Buffalo Creek Watershed-Based Plan

December 2015

Photo courtesy of Diane L. Kittle

Buffalo Creek Clean Water Partnership

Buffalo Creek Watershed Plan

December 2015

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Several other agencies and organizations provided contributions to this plan. Mike Adam, Kathy Paap and staff of the Lake County Health Department provided presentations at stakeholder meetings, lake assessments, sediment sampling and analysis, chloride monitoring and analysis, and technical assistance in the field for water quality sampling, including the installation and use of autosamplers. The Illinois EPA and USEPA provided timely review services to approve the final plan report as a watershed-based plan. Greg Denny and his staff at Environmental Monitoring and Technology provided technical guidance on the Coordinated Pollutant Monitoring Program and water quality testing parameters, as well as assisted with taking grab samples across the watershed for a reduced fee. Very importantly, the Villages of Arlington Heights, Buffalo Grove, Kildeer, Lake Zurich, Long Grove, and Wheeling, and the Buffalo Grove Park District all graciously supported our watershed planning effort by providing us with comfortable places to meet throughout the planning period. In addition to those already mentioned, technical information was presented at stakeholder meetings by Dean Maraldo (USEPA), Joe Kratzer (Metropolitan Water Reclamantion District of Greater Chicago), Dawn Thompson (Chicago Metropolitan Agency for Planning), Jennifer Clarke (Illinois EPA), Matthew Linn (Cardno), Kathryn Doyle (Lake County) and Jennifer Browning (Bluestem Communications).

Significant contributions were also made by community planning partners and watershed stakeholders including the County of Lake, the Metropolitan Water Reclamantion District of Greater Chicago, Manhard Consulting, Buffalo Grove Environmental Action Team, Deer Grove Natural Area Volunteers, Friends of Deer Grove East, Friends of Deer Grove West, the Villages of Wheeling, Buffalo Grove, Long Grove, Kildeer, Palatine, Deer Park, Lake Zurich, Arlington Heights and Prospect Heights; the Buffalo Grove Park District, Wheeling Park District, Long Grove Park District, Lake County Forest Preserve District, and Forest Preserve District of Cook County. Most of all we would

like to recognize all of the watershed stakeholders whose interest in protecting, restoring and enhancing the Buffalo Creek watershed has been critical to the success of this plan. They attended planning meetings representing municipal and county agencies, businesses, homeowners, homeowner associations, interested groups and individuals from throughout the watershed. The following individuals participated in watershed planning meetings:

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First Name	**Last Name**	**Organization**
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Deborah	Antlitz	Forest Preserve District of Cook County
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Cathy	Brady	Deer Grove East
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Steve	Goldspiel	
Leon	Gopon	
Todd	Gordon	Gewalt Hamilton Associates
Peter	Gorr	Sierra Club
Arlen	Gould	For State Representative Mathias
Ken	Gould	

Howard	Grenant	
Jane	Grubb	
Steve	Halm	Deer Grove East
Laura	Hansen Cannon	
Elliott	Harstein	
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Bill	Heider	Buffalo Grove Park District
Don	Hey	Wetlands Research Inc.
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Ron and Jun	Hoogenboom	
Tim	Howe	Buffalo Grove Park District
Brian	Huckstad	Arlington Height Park District
Holly	Hudson	Chicago Metropolitan Agency for Planning
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Mark	Janeck	Village of Wheeling
Adriane	Johnson	
Karen	Kaplan	
Joan	Karnauskas	
Michael	Katz	
Jeff	Kazmer	
Jeffrey	Kazmer	
Jim	Kelly	Hamilton Partners
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Ken	Klick	Lake County Forest Preserve District
Cheri	Klumpp	Wheeling Park District
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Lisa	Linder	
Matthew	Linn	Cardno
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Tom	Lueders	Village of Wheeling
Dean	Maraldo	
Anne	Marrin	Village of Prospect Heights

Sid	Mathias	Lake County Board
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Karen and Brett	McGovern	
Robert	Meyer	
Nick	Michaud	
Sandy	Mills	
Tom	Minarik	Metropolitan Water Reclamation District
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Vince	Mosca	Hey and Associates
Tom	Murphy	Edgewater
Jeff	Musinski	Village of Arlington Heights
John	Nelson	Forest Preserve District of Lake County
Mike	Nolan	
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Sharon	Osterby	Lake County Stormwater Management Commission
Kathy	Paap	Lake County Health Department
Joe	Papier	
Gary	Pearson	
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Larry	Raffel	Wheeling Park District
Mike	Reynolds	Village of Buffalo Grove
Brett	Robinson	Village of Buffalo Grove
George	Rupert	Village of Palatine
Ed	Sanchez	
Jim	Santeramo	
Michael	Sarlitto	Village of Long Grove
Elizabeth	Schiele	Chicago Tribune
Dan	Schimmel	Buffalo Grove Park District
Sarah	Schultz	Buffalo Grove Environmental Action Team
Rob	Seitz	
Scott	Shirley	Village of Arlington Heights
Hank	Sielck	Deer Grove East
Mike	Skibbe	Village of Buffalo Grove
Greg	Skladzien	
Gregg	Small	
Anne	Stake	Deer Grove East
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Michael	Talbett	Village of Kildeer
Irma	Terry	Gewalt Hamilton Associates
Dawn	Thompson	Chicago Metropolitan Agency for Planning
Scott	Tomkins	Illinois Environmental Protection Agency
Gary	Urbanozo	Lake County Health Department
Brian	Valleskey	Manhard Consulting
Ron	Vargason	Deer Grove East
Ronnie	Wachter	Pioneer Press
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Chapter 1 Introduction

1 Introduction

What is a ***watershed***? A watershed is the area of land drained by a river/stream system or body of water. 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 (such as streets, parking lots and buildings), stormwater and ***erosion*** are all detrimental to the health of the watershed (**Figure 1-1**).

Figure 1-1: What is a watershed? A watershed is the area of land drained by a river, stream, or other body of water. Graphic source: Arkansas Watershed Advisory Group.

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.*

Erosion: *Displacement of soil particles on the land surface due to water or wind action.*

Tributary: *Any stream that drains into a larger stream or river.*

1.1 Watershed Setting

Buffalo Creek is a ***tributary*** of the Des Plaines River, located in Lake and Cook counties. **Figure 1-2** is a map showing the location of the Buffalo Creek Watershed within the larger Des Plaines River Watershed. The Buffalo Creek Watershed is approximately 11 miles long and 2.5 miles wide with a total drainage area of 26.8 square miles. **Figure 1-3** is a detailed map of the Buffalo Creek watershed. The general orientation of the watershed slopes from the northwest to the southeast with elevations ranging from 895 feet above sea level to less than 630 feet above sea level at the mouth where it enters the Des Plaines.

Two tributaries, the North Branch and the South Branch, join together downstream of Albert Lake to form the main channel of Buffalo Creek in the northwest portion of the watershed. Buffalo Creek enters the Buffalo Creek Reservoir at the Long Grove/Buffalo Grove border just south of Checker Road. Another tributary, Tributary A, originates in the Deer Grove Cook County Forest Preserve and enters the Buffalo Creek Reservoir from the south. Buffalo Creek exits the Buffalo Creek Reservoir via a spillway located at the southwest corner of Arlington Heights Road and Checker Road. After Buffalo Creek exists the Buffalo Creek Reservoir, two more tributaries feed the main channel. Farrington Ditch enters from the north while White Pine Ditch joins from the south. Buffalo Creek continues east through the Village of Buffalo Grove. When Buffalo Creek passes under the Wisconsin Central Railroad. in the Village of Wheeling, it becomes the Wheeling Drainage Ditch. In 2001 the William Rogers Stormwater Diversion Channel, an 800 cubic feet per second (cfs) diversion channel connecting Buffalo Creek/Wheeling Drainage Ditch to the Des Plaines River, was completed. The diversion, consisting of a notched sheet pile weir on the north bank, is located just downstream of the Wisconsin Central Railroad bridge. From this point the diversion channel flows northeast to the Des Plaines River loosely following the original path of Buffalo Creek before the construction of the Wheeling Drainage Ditch in 1907. The Wheeling Drainage Ditch flows southeast until it reaches Wolf Road, where in the 1990s it was rerouted north of Palwaukee Airport to the Des Plaines River.

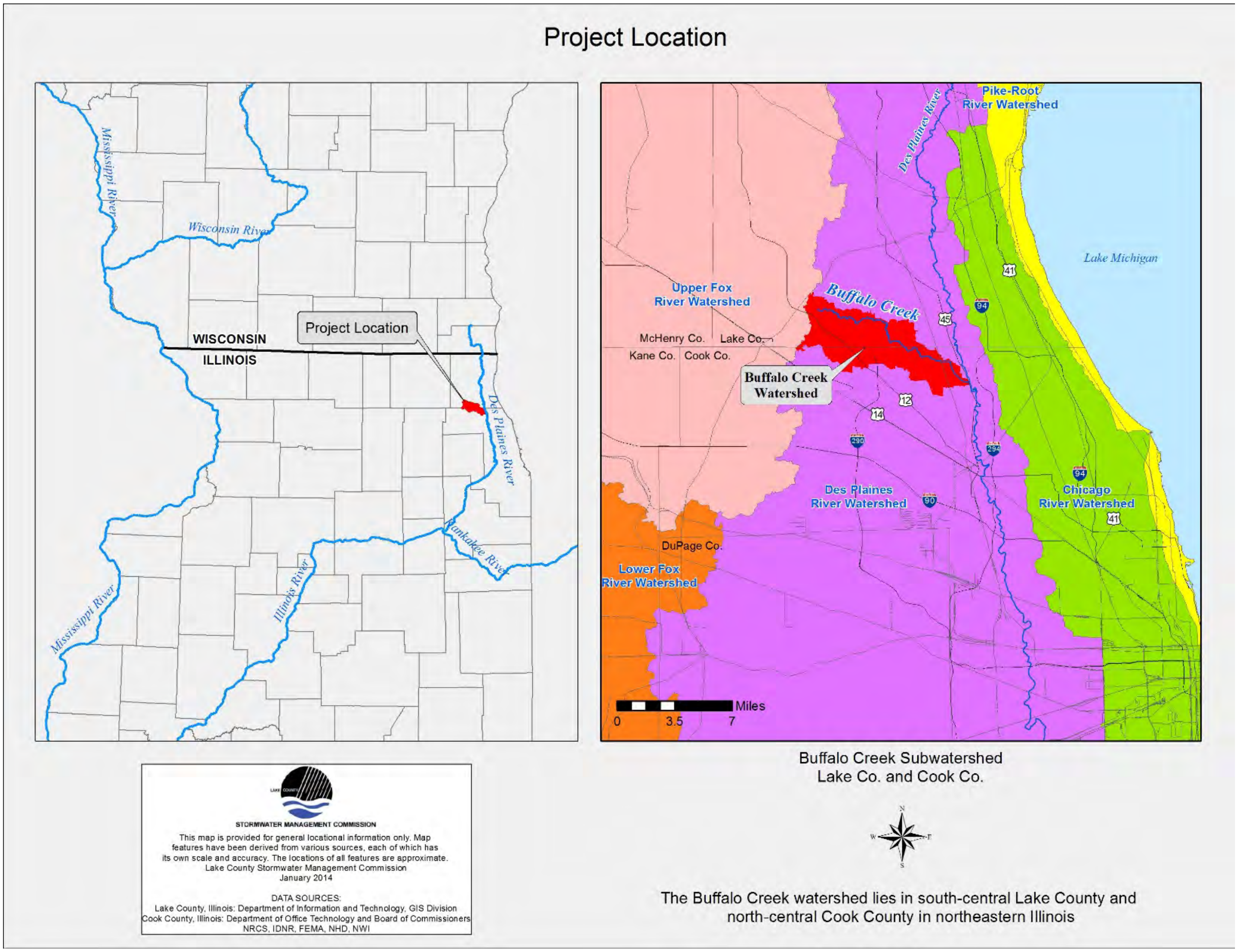


Figure 1-2: Map of the Buffalo Creek Watershed within the Larger Des Plaines River Watershed.

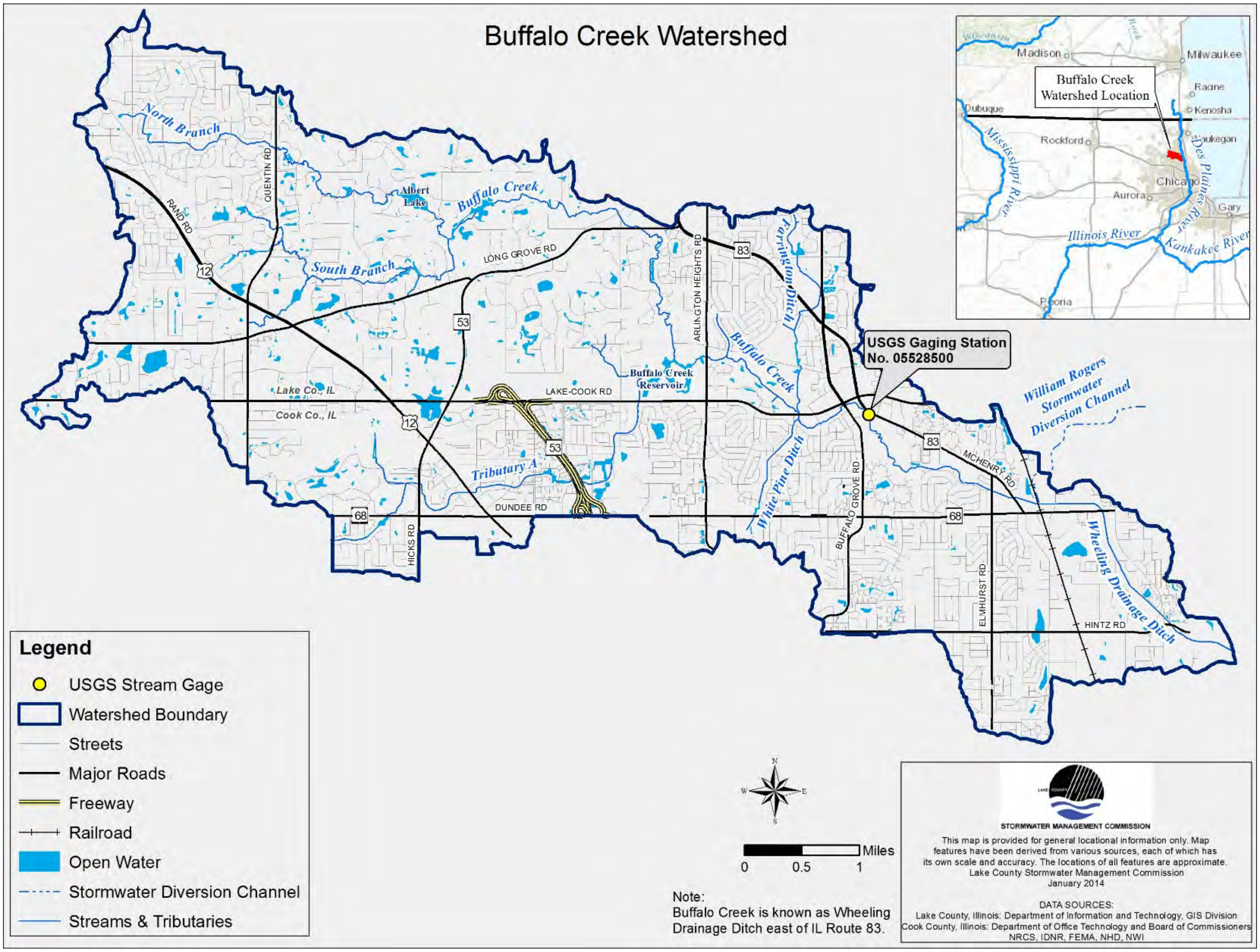


Figure 1-3: Map of the Buffalo Creek Watershed in Lake and Cook Counties, Illinois.

The Buffalo Creek watershed is hydraulically divided into two parts. The upper watershed is defined by the area above the Buffalo Creek Reservoir, while the area below the reservoir is the lower watershed (see **Figure 1-4**). The lower watershed is nearly 100 percent developed. This area lies mostly in the villages of Buffalo Grove and Wheeling. Both communities are primarily residential with major roads also having substantial commercial developments adjacent to them. In addition, Wheeling has some light industrial development in the areas surrounding the Wisconsin Central Railroad.

The upper watershed is made up of the communities of Arlington Heights, Palatine, Long Grove, Deer Park, Kildeer and Lake Zurich. This area has not developed as rapidly as the lower watershed; however, it is where most of the new development in the watershed is taking place. A large portion of the residential development that is occurring tends to be on larger lot sizes, keeping the housing density lower than that of the lower watershed. The Cook and Lake County Forest Preserves also own several large tracts of land in the upper watershed, limiting the amount of land available for development.

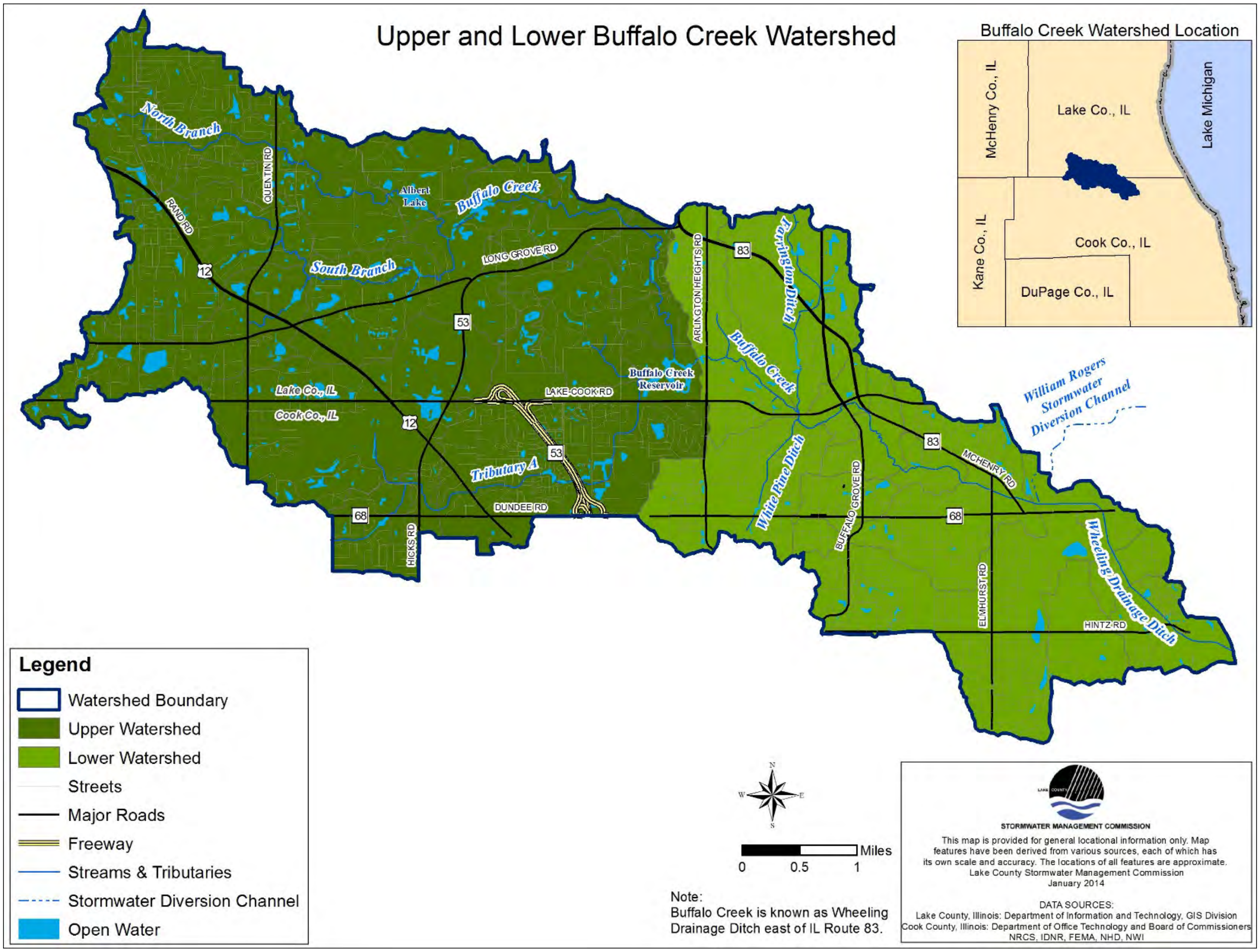


Figure 1-4: Map of the Upper and Lower Portions of the Buffalo Creek Watershed.

1.2 Geology of the Watershed

Approximately 70,000 years ago during the Pleistocene Era much of Illinois was covered by glacial ice (Neely and Heister 1987). Glaciers retreated and expanded over the Buffalo Creek Watershed. The last glacier, the Wisconsin Glacier, is responsible for the majority of the current geographic features of the watershed. As glaciers eroded away at the previous landscape of the Buffalo Creek Watershed they formed deposits in other areas. This process began approximately 26,000 years ago and ended approximately 13,000 years ago. Glacial till is the parent material of the majority of soils in the watershed. Till refers to unsorted sediments and materials that were deposited directly from the glacier.

1.3 The Watershed over Time

Historical data indicates that the Buffalo Creek Watershed has experienced significant change since ***European settlement***. Prior to European settlement the watershed was dominated by ***natural communities*** such as prairies, hardwood forests, swamps, sloughs, and lakes. Prairies and wet prairies were the most prevalent natural communities, covering approximately 84% of the watershed. The remainder of the watershed contained hardwood forest with additional patches of swamps, sloughs, and lakes. This combination of natural communities allowed for significant infiltration and storage of surface flows, which ultimately limited stormwater runoff.

However, the arrival of European settlers in the early 1800s altered the landscape of the Buffalo Creek Watershed. The natural communities of the watershed were cleared and drained for agricultural purposes. The increased use of agricultural practices such as drainage tiles and ditches also increased the volume of runoff and soil erosion, and contributed multiple nonpoint source pollutants into the watershed. Throughout the twentieth century, ***urban sprawl*** ultimately converted the majority of agricultural land to more urban land uses. These urban land uses are dramatically different from the natural communities that once existed in the watershed. Prairies with excellent infiltration capabilities are now largely replaced by impervious cover with little or no infiltration capacity.

European settlement: *A period in the early 1800's when European settlers moved across the United States in search of better lives. During this movement, natural plant communities were altered for farming and related development.*

Natural communities: *An assemblage of native plants and animals interacting with one another in a particular ecosystem.*

Urban sprawl: *The outward spread of urban development from cities and towns into nearby areas.*

Noteworthy: Natural Communities

A natural community is made up of all living things in a particular ecosystem but is usually named by its dominant vegetation type. Prior to European settlement in the 1830s, when the Potawatomie were the last of several Native American tribes who called the area home, Lake County exhibited a mix of natural communities including prairies, savannas, oak woodlands, dune complexes, and wetlands.

1.4 Impacts of Watershed Development

The water quality of streams and lakes in the Buffalo Creek Watershed is greatly influenced by land-use in the watershed. The Buffalo Creek Watershed is dominated by urban development, covering approximately 78% of the watershed. Urban land uses contain large quantities of impervious surfaces such as parking lots and roads. Impervious surfaces reduce stormwater infiltration, which increases ***peak flows*** and the volume of stormwater runoff.

An understanding of the impacts of urban development on water quality is essential before management actions can be taken. This understanding can then be utilized in the Buffalo Creek Watershed to plan ***Low Impact Development (LID)*** projects in existing urban areas. LID practices can also be used in the future to mitigate the impacts of new development throughout the watershed.

Peak flow: *The flow that occurs when the maximum flood stage, or depth, is reached in a stream or water control structure as a result of a storm event.*

LID: *A variety of development or redevelopment practices such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements that are primarily used in urban areas to increase infiltration and treatment of stormwater runoff.*

1.5 Buffalo Creek Clean Water Partnership

In 2006, Jeff Weiss, founder of the Buffalo Creek Clean Water Partnership (BCCWP), attended an event sponsored by the Indian Creek Watershed Project. He was impressed by the serious issues affecting the watershed, along with the energy of the group that was committed to address them. As a result, one of his goals when he founded the Buffalo Grove Environmental Action Team (BG EAT) in 2009 was to identify committed environmentalists to help launch a watershed group for Buffalo Creek. It wasn't until 2011, when he completed a watershed hydrology class as part of his curriculum for a MS in Natural Resources at the University of Illinois at Urbana Champaign, that he felt ready to mobilize the new group. He began recruiting individual and agency partners in December 2011 and the BCCWP was formed. The first individual to join forces was Marcy Knysz, who became the watershed coordinator. Together, Marcy and Jeff organized the first stakeholder meeting on April 25,

Photo of Buffalo Creek in Prairie Creek Subdivision, Kildeer. Photo courtesy of J. Weiss.

2012, which was attended by more than 50 people. Key watershed issues were identified by stakeholders at the first stakeholder meeting. At the second stakeholder meeting, watershed issues were ranked and voted upon. Based on the results of the ranking and voting exercise, water quality was identified as the highest priority issue within the watershed, followed by habitat, stormwater/flooding, green infrastructure projects, erosion, and education and outreach. One of the first tasks the BCCWP undertook was initiation of a Watershed-Based Plan.

The BCCWP also designed and conducted a Coordinated Pollutant Monitoring Program and secured grants for water quality monitoring and this Watershed-Based Plan. Jeff and Marcy's teamwork and leadership, along with help from many agency partners and concerned individuals, especially Tom Murphy, a retired professor of environmental chemistry at DePaul University, have been key elements in the success of the BCCWP.

1.6 Watershed-Based Plan Purpose

The first step toward improved water quality in the Buffalo Creek Watershed is the development of a Watershed-Based Plan. Watershed planning requires collaboration between local stakeholders to appropriately sustain and manage water resources. Watershed plans are a comprehensive approach to environmental protection that relies on science, policy and public involvement. Rather than focusing on single issues, watershed plans address multiple water quality issues under one program, thus taking a holistic approach of water resource management.

Photo of Green Lake Park, courtesy of M. Knysz.

The BCCWP played a central role in the initiation of the project, as well as the completion of the Watershed-Based Plan. **The purpose of this effort was to come up with a plan to restore watershed lakes, streams, and wetlands to a healthy condition while reducing the impacts of water pollution on watershed residents, and providing opportunities for watershed stakeholders to have a significant role in the process.** Completion of the Buffalo Creek Watershed-Based Plan was a collective effort between multiple watershed stakeholders, governmental agencies, watershed partners, and dedicated volunteers. A significant outcome of this planning effort and implementation of the plan going forward is to return the stream segments and watershed lakes that are presently listed as "impaired" on the Illinois 303(d) list of impaired waters to conditions that fully support their designated uses.

This plan identifies a variety of areas within the Buffalo Creek Watershed that are contributing to pollution and the degradation of water quality. The plan also includes a list of potential projects to reduce pollutant loads and restore water quality as well as recommendations for watershed stakeholders to implement to preserve, manage and restore natural resources as well as prevent actions that will cause or exacerbate unintended water quality problems. Watershed planning brings communities together to protect and improve the land and water resources they share and impact.

1.6.1 Project Planning Team and Project Funding

The Lake County Stormwater Management Commission (SMC) funded the Buffalo Creek Watershed-Based Plan through the Illinois Environmental Protection Agency's (Illinois EPA) Section 319 Nonpoint Source Pollution Control Grant Program. Section 319 grants are available to local units of government and other organizations to protect water quality in Illinois. Projects must address water quality issues relating directly to nonpoint source pollution. Funds can be used for the

Photo of White Pines Ditch, courtesy of M. Knysz.

implementation of watershed management plans including the development of information/education programs and for the installation of best management practices. To be eligible for Section 319 funds however, watershed projects are required to have an Illinois EPA-approved watershed-based plan or Total Maximum Daily Load (TMDL) implementation plan that meets the watershed-based plan requirements. The Buffalo Creek Watershed Plan is designed to meet the nine minimum elements required by the U.S. Environmental Protection Agency (U.S. EPA) for a watershed-based plan.

Illinois EPA receives these funds through Section 319 (h) of the Clean Water Act and administers the program within Illinois. The grant received by the BCCWP through SMC required a 50% match for the full project cost. This match was met using in-kind services from a variety of volunteers and agencies including municipalities and Park Districts located within the watershed, the BG EAT, Metropolitan Water Reclamation District of Greater Chicago (MWRD), Chicago Metropolitan Agency for Planning (CMAP), SMC, Lake County Health Department (LCHD), Forest Preserve District of Cook County (FPDCC), and the Lake County Forest Preserve District (LCFPD).

Once the draft watershed plan was completed and reviewed by SMC staff and the BCCWP, SMC approved the start of an official 60-day public review and comment period. A public hearing was held during the 60-day comment period at the Lake County Government Center at 18th N. County Street in Waukegan on November 5, 2015. Notice of the hearing was published in the *Lake County News Sun* (a newspaper of general circulation in the county), via email to stakeholders, and on the SMC website prior to the hearing. The public comment period ended on December 3, 2015. SMC reviewed and considered the comments received, and amended and approved the plan. SMC will recommend the plan for adoption to the Lake County Board in March 2016. The county board may then enact the proposed plan by ordinance as an amendment to the Lake County Comprehensive Stormwater Management Plan. Communities and other organizations within the watershed will also be asked to adopt the watershed plan as implementation begins.

1.6.2 Previous and Related Studies and Plans

Many areas of the Buffalo Creek Watershed have been studied previously, providing valuable data for this document. In 2013 a TMDL Report was developed for the Des Plaines River/Higgins Creek Watershed, which includes the Buffalo Creek Watershed. Albert Lake and Buffalo Creek Reservoir have been studied by the Illinois Lake Monitoring Program and Lake County Health Department. Stream and detention inventories have been performed by SMC throughout the watershed. The U.S. Geological Survey (USGS) has a stream gage location in the lower portion of the watershed near Wheeling (**See Figure 1-3**) that has been monitoring the Buffalo Creek discharge since 1952 and the gage height since 1993. MWRD provided water quality monitoring data collected since 1970 at this site. In addition, the BCCWP conducted a watershed-wide pollutant monitoring program between 2012 and 2014. All documents used in this report are listed in the literature cited section with information on who created each report and where they may be obtained.

Noteworthy: U.S. EPA's Nine Elements of a Watershed Plan

The U.S. EPA has identified nine key elements that are critical for achieving improvements in water quality. Illinois EPA requires that these nine elements be addressed in watershed plans funded with Clean Water Act Section 319 funds.

a. Identification of the causes and sources or groups of similar sources of pollution that will need to be controlled to achieve the pollutant load reductions estimated in the watershed plan.

b. Estimate of the pollutant load reductions expected following implementation of Best Management Practices (BMPs).

c. Description of the BMPs that are expected to be implemented to achieve the estimated load reductions and an identification of the critical areas in which those measures will be needed to implement the watershed plan.

d. Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement the watershed plan.

e. Public information/education component that will be implemented to enhance public understanding of the watershed plan and encourage early and continued participation in selecting, designing, and implementing the non-point source management measures that will be implemented.

f. Schedule for implementing the non-point source management measures identified in the watershed plan.

g. Description of interim, measurable milestones for determining whether non-point source management measures or other control actions are being implemented.

h. Set of criteria that can be used to determine whether pollutant load reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.

i. Monitoring component to evaluate the effectiveness of the implementation efforts over time.

1.7 Using This Plan

1.7.1 Who Should Use This Plan

The Buffalo Creek Watershed-Based Plan is of limited utility without watershed stakeholders that are dedicated to managing and restoring the watershed. Municipal and county agencies in conjunction with elected officials are responsible for taking the information presented in this document to be used for managing the watershed. While these agencies and elected officials are responsible for implementing the plan presented in this document, each community member can influence the actions of their representatives. Public agencies and other representatives represent the concerns of their constituents. Therefore, each community member has the potential to influence the actions that occur in the Buffalo Creek Watershed through active participation.

Photo of Farrington Ditch, courtesy of M. Knysz.

State and federal agencies and 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. State and Federal agencies can also design and install transportation projects in conformance with watershed plan recommendations.

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, and private landowners and residents will have to work together in order 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 in the long-term stewardship responsibility, and share the costs and benefits of watershed improvements.

Photo of Farmington Pond 8, courtesy of Diane L. Kittle, Environmental Photographer.

The success of plan implementation will also be determined by the watershed organization and its ability to coordinate, communicate, and manage activities for stakeholders. 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 providing educational outreach to the community. The BCCWP will continue to be the primary watershed organization that will engage the general public in watershed activities, support the implementation of the watershed plan, and voice their concerns and celebrate their successes in restoring watershed resources.

Buffalo Creek Reservoir (left). Volunteers at workday event (right). Photos courtesy of J. Weiss.

1.7.2 How to Use This Plan

For those unfamiliar with watershed planning, this document may appear overwhelming. There are pages of information to navigate, containing a lot of tables and maps that report on the condition of the watershed, and many costly recommendations that a lone individual could not possibly begin to implement. These recommendations are for public agencies to consider. But there are also a number of straightforward actions that each person in the watershed 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. To get a general understanding of what this plan is about, please read the Executive Summary, which also includes a list of top priority actions for each stakeholder group. For additional details, browse the table of contents and flip to the relevant section you are interested in.

To find out

… what this plan is intended to accomplish, read about the watershed goals and objectives in **Chapter 2**.

….detailed information about watershed resources and conditions, read the sections of interest in **Chapter 3**.

….detailed information about flooding, including a flood problem inventory and strategies for flood damage reduction, turn to **Chapter 4**.

….what problems the watershed is facing, **Chapter 5** includes a summary and analysis of watershed problems that need to be addressed by the action plan.

….what kind of actions can be taken to improve the watershed, the Action Plan in **Chapter 6** 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 be taken to help fix problems in a specific area.

….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**.

Chapter 2 Watershed Issues, Opportunities, Goals and Objectives

2 Watershed Issues, Opportunities, Goals and Objectives

2.1 Watershed Issues

As discussed in Section 1.5, one of the first tasks undertaken by the Buffalo Creek Clean Water Partnership (BCCWP) was to identify watershed issues based on stakeholder input. Issues were first identified by meeting participants at the April 2012 planning meeting (see **Appendix A** for stakeholder meeting minutes) and voted on at the June 2012 meeting to determine priorities. A full list of the issues/concerns of stakeholders is available in **Table 2-1**. Issues were grouped into categories by topic areas to categorize them into goal areas. All of the categories are listed below from highest concern to lowest concern, based on stakeholder voting.

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

Priority	# of Votes	Issue
1	**Total = 97**	**Water Quality**
	44	Water quality and impairments in Buffalo Creek, tributaries, Lakes and Buffalo Creek Reservoir.
	13	Illicit discharges.
	15	Pollution from stormwater.
	12	Potential groundwater pollution and the impact on private wells.
	2	Expand/implement/coordinate water quality monitoring program among jurisdictions.
	10	Clean water for the future.
	1	Concerns regarding sump pump discharges to the creek.
2	**Total = 78**	**Habitat**
	35	Natural resource/habitat protection and restoration.
	18	Invasive species control and removal.
	5	Aesthetic quality improvement.
	20	Sedimentation in creeks and lakes.
3	**Total = 73**	**Stormwater and Flooding**
	59	Flooding and stormwater management.
	9	Changes to the floodplain in the watershed from development.
	5	Stormwater runoff degrading wetlands at Deer Grove Forest Preserve.
4	**Total = 39**	**Projects**
	39	Promoting and implementing green infrastructure.
	0	Identifying and organizing a pilot project.
5	**Total = 38**	**Erosion**
	4	Erosion and the associated loss of land and trees.
	3	Erosion and impacts to water quality.
	0	Preventing and repairing channel erosion.
	29	Location specific erosion issues such as: -Creekside Development -Buffalo Creek Preserve -Buffalo Creek at Cuba Road -Hillcrest Subdivision -Buffalo Creek east of Arlington Heights Road -Buffalo Creek at Lake Cook Road -The Crossings
	0	Erosion due to development and upstream detention ponds.
	2	Erosion and tree removal concerns.

6	**Total = 30**	**Education/Outreach**
	0	Address mosquito abatement problem.
	1	Lack of communication about permitting between municipality and residents.
	26	Provide information on water quality, erosion, stormwater, illicit discharges, and septic system maintenance to targeted audiences (homeowner associations (HOAs), residents, landowners).
	3	Get younger people involved. Coordination with Buffalo Grove Environmental Action Team, Eagle Scouts, schools, Gardening Clubs, etc.
	0	Utilize homeowner groups for matching funds (for grants) and volunteers.
7	**Total = 2**	**Additional Issues Raised During Meeting**
	2	Ordinance Revisions
	0	Aesthetics (habitat)
	0	Safety

2.2 Watershed Opportunities

Following the identification of watershed issues, stakeholders provided input on what they think the watershed opportunities are. They considered what they really like about the watershed and identified these characteristics as opportunities for preserving for the future in addition to identifying opportunities for remediating issues. The opportunities identified by stakeholders are listed in **Table 2-2**.

Table 2-2: Opportunities in the Buffalo Creek Watershed Identified by Stakeholders.

Stakeholder Identified Opportunities
Target pollutants and sediments.
Expand/implement/coordinate water quality monitoring program among jurisdictions.
Promote and implement green infrastructure.
Conduct habitat restoration and invasive species removal projects.
Look for a pilot project to get people interested.
Tap into Metropolitan Water Reclamation District (MWRD) funds to implement green infrastructure projects in Cook County.
Provide information on water quality, erosion, storm water, illicit discharges, and septic system maintenance to residents.
Get people involved. Coordinate with Buffalo Grove Environmental Action Team (BG EAT), Eagle Scouts, Schools, and Gardening Clubs.
Utilize homeowner groups for matching funds (for grants) and volunteers.
Help to promote ordinances.
Volunteer opportunities.

The identification and prioritization of issues and opportunities at the outset of the planning process was the basis the planning team and stakeholders used for developing goals and objectives for the watershed plan and to guide the planning team's focus in completing the watershed assessment. The prioritization process did not limit watershed planning to only the five highest priority issues/opportunities, but rather allowed the watershed plan development team to focus their efforts and make sure that the highest priority issues are adequately addressed in the planning process and within this watershed plan report. The planning team also considered the results of the watershed assessment in developing the plan objectives.

2.3 Stakeholders Have a Vision for the Watershed

The Buffalo Creek Watershed stakeholders 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 question:

1. "What would you like the Buffalo Creek watershed landscape to look like – or be – in 20 years?"

This question was followed by the following guidance:

2. Begin with what you value related to the landscape, water resources & living conditions (consider what you like and would like to preserve – think about the future).
3. Lastly, the exercise asked participants to write a newspaper article reflecting their vision for the watershed including a headline, cover story, types of photographs to be included and quotes the article would include.

The participant response to the exercise resulted in the following vision statement for the Buffalo Creek watershed.

> ***Buffalo Creek will be a sustainable watershed success story with reduced erosion, improved water quality, thriving wildlife, decreased flooding and the beauty of native vegetation. This will be accomplished through collaborative and inclusive community and agency partnerships.***

2.4 Watershed Goals and Objectives

The Buffalo Creek Watershed planning committee generated six goals to address stakeholder issues/concerns. Establishing these goals allowed the planning committee to develop objectives and outcomes for each goal. The goals developed by the planning committee were central to the development of the Action Plan (**Chapter 6**). The goals and objectives reflect watershed conditions, address 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 best management practices for specific problem locations identified during inventories and assessments.

The goals and objectives are examined in more detail when evaluating the watershed plan's performance and progress by evaluating milestones related to measurable indicators for the goals and objectives.

GOAL #1 WATER QUALITY: Improve and protect water quality (physical, biological, and chemical health), reduce impairments and non-point source pollution, and implement land development and management practices to prevent pollution.

OUTCOME: Water bodies are not impaired (fully support designated uses) and future pollution is prevented, have healthy lakes, streams, and wetlands.

OBJECTIVES:

a. 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 lakes. Target public and private snow plow operators.

   Indicator: Amount of road salt used.

b. Reduce actions that cause phosphorous to be released into the waterways such as erosion and fertilizers with phosphorus. Watershed municipalities and counties pass ordinances banning the use of fertilizers with phosphorus unless a soil test indicates it is needed.

   Indicator: Number of municipalities and counties that adopt a phosphorous ordinance.

c. Remove sources of fecal coliform.

Indicator: Number of identified sources of fecal coliform that were addressed.

d. Reduce sediment accumulation in surface waters by reducing streambank, shoreline, and construction related erosion throughout the watershed.

Indicator: Linear feet of streambank and shoreline restored.

e. Reduce pollution caused by dissolved and suspended solids and sediment accumulation in surface waters and wetlands.

Indicator: Linear feet of streambanks addressed that were designated as "moderate erosion" and "severe erosion" in the Stream and Basin Inventory.

f. Implement stormwater management practices that minimize runoff volumes, velocities and pollutants to the creek through infiltration of rainwater on-site using stormwater Best Management Practices (BMPs) such as rain gardens, bio-retention, permeable pavement, and open swales.

Indicator: Number of BMPs installed.

g. Provide incentives/cost share programs, and promote pollution and stormwater runoff reduction programs (such as Conservation @Home) to result in retrofitting/implementing best management practices that reduce pollution and infiltrate stormwater.

Indicators: Number of incentive, cost share, pollution and stormwater runoff reduction programs established.

h. Retrofit and maintain existing stormwater management structures such as detention ponds to provide or enhance water quality improvement, including discouraging nuisance wildlife (Canada geese).

Indicator: Number of existing stormwater management structures retrofitted.

i. Develop and implement a watershed monitoring program to collect and monitor water quality and biological data on a regular basis.

Indicator: Watershed monitoring program implemented, frequency of data collection.

GOAL #2 MANAGE STORMWATER VOLUME AND REDUCE FLOODING: Reduce flooding and runoff through increased storage and infiltration of stormwater.

OUTCOME: Stormwater flooding and runoff is reduced.

OBJECTIVES:

a. Reduce the rate and volume of stormwater runoff from areas that are already developed.

Indicator: Amount of stormwater detained from new development or redevelopment.

b. Reduce the rates and volume of runoff from new development – maintain pre-development hydrology.

Indicator: Number of developments which maintain pre-development hydrology.

c. Watershed municipalities and counties pass ordinances that prohibit building in the 100-year floodplain.

Indicator: No permits issued for constructing buildings in the 100-year floodplain.

d. Watershed municipalities and counties pass ordinances and standards that require sump pump and downspout discharges be directed to lawn or rain gardens and infiltrated.

Indicator: Number of communities that pass ordinance and standards that require sump pump and downspout discharges be directed to lawn or rain gardens and infiltrated.

e. Establish institutional stream maintenance programs and standards using the American Fisheries Society standards as guidelines.

Indicator: Number of communities and public agencies with established stream maintenance programs.

f. Increase the number of buyouts of properties with structure damage caused by chronic flooding.

Indicator: Number of buyouts.

g. Reduce the number of claims filed during flood events each year by 5%.

Indicator: Number of claims field each year per community in the watershed.

h. Create stormwater utilities based on impervious surface with off-setting credits for best management practices that reduce runoff.

Indicators: Number of communities with stormwater utility programs.

GOAL #3 NATURAL RESOURCES: Protect, enhance & restore natural resources (soil, water, plant communities, fish and wildlife) through expanding environmental corridors, maintaining hydrology and buffers for high quality areas, and employing good natural resource management practices.

OUTCOME: Natural resources are protected, enhanced, or restored.

OBJECTIVES:

a. Permanently preserve more natural lands as conservation areas through purchase by forest preserve or by conservation easement.

Indicator: Area of open space preserved.

b. Maintain and expand high quality native riparian buffers (non-native not to exceed 30%) and restore native riparian buffers along those stream reaches identified as having a high or medium level of need for improvement in the stream inventory.

Indicator: Area of riparian buffer maintained, expanded and restored.

c. Restore degraded natural communities, both terrestrial and aquatic (lakes, wetlands and streams), to ecological health with natural practices and native plants to improve habitat and functional value.

Indicator: Area of degraded natural communities restored.

d. Restore and create wetlands where feasible with a minimum target of 10% wetland per Subwatershed Management Unit (SMU).

Indicator: Number and acreage of wetlands created and/or restored.

e. Identify, prioritize, and preserve open land with permeable soils, depressional storage, floodplain, wetlands, hydric soils, important natural communities, or significant cultural features within the watershed (i.e.: acquisition, conservation easements, etc.).

Indicator: Amount of open space preserved with permeable soils, depressional storage, floodplain, wetlands, hydric soils, important natural communities, or significant cultural features.

f. Remediate detrimental stream channel conditions such as armouring, channelization, siltation, and lack of habitat characteristics with in-stream and channel-specific restoration enhancements such as re-meandering, re-grading, bio-engineering approaches to stabilization, and habitat structures (pools and riffles, boulders, root wads, etc.).

Indicator: Linear feet of detrimental stream conditions restored.

g. Watershed municipalities and counties adopt policies, standards, and management practices that keep invasive species out.

Indicator: Number of municipalities and counties that adopt policies, standards, and management practices that keep invasive species out.

h. Establish no mow zones along streams or around waters.

Indicator: Number of no mow zones established.

i. Reduce and remove invasive species such as buckthorn, common reed, reed canary grass, garlic mustard, teasel, purple loosestrife, and cattails.

Indicator: Area of land maintained by removing invasive species.

GOAL #4 GREEN INFRASTRUCTURE: Use a system of both site-specific stormwater green infrastructure practices to reduce runoff and pollution, and regional greenways and trails to protect and connect the natural drainage system, natural resource areas and to provide recreational opportunities.

OUTCOME: Site level and regional green infrastructure system is established.

OBJECTIVES:

a. Identify and preserve open space in each SMU as green infrastructure or greenways to promote flood damage reduction, water quality improvement, natural resource protection, and wetland restoration.

Indicator: Amount of open space identified and preserved as green infrastructure or greenways to promote flood damage reduction, water quality improvement, natural resource protection, and wetland restoration.

b. Identify and preserve open space that provides important trail or habitat corridor connections and provides passive recreational opportunities such as hiking fishing, biking, riding, canoeing, and environmental interpretations/education as part of the greenway.

Indicator: Area of open space identified and preserved that provide trail or habitat corridor connections.

c. Implement green street retrofits and install stormwater and natural resource best management practices for new road projects to provide green infrastructure benefits.

Indicator: Length of roadway retrofitted or designed with BMPs

d. Implement green infrastructure best management practices including porous pavement in parking lots to increase infiltration and reduce runoff volumes as retrofits in existing developed areas and in new developments.

Indicator: Number of green infrastructure best management practices implemented in parking lots to increase infiltration and reduce runoff volumes as retrofits in existing developed areas and in new developments.

e. Establish cost-sharing retrofit programs as an incentive to implementing green infrastructure best management practices.

Indicator: Number of cost-sharing programs available.

f. Watershed municipalities, counties, and natural resource agencies adopt and use the Buffalo Creek Watershed Plan in local land use plans and policies.

Indicator: Number of municipalities, counties and natural resource agencies that adopt the Buffalo Creek Watershed Plan.

g. Integrate green infrastructure approach into local stormwater and capital improvement/maintenance budgets.

Indicator: Number of Green Infrastructure projects included in community and public agency capital budgets

GOAL #5 SMART DEVELOPMENT: Guide new development and redevelopment design and practices to protect or enhance existing water resources, natural resources and open space.

OUTCOME: New development occurs without impairing water resources, natural resources, and open space.

OBJECTIVES:

a. Implement conservation design developments that cluster development to protect open space as green infrastructure, protecting important natural communities.

Indicator: Number of developments using conservation design principles built.

b. Review and revise existing development codes to allow or require the stormwater green infrastructure approach to site planning and design and low impact development practices by right.

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

c. Watershed municipalities and counties will revise watershed development/subdivision ordinances to include requirement, credit or incentive for infiltration.

Indicator: Number of municipalities and the county which revise ordinances to require, credit, or incentive for infiltration.

GOAL #6 STAKEHOLDER EDUCATION: Provide watershed stakeholders with the knowledge, skills and motivation needed to implement the watershed plan. Watershed stakeholders include (but are not limited to) residents, property owners, property owner associations, businesses and institutions, government agencies and jurisdictions, and developers.

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

OBJECTIVES:

a. Educate residents and watershed jurisdictions on the importance of watershed health (water quality, flood prevention, green infrastructure) to the economy of the communities in the watershed.

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

b. Develop a detention basin maintenance campaign to educate homeowner associations, municipalities and businesses about proper maintenance of detention basins and other stormwater drainage system features.

Indicator: Number of workshops and attendees for education events regarding proper maintenance of detention basins and stormwater features.

c. Educate and provide training to residents and business owners on stormwater best management practices that can be accomplished on private property.

Indicator: Number of workshops and attendees for education events regarding reducing/eliminating pollution inputs associated with lawn care and pet waste.

d. Facilitate public training and engage residents, students, lake associations and homeowner associations in volunteer lake and stream stewardship and maintenance.

Indicator: Number of lake and stream stewardship and maintenance volunteers.

e. Promote the use of native plants, best management practices, green infrastructure, and removal of invasive plants by establishing demonstration sites and training.

Indicator: Number of demonstration sites established and trainings held.

f. Promote the watershed plan recommendations by working with stakeholders to develop a pipeline of watershed projects and funding sources for each of them.

Indicator: Number of projects implemented from the Action Plan.

g. Update watershed residents about the ecological health of the watershed by developing and disseminating a watershed report card in years 5 and 10 of plan implementation. Convey messages from the education plan with public relations, education, outreach and media vehicles to increase public awareness and understanding of watershed issues.

Indicator: Number of watershed residents that receive watershed report card.

Noteworthy: Goals and Objectives

Goals:

- Mini vision statements or targets for the watershed plan.
- Are the desired change or outcome you wish to achieve.
- Are 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.

Chapter 3 Water Resources Inventory

3 Watershed Resource Inventory & Characterization

This chapter is a compilation and analysis of data that describes the condition of the Buffalo Creek Watershed, considering such factors as climate, soils, demographics, land use, natural resources, water resource assessments, etc. This characterization of existing conditions is important so that the challenges and opportunities in the watershed can be more fully understood, and it is the basis for developing recommendations for the Action Plan.

Digital Elevation Models (DEMs): *A digital model or 3D representation of a terrain's surface (commonly for a planet, moon, or asteroid) created from terrain elevation data.*

Subwatershed Management Units (SMUs): *An SMU is a small unit of a watershed or subwatershed that is used in watershed planning efforts. An example of an SMU would be the drainage area for an individual lake located in the watershed.*

Tinley Moraine: *An accumulation of unconsolidated glacial debris that parallels Lake Michigan and passes through Flossmoor, Western Springs and Arlington Heights.*

Topographical Relief: *Refers to the variations in the height and slope of Earth's surface.*

1-foot Contours: *The change in elevation over 1 foot.*

LiDAR: *A remote sensing method that uses light in the form of a pulsed laser to measure ranges to the earth. LiDAR can be used to produce shoreline maps and digital elevation models.*

Hydrologic Unit Code (HUC): *The United States is divided and sub-divided into successively smaller hydrologic units which are classified into four levels: regions, sub-regions, accounting units and cataloging units. The hydrologic units are arranged or nested within each other, from the largest geographic area (regions) to the smallest geographic area (cataloging units). Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system.*

USGS Quadrangles: *Digital topographic maps produced by the National Geospatial Program of the USGS.*

3.1 Watershed Boundaries

As discussed in the Introduction Section of this report, a watershed is the area of land drained by a river/stream system or body of water. The Buffalo Creek Watershed comprises approximately 17,393 acres (27 square miles).

3.1.1 Topography

Topography defines the boundaries of the Buffalo Creek Watershed and is an essential component in the watershed planning process. Topographic data is used in the planning process to develop floodplain maps, water quality models, flood mitigation recommendations, ***Subwatershed Management Units*** **(SMUs)**, ***Digital Elevation Models*** **(DEMs)** and regionally significant depressional storage areas.

The topography of the Buffalo Creek Watershed was formed by glaciers that once covered the region. The watershed drains from the northwest to southeast. The upper watershed, shaped by the ***Tinley moraine***, is covered with hills of varying slopes and made of soils with moderately slow permeability. While the upper watershed does have some ***topographical relief***, the drainage is poorly defined. The northwest portion of the watershed contains the highest elevation at 895 feet above sea level. The southeast portion of the watershed contains the lowest elevation at 630 feet above sea level. Many areas drain into shallow wetlands or marshes, which have the same soil composition as the uplands with poorly drained organic soils mixed in. The lower watershed has limited topographical relief. This condition is especially true east of Elmhurst Road to the Des Plaines River, where the overland slope is approximately 0.001 feet/feet. As a result of the relatively flat slope, this part of the watershed also has poorly defined drainage patterns.

3.1.2 Watershed Delineation

The DEM shown in **Figure 3-1** is a compilation of three data sets: the 2007 Lake County ***1-foot contours***, 2008 Cook County ***LiDAR***, and 2010 Cook County 1-foot contours. The Buffalo Creek Watershed was originally delineated by the U.S. Department of Agriculture Natural Resource Conservation Service (USDA NRCS) as ***Hydrologic Unit Code*** (HUC) #071200040502. The watershed boundary was refined by the U.S. Army Corps of Engineers (USACE) as part of their Des Plaines River Phase II planning efforts. Discrepancies between the HUC and USACE watershed delineations were identified as part of this planning effort. After coordination with the Lake County Stormwater Management Commission (SMC), Illinois Environmental Protection Agency (Illinois EPA) and the USACE, it was determined that the use of the modified USACE watershed boundary and SMU delineation was appropriate and would be used for this Watershed Plan. Revisions to the watershed delineation that were made as part of this planning effort included the following:

1. Addition of areas within Lake Zurich that are tributary to Buffalo Creek via storm sewer.
2. Removal of a portion of the Deer Grove Forest Preserve that is actually tributary to Salt Creek.
3. Removal of an area at the most downstream end of the watershed in Wheeling that actually drains to the mainstem of the Des Plaines River and not to the Buffalo Creek Watershed.

