.

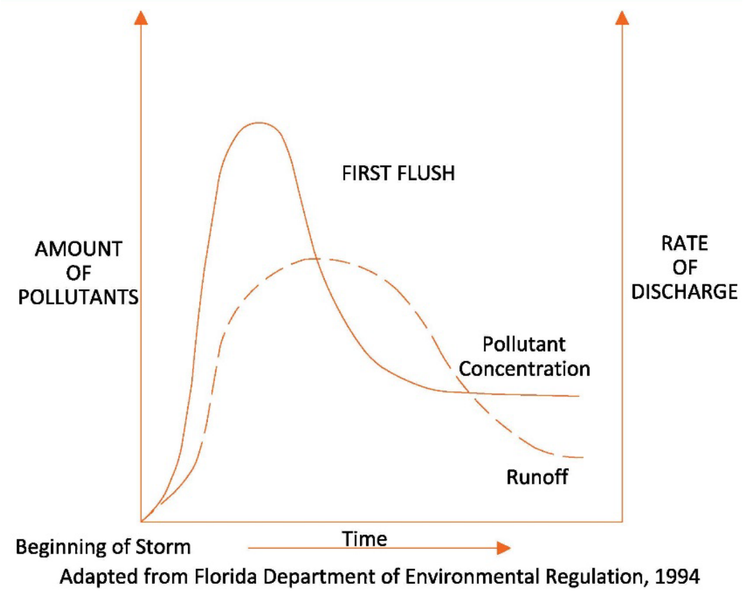


Figure 4-4: Influence of impervious surface on fate of pollutant concentrations

Stormwater pollutants come from a variety of diffuse and scattered sources, many of which are a direct or indirect result of land use change. These nonpoint source pollutants include:

- Sediment: Sources of sediment to stormwater runoff include land disturbing activities, atmospheric deposition, and surface or streambank erosion. Sediment particles can adsorb other stormwater pollutants, such as nutrients, metals, hydrocarbons, and pesticides, and transport them into receiving streams, wetlands, and other aquatic resources.
- Nutrients: Sources of nutrients such as nitrogen and phosphorus to stormwater runoff include fertilizer, pet and animal waste, leaves, grass clippings, sanitary sewer overflows, septic system discharges, and atmospheric deposition.
- Bacteria: Sources of bacteria and pathogens to stormwater runoff include pet and animal waste, sanitary sewer overflows, and septic system discharges. Runoff impacted by these sources typically exceeds public health standards for recreational contact.
- Organic Matter: Sources of organic matter to stormwater runoff include leaves, grass clippings, pet and animal waste, sanitary sewer overflows, and septic system discharges. The decomposition of this organic matter can decrease dissolved oxygen to levels that are detrimental to aquatic life.
- Metals: Sources of heavy metals, such as lead, zinc, copper, and cadmium, to stormwater runoff include atmospheric deposition, vehicle wear, and commercial, industrial, and hazardous waste sites.
- Hydrocarbons: Sources of hydrocarbons (i.e., PAHs or coal tar sealants) to stormwater runoff include vehicle wear, chemical spills, restaurant grease traps, and improper handling and disposal of waste oil and grease.
- Pesticides: Sources of insecticides, herbicides, and other pesticides to stormwater runoff include farming activities, lawn care and maintenance activities, chemical spills, and atmospheric deposition.

- Chemicals: Sources of chemicals, such as chlorine, solvents, soaps and detergents, degreasers, drain cleaners, vehicular liquids and paint, to stormwater runoff include residential, commercial, industrial, and hazardous waste sites.
- Chlorides: Sources of chlorides to stormwater runoff include winter sidewalk, driveway, roadway, and parking lot anti-icing and deicing activities, and water softeners.
- Trash and Debris: Considerable quantities of trash and debris typically accumulate on impervious or compacted pervious surfaces and are transferred to receiving waters by stormwater runoff. This trash and debris can accumulate in stormwater conveyance systems, potentially causing clogging and nuisance flooding.

As outlined below, an extensive and ever-growing body of research shows that these nonpoint source pollutants have substantial negative impacts on streams, wetlands, and other aquatic resources. Negative impacts include impaired water quality, reduced dissolved oxygen levels, increased primary productivity (e.g., eutrophication, algal blooms), sediment contamination, degradation of habitat, and a general decline in the abundance and diversity of wildlife and aquatic animals.

4.1.3 Effects of Land Use Change on Stormwater Temperature

Land use changes also affect stormwater temperature. The compacted pervious and impervious surfaces resulting from land use change absorb and retain heat, especially when exposed to sunlight. The heating of these surfaces is exacerbated by reduced shade resulting from the clearing of vegetation. During precipitation events, these heated surfaces increase the temperature of stormwater runoff, resulting in increased water temperatures and decreased dissolved oxygen in receiving waters.

4.1.4 Impacts on Aquatic Resources

Changes in hydrology and stormwater runoff characteristics (e.g., increased stormwater runoff rates, volumes, and pollutant loads) resulting from changes in land use can have a wide range of negative impacts on the aquatic resources of the DPR planning area. Additional information about these impacts is provided below.

4.1.4.1 Streams

Impacts on the stream resources within the planning area are characterized in sections 3.12.2 Stream Network Description/Stream Reaches and 3.16.3 Summary of Previous Sudies and DRWW Monitoring Program. Changes in stormwater quantity, quality, and temperature resulting from changes in land use can have multiple negative impacts on freshwater streams. These well-documented impacts (CWP, 2003; CWP, 2009; Cruse et al., 2012) include:

- Increased Channel Forming Events: Increased stormwater runoff rates and volumes resulting from land use changes increase the frequency and duration of channel forming bankfull and near-bankfull events, resulting in changes in channel form, stream channel enlargement (e.g., stream down-cutting and widening), and streambank erosion.
- Increased Flooding: Increased stormwater runoff rates and volumes resulting from land use changes also increase the frequency, duration, and severity of overbank and extreme flooding events. These flooding events can cause property damage and endanger public health and safety.

- Decreased Baseflow: Increased stormwater runoff volumes resulting from land use changes reduce the amount of recharge to shallow groundwater aquifers which supply baseflow to streams and rivers.
- Stream Channel Enlargement: Stream channels enlarge (e.g., downcut and widen) to accommodate the increased peak discharges resulting from land use changes.
- Streambank Erosion: As stream channels enlarge to accommodate an increased frequency and duration of channel forming events and the increased peak discharges resulting from land use changes, streambanks are gradually undercut, scoured, and eroded away.
- Loss of Riparian Vegetation: As stream channels enlarge and streambanks are gradually eroded away, the roots of vegetation along the stream corridor may become exposed, undercut, uprooted, and conveyed downstream.
- Degradation of Habitat: Increased stormwater runoff rates and volumes resulting from land use changes scour stream beds and degrade aquatic habitat. The increased sediment loads that result from land use changes and erosion can also degrade aquatic habitat by filling in streambeds and destroying the important pool-riffle structure found in many streams.
- Increased Temperatures: Increased stormwater runoff temperatures resulting from land use changes can raise the temperature of freshwater streams. Since aquatic organisms can only survive within a specific temperature range (e.g., some darter fish species and other cool water species), increased stream temperatures can lead to a decline in wildlife abundance and diversity.
- Degradation of Water Quality: Increased stormwater pollutant loads resulting from land use changes reduce the overall water quality of freshwater streams. This water quality degradation negatively impacts many of the ecological functions that these important natural resources provide.
- Reduced Dissolved Oxygen Levels: Increased amounts of organic matter found in urban stormwater runoff, and increased stormwater runoff temperatures that result from land use changes, reduce the amount of dissolved oxygen found in freshwater streams. Fish kills and the loss of other aquatic organisms can occur if dissolved oxygen levels decrease enough. Low dissolved oxygen levels can also cause the release of harmful pollutants such as metals, nutrients, hydrocarbons, and pesticides that have accumulated within stream bottom sediment.
- Decline in Wildlife Abundance and Diversity: Increased stormwater runoff rates, volumes, and pollutant loads resulting from land use changes degrade habitat and water quality. This reduces the abundance and diversity of aquatic organisms found in freshwater streams. Sensitive keystone or indicator organisms that require high quality habitat may become stressed and be gradually replaced by organisms more tolerant of degraded conditions. For more detailed information on threatened and endangered species see section 3.10.2.
- Reduced Recreational and Aesthetic Value: Increased trash, debris, and pollutant loads found in stormwater runoff can accumulate in freshwater streams and detract from their natural beauty and recreational value.

4.1.4.2 Lakes and Wetlands

Impacts on aquatic lake resources within the planning area are characterized in sections 3.13.2 Shoreline Erosion and Buffer Condition and 3.16 Lake and Stream Water Quality. Impacts on aquatic wetland resources within the planning area are characterized in section 3.11 Wetland Inventory. Changes in stormwater quantity and quality resulting from changes in land use can have multiple negative impacts on lakes and wetlands.

The water quality of lakes, particularly man-made lakes, is substantially negatively impacted by increased stormwater pollutant loads. Since lakes function as sinks within the landscape, incoming sediment, nutrient, bacteria, metals, hydrocarbons, pesticides, chlorides, and trash and debris can remain in a lake for a long time. The accumulation of these various pollutants can reduce overall water quality, contaminate sediments, increase primary productivity (e.g., increase algal growth), and negatively impact many of the important ecological functions that lakes provide. Elevated total suspended solids and phosphorus concentrations were observed in many of the lakes in the DPR planning area, causing impairments to aesthetic quality and aquatics. Moderate to severe shoreline erosion and low vegetative quality were observed at most of the assessed lakes (section 3.13.2). Chloride concentrations have been increasing over time in lakes throughout the DPR planning area (see Chapter 3).

As documented above, land use changes can have a wide range of impacts on the health of terrestrial and aquatic resources. These impacts, which range from additional runoff volume to degraded water quality to a decline in wildlife abundance and diversity, have been well documented by an extensive and ever-growing body of research. These impacts have been observed within the aquatic resources of the DPR planning area, as described in Chapter 3 and can, in part, be linked to the changes in hydrology and stormwater runoff characteristics (i.e., increased stormwater runoff rates, volumes, and pollutant loads) resulting from land use changes that have occurred in the watershed over the last two centuries. Changes in stormwater quantity and quality resulting from changes in land use can have multiple negative impacts on lakes and wetlands. These well-documented impacts (Wright et al., 2006; Cruse et al., 2012) include:

- Increased Ponding: Increased stormwater runoff rates and volumes resulting from land use changes can cause increased ponding within wetlands. This can stress native wetland plant communities, especially in wetlands that did not previously receive large inputs of stormwater runoff.
- Increased Water Level Fluctuations: Increased stormwater runoff rates and volumes resulting from land use changes can cause increased water level fluctuations in wetlands. This can stress native wetland plant communities and reduce plant and wildlife abundance and diversity.
- Decreased Baseflow: Increased stormwater runoff volumes resulting from land use changes reduce the amount of precipitation available to recharge shallow groundwater aquifers and provide a steady supply of baseflow to wetlands, particularly during dry weather.
- Shoreline Erosion: Increased ponding and water level fluctuations and decreased baseflow resulting from land use changes can stress native wetland plant communities and leave portions of wetland shorelines unvegetated, making them vulnerable to undercutting, scour, and erosion.
- Degradation of Habitat: Increased ponding and water level fluctuations and decreased baseflow resulting from land use changes can stress native wetland plant communities and degrade wetland habitat. Increased sediment loads resulting from land use changes and surface and streambank erosion can also degrade wetland habitat.
- Degradation of Water Quality: Increased stormwater pollutant loads resulting from land use changes reduce the overall water quality of wetlands. This negatively impacts many of the ecological functions these important natural resources provide.
- Increased Primary Productivity: Increased nutrient loads in stormwater runoff increases the primary productivity of wetlands, promoting algal growth and forcing native wetland plant communities to

compete for available nutrients. This competition can stress native wetland plant communities and reduce plant and wildlife abundance and diversity.

- Sediment Contamination: Metals, hydrocarbons, and pesticides in stormwater runoff can become attached to sediment particles and accumulate within wetlands. This can cause sediment contamination and expose aquatic and terrestrial organisms to the harmful effects of these pollutants.
- Decline in Wildlife Abundance and Diversity: When increased stormwater runoff rates, volumes, and pollutant loads resulting from land use changes degrade habitat and water quality, the abundance and diversity of plants, animals, and other organisms found in freshwater wetlands may be significantly reduced. In these situations, native wetland plant communities tend to be replaced by invasive species, and sensitive macroinvertebrate, amphibian, reptile, and bird populations become stressed and gradually replaced by populations that are more tolerant of the degraded conditions. This can result in the local extinction of native aquatic and terrestrial organisms. For more detailed information on threatened and endangered species see section 3.10.2.
- Reduced Aesthetic Value: Trash, debris, and pollutant loads in stormwater runoff can accumulate in wetlands, detracting from their natural beauty and aesthetic value.

4.1.5 Assessing the Impacts of Forecasted Land Use Changes

4.1.5.1 IC Model

Assessing impacts of forecasted land use changes within the DPR planning area involves further analysis of current land use impacts and IC. Section 3.6.3 Existing and Projected Future Percent Imperviousness presents two data sources on IC impacts: planimetric data and the NLCD. A combination model, Figure 4-5, was developed from the NLCD and planimetric **GIS** datasets to assist in identifying IC in rural areas that typically lack planimetric data. The combined model shows land use and construction impacts beyond the developed artificial surfaces. The combined datasets indicate that 48.32% of the DPR planning area (72,655.41 acres) is within the impacted and degraded Medium and High IC classification and 31.33% of the DPR planning area contributes to significant water impacts (Table 4-1). The addition of the planimetric data to the NLCD dataset refines the data and decreases acreage of Low IC within the NLCD data by 0.71%, and increases the acreage of High IC by 0.71% (1,037.37 acres).

Geographic Information System: A computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface.

The combined imperviousness analysis data was joined geospatially to the subwatersheds within the DPR planning area to determine IC within each subwatershed (Table 3-13). Aptakisic Creek and Buffalo Creek currently have over 50% (62.65% and 53.34%, respectively) of their respective subwatersheds within the High IC classification and less than 19% (11.18% and 18.93%, respectively) of their respective subwatershed within the Low IC classification. Indian Creek analysis indicates that 26.34% of the subwatershed can be considered Low IC with 67% of the subwatershed impacted by various land uses. Aptakisic, Buffalo, and Indian Creek have a significant percentage of IC within their respective subwatersheds. The Bull Creek subwatershed has a mix of impervious impacts with Low IC of approximately 38% of the subwatershed and 21% of the subwatershed in Medium IC.

The Upper Des Plaines, Lower Des Plaines, and Mill Creek subwatersheds within the DPR planning area have approximately 50% of their respective subwatersheds within the Low IC classification and the other 50% of their subwatershed in the High IC classification. The Newport Drainage Ditch, North Mill Creek/Dutch Gap Canal, and Bull's Brook subwatershed currently have greater than 68% of their respective subwatersheds in areas of Low IC (70.18%, 78.04%, and 68.41%, respectively). These subwatersheds have relatively low development and urbanization impacts and have a larger percentage of their land as open space and agricultural lands.

Table 4-1: Combined Percent IC by Subwatershed
Open water not included in acre totals

SUBWATERSHED	COMBINED IC PERCENTAGE 0-9% (Low)		COMBINED IC PERCENTAGE 10-29% (Medium)		COMBINED IC PERCENTAGE 30-100% (High)	
	ACRES	% AREA	ACRES	% AREA	ACRES	% AREA
Aptakisic Creek	488.97	11.18%	954.83	21.83%	2,740.35	62.65%
Buffalo Creek	3,292.70	18.93%	4,220.94	24.27%	9,276.50	53.34%
Bull's Brook	1,242.94	68.41%	234.37	12.90%	249.63	13.74%
Bull Creek	2,707.32	37.94%	1,509.90	21.16%	2,528.42	35.43%
Indian Creek	6,361.79	26.34%	6,842.93	28.33%	9,508.80	39.37%
Lower Des Plaines River	6,776.18	46.39%	2,356.53	16.13%	4,895.48	33.51%
Mill Creek	9,847.87	49.78%	2,537.26	12.83%	5,812.37	29.38%
Newport Drainage Ditch	3,521.43	70.18%	604.22	12.04%	799.86	15.94%
North Mill Creek/Dutch Gap Canal	18,365.50	78.04%	1,383.70	5.88%	2,296.78	9.76%
Upper Des Plaines River	17,156.14	52.71%	4,900.89	15.06%	9,001.67	27.66%

To determine the forecasted impacts of land use, the current IC model data is first associated with current land use data to develop observational trends for a forecast model (Table 4-2). The prediction model then compares the impact trends from Table 4-2 to anticipated FLU data (Table 3.14 and Table 3.15) to present a forecast model of impacts.

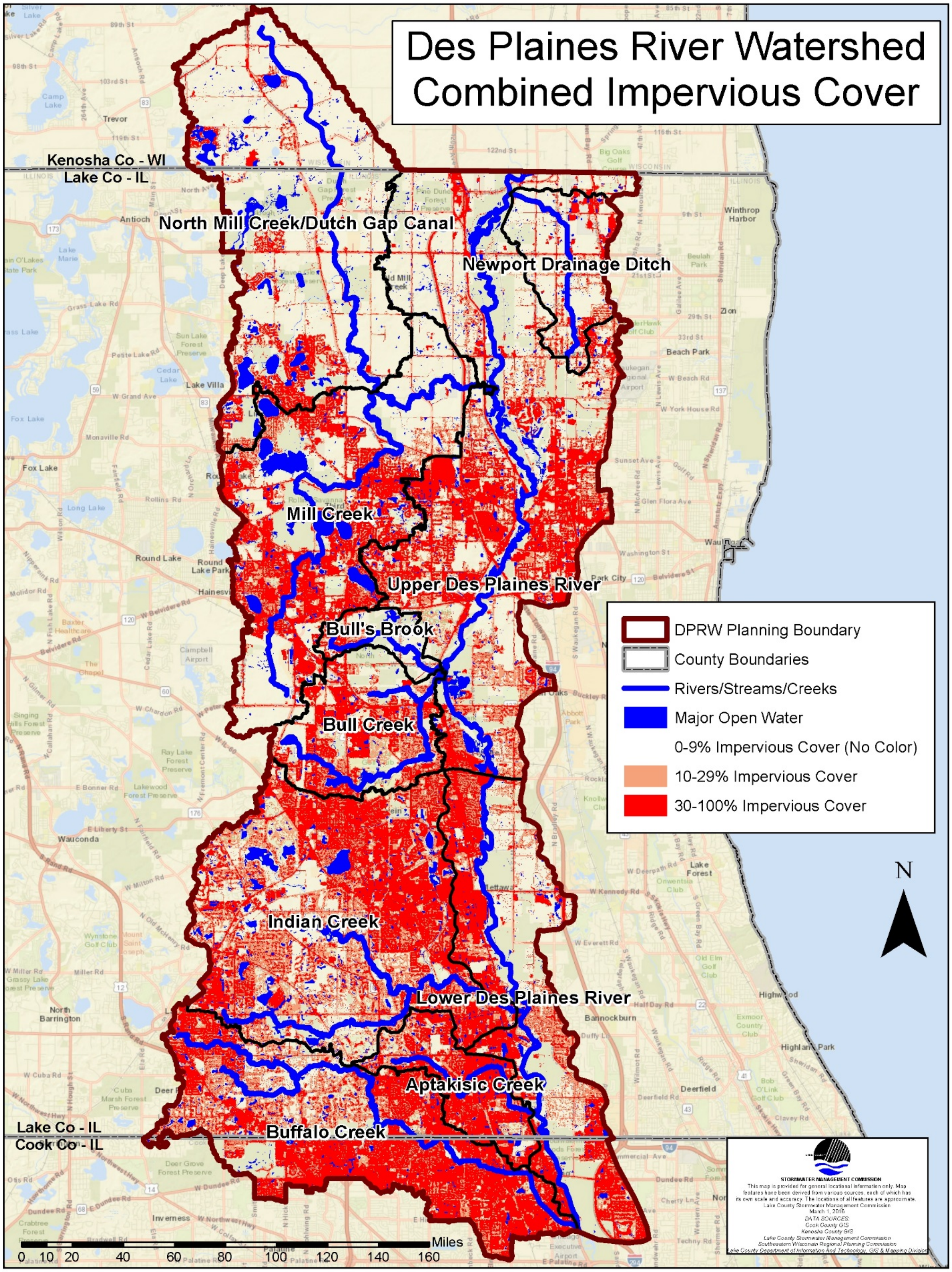


Figure 4-5: Combined Imperviousness
Data from Table 4-1

Table 4-2: Current Planning Area Land Use with Aggregate Percent IC
Open water not included in acre totals

LAND USE	COMBINED IC PERCENTAGE 0-9% (Low)		COMBINED IC PERCENTAGE 10-29% (Medium)		COMBINED IC PERCENTAGE 30-100% (High)	
	ACRES	% AREA	ACRES	% AREA	ACRES	% AREA
Agricultural Land	21,775.05	87.39%	1,601.67	6.43%	1,539.66	6.18%
Commercial and Services	172.07	3.39%	321.23	6.32%	4,588.92	90.29%
Forest, Grassland, and Wetlands	15,196.98	71.34%	3,359.21	15.77%	2,745.89	12.89%
Industrial, Warehousing, and Wholesale	122.51	3.30%	216.35	5.82%	3,377.49	90.88%
Institutional	545.26	17.97%	626.11	20.64%	1,862.08	61.38%
Open Space	21,766.83	76.63%	4,451.39	15.67%	2,186.58	7.70%
Residential	7,598.65	20.32%	12,051.40	32.22%	17,750.79	47.46%
Transportation, Communication, and Utilities	2,101.70	11.71%	2,865.82	15.96%	12,985.58	72.33%

4.1.5.2 Forecasted Land Use Changes

FLU is forecasted to increase IC, based on the past and current trends on land use conversions described in 3.6.1 Historic Land Cover to 3.6.2 Existing Land Use in the DPR Planning Area. As forecast, FLU (Figure 4-6) will continue to impact water quality through the conversion of vegetated or naturalized land uses (Agricultural, Open Space and Forest, Grassland, and Wetlands) to urbanized land uses that increase IC (Industrial; Warehousing and Wholesale; Commercial and Services; Institutional; Residential; and Transportation, Communication, and Utilities). The impact of FLU changes on water quality will depend on the retrofitting of existing developed land uses (6.3 Site-Specific Action Plan) and the utilization of sustainable land development or green infrastructure solutions (6.2 Programmatic Action Plan).

Presuming the FLU estimates progress as forecasted by the current data, approximately 34,776 acres of vegetated or naturalized land uses (Agricultural, Open Space and Forest, Grassland, and Wetlands) will be impacted by new development (Table 4-3). The forecast is that 85% of the 34,776 acres of impact will be converted from Low IC to Medium and High IC, with 61% being High IC.

Table 4-3: Forecasted Increase in Acreage of IC Based on Forecasted FLU Data

LAND USE	PERCENT IC 0-9% (Low)	PERCENT IC 10-29% (Medium)	PERCENT IC 30-100% (High)	% INCREASE FLU VS. CURRENT LAND USE
Commercial and Services	+258	+482	+6,882	250%
Industrial, Warehousing, and Wholesale	+83	+146	+2,280	168%
Institutional	+333	+382	+1,137	161%
Residential	+4,447	+7,052	+10,387	159%
Transportation, Communication, and Utilities	+106	+145	+656	105%

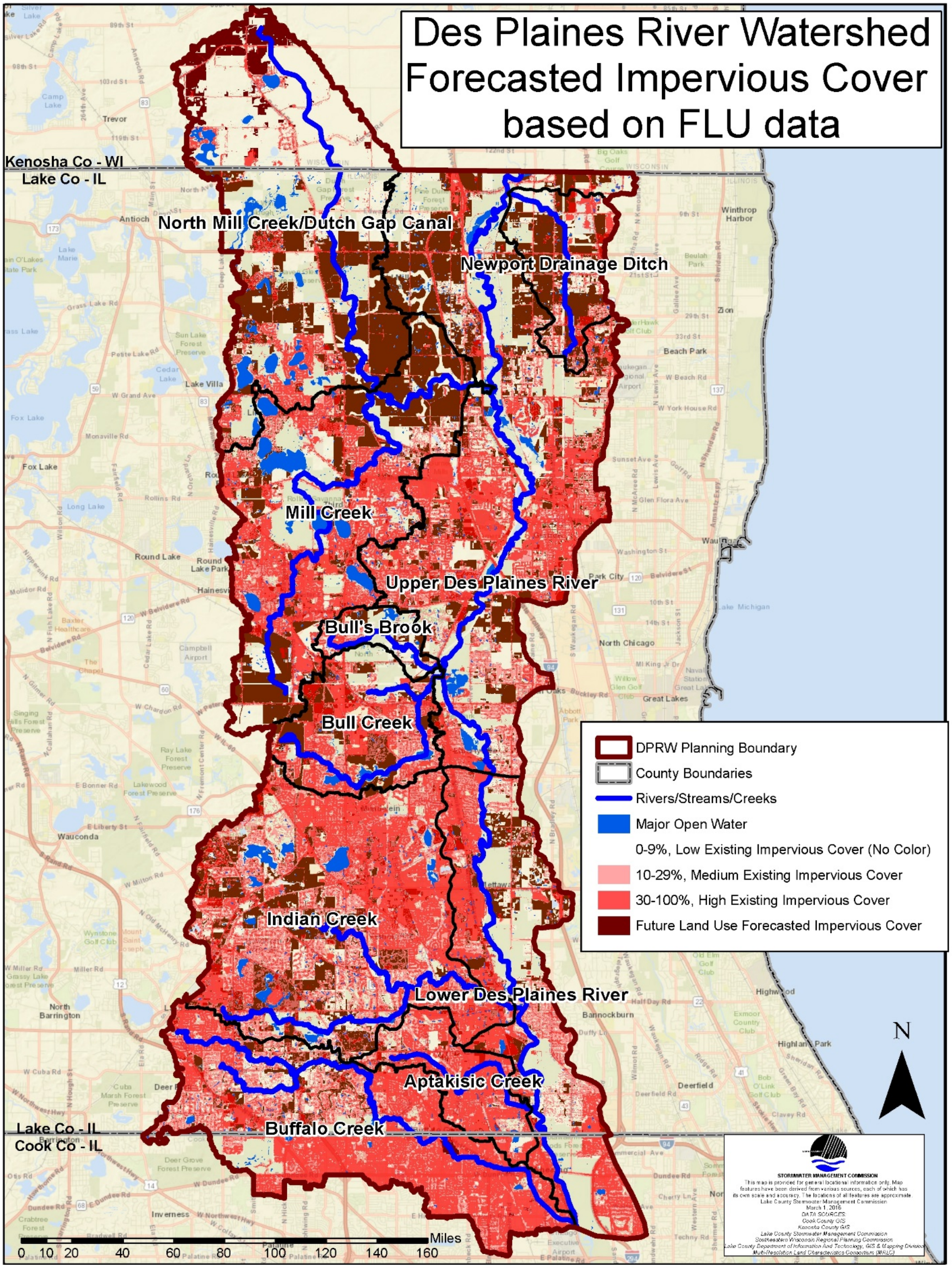


Figure 4-6: Forecasted FLU increases in IC

The FLU datasets utilized in this study have varying projected future year targets: Lake County has no projected date (the data are based on underlying municipal and Lake County land use plans), CMAP projections are to 2040, and Kenosha County projections are to 2035. In their NLCD dataset, the MRLC includes observations of IC during the years 2001, 2006, and 2011. During the MRLC 10-year study period, 2001-2011, the conversion of land use increased IC approximately 4,487.42 acres. Within the study area, between the years 2001-2006, approximately 3,378.81 acres were converted from low IC to medium and high IC. During the years 2006-2011, approximately 1,108.60 acres converted from low IC to medium and high IC. Table 4-4 indicates the observed IC changes during the years 2001-2011.

The NLCD data indicated approximately 450 acres of conversion to higher classes of imperviousness per year occurred during the years 2001-2011. At this rate, it will take approximately 77 years to reach the 34,776 acres of increased imperviousness estimated by the FLU NLCD 2001-2011 IC model. Conversion to higher classes of imperviousness would need to increase to approximately 1,738 acres per year to reach the same acreage estimated by the FLU IC model in 20 years (a typical life span for land use plans). In considering that FLU datasets target an approximate 20-year timeline, land conversion of approximately 1,738.00 acres per year would reach the FLU target of 34,776 acres. Forecasted land use and IC has the potential to range from 450 to 1,738 acres per year of new IC for an additional 9,000 to 34,776 acres of Medium and High IC over a 20-year forecast model. Forecasted IC will depend on the type of land use, infill land use, and types of retrofit projects that protect, improve, and restore water quality within the DPR planning area.

Table 4-4: Study Area IC Increase from 2001-2011

TYPE	ACRES	% OF DPR PLANNING AREA
OBSERVED IC INCREASES BETWEEN 2001-2006		
Increase in Imperviousness by 0-9%	-	0.00%
Increase in Imperviousness to 10-29%	1,178.12	0.83%
Increase in Imperviousness to 30-100%	2,200.69	1.55%
OBSERVED IC INCREASES BETWEEN 2006-2011		
Increase in Imperviousness to 0-9%	-	0.00%
Increase in Imperviousness to 10-29%	-	0.00%
Increase in Imperviousness to 30-100%	1,108.60	0.78%

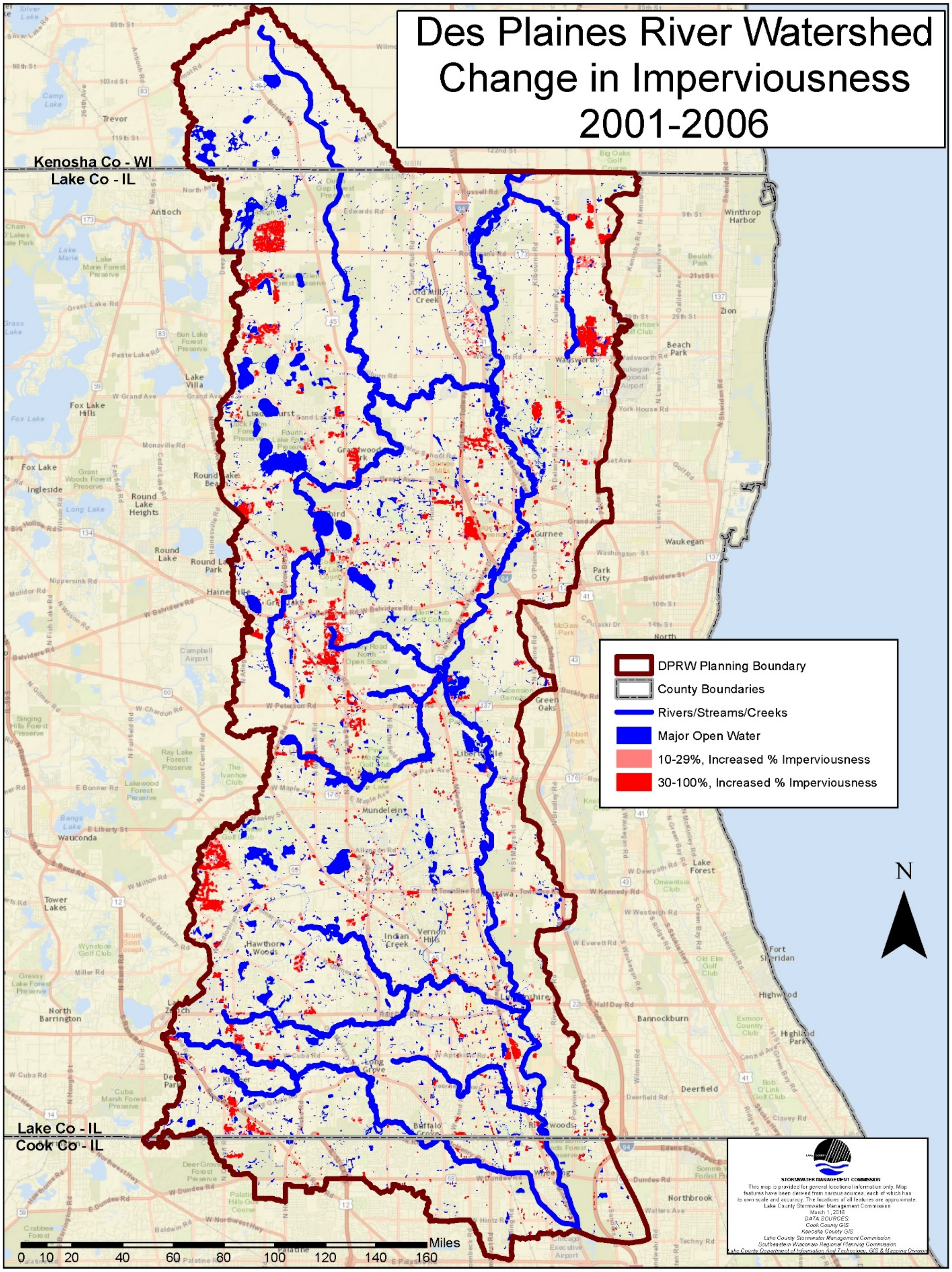


Figure 4-7: Observed NLCD Increased IC during 2001-2006
Data from Table 4-3

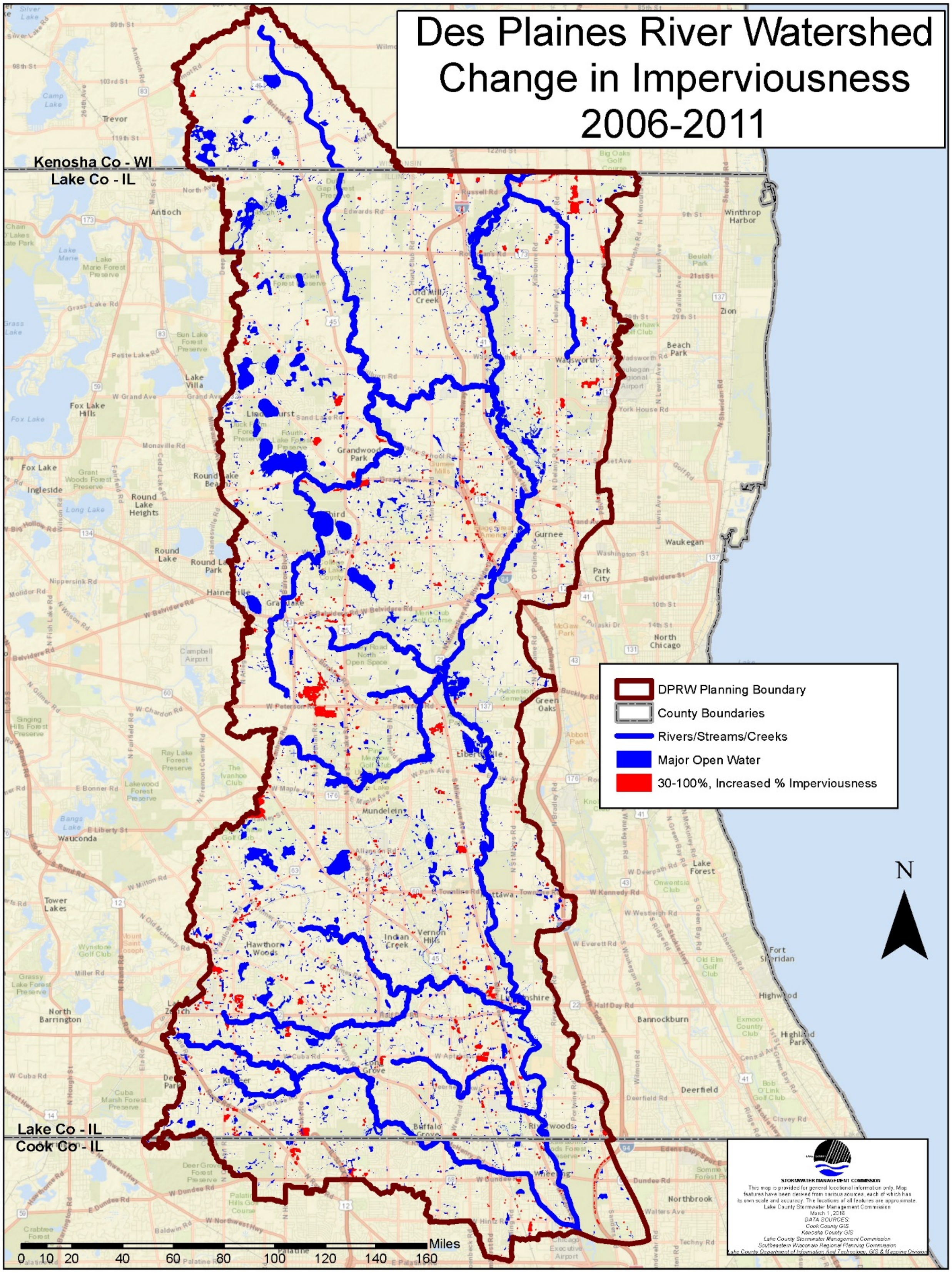


Figure 4-8: Observed NLCD Increased IC during 2006-2011

Data from Table 4-3

4.1.6 Reducing Land Use Impacts Through Development Standards and Policy

The Des Plaines River Watershed-Based Plan recommends actions for protecting and restoring natural resources, improving water quality, and reducing and preventing flood damage in the watershed. These actions include both remedial and preventative measures for communities to support. Among the most significant and influential are preventative measures such as policies and regulatory programs, which are proactive practices rather than costly remedial measures after the problems become unavoidable.

This watershed-based plan does not recommend specific land uses or zoning; however, it does consider the health of watershed lakes, streams, and wetlands, which is a direct reflection of land use and land management. Therefore, consideration of land management and development impacts by local land use authorities is necessary for effective watershed planning. Current water resource problems and consideration of potential land use changes signal the need to review and modify policies, standards, and practices guiding land development and management in the DPR planning area.

It is anticipated that stormwater runoff volume and pollution will continue to increase as IC increases within the DPR planning area. Municipalities and counties should review relevant ordinances to evaluate policies, standards, and regulations for new and retrofitted development, and for land management as it pertains to stormwater runoff volume, detention, water quality, **floodplains/floodways**, and wetlands. Both watershed development regulations and policies focused on stormwater management and local ordinances and policy that direct development practices that influence IC and drainage should be reviewed based on their potential to positively influence watershed health by preventing negative land development impacts.

Floodplains: Floodplains are lowlands, adjacent to rivers, streams and creeks that are subject to recurring floods. Mapped regulatory floodplains are defined as the area of land, which is inundated with water during 100-year flood events.

Floodway: A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

4.1.6.1 Stormwater Management

Current stormwater regulations are enforced locally with minimum requirements for development based on local ordinance and NPDES minimum requirements. Section 4.3 Watershed Jurisdictional Coordination identifies roles and jurisdictions of development programs. Section 3.18 NPDES Phase II Stormwater Permits identifies national stormwater requirements. Future local ordinance revisions could consider conditions unique to individual subwatersheds that warrant consideration for developing and administering watershed-specific stormwater management regulations to address the technical issues of concern in the subwatershed.

The primary technical issues of concern related to stormwater management are:

- Hydrologic changes have resulted in stream channel changes. Deepening and widening of the stream corridors in some locations has created excessive erosion and sedimentation, property loss, debris loads and blockages, and aquatic habitat impairments.
- Current IC and land use vary within an individual catchment or jurisdiction.
- Current drainage infrastructure varies within an individual catchment and/or jurisdiction with undersized, older, not maintained, or inadequate infrastructure which largely contributes to urban flooding.

- Significant increases in impervious surface and resulting hydrologic changes are projected for areas that are currently naturalized, agricultural, or vacant land uses.
- Nonpoint source pollution from urban land uses, transportation infrastructure and maintenance practices, and agricultural runoff are projected to impair watershed lakes.

The effects of increased runoff volume resulting from land use changes can be addressed in a variety of ways, including the following examples:

- Institute more effective and consistent runoff volume reduction practices as 9,000 to 34,776 acres of undeveloped lands in the watershed (agricultural, open space, and water) are projected to convert to land uses with greater IC (e.g., residential, commercial/retail, transportation).
- Review the detention volume/release rate requirements for the watershed and determine if unique conditions warrant adjustments or changes to storage and release regulations.
- Review and revise ordinance and policy language to ensure that the disconnection and minimization of impervious surfaces are allowed by right.
- LID practices and the use of green infrastructure best practices (that maintain natural hydrology post-development) could be expanded by municipal and county ordinances for all new development and significant redevelopment.
- Mitigate unavoidable wetland loss within the watershed or subwatershed where the wetland impact/loss occurs.
- Utilize tree preservation ordinances that protect mature healthy native trees and stands of forest/savanna for stormwater reductions, habitat value and increased urban tree canopy coverage.

Water quality has been identified as a major watershed issue and concern. Local community ordinances can be reviewed and revised to ensure that development codes do not preclude but rather encourage BMPs to protect and improve water quality. Examples of such BMPs include:

- The use of native vegetation in home and business landscaping.
- Sustainable street designs, including alternative transportation opportunities (complete streets) and bio-swales or other vegetated conveyance systems for stormwater management instead of traditional curb and gutter.
- Infiltration for a significant portion of increased runoff volume due to land development. The WDO was amended in 2013 to include runoff volume reduction requirements.
- Preservation of natural retention and infiltration areas recognized as green infrastructure to reduce polluted runoff.
- Rainwater harvesting such as through the use of rain barrels and cisterns.

Site-specific erosion issues were identified as a concern. Many of these erosion issues can be addressed with the following:

- Requirements or incentives for stream corridor buffering and restoration for stream reaches located on new development sites could provide water quality, flood reduction, and habitat enhancement benefits. Currently stream corridor enhancements are not required as part of land development activities.

- Developing stream maintenance and restoration standards that can be applied throughout the DPR planning area.
- Continued outreach and education to riparian landowners on proper maintenance and protections.
- Development and support for standardized long-term maintenance and monitoring protocols for naturalized stormwater drainage systems and natural areas. Development of a standardized protocol for monitoring and maintenance plans for new developments and required endowment funds for long-term implementation of the plans.

4.1.6.2 Local Municipal and County Policies and Ordinances

Policy and regulatory changes regarding land use are the responsibility of the county and municipal planning and development departments. All of those entities should consider developing and implementing sound environmental long-term planning goals in their guiding documents. Planning documents vary in function (e.g., master plans, comprehensive plans, overlay or area-specific plans) but can seek balanced land use, land preservation, and development guidelines to positively affect watershed response. Development guidelines may be the best avenue for incorporating watershed-specific development standards and practices that prevent flood damage and protect water quality. Because elected officials change, long-term planning guidelines support county and municipal staff in preserving watershed health through the available resources for enforcement and recommendations.

Planning and zoning guidance provides the next level of watershed protection. Most planning and zoning regulation is in the form of local comprehensive land use plans and development-related ordinances that regulate onsite land use practices to ensure adequate floodplain, wetland, stream, lake, pond, soil conservancy, and other natural resource protection. Zoning ordinances, and overlay districts in particular, define the allowed type of development and where it can be located relative to natural resources. Other examples of planning/zoning resource protection include riparian and wetland buffers, impervious area reduction, open space/greenway dedication, and conservation development.

An excellent source of information on model development principles and a sample code and ordinance review worksheet can be found in *Better Site Design: A Handbook for Changing Development Rules in Your Community* (CWP, 1998). In addition, the CWP and USEPA have self-appraisal checklists that watershed communities may use to evaluate their existing codes and ordinances to identify where they can change or modify regulations to improve the preservation and use of green infrastructure in the DPR planning area. Adopting watershed-friendly codes and ordinances will elevate protection and enhancement of watershed resources. Watershed communities should perform this self-appraisal and establish an action plan to revise ordinances and codes where needed.

Improved coordination and communication between county and local government would benefit water resource protection. Local enforcement officers, local planners, and zoning boards should be very familiar with watershed development regulations, and should consider revising local ordinances that address watershed and site-specific water, natural resource, and flooding issues not covered by county, regional, or state program requirements.

NOTEWORTHY: COMMUNITY PROGRAMS AND REGULATIONS INFLUENCE WATERSHED HEALTH

Many codes and ordinances influence the health and function of a watershed. The table below includes typical types of codes and ordinances to evaluate and potentially change or modify to help improve watershed conditions.

Code or Ordinance Types with Ties to Watershed Health

SUBJECT OF REGULATION	CODE/ORDINANCE/REGULATION
Erosion and Sediment Control	Zoning Ordinance, Stormwater Ordinance
Environmental Regulations (e.g., Buffers, Water Quality, Wetlands, Threatened/Endangered Species)	Subdivision Codes, Stormwater Ordinance, Planned Unit Development Agreements, Special Use Permits
Floodplain Regulations	Zoning Ordinance, Stormwater Ordinance, Subdivision Codes, Building Code
Stormwater Management and Drainage	Stormwater Ordinance, Subdivision Codes, Zoning Ordinance, Planned Unit Development Agreements, Street Standards and Road Design, Building Code, Fire Code
Tree Protection and Landscaping	Tree Protection Ordinance, Landscape Ordinance, Nuisance Ordinance, Planned Unit Development Agreements, Building Code, Fire Code
Parking Requirements	Zoning Ordinance; Planned Unit Development Agreements, Special Use Permit, Grading Ordinance

NOTEWORTHY: CONSERVATION AND LID

County and local governments can work together to develop incentives for conservation and LID. Conservation development is the ideal compromise between economic development and water resource protection. Some ways to incorporate conservation development into developing communities and provide incentives for developers include:

- Allow conservation development "by-right" (does not require variances)
- Establish a joint review department/agency application process that reduces review time for conservation development
- Reduce fees for conservation development application review
- County and municipalities work together to locate appropriate parcels for future conservation development, and then zone those parcels as conservation development (parcels in the green infrastructure network that are proposed for development would be good candidates)
- Require all developments have a certain percentage of preserved open space
- Develop native landscaping ordinances
- Reduce setback requirements between lots and encourage multi-level and clustered residential development to reduce land consumption
- Provide credit for combining natural buffers with recreational opportunities
- Require native plantings in all detention basins
- Provide detention credit for green infrastructure BMPs

Communities may incorporate conservation and LID using several methods and strategies. Conservation development zoning could be applied to rezoning changes in rural areas. The conservation development zoning classification should outline the intent, design guidelines, density bonus, and the specific areas where conservation development zoning changes would be permitted. The areas that may be rezoned to a conservation development might include areas that are adjacent to ecologically significant lands or are identified in the green infrastructure system. Rural residential districts or less productive agricultural areas may also be considered. Areas that are defined as rural residential could provide a transition from higher density residential to rural.

Design guidelines for conservation developments should include LID practices, a detailed outline of the process used to define the environmentally sensitive areas on the site, and identify areas on the site that are developable. Because each site will have different developable areas and sizes, design guidelines should be flexible and should consider different development characteristics, such as roadway length, width, and lot size. Density bonuses may be written into the zoning code and could include bonuses for the following: use of native vegetation throughout the development including individual lots, reduction in pavement or impervious surface, use of permeable pavements, increased percentages of open space, trail or sidewalk connections to other developments or regional trails, additional expanded buffering of natural areas and adjacent spaces, and creation of wildlife habitat.

4.2 WATERSHED RESOURCE PROBLEMS ASSESSMENT

This section assesses the problems and concerns identified in Chapter 2 and Chapter 3 in order to better understand them and guide informed and prioritized actions to address them. Many lakes and streams in the watershed have poor water quality which negatively affects aesthetic value, aquatic habitat, recreational value, and fish consumption uses. Total phosphorus, total suspended solids, and sedimentation/siltation are the most common causes of impairments for both streams and lakes in the DPR planning area. Low dissolved oxygen, chloride, fecal coliform, and aquatic algae are also considered prevalent causes of problems throughout the DPR planning area.

The following subsections describe further analysis used to assess how watershed conditions are affecting the water quality, natural resources, and green infrastructure throughout the DPR planning area.

4.2.1 Lake Impairments

Based on the 2004 Illinois EPA 305(b) list, 73 of 81 assessed lakes in the DPR planning area have statutory impairments, as thoroughly detailed in Chapter 3. More robust monitoring programs are beneficial to thoroughly characterize a waterbody, its watershed, and understand the issues that affect aquatic life and the overall health and function of the system.

Of the 73 lakes in the DPR planning area with impairments, 52 are listed as impaired for phosphorus, 43 for total suspended solids, and 33 for aquatic algae. Low dissolved oxygen, unknown causes, and fecal coliform combined are listed as the cause of 21 lake impairments.

Many of the lakes are in poor water quality condition due to nonpoint sources of phosphorus and total suspended solids. The lakes suffering from high sediment and nutrient concentrations are vulnerable to low dissolved oxygen, algae blooms, and invasive aquatic plant growth which negatively affect recreational, habitat, and aesthetic value. In addition to nonpoint sources of sediment and phosphorus, internal lake processes contribute to nutrient and sediment issues.

Algae blooms and invasive species are responsible for decreasing the biological productivity and limit the diversity of both fish and macroinvertebrate species. Lake shoreline erosion is also another consideration; as inventoried in Chapter 3, and further analyzed in section 4.2.5, shoreline erosion impacts the water quality of the lakes, and contributes to the loss of shoreline and property. Additionally, a trend of steadily rising chloride levels has been identified in lakes across the DPR planning area, though levels do not currently exceed Illinois water quality standards.

4.2.2 Stream Impairments

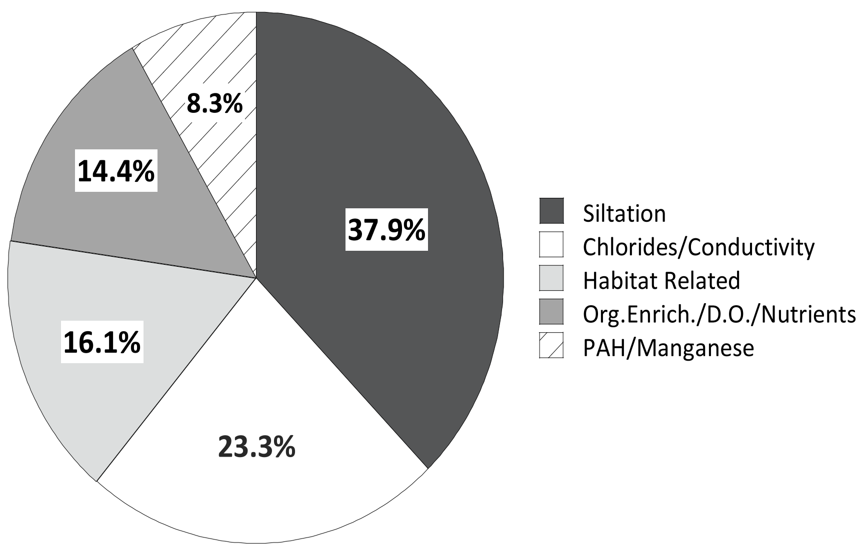


Figure 4-9: Major Causes Associated with Aquatic Life Impairments Identified by the DRWW Monitoring Study, 2016
MBI, 2017

Twelve of the 13 assessed stream segments in the DPR planning area are classified as impaired by the Illinois EPA (Chapter 3). Sixteen different causes are listed for the impairments; the predominant causes are phosphorus, mercury, arsenic, low dissolved oxygen, fecal coliform, PCBs, sediment/siltation, total suspended solids, and chloride. These statutory impairments are based on a limited set of data and more robust monitoring programs are beneficial to thoroughly characterize a watershed and understand the issues that affect aquatic life and the overall health and function of the watershed. In 2015, the DRWW implemented a comprehensive water quality monitoring program for the DPR planning area (Lake County portion only), and this data, along with commissioned studies (MBI, 2017), have been instrumental in further characterizing watershed problems and how water quality is affecting aquatic health throughout the DPR planning area. Figure 4-9 shows major causes associated with aquatic life impairments based on MBI's 2017 Monitoring Study performed for the DRWW. The monitoring data and study help analyze trends, prioritize actions, and will help monitor and measure success of watershed management activities and augment the limited data used to determine the statutory water quality impairments.

4.2.3 Causes and Sources

Chapter 3 introduced and identified problems and impairments in the DPR planning area, and this section aims at better understanding the causes and sources of impairments. Various sources of quantitative and qualitative data and information were analyzed with the goal to identify the causes and sources of water pollution that will need to be managed to achieve the estimated pollutant load reductions and the goals and objectives of this plan.

The combined efforts outlined in the inventory presented in Chapter 3, the MBI 2017 Monitoring Study, and the Illinois EPA Integrated Report (2016) study provide a wealth of data, scientific assessment, and watershed knowledge to assess the stream impairments and better understand the causes and sources. Table 4-5 provides a planning level inventory of impairments, causes, and sources based on the characterization and inventory of the DPR planning area. This table serves as a summary to document the issues and provides a baseline to further characterize them in a sufficient manner to recommend priority areas and specific actions.

Table 4-5: Summary of Causes and Sources of Pollution and Impairments

IMPAIRMENT	CAUSES	SOURCES	PRIORITY	HIGHEST PRIORITY WATERSHEDS
Aquatic Life and Aesthetic Quality	Chloride / Conductivity	▪ Urban runoff, impervious surfaces not detained or retained ▪ Salt application for deicing of parking lots and roadways ▪ Wastewater treatment plants	HIGH	Buffalo Creek (TMDL), Indian Creek, Upper DPR, Aptakisic Creek, Newport Drainage Ditch, Lower Des Plaines
	Total Suspended Solids (TSS)	Streams / Rivers ▪ Agricultural land use ▪ Altered hydrology ▪ Urban runoff ▪ Streambank modifications/destabilization (MBI report) ▪ Site Clearance (Land Development or Redevelopment)(Illinois EPA) ▪ Bank Erosion Lakes ▪ Sediment Resuspension (Clean Sediment) (Illinois EPA)	HIGH	Watersheds Indian Creek, North Mill/Dutch Gap, Mill Creek Lakes 43 lakes in the DPR planning area
	Siltation / Sedimentation			

IMPAIRMENT	CAUSES	SOURCES	PRIORITY	HIGHEST PRIORITY WATERSHEDS
Aquatic Life and Aesthetic Quality (continued)		▪ Impervious surface/parking lot runoff (Illinois EPA) ▪ Other recreational pollutant sources (Illinois EPA) ▪ Littoral/Shore area modifications (non-riverine) (Illinois EPA) ▪ Lakeshore Erosion		
	Organic Enrichment	▪ Wastewater treatment plants ▪ Agricultural runoff	MEDIUM	Upper DPR, Lower DPR
	Dissolved Oxygen	▪ Altered hydrology ▪ Urban runoff ▪ Agricultural runoff ▪ Wastewater treatment plants	MEDIUM	Buffalo Creek, Upper DPR, Lower DPR, Indian Creek, Mill Creek
	Total Phosphorus	<u>Streams/Rivers</u> ▪ Wastewater treatment plants ▪ Agricultural runoff ▪ Urban Runoff/storm sewers <u>Lakes</u> ▪ Rural (Residential Areas) (Illinois EPA) ▪ Runoff from Forest/Grassland/Parkland (Illinois EPA) ▪ Waterfowl (Illinois EPA) ▪ Internal nutrient recycling (Illinois EPA) ▪ On-site Treatment Systems (Septic Systems and Similar Decentralized Systems) (Illinois EPA) ▪ Yard Maintenance (Illinois EPA) ▪ Residential Districts (Illinois EPA) ▪ Golf courses (Illinois EPA)	HIGH	<u>Watersheds</u> Buffalo Creek, Indian Creek, North Mill/Dutch Gap <u>Wastewater Treatment Plants</u> <u>Lakes</u> 52 lakes in the DPR planning area
	Bank Erosion	▪ Urban runoff ▪ Altered hydrology ▪ Habitat alteration ▪ Streambank modifications/destabilization	HIGH	Mill Creek, Buffalo Creek, Upper DPR, Lower DPR, Bull Creek, North Mill Creek
	Channel Modification	▪ Channelization	MEDIUM	North Mill, Mill Creek, Aptakisic Creek, Buffalo Creek

IMPAIRMENT	CAUSES	SOURCES	PRIORITY	HIGHEST PRIORITY WATERSHEDS
Aquatic Life and Aesthetic Quality (continued)	Other flow regime alterations & Changes in Stream Depth and Velocity Patterns (Illinois EPA)	▪ Dam or impoundment ▪ Impacts from hydrostructure flow regulation/modification ▪ Urban Runoff/Stormsewers	MEDIUM	North Mill/Dutch Gap, Hastings Creek
	Aquatic Algae (Streams)	▪ Wastewater treatment plants ▪ Agricultural runoff ▪ Urban runoff	MEDIUM	Lower DPR
	Aquatic Plants (Lakes)	▪ Wastewater treatment plants ▪ Agricultural runoff ▪ Urban runoff	MEDIUM	<u>Lakes</u> 34 lakes in the DPR planning area
	Non-native aquatic plants (Illinois EPA)	▪ Unknown	LOW	Osprey Lake (Upper DRP)
	Alterations in stream-side or littoral vegetative cover (Illinois EPA, Riparian)	▪ Habitat alteration ▪ Streambank modifications/destabilization	HIGH	Indian Creek, Upper DPR, Newport, Aptakisic Creek
	PAHs & Manganese	▪ Urban runoff ▪ Agricultural runoff ▪ Altered hydrology ▪ Contaminated Sediment	MEDIUM	Indian Creek, Lower DPR, Buffalo Creek, Upper DPR
	Arsenic	▪ Urban runoff ▪ Altered hydrology ▪ Contaminated Sediment	LOW	Upper DPR, Lower DPR, North Mill/Dutch Gap
	pH	▪ Unknown	LOW	Mill Creek

IMPAIRMENT	CAUSES	SOURCES	PRIORITY	HIGHEST PRIORITY WATERSHEDS
Primary Contact Recreation	Fecal Coliform Bacteria	▪ Failed septic systems ▪ Urban runoff	HIGH	Watersheds Buffalo Creek, Lower DPR, North Mill/Dutch Cap, Newport Drainage Ditch Lakes Druce, Hastings, Loch Lomond, Sylvan
Fish Consumption	PCBs	▪ Contaminated Sediment (Illinois EPA)/legacy	LOW	Upper DPR, Lower DPR
	Mercury	▪ Atmospheric Deposition (Illinois EPA)	LOW	

Des Plaines River Watershed Workgroup (DRWW), Monitoring data 2015 – 2017; MBI, 2017; Illinois Environmental Protection Agency (IEPA). 2016 303(d) List

4.2.4 Pollution Loading and Nonpoint Sources

Pollutant loading from a watershed is the sum of point sources and nonpoint sources. Nonpoint source pollution is a primary concern related to water quality in the DPR planning area based on the watershed characterization and the recent bioassessment of the Upper Des Plaines River and its tributaries (MBI, 2017). Based on the data available, the watershed planning committee has identified priority impairments and problems to address in this watershed-based plan as detailed in Table 4-5.

Point sources are also major contributors to the overall watershed pollutant loads, especially phosphorus, nitrogen, and chloride. Existing regulatory permit processes and enforcement address point source pollution; however, some parameters are not regulated and contribute to watershed problems and stakeholder concerns. The permitted point source facilities within the DPR planning area include 18 wastewater treatment facilities. All permitted facilities are subject to regulatory monitoring and reporting requirements, which are all public records.

Northwater Consulting performed a flow and load duration analysis at five USGS gaging stations (Des Plaines River at Russel Road, Des Plaines River near Des Plaines, Des Plaines River near Gurnee, North Mill Creek near Milburn, Mill Creek at Old Mill Creek and Buffalo Creek near Wheeling) using 2015, 2016 and 2017 DRWW water quality monitoring data from these locations. Streamflow statistics were evaluated for the Des Plaines River at Des Plaines USGS station and determined that the water year of 2014 was representative of an average year of data over the last 30-years (1986-2016). 2014 water year data was applied to perform flow and load duration analyses for the DPR planning area USGS. Table 4-6 summarizes the estimated loading of select pollutants from the DPR planning area using data from all pollutant sources evaluated.

Table 4-6: Summary of Pollutant Loading in the DPR Planning Area

POLLUTANT	UNITS	NONPOINT SOURCE POLLUTION LOAD MODEL	POINT SOURCES	STREAM-BANK AND GULLY	LAKE SHORE-LINE	SEPTIC FAILURE	TOTAL	FLOW/ LOAD DURATION ANALYSIS[1]
Total Phosphorus	lbs/yr	43,622	169,000[A]	13,495	206	3,000	229,323	304,435
Total Nitrogen	lbs/yr	974,965	3,123,802[B]	27,112	414	7,600	4,133,893	2,791,561
Total Suspended Solids	tons/yr	23,698	67.29[C]	13,556	206	NA	37,527	6,348
Chloride	lbs/yr	51,873,595	36,383,729[D]	NA	NA	NA	88,257,324	108,460,867
E.Coli Bacteria	CFU/yr (in billions)	152,182	NA[E]	NA	NA	22,084	174,266	983,724
Fecal Coliform Bacteria	CFU/yr (in billions)	225,991	NA	NA	NA	32,795	258,786	1,460,830

[1]Detailed in the narrative above; [A]No phosphorus reporting or data for 8 of 18 facilities; [B]Total Nitrogen data obtained from Waukegan and Gurnee WWTPs; average concentration applied to all other plants; [C]No reporting or data for 1 of 18 facilities, [D]E.coli to Fecal coliform multiplier of 1.485, [E]Chloride data obtained from Waukegan and Gurnee WWTPs; average concentration applied to all other plants.

The flow and load duration analysis is based on direct measurements and accounts for cumulative loading from all sources. When comparing pollutant loading estimates with the load duration analysis results, it is clear that phosphorus, nitrogen, chloride, and bacteria loading estimates are all lower than what was actually measured in the field. This difference can partially be attributed to an incomplete estimate of point source loading due to data gaps. Possible explanations for differences between estimated loads for each pollutant are provided below:

- Total Phosphorus – Data are not reported by all point source discharges.
- Total Nitrogen – Data are only available for two discharges; average concentration applied to all other discharges.
- Total Suspended Solids – The load duration analysis results based on DRWW data are much lower than model estimates; the DRWW monitoring program sampling method (and program) is not designed to estimate sediment loading, resulting in a significant underestimate.

- Chloride – Data are only available for two discharges; average concentration applied to all other discharges.
- Bacteria – Data are not reported by all point source dischargers.

4.2.4.1 Nonpoint Source Pollution Load Model

A custom GIS model (Spatial Watershed Assessment and Management Model, SWAMM™) was developed to estimate current and future nonpoint source pollutant loads for five (5) parameters, which included total phosphorus, total nitrogen, total suspended solids, chloride, and fecal coliform bacteria.

The model output illustrates and quantifies the spatial distribution of nonpoint source loading in the DPR planning area. The nonpoint source loads are subtotaled by land use category and at the catchment scale.

SWAMM™ incorporates the land use described in Chapter 3 and Soil Survey Geographic Database (SSURGO) soils data for the DPR planning area. Average annual runoff volumes were estimated for the basin using the land use, soil-types, and climate statistics. **Event mean concentrations (EMCs)** were applied to the runoff volumes based on land use practices. The EMCs are established based on literature sources, water quality studies, and professional experience, and are listed in Appendix G. In agricultural areas, the model incorporates a universal soil loss equation (USLE) with a delivery ratio based on distance to the closest receiving water body (Appendix G). The USLE portion of the model allows for refined loading estimates based on soil types and topography. Formulas and selected variables incorporated into the model are largely derived from STEPL, Version 3 and Schueler's Simple Method (Appendix G). Furthermore, the model was calibrated using local water quality data collected by the DRWW and stream flow data generated by the USGS. Model parameters were calibrated based on professional judgement and considered the results of the load duration analysis.

4.2.4.2 Nonpoint Source Loading, Current Conditions

Figure 4-10 through Figure 4-14 illustrate the spatial distribution of nonpoint source loading for total suspended solids, total phosphorus, total nitrogen, chloride, and fecal coliform bacteria, respectively.

> **EVENT MEAN CONCENTRATION (EMC):** Method for characterizing pollutant concentrations in stormwater runoff. The pollutant concentrations are measured in studies and on-going research that collects and analyzes runoff from various land-use practices in different geographic and climatic regions. The values are determined by compositing (in proportion to flow rate) a set of samples, taken at various points in time during a runoff event, into a single sample for analysis.
>
> **COLONY FORMING UNIT (CFU):** CFU is a measure of viable bacterial or fungal numbers. Unlike direct microscopic counts where all cells, dead and living, are counted, CFU measures viable cells.

> **NOTEWORTHY – SPREADSHEET TOOL FOR ESTIMATION OF POLLUTANT LOAD (STEPL)**
>
> STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various BMPs. STEPL development is supported and funded by the EPA.

Table 4-7 through Table 4-9 display the total pollutant load results for the DPR planning area by land use category and subwatershed.

Results show that transportation land uses and water (receiving bodies for much of the chloride) contribute the highest annual per acre nonpoint source loads of chloride. Agriculture represents the highest phosphorus, nitrogen, and sediment nonpoint source loads. Residential land uses contribute the highest fecal coliform nonpoint source loading, and open space ranks near the lowest for all pollutants. Bull's Brook was the lowest for all types of nonpoint source pollution loading. The Upper Des Plaines River subwatershed was second highest for sediment pollution loading but was highest for all other types of nonpoint source pollution loading.

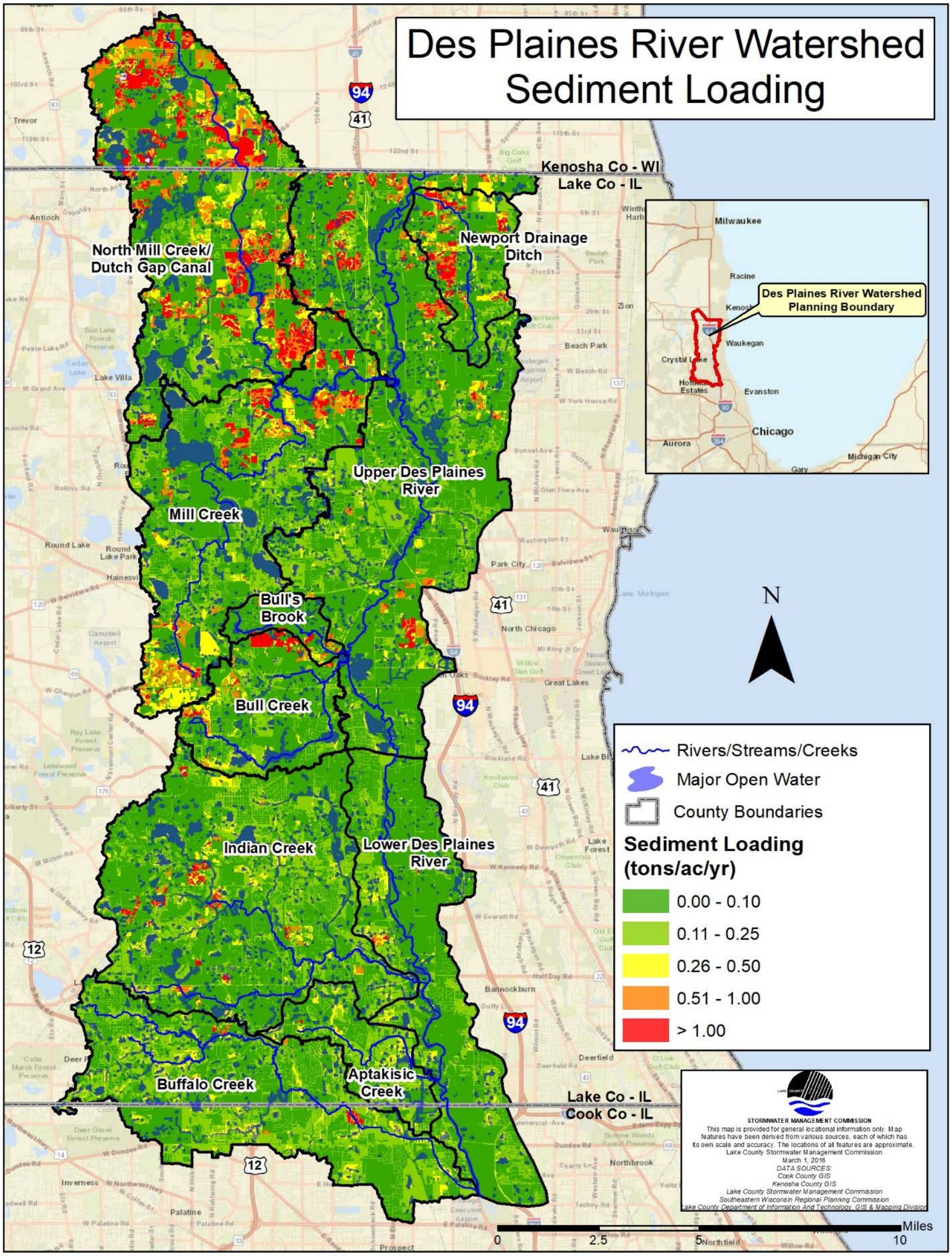


Figure 4-10: Modeled Annual Nonpoint Source Sediment Loading

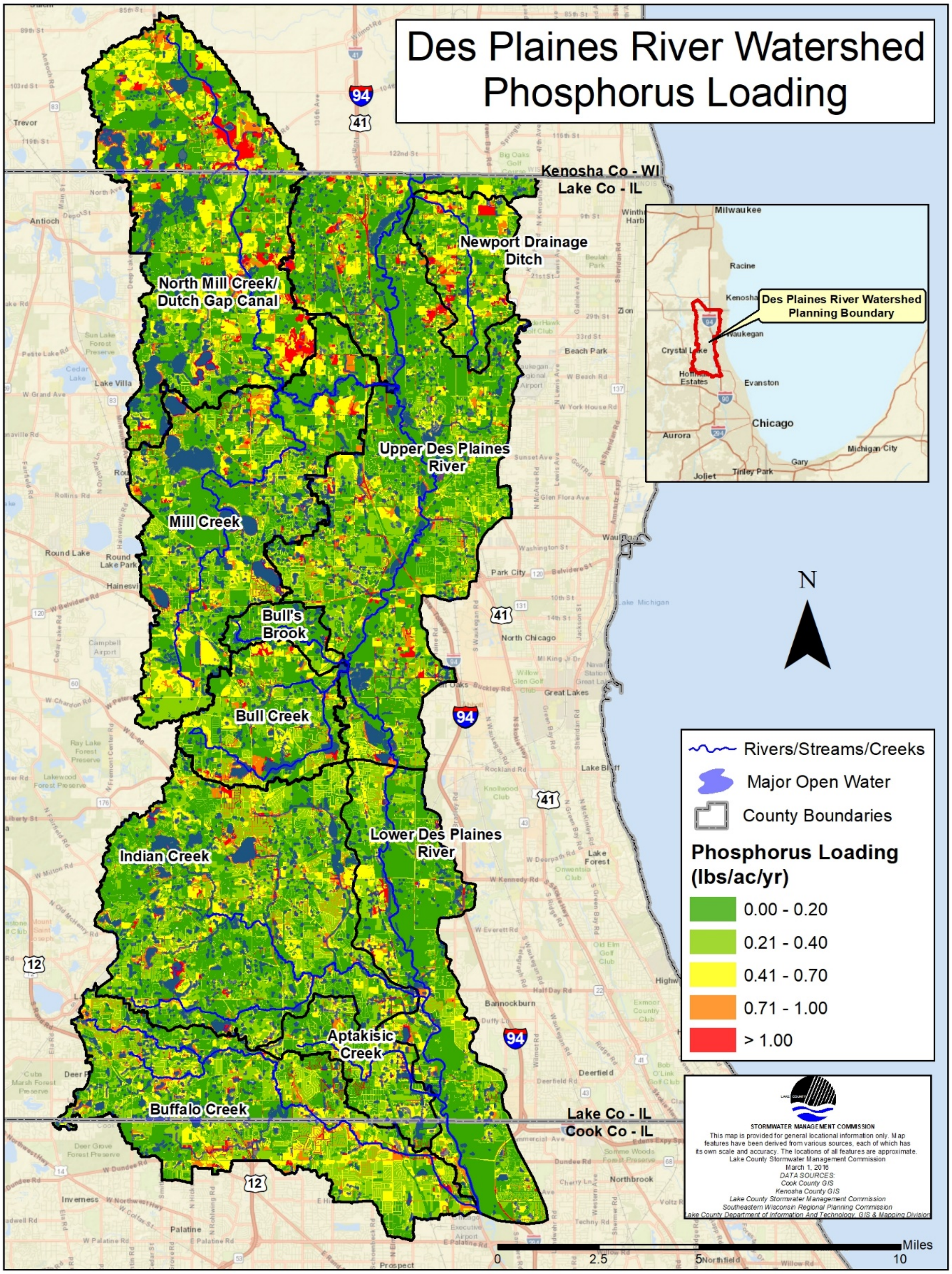


Figure 4-11: Modeled Annual Nonpoint Source Phosphorus Loading

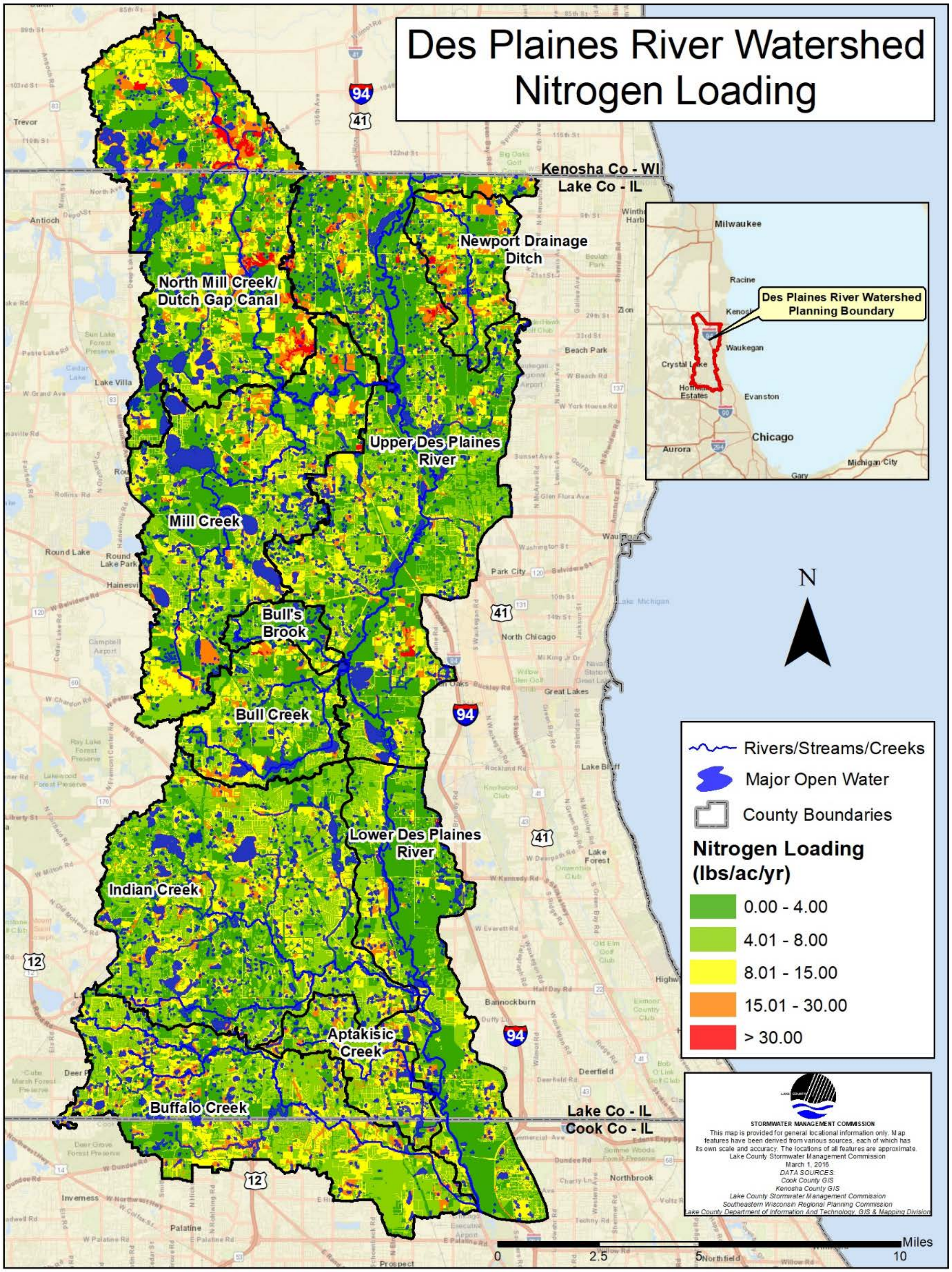


Figure 4-12: Modeled Annual Nonpoint Source Nitrogen Loading

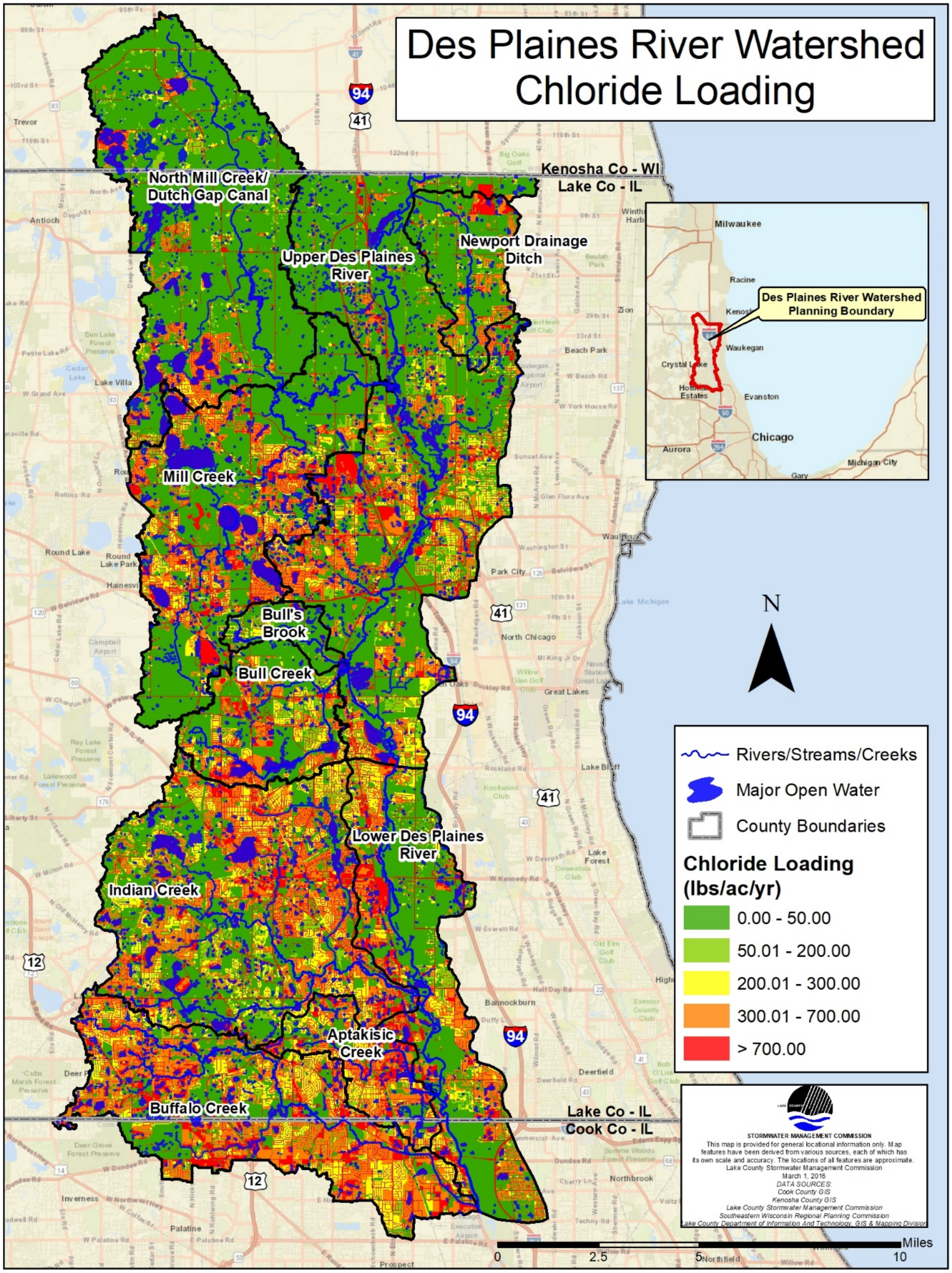


Figure 4-13: Modeled Annual Nonpoint Source Chloride Loading

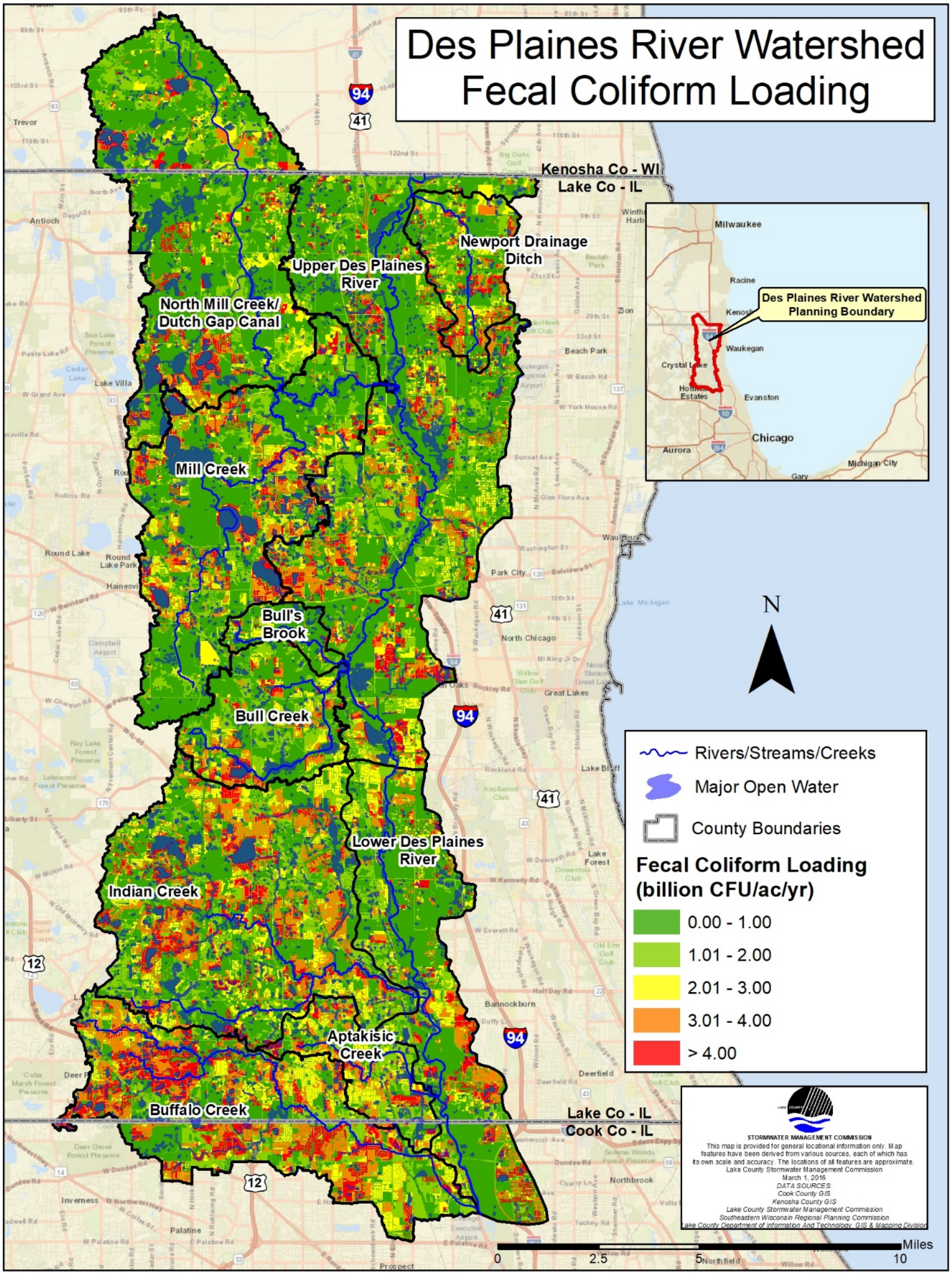


Figure 4-14: Modeled Annual Nonpoint Source Fecal Coliform Loading

Table 4-7: Annual Nonpoint Source Loading Estimates

PARAMETER	UNIT	TOTAL	AVG – PER ACRE
Total Suspended Solids	tons/yr	23,698	0.157
Total Phosphorus	lbs/yr	42,622	0.283
Total Nitrogen	lbs/yr	974,965	6.48
Fecal Coliform Bacteria	CFU in billions/yr	225,991	1.5
Chloride	lbs/yr	51,873,595	344.6

Table 4-8: Annual Nonpoint Source Loading By Land Use

LAND USE	ACRES	PHOSPHORUS		NITROGEN		CHLORIDE		FECAL COLIFORM		TOTAL SUSPENDED SOLIDS	
		Total (lbs)	Average (lbs/ac)	Total (lbs)	Average (lbs/ac)	Total (lbs)	Average (lbs/ac)	Total (cfu in billions)	Average (per acre)	Total (tons)	Average (tons/ac)
Airport	93	45	0.49	603	6.6	78,649	861	89	0.97	9.5	0.10
Beaches	7.3	1.1	0.15	29	3.8	10	1.4	8.7	1.1	0.09	0.01
Bus Facility	3.8	1.2	0.35	27	7.3	1,924	621	3.1	0.84	0.63	0.17
Cemetery	279	74	0.22	1,402	3.5	37,309	100	121	0.31	9.0	0.02
Commercial/ Retail	2,015	1,082	0.49	20,497	8.8	1,690,793	707	2,334	0.99	312	0.13
Cultural and Entertainment	330	106	0.34	2,116	6.2	159,522	463	347	1.0	47	0.13
Equestrian Pasture	1,492	516	0.36	11,062	7.7	2,010	1.2	5,302	3.5	70	0.05
Farm Building	866	280	0.31	11,083	12	63,679	68	2,699	3.0	63	0.07
Feed Lot	93	218	2.0	2,884	27	211	2.1	1,352	13	18	0.17
Forest	16,163	1,200	0.06	23,633	1.3	15,421	0.82	3,333	0.18	129	0.006
Golf Courses	3,132	1,312	0.37	23,570	6.3	6,106	1.6	3,243	0.87	134	0.03
Government/ Institutional	2,069	1,021	0.44	19,989	8.6	942,518	404	2,159	0.93	287	0.12
Grassland	10,490	702	0.06	8,462	0.72	11,089	0.94	2,371	0.20	80	0.005
Hotel/Motel	86	39	0.43	818	8.6	41,354	433	130	1.4	13	0.13
Industrial	2,524	839	0.31	19,176	6.7	1,211,445	420	3,809	1.3	421	0.14
Junk Yard	7.4	1.3	0.17	32	4.0	1,886	231	5.9	0.73	0.80	0.10
Landfill	519	254	0.30	6,496	7.1	379,313	412	1,188	1.3	145	0.14
Mobile Home	127	41	0.31	1,081	7.3	16,834	113	540	3.7	11	0.07
Office/Researc h	766	377	0.44	8,656	9.2	410,446	435	721	0.77	95	0.10
Open Space Road	287	96	0.28	1,110	3.4	4,666	15	60	0.19	5.6	0.02
Open Water	7,082	956	0.09	32,672	3.5	10,550,867	1,151	4,706	0.50	33	0.003
Open Water Stream	779	571	0.61	13,296	15	745,935	850	1,054	1.2	8.3	0.01
Orchards and Nurseries	1,433	362	0.22	13,864	8.6	1,877	1.2	2,066	1.3	70	0.04
Other Conservation	218	18	0.07	175	0.75	229	0.98	49	0.21	29	0.02
Other Open Space	143	7.4	0.05	175	1.3	116	0.84	24	0.18	0.86	0.006
Parking Lot	3,295	1,639	0.48	31,063	8.9	3,448,919	988	4,400	1.3	455	0.13
Parks and Recreation	2,778	298	0.09	9,663	3.1	26,979	9.6	746	0.24	27	0.008
Pasture	487	181	0.45	3,813	8.8	626	1.3	1,784	4.0	21	0.05

Table 4-8 continued

LAND USE	ACRES	PHOSPHORUS		NITROGEN		CHLORIDE		FECAL COLIFORM		TOTAL SUSPENDED SOLIDS	
		Total (lbs)	Average (lbs/ac)	Total (lbs)	Average (lbs/ac)	Total (lbs)	Average (lbs/ac)	Total (cfu in billions)	Average (per acre)	Total (tons)	Average (tons/ac)
Rail Station	6.8	2.3	0.31	48	5.8	3,146	382	5.5	0.68	0.69	0.09
Railroad	455	166	0.33	2,207	4.5	164,741	336	368	0.75	58	0.11
Recreational Trails	196	24	0.12	940	4.9	5,698	30	74	0.38	5.9	0.03
Residential-Multi Family	637	134	0.21	3,251	5.0	73,718	113	2,018	3.1	147	0.10
Residential-Single Family	1,152	353	0.25	11,121	7.7	526,806	365	5,567	3.9	3,445	0.10
Residential Farm	32,784	9,193	0.27	251,440	7.3	11,820,975	345	127,494	3.7	27	0.04
Roads	12,505	8,420	0.60	142,156	10	18,818,348	1,370	20,364	1.5	2,114	0.15
Row Crops	18,351	9,861	0.45	241,975	11	34,290	1.6	19,342	0.92	14,894	0.71
Under Development	723	124	0.15	2,391	2.9	28,652	35	465	0.57	63	0.08
Urban Open Space	7,810	605	0.07	26,603	3.0	10,001	1.1	2,052	0.23	257	0.01
Utilities	410	125	0.27	2,273	4.2	169,842	327	300	0.59	29	0.05
Utility ROW	645	37	0.05	1,455	2.2	536	0.80	114	0.17	6.7	0.008
Vacant	183	11	0.05	214	1.0	151	0.73	32	0.16	1.0	0.005
Vehicle Dealership	52	25	0.43	481	8.4	40,548	699	43	0.75	7.1	0.12
Warehousing	577	314	0.48	5,241	8.0	304,871	463	895	1.4	92	0.14
Wetlands	16,465	1,994	0.10	15,720	0.87	20,537	1.1	2,213	0.12	55	0.003

*Estimates in this table are the result of the nonpoint source model and do not account for major gully and streambank erosion sources

Table 4-9: Annual Nonpoint Source Pollutant Loading By Subwatershed

SUBWATERSHED	ACRES	PHOSPHORUS		NITROGEN		CHLORIDE		FECAL COLIFORM		TOTAL SUSPENDED SOLIDS	
		Total (lbs)	Average (lbs/ac)	Total (lbs)	Average (lbs/ac)	Total (lbs)	Average (lbs/ac)	Total (cfu in billions)	Average (per acre)	Total (tons)	Average (tons/ac)
Aptakisic Creek	4,384	1,262	0.23	33,602	6.1	2,511,012	499	8,448	1.3	490	0.08
Buffalo Creek	17,430	5,651	0.26	127,876	6.0	8,698,163	444	40,715	1.7	1,884	0.08
Bull Creek	7,132	2,137	0.24	44,143	4.9	2,524,804	322	9,692	1.1	1,150	0.08
Bull's Brook	1,817	336	0.17	7,126	3.6	290,285	179	1,426	0.78	197	0.07
Dutch Gap Canal/North Mill Creek	23,537	7,921	0.25	184,750	5.5	4,699,445	243	28,057	1.2	8,206	0.14
Indian Creek	24,222	6,687	0.23	149,842	5.1	9,834,505	350	41,780	1.3	2,452	0.07
Lower Des Plaines River	14,636	3,571	0.23	74,669	4.9	4,809,685	355	18,806	1.2	881	0.06
Mill Creek	19,789	5,470	0.24	125,151	5.4	7,531,358	378	26,897	1.3	3,223	0.09
Newport Drainage Ditch	5,018	1,723	0.26	39,669	5.6	976,897	260	8,079	1.3	1,210	0.10
Upper Des Plaines River	32,550	8,863	0.23	188,137	4.9	9,997,441	305	42,092	1.1	4,005	0.07

4.2.4.3 Point Source Loading

Permitted point source discharge locations that report phosphorus, nitrogen, sediment, and chloride were tabulated to estimate pollution loading and are shown in Table 4-10. Loading of bacteria cannot be estimated because that data is not reported, but a generalized estimate of phosphorus, total nitrogen, chloride, and sediment from point sources can be derived.