Supporting documentation on this revision process is provided in **Appendix B**. The current watershed boundary includes 17,393 acres and covers portions of the Wheeling, Lake Zurich and Arlington Heights ***USGS Quadrangles***.

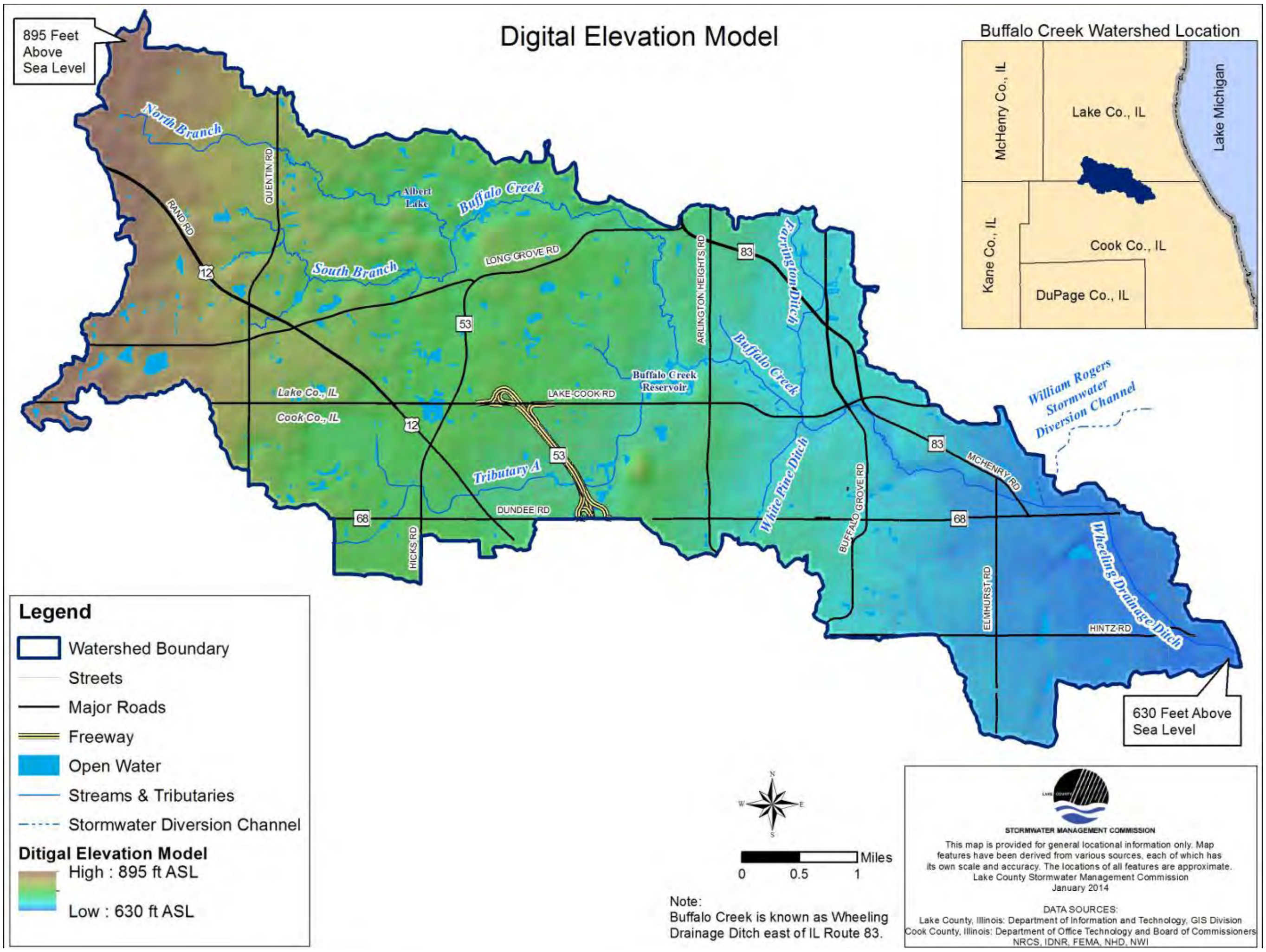


Figure 3-1: Digital Elevation Model of the Buffalo Creek Watershed.

3.1.3 Subwatershed Management Units

As part of the USACE watershed delineation discussed in Section 3.1.2, the watershed was further divided into 32 SMUs using USGS 7.5-minute series topographic maps, augmented with the 2-foot topography collected by the Illinois Department of Natural Resources – Office of Water Resources (IDNR-OWR) and 2000 LIDAR data. The Buffalo Creek Watershed area is 17,393 acres, consisting of 32 SMUs ranging in size from 78 acres to 1,943 acres. The average SMU size is 544 acres. **Figure 3-2** shows the location of SMUs in the Buffalo Creek Watershed. **Table 3-1** includes a breakdown of the SMUs in the Buffalo Creek Watershed and their respective acreages.

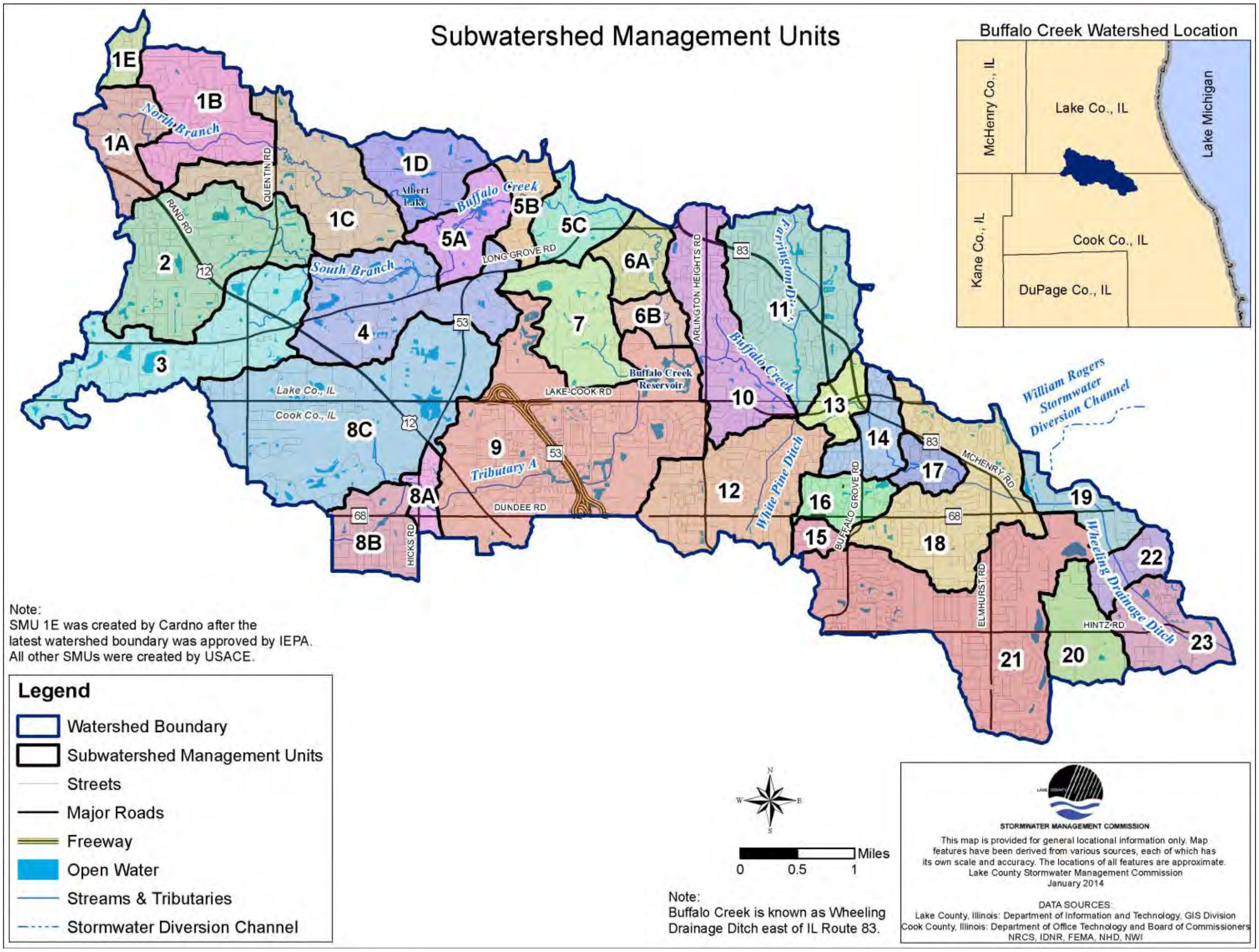


Figure 3-2: Subwatershed Management Units for the Buffalo Creek Watershed.

Table 3-1: Subwatershed Management Units for Buffalo Creek Watershed.

SMU	Area (Acres)	SMU	Area (Acres)	SMU	Area (Acres)
1A	332.4	6A	227.5	14	254.0
1B	611.0	6B	145.5	15	77.7
1C	747.7	7	505.0	16	209.9
1D	401.8	8A	107.3	17	139.4
1E	101.3	8B	335.7	18	884.7
2	967.8	8C	1630.2	19	232.8
3	903.9	9	1942.9	20	342.3
4	865.1	10	672.9	21	1452.7

5A	309.5	11	962.4	22	189.2
5B	193.3	12	827.5	23	380.7
5C	269.0	13	169.4		
				TOTAL	**17,393.0**

3.2 Climate and Precipitation

3.2.1 Climate

Illinois 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. There are several other environmental factors that affect the climate of Illinois, including solar energy, the proximity of Lake Michigan and urban areas. The intensity of the sun's incoming energy is determined by Illinois' mid-latitude position. This position causes Illinois to experience warm summers and cold winters, because the regional solar energy input is three to four times greater in the summer than in the winter. 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).

Locally, Lake Michigan influences the climate of Illinois, including the Buffalo Creek Watershed. 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 and decreases summer precipitation. During the winter, Lake Michigan enhances precipitation totals by adding lake-effect snow, which occurs when winds originate from the north or northeast (National Climatic Data Center, 2009).

Data obtained from the ***National Climatic Data Center*** (Barrington station) best represents the overall climate and weather patterns experienced in the Buffalo Creek Watershed. The 1981 to 2010 Climate Normals are the National Climatic Data Center's latest three-decade averages of climatological variables, including temperature and precipitation. The Climate Normals show that winter months are cold, averaging 23.5°F; and winter lows average 15.8°F. Summers are warm, averaging 70°F; and summer highs average 79.5°F. The Climatic Normals for temperature can be found in **Figure 3-3.**

3.2.2 Precipitation

Illinois exhibits a wide variability in annual precipitation. January and February are normally the driest months, while May and August are typically the wettest months. The Climatic Normals for precipitation can be found in **Figure 3-4**. The wide variety of climate conditions creates diverse watershed conditions. For example, during the winter months the watershed experiences precipitation in the form of snow; however, this precipitation minimally affects flooding. Snow melt in the spring, combined with rain events, may result in stream and localized flooding. During the spring the watershed will usually experience warming temperatures and wet weather conditions. In contrast, during the fall, the watershed experiences cooling temperatures and precipitation frequency decreases.

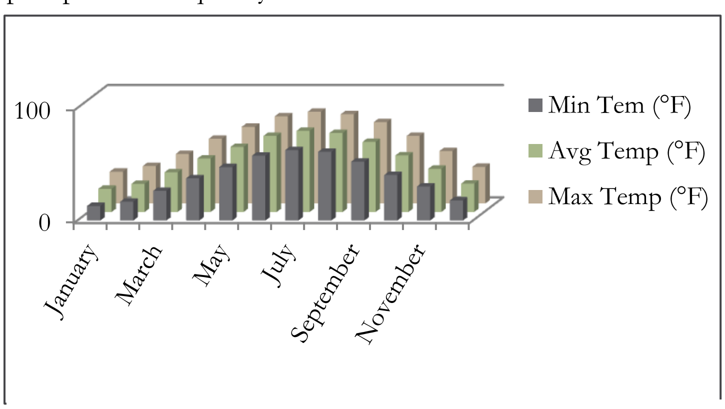


Figure 3-3: National Climatic Data Center's 1981-2010 Climate Normals – Temperature (Barrington, IL station).

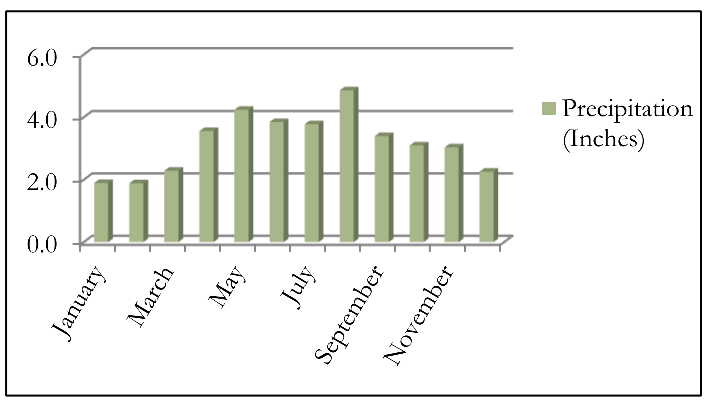


Figure 3-4: National Climatic Data Center's 1981-2010 Climatic Normals - Precipitation (Barrington, IL station).

3.3 Soils

> ***Soil series:*** *A group of soils that have profiles which are almost alike, except for differences in texture of the surface layer. All soils of a series have horizons that are similar in composition, thickness, and arrangement.*
>
> ***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.*

Deposits left during the last period of glaciation approximately 14,000 years ago are the raw materials of present soil types in the Buffalo Creek Watershed. 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 manner in which soils in a particular area will interact with water in the environment, and therefore are useful in watershed planning. In particular, these soil characteristics can help to guide where restoration and best management practices are likely to be successful and where there may be constraints to project implementation.

The USDA NRCS has produced a detailed soil survey for Lake and Cook Counties. 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 Lake and Cook Counties. The soil surveys were utilized to extract detailed soil data for the Buffalo Creek Watershed.

Fifty-five different soil series have been identified throughout the watershed based on soil series coverage area as determined by the NRCS's Soil Survey of Lake County (NRCS 2012) and the NRCS's Soil Survey of Cook County (NRCS 2011). These soil types are symbolized on **Figure 3-5.** Of the 55 different soil series, only the 30-most dominant have been listed in **Table 3-2.** The remaining 25 soils have been classified as "non-dominant soils." Combined, non-dominant soils cover approximately 6% of the entire watershed. Markham silt loam is the predominant soil type in the watershed, covering approximately 2,436 acres or approximately 14% of the watershed. The Markham silt loam soil type is a very deep and moderately well drained soil of the till plains. Ashkum silty clay loam soils are the next most dominant soil series covering approximately 2,066 acres or approximately 12% of the watershed. The Ashkum silty clay loam soil type is a very deep and poorly drained soil of the till plains.

Table 3-2: Major Soil Types in the Buffalo Creek Watershed.

Soil Series	Soil Series Name	Acres	Hydrologic Soil Group (HSG)	Hydric Rating	% of Watershed
531	Markham silt loam	2,436	C	Not Hydric	14.00%
232A	Ashkum silty clay loam	2,066	C/D	Hydric	11.90%
530	Ozaukee silt loam	1,871	C	Not Hydric	10.80%
805B	Orthents, clayey	1,703	D	Not Hydric	9.80%
146	Elliott silt loam	1,238	C/D	Not Hydric	7.10%
223	Varna silt loam	645	C	Not Hydric	3.70%
298	Beecher silt loam	633	C/D	Not Hydric	3.60%
442B	Mundelein silt loam	531	B/D	Not Hydric	3.10%
153	Pella silt loam	438	B/D	Hydric	2.50%
984B	Barrington and Varna silt loams	424	B	Not Hydric	2.40%
854B	Markham-Ashkum-Beecher complex	415	C/D	Partially Hydric	2.40%
152A	Drummer silty clay loam	332	B/D	Hydric	1.90%

989	Mundelein and Elliott silt loams	327	B	Not Hydric	1.90%
189	Martinton silt loam	326	C	Not Hydric	1.90%
802B	Orthents, loamy	297	C	Not Hydric	1.70%
443B	Barrington silt loam	255	C	Not Hydric	1.50%
903A	Muskego and Houghton mucks	238	C/D	Hydric	1.40%
293A	Andres silt loam	205	C/D	Not Hydric	1.20%
541B	Graymont silt loam	201	C	Not Hydric	1.20%
294B	Symerton silt loam	195	C	Not Hydric	1.10%
979B	Grays and Markham silt loams	191	B	Not Hydric	1.10%
530	Ozaukee silty clay loam	189	C	Not Hydric	1.10%
330A	Peotone silty clay loam	188	C/D	Hydric	1.10%
103A	Houghton muck	175	A/D	Hydric	1.00%
3107A	Sawmill silty clay loam	165	B/D	Hydric	0.90%
978	Wauconda and Beecher silt loams	148	B	Not Hydric	0.90%
1107A	Sawmill silty clay loam, undrained	147	B/D	Hydric	0.80%
1103A	Houghton muck, undrained	136	A/D	Hydric	0.80%
848B	Drummer-Barrington-Mundelein complex	132	B/D	Partially Hydric	0.80%
531D2	Markham silt loam	34	C	Not Hydric	0.20%
	TOTAL	**16,281 acres**		**93.8%**	

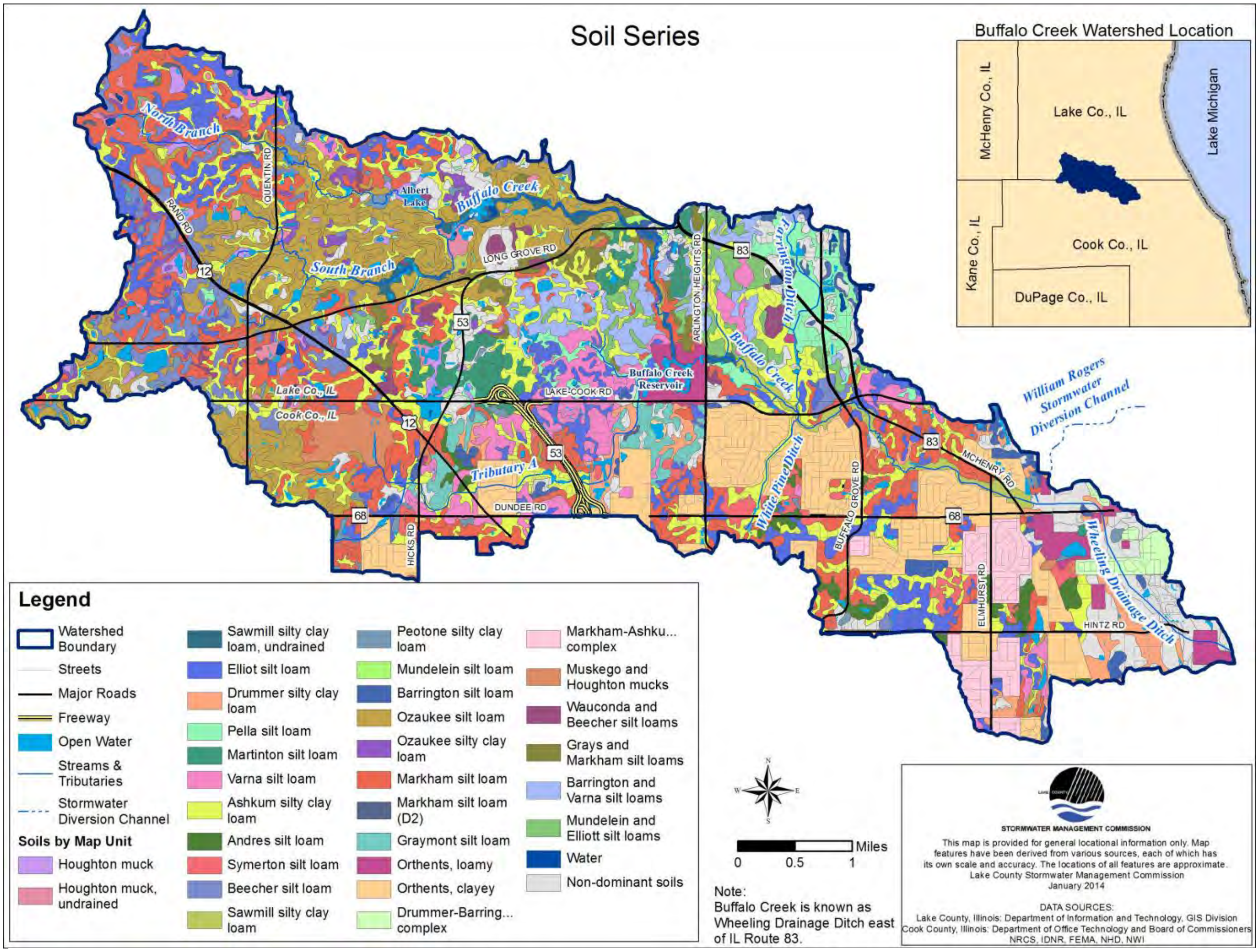


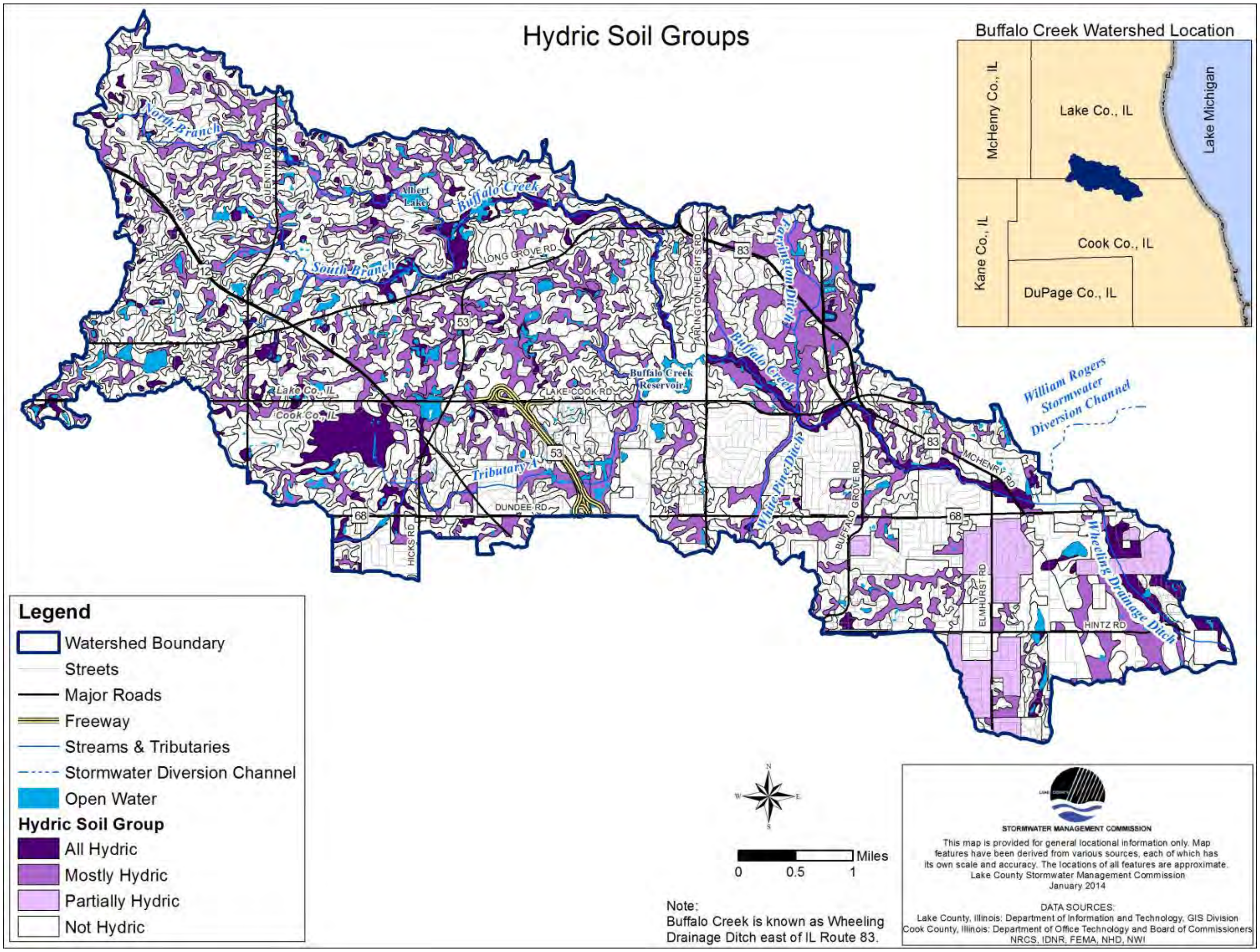
Figure 3-5: Major Soil Types in the Buffalo Creek Watershed.

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***, or plants that tolerate or require saturated soil or standing water. Therefore, the presence of hydric soils is indicative of present or historical wetland conditions or may indicate depressional areas. Areas with hydric soils and drained hydric soils that do not presently contain wetlands may be candidates 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:*** *Plant life growing in water, soil or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; one of the indicators of a wetland.*

Figure 3-6 maps hydric soils in the Buffalo Creek Watershed, according to the NRCS 2012 Lake County Soil Survey and 2011 Cook County Soil Survey. Hydric soils are listed in **Table 3-3** and comprise approximately 4,650 acres (27%), while non-hydric



soils comprise 12,743 acres (73%) of the watershed. Most of the streams, lakes, and other surface waters in the watershed have hydric soils associated with them. Additionally, smaller pockets of hydric soils are well-distributed throughout the watershed.

Figure 3-6: Hydric Soil in the Buffalo Creek Watershed.

Table 3-3: Hydric Soils in the Buffalo Creek Watershed.

Soil Series Name	Area (Acres)	% of Watershed
Houghton muck, undrained, 0 to 2 percent slopes	136	0.80%
Sawmill silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	147	0.80%
Selma loam, 0 to 2 percent slopes	37	0.20%
Muskego and Houghton mucks, undrained, 0 to 2 percent slopes	3	0.00%
Bryce silty clay, 0 to 2 percent slopes	4	0.00%
Sawmill silty clay loam, 0 to 2 percent slopes, frequently flooded	165	0.90%
Will silty clay loam, 0 to 2 percent slopes	73	0.40%

Peotone silty clay loam, 0 to 2 percent slopes	188	1.10%
Muskego and Peotone soils, ponded, 0 to 2 percent slopes	14	0.10%
Harpster silty clay loam, 0 to 2 percent slopes	8	0.00%
Muskego and Houghton mucks, 0 to 2 percent slopes	238	1.40%
Houghton muck, 0 to 2 percent slopes	175	1.00%
Peotone silty clay loam, undrained, 0 to 2 percent slopes	32	0.20%
Drummer silty clay loam, 0 to 2 percent slopes	332	1.90%
Pella silty clay loam, 0 to 2 percent slopes	426	2.40%
Pella silt loam, 0 to 2 percent slopes, overwash	12	0.10%
Ashkum silty clay loam, 0 to 2 percent slopes	2,066	11.90%
Houghton muck, ponded, 0 to 2 percent slopes	44	0.30%
Granby fine sandy loam, 0 to 2 percent slopes	3	0.00%
Drummer-Barrington-Mundelein complex, 1 to 6 percent slopes	132	0.80%
Markham-Ashkum-Beecher complex, 1 to 6 percent slopes	415	2.40%
TOTAL	**4,650**	**27%**

3.3.2 Hydrologic Soil Groups

The NRCS broadly classifies soils based on their drainage characteristics into four different ***Hydrologic Soil Groups (HSG)***. 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. HSG permeability and surface runoff characteristics are defined as follows:

Group A, due to high infiltration rates, have low total surface runoff potential. These soils are composed mainly of deep, well drained sands and gravels. These soils have high water transmission rates (greater than 0.30 in/hour)

Group B have low to moderate runoff potential with moderate infiltration rates and consist of moderately coarse to moderately fine textures. These soils have moderate water transmission rates (0.15-0.30 in/hour).

Group C have moderate to high surface runoff potential with slow infiltration rates. They chiefly consist of soils with layers that impede the downward movement of water. Their textures are fine to moderately fine. These soils have a low water transmission rate (0.05-0.15 in/hour).

Group D have the greatest runoff potential with very slow infiltration rates. They consist chiefly of clay soils with high water tables and shallow soils over nearly ***impervious materials***. These soils have a very low water transmission rate (0-0.05 in/hour).

There are also areas with combined soil groups: HSG-A/B, HSG-A/D, HSG-B/D and HSG-C/D. 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 (A/D, B/D and C/D) 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 can be a number from 0 to 100. Lower runoff curve numbers indicate low runoff potential, while larger runoff curve numbers indicate increased runoff potential. A runoff curve number of 98 is representative of typical ***impervious surfaces***.

Hydrologic Soil Groups: *Groupings of soils according to their runoff potential.*

Impervious Materials: *The total area of rooftops, pavement, and other compacted or hard surfaces that prevent infiltration of precipitation into the ground and therefore result in the generation of surface runoff from nearly all precipitation events).*

Runoff Curve Numbers: *An empirical parameter used in hydrology for predicting direct runoff or infiltration from rainfall. Runoff curve numbers have range from 0 to 100; lower numbers indicate low runoff potential while larger numbers are for increasing runoff potential. The lower the curve number, the more permeable the soil is.*

Impervious Surfaces: *The total area of rooftops, pavement, and other compacted or hard surfaces that prevent infiltration of precipitation into the ground and therefore result in the generation of surface runoff from nearly all precipitation).*

Overall, soils in the Buffalo Creek Watershed are not well drained, as shown in **Table 3-4** and **Figure 3-7**. No soils are classified in H "A," or well-drained soils. Soils classified in hydrologic soil group "B" comprise 8% of the watershed, and are characterized as "moderately well drained" relative to other soil types. More than 50% of the Buffalo Creek Watershed is covered by surface water or soils in hydrologic groups "C" and "D," which exhibit "slow" and "very slow" infiltration and transmission rates, relative to other soil types.

Table 3-4: Hydrologic Soil Groups in the Buffalo Creek Watershed.

Hydrologic Soil Group	Area (Acres)	% of Watershed
A/D	344	2%
B	1,349	8%
B/D	1,847	11%
C	6,434	37%
C/D	5,129	29%
D	1,927	11%
Open Water	363	2%
TOTAL	**17,393**	**100.0%**

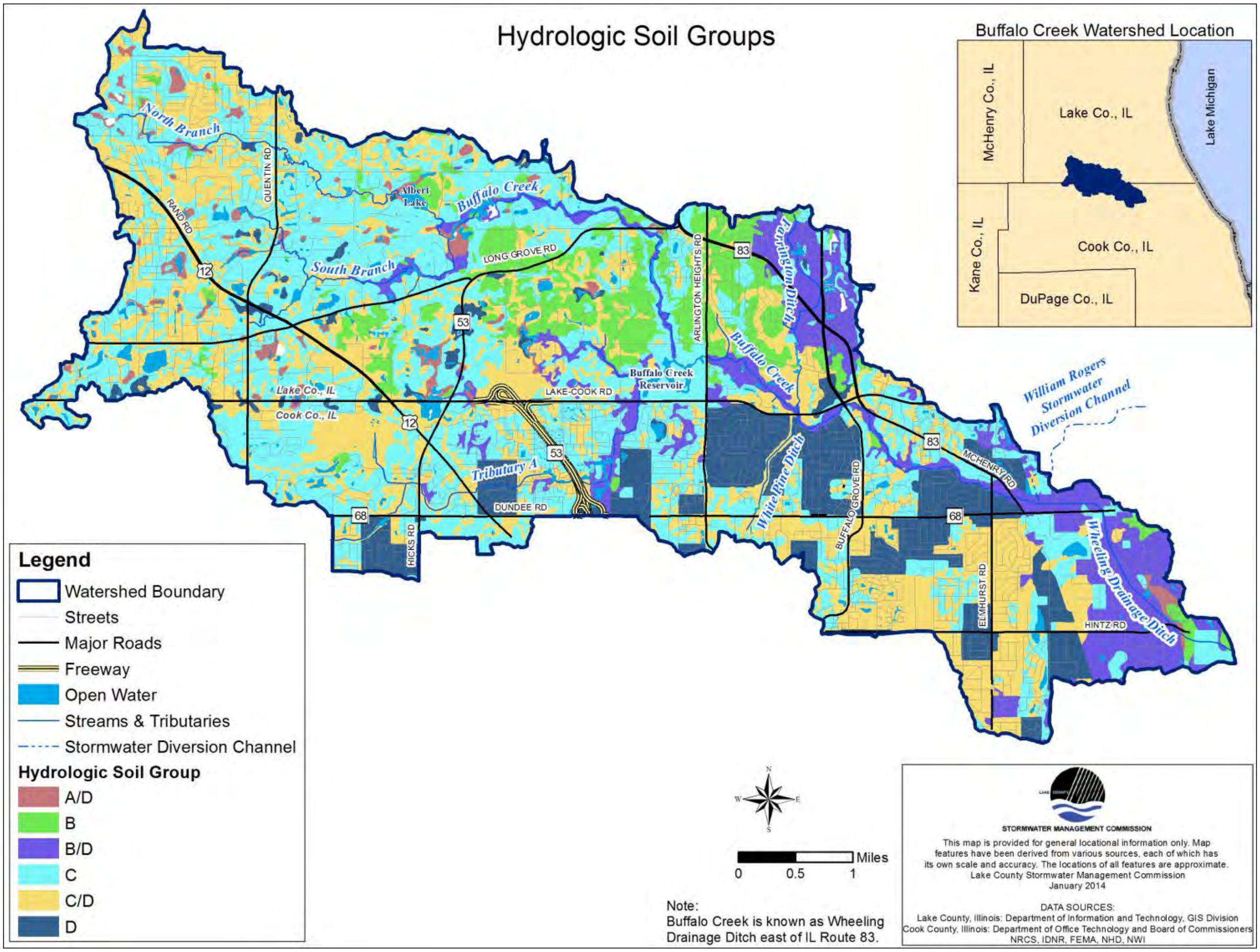


Figure 3-7: Hydrologic Soil Groups in the Buffalo Creek Watershed.

3.3.3 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 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. This results in degradation of water quality due to silt and sediment deposition and pollution. 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 expensive from a public works maintenance perspective.

In the Buffalo Creek Watershed, 10,625 acres (61%) are classified as having highly erodible soil. This suggests that a significant amount of the soils in the watershed have the potential to contribute to water quality issues. **Figure 3-8** maps the locations of highly erodible soils within the Buffalo Creek Watershed, and **Table 3-5** summarizes the highly erodible soils present in the watershed. Highly erodible soils do not include any hydric soils and are represented by hydrologic soil groups "B" and "C," described as moderately poor to moderately well-drained soils. Erodible soils along lakeshores and stream channels, and on 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 Buffalo Creek Watershed are associated with open water (see **Figure 3-8**). Therefore, stabilization practices near shorelines and stream channels could reduce erosion. Additionally, land developers are required to follow the National Pollutant Discharge Elimination System (NPDES) and the Lake County Watershed Development Ordinance (WDO) regulations regarding soil erosion and sediment control measures during construction.

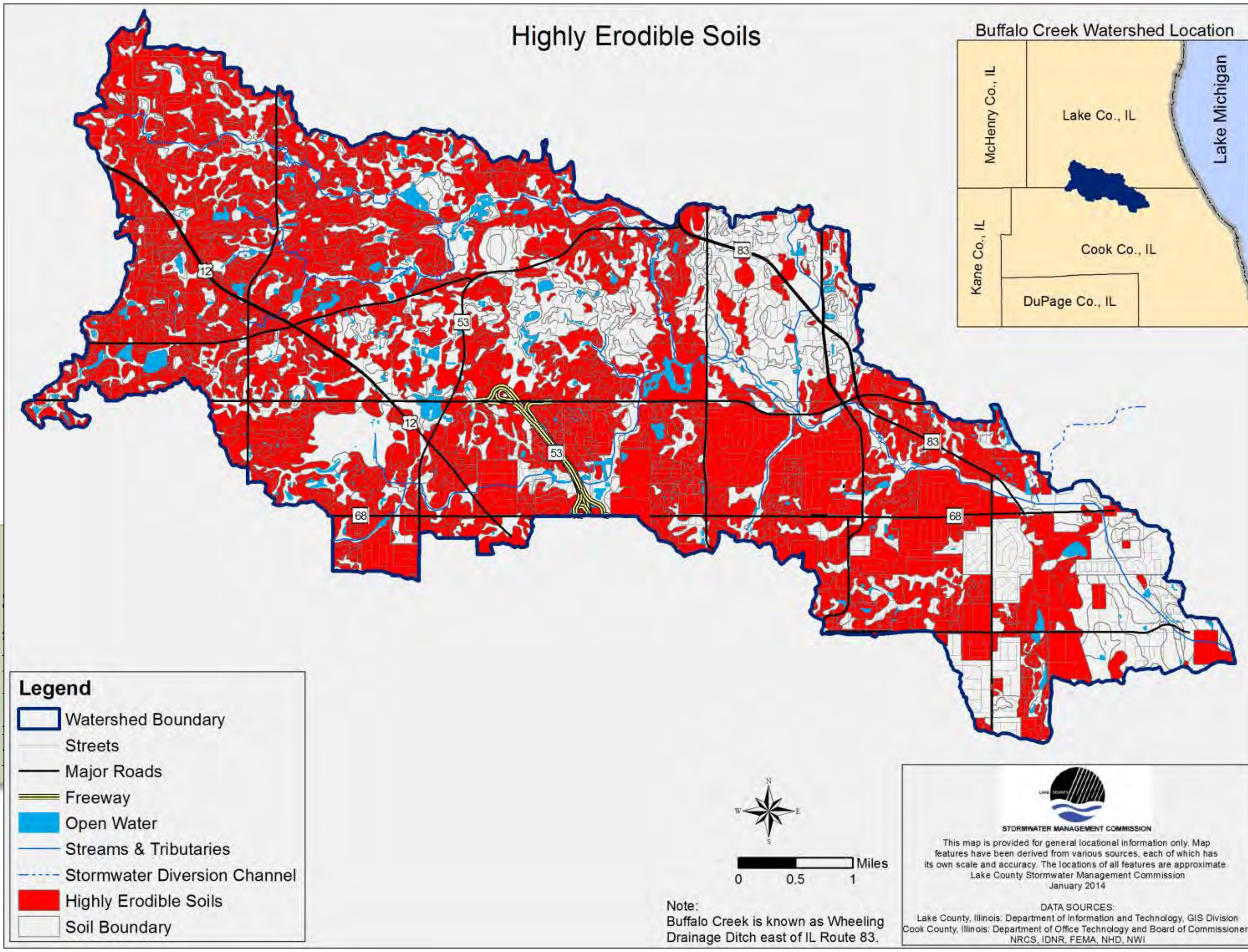


Figure 3-8: Highly Erodible Soils in the Buffalo Creek Watershed.

Table 3-5: Highly Erodible Soils in the Buffalo Creek Watershed.

Major Highly Erodible Soil Series Name	Area (Acres)	% of Watershed
Symerton silt loam	195	1.10%
Ozaukee silty clay loam	189	1.10%

Graymont silt loam	201	1.20%
Andres silt loam	205	1.20%
Barrington silt loam	255	1.50%
Orthents, loamy	297	1.70%
Martinton silt loam	326	1.90%
Beecher silt loam	633	3.60%
Varna silt loam	645	3.70%
Elliott silt loam	1,238	7.10%
Orthents, clayey	1,703	9.80%
Ozaukee silt loam	1,871	10.80%
Markham silt loam	2,436	14.00%
Minor Series (Swygert, Saylesville, Markham, Chenoa, Zurich, Grays, Blount)	333	1.9%
TOTAL	**10,625**	**61%**

3.4 Watershed Jurisdictions

3.4.1 Watershed Planning and Political Boundaries

The Buffalo Creek Watershed 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.

Eight-five percent of the Buffalo Creek Watershed is incorporated, within nine municipalities. The Village of Wheeling occupies the largest area of any municipality within the watershed, at nearly 3,041 acres, or almost 17% of the total watershed area, and the Villages of Buffalo Grove and Long Grove each occupy approximately 16% of the watershed. Unincorporated areas of Lake County total 986 acres (approximately 5% of the watershed) and unincorporated areas of Cook Counties total 1,074 acres (approximately 6% of the watershed). ***Incorporated*** and ***unincorporated*** areas are shown in **Figure 3-9 and Table 3-6.**

One of the challenges of watershed planning, and implementing a watershed plan, is that a watershed usually includes multiple jurisdictions that have varying interests, resources, and responsibilities. This variability can be positive 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 negative 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.

> ***Incorporated:*** *Land that is part of a municipality and is subject to its taxation and services.*
>
> ***Unincorporated:*** *Land that is not part of a municipality and is not subject to its taxation and services.*

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 will benefit the watershed as a whole. 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-range conservation plan for the community. 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 whatever feature made it environmentally sensitive. Sharing information about the land during the comprehensive planning process can avert these kinds of problems down the road.

Table 3-6: Municipalities within the Buffalo Creek Watershed.

Jurisdictional Body	Acres in Lake County	Acres in Cook County	Total Acres	% of Watershed
Wheeling	26	3,267	3,293	18.93%
Buffalo Grove	1,536	1,259	2,795	16.07%
Long Grove	2,518	0	2,518	14.48%
Kildeer	1,723	0	1,723	9.91%
Palatine	0	1,491	1,491	8.57%
Lake Zurich	1,418	0	1,418	8.15%
Deer Park	1,165	9	1,174	6.75%
Arlington Heights	0	920	920	5.29%
Forest Preserve District of Cook County	0	640	640	3.68%
Ela Township	546	0	546	3.14%
Lake County Forest Preserve District	437	0	437	2.51%
Palatine Township	0	166	166	0.95%
Prospect Heights	0	207	207	1.19%
Wheeling Township	0	61	61	0.35%
Vernon Township	3	0	3	0.02%
Total	**9,372**	**8,020**	**17,393**	**100**

3.4.2 Lake County Jurisdictions

The Lake County portion of the Buffalo Creek Watershed has 9,372 acres of the 17,393 total acres and includes the townships of Ela and Vernon and the municipalities of Arlington Heights, Buffalo Grove, Deer Park, Kildeer, Lake Zurich, Long Grove, and Wheeling. Additional Illinois jurisdictional bodies that are located in the watershed are shown in **Figure 3-9** through **Figure 3-13** and **Table 3-7** and include:

1. Lake County Board Districts (19th District, 20th District)
2. Lake County Forest Preserve District (LCFPD)
3. Park Districts (Arlington Heights, Barrington, Buffalo Grove, Long Grove, Wheeling)
4. Illinois State Representative Districts (51st District, 57th District, 59th District)
5. Illinois State Senatorial Districts (26th District, 29th District, 30th District)
6. US Congressional Districts (10th District, 6th District)

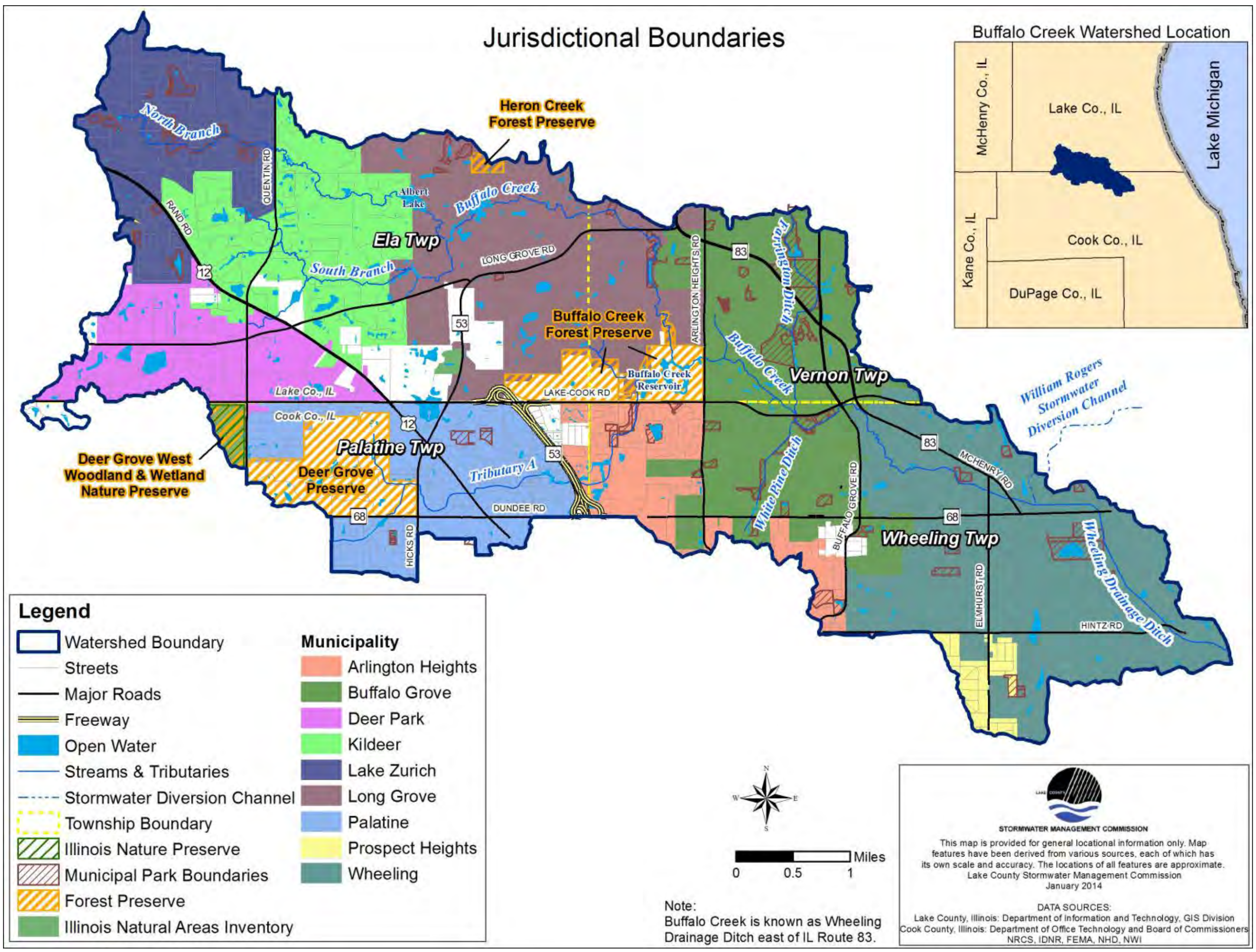


Figure 3-9: Jurisdictional Boundaries in the Buffalo Creek Watershed.

There is public and private shared responsibility for management, regulation, and protection of watersheds in Lake County. The Lake County WDO is applied county-wide by municipal and county governments to provide consistent development standards for development and redevelopment that could affect water resources within incorporated and unincorporated areas. Incorporated areas are responsible for land use planning, zoning, permitting and enforcement for development within their jurisdictions. Development activities in unincorporated areas are permitted and enforced by the Lake County Planning, Building and Development Department (LCPB&D) utilizing the Unified Development Ordinance (UDO).

3.4.3 Cook County Jurisdictions

The Cook County portion of the watershed has 8,020 acres of the 17,393 total acres and includes the townships of Palatine and Wheeling and the municipalities of Arlington Heights, Buffalo Grove, Deer Park, Palatine, Prospect Heights, and Wheeling. These municipalities are responsible for land use planning, zoning, permitting, and enforcement for development within their jurisdictions. Additional Illinois jurisdictional bodies that are located in the watershed are shown in **Figures 3-9** through **3-13** and **Table 3-8** and include:

1. Cook County Forest Preserve District
2. Park Districts (Arlington Heights, Barrington, Buffalo Grove, Palatine, Prospect Heights, Wheeling)
3. Illinois State Representative Districts (53rd District, 54th District, 57th District, 59th District)
4. Illinois State Senatorial Districts (27th District, 29th District, 30th District)
5. US Congressional Districts (6th District, 8th District, 9th District, 10th District)

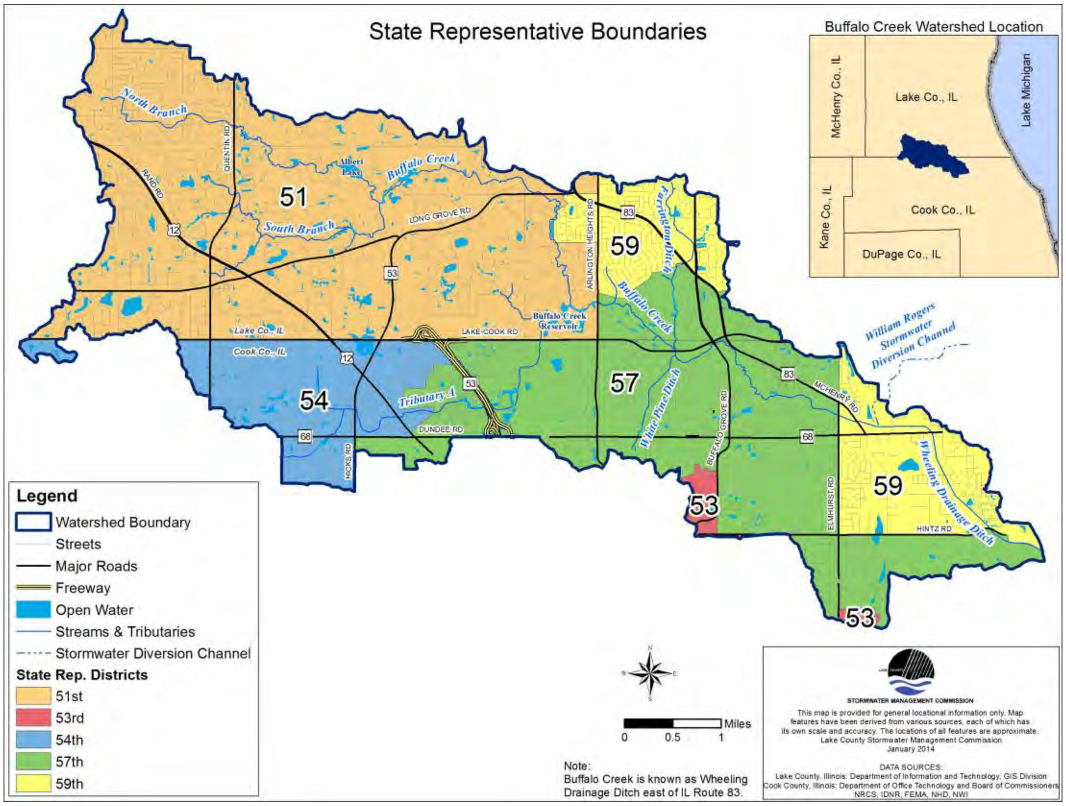
There is public and private shared responsibility for management, regulation, and protection of watersheds in Cook County. The Cook County Watershed Management Ordinance (WMO) is applied county-wide (excluding the City of Chicago) by the Metropolitan Water Reclamation District (MWRD). The purpose of the WMO is to abate the negative impacts of stormwater runoff (e.g. flooding, erosion, water quality impairments, etc.) from new upstream developments or redevelopments.

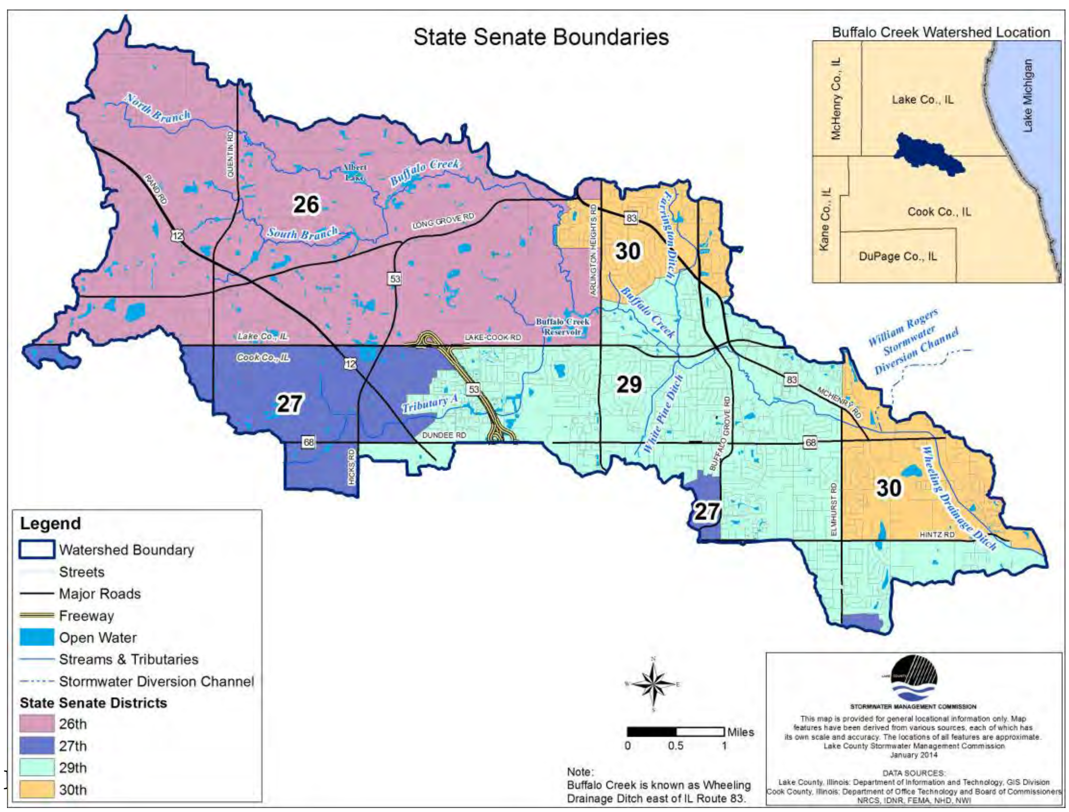
Table 3-7: Jurisdictional Bodies in the Lake County Portion of the Buffalo Creek Watershed.

Jurisdiction Body	Acres	% of Watershed	% of County
Lake County	9,372.3	53.9%	100.0%
Municipalities			
Buffalo Grove	1,535.7	8.8%	16.4%
Deer Park	1,165.9	6.7%	12.4%
Kildeer	1,723.0	9.9%	18.4%
Lake Zurich	1,417.9	8.2%	15.1%
Long Grove	2,518.2	14.5%	26.9%
Wheeling	25.7	0.1%	0.3%
Unincorporated	986.0	5.7%	10.5%
Total	**9,372.3**	**53.9%**	**100.0%**
Townships			
Ela Township	6,871.0	39.5%	73.3%
Vernon Township	2,510.0	14.4%	26.8%
Total	**9,381.0**	**53.9%**	**100.1%**
U.S. Congressional Districts			
10th Congressional District	2,512.0	14.4%	26.8%
6th Congressional District	6,865.0	39.5%	73.2%
Total	**9,377.0**	**53.9%**	**100.0%**
State Representative Districts			
State Representative District - 51st	7,813.0	44.9%	83.4%
State Representative District - 57th	596.0	3.4%	6.4%
State Representative District - 59th	967.0	5.6%	10.3%
Total	**9,377.0**	**53.9%**	**100.0%**
State Senate Districts			
State Senate District - 26th	7,813.0	44.9%	83.4%
State Senate District - 29th	596.0	3.4%	6.4%
State Senate District - 30th	967.0	5.6%	10.3%
Total	**9,377.0**	**53.9%**	**100.0%**
County Board Districts			
Lake County Board - 19th District	4,485.0	25.8%	47.9%
Lake County Board - 20th District	4,892.0	28.1%	52.2%
Total	**9,377.0**	**53.9%**	**100.0%**
Park Districts			
Arlington Heights Park District	15.0	0.1%	0.2%
Barrington Park District	1.0	0.0%	0.0%
Buffalo Grove Park District	1,675.0	9.6%	17.9%
Long Grove Park District	2,663.0	15.3%	28.4%
Wheeling Park District	24.0	0.1%	0.3%
Total	**4,379.0**	**25.2%**	**46.7%**

Table 3-8: Jurisdictional Bodies in the Cook County Portion of the Buffalo Creek Watershed.

Jurisdiction Body	Acres	% of Watershed	% of County
Cook County	8,020.4	46.1%	100.0%
Municipalities			
Arlington Heights	919.6	5.3%	11.5%
Buffalo Grove	1,259.0	7.2%	15.7%
Deer Park	8.6	0.0%	0.1%
Palatine	1,490.6	8.6%	18.6%
Prospect Heights	207.4	1.2%	2.6%
Wheeling	3,267.8	18.8%	40.7%
Unincorporated	867.4	5.0%	10.8%
Total	**8,020.4**	**46.1%**	**100.0%**
Townships			
Palatine Township	2,378.6	13.7%	29.7%
Wheeling Township	5,632.9	32.4%	70.3%
Total	**8,011.6**	**46.1%**	**100.0%**
U.S. Congressional Districts			
6th Congressional District	1,645.8	9.5%	20.5%
8th Congressional District	3,402.6	19.6%	42.5%
9th Congressional District	365.6	2.1%	4.6%
10th Congressional District	2,609.3	15.0%	32.6%
Total	**8,023.3**	**46.1%**	**100.0%**
State Representative Districts			
State Representative District - 53rd	169.4	1.0%	2.1%
State Representative District - 54th	1,762.5	10.1%	22.0%
State Representative District - 57th	4,730.7	27.2%	59.0%
State Representative District - 59th	1,361.6	7.8%	17.0%
Total	**8,024.2**	**46.1%**	**100.0%**
State Senate Districts			
State Senate District - 27th	1,932.0	11.1%	24.1%
State Senate District - 29h	4,730.7	27.2%	59.0%
State Senate District - 30th	1,361.6	7.8%	17.0%
Total	**8,024.2**	**46.1%**	**100.0%**
Park Districts			
Arlington Heights Park District	710.6	4.1%	8.9%
Barrington Park District	23.2	0.1%	0.3%
Buffalo Grove Park District	1,401.2	8.1%	17.5%
Palatine Park District	2,056.6	11.8%	25.7%
Prospect Heights Park District	270.1	1.6%	3.4%
Wheeling Park District	3,050.8	17.5%	38.1%
Total	**7,512.5**	**43.2%**	**93.8%**


State Representative Boundaries
Buffalo Creek Watershed Location
McHenry Co., IL
Lake Co., IL
Lake Michigan
Kane Co., IL
Cook Co., IL
DuPage Co., IL
North Branch
South Branch
Buffalo Creek
Albert Lake
Farrington Ditch
Tributary A
White Pine Ditch
Wheeling Drainage Ditch
William Rogers Stormwater Diversion Channel
Buffalo Creek Reservoir
51
54
57
59
53
Legend
Watershed Boundary
Streets
Major Roads
Freeway
Open Water
Streams & Tributaries
Stormwater Diversion Channel
State Rep. Districts
51st
53rd
54th
57th
59th
Miles
0
0.5
1
Note:
Buffalo Creek is known as Wheeling Drainage Ditch east of IL Route 83.
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
January 2014
DATA SOURCES:
Lake County, Illinois: Department of Information and Technology, GIS Division
Cook County, Illinois: Department of Office Technology and Board of Commissioners
NRCS, IDNR, FEMA, NHD, NWI


State Senate Boundaries
Buffalo Creek Watershed Location
McHenry Co., IL
Lake Co., IL
Lake Michigan
Kane Co., IL
Cook Co., IL
DuPage Co., IL
North Branch
South Branch
Buffalo Creek
Albert Lake
Farrington Ditch
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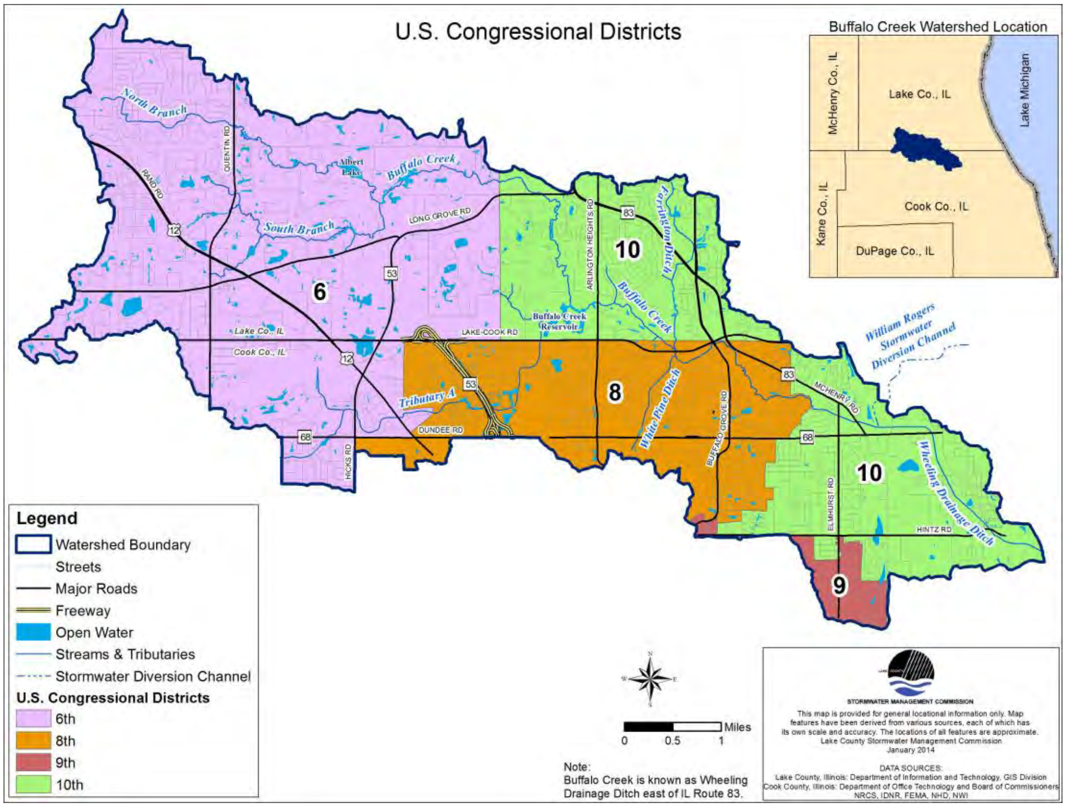
Wheeling Drainage Ditch
William Rogers Stormwater Diversion Channel
Buffalo Creek Reservoir
26
27
29
30
Legend
Watershed Boundary
Streets
Major Roads
Freeway
Open Water
Streams & Tributaries
Stormwater Diversion Channel
State Senate Districts
26th
27th
29th
30th
Miles
0
0.5
1
Note:
Buffalo Creek is known as Wheeling Drainage Ditch east of IL Route 83.
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
January 2014
DATA SOURCES:
Lake County, Illinois: Department of Information and Technology, GIS Division
Cook County, Illinois: Department of Office Technology and Board of Commissioners
NRCS, IDNR, FEMA, NHD, NWI



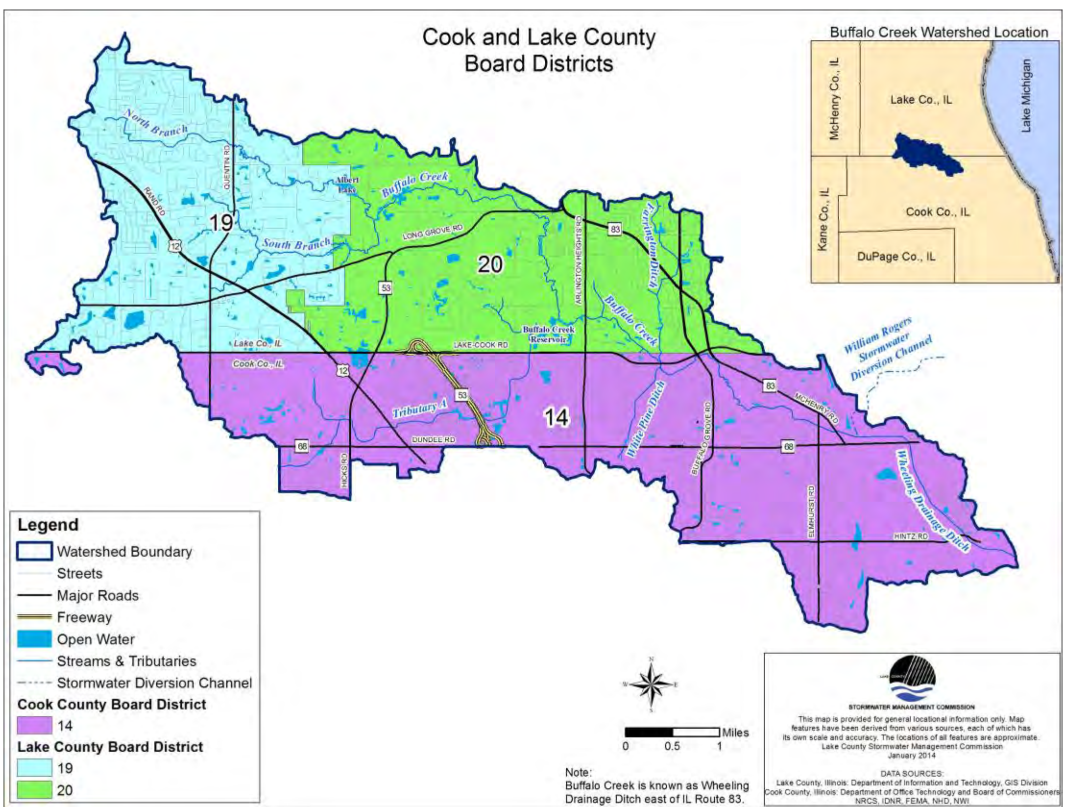


Figure 3-13: Cook and Lake County Board Districts in the Buffalo Creek Watershed.

Figure 3-12: U.S. Congressional Districts in the Buffalo Creek Watershed.

3.5 Demographics

Based on the 2010 decennial census, the population within the Buffalo Creek Watershed is approximately 123,813. The Chicago Metropolitan Agency for Planning (CMAP) forecasts population to increase by an additional 23% by the year 2040 (see **Figure 3-14** and **Table 3-9**). This population change is also 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 3-15** and **Table 3-9**). As of 2010, there were approximately 55,348 jobs in the Buffalo Creek Watershed. CMAP forecasts employment to increase by 25.5% by the year 2040 (see **Figure 3-16** and **Table 3-9**), similar to the ratio forecast for population growth. 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. Because the Buffalo Creek Watershed is a relatively 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.

Table 3-9: CMAP's 2040 Forecast Data for the Buffalo Creek Watershed.

	2010	2010 Density/acre	2040	2040 Density/acre	Forecast Change (2010-2040)	Percent Change (2010-2040)
Population	123,813	7.1	152,332	8.8	28,519	23.0%
Households	46,328	2.7	53,954	3.1	7,626	16.5%
Employment	55,348	3.2	69,479	4.0	14,131	25.5%

Source: Chicago Metropolitan Agency for Planning 2040 Forecasts

Noteworthy: Demographic Forecasts

To create demographic projections, regional agencies analyze data from local agencies for various demographic criteria, including population, households, and employment. After the data is collected from local governments, adjustments must be made to the data in situations where there is overlapping or contradictory information amongst the local jurisdiction boundaries. Forecasts are then projected for quarter sections, which are 160-acre tracts of land.

Chicago Metropolitan Agency for Planning
CMAP
www.cmap.illinois.gov

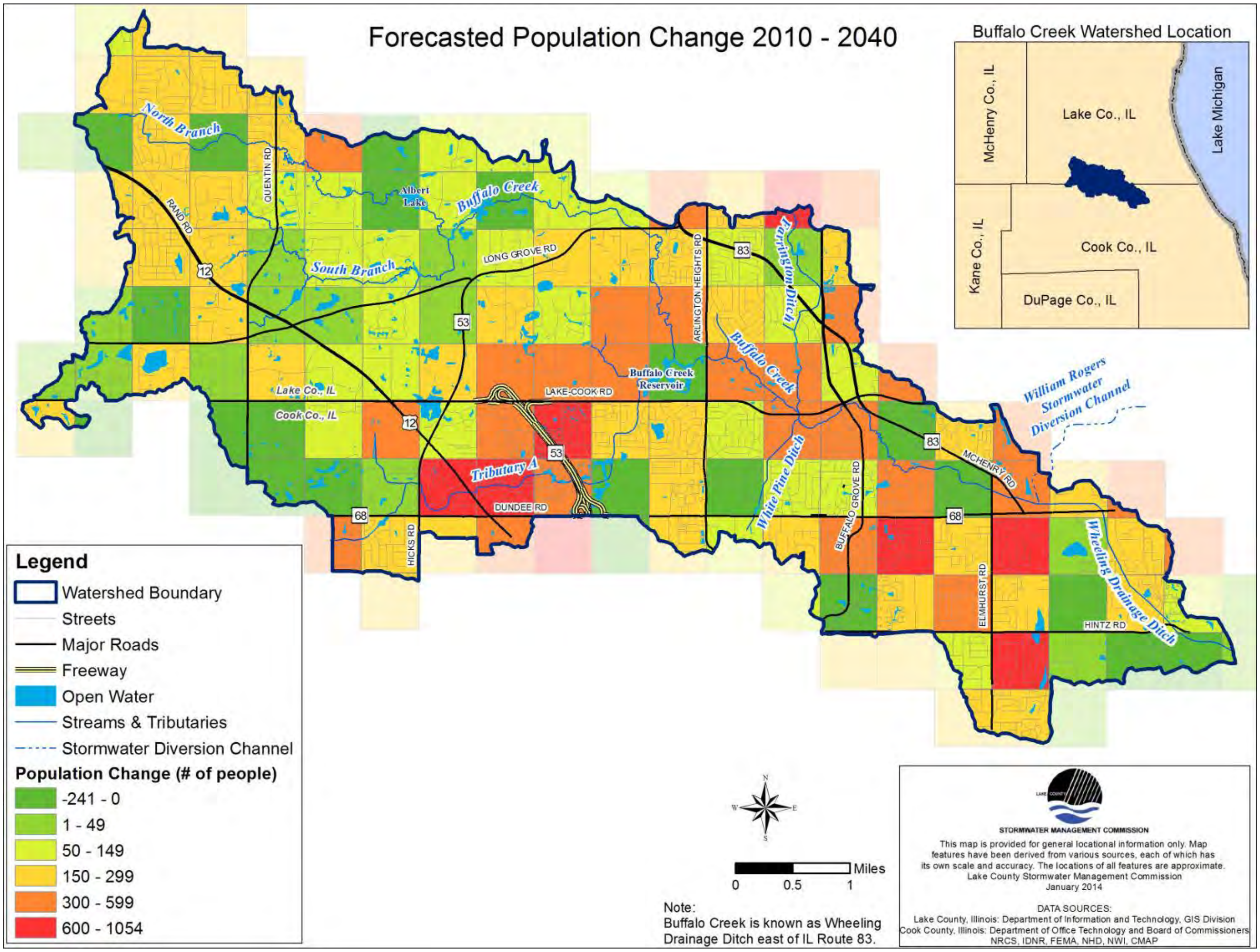


Figure 3-14: Forecasted Population Change in the Buffalo Creek Watershed.

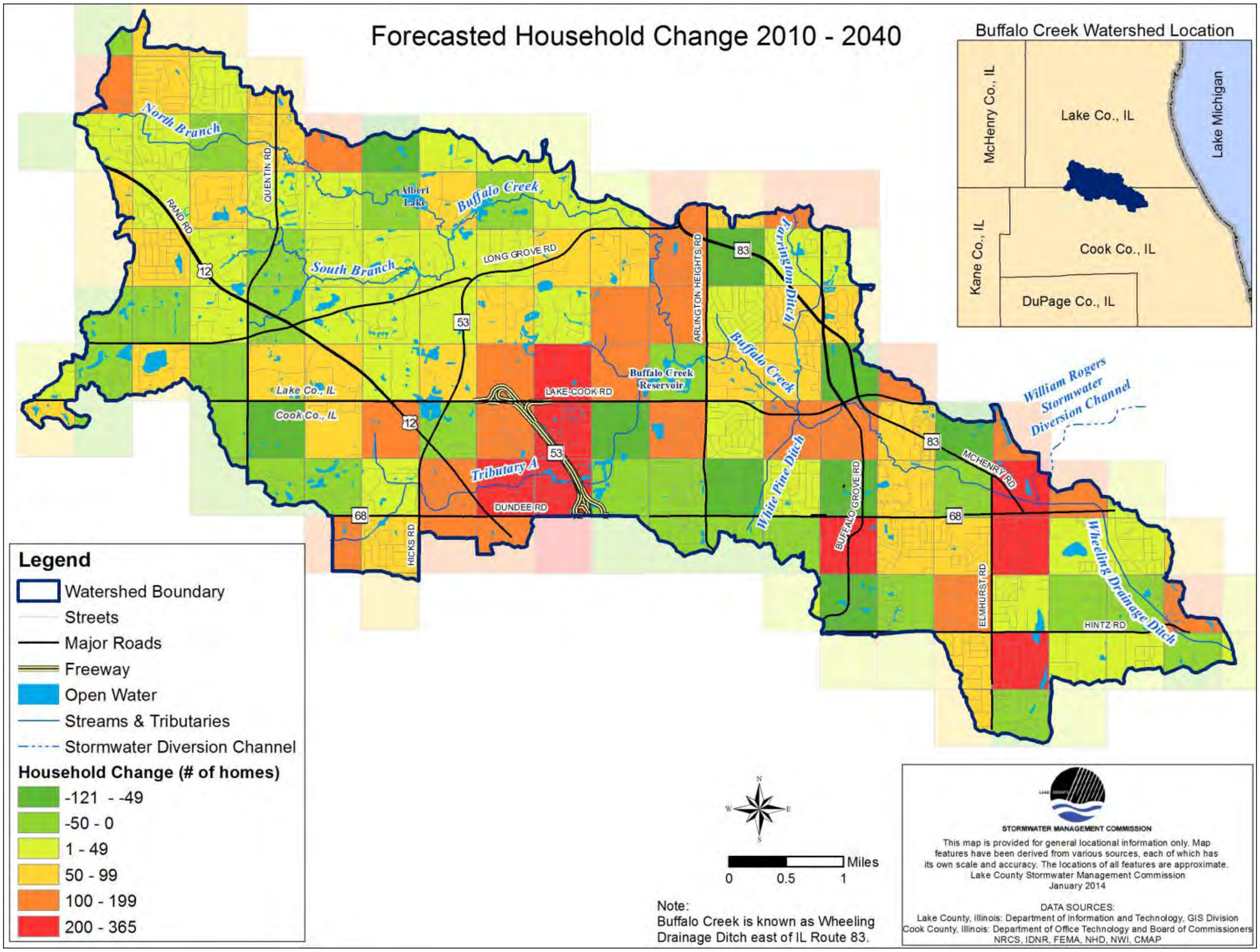


Figure 3-15: Forecasted Household Change (# of homes) in the Buffalo Creek Watershed.

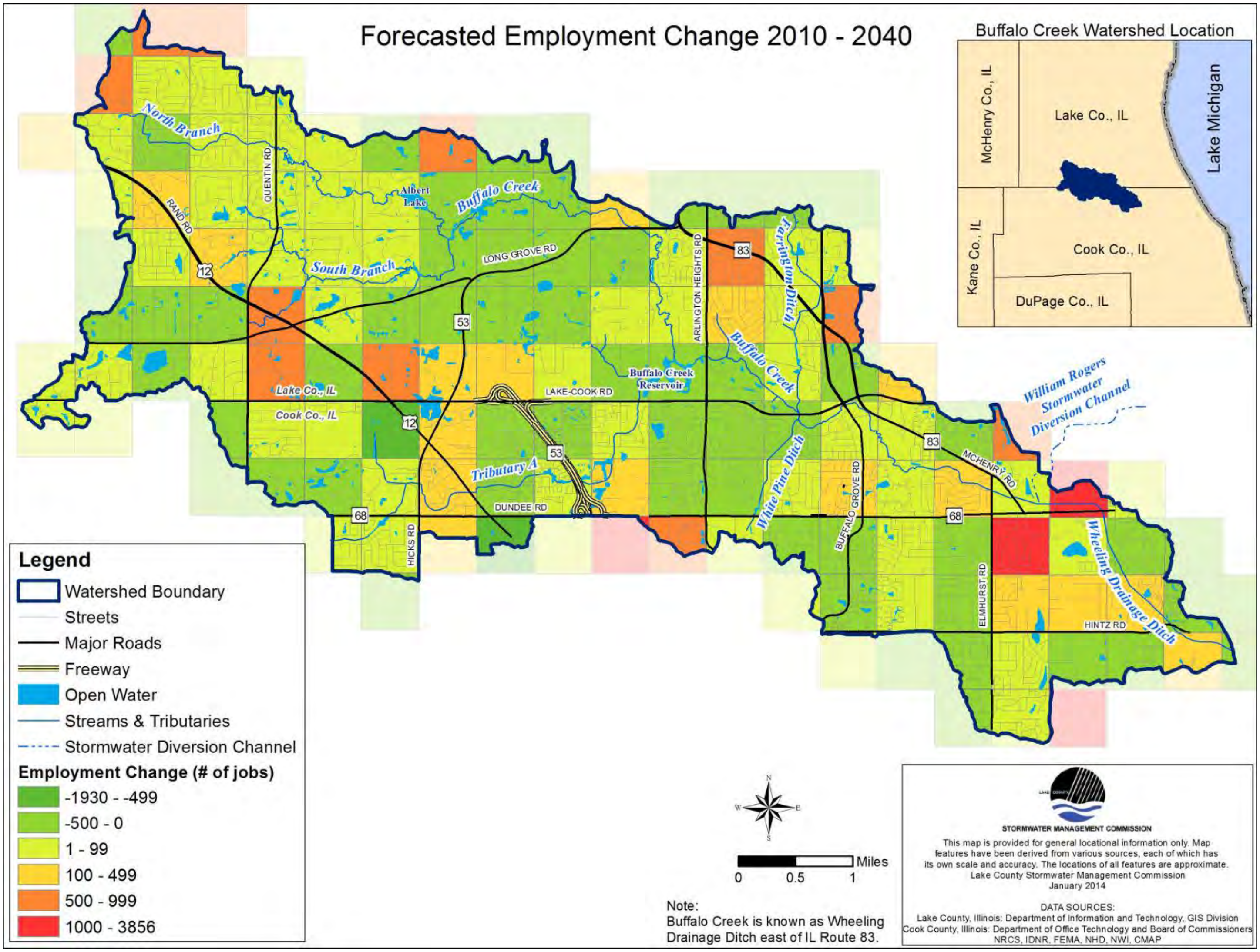


Figure 3-16: Forecasted Employment Change (# of jobs) in the Buffalo Creek Watershed.

3.6 Land Use and Land Cover

3.6.1 Historic Land Cover

Pre-settlement vegetation within the Buffalo Creek Watershed was evaluated in the Final Report Region 5 Wetland Management Opportunities and Marketing Plan: Select Watersheds in the Lower Fox and Des Plaines River Watersheds (R5WMO) by Tetra Tech for the USEPA dated March 2015; using CMAP's Green Infrastructure Vision dataset and the Illinois Natural History Survey's Historic Vegetation database. Based on this analysis, pre-settlement vegetation consisted of approximately 5,364 acres of wetland with the Buffalo Creek Watershed. The pre-settlement communities are shown in **Figure 3-17** and **Table 3-10**. Following European settlement, most of this land was converted to agricultural practices, followed by residential and commercial land uses.

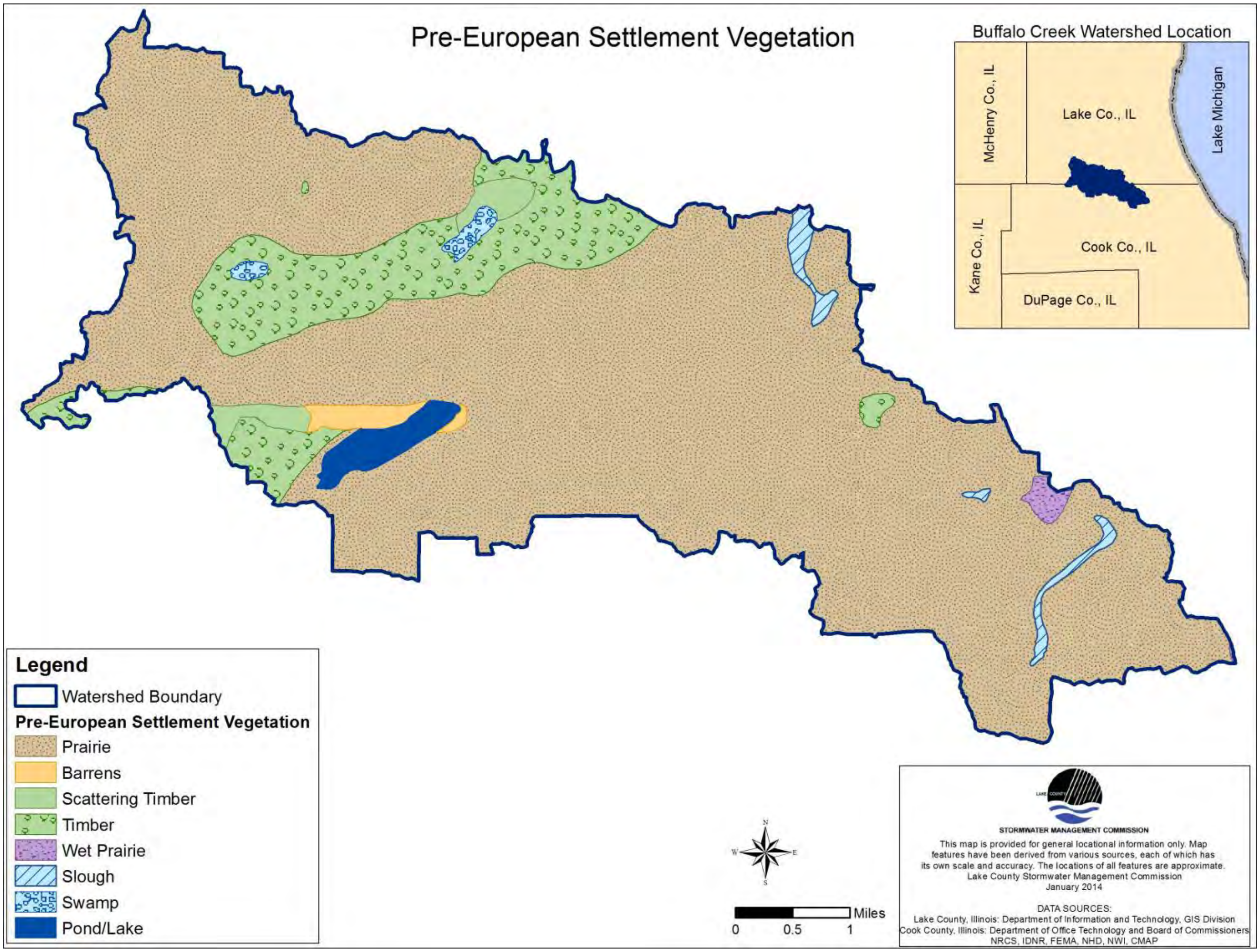


Figure 3-17: Pre-European Settlement Vegetation in the Buffalo Creek Watershed.

Table 3-10: Pre-European Settlement Vegetation in the Buffalo Creek Watershed.

Vegetation Type	Acres	% of Watershed
Prairie	14,500	83%
Barrens	133	1%
Scattering Timber	215	1%
Timber	1999	11%
Wet Prairie	67	<1%
Slough	171	1%
Swamp	84	<1%
Pond/Lake	223	1%

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.*

3.6.2 Existing Land Use/Land Cover

Existing ***land use*** of the Buffalo Creek Watershed was determined using a 2005 CMAP land use/cover layer. To ensure land use and ***land cover*** represented the most recent watershed conditions, this layer was updated by interpreting 2012 aerial imagery. If any discrepancies were observed between the imagery and the land use/cover layer, such as where development has recently occurred or where errors were noted in land use/cover categories or boundaries, adjustments were made. In addition, 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). **Table 3-11** includes land use/cover categories, including acreage and overall percentage, and **Figure 3-18** illustrates land use in map format.

> ***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.*

The residential land use class accounts for the greatest area of the watershed with 9,394 Acres (54%). Total open space, including all open land (agricultural, private/public open space, wetlands, and water) comprises 3,026 acres or 17% of the watershed. Total developed land, including residential, commercial/retail/mixed use, government/institutional, industrial, office and research parks, transportation, and utilities accounts for 14,359 acres or 83% of the watershed.

The developed land uses in the watershed contain varying degrees of impervious cover. Impervious cover estimates were obtained from the United States Department of Agriculture's Urban Hydrology for Small Watersheds TR-55 (Revised Edition). Approximately 93% of the Buffalo Creek Watershed has some degree of impervious cover. Land use data indicates that the majority (75%) of the developed land use in the watershed is between 0-19% impervious cover. Less than 1% of the land use in the watershed is between 20-49% impervious cover. Approximately 23% of the developed land use in the watershed is between 50-79% impervious cover. Another 2% of the developed land use in the watershed is between 80-100% impervious cover.

Table 3-11: Current Land Use in the Buffalo Creek Watershed by Category.

Land Use Class	Total Area (acres)	% of Watershed
Residential - Single Family	9,394	54.00%
Commercial/Retail	1,502	8.60%
Residential - Multi-Family	1,102	6.30%
Open Space - Conservation	1,085	6.20%
Vacant	783	4.50%
Industrial	753	4.30%
Open Space – Park	662	3.80%
Gov't/Institutional	512	2.90%
Open Space - Golf Course	329	1.90%
Wetland	285	1.60%
Open Water	263	1.50%
Transportation	214	1.20%
Agriculture – Row Crop	209	1.20%
Agriculture - Greenhouse/Nursery	149	0.90%
Utilities	100	0.60%
Agriculture - Equestrian	44	0.30%
Cemetery	8	0.00%
TOTAL	**17,393**	**100.0%**

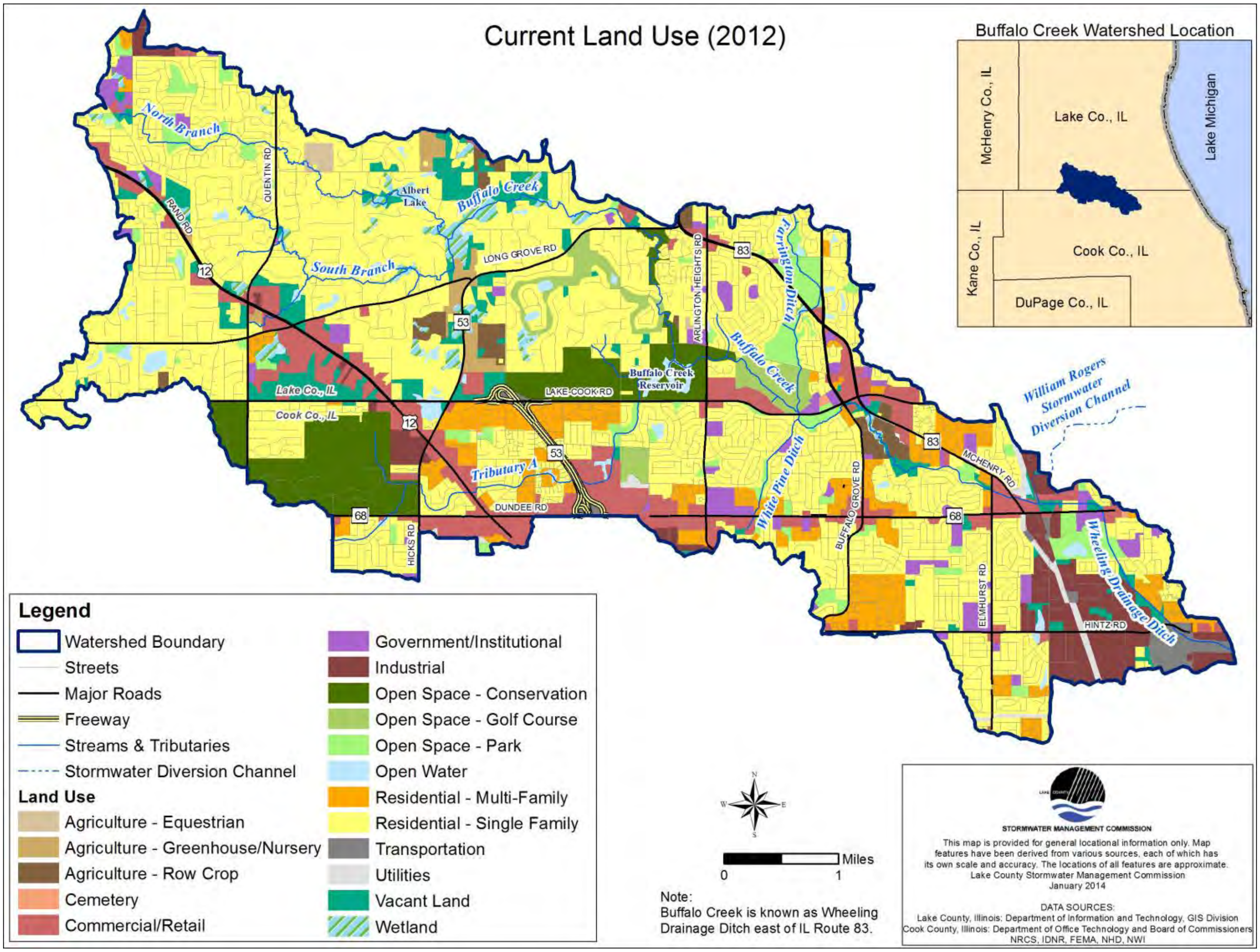


Figure 3-18: Current Land Use in the Buffalo Creek Watershed.

Noteworthy: How We Use Land Effects Water Quality

Studies have shown that land use has a direct effect on water quality. The greater amount of impervious area, the greater the pollution load it generates. Pollutants from a variety of diverse and diffuse sources collect on impervious surfaces and are flushed into rivers and streams when it rains. Lawns, driveways, rooftops, parking lots and streets are source areas for these pollutants, while the causes include vehicles, road surface applications, direct atmospheric deposition, fertilizer/pesticides/herbicides, litter, pet waste, vegetative decay, and soil erosion. Urban runoff also carries pollutants such as oil and grease, metals, and pathogens like fecal coliform bacteria. Runoff from impervious surfaces can be 10 to 12 degrees warmer than runoff from land in a natural state, which combined with reduced summer flows results in higher in-stream water temperatures.

3.6.3 Future Land Use Projections

Future land use projections were based on a review of municipal future land use maps. **Figure 3-19** shows future land use predicted on build-out conditions in the watershed. Approximately 3.5% of the watershed is expected to change land use; 3.4% of the watershed that is currently considered ***pervious*** will be converted to imperious cover. This is primarily a result of the increase in commercial and industrial properties and single family residential land use (see **Table 3-12**), which is supported by the expected increase in household and population (see **Table 3-9**). Approximately 95% of the expected land use changes are expected to occur on agricultural and vacant land uses. The population density is expected to increase from 7.1 persons per acre to 8.8 persons per acre.

> ***Pervious:** Allowing water to pass through.*

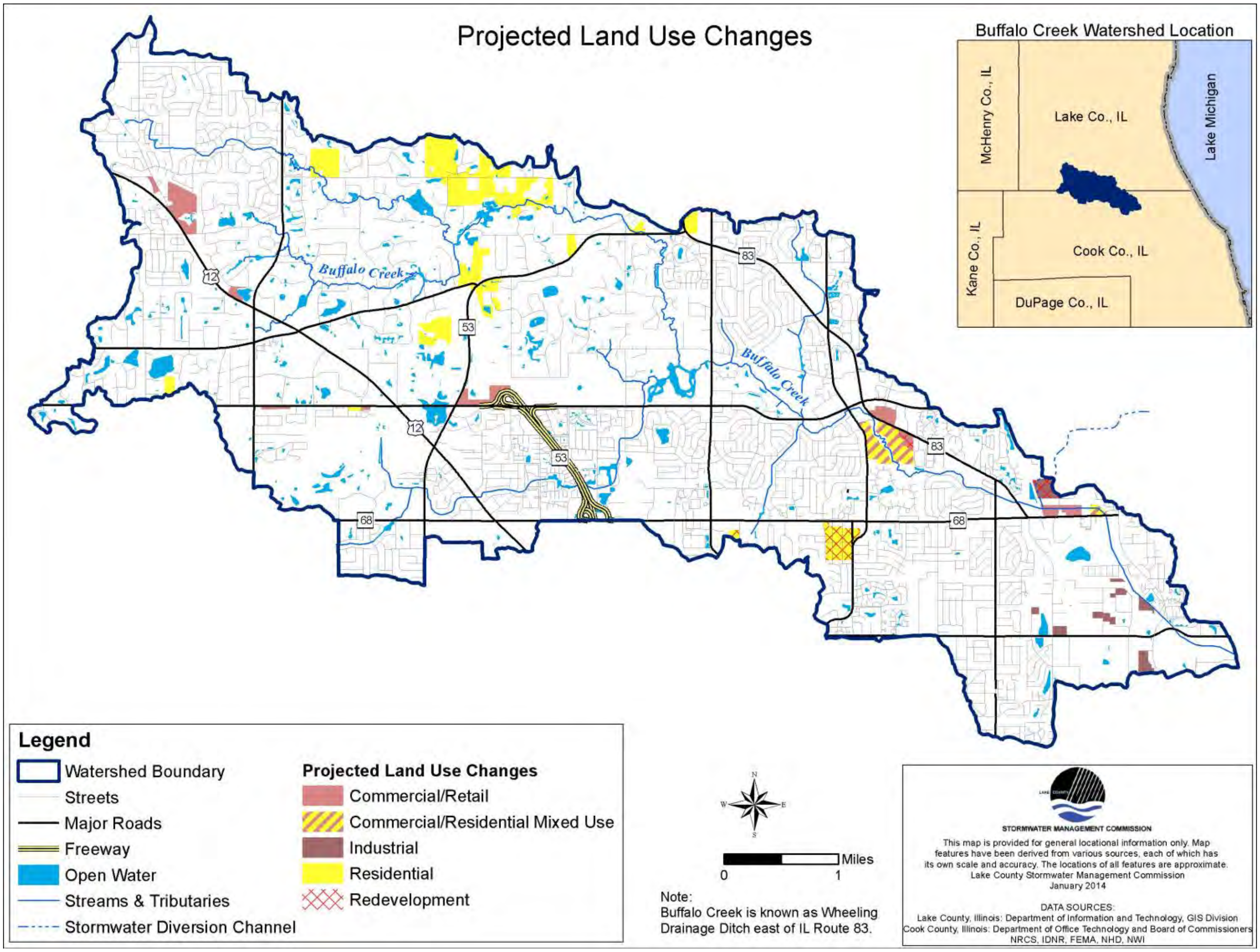


Figure 3-19: Projected Future Land Use Changes in the Buffalo Creek Watershed.

Table 3-12: Future Land Use Projections for the Buffalo Creek Watershed.

Land Use Type	2012 Acres	% of Watershed	Projected 2020 Acres	% of Watershed	% Change
Residential - Single Family	9,394	54.00%	9,743	56.00%	3.72%
Commercial/Retail	1,502	8.60%	1,624	9.30%	8.12%
Residential - Multi-Family	1,102	6.30%	1,102	6.30%	0.00%
Open Space - Conservation	1,085	6.20%	1,085	6.20%	0.00%
Vacant	783	4.50%	461	2.70%	-41.13%
Industrial	753	4.30%	799	4.60%	6.00%
Open Space - Park	662	3.80%	662	3.80%	0.00%
Gov't/Institutional	512	2.90%	512	2.90%	0.00%
Open Space - Golf Course	329	1.90%	329	1.90%	0.00%
Wetland	285	1.60%	285	1.60%	0.00%
Open Water	263	1.50%	263	1.50%	0.00%
Transportation	214	1.20%	214	1.20%	0.00%
Agriculture - Row Crop	209	1.20%	47	0.30%	-77.66%
Agriculture - Greenhouse/Nursery	149	0.90%	84	0.50%	-43.65%
Utilities	100	0.60%	100	0.60%	0.00%
Agriculture - Equestrian	44	0.30%	4	0.00%	-90.61%
Cemetery	8	0.00%	8	0.00%	0.00%
Commercial/Residential Mixed Use	-	0.00%	74	0.40%	100%
TOTAL	**17,393**	**100%**	**17,393**	**100%**	

Noteworthy: Definitions for Land Use Types

Residential-Single Family: Includes housing where a single family resides.

Residential-Multi-Family: Includes housing where multiple separate housing units are contained in one building or complex.

Commercial/Retail: Includes shopping malls and associated parking, single building offices, office parks, restaurants, auto repair shops, grocery stores, etc.

Open Space-Conservation: Includes nature preserves, game preserves, botanical gardens and forest preserves.

Open Space-Park: Includes all parks such as athletic fields and recreational trails.

Open Space-Golf Course: Includes all public and private golf courses.

Industrial: Includes mineral extraction, manufacturing, warehousing/distribution centers and industrial parks.

Gov't/Institutional: Includes military bases and associated living quarters, medical and healthcare facilities, educational facilities, government administration and services (fire, police, post offices, etc.) and correctional facilities.

Wetland: Includes land uses that are saturated with water seasonally or permanently and contain hydric vegetation.

Open Water: Includes rivers, streams, canals (wider than 200ft), lakes, reservoirs and lagoons.

Transportation: Includes roadways, road right-of-ways, interstates, toll roads, bus facilities and air transportation centers.

Utilities: Includes waste water facilities, landfills, railroads, telephone poles and cell towers.

Agriculture -Greenhouse/Nursery: Includes nurseries, orchards and vineyards.

Agriculture -Row Crop: Includes row crops, pasture, fallow lands, dairy and other livestock enterprises.

Agriculture -Equestrian: Includes land uses for recreational horse keeping.

Cemetery: Includes cemeteries of all sizes.

Vacant: Includes any land use that does not that does not fall under any of the above land use types.

3.7 Transportation

Transportation corridors in the Buffalo Creek Watershed 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 non-point source pollution in urban settings. A number of factors contribute to high pollutant loading from streets. Streets are typically connected to the drainage system and tend to be the collector of 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. How transportation facilities and corridors are designed, constructed and maintained can play a significant role in determining whether the influence of transportation is positive or negative as it relates to watershed health and the wellbeing of watershed residents.

The Buffalo Creek Watershed includes 343 miles of roads, 84 miles of trails and 2.2 miles of commuter rail lines that make up the existing network of transportation corridors in the watershed. Although not analyzed in detail in this section, other important components of the transportation network include the 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 Roadways

Currently, there are approximately 343 roadway miles in the Buffalo Creek Watershed equaling 13.5 miles of road per square mile of watershed area. Roads are managed by various local and state entities with jurisdictions in Lake and Cook County. The roadway network includes local roads, township roads, county roads, and state highways. In the Buffalo Creek Watershed, roads and roadway planning are the responsibility of multiples entities including the Cook County Department of Transportation (CCDOT), Lake County Division of Transportation (LCDOT), Illinois Department of Transportation (IDOT), Illinois Tollway Authority (Tollway), Forest Preserve District of Cook County (FPDCC), Lake County Forest Preserve District (LCFPD), townships and municipalities. **Table 3-13** provides the miles of road in the watershed per jurisdiction.

Table 3-13: Roadway Miles in the Buffalo Creek Watershed.

Roadway Jurisdiction	Miles	% of Total Watershed Miles
Buffalo Grove	64.51	18.83%
Wheeling	64.32	18.77%
Lake Zurich	34.01	9.93%
Palatine	31.15	9.09%
Long Grove	25.93	7.57%
Kildeer	23.23	6.78%
IDOT	22.67	6.62%
Arlington Heights village	19.27	5.62%
Deer Park village	14.94	4.36%
CCDOT	14.72	4.30%
LCDOT	9.1	2.66%
Tollway	4.96	1.45%
Prospect Heights	4.66	1.36%
Palatine Township	4.11	1.20%
Ela Township	2.11	0.62%
Wheeling Township	1.24	0.36%
FPDCC	0.91	0.27%
LCFPD	0.82	0.24%
TOTAL	**342.66**	**100%**

Through the watershed, Rand Road, Quentin Road and McHenry Road are the principal north-south arterials, while Lake Cook Road and Dundee Road are the principal east-west arterials. Other minor arterials in the watershed include Long Grove Road, Arlington Heights Road, Buffalo Grove Road and West Cuba Road. **Figure 3-20** shows the major roadways in the watershed and their jurisdiction. The northern terminus of IL Route 53 is located at Lake Cook Road in the central portion of the watershed and is under the jurisdiction of the Tollway.

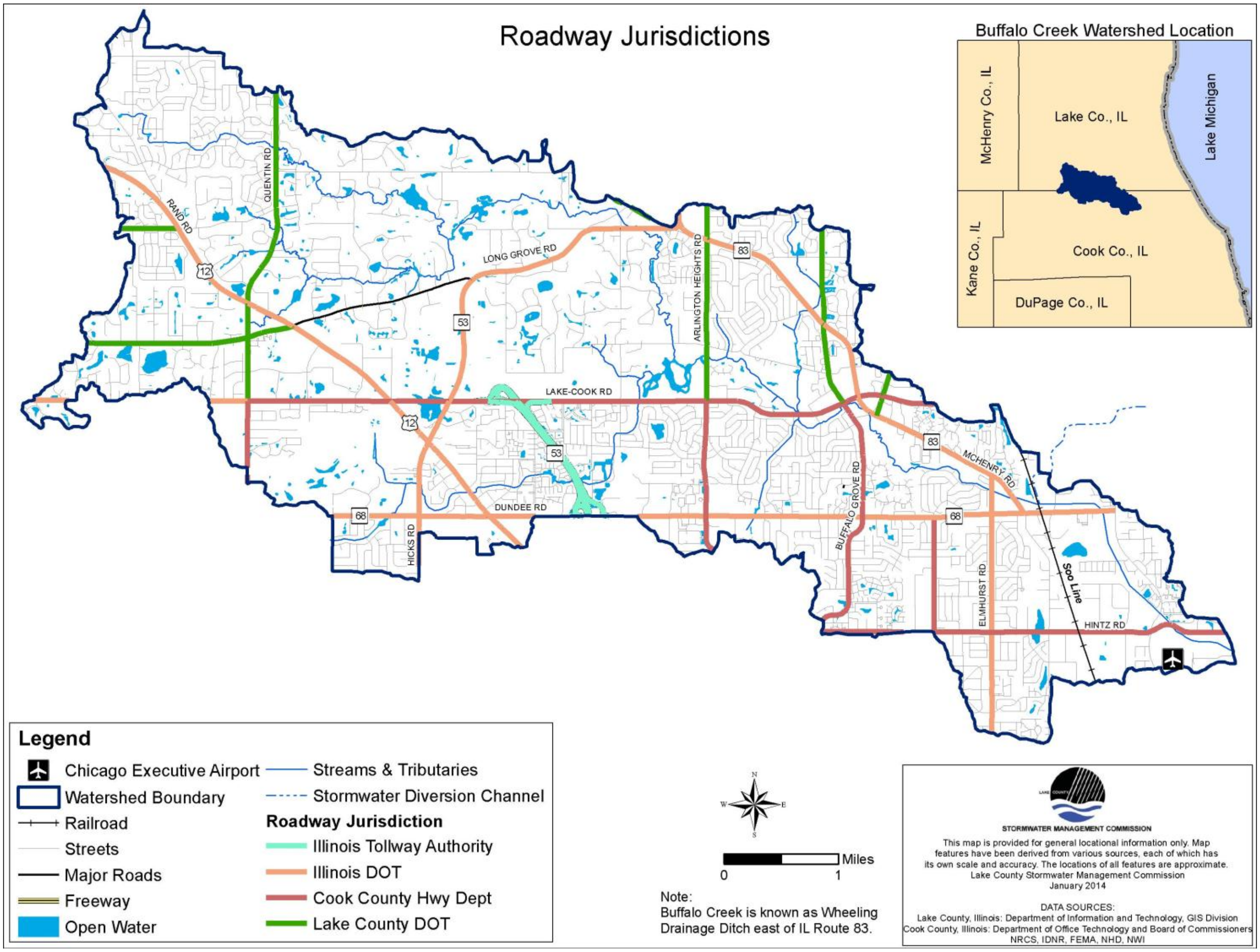


Figure 3-20: Major Roadways in the Buffalo Creek Watershed and Their Jurisdiction.

The following roadways are under IDOT jurisdiction:

- Route 83
- Elmhurst Road
- Route 53/Hicks Road
- Long Grove Road (east of Route 53)
- Route 68/Dundee Road
- Route 12/Rand Road

The following roadways are under LCDOT jurisdiction in Lake County:

- Quentin Road
- Arlington Heights Road
- Deerfield Parkway
- Weiland Road
- Cuba Road
- Long Grove Road
- Buffalo Grove Road

The following roadways are under CDOT jurisdiction in Cook County:

- Arlington Heights Road
- Lake Cook Road
- Quentin Road
- Schoenbeck Road
- S. Buffalo Grove Road
- Hintz Road

3.7.2 Public Transportation

The Metra North Central Service rail line traverses the eastern portion of the Buffalo Creek Watershed (see **Figure 3-20**). This rail line extends from Union Station in Chicago to Antioch in northern Lake County. A Metra rail station associated with this rail line is located at 400 Town Street in the Village of Wheeling. Pace Bus Route 234 provides weekday service from the Wheeling Metra rail station to the following major destinations: Holy Family Hospital, Metra UP Northwest Line stations (Des Plaines, Cumberland, and Mt. Prospect), Randhurst Mall, Wheeling High School, Wheeling Municipal Complex and Wheeling Tower.

***Noteworthy:* Streets and Non-Point Source Pollution**

According to a Chesapeake Bay Commission study, residential, commercial, and industrial streets were found to be the main contributor of non-point source pollution in an urban setting. "Not only did streets produce some of the highest concentrations of phosphorus and suspended solids, bacteria and several metals, but they also generated a disproportionate amount of the total runoff volume. Consequently, streets typically contributed four to eight times the pollutant load than would have been expected if all source areas contributed equally." (Chesapeake Bay Commission, 2003) A number of factors contribute to high pollutant loading from streets. Streets are directly connected to the drainage system resulting in a high runoff coefficient. In addition, street curb and gutter systems tend to trap and retain fine particles that blow into them and are then flushed off by stormwater into pipes that empty to streams, rivers and lakes during a rain event or in snow melt.

3.7.3 Airports

The Chicago Executive Airport is located at the downstream end of the Buffalo Creek Watershed, at the northwest corner of Palatine Road and South Milwaukee Avenue in Wheeling. The Chicago Executive Airport was founded in 1925 as Gauthier's Flying Field. In 1928, the field was renamed Palwaukee, after the two highways that formed its southern and eastern borders (Palatine Road and Milwaukee Avenue). The airport was purchased in 1953 by George Priester, who over the next 33 years expanded and developed the facility until 1986, when it was purchased by the neighboring Villages of Wheeling and Prospect Heights. Renamed Chicago Executive Airport in 2006 to more accurately reflect its regional importance, the facility now covers 113 acres within the Buffalo Creek Watershed. Today, the Chicago Executive Airport serves the general and business aviation sector, and is the third busiest airport in Chicagoland, after O'Hare International and Midway. Approximately 300 aircraft are based on the field and approximately 200,000 take-offs and landings occur annually.