- Sediment from point sources is estimated at 67.3 tons/yr, which is 0.3% of the total watershed loading.
- Total nitrogen from point sources is estimated at 3,123,802 lbs/yr, which equates to approximately 76% of the total watershed loading.
- Phosphorus from point sources is estimated to be in the range of 169,000 lbs/yr; this is nearly 80% of the total watershed loading.
- Chloride loading from point sources is estimated to be 36,383,729 lbs/yr, or 42% of the total watershed load.

Point source discharges are a significant source of nitrogen, phosphorus, and chloride in the DPR planning area. The phosphorus estimate of 169,000 lbs/yr is based on the direct calculation listed in Table 4-10. To account for facilities without data, 5.69 lbs per million gallons of discharge were assumed, based on the lower quartile of the facilities that reported phosphorus data.

Based on the DRWW monitoring and measured nitrogen data from two DPR planning area point source dischargers, point sources appear to be a major contributor of nitrate (MBI, 2017). Using measured data from two plants, point sources also appear to be a substantial contributor of chloride. Point sources do not appear to be a major contributor of sediment, and further data is necessary to evaluate the fecal coliform bacteria loading from point sources.

Table 4-10: Loading Estimates from Point Sources

FACILITY	PERMIT NUMBER	DESIGN AVG. FLOW (MGD)	DESIGN MAX. FLOW (MGD)	2016 ANNUAL FLOW (MG)	ANNUAL PHOS-PHORUS LOAD (LBS/YR)	ANNUAL TOTAL NITROGEN LOAD (LBS/YR)[2]	ANNUAL SEDIMENT LOAD (TONS/YR)[3]	CHLORIDE LOAD (LBS/YR)[4]
Alden Long Grove Rehabilitation Center STP	IL0051934	0.015	0.037	12.8	ND	1,971	0.35	22,800
Fox Point MHP STP - Wheeling	IL0049930	0.016	0.04	2.2	66.6	338	0.02	3,908
Lake County Public Works Des Plaines River	IL0022055	16	51.8	3,449	63,684	532,185	30	6,156,083
Lake County Public Works Mill Creek STP	IL0071366	2.1	7.8	288	281	44,490	2.2	514,636
Lake County Public Works New Century Town STP	IL0022071	6	18	1,332	7,592	205,553	9.1	2,377,747
Lindenhurst Sanitary District STP	IL0020796	1.57	5.7	442	5,272	68,142	10.52	788,239
Lou Perrines Gas & Groceries STP	IL0072966	0.015	0.022	0.2	ND	31.5	0.0016	365
Mobil Oil Service Gas Station WWTP	IL0078093	0.0043	0.011	1.5	ND	231	0.038	2,671
North Shore Water Reclamation District Gurnee STP	IL0035092	23.6	47.2	4,964	ND	840,415	0	10,184,341
North Shore Water Reclamation District Waukegan STP	IL0030244	22	44	8,322	9,957	1,110,488	0	12,631,797
Paramski Mobile Homes Rainbow	WI0030481	0.04	ND	12.8	ND	1,971	ND	22,800
St. Mary's of the Lake Seminary - STP	IL0024350	0.03	0.075	5.8	144	901	0.037	10,423
Toor Car & Truck Plaza STP	IL0073431	0.0075	0.011	1.4	ND	220	0.009	2,541
Tristar Gas and Food _ Wadsworth Plaza	IL0071722	0.012	0.02	0.9	ND	141	0.017	1,629
Village of Libertyville STP	IL0029530	4	8	1,219	49,247	188,095	14.9	2,175,801
Village of Mundelein STP	IL0022501	4.95	15	832	0	128,400	0	1,485,277
Wadsworth Crossing STP	IL0074535	0.008	0.032	0.8	ND	124	0.0036	1,433
Wadsworth Marathon STP	IL0047619	0.004	0.01	0.7	29.6	107	0.0076	1,238
	TOTALS	80.4	198	20,888	136,273	3,123,802	67.3	36,383,729

ND – No data available or reported; 2 Total Nitrogen data obtained from Waukegan and Gurnee WWTPs; average concentration applied to all other plants, 3 total suspended solids, 4Chloride data obtained from Waukegan and Gurnee WWTPs; average concentration applied to all other plants

4.2.4.4 Sediment Source Analysis

The nonpoint source model does not directly account for significant sources of streambank and gully erosion. Estimates for significant gully and streambank erosion were made based on a windshield survey of the DPR planning area that was conducted in the spring of 2017 and a review of similar surveys done for subwatersheds in which previous SMC-led plans were developed. Stream inventory data collected by the Lake County SMC throughout the DPR planning area (Chapter 3) was also used to support this analysis.

NOTEWORTHY – GULLY EROSION

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

<u>Sediment Loading in the Watershed</u>

- Nonpoint sources: 23,437 tons/yr
- Streambank erosion: 11,481 tons/yr
- Gully erosion: 2,075 tons/yr
- Lake shorelines: 206 tons/yr
- NPDES point sources: 67 tons/yr

4.2.4.5 Streambank Erosion

Table 4-11 summarizes the streambank load estimates. Streambank erosion was estimated using data collected by SMC throughout the DPR planning area, specifically lateral recession rates (LRRs) and eroding bank heights. To ensure consistency with results from previously completed watershed-based plans, this information was adjusted to fit results tabulated for two previous plans within the Des Plaines River Watershed (Mill Creek and North Mill Creek). The adjustment was performed largely to resolve data collection discrepancies between field teams of summer interns that performed the surveys. An adjustment factor representing the average percent of total load attributed to streambank erosion (25.5%) was applied to all streambank inventory data as a result.

For streams that were unassessed by a field team, average eroding bank heights and LRRs were generated from similarly assessed tributary segments in the same subwatershed and applied to populate stream reaches. Streambank erosion and corresponding nutrient loads were calculated for all but two subwatersheds, Mill and North Mill, where previous estimates have been provided.

Table 4-11: Streambank Pollutant Loading Estimates

WATERSHED	TOTAL NITROGEN (lbs/yr)	TOTAL PHOSPHORUS (lbs/yr)	TOTAL SEDIMENT (tons/yr)	NOTES
North Mill Creek/Dutch Gap Canal	5,000	2,500	2,500	Sediment results from watershed plan. Nitrogen and phosphorus calculated from sediment totals
Mill Creek	6,034	3,017	3,017	Sediment and phosphorus results from watershed plan. Nitrogen calculated from sediment totals
Upper & Lower Des Plaines River	7,477	3,738	3,738	Calculated from SMC Data; sum of Upper and Lower Des Plaines River Sub-Watersheds
Newport Drainage Ditch	73	37	37	Calculated from SMC Data
Bull's Brook/Bull Creek	233	116	116	Calculated from SMC Data; sum of Bull's Brook and Bull Creek Sub-Watersheds
Indian Creek	1,243	622	622	Calculated from SMC Data
Aptakisic Creek	214	107	107	Calculated from SMC Data
Buffalo Creek	2,688	1,344	1,344	Calculated from SMC Data
TOTALS	**22,962**	**11,481**	**11,481**	

It is estimated that at least 11,481 tons of sediment are delivered to waterways annually as the result of streambank erosion sources in the DPR planning area. Although streambank erosion is a large source of sediment loading in the DPR planning area, it is not as significant as sheet and rill erosion. Areas of significant gully erosion in the Mill and North Mill Creek Watershed were identified during previous planning efforts. All remaining gullies were assessed during the DPR planning area windshield survey performed in the spring of 2017.

4.2.4.6 Gully Erosion

Gully erosion in the DPR planning area was evaluated during the DPR planning area windshield survey and estimated using GIS. Gully erosion totals presented in this section include results from previously completed watershed-based plans; gully erosion presented in older plans was updated to reflect current conditions. A total of 417 eroding gullies, both ephemeral (those that form each year) and permanent (those that receive intermittent streamflow and expand over time such as a forested ditch or channel) were evaluated.

For those ephemeral gullies not visible from a road or observed during site assessment, GIS was used to estimate their location and extent. Gullies were delineated in GIS using aerial imagery, and conservative width

(0.5 ft), depth (0.5 ft), and years eroding (1 yr) were applied to each gully. For gullies observed in the field, dimensions were directly measured in the field and transferred to GIS for analysis.

Total net erosion in tons/year and estimates of nitrogen and phosphorus loading were calculated using GIS and equations derived from IEPA's load reduction spreadsheet. A distance-based delivery ratio was applied to account for distance to a receiving waterbody. Sediment trapping efficiency was accounted for, if the gully drained to a retention or detention structure.

The following equations were applied to estimate sediment and nutrient yields from gully sources:

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

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

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

TN – Total nitrogen load from gully in lbs/yr
Sy – Sediment yield in tons/yr
Nc – Nitrogen concentration in soil (0.001 lbs/lb)
Cf – Correction factor, 1.0

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

TP – Total nitrogen load from gully in lbs/yr
Sy – Sediment yield in tons/yr
Pc – Phosphorus concentration in soil (0.0005 lbs/lb)
Cf – Correction factor, 1.0

Table 4-12: Gully Pollutant Loading Estimates

WATERSHED	TOTAL NITROGEN (lbs/yr)	TOTAL PHOSPHORUS (lbs/yr)	TOTAL SEDIMENT (tons/yr)	NOTES
North Mill Creek/Dutch Gap Canal	1,376	688	688	Updated previous results using current methodology
Mill Creek	790	334	395	Sediment and phosphorus results from watershed plan. Nitrogen calculated from sediment totals.
Upper Des Plaines River	637	319	319	Results tabulated using current methodology
Lower Des Plaines River	6	3	3	Results tabulated using current methodology
Newport Drainage Ditch	816	408	408	Results tabulated using current methodology
Bull's Brook	1	1	1	Results tabulated using current methodology
Bull Creek	448	224	224	Results tabulated using current methodology
Indian Creek	70	35	35	Results tabulated using current methodology
Aptakisic Creek	2	1	1	Results tabulated using current methodology
Buffalo Creek	5	2	2	Results tabulated using current methodology
TOTALS	**4,150**	**2,014**	**2,075**	

Gully erosion in the DPR planning area is moderate, with the majority occurring on agricultural land. Sustainable agriculture practices observed in the DPR planning area, such as water and sediment control basins (WASCOBs) or grassed waterways and other grade control structures, have been implemented in places to address this type of erosion. Results indicate that there are 43.5 miles of eroding gullies in the DPR planning area, of which 8.5 miles (20%) drain to an existing pond or detention structure. It is estimated that gully erosion is responsible for the annual delivery of 2,075 tons of sediment, 2,014 pounds of phosphorus, and 4,150 pounds of nitrogen. As shown in the results of the gully assessment (Table 4-12), the North Mill Creek/Dutch Gap subwatershed produces the largest total sediment and nutrient load from gully erosion, followed by Newport Drainage Ditch and Mill Creek subwatersheds.

4.2.4.7 Lake Shoreline Erosion

Lake shoreline erosion in the DPR planning area was estimated using a combination of shoreline assessment data provided by the LCHD combined with a field assessment performed by Northwater and SMC in August 2017. As described in Chapter 3, assessed lakes (only those greater than 20 acres in size) were assigned an erosion rank ranging from 0 (no erosion) to 3 (severe erosion). In order to quantify pollutant loading, each rank was assigned an average eroding bank height and lateral recession rate determined by direct observation at a selection of lakes (greater than 20 acres in size) in the DPR planning area determined to be representative by the LCHD. Four lakes were evaluated for this purpose during the 2017 reconnaissance: Countryside Lake, Lake Minear, Big Bear Lake, and St. Mary's Lake. At each lake, a series of data points (94 total points) representing a cross-section of erosion rankings were collected and eroding height and lateral recession rates were recorded. The newly collected data were appended to the corresponding shoreline segments in GIS, and average values were generated for each rank and applied to the remaining assessed lakes in the DPR planning area. Due to the unique nature of St. Mary's Lake, results represent direct measurements taken; average values were not applied to this lake. Through consultation with the LCHD and observations of lake bank erosion, it was determined that St. Mary's Lake exhibits higher rates of bank erosion compared to all other lakes in the watershed and therefore, the application of average values would have underestimated the true rate of erosion.

Table 4-13: Average Values Applied for Lake Shoreline Erosion Rankings

RANK	AVG ERODING BANK HEIGHT (FT)	AVG LATERAL RECESSION RATE (FT)
0	0	0
1	0.52	0.017
2	0.77	0.03
3	1.6	0.12

Total sediment and nutrient loading from assessed shorelines are summarized in Table 4-13 by ranking category. For those assessed lakes in the DPR planning area, annual sediment loading from lake shorelines is estimated at 206 tons, total annual nitrogen loading is 414 pounds, and total annual phosphorus loading is 206 pounds (Table 4-14).

Table 4-14: Pollutant Load Estimates from Lake Shorelines by Ranking

RANK	TOTAL SEDIMENT LOAD (TONS/YR)	TOTAL NITROGEN LOAD (LBS/YR)	TOTAL PHOSPHORUS LOAD (LBS/YR)
0	0	0	0
1	33	67	33
2	36	72	36
3	137	275	137
TOTAL	**206**	**414**	**206**

By subwatershed, the largest lake bank sediment and nutrient load is originating from the Indian Creek subwatershed followed by Bull Creek (Table 4-15).

Table 4-15: Pollutant Load Estimates from Lake Shorelines by Subwatershed

SUBWATERSHED	TOTAL NITROGEN LOAD (lbs/yr)	TOTAL PHOSPHORUS LOAD (lbs/yr)	TOTAL SEDIMENT LOAD (tons/yr)
North Mill Creek/Dutch Gap Canal	72	36	36
Mill Creek	73	36	36
Upper Des Plaines River	72	36	36
Lower Des Plaines River	No lakes	No lakes	No lakes
Newport Drainage Ditch	No lakes	No lakes	No lakes
Bull's Brook	No lakes	No lakes	No lakes
Bull Creek	81	40	40
Indian Creek	100	50	50
Aptakisic Creek	No lakes	No lakes	No lakes
Buffalo Creek	16	8	8
TOTAL	**414**	**206**	**206**

4.2.4.8 Septic Systems Analysis

Pollutant loading from failing septic systems was estimated using data generated from previous watershed-based plans and combined with planimetric data to assess the remainder of the DPR planning area. The three watershed-based plans from within the DPR planning area that included pollutant load estimates from failing septic systems are North Mill Creek/Dutch Gap Canal, Mill Creek, and Buffalo Creek. For these watershed-based plans, the number of failed septic systems was estimated by quantifying the number of water wells that fall outside of sewered areas, assuming that the presence of a well also indicates the presence of a septic system. An estimated septic system failure rate of 2% was applied in these previous plans to estimate loading.

For the remainder of the DPR planning area, a different method was applied. The presence of a septic system was assumed for each building with a planimetric footprint greater than 100 square-feet located within a nonsewered area. Similar to the previous watershed-based plans, a 2% septic system failure rate was applied to estimate loading.

Septic system loading for phosphorus and nitrogen was calculated using STEPL, Version 3 and the methodology outlined by Lowe *et al.* (2007) and is presented in Table 4-16. Assuming 2.43 people per system and an average of 0.15 billion CFU/person/day, it is estimated that failing septic systems may contribute an annual load of 7,660 lbs/yr of nitrogen, 3,000 lbs/yr of phosphorus, and an annual fecal coliform bacteria load of 32,795 billion CFU/yr. Figure 4-15 depicts the distribution of potential septic systems in all previously unplanned areas of the DPR planning area.

Table 4-16: Septic Systems Analysis and Associated Pollutant Load Estimates

WATERSHED	ESTIMATED NO. OF FAILING SEPTIC SYSTEMS	TOTAL NITROGEN LOAD (lbs/yr)	TOTAL PHOSPHORUS LOAD (lbs/yr)	TOTAL FECAL COLIFORM LOAD (billion CFU/yr)	NOTES
North Mill Creek/Dutch Gap Canal	13	417	163	1,783	Nitrogen and phosphorus results gathered from watershed plan; Bacteria load calculated.
Mill Creek	14	435	171	1,870	Phosphorus and bacteria results gathered from watershed plan; Nitrogen load calculated
Upper Des Plaines River	78	2,428	951	10,377	Calculated using building and sewered area data
Lower Des Plaines River	22	691	271	2,927	Calculated using building and sewered area data
Newport Drainage Ditch	36	1,124	440	4,790	Calculated using building and sewered area data
Bull's Brook/Bull Creek	18	547	214	2,395	Calculated using building and sewered area data
Indian Creek	11	339	133	1,463	Calculated using building and sewered area data
Aptakisic Creek	1	31	12	133	Calculated using building and sewered area data
Buffalo Creek	53	1,648	645	7,057	Bacteria results gathered from watershed plan; Nitrogen and phosphorus load calculated.
TOTAL	**246**	**7,660**	**3,000**	**32,795**	

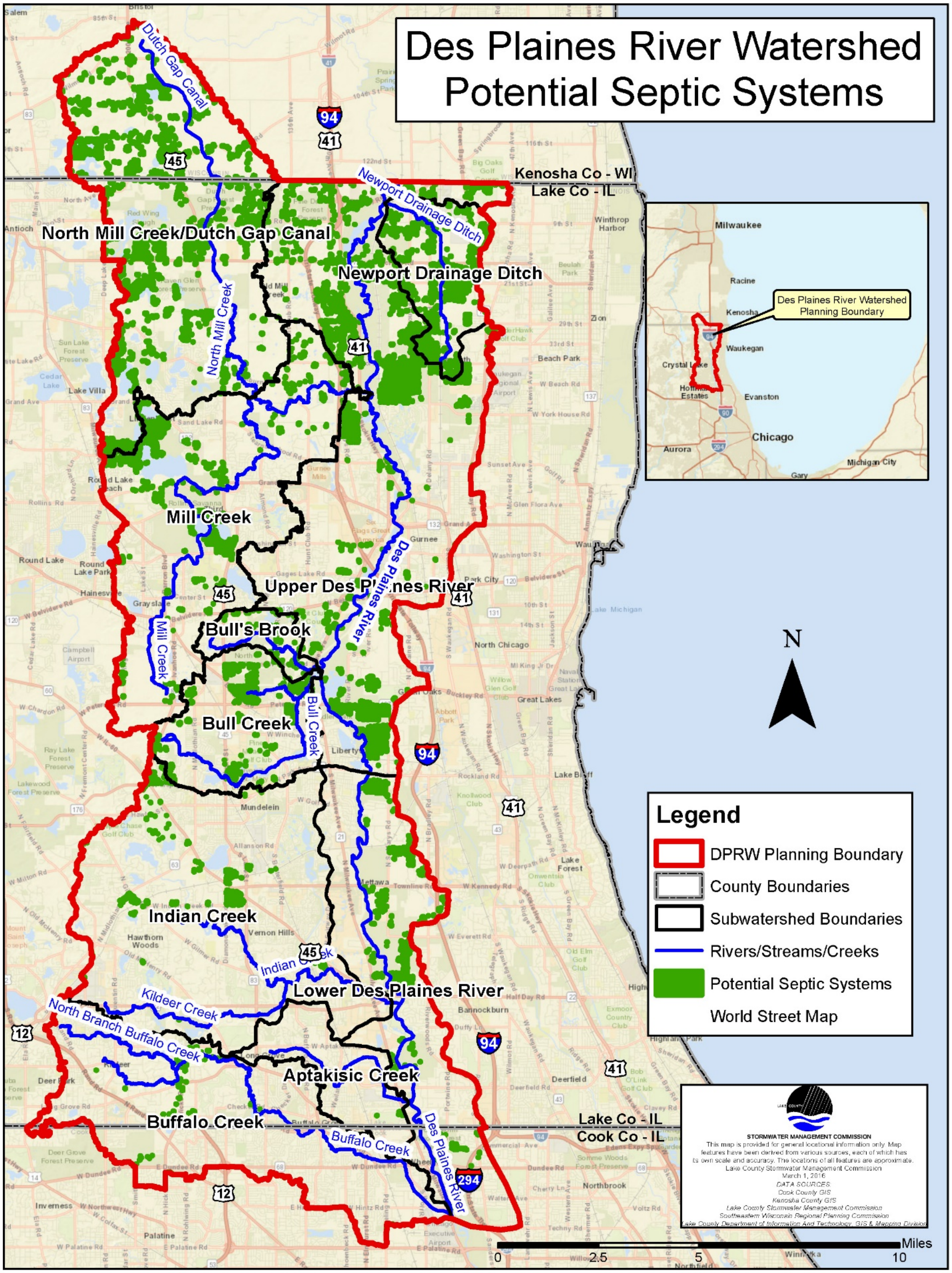


Figure 4-15: Septic System Distribution in the DPR Planning Area

4.2.4.9 Projected Future Nonpoint Source Loading

A separate model scenario was run to simulate future land use conditions. Information on future land use projections within the DPR planning area was obtained from Lake County GIS, CMAP (consisting of municipal/township FLU projections) and SEWRPC data and incorporated into the model. Slight modifications were made to the layer by SMC to account for recent infrastructure planning. In order to perform the comparative analysis, current land use categories had to be grouped into broader categories. It is important to note that the resolution and breakdown of current land use is much more detailed than the future condition. Understanding the impacts of future development can inform planning and development decisions and can assist in mitigating water quality concerns before they arise. Table 4-17 through Table 4-19 present the results of the future conditions modeling analysis.

When comparing existing conditions to future conditions, increases are estimated to occur in chloride (43%), phosphorus (87%), and bacteria (96%) (Table 4-17). Due to the likely reduction in agricultural ground in the future, changes in sediment loads are not expected to change significantly. Table 4-18 outlines the future nonpoint source loading by land use category, and Table 4-19 outlines the subwatersheds where land use and nonpoint source water quality conditions are most likely to change. The majority of the land use and pollutant loading changes are expected to occur in the north and western portions of the DPR planning area where there is more undeveloped land. Figure 4-16 shows the land use vulnerability in the DPR planning area based on future scenarios of nonpoint source loading.

Table 4-17: Future Scenario, Annual Nonpoint Source Loading

PARAMETER	FUTURE MODEL RESULTS	AVG PER ACRE	% CHANGE FROM CURRENT SCENARIO
Total Suspended Solids (ton/yr)	24,765	0.16	+4.5%
Total Phosphorus (lbs/yr)	79,285	0.53	+82%
Total Nitrogen (lbs/yr)	1,504,989	10.0	+54%
Fecal Coliform (CFU billions/yr)	440,815	2.93	+95%
Chloride (lbs/yr)	70,664,455	470	+36%

Table 4-18: Future Scenario, Nonpoint Source Loading by Land Use

LAND USE	ACRES	PHOSPHORUS		NITROGEN		CHLORIDE		FECAL COLIFORM		TOTAL SUSPENDED SOLIDS	
		Total (lbs)	lbs/ac	Total (lbs)	lbs/ac	Total (lbs)	lbs/ac	Total (cfu in billions)	per acre	Total (tons)	tons/ac
Agricultural	9,947	8,045	0.81	190,393	19.1	24,403	2	13,857	1.39	10,249	1.03
Commercial/	8,069	7,019	0.87	100,277	12.4	8,356,439	1,036	11,958	1.48	1,508	0.19
Gateway	798	495	0.62	7,546	9.5	349,004	438	844	1.06	81	0.10
Government/	4,488	3,965	0.88	60,426	13.5	2,794,683	623	6,755	1.51	864	0.19
Industrial	6,708	4,457	0.66	69,016	10.3	4,255,987	634	14,288	2.13	1,477	0.22
Low Density Urban	6	1	0.15	18	3.3	851	151	10	1.70	0	0.03
Low Residential	749	216	0.29	4,676	6.2	203,229	271	2,522	3.37	21	0.03
Medium Density Urban	8	2	0.19	33	4.0	1,517	187	17	2.11	0	0.04
Mixed Use	1,112	617	0.55	8,810	7.9	434,641	391	817	0.73	96	0.09
Office and Research Parks	4,329	4,377	1.01	66,705	15.4	3,085,094	713	7,457	1.72	718	0.17
Public/Private Open Space	32,561	6,446	0.20	161,160	4.9	966,960	30	12,812	0.39	446	0.01
Residential	59,787	31,109	0.52	663,668	11.1	30,694,662	513	346,244	5.79	7,015	0.12
Utilities/ Transportation	15,988	11,540	0.72	142,559	8.9	10,046,980	628	18,889	1.18	2,258	0.14
Vacant	101	10	0.10	171	1.7	120	1	26	0.26	1	0.01
Water	5,726	984	0.17	29,531	5.2	9,449,885	1,650	4,320	0.75	29	0.01

Table 4-19: Future Scenario, Nonpoint Source Loading by Watershed

WATERSHED	ACRES	PHOSPHORUS		NITROGEN		CHLORIDE		FECAL COLIFORM		TOTAL SUSPENDED SOLIDS	
		Total (lbs)	lbs/ac	Total (lbs)	lbs/ac	Total (lbs)	lbs/ ac	Total (cfu in billions)	per acre	Total (tons)	tons/ac
Aptakisic	4,384	2,559	0.58	44,235	10.1	2,398,841	548	13,589	3.10	629	0.14
Buffalo Creek	17,430	9,667	0.56	184,127	10.6	9,435,325	542	70,391	4.04	2,175	0.12
Bull Creek	1,817	550	0.30	11,152	6.1	452,468	249	2,905	1.60	88	0.05
Bulls Brook	7,132	3,732	0.52	63,713	8.9	3,529,152	495	15,878	2.23	800	0.11
Indian Creek	23,537	12,738	0.54	274,909	11.7	7,869,951	334	57,681	2.45	7,786	0.33
Lower Des Plaines River	24,222	11,957	0.50	223,003	9.2	12,337,776	511	80,499	3.33	2,587	0.11
Mill Creek	14,636	6,997	0.48	130,822	9.0	6,136,854	420	38,930	2.66	1,317	0.09
Newport Drainage	19,789	9,823	0.50	181,467	9.2	10,026,894	507	51,928	2.62	2,672	0.14
North Mill – Dutch Gap Canal	5,018	3,388	0.68	62,402	12.4	3,116,737	621	22,495	4.48	946	0.19
Upper Des Plaines River	32,550	17,874	0.55	329,158	10.1	15,360,456	472	86,519	2.66	5,765	0.18

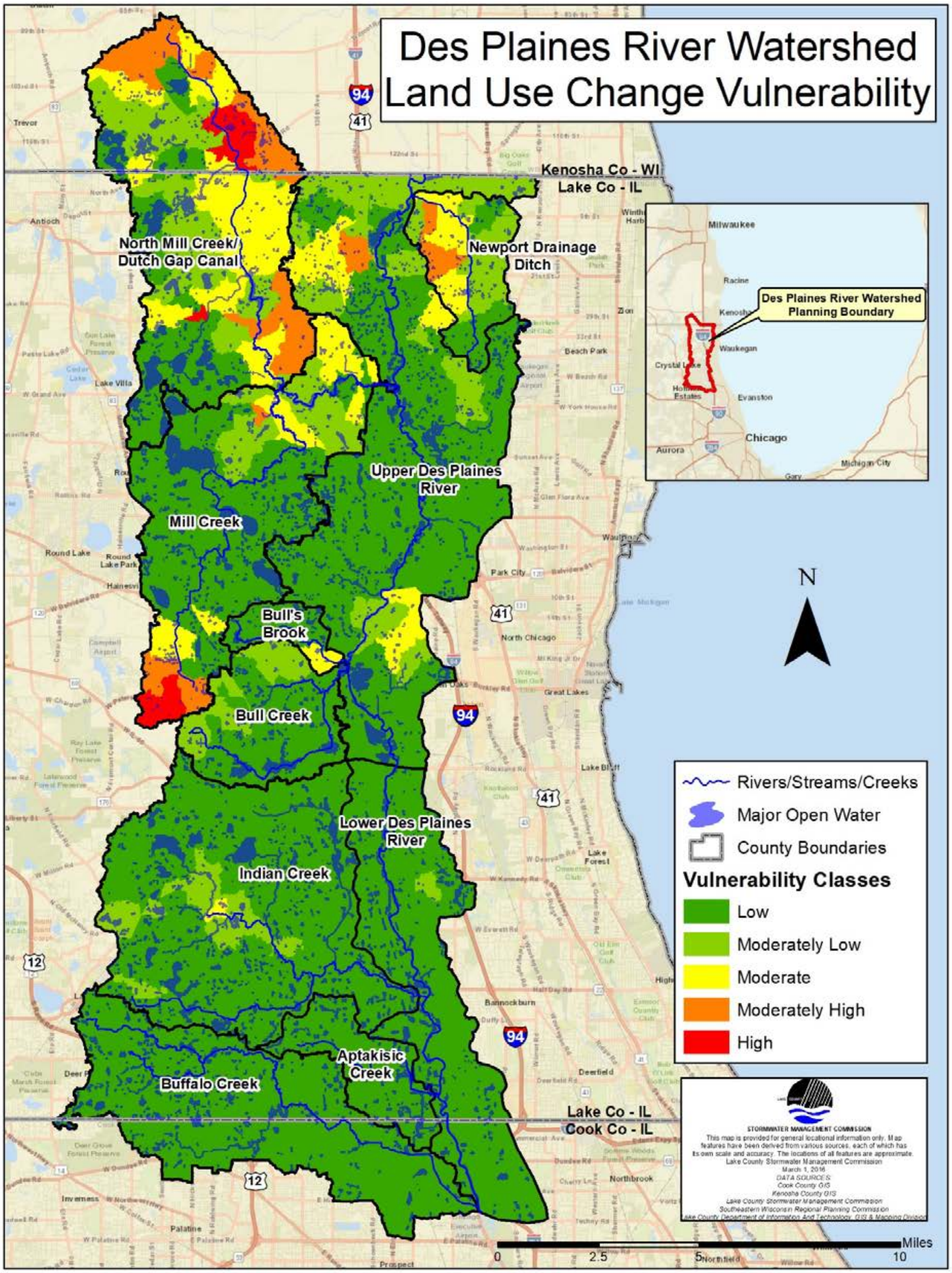


Figure 4-16: Land Use Change Vulnerability

4.2.4.10Pollution Loading Hotspots

Pollution loading hotspots are defined as the catchments with the highest annual nonpoint source load contributions. Understanding hotspots helps to focus and prioritize BMP implementation to achieve the goals and objectives of the plan. Nonpoint pollution loading hotspots were determined from each modeled parameter. Using the model described in section 4.2.4.1, pollutant loading hotspot catchments were chosen as those exceeding an annual loading criterion for each pollution parameter. The North Mill-Dutch Gap Canal subwatershed contains most of the hotspot catchments (19) for three of five nonpoint source pollutant loading parameters (total suspended solids, total phosphorus, and total nitrogen). The Buffalo Creek subwatershed contains the most hotspot catchments for fecal coliform loading (6), as well as the most hotspot catchments for chloride loading (20). Meanwhile, Mill Creek (15) and the Upper Des Plaines River (13) subwatersheds have the second and third highest number of hotspot catchments for chloride loading.

Overall, 19% of catchments in the DPR planning area meet the criteria for a chloride hotspot. The North Mill-Dutch Gap Canal and Upper Des Plaines River subwatersheds have hotspot catchments for all 5 pollution parameters with 27 and 18 hotspot catchments respectively; however, the majority of hotspot catchments in each subwatershed meet differing pollution parameter criteria. Table 4-20 lists nonpoint pollution loading hotspot catchments for each pollution parameter, along with their associated subwatersheds and pollutant parameter criteria.

Table 4-20: Hotspot Catchments for Nonpoint Source Pollution Loading

PARAMETER	HOTSPOT CATCHMENTS	CORRESPONDING SUBWATERSHEDS	CRITERIA
Total Suspended Solids	NM056, NM046, NM042 NM004, NM039, NM055 NM028, BC006, UD087	North Mill-Dutch Gap Canal Bull Creek	> 0.70 tons/ac/yr
Total Phosphorus	NM046, NM052, NM050 NM004, NM048, NM039	North Mill-Dutch Gap Canal Upper Des Plaines	> 0.60 lbs/ac/yr
Total Nitrogen	NM046, NM052, NM050 NM004, NM039, NM048	North Mill-Dutch Gap Canal Upper Des Plaines	> 14 lbs/ac/yr
Fecal Coliform	BF009, BF023, BF035 BF010, BF037, BF008 IC052, LD015, UD020	Buffalo Creek Indian Creek Lower Des Plaines	> 3.5 billion CFU/yr
Chloride	84 of 432 total catchments	Fraction of Catchments Per Subwatershed: ▪ 20/43 Buffalo Creek, 47% ▪ 15/58 Mill Creek, 26% ▪ 13/94 Upper Des Plaines, 14% ▪ 9/64 Indian Creek, 14% ▪ 9/58 Lower Des Plaines, 16% ▪ 7/63 North Mill-Dutch Gap, 11% ▪ 7/9 Aptakisic Creek, 78% ▪ 3/21 Bull Creek, 14% ▪ 1/16 Newport Drainage Ditch, 6%	> 500 lbs/ac/yr

4.2.5 Critical Areas Analysis

Critical areas are defined as catchments in the watershed best suited to focus implementation efforts to help achieve the goals and objectives of the watershed-based plan. Critical areas represent catchments that likely contribute to water quality impairments and problems in the watershed and present opportunities where project implementation would provide the greatest value and benefit. Due to the size and diversity of land use practices in the DPR planning area, five separate critical area analyses were performed. These include:

1. Aggregate critical catchments, based on both the scoring of several normalized criteria and previous watershed-based plans
2. Chloride critical catchments, based on both the scoring of load modeling and impervious surface density, and DRWW chloride datasets
3. PAH critical catchments, based on commercial and parking lot land use, and DRWW PAH datasets
4. Lakeshore erosion critical reaches, based on lakeshores assessed by LCHD
5. Streambank erosion critical reaches, based on streambanks assessed by SMC

4.2.5.1 Aggregate Critical Areas

A methodology was developed to define aggregate critical area catchments. This methodology uses a ranking system based on the criteria below and detailed in Table 4-21. The analysis was performed on the entire DPR planning area. Although each catchment met some or all the criteria, only the highest-ranked catchments were selected as priority; this represents 10% of all catchments. Twenty-one critical catchments defined in previous watershed-based plans were then incorporated; this ensured a comprehensive listing of aggregate critical area catchments. Selection criteria included:

1. Agricultural highly erodible soils
2. Areas of greatest future land use change
3. Greatest length of streambank erosion
4. Nonpoint source pollution loading hotspots; catchments of greatest loading per acre
5. Highest septic density
6. Greatest length of stream channelization
7. Total number of publicly-operated wastewater treatment plant outfalls
8. Previously defined critical areas

Noteworthy – Aggregate Critical Area Analysis

Each catchment was ranked for each of the seven criteria, after which the catchments were normalized statistically on a scale of 0-1.0. The normalized ranking of each critical area criteria was summed for each catchment, after which the data were renormalized on a scale of 0-100. The statistical process identifies priority catchments that associated a combined score of all criteria. All criteria were given the same weight.

A total of 67 catchments (16% of all catchments) were selected as critical. A small number of catchments were selected to ensure that each subwatershed contained at least two critical area catchments. As a result, one additional catchment was selected for Buffalo Creek and the Bull's Brook subwatersheds; two additional catchments were selected for Aptakisic Creek, Indian Creek, and the Lower Des Plaines River subwatersheds. Table 4-22 and Figure 4-17 show the final critical areas, their scoring and ranking, and method of selection. It is recommended to also reference and utilize the recent, previous subwatershed plans when working in those subwatersheds. Chapter 6 outlines recommended actions for the critical area catchments.

Table 4-21: Aggregate Critical Area Criteria

CRITICAL AREA CRITERIA	DESCRIPTION	TOP CATCHMENTS[1]
Highly Erodible Land	Chapter 3 identifies highly erodible soils in the DPR planning area, these soils in agricultural areas are susceptible to erosion. Highly erodible soils that are within agricultural and equestrian pasture areas are considered for this analysis.	UD080, UD086, MC057, MC058, MC055 over 20%
Land Use Changes	The comparison between current and future land use allowed for each catchment to be analyzed. Catchments with the greatest percentage of land use categories vulnerable to change were ranked higher.	NM022, NM046, MC058, NM050, NM052
Streambank Erosion	The surveys conducted by SMC mapped, assessed and quantified streambank erosion. The length of severe streambank erosion was analyzed for each catchment, and those with greater lengths were ranked higher.	UD054, UD017, UD031, LD041, LD017
Nonpoint Source Pollution Loading Hotspots	Catchments with the highest percentile (per unit acre) of nonpoint source pollutant loading for phosphorus, sediment, nitrogen, chloride and fecal coliform bacteria; calculated from nonpoint source pollutant model	NM046, NM037, UD069, UD015, MC017
Septic System Density	Septic system density was estimated for each catchment. This was developed by quantifying the number of buildings that exceeded 100 square feet in non-sewered areas.	LD003, UD006, NP008, NP009, NP016
Channelization	Based on the DRWW findings, catchments that have the greatest length of stream/river channelization based on the SMC dataset.	AC002, BF003, UD007, UD003, UD053
Publicly-Operated Wastewater Treatment Outfalls	Catchments that contain publicly-operated WWTP outfalls.	LD049, LD048, MC005, LD034, UD028, UD045, AC004, NM015

[1] Top catchments listed in this table under each criterion may not necessarily be listed as aggregate critical catchments

Table 4-22: Aggregate Critical Area Ranking By Catchment

CATCHMENT	SUBWATERSHED	SCORE	RANK	SELECTION METHOD[1]
AC002	Aptakisic Creek	69.2	121	C
AC004	Aptakisic Creek	80.5	91	C
BB001	Bull's Brook	98.2	13	C
BB005	Bull's Brook	39.5	232	C
BC006	Bull Creek	98.0	15	C
BC020	Bull Creek	94.3	32	C
BF003	Buffalo Creek	60.0	152	P
BF009	Buffalo Creek	79.0	94	P
BF011	Buffalo Creek	94.1	34	B
BF025	Buffalo Creek	59.2	156	P
BF038	Buffalo Creek	30.5	286	P
BF039	Buffalo Creek	43.4	217	P
IC041	Indian Creek	91.5	53	C
IC049	Indian Creek	92.3	48	C
LD011	Lower Des Plaines River	65.4	141	C
LD014	Lower Des Plaines River	73.2	112	C
MC001	Mill Creek	48.9	198	P
MC002	Mill Creek	81.8	88	P
MC015	Mill Creek	94.1	35	C
MC018	Mill Creek	65.8	139	P
MC025	Mill Creek	57.0	165	P
MC053	Mill Creek	66.6	134	P
MC054	Mill Creek	86.7	74	P
MC057	Mill Creek	92.7	43	C
MC058	Mill Creek	84.9	79	P

CATCHMENT	SUBWATERSHED	SCORE	RANK	SELECTION METHOD[1]
NM003	Dutch Gap Canal/North Mill Creek	96.7	22	C
NM004	Dutch Gap Canal/North Mill Creek	94.2	33	B
NM005	Dutch Gap Canal/North Mill Creek	70.2	118	P
NM015	Dutch Gap Canal/North Mill Creek	96.9	21	C
NM016	Dutch Gap Canal/North Mill Creek	30.9	282	P
NM017	Dutch Gap Canal/North Mill Creek	83.0	83	P
NM019	Dutch Gap Canal/North Mill Creek	93.8	37	C
NM021	Dutch Gap Canal/North Mill Creek	99.1	7	B
NM028	Dutch Gap Canal/North Mill Creek	98.5	10	C
NM029	Dutch Gap Canal/North Mill Creek	93.4	40	C
NM031	Dutch Gap Canal/North Mill Creek	50.3	191	P
NM035	Dutch Gap Canal/North Mill Creek	98.2	14	C
NM036	Dutch Gap Canal/North Mill Creek	95.3	25	C
NM039	Dutch Gap Canal/North Mill Creek	98.4	12	C
NM040	Dutch Gap Canal/North Mill Creek	93.7	39	C
NM045	Dutch Gap Canal/North Mill Creek	91.1	56	P
NM046	Dutch Gap Canal/North Mill Creek	95.1	26	C
NM052	Dutch Gap Canal/North Mill Creek	94.3	31	B
NM058	Dutch Gap Canal/North Mill Creek	94.4	28	C
NM061	Dutch Gap Canal/North Mill Creek	92.7	42	C
NP001	Newport Drainage Ditch	99.6	3	C
NP002	Newport Drainage Ditch	94.3	30	C
NP004	Newport Drainage Ditch	99.9	2	C
NP005	Newport Drainage Ditch	99.4	4	C
NP008	Newport Drainage Ditch	93.0	41	C

Table 4-22 continued

CATCHMENT	SUBWATERSHED	SCORE	RANK	SELECTION METHOD[1]
NP009	Newport Drainage Ditch	96.3	23	C
NP012	Newport Drainage Ditch	97.4	19	C
NP013	Newport Drainage Ditch	99.9	1	C
UD014	Upper Des Plaines River	99.3	5	C
UD015	Upper Des Plaines River	98.4	11	C
UD016	Upper Des Plaines River	95.9	24	C
UD017	Upper Des Plaines River	94.0	36	C
UD031	Upper Des Plaines River	97.0	20	C
UD060	Upper Des Plaines River	94.4	29	C
UD069	Upper Des Plaines River	98.8	9	C
UD078	Upper Des Plaines River	98.8	8	C
UD080	Upper Des Plaines River	97.8	17	C
UD081	Upper Des Plaines River	99.2	6	C
UD086	Upper Des Plaines River	97.4	18	C
UD087	Upper Des Plaines River	94.5	27	C
UD093	Upper Des Plaines River	97.9	16	C
UD094	Upper Des Plaines River	93.7	38	C

[1] Critical area selection methods: C = selected from aggregate critical criteria analysis; P = selected from previous subwatershed plan; B = selected by both aggregate critical criteria analysis and previous subwatershed plan.

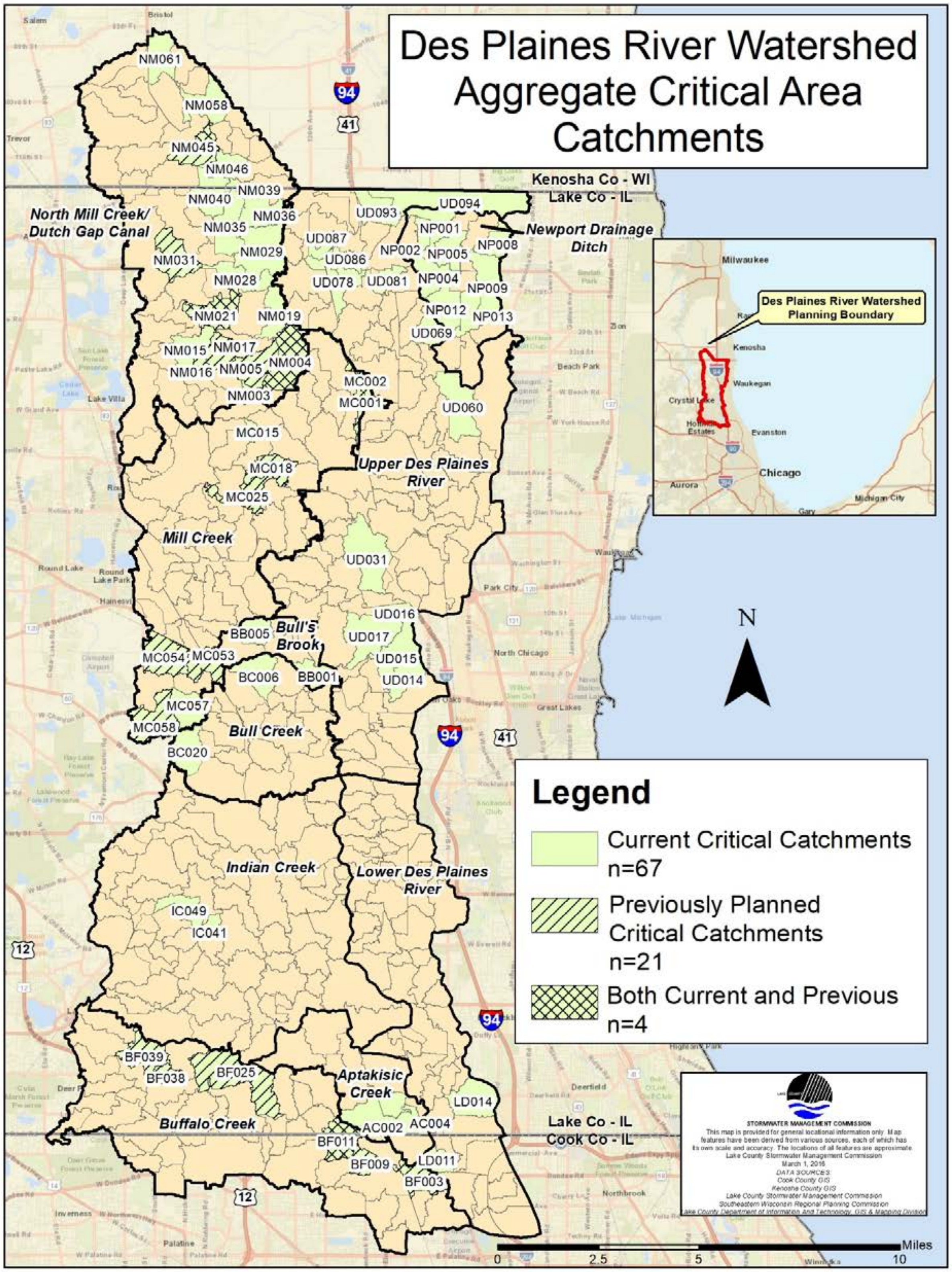


Figure 4-17: Aggregate Critical Area Catchments and Selection Methods

4.2.5.2 Chloride Critical Areas

Chloride is a major cause of water quality impairments in the DPR planning area and problematic to address using traditional practices. As a result, a separate critical areas analysis was performed for chloride in order to better focus efforts aimed at reducing nonpoint source chloride loads in the DPR planning area. The methodology utilizes nonpoint source load modelling, impervious area, and DRWW monitoring data. This allowed for an effective and comprehensive approach to determine critical areas for chloride loading and was performed for the entire DPR planning area (including subwatersheds with existing plans). Chloride critical area catchments were selected using the following criteria:

1. Rank, based on highest chloride loading per unit area as calculated by the nonpoint source model
2. Percentage of impervious area
3. Catchments tributary to, or that include, the 10 DRWW monitoring stations with the highest geometric mean chloride concentrations

Per acre pollutant load results and percentage impervious area were calculated and normalized statistically, summed by catchment, and ranked. The top 20 highest-ranked catchments were selected. The DRWW monitoring data were then analyzed to determine those stations with the highest measured concentrations. Geometric mean chloride concentrations ranged from 89 mg/L to 371 mg/L with ten stations exhibiting the highest mean chloride concentrations; those greater than 190 mg/L. All catchments that included or were tributary to one of one of these ten stations were selected, resulting in 41 catchments.

In total, 61 catchments represent chloride critical areas (Figure 4-18). Indian Creek, Aptakisic Creek, and the Upper Des Plaines River subwatersheds contain the greatest total number and area of chloride critical area catchments (Table 4-23).

Table 4-23: Chloride Critical Areas by Subwatershed

WATERSHED	NUMBER OF CATCHMENTS	ACRES OF CHLORIDE CRITICAL AREA
Aptakisic Creek	8	3,828
Buffalo Creek	4	1,228
Bull Creek	8	2,758
North Mill Creek/Dutch Gap Canal	6	2,223
Indian Creek	14	6,695
Lower Des Plaines River	6	1,508
Mill Creek	1	260
Upper Des Plaines River	14	4,779
TOTAL	**61**	**12,011**

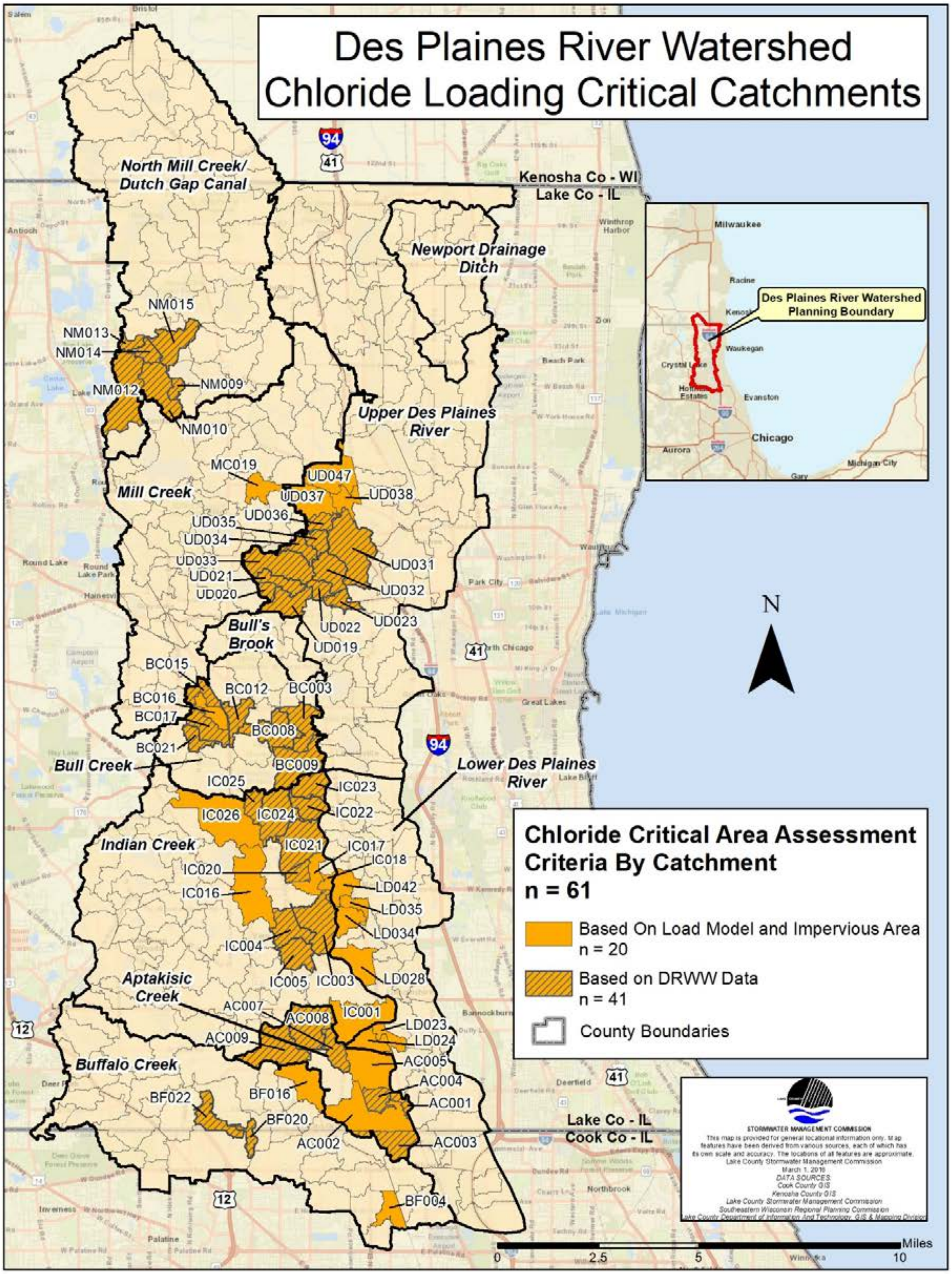


Figure 4-18: Chloride Critical Area Catchments

4.2.5.3 PAH Critical Areas

PAHs are considered one of the emerging causes of aquatic life impairments in the watershed (MBI, 2017). Land use information and DRWW water quality monitoring data were used to establish unique critical area catchments for PAHs. A recent study of PAHs in streambed sediment in the Milwaukee-area (Baldwin et al., 2016) found that the primary source of PAHs was coal-tar pavement sealant. The study also suggested statistically that commercial land use and parking lots were the major contributors of PAHs. As a result, land use and stream sediment data were used to determine PAH critical areas for the DPR planning area. PAH critical area catchments are those where efforts can be focused to achieve meaningful PAH reductions. This analysis was performed for the entire DPR planning area and included:

1 Catchments with the greatest proportion of parking lots and commercial land use
2 Catchments directly tributary to or that include DRWW sediment sampling sites resulting in the highest number of PAH exceedances of sediment quality guidelines

Percent area of parking lots and commercial land use was calculated for each catchment using a customized GIS land use layer; the top 25 highest catchments were selected. Of these catchments, the percentage area of parking lots and commercial land use ranged from 19%-61%; the average percentage area of parking lots and commercial land use was 29%.

The sum of PAH exceedances for both the threshold effect concentration (TEC) and probable effect concentration (PEC) for any given DRWW monitoring station ranged from 0-13. The top ten stations were selected, all with at least 10 TEC and PEC exceedances. The catchments directly tributary to, or that included these stations, were selected. A total of 25 catchments were selected based on the DRWW data.

A total of 46 PAH critical catchments were selected; four of which met both criteria in the Upper Des Plaines subwatershed (Figure 4-19). Indian Creek, Lower Des Plaines River, and Buffalo Creek subwatersheds have the greatest acreage of PAH critical areas while Indian Creek, Lower Des Plaines River, and the Upper Des Plaines River subwatersheds contain the greatest number of catchments (Table 4-24).

Table 4-24: PAH Critical Areas by Subwatershed

WATERSHED	NUMBER OF CATCHMENTS	ACRES OF PAH CRITICAL AREA
Aptakisic Creek	4	2,510
Buffalo Creek	5	2,702
Bull Creek	4	1,759
Indian Creek	7	2,558
Lower Des Plaines River	15	4,293
Mill Creek	5	1,627
Upper Des Plaines River	6	2,582
GRAND TOTAL	**46**	**18,031**

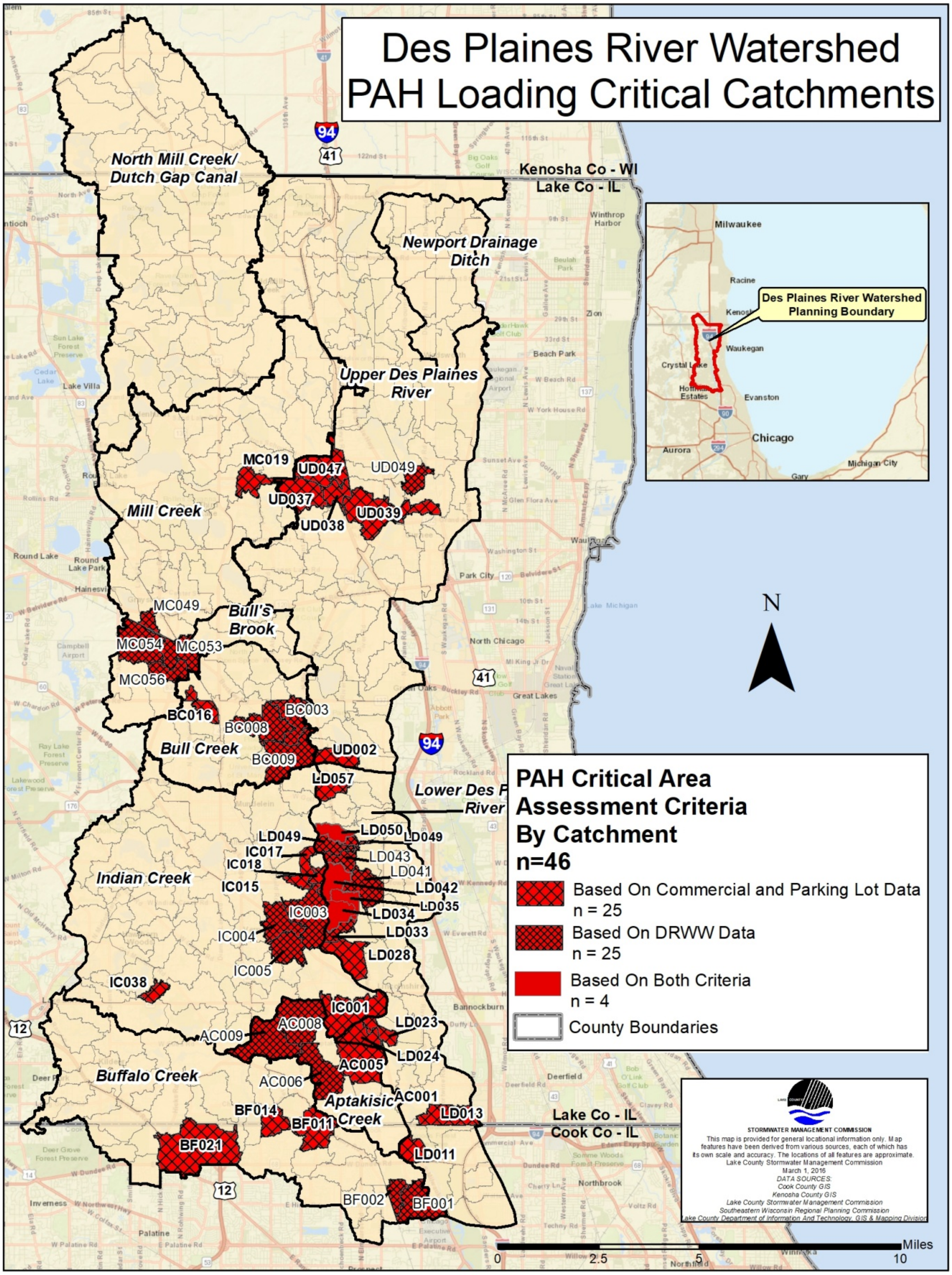


Figure 4-19: PAH Critical Area Catchments

4.2.5.4 Lakeshore Erosion Critical Areas

Lakeshore erosion critical areas represent shorelines in need of stabilization to reduce sediment and nutrient loading and improve lake water quality. Lake shoreline erosion is described in Chapter 3 and quantified in section 4.2.1. Lakeshore erosion critical areas are based on the following criteria; only those shorelines meeting all three criteria were selected:

1. Erosion severity; a ranking system developed by the LCHD; 0 indicating no erosion, 1-3 slight, moderate, and severe, respectively. Only shorelines with a severe erosion category were selected.
2. Average annual recession rate, the thickness of soil measured perpendicularly to the bank surface, which is eroded every year, measured in feet per year. Only shorelines with an average annual recession rate of 0.1 ft/yr or greater were selected.
3. Length of shoreline, measured in feet. Only shorelines equal to or greater than 50 ft in length were selected.

The DPR planning area contains a total of 70 lakeshore erosion critical areas, comprising 14,173 ft (2.7 mi) of lake shoreline. The Upper Des Plaines River and Indian Creek subwatersheds have the greatest total length of critical area, followed closely by Mill Creek and Dutch Gap Canal-North Mill Creek subwatersheds. The three lakes with the greatest length of critical areas are County Side, Grandwood Park, and St. Mary, respectively. Aptakisic Creek, Bull's Brook, the Lower Des Plaines River, and Newport Drainage Ditch subwatersheds have no identified lake shoreline critical areas. Table 4-25 lists lakes with critical shoreline erosion areas by subwatershed and catchment, along with sediment load and length. Figure 4-20 shows the location of the critical shoreline erosion areas.

Table 4-25: Lakeshore Erosion Critical Areas and Information

SUBWATERSHED	CATCHMENT	LAKES	LAKE SEDIMENT LOADING (TONS/YR)	TOTAL SUBWATERSHED LOADING (TONS/YR)	LENGTH (FT)	TOTAL SUBWATERSHED LENGTH (FT)
Bull Creek	BC010	St. Mary's	19.7	19.7	1,485	1,485
Buffalo Creek	BF020	Buffalo Creek Reservoir 1	6.9	6.9	893	893
Indian Creek	IC017	Little Bear	1.2	24.3	152	3,167
	IC021	Lake Charles	1.5		190	
Mill Creek	MC024	Druce	0.6	22.2	73	2,884
	MC025	Grandwood Park	13.4		1,750	
North Mill Creek - Dutch Gap Canal	NM007	Waterford	1.7	19.1	218	2,490
	NM007	McDonalds Woods Lake 2	3.4		440	
	NM010	Hastings	1.9		248	
	NM011	Slough	3.8		490	
Upper Des Plaines River	UD004	Minear	21.8	25.0	2,835	3,253
		Total:		**117.2**		**14,173**

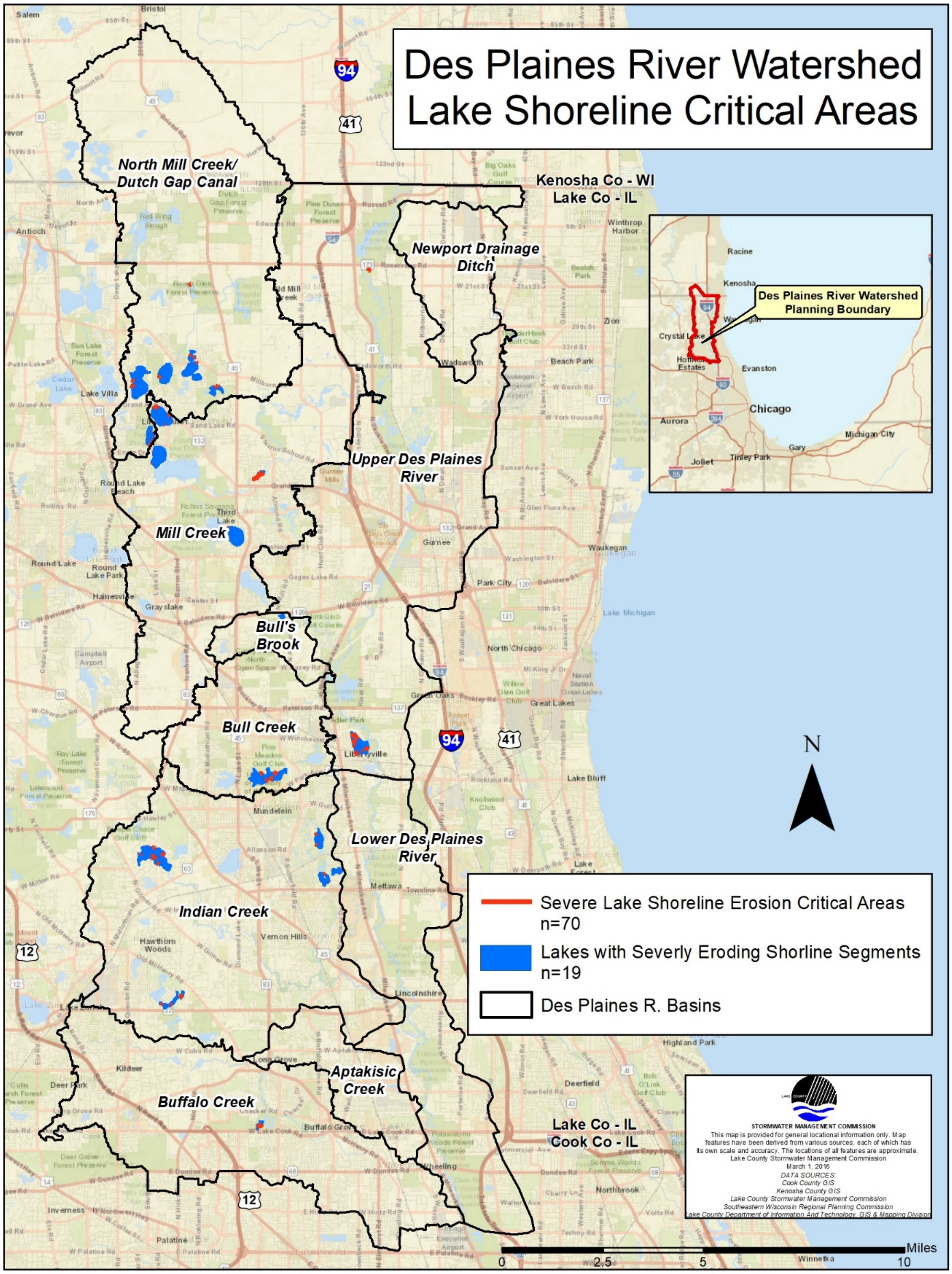


Figure 4-20: Lake Shoreline Critical Areas

4.2.5.5 Streambank Erosion Critical Areas

Streambank erosion critical areas are banks exhibiting high rates of failure or those best suited for stabilization efforts to reduce sediment and nutrient loading. Streambank erosion was discussed previously in Chapter 3 and quantified in section 4.2.4.5. The following criteria were used to select critical areas:

1. Total sediment load
2. Location, either on the mainstem Des Plaines River, or on a tributary

A total of ten miles of streambanks were selected as critical areas; five miles on the Des Plaines River mainstem and five miles of streambanks on tributaries to the Des Plaines River with the highest sediment loading. These critical areas account for 17% of the total DPR planning area sediment load from streambank erosion (Table 4-11). Critical areas are located along 8 different streams (Table 4-26) with the highest load occurring in the Mill Creek subwatershed, followed closely by the Lower Des Plaines River (Table 4-27). The Mill Creek subwatershed also has the highest ratio of total sediment loading to total critical area length (Table 4-27).

The longest total length occurs in the Upper Des Plaines River subwatershed, followed by the Lower Des Plaines River subwatershed (Table 4-27). The Aptakisic Creek, Bull's Brook, Bull Creek, Indian Creek, and Newport Drainage Ditch subwatersheds contain no streambank erosion critical areas. Figure 4-21 shows the location of critical streambank erosion areas.

Table 4-26: Streambank Erosion Critical Areas Sediment Loading by Stream

STREAM	TOTAL LENGTH (ft)	SEDIMENT LOAD BY STREAM (tons/yr)
Belvidere Road Tributary	1,638	33.4
Buffalo Creek/Wheeling Drainage Ditch	2,540	88.6
Des Plaines River	27,678	850.2
Irondale Creek	4,613	70.6
Mill Creek	8,453	849.8
Stoneroller Creek	1,826	33.5
Unnamed Tributary 1	4,992	34.5
Unnamed Tributary 2	1,270	41.5

Table 4-27: Streambank Erosion Critical Areas by Catchment

SUBWATERSHED	CATCHMENTS	STREAM NAME	STREAM SEGMENT LENGTH (FT)	TOTAL SUB-WATERSHED LENGTH (FT)	STREAM SEGMENT SEDIMENT LOADING (TONS/YR)	TOTAL SUB-WATERSHED SEDIMENT LOADING (TONS/YR)
Buffalo Creek	BF003 BF009 BF010	Buffalo Creek / Wheeling Drainage Ditch	1,504 566 470	2,540	53 19 16	89
Lower Des Plaines River	LD001 LD010 LD011 LD012 LD013 LD017 LD032 LD036 LD041	Des Plaines River Des Plaines River Des Plaines River Des Plaines River Unnamed Tributary 2 Des Plaines River Des Plaines River Des Plaines River Des Plaines River	1,424 108 3,310 3,091 1,270 1,889 532 127 3,990	15,740	54 4 127 90 41 55 33 8 244	656
Mill Creek	MC001 MC018 MC042 MC042 MC042 MC042 MC042 MC042 MC042 MC042 MC042 MC042 MC042 MC042 MC043 MC043 MC044 MC054	Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek Mill Creek	1,098 1,005 397 96 425 271 283 104 451 117 127 161 260 29 131 362 361 1,217	6,895	48 29 33 33 54 45 36 31 30 53 89 67 33 5 24 67 69 34	781

SUBWATERSHED	CATCHMENTS	STREAM NAME	STREAM SEGMENT LENGTH (FT)	TOTAL SUB-WATERSHED LENGTH (FT)	STREAM SEGMENT SEDIMENT LOADING (TONS/YR)	TOTAL SUB-WATERSHED SEDIMENT LOADING (TONS/YR)
Upper Des Plaines River	UD011 UD013 UD014 UD016 UD017 UD022 UD023 UD031 UD056 UD076	Des Plaines River Irondale Creek Irondale Creek Des Plaines River Des Plaines River Belvidere Rd Tributary Des Plaines River Stoneroller Creek Mill Creek Unnamed Tributary 1	2,673 396 4,217 768 9,446 1,638 322 1826 1558 4992	27,836	48 35 35 14 169 33 6 34 69 35	476
			GRAND TOTAL	53,011	GRAND TOTAL	2,002

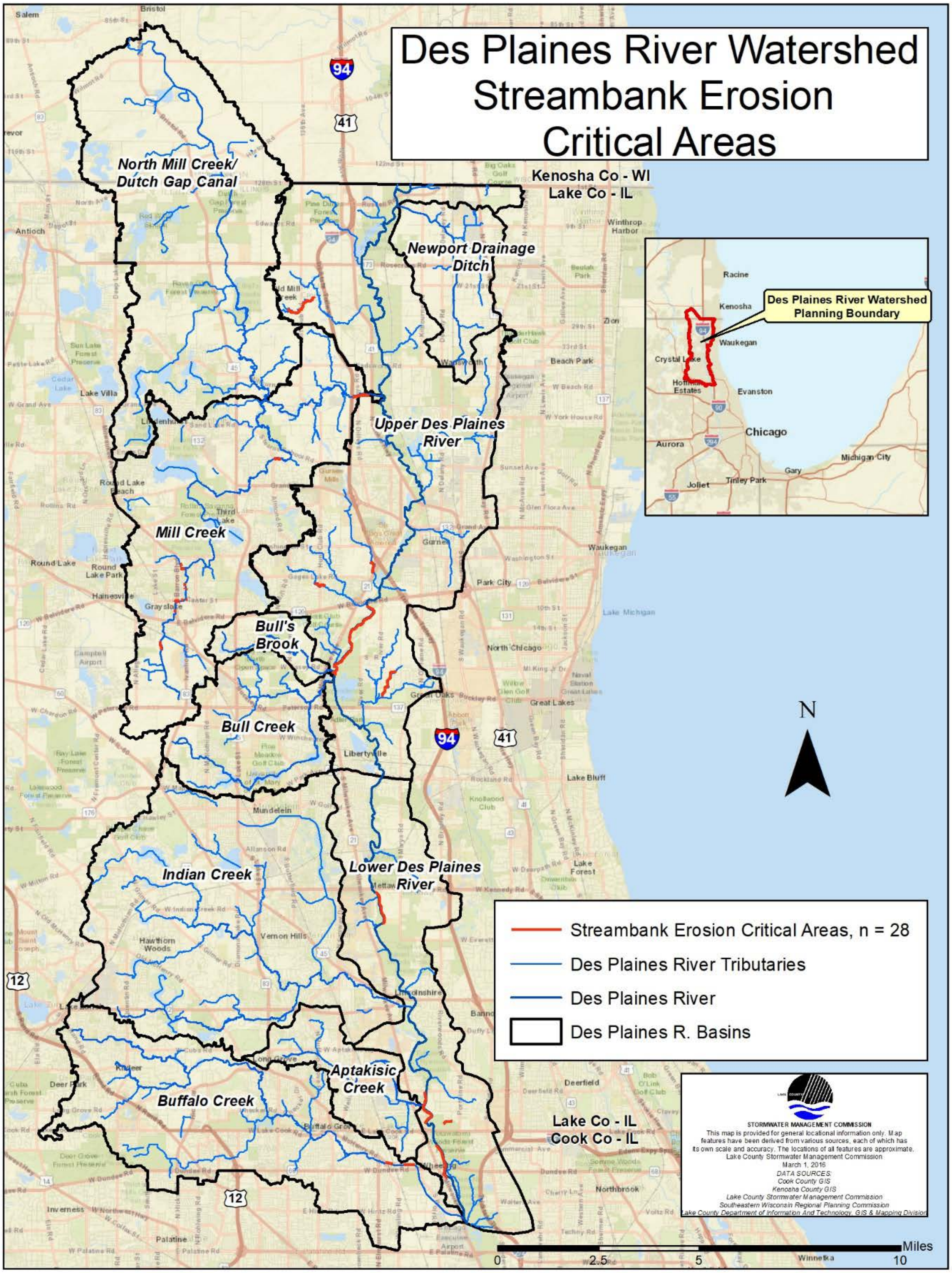


Figure 4-21: Streambank Erosion Critical Areas

4.3 WATERSHED JURISDICTIONAL COORDINATION

Watershed protection, which is a shared responsibility of multiple jurisdictions in the DPR planning area, is problematic because the jurisdictions operate with different policies, practices, and regulations. A coordinated and consistent watershed management effort does not exist due to the multiple authorities and jurisdictions and their divergent management practices and development requirements related to land and water resources. Requirements for and application of BMPs also vary based on county, municipal, township, drainage, park, forest preserve, and school district policies, standards, requirements, and incentives.

While public policies and regulations can significantly influence the prevention of further watershed degradation, private efforts need to be combined with public initiatives to address current watershed issues, such as concentrated areas of flood damage and the poor water quality in lakes and degraded stream conditions prevalent throughout the DPR planning area. Private landowners (urban and rural) and homeowner groups should voluntarily incorporate BMPs in the landscapes they manage to resolve existing watershed problems and improve conditions. Education and outreach can substantially influence voluntary participation in watershed improvement activities and improve the general public's understanding of the need for jurisdictional projects and programs. For more information on education and outreach strategies and tools, see Chapter 8 Education and Outreach Strategy and Tools.

Because the DPR planning area comprises multiple jurisdictions, the ability to coordinate is a primary limitation in adopting consistent preventative practices. The ability to coordinate also presents challenges in completing BMP projects or instituting programs and policies that may provide broad watershed benefits. Presently, no watershed-wide stakeholder engagement effort exists that supports education, outreach, and voluntary implementation of BMPs, although there are examples of these types of efforts in the Buffalo Creek, Bull Creek-Bull's Brook, and Indian Creek subwatersheds. The following section describes watershed jurisdictional coordination roles and responsibilities.

4.3.1 Issues to be Addressed by Coordinated Jurisdictional Effort

The watershed planning process identified multiple issues that would be most effectively addressed at the watershed level through a coordinated effort of watershed jurisdictions, with the support of private stakeholders, including:

- Volume of stormwater runoff
- Poor water quality
- Poor habitat quality
- Lack of water quality data
- Barriers to alternative transportation (connecting routes and modes)
- Flood damage/regional flood storage
- Protection and restoration of natural resources
- Education and outreach regarding watershed issues

Table 4-28 includes a summary of the issues identified in the watershed planning process that would be best addressed through coordinated partnership efforts.

Table 4-28: Issues to be addressed with watershed-level coordination

ISSUE	STRATEGIES TO ADDRESS ISSUE	POTENTIAL ACTIONS	RESPONSIBILITY
Volume of stormwater runoff	Review adequacy of runoff volume reduction requirements for watershed	Review regulations and update as needed.	Municipalities, Counties, SMC, MWRD
	Porous pavement	Promote through public/private BMP programs.	Municipalities, Counties
	Installing and maintaining neighborhood and site scale green infrastructure; Native landscaping; Downspout disconnection; Rain garden program	Review ordinances and land management standards to allow by right and set up voluntary incentive programs.	Municipalities, Counties, CLC, Park Districts
	Wetland mitigation in the watershed	Future potential watershed-specific policy.	SMC, MWRD, USACE, Certified Communities
	Preserving landscape scale green infrastructure; Wildlife and floodplain connections with greenway corridors	Incorporate green infrastructure network in land use plans. Set up partnership to fund and implement.	Municipalities, Counties, FPD, Park Districts
	Road improvement/retrofit projects/designs	Incorporate stormwater BMPs. Score all projects with I-Last™ or similar tool.	IDOT, Tollway County DOTs, Municipalities, Townships
	Pollution prevention education	Coordinate with NPDES II program outreach.	Municipalities, SMC, MWRD, CLC, Counties, Watershed Groups

ISSUE	STRATEGIES TO ADDRESS ISSUE	POTENTIAL ACTIONS	RESPONSIBILITY
Water Quality Impairment	Utilization of DRWW monitoring data	Implement targeted projects and programs based on DRWW data to reduce the number of water quality impairments	DRWW, SMC, Municipalities, MWRD, Townships, Counties, LCDOT, IDOT, Park Districts, LCFPD, CLC, U of IL Extension; (All watershed stakeholders)
	Phosphorus ban	Adopt ban(s).	Municipalities, Counties
	Nutrient management plans and agricultural BMPs	Provide cost-share or free technical service to agricultural producers with grant or farm program support.	Agricultural Producers, Municipalities, County, NRCS/SWCDs
	Reduce sodium chloride application with alternative practices and chemicals	Form buying consortium to share equipment and reduce cost of alternative products.	Municipalities, County DOTs, Townships
	Coal tar sealant ban	Adopt ban(s).	Municipalities, Counties
	Calibrate salt application equipment	Document calibration.	All applicators
	Consistent snow removal policies and application rates	Determine model policy and application rates as a base from which jurisdictions develop or modify individual policies.	Municipalities, County DOTs, IDOT, Tollway, Townships
	Coordinate geography-based plow routes among jurisdictions for efficiency and reduced travel, equipment and materials storage costs.	Optimize route efficiency recommendations and maintain coordinated effort/standards via Memorandum of Understanding.	County DOTs, IDOT, Municipalities, Townships, Watershed Groups

ISSUE	STRATEGIES TO ADDRESS ISSUE	POTENTIAL ACTIONS	RESPONSIBILITY
Water Quality Impairment (continued)	Applicator certification/ registration	State requirement. Phase in as a requirement via municipal ordinance, County Township.	Illinois EPA, IDOT, Municipalities, Townships, County DOTs
	Coordinated intergovernmental purchase of private contractor services for winter maintenance	Counties take lead in coordinating shared service with municipalities. Only qualified contractors eligible for bid.	LCDOT, Municipalities, Townships, Private, Watershed Groups
Poor habitat quality	Stream, wetland, and lake maintenance program and restoration strategy; Dam repair/removal	Develop and adopt standards for stream, wetland, and lake maintenance and restoration.	SMC, MWRD, Municipalities, Counties, Drainage Districts, IDNR/WI DNR
	Communities participate in invasive plant control; Inform private landowners about invasive plant control	Each community and transportation agency adds invasive plant management to maintenance programs (technical support from invasive plant network and FPDs). Coordinate outreach with established programs like NPDES II and FPD education programs.	Municipalities, Counties, Park Districts, FPD, CLC, U of IL Extension, County DOTs, IDOT, Townships
Lack of water quality data	Coordinated NPDES II and stream gage monitoring	Watershed municipalities collaborate on developing coordinated monitoring program (under-way).	SMC, LCHD-ES, DRWW, MWRD, USGS, Watershed Groups
	Participate in monitoring program of DRWW	Each NPDES community/agency participates in work group.	Municipalities, Townships, Drainage Districts, Counties

ISSUE	STRATEGIES TO ADDRESS ISSUE	POTENTIAL ACTIONS	RESPONSIBILITY
Barriers to alternative transportation - connecting routes and modes	Neighborhood connections with trails; Connecting trails and safe sidewalks to transportation hubs and work centers (e.g., train stations and bus stops, commercial centers, business parks)	Assess underserved neighborhoods and disconnected transportation hubs, work, and business centers. Meet with appropriate jurisdictions to formulate strategies to address in Lake County 2040 Transportation Plan.	County DOTs, Municipalities, IDOT, Counties
Flood damage	Regional Flood Storage Sites	Assess if regional flood storage will mitigate or prevent flood damage and implement priority storage sites.	SMC, MWRD, Municipalities, Townships, Counties
	Evaluating Stormwater Infrastructure	Clear, repair, or replace blocked, damaged, and failing stormwater infrastructure to maintain or improve conveyance.	SMC, MWRD, Municipalities, Townships, Counties, IDOT, County DOTs
	Flood Mitigation Projects	Utilizing local and regional partnerships to fund and implement flood mitigation projects such as buy-outs	SMC, MWRD, Municipalities, Townships, Counties, IDNR, IEMA
Protection and restoration of natural resources	Habitat Protection, & Wetland and Stream Restoration	Restoration of hydrology and native plant communities in existing natural areas.	Park Districts, FPD, Municipalities, Townships, IDNR, WI DNR
Education and outreach regarding watershed issues	Inform residents about BMP's, water quality and water resources, and agency roles; Promote volunteer opportunities	Coordinate outreach with established programs.	Municipalities, Counties, Park Districts, FPD, CLC, U of IL Extension, County DOTs, IDOT, Townships

4.3.2 Watershed Roles and Responsibilities

Watershed management in the DPR planning area is a shared responsibility of both public and private interests. Watershed protection provided by jurisdictional entities and private stakeholders comes in several forms: policy, regulation, planning, zoning, development and land management standards/incentives, education, outreach, and in-the-ground BMP projects.

Municipal and county governments share the greatest responsibility for watershed protection because they influence and oversee development impacts to the watershed through land use planning, land management and development policies, and regulatory oversight. Transportation infrastructure improvements are necessary to accommodate business and population growth. The operation, maintenance, and construction of roadways can substantially influence water resources. Roadways are initiated and maintained by multiple stakeholders including townships, municipalities, counties, the Illinois and Wisconsin Departments of Transportation, and the Illinois Tollway Authority. In addition, the Illinois Tollway Authority is considering the development of the Route 53/120 corridor, which would increase their footprint in the DPR planning area.

Other agencies and private entities with watershed or technical advisory roles include the North Shore Water Reclamation District (NSWRD), MWRD, LCFPD, FPDCC, park districts, drainage districts, Openlands, CLC, DRWW, U of I Extension Service, NCSWCD, and the MLSWCD. The NSWRD operates two wastewater treatment plants that discharge effluent to the Des Plaines River within the planning area. MWRD has stormwater management authority in the Cook County portion of the planning area and operates flood control projects in the Buffalo Creek subwatershed. The forest preserves and park districts provide important recreation opportunities and protect natural resources such as rare or high-quality habitat and threatened or endangered species. They protect and manage land that often contains wetlands, lakes, ponds, and streams. SWCDs provide technical resource assistance to the public and other regulatory agencies including soil erosion and sediment control inspections. Drainage districts such as Avon-Fremont Drainage District and Grubb School Drainage District have authority to maintain the conveyance function of certain creeks and streams in the DPR planning area. The U of I Extension Service and the CLC are well situated to be demonstration sites and provide technical assistance and educational outreach programs to watershed stakeholders.

NOTEWORTHY: DRWW'S TECHNICAL ROLE IN THE WATERSHED

DRWW's continuous monitoring efforts will accurately assess the water quality problem and identify specific locations for implementation projects that will provide the greatest cost/benefit ratio. It will also allow for a consistent measure of progress. By monitoring over an extended period, using a consistent methodology, DRWW will identify BMPs that are successful at reducing nonpoint source pollution and improving water quality.

4.3.2.1 Watershed Development

Development practices that affect water resources (rivers, streams, lakes, isolated wetlands, and floodplains) are largely regulated by the WMO in Cook County, the WDO in Lake County, and the WI DNR in Kenosha County, along with county and municipal ordinances and land use plans. In addition to local regulations, the USACE regulates discharge of "fill" material into WOUS (including adjacent and connected wetlands), and the IDNR has floodplain/floodway regulatory and oversight authority. The Illinois and Wisconsin Departments of Transportation and the Illinois State Toll Highway Authority design and construct roadways in the DPR planning area. (State and federal projects are not required to meet local regulatory requirements but are governed by state and federal policies and regulations.)

In Lake County, the WDO is administered and enforced by SMC or a Certified Community. A community can be fully certified with authority to review and enforce both the standard stormwater and the isolated wetland provisions of the WDO, or partially certified with delegation to review and enforce one aspect of the WDO (either the standard or isolated wetland provisions). SMC retains certain review authorities for all communities, primarily for several specific floodplain and floodway provisions of the WDO. Development practices within unincorporated areas are guided by the Lake County Framework Plan and must meet the requirements of the UDO. The Lake County PB&D administers the UDO on unincorporated parcels. Lake County PB&D operates under direction from the Regional Planning Commission, the Zoning Board of Appeals, the Planning, Building and Zoning Committee of the Lake County Board, and the full County Board. The County Board oversees decisions made by county departments and, therefore, can affect policies and regulations for unincorporated Lake County (29% of the DPR planning area). Development affecting water resources in the unincorporated areas of the townships must be reviewed by Lake County PB&D, except publicly funded projects in the floodway, which are reviewed by SMC. Lake County PB&D reviews may involve coordination with SMC on issues such as base (100-year) flood elevation determinations. Authority for local land use planning and development regulation within municipalities (incorporated areas) within Lake County rests with the municipality and its municipal codes and regulations. All development in Lake County municipalities must meet the minimum standards set forth by the WDO (many municipalities are certified to administer WDO standards). The IDNR has floodplain/floodway regulatory and oversight authority within Cook and Lake counties. IDNR has delegated floodplain/floodway review authority for Lake County to SMC. For the most up-to-date information on Lake County regulatory authority, visit Lake County's website.