Chicago Executive Airport. Photo courtesy of CMT.

The primary water quality concern regarding airports is deicing runoff. Deicing runoff into surface waters has been known to increase biological oxygen demand, alkalinity and pH. The Chicago Executive Airport currently uses urea (a dry product) for deicing and E36 Liquid Runway Deicer (potassium acetate) for anti-icing before a storm. Drainage from the runways ends up in retention areas located on the airport property.

Figure 3-21: Location of Chicago Executive Airport, courtesy of Chicago Executive Airport.

The Chicago Executive Airport is currently undergoing a Master Plan per the guidelines of the Federal Aviation Administration. These guidelines require the airport to consider itself as part of its surrounding and the communities it serves, as well as to examine how well the airport functions as part of the national aviation system. Other aspects such as safety, operations and financial viability are also examined as part of the Master Plan.

3.7.4 Trails

There are currently approximately 107 miles of walking paths and bike trails in the Buffalo Creek Watershed (see **Figure 3-22**). Trails are in various forms ranging from mowed footpaths to concrete or asphalt, and are designed for single or multiple purpose users. Several jurisdictions develop and manage trails in the watershed including the Forest Preserve Districts, Park Districts, Municipalities, Townships, Homeowner Associations (HOAs), CDOT, and LCDOT. The Villages of Wheeling (42%) and Buffalo Grove (28%) account for the majority of existing trails in the watershed, with the majority of trails located in the southeast portion of the watershed. Several villages support trail systems along and across roadways within their jurisdiction, which contribute to transportation networks. Park Districts also provide and maintain a trail network to connect people to parks and other community centers. The Forest Preserves provide many miles of trails within and connecting forest preserves. HOAs provide neighborhood trails connecting to community trail systems, within the subdivision, and to neighborhood parks. Lastly, there are short segments of connector trails constructed and maintained by the LCDOT and townships that are part of a large trunk system for bicyclists.

The majority of the existing and planned trail system is located in the eastern portion of the watershed. Proposed trails in the western portion of the watershed include connecting Quentin Road, Lake Cook Road, Rand Road and Long Grove Road to the Deer Grove Forest Preserve and Deer Park Mall. **Table 3-14** presents the existing and proposed trail miles by jurisdiction.

The Buffalo Creek Forest Preserve contains approximately 8 miles of bicycling, cross-country skiing and hiking trails. The hiking and bicycle trails provide pedestrian access at the corner of Checker Road and Arlington Heights Road, on Checker Road West of Schaeffer Road and at the corner of Lake Cook and Arlington Heights Roads. A paved parking lot is located off Checker Road. The LCFPD is planning a new looped trail system as part of a proposed reservoir expansion project. Deer Grove Forest Preserve contains approximately 6.25 miles of trails within the Buffalo Creek Watershed. Additional trails are located within the preserve, but outside of the Buffalo Creek Watershed. A parking lot is accessible from Northwest Highway.

Table 3-14: Existing and Proposed Trail Mileage within the Buffalo Creek Watershed.

Jurisdiction	Existing Trails (miles)	% of Total Existing Trails	Planned Trails (miles)	Total Trail Miles	% of Total Trails
Wheeling	45.21	42.14%	7.73	52.94	36.89%
Buffalo Grove	30.43	28.36%	11.28	41.71	29.07%
Deer Park	9.86	9.19%	2.46	12.32	8.59%
LCFPD	7.26	6.77%	0.86	8.12	5.66%
FPDCC	6.25	5.83%	1.18	7.42	5.17%
Arlington Heights	4.31	4.02%	2.00	6.31	4.40%
Kildeer	1.04	0.97%	2.36	3.4	2.37%
Lake Zurich	1.02	0.95%	1.53	2.55	1.78%
Long Grove	0.88	0.82%	0.63	1.51	1.05%
Prospect Heights	0.59	0.55%	1.22	1.81	1.26%
Palatine	0.13	0.12%	3.82	3.95	2.75%
Ela Township	0.12	0.11%	0.91	1.03	0.72%
Wheeling Township	0.1	0.09%	0.33	0.34	0.24%
Vernon Township	0.09	0.08%	0	0.09	0.06%
TOTAL	**107.29**	**100%**	**36.31**	**143.5**	**100%**

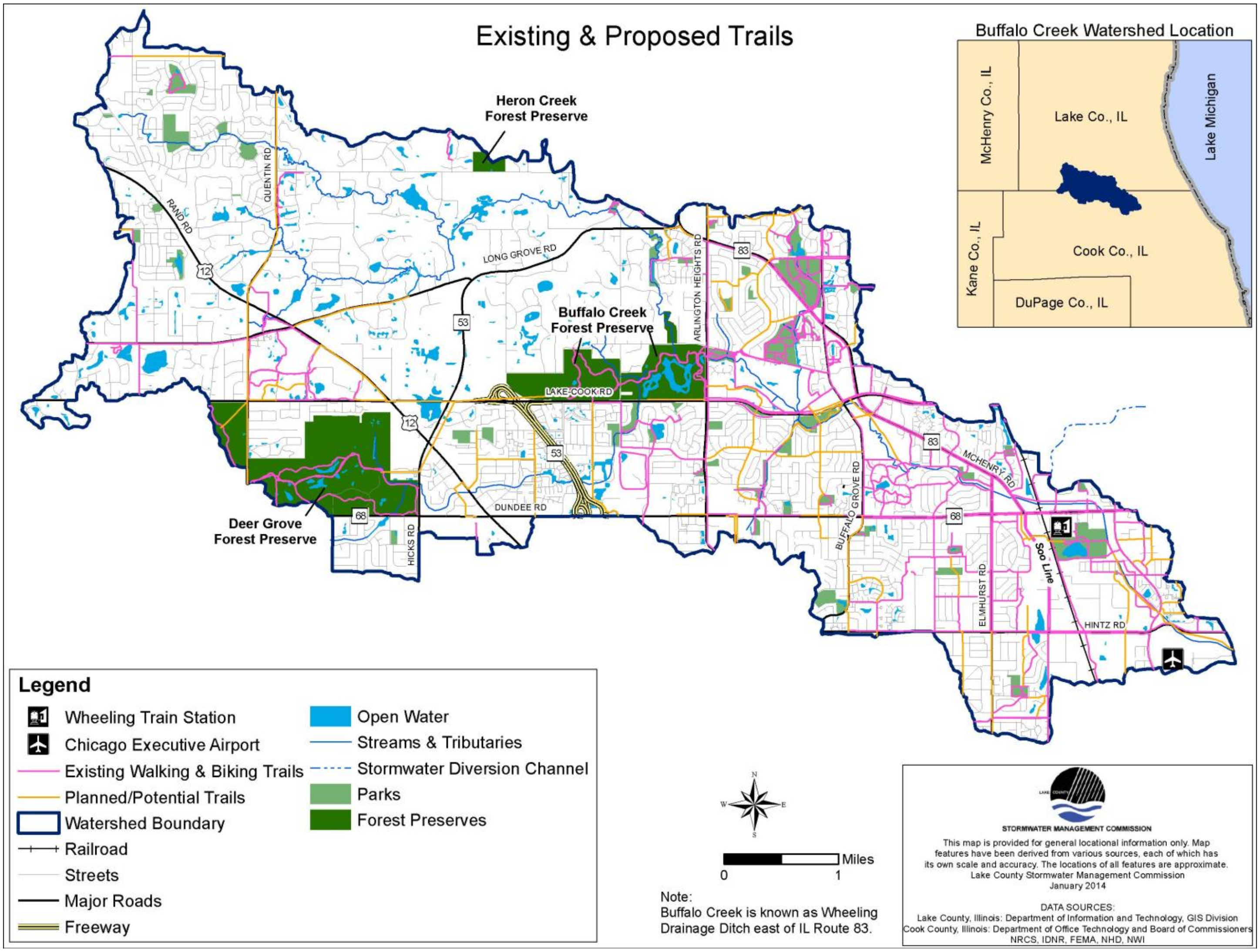


Figure 3-22: Existing and Proposed Trail Network in the Buffalo Creek Watershed.

3.7.5 Planned Transportation Improvements

Information about planned roadway improvements in the watershed was gathered through local, regional, and state transportation contacts and from available road planning reports. While the "future conditions" data gathering and research may not be exhaustive, especially as it relates to local streets that may be built to serve new commercial or residential developments in the watershed, the major county, regional, and state roadway projects that are being planned for the watershed are described in this section and shown in **Figure 3-23**.

3.7.5.1 LCDOT Planned Projects

The following projects are identified on the 2013-2018 Highway Improvement Program:

Buffalo Grove Road Widening from Deerfield Parkway to IL Route 22– LCDOT is performing a Preliminary Engineering and Environmental Study (Phase I Study) for Buffalo Grove Road from Deerfield Parkway to IL Route 22 in Lake County (see **Figure 3-24**). The purpose of the Phase I Study is to evaluate the long term improvement needs for Buffalo Grove Road in compliance with criteria for environmental studies. A concrete bike path (8' wide) runs along the east side of Buffalo Grove Road for most of its length. Just north of Aptakisic Road the path moves into the subdivision to the west before working its way back to Buffalo Grove Road. The Village of Buffalo Grove is interested in completing the bike path north along Buffalo

Grove Road where there is currently a gap. The first public meeting was held from 5:00 pm to 7:00 pm on November 8, 2011, at Twin Groves Middle School.

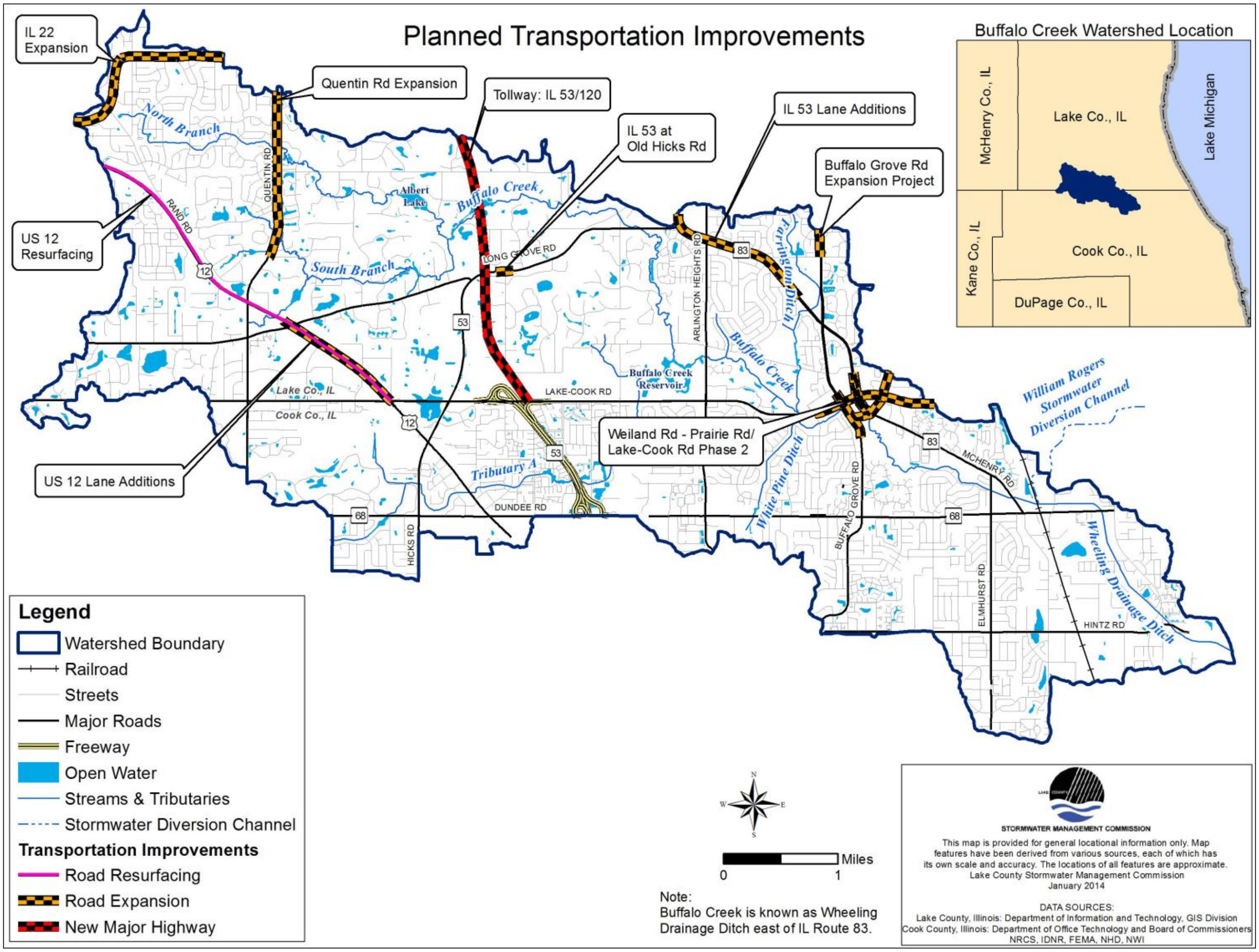


Figure 3-23: Planned Transportation Improvements in the Buffalo Creek Watershed.

Weiland Road & Lake Cook Road Improvements – This project consists of the widening and reconstruction of over three miles of Weiland Road and over one mile of Lake Cook Road in the Villages of Buffalo Grove and Wheeling (see **Figure 3-25**). The improvement will include two through lanes in each direction on Weiland Road and three through lanes in each direction on Lake Cook Road, separated by a center median to allow for left turn channelization at intersections. This project also includes the construction of a new roadway on a new alignment that will link up Weiland Road directly with Prairie Road. Short Aptakisic Road will also be realigned between Buffalo Grove Road and IL Route 83 to improve safety and operation and pro-

Weiland Road project location photo, courtesy of Civiltech Engineering, Inc.

vide a route that can better accommodate traffic movements between Buffalo Grove Road and both Weiland Road and Lake Cook Road. In addition, pedestrian and bicycle accommodations will be provided.

The proposed improvements include the widening in-kind of the single span rolled beam bridge that carries Buffalo Grove Road over Buffalo Creek, and the replacement of the triple cell box culvert that carries short Aptakisic Road over Buffalo Creek with a three-span slab bridge. The use of a three-span slab bridge is preferred over a box culvert, where the natural substrate is replaced with the structure. Furthermore, the box culvert tends to trap large deposits of sediments, impeding the flow of water.

The proposed improvements include numerous drainage features within the project area including new storm sewers and new detention basins that will collect a majority of the roadway runoff before it enters Buffalo Creek.

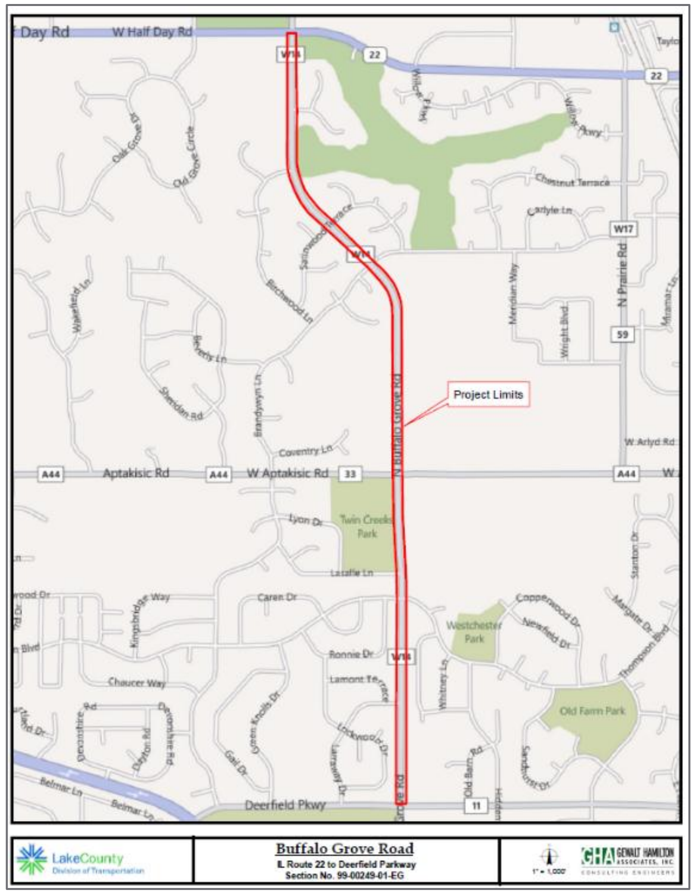


Figure 3-24: Buffalo Grove Road from Deerfield Parkway to IL Route 22 Widening Project Location Map.

3.7.5.2 IDOT Planned Projects

Projects funded in 2015-2020 IDOT Multi-Modal Multi-Year Program (MYP) include the following:

- Resurfacing of **US 12 from Ela Road to Lake-Cook Road**; includes a milled rumble strip. Construction is targeted for the early portion of 2016-2020 MYP.
- **IL 53 at Old Hicks Road** – Add left turn lane on IL Route 53 at Old Hicks Road.

Unfunded identified needs on the IDOT system include:

- Addition of lanes on US Route 12 from 0.1 miles north of Long Grove Road to Lake-Cook Road.
- Addition of lanes on IL Route 83 from IL Route 22 to 0.2 miles south of Lucinda Drive.

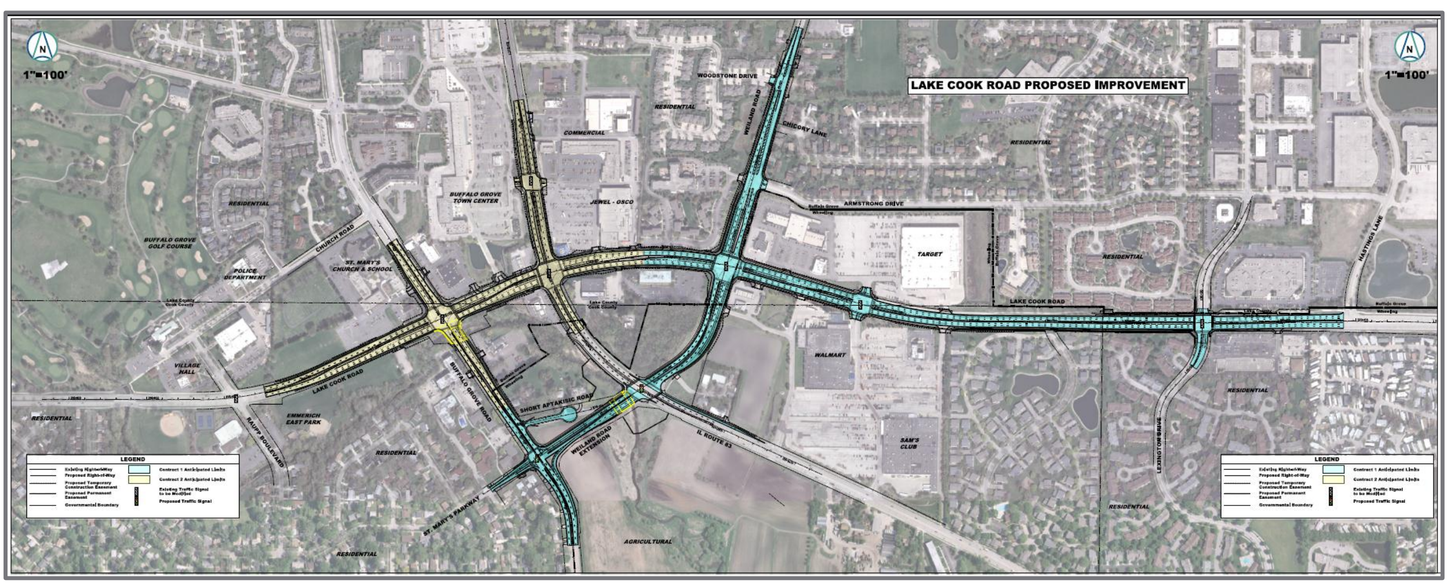


Figure 3-25: Weiland Road – Prairie Road/Lake Cook Road Phase 2 Improvements.

3.7.5.3 Tollway Planned Projects

IL Route 53/120: New road construction to extend approximately 12.5 miles of Route 53 through central Lake County to connect with an approximate 12 miles of an improved Route 120 is being studied as shown in **Figure 3-26**. This project would result in approximately 2 miles of new roadway in the Buffalo Creek Watershed. The Illinois Tollway created the Illinois Route 53/120 Blue Ribbon Advisory Council (BRAC) to assist in the planning and potential building of the Illinois Route 53/120 project in Lake County. The Council's Resolution and Summary Report recommend that the Tollway proceed with further project development, revised scope, configuration and design elements, and propose a financial framework. The BRAC report provided the scope, configuration, and design elements of the new roadway and identified potential methods for financing the project.

The BRAC defined a set of guiding principles to ensure that outcomes are clearly defined and the project fulfills its goals. Three of these principles include the use of innovative and environmentally beneficial design solutions to strike a balance between improving mobility and access while minimizing negative environmental and long-term developmental impacts.

Figure 3-26: Illinois Route 53/120 Project Route.

The Tollway approved initiation of an environmental impact statement ("EIS") for the Illinois Route 53/120 Project on December 17, 2015. See the Tollway website for more information at http://www.illinoistollway.com/

> ***Rights-of-way:*** *Land granted for transportation purposes.*

3.7.6 Potential Impacts of Roadway Expansion Projects on the Watershed

As described earlier in this section, "car habitat" makes up a significant area of impervious cover in the watershed. As impervious surfaces such as roadways and parking lots increase, more water flows off and is delivered quickly to receiving waters. The increased activity on these impervious surfaces means that more polluting material is available and likely to be flushed in stormwater runoff. Minimizing the mobilization of this material from streets and highways where pollutants tend to accumulate and collect is the goal of successful roadway runoff management. **Table 3-15** includes a list of the types of constituents in highway runoff that are sources of pollution.

The design of ***rights-of-way*** has a significant impact on the livability of communities as well as the health, safety and welfare of residents. Roadway improvement projects are intended to benefit watershed and county residents and the local economy by providing better transportation access. While these are necessary goals, the fact that these projects also have the potential to have significant negative impacts on water quality and aquatic resources if not designed and maintained in ways that avoid and minimize these impacts cannot be overlooked.

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). In addition, highway projects are linear in nature and, as such, are faced with practical limitations in terms of locating and maintaining stormwater treatment facilities within the road right of way.

Table 3-15: 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.

3.7.7 Roadway Design and Maintenance

Even considering these challenges, transportation agencies have the authority to design and maintain roadways and public transportation facilities that deliver multiple benefits and include structural and non-structural BMPs that reduce stormwater runoff and pollutants from roadways. Because adjacent land uses influence the contribution of pollutants from roadways, the stormwater management features of the roadway need to be designed and maintained in consideration of adjacent land use. By using BMPs, transportation jurisdictions can design and maintain roads to achieve the following objectives:

- Reduce the volume of polluted runoff reaching receiving waters.
- Incorporate stream crossings that protect aquatic habitat.
- Address the impacts of roadway proximity to sensitive lakes/wetlands.
- Reduce chloride pollution resulting from road salt and winter maintenance practices.
- Connect the green infrastructure network and include wildlife crossings.
- Connect people and communities – including low/moderate income areas to the transportation network (bus lines, trails).

Watershed-healthy and sustainable transportation BMPs that may be implemented to move toward sustainability in the watershed include:

- Incorporate BMPs into new and expanded roadway designs

  - Practices that reduce runoff volume from roads and parking lots (reduce pavement extent, use porous pavement where appropriate, infiltrate runoff where appropriate).
  - Practices that capture and treat runoff.
  - Route roadways to avoid waters and wetlands where possible.
  - Include environmentally friendly stream crossings that protect aquatic habitat.
  - Provide for safe, accessible and connected non-motorized transportation (including underserved and low to moderate income areas with alternative transportation options).
  - Consider wildlife crossings.
- Use I-LAST Scoring System or equivalent for all new roadway expansion and extension projects (see Noteworthy).
- Construction BMPs
  - Soil erosion and sediment control (install BMPs first, phase ground disturbance if possible, button up construction site daily, minimize length of time ground is bare and disturbed).
  - Provide adequate construction oversight.
- Post construction BMPs
  - Monitoring and maintaining BMPs post-construction.
  - Street sweeping and inlet cleaning.
  - Winter maintenance (develop a winter maintenance policy and use alternative products and practices such as liquids, anti-icing, calibrating trucks and equipment).

Noteworthy: The Illinois – Livable and Sustainable Transportation Rating System and Guide (I-LAST)

The Purpose of the I-LAST guide is to:

- Provide a comprehensive list of practices that have the potential to bring sustainable results to highway projects.
- Establish a simple and efficient method of evaluating transportation projects with respect to livability, sustainability, and effect on the natural environment.
- Record and recognize the use of sustainable practices in the transportation industry.

I-LAST goals to provide sustainable features in the design and construction of highway projects include:

- Minimize impacts to environmental resources
- Minimize consumption of material resources
- Minimize energy consumption
- Preserve or enhance the historic, scenic and aesthetic context of a highway project
- Integrate highway projects into the community in a way that helps to preserve and enhance community life
- Encourage community involvement in the transportation planning process
- Encourage integration of non-motorized means of transportation into a highway project
- Find a balance between what is important:
  - ➢ to the transportation function of the facility
  - ➢ to the community
  - ➢ to the natural environment
  - ➢ and is economically sound
- Encourage the use of new and innovative approaches in achieving these goals.

I-LAST includes a point system for evaluating the sustainable measures included in a project. The evaluation includes environmental and water quality metrics in addition to others and includes the following:

1. At the beginning of the project, the project team can determine which elements are applicable to the project. Applicable items can be noted and considered in the development of the project.
2. At the end of the project, the team can determine which of the applicable items were included in the project plans. This evaluation can then be included in the project's file.

Note: I-LAST is purely advisory in nature, while it is intended to ascertain and document sustainable practices proposed for inclusion on state highway projects, use of I-LAST is purely voluntary on the part of the jurisdictional agency for which a project is being developed and completed.

Illinois - Livable and Sustainable Transportation Rating, 9/27/12

3.8 Parks and Recreation

3.8.1 Forest Preserves

Three forest preserve areas totaling 1,083 acres (651 acres in Cook County, 432 acres in Lake County) are located in the Buffalo Creek Watershed and are described below. There are approximately 8.7 acres of forest preserves per 1,000 residents in the watershed.

3.8.1.1 Heron Creek Forest Preserve

Heron Creek Forest Preserve is a 242-acre preserve (24 acres in the Buffalo Creek Watershed) located on the southwest corner of Route 22 and Old McHenry Road in Long Grove. The preserve features a rolling landscape of scenic woodlands and open fields. The preserve offers exceptional wildlife habitat and plant communities, including a sedge meadow. The preserve includes 2.3 miles of gravel trails for hiking, biking, and cross-country skiing (all located outside of the Buffalo Creek Watershed). More than 116 species of birds appear here, including a resident population of waterfowl and herons. Heron Creek Forest Preserve is owned by the LCFPD.

Heron Creek Forest Preserve. Photo courtesy of the LCFPD website (www.lcfpd.org/heron-creek).

3.8.1.2 Buffalo Creek Forest Preserve

The Buffalo Creek Forest Preserve is a 408-acre preserve located on the southern border of Lake County in an unincorporated region of the county. Prior to European settlement, this land supported a tallgrass prairie interspersed with a few small wetlands. Restoration of that prairie has been underway since the 1980s. Though the land has been drastically altered, first by farming and later during reservoir construction, a surprising diversity of grassland birds use the preserve, including bobolinks and eastern meadowlarks. Much of this preserve is managed for flood control, as displayed by a dam on Buffalo Creek and the reservoir that results. Careful and creative design of the reservoir has created a natural-looking wetland. There are also expansion and improvement plans being developed by the MWRD and LCFPD. These expansion and improvement plans would improve the floodwater storage of the reservoir, habitat, and public access throughout the reservoir. The recently proposed expansion of Buffalo Creek Reservoir would increase the flood volume by 171.3 acre-feet, wetland habitat by 0.7 acres, emergent zone area by 4.5 acres, and open water area by 6.3 acres. Increases in wetland and emergent vegetation from this proposed expansion would likely increase nutrient uptake, while also reducing shoreline erosion. Buffalo Creek Forest Preserve is owned by the LCFPD.

Photo of the spillway at the Buffalo Creek Reservoir. Photo courtesy of M. Knysz.

As previously stated in the Trails Section above, the Buffalo Creek Forest Preserve contains eight miles of bicycling, cross-country skiing, and hiking trails. The MWRD, in cooperation with the LCFPD, is developing engineering design plans to expand MWRD's existing Buffalo Creek Reservoir and improve public access at the preserve. A new looped trail system will surround the new reservoir, providing a variety of scenic views and recreational opportunities. The reservoir will also offer visitors a second location within the Preserve for shoreline fishing. Planned natural resource restoration efforts include transforming an existing agricultural field into high-quality wetland and prairie, installing a man-made rookery for nesting herons and egrets, planting hundreds of native oaks along the trails and in groves in the prairie, and reseeding the entire Preserve with native prairie grasses and flowers.

Public access improvements include redesigning existing recreational trails and reconstructing them on higher ground to protect from washouts during flood events. Other plan elements include creating new trail loops and foot bridges, constructing a new trail link to the Long Grove Park on Old Hicks Road, building two family picnic shelters, expanding the current parking area on Checker Road and adding a second entrance, parking area and restroom facility off of Schaeffer Road.

3.8.1.3 Deer Grove Forest Preserve

Deer Grove East Forest Preserve. Photo courtesy of Friends of Deer Grove East.

Deer Grove Forest Preserve (which consists of Deer Grove East and Deer Grove West) sits along the border of the Buffalo Creek and Salt Creek watersheds in Cook County. Deer Grove Forest Preserve is owned by the FPDCC. Most of Deer Grove Forest Preserve once drained into Buffalo Creek; however, at some point the mainstem of Buffalo Creek running through Deer Grove West was re-routed into Salt Creek, thus at present most of Deer Grove West drains southward into Salt Creek. Most of Deer Grove East and a small portion of Deer Grove West still drain into Buffalo Creek.

In 1916, soon after the FPDCC was established as the Nation's first forest preserve district, it purchased the first 500 acres of what would become Deer Grove West, making Deer Grove the first forest preserve site in the country. Deer Grove West currently consists of approximately 1,200 acres (93 acres in the Buffalo Creek Watershed) and represents a significant natural area right in our midst. Deer Grove West was dedicated as an Illinois Nature Preserve in 2010.Deer Grove West contains several significant natural communities, including oak woodland, a forested ravine, numerous wetlands of varying sizes, and savanna and prairie remnants. Deer Grove West is identified in the Illinois Natural Areas Inventory (INAI).

Workday at Deer Grove. Photo courtesy of Friends of Deer Grove East.

Deer Grove East is approximately 624 acres (558 acres in the Buffalo Creek Watershed) and is located just east of Deer Grove West Forest Preserve. While Deer Grove West is primarily wooded, Deer Grove East is more open, with recently restored wetlands and prairie, including 23 wetlands restored by disabling drain tiles that drained former farm fields at the site. Approximately 120 acres of buffer areas consisting of woodland, savanna, and prairie areas are also being restored and monitored as habitat for native plants, birds, insects, reptiles and amphibians.

Baseline studies began at Deer Grove East in the summer of 2007 across all 624 acres of the site. Site management of invasive species in targeted areas for wetland restoration began in 2007. In the fall of 2009, the project was approved by the USACE. Between 2009 and 2012, invasive species were removed to prepare for the conversion of 75 acres of Eurasian meadow to Illinois prairie. During the winters of 2010 and 2012, invasive trees and shrubs were removed from 65 acres of remnant oak woodland and wetland, 40 acres of secondary growth, and 20 acres of grassland habitat. Significant project milestones include the presence of rare plants in the wooded wetlands in 2010 and the presence of breeding pairs of red-headed woodpeckers beginning in 2011. The restoration project at Deer Grove East is part of a series of restorations across the Des Plaines River Watershed that were undertaken in conjunction with the USACE and the Chicago Department of Aviation. Funding for the project was made available by the O'Hare Modernization Mitigation Account, which seeks to offset the impact on aquatic resources caused by the expansion of O'Hare International Airport.

The Deer Grove Preserve is also home to Camp Reinberg, which offers a wide variety of recreation opportunities. Improvements to Camp Reinberg are outlined in the district's 2013 Camping Master Plan. The district's ultimate plan at Camp Reinberg is to renovate the existing dining hall and security building, provide tent sites, small cabins, a limited number of RV sites and toilet and shower facilities. The maximum capacity will be 217 persons or campers. The District has requested approval to connect to the Village of Palatine's sanitary sewer to remedy the existing failing septic system. Camp Reinberg holds one of the two National Pollutant Discharge Elimination System Permits in the watershed from the Illinois EPA for point discharges into Buffalo Creek. **Figure 3-27** shows the Master Plan for Camp Reinberg (taken from the FPDCC Master Plan).

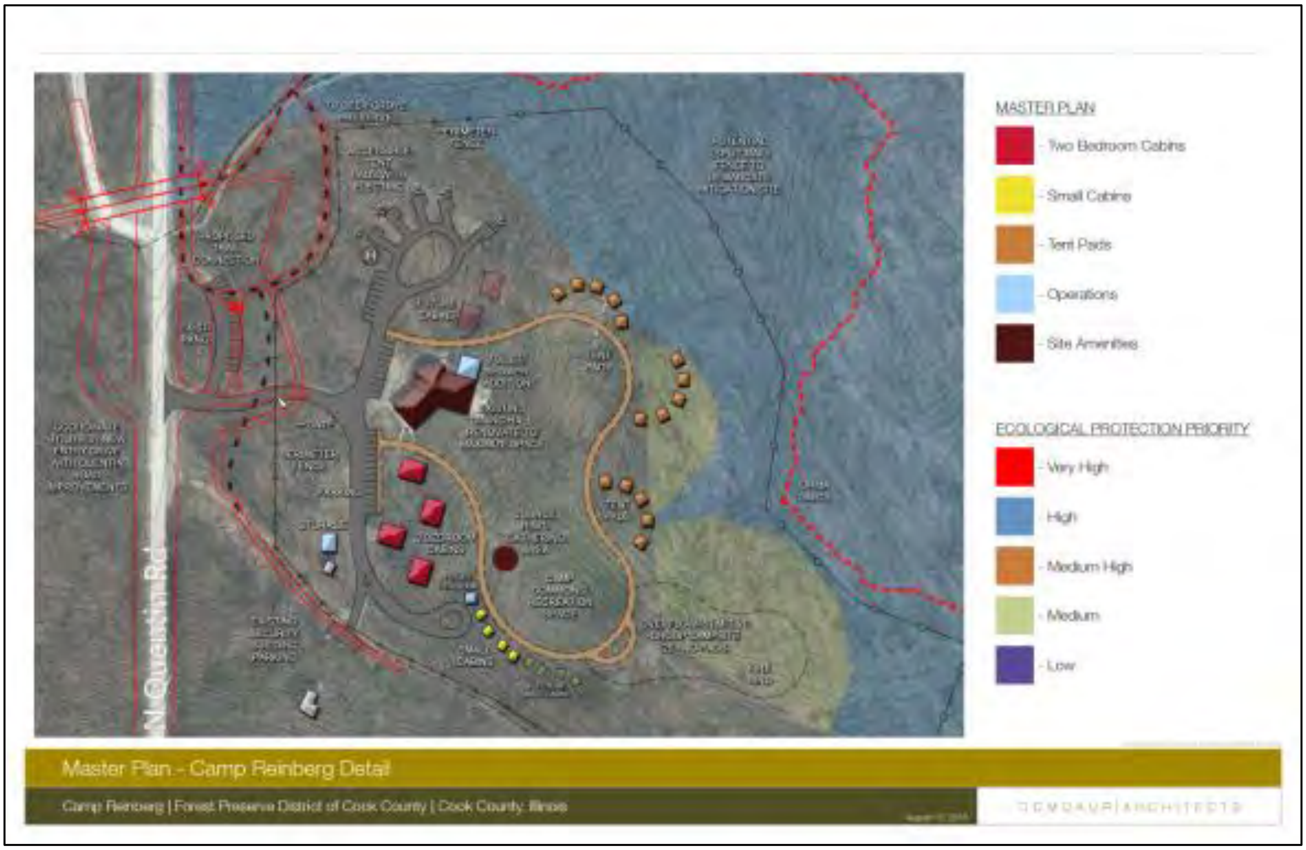


Figure 3-27: Camp Reinberg Master Plan.

The Friends of Deer Grove East is a stewardship group that was formed in 2011 to support and extend restoration work in the mitigated wetlands and buffer areas. The Buffalo Creek Clean Water Partnership (BCCWP) co-sponsors workdays and events, and members also lead volunteer work at the Preserve. Overall, more than 400 volunteers have participated in the following activities:

RiverWatch: *a partnership among Illinois citizens to monitor, restore and protect the state's rivers and streams. RiverWatch volunteers conduct stream habitat assessments and assist in the sampling and identification of aquatic macro-invertebrates. Data collected by Citizen Scientists is posted to an electronic bulletin board and used by the scientific community to gauge long-term trends in the environment.*

1. Habitat Restoration – including brush cutting and seed gathering at monthly and Earth Day workdays.

2. Citizen Science – monitoring animals and plants, including scouting for noxious invasive plants and ***RiverWatch*** program macro-invertebrate monitoring within the Preserve.

3. Community Outreach – sponsoring educational, recreational and volunteer events.

4. Communications – photography, website, Facebook, writing, speaking to groups.

RiverWatch sampling event in Buffalo Creek. Photo courtesy of the Buffalo Creek Clean Water Partnership.

3.8.2 Parks

Sixty-six (66) parks totaling approximately 667 acres were identified within the Buffalo Creek Watershed. The breakdown of parks per municipality is presented in **Table 3-16** and graphically displayed in **Figure 3-28.**

Table 3-16: Distribution of Parks with the Buffalo Creek Watershed.

Park Location	Size (Acres)	% of the Watershed
Arlington Heights	57.0	0.33%
Buffalo Grove	272.5	1.57%
Deer Park	54.2	0.31%
Lake Zurich	111.6	0.64%
Long Grove	23.7	0.14%
Palatine	29.5	0.17%
Prospect Heights	13.1	0.08%
Wheeling Township	0.2	0.00%
Wheeling	106.7	0.61%
TOTAL	**666.6 acres**	**3.84%**

Mike Rylko Community Park. Photo courtesy of M. Knysz.

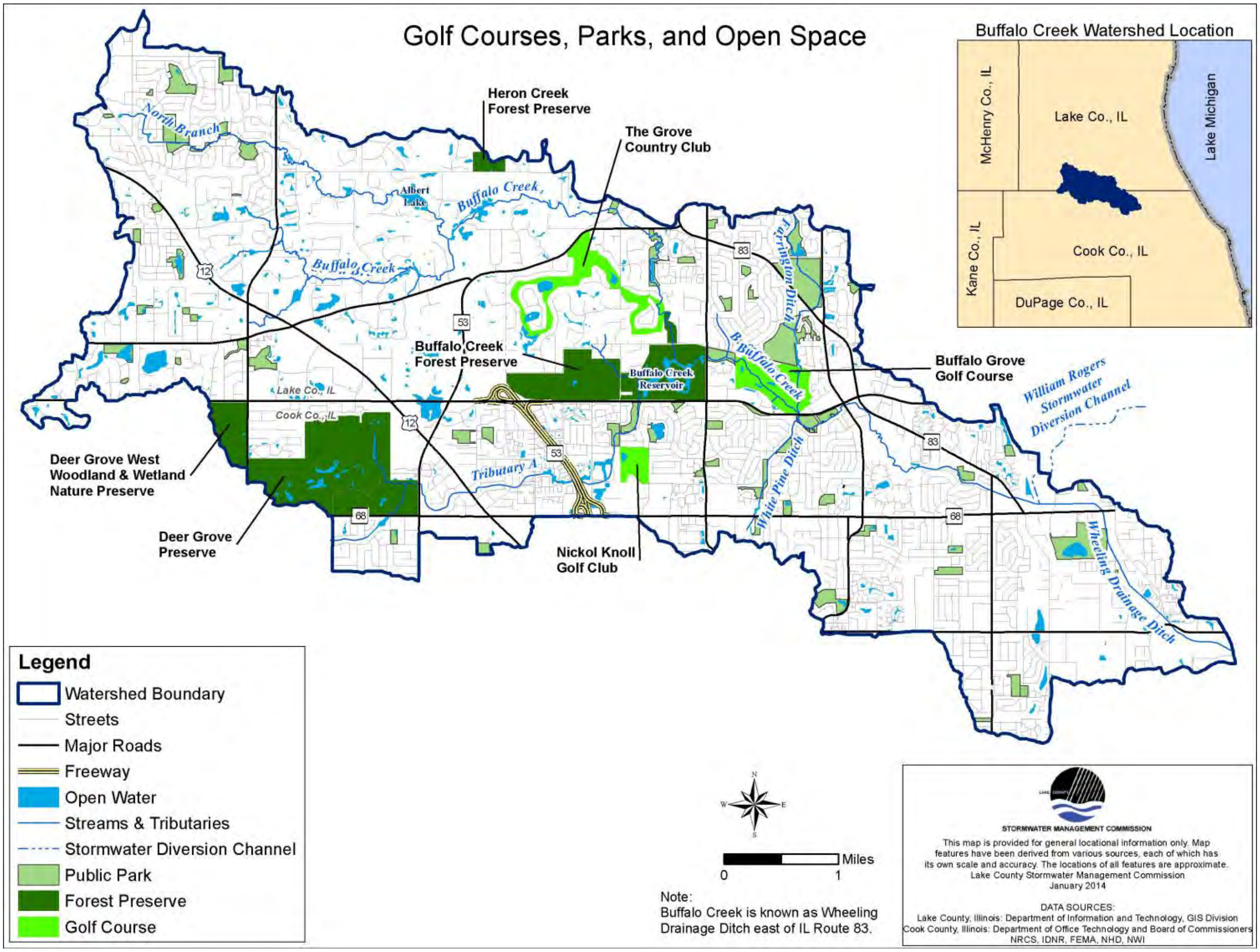


Figure 3-28: Location of Golf Courses, Parks, and Open Space in the Buffalo Creek Watershed.

One park, the Buffalo Creek Nature Center, is situated in a key location with the watershed, immediately downstream of the Buffalo Creek Reservoir. The Buffalo Creek Nature Preserve is a 15-acre park owned by the Village of Buffalo Grove, located southeast of the intersection of Arlington Heights Road and Checker Drive (see **Figure 3-28**). The Buffalo Creek Nature Preserve contains important natural areas including floodplain, prairie, wetlands, and the Buffalo Creek mainstem. A system of paved paths are located throughout the park, including an underpass under Arlington Heights Road which connects the park to the Buffalo Creek reservoir. The south end of the park is adjacent to the Buffalo Grove Golf Course.

Educational sign at the Buffalo Creek Nature Preserve. Photo courtesy of M. Knysz.

3.8.3 Golf Courses

Three golf courses totaling approximately 329 acres are located within the Buffalo Creek Watershed (see **Figure 3-28**) and are described below.

The Grove Country Club (148.8 acres) is a privately owned facility located at 3217 RFD in Long Grove, just west of Illinois Route 83. The Grove Country Club features a 7,000-yard, par 72 layout in addition to four other sets of tees. The country club also includes a clubhouse, outdoor swimming pool and tennis courts. Approximately 900 feet of the Buffalo Creek mainstem is located on the golf course property.

The Buffalo Grove Golf Course (134 acres) is located north of Lake Cook Road and west of Buffalo Grove in Buffalo Grove. This golf course is owned and operated by the Village of Buffalo Grove. The 18-hole course offers three sets of tees and the property also includes four ponds, clubhouse, restaurant, driving range, and maintenance facility. The golf course is located within the 100-year floodplain of Buffalo Creek and also contains approximately 3,800 feet of the Buffalo Creek mainstem and approximately 2,000 feet of Farrington Ditch.

Buffalo Grove Golf Course. Photo courtesy of the Village of Buffalo Grove.

The Nickol Knoll Golf Club (46 acres) is located on N. Kennicott Avenue in Arlington Heights, north of Dundee Road and west of Arlington Heights Road. This 56-acre golf course is owned and operated by the Arlington Height Park District. The course features 9 holes totaling 1,163 yards. The property drains to a detention basin located at the northwest corner of the golf course, ultimately draining directly to Tributary A.

Stormwater runoff from all three golf courses flows directly into Buffalo Creek and Tributary A. Landscaping and maintenance practices at the golf courses directly impact Buffalo Creek. While fertilizers and pesticides maximize productivity and performance of turf grass, the Buffalo Creek Watershed 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, 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 if accidentally related. 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 Buffalo Creek Watershed.

Golf courses in the Buffalo Creek Watershed should employ BMPs to prevent and minimize negative effects of golf course management on surface and groundwater in the watershed. Pollution prevention is easier, less expensive, and more effective than addressing problems "downstream". Essentially, BMPs are a sustainable approach to providing environmental, economic, and social benefits to golfs and the environment. Recommended BMPs for golf courses (Cornell University, 2014) include:

- 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 allowed to be 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.

Photo of geese on a golf course. Source: www.birdbgone.com.

- Utilize biological controls (other living organisms) to suppress or eliminate pests.
- 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).

3.9 Natural Resources

3.9.1 Threatened and Endangered Species

Threatened and ***endangered (T&E)*** species and communities, rare habitats, and important natural areas, including natural area inventory sites, forest preserves, nature preserves, and high quality ***advanced identification (ADID)*** wetlands make up the high quality natural resources in the watershed. While no federally endangered or threatened species have been observed in the watershed, there are several Illinois "state-listed" species present.

As of 2014 there are 138 state-listed T&E species listed for Lake County and 117 state-listed T&E species for Cook County, with 8 species located in the Buffalo Creek Watershed. **Table 3-17** lists each state-listed T&E species observed within the watershed and provides additional information, such as status and source of data. State-listed T&E species are designated "endangered" if in danger of extinction as a breeding species, while a "threatened" species includes any breeding species that is likely to become an endangered species within the foreseeable future.

> ***Endangered:*** *An "endangered" species is one that is in danger of extinction throughout all or a significant portion of its range.*
>
> ***Threatened:*** *A "threatened" species is one that is likely to become endangered in the foreseeable future.*
>
> ***Advanced Identification (ADID) Sites:*** *Aquatic sites that have been determined to provide biological value by the USACE, Chicago District and the USEPA.*

The majority of the Illinois T&E species were found near Deer Grove West Woodland and Wetland Nature Preserve, which is the only state-dedicated nature preserve in the Buffalo Creek Watershed. Ecologically significant and protected areas in the Buffalo Creek Watershed provide habitat for T&E species and contain examples of high-quality natural communities. These areas include

ADID wetlands, one Illinois Natural Area Inventory (INAI) Site (Deer Grove West), three forest preserves (Deer Grove, Heron's Creek, and Buffalo Creek Reservoir), and one Illinois Nature Preserve (Deer Grove West).

Table 3-17: T&E Species Occurrences in the Buffalo Creek Watershed.

Common Name	Scientific Name	Type	Status*	Source
Black Tern	*Chlidonias niger*	Vertebrate Animal	SE	IDNR
Blanding's Turtle	*Emydoidea blandingii*	Vertebrate Animal	SE	IDNR
Bulrush	*Scirpus hattorianus*	Vascular Plant	ST	IDNR
Common Moorhen	*Gallinula chloropus*	Vertebrate Animal	SE	IDNR
Forked Aster	*Aster furcatus*	Vascular Plant	ST	IDNR
Marsh Speedwell	*Veronica scutellata*	Vascular Plant	ST	IDNR
Mountain Blue-eyed Grass	*Sisyrinchium montanum*	Vascular Plant	SE	IDNR
Yellow-headed Blackbird	*Xanthocephalus*	Vertebrate Animal	SE	IDNR

***ST= State Threatened SE=State Endangered**

3.9.2 High Quality Natural Areas

One (1) dedicated Illinois Nature Preserve and 3 Forest Preserves (totaling 1,083 acres) are located in the watershed and are owned and maintained by either the Lake or Cook County Forest Preserve District. The Illinois Nature Preserves are designated by the Illinois Nature Preserves Commission, but maintained by the property owner with oversight from the Illinois Nature Preserves Commission and offer the highest level of protection for rare flora and fauna and high quality natural communities. **Figure 3-29** identifies the location of the high quality natural resources in the watershed.

3.9.3 Wetland Inventory

Wetlands provide a variety of functions. They provide areas where groundwater is recharged by surface water and where groundwater is discharged to the land surface. They also filter sediments and nutrients in runoff, provide wildlife habitat, reduce flooding, and help maintain water levels in streams. These functions improve the water quality and biological health of downstream waterbodies, making wetlands a valuable watershed management tool.

European settlers to the region altered much of the Buffalo Creek Watershed's natural hydrology and wetland processes. Settlers drained wet areas, channelized streams, and cleared forests in order to farm the rich soils. Even after being cleared or drained, the underlying soil retains its characteristics. Hydric soils (soils that remain wet for an extended period of time) are a source used to identify pre-settlement wetlands. Based on hydric soils mapping, approximately 71% of the wetland land area that existed prior to European settlement has been lost in the Buffalo Creek Watershed (U.S. EPA, 2015). Development of the Buffalo Creek Watershed has reduced the potentially restorable wetlands by 73%, with 1,019 acres of potentially restorable wetlands remaining on undeveloped land (U.S. EPA, 2015).

Existing wetland locations are derived from two data sets – the Lake County Wetland Inventory (LCWI) and the National Wetlands Inventory (NWI) in Cook County. While the NWI is available for both counties, the LCWI was used in Lake County for this plan as it represents a more accurate representation of wetlands in the watershed. A summary of wetlands mapped in Lake and Cook County according to the NWI is presented in **Table 3-18**. All wetlands in the Buffalo Creek Watershed are classified in the NWI as either lacustrine (deepwater habitats lacking trees, shrubs, and ***emergent plants***) or palustrine (an area dominated by trees, shrubs, and emergent plants.

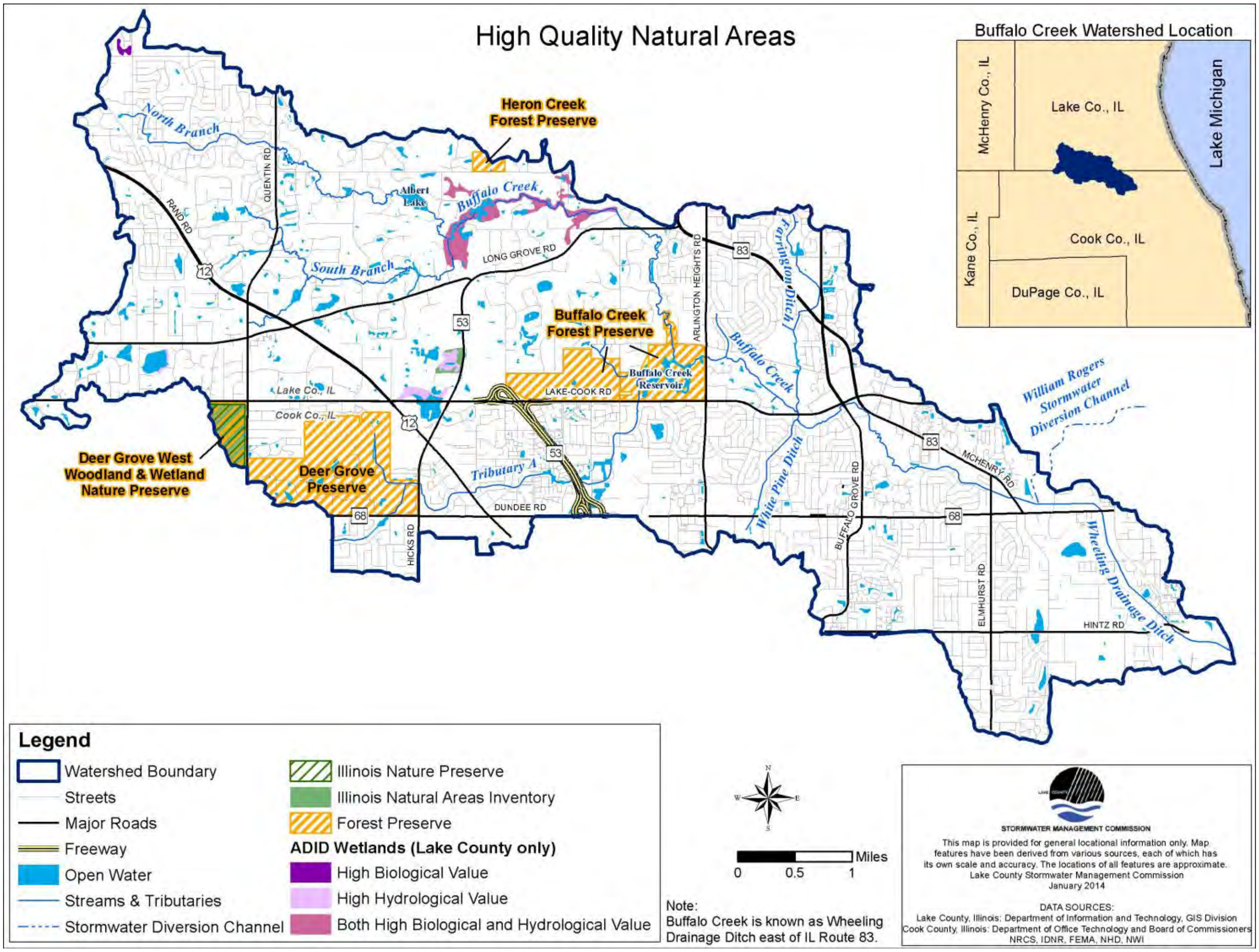


Figure 3-29: High Quality Natural Areas in the Buffalo Creek Watershed.