In Cook County, the WMO is administered and enforced by MWRD or an Authorized Municipality. MWRD retains certain review authorities, primarily for developments that are tributary to combined sewers; developments proposing outfalls to the waterways or Lake Michigan within Cook County; and certain modifications and reconfigurations to existing detention facilities. The WMO allows local municipalities whose corporate boundary lies within both Cook County and an adjacent collar county (such as Lake County) to adopt and enforce the ordinance of the adjacent county in lieu of the WMO. Those municipalities must enter into an IGA with MWRD to follow the indicated ordinance. Municipalities, whether Authorized/Certified or not, can always enforce more stringent provisions for development if they determine there are conditions that warrant stricter requirements for their community. For the most up-to-date information on Cook County regulatory authority, visit Cook County's website.

In Kenosha County, the WI DNR regulates wetland, floodway, and floodplain impacts, as well as shoreline zoning, runoff reduction standards, and disturbances over an acre. Development practices are also regulated by the Village of Bristol and the Village of Salem Lakes municipal ordinances. The SEWRPC has developed a watershed management plan, natural areas management plan, and has restudied and remapped the floodplains in the Wisconsin portion of the DPR planning area. For the most up-to-date information on Kenosha County regulatory authority, visit the WI DNR and SEWRPC websites.

4.3.2.2 In-the-Ground Projects

In-the-ground projects are encouraged and incentivized when local units of government throughout the county adopt a watershed management plan. Plan adoption should be followed by close coordination and development of funding mechanisms, timelines, and shared responsibilities for implementing the projects prioritized by watershed planning efforts. Implementation of projects identified within the watershed-based plan requires partnerships between stakeholder groups, including homeowner associations, nonprofit organizations, businesses, schools, and community agencies, who must coordinate, fundraise, secure grants, and oversee project implementation. The experience and success that partnerships often gain from working together on a watershed project can influence regulatory changes and increase cooperation among policy-makers.

The watershed action plan (Chapter 6 and Appendix N) identifies lead and support roles for multiple units of government to assist private landowners and watershed groups. Specific types of aid that governments can provide to private landowners can include BMP project cost-share funding or technical assistance, particularly for studies or plans. Private entities as partners can also provide cost-share for design, consulting, and construction work for projects, and in-kind BMP services, such as seeding, planting, restoration work, trail construction, and interpretive education.

Watershed projects benefit from partnerships that share design, permitting, material, and labor costs. Public/private partnerships are also important for securing state or federal funding for in-the-ground projects. Projects with shared costs and benefits often result in more successful project outcomes because of the relationships built among partners who share a vested interest in the success of their projects. Partnership on a first project may establish an institutional relationship that results in implementing projects in the future.

4.3.2.3 Post-Construction Monitoring and Maintenance

Opportunities should also be identified for establishing partnerships to improve the effectiveness and efficiency of monitoring and maintenance. Partnerships could share responsibility for stream monitoring and maintenance, stormwater monitoring, road and parking lot deicing, detention basin monitoring and maintenance, and invasive plant management. Additionally, partnerships may be established to share technical expertise; develop maintenance guidelines or standards; share services, equipment, or storage locations; or combine contracts with neighboring jurisdictions for similar activities, such as winter road maintenance and invasive plant management. Information on work responsibilities for each organization/jurisdiction should be available online to all watershed partners and residents to increase transparency and information availability. Interjurisdictional coordination may entail doing business in a new or different way; however, it results in watershed goals being achieved in a more efficient, effective, and sustainable manner. The DRWW is an example of an interjurisdictional partnership providing some of the services identified above.

4.4 STORMWATER GREEN INFRASTRUCTURE ANALYSIS

4.4.1 Parcel Prioritization Criteria

2015 aerial photography of Kenosha County, WI, Lake County, IL, and Cook County, IL identified open and partially open parcels in the DPR planning area. Open parcels are those with no development such as residences, farmsteads, accessory buildings, and roads. Open parcels may contain structures such as park gazebos, picnic facilities, and trails or maintenance roads. Partially open parcels may contain some development such as residences, farmsteads, accessory buildings and roads; however, the majority (typically greater than 75-80%) of the parcel is open space. To further define the open and partially open parcels in the DPR planning area, edge of pavement, building footprints, and the NLCD were all overlaid on the 2015 aerial photography layer, then visually inspected to verify the locations.

Once the inventory of open/partially open parcels was created, additional criteria were considered based on stakeholder feedback obtained during a watershed planning committee meeting. Prioritization criteria were selected based on the benefits the parcels would provide in meeting four goals (flood prevention/reduction, water quality improvement, stormwater management and drainage, and natural resources improvement). Table 4-29 contains a list of the stakeholder approved ranking criteria for open and partially open parcels and the goals that are addressed by each criterion.

Table 4-29: Green Infrastructure Prioritization Criteria for the DPR Planning Area

RANKING CRITERIA FOR OPEN AND PARTIALLY OPEN PARCELS	FLOOD PREVENTION/ REDUCTION	WATER QUALITY IMPROVEMENT	STORMWATER MANAGEMENT AND DRAINAGE	NATURAL RESOURCES
1. Parcels that intersect 100-year floodplain.	X		X	
2. Parcels within catchments with less than 1 square mile of drainage to a channel	X	X		X
3. Parcels that intersect with a wetland polygon.	X	X		X
4. Parcels that are adjoining to or include at least 2.5 acres of drained hydric soils.	X	X		X
5. Parcels within 0.5 miles radius of a known flood problem area.	X			
6. Parcels that are within 100 feet of a watercourse or lake (equal to or greater than 6 acres).	X	X	X	X
7. Parcels intersecting with nonpoint source pollutant hotspot catchments.	X		X	
8. Parcels adjoin to or including forest preserves, land trusts, townships, and privately/publicly protected open space (including Illinois Natural Area Inventory sites).		X		
9. Parcels adjoining to or including mapped high-quality wetlands (ADID).		X		X
10. Parcels adjoining to or including threatened and endangered species sites.				X
11. Parcels with prime agricultural soils.		X		
12. Parcels with highly erodible soils.			X	X
13. Parcels greater than 5 acres (this reflects the median size of OPEN parcels in the watershed).	X	X	X	
14. Parcels intersecting ecological complexes (see Section 3.8.1).	X	X		X
15. Parcels that connect existing protected open space areas.		X		

4.4.2 Green Infrastructure Parcel Analysis and Prioritization

4.4.2.1 Parcel Prioritization Results

The open and partially open parcels were identified based on the prioritization criteria using a GIS and a binomial process. If a parcel met a criterion, it received a "Yes" or one point. If the parcel did not meet that criterion, it received a "No" or zero points. GIS was then used to rank the parcels. Rank was determined based on the maximum points received by each parcel for each goal. For example, the total maximum points for Flood Prevention and Reduction is 9. Figure 4-22 depicts the parcel prioritization process.

After completion of the prioritization, parcels were categorized as high, medium, or low priority. Finally, the total points for each parcel were summed to determine the overall parcel priority for the green infrastructure system. Parcels with the highest number of points overall were ranked highest in the context of the stormwater green infrastructure network, meaning that they possess the greatest capacity for watershed protection or improvement by meeting multiple goals (flood prevention/reduction, water quality improvement, stormwater management and drainage and natural resources improvement). The priority categorization was visually displayed and evaluated, and connector parcels were identified and manually categorized.

4.4.2.2 Overall Prioritization: A Stormwater Green Infrastructure Network

Figure 4-23 and Table 4-30 display the results of the priority parcel ranking for all criteria that were described in Table 4-29. Parcels with 10 or more total points were categorized as high priority parcels. Parcels with total scores between five and nine points were categorized as medium priority parcels. Parcels with total scores between zero and four points were categorized as low priority parcels.

The green infrastructure parcel prioritization analysis demonstrates that high priority parcels are the least prevalent of the three categories. 763 parcels totaling 24,797 acres are categorized as high priority parcels. The majority of these parcels are public lands such as parks and forest preserves. Medium priority parcels are the most prevalent of the three categories in terms of acreage. 6,241 parcels totaling 47,848 acres are categorized as medium priority parcels. Medium priority parcels are scattered throughout the DPR planning area, with many medium priority parcels located in close proximity to high priority parcels. Low priority parcels are the second least prevalent in terms of

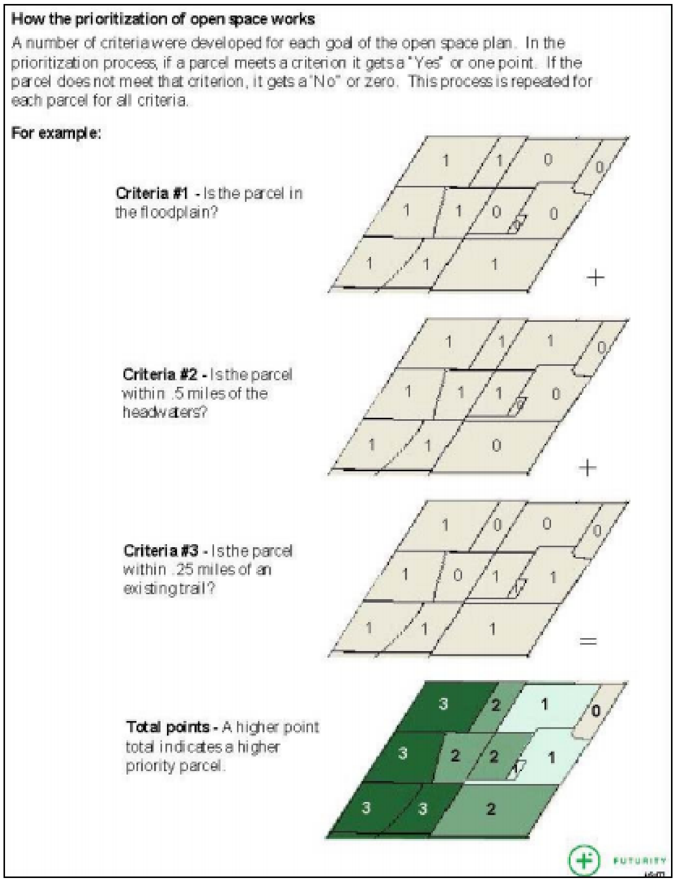


Figure 4-22: Green infrastructure Parcel Prioritization Process
Source: Futurity Inc., Christy SF 2005

acreage of the three categories. 7,834 parcels totaling 7,563 acres are categorized as low priority. Based on the results, average parcel size increases with priority, as larger open space parcels typically satisfy more of the prioritization criteria than smaller parcels.

The majority of the high and medium priority parcels are associated with stream corridors, wetlands, and high quality natural areas. While medium and low priority parcels may initially appear to be scattered throughout the DPR planning area, some of these parcels are important as connectors between higher priority parcels.

Table 4-30: Results of Priority Parcel Ranking Priority in DPR Planning Area

PRIORITY PARCEL RANKING	HIGH PRIORITY (10+ POINTS)	MEDIUM PRIORITY (5-9 POINTS)	LOW PRIORITY (0-4 POINTS)
No. of Parcels	763	6,241	7,834
Acres	24,797	47,848	7,563

Table 4-31: Results of Priority Parcel Ranking Priority per subwatershed in the DPR Planning Area

WATERSHED	HIGH PRIORITY ACRES/% OF WATERSHED	MEDIUM PRIORITY ACRES/% OF WATERSHED	LOW PRIORITY ACRES/% OF WATERSHED	WATERSHED TOTAL ACRES/%
Aptakisic Creek	41 (0.94%)	972 (22.22%)	196 (4.48%)	1,209 (27.64%)
Buffalo Creek	468 (2.69%)	3,568 (20.51%)	650 (3.74%)	4,686 (26.94%)
Bull Creek	760 (10.65%)	2,260 (31.67%)	414 (5.80%)	3,434 (48.12%)
Bull's Brook	717 (39.46%)	510 (28.07%)	27 (1.49%)	1,254 (69.01%)
Indian Creek	1,939 (8.03%)	6,234 (25.81%)	1,765 (7.31%)	9,938 (41.15%)
Lower Des Plaines River	2,484 (17.01%)	3,482 (23.84%)	809 (5.54%)	6,775 (46.38%)
Mill Creek	3,492 (17.65%)	7,411 (37.46%)	1,032 (5.22%)	11,935 (60.33%)
Newport Drainage Ditch	712 (14.19%)	2,386 (47.55%)	219 (4.36%)	3,317 (66.10%)
Dutch Gap-North Mill Creek	8,646 (36.74%)	10,290 (43.73%)	533 (2.27%)	19,469 (82.73%)
Upper Des Plaines River	5,538 (17.01%)	10,735 (32.98%)	1,918 (5.89%)	18,191 (55.89%)
Planning Area Total	24,797 (16.49%)	47,848 (31.82%)	7,563 (5.03%)	80,208 (53.34%)

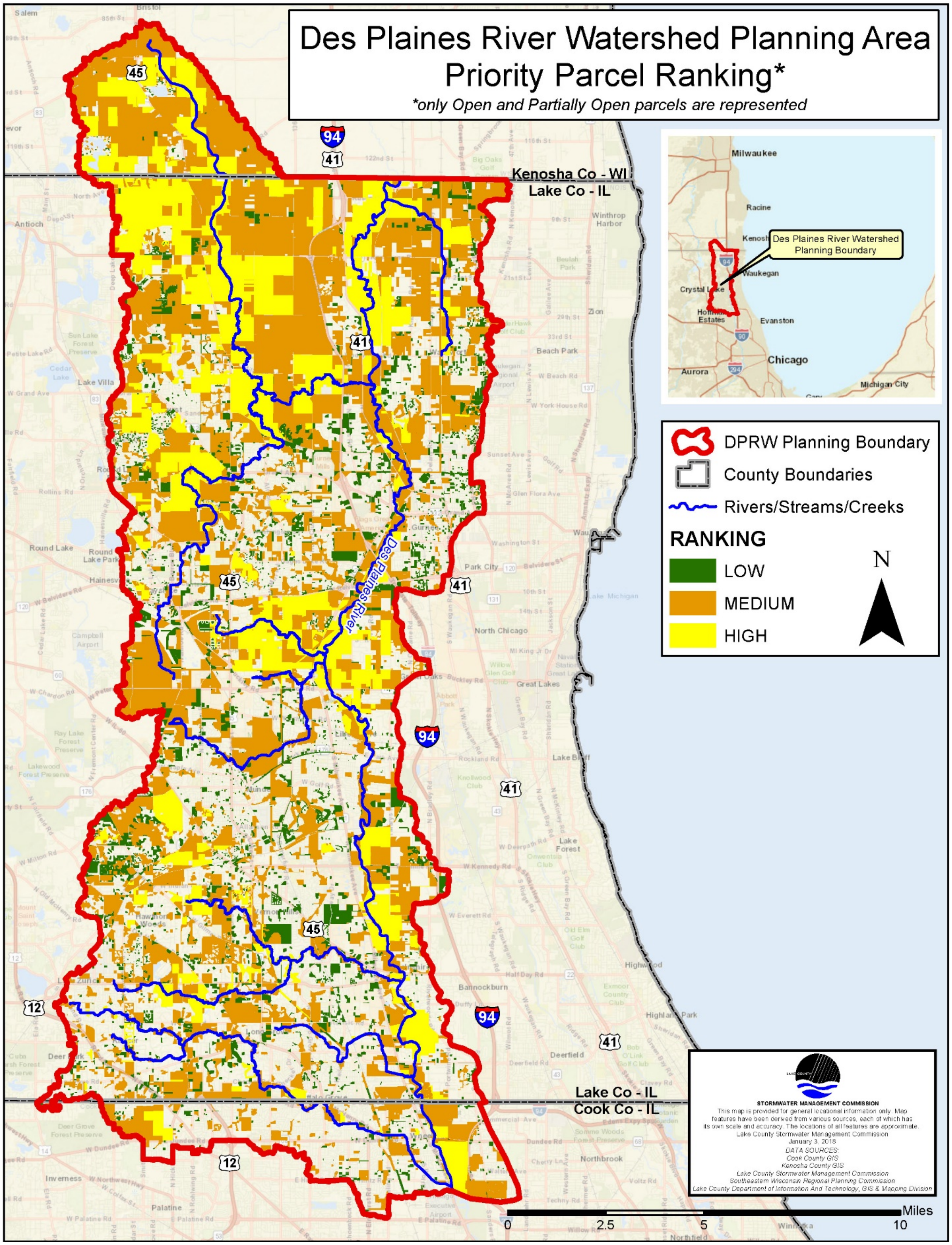


Figure 4-23: Priority Parcel Ranking for Green Infrastructure Network

While high priority parcels only account for 16% of the DPR planning area in total acres, their protection and enhancement will be an integral part of the restoration of the planning area. The majority of the parcels in this category are public lands such as parks and forest preserves. Continuing to protect these high priority public parcels will preserve natural ecosystems that promote stormwater infiltration and reduce stormwater runoff.

The majority (in terms of acreage) of the open or partially open parcels in the DPR planning area are classified as medium priority parcels. Medium priority parcels are scattered throughout the DPR planning area and comprise nearly 60% of the open and partially open parcel acreage. Medium priority parcels are often located in proximity to high priority parcels and stream corridors. The medium priority parcels with existing protection provide excellent opportunities for a variety of green infrastructure practices. Lastly, scattered low-priority open areas offer important opportunities for stormwater green infrastructure practices and should be considered for local stormwater infiltration BMPs.

Utilizing the high and medium priority parcels only, a Stormwater Green Infrastructure Network (see Figure 4-24) for the DPR planning area was developed. Parcels that connect existing protected open space areas were also given a score of one (refer to Criteria 15 – Table 4-29) if they provided a connection or corridor between existing protected open space areas.

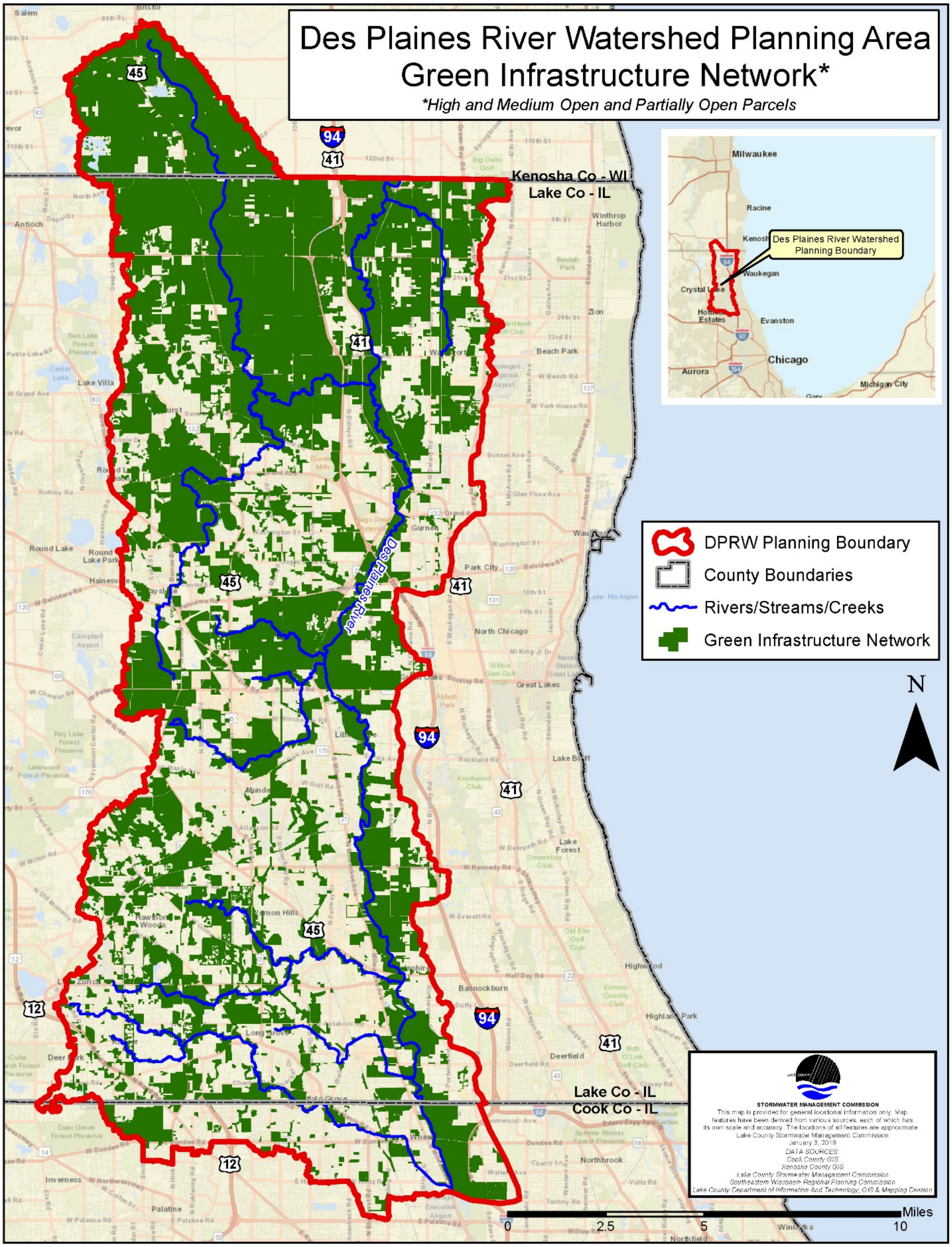


Figure 4-24: Green Infrastructure Network of High and Medium Parcels

In order to achieve the goals of the watershed-based plan, the integrity of the Stormwater Green Infrastructure Network will need to be preserved or enhanced across multiple jurisdictions. In many cases this will require significant coordination and planning among jurisdictions. Priority should be given to preserve the rainfall infiltration and storage capacity of the high and medium priority parcels that are not currently protected. The protection and additional implementation of green infrastructure practices on these parcels where appropriate will increase infiltration and effectively reduce stormwater runoff. Further priority should be given to protect and improve water quality and stream condition of the high and medium priority unprotected parcels that are located within the stream corridors of the planning area and its tributaries. While the scattered low priority open and partially open parcels may not be incorporated into the connected green infrastructure network, communities, park districts, road agencies, and private landowners may significantly reduce runoff and pollution in the DPR planning area by strategically implementing stormwater green infrastructure practices on these sites.

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COMMON ACRONYMS/ABBREVIATIONS USED IN CHAPTER 5

ANHMP - All-Natural Hazards Mitigation Plan

BFE – Base Flood Elevation

CRS - Community Rating System

DCEO - Department of Commerce and Economic Opportunity

DMA 2000 - Disaster Mitigation Act of 2000

DPR Planning Area – Des Plaines River Watershed Planning Area

FEMA – Federal Emergency Management Agency

FIRM – Flood Insurance Rate Map

FIS – Flood Insurance Study

FPA – Flood Problem Area

FPAI – Flood Problem Areas Inventory

GIS – Geographic Information System

HEC – Hydrologic Engineering Center

HMPC - Hazard Mitigation Planning Committee

IDNR-OWR – Illinois Department of Natural Resources – Office of Water Resources

IEMA – Illinois Emergency Management Agency

ISWS – Illinois State Water Survey

ITR – Independent Technical Review

LiDAR - Light Detection and Ranging

NFIP – National Flood Insurance Program

NRCS – Natural Resources Conservation Service

PB&D – Planning, Building & Development

RVR – Runoff Volume Reduction

SFHA – Special Flood Hazard Areas

SMC – Lake County Stormwater Management Commission

SMU – Subwatershed Management Unit

USACE – United States Army Corps of Engineers

USDA – United States Department of Agriculture

USGS – United States Geological Survey

WDO – Lake County Watershed Development Ordinance

WMO – Cook County Watershed Management Ordinance

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5 FLOOD PROBLEM ASSESSMENT

Floodplains and floodways along stream and river corridors perform a variety of benefits. Some of these benefits include aesthetic value, flood storage, water quality, and plant and wildlife habitat. The most important function, however, is the capacity of the floodplain to hold water during significant runoff events to minimize flood damage. Upland areas outside of the floodplains and floodways can experience urban flooding, which is common in older sections of communities where original storm sewers were not designed to present-day standards (prior to stormwater and floodplain regulations). Urbanization has increased runoff, and climate is trending to more frequent and intense storm events (Illinois Urban Flooding Awareness Act, 2015). The increased stormwater runoff, in combination with areas with inadequate and poorly maintained stormwater infrastructure, lead to flash flooding in these urbanized areas.

5.1 FLOOD EVENTS

Flooding is a problem many DPR planning area residents have experienced, whether at home, in their yard, in their neighborhood, at work, or on area roadways. As SMC compiled the Des Plaines River Watershed-Based Plan, more information was needed about when and where flooding occurs that impacts residents in the DPR planning area. As part of the watershed planning process, SMC wanted to identify structures in the watershed that are at risk of flooding so that the watershed plan can include reasonable solutions to reduce flood damage in a cost-effective manner. Throughout the watershed, overbank flooding is most extensive along the Des Plaines River with the highest recorded crest elevations occurring in 2017, 1986, and 2004. Numerous additional historical floods have occurred in the watershed and are mentioned below. The description of these floods below was obtained through various historical resources, including hydrologic atlases and flood hazard mitigation plans and reports.

5.1.1 1938

Figure 5-1: Libertyville Fire Department draining the Fould's Milling Co.
Source: Independent Register on July 8, 1938.

The 1938 flood was one of the more notable floods that occurred in Lake County. This flood seemed to have a two-pronged attack hitting areas around both Butler Lake and the Des Plaines River, which was caused by a tremendous amount of rain in a small window of time. Some residents were surprised when they left for work and found they could not reach their cars due to the flood waters. This flood was thought to have about $1 million worth of property damage and $35,000 of that came from property from Fould's Milling Co. (Hillier, 2015). The Fould's factory was located on Church St. and was right next to both the Des Plaines River and Liberty Lake. Most of the flooding damage occurred in the basement of the factory destroying thousands of dollars' worth of products (see Figure 5-1). The Libertyville Fire Department sent their truck in to help syphon out water, with many fireman and volunteers working through the night to get the basement clear again. While Fould's Milling Co. was dealing with their flood damage, Butler Lake was dealing with their own problems (see Figure 5-2). Lake County's record-setting flood of 1938 became a bit of town lore in Grayslake as the "day that fish swam down main street" (French & Associates, Ltd., 2001).

Figure 5-2: Butler Lake flooding of Lake Street
Source: Libertyville Independent Register on July 8, 1938.

The flood of 1938 wasn't the first flood in Libertyville, but it seemed to be the first that illustrated what a problem flooding could be. Officials for the town realized that something needed to happen to curtail the flooding and damage. However, no one could seem to agree on what should be done or whose responsibility it was. About 25 years later, Libertyville would have two floods in three years that were worse than their 1938 predecessor, but it would be years beyond that before any government action would take place to address the prevention of flooding.

5.1.2 1950s

In 1951, flooding occurred along Indian Creek and around Countryside Lake. The flooding along Indian Creek was reported at the time to be the highest in recent years. In July 1957, flooding occurred around Gages and Diamond Lakes and along Buffalo Creek and its tributaries, Seavey (Hawthorn) Drainage Ditch, Aptakisic Creek, and Wheeling Drainage Ditch.

5.1.3 1960s

The floods of April 1960 resulted from snowmelt followed by heavy rains which eventually overwhelmed the available floodplain storage and set new flood stage records on the Fox and Des Plaines Rivers, respectively. Flooding occurred from March-April 1960 along Mill Creek and Avon-Fremont drainage ditch, Indian Creek, Kildeer Creek (S. Branch Indian Creek), Bull Creek, North Mill Creek and Dutch Gap Canal, the Des Plaines River, and along many other small streams and lakes in the area. In April 1965, Hastings Creek and the Avon-Fremont drainage ditch flooded, as did areas around Sylvan and Forest Lakes. The 1960 flood is notable in that it spurred the first floodplain mapping effort in northeastern Illinois, undertaken by the Northeastern Illinois Planning Commission (now CMAP).

5.1.4 1986 and 1987

The 1986 flood was triggered by widespread regional rainfall with varying intensity and duration which had been preceded by two weeks of nearly continuous rain falling across northern regions of the Des Plaines River, North Branch of the Chicago River and Fox River watersheds. As a result, flooding occurred in rivers and streams across Lake, McHenry, northern Cook Counties (Juhl, 2018).

The Des Plaines River has a long history of flooding that has caused significant economic losses. The damages associated with the 1986 floods was an estimated $35 million in damages to 10,000 dwellings and 263 business and industrial sites. More than 15,000 residents were evacuated from the flooded area and seven lives were lost. Severe impacts to transportation occurred in 33 municipalities along the Des Plaines River in Lake and Cook Counties (USACE, 2014).

Figure 5-3: Des Plaines River flooding 1986

The Des Plaines River took four weeks to pass this floodwater. Northeastern Illinois received almost one inch of rain daily from September 21 through October 4; on some days, as much as three inches of rain fell. Over this two-week period, the Des Plaines River watershed received up to 12.9 inches of rain compared to the normal monthly amount of three inches. The flooding in Lake County killed four people; one person drowned when his boat capsized, and three people had heart attacks fighting the flood. A federal disaster declaration was declared by President Ronald Reagan for the region. Figure 5-3 shows the Des Plaines River flooding in 1986.

The 1987 flooding was caused by short duration high intensity storms. The flooding affected 11,500 single family units and caused $53 million in private property damage in northern Illinois.

The storms of October 2-3, 1986, and August 13-14, 1987, in Illinois, though of contrasting types, both caused record floods and stream discharges with recurrence intervals exceeding 100 years. The 1986 floods were scattered throughout northeastern Illinois and were most severe in Lake and Cook Counties in Illinois. The floods of 1987 were localized and confined to the Des Plaines River basin. Flood damages were great, leaving many residents and motoring public stranded and without access to services. The 1986 and 1987 floods generated enough public awareness of the continued problems of drainage and flooding for the Illinois General Assembly to pass legislation authorizing the formation of countrywide stormwater management programs. Such programs, in conjunction with state and federal programs, are providing stormwater management planning, watershed planning, regulation of construction within floodplain areas, and new sources of funding to manage local drainage and flooding problems.

Lake County adopted a comprehensive stormwater management plan and ordinance to address increased flooding and improve water quality. Existing development, however, is still subject to flooding. As a result, SMC in cooperation with local, state and federal agencies initiated a flood mitigation program to reduce flooding in developed areas.

5.1.5 2004

Figure 5-4: Flooding at the Gurnee Grade School

In May 2004, record to near record flooding occurred in Lake and Cook counties. Heavy rainfall and resultant runoff from the headwaters of the Des Plaines River in Kenosha County, Wisconsin brought the Des Plaines River to flood stage from the Russell to Gurnee stream gages on May 18th. Monthly average rainfall reported re between 10 and 13 inches of rain, with the Upper Des Plaines, Fox River, and Southern Wisconsin watersheds receiving around 40 percent of annual precipitation in 30 days (NOAA, National Weather Service 2004). Floodwaters inundated large areas in Lake County Illinois. The area along the Des Plaines River from Russell to Gurnee stream gages suffered the worst flood problems. Floodwaters inundated large areas of low lying farmland near Russell and surrounded some houses as well. Many residents were evacuated from their homes as flood waters continued to rise. Approximately 40 homes and 20 businesses were affected by high water in Gurnee with 35 homes evacuated. Gurnee area schools were closed. Flood waters surrounded Viking School and the Gurnee Grade School during the peak of the flooding, but sandbagging efforts helped prevent any major flood damage. Many major roads were impacted by flooding and at one time only 4 east-west roads were open from the Wisconsin state line down to Gurnee. Figure 5-4 shows the sandbagging efforts of the Gurnee Grade School in Gurnee during this storm event.

5.1.6 2008

In 2008, multiple storm events associated with the remnants of Hurricane Ike led to 51 consecutive hours of precipitation in Northeastern Illinois. The largest rainfall accumulations occurred south of Lake County but resulted in a disaster declaration for Lake and other surrounding counties for these storms and flooding.

5.1.7 2013

Figure 5-5: April 2013 flood event in Grandwood Park
Flooding damage to the Grandwood Park Dam

In 2013, a massive rainstorm on April 17-18, 2013 delivered between 4-7 inches of rainfall to Northern Illinois (NOAA National Weather Service, 2014). The late snow melt and heavy rains in early April combined with the two-day rain event on April 17-18th, 2013 resulted in extended, widespread riverine flooding in the Des Plaines River watershed. Major flood stage, as defined by the National Weather Service is "extensive inundation of structures and roads." On April 19th, 2013, the Des Plaines River at

Lincolnshire stream gage reached peak water level of 16.36 feet setting a record. The peak water level near Gurnee reached 11.32 feet, just shy of the record 11.95 feet set in 1986. (USACE, 2017).

The heavy rains overwhelmed storm and sanitary sewer systems, caused sewer backups, localized and riverine flooding throughout the County. Floods damaged an estimated 3,200 properties, forced evacuations, and caused numerous power outages and road closures. In Lincolnshire, a levee was breached requiring 49 homes to be evacuated. In Buffalo Grove, the basin at Buffalo Creek Forest Preserve overtopped the dam and Buffalo Creek discharge increased to record levels causing substantial erosion and habitat loss. In response to flooding and severe storms, President Obama declared that a major disaster exists in the State of Illinois. This declaration made federal disaster assistance available for Individuals and Public Assistance. In Lake County, 1,159 individuals and/or households received upwards of $2.7 million dollars in federal disaster assistance. Figure 5-5 shows the April 2013 flood event damage to the Grandwood Park District Dam and the surrounding flooding.

5.1.8 2017

Torrential rounds of heavy rain began late on the night of July 11th, 2017 and continued into the morning of July 12th 2017. Multiple rounds of rain continued over the same locations produced 3-7 inches of rain which brought flash flooding by daybreak and continued throughout the entire day and into the next night. Flooding occurred, and at times very rapidly, affecting flood-prone areas as well as communities that had not experienced this type of flooding before. The heavy rain overwhelmed stormwater infrastructure and the rapid rise of several feet of water along the Des Plaines River led to widespread flooding in the southern portion of the watershed. Major roads were closed, and residents in several areas were evacuated. Hundreds of homes and properties sustained major damage and another 3,000 homes had less severe damage. Record crests were recorded for the Des Plaines River at the Gurnee, Lincolnshire, and Russell Road stream gage locations. Flood waters in many locations along the river did not recede for several days after the rain began. Three Illinois counties including Lake County were proclaimed disaster areas by Governor Bruce Rauner, however federal assistance for a major disaster declaration was denied because the total amount of flood damages did not meet the state threshold for federal assistance. Figure 5-6 shows the extent of flash flooding that occurred in downtown Mundelein during the July 2017 storm event.

Figure 5-6: Flooding in downtown Mundelein

5.1.9 June 2015 Illinois Urban Flooding Awareness Act Final Report

In August 2014, the Illinois General Assembly through PA98-0858 tasked the IDNR to prepare a report on the extent, cost, prevalence, and policies related to urban flooding (Illinois Urban Flooding Awareness Act, 2015). In addition, IDNR was tasked to identify resources and technology that may lead to mitigating the impacts of urban flooding. Flooding in urban areas has received increasing attention in the last decade, with at least $2.319 billion in documented damages between 2007 and 2014, of which $1.240 billion were private claims that typically represent basement flooding and sewer backup (Illinois Urban Flooding Awareness Act, 2015). The Urban Flooding Awareness Act requires FEMA to direct a study to quantify these facts and develop recommendations to assist federal, state, and local governments in their efforts to prevent and provide relief from urban flooding to homeowners and businesses across the country. The Urban Flooding Awareness Act specifically identifies the following nine topics to be addressed in the report:

1. Prevalence and costs associated with urban flooding events across the state and the trends in frequency and severity over the past two decades.
2. Apparent impact of global climate change on urban flooding.
3. The impact of county stormwater programs on urban flooding over the past two decades, including a list of projects and programs and the flood damages avoided.
4. An evaluation of policies such as using the 100-year storm as the standard for designing urban stormwater detention infrastructure and the 10-year storm for the design of stormwater conveyance systems.
5. Review of technology to evaluate the risk of property damage from urban flooding and whether a property is in or adjacent to a 1% (100-year) floodplain or not, including LiDAR and GIS.
6. Strategies for minimizing damage to property from urban flooding, with a focus on rapid, low-cost approaches such as nonstructural and natural infrastructure, and methods for financing them.
7. The consistency of the criteria for state funding of flood control projects between IDNR, IEMA, and DCEO.
8. Strategies for increasing participation in the NFIP and Community Rating System (CRS).
9. Strategies and practices to increase the availability, affordability, and effectiveness of flood insurance and basement backup insurance.

5.2 FLOOD PROBLEM AREAS INVENTORY

5.2.1 Flood and Stormwater Questionnaire

As part of the watershed planning process, SMC identified structures in the watershed that are at risk of flooding so that the watershed-based plan can include reasonable solutions to reduce flood damage. In February 2016, SMC mailed 6,946 hard copies and over 1,500 emails of the voluntary flood and stormwater questionnaire. Recipients were made up of DPR planning area stakeholders in SMC's contact database and known flood problem area residents. The flood and stormwater questionnaire was also accessible to the public through SMC's website and was publicized at the March-May 2016 Des Plaines River watershed planning meetings. The flood and stormwater questionnaires were collected and summarized in May 2016.

The flood and stormwater questionnaire results can help address watershed flooding issues and needs by providing information for residential and business flood damage and flood history. The flood questionnaire focused on characteristics of the landowner's property (i.e., type of property, foundation, basement, water supply, etc.), types of insurance, flood history (possible sources of historical flooding, flood damage, frequency), flood mitigation measures, and other flooding or stormwater management issues in their community.

SMC received 237 completed questionnaires to summarize (without any address specific data) and use for flood mitigation planning purposes in the watershed assessment and action plan. The results of the flood and stormwater questionnaire indicated that 44% of the respondents said flooding was a concern and 30% of respondents said drainage was a concern. 80% of the respondents that indicated they have flooded said they are located in a floodplain. The top three causes of flooding specified by stakeholders are multiple causes, overbank flooding, and storm sewer backup. Stakeholders identified flood damage reduction and maintaining infrastructure as a high priority by category. Flood problem area information was obtained through some of the received questionnaires and included in the overall FPAs inventory. See Figure 5-7 for flood questionnaire results on the types of flooding identified in the DPR planning area.

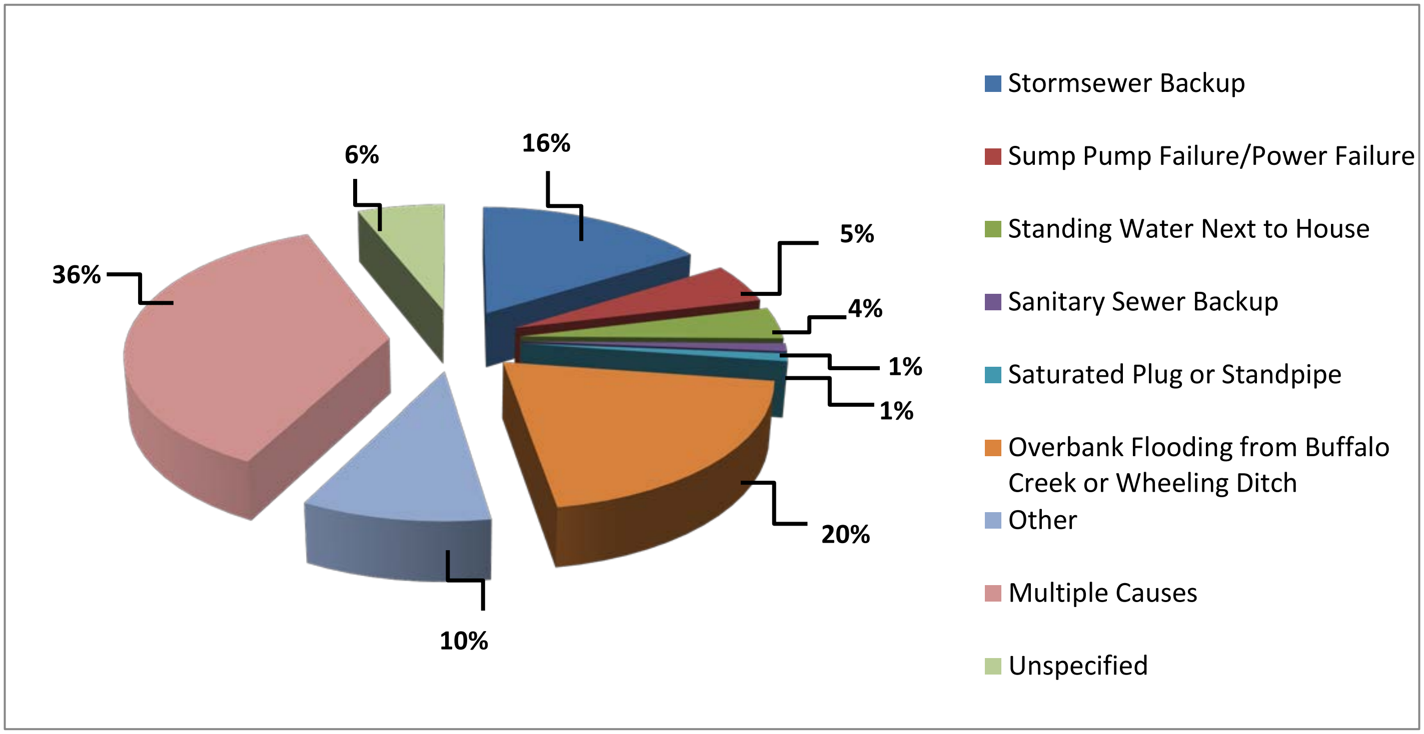


Figure 5-7: Causes of flooding identified from the Flood and Stormwater Questionnaire

5.2.2 Characterization of Flood Problem Areas

Flood Problem Area (FPA): One or more structures in a geographical area that are damaged by the same primary source or cause of flooding. Structures include transportation, utility infrastructure, buildings, and well and septic failure caused by flooding. Areas also include locations where road flooding results in damage to infrastructure, loss of critical access, or threatens safety.

SMC conducted the countywide Flood Problem Areas Inventory (FPAI) in 1995-1996 and updated it in 2002. The FPAI, and a flood risk assessment based on mapped floodplains, identified structures that have been or may be damaged by flood events that are less than the 100-year event. The FPAI is used to locate flood damage problem areas based on reports of flood damage by residents or communities. The FPAI identifies the primary cause of flood damage for each area and is used to recommend flood mitigation priorities. The flood risk assessment identifies additional locations where structures occur in mapped floodplain areas and are likely at risk of flood damage. The purpose was to identify those structures that are at risk of flooding so that the plan can recommend ways to reduce flood damage.

As part of the watershed planning process, SMC updated the inventory of local FPAs to identify the sources of flooding, improve opportunities for reducing flood damage, aid decision-makers about determining adequate downstream capacity when issuing development permits in proximity to FPAs, and reduce flood damage at existing sites from nearby development projects. In March 2016, SMC mailed and emailed 44 watershed municipalities, townships, and large jurisdictions the current flood problem area map and information forms for their jurisdiction to provide updated or new flood problem information. The FPAI information was collected and summarized in April 2017; 30 jurisdictions responded to this inventory update with updated and new information.

Before starting the Des Plaines River watershed planning process, 149 FPAs were known in the DPR planning area. As a result of this FPAI update, SMC received updates on 32 known FPAs, removed 12 locations (flood mitigation efforts were implemented), and added 77 new FPAs to the inventory. Currently, there are 214 known FPAs in the DPR planning area (see Figure 5-8); this number does not include all of the flood data collected from the July 2017 flood event. Because the FPAI includes many areas affected by storms less than the 100-year event, the July 2017 flood event data is excluded given the larger magnitude of that particular storm.

5.2.2.1 July 2017 Flood Event FPAs and Critical Facilities

From July 11-12, 2017 a major precipitation event resulted in rainfall amounts between 3.4 and 7.2 inches in Lake County causing substantial flooding. SMC, Lake County PB&D, and local municipalities surveyed impacted areas to identify FPAs, impacted properties, and impacted critical facilities using data from resident self-reporting and the IEMA. SMC defined FPAs as areas that experienced flooding during the event. FPAs varied in size, with some impacting one property and others impacting over 100 properties. Critical facilities are areas that may require a special response because of human needs or potential environmental impacts, including daycares, schools, gas stations, nursing homes, long term care facilities, and similar facilities. SMC identified 486 FPAs that impacted 2,233 properties and 46 critical facilities within the Lake County portion of the DPR planning area (Figure 5-8). The July 2017 flood event identified FPAs overlapped with approximately 29 existing FPAs in the DPR planning area.

During the survey, structure damage from flooding and multiple forms of flooding were observed, including sewer backups; street, yard, and driveway flooding; and structure flooding. Table 5-1 summarizes the number of FPAs, impacted properties, and impacted critical facilities for each type of flooding. This flood impacted multiple municipalities within the DPR planning area, with Grayslake, Gurnee, Libertyville, Mundelein, and Warren Township having the largest number of impacted properties (Table 5-2). From this event, IEMA received over 3,500 flood damage assessment form entries, and an estimated 9,553 structures were adversely affected by the storm events in Lake County, Illinois.

Table 5-1: DPR Planning Area FPAs, impacted properties, and impacted critical facilities by type of flooding

TYPE OF FLOODING	NUMBER OF FPAS	NUMBER OF IMPACTED PROPERTIES	NUMBER OF IMPACTED CRITICAL FACILITIES
Sewer Backup	14	15	1
Street/Yard/Driveway Flooding	75	75	3
Structure Flooding	378	2,124	41
Structural Damage from Flooding	19	19	1
Total	**486**	**2,233**	**46**

Table 5-2: DPR Planning Area FPAs, affected properties, and impacted critical facilities by municipality

MUNICIPALITY	NUMBER OF FPAS	NUMBER OF IMPACTED PROPERTIES	NUMBER OF IMPACTED CRITICAL FACILITIES
Antioch	3	3	0
Avon Township	3	3	0
Beach Park	3	3	0
Buffalo Grove	11	25	1
Ela Township	1	1	0
Fremont Township	11	19	0
Grayslake	61	353	12
Green Oaks	7	7	0
Gurnee	73	182	1
Hainesville	1	2	0
Hawthorn Woods	8	8	0
Lake Villa Township	13	41	0
Lake Zurich	1	1	0
Libertyville	45	530	6
Libertyville Township	14	62	0
Lincolnshire	2	8	0
Lindenhurst	17	49	2
Long Grove	16	18	2
Mettawa	4	6	0
Mundelein	64	443	8
Newport Township	5	48	0
Park City	2	2	0
Riverwoods	9	10	0
Round Lake Beach	9	13	1

MUNICIPALITY	NUMBER OF FPAS	NUMBER OF IMPACTED PROPERTIES	NUMBER OF IMPACTED CRITICAL FACILITIES
Third Lake	5	29	0
Vernon Hills	17	38	1
Vernon Township	10	30	1
Wadsworth	4	4	0
Warren Township	54	272	11
Waukegan	11	19	0
Waukegan Township	1	3	0
Zion	1	1	0

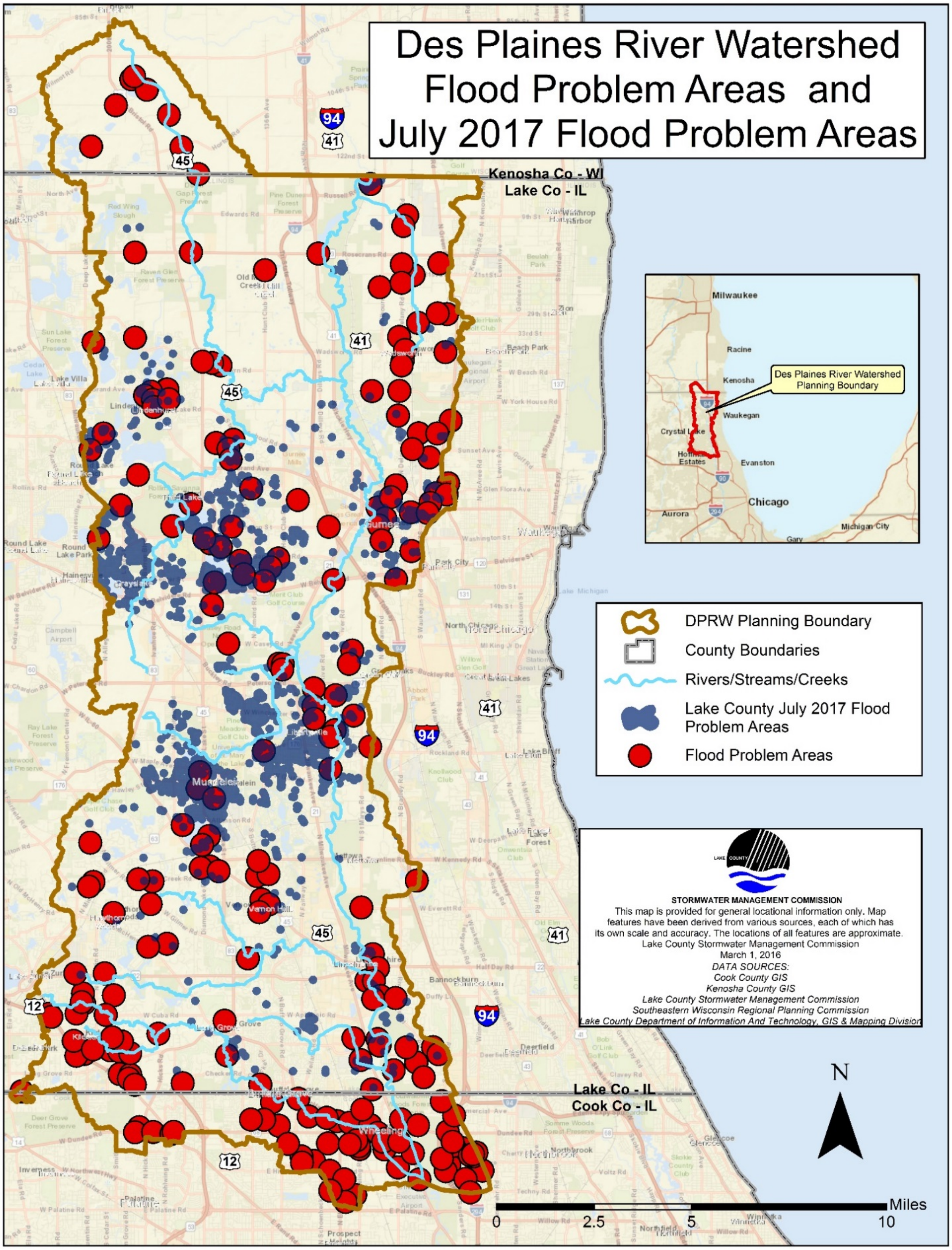


Figure 5-8: Des Plaines River Watershed FPAs and July 2017 flood damage assessment map

5.3 FLOOD RISK ASSESSMENT – STRUCTURES IN THE FLOODPLAIN

Flood risk areas are Special Flood Hazard Areas (SFHA) where structures have been identified as being at risk for flood damage because they are located in the 100-year floodplain. SMC compared the revised floodplain maps with recent (2015) aerial photographs to locate structures in the floodplain. All structures located within the 100-year floodplain are shown in Figure 5-9. Many of the identified structures are in or near potential FPAs. An estimated 4,911 structures (schools; churches; businesses; and residences, including garages, sheds, and gazebos), are at risk of flooding due to their location in the **100-year floodplain**. Of the 4,911 structures, approximately 4,564 properties are within the 100-year floodplain.

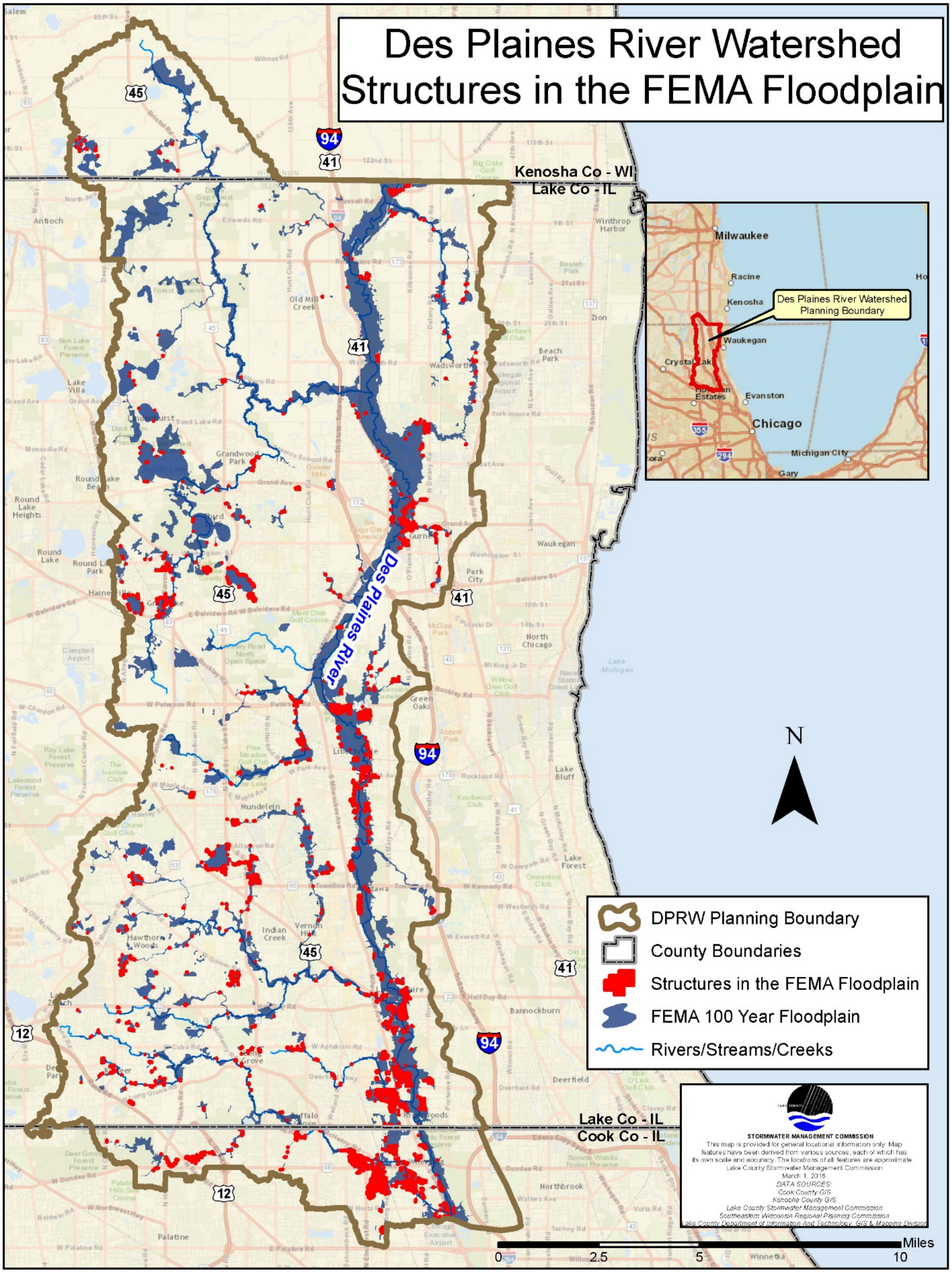


Figure 5-9: Des Plaines River Watershed Structures in the FEMA Floodplain

5.4 FLOODPLAIN STUDY SUMMARY

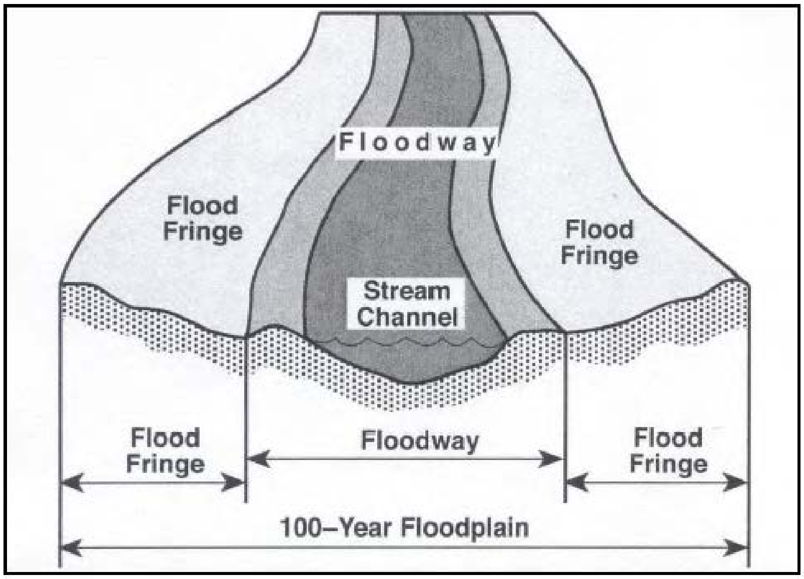


Figure 5-10: Graphical representation of the typical floodplain and floodway

Hydrologists assign statistical probabilities to different size floods to characterize common, less likely, and severe floods for individual streams. For example, a 2-year flood event has a 50% probability of occurring in any year, and a 100-year flood has a 1% chance of being equaled or exceeded in any year. The 100-year flood event, also referred to as the "base flood," is the standard used by the NFIP to determine the need for flood insurance. The 100-year flood event has become the accepted national standard for floodplain regulatory purposes and was developed in part to guide floodplain development that lessens the damaging effects of floods. The **100-year floodplain** may also include a designated floodway. The floodway is the portion of the stream or river channel that must be reserved to discharge the base flood without increasing the water surface elevation more than 0.1-foot. A graphic representation of a typical floodplain and floodway is shown in Figure 5-10.

FEMA has conducted **Flood Insurance Studies** (FIS) that assess a watershed's **hydrology**, land use, and drainage characteristics to identify areas that have the highest probability of flooding. FIS are used to produce **Flood Insurance Rate Maps** (FIRM). These maps depict the probable extent of the floodplain during a 100-year flood event. The FIRM are used to determine flood insurance requirements and calculate insurance costs. The maps are also used in concert with local, state, and federal ordinances to regulate development and building protection requirements within and adjacent to floodplain areas. The DPR planning area covers approximately 150,361 acres, and approximately 14% of the watershed is inundated during the 100-year flood event. Figure 5-11 reflects the regulatory floodplain boundary based on the effective FIRM.

Prior to the Countywide FIS, multiple communities located within the Des Plaines River Watershed completed hydrologic and **hydraulic** analyses. The pre-Countywide FIS studies were included in FIS studies from approximately 1979 to 1980.

FLOOD INSURANCE STUDY (FIS): Studies conducted by FEMA to determine areas that have the highest probability for flooding.

HYDROLOGY: Hydrology is the study of the occurrence, circulation, distribution, and properties (e.g., quality) of Earth's water.

HYDRAULICS: Hydraulics is the study of how water flows over the land surface. This includes flows within sewers, culverts, stream channels, wetlands, lakes, impoundments, etc.

FLOOD INSURANCE RATE MAP (FIRM): A map prepared by FEMA that depicts the SFHA within a community. The FIRM includes zones for the 100-year and 500-year floodplains and may or may not depict Regulatory Floodways.

The USACE updated the hydrologic and hydraulic analysis for the Des Planes River for FEMA in the September 2000 Flood Insurance revision. The work performed by the USACE was completed in September 1995. The updated study included corrections to nomenclature and planimetric information such as corporate limits. The limits of the DPR study are bound by Lake Cook Road at the southern limit of the county and extends north to approximately 0.8 miles north of Russel Road. Hydrologic data was based on USGS gaging stations. The gage data was analyzed utilizing a log-Pearson type III distribution, following guidelines recommended by the U.S. Water Resources Council. The USACE completed an analysis of the DPR frequency discharge curves for the four main stem recording gages within the study reach. The results were calibrated to match the statistical results using the HEC-1 hydrologic model. Currently, there are three floodplain studies in the DPR planning area for Newport, Bull Creek, and Mill Creek watersheds. Table 5-3 contains more information on the DPR planning area watershed floodplain studies and the status of data for usage as regulatory “best available”.

Table 5-3: Floodplain Studies in the DPR Planning Area and Status of Data for Usage as Regulatory "Best Available"

FLOODPLAIN STUDIES	CONTRACTOR	INDEPENDENT TECHNICAL REVIEW (ITR)	ITR COMPLETED?*	SMC ADOPTED?**	IDNR/ FEMA REVIEWED?	STATUS
Newport	MWH Global	Hey & Associates	Yes	No	No	Bleck Engineering has made comments on study.
Bull Creek (Des Plaines)	USGS / FluidClarity	Hey & Associates	Yes	No	No	ITR completed comments and incorporated in final Fluid Clarity study. Model updated after ITR review.
Mill Creek	Tetra Tech	Bleck Engineering	Yes	No	Flows Certified	ISWS completed revisions/waiting on Grayslake for possible additional revisions (Status: 5/2014).

* can be recommended for use as regulatory best available (where BFEs are higher than FEMA's)
** can be required for use as regulatory best available (where BFEs are higher than FEMA's)

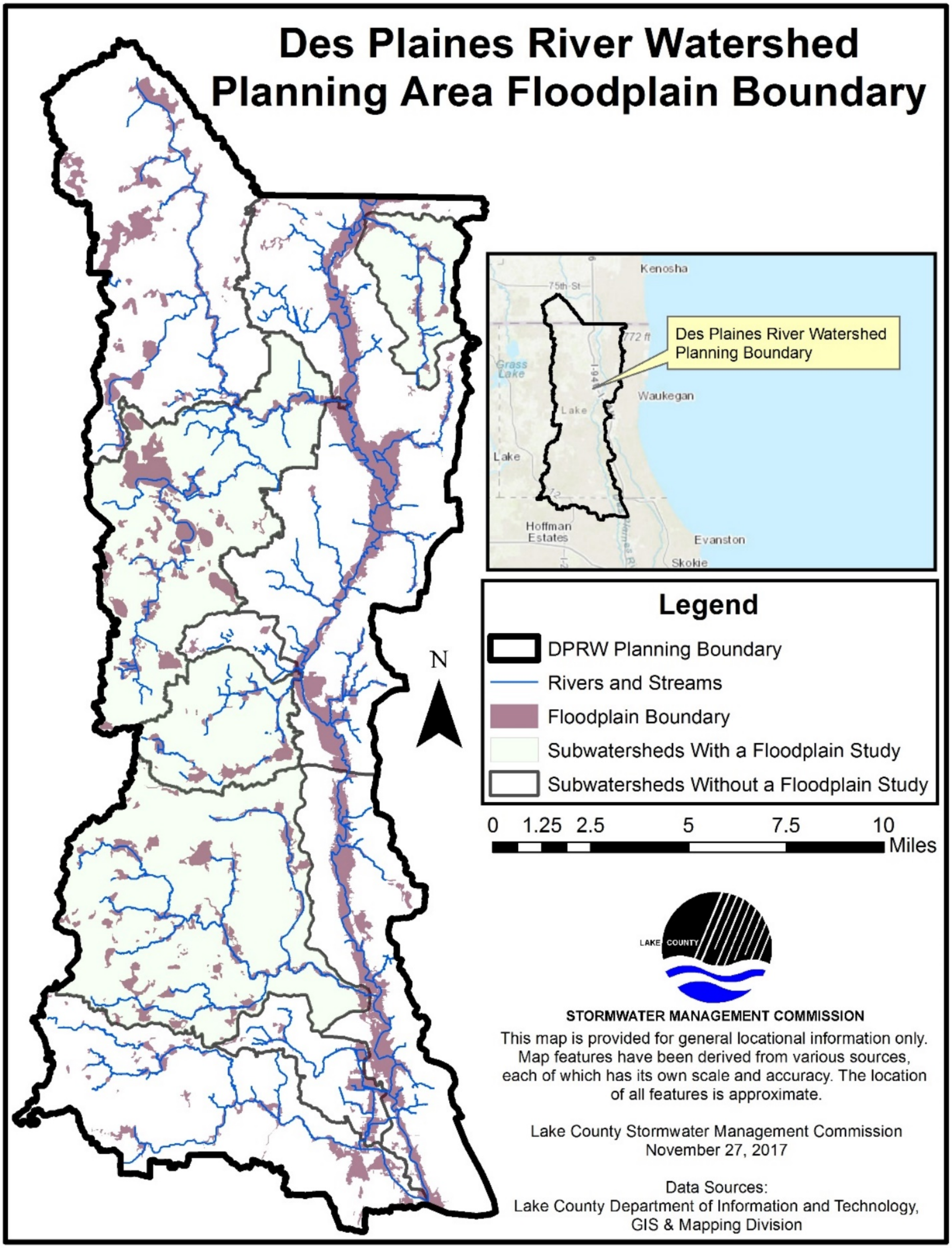


Figure 5-11: Des Plaines River Watershed Planning Area Floodplain Boundary

5.5 FLOOD DAMAGE REDUCTION

Flooding is a common issue in the DPR planning area because of urban development and a relatively flat regional topography. Urban development has increased impervious surfaces and modified or built in natural storage and floodplain areas, resulting in increased stormwater runoff volumes and rates. The relatively flat topography of the region results in excess water dispersing over a large area. Protection of the existing flood storage capacity of the landscape, including depressional areas, wetlands, and floodplains, is necessary to prevent increased flood risks in the region. Flood damage reduction is necessary to reduce the extent, frequency, and impact of flooding where development has already occurred. Flood damage reduction can be accomplished utilizing preventative or remedial measures.

5.5.1 PREVENTATIVE MEASURES

Flood prevention techniques, including zoning, regulation, land acquisition, and runoff reduction, seek to prevent flooding problems before they occur. Zoning and floodplain regulations seek to prevent flood damages by limiting development in areas where flooding is most likely to occur. Land acquisition maintains open space, preserving rainfall infiltration and natural storage areas. Runoff reduction techniques reduce flood damage potential at the source by decreasing the amount of runoff from a developed site. This is accomplished by reducing on-site drainage, minimizing impervious surfaces, and implementing natural drainage measures.

5.5.1.1 Floodplain Zoning

Zoning ordinances regulate development by dividing the community into zones or districts and setting development criteria for each district. Zoning can prevent increased flood risks by controlling where new development or redevelopment occur. Zoning ordinances can establish separate zoning districts or overlay zoning. Separate districts designate floodplains as a special zoning districts that only allow development that is not susceptible to flood damage, such as some recreational uses, conservation, or agriculture. Overlay zoning adds special development limitations to the underlying zoning (i.e., residential, commercial, industrial, etc.) in areas subject to flooding. Special development limitations can include local, state or federal building requirements related to flood safety and can restrict the types of development occurring in overlay zoning districts or require additional permitting or oversight in these districts.

5.5.1.2 Floodplain Regulations

Regulations that restrict construction in floodplains are usually found in one or more of the following documents: subdivision ordinances, building codes, and separate stand-alone floodplain ordinances such as the Lake County WDO, Cook County WMO, and Wisconsin's local (municipal) floodplain ordinances. If the zoning for a site allows a structure to be built, then the applicable subdivision and building regulations impose construction standards to protect buildings from flood damage and will require compensatory storage to prevent the development from aggravating the flooding problem. Subdivision ordinances specifically govern how land will be subdivided into lots and regulate standards for infrastructure provided by the developer, including roads, sidewalks, utilities, stormwater detention, storm sewers, and drainage ways. Both building codes and the countywide and local ordinances establish flood protection standards for all structures. Individual communities can adopt floodplain regulations that are more restrictive than the minimum WDO, WMO, or NFIP requirements.

All development in Lake County floodplains requires a WDO permit. The WDO restricts development in mapped floodways and limits development in the 100-year floodplain. Lowest floor elevations (including basements) must be a minimum of 2 feet above the BFE for residential structures constructed in the floodplain. Nonresidential structures must also meet these lowest floor elevation requirements or be dry-flood-proofed to 2 feet above the BFE, and compensatory storage must be provided for water storage lost due to floodplain fill at a ratio of 1.2:1 for riverine floodplain and 1:1 for depressional floodplain. All Lake County communities must adhere to the standards required in the WDO as minimum development requirements for their community. Individual communities can adopt floodplain regulations that are more restrictive than the minimum requirements of the WDO. Since the WDO applies to both new developments and redevelopment projects, the WDO flood prevention and water quality provisions have the potential to improve conditions in redeveloped areas.

Cook County communities must adhere to the standards required in the WMO as minimum development requirements for their community. All development in a **Flood Protection Area** requires a Watershed Management Permit. The WMO restricts development in mapped floodways and limits development in the 100-year floodplain. Compensatory storage must be provided for floodplain storage lost due to floodplain fill at a ratio of 1.1:1.

FLOOD PROTECTION AREA: Regulatory floodplains, regulatory floodways, riparian environments, wetlands, and wetland buffers.

Wisconsin floodplain development is managed through local floodplain ordinances. All local floodplain ordinances must meet the minimum requirements of the NFIP. Floodplain ordinances are adopted at the local level in the same manner as any other ordinance. Enforcement of the floodplain regulations is the responsibility of local officials. For most communities, the responsible official is the Zoning Administrator. Every community that participates in the NFIP must have the FIRMs and FIS available for the public. Communities that do not adequately enforce the local floodplain ordinance can be penalized by FEMA through probation or suspension from the NFIP. Violations of the minimum requirements of ch. NR 116 can result in enforcement action by the WI DNR. Development and redevelopment in Wisconsin within the entire Des Plaines River Watershed (including outside of the DPR planning area) can affect stormwater drainage coming into Lake & Cook County, Illinois. See section 4.1 for more information about the effects of impervious surfaces and development to downstream sites.

5.5.1.3 Floodplain Property Acquisition

Floodplain property acquisition is one of the flood mitigation tools used by Lake County to abate the potential increase in flood risk, including the implementation of the Lake County WDO and Comprehensive Planning to protect against new flood damages. Floodplain property acquisitions ensure that buildings in a flood-prone area will cease to be subject to damage. Acquisitions are usually undertaken by a government agency, using a combination of state, local and federal (FEMA) cost-share funding to reduce the financial impact to the property owner. Properties acquired are cleared of buildings and structures and returned to public open-space areas such as parks, greenways, recreational trails, river access points, and wildlife habitat corridors. The resulting open space from acquisitions and demolition of property in the floodplain and flood-prone areas can also be used for stormwater management and/or serve as a buffer to protect against damage from increased flooding and stormwater runoff. Floodplain property acquisitions provide the best long-term flood protection measure and coverts problem areas into a community asset.

5.5.1.4 Runoff Reduction

Runoff reduction can be accomplished utilizing techniques that improve infiltration, site design, or stormwater regulation. Improved infiltration techniques include natural landscaping with deep-rooted plants, permeable pavers or porous pavement, and bio infiltration devices. Improved site design techniques include preserving natural drainage systems, impervious surface reduction, alternative streetscapes that reduce and infiltrate runoff, alternative parking lot designs, and green roofs.

Stormwater regulations can also reduce the quantity of runoff from developments. Due to a trend of increasing Runoff Volume Reduction (RVR) requirements of the Illinois EPA, both the WDO and WMO have adopted both qualitative and quantitative RVR provisions. The WDO is a credit-based system designed to capture a percent of the annual rainfall event to the maximum extent practicable. The WMO is tied to the first inch of runoff from the impervious area of a development site, defined as the control volume. These measures will decrease the volume and flow rate of stormwater that is discharged off a site thereby preventing future flood damage.

NOTEWORTHY – LAKE COUNTY WDO REGULATIONS

The Lake County WDO defines adequate downstream stormwater capacity as a system that can be shown to "store or convey up to and including the 100-year stormwater runoff without increasing damage to adjoining properties or to a point downstream known to the Enforcement Officer to be a restriction causing significant backwater."

5.5.2 REMEDIAL MEASURES

Flooding problems are reduced or eliminated by both structural and non-structural means. Structural flood mitigation measures focus on reducing the probability of flooding (i.e., removing or reducing the ability of flood waters to reach a property or structure) while nonstructural flood mitigation measures focus on reducing the consequences of flooding (i.e., flood-proofing a structure located in the floodplain.)

Structural flood mitigation measures include improving overland flow routes, increasing storm sewer capacity, and implementing other conveyance-related drainage improvements. Improved conveyance practices should be designed to ensure that adjacent and downstream properties and waterways will not be negatively impacted by increased flows. More complex structural flood mitigation measures may involve the construction of structures such as reservoirs, levees, and floodwalls to confine or redelineate the flooding limits. Nonstructural mitigation alternatives include practices such as acquisition or relocation of flood-prone structures, flood-proofing, or implementation of ordinances and codes. Several common types of structural and nonstructural mitigation measures are described below.

5.5.2.1 Structural Flood Mitigation Measures

Structural measures control or contain water and are designed to prevent floodwaters from reaching buildings or property. Structural alternatives include reservoirs, levees and floodwalls, diversions, stream channel conveyance improvements, and drainage and storm sewer improvements. Large or complex structural flood mitigation alternative projects are often costly to implement, so local agencies and private land owners often request help from state or federal agencies such as the IDNR-OWR, the USACE, and the USDA NRCS.

Structural flood control is generally the most expensive type of mitigation measure because of installation time and costs, maintenance requirements, and environmental impacts. Thorough assessment of alternatives prior to selecting a structural flood control measure can minimize costs and impacts. The advantages and disadvantages of structural flood control techniques are discussed in Table 5-4 (Association of State Floodplain Managers, 2007).

Table 5-4: Benefits and drawbacks to structural flood control measures

ADVANTAGES	SHORTCOMINGS
May provide the greatest amount of protection for land area used.	They disturb the land and disrupt natural water flow, often destroying wildlife habitat.
Because of land limitations, may be the only practical solution in some circumstances.	They require regular maintenance, which if neglected, can have disastrous consequences.
Can incorporate other benefits into structural project design such as water supply and recreational uses.	They are built to a certain flood protection level that can be exceeded by larger floods, causing extensive damage.
Regional detention may be more cost efficient and effective than requiring numerous small detention basins.	They can create a false sense of security, as people protected by a project often believe the structure eliminates any flooding risk.
	Although it may be unintended, in many circumstances they promote more intensive land use and development in the floodplain.
	They can create new flooding problems if improperly designed or built.
	Levees and reservoirs can significantly degrade riparian and aquatic habitat and water quality.

5.5.2.1.1 Reservoirs and Regional Detention

Reservoirs and regional detention are large structures that control flooding by holding water behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate that is equal to or less than the capacity of the downstream channel. Reservoirs that maintain a normal water level may be used for water supply or to provide water-based recreational benefits. Additionally, wet or dry detention basins can serve multiple uses by doubling as parks or other open space uses.

Figure 5-12: Flood control reservoir

The amount of land needed, coupled with the expense of construction, management, and maintenance, limit the use of reservoirs. Additionally, reservoirs may fail to prevent floods that exceed their design levels, eliminate the natural and beneficial functions of the floodplain, and negatively impact water quality and aquatic habitat. Figure 5-12 shows an example of a flood control reservoir.

5.5.2.1.2 Detention Basins

Some localized flooding problems can be minimized by enlarging or adjusting flows through existing detention basins or by constructing new basins. Detention basins are effective at flood reduction in watersheds of up to 30 square miles. While regional detention is generally more cost-effective than constructing numerous small detention facilities, in some cases there may not be sufficient land available for regional detention. Smaller detention basins may be the most cost-effective solution for localized flood problems. Slowing release rates from new and existing detention basins can reduce the downstream flood risk and impacts of short duration-high-velocity events on the stream channel. Retrofitting older detention basins to improve functionality or storage volume or constructing new detention basins are often viable flood mitigation alternatives, especially for smaller tributary areas (less than 100 acres).

5.5.2.1.3 Levees and Floodwalls

Earthen levees or concrete floodwalls are constructed between rivers and at-risk properties to mitigate overbank flooding. Levees and floodwalls confine water to the stream channel by artificially raising the banks (Figure 5-13). Regulatory levees must meet very strict and onerous design and permitting requirements. A serious concern with levees is that they frequently offer a false sense of security. In some cases, land use behind a levee can change to high intensity, high-value occupation under the false assumption that all future floods will be controlled by the levee, when in reality, large floods may overtop or breach the levee creating more flood damage than would have occurred.

Figure 5-13: Floodwall example

Levees and floodwalls have other limitations. Placed along the river or stream edge, they degrade riparian and aquatic habitat. Levees are expensive to construct, require considerable land and maintenance, and are more likely to push floodwater onto other properties upstream or downstream. In some cases, it may be necessary to include expensive and noisy pumping operations for internal drainage. Levees also act as barriers to river access, block views, and disrupt local drainage patterns.

5.5.2.1.4 Barriers

Constructing barriers such as nonregulatory low floodwalls and berms around an individual property can keep floodwaters from reaching the structure. Berms are commonly used in areas subject to shallow flooding; see Figure 5-14 for a diagram of a backyard berm. Not considered engineered structures, berms are made by regrading or filling an area. Low floodwalls may be built around stairwells to protect the basements and lower floors of structures. By keeping water away from the structure walls, the problems of seepage and hydrostatic pressure are reduced. Barriers are commonly referred to as nonregulatory since a barrier typically cannot be used to remove a structure or property from the Regulatory Floodplain.

Figure 5-14: Example of a backyard berm
Diagram Courtesy of Seattle Public Utilities (Seattle.gov)

As with levees, the use of low floodwalls and berms must also include a plan to install drainpipes or sump pumps to handle leaks and water seepage through or under the barrier, and to remove water that may collect within the barrier. Care must be taken in the design, location, and installation of low floodwalls or berms to ensure that flood waters are not inadvertently pushed onto adjacent properties.

5.5.2.1.5 Improved Channel Conveyance

Channel conveyance improvements alter channels to increase drainage rate and volume. Improvements include making channels wider, deeper, smoother, or straighter. Some channels in urban areas have also been lined with concrete or put in underground pipes. Channel conveyance improvements such as channelization and dredging are environmentally destructive with respect to habitat and water quality and are frequently unsustainable.

Straightening, deepening, or widening a stream or river channel, commonly referred to as channelization, has been traditionally utilized to reduce riverine overbank flooding problems. Channelized rivers and streams drain water faster from areas adjacent to and upstream of the channel but can increase or create new flooding problems downstream as larger volumes of water are transported at a faster rate. Channelized waterways tend to be less stable and more susceptible to streambank erosion; therefore, the need for periodic reconstruction, streambank stabilization, and silt removal becomes cyclic, making stream and channel maintenance extremely expensive.

Dredging is another type of conveyance improvement; however, it is frequently cost prohibitive due to dredged material disposal costs. Additionally, dredged areas typically fill in relatively quickly if upstream erosion is not reduced.

5.5.2.1.6 Drainage Improvements

Drainage improvements can include open ditches, swales, or storm sewers. Man-made ditches and storm sewers help drain areas where surface drainage is inadequate or where underground drainageways may be safer or more practical. Drainage and storm sewer improvements can be a quick and relatively cost-effective way to safely convey runoff for a wide range of smaller storm events. Storm sewer improvements may include the installation of new sewer lines or inlets, modifications to existing sewer inlets, installation of larger pipes, construction of better defined or more effective overland flow routes, and the use of mechanical measures, such as pumps or backflow preventers. Since drainage improvements typically result in runoff being more efficiently conveyed to a downstream location, these mitigation measures should only be used when the receiving waterway has sufficient capacity to handle the additional volume and flow of water. To prevent cumulative downstream flood impacts, drainage improvements are often combined with other storage volume creation or runoff reduction measures.

Performing regular maintenance on stormwater infrastructure for drainage improvements, such as channel clearing, dredging, storm sewer cleaning, or clogged debris removal, can be the most cost-effective measure in reducing future larger, more expensive infrastructure problems. “All stormwater management systems, whether gray or green, require maintenance. Appropriate operation and maintenance activities ensure that green (and gray) infrastructure will continue to function properly and yield expected water quality and environmental benefits, protect public safety, meet legal standards, and protect communities’ financial investment.” (U.S. Environmental Protection Agency - Office of Water, 2013).

5.5.2.2 Nonstructural Flood Mitigation Measures

Flooding problems can also be addressed using nonstructural methods. Nonstructural flood control techniques include flood-proofing, and elevation or relocation of a structure. More communities and county-wide agencies could get involved in nonstructural programs such as acquisition by helping to identify repetitively flooded properties. Runoff reduction techniques may also be used by individual homeowners or neighborhood associations in retrofit projects to lessen flooding problems.

5.5.2.2.1 Buyouts and Acquisitions

Acquisition ensures that structures in a flood-prone area will cease to be subject to flood damage. The major difference is that acquisition is undertaken by a government agency, so the cost is not borne by the property owner, and the land is converted to an appropriate permanent public use such as a park. Acquiring and clearing structures from the floodplain is the best long-term flood protection measure, one which converts a problem area into a community asset that can provide environmental and recreational benefits. To achieve maximum benefits from this type of public investment, acquisition and land reuse should be a component of a community's redevelopment plan, and be incorporated as a strategy in park, greenways, and capital improvement plans. See Figure 5-15 for before and after photos of the Gurnee Grade School (Gurnee, Illinois) flood buyout location.

Figure 5-15: 2013 Gurnee Grade School flood mitigation site during flood events
Before buyout looking south (top); after buyout and school removed looking north (bottom)
"X" is the same spot on the site location

5.5.2.2.2 Structure Relocation

Moving a structure to higher ground is an extremely effective way to protect it from flooding. In many cases structure relocation is cost prohibitive because of the size, condition, and type of structure and the cost of acquiring a relocation site. Structure relocation can be cost effective where flooding is relatively severe or frequent. Structure relocations have high initial costs, but they may be more cost-efficient than paying for repetitive flood damages or high flood insurance premiums. Relocation is typically the responsibility of the structure owner; however, government-sponsored loans or grants may be available for cost-share.

5.5.2.2.3 Structure Elevation

Raising a structure above the floodplain elevation is the best way to protect a structure that cannot be removed from the floodplain. The structure is elevated on a foundation or piers so that the lowest floor is above the BFE. When flooding occurs, water levels stay below the main floor, causing minimal damage to the structure or its contents. Raising a structure above the flood level is less expensive than moving it and can be less disruptive to a neighborhood. Commonly practiced in flood-prone areas nationwide, this protection technique is required by law for new and substantially damaged residences located in a 100-year floodplain.

Although flood damages can be reduced or eliminated through structure elevation, remaining in a flood-prone location has some limitations. While the structure itself is sufficiently elevated to be protected from flood damage, flooding may isolate the building and make it inaccessible. Flood waters surrounding the structure can also result in a loss of utility service or septic use, making the structure uninhabitable. Additionally, pollutant contamination in flood waters may present health and safety concerns.

5.5.2.2.4 Flood Proofing

Flood-proofing measures include dry flood-proofing or wet flood-proofing. In areas where there is shallow flooding, dry flood-proofing measures can be used to prevent water from entering at-risk structures. Dry flood-proofing is a combination of practices that are used to make a building watertight, so flood waters do not enter the structure, including the basement or crawl space. Various FEMA and the USACE publications highlight the range of practices that can be used to dry flood-proof a structure. Figure 5-16 shows an example of dry flood proofing practices.

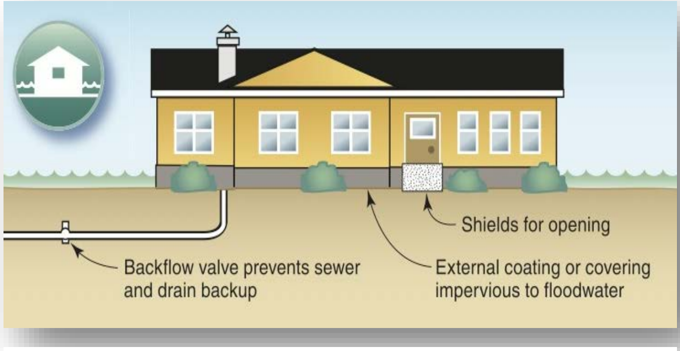


Figure 5-16: Dry flood-proofing

As defined by FEMA, wet flood-proofing includes permanent or contingent measures applied to a structure or its contents that prevent or provide resistance to damage from flooding while allowing flood waters to enter the structure or area. Wet flood-proofing allows water to enter the structure, but minimizes the damage to the structure and its contents. Wet flood-proofing includes some of the least expensive and easiest mitigation practices to install. Generally, this includes properly anchoring the structure, using flood resistant materials below the BFE, protecting mechanical and utility equipment, and using openings or breakaway walls. Several low-cost steps can be taken to wet floodproof a structure. For example, simply moving furniture and electrical appliances out of the flood-prone portions of the structure can prevent thousands of dollars in damages. One strong advantage of wet flood-proofing is that flood damage can be reduced through some common sense, low or no-cost practices. Figure 5-17 shows an example of wet flood proofing practices.

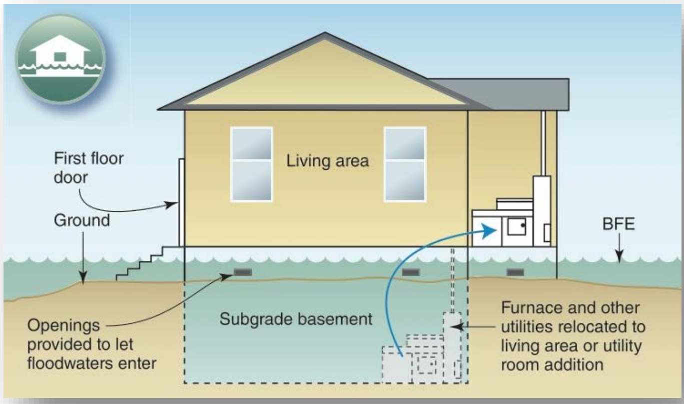


Figure 5-17: Wet flood-proofing

5.5.2.2.5 Runoff Reduction

Examples of runoff reduction techniques include the use of natural landscaping, permeable pavement, rain gardens and green roofs. Implementing these runoff reduction retrofits is generally the responsibility of individual property owners. These techniques typically do not have a substantial impact when applied on a single site; however, the cumulative effect of runoff reduction techniques at numerous sites throughout the watershed can result in substantial flood reduction benefits. The large scale of individual implementation required to achieve measurable flood reduction benefits makes this flood mitigation measure a long-term complementary mitigation measure rather than an immediate flood mitigation alternative.

5.5.3 All-Natural Hazards Mitigation Plan Recommendations

The DPR planning area is subject to natural hazards that potentially threaten life and property. Flooding, severe summer and winter storms, extreme cold and heat, and tornadoes are the most significant natural hazards that affect Lake County (including the DPR planning area).

To prepare for and mitigate the effects of natural hazards, counties within the DPR watershed have developed hazard mitigation plans. FEMA, through the Disaster Mitigation Act of 2000 (DMA 2000) and the Stafford Act, requires that each community develop and adopt a FEMA-approved All-Natural Hazards Mitigation Plan (ANHMP) in order to be eligible for hazard mitigation grant funds. DMA 2000 and the Stafford Act require that the mitigation ANHMP be updated and readopted every five years to maintain grant eligibility. An ANHMP assesses the natural hazards that affect counties, sets mitigation goals, considers mitigation efforts currently being implemented, evaluates additional mitigation strategies, and recommends mitigation actions to be implemented over the next five years. The mitigation actions are designed to utilize both public and private sectors to protect the people and assets of the counties. Implementation of all action items is contingent on the availability of staff and funding.

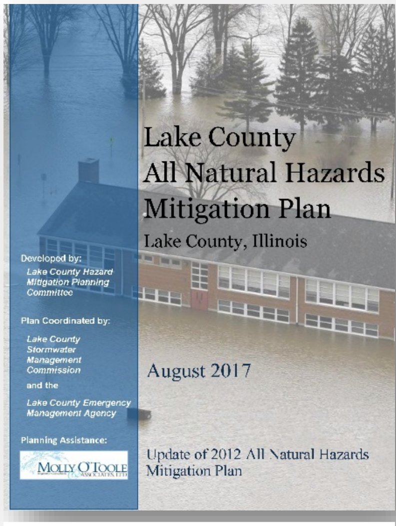


Figure 5-18: 2017 ANHMP

Lake County and the hazard mitigation planning committee (HMPC) developed and adopted the Lake County Countywide ANHMP in 2006 as a multi-jurisdictional plan; the plan was updated in 2012 and 2017 (see Figure 5-18).The 2017 update to the ANHMP was developed by the Lake County HMPC as a multi-jurisdictional ANHMP to meet federal mitigation planning requirements. The 2017 ANHMP is adopted by resolution by the County and each participating municipality. The 2017 ANHMP will be implemented and maintained through both countywide and individual initiatives, as funding and resources become available.