The LCWI was updated in 2002 using high resolution aerial photography and enhanced topographic information. The LCWI identifies five categories of wetlands including: wetlands, farmed wetlands, artificial wetlands, converted wetlands, and ADID wetlands. The ADID was developed by the USEPA et al. in 1992 and identified high functionality wetlands that should be protected. Three primary functions were used 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, shoreline/bank stabilization). ADID wetlands are assessed to determine locations appropriate for preservation, restoration, and management options. Potential wetland restoration sites are discussed in Chapter 7.

There are approximately 1,576 acres of mapped wetlands remaining in the watershed (Tetra Tech, 2015), with approximately 208 acres identified in Lake County classified as ADID wetlands. It should be noted that the NWI identified approximately 537 acres in Lake County. The ADID process identifies wetlands of high value based on their habitat, water quality, and stormwater storage functions. The locations of mapped wetlands in the Buffalo Creek Watershed are shown in **Figure 3-30.** There is a 149 acre wetland complex located downstream of Albert Lake that is of both high biological and hydrological value. The remaining 53 acres of ADID wetlands are scattered throughout the watershed and are of high hydrological value. A 6-acre wetland in the northwest corner of the watershed has high biological value.

Based on the NWI, there are 140 wetlands totaling 327 acres in the Cook County portion of the watershed. Deer Grove East contains recently restored wetlands and prairie, including 23 wetlands restored by disabling drain tiles that drained former farm fields at the site. Deer Grove East contains the largest wetland in the Cook County portion of the watershed.

Table 3-18: NWI Summary for Buffalo Creek Watershed.

NWI Classification	# of Wetlands Cook County	Acres in Cook County	# of Wetlands Lake County	Acres in Lake County
Lacustrine Limnetic	1	17.18	2	9.71
Palustrine Aquatic Bed	-	-	5	4.11
Palustrine Emergent/Aquatic Bed	-	-	1	1.54
Palustrine Forested/Emergent	2	6.84	4	39.56
Palustrine Scrub-Shrub/Emergent	2	2.81	5	39.73
Palustrine Emergent	41	194.91	111	224.88
Palustrine Forested/Scrub-Shrub	-	-	1	13.18
Palustrine Forested	8	13.18	11	29.35
Palustrine Scrub-Shrub	1	1.10	7	9.46
Palustrine Unconsolidated Bottom	85	91.18	112	165.86
TOTAL	**140**	**327.20**	**259**	**537.38**

Emergent Plants: *Plants that have their roots contained in shallow water with most of its vegetative growth above the water.*

Limnetic: *Deep water habitats greater than 6.6 feet deep.*

Aquatic Bed: *Includes wetlands and deeper water habitats dominated by plants that grow on or below the surface.*

Forested: *Areas where woody vegetation is taller than 20 feet and covers more than 30% of an area.*

Scrub-Shrub: *Areas where woody vegetation is shorter than 20 feet and covers more than 30% of an area.*

Unconsolidated Bottom: *Wetlands in which the substrate is at least 25% particles smaller than stones, has greater than 30% vegetative cover, and is permanently flooded.*

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, exceptional natural communities and special geological features. The database has compiled information from a broad range of sources, including museum and herbarium collection records, publications, and experts throughout the state. Guided by this information, the Division of Habitat Resources participates in considerable field surveys every year to build the database and keep it current. Staff members, contractors, and volunteers perform field surveys to find and verify specific locations of the features of highest priority and to collect accurate information on the condition, quality, and management needs of these features. Scientists, resource managers, and volunteers contribute to the database. Major contributors include the IDNR, Nature Conservancy, Illinois Natural History Survey, Morton Arboretum, Southern Illinois University-Carbondale, Eastern Illinois University, Illinois State Museum, Illinois Nature Preserves Commission, and the Illinois Endangered Species Protection Board.

Illinois Sustainable Natural Areas Vision (SNAV): The SNAV is the corollary to the Illinois Natural Areas Plan written in 1980 following the completion of the first INAI. The primary goal of this first plan was to protect existing INAI sites and manage them to sustain them into the future. The primary goal of SNAV is to set forth a workable, implementable framework for creating a sustainable, connected system of natural areas. In the short term, efforts will be made to protect natural areas as they exist today, encompassing all the current ecological functions and biodiversity of these sites. Secondary goals include the identification of the potential roles of all stakeholders in this effort, and to consider the many challenges and opportunities that exist in protecting natural areas and creating sustainability.

Illinois Nature Preserves: State-protected areas that are provided the highest level of legal protection, and have management plans in place.

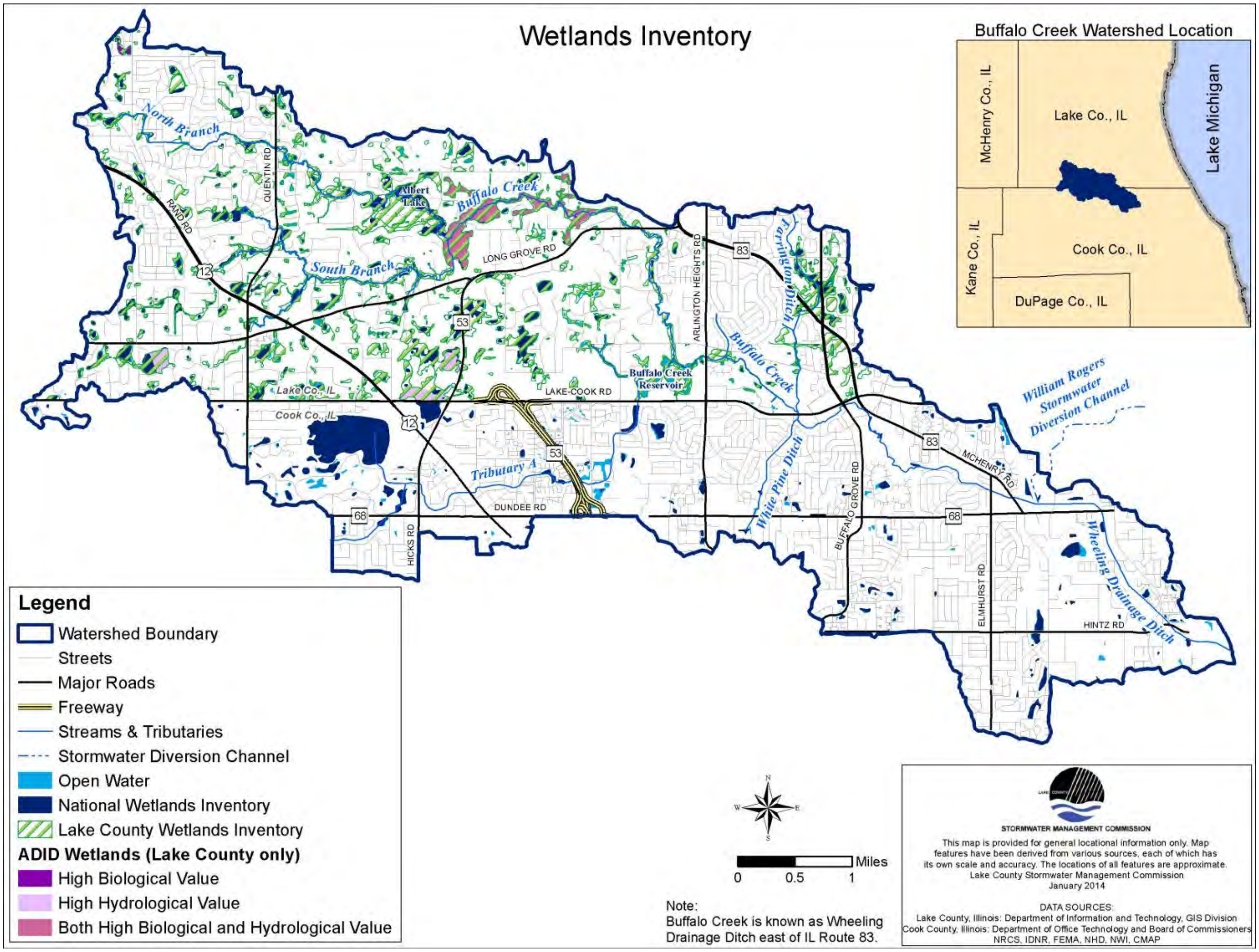


Figure 3-30: Wetlands Inventory for the Buffalo Creek Watershed.

Noteworthy: Wetland Classifications Systems

The **Advanced Identification (ADID)** process involved collecting information on the values and functions of wetlands identifying those of high value based on their habitat, water quality, and stormwater storage functions. The EPA conducts the process in cooperation with the USACE, USFWS and local and regional agencies. Designation as an ADID wetland results in a more rigorous permitting review when impacts such as filling are proposed. As a result, alterations of ADID wetlands are strongly discouraged. The ADID wetlands inventory was completed for Lake County in 1992 and updated in 2002.

The **NWI** was established by the USFWS to conduct a nationwide inventory of U.S. wetlands to provide biologists and others with information on the distribution and type of wetlands to aid in conservation efforts. To do this, the USFWS developed a wetland classification system (Cowardin et al. 1979) that is now the official USFWS wetland classification system and the Federal standard for wetland classification. The NWI is a database of information used to identify the status of wetlands across the United States. The system contains wetland data in map and digital formats. Wetlands are classified into five major systems (according to the Cowardin system): marine, estuarine, riverine, lacustrine, and palustrine.

> ***Wetland Restoration:*** *Rehabilitation or creation of prior existing wetlands that have been drained, usually by drain tiles or ditched. Restoration results in a gain of wetland acres.*
>
> ***Wetland Enhancement:*** *Manipulation of the physical, chemical, or biological characteristics of a wetland (undisturbed or degraded) site that heighten, intensify, or improve specific function(s). Enhancement does not result in a gain of wetland acres.*

Wetland restoration can prove extremely beneficial in restoring the basic functions that historic wetlands once provided, including reducing flood volumes and rates, increasing biodiversity, reducing nonpoint source pollution, and improving water quality conditions. Restorations typically occur on areas that have been drained, in most cases for agricultural practices. When a wetland is drained, the soil characteristics often remain intact and are referred to as hydric soils. Wetlands can be restored on drained hydric soils when drain tiles are disabled or other wetland dewatering systems (e.g., ditches) are modified. Wetlands restored in agricultural areas can reduce phosphorus levels in runoff by 60% and nitrates by 40%, resulting in cleaner water entering stream and lake systems and a potential decrease in algal blooms and aquatic vegetation overgrowth. Wetland enhancement improves specific function(s) in existing wetlands, typically plant diversity, or can be for a specific purpose such as water quality improvement, flood water retention, or wildlife habitat. Potential wetland restoration and enhancement sites are detailed further in **Chapter 6**.

3.10 Watershed Drainage System

3.10.1 Hydrology and Flow

Hydrology is the study of the occurrence, circulation, distribution, and properties (e.g., quality) of the earth's water. A central theme of science is that the earth's water is constantly being cycled – between the ocean, the air, and the land – through different pathways and at different rates. The movement of the earth's water through these various pathways is called the hydrologic cycle.

> ***Stormwater Runoff:*** *Water from rain or melting snow that "runs off" across the land instead of seeping into the ground. Generally speaking, stormwater is rain (also melting snow and ice) that washes off driveways, parking lots, roads, yards, rooftops, and other hard surfaces.*

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, and wetlands. 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. A graphic representation of the hydrologic cycle is shown in **Figure 3-31**.

Primarily, hydrology involves studying the flow of water between its various states – or within a given state – through the various hydrologic pathways that can be found within a particular geographical region or area. These pathways connect every component of the landscape with every other and can generally be divided into two categories: surface water hydrologic pathways, which include all of the hydrologic pathways that can be found at or above the land surface (e.g., precipitation, interception, evapotranspiration, surface water flow); and, ground water hydrologic pathways, which include all of the hydrologic pathways that can be found below the land surface (e.g., infiltration, interflow, groundwater flow). The study of the surface water hydrologic pathways that connect the various parts of the landscape is known as surface water hydrology, while the study of the ground water hydrologic pathways that connect the various parts of the landscape is known as hydrogeology. 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, either for scientific knowledge or for making predictions.

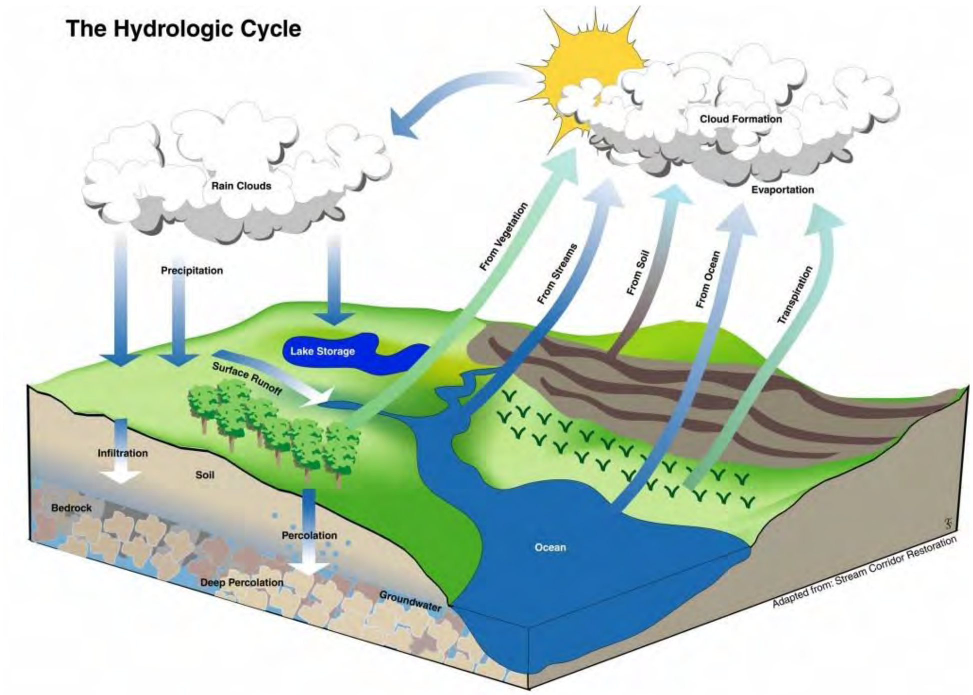


Figure 3-31: The Hydrologic Cycle (Source: Department of Natural Resources Ecology and Management at Iowa State University. Tom Schultz).

When applied to a watershed, hydrology typically involves studying the flow of water between the surface water hydrologic pathways that connect the air, the land, and the lakes, rivers, and wetlands found within the watershed. Such investigations usually begin with a delineation of the watershed. As discussed in **Chapter 3**, the Buffalo Creek Watershed was originally delineated by the USDA NRCS and was refined by the USACE as part of their Des Plaines Phase II planning efforts. The watershed boundary was further revised by Cardno during the watershed planning process to include areas within Lake Zurich that are tributary to Buffalo Creek via storm sewer and to remove a portion of the Deer Grove Forest Preserve that is actually tributary to Salt Creek. Once the watershed boundary is determined, a combination of desktop assessment and field reconnaissance work can then be performed to investigate the surface water hydrology of the watershed. Such investigations usually include identification of surface water inputs to the watershed, surface water outputs from the watershed, and surface water flow paths within the watershed. Understanding how water moves and flows is an important component of understanding a watershed. All of the parameters listed in the previous sections (i.e. topography, soils, precipitation and land use) impact hydrology. Hydrological data are available from the USGS website (www.usgs.gov). The USGS maintains stream gages throughout the United States and they monitor conditions such as gage height and stream flow, and at some locations, precipitation. The Buffalo Creek USGS stream gage (05528500) is located in the central portion of the watershed near Wheeling, and includes data from 1953 to 2013. **Figure 3-32** displays the location of the USGS gaging station. Buffalo Creek's highest average annual stream flow of 35 cubic feet per second (cfs) was recorded in 2007, while the lowest average annual stream flow (2 cfs) was recorded in 1963 (see **Figure 3-33**). April has the highest average monthly discharge for Buffalo Creek, while October has the lowest average monthly discharge (see **Figure 3-34**)

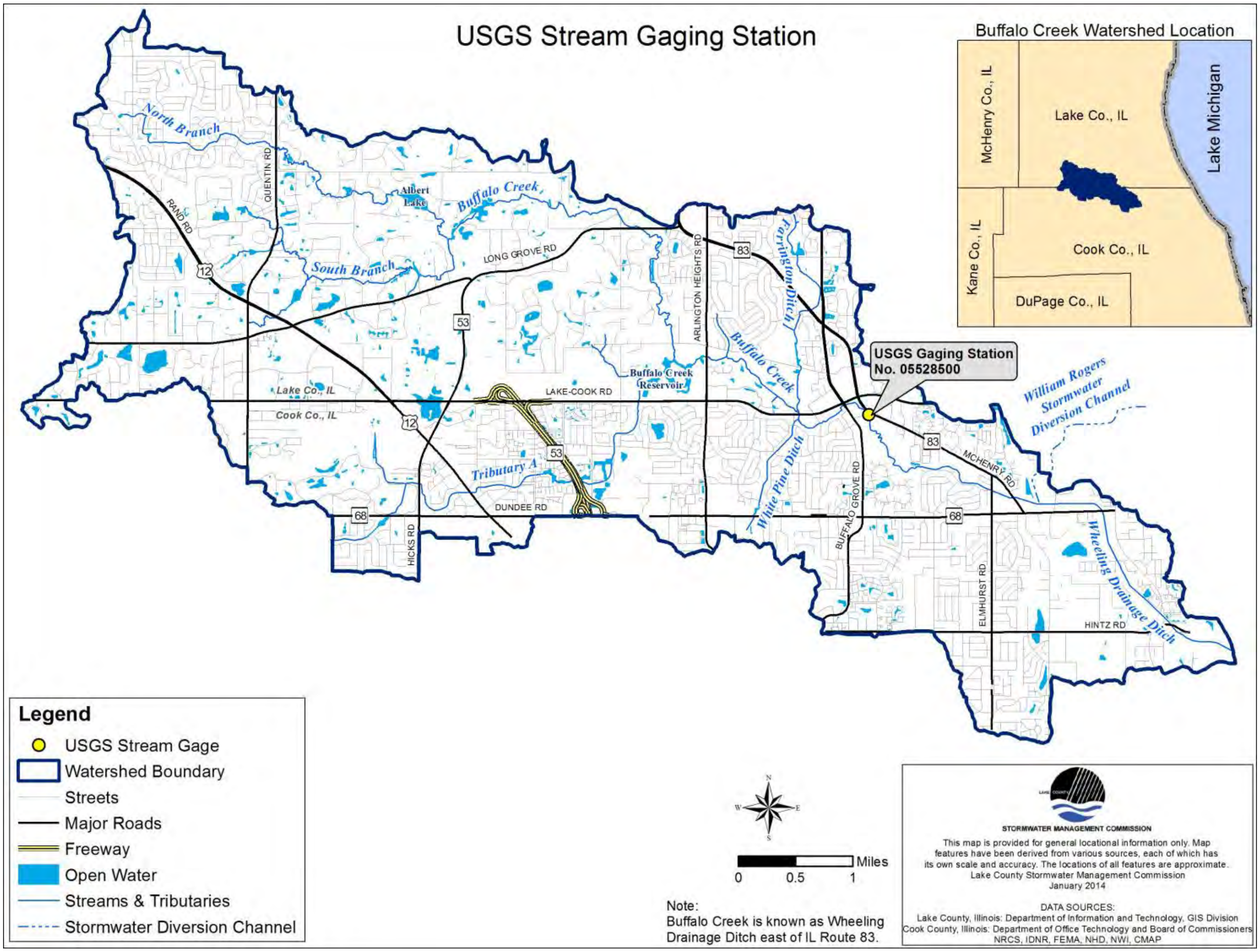


Figure 3-32: USGS Stream Gaging Station in the Buffalo Creek Watershed.

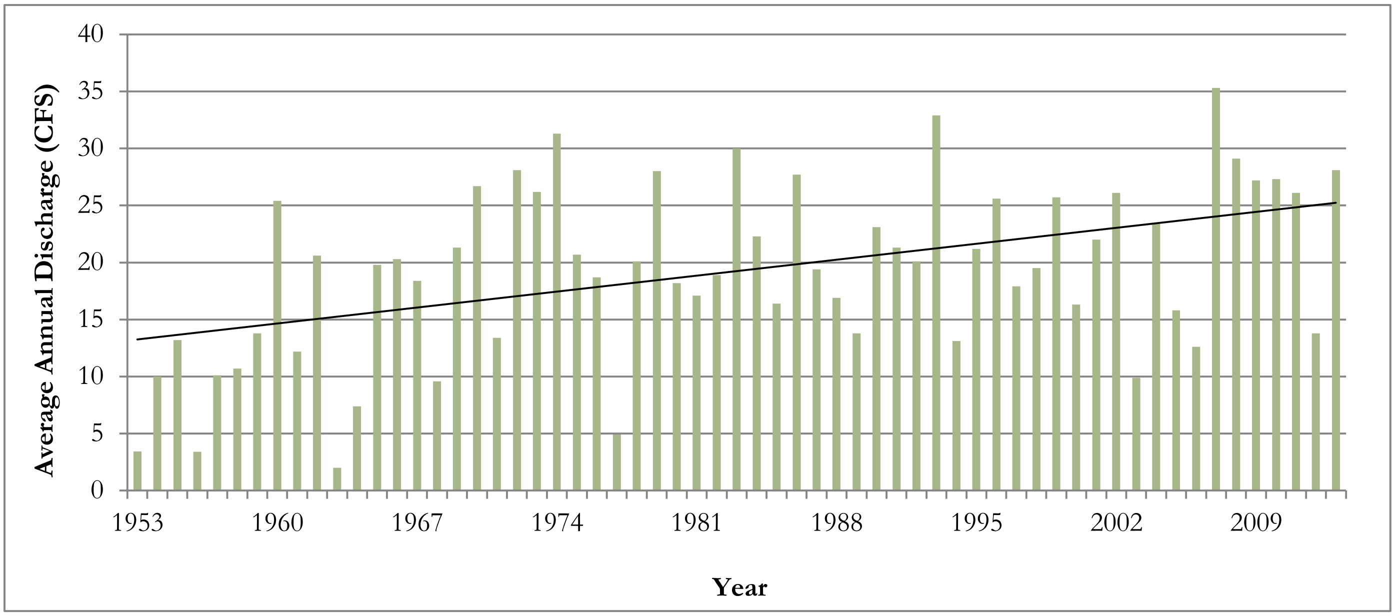


Figure 3-33: Average Annual Stream Flow (CFS), USGS Buffalo Creek Stream Gage.

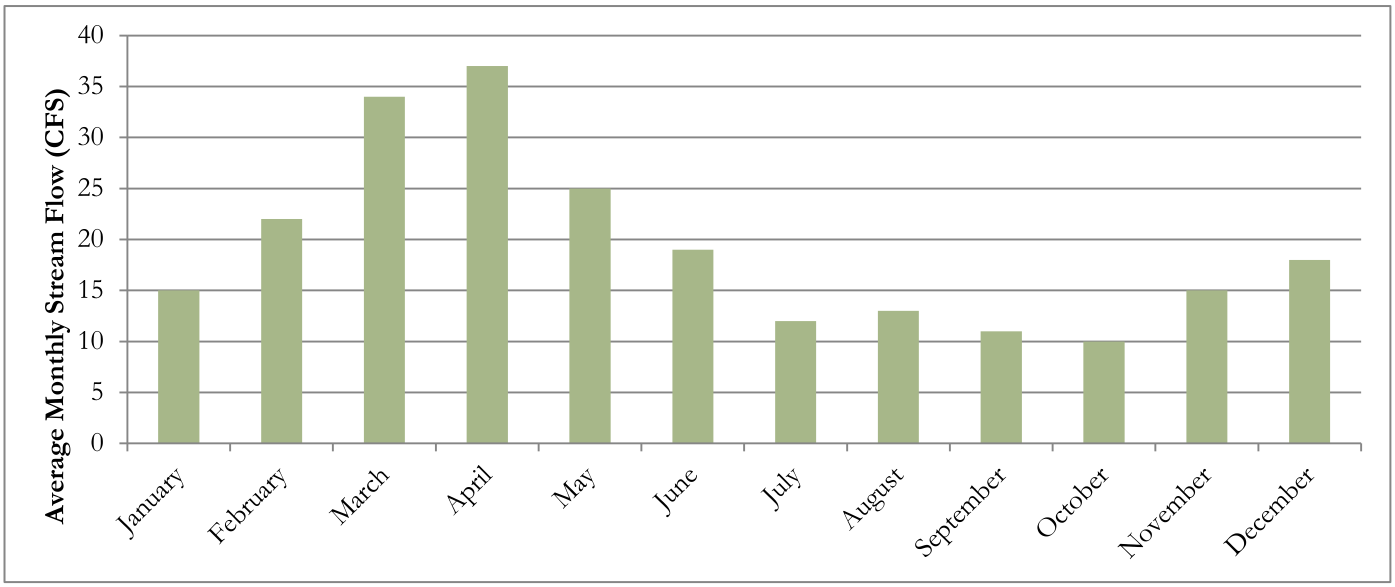


Figure 3-34: Average Monthly Stream Flow (CFS), USGS Buffalo Creek Stream Gage from 1953 through 2013.

Within the Buffalo Creek Watershed surface water generally flows from northwest to southeast, with the highest elevations found in the northwest corner of the watershed, and the lowest found in the southeast. Along the way, surface water passes through various streams, lakes, wetlands and detention/retention ponds that were further investigated and are described in more detail in the following sections. Major surface water inputs include inflow from streams (such as the Farrington Ditch, White Pine Ditch, Tributary A and the North Branch/South Branch of Buffalo Creek) and precipitation. Major surface water outputs include outflow (i.e. an overflow weir on the north side of Buffalo Creek conveys flood waters to the William Rogers Memorial Diversion Channel in Wheeling, which joins the Des Plaines River east of Milwaukee Avenue) and ***evapotranspiration***.

> ***Evapotranspiration:*** *The evaporation from soils, plant surfaces, and water bodies and water losses through plant leaves.*

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 fairly constant over time, but how much of that water is found 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 – and across the surface of the earth – through various hydrologic pathways, such as evaporation, transpiration, condensation, precipitation, infiltration, surface water flow, and interflow (i.e., shallow groundwater flow).

As water moves from one state to another, such as from water vapor to water (i.e., rain), 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 it condenses, energy is released and the surface of the earth is warmed (see **Figure 3-31**). These energy exchanges, which take place 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 is the most important greenhouse gas, absorbing and emitting energy back toward the surface of the earth, but, in the form of clouds, also works to reflect 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 for all creatures found upon, below, and above its surface.

3.11 Constructed Drainage Systems

As European settlers converted the watershed's natural landscape to agriculture, they improved the drainage of wetland (hydric) soils by using underground drain tiles and ditches. Likewise, as land owners today convert natural and farmed lands to residential, industrial, and commercial land uses they improve the drainage of the landscape with storm sewer systems and stormwater storage facilities (detention basins), to maximize the land's development potential and to reduce the likelihood of flooding problems

3.11.1 Agricultural Drain Tile Network

The natural drainage system of overland flow paths and wetlands draining into streams, lakes, and watersheds began to change when European settlers discovered the potential agricultural productivity of the soils in the area. Most of these soils remained wet for several days following a rain event, which causes significant problems with crop production. Saturated soils do not provide sufficient aeration for crop root development and lead to crop stress.

In the late 1800s, European settlers began using primitive agricultural drainage tile systems and ditches to remove standing or excess water from poorly drained lands. By the 1960s and 1970s, drainage tiles became the standard for removing unwanted water from the land. Drainage tiles ultimately carry water to ditches, streams, or lakes. Drainage systems generally accelerate the speed that runoff reaches receiving streams, thereby increasing peak flows and the duration of ***bankfull*** flows, which can lead to stream channel degradation (erosion downcutting and widening) and downstream flooding.

Bankfull: *A 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 on to the adjacent floodplain.*

3.11.2 Storm Sewers System and Detention Basins

> ***Peak runoff:*** *The maximum amount of water being discharged at a specific location during a storm event.*
>
> ***Streambank erosion:*** *The removal of soil particles from the banks of a stream by the flow of water.*
>
> ***Riparian Area:*** *Vegetation, habitats, or ecosystems that are associated with bodies of water (streams or lakes) or are dependent on the existence of perennial, intermittent, or ephemeral surface or subsurface water drainage.*

As settlement of the watershed area increased, the natural drainage system began to experience more changes as residential, commercial, and industrial land uses replaced open lands. These land use/cover changes limited the land's capacity to infiltrate and store precipitation and runoff. In the developed areas of the watershed, a storm sewer network drains runoff directly to a stream or lake, or into a detention basin, which collects and holds the water for a period of time before discharging it to a stream or lake. 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.

Since early urban development was constructed without detention basins, runoff was directly sent to wetlands, lakes, streams, and rivers causing an increase in ***peak runoff*** discharge (see **Figure 3-35**). An increase in peak discharges usually results in increased flooding. Detention basins are designed to capture stormwater runoff from a surrounding development and release the water slowly over a given amount of time, thereby reducing peak flows. Limited release from the frequent storms allows for more close approximation of the bankfull flow capacity of stream channels. Although many flood problems are alleviated using this method, channel degradation can result as prolonged bankfull flows cause ***streambank erosion***. In addition, while regulating the outflow from detention basins to the stream channel reduces peak flows, detention basins do not address the total volume of runoff. Consequently, flows from tributaries collect in mainstem river channels where the total volume of runoff results in flooding and flood damage.

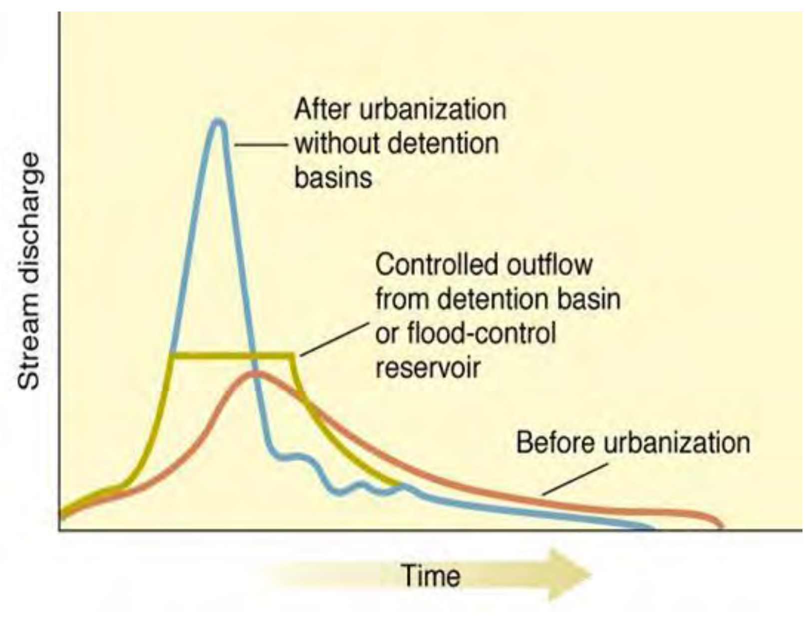


Figure 3-35: Hydrograph Example (Source: Carleton College Science Education Research Center).

3.12 Stream Inventory

3.12.1 Introduction and Methods

Defined Channel: *The bed where a natural stream of water runs.*

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 stormwater flows back into a lake or stream channel*

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.*

In the summer of 2013, SMC staff and interns conducted a stream inventory of Buffalo Creek to assess the current condition of the stream channel and ***riparian area***. The stream inventory is a largely qualitative assessment of several easily observed and measured parameters that can be analyzed individually or collectively to provide insight as to the present condition of the stream system. The data is also useful for documenting "baseline" conditions and prioritizing potential project needs and locations. For the purposes of the stream inventory, the entire stream network within the watershed was divided into reaches, which are smaller, geographically-defined segments of the stream for which data are aggregated and evaluated. Reaches ranged from approximately 765 feet to 4,670 feet in length. Dams, bridges, roads and railroad crossings are typically used to define the upstream and downstream limits of a reach. Each reach was assigned a unique identification code such as BC001 (Buffalo Creek Reach 1). The Buffalo Creek stream network and flow path was divided into 75 reaches (27.7 miles), of which 59 reaches (23.3 miles) were assessed in the inventory, 2 reaches (0.6 miles) were inaccessible due to construction, and 14 reaches (3.9 miles) lacked a defined channel, or were not streams (i.e., lakes, ponds, wetlands or engineered stormwater systems). The average length of assessed reaches in the Buffalo Creek inventory is 1,941 feet (less than ½ mile). Stream reaches are shown on **Figure 3-36** and a summary of the stream inventory assessment is located in **Appendix C**. A link to the ArcGIS map identifying the location and results of the stream and basin inventory can be found on the BCCWP webiste (www.buffalocreekcleanwater.org).

The stream inventory is designed to assess the condition of stream channels, therefore, data are collected only for reaches with a ***"defined" channel*** and that are safe to wade. Stream inventory data are not collected for open-water ponds, lakes and impoundments, wetland complexes with no defined channel, and areas where the depth of water and/or unstable substrate creates a hazard for the observer(s). Note that White Pine Ditch was not assessed during the stream inventory as it is classified as a minor flow tributary/ditch with no associated name (according to the Cook County GIS data). Roadside swales and smaller minor tributaries were also not included as part of the inventory.

The following types of data were collected during the inventory and are discussed in detail in the following sections:

- 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)

Data are collected by a team of two observers walking the entire length of every assessed reach. 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 areas of moderate to severe ***erosion***, significant ***sediment deposition*** and debris jams, all ***hydraulic structures*** and all ***discharge points***. Photos and measurements of the stream channel also document conditions that are representative of the reach. Because the observers use a camera that is equipped with a ***global positioning system (GPS)***, each photo is tagged with geographic coordinates that are translated into point locations in a GIS during post-processing. This manner of conversion allows for analysis and mapping of the collected data.

3.12.2 Stream Network Descriptions

The Buffalo Creek Watershed contains approximately 27.7 miles of flow path through streams, wetlands, and lakes, (of which 23.2 miles of stream channel were assessed during the stream inventory), as shown in **Figure 3-36** and **Table 3-19.** The network of stream channels in the watershed includes natural meandering channels, channelized or straightened segments of natural streams and wholly constructed channels or ditches that were created primarily to drain land. In addition to the stream network, these channels are connected to an array of wetlands, lakes and impoundments. For the purposes of discussion in this section, the areas assessed during the stream inventory are divided into 4 geographic sections (see **Figure 3-36**):

1. **Buffalo Creek Mainstem:** Originates in Long Grove at the confluence of the North and South Branches of Buffalo Creek.
2. **North Branch of Buffalo Creek**: One of the two branches that merge to form the Buffalo Creek Mainstem, originating in Lake Zurich.
3. **South Branch of Buffalo Creek:** One of the two branches that merge to form the Buffalo Creek Mainstem, originating in Kildeer.
4. **Tributary A:** Originates in Cook County, just east of Deer Grove Forest Preserve. Flows north under Lake Cook Road into the Buffalo Creek Reservoir.
5. **Farrington Ditch:** Tributary originating from Green Knolls Park Pond (and receiving drainage from two other residential detention facilities) draining south, parallel to Buffalo Grove Road in Buffalo Grove.

Table 3-19: 2013 Stream Inventory Miles in the Buffalo Creek Watershed.

	Buffalo Creek Mainstem	North Branch of Buffalo Creek	South Branch of Buffalo Creek	Tributary A	Farrington Ditch	Total
Number of Reaches	24	7	13	10	5	59 Reaches
Assessed Miles	10.0	3.0	4.2	4.0	2.1	23.3 Miles

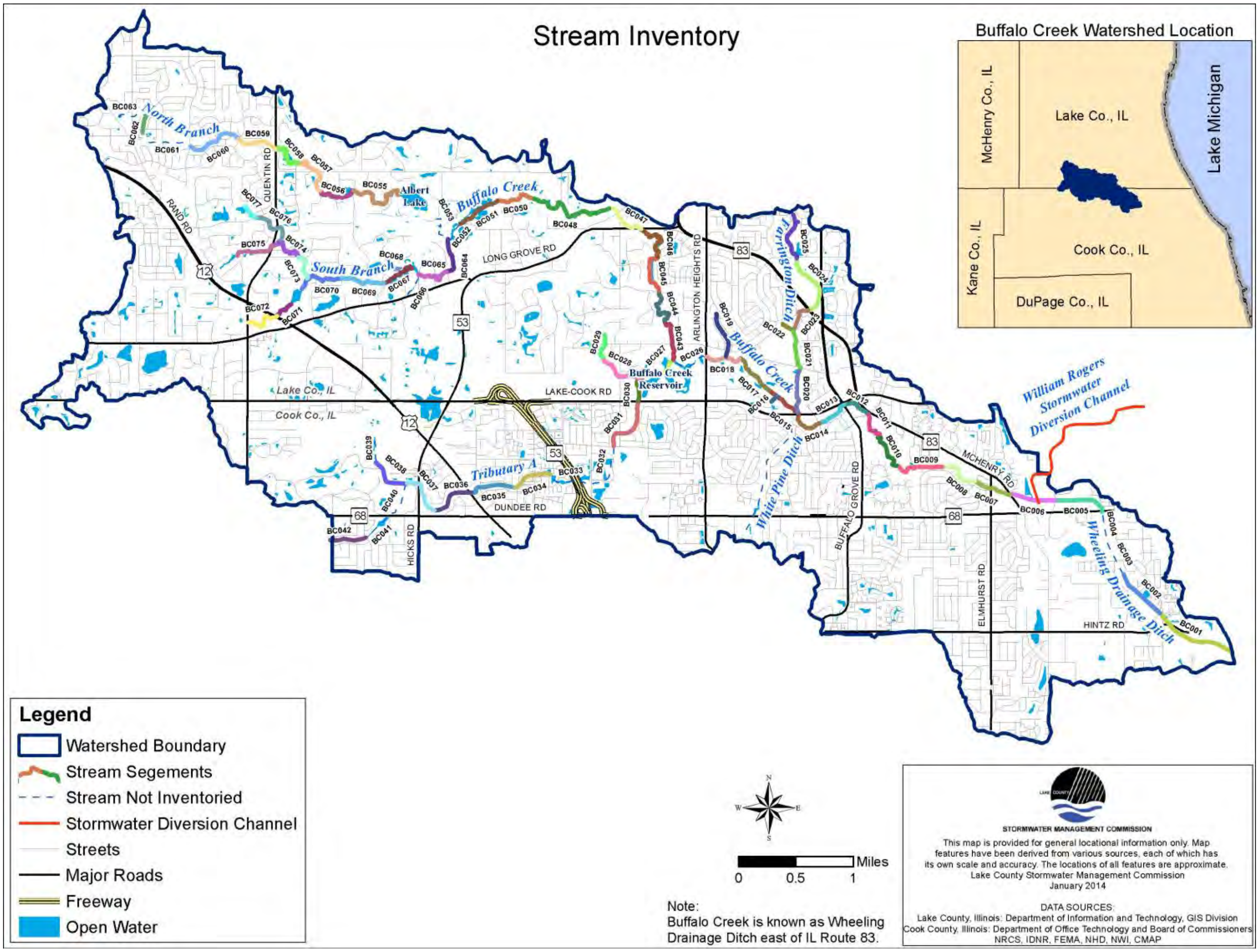


Figure 3-36: 2013 Stream Inventory Stream Reaches in the Buffalo Creek Watershed.

3.12.2.1 Channel Conditions

Measurements of the physical dimensions of the stream channel reflect both the shape of the channel as well as the amount of water that it can transport under ***low and high flow conditions***, as shown in **Table 3-20**. The Buffalo Creek Mainstem and the South Branch of Buffalo Creek have large channels relative to the other tributaries in the watershed. This pattern of narrow-shallow headwater streams gradually draining into wider-deeper mainstem streams is common in stream hydrology.

> ***Low or High Flow Conditions:***
> *Typically measured as a 7 day average of the lowest or highest water flow rates annually.*

3.12.2.2 Channelization

Channelization refers to the straightening of natural, meandering stream channels or the construction of channels for drainage or navigation, although no channels in the Buffalo Creek Watershed have been altered or constructed to improve navigation. In natural meandering streams, channelization has the effect of reducing the overall length of the stream and increasing the gradient of the channel. In both streams and constructed channels, channelization increases the speed at which runoff flows through the stream system. 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.

Table 3-20: 2013 Stream Inventory - Channel Conditions in the Buffalo Creek Watershed.

Stream Segment	Bank Height (ft.)		Channel Width, Top (ft.)		Channel Width, Bottom (ft.)	
	Min.	Max.	Min.	Max.	Min.	Max.
Buffalo Creek Mainstem	0.3	15.0	7.0	70.0	0.83	45.2
North Branch of Buffalo Creek	0.1	3.2	4.5	61.5	2.5	45.0
South Branch of Buffalo Creek	0.1	16.0	3.6	130.0	1.5	36.0
Tributary A	0.25	7.5	0.67	75.0	0.7	27.5
Farrington Ditch	0.1	3.5	0.1	75.0	0.1	27.0

Figure 3-37 and Table 3-21 illustrate the degree of channelization of assessed reaches in the Buffalo Creek Watershed. The reaches of Buffalo Creek upstream of the Buffalo Creek Reservoir primarily have a low to moderate degree of channelization. The areas with the highest degree of channelization are Farrington Ditch and the section of Buffalo Creek located east of Elmhurst Road (known as Wheeling Drainage Ditch). Farrington Ditch is a channelized ditch that runs through the backyards of many homes and also through the Buffalo Grove Golf Course and Willow Stream Park Frisbee disc course. Farrington Ditch is primarily surround by mowed turf grass with very little buffer. Streams such as Farrington Ditch that are channelized have reduced ***instream habitat*** and stability.

Instream Habitat: *Within a stream, the environment in which an animal or plant normally lives or grows.*

Table 3-21: 2013 Stream Inventory - Degree of Channelization in the Buffalo Creek Watershed.

Degree of Channelization	North Branch			South Branch			Buffalo Creek Mainstem			Tributary A			Farrington Ditch		
	Reaches	Miles	% of Miles	Reaches	Miles	% of Miles	Reaches	Miles	% of Miles	Reaches	Miles	% of Miles	Reaches	Miles	% of Miles
None	3	1.49	50%	9	2.84	67%	4	2.04	21%	1	0.36	9%	1	0.34	**16%**
Low	4	1.49	50%	2	0.86	20%	9	3.15	32%	2	0.94	24%	1	0.6	**29%**
Moderate	0	0	0%	1	0.37	9%	6	2.28	23%	6	2.35	59%	0	0	**0%**
High	0	0	0%	1	0.16	4%	5	2.48	25%	1	0.32	8%	3	1.15	**55%**
TOTAL	**7**	**2.98**	**100%**	**13**	**4.2 3**	**100%**	**24**	**9.95**	**100%**	**10**	**3.97**	**100%**	**5**	**2.09**	**100%**


Photos of channelized (left) and natural (right) stream reaches in the Buffalo Creek Watershed.

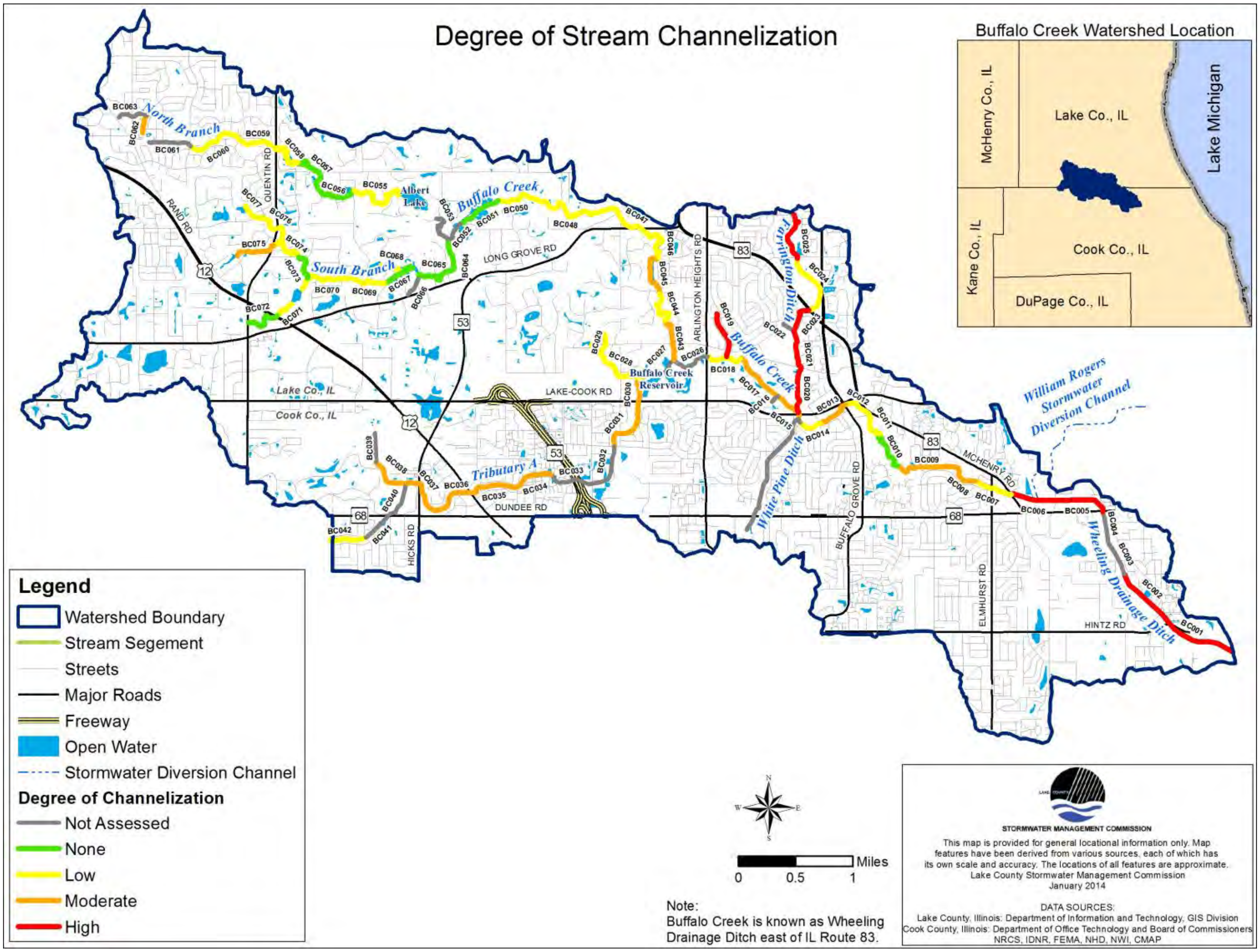


Figure 3-37: 2013 Stream Inventory - Degree of Channelization in the Buffalo Creek Watershed.

3.12.2.3 Pool-Riffle Development

Pool-riffle development refers to the degree to which naturally-undulating stream bed topography is present in a reach. Natural, meandering streams develop sequences of deeper bowl-shaped "holes," or pools, as well as steeper shallow areas, or riffles. Streams also develop relatively straight sections between pools and riffles called "runs". Pools, riffles and runs all provide an array of ecosystem services in streams (aeration, refuge, spawning and nursery areas, foraging areas, etc.). Pool/riffle development may be low or absent in channelized or modified stream reaches.

The stream inventory noted a difference in pool-riffle development for Farrington Ditch, the North and South Branches of Buffalo Creek and the mainstem, as shown in **Table 3-22** and **Table 3-23**. As might be expected, the mainstem and the North Branch of Buffalo Creek, which both contain significant portions of natural stream channel, have more pool-riffle development than the constructed and channelized Farrington Ditch.

Table 3-22: 2013 Stream Inventory - Pool Development in the Buffalo Creek Watershed.

Degree of Pool Development	North Branch		South Branch		Buffalo Creek Mainstem		Tributary A		Farrington Ditch	
	Reaches	**%**	**Reaches**	**%**	**Reaches**	**%**	**Reaches**	**%**	**Reaches**	**%**
None (<5%)	3	51%	7	57%	9	35%	7	67%	5	100%
Low (5-33%)	3	33%	4	35%	13	57%	3	33%	0	0%
Moderate (34-66%)	1	16%	1	3%	2	8%	0	0%	0	0%
High (>67%)	0	0%	1	4%	0	0%	0	0%	0	0%
TOTAL	**7**	**100%**	**13**	**100%**	**24**	**100%**	**10**	**100%**	**5**	**100%**

Table 3-23: 2013 Stream Inventory - Riffle Development in the Buffalo Creek Watershed.

Degree of Riffle Development	North Branch		South Branch		Buffalo Creek Mainstem		Tributary A		Farrington Ditch	
	Reaches	**%**	**Reaches**	**%**	**Reaches**	**%**	**Reaches**	**%**	**Reaches**	**%**
None (<5%)	4	56%	7	57%	7	36%	8	80%	5	100%
Low (5-33%)	3	44%	6	43%	12	43%	2	20%	0	0%
Moderate (34-66%)	0	0%	0	0%	5	21%	0	0%	0	0%
High (>67%)	0	0%	0	0%	0	0%	0	0%	0	0%
TOTAL	**7**	**100%**	**13**	**100%**	**24**	**100%**	**10**	**100%**	**5**	**100%**

Noteworthy: Stream Geomorphology

Streambank erosion is a natural process and contributes to the meandering form often associated with natural streams. Common channel patterns include straight, meandering, braided and anastomosing. Each of these channel patterns is distinguished based on the sinuosity or "wiggliness" of the channel. Stream morphology is naturally formed by a balance between the amount of material eroded from one streambank and the amount of material deposited on another streambank. Streams naturally have pool-riffle sequences (see **Figure 3-38)**, which are a result of the stream pattern. Pools are an area of deeper, slower moving water, with fine bed materials. Riffles on the other hand contain coarser bed materials and shallow faster moving water. Pool-riffle sequences are generally found in natural meandering streams, with pools located in the outside bend and riffles located at crossover stretches. Riffle-pool sequences provide unique habitats that support a diverse community of aquatic organisms. Riffles generally provide increased water velocities and oxygen that supports filter feeding macroinvertebrates, while pools provide habitat for larger fish during low flow conditions. Streams naturally shift and change shape over time based on the geological history, stream slope, discharge and sediment

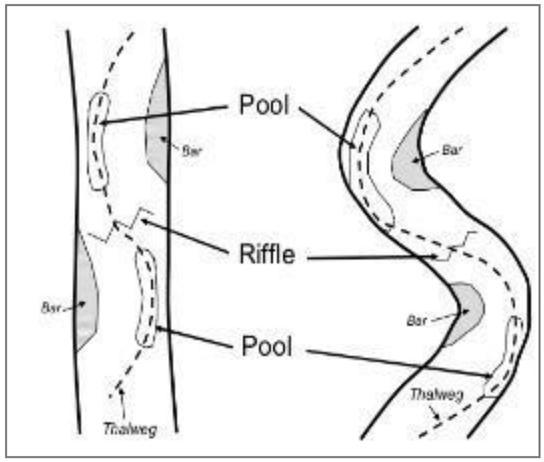


Figure 3-38: Graphic Depicting Pool and Riffle Sequences in a Stream. Source: Michigan State University – Watershed Management Short Course.

3.12.2.4 Aquatic Habitat and Substrate

Substrate refers to the materials that rest on the bottom of the stream (streambed). Documentation of the substrate composition and stability in streams assists with understanding the stream's ability to withstand erosion and the benthic (or stream bottom) habitat it provides. The primary substrate found in Buffalo Creek is gravel followed by sand, ***silt***, ***cobble*** and ***organic matter***. The majority of the substrates in Buffalo Creek are highly stable (see **Table 3-24**). Farrington Ditch substrates are dominated by organic matter followed by silt, sand and concrete. The substrate materials present in Farrington Ditch provide little substrate stability. The primary substrates found in the North Branch of Buffalo Creek are sand followed by ***claypan***, gravel, organic matter and silt. These substrate materials provide the majority of the stream with high stability, however, there is a large portion of the stream with low streambed stability. The primary substrates found in the South Branch of Buffalo Creek and Tributary A are gravel followed by sand, silt, organic matter and cobble. Most of the South Branch of Buffalo Creek and Tributary A has no or low streambed stability.

Aquatic organisms such as fish, macroinvertebrates, freshwater mussels and amphibians often have specific habitat requirements. These habitat requirements are often required for feeding, refuge or reproduction. In 2013 the presence of stream habitat features such as undercut banks, deep pools, ***macrophytes***, logs, overhanging vegetation, ***root wads***, boulders and ***backwaters*** were documented for each stream segment of the Buffalo Creek Watershed. The North and South Branches of Buffalo Creek, Buffalo Creek mainstem and Tributary A each had at least one stream segment containing one of the habitats listed in **Table 3-25**. However, Farrington Ditch did not have any stream segments containing deep pools, logs, root wads or boulders. This data indicates that Farrington Ditch has the lowest habitat diversity.

Silt: *A sedimentary material consisting of grains or particles of disintegrated rock, smaller than sand and larger than clay.*

Cobble: *A rock fragment, often rounded, with a diameter of 64–256 mm, smaller than a boulder but larger than a pebble*

Organic Matter: *Matter composed of organic compounds that has come from the remains of organisms such as plants and animals and their waste products in the environment.*

Claypan: *A layer of stiff impervious clay situated just below the surface of the ground, which holds water after heavy rain.*

Macrophytes: *A plant, especially a marine plant, large enough to be visible to the naked eye.*

Root Wads: *A combination of interlocking tree materials where a mass of tree roots is utilized with other tree parts and revegetation methods to stabilize streambanks and provide aquatic habitat.*

Backwater: *A body of stagnant water connected to a river.*

Table 3-24: 2013 Inventory of Stream Substrate Stability in the Buffalo Creek Watershed.

Substrate Stability	North Branch	South Branch	Buffalo Creek Mainstem	Tributary A	Farrington Ditch
None	0%	35%	0%	30%	58%
Low	18%	32%	13%	29%	0%
Moderate	50%	19%	36%	21%	0%
High	32%	13%	52%	20%	42%

Table 3-25: Percentage of Stream Segments Containing In-Stream Cover Habitats in the Buffalo Creek Watershed.

Stream Segment	Undercut Banks	Deep Pools	Macrophytes	Logs	Over-hanging Vegetation	Root Wads	Boulders	Backwaters
North Branch	86%	50%	33%	86%	86%	29%	100%	78%
South Branch	51%	43%	24%	54%	51%	42%	54%	29%
Buffalo Creek Mainstem	89%	78%	63%	68%	83%	58%	85%	36%
Tributary A	52%	13%	33%	52%	62%	43%	43%	39%
Farrington Ditch	29%	0%	29%	0%	58%	0%	0%	29%

3.12.2.5 Streambank Erosion

Photo of a streambank experiencing severe erosion in the Buffalo Creek Watershed.

Streambank erosion is a function of the amount of water flowing along the bank, steepness of the bank, vegetative cover or ***armoring*** on the bank, and the material (earth) of which the bank itself is composed. Streambank erosion is a natural process and contributes to the sinuous, meandering form often associated with natural stream channels. In these relatively natural systems, there is typically an overall balance between the amount of material eroded from one streambank and the amount of sediment deposited on another (see **Figure 3-39**). However, in watersheds with significant human development, streambank erosion rates are often exacerbated by changes in watershed hydrology, leading to several problems. Erosion can cause physical water quality problems such as increased or excessive ***turbidity*** (cloudiness) in the water and sedimentation, which can "choke" stream channels, reducing the volume that can be conveyed and covering streambed materials such as gravel, which are important for aquatic organisms. Additionally, erosion can lead to chemical water quality problems because nutrients, phosphorus in particular, are often bound to sediment particles and introduced to the aquatic environment by erosion. Excessive erosion can be problematic for property owners and land managers because it can lead to the loss of land, property or structures.

Armoring: *Installation of a safeguard or protection.*

Turbidity: *A measure of water clarity based on the amount of sediment suspended in the waterbody.*

The Buffalo Creek stream inventory assessed the degree of streambank erosion along the right and left bank (facing upstream) for each assessed stream, as shown in **Table 3-26 and Figure 3-40**. Because all streambanks are assumed to have some degree of erosion, reaches were rated as having slight, moderate or severe erosion for each bank. The qualitative assessment criterion for each rating is given below. Approximately 87,824 linear feet were moderately eroded and 19,872 linear feet were severely eroded. The results indicate that nearly all stream reaches are moderately or severely eroded, suggesting that the stream channel may be adjusting to overall changes in watershed hydrology. The Buffalo Creek mainstem, the North and South Branches of Buffalo Creek and Tributary A have the largest number of moderate or severely eroded streambanks. Farrington Ditch has a limited number of moderately eroded banks and no severely eroded banks. Farrington Ditch is not experiencing as much erosion as the other tributaries because it drains through four man-made detention basins which control the rate and volume of stormwater being discharged downstream.

Slight - Some bare bank but active erosion not readily 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 op-

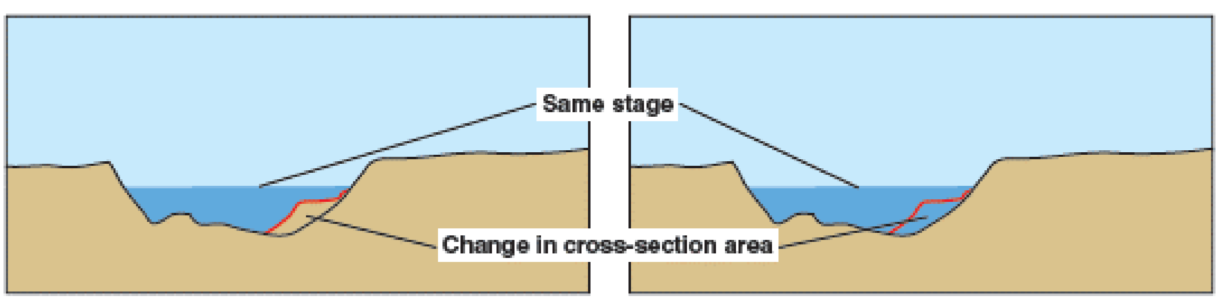


Figure 3-39: Diagram demonstrating a natural stream cross-section (left) and the altered cross-section of the same stream following erosion (right). Source: USGS.

posed to V-shaped.

Table 3-26: 2013 Stream Inventory – Number of Stream Reaches with Streambank Erosion.

	North Branch		South Branch		Buffalo Creek Mainstem		Tributary A		Farrington Ditch	
Extent of Erosion	Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank
None	0	0	2	2	1	2	1	1	3	3
Slight	0	0	0	0	0	0	0	0	0	0
Moderate	5	4	10	10	16	14	8	8	2	2
Severe	2	3	1	1	7	8	1	1	0	0

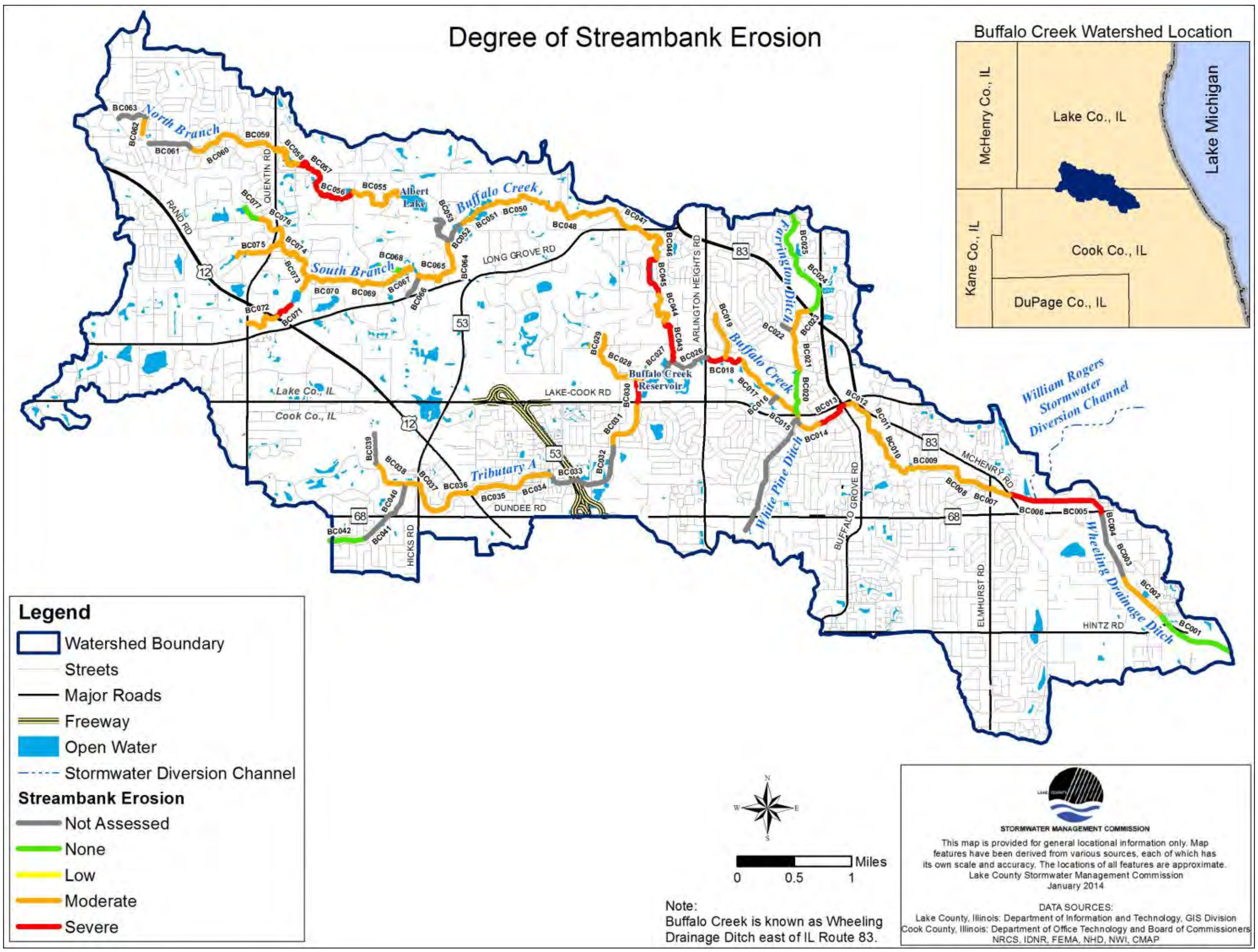


Figure 3-40: Degree of Streambank Erosion in the Buffalo Creek Watershed.

3.12.2.6 Sediment Accumulation

As mentioned in the previous section, sediment transport is a natural process occurring in all streams, but the magnitude can be affected by human modifications to the watershed. Typically, streams suspend and transport sediment through high-gradient (steep) reaches and deposit sediment in low-gradient (flat) reaches or areas where velocity slows. These may be naturally occurring flat sections of the stream (such as areas where the stream enters a wetland complex), areas behind beaver dams or debris jams, or areas upstream of human impediments such as culverts or dams.

Most reaches in the watershed have low or moderate sediment accumulation; see **Table 3-27**. Minimal sedimentation was observed in Farrington Ditch. High sedimentation was noted in the North and South Branches of Buffalo Creek and the mainstem of Buffalo Creek, which is likely the result of the severe streambank erosion in these areas (see **Figure 3-40**).

Table 3-27: 2013 Buffalo Creek Watershed Stream Inventory - Sediment Accumulation.

Sediment Accumulation	North Branch		South Branch		Buffalo Creek Mainstem		Tributary A		Farrington Ditch	
	Reaches	%	Reaches	%	Reaches	%	Reaches	%	Reaches	%
None (<5% of reach)	3	37%	2	7%	2	12%	0	0%	3	64%
Low (5-33%)	1	13%	4	37%	6	24%	7	67%	1	20%
Moderate (34-66%)	0	0%	2	19%	13	46%	2	24%	0	0%
High (67-100%)	3	50%	4	30%	3	18%	1	10%	0	0%
Unknown	0	0%	1	6%	0	0%	0	0%	1	16%
TOTAL	**7**	**100%**	**13**	**100%**	**24**	**100%**	**10**	**100%**	**5**	**100%**

3.12.2.7 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 in-stream environment. However, too much debris can be problematic and may result in large debris jams, causing backwater flooding and sediment deposition. Debris jams can also cause erosion of the streambanks which can lead to damage of riparian lands and property. It is not uncommon for streams that have a high degree of streambank erosion to also have high debris loads as trees along the stream banks are undercut by erosion and fall into the stream channel.

Photo of a stream reach that fails the debris load test in the Buffalo Creek Watershed, courtesy of SMC.

In the Buffalo Creek Watershed, 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 3-28** summarizes the reaches that "failed" the debris load test, having moderate or high in-stream 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 the Buffalo Creek watershed, 49 of the 59 assessed reaches failed the debris load test. The large number of stream reaches that failed the debris loading test are likely contributing to many of the flooding and streambank erosion issues plaguing the Buffalo Creek Watershed.

Table 3-28: 2013 Buffalo Creek Watershed Stream Inventory - Debris Loading.

Moderate or High Debris Load	North Branch		South Branch		Buffalo Creek Mainstem		Tributary A		Farrington Ditch	
	Reaches	%	Reaches	%	Reaches	%	Reaches	%	Reaches	%
Instream	4	55%	6	44%	10	42%	5	52%	2	42%
Overbank	4	55%	4	26%	8	38%	4	39%	2	42%

3.12.2.8 Hydraulic Structures

Photo of culverts in the Buffalo Creek Watershed, courtesy of SMC.

Hydraulic structures are bridges, culverts, dams, weirs, or other structures spanning or crossing the stream channel. These structures modify or have the potential to modify the pattern or amount of flow in the creek and may act as constriction points under certain flow conditions (such as floods), 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 any obstructed bridges and culverts, 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 are listed as "problem" structures to call attention to the need for further investigation, but this designation is not a definitive determination that the structure is defective.

Table 3-29 contains a summary of hydraulic structures in the Buffalo Creek Watershed. Locations of problem hydraulic structures are shown in **Figure 3-41**. The most common hydraulic structures in the Buffalo Creek Watershed are bridges, culverts and pipes which account for 87% of the hydraulic structures in the watershed. The Buffalo Creek mainstem contains the largest number of hydraulic structures (see **Table 3-29**). Only 13 of the 201 structures (8%) identified in the inventory were identified as Problem Hydraulic Structures; of these the most common problem noted in the inventory was stream flow impairments.

Table 3-29: 2013 Buffalo Creek Watershed Stream Inventory - Hydraulic Structures.

Hydraulic Structures	North Branch	South Branch	Buffalo Creek Mainstem	Tributary A	Farrington Ditch
Bridge	8	13	34	23	**9**
Culvert	6	11	3	16	2
Dam	3	5	3	1	1
Pipe	10	17	6	3	13
Other	0	3	7	3	1
Total Hydraulic Structures	**27**	**49**	**53**	**46**	**26**
Hydraulic Structures per stream mile	9	12	5	12	12
Problem Hydraulic Structures	**1**	**7**	**3**	**2**	**0**

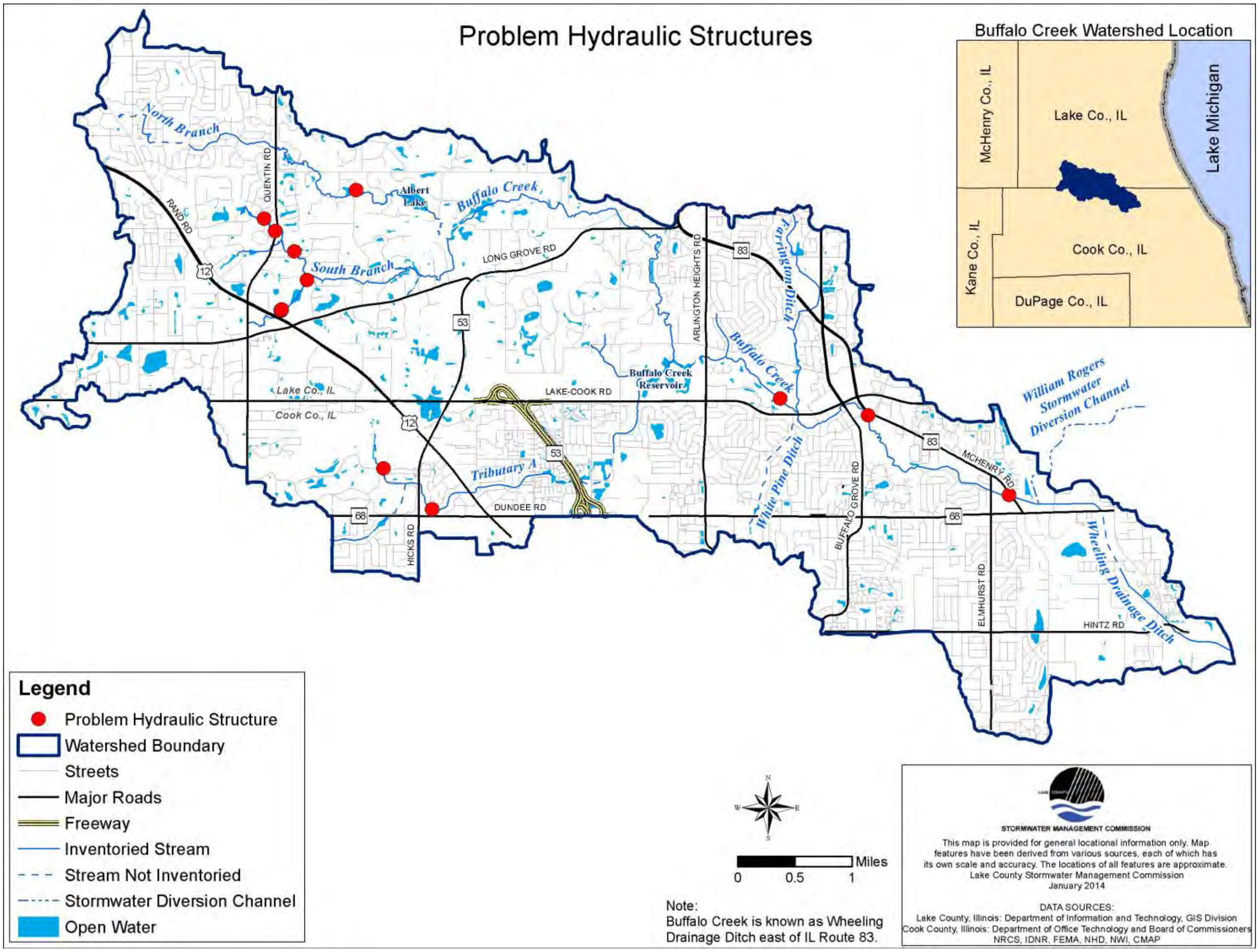


Figure 3-41: 2013 Buffalo Creek Watershed Stream Inventory - Problem Hydraulic Structures.

3.12.2.9 Discharge Points

Discharge points are identified as any outfalls into streams, and include "pipes" such as drain tile outlets, sump pump discharges and storm sewers as well as "open channel" discharges such as drainage swales, ***gullies*** and small tributaries. The stream inventory documented 283 discharge points into the stream network within the assessed reaches. The mainstem of Buffalo Creek contains the majority (50%) of the documented discharge points. Most of these discharge points in Buffalo Creek are storm sewer pipes, culverts and drain tiles. Mainstem Buffalo Creek also contains the majority (78%) of problem discharge points in the Buffalo Creek Watershed. Tributary A and the South Branch of Buffalo Creek combined account for 22% of discharge points in the Buffalo Creek Watershed. There are no problem discharge points in the North Branch of Buffalo Creek or Farrington Ditch.

Photo of a drainage tile in the Buffalo Creek Watershed, courtesy of SMC.

Gully: *A small valley or ravine originally worn away by running water and serving as a drainageway after prolonged heavy rains.*

Problem discharge points in the Buffalo Creek Watershed contribute to streambank erosion and the transport of excess sediment and associated nutrients to the stream channel. The location of these points is shown in

Figure 3-42 and summarized in **Tables 3-30**. Pipes commonly cause erosion below the end of the pipe, resulting in a positive feedback loop of bank erosion near the pipe, and may ultimately result in the failure of the pipe itself. End sections, aprons and supporting structures sometimes fail as a result of this type of erosion. Gullies and other open channels can also result in bank erosion, as they deliver concentrated flow to the stream channel. In some cases, pipes appear to be in poor repair, or flow may be discolored or appear to contain substances other than water. These cases are noted in the inventory as well.

Table 3-30: 2013 Buffalo Creek Watershed Stream Inventory - Discharge Points.

Discharge Points	North Branch	South Branch	Buffalo Creek Mainstem	Tributary A	Farrington Ditch
Swales, gullies, and tributaries	9	25	23	7	0
Pipes including storm sewers, culverts and drain tiles	24	30	119	35	11
Total Discharge points	**33**	**55**	**142**	**42**	**11**
Discharge points per stream mile	11	13	14	11	5
Problem discharge points	**0**	**2**	**40**	**9**	**0**

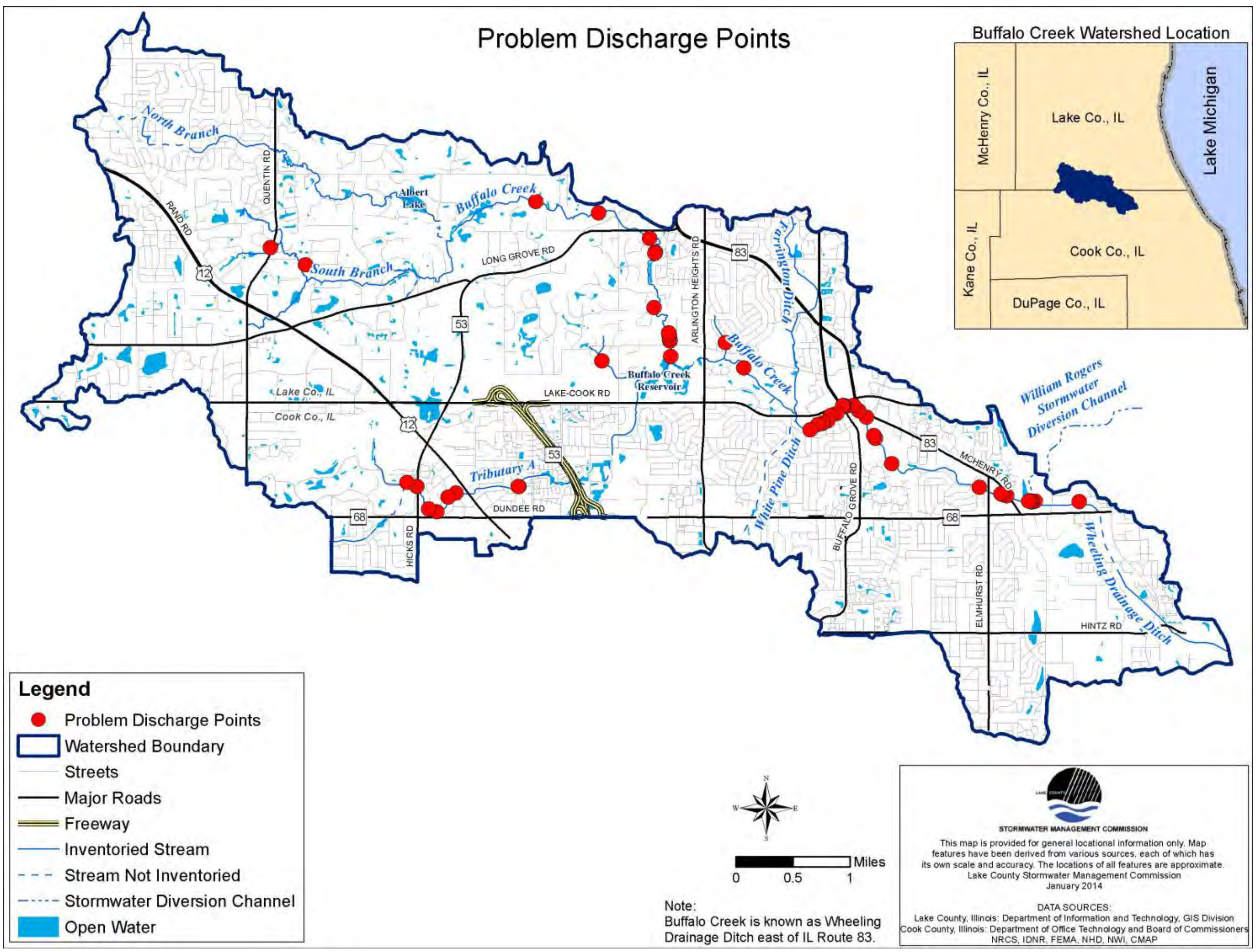


Figure 3-42: 2013 Buffalo Creek Watershed Stream Inventory - Problem Discharge Points.

3.12.2.10 Riparian Buffers

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. 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***. Using this combination of methods, the width of the vegetated riparian buffer was assessed for each reach, including several reaches that were not otherwise assessed in the inventory. **Table 3-31** summarizes the assessment criteria for buffer width, while **Table 3-32** displays the observed vegetated riparian buffer quality in 2013. **Figure 3-43** displays the spatial distribution of riparian buffers in the watershed. Throughout the watershed, riparian buffer width is related to riparian land use. Typically, wide riparian buffers ("High" buffer width) are found in locations where the stream flows through open space areas, and narrow buffers ("Low" buffer width) are found in locations where the stream flows through developed areas.

Riparian Buffer: *A vegetated area near a stream, usually forested, which helps shade and partially protect a stream from the impact of adjacent land uses.*

Green Infrastructure Network: *Uses vegetation, soils, and natural processes to manage water and create healthier urban environments.*

Photo of a stream in the Buffalo Creek Watershed with adequate natural riparian vegetation (right) and turf grass with no natural riparian vegetation (left). Courtesy of SMC.

The mainstem of Buffalo Creek has more stream miles with no stream buffer or low stream buffer than any other stream in the Buffalo Creek Watershed. However, the mainstem of Buffalo Creek has one of the greatest numbers of stream miles with moderate or high stream buffers, second to Farrington Ditch. There are smaller streams with a greater percentage of stream miles with no or low stream buffers than the Buffalo Creek mainstem, including the North and South Branches of Buffalo Creek, Tributary A and Farrington Ditch.

Table 3-31: 2013 Buffalo Creek Watershed Stream Inventory - Riparian Buffer Width Assessment Criteria.

Buffer Width Rating	None	Low	Moderate	High
Description	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.	Width of riparian zone 20-40 feet; human activities have impacted zone a great deal.	Width of riparian zone 40-60 feet; human activities impacted zone minimally.	Width of riparian zone >60 feet; human activities (parking lots, roadbeds, lawns, crops) have not impacted zone.

Noteworthy: Riparian Buffers & Impervious Cover

Large amounts of impervious cover such as driveways, roads, parking lots, rooftops, and sidewalks cannot efficiently absorb rainfall. This reduced infiltration increases runoff and peak flows. However, riparian buffers can mitigate some of the negative effects caused by impervious cover. Riparian buffers can slow surface runoff, thereby maintaining stable streambanks and reducing peak flows. Sediment, nitrogen, phosphorus and other pollutants common to urban runoff can be effectively filtered by riparian vegetation.

Table 3-32: 2013 Buffalo Creek Watershed Stream Inventory – Percentage of Stream Reaches and Stream Miles in Each Buffer Width Category.

Buffer Width Category	North Branch Left Bank		North Branch Right Bank		South Branch Left Bank		South Branch Right Bank		Buffalo Creek Mainstem Left Bank		Buffalo Creek Mainstem Right Bank	
	%	Miles	%	Miles	%	Miles	%	Miles	%	Miles	%	Miles
Poor	71.14	2.12	71.14	2.12	61.47	2.60	65.48	2.77	58.69	5.84	53.67	5.34
Fair	28.86	0.86	28.86	0.86	28.37	1.20	24.35	1.03	32.46	3.23	38.49	3.83
Good	0.00	0.00	0.00	0.00	10.17	0.43	10.17	0.43	8.84	0.88	7.84%	0.78
TOTALS	**100%**	**2.98**	**100%**	**2.98**	**100%**	**4.23**	**100%**	**4.23**	**100%**	**9.95**	**100%**	**9.95**

Buffer Width Category	Tributary A Left Bank		Tributary A Right Bank		Farrington Ditch Left Bank		Farrington Ditch Right Bank	
	%	Miles	%	Miles	%	Miles	%	Miles
Poor	36.52	1.45	46.60	1.85	83.25	1.74	100	2.09
Fair	53.40	2.12	43.32	1.72	16.75	0.35	0.00	0.00
Good	10.08	0.40	10.08	0.40	0.00	0.00	0.00	0.00
TOTALS	**100%**	**3.97**	**100%**	**3.97**	**100%**	**2.09**	**100%**	**2.09**

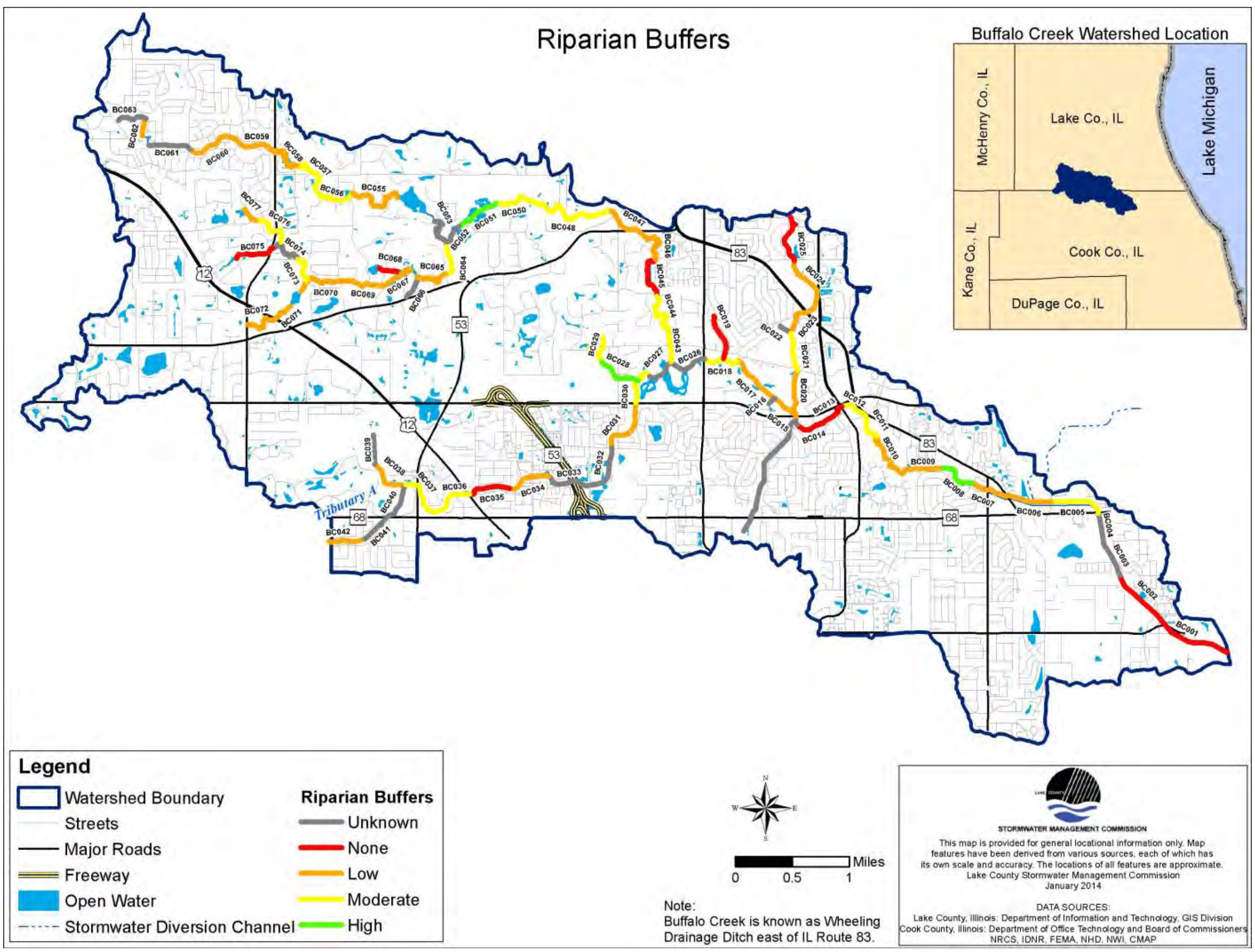


Figure 3-43: 2013 Buffalo Creek Watershed Stream Inventory – Riparian Buffers.

3.13 Detention Basin Inventory

> ***Detention Basin:*** *An excavated area installed to collect runoff that is discharged to streams, wetlands or lakes to protect against flooding and, in some cases, downstream erosion by storing water for a limited period of a time.*

In 2013, SMC conducted a ***detention basin*** inventory on all detention basins in the watershed. Detention basins are man-made areas that are used to temporarily store stormwater runoff. Detention basins can be either dry or contain a permanent pool of water. The primary role of a detention basin is to control the quantity of water to prevent flooding, but the quality of stormwater runoff that enters local waterways is not addressed. Detention basins are constructed to capture stormwater from rain events and snowmelts, and then slowly release this water to a receiving stream or stormwater channel. This action reduces and delays peak flows downstream. Problems such as streambank erosion and water pollution are just a few of the consequences of poorly managed stormwater. Degraded streams and waterways can be restored by employing BMPs, such as retrofitting detention basins.

Detention basin retrofits include replacing turf grass, concrete channels and other impervious surfaces with native vegetation to maximize stormwater infiltration into the ground and increase evaporation and evapotranspiration. A number of vegetation types can be appropriate replacements for high-maintenance turf grass. These include native grasses, wildflower mixes or other herbaceous vegetation planted in the bottom or on the slopes of the basin. Additional benefits of retrofitting a detention basin include:

- Enhance and naturalize the landscape and improve native habitat.
- Prevent stream degradation and restore stream water quality.
- More effectively control runoff from small more frequent storms.
- Protect streams from polluted runoff, since basins that manage small storms more effectively capture and treat the "first flush" of non-point source pollutants found in surface runoff.
- Replenish groundwater and recharge aquifers.
- Reduce facility maintenance requirements.

Native vegetation can improve the infiltration of water back into the ground as well as remove pollutants from the stormwater runoff. Furthermore, native vegetation reduces mowing frequency to once or twice per year. Finally, this vegetation provides habitat for desirable wildlife species and provides ecological benefits.

An inventory of the detention basins within the watershed provides valuable information that can be used to identify opportunities for existing detention basin water quality improvements. A total of 286 ponds were identified as potential detention basins using aerial image analysis, and 246 were subsequently field verified to insure that these areas were man-made detention basins. The location for each detention basin is illustrated in **Figure 3-44**. Forty detention basins are labeled as "Not Assessed" on **Figure 3-44** because the field crews were unable to gain access to the basins during the inventory and were therefore not assessed. There are approximately 350 acres of detention basins in the watershed.

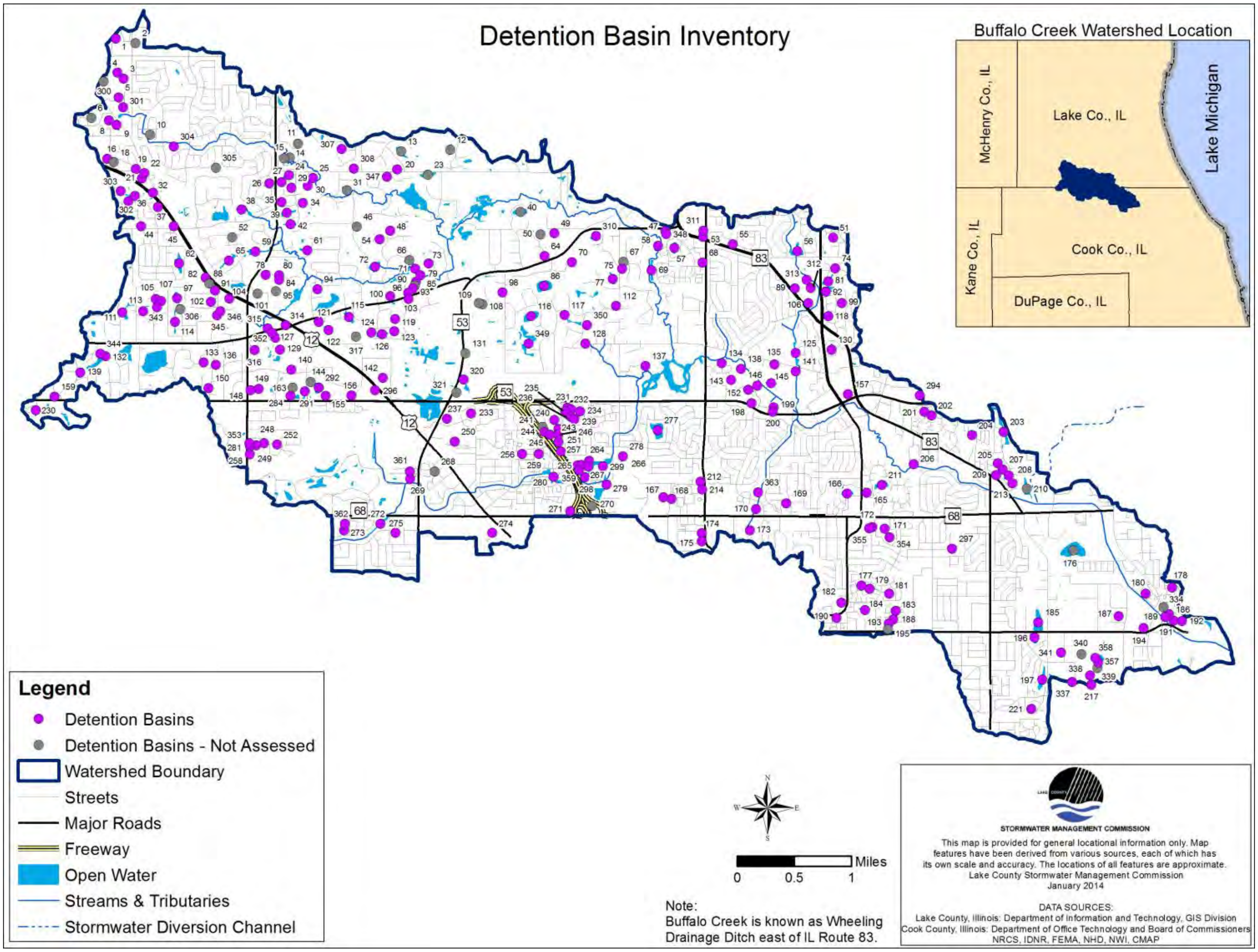
Example of a detention basin retrofit. Source: Fairfax County Soil & Water Conservation District.

During the field verification process each basin was reviewed for the following information:

- Location (latitude/longitude).
- Size and drainage characteristics.
- Design features.
- Maintenance and design problems.
- Potential safety problems.

- Retrofit opportunities.

The results of the inventory indicate that 238 of the 246 (97%) of the detentions basins would benefit from some type of improvement. Of those detention basins that could be improved, 58% are located in Lake County and 42% are located in Cook County. The addition of aerators and the removal of woody vegetation, accumulated sediment and other debris would also



contribute to improving the overall water quality function of these detention basins.

3.14 Watershed Lakes

The Buffalo Creek Watershed includes more than 566 acres of open water. Open water includes all lakes, ponds, streams and wetlands with open water surfaces. Initially, there appeared to be 5 lakes greater than 10 acres within the watershed. After further investigation, 3 of the lakes greater than 10 acres within the watershed were determined to be wetlands and not considered a lake (see **Table 3-33**). Two of the lakes greater than 10 acres within the watershed, Buffalo Creek Reservoir and Albert Lake, were identified as impaired by the Illinois EPA in the Illinois 2008 Integrated Report (303(d) and Waterbody Assessment) Information for Des Plaines/Higgins Creek Watershed. Both lakes are impaired for total phosphorus and dissolved oxygen. Two additional lakes in the watershed, Bishop Lake and Lucy Lake, were also identified as impaired by the Illinois EPA. While these two lakes are under the 10 acre threshold, they are included in this section due to the designated impairment. Further discussion of these impairments is discussed in **Chapter 5**. **Table 3-33** provides information on the assessment status of lakes greater than 10 acres within the watershed and the two additional impaired lakes smaller than 10 acres. Four of these lakes have been monitored by the Lake County Health Department – Ecological Services (LCHD-ES) (see **Figure 3-45**). Buffalo Creek Reservoir and Albert Lake were assessed in 2013 by LCHD-ES. Copies of detailed lake reports, including historical data on all lakes in Lake County, can be obtained from http://health.lakecountyil.gov/Population/LMU/Pages/Lake-Reports.aspx.

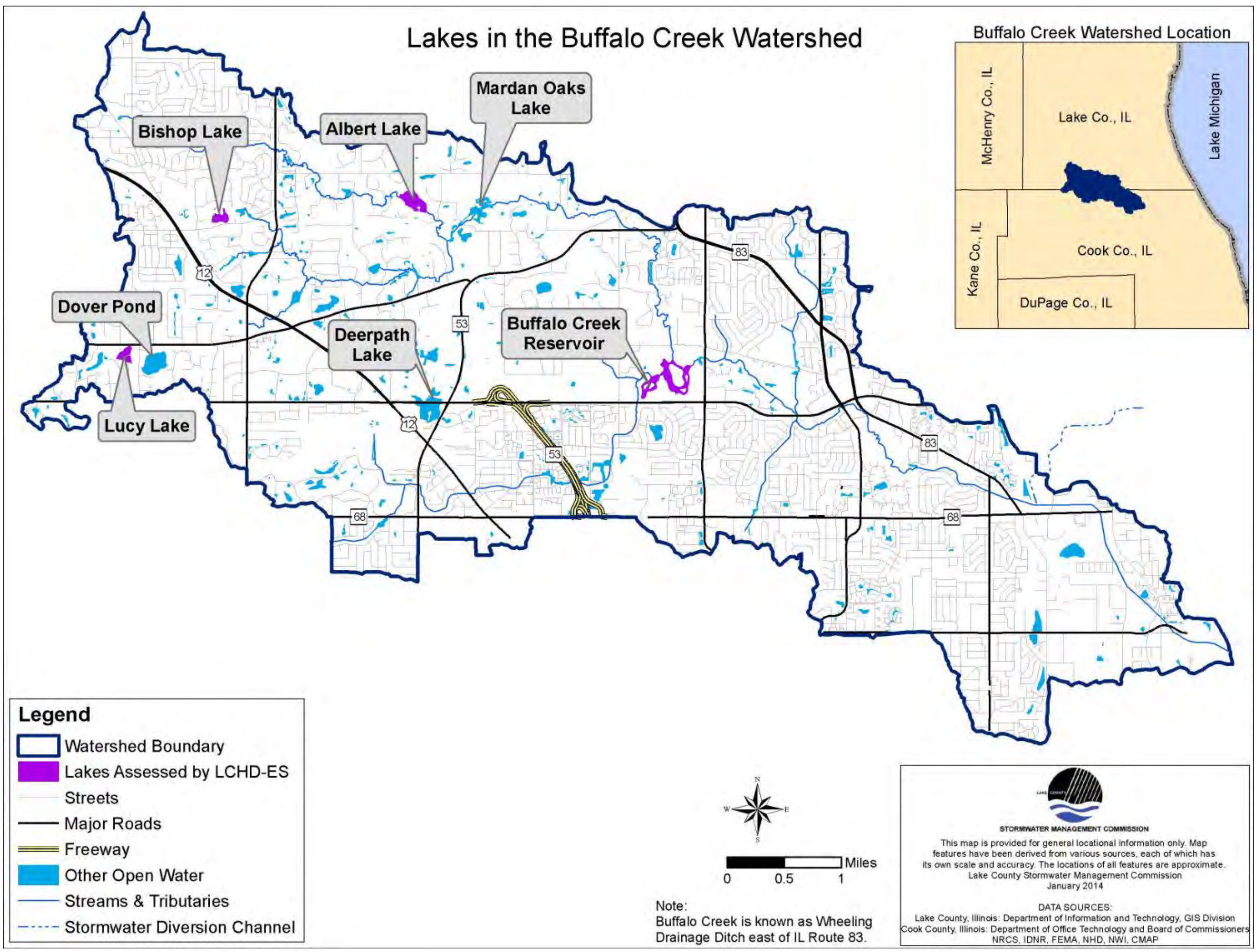


Figure 3-45: Lakes in the Buffalo Creek Watershed.

Table 3-33: Lakes in the Buffalo Creek Watershed Greater than 10 Acres

Name	Acres	Assessment Status/ Comments

Deerpath Lake (mostly Cook)	16.5	Open water with wetland fringe
Buffalo Creek Reservoir	31.4	Assessed by LCHD-ES in 2013
Dover Pond	19.3	ADID Wetland 182
Mardan Oaks Lake/ Pond	22.5	Wetland
Albert Lake	17.8	Assessed by LCHD-ES in 2013
Bishop Lake	7.1	Assessed by LCHD-ES in 2004
Lucy Lake	8.2	Assessed by LCHD-ES in 2004

Threats to lakes can be described as coming from both external and internal sources. External sources include pollutants and nutrients draining into the lake from the watershed, such as stormwater runoff, fertilizers, and erosion. Once in the lake, many of these pollutants and nutrients stay in the lake for long periods of time. Internal processes in the lake then recycle many of the pollutants, particularly nutrients such as nitrogen and phosphorus. Plants and algae take up the nutrients, but once they die and decompose, the nutrients are recycled back into the system. In addition, if a lake exhibits anoxic conditions (less than 1 mg/L dissolved oxygen) at the bottom of the lake, additional processes take place that make additional nutrients and metals available in the water column. Thus, lake management must consider both the external and internal issues.

3.14.1 Individual Lake Summaries

3.14.1.1 Albert Lake

Albert Lake is located in Ela Township and is partially in the Villages of Long Grove and Kildeer (**Figure 3-46**). The lake was created in the 1950's when a rock dam was constructed and flooded the surrounding area forming a shallow 18.7 acre lake. This dam failed and was replaced with the current dam by Hawthorne Developers. Albert Lake has a mean depth of 1.0 foot and maximum depth of 4.0 feet. The shoreline of the lake is approximately one mile long and dominated by a mix of wetland and woodland plant species. The lake's main use appears to be aesthetics since the shallow morphology of the lake prevents recreational use activities such as boating, fishing and swimming. No gas motors are permitted on the lake.

Figure 3-46: Location Map for Albert Lake.

Albert Lake is on-line with Buffalo Creek and it receives water from a pond from the Tall Oaks Subdivision. Buffalo Creek winds through mostly residential areas before it enters Albert Lake from the west side of the lake. The water flows out of Albert Lake and into Buffalo Creek, eventually flowing into the Buffalo Creek Reservoir and then into the Des Plaines River.

Photo of Albert Lake, courtesy of J. Weiss.

Albert Lake Facts

Major Watershed: Des Plaines
Sub-Watershed: Buffalo Creek
Location: T 43N, R 10-10E, S 26
Surface Area: 18.7 acres
Shoreline Length: 0.982 miles
Maximum Depth: 4 feet
Average Depth: 1 foot
Lake Volume: 18.7 acre feet
Watershed Area: 1,812 acres
Lake Type: Man-made impoundment.
Management Entity: Deerwood Estates HOA
Current Uses: Aesthetics
Access: Private

Photos of Albert Lake courtesy of Lake County Health Department – Environmental Services

3.14.1.2 Buffalo Creek Reservoir

The 35.18 acre Buffalo Creek Reservoir is located within the 408 acre Buffalo Creek Forest Preserve property in unincorporated Lake County, Illinois (**Figure 3-47**). The LCFPD acquired the property between 1978 and 1987. The reservoir was constructed in 1984 as part of a joint effort between LCFPD and the MWRD to store stormwater from the Buffalo Creek Watershed. It was later expanded in 1989. Flora and fauna are found in the area and it is common to see great blue heron and egret along the shorelines of the basins.

The reservoir contains two basins that are separated by a gabion weir. BCR1 is the basin on the west side, and receives water from a small part of the Buffalo Creek

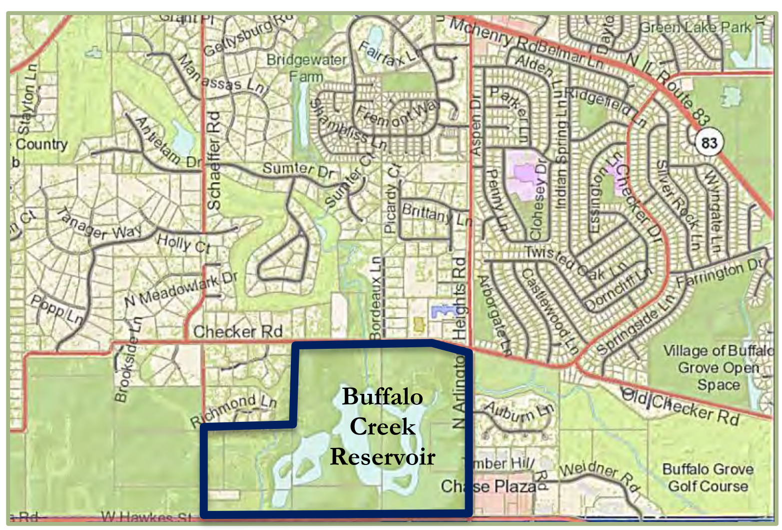


Figure 3-47: Location Map for the Buffalo Creek Reservoir.

watershed located in Lake County plus the Tributary A drainage area in Cook County. BCR2 is located to the east of BCR1 and receives water from BCR1 as well as the remaining drainage area of the North and South Branches of Buffalo Creek in Lake County. The maximum depth of the basins differs slightly, BCR1 is 3.91 feet deep and BCR2 is 4.92 feet deep. The MWRD, in cooperation with LCFPD, is developing engineering design plans to expand MWRD's existing Buffalo Creek Reservoir and improve public access at the preserve. The concept plan (see **Figure 3-48**) will help guide stormwater storage, public access improvements and extensive natural resource restoration work at the 408-acre Preserve. The plan calls for an additional 30-acre regional stormwater storage flood control reservoir to be constructed and paid for by the MWRD. It will be designed to blend into and enhance the natural environment. In order to construct the reservoir, the MWRD needs to obtain a drainage easement over the middle portion of Buffalo Creek, just west of Schaeffer Road. The concept plan improvements for Buffalo Creek would be funded by the MWRD and are estimated to be in excess of $10.4 million.

Buffalo Creek Reservoir Facts

Major Watershed: Des Plaines
Sub-Watershed: Buffalo Creek
Location: T46N, R10E, Section 34
Surface Area: 35.18 acres
Shoreline Length: 2.98 miles (BCR1, 0.95 miles; BCR2, 2.03 miles)
Maximum Depth: BCR1, 3.91 feet; BCR2, 4.92 feet
Average Depth: 3.00 feet
Lake Volume: BCR1, 125.84 acre-feet; BCR2, 186.03 acre-feet
Maximum storage capacity: Approx. 700 acre-feet
Watershed Area: 10,299.76 acres
Lake Type: Stormwater Impoundment
Management Entity: MWRD/Lake County Forest Preserve District
Current Uses: fishing, aesthetics, storm water retention
Access: Public

Great Blue Heron and Great White Egret on Beaver Den, 2013. Photo courtesy of LCHD-ES.

Photo of the spillway at the Buffalo Grove Reservoir. Photo courtesy of M. Knysz.

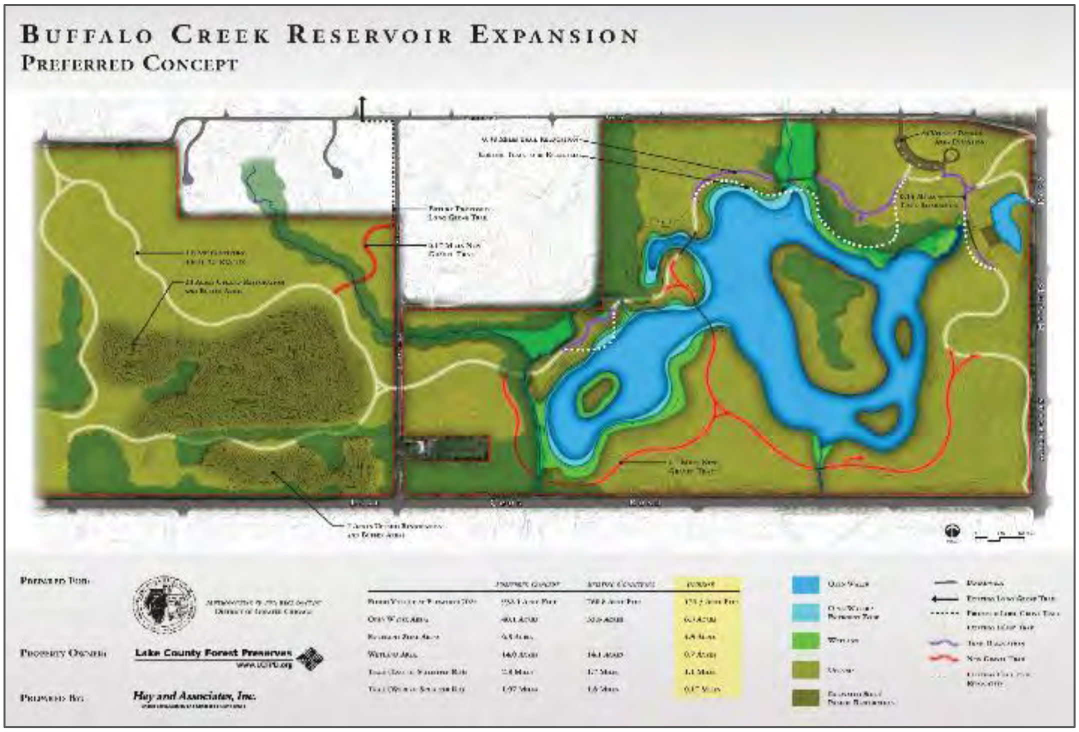


Figure 3-48: Buffalo Creek Reservoir Expansion Concept Plan. Figure taken from the Lake County Forest Preserve website: www.lcfpd.org.

3.14.1.3 Bishop Lake

Bishop Lake is privately owned, and located within the Village of Kildeer. The outlet of the lake is a dropbox culvert at the northeast part of the shoreline, which then drains east to Buffalo Creek. Bishop Lake is a man-made lake, created in approximately 1926. The lake has a surface area of 7.12 acres and a maximum depth of 12 feet. Development around the lake began in the early to mid-1980's, and in 1992, an informal association, the Bishop Lake Property Owner's Association (BLPOA), was formed. The association has implemented some lake management activities such as fish stocking and the installation of an aeration system. They also treat the lake with herbicides and algaecides on an annual basis. Association members primarily use the lake for aesthetic purposes, but fishing and non-motorized boating are allowed. Some homes have private beaches for swimming. Use of the lake is limited to the homeowners and their guests. Approximately 80% of the shoreline is considered developed, with the majority typified as seawall. Other shoreline types are lawn, buffer and woodland (LCHD_ES, 2004).