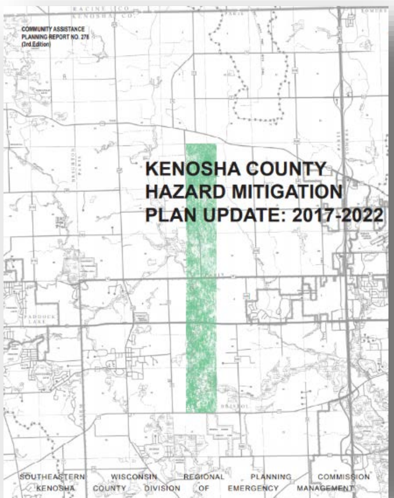
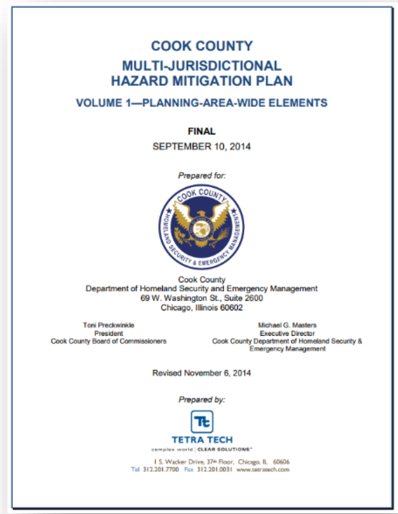


Figure 5-19: Kenosha County ANHMP

SEWRPC and the Kenosha County Division of Emergency Management cooperatively developed the Kenosha County ANHMP in 2005 (Figure 5-19); the plan was updated in 2009 and 2017. The plan follows the guidelines and requirements of the Wisconsin Department of Military Affairs, Division of Emergency Management, and FEMA. The plan was written with the guidance of the Kenosha County Hazard Mitigation Task Force. The plan has been adopted and approved by Kenosha County and the municipalities within the county.

The Cook County Department of Homeland Security and Emergency Management developed the Cook County Multi-Jurisdictional Hazard Mitigation Plan (Figure 5-20) in 2014 with guidance from a steering committee comprised of planning partners and local stakeholders. The plan was developed under a grant from the IEMA in coordination with 115 planning partners and is the largest multijurisdictional all hazards mitigation plan ever completed in the United States. That plan incorporated existing local and state plans, studies, reports, and technical information.



COOK COUNTY
MULTI-JURISDICTIONAL
HAZARD MITIGATION PLAN
VOLUME 1—PLANNING-AREA-WIDE ELEMENTS
FINAL
SEPTEMBER 10, 2014
Prepared for:
Cook County
Department of Homeland Security and Emergency Management
69 W. Washington St., Suite 2600
Chicago, Illinois 60602
Toni Preckwinkle
President
Cook County Board of Commissioners
Michael G. Masters
Executive Director
Cook County Department of Homeland Security & Emergency Management
Revised November 6, 2014
Prepared by:
TETRA TECH

Figure 5-20: Cook County ANHMP

5.6 EXISTING AND POTENTIAL REGIONAL FLOOD STORAGE

5.6.1 Existing Flood Storage

Existing flood storage is defined as depressional areas and floodplains that are presently storing, or potentially could store, stormwater runoff to decrease flooding in the watershed. Besides flood protection, flood storage areas can be used for the mitigation of wetland losses (wetland restoration), channel protection, and water quality protection. Flooding is a common problem in the DPR planning area. Creating or enhancing storage would provide many benefits including reducing runoff to streams and minimizing channel erosion. Storage areas that are created through wetland restoration would improve water quality and habitat and increase groundwater recharge. The criteria used to identify existing storage locations are:

Figure 5-21: Wetland with high flood storage

- Include all mapped FEMA 100-year floodplains (SFHA), wetlands with high flood storage function (as identified in the WRAPP), detention basins, and open water areas (Example Figure 5-21).
- Minimum storage size of 1 acre-foot on partially open or open parcels.
- Includes stream corridors.

The existing flood storage locations are identified in Figure 5-22**.** These locations range from 1-5,084 acre-feet of storage with a median storage of 4 acre-feet. The total of 1,931 storage areas encompass 24,219 acres (16% of the DPR planning area) with an estimated potential to store a total of 50,348 acre-feet of water.

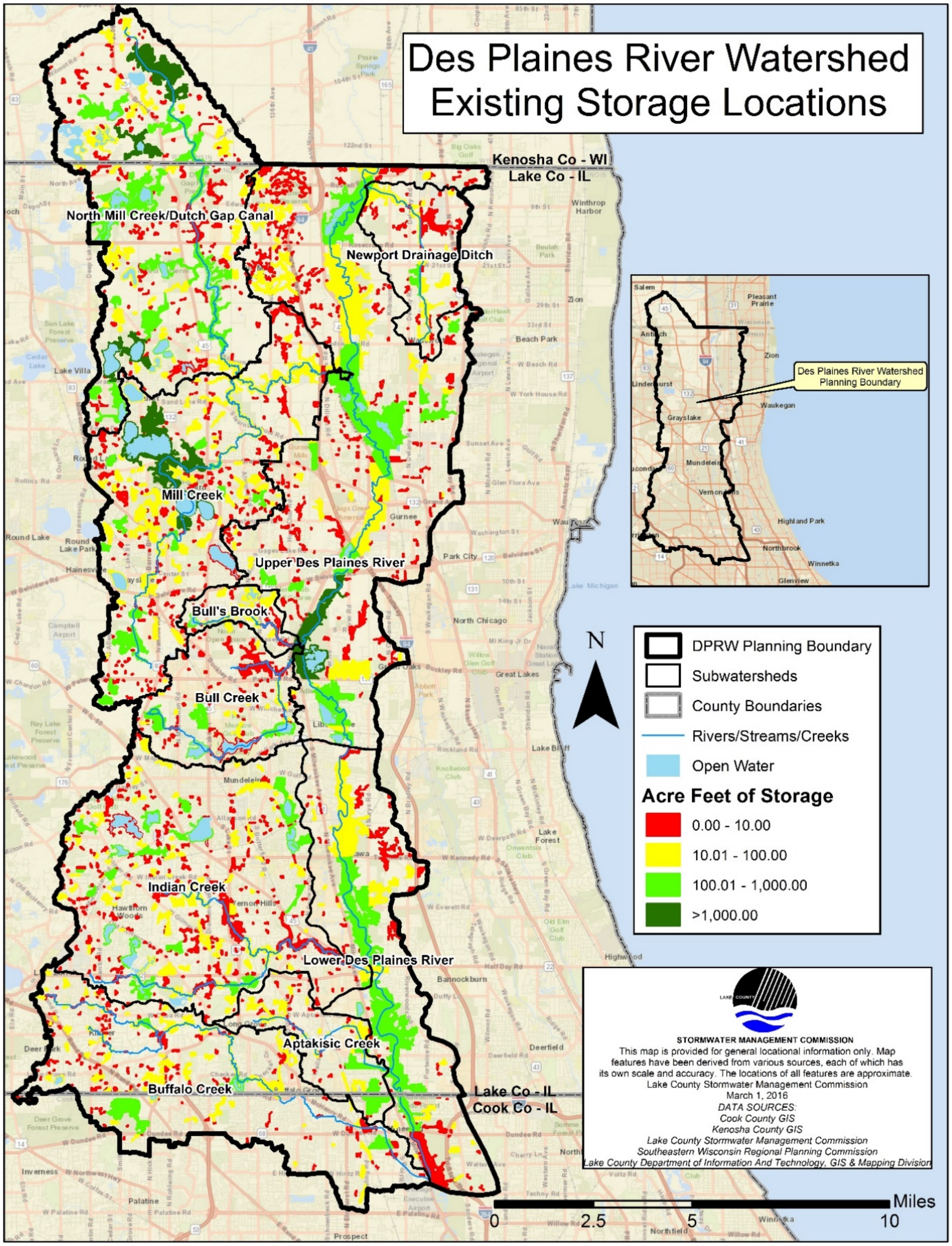


Figure 5-22: Des Plaines River Watershed Existing regional flood storage

5.6.2 Regional Storage Analysis

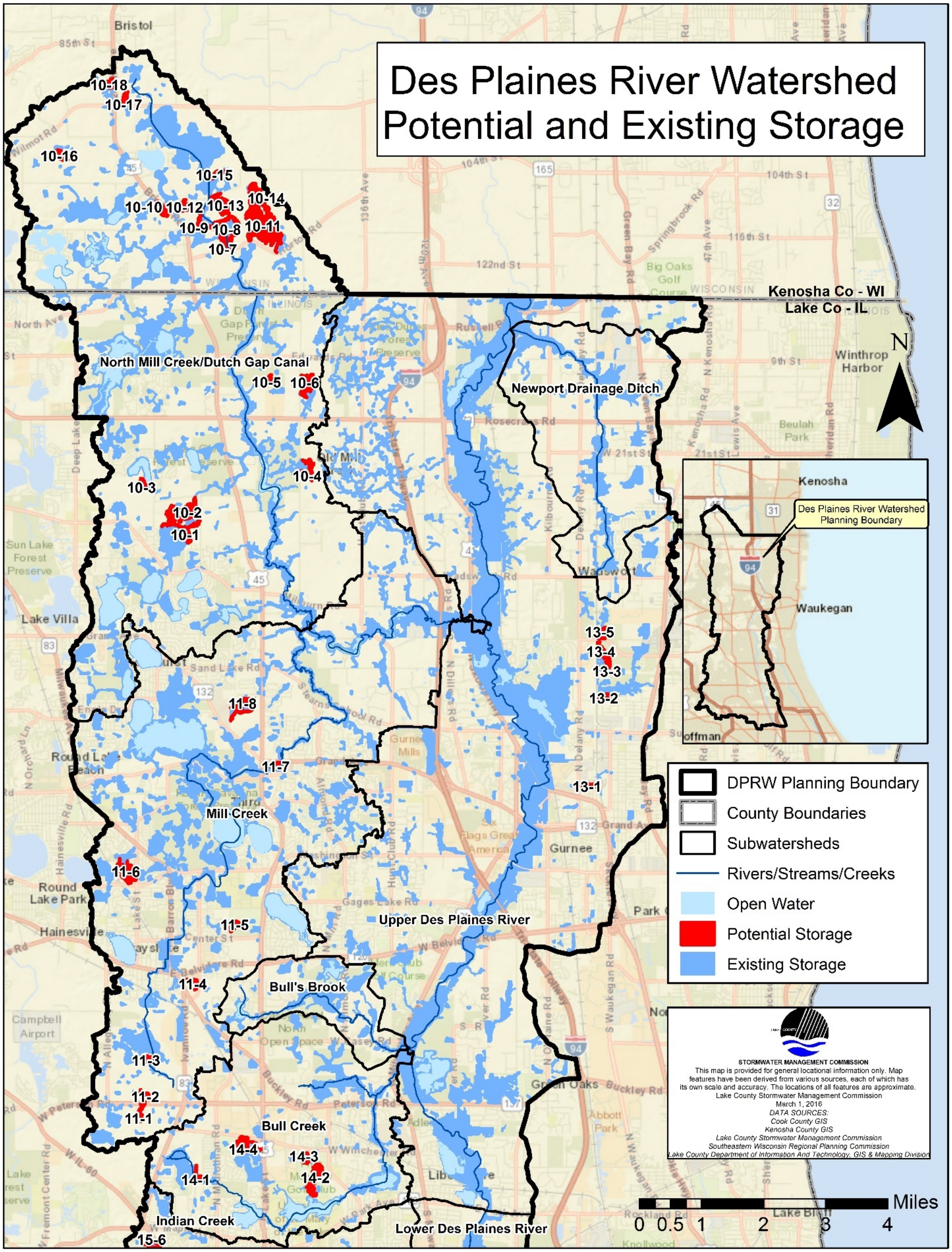
A GIS analysis of the watershed was performed to identify potential regional storage locations. Regional storage locations are depressional areas in the watershed that are within open space land use and are not currently classified as large lakes or large wetland complexes. Identified regional storage locations met the following criteria:

- Locations greater than 5 acres in size
- At least 100 acres of tributary drainage area
- Excludes existing flood storage locations
- Excludes building and transportation footprints on open and partially open parcels
- Not an existing WRAPP wetland

Sites meeting the above criteria were visually screened to eliminate artifacts of the GIS analysis and locations where site characteristics would impede creation of additional storage. Fifty-three sites with a total potential storage of 1,485 acre-feet of storage were identified based on the regional storage criteria defined above and additional screening (Table 5-5 and Figure 5-23). Chapter 6 further details implementation actions regarding the identified potential regional storage locations.

Table 5-5: Potential Regional Flood Storage Sites

SITE ID	SUBWATERSHED	ESTIMATED POTENTIAL STORAGE (ACRE-FEET)	SITE ID	SUBWATERSHED	ESTIMATED POTENTIAL STORAGE (ACRE-FEET)
10-1	North Mill Creek	19.80	13-2	Upper Des Plaines River	48.91
10-2	North Mill Creek	100.05	13-3	Upper Des Plaines River	19.81
10-3	North Mill Creek	17.56	13-4	Upper Des Plaines River	38.66
10-4	North Mill Creek	8.28	13-5	Upper Des Plaines River	27.77
10-5	North Mill Creek	3.42	14-1	Bull Creek	17.39
10-6	North Mill Creek	45.28	14-2	Bull Creek	44.62
10-7	North Mill Creek	9.47	14-3	Bull Creek	13.54
10-8	North Mill Creek	19.55	14-4	Bull Creek	123.41
10-9	North Mill Creek	8.80	15-1	Indian Creek	16.14
10-10	North Mill Creek	6.09	15-2	Indian Creek	7.43
10-11	North Mill Creek	170.65	15-3	Indian Creek	90.01
10-12	North Mill Creek	9.98	15-4	Indian Creek	19.09
10-13	North Mill Creek	39.68	15-5	Indian Creek	68.90
10-14	North Mill Creek	22.27	15-6	Indian Creek	42.39
10-15	North Mill Creek	4.91	16-1	Lower Des Plaines River	42.61
10-16	North Mill Creek	7.33	17-1	Buffalo Creek	24.13
10-17	North Mill Creek	19.24	17-2	Buffalo Creek	11.01
10-18	North Mill Creek	7.10	17-3	Buffalo Creek	6.16
11-1	Mill Creek	18.57	17-4	Buffalo Creek	13.30
11-2	Mill Creek	13.90	17-5	Buffalo Creek	6.27
11-3	Mill Creek	5.65	18-1	Aptakisic Creek	21.55
11-4	Mill Creek	12.18	18-2	Aptakisic Creek	42.42
11-5	Mill Creek	20.94	18-3	Aptakisic Creek	10.13
11-6	Mill Creek	55.75	18-4	Aptakisic Creek	6.47
11-7	Mill Creek	23.01	18-5	Aptakisic Creek	11.55
11-8	Mill Creek	22.98	18-6	Aptakisic Creek	6.84
13-1	Upper Des Plaines River	12.01	**TOTAL ESTIMATED POTENTIAL STORAGE**		**1,484.96**


Des Plaines River Watershed
Potential and Existing Storage
Kenosha Co - WI
Lake Co - IL
North Mill Creek/Dutch Gap Canal
Newport Drainage Ditch
Mill Creek
Upper Des Plaines River
Bull's Brook
Bull Creek
Indian Creek
Lower Des Plaines River
10-18
10-17
10-16
10-15
10-14
10-10
10-12
10-13
10-9
10-8
10-11
10-7
10-5
10-6
10-4
10-3
10-2
10-1
13-5
13-4
13-3
13-2
13-1
11-8
11-7
11-6
11-5
11-4
11-3
11-2
11-1
14-4
14-3
14-2
14-1
15-6
Kenosha
Des Plaines River Watershed Planning Boundary
Waukegan
DPRW Planning Boundary
County Boundaries
Subwatersheds
Rivers/Streams/Creeks
Open Water
Potential Storage
Existing Storage
STORMWATER MANAGEMENT COMMISSION
This map is provided for general locational information only. Map features have been derived from various sources, each of which has its own scale and accuracy. The locations of all features are approximate.
Lake County Stormwater Management Commission
March 1, 2016
DATA SOURCES:
Cook County GIS
Kenosha County GIS
Lake County Stormwater Management Commission
Southeastern Wisconsin Regional Planning Commission
Lake County Department of Information And Technology, GIS & Mapping Division
Miles
0 0.5 1 2 3 4
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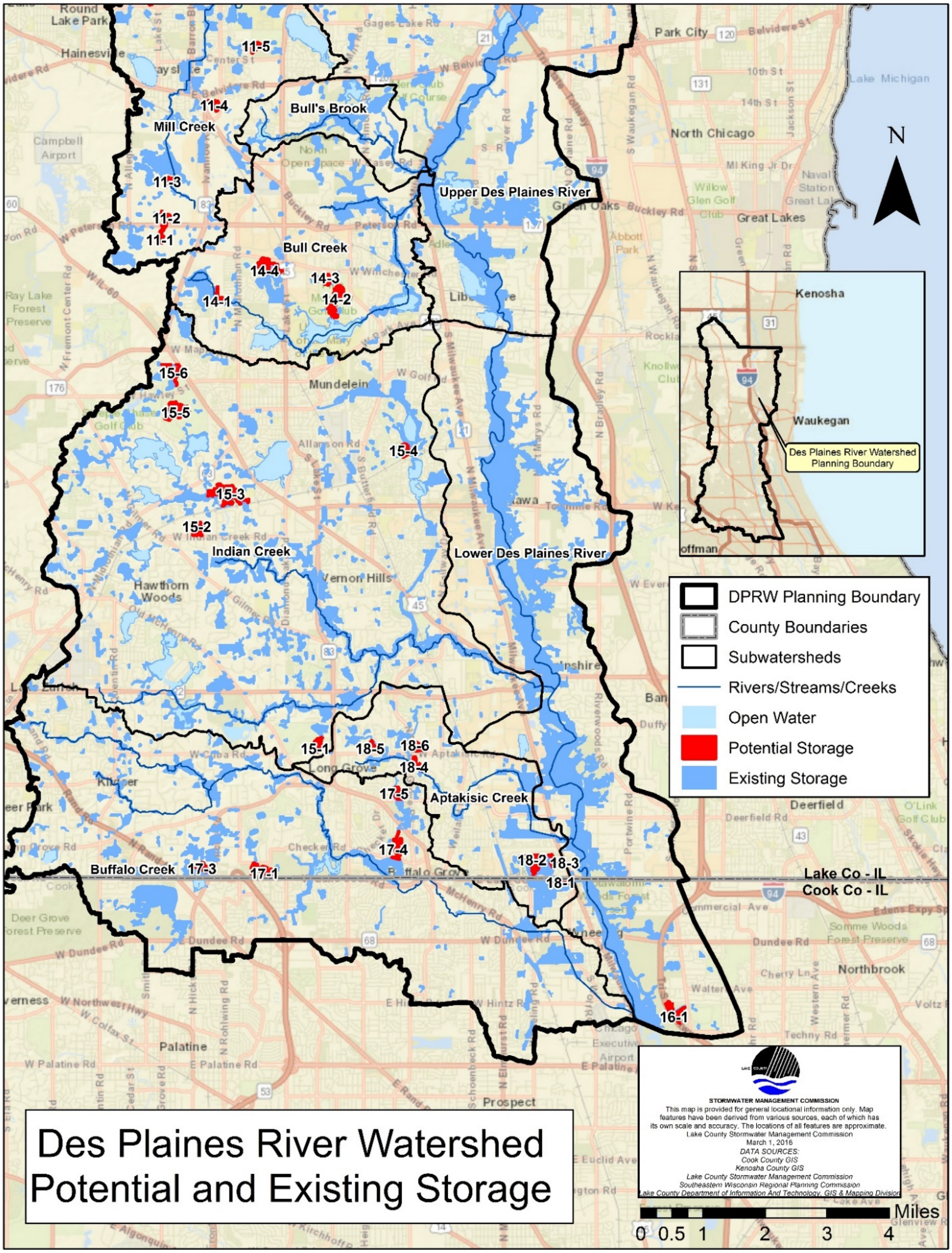

Figure 5-23: Des Plaines River Watershed potential and existing regional flood storage

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

COMMON ACRONYMS/ABBREVIATIONS USED IN CHAPTER 6

AG - Agricultural Producers
APMP – Aquatic Plant Management Plan
BACT - Barrington Area Conservation Trust
BC-BB - Bull Creek- Bulls Brook
BMP – Best Management Practices
CBL - Corporation and Business Landowners
CCDPH - Cook County Department of Public Health
CCPW - Cook County Public Works
CL - Conserve Lake County
CLC – College of Lake County
CMAP - Chicago Metropolitan Agency for Planning
DD - Drainage District
DH - Developers and Homebuilders
DOT - Departments/Divisions of Transportation
DPR planning area – Des Plaines River Watershed Planning Area
DRWW - Des Plaines River Watershed Workgroup
EIG - Environmental Interest Groups
EM - State Emergency Management Agencies
EO - Elected Officials
EQ - Equestrian Facilities
EXT - County Extension Services
FB - Farm Bureaus
FEMA - Federal Emergency Management Agency
FPD - Forest Preserve Districts
GI – Green Infrastructure
GIS – Geographic Information System
HOA - Homeowners Associations
IDNR - Illinois Department of Natural Resources
I-LAST – Illinois – Livable and Sustainable Transportation Rating System
IL/WI DOA - Illinois and Wisconsin Departments of Agriculture
Illinois EPA - Illinois Environmental Protection Agency
ISD - LC Health Department Individual Sewage Disposal Program
ISGS - Illinois State Geological Survey
ISWS - Illinois State Water Survey
KRLT - Seno Kenosha/Racine Land Trust Conservancy
LA - Lake Associations
LCHD - Lake County Health Department
LCPW - Lake County Public Works Department
M - Municipalities
MS4 – Municipal Separate Storm Sewer Systems
MWRD - Metropolitan Water Reclamation District
N/L - Nursery and Landscaping Business
NRCS - Natural Resources Conservation Service
OL - Open Lands Project
PAH – Polycyclic Aromatic Hydrocarbons
PB&D - County Planning, Building, and Development (Includes Cook, Kenosha, and Lake counties)
PC - Snow Removal and Deicing Private Contractors and Consultants
PD - Parks and Recreation Districts
POA - Property Owners Associations
POTW - Publicly Owned Treatment WorkS
PR - Private Residential
RL - Riparian Landowner

SEWRPC - Southeastern Wisconsin Regional Planning Commission
SI - Schools and Institutions
SMC - Lake County Stormwater Management Commission
SWALCO - Solid Waste Agency of Lake County
SWCD - Soil and Water Conservation District
T - Townships
TMDL – Total Maximum Daily Load
TSS – Total Suspended Solids
UDO – Unified Development Ordinance
USACE - U.S. Army Corps of Engineers
USFWS - U.S. Fish and Wildlife Service
USGS - United States Geological Survey
VLM - Volunteer Lake Monitoring
WDO – Watershed Development Ordinance
WI – Wisconsin
WI DNR - Wisconsin Department of Natural Resources
WPC - Watershed Planning Committee(s)
WRAPP – Wetlands Restoration and Preservation Plan
WWTP - Wastewater Treatment Plants

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6 PRIORITIZED ACTION PLAN SUMMARY

NOTEWORTHY – ACTION PLAN RECOMMENDATIONS

The action plan recommendations in this Prioritized Action Plan Summary are to be interpreted as guidance recommendations (projects) for watershed stakeholders and not a regulatory document.

A variety of BMPs and programs are discussed in this plan as potential options for the mitigation of pollutant issues in the DPR planning area. In this chapter, specific ***recommendations*** are made to meet the goals of the watershed plan and previously approved (sub)watershed-based plans, including the identification of specific locations for BMPs in the DPR planning area. This chapter presents specific recommended action items developed jointly by the watershed planning committee, SMC, DRWW and the consultant planning team to meet the goals of this watershed-based plan. Due to the size of the planning area and sheer number of site-specific action recommendations developed during the course of the planning process, readers of the plan are encouraged to use the ***online mapping application*** (https://tinyurl.com/ycthwx9x). The individual recommendations are also listed in tables, organized by jurisdiction, in Appendix N. Maps showing the action recommendations are included in Appendix N, but users are encouraged to use the online mapping application. The critical implementation partners for the watershed are identified in Section 6.1.

There are two primary types of action plan recommendations presented in this chapter: 1) programmatic actions and 2) site-specific project actions including critical area (pollutant load "hotspot") actions. The action plan recommendations identify specific locations for projects and activities recommended for implementation at the watershed-scale.

1. "Programmatic Actions" represent program, policy, regulatory, and project actions that are applicable throughout the watershed. The actions are based on achieving the goals and objectives of the watershed-based plan as outlined in **Chapter 2**.
2. "Site-Specific Actions" address site-specific project opportunities or issues that have been identified throughout the DPR planning area. Site-specific projects were identified through the stream and detention basin inventories, local stakeholders and agency staff, DRWW and the consultant team. Some of the site-specific practices were identified using existing map data and have not been field verified; however, they do represent actual locations where recommended BMPs are applicable. Overall, these site-specific actions are the result of watershed assessment activities, a detailed analysis of existing watershed data, a windshield survey of the DPR planning area and stakeholder input.

SITE-SPECIFIC ACTION PLAN ONLINE MAPPING APPLICATION

An online mapping application was developed for stakeholders to view the action recommendations from this plan. Because the planning area covers 235 square miles and there are thousands of individual action recommendations across dozens of jurisdictions, it is likely easier for plan users to navigate to their individual areas of interest or browse areas they are familiar with for certain types of project recommendations. Printable maps are included in Appendix N, but due to the scale of the planning area, most users will likely find more utility in the online application, which can be accessed at: https://tinyurl.com/ycthwx9x or via the DesPlaines River Watershed-Based Plan page on the Lake County Stormwater Management Commission website (www.lakecountyil.gov/stormwater).

a. "Critical Area Actions" identify critical catchments, streambanks and lake shorelines based on the "Pollutant Load Hotspot Analysis" to focus actions. These areas include hotspot catchments identified in **Chapter 4**. Actions implemented in these critical areas will provide the greatest value and benefit to the watershed.

For each of the seven watershed goals identified in **Chapter 2**, there is an action table that describes each recommended action including its 1) priority, 2) cost estimate (if applicable), 3) lead partners and support partners (if applicable) and 4) recommended implementation timeframe.

1. Priority was assigned to each of the recommended actions and classified as H (high), M (medium) or L (low). Priority was based on multiple factors including lead partners, land ownership, cost, and technical requirements based on circumstances and conditions observed at the time the plan was written. These circumstances and conditions will likely change over time resulting in changes to the priority of projects. This watershed-based plan is considered a living document that can be updated and adapted as conditions and priorities change.
2. Cost estimates are provided only for those watershed improvement actions that involve remedial projects, such as planting native vegetation, retrofitting detention basins, etc. Cost estimates are not provided for preventative measures such as education and regulatory action. Cost estimates should not be considered price quotes, but used as a way to compare the relative costs of proposed treatments. Furthermore, BMP implementation projects vary drastically by specific technique employed, size of area, access to location, property values, and other factors.
3. Lead and support partners are those organizations or agencies that have the greatest potential to implement each recommended action.
4. Timeframe refers to the period of time in which the recommended action could be implemented. Timeframe is classified into three categories including:
   - S (Short = 1-5 years)
   - M (Medium = 6-10 years)
   - L (Long = 10+ years)

Chapter 7 outlines an implementation and evaluation strategy for the action plan, and **Chapter 8** identifies outreach and education strategies and tools that will provide watershed stakeholders with the knowledge and skills necessary to implement the watershed-based plan.

6.1 IMPLEMENTATION PARTNERS

Throughout the prioritized action plan tables and narrative, responsible parties are suggested for taking the lead partner role or providing a supporting partner role in plan implementation. This section presents the responsible parties as well as a brief description of their role. Table 6-1 provides a concise reference or key of implementation partners for reviewing the programmatic and site-specific action plan tables that follow. Implementation partners do not necessarily have the resources to complete a recommendation, but these recommendations can be implemented through coordination with other partners, grant funding, and more.

LEAD PARTNERS: Identify the lead public or private landowner, agency or other stakeholder with the greatest potential to implement the action.

SUPPORT PARTNERS: Include parties that could be involved in assisting in the action implementation related to regulation, permitting, coordination, technical needs and funding assistance.

Table 6-1: DPR Planning Area Implementation Partners

ACRONYM	RESPONSIBLE PARTY	GENERAL RESPONSIBILITY
AG	Agricultural Producers	Management and operation of cropped and other agricultural lands.
BACT	Barrington Area Conservation Trust	Promote Conservation@Home and green infrastructure in municipalities near Deer Grove Forest Preserve.
C	Counties	Land use and development, technical and financial support, and drainage system management.
CBL	Corporation and Business Landowners	Grounds management and maintenance. Implementation and maintenance of stormwater BMPs.
CCDPH	Cook County Department of Public Health	Permit well and private sewage disposal systems in Cook County. Enforce Cook County and Illinois state laws relating to environmental health issues. Regularly inspect, monitor, regulate, educate, and advise the public on environmental health concerns that adversely impact human health.
CCPW	Cook County Public Works	Manage water and wastewater facilities in Cook County.
CMAP	Chicago Metropolitan Agency for Planning	Technical, planning, training, and funding assistance.
DD	Drainage Districts	Maintain conveyance, stability, and function of drainage ways within district boundaries. *Includes Avon-Fremont and Grubb School.
DH	Developers and Homebuilders	Land development, stormwater management system design and construction.
DOT	Departments/Divisions of Transportation	Maintain, design, and construct transportation infrastructure in the watershed including stream, lake, and wetland crossings. *Includes State, Illinois Tollway, County, Municipal and Township Highway and Streets Departments.
DRWW	Des Plaines River Watershed Workgroup	Voluntary dues paying consortium of publicly operated treatment works (POTWs) and MS4s (municipal separate storm sewer system permit holders) organized to improve water quality throughout the Des Plaines River Watershed in Lake County and remove the Des Plaines River waterways from the Illinois EPA 303(d) impaired waters list.
EIG	Environmental Interest Groups	Advocate group positions on topics including environmental and land management. *Includes: Sierra Club & League of Women Voters
EM	State Emergency Management Agencies	Flood and disaster planning, emergency response, and hazard mitigation.

ACRONYM	RESPONSIBLE PARTY	GENERAL RESPONSIBILITY
		*Includes Illinois & Wisconsin Emergency Management Agency.
EO	Elected Officials	Decision-making authority for county policies and ordinances [including the Watershed Development Ordinance (WDO) and Unified Development Ordinance (UDO)].
EQ	Equestrian Facilities	Owners, managers, operators, tenants, and users of equestrian facilities and land uses.
EXT	County Extension Services	Provides education and technical support. *Includes University of Illinois & University of Wisconsin Extension.
FB	Farm Bureaus	Promotes farming practices that promote environmental stewardship. *Includes Cook, Kenosha, and Lake County Farm Bureaus.
FEMA	Federal Emergency Management Agency	National Flood Insurance Program, floodplain mapping and enforcement, and mitigation funding.
FPD	Forest Preserve Districts	Manage and maintain green infrastructure, natural areas, and open space. *Includes Cook and Lake County Forest Preserve Districts.
HOA/POA	Homeowners Associations/Property Owners Associations	Management of common areas and natural and constructed drainage systems.
IDNR	Illinois Department of Natural Resources	Natural area preservation and management, research, technical, and financial assistance.
IL/WI DOA	Illinois and Wisconsin Departments of Agriculture	Farmland and natural resource technical and financial assistance
Illinois EPA	Illinois Environmental Protection Agency	Water resource monitoring, pollution regulation and control, technical assistance and project funding.
ISD	LC Health Department Individual Sewage Disposal Program	Regulates the use of septic systems in incorporated and unincorporated areas of Lake County where sanitary sewer systems are not yet available. Regulation involves inspecting, planning, and installing septic systems.
ISGS/USGS	Illinois State Geological Survey & United States Geological Survey	Gather and manage geologic and water quality data.
ISWS	Illinois State Water Survey	Flood risk modeling and floodplain mapping
KRLT	Seno Kenosha/Racine Land Trust Conservancy	Natural resources education, conservation, and land preservation.
LA	Lake Associations	Lake management for water quality and recreation.
LCHD	Lake County Health Department	Monitor, manage, and provide technical support for water resources. Includes environmental services unit.
LCPW	Lake County Public Works Department	Manages water and wastewater facilities in Lake County.
M	Municipalities	Land use and development, technical and financial support, and drainage system management.
MWRD	Metropolitan Water Reclamation District of Greater Chicago	Controls municipal sewer construction permits outside the city of Chicago. Administers the Watershed Management Ordinance in suburban Cook County.
NRCS/SWCD	Natural Resources Conservation Service Soil and Water Conservation District	Provide technical and financial assistance for natural resource management. *Includes McHenry-Lake, North Cook, & Kenosha County SWCDs.

ACRONYM	RESPONSIBLE PARTY	GENERAL RESPONSIBILITY
N/L	Nursery and Landscaping Business	Grow and maintain landscaping plant materials. This includes irrigation or watering and storage of equipment and materials.
OL	Openlands	Provide technical assistance for land acquisition and preservation
PB&D	County Planning, Building, and Development (Includes Cook, Kenosha, and Lake counties)	Land use planning and permitting for unincorporated areas, natural resources and system management.
PC	Snow Removal and Deicing Private Contractors & Consultants	Land and pavement management and maintenance for snow removal and deicing.
PD	Parks and Recreation Districts	Management and maintenance of parks and open space.
PO	Property Owner	The owner on record for a particular tax parcel.
PR/RL	Private Residential/Riparian Landowner	Land management and maintenance including stream channels and riparian corridors.
RR	Railroad	Land Management in railroad right of way.
SEWRPC	Southeastern Wisconsin Regional Planning Commission	Southeastern Wisconsin regional planning for information and professional planning initiatives for the proper planning and design of public works systems (highways, transit, sewerage, water supply and parks and open space facilities).
SI	Schools and Institutions	Schools and institutions with large properties or campus settings. *Includes College of Lake County and secondary schools
SMC	Lake County Stormwater Management Commission	Technical and financial assistance for flooding, watershed planning, and water quality. Administers the Watershed Development Ordinance in Lake County.
SWALCO	Solid Waste Agency of Lake County	Implements the Lake County Solid Waste Management Plan.
T	Townships	Road maintenance and support for watershed improvement projects.
USACE	U.S. Army Corps of Engineers	Wetland protection and regulation and restoration funding.
USFWS	U.S. Fish and Wildlife Service	Threatened and endangered species protection, technical and financial assistance for habitat restoration.
UT	Utilities	Land Management in utility right of way
WI DNR	Wisconsin Department of Natural Resources	Natural area preservation and management, research, and technical assistance. Water resource monitoring, pollution regulation and control, and project funding.
WPC	Watershed Planning Committee(s)	Coordinate watershed plan implementation, education and outreach. Planning and support for watershed improvement projects. *Includes Subwatershed Planning Committees (Upper Des Plaines River Ecosystem Partnership, Buffalo Creek Clean Water Partnership, Bull Creek Planning Committee, and Indian Creek Watershed Project).
WWTP	Wastewater Treatment Plants	Maintain wastewater treatment regulatory standards. *Includes privately and publicly owned treatment works

6.2 PROGRAMMATIC ACTION PLAN (BASIN WIDE)

6.2.1 Goal #1: Water Quality Improvements

GOAL: Improve water quality and prevent future pollution impacts to streams, lakes, ponds, and wetlands within the DPR planning area.

OUTCOME: Overall water quality is improved. Water bodies will fully support their designated uses (are not impaired).

Table 6-2: Actions for Goal #1

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
1	Develop and implement a watershed monitoring program to assess whether water quality standards are being met and evaluate watershed implementation effectiveness.	**Buffalo Creek:** Table 6 -2 Action 1-E **BC-BB:** Table 56 Action 5 **North Mill Creek:** Table 5-2 Action 1-G **Mill Creek:** Table 6-4 G Action 3.J	H	DRWW, M, LCHD, CCDPH, ISWS, USGS	Illinois EPA, FPD, IDNR, SMC, WPC	S
2	Continue to support (and improve) Lake County Health Department and Illinois EPA's Volunteer Lake Monitoring Programs.	**Buffalo Creek:** Table 6 -2 Action 1-F **BC-BB:** Table 56 Action 6 **North Mill Creek:** Table 5-2 Action 1-H **Mill Creek:** Table 6-3 Action 2.L	M	LCHD, LA	Illinois EPA, DRWW, SMC, M, SI, IDNR, CMAP	S
3	Employ charcoal packets or other appropriate techniques to track organics from agricultural fields.	**BC-BB:** Table 56 Action 5	L	NRCS/SWCD, AG, WI/IL DOA, EXT	Illinois EPA, FB ISGS/USGS, ISWS	M
4	Evaluate existing data to identify areas that are impacted by toxic sediment. If toxic sediment is found, identify contaminants of concern, human and ecological health risks and potential responsible parties. Pursue investigation and remediation if human or ecological risks are likely.	**Mill Creek:** Table 6-3 Action 2.V	M	DRWW, LCHD, Illinois EPA, CCDPH	ISWS, ISGS/USGS	M
5	Monitor lake inlets for nutrients, sediment and erosion, and create detailed nutrient budgets for lakes.	**BC-BB:** Table 56 Actions 1 and 2	M	DRWW, LA, IDNR, LCHD, WI DNR, ISWS, ISGS/USGS	CCPW, Illinois EPA, WPC	M
6	Continue to conduct intensive basin surveys for Illinois Integrated Water Quality Report on five-year rotational basis.	Not in previous plans.	M	Illinois EPA, IDNR, WI DNR	SEWRPC, LCHD, SMC, DRWW, WPC	M

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
7	Establish total maximum daily loads (TMDLs) of priority nutrients and pollutants for each of the lakes in the watershed. Regulate so that loading thresholds are not exceeded for each lake.	**Mill Creek:** Table 6-3 Action 2.U	M	Illinois EPA	LCHD, DRWW, LA	M
8	Reduce the quantity of road salt (sodium chloride) needed for safe and cost-effective winter maintenance to address rising chloride levels in local water bodies.	Not in previous plans.	H	DOT, M, CBL, N/L, EO, PR/RL, PC, HOA/POA, PD	SMC, LCHD, T, CCDPH, DRWW, MRWD, SEWRPC, Illinois EPA	S
9	Establish and publish watershed-wide recommended guidance for winter de-icing BMPs including road salt application rates and alternatives.	**Buffalo Creek:** Table 6 -2 Action 1-I **BC-BB:** Table 56 Action 10 **North Mill Creek:** Table 5-2 Action 1-K **Mill Creek:** Table 6-3 Goal 2 Action 2.F	H	DOT, SI, LCHD, M, T, SMC	Illinois EPA, WI DNR, PC, WPC, IDNR, PB&D, PR/ RL, CMAP, SEWPRC, CBL	M
10	Reduce phosphorus loads by using conservation practices on agricultural fields to reduce soil loss.	**Buffalo Creek:** Table 6 -2 Action 1-C **North Mill Creek:** Table 5-2 Action 1-E **Mill Creek:** Table 6-3 Action 2.I	M	AG, NRCS/SWCD, EQ, FPD	IL/WI DOA, SMC, T, SEWPRC, M, PR/RL	M
11	Implement effective leaf cleanup and composting programs.	Not in previous plans.	M	M, T, EO, CL, C, DOT, BACT, LCHD, HOA/POA	PB&D, PR/RL, CBL, CMAP, SEWRPC, SMC	S
12	Address re-suspension of phosphorus in lakes where feasible.	Not in previous plans.	M	M, LCHD, HOA/POA, FPD, PD, LA, PR/RL	SMC, PB&D, DRWW, MWRD, SEWRPC, T	M
13	Maintain golf courses using BMPs that minimize nutrient loads and impacts to water quality.	Not in previous plans.	M	GC, M, PD, FPD	SMC, EIG, MWRD	
14	Pass ordinances that restrict the use of lawn fertilizer with phosphorus.	Not in previous plans.	M	M, T, C, EO, HOA/POA	PB&D, CBL Illinois EPA, CMAP, PR/RL, CL, BACT, LCHD, SMC	S
15	Develop a cost-share mechanism to help private property owners upgrade/fix aging/failing septic systems and eliminate illicit connections.	**Buffalo Creek:** Table 6 -2 Action 1-D **North Mill Creek:** Table 5-2 Action 1-F **Mill Creek:** Table 6-3 Action 2.J **Indian Creek:** Table 66 Action 32	M	HOA/POA, ISD, LCHD, CCDPH, Illinois EPA	M, PR/RL, SI, DRWW	L

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
16	Work with Illinois EPA to evaluate wastewater treatment systems for overall water quality impacts, upgrade plants to accommodate phosphorus control, and address problem discharges if any are identified.	**BC-BB:** Table 56 Action 8	M	WWTP, DRWW, MWRD, Illinois EPA, M, LCPW	LCHD, WPC	M
17	Where appropriate, remove or retrofit impoundments, dams, piped stream conveyance, and weirs in streams to support fish passage and migration, hydraulic connectivity.	Not in previous plans.	M	IDNR, WI DNR, USFWS, M, T, PD, PO, FPD, USACE	DRWW, SMC, WPC, SEWRPC, Illinois EPA, NRCS/SWCD, LCHD	M
18	Maximize in-stream habitat in conjunction with installation of structures (bridges, culverts, etc.) to minimize negative impacts to streams and aquatic life.	Not in previous plans.	H	DOT, M, PD, T	SMC, Illinois EPA, MWRD, WI DNR, IDNR, USACE, PB&D	M
19	Reduce streambank, shoreline, and construction-related erosion.	Not in previous plans.	H	M, DD, LA PR/RL, PO, MWRD, PD, FPD, HOA/POA	Illinois EPA, SMC, IDNR, DOT, PB&D, USACE, NRCS/SWCD	M
20	Identify and restore degraded stream banks and beds where possible.	**BC-BB:** Table 58 Actions 3 and 5 **Indian Creek:** Table 65 Actions 27 and 28, and Table 66 Action 19	M	SMC, PR/RL, M, T, CMAP, SEWPRC	USACE, IDNR, WI DNR	L
21	Reduce/eliminate harmful algae blooms in lakes.	Not in previous plans.	H	LCHD, LA, PR/RL	DOT, Illinois EPA, WI DNR, M, C, T, FPD, CMAP, USACE, USFWS, IDNR, WPC, DRWW, WWTP	M
22	Creation and enforcement of ordinances requiring proper cleanup and disposal of pet waste.	Not in previous plans.	L	M, C, EO, FPD, PD	SMC, SEWRPC, DRWW, WPC, PB&D, CCDPH, LCHD, Illinois EPA, WI DNR	M
23	Conduct routine well and septic evaluations and repairs.	**Indian Creek:** Table 66 Action 28	L	PO, AG, HOA/POA	ISD, LCHD, CCDPH	M
24	Remediate aging and failing sanitary sewer lines that cross-connect with stormsewers and seasonally high groundwater tables.	**Mill Creek:** Table 6-2 Action 1.E	H	M, C, T, PO, LCPW, PB&D, CCPW	DOT	M

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
25	Reduce or ban the use and direct discharge of substances known to be sources of PAHs, including coal tar sealants.	Not in previous plans.	M	PR/RL, PO, M, T, C, CBL, PD, AG, HOA/POA	DRWW, WPC, SMC, LCHD, CCDPH, Illinois EPA	S
26	Prepare pollution prevention plans to address emergency response for potential catastrophic environmental events such as pipeline leaks and flooding.	Not in previous plans.	H	SMC, MWRD, PB&D, M, PO, CBL	M, FEMA, EM	S
27	Conduct further investigation of high priority Environmental Data Resource (EDR) sites by monitoring for the chemical constituents in these releases to resolve questions of hazard waste contamination.	**BC-BB:** Table 56 Action 17	M	PO, ISD, ISGS/USGS, ISWS	Illinois EPA, WI DNR	M
28	Minimize runoff volumes, velocities, and pollution to waterways by creating/restoring wetlands, natural landscapes, and stormwater best management practices such as infiltration and pollutant filtration systems.	**Buffalo Creek:** Table 6 -2 Action 1-A **North Mill Creek:** Table 5-2 Action 1-C **Mill Creek:** Table 6-3 Action 2.H **Indian Creek:** Table 66 Action 4	M	AG, PR/RL, PD, FPD, WPC, M, T	NRCS/SWCD, Illinois EPA, WI DNR, USACE, OL, DRWW, SMC, IDNR, MWRD, SEWRPC, CMAP	M
29	Where feasible, retrofit existing swales and open drainage-ways to infiltrate runoff with natural landscaping.	**Buffalo Creek:** Table 6 -2 Action 1-K **North Mill Creek:** Table 5-2 Action 1-P **Mill Creek:** Table 6-3 Action 2.R **Indian Creek:** Table 66 Action 3	M	PO, HOA/ POA, EQ, CBL, DOT, AG, PD	DH, SMC, MWRD, OL, Illinois EPA, WI DNR, BACT, NRCS/SWCD	M
30	Install bioretention BMPs to capture rooftop runoff	**Buffalo Creek:** Table 6 -2 Action 1-J **North Mill Creek:** Table 5-2 Actions 1-S and 1-L **Mill Creek:** Table 6-3 Actions 2.N and 2.T	M	DH, CBL, C, M, SI, T, PO	SMC, PB&D, Illinois EPA, WI DNR, MWRD	M
31	Replace riprap, concrete and turf grass shorelines with deep-rooted native landscaping and bioengineering where possible.	**Buffalo Creek:** Table 6 -2 Action 1-H **North Mill Creek:** Table 5-2 Action 1-J **Mill Creek:** Table 6-3 Actions 2.B and 2.C **Indian Creek:** Table 66 Action 22	H	LA, M, CBL HOA/POA, SI, FPD, DD, WI DNR, DH, PD, PR/RL	PB&D, SMC Illinois EPA, IDNR, FPD, USFWS, CMAP, WPC, USACE, NRCS/SWCD	M

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
32	Replace or restore failed hydraulic structures and discharge pipes.	**Buffalo Creek:** Table 6 -2 Action 1-L **North Mill Creek:** Table 5-2 Action 1-Q **Mill Creek:** Table 6-3 Action 2.S **Indian Creek:** Table 66 Actions 18, 23, and 40	H	PO, DD, DOT, HOA/POA, LA, T, M	FEMA, EM, SMC, USACE	M
33	Install stormwater green infrastructure BMPs in new or existing developments. Reduce use of centralized detention ponds and replace with distributed infiltration-based stormwater management systems using bioretention practices.	**BC-BB:** Table 56 Action 15 **Mill Creek:** Table 6-4 Action 3.B	H	DH, PD, CBL, M, C, HOA/POA, SI	SMC, MWRD, WPC, PB&D,	M
34	Install filtration BMPs (ex. sand, filtration basins, treatment wetlands) downstream of government maintenance, industrial and commercial facilities; new infrastructure and improvement projects; transportation runoff collection points; and other land uses potentially generating a heavy load of pollutants.	Not in previous plans.	H	DH, CBL, DOT, M, C, SI, T, PR/RL, PO	SMC, Illinois EPA, WI DNR, MWRD, USACE, PB&D	L
35	Disable drain tiles to restore wetland hydrology.	**Indian Creek:** Table 66 Action 43	L	AG, PO, PD, FPD, M, T	USACE, NRCS/SWCD, PB&D, SMC	L
36	Use Stormwater Treatment Train concepts wherever possible to infiltrate and clean stormwater runoff.	Not in previous plans.	H	PO, M, PB&D, CBL, DOT, DH, HOA/POA	SMC, Illinois EPA, MWRD, NRCS/SWCD, WI DNR	S
37	Establish pharmaceutical disposal center(s) or a system to collect unused pharmaceuticals to encourage proper disposal	**North Mill Creek:** Table 5-2 Action 1-M **Mill Creek:** Table 6-3 Action 2.O	M	SWALCO, LCHD, Illinois EPA	M, T, C, Pharmacies	M
38	Identify, repair, or disconnect all illegal discharges (illicit storm drain and/or sump pump hookups).	**BC-BB:** Table 56 Action 7 **Indian Creek:** Table 66 Actions 29 and 31	H	M, T, PR/RL, CBL, HOA/POA, ISD	SMC, LCHD, CCDPH, MWRD, SEWRPC, Illinois EPA, DRWW	L
39	Retrofit detention basins by converting dry to wet or wetland bottom basins and/or removing concrete or low flow channels, where feasible.	**BC-BB:** Table 56 Action 13 **Indian Creek:** Table 66 Action 16	M	PO, M, C, HOA/POA, CBL, PD	SMC, FPD USACE, PB&D, Illinois EPA	M

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
40	Identify opportunities for wetland protection and enhancement on high priority parcels identified to maintain or improve water quality.	**BC-BB:** Table 56 Action 14	H	M, T, FPD, PD, SMC, PO	USACE, Illinois EPA, WPC	S
41	Replace failing seawalls with bioengineering stabilization measures.	**BC-BB:** Table 58 Action 6	M	PR/RL, LA, CBL, HOA/POA	SMC, IDNR, USACE, WI DNR	M
42	Relocate and/or place storm drain inlets away from areas with potential land use impacts to water quality (direct or indirect discharge).	Not in previous plans.	M	PO, DH, M, C, PB&D, DOT, CBL, HOA/POA	SMC, MWRD	M
43	Increase native tree installation for stormwater benefits (ex. reduced erosion and runoff)	Not in previous plans.	L	PO, M, C, T, HOA/POA, LA, PD, FPD	NRCS/SWCD SMC, EIG, N/L CMAP, IDNR, SEWRPC, WI DNR, BACT, OL	L
44	Implement projects identified by DRWW monitoring and studies that reduce or remove causes of impairment and/or help to attain the aquatic life use standard for impaired waters	Not in previous plans	H	DRWW, PO	DRWW members, Illinois EPA, IDNR	M
45	Implement BMPs that reduce pollutants with a TMDL	Not in previous plans.	H	AG, C, CBL, FPD, PD, HOA/POA, M, PO, PR/RL, T	BACT, CMAP, DD, DH, DOT, IDNR, IL/WI DOA, Illinois EPA, LCHD, LCPW, NRCS/SWCD, PB&D, SI, SMC, WI DNR, WPC	L

6.2.2 Goal #2: Regional Green Infrastructure and Natural Resources Improvements

GOAL: Protect, enhance, and restore natural resources (soil, water, plant communities, and fish and wildlife) by employing good natural resource management practices. Using green infrastructure on public and private properties to maintain, enhance, or restore natural hydrology, native plant and wildlife communities, provide buffers for streams, lakes, wetlands, and high-quality areas. Expand environmental corridors to provide ecological, educational, and recreational benefits.

OUTCOME*:* Natural resources are protected, establishing a series of interconnected hubs and corridors that work to preserve and enhance the high-quality natural areas of the watershed.

Table 6-3: Actions for Goal #2

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
1	Develop resource conservation and management plans, especially for ADID wetlands and other biodiversity sites.	**BC-BB:** Table 55 Action 3 **Indian Creek:** Table 67 Action 9	M	SMC, FPD, IDNR, PD, AG, M, T	USACE, NRCS/SWCD, CMAP, USFWS	M
2	Develop private/public property and high/medium priority green infrastructure protection strategies for natural communities, using acquisition, conservation easements, and other techniques.	**Buffalo Creek:** Table 6 -2 Action 1-N **BC-BB:** Table 55 Action 4, Table 59 Action 4 **North Mill Creek:** Table 5-5 Action 4.I **Mill Creek:** Table 6-5 Action 4-D **Indian Creek:** Table 67 Actions 6 and 15	M	M, C, T, SMC, OL, KRLT, IDNR, WPC, FPD, AG	CMAP, USFWS	M
3	Identify/initiate private/public partnerships and funding to complete restoration projects *Potential participants are also lead partners.	**Indian Creek:** Table 66 Action 42	M	WPC, PO, CBL, EIG	IDNR, USFWS, FPD, PD, WI DNR, Illinois EPA, CMAP, SMC, HOA/POA	
4	Avoid development in and installation of gray infrastructure through high priority green infrastructure system parcels wherever possible.	**Buffalo Creek:** Table 6-5 Action 4-E **North Mill Creek:** Table 5-5 Action 4.H	H	M, C, DOT, T, DH, LCPW, CCPW	CMAP, SMC, SEWRPC, MWRD, EIG	S
5	Expand Forest Preserve sites where adjacent landowners are willing to participate	Not in previous plans	H	FPD, PO	WPC	L

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
6	Restore degraded terrestrial and aquatic resources (lakes, wetlands and streams) using BMPs to improve habitat. This includes in-stream habitat features, such as natural channel substrates and pools and riffles to improve water quality and aquatic biodiversity.	**Buffalo Creek:** Table 6-4 Action 3-D **North Mill Creek:** Table 5-3 Action 2.D **Mill Creek:** Table 6-5 Action 4-H	H	PR/RL, DD, FPD, WI DNR, PD, IDNR	USACE, M, SMC, MWRD, NRCS/SWCD, Illinois EPA, PB&D	M
7	Convert highly erodible land areas, 10-year floodplain, and lands adjacent to ADID wetlands into passive land use practices.	**Mill Creek:** Table 6-5 Action 4-P	M	PR/RL, M, C, SMC, PD, T, AG, EQ, CBL, SI, HOA/POA	NRCS/SWCD, SMC, IL/WI DOA	L
8	Modify, retrofit, or eliminate constructed hydraulic restrictions along the stream corridors to promote natural stream morphology.	**Buffalo Creek:** Table 6-3 Action 2-A **North Mill Creek:** Table 5-4 Action 3.A	H	DD, M, C, PR/RL, FPD, DOT, HOA/POA, MWRD	USACE, IDNR, SMC, WI DNR, NRCS/SWCD, SEWRPC	M
9	Incorporate naturalized stream restoration as part of new developments where applicable.	**North Mill Creek:** Table 5-6 Action 5.G	M	DH, HOA/POA	SEWRPC, SMC, CMAP, M, C, PB&D, EO	L
10	Modify, retrofit or eliminate hydraulic restrictions along the stream corridors to promote natural stream morphology and maintain conveyance for adequate drainage.	**Buffalo Creek:** Table 6-6 Action 5-D **BC-BB:** Table 58 Actions 4 and 10 **North Mill Creek:** Table 5-4 Action 3.J **Indian Creek:** Table 65 Actions 3 and 30, Table 66 Action 37	H	PR/RL, USACE, M, C, T, DD, FPD	IDNR, SMC, FEMA, MWRD, WI DNR, CMAP	L
11	Develop a stream restoration plan and cost estimate for moderately and severely eroded stream reaches.	**Buffalo Creek:** Table 6-4 Action 3-E **North Mill Creek:** Table 5-3 Action 2.E	H	DD, SMC, FPD, USACE	IDNR, Illinois EPA, WI DNR, NRCS/SWCD, CCDPH, CMAP, SEWRPC, PB&D	S
12	Maintain, expand, or restore high quality native plant buffers along river, streams, lakes, and wetlands.	**Mill Creek:** Table 6-5 Action 4-C **Indian Creek:** Table 67 Actions 2 and 10	H	PR/RL, CBL, HOA/POA, LA, DD, SMC, FPD, IDNR, EQ, PD WI DNR, AG	USACE, NRCS/SWCD, CMAP, USFWS	S
13	Include high quality stream reaches in green infrastructure plan for conservation and protection.	**BC-BB:** Table 60 Action 4	H	T, FPD, SMC, M, C, CMAP	IDNR, PB&D, WI DNR, DRWW, Illinois EPA	S

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
14	Preserve, restore, and create wetlands areas with a target of a minimum 10% wetland land cover per subwatershed.	Not in previous plans.	H	SMC, PB&D, WI DNR, Illinois EPA, M, T, IDNR, USACE	EO, CMAP	L
15	Identify potential wetland mitigation banking sites in the watershed and encourage private and/or public investment for in-watershed mitigation.	**BC-BB:** Table 59 Actions 13 and 16 **North Mill Creek:** Table 5-6 Action 5.E **Mill Creek:** Table 6-4 Action 3.G **Indian Creek:** Table 67 Actions 11 and 12	H	SMC, FPD, USACE, PB&D	PD, M, C, T, SEWRPC, CMAP, WI DNR, IDNR	L
16	Identify and preserve natural areas that provide important ecological, environmental education, and recreational opportunities.	**Buffalo Creek:** Table 6-4 Action 3-A **North Mill Creek:** Table 5-3 Action 2.A	H	FPD, PD, SEWRPC, CMAP, SI, M, T, SMC, IDNR, WI DNR	Illinois EPA, MWRD	L
17	Municipalities and County review development standards and policies and adopt changes as needed to implement the watershed plan and preserve and protect healthy aquatic life and good water quality.	**Buffalo Creek:** Table 6-5 Action 4-C **North Mill Creek:** Table 5-5 Actions 4.D and 4.E **Mill Creek:** Table 6-5 Action 4-M	H	M, C, EO	IDNR, DOT, WI DNR, MWRD, SMC, PB&D, SEWRPC, CMAP, T	S
18	Clearly identify and designate areas prioritized in the Green Infrastructure Plan as green infrastructure conservation areas in county, park district, and municipal comprehensive plans and maps.	**Buffalo Creek:** Table 6-5 Action 4-D **North Mill Creek:** Table 5-5 Action 4.F **Mill Creek:** Table 6-5 Action 4-N	H	M, C, PD, PB&D, T, FPD	IDNR, WI DNR, SMC, OL, CMAP, SEWRPC	M
19	Require developers to maximize open space through conservation easements and dedications.	**BC-BB:** Table 57 Action 13 and Table 59 Action 10	L	EO, M, C, T, SMC, PB&D	WI DNR, Illinois EPA, CMAP	L
20	Encourage at least 50% of open space to be planted with native vegetation.	**BC-BB:** Table 59 Action 2	H	M, C, T, HOA/POA, LA, PD, BACT, OL	NRCS/SWCD, SMC, EIG, CMAP, IDNR SEWRPC, WI DNR	M
21	Identify green infrastructure needs based on projected buildout conditions in the watershed and assess land protection needs to meet the desired level of service.	**BC-BB:** Table 60 Action 8	M	WPC, FPD, SEWRPC, CMAP, SMC	USACE, IDNR, WI DNR, M, PB&D	L
22	Identify high quality areas for protection, acquisition, wetland protection, and habitat enhancement.	**BC-BB:** Table 55 Action 5 **Indian Creek:** Table 67 Actions 5 and 7	M	PR/RL, DD, FPD, WI DNR, PD, PB&D, IDNR	USACE, M, C, MWRD, SMC NRCS/SWCD Illinois EPA	M

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
23	Adopt standards for conservation development to be applied on high priority open space.	**BC-BB:** Table 59 Action 7	H	M, C, PB&D, T,	EO, SMC, CMAP	M
24	Maximize buffers, habitat and natural areas in golf courses.	Not in previous plans.	M	GC, M, PD, FPD	SMC, EIG, MWRD	M
25	Identify, map and restore environmental corridors across community, county and state lines, and trail connections between new and existing parks and forest preserves where appropriate.	**Buffalo Creek:** Table 6-4 Action 3-C **BC-BB:** Table 60 Action 3 **North Mill Creek:** Table 5-3 Action 2.C **Mill Creek:** Table 6-5 Action 4-E **Indian Creek:** Table 67 Actions 1 and 4	M	FPD, PD, M, T, PB&D, SEWRPC, CMAP	HOA/POA, OL, IDNR, SMC, WPC	M
26	Assess current fish population and reduce or eradicate common carp and other invasive aquatic species.	Not in previous plans.	H	LCHD, LA, HOA/POA, PO, WI DNR, IDNR	ISGS/USGS, USFWS	M
27	Develop an aquatic plant management plan for lakes and streams that targets the reduction of invasive species, promotes native plant diversity and recreational use.	**Buffalo Creek:** Table 6-4 Action 3-F **North Mill Creek:** Table 5-3 Action 2.F **Mill Creek:** Table 6-5 Action 4-I	M	LA, IDNR, WI DNR, LCHD	Illinois EPA, WI DNR, FPD, USACE, USFWS, IDNR, WPC	M
28	Remove invasive species.	Not in previous plans.	M	PO, FPD, DD IDNR, WI DNR, OL, BACT, PD, CBL, DOT, EIG, HOA/POA, LA, PC, SI, EIG	SMC, CMAP, WPC, Illinois EPA	L
29	Establish a quagga/zebra mussel and invasive species reporting and monitoring system.	**North Mill Creek:** Table 5-3 Action 2.G **Mill Creek:** Table 6-5 Action 4-J	H	LA, IDNR, LCHD, WI DNR	M, C, PD, EIG POA/HOA, PR/RL, WPC, DRWW	S
30	Reintroduce extirpated native species as water resources or ecosystem improve (such as blanding turtle)	Not in previous plans.	M	USFWS, IDNR, WI DNR, FPD	Illinois EPA, WPC, PD, LA, BACT, OL	L

6.2.3 Goal #3: Flood Damage Reduction

GOAL: Reduce current flood damage in the DPR planning area and prevent future flooding from worsening in the watershed and along the Des Plaines River downstream of Lake County.

OUTCOME: Flood damages are reduced to the maximum extent achievable and impacts to residents, businesses, institutions, governments, and natural resources in the DPR planning area are minimal.

Table 6-4: Actions for Goal #3

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
1	Identify and increase additional flood storage at regional wetland/lake restoration or flood storage sites.	**BC-BB:** Table 57 Action 9 **Mill Creek:** Table 6-4 Action 3.J **Indian Creek:** Table 65 Action 33	H	SMC, MWRD IDNR, FPD, M, T, PD, PO, WI DNR	LCHD, DD, CMAP, PB&D	M
2	Increase storage capacity and retrofit existing detention basins to 2-year release.	**Indian Creek:** Table 65 Action 6, 18	M	M, C, T, PO, HOA/POA	SMC, MWRD, CMAP, USACE, PB&D	M
3	Restore historical floodplain function by removing spoil piles along channelized stream reaches.	**BC-BB:** Table 57 Action 10 **Indian Creek:** Table 65 Action 26	L	PR/RL, T, C, M, FPD, DD	NRCS/SWCD, USACE, SMC, MWRD, IL/WI DOA	M
4	Create water storage adjacent to Flood Problem Area Inventory sites.	**Indian Creek:** Table 65 Action 5	M	SMC, MWRD, M, C, T, FPD, PD	FEMA, EM, USACE	M
5	Evaluate, preserve, and enhance the flood storage functions of existing depressional, floodplain, and riparian areas in open and undeveloped parcels.	**BC-BB:** Table 55 Actions 7 and 8, Table 57 Actions 1 and 2 **North Mill Creek:** Table 5-4 Action 3.I **Mill Creek:** Table 6-2 Actions 1.A and 1.B **Indian Creek:** Table 65 Actions 12 and 36, Table 66 Action 20	H	M, C, T, SMC, MWRD, PD, FPD, PR/RL, PO, DOT	IDNR, WPC, WI DNR, PB&D, CMAP, SEWRPC, FEMA, EM	L
6	Use infiltration and evapotranspiration provided by green infrastructure to reduce volume of runoff and mitigate flood damage.	**Buffalo Creek:** Table 6-3 Action 2-E **BC-BB:** Table 57 Actions 5 and 8 **North Mill Creek:** Table 5-4 Action 3.K **Indian Creek:** Table 65 Actions 2, 7, 9, 11 and 32.	H	PO, M, C, DH, SMC, HOA/POA, PD, T, MWRD, DOT	WI DNR, FEMA, EM, DOT, CBL, IDNR, USACE, FPD, PB&D	L

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
7	Restore and enhance under-utilized space at commercial, industrial, and residential developments with stormwater green infrastructure practices.	**Buffalo Creek:** Table 6-5 Action 4-A **North Mill Creek:** Table 5-5 Action 4.A **Mill Creek:** Table 6-5 Action 4.L	M	DH, PO, HOA/POA, CBL, SI	Illinois EPA, PB&D, SMC, CMAP, WPC, MWRD	L
8	Increase native tree installation to reduce runoff.	Not in previous plans.	H	PO, M, C, T, HOA/POA, LA, PD, BACT, OL, DH, SI, FPD, DOT	NRCS/ SWCD, SMC, EIG, CMAP, IDNR, SEWRPC, WI DNR	S
9	Maintain golf courses using BMP's that increase soil permeability and minimize stormwater runoff.	Not in previous plans.	M	GC, M, PD, FPD	SMC, EIG, MWRD	M
10	Identify or install overland flow routes for all detention facilities and flood prone depressional areas where needed.	Not in previous plans.	H	SMC, M, C, T, FPD, PD, MWRD	FEMA, EM, USACE	S
11	Require more specific/stringent maintenance and drainage easement requirements for stormwater features in new developments and re-developments.	**North Mill Creek:** Table 5-5 Action 4.B	H	SMC, EO, Illinois EPA, WI DNR, MWRD, WPC, PB&D	DH, CBL, HOA/POA	S
12	Communities adopt and implement "no adverse impact" floodplain management standards.	**BC-BB:** Table 57 Action 15	H	M, C, T, EO, CMAP, SMC, PB&D	FEMA, EIG, Illinois EPA, USACE, EM, WI DNR, SEWRPC	M
13	Reduce the use of centralized detention ponds and install stormwater green infrastructure BMPs in new or existing developments.	**Buffalo Creek:** Table 6-3 Action 2-J **Mill Creek:** Table 6-4 Action 3.B **Indian Creek:** Table 66 Action 22	H	DH, CBL, M, C, PB&D, PO, HOA/POA, SI, T	SMC, CMAP, MWRD, SEWRPC, WPC	M
14	Encourage wet or wetland detention basins for new development and retrofit existing dry basins to these types.	**BC-BB:** Table 57 Action 3 **Indian Creek:** Table 65 Action 10	M	SMC, PB&D, M, C, T, CBL, HOA/POA, DOT, MWRD	CMAP, DH	M
15	Encourage conservation developments or clustered development in Planned Unit Developments and Planned Residential Developments.	**Indian Creek:** Table 65 Actions 13 and 31	L	DH, M, CMAP, P&BD	WPC, EO, OL, BACT, EIG, SMC, MWRD	M
16	Maintain and increase local drainage system capacity to improve resiliency for changing precipitation patterns.	**Mill Creek:** Table 6-2 Action 1.M	H	M, C, T, PD, FPD, DOT, DD	LCPW, CCPW, SMC, MWRD	L
17	Evaluate and implement watershed-specific release rates for the 100-year storm event.	**Indian Creek:** Table 66 Action 26	L	SMC, MWRD, C, M, PB&D	EO, USACE, IDNR, WI DNR, EIG	M

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
18	Develop and implement a stream inspection and maintenance program throughout the watershed. Remove excessive debris loads in channels to maintain conveyance and reduce streambank erosion.	**Buffalo Creek:** Table 6-3 Action 2-C **BC-BB:** Table 58 Action 1 **North Mill Creek:** Table 5-4 Action 3.F **Mill Creek:** Table 6-2 Action 1.G **Indian Creek:** Table 65 Actions 1, 23, 25, & 27	H	M, C, PB&D, FPD, PR/RL, DD, MWRD, PD, SMC	DOT, WPC, LCPW, IDNR, Illinois EPA, WI DNR, T, CMAP, USACE, CCPW	S
19	Support flood hazard map updates, including the FEMA Flood Insurance Study, to accurately identify current flood hazard areas and streams of high concern.	**Buffalo Creek:** Table 6-3 Action 2-H **BC-BB:** Table 57 Action 14 **North Mill Creek:** Table 5-4 Action 3.D **Mill Creek:** Table 6-2 Action 1.K	H	FEMA, ISWS, WI DNR, SEWRPC, CMAP M, C, T, SMC, MWRD	PB&D, USACE, IDNR, EM	M
20	Develop flood inundation maps to show varying depths of flooding and respective area of inundation, in coordination with the Lake County All Natural Hazards Mitigation Plan, Kenosha County Hazard Mitigation Plan and Cook County Multi-Jurisdictional Hazard Mitigation Plan.	**Buffalo Creek:** Table 6-3 Action 2-I	H	SMC, M, MWRD, CMAP, SEWRPC, C, PB&D	FEMA, EM, M	M
21	Develop a consistent floodplain boundary between Kenosha and Lake counties for watershed planning and green infrastructure purposes.	**North Mill Creek:** Table 5-4 Action 3.E	H	SEWRPC WI DNR, IDNR, ISWS, FEMA	SMC, M, C	M
22	Purchase and remove structures that are chronically flood damaged through the voluntary buyout program.	**Buffalo Creek:** Table 6-3 Action 2-G **BC-BB:** Table 62 Action 6 **North Mill Creek:** Table 5-4 Action 3.K **Mill Creek:** Table 6-2 Action 1.D **Indian Creek:** Table 65 Actions 15 and 20	H	PO, SMC, M	EM, MWRD, IDNR, FPD, FEMA, PB&D	L
23	Develop and implement standardized dam and weir maintenance and inspection protocol.	**Mill Creek:** Table 6-2 Action 1.H	H	M, PB&D, FPD, PO, PD, IDNR, WI DNR	WPC, Illinois EPA, T, C, CMAP, USACE, USFWS, MWRD, DD, SMC	S

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
24	National Flood Insurance Program (NFIP) communities participate in the Community Rating System (CRS) program to mitigate flood damage and reduce flood insurance rates for residents.	**Buffalo Creek:** Table 6-3 Action 2-D	M	M, C, PB&D, FEMA	SMC, MWRD, WI DNR	M
25	Implement floodproofing measures or elevate at-risk structures.	**Buffalo Creek:** Table 6-3 Action 2-G **BC-BB:** Table 57 Action 7 **Mill Creek:** Table 6-2 Action 1.C **Indian Creek:** Table 65 Action 16	H	PO, M, C, SMC, MWRD, PB&D, CBL	FEMA, EM, DOT, IDNR, WI DNR,	M
26	Install porous or permeable surfaces (pavement, concrete, asphalt, pavers) in parking areas.	Not in previous plans.	H	PO, CBL, SI, M, PD	SMC, MWRD, PB&D, M	M

6.2.4 Goal #4: Funding, Installing, and Maintaining Stormwater Infrastructure

GOAL: Reduce the volume and improve the quality of stormwater runoff by installing appropriate gray or green stormwater infrastructure and improving the condition of existing stormwater infrastructure.

OUTCOME: Reduce stormwater runoff volume and the pollution reaching and negatively impacting water bodies and natural resources and causing flood damage.

Table 6-5: Actions for Goal #4

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
1	Reduce the rate and volume of stormwater runoff from existing or new development by minimizing impervious cover and implementing green infrastructure practices.	**Buffalo Creek:** Table 6-6 Action 5-C **North Mill Creek:** Table 5-6 Actions 5.D and 5.K **Mill Creek:** Table 6-4 Action 3.J	H	PO, DH, CBL, M, PB&D, HOA/POA, SI, DOT	SMC, MWRD, WI DNR, SEWRPC, CMAP	M
2	Maintain infiltration functionality of areas with high infiltration soil types by designating them as undisturbed open space features in developing/ redeveloping sites.	**Buffalo Creek:** Table 6-6 Action 5-A **North Mill Creek:** Table 5-6 Action 5 **Mill Creek:** Table 6-4 Action 3.D	M	M, C, PO, DH, T, HOA/POA	SMC, MWRD, WI DNR, SEWRPC	M
3	Remove direct sump pump connections to waterways and sewers and redirect to green infrastructure BMPs.	**Mill Creek:** Table 6-4 Action 3.L	H	M, PO, PR/RL, CBL, DH, PB&D	SMC, ISD	S
4	Certified Community (under WDO & WMO) staff assist developers by assessing each new development site for proper BMP site selection and implementation of stormwater management practices that best minimize runoff volumes and velocities.	**BC-BB:** Table 59 Action 17	M	M, PB&D	SMC, MWRD,	S
5	Expand funding opportunities including alternative funding mechanisms, technical assistance, and maintenance resources for improving stormwater green infrastructure and best management practices.	**BC-BB:** Table 62 Action 1 **Indian Creek:** Table 67 Action 3	H	CMAP, IDNR, USFWS, WI DNR, Illinois EPA, FEMA	FPD, PD, WPC, SMC, MWRD, EIG	L
6	Recommend HOA dues for maintenance of open space in residential developments.	**BC-BB:** Table 62 Action 3	M	HOA/POA, PO	WPC, M, PB&D	M
7	Include sanitary sewer repairs in capital improvement and public works plans.	**Indian Creek:** Table 66 Action 33	M	M, C, LCPW, CCPW	EO, ISD	S

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
8	Develop standards/guidelines for use of green infrastructure for stormwater management in site planning and design including strategically connecting to off-site green infrastructure.	Not in previous plans.	M	PB&D, SMC, CMAP, SEWRPC, M	WPC, WI DNR, Illinois EPA	M
9	Increase education and political will to provide funding and technical analysis for improving local and countywide regulations pertaining to impervious surface stormwater runoff and best management practices (BMPs).	Not in previous plans.	M	EO, WPC	IDNR, WI DNR, Illinois EPA, EIG, CMAP, SMC	M
10	Retrofit and maintain existing stormwater management and conveyance structures and design new detention basins to incorporate multiple benefits (such as maintaining conveyance, reducing erosion, and limiting nuisance wildlife).	**Mill Creek:** Table 6-3 Action 2.E	H	PO, M, C, DH, CBL, HOA/POA, SI, FPD, CMAP, DOT	PD, SMC, PB&D, MWRD	M
11	Develop and implement a monitoring and maintenance plan for stormwater detention facilities, storm drains, drainageways, and catch basins, that identifies agency responsibilities, a maintenance schedule, budget, and funding source.	**BC-BB:** Table 57 Action 11 **North Mill Creek:** Table 5-4 Action 3.G **Mill Creek:** Table 6-4 Action 3.A	h	PO, DH, CBL, HOA/POA, M, T, C	WI DNR, IDNR, SMC, MWRD, FPD, WPC	S
12	Design and install stormwater BMPs to capture and stormwater runoff from roads, parking lots, and other transportation infrastructure.	**Buffalo Creek:** Table 6-6 Action 5-F **BC-BB:** Table 59 Action 5 **North Mill Creek:** Table 5-6 Action 5.J **Mill Creek:** Table 6-4 Action 3.I	H	CBL, DOT, M, C, T, DH, SI	SMC, Illinois EPA, MWRD, WI DNR	M
13	Naturalize road rights-of-way and increase onsite bioretention.	**Indian Creek:** Table 66 Action 8	H	DOT, M, C, T	SMC, CMAP, SEWRPC	M
14	Utilize modeling and monitoring data to evaluate if design assumptions and performance of stormwater infrastructure are being achieved	Not in previous plans.	L	DRWW, SMC, CMAP, FEMA, WPC, ISWS	EM, IDNR, WI DNR, ISGS/USGS	M
15	Through a monitoring and modeling effort, develop baseline annual hydrographs to preserve baseflow conditions of creeks and tributaries.	**Mill Creek:** Table 6-4 Action 3.C	M	DRWW, SMC, FEMA, CMAP, WPC, ISWS	EM, IDNR, WI DNR, ISGS/USGS	L
16	Develop standardized 5-year and long-term maintenance and monitoring plan for natural areas within new developments and require developers to identify a funding and implementation mechanism.	**BC-BB:** Table 59 Action 6 and 9	M	CMAP, WPC, DH, HOA/POA, PO, M, PB&D	IDNR, WI DNR, SMC, MWRD	M

6.2.5 Goal #5: Community And Agency Coordination

GOAL: Improve coordination, research, and decision-making among public, private, and non-profit entities to help achieve watershed plan goals and objectives.

OUTCOME: Watershed stakeholders coordinate and utilize all their local resources to implement watershed improvement projects.

Table 6-6: Actions for Goal #5

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
1	Watershed communities adopt the Des Plaines River Watershed Based Plan.	**Mill Creek:** Table 6-4 Action 3.J	H	SMC, M, C, WPC, EO	T, OL, PB&D, FPD, CMAP, SEWRPC, MWRD, Illinois EPA, PD, DD, SI, DRWW,	S
2	Municipalities and County review development standards and policies and adopt changes as needed to implement the watershed-based plan and preserve and protect healthy aquatic life and good water quality.	**Buffalo Creek:** Table 6 -2 Action 1-G **North Mill Creek:** Table 5-2 Action 1-I **Mill Creek:** Table 6-3 Action 2.A **Indian Creek:** Table 66 Actions 21, 36 and 44, and Table 65 Action 35	H	M, C, DD, PO, MWRD, PD, FPD	USACE, Illinois EPA, SMC, IDNR, DOT, PB&D, NRCS/SWCD	M
3	The DRWW will continue to monitor water quality and develop strategies to address water quality impairments in the Des Plaines River watershed.	Not in previous plans.	H	DRWW	M, C, T, PB&D, FPD, CMAP, SEWRPC, MWRD, DD, Illinois EPA, PD, SMC, WPC	L
4	Establish a watershed organization or committee with funding and support to guide watershed plan implementation, provide technical assistance to watershed stakeholders, and coordinate multi-partner projects, and determine the roles of existing watershed communities, councils, organizations, and groups.	**BC-BB:** Table 63 Action 6	H	WPC, DRWW	Illinois EPA, LCHD, SMC, M, T, C, MWRD, PB&D, DD, FPD, CMAP, PD, Illinois EPA	S
5	Coordinate watershed committee activities and plan implementation through the hire of a coordinator or the use of shared personnel services among members of the WPC.	**BC-BB:** Table 63 Action 5	H	DRWW, WPC	M, C, T, PB&D, FPD, CMAP, SEWRPC, PD MWRD, Illinois EPA, DD, SMC	M

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
6	Identify a watershed champion in each subwatershed or local area to promote and coordinate water resource management.	Not in previous plans.	M	SMC, DRWW, WPC	M, C, T, PD, FPD, EIG	S
7	Form a multijurisdictional partnership to develop funding packages and grant proposals to implement recommendations in the watershed plan and greenway protection/connection strategies.	**BC-BB:** Table 60 Actions 5 and 7, Table 62 Action 5, and Table 63 Actions 3 and 4 **Indian Creek:** Table 66 Action 41	M	WPC	M, C, T, PB&D, FPD, CMAP, SEWRPC, DRWW, SMC MWRD, Illinois EPA, PD, DD	S
8	Develop a model or template for an intergovernmental agreement for participation in cooperative watershed projects.	**Buffalo Creek:** Table 6-6 Action 5-B **BC-BB:** Table 63 Action 1, Table 59 Action 11, Table 61 Action **North Mill Creek:** Table 5-6 Action 5.C, Table 5-8 Action 7.N **Mill Creek:** Table 6-4 Action 3.F	M	SMC, WPC, M, C, CMAP	FPD, DOT, MWRD, HOA/POA, CBL	M
9	Land use planning jurisdictions consider DPR watershed-based plan recommendations when developing local comprehensive plans and making land use decisions.	**BC-BB:** Table 63 Action 10	M	WPC, PB&D, M, C, T, FPD	CMAP, SEWRPC, SI	M
10	Incorporate watershed plan recommendations or green infrastructure protection into community and county comprehensive land use plans.	**BC-BB:** Table 63 Action 8	H	M, C, PB&D, CMAP, FPD, T	SMC, WPC, IDNR, WI DNR	M
11	Invite planners making land use decisions to lead workshops and/or make biannual presentations to watershed committee regarding land use decisions and progress made to protect green infrastructure at the community and county levels.	**BC-BB:** Table 63 Action 7	M	WPC, C, M, PB&D, CMAP, FPD, T, SEWRPC	SMC, IDNR, WI DNR	S
12	Identify high priority stormwater green infrastructure and flood problem areas on all development review maps/databases.	**BC-BB:** Table 55 Action 1, Table 63 Action	M	PB&D, M, C,	WPC, IDNR, FEMA, EM, USACE, SMC, NRCS/SWCD, WI DNR, SEWRPC, CMAP	S

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
13	Greenway coordinators designated by each municipality, township, relevant county and state agency, and private conservation/land trust organization will meet 2 times/year to evaluate and coordinate green infrastructure preservation.	**BC-BB:** Table 63 Action 12	M	DRWW, WPC, NRCS/SWCD, CMAP, M, C, T, FPD, PB&D, SMC	Illinois EPA, PD, PO, EXT	L
14	Adopt tree preservation ordinances to preserve tree quantity and quality	Not in previous plans.	L	M, C, T, EO	CMAP, WI DNR, Illinois EPA, PB&D	L
15	Watershed committee annually assesses progress on plan implementation and updates the watershed-based plan no less frequently than every 10 years.	**Mill Creek:** Table 6-6 Action 5.G	H	WPC	Illinois EPA, WI DNR, DRWW, WPC Members	M

6.2.6 GOAL #6: SUSTAINABLE AGRICULTURE SYSTEMS

GOAL: Watershed stakeholders participate in farmland preservation programs and implement sustainable agricultural practices to accomplish other watershed goals and objectives.

OUTCOME: The plan encourages farmland preservation and sustainable agriculture practices in the watershed.

Table 6-7: Actions for Goal #6

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
1	Install and expand agricultural best management practices (BMPs), including drainage and tillage, to reduce sediment, chemical, and nutrient transport.	**Buffalo Creek:** Table 6-4 Action 3-G **BC-BB:** Table 56 Action 16 **North Mill Creek:** Table 5-8 Action 7.D, Table 5-2 Action 1-B **Mill Creek:** Table 6-4 Action 3.J	H	AG, FPD, PO, NRCS/SWC, EQ	WI/IL DOA, WI DNR, Illinois EPA, IDNR	M
2	Maintain conveyance in streams and drainage-ways adjacent to and downstream of agricultural land to reduce overland flooding and pollutant loads.	**North Mill Creek:** Table 5-8 Action 7.G	M	DD, PR/RL, FPD, AG, DOT, M, EQ	USACE, SMC, IDNR, WI DNR	M
3	Collect rainwater from farm building and agricultural arena roof tops for non-potable animal use (i.e. washing, rinsing) or garden water demand.	**North Mill Creek:** Table 5-8 Action 7.O	L	AG, EQ, PO	IL/WI DOA, NRCS/SWCD, FB, EXT	M
4	Encourage livestock rotational grazing	**North Mill Creek:** Table 5-8 Action 7.M	M	AG, EQ, FPD	IL/WI DOA, NRCS/SWCD, FB, EIG	S
5	Minimize livestock access to highly erodible lands, steep slopes, and waterways with fencing or cattle guards. Fence to keep grazing areas away from open water areas, wetlands, and riparian areas.	**Indian Creek:** Table 5-8 Actions 7.K and 7.T	H	AG, EQ, PR/RL	SMC, Illinois EPA, MWRD, WI DNR	S
6	Avoid manure disposal in floodplains, highly erodible land areas, and adjacent drainage areas of wetlands and water bodies.	**North Mill Creek:** Table 5-8 Action 7.Q	H	EQ, AG	IL/WI DOA, NRCS/SWCD, FB, EXT, SMC, USACE, WI DNR, IDNR	S
7	Cease farming in nonproductive depressional areas.	**Indian Creek:** Table 65 Action 34	L	AG, EQ, FPD	IL/WI DOA, FB NRCS/SWCD, IDNR, WI DNR	M

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
8	On private farmlands, work with non-profit organizations and USDA programs such as CRP, CREP, WRP, and EQIP to restore/enhance natural areas.	**Buffalo Creek:** Table 6-4 Action 3-G **BC-BB:** Table 62 Action 4 **North Mill Creek:** Table 5-3 Action 2.H **Mill Creek:** Table 6-5 Action 4.K	H	AG, EQ, PO	IL/WI DOA, NRCS/SWCD, FB, EXT, IDNR, WI DNR	L
9	Route runoff from agriculture facilities through bio-retention basins and swales.	**North Mill Creek:** Table 5-8 Action 7.S	M	EQ, AG, FPD	IL/WI DOA, NRCS/SWCD, FB, EXT, SMC	M
10	Create and implement Resource Management Plans (including manure management and storage and comprehensive nutrient management plans) for all farms, equestrian facilities, and nurseries in the watershed.	**BC-BB:** Table 56 Action 16 **North Mill Creek:** Table 5-8 Actions 7.B, 7.L, and 7.P, Table 5-2 Action 1-A	H	AG, FPD, EQ NRCS/SWC, N/L	IL/WI DOA, FB, EXT, SMC	M
11	Maintain drain tiles to reduce sediment transport to waterways and investigate opportunities for showcasing end-of-tile water quality BMPs at demonstration sites.	**North Mill Creek:** Table 5-8 Action 7.I	H	AG, FPD, EQ	SMC, NRCS/SWCD, FB, EXT, IL/WI DOA	M
12	Disable and remove non-functioning drainage tiles following feasibility study to evaluate potential impacts to neighboring properties	**North Mill Creek:** Table 5-8 Action 7.H **Indian Creek:** Table 65 Action 29	L	AG, FPD, SMC, EQ	NRCS/ SWCD, FB, EXT, IL/WI DOA	L
13	Investigate opportunities for a farmland preservation program (Illinois and Wisconsin portions of the watershed may require separate programs) and open space. Partner with existing farmland protection groups to share knowledge and provide support.	**North Mill Creek:** Table 5-8 Action 7.A **Indian Creek:** Table 67 Action 14	H	IL/WI DOA, AG, EQ, FPD, C	NRCS/SWCD, FB, EXT	L
14	Identify high priority and prime farmland parcels in the watershed and recommend for farmland protection program to county agencies.	**BC-BB:** Table 60 Action 10 **Indian Creek:** Table 67 Action 13	M	PB&D, C, T, FPD, NRCS/SWCD	FB, OL, CMAP, SEWRPC, WI DNR	S

6.2.7 Goal #7: Education And Outreach

GOAL: Provide watershed stakeholders with the knowledge, skills, and motivation needed to take action to implement the watershed plan.

OUTCOME: Stakeholders have adequate information and knowledge of resources to implement the watershed plan.