Photo of Bishop Lake. Source: http://thelubygroup.com/listing/22216-w-cuba-road-kildeer-

3.14.1.4 Lucy Lake

Lucy Lake is located in the Village of Deer Park, with Charlie Brown Park bordering the lake on the west side. Water exits Lucy Lake via an unnamed tributary on the southeast end and flows into a wetland before eventually entering Buffalo Creek. The lake has a surface area of 8.2 acres and mean and maximum depths of 13.5 feet and 27 feet, respectively. However, these numbers are deceptive, as the morphometry of Lucy Lake is quite unique. Approximately half of the lake is about 2 feet deep, while the other half ranges from about 5 feet to 27 feet in depth. Considering the data collected on various depths throughout Lucy Lake, the average depth is probably closer to 9 feet. Lucy Lake is managed by the Village of Deer Park, who also owns Charlie Brown Park. The lake is used by residents and park visitors for non-motorized boating, fishing and aesthetics (LCHD-ES, 2004).

Photo of Lucy Lake from Charlie Brown Park. Source: http://activerain.com/blogsview/1581818/welcome-to-deer-park-il-a-park-like-village-with-an-upscale-shopping-mall-and-good-schools.

3.14.2 Lake Inventory

The following sections describe the results of the lake inventory conducted in 2013 by the LCHD-ES for Albert Lake and the Buffalo Creek Reservoir. Lakes were assessed for shoreline erosion, aquatic plants, floristic quality and water quality.

3.14.2.1 Shoreline Erosion

As part of the lake inventory, shoreline erosion was assessed in Albert Lake and the Buffalo Creek Reservoir. Erosion is a natural process primarily caused by excessive runoff from rain or melting snow, and wave action, which results in the loss of material from the shoreline. Shorelines disturbed by human activity such as clearing of natural vegetation and beach rocks, and increasing runoff will accelerate erosion. Shoreline erosion contributes to poor water quality by increasing the amount of both total suspended solids and phosphorus concentrations in a lake, resulting in either: 1) a very productive lake due to an increase of the ***limiting nutrient*** (phosphorus) or 2) a lake with few aquatic plants due to decreased water clarity as either excessive amounts of sediment or algae are in the water column. In a system without plants, algae can become a problem due to the lack of competition for nutrients. Sedimentation can cause destruction of habitat for fish and other macroinvertebrates by reducing foraging and breeding sites or by direct suffocation of eggs. The results of the 2013 shoreline assessment are depicted in **Table 3-34, Figure 3-49** and **Figure 3-50**.

> ***Limiting Nutrient:*** *The hardest nutrient for a plant to acquire and therefore the only nutrient that is limiting the plant's growth. Generally, phosphorus is a limiting nutrient in freshwater systems and nitrogen is a limiting nutrient in saltwater systems.*

Table 3-34: 2001 and 2013 Shoreline Erosion Assessment for Lakes in the Buffalo Creek Watershed.

	Albert Lake		Entire Buffalo Creek Reservoir		Buffalo Creek Reservoir 2013	
Erosion	**2001**	**2013**	**2001**	**2013**	**BCR1**	**BCR2**
None	37%	78%	95%	40%	52%	34%
Slight	54%	19%	0%	17%	21%	15%
Moderate	6%	3%	5%	26%	9%	34%
Severe	3%	0%	0%	17%	18%	17%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Based on the shoreline erosion assessment conducted at Albert Lake on September 19, 2013 compared to a 2001 assessment, there was a significant decrease in shoreline erosion with approximately 78% of the shoreline having no erosion in 2013. In 2001, Albert Lake had only 37% of the shore with no erosion. Overall, 19% of the shoreline had slight erosion, 3% had moderate erosion, and 0% had severe erosion in 2013. A monitoring program should be established in order to identify problem areas and manage invasive plants in these areas.

In October of 2013, the shoreline of Buffalo Creek Reservoir was assessed for erosion. Sixty percent of the reservoir was exhibiting some degree of erosion. Forty-three percent of the erosion was either moderate (26%) or severe (17%). An additional 17% was assessed as having slight erosion. The amount of erosion in the basin decreased since its last assessment in 2001. At that time, 84% of the shoreline was assessed as having some degree of erosion; however, the severity of the erosion found on the shoreline has increased. It can be expected that the reservoir would experience larger fluctuations in water levels than a typical lake would experience because the reservoir is a constructed flood control facility designed to manage stormwater. This fluctuation in water level or "bounce" may influence the stability of the shorelines, and makes shoreline stabilization more challenging. There was also a difference in the percent of shoreline eroding between the basins. The western basin, BCR1, exhibited 44% of its shoreline with some degree of erosion while the eastern basin, BCR2, exhibited some degree of erosion on 66% of its shoreline. There were also differences in the degree of erosion between the basins, with the most notable difference being in the moderate classification. BCR1 had 9% of its shoreline showing signs of moderate erosion while 34% of BCR2

Figure 3-49: Shoreline erosion on Albert Lake, 2013.

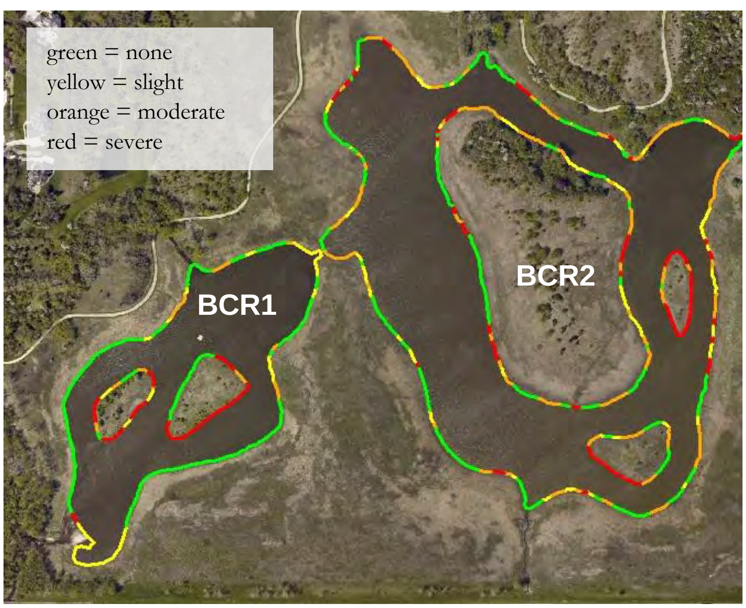


Figure 3-50: Shoreline Erosion on Buffalo Creek Reservoir, 2013.

exhibited the same degree of erosion on its shorelines. This could be due to differences in elevation between the basins; as BCR1 is situated higher in the landscape than BCR2. LCHD-ES recommends that shoreline slopes be minimized and the construction of vegetated shelves be considered during the redesigning of the basins. If there are slopes not planned to be impacted by the expansion, consideration should be given to reducing those slopes also to minimize erosion. A mix of solutions can be implemented to remedy eroded areas ranging from vegetating areas with native plants so that their deep root systems can better anchor soils along shoreline areas to the use of hardscaping materials where native plant buffers will not provide enough stability due to fluctuating water levels.

Noteworthy: Shoreline Assessment

The degree of shoreline erosion was categorically defined as none, slight, moderate, or severe. Below are brief descriptions of each category.

None – No erosion evident. This may include areas of beach and effective rip rap, and sea wall stabilization practices.

Slight – Minimal or no observable erosion; generally considered stable; no erosion control practices will be recommended with the possible exception of small problem areas noted within an area otherwise designated as "slight".

Moderate – Recession is characterized by past or recently eroded banks; area may exhibit some exposed roots, fallen vegetation or minor slumping of soil material; erosion control practices may be recommended although the section is not deemed to warrant immediate remedial action.

Severe – 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; erosion control practices are recommended and immediate remedial action may be warranted.

Shoreline erosion usually increases when deep-rooted native vegetation is replaced by shallow-rooted non-native vegetation such as turf grass. Erosion not only results in loss of shoreline, but also negatively influences the lake's overall water quality by contributing nutrients, sediment, and pollutants into the water. Additionally, turf grasses or constructed seawalls provide little habitat for wildlife and do not serve as a natural buffer to filter runoff. As suburban development increases in this area, it can be assumed that increased phosphorus loading and surface runoff will occur, resulting in increased algal blooms and decreased water quality (Novotny, 1995).

3.14.2.2 Floristic Quality Index (FQI)

Floristic Quality Index (FQI): *An assessment tool designed to evaluate how close the flora of an area is to that of undisturbed natural plant communities.*

Floristic quality, as measured by the ***Floristic Quality Index (FQI)***, is summarized in **Table 3-35** for the two assessed lakes. The plant community in Albert Lake was assessed in September when most of the aquatic plants were likely to be present. Aquatic plant populations in Albert Lake have increased since 2001. In 2001, only 7% of the sampled areas had plants while 100% of the area sampled in 2013 had plants. The density of plants has also increased with 15 of the 22 sample sites having 40-90% coverage. Flatstem pondweed (*Potamogeton zosteriformis*) is a new addition that was not observed in the 2001 aquatic plant survey. In 2013, Albert Lake had an FQI of 11.5, ranking 95th out of 162 lakes in Lake County. The FQI score of Albert Lake is below the Lake County average because there are few native species and the invasive curlyleaf pondweed (*Potamogeton crispus*) is dominant. Aquatic vegetation in Buffalo Creek Reservoir was sampled throughout the reservoir during September 2013. In total, 34 sites were evaluated, 79% of which were vegetated. There were 6 plant species identified in the reservoir in 2013. Curlyleaf pondweed, a non-native, invasive species was among those identified. The diversity of plants in the reservoir has not changed since 2001; however, species composition has changed, and species such as leafy pondweed and

Curlyleaf pondweed (*Potamogeton crispus*). Photo courtesy of Northeast Michigan Watersheds.

small pondweed have since been replaced by duckweed and elodea, which are less conservative (high quality) species. The FQI of the reservoir dropped slightly from 13.1 in 2001 to 12.5 in 2013 (ranking 81st and 82nd among Lake County lakes for BCR1 and BCR2 respectively). This is most likely due to the presence of weedier species.

Table 3-35: 2013 Floristic Quality Index Assessment for Lakes in the Buffalo Creek Watershed.

Lake	FQI	Lake County Average FQI	FQI County Ranking (out of 162)
Albert Lake	11.5	13.8	95
Buffalo Creek Reservoir (BCR-1 & BCR-2)	12.5	13.8	81 (BCR-1)/82 (BCR-2)

Noteworthy: Floristic Quality Index

Floristic quality index (FQI; Swink and Wilhelm 1994) is an assessment tool designed to evaluate how close the flora of an area is to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term trends, and 4) monitor habitat restoration efforts. Each aquatic plant in a lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). This is done for every floating and submerged plant species found in a lake. These numbers are averaged and multiplied by the square root of the number of species present to calculate an FQI. A high FQI number indicates that there are a large number of sensitive, high quality plant species or a good diversity of plants present in a lake. Non-native species were counted in the FQI calculations for Lake County lakes. (LCHD-ES Reports).

3.14.2.3 Aquatic Plants

Aquatic plants are a critical feature in most water bodies as they compete against algae for nutrients, improve water quality and provide fish habitat. Aquatic plant diversity is an important part of a healthy ecosystem. In 2013, LCHD-ES conducted an aquatic plant mapping survey of the two lakes. The survey provides information on the species, density, and distribution of plant communities in a given lake. Water clarity and depth are the major limiting factors in determining the maximum depth at which aquatic plants will grow. The LCHD-ES lake surveys results are shown in **Table 3-36** and depicted on **Figures 3-51 and 3-52.**

Table 3-36: 2013 Aquatic Vegetation Density and Percentage of Native/Invasive Species for Lakes in the Buffalo Creek Watershed.

Lake	# of Points Assessed	% of Points Vegetated	# of Native Plant Species Found	# of Invasive Plant Species Found
Albert Lake	22	100%	4	1
Buffalo Creek Reservoir	34	79%	5	1

Noteworthy: Plant Sampling

In order to randomly sample each lake, mapping software (ArcMap 9.3) overlaid a grid pattern onto an aerial photo of Lake County and placed points 60 or 30 meters apart, depending on lake size. Plants were sampled using a garden rake fitted with hardware cloth. The hardware cloth surrounded the rake tines and is tapered two feet up the handle. A rope was tied to the end of the handle for retrieval. At designated sampling sites, the rake was tossed into the water, and using the attached rope, was dragged across the bottom, toward the boat. After pulling the rake into the boat, plant coverage was assessed for overall abundance. Then plants were individually identified and placed in categories based on coverage. Plants that were not found on the rake but were seen in the immediate vicinity of the boat at the time of sampling were also recorded.

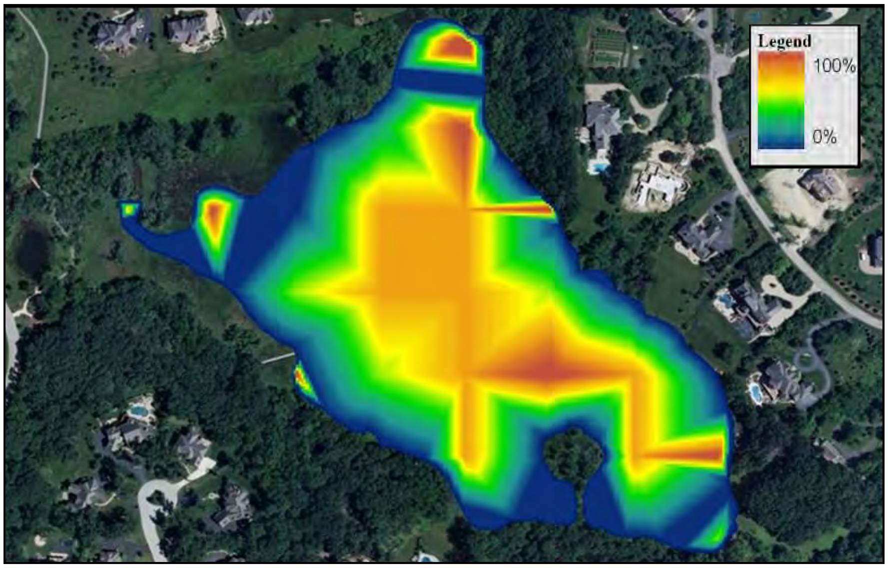


Figure 3-51: Aquatic Plant Density on Lake Albert in 2013.

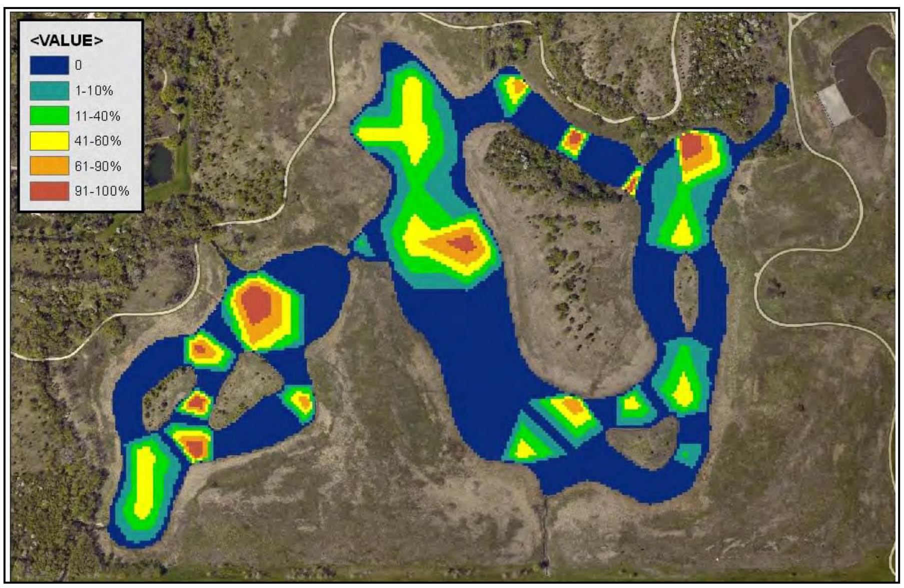


Figure 3-52: Aquatic Plant Density on Buffalo Creek Reservoir in 2013.

3.14.2.4 Water Quality

Water quality parameters such as nutrients, suspended solids, oxygen, temperature and water clarity were measured from May-September 2013 in Albert Lake and the Buffalo Creek Reservoir. The results are presented below.

Albert Lake: The average ***Total Kjeldahl nitrogen (TKN)*** concentration for Albert Lake outlet was 1.28 mg/L, which was higher than the county median of 1.170 mg/L and lower than the 2001 concentration by 46.3% (2.24 mg/L). A total nitrogen to total phosphorus (TN:TP) ratio of 22:1 indicates that phosphorus was the nutrient limiting aquatic plant and algae growth in Albert Lake. By using phosphorous as an indicator, the ***trophic state index (TSIp)*** ranked Albert Lake as ***hypereutrophic*** with a TSIp value of 93.7. This means that the lake has excessively high nutrients. Hypereutrophic lakes are often pea-soup green, with poor water clarity and are susceptible to winter fish kills. As a result, rough fish such as carp dominate Albert Lake. The 2013 average total suspended solids (TSS) concentration for Albert Lake was 10.01 mg/L, which was greater than the county median (8.0 mg/L).

Albert Lake has a large watershed that contributes to the high concentrations of chloride in the lake primarily from road salts. The conductivity of Albert Lake outlet was 0.8974 mS/cm which is higher than the county median (0.7875 mS/cm). The chloride concentration in Albert Lake in 2013 was 137 mg/L which was lower than the county median of 145 mg/L. While there is typically a correlation between conductivity and chloride levels, it is not always the case. Chloride is just one ion in the water that can influence conductivity. In the Midwest it is typically the most influential, but there could be other ions in the water that caused the conductivity in this instance to be high.

Buffalo Creek Reservoir: Sampling was conducted at two locations in 2013 (see **Figure3-53**). The overall water quality of the reservoir is poor (LCHD 2013). Like many lakes in our region, it is impaired for phosphorus based upon the Illinois EPA's standard for total phosphorus (TP) of $\geq$ 0.05 mg/L. The average TP concentrations found in the reservoir in 2013 were 0.068 mg/L and 0.096 mg/L, for BCR1 and BCR2, respectively. In 2013, the ratio of total nitrogen to total phosphorus (TN:TP) was 13:1 in BCR1 and 12:1 in BCR2. These rations indicate that there are plenty of both nutrients in the basins to promote nuisance algae or plant growth.

The TSIp for BCR1 was 65 and 70 for BCR2. A higher TSIp score indicates a nutrient rich system. Based on the TSIp scores, BCR1 is eutrophic and BCR2 is hypereutrophic.

Figure 3-53: 2013 Water quality sampling locations in the Buffalo Creek Reservoir (left) and Albert Lake (right).

Total Kjeldahl Nitrogen (TKN): *The sum of organic nitrogen, ammonia (NH_3), and ammonium (NH_4^+).*

Trophic State Index (TSIp): *Used to make a rough estimate of a water body's bio-*

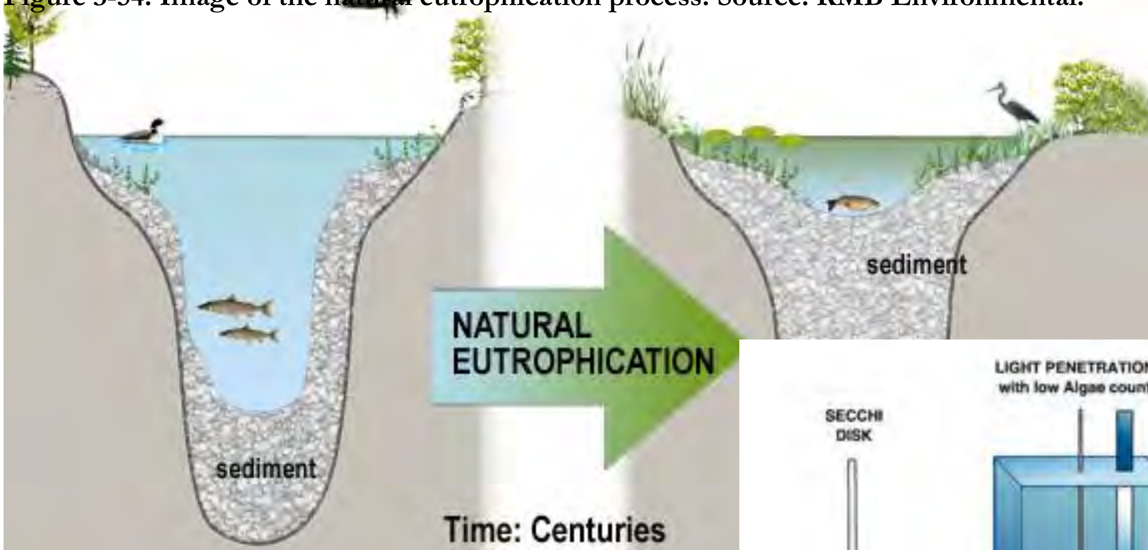
The average chloride concentration in 2013 was the same in both BCR1 and BCR2 - 210 mg/L; this is considered elevated and begins to approach the U.S. Environmental Protection Agency's (USEPA) critical concentration for chlorides of 230 mg/L. The average chloride concentration in BCR2 has decreased slightly based upon the estimated average chloride concentration of 217 mg/L from 2001.

The average ***Secchi*** depths measured at BCR1 (2.6 feet) and BCR2 (2.3 feet) with a ***secchi disk*** were both below the county median (3.00 feet) for lakes sampled between 2000 and 2013. The average Secchi depth in BCR2 has improved since 2001when it was 1.1 feet. Secchi depth can be affected by differences in precipitation, carp population, or even the amount of construction activity taking place in the watershed during the periods monitored. Water clarity is directly related to phosphorus levels. The state of Illinois set the Secchi depth (water clarity) standard at 4 feet for swimming and 1.5 feet for general water quality. **Figure 3-55** illustrates how the secchi disk is used to measure water clarity.

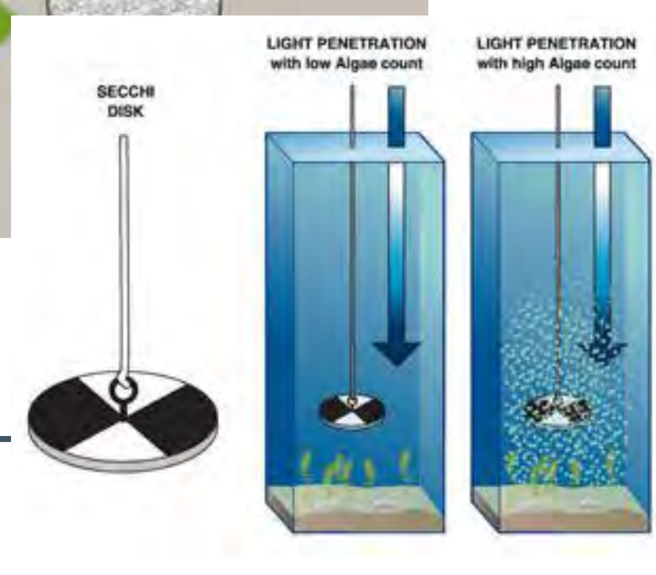
TSS concentrations in the Buffalo Creek Reservoir varied by basin. The average TSS concentration at BCR1 was 7.2 mg/L, and was below the county median of 8.0 mg/L for lakes in the county assessed between 2000 and 2013, while the average TSS concentration in BCR2 was 19.2 mg/L and is more than double the county median TSS concentration. The difference between the TSS levels in the two basins in most likely a result of carp in BCR2. BCR1 had more plants (BCR2 basically had no plants) and therefore less of a carp problem.

> ***Secchi Disk:*** *A Secchi disk is a black and white disk lowered by hand into the water to the depth at which it vanishes from sight. This depth is then recorded and is commonly used as a measure of water clarity.*

Figure 3-54: Image of the natural eutrophication process. Source: RMB Environmental.



on of a secchi disk in
Mink Lake Association.



There is no record of a fish survey being completed by the Illinois Department of Natural Resources (IDNR) for the Buffalo Creek Reservoir. It is likely that there is at the very least a rough fish population present in the reservoir as there have been frequent observations of fishermen fishing from the shorelines. **Table 3-37** below summarizes documented Secchi disk, phosphorus concentrations, nitrogen, chloride, TSS and TSIp for Lake Albert and the Buffalo Creek Reservoir.

Table 3-37: Water Quality Summary of the Lakes in the Buffalo Creek Watershed.

Lake	Secchi Depth (ft.)	Phosphorus (mg/l)	Nitrogen (TKN) (mg/l)	Chloride (mg/l)	TSS (mg/l)	TSIp Category
Albert Lake	N/A	0.495	1.28	137	10.01	Hypereutrophic
BCR 1	2.6	0.068	1.10	210	7.20	Eutrophic
BCR 2	2.3	0.096	1.18	210	19.20	Hypereutrophic

3.14.2.5 Lake Recommendations

Lake Albert's water quality has improved since 2001 with decreases in TP and TN, which means that there are fewer nutrients available for algae-blooms to occur. The TSS concentration also decreased since 2001. To improve the overall quality of Albert Lake, LCHD-ES has the following recommendations:

- Reduce or eliminate common carp.
- Mitigate shorelines exhibiting erosion.
- Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips.
- Create a curlyleaf pondweed management plan in order to allow native plants to establish in the spring.
- Participation in the Volunteer Lake Monitoring Program.
- Install a staff gauge to monitor lake level fluctuations.
- Assess current fish population.
- Help reduce chlorides by supporting wise use of road salt in the watershed.

Common Carp (*Cyprinus carpio*). Photo courtesy of NSW Department of Primary Industries.

LCHD-ES recommends the following actions for improving the water quality and overall health of Buffalo Creek Reservoir:

- Reduce or eliminate common carp.
- Promote the spread of native vegetation in basins. Management of curlyleaf pondweed early in spring before natives emerge would allow for spread of native species.
- Work with homeowner groups in Buffalo Creek Watershed to identify problems with eroding shorelines, and non-point sources of pollutants such as chlorides and phosphorus.
- Remediate eroded shorelines within the basin and throughout watershed to minimize sediments from entering into the lake. There are many options available to secure shorelines, naturalizing the shoreline with native plants provides a buffer for nutrient inputs as well as an attractive viewscape, in areas where this is not feasible a combination of hardscaping and shoreline naturalization should be considered.
- If the goal is to support fish in the reservoir, it is recommended that the depth of the basins be increased.
- Consider water quality as well as fish and wildlife habitat in any proposed expansion of the system.

Noteworthy: Trophic State Index

Another way to look at phosphorus levels and how they affect lake productivity is to use a Trophic State Index (TSI) based on phosphorus (TSIp). TSIp values are commonly used to classify and compare lake productivity levels (trophic state). Eutrophication is a natural process where lakes become increasingly enriched with nutrients. A lake's response to additional phosphorus is an accelerated rate of eutrophication. Lakes start out with clear water and few aquatic plants and over time become more enriched with nutrients and vegetation until the lake becomes a wetland. This process takes thousands of years to take place. However, human activities that supply lakes with additional phosphorus that drives Eutrophication is speeding up this process significantly. The TSIp index classifies the lake into one of four categories: oligotrophic (nutrient poor, biologically unproductive), mesotrophic (intermediate nutrient availability and biological productivity), and eutrophic (nutrient rich, highly productive), or hypereutrophic (extremely nutrient-rich, productive). In 2013, Albert Lake was eutrophic with TSIp Value of 93.7, placing it 172th out of 175 lakes in the county.

3.15 Lake and Stream Water Quality Monitoring

Multiple agencies and groups have collected water quality data in the Buffalo Creek Watershed. The agencies or groups that have collected water quality data include the MWRD, BCCWP, Volunteer Lake Monitoring Program (VLMP) and LCHD-ES.

3.15.1 Metropolitan Water Reclamation District of Greater Chicago

Since the 1970s, the MWRD has been monitoring dissolved oxygen, temperature, chloride, total phosphorus, total kjeldahl nitrogen, total suspended solids, calcium, fecal coliform and conductivity at the USGS stream gaging station in Buffalo Creek. Based on a review of their historic data, levels of chloride in the water within Buffalo Creek have been increasing while total phosphorus levels have been decreasing (see **Figure 3-56**). Decreases in total phosphorus levels in the last 40 years are likely the result of agricultural land use being converted to urban land uses and removal of phosphates from detergents and other household products. However, increases in chloride levels are also likely the result of this shift in land use. The increased amount of impervious cover associated with increased urban land use has likely increased the chloride levels in the Buffalo Creek Watershed.

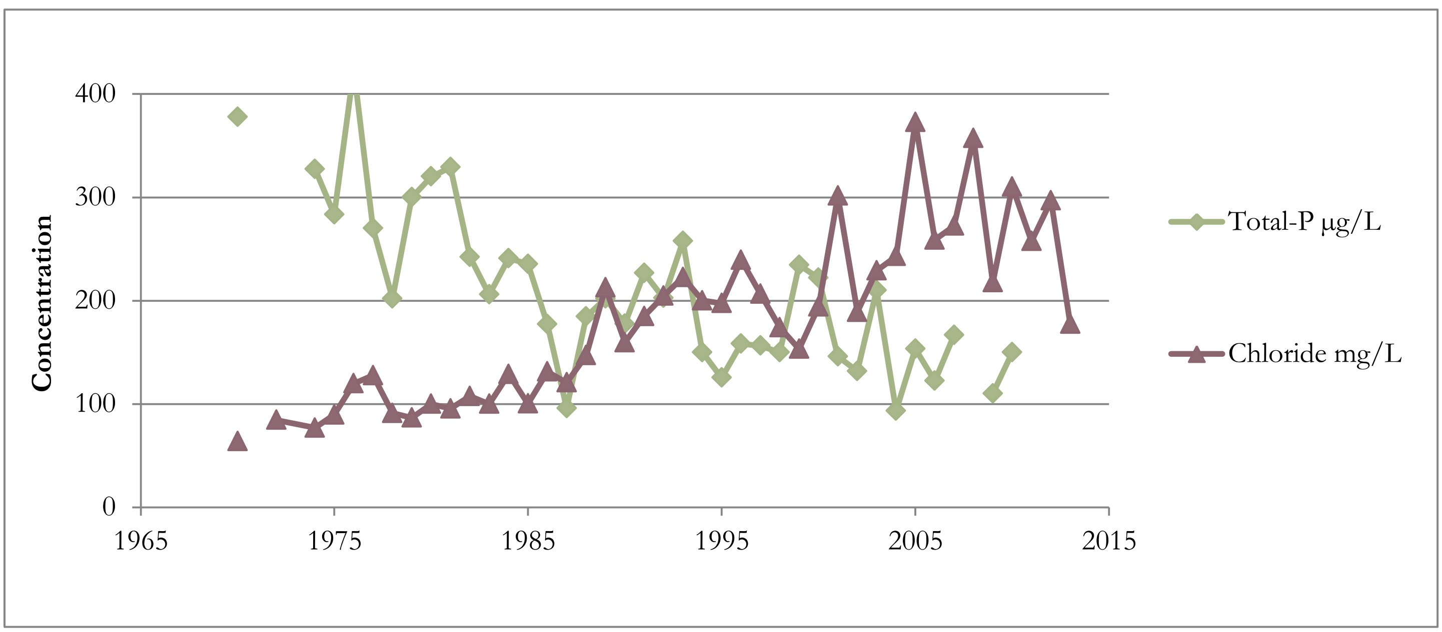


Figure 3-56: MWRD Historical Data Buffalo Creek – Chloride and Total Phosphorus.

3.15.2 Buffalo Creek Clean Water Partnership

The BCCWP was formed in April 2012. At the second stakeholders meeting on June 28, 2012, the members present voted water quality the highest priority issue for the group to address. After this meeting, BCCWP leaders Marcy Knysz and Jeff Weiss collected and reviewed all available water quality sampling data and recognized that the water quality sampling effort was infrequent and uncoordinated, resulting in limited usefulness of the water quality data to identify sources of pollutants or assess trends in watershed water quality. Key deficiencies in the existing water quality sampling effort included the following:

- Lack of water quality monitoring at key points in the watershed.
- Lack of frequent monitoring to identify seasonal trends and pollutants at different flow rates.
- No analysis available for lake sediments, which contribute to problems of eutrophication, suspended solids and low dissolved oxygen.
- Inconsistent testing regimes, conducted at different times by communities within the watershed, making it impossible to compare data across the watershed.

MS4 (Municipal separate storm sewer system): *A conveyance or system of conveyances that is owned by a state, city, town village, or other public entity that discharges to waters of the U.S and is designed or used to collect or convey stormwater (pipes, ditches etc.).*

First Flush Runoff: *The storm-event runoff that occurs at the beginning of a rainstorm of a defined threshold. The first flush carries concentrations of pollutants that have accumulated on the ground during the period of drier weather between storms. Communities often struggle to adequately define what depth of rainfall constitutes a first flush, and how it is influenced by frequency and intensity of rainfall. First flush is a metric for gaining compliance with stormwater regulations (Phase II of the NPDES and total maximum daily load (TMDL)).*

As a result of the data analysis, the BCCWP designed a Coordinated Pollutant Monitoring Program (PMP) for the Buffalo Creek watershed, received funding through a Watershed Management Assistance Grant SMC, and secured participation from the eight villages with significant land area in the Buffalo Creek watershed. The PMP included 1.) sediment sampling in Albert Lake and Buffalo Creek Reservoir, 2.) 2 years of monthly water quality sampling at 2 locations between April and October, 3.) 2 years of water quality testing at 13 locations, and 4.) collection of "first flush" samples.

The goal of the PMP is to establish a coordinated, efficient monitoring program that makes the most of community and agency investment to assess water quality trends over time. In addition the PMP should be sufficient to be used to optimize BMP locations and address water quality impairments across the Buffalo Creek Watershed. The PMP will enable water quality issues to be addressed across community and county borders, and build the spirit of cooperation needed to address other watershed issues, such as flooding, erosion and habitat quality.

The BCCWP also formed a technical committee, with significant participation from Tom Murphy, retired professor of environmental chemistry at DePaul University. The technical committee worked to determine water quality testing locations and parameters for the PMP. The information outlined in this section was obtained from the BCCWP's 2013 and 2014 Water Quality Reports.

The PMP included 13 ***Municipal Separate Storm Sewer System*** (***MS4)*** water quality sampling locations (BC1 through BC13, see **Figure 3-57**). In 2013 and 2014 water quality sampling occurred at these sites twice each year. Monthly sampling was conducted from April to October at two additional stations (known as Creekside and Checker). ***"First flush runoff"***

Photo of BCCWP volunteers and EMT staff collecting water samples. Photo by M. Knysz.

samples were collected by autosamplers placed at the Creekside and Checker sampling stations, in order to measure the presence of pollutants washed from roads and other land surfaces in the early stages of a storm event.. Consistent timing and methods were used for all sampling, with a single lab collecting samples and coordinating the testing across the watershed. Environmental Monitoring and Technology, Inc. (EMT) used a consistent panel of water quality tests and parameters to assess the quality of the stormwater runoff. Volunteers from BCCWP provided consolidated reporting and analysis. Sample collection timing, methods and parameters were consistent with those performed by MWRD at their Buffalo Creek station. Analysis of the stream flow data from the USGS stream gaging station on Buffalo Creek near Wheeling was performed. In-stream flow velocity and channel depth measurements were collected at the Creekside and Checker sites and all 13 MS4 locations on October 7, 2013.

All locations were sampled on May 6, 2013, October 7, 2013, May 5, 2014 and October 6, 2014. The results are summarized in **Table 3-38** to **3-41** and **Figures 3-58** through **3-68.** The test results were compared against the generally accepted limits for each parameter.

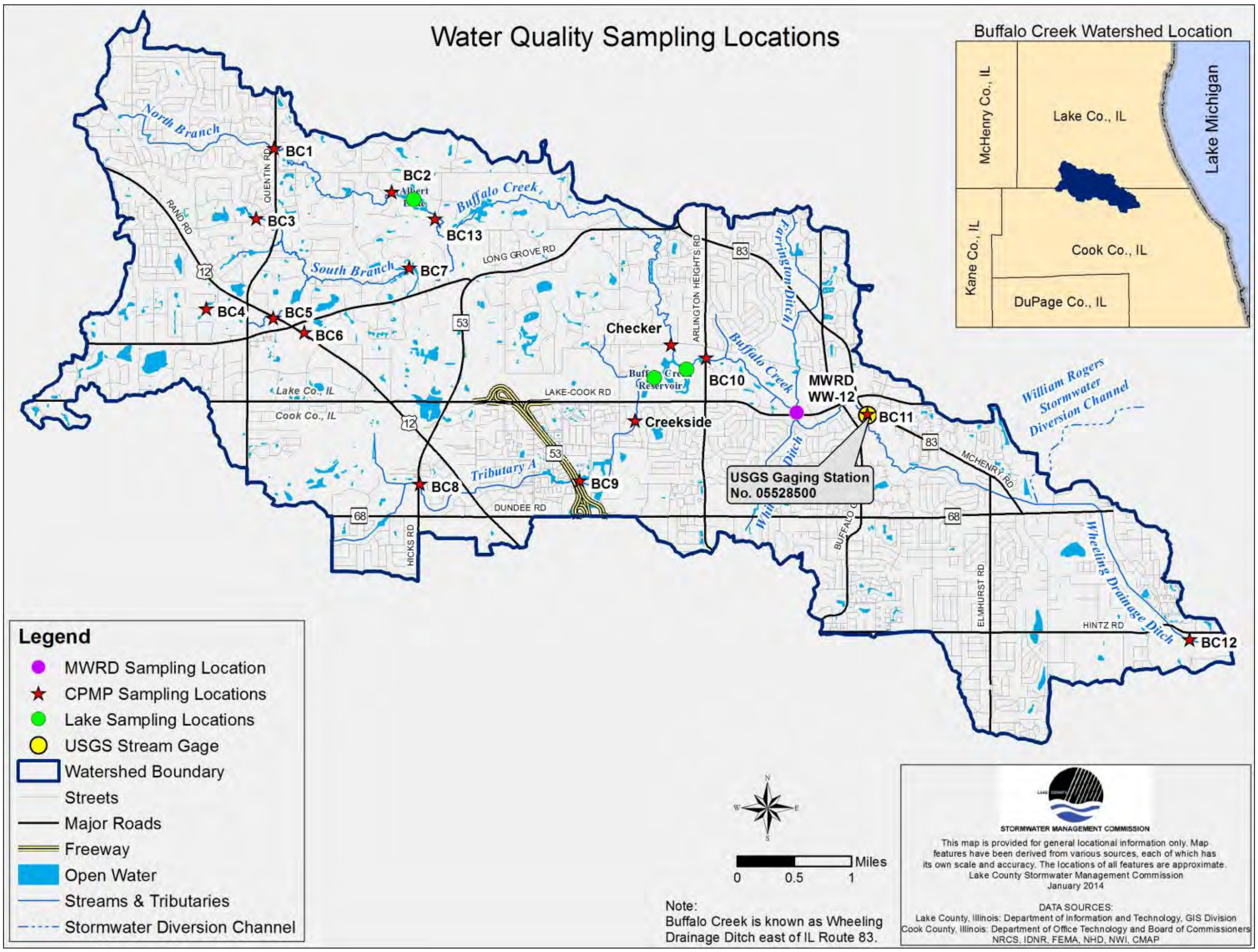


Figure 3-57: Buffalo Creek Watershed Water Quality Sampling Locations.

Table 3-38: 2013 Buffalo Creek Watershed Pollutant Monitoring Program Water Quality Testing Results (May 6, 2013).

Parameter	Cl-	DO	BOD	Total P	TDS	TSS	Kjeldahl N	Temp	Cond	pH	Fecal Coliform
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ºF	µs/cm		cfu/100 mL
Target Limits	500	At least 5.0	8.0	0.05	1,000	15-30	20	90 ºF Max	>1,500	6.5-9.0	400 max
BC1	196	13.1	5.8	**0.119**	616	12	1.39	53	1,448	8.18	70
BC2	177	13.9	5	0.027	642	3	1.67	57	1,448	8.26	**>860**
BC3	354	9.1	5.7	0.03	774	4	2.23	60	**1,925**	7.95	**>1,200**
BC4	153	9.5	7.2	**0.091**	484	**39**	1.67	60	1,231	8.13	150
BC5	174	13.2	6	**0.051**	552	<10	1.39	58	1,362	8.39	130
BC6	**975**	10.5	5.2	0.035	**1690**	9	1.39	61	**4,165**	8.48	<10
BC7	330	9.3	7.9	0.176	790	63	2.23	60	**1,920**	8.2	30
BC8	263	10.3	7	**0.059**	762	15	1.67	60	**1,720**	8.01	260
BC9	316	13.8	**12.5**	**0.069**	852	21	9.19	62	**1,906**	8.41	100
BC10	246	11.1	9.1	**0.082**	680	29	1.67	62	**1,605**	8.28	<10
BC11	246	14.4	**23.7**	**0.074**	734	12	2.23	65	**1,668**	8.73	60
BC12	270	14.3	6.2	**0.068**	766	10	1.67	65	**1,717**	8.58	60
BC13	165	11.1	2	**0.236**	526	**45**	1.39	64	1,253	8.57	10
Checker	218	10.8	7.5	**0.088**	632	18	1.39	60	**1,537**	8.07	70
Creekside	296	11	5.8	0.041	786	<10	1.67	41	**1,797**	7.97	30
MWRD	231	5.3	3	<0.2	774	12	<1.0	62	1,242	7.34	30
Average	288	11	7	**0.08**	754	21	2	59	**1,747**	8	83

Bold denotes levels above the target limit.

Table 3-39: 2013 Buffalo Creek Watershed Pollutant Monitoring Program Water Quality Testing Results (October 7, 2013).

Parameter	Cl-	DO	BOD	Total P	TDS	TSS	Kjeldahl N	Temp	Cond	pH	Fecal Coliform
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ºF	µs/cm		cfu/100 mL
Target Limits	500	At least 5.0	8.0	0.05	1,000	15-30	20	90 ºF Max	>1,500	6.5-9.0	400 max
BC1	143	8.9	3	**0.079**	374	22	1.25	54.7	749	7.58	**1100**
BC2	131	9.2	<3.0	**0.073**	324	<15	0.84	56.1	765	8.00	**440**
BC3	182	**3.3**	4	**0.125**	468	16	1.11	56.1	863	7.30	**540**
BC4	245	-	4	**0.093**	876	**76**	1.53	57.6	1030	7.71	**760**
BC5	317	7.9	3	**0.154**	844	18	1.25	55.6	1720	7.95	>120
BC6	428	**3.3**	**12.3**	**0.25**	816	**31**	3	63.9	1980	7.70	**960**
BC7	229	11.2	4	**0.124**	570	<15	1	57.4	1070	8.00	**460**
BC8	294	7.5	3.1	**0.076**	786	<15	0.56	60.2	1600	7.95	**>1500**
BC9	135	5.2	4	**0.18**	352	<15	1.39	61.2	639	7.90	**>3000**
BC10	149	11.2	5.8	**0.15**	**1,090**	24	1.11	63.14	704	8.40	**>1300**
BC11	116	8.8	4.5	**0.127**	340	19	1.25	63.9	623	7.90	**>1900**
BC12	108	9.2	4.9	**0.15**	312	<15	0.975	63.7	575	7.70	**>2400**
BC13	119	6.7	4.2	**0.18**	424	30	1.11	58.5	713	7.90	360
Checker	186	9.1	3.2	**0.19**	562	19	0.56	58.8	910	8.00	**840**

Creekside	148	8	4.2	**0.126**	358	<15	0.84	66.0	709	7.82	**>1800**
MWRD	113	7.2	3	**<0.2**	636	18	<1.0	75.2	378	7.87	**3400**
Average	190	7.8	4.4	**0.14**	571	27	1.2	60.8	939	7.86	984

Bold denotes levels above the target limit.

Table 3-40: 2014 Buffalo Creek Watershed Pollutant Monitoring Program Water Quality Testing Results (May 5, 2014).

Parameter Unit	Cl- mg/L	DO mg/L	BOD mg/L	Total P mg/L	TDS mg/L	TSS mg/L	Kjeldahl N mg/L	Temp ºF	Cond µs/cm	pH	Fecal Coliform cfu/100 mL
Target Limits	500	At least 5.0	8.0	0.05	1,000	15-30	20	90 ºF Max	>1,500	6.5-9.0	400 max
BC1	322	10.9	<4	<0.05	902	<15	<2.5	47.4	**1710**	8.2	52
BC2	272	13.9	8	<0.05	858	<15	<2.5	48.5	**1590**	7.14	14
BC3	735	8.6	<5	**.072**	**1500**	<15	<2.5	52.2	**2940**	8.12	16
BC4	220	11.4	**10**	**0.078**	702	22	<2.5	52.3	1350	8.7	100
BC5	326	9.6	<4	**0.057**	922	<15	<2.5	48.2	**1740**	7.92	>130
BC6	**2700**	13.5	**10**	**0.065**	**4350**	43	<2.5	53.1	**8420**	8.04	<2
BC7	**546**	16.2	<3	<0.05	**1250**	<15	<2.5	51.7	**2400**	8.37	48
BC8	414	10.9	6	**0.068**	**1050**	<15	<2.5	51.9	**2000**	8.32	48
BC9	491	12	<4	<0.05	**1100**	21	<2.5	54.6	**2230**	8.74	58
BC10	383	9.6	<5	<0.05	**1250**	20	<2.5	55	**1850**	8.53	4
BC11	404	15.8	<4	<0.05	934	18	<2.5	57.6	**1910**	8.04	20
BC12	418	15.5	<5	**0.061**	904	<15	<2.5	56.6	**1940**	7.74	32
BC13	244	11.6	6	**0.142**	770	28	<2.5	55.8	1360	7.48	8
Checker	326	17.8	<4	**0.063**	918	<15	<2.5	55.7	**1650**	7.93	38
Creekside	499	15.4	6	0.05	**1080**	15	<2.5	56.2	**2180**	8.04	24
MWRD	382	10.5	4	**<0.2**	996	12	1.2	53.6	**1730**	8.24	20
Average	**542.6**	12.7	5.5	**0.1**	**1,217.9**	18.7	2.4	53.2	**2,312.5**	8.1	38.4

Bold denotes levels above the target limit.

Table 3-41: 2014 Buffalo Creek Watershed Pollutant Monitoring Program Water Quality Testing Results (October 7, 2014).

Parameter Unit	Cl- mg/L	DO mg/L	BOD mg/L	Total P mg/L	TDS mg/L	TSS mg/L	Kjeldahl N mg/L	Temp ºF	Cond µs/cm	pH	Fecal Coliform cfu/100 mL
Target Limits	500	At least 5.0	8.0	0.05	1,000	15-30	20	90 ºF Max	>1,500	6.5-9.0	400 max
BC1	151	9.98	3	0.046	572	14	0.840	51.8	1050	7.7	**420**
BC2	150	10.8	3	0.046	588	10	0.98	52.52	1190	7.5	>300
BC3	165	7.89	6	**0.079**	594	<3.10	0.840	53.1	963	7.3	>200
BC4	157	10.8	5	**0.066**	520	99	1.4	50.4	1020	7.5	**440**
BC5	224	10.1	4	0.048	712	20	1.12	51.8	1340	7.5	>250
BC6	491	9.03	6	**0.059**	932	97	1.12	58.6	**1890**	7.2	**600**
BC7	224	10.9	4	**0.08**	596	4	0.98	53.8	767	7.5	>190
BC8	277	11.5	5	**0.078**	730	8	1.96	53.8	1470	7.3	>240
BC9	259	10.2	6	**0.088**	704	13	1.68	55.2	1350	7.47	400

BC10	215	9.98	5	0.035	536	5	1.4	56.1	1180	7.29	92
BC11	238	10.1	6	0.033	632	4	1.12	56.8	1280	7.29	>160
BC12	213	10.5	3	**0.057**	598	5	1.68	57.9	1200	7.42	>200
BC13	120	13.1	4	**0.058**	420	10	1.4	57.2	872	7.2	**700**
Checker	163	11.4	4	0.027	566	11	1.12	54.1	1070	7.5	**420**
Creekside	234	8.54	3	**0.096**	618	10	1.68	57.2	1210	7.57	>270
MWRD	196	9.3	<2	<0.2	582	<4	<1.0	55.8	918	7.2	240
Average	217.3	10.3	4.3	0.1	618.8	19.8	1.3	54.8	1,173.1	7.4	320.1

Bold denotes levels above the target limit.

Noteworthy: Accepted Water Quality Limits

Water Quality Parameter	Reference	Accepted Limits
Chloride	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; Part 302 Water Quality Standards Section 302.304	500 mg/L
Phosphorus, Total	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; Part 302 Water Quality Standards Section 302.205	0.05 mg/L
Fecal Coliform	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; Part 302 Water Quality Standards Section 302.209	200 cfu/100 ml geometric mean based on a minimum of 5 samples taken over any 30 day period; 400 cfu/100 ml maximum not to be exceeded in more than 10% of samples taken during any 30 day period.
Total Kjeldahl Nitrogen	Standards Methods for the Examination of Water and Wastewater, 1999	20 mg/L
Total Suspended Solids	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; Part 304 Effluent Standards	15.0-30.0 mg/L
Total Dissolved Solids	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; Part 302 Water Quality Standards Section 302.304	1000 mg/L
Dissolved Oxygen	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; Part 302 Water Quality Standards Section 302.206	March - July at least 5.0 August – February at least 3.5
BOD	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; Part 304 Effluent Standards.	<8.0 mg/L
Conductivity	USEPA Volunteer Stream Monitoring Manual, 1997	50.0 – 1500.00 µs/cm
Temperature (°F)	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; Part 302 Water Quality Standards Section 302.211	December – March 60.0°F Max April – February 90.0°F Max
pH	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; Part 302 Water Quality Standards Section 302.304	6.5 – 9.0, except for natural causes

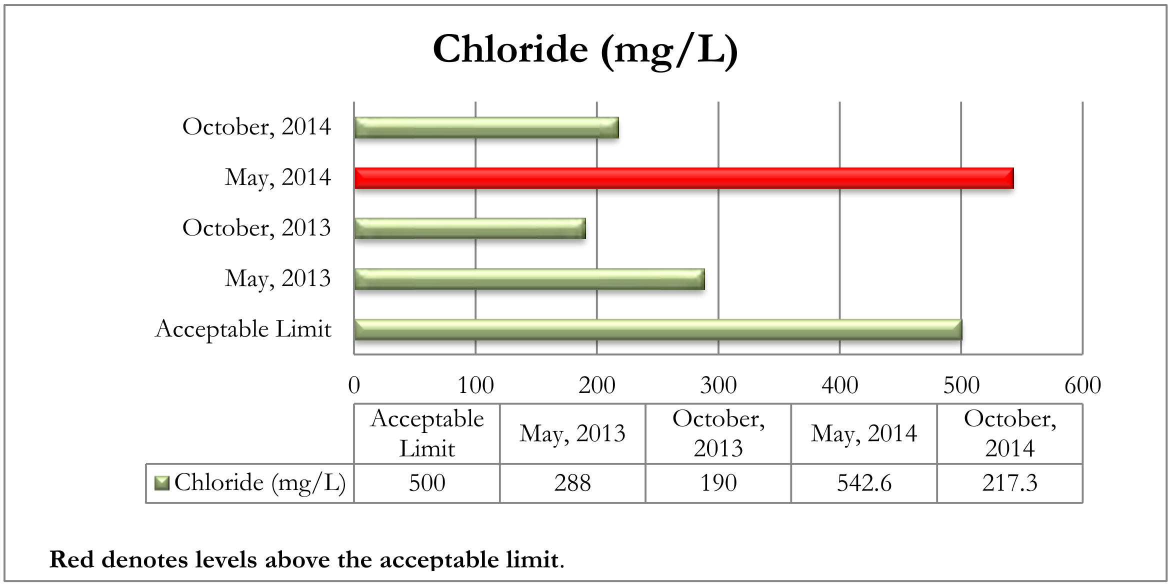


Figure 3-58: Average Chloride (mg/L) Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.