Table 6-8: Actions for Goal #7

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
1	Provide information and training to riparian landowners on best practices for stream and lake shoreline restoration and maintenance that will reduce erosion and increase water quality.	**Buffalo Creek:** Table 6-7 Action 6-G **BC-BB:** Table 61 Action 11 **North Mill Creek:** Table 5-7 Action 6.E **Mill Creek:** Table 6-4 Action 3.J **Indian Creek:** Table 65 Action 21	M	SMC, WPC, NRCS/SWCD, MWRD, LA, LCHD, HOA/POA	M, C, T, PD, OL, KRLT, BACTPR/RL, CMAP	S
2	Conduct a watershed outreach campaign to inform and engage the public about watershed issues, landowner responsibilities, and available resources.	Not in previous plans.	H	WPC,	SMC, CMAP, SEWRPC, KRLT, OL, BACT, LCHD, DRWW, HOA/POA, M, C, T	S
3	Continue to educate local municipalities, landowners, and public works staff on road salt alternatives and application BMPs to minimize the use of road salt by public and private snow removal providers.	**Buffalo Creek:** Table 6-7 Action 6-E **BC-BB:** Table 61 Action 15 **North Mill Creek:** Table 5-7 Action 6.D **Mill Creek:** Table 6-6 Action 5.J	H	SMC, LCHD, LCPW, DOT	WI DNR, Illinois EPA, MWRD, CCDPH, SEWRPC, DRWW, M, C, T, WPC	S
4	Inform the public and distribute educational materials on the importance of watershed health (water quality, flood prevention/mitigation, soil conservation and agricultural production, green infrastructure, water-based recreation) to the economy of watershed communities.	**Buffalo Creek:** Table 6-7 Action 6-D **North Mill Creek:** Table 5-7 Action 6.B **Indian Creek:** Table 6-6 Action 6.H	H	WPC	LCHD, M, C, T, SI, HOA/POA, IDNR, WI DNR, EIG, CMAP, MWRD, SMC, EXT, DRWW, OL, FPD	S
5	Inform homeowners and municipalities about water quality problems associated with sump pump, septic systems, and illicit storm drain hookups.	**Buffalo Creek:** Table 6-7 Action 6-F **BC-BB:** Table 61 Action 3 **Indian Creek:** Table 66 Action 30	M	SMC, LCHD, PB&D, MWRD	Illinois EPA, M, C, T, EIG	S
6	Provide information on mosquito prevention measures for individual homeowners, including removing stagnant water in tires, buckets, clogged gutters etc.	Not in previous plans.	L	LCHD, CCDPH	POA/HOA	L

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
7	Provide information and training to farmland owners on how to develop and implement resource management plans designed to improve agricultural practices to reduce erosion and limit fertilizer/pesticide use.	**BC-BB:** Table 61 Action 6	H	NRCS/SWCD, FB, EXT, AG	WI/IL DOA, IDNR, WI DNR	S
8	Inform developers, municipalities, and residents about the negative impacts that untreated or unmitigated impervious surface coverage has on water resources.	**BC-BB:** Table 61 Action 9	H	WPC, OL	SMC, LCHD, MWRD, SEWRPC	S
9	Inform municipalities, businesses, and homeowner associations about detention basin and stormwater inlet maintenance practices that improve water quality and reduce flooding.	**BC-BB:** Table 61 Action 10	H	LCHD, WPC LCPW, SMC, CCPW, DRWW	HOA/POA	S
10	Offer and provide technical assistance to the public and local government for funding and cost-share opportunities and support with project development to implement the watershed plan.	**BC-BB:** Table 61 Actions 12 and 18 **North Mill Creek:** Table 5-7 Action 6.H **Mill Creek:** Table 6-6 Actions 5.C and 5.L	M	WPC, SMC, NRCS/SWCD WPC, CMAP, SEWRPC	MWRD, LCHD, M, Illinois EPA, T, C	M
11	Provide watershed residents with a 5 and 10-year report card that illustrates the ecological health of the watershed and reports progress towards watershed goals.	**Mill Creek:** Table 6-6 Action 5.G	H	WPC,	Illinois EPA, M, C, T, DRWW, LCHD, SMC, MWRD	M
12	Support and promote the Conservation@Home program to reduce stormwater runoff and gully formation. Non-profit in Kenosha County should consider promoting and supporting a similar program.	**Buffalo Creek:** Table 6-7 Action 6-C **BC-BB:** Table 61 Action 16 **North Mill Creek:** Table 5-7 Action 6.F	M	KRLT, WPC, FPD, BACT, OL, NRCS/SWCD	SMC, MWRD	M
13	Facilitate public training and engage students, teachers, riparian landowners, lake associations, and homeowner associations to volunteer for lake, stream, and natural area stewardship (i.e. stream and lake clean-up days) and monitoring of water resources.	**BC-BB:** Table 61 Action 7 **Mill Creek:** Table 6-6 Action 5.E	M	WPC, LA, HOA/POA, LCHD, SI, CMAP, DRWW	SMC, Illinois EPA, DD, MWRD, OL, KRLT, LS	M
14	Non-profit organizations choose a school to work with to naturalize open space and potentially adopt into the green infrastructure network.	**North Mill Creek:** Table 5-5 Action 4.J **BC-BB:** Table 60 Action 9	M	SI, CL, BACT, KRLT	SMC, CMAP	M

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
15	Promote the removal of invasive plants by providing trainings aimed at species identification/control (species such as: phragmities, teasel, garlic mustard, buckthorn).	**Buffalo Creek:** Table 6-7 Action 6-H **BC-BB:** Table 61 Action 8 **North Mill Creek:** Table 5-7 Action 6.G	L	OL, SI, BACT, EXT, EIG, HOA/POA	LCHD, SMC, CCDPH, MWRD, CMAP, N/L, WPC, FPD, PD	S
16	Outreach campaign, demonstration site, and workshop promoting the establishment of native plants and proper plant selection.	Not in previous plans.	L	OL, SI, BACT, EXT, EIG, HOA/POA	LCHD, SMC, CCDPH, MWRD, CMAP, N/L, WPC, FPD, PD	M
17	Inform communities about the benefits of adopting the “no adverse impact standard” and maintaining floodplain as open space in reducing flood damage.	**BC-BB:** Table 61 Action 1 **North Mill Creek:** Table 5-4 Action 3.H **Mill Creek:** Table 6-2 Action 1.L	H	SMC, PB&D, MWRD, WI DNR	IDNR, EM, FEMA, EIG	M
18	Provide outreach and workshops for the public affected by flood damage to educate them about the causes of flooding, flood mitigation practices, and ways to prevent local and regional flood damage.	**Buffalo Creek:** Table 6-7 Action 6-J **BC-BB:** Table 61 Action 2 **North Mill Creek:** Table 5-7 Action 6.I **Mill Creek:** Table 6-6 Action 5.M	H	SMC, PB&D, MWRD, WI DNR	IDNR, EM, FEMA, LCPW, CCPW	S
19	Inform homeowner's associations about the importance of funding and maintaining open space in developments.	**BC-BB:** Table 61 Action 17	M	WPC, SMC, PB&D, M, EIG	HOA/POA, DH, C, T, CMAP, WI DNR	M
20	Include stream name signs at all stream crossings.	**Buffalo Creek:** Table 6-7 Action 6-B **North Mill Creek:** Table 5-7 Action 6.A **Mill Creek:** Table 6-6 Action 5.B	M	DOT, T, DD, PD, FPD, M, WPC	SMC, LA, MWRD, PD	M
21	Incorporate watershed signage and information at public properties such as forest preserves, public parks, and public lake boating areas.	**Buffalo Creek:** Table 6-7 Action 6-B **North Mill Creek:** Table 5-7 Action 6.A **Mill Creek:** Table 6-6 Action 5.B	H	M, C, T, WI DNR	SMC, MWRD, PD, FPD, LA, LCHD	S
22	Promote invasive species awareness at public boat launches regarding boat transport, live-well water, and use of live bait.	**North Mill Creek:** Table 5-3 Action 2.G **Mill Creek:** Table 6-5 Action 4-J	H	LA, IDNR, LCHD, WI DNR	M, PD, FPD, HOA/POA, WPC, EIG	S
23	Conduct an analysis to quantify the economic costs, benefits and value of water resources in the watershed.	Not in previous plans.	M	WPC	EIG, SMC, FPD, CMAP, LCHD, M, T, C, MWRD, CCDPH, WI DNR, IDNR, SEWRPC, Illinois EPA, SI	L

ACTION #	ACTION	PREVIOUS PLANS	PRIORITY	LEAD PARTNERS	SUPPORTING PARTNERS	TIME FRAME
24	Continue to support rain barrel distribution and sale programs within the watershed.	Not in previous plans.	H	SWALCO, MWRD	SMC, FPD, SWCD	L

6.2.8 Regulatory and Policy Programmatic Actions

This watershed-based plan does not include land use recommendations because land use planning and development decisions are the right and responsibility of watershed municipalities and counties. This plan does consider the health of DPR planning area lakes, streams and wetlands, which is a direct reflection of land use and management. Therefore, municipal and county consideration of land management and development impacts is necessary for effective watershed planning. Modifications and changes to local regulations and policy can have a significant influence on improving the ecological, environmental, safety and economic conditions of the watershed. Design standards, ordinances, codes and other regulatory tools are key mechanisms for implementing a vision for the watershed that will prevail into the future. The way that many codes and ordinances are written may encourage or require design approaches that unintentionally neglect preserving and enhancing watershed health. Local regulating entities are encouraged to provide incentives for design approaches, development and redevelopment standards, codes and ordinances that allow innovative watershed development that reduces flood damage, improves water quality and preserves or includes green infrastructure.

An excellent source of information on model development principles and a sample code and ordinance review worksheet can be found in *Better Site Design: A Handbook for Changing Development Rules in Your Community* (Center for Watershed Protection, 1998).

During the watershed planning process, stakeholders identified opportunities for policy and regulatory changes to benefit the DPR planning area and address flooding, water quality and natural resource concerns. Several stakeholders indicated a desire for more proactive enforcement of existing regulations. Recommended opportunities for policy and regulatory review and modification are based on stakeholder input during watershed planning committee meetings and specific watershed issues identified through the watershed assessment process. Issues to be addressed and opportunities include:

6.2.8.1 Development and Stormwater Runoff

1. Local land development standards should:
   - Allow, incentivize, and/or credit Low Impact Development standards/practices, infiltration BMPs, and maintaining pre-development hydrology.
   - Offset the impact of future impervious cover to insure that additional impervious cover does not degrade subwatershed management units.
   - Reduce the rate and volume of stormwater runoff from areas that are already developed.

2. Establish rain garden program(s).
3. Communities and the county enact ordinances and standards for sump pump and downspout discharges to be directed to lawn or rain gardens and infiltrated.

6.2.8.2 Pollution Prevention

1. Reduce the quantity of road salt (sodium chloride) needed for safe and cost-effective winter maintenance to reverse the current trend of rising chloride levels in water bodies. Adopt standards for the use of deicing chemicals/practices.

2. Regulate and limit the use of lawn chemicals, such as nitrogen fertilizers and pesticides, and tar for seal coating asphalt surfaces.
3. Reduce phosphorus loads by watershed municipalities and the county by passing an ordinance that bans the use of fertilizer with phosphorus unless a soil test indicates it is needed.
4. Reduce fecal coliform pollution by regulating septic system construction and maintenance, requiring regular maintenance and enforcement of ordinances requiring proper cleanup and disposal of pet waste.

6.2.8.3 Monitoring and Stream Maintenance

1. Develop and implement a watershed monitoring program to collect and monitor water quality and biological data on a regular basis.
2. Establish institutional stream maintenance program and standards using the American Fisheries Society standards as guidelines.

6.2.8.4 Wetlands and Floodplains

1. Maintain riparian and depressional floodplain and wetlands to maximize flood storage and conveyance.
2. Restore and create wetlands where feasible with a minimum target of 10% wetland per subwatershed.

6.2.8.5 Green Infrastructure

1. Identify and preserve open space as green infrastructure or greenways to promote flood damage reduction, water quality improvement, natural resource protection and wetland restoration.
2. Adopt and prioritize Green Infrastructure Plan elements and support implementation of these elements through local land use plans, policies and maps. Amend local and county zoning ordinances to encourage green infrastructure practices.

6.2.8.6 Transportation Sustainability Practices

1. Use I-LAST Scoring System for all new roadway expansion and extension projects.
2. Use practices that reduce and treat runoff volumes from roads and parking lots (reduce pavement extent, use porous pavement where appropriate, infiltrate runoff where appropriate).
3. Transportation design should consider wildlife crossings and avoid waters and wetlands where possible.
4. Include environmentally friendly stream crossings that protect aquatic habitat.
5. Monitor and maintain BMPs post-construction.
6. Conduct street sweeping and inlet cleaning.

Table 6-9 illustrates the most significant local entities in the watershed that influence, develop and enforce local policy and regulation. State and federal agencies are not highlighted due to the fact that state and federal regulation and policy change should not be the focus of a locally led watershed planning effort.

Table 6-9: Regulatory/Policy Action Recommendations

ID	Action	Priority	Lead Partners	Supporting Partners
RP-1	Review and modify land and transportation development standards, practices, codes and ordinances for new development and redevelopment to allow and incentivize low impact development design and green infrastructure practices.	H	M, PB&D, DOT	SMC, MWRD, WI DNR, Illinois EPA
RP-2	Encourage the use of stormwater green infrastructure BMPs for detention credit.	M	M, PB&D	SMC, MWRD, WI DNR, Illinois EPA
RP-3	Provide programs with incentives to retrofit existing developed areas and construct new developments with green infrastructure BMPs to reduce runoff volumes and rates and mitigate water quality impacts.	H	M, PB&D	SMC, MWRD, Illinois EPA, WI DNR
RP-4	Require downspout and sump pump discharges be disconnected from the storm sewer system and be directed to rain gardens, lawns, drywells or other practices for infiltration.	M	M, PB&D	HOA/POA, MWRD, CMAP, SMC
RP-5	Regulatory agencies and units of government determine if current enforcement supports existing regulations	M	M, PB&D, DOT, SMC, MWRD, Illinois EPA, IDNR, WI DNR, USACE	EO
RP-6	Jurisdictions with transportation maintenance authority should have an adopted winter maintenance/snow and ice removal policy that includes snow removal priorities, practices and products used. Municipalities should require that all chemical applicators whether public or private must be registered with the jurisdiction and have appropriate training.	H	M, DOT, T, FPD	SMC, LCHD, CCDPH, MWRD, Illinois EPA, WI DNR, CCPW, LCPW
RP-7	Ban the use of fertilizer with phosphorus unless a soil test indicates it is needed.	H	M, PB&D	LCHD, CCDPH, DRWW
RP-8	Investigate limiting or banning the use of coal tar seal-coating products and lawn pesticides known to runoff and pollute waters.	M	M, PB&D	LCHD, CCDPH, DRWW
RP-9	In compliance with Illinois EPA, establish total suspended solids (TSS) or other numerical water quality performance standard for new developments and redevelopment in DPR planning area.	M	SMC, MWRD, WI DNR, DRWW	M, PB&D

ID	Action	Priority	Lead Partners	Supporting Partners
RP-10	Participate in a coordinated watershed monitoring program to collect and monitor water quality and biological data on a regular basis.	M	DRWW, WWTP	SMC, LCHD, CCDPH, M
RP-11	Cooperatively establish, adopt and implement stream maintenance standards in conformance with American Fishery Society guidelines.	M	SMC, M, MWRD, WI DNR, IDNR	LCHD, FPD, CCDPH
RP-12	Review effectiveness of wetland regulations and develop watershed-specific provisions if needed.	L	SMC, MWRD, USACE, WI DNR, IDNR	M, PB&D
RP-13	Require in-watershed (DPR planning area) mitigation for all floodplain wetland impacts.	H	SMC, MWRD, USACE, WI DNR, IDNR	M, PB&D
RP-14	Map depressional wetlands/floodplain and investigate flood damage in these areas to determine if floodplain development in depressional areas should be restricted for safety reasons.	H	SMC, MWRD, M, PB&D, SEWRPC	FEMA
RP-15	Adopt and prioritize green infrastructure elements and support implementation of these elements through local land use plans, policies and maps.	H	M, PB&D	SMC, MWRD, FPD, SEWRPC
RP-16	Adopt and implement “complete streets” and sustainable transportation policies that are multi-modal and provide safe, accessible and connected non-motorized transportation (including underserved and low to moderate income areas with alternative transportation options).	M	M, T, DOT	PB&D, FPD, SMC, CMAP, MWRD, SEWRPC
RP-17	Develop and implement roadway design standards that include environmentally friendly stream crossings that protect aquatic habitat, route roadways away from sensitive waters and wetlands where possible and consider and incorporate wildlife crossings.	H	M, DOT, T	WI DNR, IDNR, SMC
RP-18	Implement street-sweeping and inlet clearing programs, particularly during autumn months	H	DOT, M, T	LCHD, DRWW
RP-19	Consider impervious surface coverage regulations at appropriate scales such as parcels or catchments to reduce runoff volumes new development and redevelopment.	M	M, PB&D, WPC, SMC, DRWW, CMAP, BACT	USACE, IDNR, Illinois EPA, EIG, OL
RP-20	Require that developers demonstrate measures taken to minimize impervious surfaces (i.e. parking ratios, multi-	M	CBL, DOT, M, T, SI, EO	SMC, Illinois EPA, MWRD, WI DNR

ID	Action	Priority	Lead Partners	Supporting Partners
	level parking, permeable surface parking, reduced street widths, and sidewalks on one side of street, etc.).			

See Section 6.1 Implementation Partners for descriptions of the Lead/Support Partners.

6.2.9 DRWW Recommendations

The DRWW completed a biological and water quality assessment of the Upper Des Plaines River and Tributaries in 2016; the final report was published in December, 2017. In general, the assessment focused on biological indicators of stream health and what causes, and sources of impairments are present in the watershed. As noted in the report, eleven (11) different causal categories and four different source categories were identified and, in some cases, differed from causes and sources of aquatic life impairment identified for the same water body by Illinois EPA in the 2016 Integrated Report. For causes, four (4) were habitat-related (siltation, no riparian, bank erosion, and channel modification) and seven (7) were chemical (low dissolved oxygen, organic enrichment, nutrients, chlorides, conductivity, manganese, PAHs). Certain causes such as siltation (66 of 70 sites) and chlorides (41 of 70 sites) were pervasive throughout the study area while others were either localized or sporadic throughout the study area. Sources included urban runoff, habitat alterations, altered hydrology, and WWTP effluent. These constitute the principal causes and sources that would need to be addressed to resolve the aquatic life impairments (MBI, 2017).

The report provides a thorough synthesis of results and draws meaningful conclusions from the data; this was used to generate a series of recommendations that should be considered when determining what plan actions should be prioritized or considered to address water quality. Many of the actions described in the following section directly address report conclusions listed below:

1. Excessive stream siltation associated with habitat alterations and altered hydrology from urban and suburban runoff is the primary stressor in the watershed. Actions that reduce instream sediment loads and address altered hydrology should receive priority. These actions could include:
   a. Streambank and stream bed stabilization.
   b. Retention and detention to reduce peak flows and trap eroded sediment.
   c. Stream restoration and maintenance practices that restore critical habitat features.

2. Organic enrichment-related biological responses were observed downstream from WWTPs. Efforts underway by these plants to reduce phosphorus loading will benefit overall water quality and biological conditions.

3. Sediment contamination with PAH compounds was observed on the mainstem of the DPR and several tributaries, correlated with the degree of urbanization. Detention and retention practices that trap and filter these pollutants should be targeted to heavily urbanized areas of the watershed. These practices could include porous/permeable pavement, detention/retention basins, filter/buffer strips, rain gardens, and other urban BMPs.

4. Chloride concentrations are increasing and chlorides were identified as the second-most prevalent cause of biological impairment. Efforts that reduce the application of road salts is critically important throughout the watershed. Chloride loading from WWTPs is also a potential concern as these point sources are responsible for a relatively high percentage of the total watershed chloride load (Chapter 4). Areas upstream of WWTPs with high chloride loads (NPS chloride loads) may need to be evaluated separately from areas downstream of point sources of chloride.

6.3 SITE-SPECIFIC ACTION PLAN

NOTEWORTHY: PROJECT SPECIFIC ACTIONS

Site-specific watershed projects/actions include urban and agricultural BMPs, detention basin retrofits, problem hydrologic/hydraulic structure modification, flood mitigation solutions, streambank and lake bank stabilization, and wetland preservation/restoration and creation priorities.

Project or site-specific action items and recommendations are tied to a particular location or locations in the watershed. As with the programmatic actions, these site-specific recommendations were developed to address watershed problems, to improve watershed resources and to achieve goals and objectives. Due to the size of the planning area and sheer number of site-specific action recommendations developed during the course of the planning process, readers of the plan are encouraged to use the ***online mapping application*** (https://tinyurl.com/ycthwx9x). The individual recommendations are also listed in tables, organized by jurisdiction, in Appendix N. Maps showing the action recommendations are included in Appendix N, but users are encouraged to use the online mapping application.

During development of the watershed-based plan, many methods were used to identify specific project sites, which are outlined below:

- Direct stakeholder input.
- Detention basin inventory.
- Stream inventory and assessment.
- Lake shoreline inventory and assessment.
- Flood problem area inventory.
- Flood storage area analysis.
- Lake County Wetland Restoration & Preservation Plan (WRAPP).
- Green infrastructure analysis.
- GIS analysis and water quality modeling.
- Windshield surveys.
- Previously planned projects.

The identification of specific sites suited for watershed improvement projects has been ongoing during past planning efforts in subwatersheds of the DPR planning area. Specifically, Mill Creek, North Mill Creek/Dutch Gap, Indian Creek, and Buffalo Creek have current watershed-based plans that should be considered jointly with this regional plan. This chapter is not a comprehensive inventory of all possible projects in the DPR planning area; it is only intended to provide guidance on where to "kick start" implementation.

For the purposes of this plan, wetland enhancement includes only existing wetlands and restoring their natural function, efficiency and biodiversity whereas wetland restoration and creation includes creating wetlands where they do not currently exist. Opportunity sites for flood mitigation and regionally significant storage site action recommendations are also highlighted.

NOTEWORTHY: SITE-SPECIFIC ACTIONS VS. BASIN-WIDE SITE-SPECIFIC ACTIONS

SITE-SPECIFIC ACTIONS:
Recommendations for a specific geographic location in the planning area. Sites may be represented by single points, linear features (such as stream banks), or polygons (specific areas, such as a wetland).

BASIN-WIDE SITE-SPECIFIC ACTIONS:
Recommendations that can be applied to a specific geographic location but which are generally identified across the planning area based on land use/land cover or some other "mappable" geographic characteristic. Opportunities for runoff volume reduction are an example of basin-wide site-specific actions.

This section outlines and summarizes site-specific actions and basin-wide site-specific actions. Where applicable, the action recommendations are coded by jurisdictions (Table 6-10) and project type category (Table 6-11). Actions and projects are then further described and summarized, by major action category and jurisdiction in Section 6.3.6. Individual site-specific actions and their attributes and details are available through the online web application hosted by SMC and in detailed jurisdictional tables located in Appendix N. Chapter 7 includes overall cost estimates, pollutant load reductions, and implementation strategies. There are over 5,000 site-specific and basin-wide site-specific action recommendations, spanning 56 separate jurisdictions. These actions are summarized in Table 6-12, Table 6-13, Table 6-14, and Table 6-15. If implemented, the actions would benefit over 100,000 acres and nearly 19 miles of streambank/lake shoreline.

Table 6-10: Site-specific Jurisdiction Coding

ABBREVIATIONS	JURISDICTION
ANT	Village of Antioch
ARL	Village of Arlington Heights
BEA	Village of Beach Park
BRI	Village of Bristol
BUF	Village of Buffalo Grove
CFP	Cook County Forest Preserve District
DFD	Village of Deerfield
DPK	Village of Deer Park
GLV	Village of Glenview
GRN	Village of Green Oaks
GRY	Village of Grayslake
GUR	Village of Gurnee
HAW	Village of Hawthorn Woods
HNS	Village of Hainesville
IND	Village of Indian Creek
KLD	Village of Kildeer
LFP	Lake County Forest Preserve District
LFT	City of Lake Forest
LIB	Village of Libertyville
LND	Village of Lindenhurst
LNG	Village of Long Grove
LSH	Village of Lincolnshire
LVA	Village of Lake Villa

ABBREVIATIONS	JURISDICTION
PPH	City of Prospect Heights
PRK	City of Park City
RLB	Village of Round Lake Beach
RLP	Village of Round Lake Park
RIV	Village of Riverwoods
SAL	Village of Salem Lakes
SOI	State of Illinois
TANT	Antioch Township
TAVN	Avon Township
TBEN	Benton Township
TELA	Ela Township
TFRE	Fremont Township
TLIB	Libertyville Township
TLVA	Lake Villa Township
TNEW	Newport Township
TNFD	Northfield Township
TPAL	Palatine Township
TRD	Village of Third Lake
TVRN	Vernon Township
TWAK	Waukegan Township
TWAR	Warren Township
TWDF	West Deerfield Township
TWHE	Wheeling Township

ABBREVIATIONS	JURISDICTION
LZR	Village of Lake Zurich
MET	Village of Mettawa
MND	Village of Mundelein
NBK	Village of Northbrook
OLD	Village of Old Mill Creek
PAL	Village of Palatine

ABBREVIATIONS	JURISDICTION
VRN	Village of Vernon Hills
WAD	Village of Wadsworth
WAK	City of Waukegan
WHE	Village of Wheeling
ZIO	City of Zion

Table 6-11: Site-Specific Action Categories

PROJECT SPECIFIC ACTION CATEGORY	ID CODE	DESCRIPTION
Site-specific BMPs	SSD	Site-Specific (project recommendations are based on coordination with stakeholders and project opportunities identified during windshield surveys. The practice applies to a very specific single location on the ground.
Site-specific stakeholder project recommendations	DST	Direct recommendations from stakeholders or jurisdictions. Recommendations are specific locations. Subcategories include DSTF for site-specific flooding issues, DSTFP for recommended flood damage reduction projects and DSTG for generalized site-specific recommendations.
Streambank erosion control practices	SBD	Site-specific streambank erosion control recommendations, including severely eroding streambanks identified from inventories.
Stream Buffers	DSB	Buffers/filter strips generated from stream inventory data. These locations were identified by SMC as having poor or nonexistent riparian zones.
Lake shore erosion control practices	DL	Site-specific lakeshore recommendations include severely eroding lake banks identified during the inventory.
Detention basin retrofit projects	DD	Detention basin retrofit recommendations are based on a basin survey completed by SMC. These projects include maintenance and actions to improve basin function.
Problem discharge locations	DPD	Problem discharge points are any direct discharges streams that should be evaluated and/or repaired. These locations were identified by SMC staff during various stream inventories.
Problem hydraulic impediments	DPH	Hydraulic impediments are any notable issues that impede the conveyance and function of the waterway. These locations were identified by SMC staff during various stream inventories.
Cover Crops*	CC	Recommendations for implementing cover crop use.
Runoff volume reduction*	RVR	Recommendations for installation of runoff volume reduction BMPs such as rain barrels, rain gardens, green roofs, curb and gutter cuts, permanent vegetation cover, bioswales (vegetated swales) and tree installation practices.
Feed area management*	FAM	Recommendations for installation of feed area basins.
No-till/strip-till*	TIL	Recommendations for implementing no-till/strip-till farming practices.
Nutrient management*	NU	Recommendations for developing nutrient management plans.
Pasture enhancement*	PE	Recommendations for enhancing existing pasture operations.
De-icing practices/ salt management*	ICE	Recommendations to reduce road salt application.
Wetland creation/restoration*	WLR	Recommendations to create wetlands.
Wetland enhancement*	WLE	Recommendations to enhance wetlands.
Flood problem areas	DFPAI	Site-specific flood mitigation projects to address the flood problem area inventory sites described in Chapter 5.

PROJECT SPECIFIC ACTION CATEGORY	ID CODE	DESCRIPTION
Potential regionally significant flood storage sites	DFS	Potential storage areas that should be evaluated in the watershed.
Site-specific wetland creation sites	DWS	Site-specific wetland creation/restoration sited compiled from the WRAPP including high priority WRAPP wetlands and those that will achieve the greatest sediment and nutrient load reductions.
High Priority Previously Planned Actions	N/A	Those actions identified in a previously completed plan. All actions are considered high priority and contain a master locator number or a previously established code.

* Basin wide site-specific actions. These recommendations are aggregated and mapped by jurisdiction.

Table 6-12: Summary of Site-Specific Actions by Priority

BMP TYPE	# OF PROJECTS				ACRES BENEFITED				UNIT OF PRACTICE			
	H	M	L	TOTAL	H	M	L	TOTAL	H	M	L	TOTAL
Bioswale	1	0	0	1	6.8	0	0	6.8	0.23 ac	0	0	0.23 ac
Debris Jam	4	11	1,444	1,459	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Detention Basin Retrofit	0	478	128	606	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Discharge Point	111	68	0	179	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Field Border	43	0	0	43	1,029	0	0	1,029	64 ac	0	0	64 ac
Filter Strip	13	0	0	13	780	0	0	780	44 ac	0	0	44 ac
Grade Control	2	0	0	2	44	0	0	44	N/A	N/A	N/A	N/A
Grass Conversion	4	0	0	4	34	0	0	34	34 ac	0	0	34 ac
Grass Waterway	31	0	0	31	1,098	0	0	1,098	50 ac	0	0	50 ac
Hydraulic Structure	23	64	1	88	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lake Shoreline Stabilization	88	0	0	88	N/A	N/A	N/A	N/A	2.9 mi	0	0	2.9 mi
Permeable Pavement	1	0	0	1	1	0	0	1	1 ac	0	0	1 ac
Pond	0	0	4	4	286	0	0	286	N/A	N/A	N/A	N/A
Rain Barrel/Rain Garden	2	0	0	2	84	0	0	84	510 rain barrels, 250 rain gardens	0	0	510 rain barrels, 250 rain gardens
Sediment Forebay	3	0	0	3	3,890	0	0	3,890	900 ft	900 ft	900 ft	900 ft
Stormwater Management BMP	1	0	0	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Stream Buffer	194	0	0	194	434	0	0	434	75 ac	0	0	75 ac

BMP TYPE	# OF PROJECTS				ACRES BENEFITED				UNIT OF PRACTICE			
	H	M	L	TOTAL	H	M	L	TOTAL	H	M	L	TOTAL
Stream Bank Stabilization	61	0	0	61	N/A	N/A	N/A	N/A	15.5 mi	0	0	15.5 mi
Swale/Open Channel	5	20	0	25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Urban Detention	4	0	0	4	163	0	0	163	N/A	N/A	N/A	N/A
WASCoB	8	0	0	8	70	0	0	70	N/A	N/A	N/A	N/A
Wetland Creation/ Restoration	131	0	0	131	49,734	0	0	49,734	1,300 ac	0	0	1,300 ac
Totals	730	641	1,577	2,948	57,654	0	0	57,654	1,568 ac & 19 mi	0	0	1,568 ac & 19 mi

[1] This practice is located on SMC property and was completed in 2017
[2] Projects may identify multiple wetland restoration/creation sites

Table 6-13: Summary of Site-Specific Action Costs by Priority

BMP TYPE	ESTIMATED COST			
	H	M	L	TOTAL
Bioswale[1]	$150,282	$0	$0	$150,282
Debris Jam	$40,000 - $320,000	$110,000 - $880,000	$14,440,000 - $115,520,000	$14,590,000 - $116,720,000
Detention Basin Retrofit	$0	$2,390,000 - $23,900,000	$640,000 - $6,400,000	$3,030,000 - $30,300,000
Discharge Point	$555,000 - $3,330,000	$340,000 - $2,040,000	$0	$895,000 - $5,370,000
Field Border	$257,000	$0	$0	$257,000
Filter Strip	$175,360	$0	$0	$175,360
Grade Control	$16,000	$0	$0	$16,000
Grass Conversion	$135,200	$0	$0	$135,200
Grass Waterway	$400,000	$0	$0	$400,000
Hydraulic Structure	$230,000 - $1,840,000	$640,000 - $5,120,000	$10,000 - $80,000	$880,000 - $7,040,000
Lake Shoreline Stabilization	$1,550,833	$0	$0	$1,550,833
Permeable Pavement	$627,264	$0	$0	$627,264
Pond	$0	$0	$200,000	$200,000
Rain Barrel/Rain Garden	$915,800	$0	$0	$915,800
Sediment Forebay	$1,404,000	$0	$0	$1,404,000
Stormwater Management BMP	$250,000	$0	$0	$250,000

BMP TYPE	ESTIMATED COST			
	H	M	L	TOTAL
Stream Buffer	$301,104	$0	$0	$301,104
Stream Bank Stabilization	$32,834,536 - $41,084,536	$0	$0	$32,834,536 - $41,084,536
Swale/Open Channel	$25,000 - $150,000	$100,000 - $600,000	$0	$125,000 - $750,000
Urban Detention	$400,000	$0	$0	$400,000
WASCoB	$124,000	$0	$0	$124,000
Wetland Creation/Restoration	$103,998,098	$0	$0	$103,998,098
Total	$144,389,557 - $157,429,557	$3,580,000 - $32,540,000	$15,290,000 - $122,200,000	$163,259,477 - $312,169,477

[1] This practice is located on SMC property and was completed in 2017

Table 6-14: Summary of Acres of Recommended Basin-Wide Site-Specific Actions by Priority

BMP TYPE	ACRES OF PRACTICE			
	HIGH PRIORITY	MEDIUM PRIORITY	LOW PRIORITY	TOTAL
Cover Crops (CC)	15,204	3,097	42	18,343
Runoff Volume Reduction (RVR)	10,709	13,704	0	24,413
Nutrient Management (NU)	0	18,341	0	18,341
No-Till /Strip-Till (TIL)	9,771	2	1	9,775
Pasture Enhancement (PE)	0	134	1	135
Feed Area Management (FAM)	68	0	0	68
Wetland Creation/Restoration (WLR)	1,608	0	0	1,608
Wetland Enhancement (WLE)	0	1,217	0	1,217
Total	**43,176**	**30,719**	**4**	**73,900**

Table 6-15: Summary of Cost of Recommended Basin-Wide Site-Specific Actions by Priority

TYPE	ESTIMATED COST			
	HIGH PRIORITY	MEDIUM PRIORITY	LOW PRIORITY	TOTAL
Cover Crops (CC)	$440,042	$660,453	$41	$1,100,536
Runoff Volume Reduction (RVR)	$156,781,260	$200,628,932	$0	$357,410,192
Nutrient Management (NU)	$0	$366,822	$0	$366,822
No-Till /Strip-Till (TIL)	$342,011	$75	$33	$342,118
Pasture Enhancement (PE)	$0	$4,079,775	$42,239	$4,122,014
Feed Area Management (FAM)	$4,068,535	$0	$0	$4,068,535
Wetland Creation/Restoration (WLR)	$128,613,837	$0	$0	$128,613,837
Wetland Enhancement (WLE)	$36,499,279	$0	$0	$36,499,279
Total	**$326,744,964**	**$205,736,057**	**$42,313**	**$532,523,333**

6.3.1 Critical Area Actions

Critical areas are defined in Chapter 4. Actions addressing these critical areas will have the greatest value and benefit to the DPR planning area. Table 6-16 summarizes the critical area categories, relevant jurisdictions, and relevant actions. Jurisdictions can reference this table to review which critical areas are relevant. Figure 6-1 illustrates the critical areas in map format with jurisdictional boundaries. Site specific actions that fall within critical areas are considered high priority and are attributed with this information in the online mapping system and in Appendix N.

Table 6-16: Critical Area Categories, Jurisdictions, and General Actions

CRITICAL AREA CATEGORY	JURISDICTIONS	GENERAL RELEVANT ACTIONS
Critical Catchments (Aggregate)	**Townships:** Antioch, Avon, Benton, Ela, Fremont, Lake Villa, Libertyville, Newport, Vernon, Warren, West Deerfield, Wheeling **Municipalities:** Waukegan, Zion, Antioch, Beach Park, Bristol, Buffalo Grove, Deerfield, Grayslake, Green Oaks, Gurnee, Hawthorn Woods, Kildeer, Lake Zurich, Libertyville, Lindenhurst, Long Grove, Mundelein, Old Mill Creek, Riverwoods, Third Lake, Wadsworth, Wheeling **State/Forest Preserve:** Edward L. Ryerson, Red Wing Slough, Almond Marsh, Bristol Woods, Buffalo Creek, Casey Trail & Greenway, Dutch Gap, Ethel's Woods, Fourth Lake, Hastings Lake, Heron Creek, Independence Grove, Lake Carina, Mill Creek, Oak-Hickory, Pine Dunes, Potawatomi Woods, Prairie Stream, Raven Glen, Rollins Savanna, Sedge Meadow, Van Patten Woods, Wadsworth Savanna, Waukegan Savanna	Agricultural and urban BMPs, enhance and expand green infrastructure, wetland restoration restoration/creation and enhancement, maintain infiltration and hydrology of catchment, stream maintenance, detention basin retrofits, monitoring
Critical Catchments (Chloride)	**Townships:** Antioch, Ela, Fremont, Lake Villa, Libertyville, Palatine, Vernon, Warren, Wheeling **Municipalities:** Prospect Heights, Arlington Heights, Buffalo Grove, Grayslake, Gurnee, Indian Creek, Lake Villa, Libertyville, Lincolnshire, Lindenhurst, Long Grove, Mundelein, Palatine, Riverwoods, Vernon Hills, Wheeling **State/Forest Preserve:** MacArthur Woods, Buffalo Creek, Cahokia Flatwoods, Captain Daniel Wright Woods, Duck Farm, Edward L. Ryerson, Independence Grove, Lake Carina	Road Salt management and reduce application, detention/retention, monitoring,
Critical Catchments (PAHs)	**Townships:** Avon, Ela, Fremont, Libertyville, Northfield, Palatine, Vernon, Warren, West Deerfield, Wheeling **Municipalities:** Waukegan, Arlington Heights, Buffalo Grove, Deerfield, Grayslake, Gurnee, Indian Creek, Kildeer, Libertyville, Lincolnshire, Long Grove, Mettawa, Mundelein, Northbrook, Palatine, Riverwoods, Vernon Hills, Wheeling **State/Forest Preserve:** MacArthur Woods, Buffalo Creek, Cahokia Flatwoods, Captain Daniel Wright Woods, Dam No.1 Woods, Deer Grove, Edward L. Ryerson, Half Day, Lake Carina, Potawatomi Woods, Sedge Meadow, Wilmot Woods	Urban BMPs, detention/retention, general erosion control from urban areas, monitoring
Lakeshore Erosion	**Townships:** Antioch, Ela, Freemont, Lake Villa, Newport, Vernon and Warren Townships, Hastings Lake, Half Day, **Municipalities:** Kildeer, Libertyville, Lindenhurst, Long Grove, Mundelein, Third Lake, Vernon Hills **State/Forest Preserve:** McDonald Woods, Wadsworth Savanna, Buffalo Creek, Duck Farm, Hastings Lake	Stabilize severely eroding lake shorelines
Streambank Erosion	**Townships:** Newport, Warren, Avon, Libertyville, Vernon **Municipalities:** Waukegan, Buffalo Grove, Grayslake, Green Oaks, Gurnee, Mettawa, Old Mill Creek, Riverwoods, Wadsworth, Wheeling **State/Forest Preserve:** Cahokia Flatwoods, Captain Daniel Wright Woods, Independence Grove, Dam No.1 Woods, Potawatomi Woods	Stabilize severely eroding streambanks

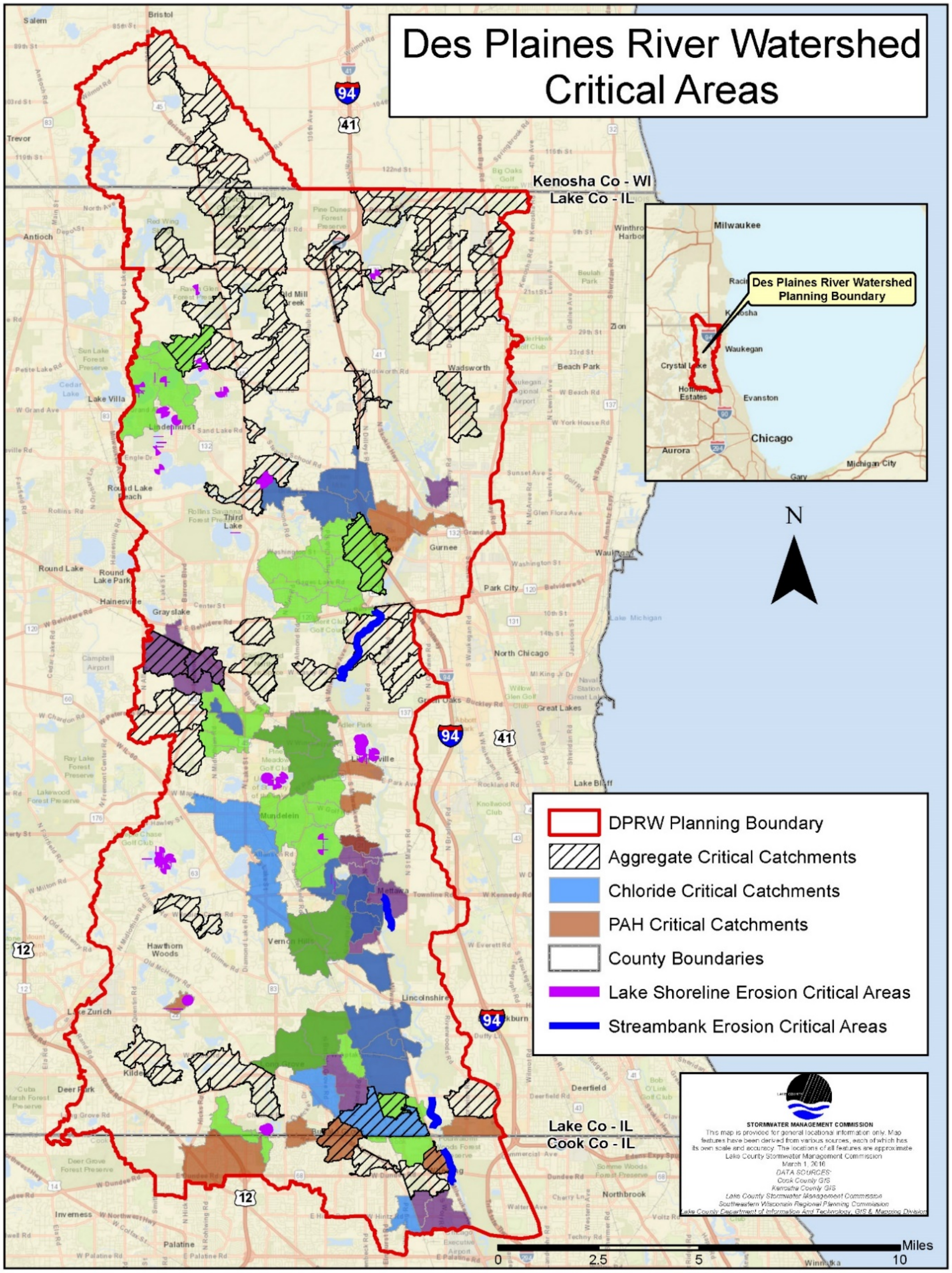

Figure 6-1: DPR Planning Area Critical Areas

6.3.2 Flood Problem Area Mitigation Actions

Lake County SMC has advanced progress towards flood mitigation efforts by inventorying and maintaining a database of flood problem areas as reported by watershed residents and stakeholders. Maps and summary information of the flood problem areas are included in Chapter 5, and this chapter intends to guide and direct actions to address the problems. There are 722 flood problem areas in the Lake County database, and 214 of these are located within the DPR planning area (Chapter 5). The Upper Des Plaines River, Buffalo Creek, Lower Des Plaines River and Indian Creek subwatersheds have the most reported problem areas (Table 6-17). It is not within the scope or objectives of this plan to assess each individual problem and propose specific mitigation actions, however it is important to enable jurisdictions and stakeholders to better understand the problems to address and prioritize actions. The flood problem area data was reviewed, and a planning-level GIS analysis was applied to guide and focus actions.

The mitigation projects are ranked as high (H), medium (M) and low (L) based on the type of flooding problem area reported, number of July 2017 flood incidents reported and the number of structures. Priorities given to flood problem area inventory sites from previous subwatershed-based plans (Buffalo Creek, Bull Creek-Bulls Brook, Mill Creek, North Mill-Dutch Gap, and Indian Creek) were carried over for this ranking process.

A high priority (H) was given to reported structural or roadway flooding on an annual basis or more and impacted the most residents, structural damage from flooding (type), structural flooding located in the floodplain and if the site locations impacted 5 structures or more. In total, the 176 high priorities included 2,308 structures. Medium priority (M) was applied to areas that had less frequent structural and roadway flooding and impacting fewer residents, and structural flooding that impacted less than 5 structures. In total, there were 328 medium priority sites with 1,031 structures. Low priority (L) was applied to Street/Driveway/Yard Flooding, and Sewer Backups. In total, there were 186 low priority sites with 281 structures. Some sites were classified as “V” for Verify from the Buffalo Creek Watershed-Based Plan for flood problem areas that had been mitigated to some degree (improvements have been completed at these sites to reduce or eliminate the flood damage). This prioritization exercise is for planning purposes only, all flood problem areas outlined in this plan warrant attention and have reported impacts. Indian Creek, Mill Creek, and the Upper Des Plaines subwatersheds have the greatest number of high priority actions.

Table 6-17: Summary of Flood Action Priorities by Subwatershed

SUBWATERSHED	FLOOD PROBLEM AREA INVENTORY SITES	JULY 2017 FLOOD INCIDENTS	# HIGH PRIORITY ACTIONS	# OF STRUCTURES
Aptakisic Creek	4	12	6	44
Buffalo Creek	57	9	12	382
Bull Creek – Bulls Brook	4	37	14	263
Indian Creek	26	107	37	729
Lower Des Plaines River	34	28	15	375
Mill Creek	15	137	49	741
Newport Drainage Ditch	11	3	1	116
North Mill Creek/Dutch Gap Canal	21	23	6	103
Upper Des Plaines River	42	130	36	953

6.3.2.1 Approach to Flood Mitigation Actions

Field reconnaissance is necessary to first evaluate the sites; this would be followed by a detailed flood study or drainage analysis in combination with some level of engineering design and property owner(s) input to define alternatives and the most feasible mitigation measures for a specific problem area.

Flood problems are often complex and require specialized expertise; numerical modeling is sometimes necessary to adequately understand and diagnose the problem and design solutions. Flood mitigation activities also require a comprehensive understanding of regulations, local ordinances, and floodplain management. Professional engineers, certified floodplain managers and stormwater managers need to be engaged in addressing flooding problems and the design of mitigation solutions.

An important action recommendation is to avoid a strict focus of directly addressing flood problems alone; a more holistic approach should be adopted to consider the flood problem locations and integrating these issues in all planning, permitting, development, and infrastructure processes so that the issues can potentially be addressed, and precautions can be taken so the problems do not worsen. It is also important to consider the toolbox of programmatic recommendations, preventative mitigation strategies and industry standard structural and non-structural flood mitigation best practices which are discussed in Chapter 5.

Section 6.3.6 defines actions based on jurisdictions, and Appendix N includes supporting details for each of the sites.

6.3.3 POTENTIAL REGIONAL FLOOD STORAGE SITES

Based on the analysis presented and illustrated in Chapter 5, there are 53 potential regional storage locations identified in the watershed with a total potential storage of 1,485 acre-feet.

Table 6-18 outlines the potential storage by subwatershed, and a feasibility study is recommended for each of the sites to evaluate the cost and benefit of increasing or creating flood storage in these areas. Prioritization should be considered for sites that would benefit flood problem areas.

Storage at most of these sites could potentially be created in the watershed by constructing berms and performing moderate grading and excavation. It is important to note that significantly more storage is available in the watershed in existing open water lakes and large wetland complexes; however, these areas were excluded from this analysis in order to focus on previously unidentified areas. Section 5.6 identifies existing regional storage locations in the planning area. Section 6.3.6.6 further details potential regional flood storage actions by jurisdiction.

Table 6-18: Potential Flood Storage by Subwatershed

SUBWATERSHED	# POTENTIAL STORAGE SITES	TOTAL ESTIMATED POTENTIAL STORAGE (acre-feet)
Aptakisic Creek	6	99
Buffalo Creek	5	61
Bull Creek	4	199
Bulls Brook	-	-
Newport Drainage Ditch	-	-
North Mill Creek/Dutch Gap Canal	18	519

SUBWATERSHED	# POTENTIAL STORAGE SITES	TOTAL ESTIMATED POTENTIAL STORAGE (acre-feet)
Indian Creek	6	244
Lower Des Plaines River	1	43
Mill Creek	8	173
Upper Des Plaines River	5	147
TOTAL	**53**	**1,485**

6.3.4 Potential Wetland Enhancement and Restoration Sites

As described in Chapter 3, the Wetland Restoration and Protection Plan (WRAPP) identified specific opportunities for the enhancement of existing wetlands and the restoration or creation of wetlands or those that are potentially restorable. These wetlands were evaluated, based on priority and developed into site-specific and basin-wide site-specific actions; the WRAPP provided scoring totals from which to select high priority sites. Existing wetlands, suitable for enhancement are summarized below based on their priority. As with restoration/creation, the WRAPP dataset provided scoring totals from which to select high priority enhancement sites.

6.3.4.1 Wetland Enhancement

Wetland enhancement can be described as those existing wetlands that could benefit from remedial actions that enhance their extent or function. Existing wetlands include those that are on publicly owned open space parcels identified as farmed, excavated, ditched, drained, channelized, or spoil/disposal areas. A total of 16,639 acres of existing wetland are identified in the WRAPP. While nearly all wetlands in the DPR planning area would likely benefit from some enhancement or management activity, 1,214 acres can be considered high priority for enhancement; this represents 7% of the total acreage (Figure 6-2). The highest percentage of wetland enhancement area (as a fraction of total existing wetland area) is found within the Aptakisic and Bull Creek subwatershed. The greatest total area of high priority wetland enhancement is within Mill Creek and the Upper Des Plaines River (8). High priority sites are further quantified in section 6.3.6.

Table 6-19: Wetland Enhancement by Subwatershed

SUBWATERSHED	WETLAND ENHANCEMENT (acres)	HIGH PRIORITY (acres)	% TOTAL ENHANCEMENT
Aptakisic Creek	203	51	25%
Buffalo Creek	861	21	2.5%
Bull Creek	671	202	30%
Bull's Brook	317	4	1.2%
North Mill Creek/Dutch Gap Canal	3,267	126	3.9%
Indian Creek	1,841	49	2.7%
Lower Des Plaines River	1,760	70	3.9%
Mill Creek	2,523	299	11%
Newport Drainage Ditch	607	45	7.4%
Upper Des Plaines River	4,590	348	7.6%
TOTAL	**16,639**	**1,216**	**7.3%**

Wetland enhancement sites are also located within critical area catchments. A total of 4,561 wetland acres are contained within a critical area catchment; this represents 27% of all existing wetland acres. Thirteen percent of all high priority wetland enhancement sites are located in a critical area catchment; the greatest percentage and total area is found within the Mill Creek and Bull Creek subwatersheds (Table 6-20).

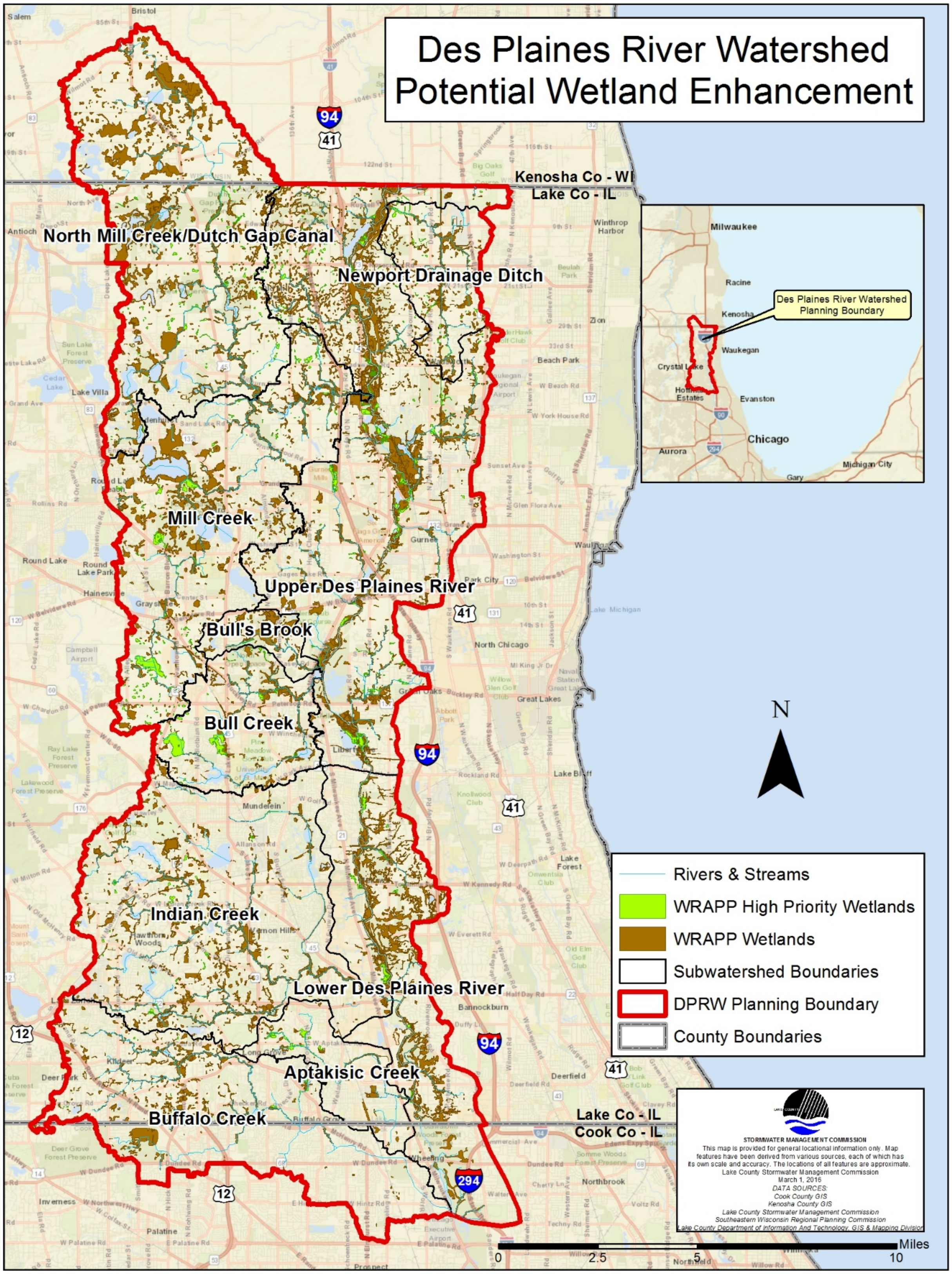

Figure 6-2: WRAPP Potential Wetland Enhancement

Table 6-20: Wetland Enhancement by Critical Area Catchment

SUBWATERSHED	WETLANDS IN CRITICAL CATCHMENTS (acres)	HIGH PRIORITY ENHANCEMENT IN CRITICAL CATCHMENTS (acres)	% OF TOTAL WETLAND AREA
Aptakisic Creek	202	51	25%
Buffalo Creek	272	16	5.8%
Bull Creek	340	149	44%
Bull's Brook	71	0.41	0.6%
North Mill Creek/Dutch Gap Canal	1,300	81	6.2%
Indian Creek	223	11	5.0%
Lower Des Plaines River	314	10	3.3%
Mill Creek	442	141	32%
Newport Drainage Ditch	342	32	9.3%
Upper Des Plaines River	1,057	116	11%
TOTAL	**4,561**	**607**	**13%**

6.3.4.2 Wetland Restoration/Creation

Wetland restoration/creation locations are predictors of the best places to attempt wetland restoration based on historic wetland conditions and existing land use/land cover; although not necessarily specific land management practices or behaviors. A selection of potentially restorable wetland restoration/creation locations were given high priority and were used to generate site-specific actions as well as general basin-wide site-specific actions. Expected annual load reductions were generated for both. For basin-wide site-specific actions, all WRAPP "high priority" wetlands excluding site-site specific locations were selected from the dataset; annual expected load reductions were calculated for the footprint of each location. These wetlands and the methodology used to choose site-specific locations are further described in Section 6.3.6 and summarized below.

The DPR planning area contains a total of 11,714 acres of potentially restorable wetlands of which 2,261 acres (19%) are considered high priority (Figure 6-3); the highest percentage of high priority potential wetland restoration acreage (as a percentage of subwatershed total potential wetland restoration acreage) is found within the Aptakisic and Bull Creek subwatersheds. The greatest total high priority potential wetland restoration acreage area is within Buffalo Creek and Indian Creek (**Error! Reference source not found.**). A total of 6,909 locations were identified as potential for restoration/creation, of which 636 or 9% are high priority.

Table 6-21: Wetland Restoration/Creation by Subwatershed

SUBWATERSHED	TOTAL RESTORATION / CREATION (acres)	HIGH PRIORITY (acres)	% TOTAL RESTORATION / CREATION
Aptakisic Creek	289	236	81%
Buffalo Creek	2,448	514	21%
Bull Creek	439	169	39%
Bull's Brook	92	33	36%
North Mill Creek/Dutch Gap Canal	3,100	377	12%
Indian Creek	1,539	472	31%
Lower Des Plaines River	404	59	15%
Mill Creek	1,085	96	8.9%
Newport Drainage Ditch	597	48	8%
Upper Des Plaines River	1,720	257	15%
TOTAL	**11,714**	**2,261**	**19%**

Wetland restoration/creation sites are also distributed within critical area catchments. A total of 5,578 acres are contained within a critical area catchment; this represents 48% of all restoration/creation acres. Twenty-one percent of all high priority sites are in critical area catchments; the greatest percentage is found in the Aptakisic and Bull's Brook subwatershed and the greatest total area within Aptakisic, Buffalo Creek, and Indian Creek (Table 6-22).

Table 6-22: Wetland Restoration/Creation by Critical Area Catchments

SUBWATERSHED	RESTORATION/CREATION IN CRITICAL CATCHMENTS (acres)	HIGH PRIORITY IN CRITICAL CATCHMENTS (acres)	% TOTAL ENHANCEMENT
Aptakisic Creek	289	235	81%
Buffalo Creek	1,295	253	20%
Bull Creek	280	134	48%
Bull's Brook	48	26	55%
North Mill Creek/Dutch Gap Canal	1,548	197	13%
Indian Creek	464	235	51%
Lower Des Plaines River	131	4.8	3.7%
Mill Creek	335	6.6	2.0%
Newport Drainage Ditch	396	19	4.7%
Upper Des Plaines River	792	81	10%
TOTAL	**5,578**	**1,191**	**21%**

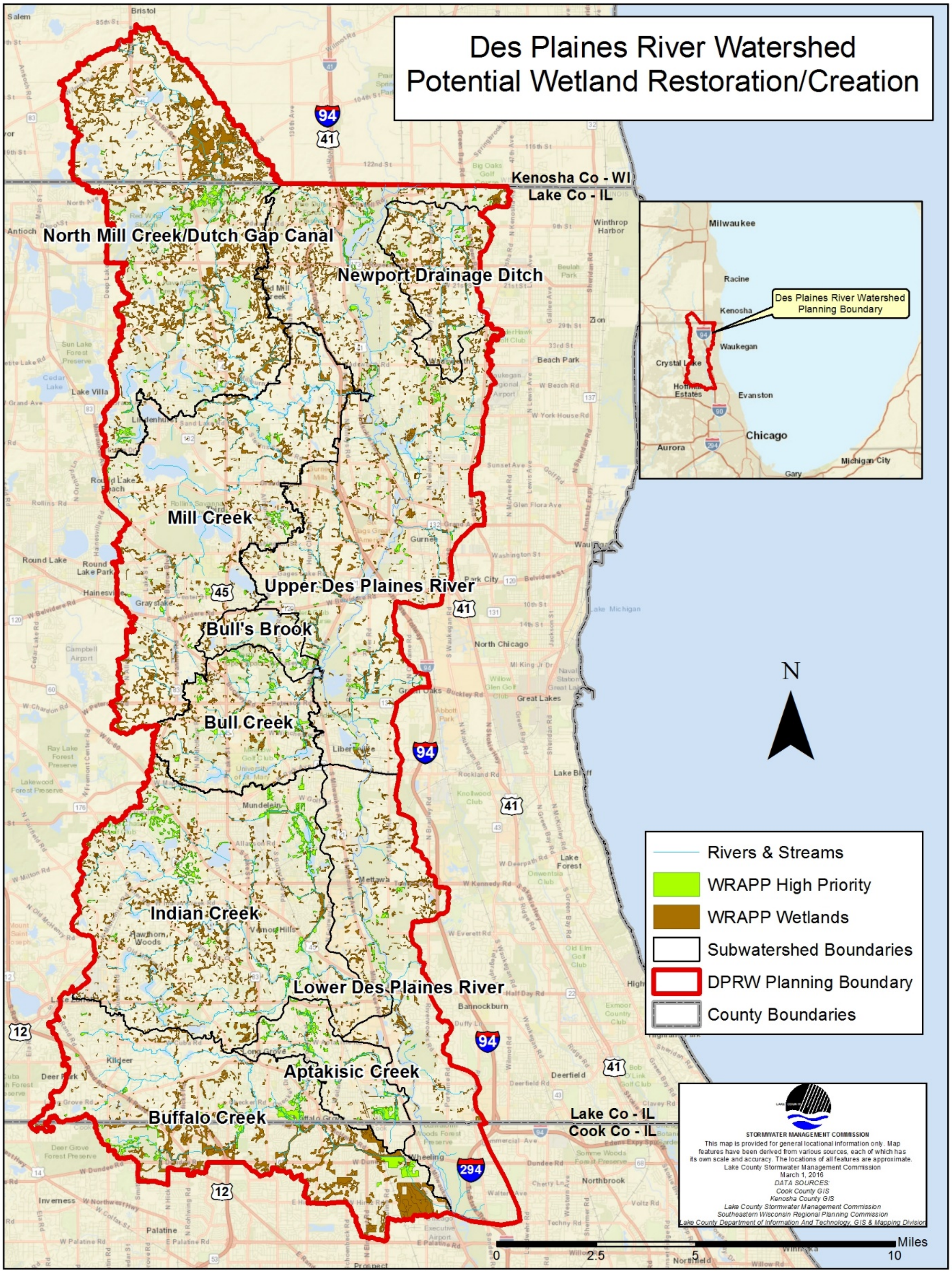

Figure 6-3: WRAPP Potential Wetland Restoration/Creation

For site-specific actions, strategic wetland restoration/creation locations were selected from the "high-priority" sites, evaluated individually and expected annual load reductions were generated for the entire drainage area to the potential wetland restoration/creation site. The following criteria were used to prioritize sites:

1. Sites within the top 20% highest nutrient and sediment loading catchments.
2. Wetlands predicted to have high functional significance for at two of the following functions: floodwater storage, nutrient retention, sediment retention, baseflow maintenance, streambank/shoreline stabilization, and carbon sequestration; and area greater than 1 acre.
3. Those not within the top 20% highest nutrient and sediment loading catchments but have a total score of 4 or greater.
4. Those wetlands greater than 10 acres in size.

Following prioritization, each individual wetland polygon was modified to fit current site constraints, drainage areas were delineated, a unique ID was applied, and annual expected load reductions were calculated. These wetlands are considered site-specific and are summarized in Section 6.3.6 and Chapter 7 and detailed by jurisdiction in Appendix N.

6.3.5 Green Infrastructure

The stormwater green infrastructure analysis detailed in section 4.4 was used as the basis to create a series of hubs and corridors that connect open space parcels to provide stormwater management, flood mitigation, economic, and biodiversity conservation benefits for the DPR planning area. Hubs and corridors either consist of existing GI, or they are areas which can be integrated into the current GI network. Using the data developed for the stormwater green infrastructure analysis, hubs were selected using the following criteria:

1. Parcel prioritization: highest priority parcels with a score of 10 or greater, adjacent to one another; these adjacent parcels were dissolved into individual polygons and anything greater than 140 acres (average size) were selected.
2. Protected parcels found in state parks, forest preserves, Illinois nature preserves, and the Illinois Natural Areas Inventory.

Using these criteria, hubs were identified in each subwatershed except Aptakisic Creek. Due to the highly developed character of the subwatershed, Aptakisic Creek contained no areas meeting either criterion. As a result, hubs in this subwatershed were manually selected from protected private and public parcels, parcels with wetlands recommended for enhancement or restoration under the WRAPP analysis, and parcels with open areas which could be converted to natural areas and protected from further development. Following the creation of hubs, corridors were selected using the following criteria:

1. Stormwater GI Parcel prioritization: highest priority parcels with a score of 9 or greater, larger than 10 acres and adjacent to one another.
2. Protected parcels found in state parks, forest preserves, Illinois nature preserves, and the Illinois Natural Areas Inventory.
3. Parcels adjacent to streams with medium to high parcel priority with a score of 5 or greater.
4. Open areas with medium to high parcel priority with a score of 5 or greater, such as row crops, wetlands, grasslands, or forest.

Corridors were further selected from parcels adjacent to streams designated as medium to high priority. Due to development density in many sections of the watershed, riparian corridors and adjacent open spaces may be the only feasible areas to serve as corridor connections. Corridors were created until every hub had at least one corridor connecting it to an adjacent hub.

6.3.5.1 Hubs

The majority of hubs are found in the northern third of the watershed which contains the greatest amount of land devoted to public protected areas such as preserves and parks; conversely, the lower two thirds are more urbanized and developed, with a lower density of lands under protection. Protected areas classified as a state park, forest preserve, Illinois nature preserves, or an Illinois Natural Area are located within one or more hubs in each subwatershed except Aptakisic Creek. The greatest number of hubs are located in the North Mill/Dutch Gap Canal and the Upper Des Plaines subwatersheds, and the greatest total area is found within the North Mill/Dutch Gap Canal subwatershed (Table 6-23).

Within all hubs, there is a greater number and area of protected parcels than unprotected and most of the protected land is publicly owned (Table 6-243). Hubs contain 97 miles of streams and 21 miles of trails although only 58 out of 97 stream miles are within protected parcels. Hubs include all or a portion of 25% of the total acres of wetlands and 38% of the total acres of potentially restorable wetlands.

Due to the lack of natural areas and the limited protection status of parcels forming hubs within the Aptakisic Creek subwatershed, it is recommended that implementation of stormwater green infrastructure BMPs and/or protection be pursued for suitable locations. Furthermore, large expanses of the planning area lack “natural” areas (e.g., the southern Bull Creek, eastern Indian Creek, and eastern and western ends of Buffalo Creek subwatersheds). These areas should be considered for future creation of naturalized green infrastructure or implementation of BMPs that mimic “natural” (rather than urban) hydrology. Within hubs across the DPR planning area, parcels with protected status containing land uses such as agriculture and developments such as golf courses could be naturalized or enhanced with BMPs in the future.

6.3.5.2 Corridors

Many of the identified corridors follow streams and serve as natural riparian areas, although only 30% of stream miles within corridors are considered protected. All identified corridors contain both a higher number and acreage of unprotected, privately owned parcels overall (Table 6-24). Selected corridors contain 58 miles of streams and 24 miles of trails; however, only 17 stream miles are within parcels considered protected. Corridors intersect or completely contain 100 WRAPP wetlands and 72 potentially restorable wetlands. Altogether, corridors intersect or contain 19% of the total acres of WRAPP wetlands and 7% of the total acres of potentially restorable wetlands.

An issue with corridor connectivity between hubs throughout the watershed is caused by major roadways. Additionally, there is little connectivity between hubs in the southwest and northwest DPR planning area. For example, no corridors directly connect hubs in the Indian Creek and Bull Creek subwatersheds, although the two subwatersheds are adjacent.

Enhancing and protecting corridors along riparian areas, especially those adjacent to unprotected stream sections, will improve water quality and help preserve and enhance biodiversity. Riparian corridor buffers should be restored to widths which benefit not only water quality but also benefit aquatic and terrestrial life. Corridor parcels identified within open or partially open space such as agricultural land can be restored to natural land cover types more easily. Furthermore, enhancing existing and restoring/creating wetlands within corridors will mitigate impacts from stormwater, improve water quality, and provide critical habitat components.

Most corridors identified along the Des Plaines River have protected status and connect protected hubs along the river. For these corridors, stormwater green infrastructure in unprotected parcels should be prioritized for enhancement and protection. Across the DPR planning area (outside of the Des Plaines River corridor), few parcels within corridors are under protection. Unprotected corridors should be prioritized for restoration or enhancement of stormwater green infrastructure to preserve critical connections between hubs. All corridor parcels within Newport Drainage Ditch are considered unprotected; protection and enhancement of corridors within this subwatershed should also receive priority.

Figure 6-4 shows locations of hubs and corridors throughout the watershed, and Figure 6-5 depicts hubs and corridors by parcel.

Table 6-23: Hub Number and Total Area per Subwatershed

SUBWATERSHED	# OF HUBS	AREA (acres)
Aptakisic Creek	2	412
Buffalo Creek	4	1,097
Bull Creek	2	535
Bull's Brook	1	782
Indian Creek	6	1,125
Lower Des Plaines River	7	3,828
Mill Creek	5	4,109
Newport Drainage Ditch	3	614
North Mill Creek/Dutch Gap Canal	10	8,558
Upper Des Plaines River	12	5,756
TOTAL	46	12,011

Table 6-24: Hubs and Corridors Land Owndership andProtections Status by Parcels and Acerage

LAND OWNERSHIP TYPE	PROTECTION STATUS	HUBS		CORRIDORS		TOTAL PARCELS	TOTAL ACRES
		PARCELS	ACRES	PARCELS	ACRES		
Private Land	Protected	49	837	32	254	81	1,091
	Unprotected	678	8,264	847	5,417	1,525	13,681
Public Land	Protected	1,059	17,685	371	3,676	1,430	21,361
	Unprotected	7	30	1	0.34	8	30
	TOTAL	1,793	26,815	1,251	9,347	3,044	36,163

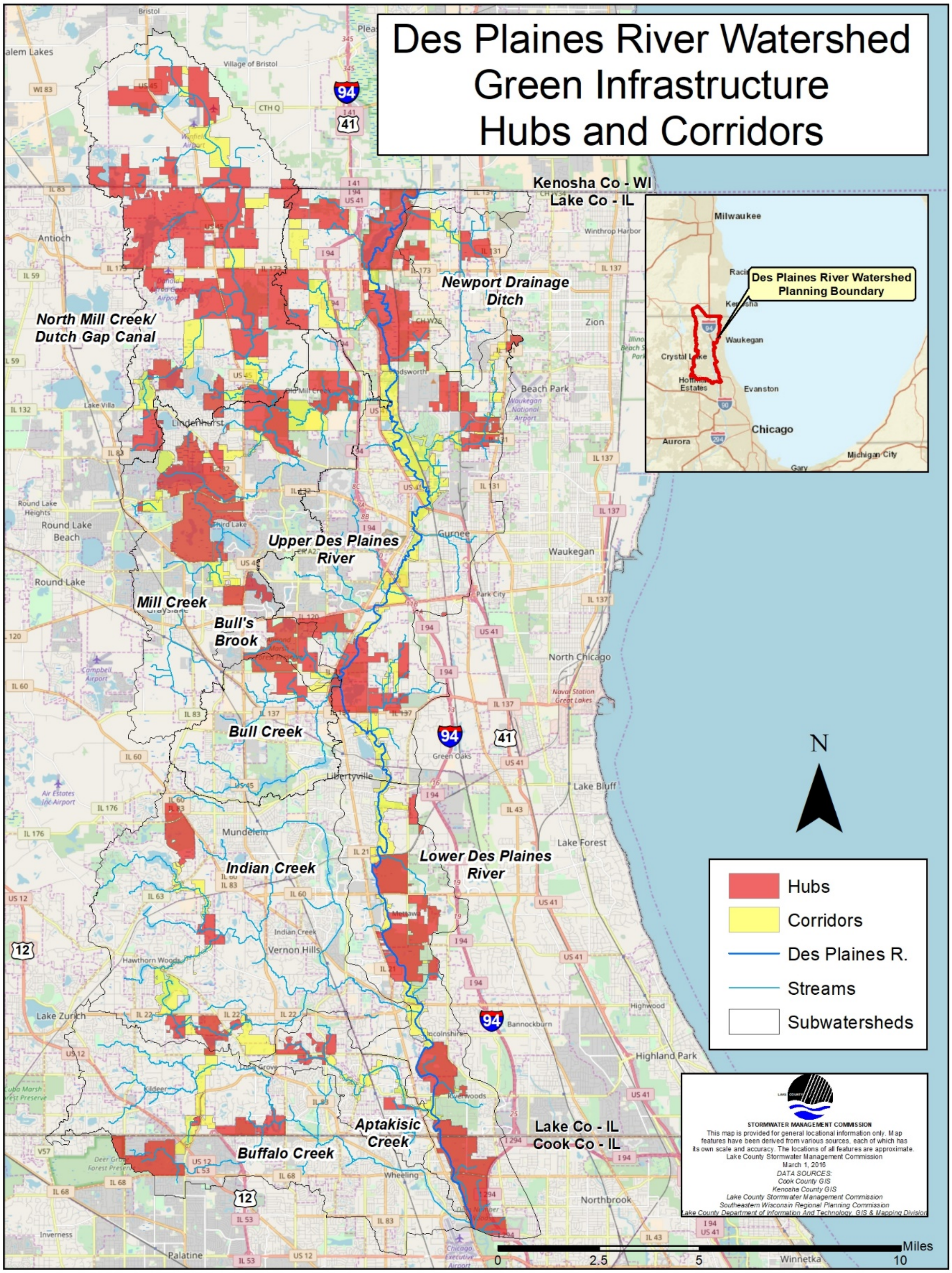

Figure 6-4: DPR Planning Area Green Infrastructure Hubs and Corridors

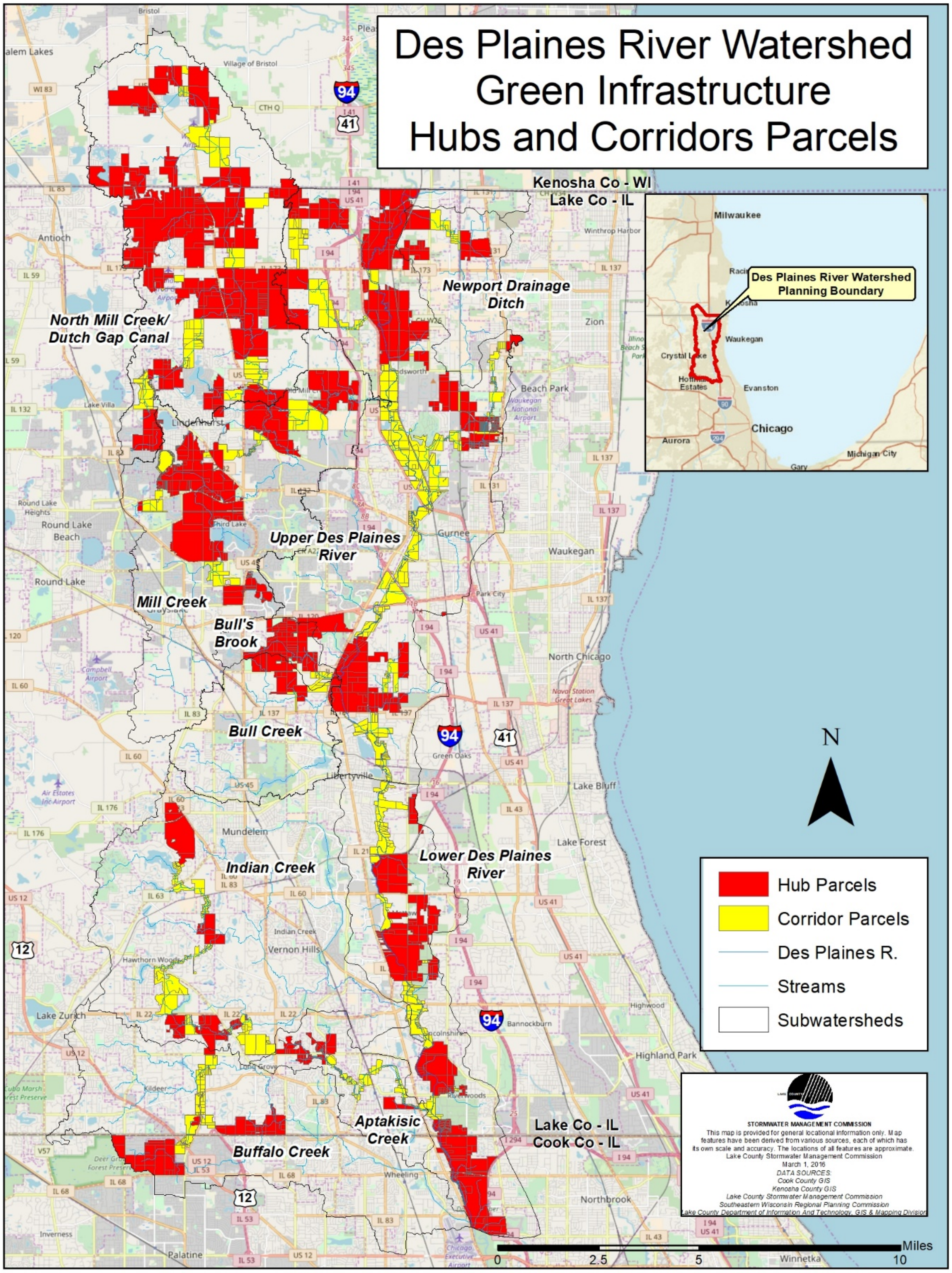

Figure 6-5: DPR Planning Area Green Infrastructure Hubs and Corridors Parcels

6.3.6 Site-Specific Actions By Jurisdiction

The following section summarizes previously planned actions and new project specific recommendations or actions for each jurisdictional area within the DPR planning area. Due to the large number of practices, specific details on individual actions are included in Appendix N and available through the Lake County SMC web application. Appendix N therefore includes tables containing specific actions by jurisdiction, subwatershed, and catchment; these tables include unique action item codes, type, a description, catchment, subwatershed, quantities and units, cost estimates (if applicable), coordinates, priority status and timeline, critical catchment status, plan goals addressed, supporting partners, implementation status, and load reductions if applicable.

This section is organized by major action category: previously planned high priority actions, site-specific practices, basin-wide site-specific actions, problem discharge locations, problem hydraulic impediments and detention basin retrofits, and flood problem areas and regional flood storage.

6.3.6.1 Previously Planned High Priority Actions

Site-specific actions were compiled by SMC from previous watershed-based plans and are presented by jurisdiction. All items are considered high priority and they are not inclusive of all other actions from previous watershed-based plans. Other subwatershed-based plans can be referenced for a complete list. Table 6-25 and Figure 6-6 summarize and display the high priority actions from previous plans' major categories. There are a total of 688 high priority practices spanning 35 individual jurisdictions. Stormwater infrastructure practices account for 30% of all actions, followed by detention basin retrofit's (24%) and stream and lake bank maintenance and restoration (23%).

Table 6-25: Previously Planned High Priority Action Summary

JURISDICTION	BMP[1]	DETENTION BASIN RETROFIT	STORMWATER INFRASTRUCTURE [2]	STREAM & LAKE BANK MAINTENANCE & RESTORATION[3]	DRAINAGE [4]	OTHER [5]	TOTAL
	# OF ACTIONS						
VILLAGE/MUNICIPALITY							
City of Lake Forest	0	0	2	0	0	0	2
City of Park City	0	0	0	0	0	0	0
City of Prospect Heights	0	0	0	0	0	0	0
City of Waukegan	0	0	0	0	0	0	0
City of Zion	0	0	0	0	0	0	0
Village of Salem Lakes	0	0	0	0	0	0	0
Village of Antioch	0	0	2	0	0	0	2
Village of Arlington Heights	2	4	0	0	0	0	6
Village of Beach Park	0	0	0	0	0	0	0
Village of Bristol	0	0	27	0	0	0	27
Village of Buffalo Grove	0	19	5	7	3	0	34
Village of Deer Park	0	12	1	0	0	0	13
Village of Deerfield	0	0	0	0	0	0	0

JURISDICTION	BMP[1]	DETENTION BASIN RETROFIT	STORMWATER INFRASTRUCTURE [2]	STREAM & LAKE BANK MAINTENANCE & RESTORATION[3]	DRAINAGE [4]	OTHER [5]	TOTAL
	# OF ACTIONS						
Village of Glenview	0	0	0	0	0	0	0
Village of Grayslake	31	6	25	6	3	5	76
Village of Green Oaks	0	0	0	0	0	0	0
Village of Gurnee	2	3	0	1	0	0	6
Village of Hainesville	0	0	0	0	0	0	0
Village of Hawthorn Woods	0	1	8	5	4	0	18
Village of Indian Creek	0	1	3	0	0	0	4
Village of Kildeer	5	13	0	1	2	0	21
Village of Lake Villa	0	0	0	0	0	0	0
Village of Lake Zurich	2	15	1	0	1	0	19
Village of Libertyville	11	24	5	15	1	0	56
Village of Lincolnshire	0	6	6	1	0	0	13
Village of Lindenhurst	2	5	12	3	0	0	22
Village of Long Grove	2	4	11	5	3	0	25
Village of Mettawa	0	0	0	0	0	0	0
Village of Mundelein	5	8	7	20	0	0	40
Village of Northbrook	0	0	0	0	0	0	0
Village of Old Mill Creek	0	0	21	0	0	1	22
Village of Palatine	0	3	0	0	0	0	3
Village of Riverwoods	0	0	0	0	0	0	0
Village of Round Lake Beach	0	0	0	0	0	0	0
Village of Round Lake Park	0	0	0	0	0	0	0
Village of Third Lake	0	1	2	1	0	0	4
Village of Vernon Hills	3	30	0	10	1	0	44
Village of Wadsworth	0	0	0	0	0	0	0
Village of Wheeling	1	7	6	0	6	0	20
TOWNSHIP							
Antioch	0	0	5	0	0	0	5
Avon	1	0	1	2	0	0	4
Benton	0	0	0	0	0	0	0
Ela	1	0	3	4	5	0	13
Fremont	10	0	0	3	3	0	16
Lake Villa	1	0	2	8	0	0	11
Libertyville	6	3	4	22	0	0	35
Newport	2	0	2	0	0	0	4

JURISDICTION	BMP[1]	DETENTION BASIN RETROFIT	STORMWATER INFRASTRUCTURE [2]	STREAM & LAKE BANK MAINTENANCE & RESTORATION[3]	DRAINAGE [4]	OTHER [5]	TOTAL
	# OF ACTIONS						
Northfield	0	0	0	0	0	0	0
Palatine	0	3	0	0	0	0	3
Vernon	1	0	0	4	2	0	7
Warren	5	0	6	14	1	0	26
Waukegan	0	0	0	0	0	0	0
West Deerfield	0	0	0	0	0	0	0
Wheeling	0	0	0	0	1	0	1
STATE OF ILLINOIS/FOREST PRESERVE DISTRICT							
Lake County Forest Preserve District	16	0	35	13	3	3	70
Forest Preserve District of Cook County	0	0	0	0	0	0	0
State of Illinois	0	0	0	0	0	1	1
TOTAL ACTIONS	**111**	**168**	**205**	**155**	**39**	**10**	**688[6]**

[1] Includes the following: agriculture, bioretention, buffers, retention basin, filter strip, grass waterway, rain garden, stormwater pond, stormwater wetland, WASCoB, wetland restoration. [2] Includes the following: culvert, outfall maintenance, problem hydraulic structure, problem outfall, stormwater infrastructure, stormwater infrastructure retrofit, maintenance. [3] Includes the following: debris and sediment removal, lake shoreline stabilization, streambank stabilization, stream maintenance and restoration. [4] Includes the following: flood problem resolution, regional detention facility. [5] Includes the following: dam removal, open space, restoration, comprehensive, unknown. [6] Some practices may overlap such as streambank stabilization that can span multiple jurisdictions

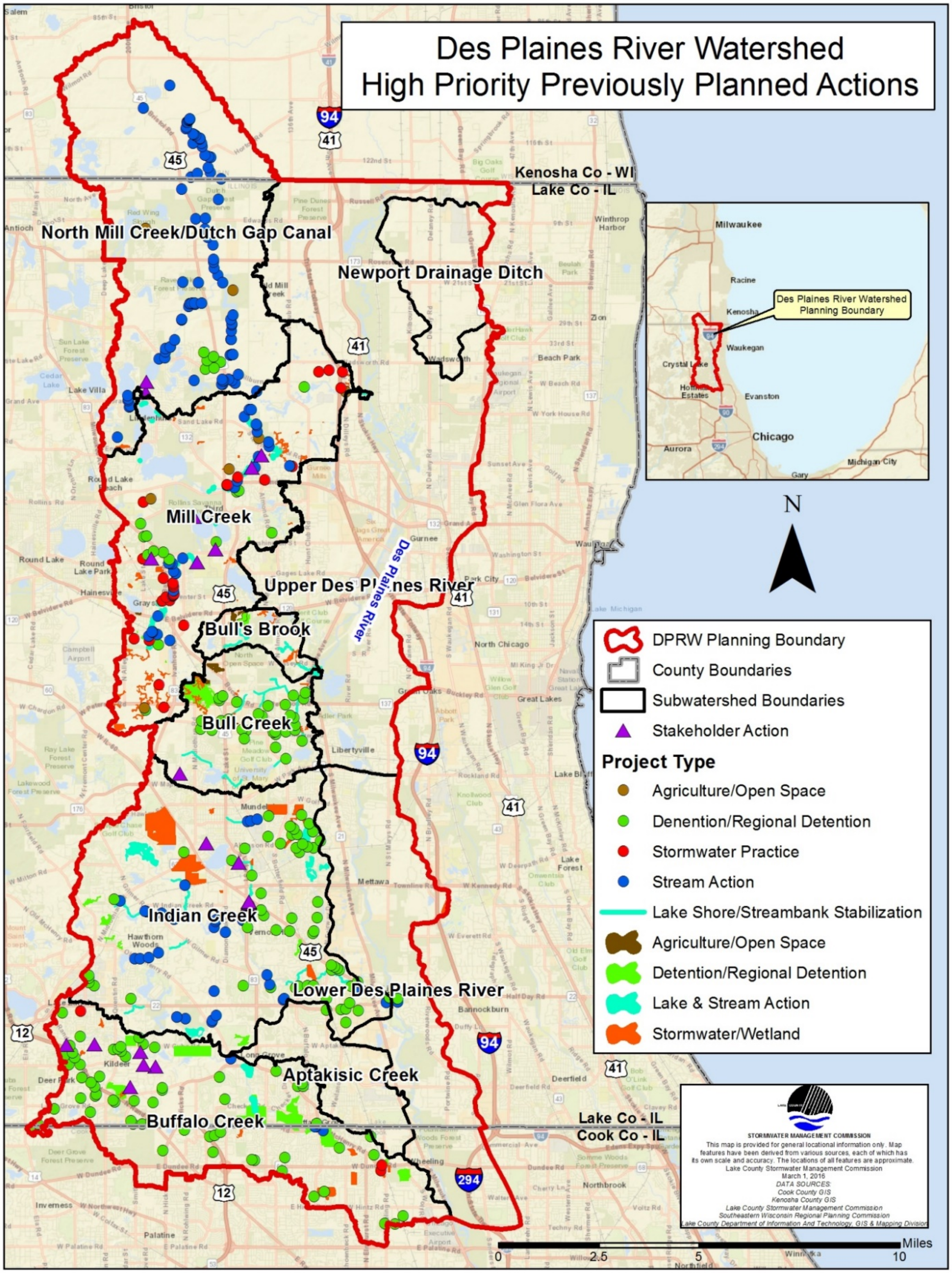

Figure 6-6: Des Plaines River Watershed High Priority Previously Planned Actions

6.3.6.2 Site-Specific Actions

Site-specific actions are comprised of **new** project recommendations and are based on lake and stream inventories, coordination with stakeholders and project opportunities identified during windshield surveys. The practice applies to a single specific geographic location. This section also includes stakeholder recommendations tied to a physical location. Table 6-265 summarizes all new actions by jurisdiction; a detailed table of each individual action item (SSD, SBD, DSB, DLD, DWS, and DST), complete with all applicable attributes is located in Appendix N. Figure 6-7 shows the location of all site-specific practices and Figure 6-8 depicts the locations identified by watershed stakeholders during the planning process. It is important to note that many of the actions align with recommendations developed from DRWW monitoring efforts, designed specifically to address causes and sources of biological impairments.

The Village of Old Mill Creek contains the greatest recommended area of field borders, grass conversion and grassed waterways; 19 acres of filter strips and stream buffers are located in the Village of Wadsworth. Warren Township and the Forest Preserve Districts contain the greatest cumulative length of streambank and lake shoreline stabilization, 164 acres of potentially restorable wetlands are located in the Village of Vernon Hills and 130 acres on FPD property. Two out of the 3 recommended in-lake sediment forebays are in Mundelein, Wadsworth contains the most water and sediment control basins (WASCoBs) and the majority of new site-specific urban BMPs are in Mundelein as well. Finally, there are a total of 118 location-specific stakeholder actions comprised of additional water quality, lake and stream restoration, flood damage reduction, and infrastructure projects.

Table 6-26: New Site-Specific Action Summary

JURISDICTION	FIELD BORDERS / GRASS COVERSION/ GRASSED WATERWAY	FILTER STRIPS / STREAM BUFFERS	LAKE BANK/ STREAMBANK STABILIZATION [1]	WETLAND RESTORATION / CREATION	SEDIMENT FOREBAY[2] / GENERAL STORMWATER MANAGEMENT	GRADE CONTROL / WASCoB / POND	URBAN BMPS [6]	GENERAL STAKEHOLDER
	ACRES	ACRES	FEET	ACRES	#	#	#	#
MUNICIPALITY								
City of Lake Forest	0	0	0	0	0	0	0	0
City of Park City	0	0	0	7.3	0	0	0	0
City of Prospect Heights	0	0	0	0	0	0	0	0
City of Waukegan	2	6.9	1,045	60	0	0	0	3
City of Zion	0.6	2.5	0	5.6	0	0	0	0
Village of Salem Lakes	1.2	0	0	0	0	0	0	0
Village of Antioch	0	0	0	1	0	0	0	0
Village of Arlington Heights	0	0	0	0	0	0	0	0
Village of Beach Park	0	0.3	0	2.4	0	0	0	2
Village of Bristol	13	1.8	0	61	0	0	0	0
Village of Buffalo Grove	0	11	37	174	0	0	1	1

JURISDICTION	FIELD BORDERS / GRASS COVERSION/ GRASSED WATERWAY	FILTER STRIPS / STREAM BUFFERS	LAKE BANK/ STREAMBANK STABILIZATION [1]	WETLAND RESTORATION / CREATION	SEDIMENT FOREBAY[2] / GENERAL STORMWATER MANAGEMENT	GRADE CONTROL / WASCoB / POND	URBAN BMPS [6]	GENERAL STAKEHOLDER
	ACRES	ACRES	FEET	ACRES	#	#	#	#
Village of Deer Park	0	0	0	0	0	0	0	0
Village of Deerfield	0	0	0	0	0	0	0	0
Village of Glenview	0	0	0	0	0	0	0	0
Village of Grayslake	9.3	1.8	0	108	0	0	0	2
Village of Green Oaks	0	0	0.0	1.2	0	1	0	0
Village of Gurnee	0	6	8,820	39	0	0	0	3
Village of Hainesville	0	0	0	0.0	0	0	0	0
Village of Hawthorn Woods	0	3.8	809	18	0	2	2	3
Village of Indian Creek	0	0	0.1	0	0	0	0	0
Village of Kildeer	0	0	628	0	0	0	0	2
Village of Lake Villa	0	0	0	0.2	0	0	0	0
Village of Lake Zurich	0	0	963	15	0	0	0	2
Village of Libertyville	2.3	0	6,903	63	0	0	0.2 (ac)	12
Village of Lincolnshire	0	0.8	541	11	0	0	0	3
Village of Lindenhurst	0.6	0	1,622	5.4	0	0	0	2
Village of Long Grove	6.6	1.2	1,036	71	0	0	1.2 (ac)	22
Village of Mettawa	0	0	597	2.9	0	0	0	0
Village of Mundelein	23	4.7	485	68	3[3]	0	521[4]	12
Village of Northbrook	0	0	0	0	0	0	0	0
Village of Old Mill Creek	29	0.5	0	65	0	2	0	2
Village of Palatine	0	0	0	0	0	0	0	0
Village of Riverwoods	0	0	3,306	2	0	0	0	0
Village of Round Lake Beach	0	0	0	0	0	0	0	0
Village of Round Lake Park	0	0	0	0	0	0	0	0
Village of Third Lake	0	4.8	73	0	0	0	0	2
Village of Vernon Hills	5.3	9.6	1,211	164	0	0	0	2

JURISDICTION	FIELD BORDERS / GRASS COVERSION/ GRASSED WATERWAY	FILTER STRIPS / STREAM BUFFERS	LAKE BANK/ STREAMBANK STABILIZATION [1]	WETLAND RESTORATION / CREATION	SEDIMENT FOREBAY[2] / GENERAL STORMWATER MANAGEMENT	GRADE CONTROL / WASCoB / POND	URBAN BMPS [6]	GENERAL STAKEHOLDER
	ACRES	ACRES	FEET	ACRES	#	#	#	#
Village of Wadsworth	8.4	19	966	15	0	16	0	5
Village of Wheeling	0	2.8	0	42	0	0	1	0
TOWNSHIP								
Antioch	1.7	0	235	8.7	0	0	0	0
Avon	0	2.7	4,051	0	0	0	0	1
Benton	0	0	0	0	0	0	0	0
Ela	0.9	5.8	113	7.6	1	2	0	3
Fremont	7.3	16	998	14	0	0	240[5]	10
Lake Villa	3.5	0	1,041	3.8	0	6	0	0
Libertyville	11	2.6	1,711	36	0	1	0	8
Newport	6.3	6.4	67	27	0	0	0	0
Northfield	0	0	0	0	0	0	0	0
Palatine	0	0	0	0	0	0	0	0
Vernon	0	5.8	1,607	49	0	0	0	1
Warren	6.8	0	18,642	13	0	6	0	5
Waukegan	0	0	0	0.6	0	0	0	0
West Deerfield	0	0	0	0	0	0	0	0
Wheeling	0	0	0	0	0	0	0	0
STATE OF ILLINOIS/FOREST PRESERVE DISTRICT								
Lake County Forest Preserve District	8.4	6.6	35,036	130	0	1	0	9
Forest Preserve District of Cook County	0	0	4,912	0	0	0	0	0
State of Illinois	1	0	0	0	0	0	0	0
TOTAL ACTIONS	**149**	**123**	**97,455**	**1,292**	**4**	**37**	**766**	**118**

[1] Streambank stabilization also requires riffle structures; riffle counts are listed by bank ID in Appendix N. [2] All in-lake dams are estimated at 300 ft in length. [3] Village of Mundelein includes 2-in-lake dams, 1 general stromwater management stakeholder recommendation. [4] Village of Mundelein includes 1 urban detention basin, 350 rain barrels and 170 rain gardens. [5] Freemont Township includes 160 rain barrels and 8 rain gardens. 6 Urban BMPs include: permeable/porous pavement, bioswale, detention basin, rain barrels and rain gardens; the biswale project was completed in 2017.

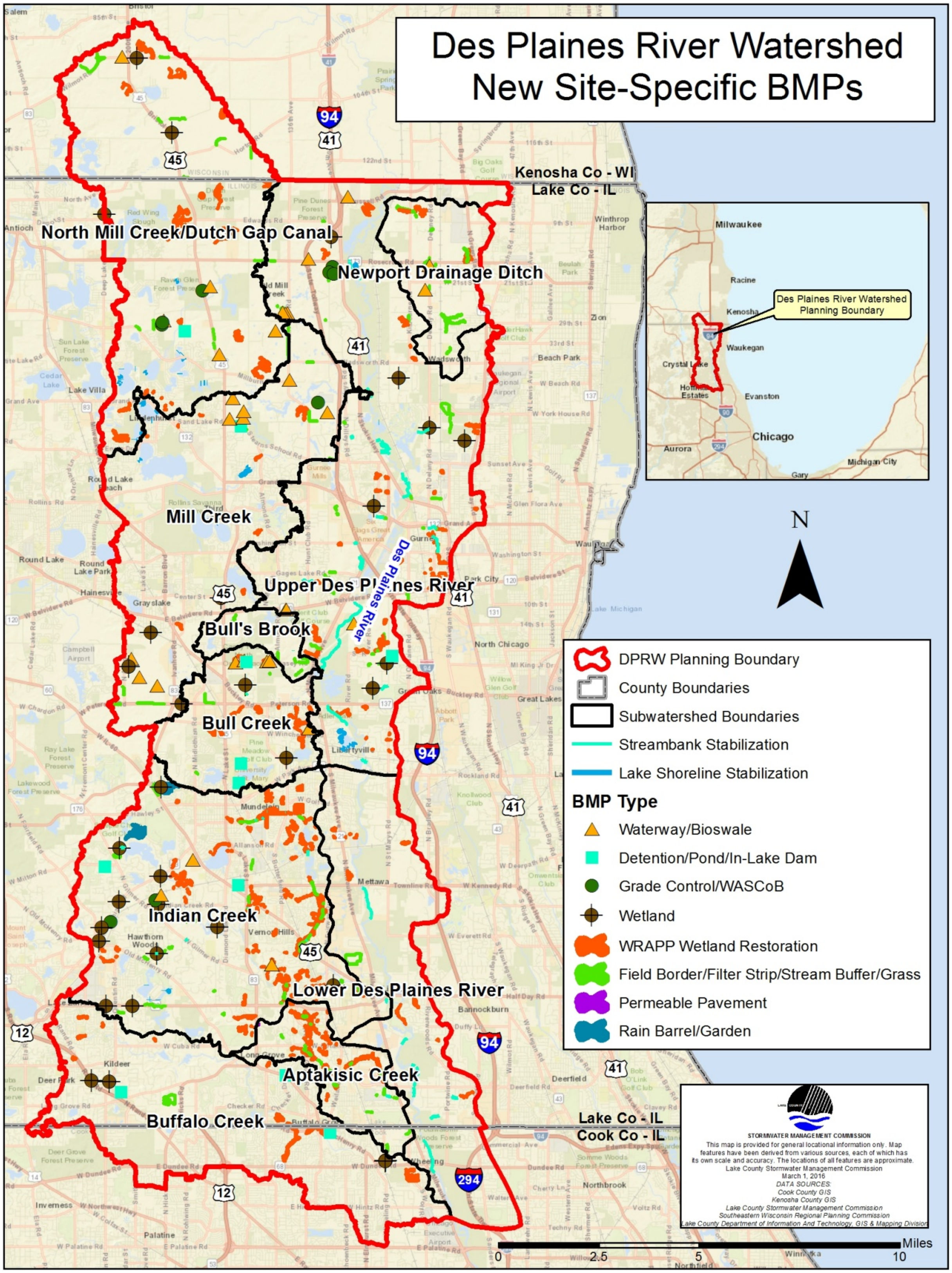

Figure 6-7: Des Plaines Watershed New Site-Specific BMPs

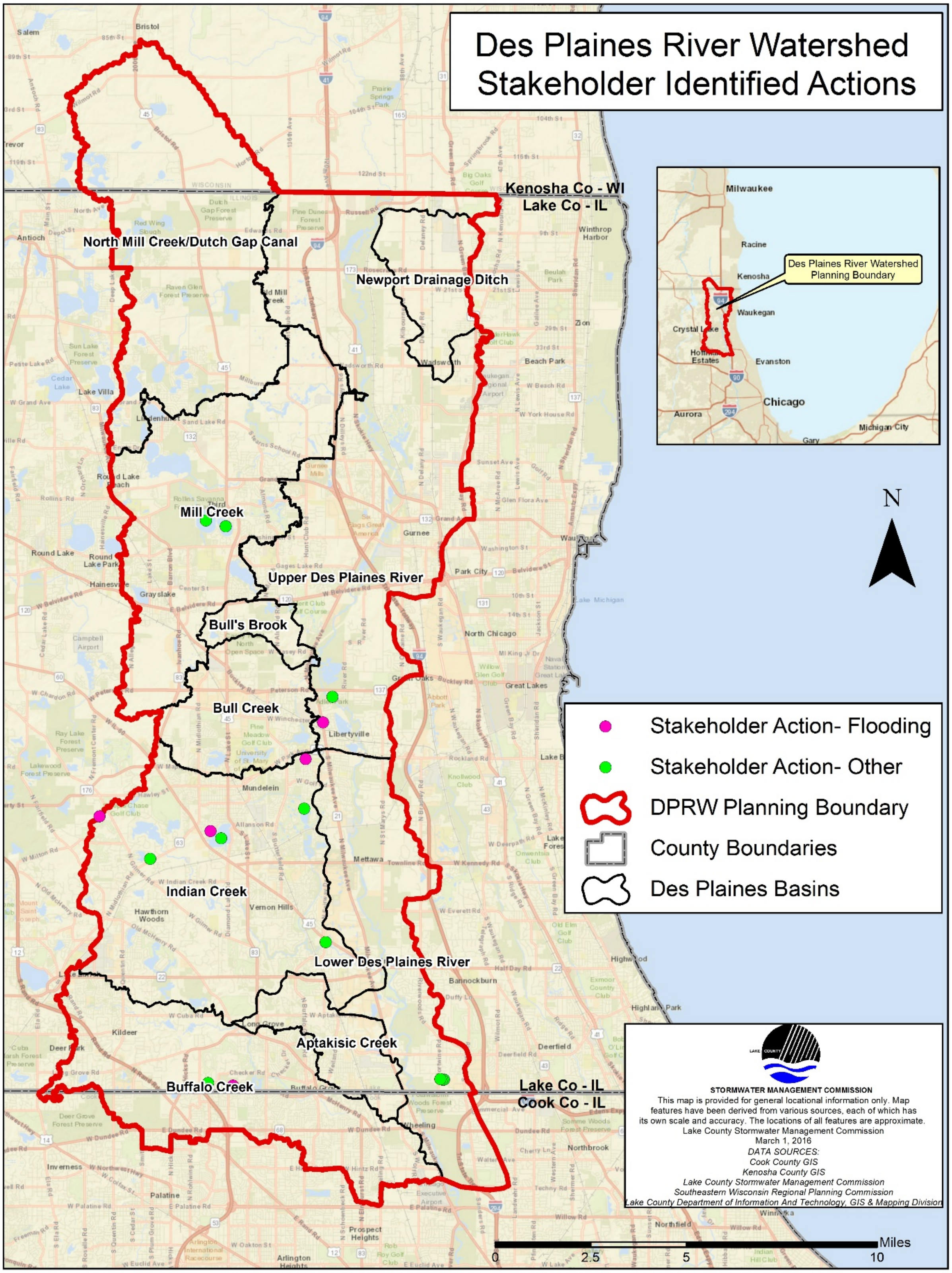

Figure 6-8: Des Plaines River Watershed Stakeholder Identified Actions

6.3.6.3 Basin-Wide Site-Specific Actions

Basin-wide site-specific project recommendations are those practices that can be implemented at specific geographic locations, but for which there are a wide array of opportunities across the planning area. They are based on GIS analysis and although they are "site specific," they are mapped across a large geographic area.

Table 6-27 summarizes all basin-wide site-specific actions by jurisdiction; detailed tables of each individual action item, by jurisdiction, complete with all applicable attributes is located in Appendix N. Figure 6-9 shows the location of all basin-wide site-specific practices. Many actions align with recommendations developed from DRWW monitoring efforts, designed specifically to address causes and sources of biological impairments.

Table 6-27: Basin-Wide Site-Specific Action Summary by Jurisdiction

JURISDICTION	COVER CROPS / TILLAGE	NUTRIENT MGMT.	PASTURE/ FEED AREA ENHANCE.	RUNOFF VOLUME REDUCTION	ROAD SALT MGMT.	WETLAND REST/ CREATE	WETLAND ENHANCE
	AREA (ACRES)						
MUNICIPALITY							
City of Lake Forest	0	0	0	25	19	0	0
City of Park City	0	0	0	65	33	0	1
City of Prospect Heights	0	0	0	178	52	0	0
City of Waukegan	696	512	7	291	231	15	29
City of Zion	196	115	0	36	53	32	0.5
Village of Salem Lakes	545	290	5	139	48	0	0
Village of Antioch	480	234	0	59	101	12	3
Village of Arlington Heights	0	0	0	203	143	32	0
Village of Beach Park	128	123	4	209	114	8	10
Village of Bristol	6,023	3,442	37	418	215	2	0
Village of Buffalo Grove	42	24	0	1,437	1,060	324	47
Village of Deer Park	18	9	0	164	126	5	0.1
Village of Deerfield	0	0	0	0	4	0	0
Village of Glenview	0	0	0	1	1	0	0
Village of Grayslake	1,702	1,260	14	920	661	46	156
Village of Green Oaks	29	28	0.1	244	82	4	10
Village of Gurnee	74	67	0	1,590	879	58	34
Village of Hainesville	0	0	0	1	1	0	0
Village of Hawthorn Woods	230	143	0.9	560	243	11	9
Village of Indian Creek	0	0	0	83	24	0	0
Village of Kildeer	36	29	0	473	296	1	2
Village of Lake Villa	44	22	0	3	24	0.7	0.7
Village of Lake Zurich	14	14	0	360	308	11	0
Village of Libertyville	163	88	0	1,966	86	91	22
Village of Lincolnshire	46	23	0	661	270	3	7
Village of Lindenhurst	389	197	0	493	441	8	6

JURISDICTION	COVER CROPS / TILLAGE	NUTRIENT MGMT.	PASTURE/ FEED AREA ENHANCE.	RUNOFF VOLUME REDUCTION	ROAD SALT MGMT.	WETLAND REST/ CREATE	WETLAND ENHANCE
	AREA (ACRES)						
Village of Long Grove	710	485	1	1,319	671	107	31
Village of Mettawa	4	4	2	214	136	0	2
Village of Mundelein	160	108	0	1,824	558	87	109
Village of Northbrook	0	0	0	192	122	0	0
Village of Old Mill Creek	4,664	2,932	1	216	173	0.1	78
Village of Palatine	0	0	0	655	169	6	0
Village of Riverwoods	0	0	0	436	155	0	0
Village of Round Lake Beach	0	0	0	139	65	5	3
Village of Round Lake Park	40	29	0	3	1	0	0.1
Village of Third Lake	18	18	0	52	50	0.3	2
Village of Vernon Hills	160	80	0	1,227	597	174	7
Village of Wadsworth	977	685	33	952	356	14	28
Village of Wheeling	122	61	0	1,899	621	138	0
TOWNSHIP							
Antioch	1,878	1,200	21	156	87	29	30
Avon	99	54	0	73	31	0	11
Benton	150	82	0.6	0.3	2	0.8	1
Ela	436	298	2	317	77	5	10
Fremont	723	648	5	510	106	13	89
Lake Villa	542	346	1	613	165	0.4	15
Libertyville	665	401	0.5	490	77	100	18
Newport	2,780	1,809	53	525	283	20	68
Northfield	0	0	0	123	21	0	0
Palatine	0	0	0	0	10	0.26	0
Vernon	154	110	0	263	135	115	5
Warren	691	510	9	1,370	523	23	20
Waukegan	0	0	0	65	11	0	0
West Deerfield	0	0	0	0	0.7	0	0
Wheeling	0	0	0	79	19	1	0
STATE OF ILLINOIS/FOREST PRESERVE DISTRICTS							
Lake County Forest Preserve District	2,266	1,851	7	60	34	670	349
Forest Preserve District of Cook County	0	0	0	62	0	74	0
State of Illinois	15	15	0	1	1	15	1
TOTALS	**28,142**	**18,362**	**203**	**24,414**	**10,798**	**2,261**	**1,215**

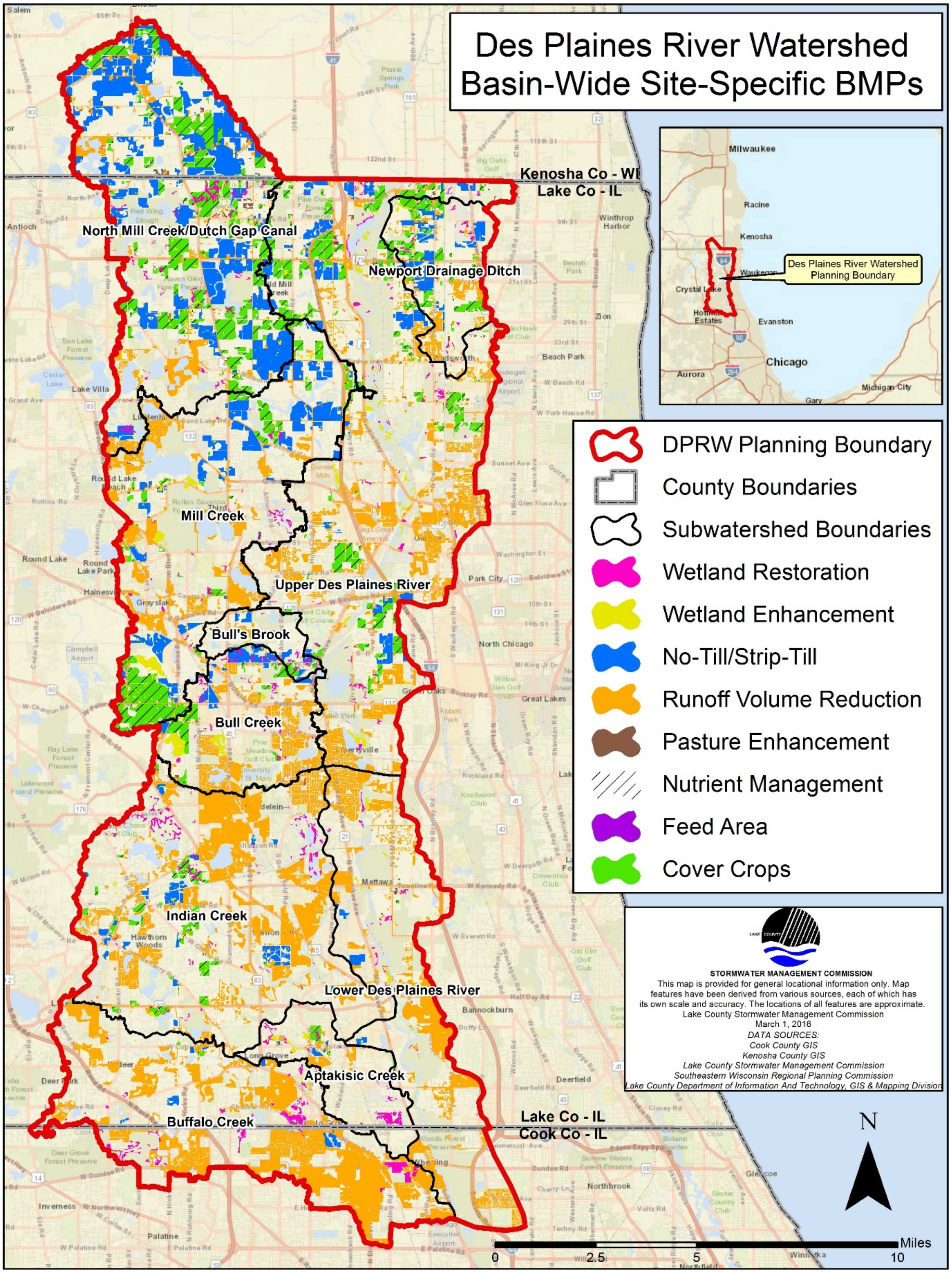

Figure 6-9: Des Plaines River Watershed Basin-Wide Site-Specific BMPs

6.3.6.4 Problem Discharge Locations, Problem Hydraulic Impediments, and Detention Basin Retrofits

Problem discharge locations represent potential maintenance or repair needs related to direct discharges to streams in the DPR planning area, captured by SMC staff during a stream inventory. Problem discharge locations include both outlet structures and open swales. Problem hydraulic impediments represent any notable issues that impede the conveyance and function of a waterway, also captured by SMC staff during a stream inventory. Hydrologic impediments include both debris jams and problem hydraulic structures.

Detention basin retrofit recommendations are based on a detention basin inventory completed by SMC and include maintenance and actions to improve or enhance basin function. All actions presented in this section include updated data from older subwatershed-based plans and newly acquired data from the recent assessment effort. Figure 6-10 shows all hydraulic impediments, problem discharge locations, and detention basin retrofits.

The Village of Gurnee and Libertyville contain the greatest total number of problem discharge locations, the Village of Long Grove and the Lake County FPD contain the greatest number of problem hydraulic impediments; 426 instances of debris jams were identified on FPD property. A total of 135 detention basin retrofit opportunities are located in Gurnee and 79 in the Village of Buffalo Grove (Table 6-28).

Table 6-28: Problem Discharge, Hydraulic Impediment, and Detention Basin Retrofit Summary by Jurisdiction

JURISDICTION	PROBLEM DISCHARGE LOCATIONS		PROBLEM HYDRAULIC IMPEDIMENT		DETENTION BASIN RETROFIT	TOTAL
	OUTLET STRUCTURE	OPEN CHANNEL/SWALE	DEBRIS JAM	HYDRAULIC STRUCTURE		
	# OF ACTIONS					
VILLAGE/MUNICIPALITY						
City of Lake Forest	0	0	0	0	1	1
City of Park City	5	0	14	1	1	21
City of Prospect Heights	0	0	0	0	0	0
City of Waukegan	12	1	40	3	51	107
City of Zion	0	0	11	1	19	31
Village of Salem Lakes	0	0	0	0	0	0
Village of Antioch	0	0	0	0	0	0
Village of Arlington Heights	0	0	0	0	0	0
Village of Beach Park	0	0	9	1	10	20
Village of Bristol	0	0	0	0	2	2
Village of Buffalo Grove	9	1	37	2	79	128
Village of Deer Park	0	0	0	0	1	1
Village of Deerfield	0	0	0	0	0	0
Village of Glenview	0	0	0	0	0	0
Village of Grayslake	1	0	0	2	14	17
Village of Green Oaks	5	0	12	3	7	27
Village of Gurnee	42	3	115	4	135	299
Village of Hainesville	0	0	0	0	0	0

JURISDICTION	PROBLEM DISCHARGE LOCATIONS		PROBLEM HYDRAULIC IMPEDIMENT		DETENTION BASIN RETROFIT	TOTAL
	OUTLET STRUCTURE	OPEN CHANNEL/SWALE	DEBRIS JAM	HYDRAULIC STRUCTURE		
	# OF ACTIONS					
Village of Hawthorn Woods	7	1	37	8	15	68
Village of Indian Creek	0	0	0	0	3	3
Village of Kildeer	2	0	15	5	3	25
Village of Lake Villa	0	0	0	0	0	0
Village of Lake Zurich	0	1	17	1	12	31
Village of Libertyville	24	5	12	1	40	82
Village of Lincolnshire	5	1	16	0	24	46
Village of Lindenhurst	0	0	0	0	5	5
Village of Long Grove	12	2	206	6	28	254
Village of Mettawa	1	0	37	2	1	41
Village of Mundelein	5	0	25	5	33	68
Village of Northbrook	0	0	0	0	8	8
Village of Old Mill Creek	0	0	0	1	0	1
Village of Palatine	0	0	0	0	1	1
Village of Riverwoods	5	1	17	1	8	32
Village of Round Lake Beach	0	0	0	0	1	1
Village of Round Lake Park	0	0	0	0	0	0
Village of Third Lake	0	0	0	0	1	1
Village of Vernon Hills	7	0	47	3	47	104
Village of Wadsworth	3	0	108	6	19	136
Village of Wheeling	0	0	0	0	10	10
TOWNSHIP						
Antioch	0	0	0	0	0	0
Avon	0	0	0	0	0	0
Benton	0	0	0	0	1	1
Ela	2	1	1	1	7	12
Fremont	1	0	48	3	3	55
Lake Villa	0	0	0	0	0	0
Libertyville	8	3	51	10	4	76
Newport	2	0	35	4	1	42
Northfield	0	0	0	0	0	0
Palatine	0	0	0	0	1	1
Vernon	6	0	24	2	9	41
Warren	9	0	70	7	49	135
Waukegan	0	0	0	0	0	0
West Deerfield	0	0	0	0	0	0

JURISDICTION	PROBLEM DISCHARGE LOCATIONS		PROBLEM HYDRAULIC IMPEDIMENT		DETENTION BASIN RETROFIT	TOTAL
	OUTLET STRUCTURE	OPEN CHANNEL/SWALE	DEBRIS JAM	HYDRAULIC STRUCTURE		
	# OF ACTIONS					
Wheeling	0	0	4	0	0	4
STATE OF ILLINOIS/FOREST PRESERVE DISTRICT						
Lake County Forest Preserve District	7	5	421	5	3	441
Forest Preserve District of Cook County	1	0	5	0	0	6
State of Illinois	0	0	25	0	1	26
TOTAL ACTIONS	**181**	**25**	**1,459**	**88**	**658**	**2,411**

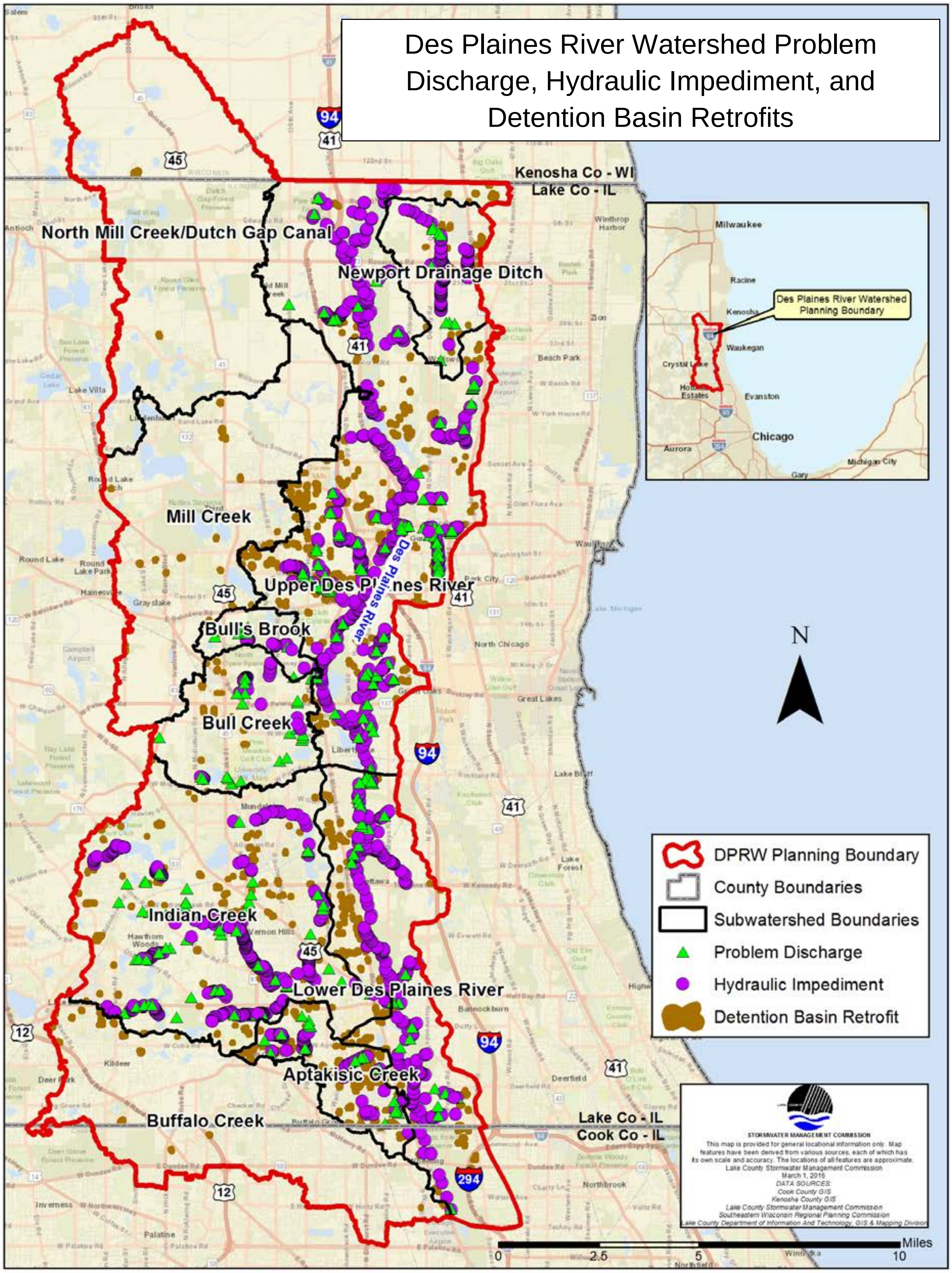

Figure 6-10: Des Plaines River Watershed Problem Discharge, Hydraulic Impediment, and Detention Basin Retrofits

6.3.6.5 Flood Problem Area Mitigation

Table 6-29, Table 6-30 and Table 6-31 summarize the flood problem areas and the July 2017 flood incidents within each jurisdiction. It is important to note that some of the flood problem areas inventory sites overlap with reported flood problems from the July 2017 flood event (see Chapter 5, Figure 5-8).

Figure 6-11 shows the distribution of flood problem are inventory sites throughout the DPR planning area.

There are 176 high priority action projects (sites), which include 2,308 structures and spread across 20 municipalities and 10 townships (Table 6-29). Mundelein, Grayslake, Libertyville, Gurnee and Warren Township have the greatest documented need for flood mitigation actions and have the greatest number of high priority actions.

Table 6-29: Summary of High Priority Flood Mitigation Actions by Jurisdiction

JURISDICTION	# OF HIGH PRIORITY PROJECTS	ESTIMATED # OF AFFECTED STRUCTURES
Avon Township	1	1
Fremont Township	4	24
Lake Villa Township	7	28
Libertyville Township	5	144
Newport Township	4	80
Northfield Township	2	70
Vernon Township	4	20
Village of Beach Park	1	1
Village of Buffalo Grove	8	22
Village of Grayslake	23	293
Village of Green Oaks	3	3
Village of Gurnee	15	65
Village of Hainesville	1	2
Village of Hawthorn Woods	2	2
Village of Lake Zurich	3	19
Village of Libertyville	17	484
Village of Lincolnshire	1	1
Village of Lindenhurst	4	33
Village of Long Grove	5	5
Village of Mettawa	1	2
Village of Mundelein	24	396
Village of Riverwoods	4	24
Village of Third Lake	2	23
Village of Vernon Hills	4	20
Village of Wadsworth	1	7
Village of Waukegan	3	32
Village of Wheeling	5	232
Warren Township	19	262
Waukegan Township	2	7
Wheeling Township	1	6
TOTAL	**176**	**2,308**

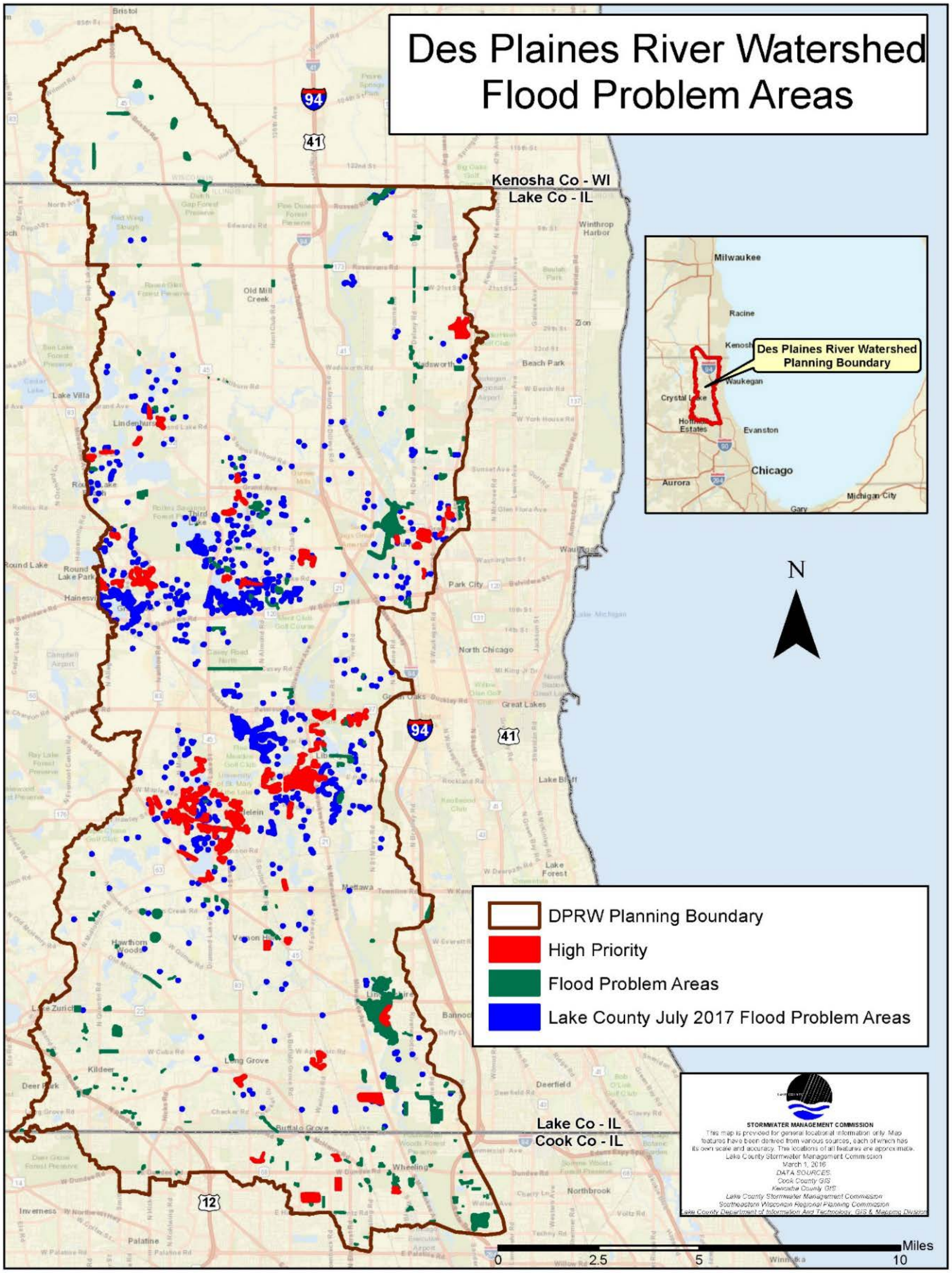

Figure 6-11: DPR Planning Area Flood Problem Areas

Table 6-30: Summary of Reported Flood Problems & Mitigation Need by Flooding Type (Municipalities & Townships)

JURISDICTION	FPAI & 2017 INVENTORY SITES & STRUCTURES				FLOODING TYPE NO. OF SITES (NO. OF STRUCTURES)								
	NUMBER OF FPAI SITES	NUMBER OF 2017 FLOOD INCIDENTS	NUMBER OF FPAI STRUCTURES	2017 AFFECTED STRUCTURES	DEPRESSIONAL FLOODING	EROSION	OVERBANK FLOODING	LOCAL DRAINAGE PROBLEMS	SEWER OR SEPTIC FAILURE	SEWER BACKUP	STREET, DRIVEWAY OR YARD	STRUCTURE DAMAGE FROM FLOODING	STRUCTURE FLOODING
Avon Township	2	2	--	2	1	--	1		--	--	--	--	2 (2)
City of Lake Forest	1	--	4	--	--	--	--	1 (4)	--	--	--	--	--
City of Park City	1	2	4	2	--	--	1 (4)		--	--	--	--	2 (2)
City of Prospect Heights	4	--	1	--	--	--	--	4 (1)	--	--	--	--	--
City of Waukegan	2	11	24	19	1 (24)	--	1	--	--	--	1 (1)	--	10 (18)
City of Zion	--	1	--	1	--	--	--	--	--	1 (1)	--	--	--
Ela Township	3	1	3	1	--	--	--	3 (3)	--	--	--	--	1 (1)
Fremont Township	2	11	16	19	--	--	1 (6)	1 (10)	--	--	3 (3)	--	8 (16)
Lake Villa Township	3	13	10	41	1 (4)	--	--	2 (6)	--	--		--	13 (41)
Libertyville Township	6	14	148	62	--	--	4 (143)	2 (5)	--	2 (2)	5 (6)	--	7 (54)
Newport Township	2	5	35	48	1 (1)	--	1 (34)	--	--	--	--	--	5 (48)
Northfield Township	2	--	70	--	2 (70)	--	--	--	--	--	--	--	--
Vernon Township	1	8	3	26	--	--	1 (3)	--	--	--	1 (1)	--	7 (25)
Village of Antioch	2	3	--	3	--	--	1	1	--	--	--	--	3 (3)
Village of Beach Park	3	3	104	3	--	--		3 (104)	--	--	1 (1)	--	2 (2)
Village of Bristol	8	--	17	--	3 (6)	--	5 (11)	--	--	--	--	--	--
Village of Buffalo Grove	7	11	19	25	1 (6)	2	2 (11)	2 (2)	--	--	--	3 (3)	8 (22)
Village of Deer Park	2	--	4	--	2 (4)	--	--	--	--	--	--	--	--
Village of Grayslake	2	62	1	352	1	--	1 (1)	--	--	1 (1)	10 (10)	3 (3)	48 (338)
Village of Green Oaks	3	7	2	7	1 (1)	--	--	2 (1)	--	--	--	1 (1)	6 (6)
Village of Gurnee	10	73	253	182	2 (9)	--	3 (164)	3	2 (80)	2 (2)	9 (8)	2 (2)	60 (170)
Village of Hainesville	--	1	--	2	--	--	--	--	--	--	--	--	1 (2)
Village of Hawthorn Woods	7	8	6	8	3 (4)	--	--	4 (2)	--	--	--	--	8 (8)
Village of Indian Creek	2	--	11	--	--	--	--	2 (11)	--	--	--	--	--
Village of Kildeer	11	--	--	--	3	--	3	5	--	--	--	--	--
Village of Lake Forest	1	--	4	--	--	--	--	1 (4)	--	--	--	--	--
Village of Lake Zurich	5	1	20	1	1 (1)	--	1 (1)	3 (18)	--	--	--	--	1 (1)
Village of Libertyville	4	45	15	530	--	--	3 (15)	1	--	3 (3)	5 (6)	--	37 (521)

JURISDICTION	FPAI & 2017 INVENTORY SITES & STRUCTURES				FLOODING TYPE NO. OF SITES (NO. OF STRUCTURES)								
	NUMBER OF FPAI SITES	NUMBER OF 2017 FLOOD INCIDENTS	NUMBER OF FPAI STRUCTURES	2017 AFFECTED STRUCTURES	DEPRESSIONAL FLOODING	EROSION	OVERBANK FLOODING	LOCAL DRAINAGE PROBLEMS	SEWER OR SEPTIC FAILURE	SEWER BACKUP	STREET, DRIVEWAY OR YARD	STRUCTURE DAMAGE FROM FLOODING	STRUCTURE FLOODING
Village of Lincolnshire	6	2	105	8	--	--	6 (105)	--	--	--	--	--	2 (8)
Village of Lindenhurst	7	17	19	49	5 (17)	--	--	2 (2)	--	--	2 (2)	--	15 (47)
Village of Long Grove	5	16	--	18	--	1	--	5	--	--	5 (5)	--	11 (13)
Village of Mettawa	1	4	--	6	--	--	1	--	--	--	--	--	4 (6)
Village of Mundelein	5	64	13	443	--	--	1 (4)	4 (9)	--	3 (4)	19 (18)	8 (8)	34 (413)
Village of Northbrook	13	--	1	--	4	--	--	9 (1)	--	--	--	--	--
Village of Old Mill Creek	4	--	--	--	1	--	--	3	--	--	--	--	--
Village of Palatine	4	--	--	--	--	--	1	3	--	--	--	--	--
Village of Riverwoods	7	9	59	10	1 (20)	--	3 (30)	3 (9)	--	--	1 (1)	--	8 (9)
Village of Round Lake Beach	--	9	--	13	--	--	--	--	--	--	--	--	9 (13)
Village of Third Lake	2	5	2	29	--	--	--	2 (2)	--	--	1 (1)	--	4 (28)
Village of Vernon Hills	3	17	--	38	--	--	--	3	--	--	3 (3)	--	14 (35)
Village of Wadsworth	13	4	15	4	5 (10)	--	4 (5)	4	--	--	1 (1)	--	3 (3)
Village of Wheeling	22	--	325	--	1 (40)	--	12 (93)	9 (192)	--	--	--	--	--
Warren Township	16	53	145	270	7 (84)	--	2 (10)	7 (51)	--	2 (2)	7 (7)	2 (2)	42 (259)
Waukegan Township	2	1	7	3	1 (3)	--	--	1 (4)	--	--	--	--	1 (3)
Wheeling Township	1	--	6	--	1 (6)	--	--	--	--	--	--	--	--
SITE TOTALS:	**207**	**483**	--	--	**48**	**3**	**59**	**95**	**2**	**14**	**74**	**19**	**376**
STRUCTURE TOTALS	--	--	**1,471**	**2,225**	**(310)**	--	**(640)**	**(441)**	**(80)**	**(15)**	**(74)**	**(19)**	**(2,117)**

Note: Table 6-30 displays the number of flood sites followed by () of structures affected. Example 2 sites (3 structures affected)

Table 6-31: Summary of Reported Flood Problems & Mitigation Need by Flooding Type (State and Forest Preserve Land)

STATE OR FOREST PRESERVE LAND	FPAI & 2017 INVENTORY SITES & STRUCTURES				FLOODING TYPE NO. OF SITES (NO. OF STRUCTURES)			
	NUMBER OF FPAI SITES	NUMBER OF 2017 FLOOD INCIDENTS	NUMBER OF FPAI STRUCTURES	2017 AFFECTED STRUCTURES	DEPRESSIONAL STORAGE FLOOD	OVERBANKING FLOODING	LOCAL DRAINAGE PROBLEMS	STRUCTURE FLOODING
Deer Grove East Forest Preserve	1	--	--	--	--	1	--	--
Edward L. Ryerson Nature Preserve	3	--	6	--	--	2 (4)	1 (2)	--
Half Day Forest Preserve	1	--	12	--	--	--	1 (12)	--
Lake Carina	1	--	2	--	--	1 (2)	--	--
Potawatomi Woods	1	1	--	--	1	--	--	1
Waukegan Savanna	--	1	--	--	--	--	--	1
Wilmot Woods	--	1	--	--	--	--	--	1
SITE TOTALS:	**7**	**3**	**--**	**--**	**1**	**4**	**2**	**3**
STRUCTURE TOTALS	**--**	**--**	**20**	**0**	**--**	**(6)**	**(14)**	**--**

Note: Table 6-31 displays the number of flood sites followed by () of structures affected. Example 2 sites (3 structures affected)

6.3.6.6 Potential Flood Storage

Table 6-32 and Figure 6-12 define the potential flood storage projects by jurisdiction. These sites can be further evaluated to determine feasibility of creating additional flood storage in the DPR planning area. General examples of practices to increase flood storage include construction of wetlands, berms and basins.

- Thirty-three sites are located in municipalities; the Village of Bristol, Wisconsin has the greatest opportunity to increase flood storage in the watershed (325 acre-feet). This is followed by the Village of Mundelein (199 acre-feet), and the Village of Grayslake (106 acre-feet).
- Ten sites are located in unincorporated areas of townships; the Antioch Township has the greatest opportunity to increase flood storage in the watershed (100 acre-feet). This is followed by Vernon Township (75.5 acre-feet), and Newport Township (45 acre-feet).
- Ten sites with the potential to provide 348.5 acre-feet of storage are located on Lake County Forest Preserve District Property.

Table 6-32: Potential Flood Storage Sites for Evaluation

JURISDICTION	SITE ID	POTENTIAL STORAGE (acre-feet)
Village of Antioch	10-3	17.56
Village of Bristol (WI)	10-16	7.33
	10-10	6.09
	10-15	4.91
	10-17	19.24
	10-18	7.10
	10-12	9.98
	10-7	9.47
	10-9	8.80
	10-14	22.27
	10-8	19.55
	10-13	39.68
	10-11	170.65
Village of Buffalo Grove	17-5	6.27
	18-4	6.47
	17-4	13.30
Village of Grayslake	11-3	5.65
	11-2	13.90
	11-4	12.18
	11-1	18.57
	11-6	55.75
Village of Gurnee	13-1	12.01
Village of Lindenhurst	11-8	22.98
Village of Long Grove	18-5	11.55
	15-3	90.01
Village of Mundelein	14-1	17.39
	14-3	13.54
	14-2	44.62
	14-4	123.41
Village of Old Mill Creek	10-4	8.28
Village of Vernon Hills	15-4	19.09
Village of Wheeling	18-1	21.55
Antioch Township	10-2	100.05
Ela Township	15-2	7.43
	17-3	6.16
Lake Villa Township	10-1	19.80
Newport Township	10-6	45.28
Vernon Township	18-3	10.13
	18-6	6.84
	15-1	16.14
	18-2	42.42
Warren Township	11-7	23.01

JURISDICTION	SITE ID	POTENTIAL STORAGE (acre-feet)
Forest Preserve	13-3	19.81
	10-5	3.42
	13-2	48.91
	17-2	11.01
	13-5	27.77
	11-5	20.94
	13-4	38.66
	15-6	42.39
	17-1	24.13
	16-1	42.61
	15-5	68.90

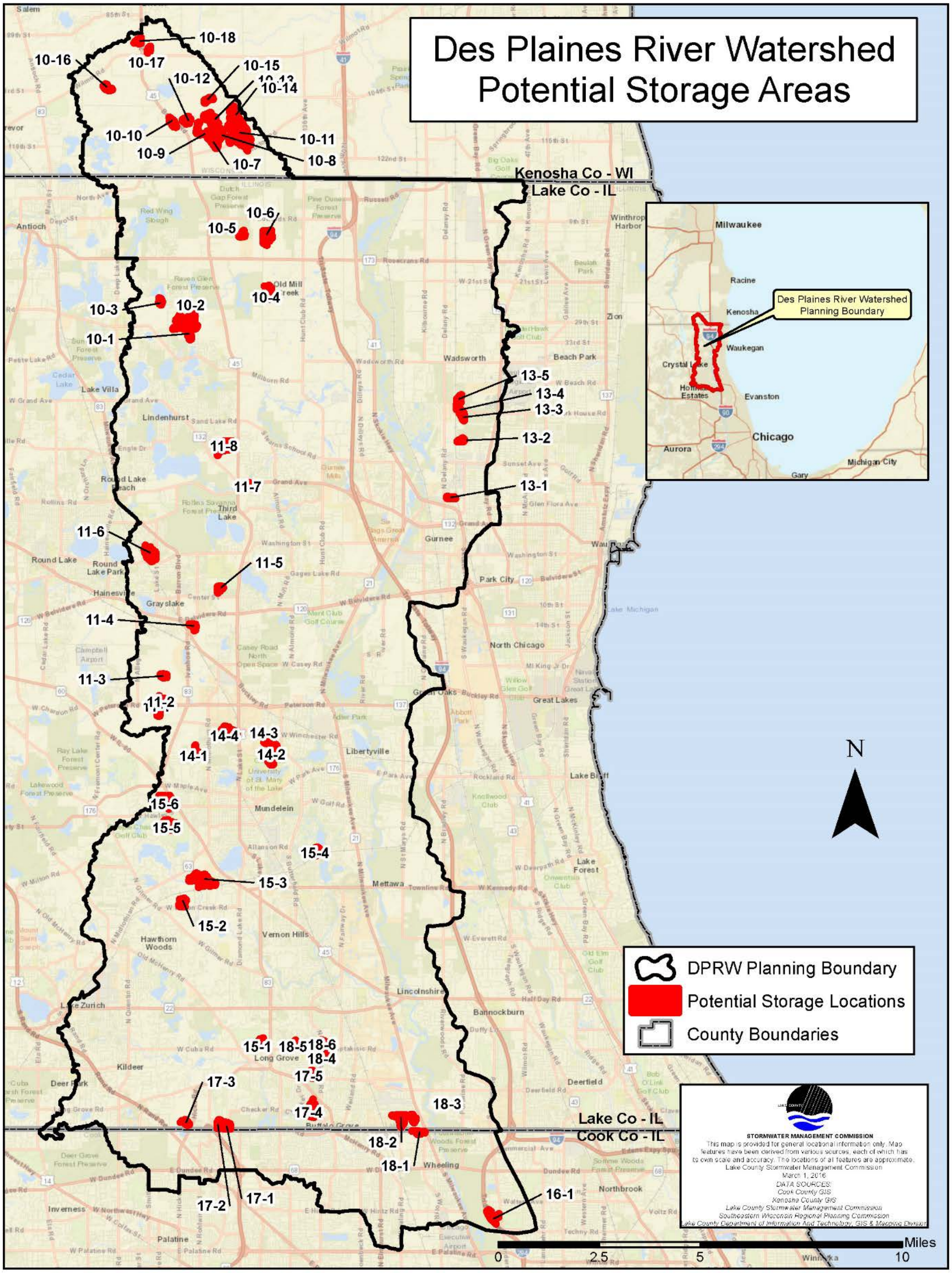

Figure 6-12: Potential Flood Storage Locations

6.3.7 LAKE ACTIONS

6.3.7 Lake Action Recommendations

This section identifies more than 400 actions for 71 lakes and is largely based on data and recommendations identified in Lake County Health Department Lake Reports dating back to around the year 2000 (Table 6-33). Lake-specific actions include programmatic, planning, and BMP recommendations. In some cases, the age of the lake report suggests that additional monitoring should be done before implementing any of the other recommendations for that lake. Because the recommendations are based on lake reports, actions may reflect the uses of a particular lake. For instance, where fishing is an active use, lakes may have fishery surveys identified as a recommendation. In general, the most important recommendations across all lakes from a water quality perspective include the development of (and adherence to) lake management plans, implementation of NPS pollution reduction BMPs (particularly for chloride and TMDL pollutants), shoreline restoration, and the management/control of aquatic invasive and exotic species. Similar to the other types of action recommendations in this plan, lake actions have been given a unique ID, priority, time frame for implementation, lead partners are identified, and estimated cost is provided. Lakes with action recommendations are shown in

Figure 6-13 and actions are listed in Table 6-34. Lake action recommendations are also included in the online mapping application for the Des Plaines River Watershed-Based Plan.

Table 6-33: Summary of Lake Action Recommendations

Priority	Number of Actions	Estimated Cost
High	169	$4,630,872 - $7,378,842
Medium	102	$2,263,796 - $6,144,077
Low	176	$569,099 - $1,718,551
Total	**447**	**$7,463,767 - $15,241,470**

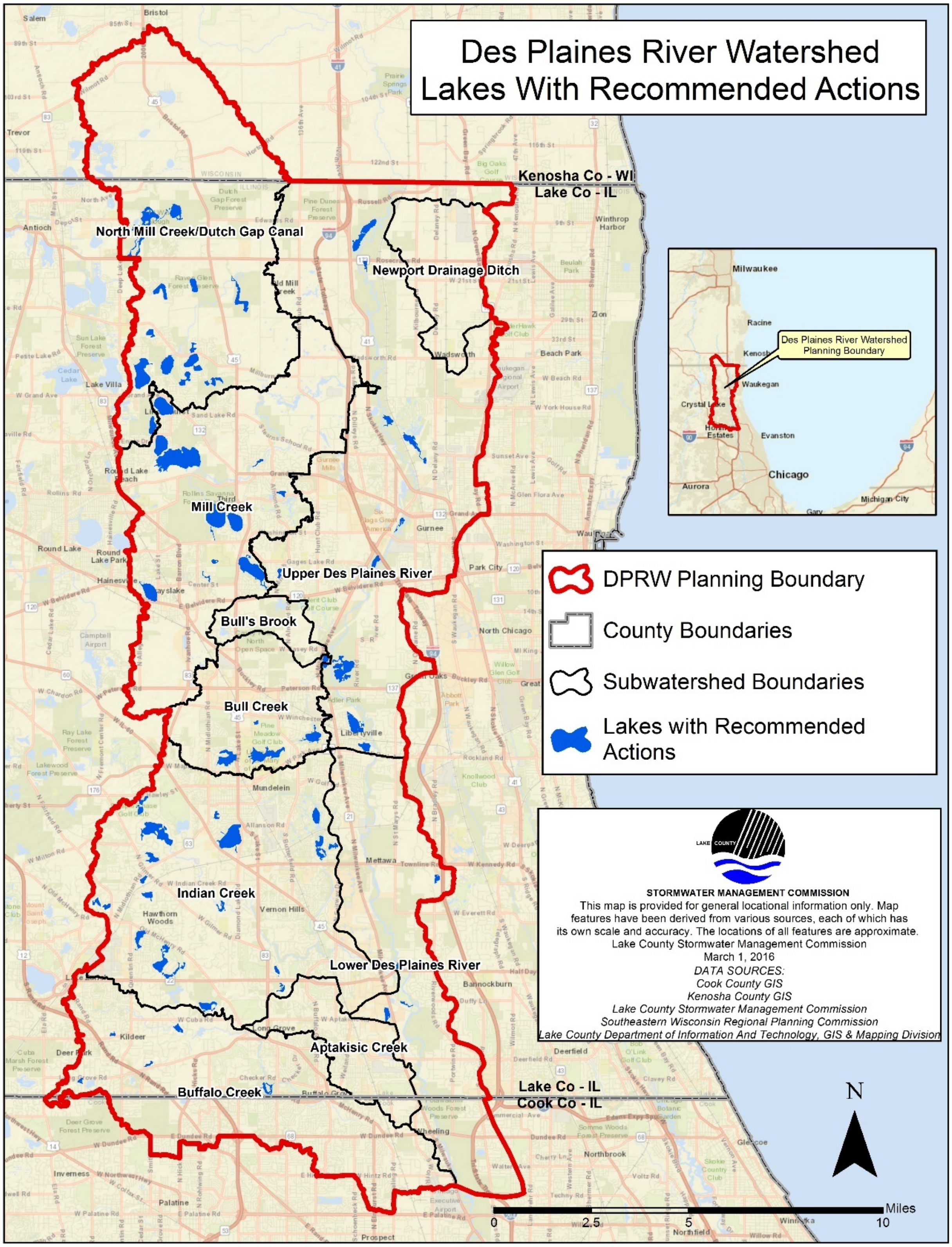

Figure 6-13: Lakes with Recommended Actions

Table 6-34: Recommended Lake Actions

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
Albert Lake	TP DO	LK1	Participate in the VLMP	L	L	HOA	$200
		LK2	Install staff gage	L	L	HOA	$500
		LK3	Develop APMP to address curlyleaf pondweed	M	M	HOA	$3,000
		LK4	Carp Removal	L	L	HOA	$6,000 - $10,000
		LK5	Conduct fishery survey	L	L	HOA	$3,000 - $5,000
		LK6	Create bathymetric map	L	L	HOA	$2,500 - $6,000
		LK7	Encourage native landscaping & riparian buffers/filter strips	M	M	HOA	$1,500
		LK8	Manage curlyleaf pondweed	M	S	HOA	$11,220
		LK9	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	HOA, M	N/A
Ames Pit - ADID 20	N/A	LK10	Participate in the VLMP	L	L	FPD	$200
		LK11	Place garbage cans near lake to reduce litter	L	S	FPD	$2,800
		LK12	Develop lake management plan for all lakes in Forest Preserves	H	M	FPD	$12,000
		LK13	Install sign near access points that shows ways to reduce the spread of aquatic invasive species	L	S	FPD	$300
		LK14	Conduct fishery survey	L	L	FPD	$3,000 - $5,000
		LK15	Update current bathymetric map in 2026	L	L	FPD	$2,500 - $6,000
Big Bear Lake	TP	LK16	Implement chloride reduction BMPs in watershed	H	L	PD, M, DOT	N/A
		LK17	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	PD	N/A
		LK18	Carp Removal	L	L	PD	$6,000 - $10,000
		LK19	Provide fish structures	L	L	PD	$500 - $3,000
		LK20	Consider IDNR recommendations for fishery stocking and management	H	L	PD	N/A
		LK21	Update current bathymetric map	L	S	PD	$2,500 - $6,000
		LK22	Stabilize shoreline using native vegetation buffer (1st priority) or other measures	H	M	PD	$123,857-$209,060
		LK23	Promote spread of aquatic vegetation	H	S	PD	N/A
		LK24	Control Eurasian watermilfoil	H	S	PD	$15,000
Bishops Lake	N/A	LK25	Participate in the VLMP	L	L	LA	$200
		LK26	Develop Lake Management Plan that incorporates aquatic plant management	L	L	LA	$12,000
		LK27	Conduct fishery survey	L	L	LA	$3,000 - $5,000
		LK28	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK29	Create bathymetric map	L	L	LA	$2,500 - $6,000
		LK30	Stabilize shoreline using native vegetation buffer	M	L	LA	$109,500
		LK31	Promote spread of aquatic vegetation	L	L	LA	N/A
Bittersweet Golf Club Pond 13	N/A	LK32	Participate in the VLMP	L	L	GC, M	$200
		LK33	Carp Removal	L	L	GC, M	$6,000 - $10,000
		LK34	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK35	Create bathymetric map	L	L	GC, M	$2,500 - $6,000
		LK36	Control invasive shoreline plants	L	L	GC, M	$839 - $1,259
		LK37	Increase wildlife habitat	L	L	GC, M	$500 - $3,000
Bresen Lake	TP	LK38	Participate in the VLMP	L	L	PR/RL	$200
		LK39	Install staff gage	L	L	PR/RL	$500
		LK40	Conduct fishery survey	L	L	PR/RL	$3,000 - $5,000
		LK41	Develop a Lake Management Plan that incorporates aquatic plant management.	L	L	PR/RL	$12,000
		LK42	Update current bathymetric map in 10 years	L	L	PR/RL	$2,500 - $6,000
		LK43	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	L	L	PR/RL	$1,500
		LK44	Maintain or enhance wildlife areas surrounding Bresen Lake	L	L	PR/RL	$500 - $3,000
		LK45	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	PR/RL, M, T	N/A
		LK46	Investigate use of aerator to control internal nutrient loading	L	L	PR/RL	N/A
Buffalo Creek Reservoir	TP DO	LK47	Continue participating in the VLMP	H	L	FPD	$200
		LK48	Implement chloride reduction BMPs in watershed	H	L	FPD, M, DOT	N/A
		LK49	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	FPD, M	N/A
		LK50	Carp Removal	L	L	FPD	$6,000 - $10,000
		LK51	Update bathymetric map following reservoir expansion	M	S	FPD	$2,500 - $6,000
		LK52	Stabilize shoreline using native vegetation buffer (1st priority) or other measures	H	M	FPD	$665,227 - $928,223
		LK53	Promote spread of native aquatic vegetation (particularly in West Basin)	H	M	FPD	N/A

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK54	Control curlyleaf pondweed in early spring	H	S	FPD	$21,108
Butler Lake	N/A	LK55	Continue participating in the VLMP	H	L	M	$200
		LK56	Install staff gage	M	L	M	$500
		LK57	Implement chloride reduction BMPs in watershed	H	L	M, DOT	N/A
		LK58	Develop Lake Management plan that includes an APMP	H	M	M	$12,000
		LK59	Install sign near access points that shows ways to reduce the spread of aquatic invasive species	L	L	M	$300
		LK60	Conduct fishery survey	M	S	M, IDNR	$3,000 - $5,000
		LK61	Reduce carp population	L	L	M	$6,000 - $10,000
		LK62	Create bathymetric map	M	S	M	$2,500 - $6,000
		LK63	Monitor Eurasian watermilfoil and curlyleaf pondweed and hand rake or manually remove to keep from spreading. (Cost does not include equipment)	H	M	M	$8,052 - $42,274
College Trail Lake	N/A	LK64	Participate in the VLMP	L	L	PD, HOA	$200
		LK65	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
Countryside Lake	TP	LK66	Create Lake Report	L	L	LCHD, LA	N/A
		LK67	Continue participating in the VLMP	H	L	LA	$200
		LK68	Support chloride reduction BMPs in watershed	H	L	LA, T, DOT	N/A
		LK69	Update APMP	M	M	LA	$3,000
		LK70	Implement BMPs in the watershed that reduce pollutants with a TMDL	M	L	LA, T	N/A
Crooked Lake	N/A	LK71	Participate in the VLMP	H	L	LA, HOA	$200
		LK72	Install staff gage	M	L	LA, HOA	$500
		LK73	Lake level alteration should be limited to reduce potential for shoreline erosion and associated impacts	H	S	LA, HOA	N/A
		LK74	Implement chloride reduction BMPs in watershed	H	L	LA, HOA, M, T, DOT	N/A
		LK75	Implement phosphorus reduction BMPs in watershed.	H	L	LA, HOA	N/A
		LK76	Develop Lake Management plan that includes an APMP	H	M	LA, HOA	$12,000
		LK77	Remove carp	H	L	LA, HOA	$6,000 - $10,000
		LK78	Consider IDNR recommendations for fishery stocking and management	H	M	LA, HOA	N/A
		LK79	Update bathymetric map in 2020	L	S	LA, HOA	$2,500 - $6,000
		LK80	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	H	M	LA, HOA	$1,500

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK81	Mitigate shoreline erosion	M	L	LA, HOA	$515,750 - $672,040
		LK82	Increase native plant diversity	H	M	LA, HOA	N/A
		LK83	Control and reduce curlyleaf pondweed	H	S	LA, HOA	$33,000
Deer Lake	N/A	LK84	Participate in the VLMP	L	L	IDNR	$200
		LK85	Educate lake users on controlling the spread of exotic species	L	L	IDNR	$1,500
		LK86	Support chloride reduction BMPs in watershed	H	L	IDNR, T, M, DOT	N/A
		LK87	Support nutrient reduction BMPs in watershed	H	L	IDNR, AG, T, M	N/A
		LK88	Update bathymetric map in 2020	L	S	IDNR	$2,500 - $6,000
Des Plaines Lake	N/A	LK89	Participate in the VLMP	M	L	FPD	$200
		LK90	Monitor Eurasian watermilfoil population	L	L	FPD	$3,200 - $10,000
		LK91	Support chloride reduction efforts in watershed	H	L	FPD, M, T, DOT	N/A
		LK12	Develop lake management plan for all lakes in Forest Preserves	H	M	FPD	$12,000
		LK92	Install sign near access points that shows ways to reduce the spread of aquatic invasive species	L	L	FPD	$300
		LK93	Reduce carp population	L	L	FPD	$6,000 - $10,000
		LK94	Update bathymetric map in 2022	L	S	FPD	$2,500 - $6,000
		LK95	Mitigate existing shoreline erosion	M	L	FPD	$70,963 - $385,230
Diamond Lake	TP	LK96	Continue participating in the VLMP	H	L	HOA, PD	$200
		LK97	Install staff gage	M	L	HOA, PD	$500
		LK98	Consider wake restrictions in nearshore or shallow areas	H	S	HOA, PD	N/A
		LK99	Implement chloride reduction BMPs in watershed	H	L	HOA, PD, M, T, DOT	N/A
		LK100	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	HOA, PD, M, T	N/A
		LK101	Create a Diamond Lake Improvement organization and a Lake Management plan	H	M	HOA, PD	$12,000
		LK102	Install signs at boat ramps educating boaters about the presence of invasive species in Diamond Lake and ways to prevent their spread	H	S	HOA, PD	$300
		LK103	Continue to coordinate with IDNR Fisheries	H	S	HOA, PD	N/A
		LK104	Update bathymetric map in 2019	L	S	HOA, PD	$2,500 - $6,000

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK105	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	H	M	HOA, PD	$1,500
		LK106	Decrease Eurasian watermilfoil and curlyleaf pondweed populations	H	S	HOA, PD	$52,133
Dog Training Pond	N/A	LK107	Participate in the VLMP	L	L	FPD	$200
		LK108	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK109	Create bathymetric map	L	L	FPD	$2,500 - $6,000
Druce Lake	N/A	LK110	Continue participating in the VLMP	H	L	HOA, M	$200
		LK111	Install staff gage	M	L	HOA, M	$500
		LK112	Support chloride reduction BMPs in watershed	H	L	HOA, M, T, DOT	N/A
		LK113	Develop Lake Management plan that includes an APMP	H	M	HOA, M	$12,000
		LK114	Install signs at boat ramps educating boaters about the presence of invasive species in Druce Lake and ways to prevent their spread	H	S	HOA, M	$300
		LK115	Conduct fishery survey	H	M	HOA, M	$3,000 - $5,000
		LK116	Update bathymetric map during next lake monitoring cycle	L	S	HOA, M	$2,500 - $6,000
		LK117	Mitigate shoreline erosion	H	L	HOA, M	$102,960 - $316,800
		LK118	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	M	L	HOA, M	$1,500
Forest Lake	TP	LK119	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK120	Implement chloride reduction BMPs in watershed	H	L	PO, M, T, DOT	N/A
		LK121	Develop APMP	L	L	PO	$3,000
		LK122	Manage curlyleaf pondweed	L	L	PO	$21,000
		LK123	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	PO	N/A
Fourth Lake	N/A	LK124	Anglers using private access should remove carp	L	L	PO	N/A
		LK125	Create new bathymetric map to replace current 1966 map	M	S	PO	$2,500 - $6,000
		LK126	Support chloride reduction BMPs in watershed	H	L	PO, M	N/A
		LK127	Control Eurasian watermilfoil	M	L	PO	$182,938
		LK128	Participate in the VLMP	H	L	PO	$200
Gages Lake	N/A	LK129	Continue participating in the VLMP	H	L	LA, PD	$200
		LK130	Install staff gage	M	L	LA, PD	$500
		LK131	Implement localized chloride reduction BMPs in watershed	H	L	LA, PD, T, DOT	N/A

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK132	Develop Lake Management plan that includes an APMP	H	M	LA, PD	$12,000
		LK133	Install signs at boat ramps educating boaters about the presence of invasive species in Gages Lake and ways to prevent their spread	H	S	LA, PD	$300
		LK134	Continue to coordinate with IDNR Fisheries	H	L	LA, PD	N/A
		LK135	Update bathymetric map during next lake monitoring cycle	L	S	LA, PD	$2,500 - $6,000
		LK136	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	H	M	LA, PD	$1,500
		LK137	Mitigate shoreline erosion	H	M	LA, PD	$411,363 - $607,253
		LK138	Control curlyleaf pondweed and Eurasian watermilfoil	H	M	LA, PD	$85,800
Grand Avenue Marsh	N/A	LK139	Participate in the VLMP	L	L	FPD	$200
		LK140	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK141	Conduct fishery survey	L	L	FPD	$3,000 - $5,000
		LK142	Update bathymetric map	L	L	FPD	$2,500 - $6,000
Grandwood Park Lake	N/A	LK143	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK144	Support nutrient reduction BMPs in watershed	H	L	PD, M, T, PR/RL, AG	N/A
		LK145	Develop APMP	L	L	PD	$3,000
		LK146	Create bathymetric map	L	L	PD	$2,500 - $6,000
		LK147	Remove carp	L	L	PD	$6,000 - $10,000
		LK148	Stabilize shoreline using native vegetation buffer (1st priority) or other measures	H	L	PD	$65,000
		LK149	Improve wildlife habitat	L	L	PD	$500 - $3,000
		LK150	Control invasive species	L	L	PD	$3,478 - $5,218
		LK151	Control aquatic plants and algae	L	L	PD	$7,200
Grays Lake	N/A	LK152	Continue participating in the VLMP	H	L	PD, M	$200
		LK153	Install staff gage	M	L	PD, M	$500
		LK154	Implement localized chloride reduction BMPs in watershed	H	L	PD, M, DOT	N/A
		LK155	Remove carp	M	L	PD, M	$6,000 - $10,000
		LK156	Continue to coordinate with IDNR for fishery management recommendations	H	S	PD, M, IDNR	N/A
		LK157	Conduct fishery assessment	H	M	PD, M	$3,000 - $5,000

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK158	Update bathymetric map during next lake monitoring cycle	L	S	PD, M	$2,500 - $6,000
		LK159	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	H	M	PD, M	$1,500
		LK160	Mitigate shoreline erosion	H	M	PD, M	$137,280 - $253,440
		LK161	Assess need for annual aquatic herbicide applications for exotic species control	M	S	PD, M	$15,192
Halfday Pit	TP DO	LK162	Participate in the VLMP	L	L	FPD	$200
		LK163	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK164	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	FPD, M, T	N/A
		LK165	Create bathymetric map	L	L	FPD	$2,500 - $6,000
Harvey Lake	N/A	LK166	Participate in the VLMP	M	L	M	$200
		LK167	Install staff gage	M	L	M	$500
		LK168	Implement localized chloride reduction BMPs in watershed	H	L	M, DOT	N/A
		LK169	Develop Lake Management plan that includes an APMP	H	M	M	$12,000
		LK170	Update the shoreline management plan to continue removal of buckthorn and purple loosestrife	H	M	M	N/A
		LK171	Conduct fishery assessment	M	M	M	$3,000 - $5,000
		LK172	Create bathymetric map	M	S	M	$2,500 - $6,000
		LK173	Continue management of invasive species within shoreline buffer	M	S	M	$3,064 - $4,597
Hastings Lake	N/A	LK174	Continue participating in the VLMP	H	L	FPD	$200
		LK12	Develop lake management plan for all lakes in Forest Preserves	H	M	FPD	$12,000
		LK175	Support chloride reduction BMPs in watershed	H	L	FPD, M	N/A
		LK176	Carp removal	H	L	FPD, LCHD	$6,000 - $10,000
		LK177	Update bathymetric map during next lake monitoring cycle	L	S	FPD	$2,500 - $6,000
		LK178	Continue management of invasive species within shoreline buffer	M	S	FPD	$4,599 - $6,898
		LK179	Mitigate existing shoreline erosion	M	L	FPD	$55,440
		LK180	Control Eurasian watermilfoil	M	L	FPD	$14,400
Hendrick Lake	N/A	LK181	Participate in the VLMP	L	L	PR/RL	$200
		LK182	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK183	Create bathymetric map	L	L	PR/RL	$2,500 - $6,000
Independence Grove	N/A	LK184	Participate in the VLMP	H	L	FPD	$200
		LK185	Install a staff gage	M	L	FPD	$500

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK186	Monitor Eurasian watermilfoil and curlyleaf pondweed population	M	M	FPD	$3,200 - $10,000
		LK12	Develop lake management plan for all lakes in Forest Preserves	H	M	FPD	$12,000
		LK187	Install signs at access points to educate users about the presence of invasive species in Independence Grove Lake and ways to prevent their spread	M	S	FPD	$300
		LK188	Conduct fishery assessment	H	S	FPD	$3,000 - $5,000
		LK189	Add large woody debris/coarse woody material for habitat benefits	L	L	FPD	$500 - $3,000
		LK190	Incorporate native plants in landscaping	M	M	FPD	$35,220
		LK191	Mitigate existing shoreline erosion	M	L	FPD	$304,127 - $1,393,920
		LK192	Rake or manually remove Eurasian watermilfoil and curlyleaf pondweed (Cost does not include equipment)	L	L	FPD	$3,293 - $17,559
International Mining and Chemical Lake	N/A	LK193	Participate in the VLMP	L	L	CBL	$200
		LK194	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK195	Create bathymetric map	L	L	CBL	$2,500 - $6,000
Kemper Lake 1	N/A	LK196	Create bathymetric map	L	L	CBL	$2,500 - $6,000
		LK197	Stabilize shoreline using native vegetation buffer	L	L	CBL	$118,100 - $408,010
		LK198	Increase native plant diversity	L	L	CBL	N/A
		LK199	Manage curlyleaf pondweed	L	L	CBL	$41,916
		LK200	Assess current fish population	L	L	CBL	$3,000 - $5,000
		LK201	Install a staff gage	L	L	CBL	$500
		LK202	Participate in the VLMP	L	L	CBL	$200
		LK203	Implement chloride reduction BMPs in watershed	H	L	CBL, M, T, DOT	N/A
Kemper Lake 2	N/A	LK204	Assess current fish population	L	L	CBL	$3,000 - $5,000
		LK205	Install a staff gage	L	L	CBL	$500
		LK206	Participate in the VLMP	L	L	CBL	$200
		LK207	Implement chloride reduction BMPs in watershed	H	L	CBL, M, T, DOT	N/A
		LK208	Create bathymetric map	L	L	CBL	$2,500 - $6,000
		LK209	Stabilize shoreline using native vegetation buffer	M	L	CBL	$443,413 - $770,140
		LK210	Increase native plant diversity	L	L	CBL	N/A
		LK211	Manage curlyleaf pondweed	L	L	CBL	$16,740
Lake Carina	N/A	LK212	Participate in the VLMP	M	L	FPD	$200
		LK12	Develop lake management plan for all lakes in Forest Preserves	H	M	FPD	$12,000

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK213	Install sign near access points that shows ways to reduce the spread of aquatic invasive species	M	S	FPD	$300
		LK214	Update bathymetric map	L	S	FPD	$2,500 - $6,000
		LK215	Conduct fishery assessment	H	S	FPD	$3,000 - $5,000
		LK216	Consider shoreline restoration in areas with visible erosion, with priority given to revegetation with native vegetation	M	L	FPD	$23,760-$104,543
Lake Charles	TP	LK217	Participate in the VLMP	M	L	PD, PO	$200
		LK218	Install staff gage	M	L	PD, PO	$500
		LK219	Develop Lake Management plan that includes an APMP	H	M	PD, PO	$12,000
		LK220	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	PD, PO, M	N/A
		LK221	Conduct fishery assessment	H	S	PD, PO	$3,000 - $5,000
		LK222	Determine water quality impacts of common carp	M	L	PD, PO	N/A
		LK223	Update bathymetric map in 2023	M	M	PD, PO	$2,500 - $6,000
		LK224	Remove reed canarygrass along entire shoreline	L	L	PD, PO	$5,149 - $7,724
		LK225	Target Eurasian watermilfoil and reduce curlyleaf pondweed	M	L	PD, PO	$21,000
Lake Farmington	N/A	LK226	Participate in the VLMP	L	L	HOA	$200
		LK227	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK228	Create bathymetric map	L	L	HOA	$2,500 - $6,000
Lake Leo	N/A	LK229	Participate in the VLMP	L	L	LA	$200
		LK230	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK231	Create bathymetric map	L	L	LA	$2,500 - $6,000
Lake Linden	N/A	LK232	Participate in the VLMP	H	L	PO	$200
		LK233	Monitor curlyleaf pondweed early in the season	M	S	PO	$3,200 - $10,000
		LK234	Develop Lake Management plans that include APMPs for all lakes in Lindenhurst	H	M	PO	$12,000
		LK235	Follow IDNR fishery management recommendations	H	S	PO	N/A
		LK236	Increase fish habitat with coarse woody material or fish structures	L	L	PO	$500 - $3,000
		LK237	Update bathymetric map in 2021	M	S	PO	$2,500 - $6,000
		LK238	Increase extent of shoreline with minimum 25-foot buffer	M	M	PO	$15,119
Lake Miltmore	N/A	LK239	Continue participating in the VLMP	H	L	LA, HOA, T	$200
		LK240	Implement chloride reduction BMPs in watershed	H	L	LA, HOA, T, DOT	N/A
		LK241	Implement nutrient reduction BMPs in the watershed to protect overall excellent water quality	H	L	LA, HOA, T	N/A

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK242	Develop Lake Management plan that includes an APMP	H	M	LA, HOA, T	$12,000
		LK243	Conduct fishery assessment	H	M	LA, HOA, T	$3,000 - $5,000
		LK244	Coordinate with IDNR on fishery management	H	M	LA, HOA, T	N/A
		LK245	Mitigate shoreline erosion	H	L	LA, HOA, T	$66,927 - $435,033
		LK246	Update bathymetric map	L	S	LA, HOA, T	$2,500 - $6,000
		LK247	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	H	M	LA, HOA, T	$1,500
Lake Naomi	N/A	LK248	Participate in the VLMP	L	L	LA	$200
		LK249	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK250	Create bathymetric map	L	L	LA	$2,500 - $6,000
Liberty Lake	N/A	LK251	Participate in the VLMP	L	L	PO	$200
		LK252	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK253	Create bathymetric map	L	L	PO	$2,500 - $6,000
Little Bear Lake	TP	LK254	Implement chloride reduction BMPs in watershed	H	L	PD, M, DOT	N/A
		LK255	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	PD, M	N/A
		LK256	Carp Removal	L	L	PD	$6,000 - $10,000
		LK257	Provide fish structures	L	L	PD	$500 - $3,000
		LK258	Consider IDNR recommendations for fishery stocking and management	H	M	PD	N/A
		LK259	Update bathymetric map	M	S	PD	$2,500 - $6,000
		LK260	Stabilize shoreline using native vegetation buffer (1st priority) or other measures	H	M	PD	$438,240
		LK261	Promote spread of aquatic vegetation	H	S	PD	N/A
		LK262	Control Eurasian watermilfoil	H	S	PD	$8,133
Loch Lomond	N/A	LK263	Continue participating in the VLMP	H	L	LA	$200
		LK264	Monitor inlets for nutrients, sediment, and erosion	L	L	LA	$20,000
		LK265	Install staff gage	M	L	LA	$500
		LK266	Implement chloride reduction BMPs in watershed	H	L	LA, M, T, DOT	N/A
		LK267	Implement recommendations of Lake Management Plan and Small Watershed Assessment and Action Plan	H	L	LA	N/A
		LK268	Install sign near access points that shows ways to reduce the spread of aquatic invasive species	H	S	LA	$300
		LK269	Conduct fishery assessment	M	M	LA	$3,000 - $5,000
		LK270	Reduce or remove common carp	M	L	LA	$6,000 - $10,000

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK271	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline buffers	M	L	LA	$1,500
		LK272	Plant emergent vegetation	M	L	LA	$10,000
Longview Meadow Lake	N/A	LK273	Participate in the VLMP	L	L	FPD, PO	$200
		LK274	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK275	Implement chloride reduction BMPs in watershed	H	L	FPD, PO, M, T, DOT	N/A
		LK276	Carp Removal	L	L	FPD, PO	$6,000 - $10,000
		LK277	Remove invasive shoreline and emergent plant species including reed canary grass, purple loosestrife, common reed, Canada thistle and buckthorn	L	L	FPD, PO	$4,284 - $6,425
		LK278	Mitigate existing shoreline erosion	M	L	FPD, PO	$25,607
		LK279	Plant emergent vegetation	L	L	FPD, PO	$10,000
Lucy Lake	N/A	LK280	Participate in the VLMP	L	L	M	$200
		LK281	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK282	Implement chloride reduction BMPs in watershed	H	L	M, DOT	N/A
		LK283	Create bathymetric map	L	L	M	$2,500 - $6,000
Mary Lee Lake	N/A	LK284	Participate in the VLMP	L	L	PO	$200
		LK285	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK286	Implement chloride reduction BMPs in watershed	H	L	M, T, DOT, PO	N/A
		LK287	Create bathymetric map	L	L	PO	$2,500 - $6,000
McDonald Woods Lake 1	N/A	LK288	Participate in the VLMP	L	L	FPD	$200
		LK289	Implement localized chloride reduction BMPs in watershed	H	L	FPD, M, DOT	N/A
		LK12	Develop lake management plan for all lakes in Forest Preserves	H	M	FPD	$12,000
		LK290	Maintain weir at outlet to prevent carp migration from McDonald Lake 2	H	S	FPD	N/A
McDonald Woods Lake 2	N/A	LK291	Participate in the VLMP	L	L	FPD	$200
		LK12	Develop lake management plan for all lakes in Forest Preserves	H	M	FPD	$12,000
		LK292	Remove carp	H	L	FPD	$6,000 - $10,000
		LK293	Remove invasive shoreline and emergent plant species and replace with natives	M	L	FPD	$23,000
Lake Minear	N/A	LK294	Continue participating in the VLMP	H	L	LA, HOA	$200
		LK295	Monitor Eurasian watermilfoil and curlyleaf pondweed	M	L	LA, HOA	$3,200 - $10,000
		LK296	Install staff gage	M	L	LA, HOA	$500

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK297	Implement localized chloride reduction BMPs in watershed	H	L	LA, HOA, M, DOT	N/A
		LK298	Develop Lake Management plan that includes an APMP	H	M	LA, HOA	$12,000
		LK299	Install signs at access points to educate users about the presence of invasive species in Lake Minear and ways to prevent their spread	M	S	LA, HOA	$300
		LK300	Update bathymetric map during next monitoring cycle	L	M	LA, HOA	$2,500 - $6,000
		LK301	Mitigate shoreline erosion	H	L	LA, HOA	$617,233 - $953,567
		LK302	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	M	L	LA, HOA	$1,500
		LK303	Rake or manually remove Eurasian watermilfoil and curlyleaf pondweed (Cost does not include equipment)	M	L	LA, HOA	$786 - $4,189
Oak Hills Lake	N/A	LK304	Create bathymetric map	L	L	PD	$2,500 - $6,000
		LK305	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK306	Participate in the VLMP	L	L	PD	$200
Osprey Lake	N/A	LK307	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK308	Participate in the VLMP	L	L	PD, GC	$200
		LK309	Create bathymetric map	L	L	PD, GC	$2,500 - $6,000
Peterson Pond	N/A	LK310	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK311	Participate in the VLMP	L	L	FPD	$200
		LK312	Create bathymetric map	L	L	FPD	$2,500 - $6,000
Pond-a-Rudy	TP DO	LK313	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK314	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	M, T	N/A
Potomac Lake	N/A	LK315	Monitor and manage curlyleaf pondweed	M	L	PO	$8,760
		LK316	Participate in the VLMP	H	L	M, PO	$200
		LK317	Implement localized chloride reduction BMPs in watershed	H	L	PO, M, DOT	N/A
		LK234	Develop Lake Management plans that included APMPs for all lakes in Lindenhurst	H	M	PO	$12,000
		LK318	Increase fish habitat with coarse woody material or fish structures	L	L	PO	$500 - $3,000
		LK319	Follow IDNR fishery management recommendations	H	S	PO	N/A
		LK320	Update bathymetric map	M	S	PO	$2,500 - $6,000
		LK321	Consider installing a shoreline buffer on south side of lake along Grass Lake Road	H	M	PO	$1,200

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK322	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	M	L	PO	$1,500
		LK323	Mitigate shoreline erosion using native vegetation or rip rap	H	M	PO	$85,537 - $370,657
Rasmussen Lake	N/A	LK324	Determine when lake can be removed from 305(b) report resulting from dam removal	H	S	FPD, Illinois EPA	N/A
Redwing Slough	N/A	LK325	Develop Lake Management plan that includes an APMP	H	M	IDNR	$12,000
		LK326	Implement chloride reduction BMPs in watershed	H	L	IDNR, T, DOT	N/A
		LK327	Install sign near access points that shows ways to reduce the spread of aquatic invasive species	L	M	IDNR	$300
Rivershire Pond 2	N/A	LK328	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK329	Participate in the VLMP	L	L	HOA	$200
		LK330	Create bathymetric map	L	L	HOA	$2,500 - $6,000
Salem Lake	TP	LK331	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK332	Participate in the VLMP	L	L	CBL, PR/RL, PD	$200
		LK333	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	M	N/A
		LK334	Create bathymetric map	L	L	CBL, PR/RL, PD	$2,500 - $6,000
Sand Lake	N/A	LK335	Install staff gage	M	L	LA, T	$500
		LK336	Continue participating in the VLMP	H	L	LA, T	$200
		LK337	Develop Lake Management plan that includes an APMP	H	M	LA, T	$12,000
		LK338	Implement chloride reduction BMPs in watershed	H	L	LA, T	N/A
		LK339	Conduct fishery assessment	H	S	LA, T	$3,000 - $5,000
		LK340	Update bathymetric map in 2021	L	S	LA, T	$2,500 - $6,000
		LK341	Mitigate shoreline erosion	H	M	LA, T	$125,927 - $369,390
		LK342	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	H	M	LA, T	$1,500
		LK343	Reduce Eurasian watermilfoil and curlyleaf pondweed populations	H	S	LA, T	$44,991
Slough Lake	N/A	LK344	Participate in the VLMP	M	L	FPD	$200
		LK345	Implement chloride reduction BMPs in watershed	H	L	FPD, M, T, DOT	N/A
		LK346	Conduct pollution source identification monitoring for septic and farm field runoff.	M	S	FPD, LCHD	N/A
		LK347	Reduce/Eliminate phosphorus fertilizer use	H	S	FPD, AG	N/A

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK348	Develop a plan to address/manage nutrient rich bottom sediments. The plan should include an assessment of the potential effectiveness/feasibility of dredging, chemical inactivation, and/or a downstream treatment train between Slough and Crooked Lakes.	M	L	FPD	$10,000 - $15,000
		LK349	Carp Removal	H	L	FPD	$6,000 - $10,000
		LK350	Stabilize shoreline using native vegetation buffer (1st priority) or other measures	M	L	FPD	$110,880 - $158,400
		LK351	Encourage or plant native vegetation once carp are removed	M	L	FPD	N/A
Saint Mary's Lake	N/A	LK352	Monitor staff gage at least monthly	M	L	SI	N/A
		LK353	Participate in the VLMP	M	L	SI	$200
		LK354	Develop Lake Management plan, including aquatic habitat and water clarity restoration	H	M	SI	$12,000
		LK355	Install signs at access points to educate users about the presence of invasive species in St. Mary's Lake and ways to prevent their spread	M	S	SI	$300
		LK356	Remove carp	L	L	SI	$6,000 - $10,000
		LK357	Conduct fishery assessment	H	S	SI	$3,000 - $5,000
		LK358	Mitigate shoreline erosion with preference given to natural vegetation	H	M	SI	$978,437 - $1,471,403
		LK359	Monitor success of carp exclosures	L	L	SI	N/A
Sterling Lake	N/A	LK360	Install staff gage	M	L	FPD	$500
		LK361	Participate in the VLMP	M	L	FPD	$200
		LK12	Develop lake management plan for all lakes in Forest Preserves	H	M	FPD	$12,000
		LK362	Install coarse woody material for habitat	L	L	FPD	$500 - $3,000
		LK363	Install signs at access points to educate users about the presence of invasive species in Sterling Lake and ways to prevent their spread	H	S	FPD	$300
		LK364	Monitor Eurasian watermilfoil and curlyleaf pondweed	M	M	FPD	$3,200 - $10,000
		LK365	Conduct fishery assessment	H	S	FPD	$3,000 - $5,000
		LK366	Update bathymetric map during next monitoring cycle	L	M	FPD	$2,500 - $6,000
		LK367	Mitigate existing shoreline erosion	M	L	FPD	$14,257 - $285,120
		LK368	Widen shoreline buffer to 25 feet where possible	M	M	FPD	$5,200
		LK369	Rake or manually remove Eurasian watermilfoil and curlyleaf pondweed (Cost does not include equipment)	M	L	FPD	$1,634 - $8,716
Stockholm Lake	N/A	LK370	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK371	Participate in the VLMP	L	L	PO	$200
		LK372	Create bathymetric map	L	L	PO	$2,500 - $6,000

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
Stone Quarry Lake	N/A	LK373	Increase fish habitat	L	L	PO	$500 - $3,000
		LK374	Create bathymetric map	M	S	PO	$2,500 - $6,000
		LK375	Increase wildlife habitat	L	L	PO	$500 - $3,000
		LK376	Mitigate shoreline erosion with preference given to natural vegetation	M	L	PO	$29,463 - $157,133
		LK377	Remove or control invasive species including purple loosestrife and reed canary grass	M	L	PO	$4,341 - $6,511
		LK378	Incorporate native plants in landscaping through rain gardens or shoreline buffers	M	L	PO	$12,000
		LK379	Monitor invasive species	M	M	PO	$3,200 - $10,000
		LK380	Monitor shoreline erosion	M	L	PO	$4,000
		LK381	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK382	Participate in the VLMP	L	L	PO	$200
		LK383	Implement chloride reduction BMPs in watershed	H	L	PO, M, DOT	N/A
		LK384	Reduce/eliminate phosphorus fertilizer use	H	M	PO, AG	N/A
Sylvan Lake	FC TP	LK385	Continue participating in the VLMP	H	L	LA	$200
		LK386	Remove waterfowl feces rather than sweeping into lake	H	S	LA	$3,900
		LK387	Do not feed geese	H	S	LA	N/A
		LK388	Implement BMPs in the watershed that reduce pollutants with a TMDL	H	L	LA, M, T	N/A
		LK389	Develop Lake Management plan, including an action plan for blue-green algae	H	M	LA	$12,000
		LK390	Promote vegetation for fish habitat and reduce fish feeders	M	L	LA	N/A
		LK391	Update bathymetric map during next monitoring cycle	M	S	LA	$2,500 - $6,000
		LK392	Mitigate shoreline erosion incorporating hardscape only where necessary	H	M	LA	$69,167 - $96,837
		LK393	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips	H	M	LA	$1,500
		LK394	Consider operating aerators to prevent stratification	M	L	LA	$10,000
Third Lake	N/A	LK395	Update Lake Report and monitoring data (Most recent report is >10 years old)	H	M	LCHD	N/A
		LK396	Continue participating in the VLMP	H	L	PO, M	$200
		LK397	Create long term plan for replacement of lake aeration system	H	M	PO, M	$100,000 - $150,000
		LK398	To the extent practicable, operate dam to reduce flood damages	M	M	M	N/A
		LK399	Support nutrient reduction BMPs in the watershed	M	L	M	N/A
		LK400	Develop Lake Management plan that includes an APMP	M	L	PO,M	$12,000
		LK401	Mitigate shoreline erosion with preference of shoreline buffer with native vegetation	L	L	PO, M	$52,800 - $633,600

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK402	Support chloride reduction BMPs in watershed	H	L	PO, M, T, DOT, FPD	N/A
Timber Lake (North)	N/A	LK403	Continue participating in the VLMP	H	L	FPD, PO	$200
		LK12	Develop lake management plan for all lakes in Forest Preserves	H	M	FPD	$12,000
		LK404	Install sign near access points to educate on ways to reduce the spread of aquatic invasive species	M	S	FPD	$300
		LK405	Implement chloride reduction BMPs in watershed	H	L	M, T, DOT	N/A
		LK406	Conduct fishery assessment	H	S	FPD	$3,000 - $5,000
		LK407	Update bathymetric map	L	L	FPD	$2,500 - $6,000
		LK408	Mitigate shoreline erosion with preference of shoreline buffer with native vegetation	M	L	FPD, PO	$23,233 - $214,897
Valley Lake	N/A	LK409	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK410	Install staff gage	L	L	PD	$500
		LK411	Continue participating in the VLMP	H	L	PD	$200
		LK412	Develop Lake Management plan that includes an APMP	L	L	PD	$12,000
		LK413	Update bathymetric map	L	L	PD	$2,500 - $6,000
Waterford Lake	N/A	LK414	Survey curlyleaf pondweed	L	L	M	$3,200 - $10,000
		LK415	Continue participating in the VLMP	H	L	M	$200
		LK234	Develop Lake Management plans that include APMPs for all lakes in Lindenhurst	H	M	M	$12,000
		LK416	Increase fish habitat with coarse woody material or fish structures	L	L	M	$500 - $3,000
		LK417	Update bathymetric map during next monitoring cycle	L	M	M	$2,500 - $6,000
		LK418	Mitigate shoreline erosion	M	L	M	$28,830 - $144,143
		LK419	Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline buffers	M	L	M	$1,500
		LK420	Restore beneficial native aquatic plants, including those already present and consider introducing native species to increase plant diversity.	M	M	M	N/A
		LK421	Do not treat native pondweeds	H	S	M	N/A
		LK422	Clear pathways if needed to allow for recreational/boating use	M	M	M	N/A
Werhane Lake	N/A	LK423	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK424	Participate in the VLMP	L	L	CBL	$200
		LK425	Create bathymetric map	L	L	CBL	$2,500 - $6,000
White Lake	N/A	LK426	Participate in the VLMP	L	L	HOA, PO	$200
		LK427	Develop Lake Management plan that includes an APMP	M	M	HOA, PO	$12,000

LAKE NAME	TMDL	PLAN ID	RECOMMENDED ACTIONS	PRIORITY	TIME FRAME	LEAD PARTNER(S)	COST
		LK428	Increase fish habitat including native aquatic plants, coarse woody material, and habitat structures	L	L	HOA, PO	$500 - $3,000
		LK429	Conduct fishery assessment	M	M	HOA, PO	$3,000 - $5,000
		LK430	Update bathymetric map during next monitoring cycle	L	M	HOA, PO	$2,500 - $6,000
		LK431	Evaluate effectiveness/sizing of aeration system	M	S	HOA, PO	N/A
Wilderness Park Lake - ADID 127	N/A	LK432	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
Willow Lake	N/A	LK433	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK434	Participate in the VLMP	M	L	SI	$200
		LK435	Create bathymetric map	M	S	SI	$2,500 - $6,000
Windward Lake	N/A	LK436	Update Lake Report and monitoring data (Most recent report is >10 years old)	L	L	LCHD	N/A
		LK437	Create bathymetric map	L	L	PO	$2,500 - $6,000

6.3.8 Small Watershed Assessment & Action Plan (SWAAP)

The Small Watershed Assessment and Action Plan (SWAAP) was completed concurrently with the Des Plaines River Watershed-Based Plan. A SWAAP provides additional information on existing watershed conditions and potential watershed protection and restoration projects, which will help: (1) address existing goals, objectives, and recommendations outlined in the watershed-based plan based on site-specific field verified solutions; (2) further engage municipalities, homeowners, and other watershed stakeholders in the implementation of many of the ideas and concepts presented in the watershed-based plan with succinct project directives; (3) provide watershed stakeholders with critical data and information required to secure further technical assistance and obtain funding to support the implementation of watershed protection and restoration programs and projects; and, (4) further advance local efforts to protect and restore local lakes, streams, and wetlands and address the goals of the Clean Water Act.

The SWAAP identifies the efforts to transition watershed-based programmatic and/or site-specific action plan recommended projects identified in the Bull Creek-Bull's Brook Watershed-Based Plan (2008) and the Buffalo Creek Watershed-Based Plan (2016) to implementation. The SWAAP presents implementable recommendations with conceptual project design, supported with project definition, probable cost and purported water quality improvement benefits for stakeholders to implement or secure future funding for project implementation. Experience confirms that if no coordinated effort is made among municipalities, residents, and other watershed stakeholders to conduct this additional work, few of the ideas and concepts presented in a watershed-based plan will be turned into reality and the potential of the watershed-based planning process to reduce the impacts of nonpoint source pollution will not be fully realized.

The two locations chosen to be assessed for this report are located within the DPR planning area. The locations assessed in detail within this SWAAP report include areas in and around Loch Lomond (AUID:IL_RGU) in Mundelein, IL and Buffalo Creek (AUID: IL_GST) in Long Grove, IL.

The Loch Lomond SWAAP component targets a study area of 469 acres, within a drainage area of 2.02 square miles for Bull Creek (AUID: IL_GV04). The SWAAP is within the Bull Creek-Des Plaines River HUC 12: 071200040302, and Loch Lomond lake is the largest waterbody in the study area (AUID: IL_RGU). The SWAAP area of Loch Lomond has previously been identified with site-specific project recommendations within the Bull Creek- Bull's Brook Watershed-Based Plan and has additional site-specific project recommendations identified within the Des Plaines River Watershed-Based Plan as part of SMC subwatershed management unit (SMU) BC019.

The Buffalo Creek SWAAP component targets a study area of 161 acres, within a drainage area of 9.70 square miles. There are 28.5 stream miles upstream of the Buffalo Creek SWAAP area, and it is located within the Wheeling Drainage Ditch HUC 12: 071200040502. Buffalo Creek is the main stream corridor in the study area (AUID: IL_GST). The SWAAP area of Buffalo Creek site has previously been identified with site-specific project recommendations within the Buffalo Creek Watershed-Based Plan will has additional site-specific project recommendations identified within the Des Plaines River Watershed-Based Plan as part of SMC SMU BF025.

The SWAAP planning process included a review of conditions within the selected study area, based on the contents of the associated watershed-based plan and other relevant information (e.g., GIS data), as well as detailed, on-the-ground assessment work in order to present a detailed characterization of the study area. The detailed assessment presents stakeholders valuable resources and information on their defined small watershed. The SWAAP assessment bolsters stakeholder awareness of water quality impacts and next steps to achieve improvement goals for progressing water quality improvements. Preliminary concept plans for stream and stream corridor restoration practices, lake and lake shoreline restoration practices, and upland protection and restoration practices are presented in following, with detailed guidance on the implementation of watershed protection and restoration projects and strategies that can help meet the watershed management goals established in the watershed-based plan.

Detailed information and proposed project locations can be referenced in **Appendix P: Small Watershed Assessment and Action Plan (SWAAP)**. Proposed project locations can be observed on the Des Plaines River Watershed-Based Plan Web Mapping Application: https://lakecountyil.maps.arcgis.com/apps/webappviewer/index.html?id=4bec638a6b8f471eb4e7c3dee717f042.

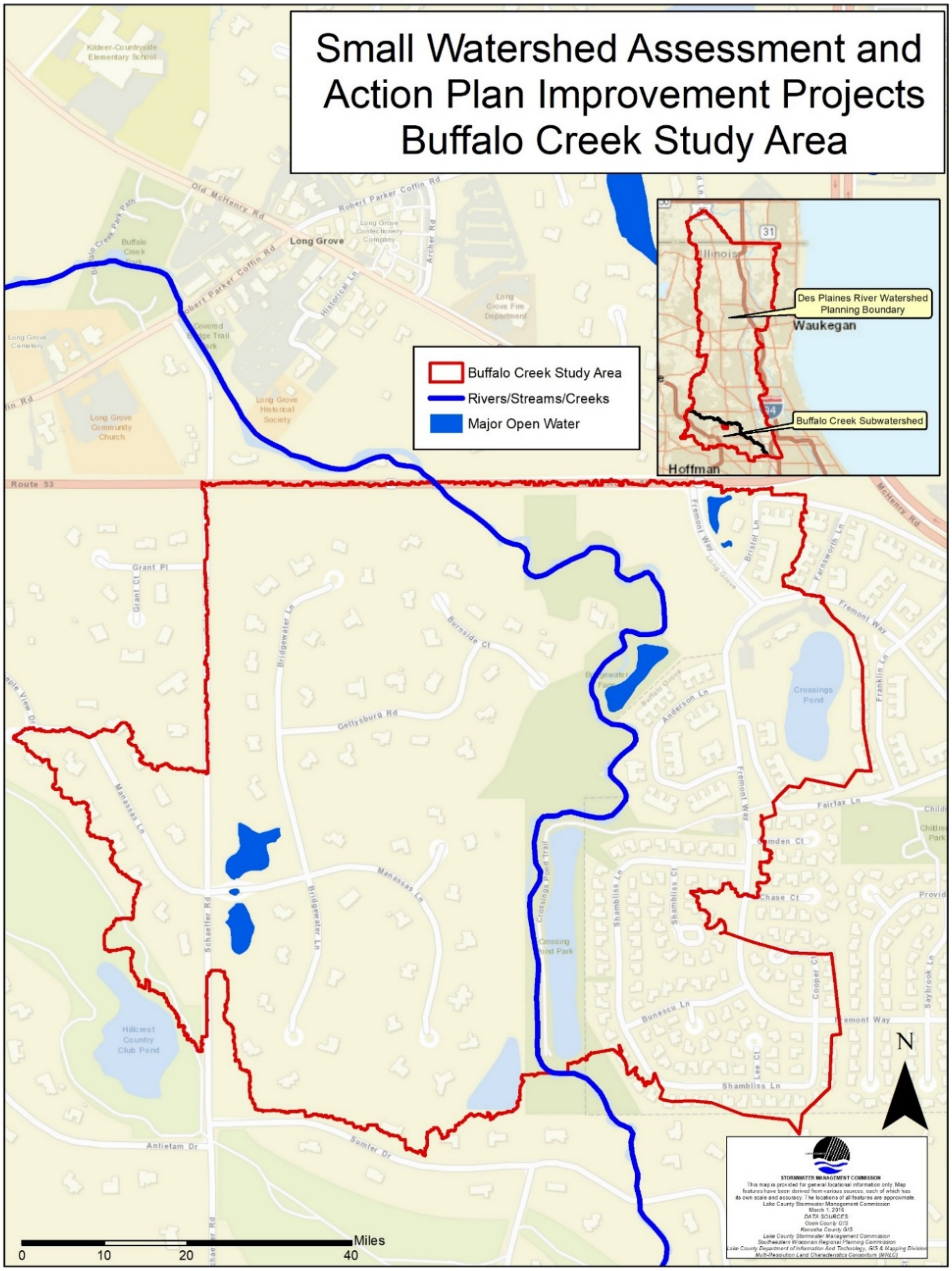

Figure 6-14: Buffalo Creek SWAAP Study Area Reference

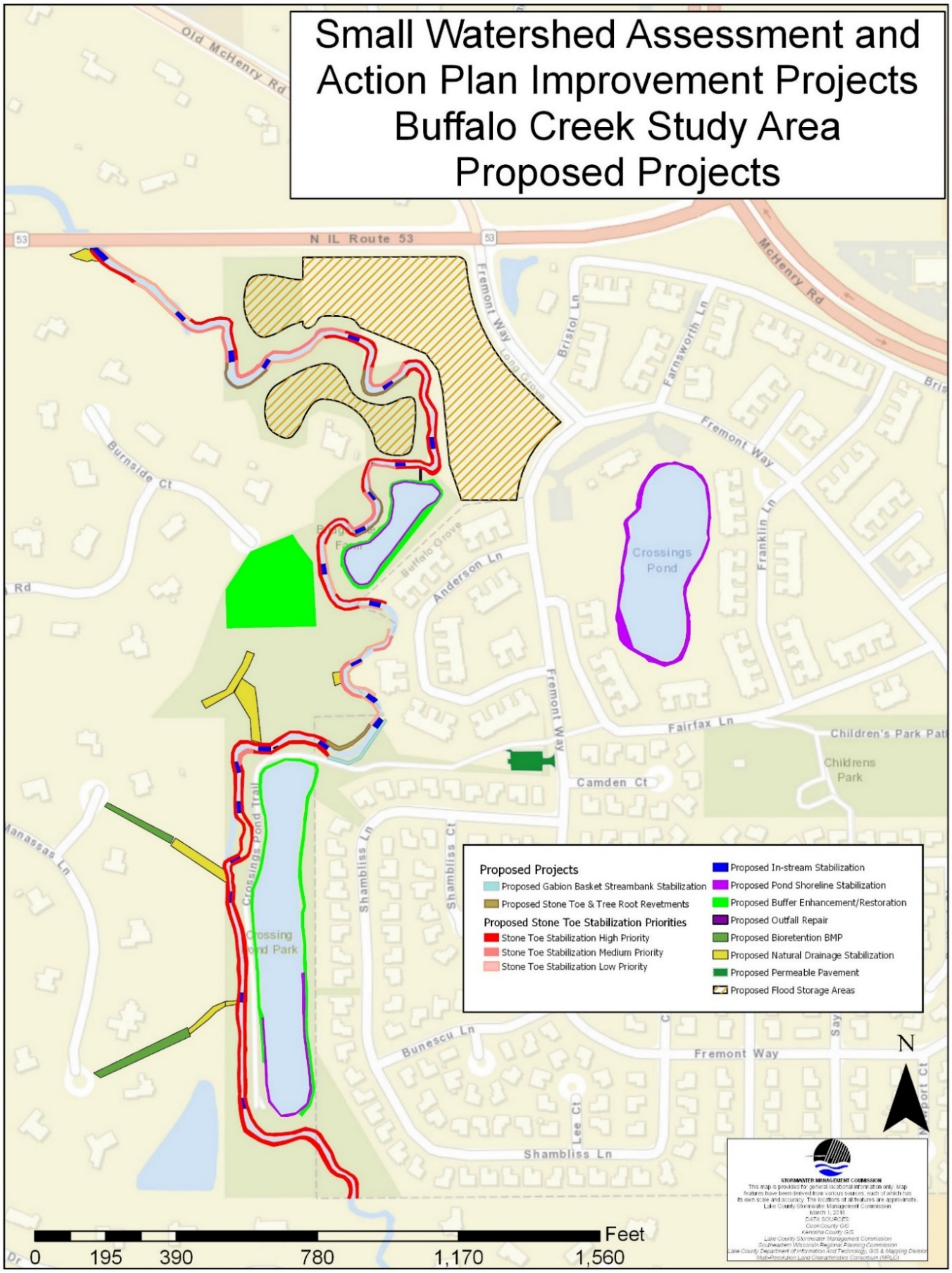

Figure 6-15: Buffalo Creek Study Area Proposed Projects

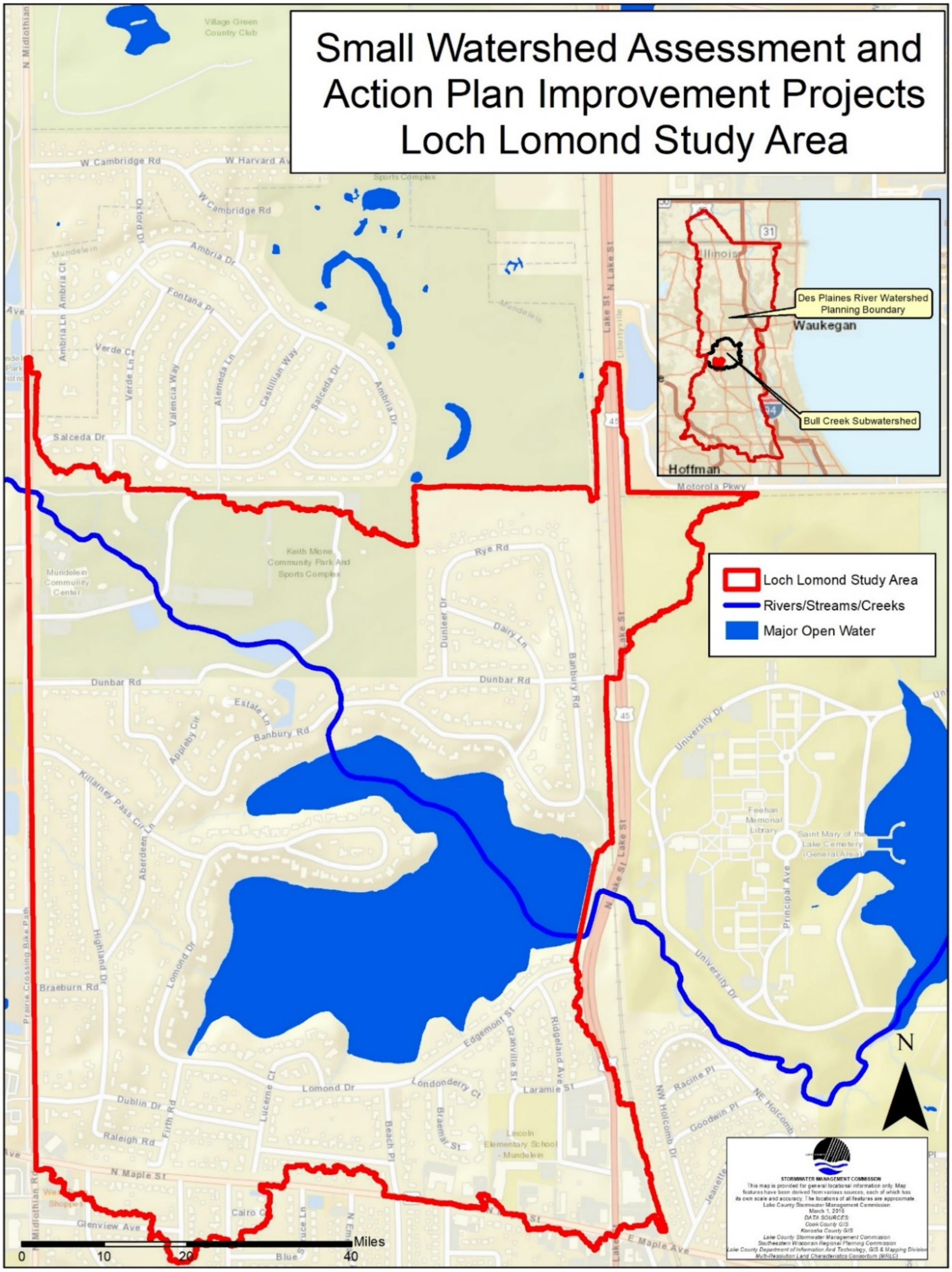

Figure 6-16: Loch Lomond SWAAP Study Area Reference

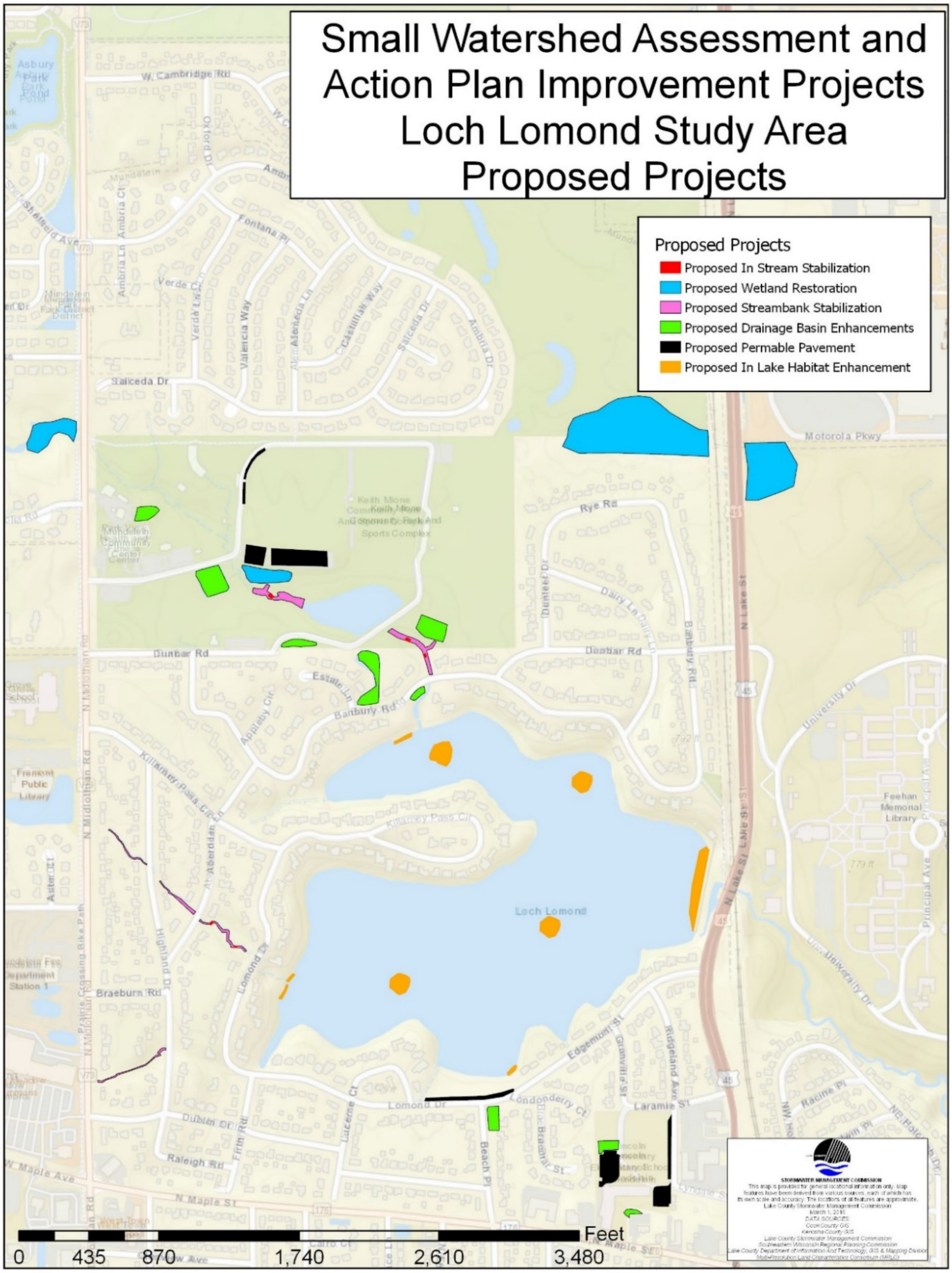

Figure 6-17: Loch Lomond Study Area Proposed Projects

6.4 REFERENCES

Center for Watershed Protection, (1998). Better Site Design: A Handbook for Changing Development Rules in Your Community.

Midwest Biodiversity Institute (MBI). 2017. Biological and Water Quality Assessment of the Upper Des Plaines River and Tributaries 2016. Lake County, Illinois. Technical Report MBI/2017-8-7. Columbus, OH. 99 pp.

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COMMON ACRONYMS/ABBREVIATIONS USED IN CHAPTER 7

ACEP – Agricultural Conservation Easement Program
BMP – Best Management Practices
CFU – Colony Forming Unit
CRP – Conservation Reserve Program
DD - Detention basin retrofit projects
DFPAI - Flood problem areas
DFS - Potential regionally significant flood storage sites
DL - Lake shore erosion control practices
DPD - Problem discharge locations
DPH - Problem hydrologic impediments
DPP - Previously planned actions
DPR planning area – Des Plaines River Watershed Planning Area
DRWW – Des Plaines River Watershed Workgroup
DSB - Stream buffers
DSG - General site-specific BMPs
DST = Stakeholder identified specific BMPs
DWS - Wetland restoration and creation sites
EQIP – Environmental Quality Incentives Program
FEMA – Federal Emergency Management Agency
FSA – Farm Service Agency
GCS – Grade Control Structure
IDNR – Illinois Department of Natural Resources
Illinois EPA – Illinois Environmental Protection Agency
INLRS – Illinois Nutrient Loss Reduction Strategy
LCFPD – Lake County Forest Preserve District
LCHD – Lake County Health Department
LMU – Lakes Management Unit
NGRREC – National Great Rivers Research and Education Center
NRCS – Natural Resources Conservation Service
QAPP – Quality Assurance Project Plan
RCPP – Regional Conservation Partnership Program
SBD - Streambank erosion practices
SMC – Lake County Stormwater Management Commission
SSD - Windshield survey identified site-specific BMPs
SWCD – Soil and Water Conservation District
SWG – State Wildlife Grant
TKN - Total Kjeldahl Nitrogen
TMDL – Total Maximum Daily Load
TOC – Total Organic Carbon
TSS – Total Suspended Solids

US EPA – United States Environmental Protection Agency

USDA – United States Department of Agriculture

USFWS – U.S. Fish and Wildlife Service

USGS – United States Geological Survey

VLMP – Illinois Volunteer Lake Monitoring Program

WASCOB – Water and Sediment Control Basin

WRAPP – Wetlands Restoration and Preservation Plan

WWTP – Wastewater Treatment Plant

7 PLAN IMPLEMENTATION AND EVALUATION

This chapter identifies a strategy and provides guidance to support transition from planning to implementation and to evaluate the effectiveness of implementation toward the goals and objectives of the plan. The primary components of this chapter include:

- Pollution load reduction estimates of action recommendations
- Estimated costs of plan implementation
- Leaders and supporters for plan implementation
- Initial steps for plan implementation
- Funding resources and opportunities
- Implementation schedule
- Evaluating plan performance
- Indicator and milestone grading system
- Water quality monitoring strategy
- Updating the watershed plan

How readily this plan is used and implemented by DPR planning area stakeholders is a major indicator of its success and is easily measured by tracking the actions taken. Improvement in watershed resources or water quality are other indicators of success achieved through monitoring. Successful plan implementation will require significant cooperation and coordination among lead and support partners to secure and allocate resources and apply them to actions in the DPR planning area. The watershed-based plan can be considered a living document and has the flexibility for stakeholders to make revisions over time that reflect shifts in local priorities or watershed conditions.

7.1 ESTIMATE OF POLLUTANT LOAD REDUCTIONS AND TARGETS

Pollution load estimates were made using the nonpoint source model described in Chapter 4. The purpose of estimating pollutant load reductions and targets in the DPR planning area is to present a general idea of BMP implementation benefits and to outline the practices that result in the greatest benefit to the watershed and achieve plan goals.

Load reduction estimates were **not** performed for all actions identified in Chapter 6; estimates were made for projects with specific on-the-ground locations, where project information was collected and reduction efficiencies are available in literature sources. Many actions presented in Chapter 6 are planning level actions, and do not have the detail of information at this time to support load reduction estimates; estimates are calculated for individual implementation projects during the design stage of the project as site information is generated. Table 7-1 includes the categories of projects for which load reduction estimates are made, and Table 7-2 outlines the average expected removal efficiencies that were applied; certain project categories have ranges in efficiencies due to variations in contributing watershed area.

Table 7-1: Project Categories Inclusive of Load Reduction Estimates

ID CODE	PROJECT SPECIFIC ACTION CATEGORY	INCLUDED IN LOAD REDUCTION ESTIMATES
SSD	Windshield survey site-specific best management practice projects	Yes[1]
DST	Stakeholder identified site-specific best management practice projects	Yes[1]
CC	Cover Crops	Yes[2]
RVR	Runoff Volume Reduction Practices	Yes
FAM	Feed Area Management	Yes
TIL	No-Till/Strip-Till	Yes
NU	Nutrient Management	Yes
PE	Pasture Enhancement[4]	Yes
ICE	De-icing Practices/Salt Management	Yes
WLR	Wetland Creation/Restoration practices	Yes
WLE	Wetland Enhancement practices	Yes
SBD	Streambank erosion practices	Yes
DSB	Stream buffers	Yes
DL	Lake shore erosion control practices	Yes
DD	Detention basin retrofit projects	No
DPD	Problem discharge locations	No
DPH	Problem hydrologic impediments	No
DFPAI	Flood problem areas	No
DFS	Potential regionally significant flood storage sites	No
DWS	Wetland restoration and creation sites	Yes
DPP	Previously planned actions	Yes[3]

[1]Load reductions are not calculated for stakeholder identified practices that lack sufficient information from which to calculate load reductions or may not result in directly measurable reductions. These practices can include: education, planning, invasive species removal, general flooding issues etc. [2] Load reductions only calculated for the footprint of high priority WRAPP sites. [3] Tabulated from previous watershed-based plans and includes all reported load reductions; some actions do not have associated reductions. [4] Pasture Enhancement includes practices such as fencing, grass planting, watering system, diversions, etc…

Table 7-2: Best Management Practice Average Expected Load Reduction Efficiencies

BEST MANAGEMENT PRACTICE	NITROGEN REDUCTION	PHOSPHORUS REDUCTION	CHLORIDE REDUCTION	SEDIMENT REDUCTION	BACTERIA REDUCTION
Site-Specific (SSD/DL/SBD/DST/DSB)					
Bioswale	10%	55%	45%	65%	45%
Wetland Restoration/Creation	10%-55%	5%-65%	5%-25%	10%-70%	15%-65%
Detention/Retention	25%-30%	40%-55%	15%-25%	60%-70%	45%-55%
Sediment Forebay	20%-40%	20%-60%	15%-25%	20%-50%	45%-55%
Grass Conversion	90%	80%	45%	90%	60%
Water and Sediment Control Basin	20%	60%	25%	70%	35%
Filter Strip/Riparian Buffer/Field Border	20%-30%	30%-40%	10%-20%	45%-60%	25%-45%
Grass Waterway	30%	25%	30%	45%	50%
Porous Pavement	35%-45%	45%-50%	50%-60%	70%-80%	35%-40%
Road Salt Management	0%	0%	25%	0%	0%
Grade Control Structure	10%	20%	20%	30%	25%
Streambank Stabilization	100%	100%	N/A	100%	N/A
Basin-Wide Site-Specific (CC/ICE/RVR/NU/WLR/PE/FAM/TIL)					
No-Till / Strip-till	10%	50%	0%	70%	20%
Cover crop (all crop)	30%	30%	0%	40%	35%
Feed Area Management	85%	83%	5%	79%	80%
Pasture Enhancement	30%	40%	20%	60%	45%
Runoff Volume Reduction	25%	40%	15%	60%	45%
De-icing Practices/Salt Management	0%	0%	25%	0%	0%
Nutrient Management Plan (All crop ground)	15%	7%	0%	0%	0%
Wetland Creation/Restoration (only wetland footprint)	90%	90%	90%	90%	90%

7.1.1 Reduction Estimates for Site Specific Actions

Load reduction estimates are provided for the majority of project/site-specific recommendations throughout the DPR planning area that are summarized in the action plan (Chapter 6) and detailed in Appendix N. Load reductions also include basin-wide site-specific BMPs, streambank, and lake shoreline stabilization BMPs. The suite of projects would benefit over 127,427 acres if fully implemented.

Table 7-3 summarizes load reductions from previously planned subwatersheds in the DPR planning area. Load reductions from previously planned subwatershed projects that have already been implemented may not be considered in Table 7-3. Efforts were made to avoid overlap with the location of previously planned BMPs and associated load reductions. Previous watershed-based plans for subwatersheds applied a wide variety of techniques for modeling and estimating load reductions, as well as different approaches to the identification of BMPs.

Figure 7-1: Proposed no-till and cover crops

Table 7-4 through Table 7-5 summarizes the annual load reduction estimates by project type for all new BMPs identified for the DPR planning area during the planning process. This inventory includes projects throughout the entire DPR planning area, including subwatersheds with previously approved watershed-based plans. Figure 7-1 through Figure 7-3 show selected site-specific BMPs identified in the watershed during the April 2017 DPR planning area windshield survey. Estimates also do not account for load reductions from programmatic, education and outreach, and policy and regulatory actions since direct impacts are not easily determined at this stage of the planning process.

Based on the review of reduction estimates, project/site-specific and basin-wide site-specific actions identified in the watershed-based plan are effective for addressing water quality problems and impairments in the watershed such as sediment, nitrogen, and phosphorus. Those actions are moderately effective in addressing bacteria and chloride, and programmatic and regulatory actions will be more effective at addressing these pollutants throughout the watershed. Due to the proportion of pollutant loading that originates from point sources, alignment and coordination with the WWTPs will also be critical for addressing chloride, nitrogen, and phosphorus loading.

Table 7-3: Annual Load Reductions from Previous Watershed Plans

SUBWATERSHED	NITROGEN	PHOSPHORUS	CHLORIDE	BOD	COD	SEDIMENT	BACTERIA	LEAD	ZINC
	LBS/YR	LBS/YR	LBS/YR	LBS/YR	LBS/YR	TONS/YR	CFU/YR (10^6)	LBS/YR	LBS/YR
Buffalo Creek	10,989	3,980	N/A	24,555	N/A	6,315	N/A	N/A	N/A
Indian Creek	18,037	N/A	N/A	86,578	549,206	3,949	N/A	1,606	1,770
Bull Creek-Bulls Brook	5,723	1,531	N/A	31,004	107,244	1,147	N/A	453	590
Mill Creek	N/A	7,930	141,383	N/A	N/A	5,717	6,783	N/A	N/A
North Mill Creek /Dutch Gap	101,175	89,357	319,186	N/A	N/A	N/A	22,998	N/A	N/A
GRAND TOTAL	**135,923**	**102,798**	**460,569**	**142,137**	**656,450**	**17,128**	**29,781**	**2,059**	**2,361**

Figure 7-2: Proposed wetland restoration/creation

Figure 7-3: Proposed field border and grade control

Table 7-4: Estimated Annual Basin-Wide BMP Load Reductions

BMP	QUANTITY (area / number / length)	NITROGEN REDUCTION (lbs/yr)	PHOSPHORUS REDUCTION (lbs/yr)	CHLORIDE REDUCTION (lbs/yr)	SEDIMENT REDUCTION (tons/yr)	BACTERIA REDUCTION (BILLION CFU/YR)
Basin-Wide Site-Specific BMPs - Total area benefited: 83,616 acres						
Cover Crops[1]	18,360 ac	72,612	2,959	0	5,958	6,782
Runoff Volume Reduction[2]	24,447 ac	52,771	4,894	2,339,500	1,749	32,321
Livestock Feed Area Basin/System[3]	68 ac / 81	1,996	151	33.6	11.4	971
No-Till / Strip-Till[1]	9,783 ac	15,667	3,203	0	8,320	2,277
Nutrient Management Plan	18,360 ac	36,306	6,905	0	0	0
Pasture Enhancement[4]	135 ac / 103	887	72	53.4	11	568
Road Salt Management	10,790 ac	0	0	4,104,866	0	0
Wetland Creation/Restoration	1,673 ac / 503	9,281	439	80,285	132	1,145
Basin-Wide BMP Total		**189,520**	**18,623**	**6,524,738**	**16,181**	**44,064**

[1] based on one year. [2] for undetained areas and could include any type or detention/retention practice. [3] these basins/systems address livestock capacity in comparison to the available pasture are observed. [4] Includes a combination of practices assumes some fencing, grass planting, a watering system, and a diversion. [5] Refers to a rock chute structure. [6] Loading and load reduction estimates for streambank and lake shoreline erosion are based on the Region 5 EPA's spreadsheet tool for "estimating pollutant load reductions for nonpoint source pollution control BMPs." All default values found in this spreadsheet tool are utilized for calculating estimates. [7] includes stream riffles for grade control and instream habitat enhancement; number calculated at 7 times bankfull width.

Table 7-5: Estimated Annual Site-Specific BMP Load Reductions – New BMPs

BMP	QUANTITY (AREA / NUMBER / LENGTH)	NITROGEN REDUCTION (LBS/YR)	PHOSPHORUS REDUCTION (LBS/YR)	CHLORIDE REDUCTION (LBS/YR)	SEDIMENT REDUCTION (TONS/YR)	BACTERIA REDUCTION (BILLION CFU/YR)
Site-Specific BMPs - Total area benefited: 38,389 acres / 295,892 ft						
Bioswale	0.23 ac / 170 ft / 1	6	1.4	1,808	0.68	3
Detention Basin, Urban	4 /1.5 ac	338	27	20,738	11	157
Field Border	43 / 61 ac / 75,032 ft	3,582	200	1,389	410	391
Filter Strip	10 /16 ac / 16,041 ft	789	46	522	64	119
Grade Control[5]	2	65	16	217	21	7.8
Grass Conversion	4 / 34 ac	431	16	112	29	11
Sediment Forebay	3 / 900 ft	8,422	430	274,241	221	3,448
Lake Shoreline Stabilization[6]	11,157 ft	171	86	0	86	0
Porous Pavement	1 / 1.2 ac	5	0.24	747	0.13	0.62
Pond[7]	4	930	127	12,244	214	228
Rain Barrel/Garden	510 barrels / 250 gardens	282	18	15,152	5	131
Stream Buffer	75 ac / 78,336 ft	1,400	77	13,324	44	440
Streambank Stabilization[6,7]	75,086 ft / 330 riffles	3,279	1,639	0	1,639	0
WASCOB	31	318	107	958	122	19
Waterway	31 / 50 ac/ 40,070 ft	5,963	960	12,466	1,246	642
Wetland Creation/Restoration	132 / 1,288 ac	62,363	2,406	918,951	2,336	17,386
Site-Specific BMP Total Reductions		**88,345**	**6,157**	**1,272,869**	**6,449**	**22,983**
Stakeholder BMPs - Total area benefited: 1,536 acres/ 33,026 ft						
Filter Strip/Riparian Buffer	28 ac / 21,056 ft	641	41	7,078	71	185
Stormwater Management BMP	1	1,644	86	57,864	40	947
Lake Shoreline Stabilization[6]	4,351 ft	3.7	1.9	0	1.9	0
Streambank Stabilization[6]	7,619 ft	402	201	0	201	0
Stakeholder BMP Total Reductions		**2,691**	**330**	**64,942**	**314**	**1,132**
TOTAL REDUCTION ESTIMATES		**91,036**	**6,487**	**1,337,811**	**6,763**	**24,115**

[1] based on one year. [2] for undetained areas and could include any type or detention/retention practice. [3] these basins/systems address livestock capacity in comparison to the available pasture are observed. [4] Includes a combination of practices assumes some fencing, grass planting, a watering system, and a diversion. [5] Refers to a rock chute structure. [6] Loading and load reduction estimates for

streambank and lake shoreline erosion are based on the Region 5 EPA's spreadsheet tool for "estimating pollutant load reductions for nonpoint source pollution control BMPs." All default values found in this spreadsheet tool are utilized for calculating estimates. [7] includes stream riffles for grade control and instream habitat enhancement; number calculated at 7 times bankfull width.

7.1.1.1 Load Reductions by Subwatershed

Load reduction estimates for nonpoint source pollutants are totaled by subwatershed as shown in Table 7-6 with bold indicating the top three highest total reductions per pollutant. Estimates indicate that the highest total nitrogen reductions can be achieved in the North Mill/Dutch Gap, Indian Creek, and Upper Des Plaines subwatersheds. The greatest phosphorus and sediment reductions can be realized in the North Mill/Dutch Gap, Mill Creek, and Upper Des Plaines subwatersheds. Efforts to address chloride and bacteria in the Buffalo Creek, Indian Creek, and Upper Des Plaines subwatersheds are likely to result in the greatest cumulative reductions.

Table 7-6: Estimated Load Reductions by Subwatershed

SUBWATERSHED	ACRES BENEFITED	NITROGEN REDUCTION (LBS/YR)	PHOSPHORUS REDUCTION (LBS/YR)	CHLORIDE LOAD REDUCTION (LBS/YR)	SEDIMENT REDUCTION (TONS/YR)	BACTERIA REDUCTION (CFU/YR 10^6)
Aptakisic Creek	3,315	6,187	287	393,278	141	1,720
Buffalo Creek	12,135	22,465	1,698	1,635,368	812	11,097
Bull Creek	13,787	24,532	1,717	456,935	1,925	7,214
Bull's Brook	738	1,672	155	2,188	176	221
Dutch Gap Canal/North Mill Creek	28,063	84,077	7,930	586,431	8,897	9,599
Indian Creek	21,370	37,284	2,490	1,643,950	1,743	14,426
Lower Des Plaines River	5,932	10,042	1,377	661,286	968	4,365
Mill Creek	16,108	34,469	3,309	1,050,887	2,909	6,250
Newport Drainage Ditch	4,753	13,344	1,466	142,850	1,418	2,195
Upper Des Plaines River	20,243	45,101	4,603	1,278,976	3,997	10,656

7.1.1.2 Load Reduction Targets

Water quality targets were established based on review of the Des Plaines River/Higgins Creek TMDL report, coordination between DPR planning area stakeholders. After a review process, it was decided that the two watershed TMDLs from within the DPR planning area (Buffalo Creek and Higgins Creek) would be used as guidance for chloride, phosphorus, and fecal coliform. The Illinois Nutrient Loss Reduction Strategy (INLRS) would be adopted for sediment, nitrogen, and phosphorus. Pollutant load reduction targets for nitrogen, phosphorus, sediment, chlorides and bacteria are shown in Table 7-7.

Table 7-7: Nonpoint and Point Source Load Reduction Targets

POLLUTANT	REDUCTION TARGET (%)	NOTES
Nitrogen	45%	Based on the INLRS
Phosphorus (lbs/yr)	50%, except for lakes with a phosphorus TMDL, where the TMDL targets apply.	Based on TMDL estimates and the INLRS. See Section 3.16.2 for TMDL load reduction targets for specific lakes.
Sediment (tons/yr)	45%	Based on INLRS target for phosphorus, and given the low sediment load in the watershed is considered an attainable target
Chloride (lbs/yr)	50%, except for Buffalo Creek, where the TMDL target applies	Target represents a range for streams modeled in the Buffalo Creek and Higgins Creek TMDL and is consistent with TMDL recommendations. See Section 3.16.2 for TMDL load reduction targets for Buffalo Creek.
Bacteria (billion CFU)	65% planning area-wide; except for Sylvan Lake and Buffalo Creek, where TMDL targets apply.	The fecal coliform target is based on the Buffalo Creek TMDL and represents an average of the modeled reductions over a range of flows; a reduction target of 65% was selected which accounts for seasonal variability. See Section3.16.2 for TMDL load reduction targets for Sylvan lake and Buffalo Creek.

Comparing the nonpoint and point source load reduction estimates to the total modelled pollutant loads suggests that moderate reductions may result from BMP implementation. Table 7-8 shows the breakdown of estimated nonpoint and point source pollutant loads in comparison to the total pollutant loads. Figure 7-4 is a series of charts showing the difference in nonpoint and point source contributions to the total estimated pollutant loads. Table 7-9 shows the estimated percent reductions in nonpoint source pollutant loads that can be achieved through BMP implementation. The key points to consider are:

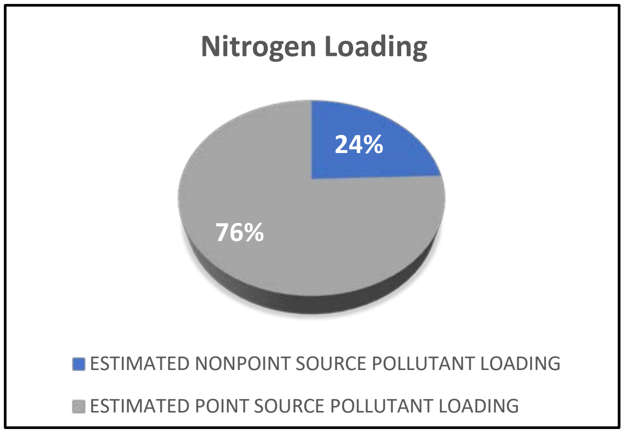
1. Project/site-specific and basin-wide site-specific actions are most effective at addressing sediment. Focusing on wide-spread adoption of cover crops and agricultural BMPs, such as field borders and grassed waterways, as well as streambank stabilization, will help address sediment loading and exceed the target reduction.
2. Project/site-specific and basin-wide site-specific actions are nominally effective in addressing nitrogen, phosphorus, and chloride. These practices do not address point sources, which are estimated to contribute 76% of the total nitrogen, 74% of the total phosphorus, and 41% of the chloride loads in the DPR planning area. Load reduction targets can only be achieved by reducing contributions from point sources. It is important to note that through new, lower permit limits, point sources within the DPR planning area are moving towards substantial reductions in phosphorus in the coming years.
3. Programmatic and regulatory actions may better address chloride by greatly reducing application rates. BMPs typically have poor chloride removal efficiencies because chloride is dissolved in the water. Furthermore, the cost of implementing BMPs to address chloride throughout dense urban areas (primary source) is high.
4. Watershed-wide detention practices, wetland restoration, streambank stabilization, and agricultural BMPs, especially wide-spread adoption of no-till/strip-till, cover crops, and nutrient management, can reduce a relatively large percentage of the nonpoint source component of phosphorus and nitrogen loading.

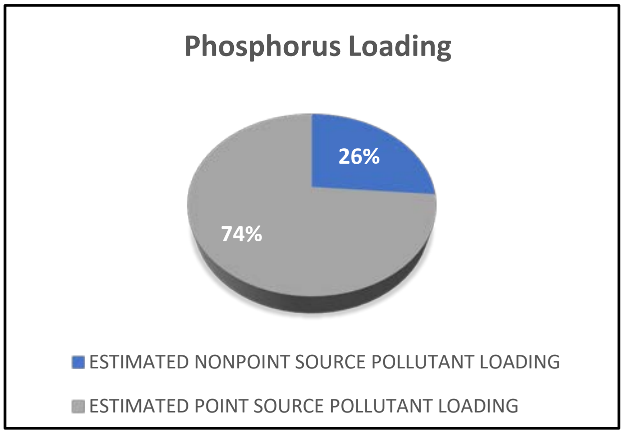
5. Project/site-specific and basin-wide site-specific actions are moderately effective in addressing nonpoint source bacteria and must be focused at addressing the major urban area sources. Watershed-wide adoption of urban detention practices are necessary to achieve more noticeable reductions in bacteria. Point source data for bacteria was not available; it is believed that notable reductions could be achieved by addressing these sources.

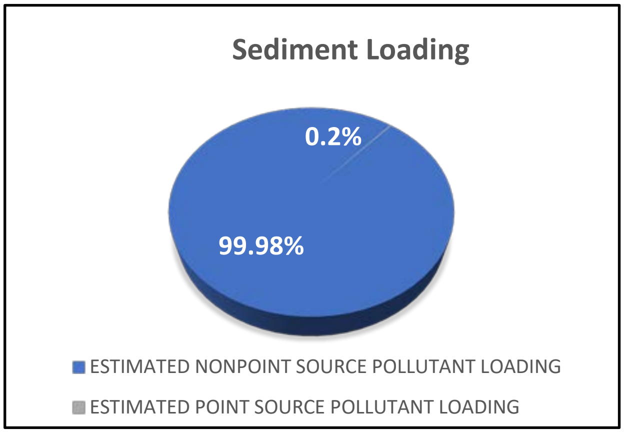
Table 7-8: DPR Planning Area Estimated Pollutant Loading (Nonpoint & Point Sources)

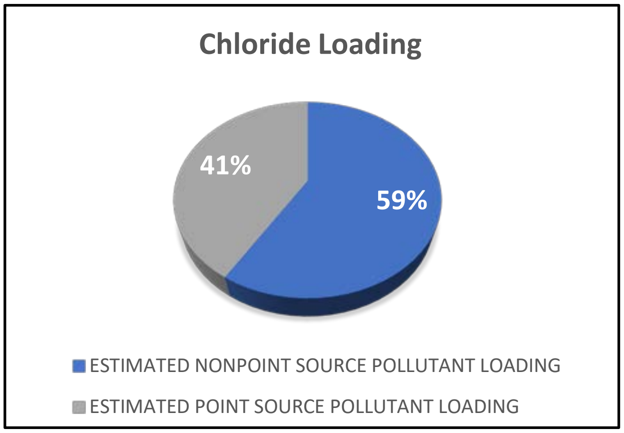
POLLUTANT	ESTIMATED NONPOINT SOURCE POLLUTANT LOADING[1]	ESTIMATED POINT SOURCE POLLUTANT LOADING	TOTAL POLLUTANT LOADING
Nitrogen (lbs/yr)	1,010,091	3,123,802	**4,133,893**
Phosphorus (lbs/yr)	60,323	169,000	**229,323**
Sediment (tons/yr)	37,460	67.29	**37,527**
Chloride (lbs/yr)	51,873,595	36,383,729	**88,257,324**
Bacteria (billion CFU)	258,786	NA	**258,786**

[1] – Nonpoint source loading totals includes stream and lake bank erosion, gully erosion and failing septic systems









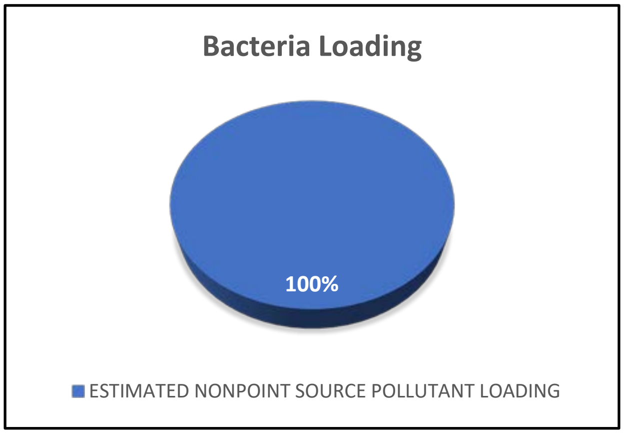


Figure 7-4: Nonpoint and Point Source Pollutant Contributions

Table 7-9: Estimated Nonpoint Source (NPS) Pollutant Load Reductions from BMPs

POLLUTANT	TOTAL ESTIMATED NPS POLLUTANT LOADING	ESTIMATED SITE-SPECIFIC BMP ANNUAL NPS POLLUTANT LOAD REDUCTIONS (%)	ESTIMATED BASIN-WIDE BMP ANNUAL NPS POLLUTANT LOAD REDUCTIONS (%)	ESTIMATED ANNUAL NPS LOAD REDUCTIONS (%)
Nitrogen (lbs/yr)	1,010,091	91,036 (9%)	189,520 (19%)	280,556 (28%)
Phosphorus (lbs/yr)	60,323	6,487 (11%)	18,623 (31%)	25,110 (42%)
Sediment (tons/yr)	37,460	6,763 (18%)	16,181 (43%)	22,944 (61%)
Chloride (lbs/yr)	51,873,595	1,337,811 (3%)	6,524,738 (13%)	7,862,549 (15%)
Bacteria (billion CFU)	258,786	24,115 (9%)	44,064 (17%)	68,179 (26%)

7.2 COST ESTIMATES

Actions recommended in this plan will be implemented by numerous lead and supporting partners (as indicated in Chapter 6 and Appendix N), and therefore the estimated costs of plan implementation are spread across various watershed stakeholders. Furthermore, the menu of projects identified is inclusive, so that the plan identifies as many potential projects as possible. The summary of cost estimates that follows is intended to provide a general idea of the scope of all projects considered in the plan but is not to be construed as a single "project cost" to be borne by a lone watershed entity. Table 7-10 summarizes the estimated funding required for the site-specific actions identified in the action plan (Chapter 6). The identified site-specific actions represent the main projects that are recommended for implementation. Table 7-11 summarizes the estimated funding required for the basin-wide site-specific actions identified in the action plan. The identified basin-wide site-specific actions represent all the projects that are needed to meet the full potential of non-point source pollution reduction in the planning area. The cost estimates are for direct implementation projects and not the administrative, project management, and watershed coordinator costs. For all BMPs, an additional 20% should be considered to account for engineering/permitting and annual maintenance.

Cost estimates are generated from a combination of technical experience, previous subwatershed plans, and the USDA's average practice cost list. Cost estimates are generalized for watershed-scale planning purposes and these estimates should not be used to calculate costs for individual projects, as costs may range significantly depending on site conditions. Appendix K includes criteria and assumptions used to develop the cost estimates listed In Table 7-9. Potential funding sources are included in Appendix L.

Table 7-10: Cost Estimates for Site-Specific Action Recommendations

TYPE	# OF PROJECTS/ACTIONS	ACRES BENEFITED / ACRES PRACTICE	UNIT COST	ESTIMATED TOTAL COST
Filter Strips/ Riparian Buffers / Field Border /Grass Conversion	255	2,276/217	$4,000/ac	$868,664
WASCOB	8 / 31 basins	70	$4,000/basin	$124,000
Grassed Waterways	31	1,098/50	$8,000/ac	$400,000
Bioswale	1	6.8/0.23	$15/sq-ft	$150,282
Streambank Stabilization	82,705 ft / 330 riffles	N/A	$300/ft / $35,000/riffle	$32,834,536 - $41,084,536
Lake Shore Stabilization	15,312 ft	N/A	$100/ft	$1,550,833
Sediment Forebay	3 / 900 ft	3,876	$1,560/ft	$1,404,000
Grade Control Structure	2	44	$8,000/structure	$16,000
Hydrologic/Hydraulic Impediments	1,547	N/A	$10,000 - $80,000/site	$15,470,000 - $123,760,000
Problem Discharge Locations	204	N/A	$5,000 - $30,000/site	$1,020,000 - $6,120,000
Detention Basin Retrofits	658	N/A	$5,000 - $50,000/site	$3,030,000 - $30,300,000
Wetland Creation/Restoration	131	49,734/1,300	$80,000/ac	$103,998,098
Stormwater BMPs	10	450/2	Variable	$2,393,064
Lake Actions	*447*	*N/A*	*Variable*	*$7,463,767 - $15,241,470*
TOTAL				**$170,723,244 - $327,410,947**

Note: Lake Actions are a mixture of both site-specific and basin-wide site-specific action plan recommendations. For more information on lake action recommendations see Chapter 6, Section 6.3.7.

Table 7-11: Summary of Cost of Recommended Basin-Wide Site-Specific Actions by Priority

Type	Estimated Cost			
	High Priority	Medium Priority	Low Priority	Total
Cover Crops (CC)	$440,042	$660,453	$41	$1,100,536
Runoff Volume Reduction (RVR)	$156,781,260	$200,628,932	$0	$357,410,192
Nutrient Management (NU)	$0	$366,822	$0	$366,822
No-Till /Strip-Till (TIL)	$342,011	$75	$33	$342,118
Pasture Enhancement (PE)	$0	$4,079,775	$42,239	$4,122,014
Feed Area Management (FAM)	$4,068,535	$0	$0	$4,068,535
Wetland Creation/Restoration (WLR)	$128,613,837	$0	$0	$128,613,837
Wetland Enhancement (WLE)	$36,499,279	$0	$0	$36,499,279
Total	**$326,744,964**	**$205,736,057**	**$42,313**	**$532,523,333**

Where readily available, costs were tabulated from previously completed watershed-based plans and are presented in Table 7-12. Although there is some overlap with action items, it is reasonable to assume that those estimates from other watershed-based plans are in addition to those presented above. Using estimates from the current and past watershed-based plans, the total cost among all stakeholders to implement all site-specific action recommendations would be approximately $265-$422 million. When basin-wide site-specific BMPs are included, the cost estimate for all possible nonpoint source reduction projects totals nearly $954 million. It is important to consider that there are many complimentary benefits in addition to water quality improvements that are not necessarily quantified in this estimate. When evaluating implementation strategies, it is important to consider the benefits such as green infrastructure enhancement, improved habitat, increased recreational value, and reduced flooding issues.

Table 7-12: Cost Estimates from Previous Plans (if available)

SUBWATERSHED PLAN	TOTAL COST ESTIMATE
Buffalo Creek	$15,269,165
Mill Creek	$49,226,882
North Mill Creek/Dutch Gap Canal	$29,646,365
GRAND TOTAL	**$94,142,412**

7.3 NEXT STEPS FOR PLAN IMPLEMENTATION

Often, the greatest challenge of any watershed management process is its coordinated implementation. Successful implementation requires widespread coordination, effective partnerships and support, local leadership, financial and technical resources, time, and a genuine willingness to translate planning to action on-the-ground. The DPR planning area includes many implementation partners and supporters that will have to coordinate efforts to implement the recommendations in the action plan. No single partner has the financial or technical resources to accomplish the plan goals and objectives; partners working together are necessary to achieve meaningful results. Responsible entities are defined as jurisdictions; these entities have primary responsibility over actions or practices within their boundaries. Jurisdictions include municipalities, townships, counties, forest preserve districts, and the State of Illinois. Supporting partners are described in Section 6.1 Implementation Partners. Responsible entities or lead jurisdictions as well as supporting partners are further detailed in the individual action item tables located in Appendix N.

Combining and coordinating resources, funding, effort, and leadership will be the most efficient and effective means of maintaining watershed health. Implementation of this plan will also require the development of partnerships with local, state, and federal organizations for implementation, technical assistance, and funding. These efforts require the investment of a significant amount of time and resources.

Table 7-13 below shows five immediate, year-one priorities. The following subsections describe the key components of successful and sustainable plan implementation.

Table 7-13: Year One Plan Implementation Priorities

RECOMMENDED ACTION/PRIORITY
1. Working with DRWW, the Bull Creek-Bull's Brook Watershed Council, Buffalo Creek Clean Water Partnership, and other active subwatershed groups, determine specific year-1 implementation actions; coordinate with DRWW on short term monitoring priorities.
2. Research funding and technical assistance to implement recommendations identified in the action plan.
3. Submit grant applications, if applicable, and secure additional funding sources for plan implementation.
4. Coordinate available programs, policy changes, and other local initiatives and programs where private landowners are responsible for participation or implementation.
5. Promote and adopt the plan; prioritize and incorporate plan recommendations into existing programs, activities, and budgets.

7.3.1 Plan Adoption

Support of the goals, objectives and recommendations of the Des Plaines River Watershed-Based plan should be formalized through its adoption by primary implementation entities (jurisdictions) and lead and support partners. Jurisdictions should adopt the watershed-based plan so that there is a basis for the incorporation of plan recommendations into the operations and procedures of the organization and its pursuit of project funding and implementation relevant to the DPR planning area. Chapter 6 outlines the DPR planning area jurisdictions and lead and support partners responsible for implementing the action recommendations of the watershed-based plan.

7.3.2 Support and Maintain Exiting Watershed Planning Committee(s)

One important step for plan implementation will be continued support for existing watershed organizations to lead, organize, and coordinate plan actions. A planning group was established for the DPR planning area as a whole and is made up of representatives from other subwatersheds where locally active groups are implementing previous plan recommendations (watershed planning committee). Responsibilities of the committee(s) include administration, coordination of stakeholders to support individual watershed projects, and working with regulatory partners on recommended policies and programs.

Throughout the watershed planning process, the existing watershed planning committee has provided valuable input regarding issues, resources, priorities, and actions. The committee can continue to hold regular meetings, take a lead in facilitating plan recommendations, organize watershed field trips, host educational workshops and forums, and bring watershed stakeholders and multiple units of government together to discuss issues and opportunities. The supporting partners can consider whether staff positions are needed or merging with the existing collaborative organizations and/or subwatershed committees would be beneficial in the future. The watershed planning committee is encouraged to generate stakeholder interest and involvement with implementation. As projects are initiated, the positive environmental, aesthetic, and community benefits will lead to additional participation.

7.3.3 Stakeholder Participation and Engagement

There are tangible benefits to stakeholder participation in watershed activities, from positive media attention to improved quality of life for residents. Increased involvement also can yield and leverage significant local, state, and federal funding opportunities to help share the cost of project implementation. Some actions can be added to existing capital improvement and maintenance plans, budgets, and schedules. This is a fairly quick and easy approach to implementing recommendations within the purview of specific jurisdictions. In other cases, an action recommendation will require the involvement of multiple stakeholders, such as residents, a municipality, and a county, state, or federal agency to provide financial and technical support. Some actions require cross-jurisdictional coordination for issues; for example, establishing a green infrastructure corridor along a stream channel, or natural area preservation and restoration often require interjurisdictional cooperation and may require a longer time frame for implementation. Other actions will require the cooperation of individual or groups of landowners, whether they are residents, homeowners’ associations, businesses, or institutions.

7.3.4 Identify Implementation Champions

Implementation actions require a leader or a single champion for the project, to organize resources and keep the project(s) moving forward. This champion may be the watershed organization, or a single entity such as a landowner, a subwatershed group, or a municipality. In some cases, actions recommend the adoption of new policies, plans, or standards that modify the form, intensity, or type of development or redevelopment in the watershed in a way that better protects resources. These actions will require some effort on the part of municipalities to understand how plans and policies can be modified and to discuss and adopt new, or modify existing, policies, plans, and standards.

7.3.5 Resources and Funding

Funding implementation and watershed coordination actions is a priority. Securing sources of funding engages contract-level accountability and performance requirements that stakeholders are often more responsive to. There are numerous sources of funds available to help support projects or provide cost-share to match other sources of funds. A list of numerous local, regional, state, and federal funding sources is identified in Appendix L. Most of the programs require a local match of funds or in-kind services. Although these funding sources can provide a good source of revenue, significant local investment of time and money will be required to move this plan forward. These soft costs must be evaluated and incorporated into the operating strategies of the individual partners.

Many federal, state, local, and private programs are available. There are numerous sources of funding available to support projects or provide cost-share to match other sources of funds. Appendix L outlines the most common and available potential sources of funding for the technical assistance and actions identified in the plan; most BMPs recommended **are** eligible for some form of funding. Information regarding potential funding sources is readily available online and applicants should research available programs ahead of time to understand the funding cycles, conditions, and terms. Most grant programs require financial or labor match, thus applications that leverage multiple sources also have the highest probability of being successful.

7.3.6 Implementation Partners

Parties who are key potential partners whose support will lead to the realization of identified goals for the DPR planning area are listed in Chapter 6 and in the detailed action plan tables in Appendix N as implementation partners. These organizations are listed as such because they are expected to fulfill one or more of the following functions:

- Oversee or implement watershed protection, restoration, and remediation strategies
- Acquire funding for watershed plan implementation
- Organize or participate in data collection
- Provide regulatory or technical guidance and issue permits
- Monitor the success of the watershed plan
- Acquire land for green infrastructure restoration or protection purposes
- Develop education strategies

Because implementation of the watershed-based plan will largely rest with local units of government, it is critical that they be involved from the beginning. They usually have the most to gain by participating and the most up-to-date information on the structure, needs, and available resources of the community. In addition, some of the most powerful tools for implementation, such as planning, controlling development standards, and zoning reside at the local, jurisdictional level.

7.4 EVALUATING PLAN PERFORMANCE

An important component of any watershed planning initiative is the ability to monitor performance towards goals and objectives. This section focuses on the administrative-based monitoring that tracks the activities of stakeholders and the range of actions that are implemented. Section 7.5 discusses direct monitoring of quantitative criteria such as water quality and aquatic health that indicate the effectiveness of implementation actions.

7.4.1 Evaluating Plan Implementation Performance

It is necessary to monitor the progress towards achieving the seven goals of this watershed-based plan outlined in Chapter 2. Tracking progress relevant to these is as simple as an organized system in each jurisdiction to keep track of what is happening in their portion of the watershed. Communicating and reporting progress towards goals is equally as important as tracking them in the first place.

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

- In the early stages of the plan implementation process, stakeholders should establish a sustainable and active watershed committee that will meet at least quarterly to discuss activities and progress towards goals. A list of completed actions, proposed, and in-progress actions should be tracked for each jurisdiction.
- The plan should be evaluated every five years to assess the progress made as well as to revise the plan, if appropriate, based on the progress achieved. The plan should also have a comprehensive review and update after 10-years (section 7.7). Amendments and changes may be made more frequently as laws change or new information becomes available that will assist in providing a better outlook for the watershed. As goals are accomplished and additional information is gathered, efforts may need to be shifted to issues of higher priority.
- The watershed planning committee should request each major jurisdiction and project partner in the watershed to provide an annual update, which could be in the form of a scorecard that tracks progress towards goal objectives via measurable milestones. The scorecard system is presented in section 7.4.2 and Appendix M. It is an easy and effective way to compile and track progress in a measurable way and evaluate the effectiveness of achieving short, medium, and long-term goals. Scorecards are an effective way to identify what needs attention and what stakeholders should focus on in the next year.
- Other opportunities for evaluating the status of plan implementation include the completion of quarterly project reports or group meeting minutes. Since this plan is a flexible tool, changes/modifications are anticipated based on usability and changes in priority throughout implementation.

7.4.2 Measureable Milestones and Scorecard System

Interim measurable milestones are directly tied to the DPR planning area performance indicators. Milestones are essential when determining if management measures are being implemented and how effective they are at achieving plan goals and objectives over given time periods. This 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. Indicators that reflect these characteristics may be used as a measure of watershed health. Goals and objectives in the plan determine which indicators should be monitored to assess success. Physical indicators could include amount of sediment entering a steam reach or presence or lack of adequate stream buffers, whereas chemical and biological indicators could include nitrogen loads or macroinvertebrate health. Social indicators can be measured using demographic data or, for example, the number of landowners adopting conservation practices.

DPR planning area scorecards were developed for each of the watershed-based plan goals and are located in Appendix M. Table 7-14 provides an example indicator and associated milestones for each goal as taken from the complete scorecards in Appendix M.

Table 7-14: Example Indicators and Milestones for Each Goal

GOAL	EXAMPLE INDICATOR	SHORT TERM MILESTONE (1-5 YRS)	MEDIUM TERM MILESTONE (6-10 YRS)	LONG TERM MILESTONE (10+ YRS)
1. Water Quality Improvements	Number of waterbodies removed from the Illinois EPA's impaired list.	2 lakes / 1 stream segment	6 Lakes / 3 stream segments	30 Lakes / 6 steam segments
2. Regional Green Infrastructure & Natural Resources	Area of degraded natural communities restored.	1,000 acres	5,000 acres	10,000 acres
3. Flood Damage Reduction	Percentage of structures with flood insurance in the 100-year floodplain.	25%	50%	100%
4. Funding, Installing, and Maintaining Stormwater Infrastructure	Number of cost-sharing programs.	10	20	50
5. Community and Agency Coordination	Number of municipalities, counties, and natural resource agencies that adopt the Des Plaines River Watershed-Based Plan.	25 Agencies	All Agencies	All Agencies
6. Sustainable Agricultural Systems	Number and area of agricultural BMPs installed.	25 BMPs treating greater than 2,500 acres	50 BMPs treating greater than 2,500 acres	100 BMPs treating greater than 5,000 acres
7. Education and Outreach	Number of people reached by outreach campaign.	Establish outreach campaign	5,000	10,000

This scorecard system should serve as an organizational monitoring plan and a tool for tracking progress toward meeting plan goals and specific recommendations and action items. Realistic short, medium, and long-term milestones are included for each indicator in the scorecards (Table 7-14). Each milestone is a specific action recommendation and is intended to fulfill plan objectives if executed. Indicators are to be used as measurement tools when determining if each milestone has or has not been met. If the measurement of each indicator becomes problematic, the watershed planning committee should revisit and make adjustments where needed. It is up to local stakeholders to determine the priority of each milestone based on their ability to follow through with them. Scorecard evaluation on an annual basis is an effective way to identify priorities and what stakeholders should focus on in the next planning year.

Milestones in the scorecards can be graded based on the following criteria: A = Met or exceeded milestone(s); B = Milestone(s) 75% achieved; C = Milestone(s) 50% achieved; D = Milestone(s) 25% achieved; F = Milestone(s) not achieved

7.4.3 Plan Implementation Schedule

Implementing actions should occur immediately where specific projects and willing stakeholders have been identified. A general implementation schedule is presented in Table 7-15. More detailed timeframes are included in Appendix N for each site-specific action.

Table 7-15: General Implementation Schedule

TASK	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
Promote and adopt the plan	X									
Determine specific year-1-5 implementation actions; coordinate with DRWW on short term monitoring priorities.	X	X								
Research funding and technical assistance to implement priority recommendations identified in the action plan.	X	X	X	X						
Submit grant applications if applicable and secure additional funding sources for plan implementation.	X	X	X	X	X	X	X	X		
Coordinate available programs, policy changes and other local initiatives and those programs where private landowners are responsible for signing up.	X	X	X	X	X	X	X	X	X	
Project planning, site surveys and project design and budget development		X	X	X	X	X	X	X	X	
Prioritize and incorporate plan recommendations into existing programs, activities, and budgets.	X	X	X	X	X	X	X	X	X	X
Implementation and construction of projects			X	X	X	X	X	X	X	X
Report and monitor progress	X	X	X	X	X	X	X	X	X	X
Communicate success stories		X	X	X	X	X	X	X	X	X
Evaluate accomplishments			X			X				X
Update Watershed-Based Plan										X

7.5 WATER QUALITY MONITORING STRATEGY

The need for water quality-monitoring has clearly been defined and communicated by stakeholders. As detailed in Chapter 3, the DRWW implemented a comprehensive watershed-wide monitoring program and quality assurance project plan with over seventy stations, and data collection started in September of 2015. The DRWW monitoring effort should be continued and financed to support further characterization of problems and to monitor conditions and health of the watershed through time. The DRWW monitoring will support a quantitative means to assess the effectiveness of plan implementation and the cumulative contribution towards goals and objectives.

Error! Reference source not found. shows the location of existing DRWW monitoring sites, Illinois EPA monitoring sites, USGS gage stations, and publicly-owned WWTPs. For more information about the monitoring strategy and monitoring locations view DRWW's website and monitoring strategy (http://www.drww.org/plans/reports). The DRWW water quality monitoring data has proven valuable throughout the planning process to characterize the watershed and prioritize actions. The feedback and recommendations summarized below are the result of analyzing and applying the DRWW monitoring data:

1. Environmental parameters that include some volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) or polycyclic aromatic hydrocarbons (PAHs), pesticides, and some metals are expensive analyses. A scientific and use case analysis of this data should be performed to determine what type of environmental monitoring should be continued. Perhaps collection of this data could be scaled back either by intensity, number of stations, or number of parameters. Indicator parameters could also be evaluated and considered.

2. Pairing DRWW monitoring data with USGS gage stations is important and the relevant stations should be maintained. Key DRWW stations that coincide with important USGS gages include 13-6, 10-4, 10-2 16-4, 16-1/16-2, 11-2, 13-1, and 17-2.

3. Data from stations downstream of wastewater treatment facilities should be used cautiously. Based on nutrient and chloride data reviewed, it is likely that the effluent and streamflow had not fully mixed. This resulted in elevated estimates of pollutant loading.

4. Installing staff gages at or near the DRWW monitoring sites should be considered and stage readings recorded during sampling events. This will allow flow to be attributed to sampling events in the future with a stage/discharge relationship.

5. From a watershed planning standpoint, the important parameters to continue monitoring are:
    a. Nitrogen, Kjeldahl, Total
    b. Nitrogen, Ammonia
    c. Nitrate, Total
    d. Nitrite, Total
    e. Phosphorus, Total
    f. Chloride, Total
    g. Total Suspended Solids
    h. E. Coli
    i. Total Dissolved Solids
    j. Conductivity
    k. pH
    l. Diel Dissolved Oxygen
    m. Temperature
    n. Total Organic Carbon (TOC)
    o. Fish Community, Fish Index of Biotic Integrity (fIBI)
    p. Aquatic macroinvertebrate Community, Macroinvertebrate Index of Biotic Integrity (mIBI)

6. The total suspended solids data was limited for estimating sediment loading in the watershed, possibly due to the method of sample collection. Future monitoring at all sites or select sites should consider alternate sample collection methods to collect a more representative sample for estimating sediment yields.

Section 7.4 tracks progress through achievement of actions, while this section outlines a strategy to directly monitor the effectiveness of the actions from a water quality perspective. Table 7-16 summarizes the proposed monitoring categories and associated recommendations. Given the current DRWW monitoring program, this section emphasizes lake and volunteer monitoring.

Table 7-16: Summary of Monitoring Categories and Recommendations

MONITORING CATEGORY	SUMMARY OF RECOMMENDATIONS
Streamflow	USGS and the DRWW maintain functioning gages in watershed; baseline hydrographs have been developed. Continue DRWW streamflow measurements.
Ambient water quality (streams)	Support and utilize current and future DRWW monitoring efforts.
Physical and biologic assessment (streams)	Support and utilize current and future DRWW monitoring efforts.
BMP effectiveness	Monitoring BMP effectiveness of specific practices or clusters of practices; coordinate with DRWW.
RiverWatch program	Partner with National Great Rivers Research and Education Center (NGRREC) to enhance the volunteer monitoring program in the watershed.
LCHD Lake monitoring	• Incorporate quantifiable and spatial monitoring of aquatic invasive species in lakes. • Incorporate monitoring for algal toxins. • Sample and assess all lakes in the watershed in the same year and on the same schedule. • Collect storm-event water quality samples from all lake inlets as part of program; install staff gages. • Conduct a lake nutrient balance assessment and evaluate available phosphorus in lake sediment. • Incorporate additional parameters into lake shoreline assessments to better quantify sediment and nutrient loads; this includes eroding bank height and estimated lateral recession rates. Collect lake bank soil cores to determine soil nutrient concentrations.
Illinois Volunteer Lake Monitoring Program (VLMP)	
Continuous watershed model	Develop a continuous flow and water quality model for the watershed to effectively evaluate future land use changes and climate change impacts on water balance and water quality for streams and lakes.
Storm event runoff monitoring	Support and utilize current and future DRWW monitoring efforts.

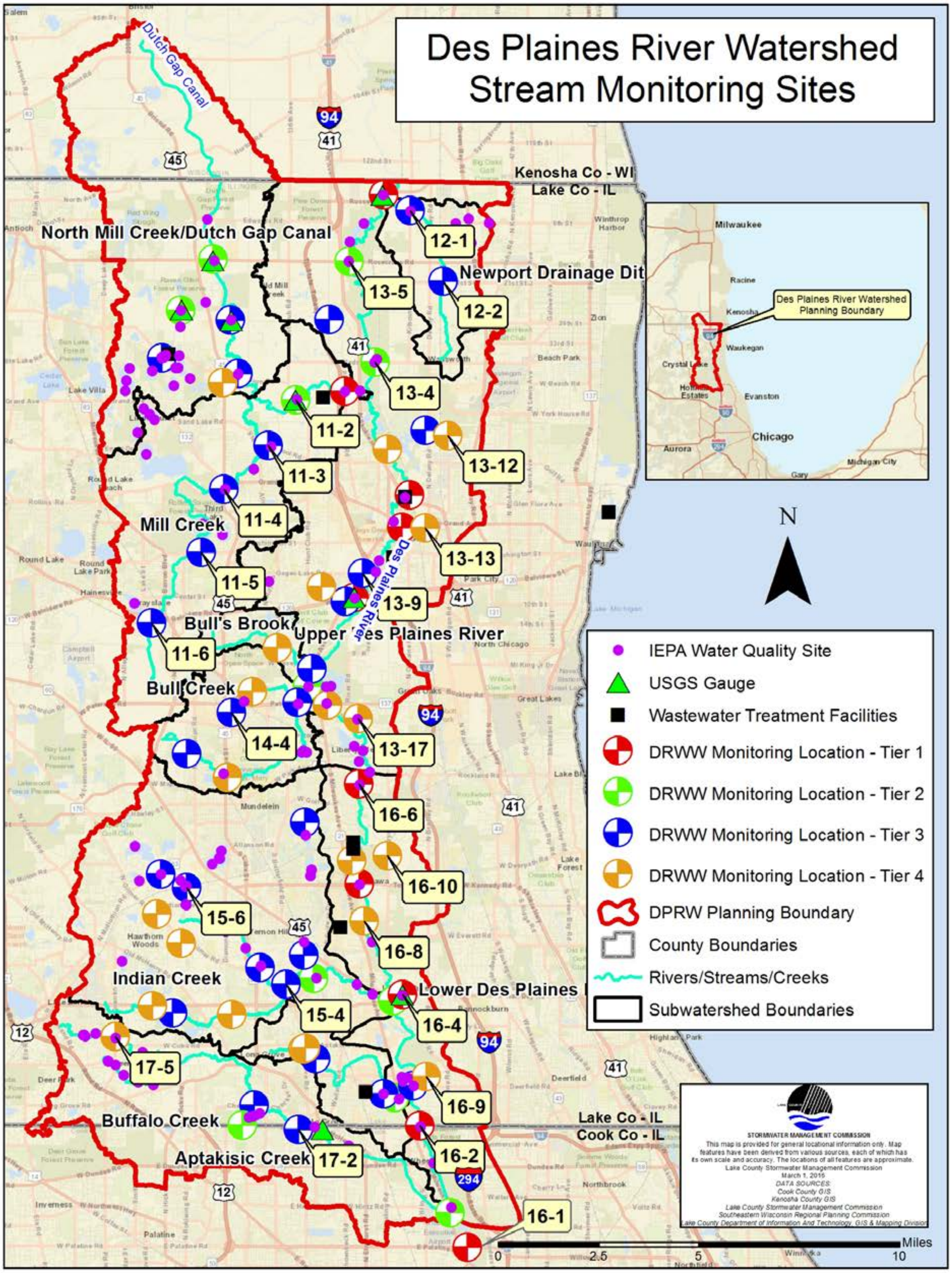


Figure 7-5: Existing DRWW Monitoring, USGS Gage, and WWTP Sites

7.5.1 BMP Effectiveness Monitoring

As funding allows, BMP effectiveness monitoring should be performed on projects to assess if actions are achieving the watershed-based plan goals and objectives. It is recommended to incorporate monitoring into the budget of BMP projects. Monitoring should be conducted by environmental consultants or independent agency staff experienced in sampling and monitoring methods.

Monitoring can be used to determine the overall effectiveness of individual or multiple spatially clustered BMPs on achieving the watershed-based plan goals. It is usually necessary to collect and analyze water quality and perform bioassessment sampling if the BMP is directly addressing a stream reach. This can be accomplished by monitoring prior to the practice (inflow) and downstream of the practice (outflow) or monitoring baseline and post-implementation conditions. It is also important to monitor the hydraulic performance and channel changes. Urbanized areas typically increase the total volume and rate of stormwater runoff that enters receiving streams and storm sewer systems. This causes changes in both hydrology and morphology. A goal of BMPs is usually to attenuate these flows and morphological impacts.

Table 7-17 includes minimum parameters that can be used as guidelines in designing and evaluating a monitoring program to evaluate BMP effectiveness. Benchmark indicators are based on water quality criteria and standards, the 2017 MBI report, or expert examination of water quality conditions to identify values representative of conditions that support designated uses and biological integrity and quality. The 2017 MBI Report and 2015 DRWW QAPP should also be referenced prior to initiating a monitoring program in order to maintain consistency.

Evaluation of the progress toward meeting targets indicates whether implemented BMPs are effective. If implemented BMPs are determined to be ineffective, the approach should be reconsidered or changed altogether.

Table 7-17: Baseline Water Quality Analysis Parameters

PARAMETERS	BENCHMARK INDICATORS
Total Phosphorus	0.05 mg/L for lakes (Illinois criteria) / 0.072 mg/L (regional reference non-effect benchmark; DRWW report)
Total Suspended Solids (TSS)	28 mg/L (regional reference non-effect benchmark; DRWW Report)
Total Dissolved Solids (TDS)	296 mg/L (regional reference non-effect benchmark; DRWW report)
Ammonia-N	15 mg/L (Illinois general use criteria)
Total Kjeldahl Nitrogen (TKN)	0.7 mg/L (regional reference non-effect benchmark; DRWW Report)
Nitrate-N	10 mg/L (Illinois drinking water standard)
Chloride	500 mg/L (Illinois criteria)
Fecal Coliform Bacteria	126 cfu/100 ml (US EPA geometric mean criteria; recreational use standard)
Dissolved Oxygen	No less than 5.0 mg/L (Illinois criteria)
Temperature	Less than 90° F (Illinois criteria)
pH	Between 6.5 – 9.0 (Illinois criteria)

PARAMETERS	BENCHMARK INDICATORS
Conductance, Specific	751 µS/cm (regional reference non-effect benchmark; DRWW report)
Flow	--
Fish	Fish Index of Biotic Integrity (fIBI) 41 or greater
Aquatic Macroinvertebrates	Macroinvertebrate Index of Biotic Integrity (mIBI) 41.8 or greater

7.5.2 RiverWatch Volunteer Program

The National Great Rivers Research and Education Center (NGRREC) administers the RiverWatch program, which educates and trains volunteers to collect data from Illinois streams. The NGRREC holds open labs and workshops throughout the state to train volunteers. The RiverWatch program was previously called EcoWatch and was administered by the IDNR.

While the RiverWatch monitoring program collects basic information about macroinvertebrates and aquatic habitat, it provides a real opportunity to engage stakeholders and volunteers to actively participate in the watershed in a meaningful way. A continuous and consistent monitoring program under RiverWatch would be a valuable tool to supplement work being done by the DRWW, evaluate the evolving condition of the watershed, and monitor the effectiveness of watershed-based plan implementation. A RiverWatch program, however, should not be seen as a replacement for physical and biologic assessments performed by the DRWW.

It is recommended that the watershed planning committee work with the DRWW to select several designated RiverWatch stream reaches in the watershed. The reaches are typically 200-300 feet in length, depending on the type of macroinvertebrate habitat. The designated reaches should either be on public land or private lands with landowner permission. Stream reaches within Forest Preserve District property should be evaluated. The designated reaches should be communicated to the NGRREC so that volunteers in the area are focused to the designated stream reaches.

The watershed planning committee may want to consider a public relations program to educate the public regarding the RiverWatch program and enlist volunteers. Funding opportunities should be considered to reimburse travel expenses for volunteers to attend the necessary training provided by NGRREC.

7.5.3 Lake Monitoring

There are numerous lakes in the DPR planning area that are characterized as part of Chapter 3. The lakes are a tremendous resource for recreation and watershed health and function. Lake monitoring should be considered a priority to maintain and manage the lake systems and their value as an ecological and recreational resource. Currently the Illinois EPA, LCHD, and Lake Associations administer lake monitoring programs in the DPR planning area. These programs should be supported and enhanced by the watershed stakeholders and implementation partners.

7.5.3.1 LCHD Lake Monitoring

The Lakes Management Unit (LMU) of the LCHD has been collecting water quality data on Lake County lakes since the late 1960s. Starting in 1999, approximately 32 lakes per year are monitored, equating to about a 5-year period between lake monitoring. Data collection includes temperature, dissolved oxygen, phosphorus, nitrogen, suspended solids, pH, alkalinity, conductivity, water clarity, plant community, and shoreline characteristics. Detailed reports are written for each lake and include data analyses, a list of problems specific to each lake, and recommendations on how to reduce or eliminate those problems. Reports are available online, although the information is not readily available in a database format. It is recommended that the watershed planning committee continue support of this existing lake monitoring program and track the results of each of the monitored lakes in the watershed to monitor the effectiveness of plan implementation.

7.5.3.2 Illinois Volunteer Lake Monitoring Program (VLMP)

The Illinois EPA established the VLMP program in 1981 to engage and educate the public about lake health and lake management while developing a means to collect data and observations about lakes throughout Illinois. The program funds volunteer training programs, technical and administrative support to volunteers, and laboratory analysis costs. As volunteers gain experience, they can graduate to higher tiers of data collection and lake assessment as shown in Table 7-18.

The LCHD LMU works directly with the Illinois EPA and the VLMP volunteers relative to Lake County. Not all lakes in the watershed have a volunteer commitment through the VLMP program. The VLMP program does not include quantity or spatial-based monitoring of aquatic invasive species, although the volunteers are free to provide narrative descriptions about aquatic invasive species.

Table 7-18: Monitoring Tiers of the Illinois VLMP

TIER LEVEL	DESCRIPTION OF VLMP MONITORING TIERS
Tier 1	Volunteers perform Secchi disk transparency monitoring and field observations only. Monitoring is conducted twice per month from May - October, typically at 3 in-lake sites. Field observations include the presence of invasive species including installation and monthly observations of zebra mussel plate installed near boat launch.
Tier 2	In addition to the tasks of Tier 1, volunteers collect water samples for nutrient and suspended solid analysis at the representative lake site (site 1). Water quality samples are taken only once per month, May - August, and October in conjunction with one Secchi transparency monitoring trip.
Tier 3	In addition to tasks of Tier 1 and 2, volunteers collect water samples at up to three sites on their lake. Their samples are analyzed for nutrients and suspended solids. They also collect and filter their own chlorophyll samples. Dissolved oxygen and temperature profiles may also be performed, depending on equipment availability. Data collected in Tier 3 is used in the category 5 Integrated Report and is subject for use in designating state impaired waters.

7.5.3.3 Lake Monitoring Recommendations

In addition to efforts currently being performed by individual Lake Associations, LCHD, and the Illinois VLMP, the following recommendations should be considered to enhance current monitoring activity that is performed on lakes, and should be considered at a minimum for all lakes 20 acres or greater, but should be applied to all other lakes as resources allow:

1. Incorporate quantifiable and spatial monitoring of aquatic invasive species in lakes.
2. Develop a rugged and long-lasting watershed-specific aquatic invasive species educational sign, if one doesn't currently exist, and install at all boat ramps.
3. Incorporate monitoring for algal toxins in lakes used for recreation.
4. Sample and assess all lakes within a five-year rotation (or shorter) and on the same schedule.
5. Per stakeholder input, collect storm-event water quality samples from all lake inlets as part of program; install staff gages.
6. Assess lake nutrient balance; evaluate available phosphorus in lake sediment.
7. Incorporate additional parameters into lake shoreline assessments by the LCHD to better quantify sediment and nutrient loads; this includes eroding bank height and estimated lateral recession rates. Collect lake bank soil cores to determine soil nutrient concentrations.

7.6 PLAN IMPLEMENTATION MILESTONES

This section includes goals, objectives, indicators, and milestones, consistent with implementation scorecards found in Appendix M. Table 7-19 through Table 7-25 list all consensus milestones established by the watershed planning committee. The "Objective ID" columns in Table 7-19 through Table 7-25 references Chapter 2, Section 2.4 goals (number) and objectives (letter).

7.6.1 Watershed Goal #1 Milestones: Water Quality Improvements

Improve water quality and prevent future pollution impacts to streams, lakes, ponds, and wetlands within the planning area. Timeframe: Short (**S**): 1-5 years, Medium (**M**): 6-10 years, Long (**L**): 10+ years.

Table 7-19: Water Quality Milestones

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
1a	Watershed stream annual monitoring program support. **Goal #1 Actions 1-4**	**S**	Continue water quality monitoring through DRWW monitoring program
		M	
		L	
		S	1. Enroll 15 lakes in the Volunteer Lake Monitoring Program (VLMP) 2. Install staff gages

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Implementation of watershed monitoring program for lakes. **Goal #1 Actions 5-7**		3. Begin Lake inlet water quality monitoring
		M	1. Enroll 30 lakes in the Volunteer Lake Monitoring Program 2. Analysis of monitoring and VLMP data 3. Estimate/assess nutrient loads from watershed for 5 lakes with sufficient data.
		L	1. Enroll 40 lakes in the Volunteer Lake Monitoring Program 2. Analysis of 5-10 year water quality trends for lakes with sufficient data
1b	Number of water bodies removed from the Illinois EPA's impairments list. **Goal #1 Actions 1-10**	S	2 Lakes / 1 stream segment
		M	6 Lakes / 3 stream segments
		L	30 Lakes / 6 steam segments
	Number of causes of impairment removed. **Goal #1 Actions 1-7**	S	5 lakes / 2 streams
		M	10 lakes / 5 streams
		L	40 lakes / 13 streams
1c	Winter Maintenance Program establishment including: policy and manual development, de-icing workshop attendance and certification. **Goal #1 Actions 8-9**	S	20% of municipal programs
		M	40% of municipal programs
		L	100% of municipal programs
1d	Number of local units of government that adopt a phosphorous ordinance. **Goal #1 Action 14**	S	8
		M	20
		L	All municipalities
	Number of exceedances of permitted phosphorus concentrations from wastewater treatment plant effluent.	S	0% reduction in exceedances
		M	25% reduction in exceedances
		L	50% reduction in exceedances

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Goal #1 Action 16		
	Number of agricultural BMPs implemented that target phosphorous. **Goal #1 Action 10**	S	1) 5 acres grass conversion 2) 10 WASCOBs 3) 5 equestrian facility/ livestock operations 4) 5 grass waterways 5) 250 acres no-till and cover crops 6) 5 field borders
		M	1) 10 acres grass conversion 2) 10 WASCOBs 3) 10 equestrian facility/ livestock operation 4) 10 grass waterways 5) 1,000 acres no-till and cover crops 6) 10 field borders
		L	1) 5 acres grass conversion 2) 10 WASCOBs 3) 10 equestrian facility/ livestock operations, 4) 10 grass waterways, 5) 3,000 acres no-till and cover crops 6) 10 field borders
	Number of upgraded septic systems. **Goal #1 Action 15**	S	500
		M	1,200
		L	2,000
	Number of municipalities that have codes that allow or require green infrastructure for stormwater management. **Goal #1 Actions 11-13**	S	8
		M	20
		L	All municipalities
1e	Number of dams and impoundments removed or retrofitted. **Goal #1 Actions 17-18**	S	1
		M	2
		L	3
1f		S	10%

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Reduction in concentrations of total suspended solids (TSS). **Goal #1 Action 19**	**M**	20%
		L	45%
	Linear feet of streambank and shoreline restored. **Goal #1 Action 20**	**S**	5,000 linear ft
		M	15,000 Linear ft
		L	30,000 Linear ft
1g	Number of algae blooms reported. **Goal #1 Action 21**	**S**	Quantify baseline number of algae blooms
		M	10% reduction
		L	20% reduction
1h	Percentage of identified sources of fecal coliform addressed. **Goal #1 Actions 22-24**	**S**	Identify and quantify sources of fecal coliform pollution
		M	50% addressed
		L	75% addressed
1i	Concentration of PAHs detected in water quality/sediment monitoring efforts. **Goal #1 Action 25**	**S**	Identify locations of high PAH concentrations
		M	Develop a management and remedial action plan
		L	Plan Implementation
1j	Number of MS4 communities maintaining a database of pollution prevention plans that address emergency response to catastrophic events. **Goal #1 Actions 26-27**	**S**	10
		M	20
		L	All
1k	Number of action recommendations completed.	**S**	50

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Goal #1 Actions 28-43	**M**	100
		L	All

7.6.2 Watershed Goal #2 Milestones: Regional Green Infrastructure and Natural Resources

Protect, enhance, and restore natural resources (soil, water, plant communities, and fish and wildlife) by employing good natural resource management practices. Using green infrastructure on public and private properties to maintain, enhance, or restore natural hydrology, native plant and wildlife communities, provide buffers for streams, lakes, wetlands, and high-quality areas. Expand environmental corridors to provide ecological, educational, and recreational benefits. Timeframe: Short (**S**): 1-5 years, Medium (**M**): 6-10 years, Long (**L**): 10+ years.

Table 7-20: Green Infrastructure and Natural Resources Milestones

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
2a	Number of water bodies removed from the Illinois EPA's impairments list. **Goal #1 Actions 1-10**	**Addressed by Objective ID 1b (1)**	
	Number of causes of impairment removed. **Goal #1 Actions 1-7**	**Addressed by Objective ID 1b (2)**	
	Area of open space identified and preserved for environmental and recreational natural areas. **Goal #2 Actions 17-24**	**S**	1,000 acres (in addition to 2018 baseline of 27,000 acres preserved)
		M	2,000 acres (in addition to 2018 baseline of 27,000 acres preserved)
		L	3,000 acres (in addition to 2018 baseline of 27,000 acres preserved)
	Acres of invasive species removal/management projects.	**S**	2,500
		M	5,000

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Goal #2 Actions 28-29	**L**	10,000
2b	Area of degraded natural communities restored. **Goal #2 Actions 1-3, 6, 7-11, 15, 16, 23, and 25-28**	**S**	1,000 acres
		M	5,000 acres
		L	20,000 acres
2c	Length of native plant buffers along water bodies maintained, expanded, and/or restored. **Goal #2 Actions 12-13**	**S**	10 miles
		M	20 miles
		L	50 miles
2d	Acres of wetlands enhanced and/or restored. **Goal #2 Actions 14-15**	**S**	500 acres
		M	1,500 acres
		L	3,000 acres
2e	Area of open space identified and preserved for environmental and recreational natural areas. **Goal #2 Actions 17-24**	**Addressed by Objective ID 2a**	
2f	Number of new trail connections. **Goal #2 Action 25**	**S**	5
		M	10
		L	20
2g	Number of lake management plans developed to address aquatic resource trends based on lake reports. **Goal #2 Action 26**	**S**	5 plans
		M	10 plans
		L	25 plans

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Number of lake management plan project recommendations implemented. **Goal #2 Action 26**	**S**	5 plans
		M	5 projects implemented
		L	10 projects implemented
2h	Number of lakes with Aquatic Plant Management Plans (APMP). **Goal #2 Action 27**	**S**	5
		M	10
		L	25
2i	Acres of invasive species removal/management projects. **Goal #2 Actions 28-29**	**Addressed by Objective ID 2a**	
2j	Number of successful reintroductions of threatened and endangered native species into natural habitats. **Goal #2 Action 30**	**S**	1 attempted
		M	5 attempted
		L	2 successful

7.6.3 Watershed Goal #3 Milestones: Flood Damage Reduction

Reduce current flood damage in the DPR planning area and prevent future flooding from worsening in the watershed and along the Des Plaines River downstream of Lake County. Timeframe: Short (**S**): 1-5 years, Medium (**M**): 6-10 years, Long (**L**): 10+ years.

Table 7-21: Flood Damage Reduction Milestones

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
3a	Area of new or restored flood storage sites. **Goal #3 Actions 1-9**	**S**	25 acres
		M	50 acres
		L	100 acres
3b		**S**	10

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Number of flood problem areas positively affected by flood mitigation projects implemented. **Goal #3 Actions 1-9**	**M**	20
		L	30
3c	Number of flood insurance policies in the watershed communities. **Goal #3 Action 24**	**S**	Track number of NFIP policies
		M	Track number of NFIP policies
		L	Track number of NFIP policies
	Number of Lake County Floodproofing Workshop attendees. **Goal #7 Actions 1-2, 4-5, 9, 13, 17-18**	**S**	300
		M	600
		L	900
3d	Number of action recommendations completed. **Goal #1 Actions 28-43** **Goal #3 Actions 6-9**	**Addressed by Objective ID 1k**	
3e	Number of mapped overland flow routes. **Goal #3 Action 10**	**S**	1 subwatershed
		M	5 subwatersheds
		L	All 10 subwatersheds
3f	Number of municipalities that have codes that allow or require green infrastructure for stormwater management. **Goal #1 Actions 11-13**	**Addressed by Objective ID 1d**	
3g	Number of local drainage system improvement projects implemented. **Goal #3 Actions 1-10, 22, 25**	**S**	25
		M	50
		L	100

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
3h	Number of communities with established stream maintenance programs. **Goal #3 Action 18**	**S**	10
		M	15
		L	All municipalities
3i	Number of updated FEMA floodplain maps (less than 10 years old). **Goal #3 Actions 19-21**	**S**	2
		M	5
		L	Entire planning area
3j	Number of Voluntary Floodplain Buyouts. **Goal #3 Action 22**	**S**	20
		M	50
		L	400
3k	Number/value of claims filed each year per community in the watershed. **Goal #3 Actions 24**	**S**	Reduce by 5%
		M	Reduce by 10%
		L	Reduce by 25%

7.6.4 Watershed Goal #4 Milestones: Funding, Installing, and Maintaining Stormwater Infrastructure

Reduce the volume and improve the quality of stormwater runoff by installing appropriate gray or green stormwater infrastructure; improving the condition of existing stormwater infrastructure. Timeframe: Short (**S**): 1-5 years, Medium (**M**): 6-10 years, Long (**L**): 10+ years.

Table 7-22: Stormwater Infrastructure Milestones

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
4a	Number of action recommendations completed. **Goal #1 Actions 28-43** **Goal #3 Actions 6-9** **Goal #4 Actions 2-4**	**Addressed by Objective ID 1k**	
4b		**S**	5

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Number of cost-sharing programs available in the DPR planning area. **Goal #4 Actions 5-7, 9**	**M**	7
		L	10
	Amount of grant funding available for stormwater green infrastructure and BMPs. **Goal #4 Actions 5 and 9**	**S**	$2,500,000
		M	$3,000,000
		L	$5,000,000
4c	Number of municipalities that have codes that allow or require green infrastructure for stormwater management. **Goal #1 Actions 11-13** **Goal #4 Actions 8-9, 11**	**Addressed by Objective ID 3f**	
4d	Number of local, county, and state representatives provided educational outreach materials for improving local and countywide regulations. **Goal #4 Action 9**	**S**	20
		M	40
		L	50
4e	Funding increase for in-the-ground stormwater BMPs. **Goal #4 Actions 5 and 9**	**S**	10% increase from 2018 baseline
		M	10% increase from 2018 baseline
		L	20% increase from 2018 baseline
4f	Number of existing stormwater management structures retrofitted. **Goal #4 Actions 10-11**	**S**	30
		M	100
		L	500
		S	30

<table>
<tr><th>OBJECTIVE ID</th><th>INDICATOR</th><th>TIMEFRAME</th><th>MILESTONE</th></tr>
<tr><td rowspan="2"></td><td rowspan="2">Number of developments built using conservation design principles and/or green infrastructure.

Goal #2 Action 19

Goal #3 Action 11-15

Goal#4 Action 4, 8</td><td>M</td><td>60</td></tr>
<tr><td>L</td><td>80</td></tr>
<tr><td rowspan="3">4g</td><td rowspan="3">Potential maintenance needs identified in future stream and detention basin inventories.

Goal #3 Action 18

Goal #4 Action 11, 15</td><td>S</td><td>N/A</td></tr>
<tr><td>M</td><td>10% aggregate reduction from 2018 baseline</td></tr>
<tr><td>L</td><td>20% aggregate reduction from 2018 baseline</td></tr>
<tr><td>4h</td><td>Number of communities with established stream maintenance programs.

Goal #3 Action 18</td><td colspan="2">Addressed by Objective ID 3h</td></tr>
<tr><td rowspan="3">4i</td><td rowspan="3">Lane miles of roadway retrofitted or constructed with BMPs.

Goal #4 Actions 12-13</td><td>S</td><td>5 miles</td></tr>
<tr><td>M</td><td>10 miles</td></tr>
<tr><td>L</td><td>15 miles</td></tr>
<tr><td rowspan="3">4j</td><td rowspan="3">Number of informational guides on roles and responsibilities for stormwater gray/green infrastructure maintenance distributed.

Goal #7 Action 9</td><td>S</td><td>2,000</td></tr>
<tr><td>M</td><td>5,000</td></tr>
<tr><td>L</td><td>10,000</td></tr>
<tr><td rowspan="3">4k</td><td rowspan="3">Number of compliant site inspections performed during the 10-year operation and maintenance period for Illinois EPA 319 grant funded projects.

Goal #4 Actions 14-16</td><td>S</td><td>All 319 grant funded projects</td></tr>
<tr><td>M</td><td>All 319 grant funded projects</td></tr>
<tr><td>L</td><td>All 319 grant funded projects</td></tr>
</table>

7.6.5 Watershed Goal #5 Milestones: Community and Agency Coordination

Improve coordination, research, and decision-making among public, private, and nonprofit entities to help achieve watershed plan goals and objectives. Timeframe: Short (**S**): 1-5 years, Medium (**M**): 6-10 years, Long (**L**): 10+ years.

Table 7-23: Community and Agency Coordination Milestones

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
5a	Number of municipalities, counties, and natural resource agencies that adopt the Des Plaines River Watershed-Based Plan. **Goal #5 Actions 1 and 2**	**S**	25 Agencies
		M	All agencies
		L	All agencies
5b	Watershed stream annual monitoring program support. **Goal #1 Actions 1-4** **Goal #5 Action 3**	**Addressed by Objective ID 1a**	
5c	Establishment of lead organization (watershed planning committee) with budget and executive committee. **Goal #5 Actions 4-6**	**S**	1 lead organization
		M	
		L	
	Number of projects advanced/undertaken with the support of the watershed planning committee. **Goal #5 Actions 7-8**	**S**	100 action plan recommendations
		M	250 action plan recommendations
		L	500 action plan recommendations
5d	Communities and organizations have designated an individual or board member(s) representative to participate on the watershed planning committee. **Goal #5 Action 4, 13**	**S**	10 communities
		M	20 communities
		L	All communities
5e		**S**	10

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Number of jurisdictions implementing watershed site-specific and programmatic actions. **Goal #5 Actions 9-11**	**M**	20
		L	All
5f	Number of jurisdictions that have ordinances and programs that protect and preserve watershed natural resource areas. **Goal #5 Actions 12-14**	**S**	10
		M	20
		L	All
	Number of municipalities that have codes that allow or require green infrastructure for stormwater management. **Goal #5 Actions 10, 14**	**Addressed by Objective IDs 3f & 4c**	
5g	Number of RiverWatch sites/lakes enrolled in volunteer/citizen scientist river and lake monitoring programs. **Goal #1 Action 2** **Goal #7 Actions 13**	**S**	25
		M	50
		L	75
5h	Number of watershed stakeholders providing feedback for the watershed report cards. **Goal #5 Action 15**	**S**	30
		M	100
		L	200

7.6.6 Watershed Goal #6 Milestones: Sustainable Agriculture Systems

Watershed stakeholders participate in farmland preservation programs and implement sustainable agricultural practices to accomplish other watershed goals and objectives. Timeframe: Short (**S**): 1-5 years, Medium (**M**): 6-10 years, Long (**L**): 10+ years.

Table 7-24: Sustainable Agricultural Systems Milestones

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
6a	Number and area of agricultural BMPs installed. **Goal #6 Actions 1-9**	**S**	25 BMPs cumulatively treating greater than 1,000 acres.
		M	50 BMPs cumulatively treating greater than 2,000 acres
		L	100 BMPs cumulatively treating greater than 5,000 acres
6b	Number or percent of farms, equestrian facilities, and nurseries with Resource Management Plans (assume 2018 baseline of 0). **Goal #6 Action 10**	**S**	5%
		M	25%
		L	50%
6c	Number of high priority sediment reduction agriculture BMPs installed. **Goal #6 Actions 11-12**	**S**	15
		M	30
		L	60
	Demonstration sites established and monitored. **Goal #7 Action 2, 7, 13**	**S**	3
		M	5
		L	7
	Length of drain tile removed or disabled. **Goal #6 Action 12**	**S**	5,000 ft
		M	10,000 ft
		L	30,000 ft
6d	Number of county and municipal agencies that have adopted a farmland preservation program(s). **Goal #6 Action 13**	**L**	Community dependent
6e	Acres of cover crops or crop residue left on fall agricultural fields.	**S**	5% of all conventional or reduced tilled fields (500 acres)

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Goal #6 Action 1, 8, 10, 13	**M**	25% of all conventional or reduced tilled fields (2,500 acres)
		L	50% of all conventional or reduced tilled fields (5,000 acres)
	Acres of waterway, wetland, WASCOB, field border, filter strip, GSS and other erosion control agriculture BMPs that are implemented, enhanced or restored. **Goal #6 Actions 1-9, 11-12**	**S**	1) 5 acres grass conversion 2) 10 WASCOBs, 3) 5 equestrian facility/livestock operations, 4) 5 grass waterways, 5) 250 acres no-till and cover crops, 6) 5 field borders 7) 5 acres filter strips, 8) 50 acres of wetlands 9) 10 nutrient management plans
		M	1) 10 acres grass conversion 2) 10 WASCOBs 3) 10 equestrian facility/livestock operations 4) 10 grass waterways 5) 1,000 acres no-till and cover crops 6) 10 field borders 7) 10 acres filter strips 8) 100 acres of wetlands 9) 50 nutrient management plans
		L	1) 5 acres grass conversion 2) 10 WASCOBs 3) 10 equestrian facility/livestock operations, 4) 10 grass waterways, 5) 3,000 acres no-till and cover crops, 6) 10 field borders, 7) 10 acres filter strips, 8) 200 acres of wetlands 9) 100 nutrient management plans
6f	Number of prime farmland acres in production. **Goal #6 Action 14**	**L**	75% of all prime farmland (2018 baseline)

7.6.7 Watershed Goal #7 Milestones: Education and Outreach

Provide watershed stakeholders with the knowledge, skills, and motivation needed to take action to implement the watershed plan. Watershed stakeholders include (but are not limited to): residents, property owners, property owner associations, government agencies, jurisdictions, and developers. Timeframe: Short (**S**): 1-5 years, Medium (**M**): 6-10 years, Long (**L**): 10+ years.

Table 7-25: Education and Outreach Milestones

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
7a	Number of landowners that receive information about best practices for stream and lake shoreline restoration and maintenance. **Goal #7 Action 1-2, 4, 13**	**S**	500
		M	500
		L	2,000
7b	Number of people reached by watershed outreach campaign. **Goal #7 Actions 2, 4, 10-11, 16**	**S**	Establish outreach campaign
		M	5,000
		L	10,000
7c	Number of public agencies and local private contractors attending the annual Lake County De-icing Workshop. **Goal #1 Actions 8-9** **Goal #7 Action 3**	**S**	20 public agencies; 100 local private contractors
		M	35 public agencies; 150 local private contractors
		L	All public agencies with winter maintenance responsibilities; 200 local private contractors
	Number of public agencies with winter maintenance responsibilities that use alternative de-icing products. **Goal #1 Actions 8-9** **Goal #7 Action 3**	**S**	20
		M	35
		L	All
7d	Number of property owners that receive information about the importance of watershed health.	**S**	2,000
		M	5,000
		L	10,000

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Goal #7 Actions 2, 4, 11		
7e	Number of landowners that receive information about watershed programs and projects. **Goal #7 Actions 2, 10, 12**	**S**	2,000
		M	5,000
		L	10,000
	Number of workshops. **Goal #7 Actions 13, 16, 18**	**S**	10
		M	20
		L	30
	Number of action recommendations completed. **Goal #1 Actions 28-43** **Goal #3 Actions 6-9** **Goal #4 Actions 2-4** **Goal #7 Actions 20-21**	**Addressed by Objective IDs 1k**	
	Continuous increase in number of contacts on the SMC Des Plaines River watershed contact database. **Goal #7 Actions 2, 4, 10-11, 16**	**S**	5% increase
		M	7% increase
		L	10% increase
7f	Pollution prevention campaign established. **Goal #7 Actions 2-5, 8, 17, 22**	**S**	Establish campaign
		M	Maintain campaign
		L	Maintain campaign
7g	Number of volunteers for lake, stream, and natural area stewardship and maintenance. **Goal #7 Actions 13-14**	**S**	500
		M	500
		L	1,000
7h		**S**	1 site / 1 training/yr.

OBJECTIVE ID	INDICATOR	TIMEFRAME	MILESTONE
	Number of native plant demonstration sites established, and trainings held. **Goal #7 Actions 15-16, 21-22**	**M**	2 sites / 2 trainings/yr.
		L	2 sites / 2 trainings/yr.
7i	Number of communities that adopt the "no adverse impact standard." **Goal #7 Action 17**	**S**	2
		M	5
		L	All applicable communities
7j	Number of educational flyers or mailings to high flood risk property owners about flood mitigation measures. **Goal #7 Action 18**	**M**	5,000
	Number of clicks (overall activity) on SMC website with flooding resources. **Goal #7 Action 4, 18**	**S**	5% increase in 2018 baseline
		M	7% increase in 2018 baseline
		L	10% increase in 2018 baseline
7k	Number of educational signs regarding aquatic invasive species installed. **Goal #7 Actions 20-22**	**S**	10
		M	20
		L	At least one sign at every lake with public access

7.7 UPDATING THE WATERSHED-BASED PLAN

Watershed-based plans are required by the Illinois EPA to be updated every 10 years. Furthermore, the watershed-based plan should be revised, as necessary, as new information is received, and progress is made. For example, as DRWW monitoring efforts continue, additional data can be used to revise loading estimates and determine if implementation efforts are achieving stated goals, milestones, and reduction targets. The Des Plaines River Watershed-Based Plan is an umbrella document, and when major updates occur, existing subwatershed plans must also be updated. Plan updates do not require an entire rewrite; typical elements that will likely require a major update or revision are summarized in Table 7-26.

Table 7-26: Plan Update Elements and Responsibilities

MAJOR PLAN ELEMENT REQUIRING UPDATE	ELEMENT COMPONENT REQUIRING UPDATE	LEAD RESPONSIBLE ENTITY (S)	PRIMARY SUPPORTING PARTNERS
Watershed Characterization	• Land use information • Water quality data/analysis • Stream/lake impairments • Climate • Demographics • Jurisdictions • Pollution loading	Lake County SMC	• Jurisdictions (Chapter 6) • DRWW • Watershed Planning Committee and subwatershed planning groups
Action and Implementation Plan Components	• Project recommendations • Expected load reductions • Milestones, timeframes, and priorities • Responsible parties and support partners • Monitoring plan	Lake County SMC	• Jurisdictions (Chapter 6) • DRWW • Watershed Planning Committee and subwatershed planning groups

7.8 REFERENCES

Des Plaines River Watershed Workgroup (DRWW). 2015. Quality Assurance Project Plan (QAPP): Bioassessment of the Des Plaines River Watershed. Lake County, Illinois. Technical Report. 54 pp.

Midwest Biodiversity Institute (MBI). 2017. Biological and Water Quality Assessment of the Upper Des Plaines River and Tributaries 2016. Lake County, Illinois. Technical Report MBI/2017-8-7. Columbus, OH. 99 pp.

CHAPTER EIGHT: EDUCATION & OUTREACH STRATEGY & TOOLS

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COMMON ACRONYMS/ABBREVIATIONS USED IN CHAPTER 8

APWA – American Public Works Association

BMP – Best Management Practices

BOMA – Building Owners and Managers Association International

CLC – College of Lake County

CMAP – Chicago Metropolitan Agency for Planning

CSA – Community-Supported Agriculture

DPR Planning Area – Des Plaines River Watershed Planning Area

DRWW – Des Plaines River Watershed Workgroup

FEMA – Federal Emergency Management Agency

FSA – Farm Service Agency

HOA – Homeowners Association

I/E – Information and Education

IDNR – Illinois Department of Natural Resources

ILCA – Illinois Landscape Contractors Association

Illinois EPA – Illinois Environmental Protection Agency

ILMA – Illinois Lakes Management Association

LCFPD – Lake County Forest Preserve District

LCHD – Lake County Health Department

LCTV – Lake County Television

LID – Low Impact Development

LA – Lake Associations

MWRD – Metropolitan Water Reclamation District of Greater Chicago

NFIP - National Flood Insurance Program

NRCS – Natural Resources Conservation Service

PB&D – Planning Building & Development

PSA- Public Service Announcement

SMC – Lake County Stormwater Management Commission

SWALCO - Solid Waste Agency of Lake County

SWCDs –Soil & Water Conservation Districts (McHenry-Lake & North Cook)

USEPA – U.S. Environmental Protection Agency

USGS – United States Geological Survey

WI DNR – Wisconsin Department of Natural Resources

WWTPs – Wastewater Treatment Plants (including publicly owned treatment works)

YCC – Youth Conservation Corps

8 EDUCATION AND OUTREACH STRATEGIES AND TOOLS

Figure 8-1: April 13, 2017 Des Plaines River Watershed planning meeting

Stakeholders provide input for the education and outreach strategy.

This chapter provides a strategy for information, education, and public involvement to address watershed topics and issues (see Figure 8-1). The education and outreach strategy provides messaging and motivation for each target audience to help achieve the goals and realize the vision for the Des Plaines River watershed:

The Des Plaines River watershed will be a destination valued by residents, businesses, and governments that join together to actively engage in education and participate in improving water quality. Stakeholders will preserve and enhance regional green infrastructure, resulting in cleaner streams and lakes, better plant and animal biodiversity, and reduced flood damage – while balancing a sustainable native landscape with development and economic growth.

8.1 WATERSHED INFORMATION AND EDUCATION NEEDS

Community engagement, outreach, and education are essential components of the Des Plaines River Watershed-Based Plan. The education and outreach strategy is designed to:

- Raise public awareness about watershed issues and foster support for solutions;
- Educate stakeholders, the public, and other identified target audiences to increase awareness and encourage behavioral changes (see Figure 8-2 for a Work-In-Progress sign);
- Provide engaged stakeholders the knowledge and skills they need to become watershed stewards and implement the watershed action plan;
- Leverage public and private partnerships to implement action items.

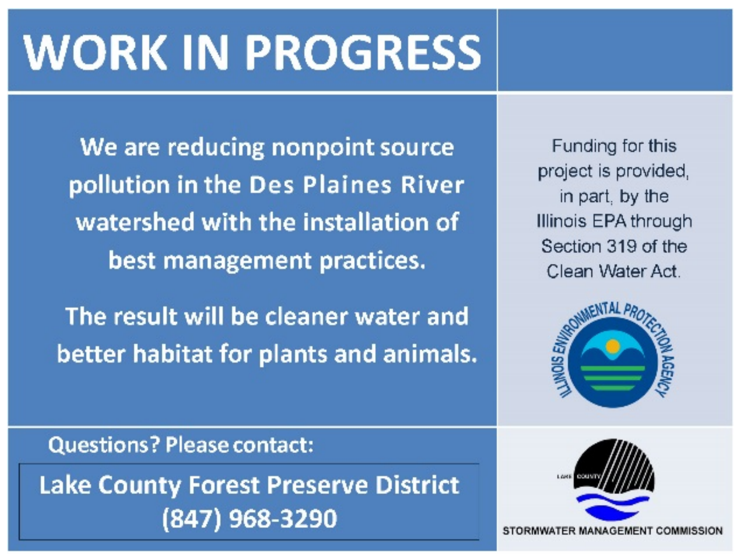

Figure 8-2: Example Work-In-Progress signs

The signs were installed at the three BMP implementation projects completed in 2017.

8.2 RECOMMENDED PROGRAMS

Development of an education and outreach program begins by defining education and outreach goals and objectives, see Figure 8-3 showing an example of an outreach program. During the June 2016 Des Plaines River watershed planning meeting, stakeholders discussed and approved the following goal and objectives related to education and outreach.

EDUCATION & OUTREACH GOAL: Provide watershed stakeholders with the knowledge, skills, and motivation needed to take action to implement the watershed plan. Watershed stakeholders include (but are not limited to): residents, property owners, property owner associations, government agencies, local units of government, and developers.

Figure 8-3: 2016 HOA Workshop on Maintenance for Subdivision Drainage Systems

***OUTCOME:** Stakeholders have adequate information and knowledge of resources to implement the watershed plan.*

OBJECTIVES:

a) Educate and provide information and training to riparian and lakeshore landowners on best practices for stream and lake shoreline restoration and maintenance that will reduce erosion and increase water quality.

b) Conduct a watershed outreach campaign to inform and engage the public about watershed issues, landowner responsibilities, and available resources.

c) Educate local government officials and agencies, consultants and contractors working in the watershed, landscapers and nurseries, and landowners on road salt alternatives and application BMPs to minimize the use of road salt by public and private snow removal providers.

d) Educate the general public on the importance of watershed health (water quality, flood prevention, soil conservation and agricultural production, green infrastructure, and water-based recreation) to the economy of the communities in the watershed.

e) Utilize trainings, workshops, public meetings, newsletters, websites, media, campaigns, and stakeholder word of mouth to provide watershed stakeholders opportunities to participate in watershed programs and projects.

f) Develop and implement a pollution prevention campaign to educate residents, businesses, developers and homebuilders on source control and runoff reduction measures that may be used on their properties. These measures can be used to reduce or eliminate pollution inputs associated with landscape maintenance and agricultural production.

g) Facilitate public training and engage schools and youth groups (students), lake associations, and homeowner associations to volunteer for lake, stream, and natural area stewardship and maintenance.

h) Promote the use of native plants and the removal of invasive plants by establishing demonstration sites and training.

i) Provide communities with the tools they need to prevent flood damage from worsening by using the “no adverse impact standard” and maintaining floodplain as open space.

j) Provide outreach and workshops for the public affected by flood damage to educate them on the causes of flooding, flood mitigation practices, and what can be done to prevent local and regional flood damage.

k) Install signs at each lake to educate riparian and lakeshore landowners and lake users on ways to reduce the spread of aquatic invasive species.

8.3 TARGET AUDIENCES

The audiences for specific education and outreach activities and topics include organizations, watershed residents, the general public, and professionals within the watershed community. These audiences have a wide range of understanding of watershed issues and needs for further education and outreach. Education and outreach intends to be responsive to existing partners, attract stakeholders that have not previously participated in watershed improvement activities, and align messages with audience knowledge levels and motivations. Education and outreach partners include the following entities.

Figure 8-4: Stakeholders participating in the watershed goals and opportunities exercise
Stakeholder input was used to create education and outreach strategy.

8.3.1 LOCAL GOVERNMENT OFFICIALS AND AGENCIES

Continued support from local governments and public landowners will be critical to implementing the education and outreach strategy. These officials and agencies develop policies and regulations and manage the land and projects within the watershed. They will need to commit to projects on public lands and communicate with and motivate residents to participate in watershed improvements. The local government target audience includes:

- Municipalities
- Townships
- County agencies
- Elected officials and policy makers
- Drainage districts
- Park districts & Forest preserve districts
- Public works agencies
- Transportation agencies (Highway Commissioners)

8.3.2 Residents and Businesses

Numerous residents and landowners in the Des Plaines River watershed have participated in one or more Des Plaines River watershed meetings or subwatershed committee meetings (see Figure 8-4). The target audience includes the following groups or residents:

- All residents and landowners (including agriculture producers, equestrian and large-track landowners)
- Not-for-Profit and Environmental interest groups
- Businesses and institutions (i.e., golf courses, shopping centers, churches and Chambers of Commerce)
- Community-Supported Agriculture (CSA) systems

8.3.3 Riparian and Lakeshore Landowners

Riparian landowners may have a disproportionate impact (positive or negative) on stream and wetland areas, and often have a vested interest in improving watershed conditions to protect their property, comply with regulations, or enhance property values. Riparian areas are critical locations because they contribute to watershed problems or hold the key to solutions. Therefore, the riparian property owners should be targeted for special attention in the education and outreach strategy. The target audience includes the following groups of riparian and lakeshore landowners:

- Homeowner and lake associations (HOAs/LAs)
- Single family residences
- Commercial and multifamily residential properties
- Owners of undeveloped land
- Railroads
- Utility companies located in floodplains or along streams, lakes, and wetlands

8.3.4 Schools and Youth Groups

Outreach and education programs and messages are targeted towards students in schools and youth groups which are needed in order to achieve sustainable improvements over time. The behaviors needed to effect long-term changes and improvements in watershed conditions will take hold in the shortest time and with the greatest effect in groups of children and young adults. Youth involvement in outdoor activities, such as stream clean-ups and habitat restoration days, is an effective way to engage groups in learning about and acting to improve watershed conditions. The student target audience includes the following schools and youth groups:

- Secondary schools
- Community colleges (CLC)
- Youth groups (Boy Scouts, Girl Scouts)

8.3.5 Developers & Homebuilders

The land development process has the potential to adversely affect watershed conditions, but development interests can be balanced with watershed goals if identified prior to or early in the design and development process. Developers and homebuilders should adopt a variety of best development standards and comply with regulations, codes, and ordinances to protect watershed resources.

8.3.6 Consultants and Contractors Working in the Watershed

Several engineering, environmental and other consultants have participated in stakeholder meetings and provided their expertise towards the watershed planning process. The watershed-based plan will provide consultants and contractors with resources to share with their clients and support for prioritization of future projects. The help of consultants and contractors will be needed to bring outreach and education messages to their clients to motivate and fund BMPs and watershed improvements far into the future.

- Restoration contractors
- Legal counsel
- Insurance companies
- Winter maintenance product/equipment suppliers
- Winter maintenance (snow removal) contractors
- Engineering, landscape architectural, and environmental consulting firms

8.3.7 Landscapers & Nurseries

Landscapers, lawn and garden centers, nurseries, hardware stores, large retail establishments, and snow removal contractors can make a huge impact by learning and following watershed-friendly lawn care and winter maintenance practices, especially by reducing their use of pollutants such as chloride and phosphorus. Communities can support education by maintaining registries for lawn care, nurseries, and winter maintenance providers.

- Lawn & garden centers

8.4 PARTNER ORGANIZATIONS

Organizations that will be responsible for implementing the watershed plan recommendations can assist in education and outreach and can also be one of the targeted audiences. Each partner should couple plan implementation efforts with parallel efforts to inform and educate. Several educational programs are currently being implemented by other organizations that watershed stakeholders may take advantage of for the Des Plaines River watershed education and outreach strategy. See Table 8-1 below for a list of potential partner organization for implementing the watershed plan recommendations.

Table 8-1: Partner Organizations

PARTNER ORGANIZATIONS	
All Residents & Landowners	Master Gardeners, Garden Blubs
Businesses and Institutions	SWCDs
CLC	Municipalities (including Public Works Depts.)
CMAP	MWRD
Conserve Lake County	NRCS
Cook County	Park Districts
Drainage Districts	SMC
Environmental Interest Groups	Townships
Farm Bureaus	Transportation Departments
Forest Preserve Districts	USGS
IDNR	USEPA
Illinois EPA	WWTPs
ILMA	Watershed Planning Committees
Kenosha County	Watershed Workgroups
Lake County	WI DNR
LCHD	YCC

8.5 GUIDANCE FOR IMPLEMENTATION

The following list provides general guidance for implementing the education and outreach strategy. More detailed recommendations for addressing specific watershed issues are included in Table 8-3.

- Use words that the general public can understand and speak to their existing values and priorities.
    - Basic watershed science education (e.g., biology, the water cycle, and stream ecology) may be needed when the audience has little knowledge about rivers, streams, lakes, wetlands, or watersheds.
    - Identify and provide for different levels of understanding and the needs of various audience groups. When interacting with a group, stress the dimensions of the project that apply most to them. For example, when interacting with homeowners, focus on items such as rain gardens, lawn care, pollution prevention and restoration, and management of riparian buffers. Develop a similar menu of topics for each target audience.
    - Be sure to inform your audience about actions they can take and behaviors they can change to help address watershed problems and issues.
- Develop multiple messages; use one broad message for the general public and a series of more specifically targeted messages for specific audiences (e.g., landowners, business owners, and municipalities).
    - Keep the message simple and straightforward with only two or three take-home points at a time, use graphics and photos to illustrate the message, and repeat it frequently.

    - Emphasize the connections between the message and the issue or resource being addressed. For example, connect the message to storms, streams, lakes, the Des Plaines River, land management, the urban landscape, and streets.
- Coordinate the education and outreach strategy with partner organizations to combine efforts, achieve economies of scale, tap into one another's networks, share costs, and ensure consistent messages.
- Use websites and other social media, as well as public places, such as libraries and village halls, to post and promote your message.
    - All materials and messages should promote the local watershed groups, with contact information and information on how to get involved.
    - Be sure to link the issue to the audience and inform the audience about actions they, specifically, can take to help address watershed problems and issues.
    - Post messages on websites and in popular public and private places, such as parks, forest preserves, libraries, grocery stores, and village halls.

8.6 MESSAGE FORMATS AND DELIVERY MECHANISMS

Numerous existing programs, tools, and materials are available that can be used or customized to accelerate education and outreach efforts. See Table 8-2 below for examples of education and outreach through print, electronic, visual and personal contact communication efforts.

Table 8-2: Examples of Education & Outreach Efforts

PRINT	ELECTRONIC	VISUALS	PERSONAL CONTACT
Brochures	Social Media	Displays/Exhibits	Demonstrations, field trips, watershed tours
Fact sheets	Websites	Signage	Presentations (meetings, events, workshops, seminars, open houses etc.…)
Newsletters	E-News/Emails	Posters/ Bulletin boards	Interviews
News releases	Videos/local cable channel	Presentations	Surveys
Feature articles	Public Service Announcements (PSA)		Target individual Discussions
Inserts/Utility bills	Bulletin Boards		
Flyers	Surveys		
Direct mail			
Manuals or plans; Technical resources			
Media kit			

8.7 EVALUATING PLAN OUTREACH

Watershed plan evaluation provides a feedback mechanism for ongoing improvement of your outreach effort and for assessing whether the effort is successful. It also builds support for further funding. The entity or persons responsible for implementing the education and information campaign should customize the following ideas. For a number of these evaluation strategies, you should collect baseline information or survey current knowledge before the outreach activities begin and check periodically throughout the outreach campaign to help measure progress and effectiveness. Evaluations conducted early in the effort will help determine which programs are working and which ones are not. Based on this information, money and time can be saved by focusing on the programs that work and discarding those that do not.

Actual achievement of the watershed plan goals and objectives, such as reductions in flooding and impairment of water quality in the Des Plaines River watershed, are perhaps the best indicators of outreach effectiveness. While it is difficult to attribute flood reduction and water quality improvement to a specific outreach strategy program or action, there is little doubt that increased understanding and involvement in the watershed is essential to watershed improvement. Indicators to evaluate, monitor, and provide a timeframe for each educational topic are listed in **Chapter 7; Section 7.6.7 & Appendix O Evaluation Scorecards**.

8.8 WATERSHED INFORMATION AND EDUCATION RESOURCES

Many resources include effective education and outreach messages, delivery techniques, watershed management planning, media relations, and strategies to assist with developing an outreach campaign. A web search provides many examples, but helpful resources include:

- USEPA Watershed Academy - http://water.epa.gov/learn/training/wacademy/index.cfm
- The Center for Watershed Protection - http://www.cwp.org/

Although larger educational activities, such as training workshops and demonstration projects, may require public or private grant sources, you can incorporate many of SMC's Stormwater Best Practices (http://www.lakecountyil.gov/2261/Stormwater-Best-Practices) into established work activities, projects, and education programs.

Table 8-3 provides educational messages, outreach methods, target audiences, and partner leads for implementing the Education and Outreach Strategy. It is important to note that although target audiences and partner leads are indicated in certain educational topics, many different target audiences and partner leads could apply to several of the topics.

Table 8-3: Educational Topics, Messages & Partners

TARGET AUDIENCES	EDUCATION/OUTREACH METHOD OR VEHICLE	PARTNER LEADS	POTENTIAL MESSAGES
TOPIC: GREEN INFRASTRUCTURE STORMWATER PRACTICES			
LOCAL GOVERNMENT OFFICIALS & AGENCIES • Elected Officials (policy makers) • Municipalities, Townships and County • Park Districts & Forest Preserve Districts • Drainage Districts • Public Works & Transportation Agencies RESIDENTS & BUSINESSES • Businesses and Institutions (golf courses) • CSA systems • Not-for-Profit & Environmental Interest Groups RIPARIAN & LAKESHORE LANDOWNERS • HOAs /LAs • Commercial & Multi-family residential properties • Utility Companies located in floodplains or along streams, lakes or wetlands SCHOOLS AND YOUTH GROUPS • Secondary Schools & Community Colleges • Youth Groups DEVELOPERS & HOMEBUILDERS CONSULTANTS AND CONTRACTORS WORKING IN THE WATERSHED • Engineering, landscape architectural, and environmental consulting firms LANDSCAPERS & NURSERIES • Lawn & Garden Centers	• Local Codes & Ordinances • LCFPD Green Infrastructure Model • Landowner Guides (Brochures), Factsheets • Presentations, Information Booths & Webinars • Target Individual Discussions • Demonstrations, tours, public meetings (watershed committee meetings), and workshops • Direct Mail, Utility Bills/Inserts, Emails • Feature Articles, Media Kit, PSA • Manuals/plans • Social Media, Websites	• SMC • Lake County PB&D • Municipalities • Townships • LCFPD • DRWW • Environmental Interest Groups	• Put a LID on Nonpoint Sources • Green Infrastructure: It Does It All • Let it Soak In; Keep It Recharging • Design with Infiltration in Mind • Green Infrastructure increases property values • Include green infrastructure protection/enhancement in community and HOA capital and operating budgets.

TARGET AUDIENCES	EDUCATION/OUTREACH METHOD OR VEHICLE	PARTNER LEADS	POTENTIAL MESSAGES
TOPIC: MINIMIZE FLOOD RISK & DAMAGE (NO ADVERSE IMPACT)			
LOCAL GOVERNMENT OFFICIALS & AGENCIES • Elected Officials (policy makers) • Municipalities, Townships and County • Drainage Districts • Park Districts & Forest Preserve Districts • Public Works & Transportation Agencies RESIDENTS & BUSINESSES • Businesses & Institutions RIPARIAN & LAKESHORE LANDOWNERS • HOAs / LAs • Single, Commercial & Multi-family residential properties • Utility Companies located in floodplains or along streams, lakes or wetlands DEVELOPERS & HOMEBUILDERS CONSULTANTS AND CONTRACTORS WORKING IN THE WATERSHED • Legal Counsel • Insurance Companies • Engineering and environmental consulting firms	• Landowner Guides, Factsheets, & Newsletters • Interviews, Target Individual Discussions • Buyout Program and Promote Via Partnerships (realtors, insurance agents, etc.) • Demonstrations, tours, presentations, public meetings, Floodproofing Workshop • Direct Mail to flood prone property owners, Utility Bills/Inserts, Emails, Surveys • News Releases, Feature Articles • Social Media, Websites, Video/Local Cable Channel (LCTV) • Local Model Ordinance • Technical Assistance with Flood Audits	• Counties • Municipalities • FEMA, NFIP • SMC • MWRD • Insurance Companies & Realtors • Chambers of Commerce • Drainage Districts • Schools • DRWW	• Maintain Your Culvert • Stream Maintenance Reduces • Convert Grey to Green Infrastructure • Infiltration Practices Reduce Runoff • Let It Soak In • Know How Your Property is Affected by Changes to Flood Maps • Floodproofing Tips for Your Home or Business • Maintain Your Detention Basin • How to protect your property from flood damage

TARGET AUDIENCES	EDUCATION/OUTREACH METHOD OR VEHICLE	PARTNER LEADS	POTENTIAL MESSAGES
TOPIC: BEST PRACTICES FOR LAKES AND LAKE SHORELINES			
LOCAL GOVERNMENT OFFICIALS & AGENCIES • Elected Officials (policy makers) • Municipalities, Townships and County • Park Districts & Forest Preserve Districts RESIDENTS & BUSINESSES • Agriculture Producers, Equestrian and Large Tract Landowners • Businesses & Institutions (golf courses, shopping centers, churches) RIPARIAN & LAKESHORE LANDOWNERS • Single, Commercial & Multi-family residential properties • HOAs/LAs • Utility Companies located in floodplains or along streams, lakes or wetlands DEVELOPERS & HOMEBUILDERS CONSULTANTS AND CONTRACTORS WORKING IN THE WATERSHED • Restoration Contractors • Engineering, landscape architectural, and environmental consulting firms	• Landowner Guides (Brochures), Factsheets, Newsletters • Lake & Yard Signage, Presentations • Interviews, Target Individual Discussions • Demonstrations, tours, HOA/Lake Management Association Meetings • Direct Mail, Utility Bills/Inserts, Emails • News Releases, Feature Articles, Media Kit, PSA • Manuals/plan, Certifications • Social Media, Websites, Video/Local Cable Channel (LCTV) • “Who to Call” list for landowner questions/assistance • Lake clean-up days • Biological Monitoring Results	• LCHD • CLC • HOAs • Park Districts • Lake Management Associations • DRWW	• If You Don’t Want It in Your Lake Don’t Put It on Your Lawn • Manage Your Edge with A Native Buffer • What Fish Testing Can Tell You About your Lake • What Shape Is Your Shoreline In • Control the Invaders • Put a Buffer Between Your Lake and The Geese • Before Dropping Anchor, Check for Zebra Mussels

TARGET AUDIENCES	EDUCATION/OUTREACH METHOD OR VEHICLE	PARTNER LEADS	POTENTIAL MESSAGES
TOPIC: STORMWATER INFRASTRUCTURE MAINTENANCE (DETENTION BASIN & OUTFALL MANAGEMENT)			
LOCAL GOVERNMENT OFFICIALS & AGENCIES • Elected Officials (policy makers) • Municipalities, Townships and County • Drainage Districts • Public Works Agencies • Transportation Agencies – Highway Commissioners • Park Districts & Forest Preserve Districts RESIDENTS & BUSINESSES • Businesses & Institutions (golf courses, shopping centers, churches, Chamber of Commerce) • Environmental Interest Groups RIPARIAN & LAKESHORE LANDOWNERS • Single, Commercial & Multi-family residential properties • HOAs/LAs • Utility Companies located in floodplains or along streams, lakes or wetlands DEVELOPERS & HOMEBUILDERS CONSULTANTS AND CONTRACTORS WORKING IN THE WATERSHED • Engineering and environmental consulting firms	• Individual Discussions • Targeted Mailings, Brochures, Factsheets • HOA Workshops; Signage, Posters • Low Impact Development workshop/tour Presentations • Social Media, Websites, Newsletters • News Releases, PSA, LCTV, Videos • Technical Assistance & Resources (manuals/plans) • County & Municipal Boards • Detention Basin Inventory (SMC Website) • Surveys & Interviews	• Municipalities • Townships • Drainage Districts • Local Elected Officials • SMC • DRWW	• Reduce Road Runoff, Road Pollutants • Purpose of/Need to Maintain HOA Detention Ponds • BMPs and How to Maintain Them • Adopt a Storm Drain • Regular Maintenance Keeps Your Facility Working • Infiltrating runoff reduces pollution and flooding • Your detention basin can clean pollutants from stormwater and reduce flooding – Just Naturalize It!

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• Municipalities, Townships and County
• Drainage Districts
• Park Districts & Forest Preserve Districts
• Public Works & Transportation Agencies
RESIDENTS & BUSINESSES
• Agriculture Producers, Equestrian & Large Tract Landowners
• Businesses and Institutions (golf courses and churches)
• Non-Profit & Environmental Interest Groups
RIPARIAN & LAKESHORE LANDOWNERS
• HOAs /LAs
• Single, Commercial & Multi-family residential properties
• Owners of Undeveloped Land
• Railroads
• Utility Companies located in floodplains or along streams, lakes or wetlands
SCHOOLS AND YOUTH GROUPS
• Secondary Schools & Community Colleges
• Youth Groups
DEVELOPERS & HOMEBUILDERS
CONSULTANTS AND CONTRACTORS WORKING IN THE WATERSHED
• Restoration Contractors
• Engineering, landscape architectural, and environmental consulting firms
LANDSCAPERS & NURSERIES
• Lawn & Garden Centers</td><td>• Landowner Guides (Brochures), Factsheets, Newsletters, Bulletin Boards and Flyers
• Displays/Exhibits, Lake & Yard Signage, Posters, Presentations
• Interviews, Target Individual Discussions
• Demonstrations, tours, public meetings and workshops aimed at developers
• Direct Mail, Utility Bills/Inserts, Emails, Surveys
• News Releases, Feature Articles, Media Kit, PSA
• Manuals/plan, Certifications
• Social Media, Websites, Video/Local Cable Channel (LCTV)
• Stream Inventory & Shoreline Assessments (SMC website)
• Encourage Lake and Stream clean-up days
• Provide a “Who to Call” list for landowner questions/assistance</td><td>• Riparian Landowners
• Park Districts & Forest Preserve District
• Dam Owners
• Elected Officials
• SMC
• DRWW
• HOAs
• Landscape Contractors
• Consultants
• Non-Profit Groups</td><td>• Dam Maintenance, Replacement, Removal
• Rain Gardens absorb runoff and are great for birds and butterflies
• Save The Bank, Invest in Native Vegetation
• Go Natural with Native Buffers
• You Are Responsible for Maintaining the Creek on Your Property
• Invasives Not Invited
• Stream Maintenance Can Help Reduce Flooding
• We Have Our Highways Give Them Theirs
• What Shape Is Your Streambanks In
• Do not dump yard waste or chemicals in the stream or stream buffers</td></tr>
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TARGET AUDIENCES	EDUCATION/OUTREACH METHOD OR VEHICLE	PARTNER LEADS	POTENTIAL MESSAGES
TOPIC: STEWARDSHIP TO PREVENT POLLUTION (FERTILIZER, PESTICIDES, & LANDSCAPING)			
LOCAL GOVERNMENT OFFICIALS & AGENCIES • Elected Officials (policy makers) • Municipalities, Townships and County • Drainage Districts • Public Works & Transportation Agencies – Highway Commissioners • Park Districts & Forest Preserve Districts RESIDENTS & BUSINESSES • Agriculture Producers, Equestrian & Large Tract Landowners • Businesses and Institutions (golf courses, shopping centers, churches and Chamber of Commerce) • Not-for-Profit & Environmental Interest Groups • CSA Systems RIPARIAN & LAKESHORE LANDOWNERS • HOAs /LAs • Single, Commercial & Multi-family residential properties • Railroads • Utility Companies located in floodplains or along streams, lakes or wetlands SCHOOLS AND YOUTH GROUPS • Secondary Schools & Community Colleges • Youth Groups DEVELOPERS & HOMEBUILDERS CONSULTANTS AND CONTRACTORS WORKING IN THE WATERSHED • Environmental consulting firms LANDSCAPERS & NURSERIES	• Landowner Guides (Brochures like Rain Garden How-To Guides, Factsheets, Newsletters, Bulletin Boards, and Flyers • Displays/Exhibits, Lake & Yard Signage, Posters, Presentations • Interviews, Target Individual Discussions • Demonstrations, tours, public meetings, Educational Campaigns and workshops aimed at developers, lake education days • Conservation @ Home Program (Conserve Lake County), Farmer Markets • Direct Mail, Utility Bills/Inserts, Emails, Surveys • News Releases, Feature Articles, Media Kit, PSA • Manuals/plan, Certifications • Social Media, Websites, Video/Local Cable Channel (LCTV) • Local Nurseries Selling Native Plants • "Who to Call" list for landowner questions/assistance • Identify Watershed Champions	• Conserve Lake County • Lawn and Garden Centers & Hardware Stores, • Park Districts • SMC • CLC & Schools • LCFPD • SWALCO • HOAs • Municipalities • DRWW • University of Illinois Extension Service • Realtors	• Cost Savings in Using Conservation Practices (ex. native landscaping); • A Healthy Yard Has Low Impact on Environment, Improves Sustainability; • What You Can Do To Improve Waters Quality • Recycle Rain Water; Harvest Rain Water; • A Healthy Yard = Less Time You Spend Maintaining It • Test Your Soil Before You Treat It • Do your part to keep waters clean • Only feed your lawn in the Fall • Use phosphorus free fertilizer • You can reduce pollution and maintenance costs while increasing profitability

TARGET AUDIENCES	EDUCATION/OUTREACH METHOD OR VEHICLE	PARTNER LEADS	POTENTIAL MESSAGES
TOPIC: BEST WINTER MAINTENANCE PRACTICES			
LOCAL GOVERNMENT OFFICIALS & AGENCIES • Elected Officials (policy makers) • Municipalities, Townships and County • Drainage Districts • Public Works Agencies • Transportation Agencies – Highway Commissioners • Park Districts & Forest Preserve Districts RESIDENTS & BUSINESSES • Businesses and Institutions (golf courses, shopping centers, churches and Chamber of Commerce) • Environmental Interest Groups RIPARIAN & LAKESHORE LANDOWNERS • HOAs /LAs • Single, Commercial & Multi-family residential properties CONSULTANTS AND CONTRACTORS WORKING IN THE WATERSHED • Winter Maintenance Product/Equipment Suppliers • Winter Maintenance (Snow Removal) Contractors • Environmental consulting firms LANDSCAPERS & NURSERIES • Lawn & Garden Centers	• Guides/Brochures, Factsheets, Newsletters, Bulletin Boards and Flyers • Displays/Exhibits, Signage, Posters, Presentations • ILMA Conferences & Meetings, Partnerships • Interviews, Target Individual Discussions • Demonstrations, tours, public meetings, Deicing Workshops (Lake County & Adjacent Counties), Product Application & Calibration Demonstration • Direct Mail, Utility Bills/Inserts, Emails, Surveys • News Releases, Feature Articles, Media Kit, PSA, Lobbying • Manuals/plan, Deicing Operator Certification • Social Media, Websites, Video/Local Cable Channel (LCTV)	• SMC • LCHD • Transportation Agencies • Local Government • State Officials • APWA • BOMA • ILCA • Schools • Business Associations • DRWW	• Salt Alternatives Save Money, Reduce Impacts to Our Water Resources • Calibration Key to Effective Product Application • Store It Right • Save Our Lakes, Use Less Salt on Our Roads • Road Salt Use Diet • Less is More- Road Salt

TARGET AUDIENCES	EDUCATION/OUTREACH METHOD OR VEHICLE	PARTNER LEADS	POTENTIAL MESSAGES
TOPIC: AGRICULTURAL & EQUESTRIAN BEST PRACTICES			
LOCAL GOVERNMENT OFFICIALS & AGENCIES • Elected Officials (policy makers) • Municipalities, Townships and County • Forest Preserve Districts RESIDENTS & BUSINESSES • Agriculture Producers, Equestrian and Large Tract Landowners • Environmental Interest Groups • Community-Supported Agriculture (CSA) systems RIPARIAN & LAKESHORE LANDOWNERS CONSULTANTS AND CONTRACTORS WORKING IN THE WATERSHED LANDSCAPERS & NURSERIES • Lawn and Garden Centers	• Landowner Guides (Brochures), Factsheets, Newsletters, Bulletin Boards • Direct Mailings (SWCD/NRCS Programs) • Target Individual Discussions, Presentations, Interviews • Social Media, Websites • Demonstrations, tours, and workshops • Technical Assistance • Manuals/plans • Lake County Farm Bureau, Illinois Horse Council, University of Illinois Extension Service	• SMC • LCFPD • University of Illinois Extension Service • Illinois Department of Agriculture – SWCDs, NRCS, FSA • DRWW • Agriculture Producers, Equestrian Landowners	• Good Practices Don't Have to Be Costly • Use Only What You Need (Nutrient Input) • Cover Crops Increase Yield, Water Retention • Soil: Keep It on the Land, Out of the Water • You can reduce farming inputs and pollution while increasing profitability

TARGET AUDIENCES	EDUCATION/OUTREACH METHOD OR VEHICLE	PARTNER LEADS	POTENTIAL MESSAGES
TOPIC: CONTROLLING NUISANCE & INVASIVE SPECIES (TEASEL, MUSKRATS, CARP, BEAVERS, GEESE, EURASIAN WATER MILFOIL, QUAGGA/ZEBRA MUSSELS)			
LOCAL GOVERNMENT OFFICIALS & AGENCIES • Elected Officials (policy makers) • Municipalities, Townships and County • Public Works & Transportation Agencies • Park Districts & Forest Preserve Districts RESIDENTS & BUSINESSES • Agriculture Producers, Equestrian and Large Tract Landowners • Environmental Interest Groups • Businesses & Institutions (golf courses) RIPARIAN & LAKESHORE LANDOWNERS • HOAs & LAs • Single, Commercial & Multi-family residential properties • Railroads CONSULTANTS AND CONTRACTORS WORKING IN THE WATERSHED • Engineering, landscape architectural, and environmental consulting firms LANDSCAPERS & NURSERIES • Lawn and Garden Centers	• Lake Reports (LCHD) • Landowner Guides (Brochures), Factsheets, Newsletters, Bulletin Boards and Flyers • Displays/Exhibits, Signage, Posters, Presentations • Interviews, Target Individual Discussions • Demonstrations, tours, and workshops • Direct Mail, Utility Bills/Inserts, Emails, Surveys • News Releases, Feature Articles, Media Kit, PSA • Manuals/plan • Social Media, Websites, Video/Local Cable Channel (LCTV)	• Municipalities • Townships • Drainage Districts • SMC • IDNR • DRWW • Riparian Landowners • Park Districts • Forest Preserve District	• Invasive plants are weeds that over run and crowd out native plant communities; • Invasive plants result in loss of habitat and biodiversity • Stop aquatic hitchhikers-clean your boat and drain your livewells

CHAPTER NINE: GLOSSARY OF TERMS

CONTENTS

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9 GLOSSARY OF TERMS

100-Year Floodplain: Areas with a 1% annual chance of flooding.

2 Year - 100 Year Flood: For each river, engineers assign statistical probabilities to different size floods to describe a common or ordinary flood versus a less likely or a severe flood. A 100-year flood is a flood that has a 1-percent chance of being equaled or exceeded in any given year. The 100-year flood, also referred to as the "base flood", is the standard used by the National Flood Insurance Program (NFIP) for floodplain management and is used to determine the need for flood insurance. A structure located within the 100-year special flood hazard area shown on an NFIP map has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage. A two-year flood event has a 50% probability of occurring in any year; 2-year rain events are important because they form the general shape of our stream systems and are the cause for much of the pollutant loading.

303(d): A state's list of impaired or threatened 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.

Advance Identification 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 primary functions evaluated were ecological value based on wildlife habitat quality and plant species diversity, hydrologic functions such as stormwater storage value and/or shoreline/bank stabilization value, and water quality values such as sediment/toxicant retention and/or nutrient removal/transformation function.

Alkalinity (ALK): A measure of the buffering capacity of water.

American Public Works Association (APWA): A professional association of public works agencies, private companies, and individuals that seeks to promote professional excellence and public awareness through education, advocacy and the exchange of knowledge

Ammonia (NH_3-N): A form of inorganic nitrogen.

Aquatic Plant Management Plan (APMP): A plan that provides a coordinated strategy for managing aquatic plants.

Artificial Wetlands: A designed wetland, created for human use, such as wastewater or sewage treatment, habitat to attract wildlife, or land reclamation after mining or other disturbances.

Bankfull: The point at which water flow in a stream fills the channel to the top of its banks just to the point where water begins to overflow onto the adjacent floodplain.

Barrens: An area with vegetation that is scattered with stunted woody growth and an exposed infertile substrate that supports species adapted to fire and drought and occurs in areas climatically suitable for forest growth of large trees.

Baseflow: Stream discharge that is not directly attributed to direct runoff or melting snow. It is usually sustained by groundwater.

Best Management Practices (BMPs): Non-structural practices, such as site planning and design aimed to reduce stormwater runoff and avoid adverse development impacts, or structural practices that are deigned to store or treat stormwater runoff to mitigate flood damage and reduce pollution. BMPs used in urban areas include stormwater detention ponds, restored wetlands, vegetative filter strips, porous pavement, silt fences and biotechnical streambank stabilization.

Biological Oxygen Demand (BOD): The amount of dissolved oxygen that is required by microscopic organisms to decompose organic matter in waterbodies.

Bioswale: Vegetated ditches that collect, convey, filter and infiltrate stormwater runoff.

Bog: A low nutrient peatland, usually in a glacial depression, that is acidic in the surface stratum and often dominated at least in part by the genus *Sphagnum.*

Building Owners and Managers Association International (BOMA): A professional organization that represents the owners and managers of commercial properties through advocacy, influence, and knowledge.

Catchments: 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 confounding pollutant sources, boundaries have fewer political jurisdictions, and monitoring/mapping assessments can be done in a relatively short amount of time. The 432 catchments in the DPR planning area have an average size of 23.5 square miles, with a range of 2.8 – 50.9 square miles.

Center for Watershed Protection (CWP): Non-profit corporation that provides local government, activists, and watershed organizations with the technical tools for protecting some of the nation's natural resources such as streams, lakes, and rivers.

Certified Community: Community authorized by SMC to administer and enforce most of the provisions of the WDO. A community can be a fully certified community (delegated to review both standard general stormwater provisions and isolated waters (wetland) aspects of the WDO) or partially certified community (delegated to review either standard or isolated wetland aspects of the WDO). SMC retains certain review authorities, primarily with respect to the floodplain and floodway provisions of the WDO in certified communities.

Channel: Any river, stream, creek, brook, ditch, gully, ravine, swale or wash, into which surface or groundwater flows, either perennially or intermittently.

Channelized stream: A stream that has been artificially straightened, deepened or widened.

Chicago Metropolitan Agency for Planning (CMAP): A regional planning agency that plans for the most effective public and private investments in northeastern Illinois region and to better integrate plans for land use and transportation. CMAP provides technical assistance and training opportunities to local governments to improve watershed management activities including watershed planning and stormwater management.

Chloride (Cl^-): A common non-point source pollutant, largely introduced into the environment through the use of deicing agents

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 toxins and improving water quality in areas where compliance with nationwide minimum discharge standards is insufficient to meet the CWA's water quality goals.

Climate Normals: 30-year averages of climatological variables including temperature and precipitation

College of Lake County (CLC): A community college accredited by the Higher Learning Commission.

Community-Supported Agriculture (CSA): A system connecting food producers and consumers by allowing the consumer to subscribe to the harvest of a certain farm or group of farms.

Colony Forming Unit (CFU): A measure of viable bacterial or fungal numbers. Unlike direct microscopic counts where all cells, dead and living, are counted, CFU measures viable cells.

Conductivity: A measure of the ability of water to pass an electrical current that is used as a proxy for the concentration of inorganic dissolved solids in water**.**

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, but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Converted Wetlands: Areas that have been drained or filled and no longer exhibit wetland or farmed wetland characteristics.

Critical Areas: Catchments in the watershed best suited to focus implementation efforts to help achieve the goals and objectives of the watershed plan. Critical areas represent catchments that likely contribute to impairments and problems in the watershed, and present opportunities where project implementation would provide the greatest value and benefit.

Defined Channel: Clearly discernable bed and banks of a flowing watercourse.

Dendritic Stream System: A stream system where there are many contributing streams (similar appearance to the twigs of a tree), which are then joined together into the tributaries of the main river. They develop where the river channel follows the slope of the terrain.

Des Plaines River Watershed Planning Area: The 235 square mile portion of the Des Plaines River watershed assessed for this watershed plan. The planning area originates at the Dutch Gap Canal/North Mill Creek Watershed in Kenosha County, Wisconsin, and extends through Lake County, Illinois, to the confluence of Buffalo Creek in Cook County, Illinois.

Des Plaines River Watershed Workgroup (DRWW): Consortium of publicly operated treatment works and MS4s organized to improve water quality throughout the Des Plaines River Watershed in Lake County and remove the Des Plaines River waterways from the IEPA 303(d) impaired waters list.

Developed Parcels: Parcels that are mostly occupied by structures and/or impervious cover.

Digital Elevation Model (DEM): A digital cartographic/geographic dataset of elevations in xyz coordinates.

Digital Terrain Models (DTM): A digital cartographic/geographic dataset of elevations in xyz coordinates that contains information on geographical elements and natural features.

Discharge Point: The location where all sanitary, storm sewer and agricultural drainpipes surface or stormwater flows back into a lake or stream channel. Discharge points also include open channels, swales, gullies and other significant tributaries.

Dissolved Oxygen: The amount of oxygen in water, usually measured in milligrams/liter (mg/L).

Drain Tile: A drainage system that removes excess water from the soil below the surface.

Drainage Basin: Land surface region drained by a length of stream channel; usually 1,000 to 10,000 square miles in size.

Dry Detention Basin: Basins that temporarily stores water before discharging to river or lake and usually dry up following large rainstorms or snow melt events. Typically, not effective at removing pollutants.

Dry Flood Proofing: A combination of practices that are used to make a building watertight, so flood waters do not enter the structure, including the basement or crawl space.

***E. coli*:** A species of fecal coliform bacteria that is specific to fecal material from warm-blooded animals, that is used as an indicator of health risk from water contact.

Emergent Vegetation: Vegetation that is rooted in the bottom sediment of a waterbody with leaves and stems that extend out of the water.

Endangered Species: A species in danger of extinction throughout all or a substantial portion of its range.

Erosion: Displacement of soil particles on the land surface due to water or wind action.

European Settlement: A period in the early 1800's when European settlers moved across the United States. During this movement, natural plant communities were altered for farming and related development.

Event Mean Concentration (EMC): Method for characterizing pollutant concentrations in stormwater runoff. Pollutant concentrations are measured in studies and on-going research that collects and analyze s runoff from various land-use practices in different geographic and climatic regions. The values are determined by compositing (in proportion to flow rate) a set of samples, taken at various points in time during a runoff event, into a single sample for analysis.

Farm Service Agency (FSA): An agency within the United States Department of Agriculture that implements farm conservation and regulation.

Farmed Wetlands: Agricultural cropped areas on hydric soil that have been cleared, partially drained, or filled.

Farmland Preservation Program: A joint effort by non-governmental organizations and local governments to protect examples of a region's farmland.

Fecal Coliforms: Bacteria that is specific to fecal material from warm-blooded animals, that is used as an indicator of health risk from water contact.

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.

Fens: A peatland, herbaceous (including calcareous floating mats) or wooded, with calcareous groundwater flow.

Filter Strip: A long narrow portion of vegetation used to retard water flow and collect sediment for the protection of watercourses, reservoirs, sensitive areas, or adjacent properties.

Flared End Section (FES): A structure commonly found at the end of pipes near waterbodies. FES are used to reduce erosion from pipe discharge and minimize debris accumulation at pipe openings.

Flash Flood: 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.

Flatwoods: Open woodlands of level uplands and terraces that occur on impervious subsoil horizons and have seasonally wet and dry soils.

Flood Insurance Rate Map (FIRM): A map prepared by FEMA that depicts the SFHA within a community. The FIRM includes zones for the 100-year and 500-year floodplains and may or may not depict Regulatory Floodways.

Flood Insurance Study: Studies conducted by the FEMA to determine areas that have the highest probability for flooding.

Floodplain: Floodplains are lowlands, adjacent to rivers, streams and creeks that are subject to recurring floods. Mapped regulatory floodplains are defined as the area of land, which is inundated with water during 100-year flood events.

Flood Problem Area (FPA): One or more structures in a geographical area that are damaged by the same primary source/cause of flooding. Structures include transportation, utility infrastructure, buildings, and well and septic failure caused by flooding. Areas also include locations where road flooding results in damage to infrastructure, loss of critical access, or is a threat to safety.

Flood Protection Area: Regulatory floodplains, regulatory floodways, riparian environments, wetlands, and wetland buffers.

Floodway: A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

Floristic Quality Assessment (FQI): A metric that evaluates how close the flora of an area is to undisturbed conditions.

Forest Preserve District: Districts designed to protect large natural areas and provide passive recreation.

Geographic Information System (GIS): A computer-based approach to interpreting maps and images and applying them to analysis of systems and problem-solving.

Glacial Slough: Shallow, wetland-type lake that are formed during glacial retreat

Global Positioning System (GPS): Satellite mapping systems that enables locators and mapping to be created via satellite.

Goal: A clear, concise, and measurable statement or target for the watershed plan that identifies a change or outcome to be achieved.

Grade Stabilization Structure (GSS): A structure with a drop spillway, built across a drainageway with a sudden drop in elevation, that is used to prevent gully erosion.

Gray Infrastructure: A network of transportation, power, communication and other human constructed systems that are designed to connect across multiple jurisdictions and incorporate facilities that function at different scales.

Green Infrastructure: Defined by the Lake County Stormwater Management Commission as: on a local scale, municipal or neighborhood, green infrastructure consists of site-specific best management practices (such as naturalized detention facilities, vegetated swales, porous pavements, rain gardens, and green roofs) that are designed to maintain natural hydraulic functions by absorbing and infiltrating precipitation where it falls. On the regional scale, green infrastructure consists of the interconnected network of open spaces and natural areas (such as forested areas, floodplains and wetlands, greenways, parks, and forest preserves) that mitigate stormwater runoff, naturally recharge aquifers, and improve water quality while providing recreational opportunities and wildlife habitat.

Green Infrastructure Model and Strategy (GIMS): A GIS based model that provides a framework for identifying land conservation and restoration opportunities to guide regional and local green infrastructure planning.

Green Infrastructure Network: Use of vegetation, soils, and natural processes to manage water and create healthier urban environments.

Green Infrastructure Vision (GIV): A GIS based regional scale green infrastructure vision that consists of spatial data and policies that identify the most important natural areas to protect in the Chicago region.

Gully Erosion: The removal of soil along drainage lines by surface water runoff. Once started, gullies will continue to move by headward erosion or by slumping of the side walls until the disturbance is stabilized.

Homeowners Association (HOA): An organization in a subdivision, planned community or condominium that makes and enforces rules for the properties within its jurisdiction.

Hummocky: Extremely irregular surface.

Hydraulics: A branch of science that deals with practical applications of liquid in motion.

Hydraulic Conductivity: A measure of a material's capacity to transmit water.

Hydraulic Structures: Bridges, culverts, dams, weirs, or other structures spanning or crossing the stream channel.

Hydric Soils: A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. These conditions alter the physical, biological and chemical characteristics of the soil, thereby influencing the species composition or growth, or both, of plants on those soils.

Hydrogeomorphic Descriptors: Characteristics that emphasize geomorphic and hydrologic attributes such as the landscape position, landform, water flow path, and waterbody type of a wetland or water body.

Hydrologic Cycle: The continuous movement of water on, above, or below the surface of the Earth.

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.

Hydrologic Unit Code (HUC): A hydrologic unit can accept surface water directly from upstream drainage areas, and indirectly from associated surface areas such as remnant, noncontributing, and diversions to form a drainage area with single or multiple outlet points. Hydrologic units are only synonymous with classic watersheds when their boundaries include all the source area contributing surface water to a single defined outlet point. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on the six levels of classification:

- 2-digit HUC first-level (region)
- 4-digit HUC second-level (subregion)
- 6-digit HUC third-level (accounting unit)
- 8-digit HUC fourth-level (cataloguing unit)

- 10-digit HUC fifth-level (watershed)
- 12-digit HUC sixth-level (subwatershed)

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 because 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 (Illinois EPA): Government agency established to safeguard environmental quality, consistent with the social and economic needs of the State, to protect health, welfare, property, and the quality of life.

Illinois Lakes Management Association (ILMA): An association that provides education and professional advice to assist in lake management decisions.

Illinois Landscape Contractors Association (ILCA): An association whose mission is to enhance the professionalism and capabilities of members by providing leadership, education, representation, and services while promoting environmental awareness and the value of the landscape industry.

Illinois- Livable and Sustainable Transportation Rating System and Guide (I-Last™): A transportation sustainability performance metric system developed by the Joint Sustainability Group of the Illinois Department of Transportation, the American Council of Engineering Companies and the Illinois Road and Transportation Builders Association.

Illinois Natural Areas Inventory (INAI): A survey conducted by the Illinois Department of Natural Resources to catalog high quality natural areas, threatened and endangered species and unique plant, animal and geologic communities for maintaining biodiversity.

Impervious Cover: 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

Index of Biotic Integrity (IBI): A numeric rating based on fish surveys that is dependent on the abundance and composition of the fish species in a stream. Fish communities are useful for assessing stream quality because fish represent the upper level of the aquatic food chain and therefore reflect conditions in the lower levels of the food chain. Fish population characteristics are dependent on the physical habitat, hydrologic and chemical conditions of the stream, and are considered good indicators of overall stream quality because they reflect stress from both chemical pollution and habitat perturbations. For example, the presence of fish species that are intolerant of pollution is an indicator that water quality is good. The IBI is calculated on a scale of 12 to 60, with higher scores indicating better water quality.

Infiltration: The portion of rainfall or surface runoff that moves into the subsurface soil.

Instream Habitat: The environment within a stream in which an animal normally lives or grows.

Intergovernmental Agreement (IGA): An agreement between two or more jurisdictions in cooperation to solve problems of mutual concern.

Kettle Lake: Shallow, glacial lakes that are formed when partially buried ice blocks from glaciers melt creating a depression that fills with water.

Lake County Health Department – Ecological Services (LCHD-ES): Government agency initiated to monitor the quality of Lake County's surface water in order to maintain or improve water quality and alleviate nuisance conditions, promote healthy and safe lake conditions, and protect and improve ecological diversity.

Lake County Planning Building and Development (LC PB&D): A government agency that is responsible for land use planning and permitting in unincorporated areas, and natural resources and systems management in Lake County.

Lake County Stormwater Management Commission (SMC): The Lake County Stormwater Management Commission established and existing under state statute [55 ILCS 5/5-1062] for the purposes of developing, revising, and implementing a countywide stormwater management plan.

Lake County Watershed Development Ordinance (WDO): One part of the adopted Lake County Comprehensive Stormwater Management Plan. It sets forth the minimum requirements for the stormwater management aspects of development in Lake County.

Lakeowner Association (LOA): An organization that makes and enforces rules for the lakes within its jurisdiction.

Land Cover: The physical material that covers the surface of the Earth, including forests, urban areas, water, prairies, etc.

Landform: The large-scale landscape features that affect the physical shape of a wetland or water feature (e.g., basin, flat, slope, island, or fringe).

Landscape Position: The physical setting of a wetland relative to a water body, if present (e.g., a wetland associated with a lake, a river, or a depression surrounded by uplands).

Land Use: The type of human activity that takes place on an area of land.

Lateral Recession Rate (LRR): The rate a channel or shoreline is receding due to erosion.

Light Detection and Ranging (LiDAR): A remote sensing method that uses a pulsated laser to measure distances to the Earth to generate three-dimensional data of the Earth's surface.

Loess: A fine-grained unstratified accumulation of clay and silt deposited by wind.

Low Impact Development (LID): A development practice that retains and infiltrates rainfall on-site utilizing site design and planning techniques that mimic the natural infiltration-based, groundwater-driven hydrology of the landscape.

Low or High Flow Conditions: Typically measured as a 7-day average of the lowest or highest water flow rates annually.

Macroinvertebrates: Invertebrates that can be seen by the unaided eye. 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 mussels and worms. The presence of benthic macroinvertebrates that are intolerant of pollutants is an indicator of good water quality.

Marl: A loose or crumbling earthy deposit that contains a substantial amount of calcium carbonate.

Marsh: Low-lying land area, dominated by herbaceous plants, that is usually saturated or inundated with surface or ground water.

McHenry-Lake Soil and Water Conservation District (MLSWCD): A government agency that assists McHenry and Lake County residents and business with conserving and protecting land, air, water and other resources.

Metropolitan Water Reclamation District (MWRD): An independent government and taxing body that treats wastewater in Cook County.

Mitigation Banking: A system of credits and debits to offset environmental impacts associated with site development and achieve no net loss, typically accomplished via restoration, creation, enhancement, or preservation of similar wetland, stream, or natural habitats near the area of impact with the specific goal of compensating for unavoidable impacts to aquatic resources.

Municipal Separate Storm Sewer Systems (MS4s): A water conveyance owned by a state, city, town, village, or other public entity that discharges to waters of the United States, that is designed or used to collect or convey stormwater and is not a combined with sewage infrastructure. Certain operators of MS4s are required to obtain NPDES permits and develop stormwater management programs.

Moraines: A mass of rocks and sediment transported and deposited by glaciers, typically as ridges at its edges or extremity.

National Flood Insurance Program (NFIP): Managed by the Mitigation Division within the Federal Emergency Management Agency, participants in the NFIP adopt and enforce floodplain management ordinances to reduce future flood damage and in exchange are eligible to receive federally funded flood insurance.

National Land Cover Database (NLCD): A national land cover product created by the Multi-Resolution Land Characteristics (MRLC) Consortium.

National Pollutant Discharge Elimination System (NPDES): Clean Water Act law requiring smaller communities and public entities that own and operate an 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:

- Public education and outreach on stormwater impacts
- Public involvement/participation
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management in new development and redevelopment
- Pollution prevention/good housekeeping for municipal operations

Natural Community: An assemblage of plants and animals interacting with one another and their physical environment.

Natural Resource Conservation Service (NRCS): NRCS provides technical expertise and education on conservation, development, management, and wise use of natural resources to landowners and land managers. Areas of expertise include streambank stabilization and soil erosion/ sediment control, wetland and habitat restoration, agricultural conservation, water quality protection, conservation planning, and natural resource maps and reports. NRCS administers several cost-share programs targeted to water quality, wetland restoration, and other watershed priorities.

Nitrate (NO_3^-): A form of inorganic nitrogen.

Non-Point Source Pollution (NPS): 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.

North American Vertical Datum of 1988 (NAVD88): The vertical control datum of orthometric height established for vertical control surveying in the United States of America based upon the General Adjustment of the North American Datum of 1988.

North Shore Water Reclamation District (NSWRD): A municipal body that collects and conveys wastewater from local sewer systems from 17 communities in Lake County to water reclamation facilities in Gurnee, Waukegan, and Highland Park.

Objectives: Specific, precise, measurable, attainable, relevant, and time-based steps needed to attain watershed plan goals.

Onstream (or Online) Basins: Basins that are connected to a "natural" surface waterway (creek, stream, river etc.), whether that waterway flows in and/or out of the pond.

Open Parcels: Parcels with no built structures or impervious cover.

Outwash: Sand and gravel deposits removed or washed out from a glacier.

Partially Open Parcels: Parcels that have a small structure (building, parking lot) relative to the parcel, allowing for the potential implementation of BMPs.

Pesticides General Permit (PGP): A permit issued under the Clean Water Act's National Pollutant Discharge Elimination System, that regulates point source discharges of biological and chemical pesticides that leave a residue.

pH: A measure of the concentration of the hydrogen ion in water, which affects multiple chemical processes within a lake such as the carbonate equilibrium cycle.

Point Source Pollution: Discharges from a single source such as an outfall pipe conveying wastewater from an industrial plant or wastewater treatment facility.

Polychlorinated biphenyl (PCB): An organic compound that was banned in the United States in 1979 because it is hazardous to human and environmental health. PCBs do not easily break down or degrade and are persistent in the environment.

Polycyclic Aromatic Hydrocarbons (PAH): A class of chemicals commonly present in urban and suburban non-point source pollution. PAH's are naturally formed in coal, crude oil, and gasoline, and can be formed when coal, oil gas, wood, garbage, or tobacco is burned.

Potentially Restorable Wetlands: Areas with predominantly hydric soils that are not mapped as wetlands on the LCWI and have not been converted to urban land use.

Prairie: An extensive flat or rolling area dominated by grasses. Prairie grasslands once covered much of central North America.

Probable Effect Concentration: A consensus based sediment quality guideline. Concentrations of a substance higher than the PEC are expected to frequently cause adverse effects to biota.

Problem Hydraulic Structures: Structures that may require further inspection or repairs.

Publicly Owned Treatment Works (POTWs): A sewage treatment plant that is owned by a government agency.

Rainwater Harvesting: Onsite collection, storage, and reuse of rainwater.

Rapid Assessment Point Method (RAP-M): A method used to capture erosion and sediment information on a watershed scale.

Riparian: The riverside or riverine environment next to the stream channel, e.g., riparian, or streamside, vegetation.

River Watch: A volunteer stream monitoring program that seeks to engage Illinois adults by training them as Citizen Scientists to collect consistent, high-quality data on the conditions of local streams.

Runoff: The portion of rain or snow that does not infiltrate into the ground and is discharged into streams by flowing over the ground instead.

Savanna: A type of woodland characterized by open spacing between trees and intervening grassland.

Secchi Disk: A circular disk with an alternating black and white pattern used to measure water transparency or turbidity.

Sedimentation: The process that deposits soils, debris and other materials on ground surfaces or in bodies of water or watercourses.

Seep: A wetland, herbaceous or wooded, with saturated soil or inundation resulting from the diffuse flow of groundwater to the surface stratum.

Slough: A swamp or shallow lake system, usually a backwater to a larger body of water.

Soil Phase: A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

Soil Series: A level of classification in the USDA Soil Taxonomy classification system hierarchy.

Soil Survey Geographic Database (SSURGO): A database that contains information about soil that was collected by the National Cooperative Soil Survey.

Soluble Reactive Phosphorous (SRP): A measure of phosphorus in the dissolved form that is readily available for plant and algal growth.

Solid Waste Agency of Lake County (SWALCO): An agency in Lake County that implements a regional approach to solid waste management.

Southeastern Wisconsin Regional Planning Commission (SEWRPC): The official areawide planning agency for southeastern Wisconsin that provides planning and technical assistance for public works systems and provides regional expertise in addressing environmental issues.

Spatial Watershed Assessment and Management Model (SWAMM™): A spatially based GIS model and management system for estimating non-point source pollution loading and identifying locations for BMP implementation.

Spreadsheet Tool for Estimating Pollutant Load (STEPL): A spreadsheet that employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various BMPs.

Stormwater Pollution Prevention Plan (SWPPP): A document that details how a construction project will minimize stormwater pollution.

Subwatershed: A smaller basin within a larger drainage area that all drains to a central point of the larger watershed.

Thalweg: A line connecting the lowest points of successive cross-sections along the course of a valley or river.

Threatened Species: A species likely to become endangered.

Threshold Effect Concentration (TEC): A consensus based sediment quality guideline. Concentrations of a substance lower than the TEC are not expected to cause adverse effects to biota.

Till: A heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders deposited directly by and underneath a glacier without stratification.

Total Maximum Daily Load (TMDL): The maximum amount of point and non-point source pollutants a stream can take in during a single day and still support its designated uses.

Total Dissolved Solids (TDS): A measure of the dissolved solids in a water sample.

Total Kjeldahl Nitrogen (TKN): A measure of organic nitrogen and ammonia in a water sample.

Total Phosphorus: A measure of all organic and inorganic phosphorus in a water sample.

Total Solids (TS): A measure of all suspended and dissolved solids in a water sample.

Total Suspended Solids (TSS): A measure of organic and inorganic material greater than 0.45 microns in size that are suspended in the water column.

Total Volatile Solids (TVS): A measure of organic solids in the water column, including algae, plant material, and zooplankton.

Unified Development Ordinance (UDO): Ordinance that regulates zoning, subdivision, signs and site development in unincorporated Lake County.

United States Environmental Protection Agency (USEPA): A federal government agency created to protect human and environmental health by writing and enforcing regulations.

United Stated 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 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 the loss of life and property from natural disasters, manage water, biological, energy, and mineral resources, and enhance and protect our quality of life.

Universal Soil Loss Equation (USLE): A mathematical model commonly used to estimate yearly soil loss.

University of Illinois Extension: The University of Illinois Urbana-Champaign outreach effort that provides technical assistance and educational outreach relating to energy and environmental stewardship, food safety and security, economic development and workforce preparedness, family health financial security and wellness, and youth development.

Vernal Pools: A wetland that is characterized by temporary pools of water.

Waterbody Type: A distinction in the underlying nature of the wetland based on size and shape of the associated water component: Lake, Pond, River, or Stream.

Water Clarity: A measure of the depth that light penetrates through the water column.

Water and Sediment Control Basin (WASCOB): A series of small embankments across concentrated flow paths, that store then slowly release runoff through an underground outlet.

Water Flow Path: Descriptors that characterize the direction of water flow (inflow, outflow, throughflow, bidirectional flow, etc.).

Watershed: Land area 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 Development Ordinance (WDO): One part of the adopted Lake County Comprehensive Stormwater Management Plan. It sets forth the minimum requirements for the stormwater management aspects of development in Lake County.

Watershed Management Ordinance (WMO): Ordinance that establishes uniform, minimum, and comprehensive countywide stormwater management regulations for Cook County.

Watershed Planning Committee: A committee comprised of SMC staff and watershed stakeholders, with a goal of creating an umbrella "watershed-based plan" for the Des Plaines watershed and reducing nonpoint source pollution.

Wastewater Treatment Plant (WWTP): A facility that treats sewage and wastewater prior to discharging it into the environment.

Wet Detention Basin: A permanent pool of water with designed dimensions, inlets, outlets and storage capacity, constructed to collect, detain, treat and release stormwater runoff.

Wet Flood Proofing: Wet flood-proofing allows water to enter the structure, but minimizes the damage to the structure and its contents.

Wetland: Land that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, under normal conditions, a prevalence of vegetation adapted for life in saturated soil conditions. A wetland is identified based on hydrology, soils, and vegetation as mandated by the current Federal wetland determination methodology.

Wet Meadows: 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.

Waters of the United States (WOUS): For the purpose of the Watershed Development Ordinance 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.

Wetland Creation: Development of a wetland in an area that was not previously a wetland (i.e., not in a drained or otherwise modified hydric soil).

Wetland Enhancement: Augmenting wetland functions beyond the current conditions; enhancement of one function sometimes can occur at the expense of other functions.

Wetland Preservation: Actions taken to maintain the size and functions of an existing wetland or water body.

Wetland Restoration: The re-establishment of wetlands in areas where they previously existed and were altered by drainage activities or landscape modifications.

Wetlands Restoration and Preservation Plan (WRAPP): A plan, developed by SMC in 2018, with input from a technical advisory group. The WRAPP estimates functions of mapped wetlands and water resources for existing and pre-European settlement conditions within Lake County. The WRAPP will include an on-line decision support tool to help users prioritize restoration and preservation opportunities based on acreage, wetland function or functional loss.

Wisconsin Department of Natural Resources (WI DNR): A state department that oversees watershed planning, water quality programs, floodplain, stormwater and non-federal wetland permitting, shoreline management, and fishery and wildlife management in Wisconsin. The WNDR also controls allocation of Federal Clean Water Act ("Section 319") funding for nonpoint source pollution reduction projects.

Wisconsin Department of Transportation (WISDOT): A department responsible for planning, building, and maintaining Wisconsin's state highway, interstate system, and transportation system.

Woodland: An area that is mostly covered with trees and shrubs.