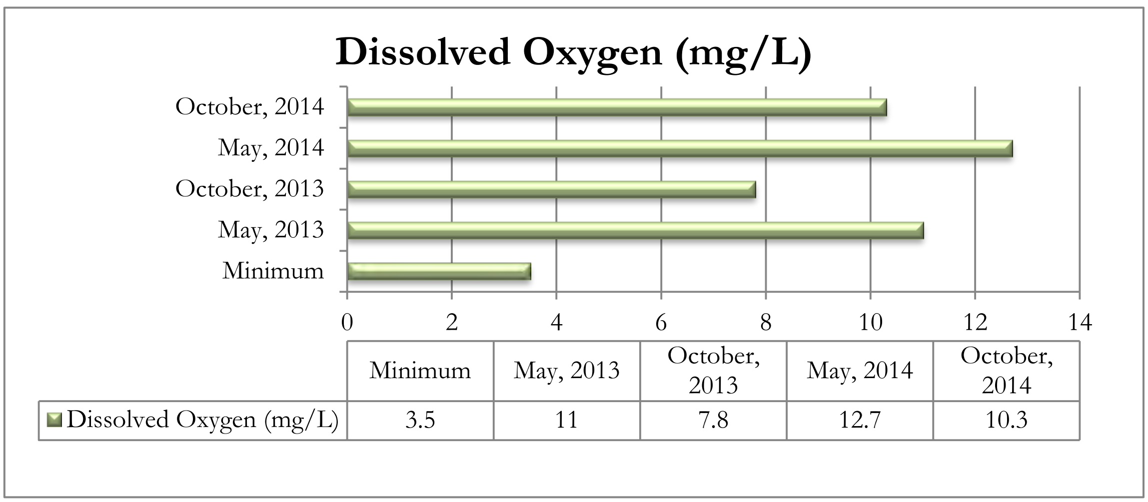
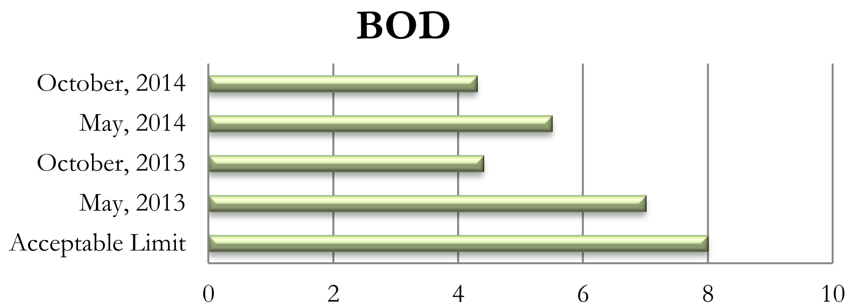
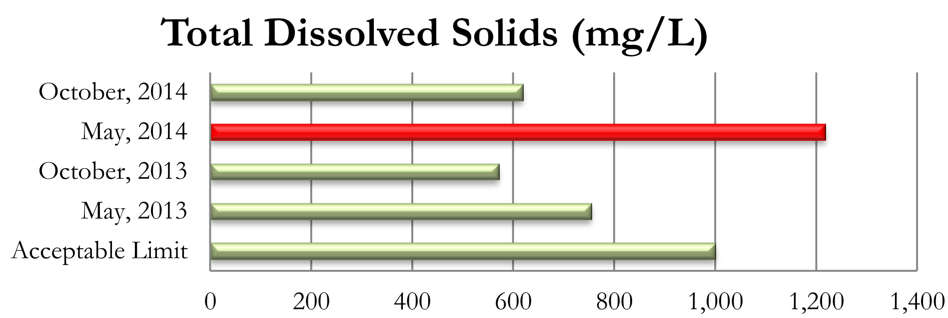


Figure 3-59: Average Dissolved Oxygen (mg/L) Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.



	Acceptable Limit	May, 2013	October, 2013	May, 2014	October, 2014
BOD	8	7	4.4	5.5	4.3

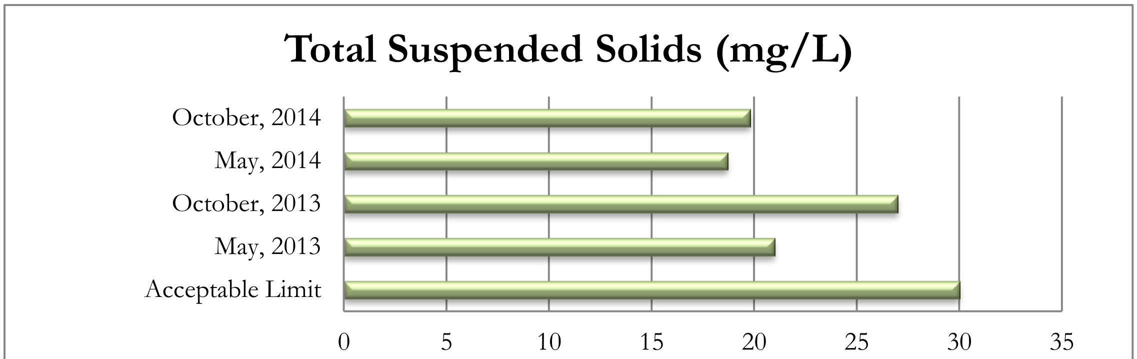
Figure 3-60: Average Biochemical Oxygen Demand Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.



	Acceptable Limit	May, 2013	October, 2013	May, 2014	October, 2014
Total Dissolved Solids (mg/L)	1,000	754	571	1217.9	618.8

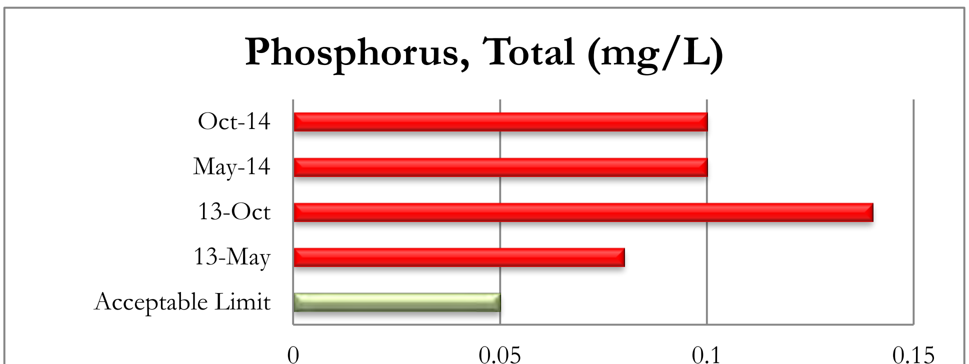
Red denotes levels above the acceptable limit.

Figure 3-61: Average Total Dissolved Solids (mg/L) Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.



	Acceptable Limit	May, 2013	October, 2013	May, 2014	October, 2014
Total Suspended Solids (mg/L)	30	21	27	18.7	19.8

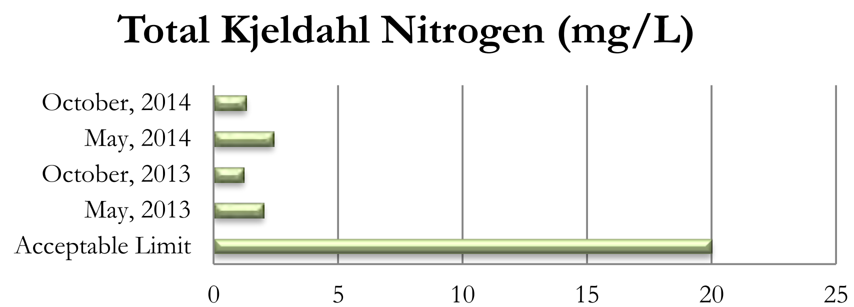
Figure 3-62: Average Total Suspended Solids (mg/L) Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.



	Acceptable Limit	13-May	13-Oct	May-14	Oct-14
Phosphorus, Total (mg/L)	0.05	0.08	0.14	0.1	0.1

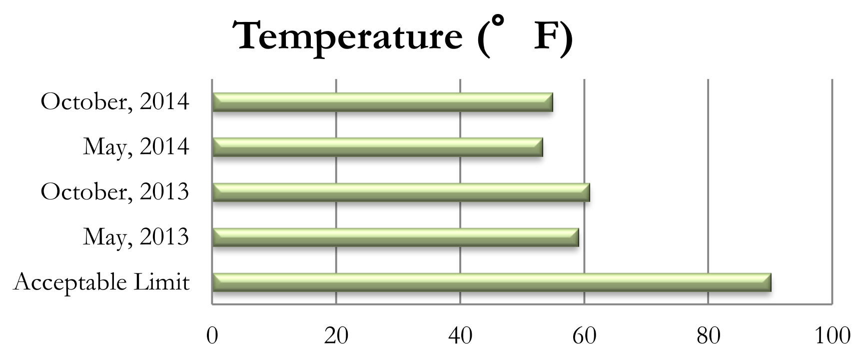
Red denotes levels above the acceptable limit.

Figure 3-63: Average Total Phosphorus (mg/L) Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.



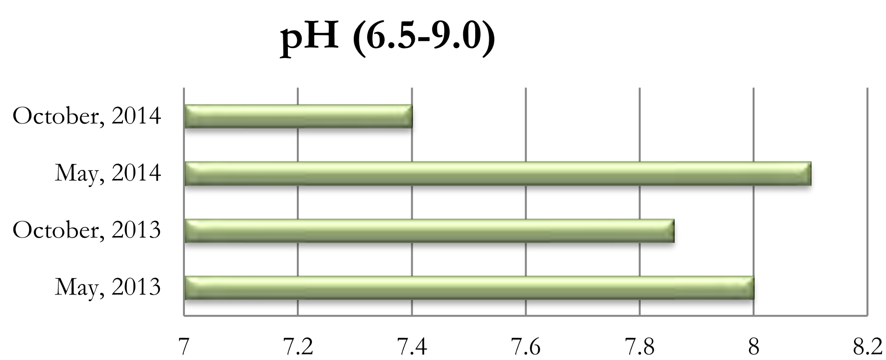
	Acceptable Limit	May, 2013	October, 2013	May, 2014	October, 2014
Total Kjeldahl Nitrogen (mg/L)	20	2	1.2	2.4	1.3

Figure 3-64: Average Total Kjeldahl Nitrogen (mg/L) Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.



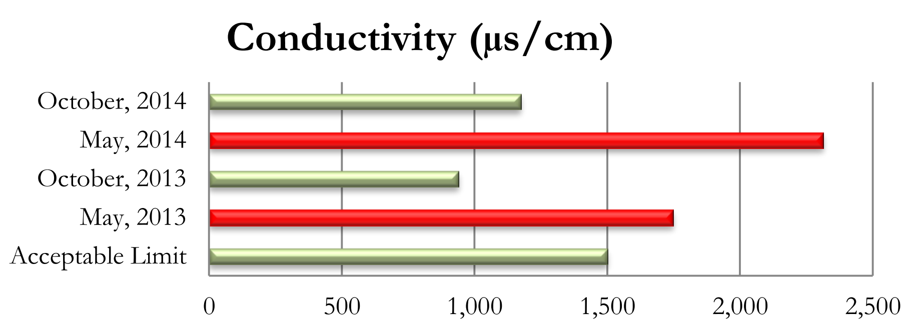
	Acceptable Limit	May, 2013	October, 2013	May, 2014	October, 2014
Temperature (°F)	90	59	60.8	53.2	54.8

Figure 3-65: Average Temperature (°F) Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.



	May, 2013	October, 2013	May, 2014	October, 2014
pH (6.5-9.0)	8	7.86	8.1	7.4

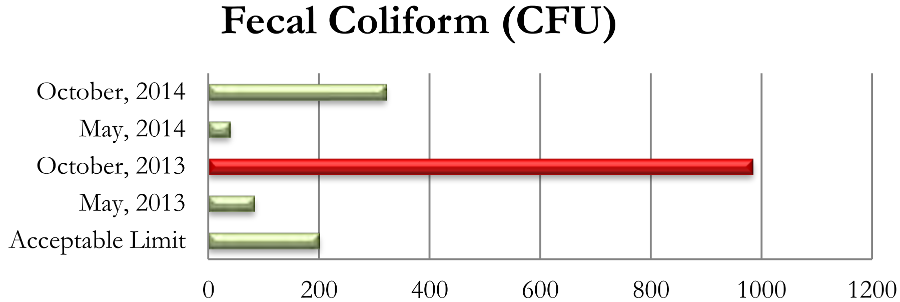
Figure 3-66: Average pH Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.



	Acceptable Limit	May, 2013	October, 2013	May, 2014	October, 2014
Conductivity (µs/cm)	1,500	1747	939	2312.5	1173.1

Red denotes levels above the acceptable limit.

Figure 3-67: Average Conductivity (µs/cm) Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.



	Acceptable Limit	May, 2013	October, 2013	May, 2014	October, 2014
Fecal Coliform (CFU)	200	83	984	38.4	320.1

Red denotes levels above the acceptable limit.

Figure 3-68: Average Fecal Coliform Concentration Across All Sample Locations in the Buffalo Creek Watershed, 2013-2014.

Water quality data collected by the PMP indicates there are multiple pollutants that exceed acceptable limits. The average for all sample locations each year exceeded the acceptable standard for total phosphorus. Average conductivity limits were exceeded in May of 2013 and 2014. The average fecal coliform exceeded the acceptable limit in October of 2013. Chloride, dissolved oxygen, BOD, total dissolved solids, total suspended solids, total kjeldahl nitrogen, temperature and pH exceeded acceptable limits at a limited number of sample locations. Based on the water quality data collected by PMP the primary water quality parameters of concern in the Buffalo Creek Watershed are total phosphorus, conductivity and fecal coliform.

3.15.3 Chloride Monitoring

Chloride ions enter waterways through various means. In the Midwest, the most common source is from winter road maintenance operations. Road salt, which is primarily composed of sodium chloride, enters water either directly or more commonly during snow melt. High chloride concentrations in waters can have negative impacts on aquatic life, and since the chloride ion is highly mobile, it can also seep into groundwater sources, some of which are used by people as their primary source of drinking water. The USEPA has a chronic standard for aquatic life of 230 mg/L. The Illinois EPA has a drinking water standard of 250 mg/L and a general use standard of 500 mg/L.

In late winter 2014 and 2015, the LCHD-ES and SMC conducted chloride monitoring in streams at numerous locations in Lake County around the time of significant snowmelt. Several sites were selected within the Buffalo Creek Watershed (Checker Road, Harvard Street Bridge, Schaeffer Road, and Long Grove Road). Sites were screened with a probe for conductivity as a surrogate for chloride concentrations. Conductivity and chloride are strongly correlated. Roughly, a conductivity reading of 2.0 mS/cm corresponds to a chloride concentration of 500 mg/L. A few water samples were taken and analyzed at the LCHD lab for chloride.

Table 3-42 shows the results for all sampled sites throughout the County. Note that over half of the sites had conductivity readings that were >2.0 mS/cm (i.e., exceeding the state general use standard). Buffalo Creek sites were similar with 57% and 72% exceeding 2.0 mS/cm in 2014 and 2015, respectively. The highest conductivity reading (11.8 mS/cm) in 2014 was on February 19th at a culvert on Schaeffer Road in Cook County. The highest conductivity reading (4.6 mS/cm) in 2015 was on March 9th at Long Grove Road.

The data represent only a "snapshot" of the situation. The readings were done *in-situ* and do not constitute continuous concentration data. Stream flow was also not recorded, so the true loading to the stream was not calculated. However, it does illustrate the potential impact that road salt is having on our aquatic resources.

Table 3-42: Conductivity and Maximum Chloride Concentrations at All Sites in Lake County in 2014 and 2015 During Snow Melt.

All Sites in Lake County					
Year	Sites	Min Conductivity	Max Conductivity	Max Chloride	% > 2 mS/cm
2014	25	0.553	70.42	8,450	51.00%
2015	39	1.004	91.02	33,400	67.70%

3.15.4 Flush Sample Analysis

Events such as melting snows and heavy rainfalls tend to carry elevated levels of pollutants into receiving waters in urban streams. An extraordinary event occurred on June 26, 2013. Between 3 AM and 11 AM, 5.36 inches of precipitation was recorded at the Buffalo Grove rain gage. The runoff resulted in severe flooding issues in Buffalo Grove and surrounding communities. The resulting stream flows set an all-time record at the USGS Buffalo Creek stream gage since measurements began in 1952, with a measured discharge rate of 665 cubic feet per second.

BCCWP volunteers had set two ISCO autosamplers to collect twelve water samples at thirty minute intervals during a rising stream stage at the sites where monthly sampling occurred during 2013. Samples from each autosampler were collected and composited at 11:30 am on June 25, and submitted to the testing laboratories for analysis in order to assess peak pollutant transport rates during a flood event. Levels of three pollutants (phosphorus, total suspended solids and fecal coliform) were compared based on average flow to the next highest values recorded for each site during monthly sampling (100 times average flow of 6 cubic feet per second) and the next highest level recorded for each. **Figure 3-69, Figure 3-70** and **Figure 3-71** present the pollutant concentrations during the June 26, 2013 storm event compared to the 2013 average pollutant concentration amounts and the acceptable limits.

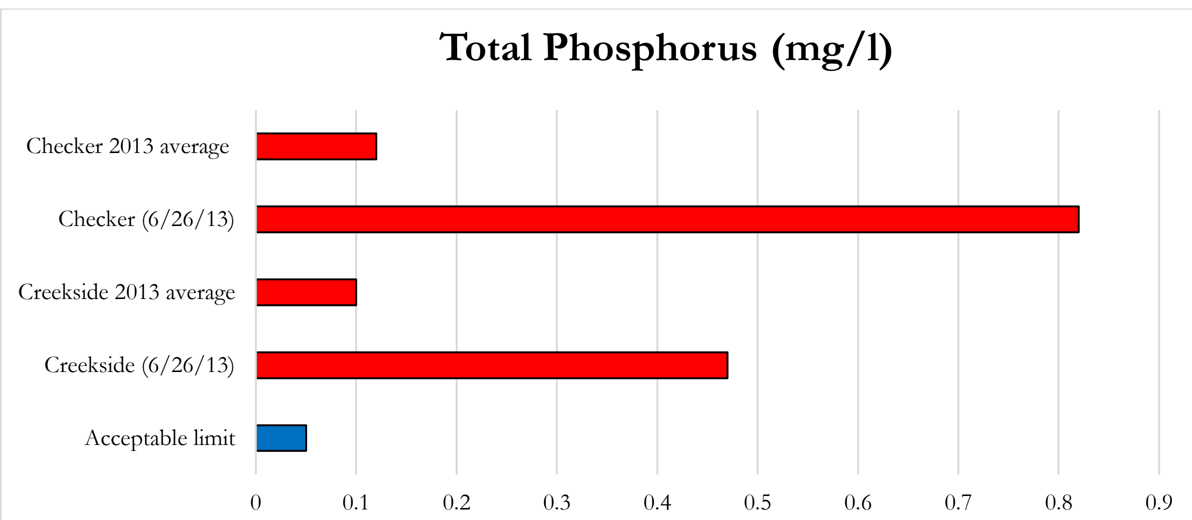


Figure 3-69: Concentration of Phosphorus During Storm Event of June 26, 2013 Versus Annual Average, 2013.

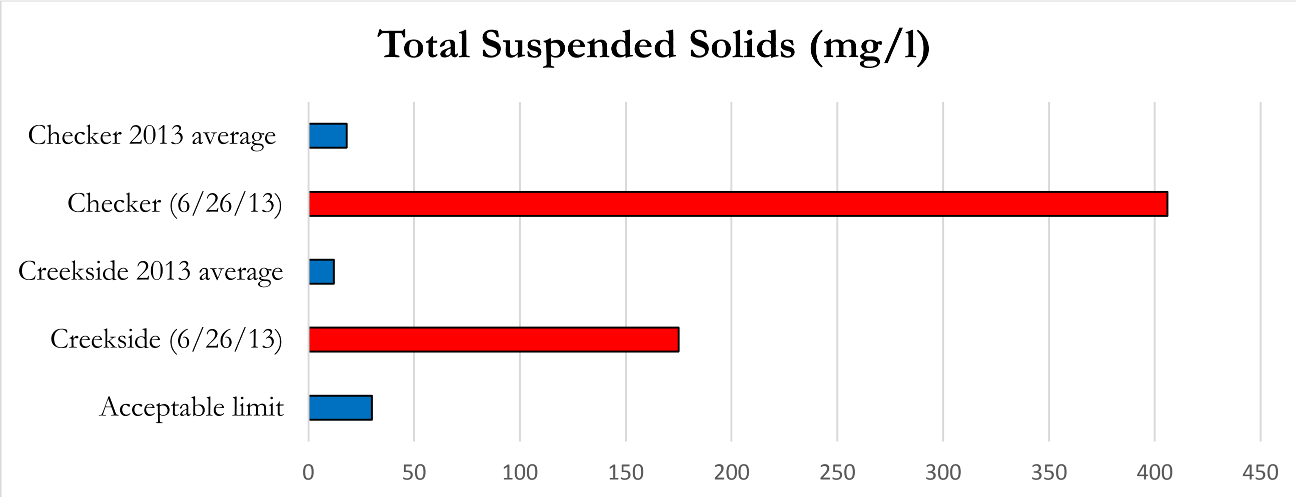


Figure 3-70: Concentration of Total Suspended Solids During Storm of June 26, 2013 Versus Annual Average, 2013.

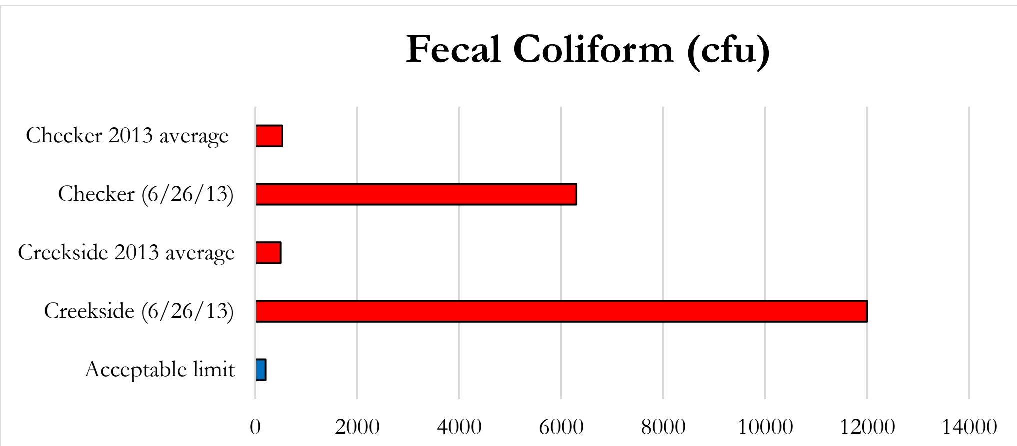


Figure 3-71: Concentration of Fecal Coliform During Storm of June 26, 2013 Versus Annual Average, 2013.

To provide a perspective on the relative amount of pollution that was transported during the storm, **Table 3-43** shows a "flow-adjusted increase" calculation when the increased concentration is multiplied by the increased flow carried by Buffalo Creek on June 26, 2013. For example, there was 683 times more phosphorus than the average level at Creekside Park during the event. In addition, new debris jams and fresh evidence of erosion of streambanks and lake shorelines were observed following the event.

Table 3-43: Pollution Transport During Flood Event of June 26, 2013

Location	Total Phosphorus mg/l	Fecal Coliform cfu	Total Suspended Solids mg/l
Checker 2013 average	0.12	531	18
Checker (6/26/13)	0.82	6300	406
Flow-adjusted increase	683 times	1186 times	2255 times
Creekside 2013 average	0.1	500	12
Creekside (6/26/13)	0.47	12000	175
Flow-adjusted increase	470 times	2400 times	1458 times
Acceptable limit	0.05	200	30

3.15.5 Lake Sediment Sampling

In 2013, LCHD-ES collected sediment samples for the BCCWP as part of the PMP. Three composite samples were taken at the following locations: Albert Lake and Buffalo Creek Reservoir (BCR-1, and BCR-2). The samples were analyzed for 136 parameters. Of the 136 parameters analyzed, 7 were above listed sediment quality guidelines in Albert Lake and 10 in Buffalo Creek Reservoir (BCR-1 and BCR-2). The sediment quality standards used to determine if the pollutants were above normal limits was McDonald et al., 2000 and Mitzelfelt, 1996.

- McDonald used two Standard Quality Guidelines (SQG): the threshold effect concentration (TEC) and the probable effect concentration (PEC). The TEC's were intended to identify contaminant concentrations below which harmful effects on sediment dwelling organisms are not expected (Smith et al. 1996; US EPA 1996a). The PEC's were intended to identify contaminant concentrations above which harmful effects on sediment-dwelling organisms were expected to occur frequently (MacDonald et al. 1996; Swaru 1999).
- Mitzelfelt either described the contaminant as elevated or highly elevated in the soils. These classifications were assigned by deviation from mean concentrations found from 273 samples of 63 Illinois lakes.

Albert Lake: The sediments in Albert Lake whose values exceeded the SQG's, also exceeded McDonald's TEC standards. Copper concentration was 36.8 mg/Kg-dry and Nickel concentration was 28.8 mg/Kg-dry, which are both above the minimum TEC of 31.6 mg/Kg-dry for Copper and 22.7 mg/Kg-dry for Nickel. The Silver concentration is considered highly elevated with a concentration of 4.38 mg/Kg-dry based on Mitzelfelt. The concentration of Mercury was above the TEC, PEC and considered elevated under Mitzelfelt at 1.49 mg/Kg-dry. While mercury was found in the samples, it may be bound to the sediment and poses minimal risk. However this information may affect any sediment removal projects in the future.

It is suspected that the source of at least some of the metals is the old Lake Zurich sewage treatment plant that discharged into the creek upstream of Albert Lakethe southeast branch of the Lake Zurich sewage treatment plant was located upstream of Albert Lake at Old Mill Grove Road, south of Rt. 22. From 1986 through 1988 the southeast branch of the Lake Zurich sewage treatment plant exceeded discharge limitations for multiple pollutants including biological oxygen demand, total suspended solids and fecal coliforms. The northwest branch of the Lake Zurich sewage treatment plant also regularly violated discharge limitations, which ultimately led to its closing in 1989. The southeast branch of the Lake Zurich sewage treatment plant was closed in 1993 and water was rerouted to the Lake County sewage treatment plant in Buffalo Grove.

Buffalo Creek Reservoir: The copper concentration in the sediment of BCR-2 was above the TEC of 31.6 mg/Kg-dry, however it was not considered elevated under Mitzelfelt. The silver concentration from the sample collected in BCR-1 was considered highly elevated by Mitzelfelt, with a concentration of 3.48 mg/Kg-dry. The concentration of mercury in BCR-1 was above the TEC and is considered elevated.

The results of the sediment sampling in both lakes are summarized in **Table 3-44.** Inorganic compounds such as metals are not biodegradable in aquatic ecosystems and often become locked up in the sediment. However, some metals can be released from the sediment, where they are assimilated into the tissues of aquatic organisms such as fish. For example, trace amounts of mercury are regularly found in fish tissue and can pose a health risk to humans. Identifying lakes with high metal concentration will assist with prioritizing future remediation efforts.

Table 3-44: 2013 Sediment Sampling Results in Albert Lake and Buffalo Creek Reservoir.

Analyte	Units	Albert Lake	BCR-1	BCR-2	MacDonald, et al. 2000		Mitzelfelt, 1996	
					TEC	PEC	Elevated	Highly Elevated
Copper	mg/Kg-dry	36.8	25.2	34.8	31.6	149	100 to <590	590 or greater
Nickel	mg/Kg-dry	28.8	17.6	21.3	22.7	48.6	31 to <43	43 or greater
Silver	mg/Kg-dry	4.38	3.48	<3.8	NA	NA	0.1 to <1.0	1.0 or greater
Mercury	mg/Kg-dry	1.49	0.46	0.10	0.18	1.06	0.15 to <7.01	7.01 or greater

3.15.6 Volunteer Lake Monitoring Program

In 2012 and 2013, Buffalo Creek Reservoir had two VLMPs participating in modified Tier II monitoring. They actively monitored the basins for water clarity (Secchi depth) and DO, additionally collecting water samples for chlorophyll a. Chlorophyll a is a pigment found in phytoplankton that can be quantified and used as a measure of primary productivity. The goal of the VLMP is to collect data every two weeks from May through August. Buffalo Creek Reservoir had four VLMP sites selected for monitoring, two in each of the basins (BCR-1 and BCR-2) that make up the entire reservoir. The results of the VLMP Secchi data for 2012 and 2013 are summarized in **Figure 3-72** as annual average Secchi depths. The results of the 2013 VLMP monitoring indicate that the water clarity in BCR-1 is better than BCR-2. This agrees with the results from water clarity monitoring conducted in the basins in 2013 by the LCHD-ES (Buffalo Creek Reservoir Summary Report, 2013).

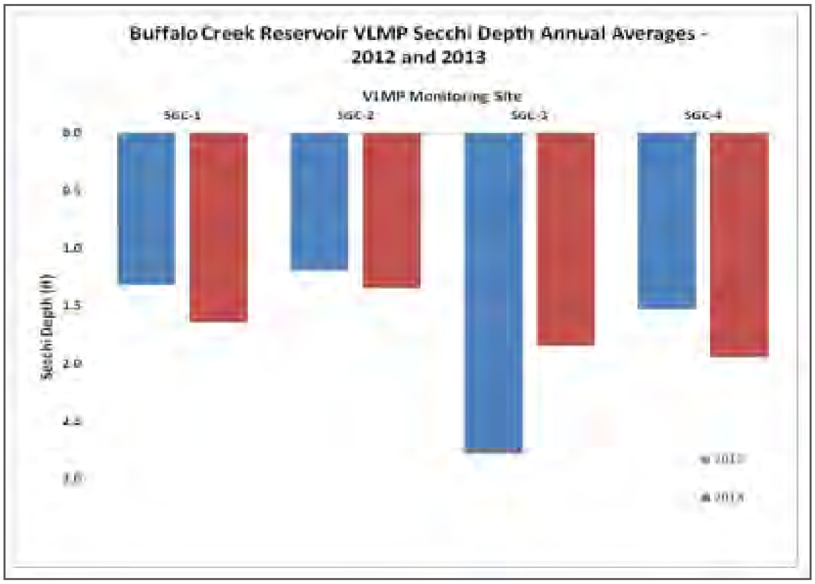


Figure 3-72: 2012 and 2013 VLMP Tier-2 Average Annual Secchi Depths.

Photo of Secchi disc in use by VLMP volunteers. Photo courtesy of J. Weiss.

3.15.7 Illinois RiverWatch Network

In addition to physiochemical indicators of water quality like phosphorus and dissolved oxygen, the diversity and abundance of aquatic organisms also helps paint a picture of watershed health. The data summarized in **Table 3-46** were gathered by the Illinois RiverWatch Program, a program of the IDNR that relies on volunteer monitoring by trained citizens in order to evaluate the health of a stream or river. Data was gathered via biological monitoring and stream habitat surveys and compiled by IDNR trained Citizen Scientists. **Table 3-45** provides a brief summary of the measures. The sampling locations can be found in **Figure 3-73**. All of these sites are Illinois RiverWatch Program sites.

Table 3-45: Summary of Illinois RiverWatch Measures.

Measure	Summary
Macroinvertebrate Biotic Index (MBI)	Rates stream health using organisms tolerant to pollution and sample density. The lower the MBI score, the better the stream quality.
EPT Score	Evaluates the number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). EPT species richness increases with stream water quality.
Total Taxa Richness (TXR)	Total number of taxa (out of a total of 37 indicator taxa) identified by the volunteers at each monitoring site.

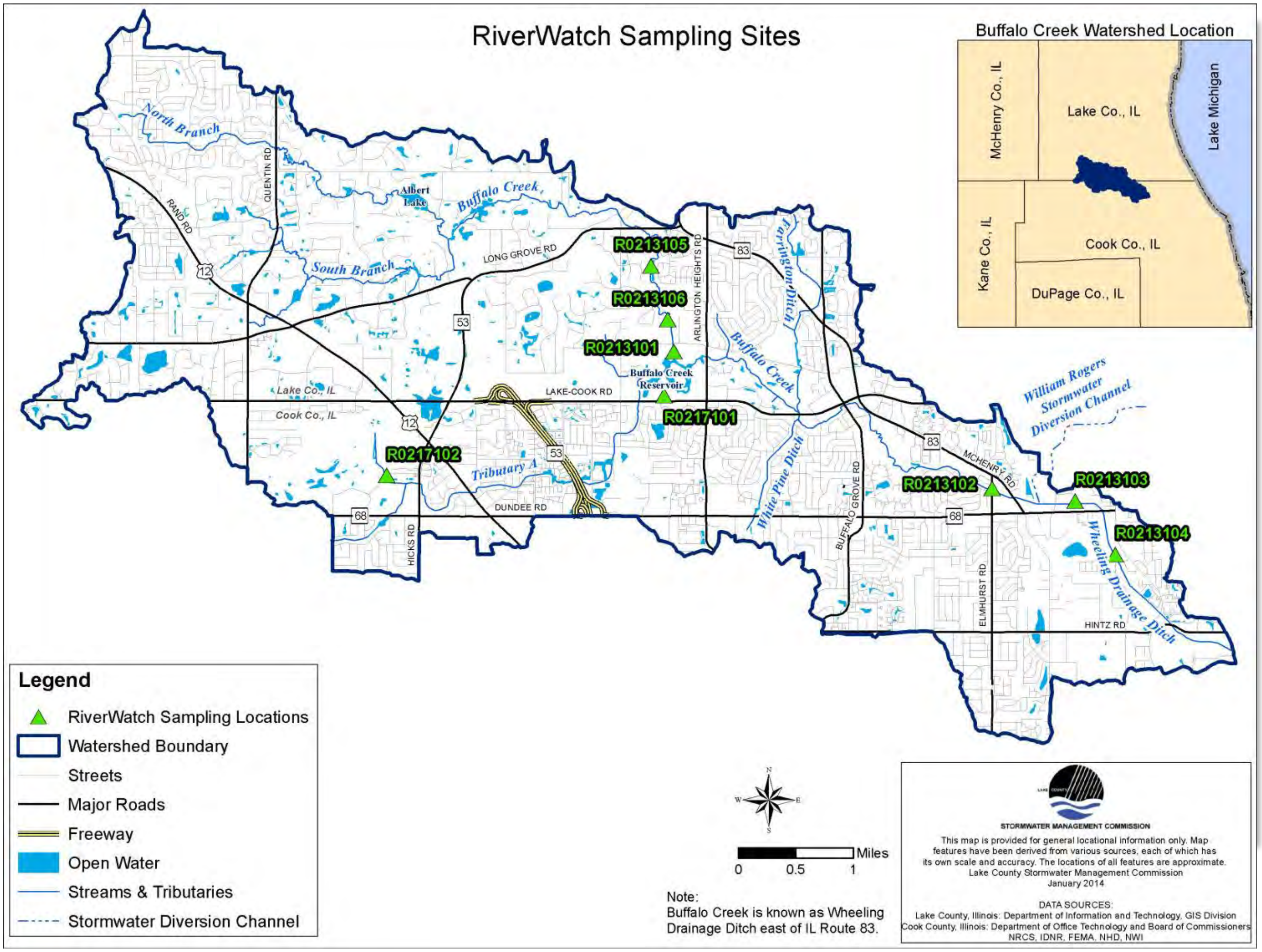


Figure 3-73: RiverWatch Sampling Locations in the Buffalo Creek Watershed.

Noteworthy: Illinois RiverWatch Network

The Illinois RiverWatch Network is a volunteer stream monitoring program that seeks to engage Illinois citizens by training them as Citizen Scientists. Each year at adopted stream sites in their communities, Citizen Scientists conduct habitat and biological surveys, including the collection and identification of small stream organisms called macroinvertebrates that serve as bio-indicators of water quality.

RiverWatch was initiated in 1995 as part of the Critical Trends Assessment Project (CTAP), an IDNR project designed to conduct a long-term, comprehensive assessment of the environment in Illinois. In February of 2006, responsibility for RiverWatch was officially transferred to the National Great Rivers Research and Education Center (NGRREC℠) with support from the Office of Lieutenant Governor. NGRREC's unique location, strong partnerships, and mission make it an ideal home for RiverWatch. More information on the program can be found on the NGRREC's website at http://www.ngrrec.org/riverwatch/.

Table 3-46: IDNR RiverWatch Data Summary, Buffalo Creek 1996-2014.

Site	Sampling Date	TXR	Taxa Richness Score	EPT Taxa Richness	EPT Taxa Richness Score	MBI	MBI Score
Wheeling Drainage Ditch (Site ID R0213101)	2000	6	Very Poor	1	Very Poor	5.9	Poor
	1998	10	Fair	2	Poor	5.6	Fair
	1997	11	Fair	2	Poor	6.2	Poor
	1996	9	Fair	3	Fair	5.7	Poor
Wheeling Drainage Ditch (Site ID R0213102)	2003	9	Fair	1	Very Poor	7.9	Very Poor
	2002	9	Fair	2	Poor	5.5	Fair
	2001	6	Very Poor	1	Very Poor	5.6	Fair
	2000	7	Poor	1	Very Poor	5.4	Fair
	1999	6	Very Poor	1	Very Poor	5.9	Poor
	1998	7	Poor	2	Poor	5.6	Fair
	1997	8	Poor	1	Very Poor	6.0	Poor
Wheeling Drainage Ditch (Site ID R0213103)	2003	5	Very Poor	0	Very Poor	5.9	Poor
	2002	10	Fair	1	Very Poor	5.7	Poor
	2001	8	Poor	1	Very Poor	6.0	Poor
	2000	6	Very Poor	1	Very Poor	5.8	Poor
	1999	9	Fair	1	Very Poor	5.6	Fair
	1998	10	Fair	1	Very Poor	5.8	Poor
Wheeling Drainage Ditch (Site ID R0213104)	1998	4	Very Poor	0	Very Poor	7.4	Very Poor
Wheeling Drainage Ditch (Site ID R0213105)	2014	5	Very Poor	0	Very Poor	6.3	Very Poor
	2013	8	Poor	2	Poor	4.7	Good
Buffalo Creek (Site ID R0213106)	2014	11	Fair	5	Excellent	5.2	Fair
Buffalo Creek Tributary (Site ID R0217101)	2014	8	Poor	1	Very Poor	6.8	Very Poor
	2013	4	Very Poor	1	Very Poor	6.0	Poor
	2012	8	Poor	1	Very Poor	6.0	Poor
Buffalo Creek Tributary (Site ID R0217102)	2014	7	Poor	0	Very Poor	6.2	Poor

Chapter 4 Flooding

4 Flooding

Floodplains 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 rain events, in order to minimize flood damages.

4.1 Flood Risk Assessment

4.1.1 Floodplain

Hydrologists assign statistical probabilities to different size floods to describe a common or ordinary flood for a particular stream versus a less likely or a severe flood for the same stream. For example: a 2-year flood event has a 50% probability of occurring in any year; a 100-year flood is a flood that has a 1% chance of being equaled or exceeded in any given year. The 100-year flood event, also referred to as the "base flood," is the standard used by the National Flood Insurance Program (NFIP) to determine the need for flood insurance. However, 100-year floods can and do occur more frequently. The 100-year flood has become the accepted national standard for floodplain regulatory purposes and was developed in part to guide floodplain development to lessen 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 in order to discharge the base flood without increasing the water surface elevation more than a 0.1-foot. A graphic representation of a typical floodplain and floodway is shown in **Figure 4-1**.

The Federal Emergency Management Agency (FEMA) has conducted ***Flood Insurance Studies*** (FIS) that assess a watershed's ***hydrology***, land use and drainage characteristics to determine areas that have the highest probability of flooding. Flood Insurance Studies are then used to produce ***Flood Insurance Rate Maps*** (FIRM). These map products depict the probable extent of the floodplain during a 100-year 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 effective FISs for the Buffalo Creek watershed were developed in the mid to late 1970s. An updated FIS has not been conducted for Buffalo Creek.

100-year Floodplain: *The area of land along or surrounding a water that floods during a 100-year storm event. A 100-year flood is a flood that has a 1-percent chance or probability of being equalled or exceeded in any given year. However, 100-year floods can and do occur more frequently than once every one hundred years. A 100-year flood may also be referred to as the base flood.*

Flood Insurance Study (FIS): *Studies conducted by the Federal Emergency Agency (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 the earth's water.*

Flood Insurance Rate Map (FIRM): *A map prepared by the Federal Emergency Management Agency that depicts the special flood hazard area (SFHA) within a community. The FIRM includes zones for the 100-year and 500-year floodplains and may or may not depict Regulatory Floodways.*

In 2011, the Metropolitan Water Reclamation District (MWRD) completed detailed watershed plans for the Lower Des Plaines River. As part of the detailed watershed plans, MWRD developed hydrologic and hydraulic models; the output from the models was used to produce flood inundation maps associated with the 100-year event. The flood inundation maps were produced by overlaying the results of the hydraulic modelling on the ground elevation model of the watershed, which was derived from Cook County LiDAR data. In many areas the limits of the MWRD inundation maps are greater than that depicted on the FIRM. Discrepancies may be the result of updated rainfall data, updated land use data, and differences in modelling methodology.

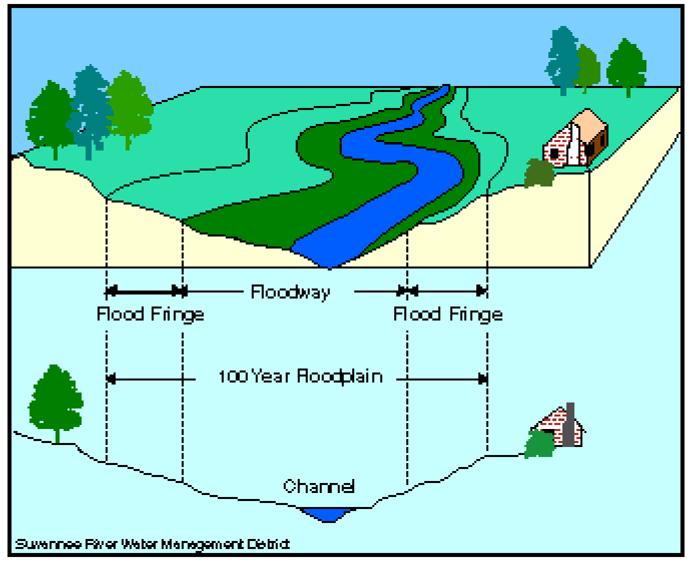


Figure 4-1: Graphic of a Typical Floodplain. Source: Suwannee River Water Management District.

The Buffalo Creek watershed covers approximately 17,393 acres. Roughly 10% (1,721-ac) is expected to be flooded during a 100-year flood, which includes 1,590 acres of floodplain as depicted on the FIRM and an additional 1,310 acres identified by MWRD as inundation areas that extend beyond the limits of the floodplain as depicted on the FIRM. **Figure 4-2** reflects the regulatory floodplain boundary based on the effective FIRM and the extent of the MWRD inundation mapping.

A Discovery Report for the Des Plaines River Watershed (HUC 8) was produced by FEMA, last updated December 22, 2014. The report is based on flood assessment work completed by the Illinois State Water Survey (ISWS) and the Wisconsin Department of Natural Resources. Although DFIRMs have been produced for many of the counties in the Des Plaines HUC 8 watershed (including Buffalo Creek), it was determined that there are still study and mapping needs that exist. Using the Coordinated Needs Management System (CNMS) and input from community stakeholders, ISWS determined a methodology to rank streams based on several criteria to provide a basis for prioritizing flood mapping needs in the watershed. Streams of concern were identified by performing a spatial analysis to determine where there are combinations of potentially unverified engineering data related to flooding, high flood risk, and community concerns. As part of this effort ISWS reviewed locations with Letters of Map Changes (LOMC). High concentrations of LOMCs indicate that the current floodplain map may not accurately represent current conditions. As part of this effort, study requests contained in the CNMS, as well as local mapping concerns collected at the Discovery meeting, were used to identify areas of known flooding issues. **Figure 4-3** depicts key data from the Discovery Report.

Noteworthy: FIRM Updates

There have been other updates to the effective FIRM panels since the 1970s; these updates are a result of map product changes as opposed to a re-study of the watershed's hydrology, land use and drainage characteristics. For example, all Lake County map panels were revised in 1997 when the mapping system went to a countywide format; originally map panels were produced based on municipal boundaries. The USACE completed an updated study for the Des Plaines River in September 1995; the Lake County FIRM issued in September 2000 revised the floodplain elevations of the Des Plaines River and all tributary rivers, including Buffalo Creek, in the vicinity of their confluence with the Des Plaines River. The Countywide FIRM and FIS for Cook County were first issued in November 2000. These initial countywide products incorporated the 1995 Des Plaines River study.

There are several effective FIRMs that have been updated since the maps were reissued in 1997 based on Letters of Map Change that were submitted to FEMA. In April 2007 FEMA produced an updated FIS for the Cook County portion of the watershed using best available digital base map files and USGS 7.5-minute series topographic maps. Associated FIRM and Digital Firm Insurance Rate Map (DFIRM) panels for Cook County were adopted in August 2008. In September 2013 FEMA produced updated FIRM and DFIRM panels for the Lake County portion of the watershed. The floodplain boundary used for these map products is based on the Lake County's 2007 digital 1-foot topography. While the more detailed topography improves the accuracy of mapping the floodplain boundary, this product was not associated with an

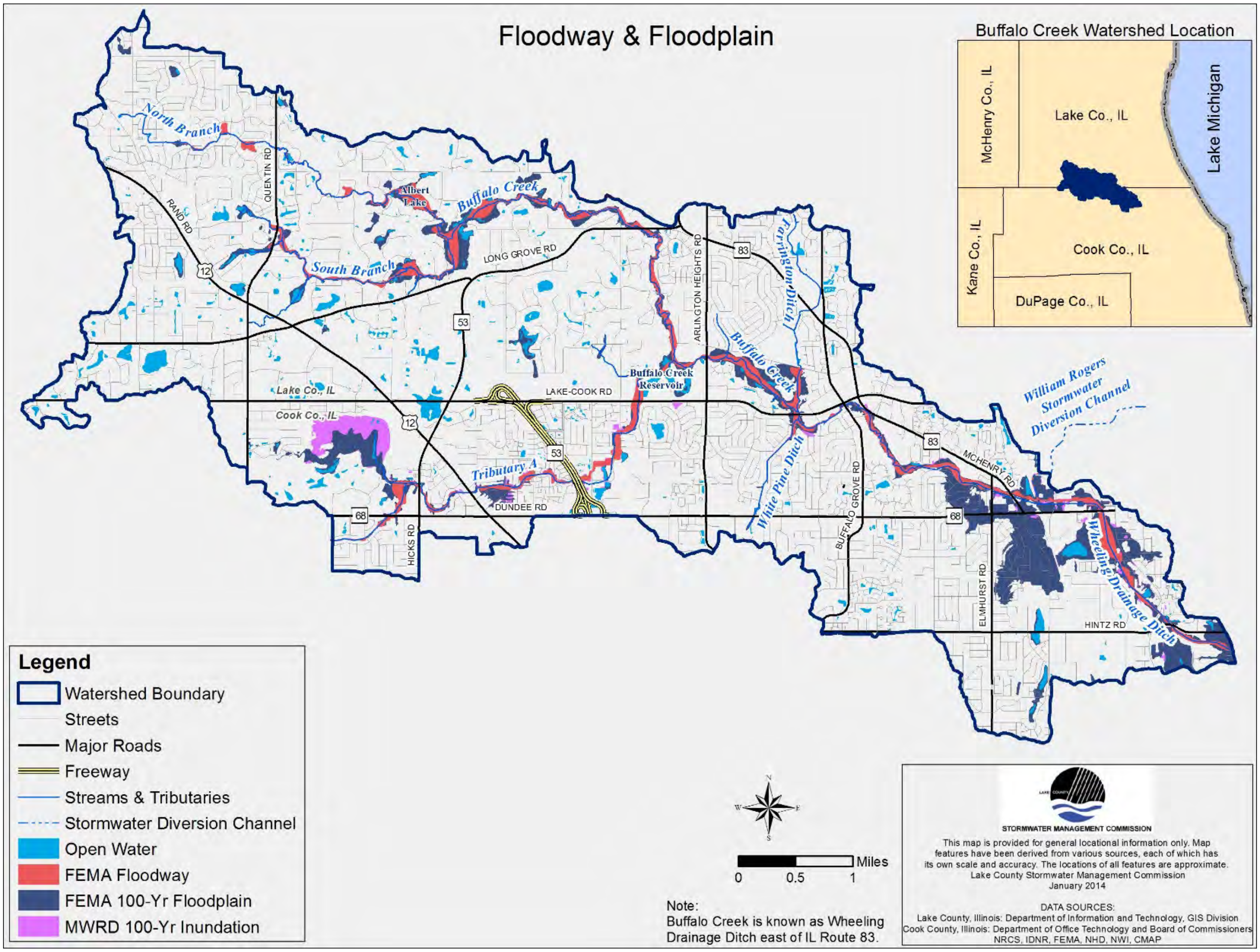


Figure 4-2: 100-Year Floodplain.

Noteworthy: Flood Risk: What is more likely flood or fire?

The term "100-year flood" has caused a lot of confusion for people not familiar with statistics. Another way to look at flood risk is to think of it in terms of the odds that a 100-year flood will happen sometime during the life of a 30-year mortgage. There is a 26% chance for a structure located in the 100-year floodplain to flood during the 30-year period. Compare those odds to an only 1-2% chance that the house will catch fire during the same 30-year mortgage period.

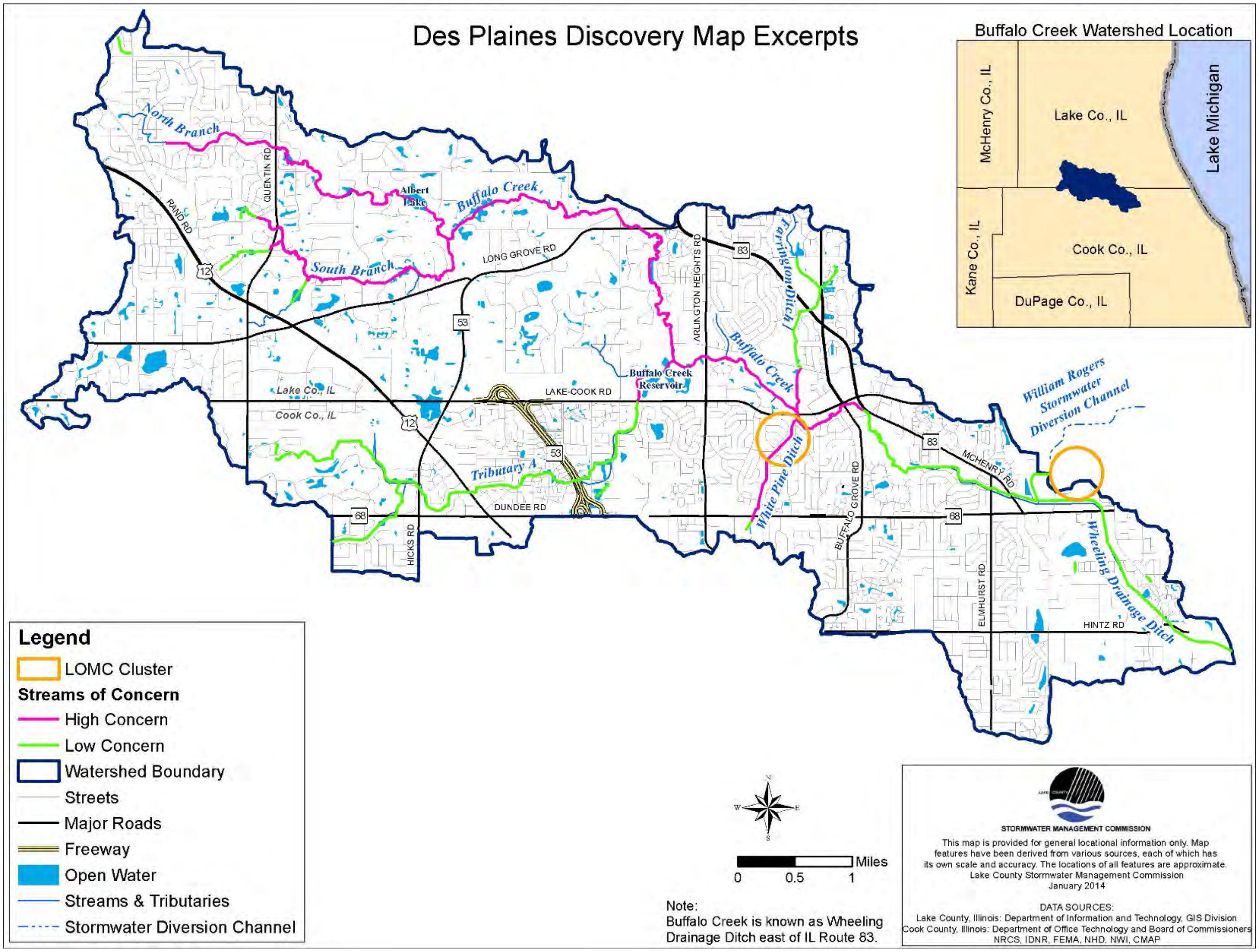


Figure 4-3: Des Plaines Discovery Map Excerpts.

A subset of stream segments was created by combining those stream segments identified as having engineering analyses that may no longer be valid and any stream segment for which participant comments indicate that the SFHA mapping is inaccurate or inadequate. This subset was further refined based on the FEMA National Flood Risk Analysis HUC Risk Data into three categories: High, Medium, and Low. The stream reaches within the Buffalo Creek watershed were all classified as either of High or Low concern. This FEMA/ISWS stream classification along with LOMC clusters are depicted on **Figure 4-3**.

4.1.2 Flood Risk – Structures in the Floodplain

Flood risk areas are SFHAs where structures have been identified as being at risk for flood damage because of their location in the 100-year floodplain. For the Lake County portion of the watershed, the September 2013 DFIRM was compared with a building footprint data layer. Per Lake County, all structures with an area larger than 100 square feet should be represented in this data layer as of April 2010. The resultant data subset was manually classified based on a review of aerial photographic data. For the Cook County portion of the floodplain, the March 2012 ArcMap World Imagery was used to manually classify structures in the FEMA floodplain and the MWRD 100-year inundation area.

All structures located within the 100-year floodplain are shown in **Figure 4-4**. Many of the identified structures are in or near potential flood problem areas, as further described in **Chapter 5**. **Table 4-1** includes a summary of these structures. According to the findings, there are approximately 2,900 structures located within the 100-year floodplain and are therefore at risk of flood damage. Of these structures, houses (1,498), garages (826), sheds (345), and business/commercial structures (139) are the most common. Approximately 97% of the structures are located within the floodplain in the Cook County portion of the watershed, as depicted on **Figure 4-5**. This is disproportionate to the floodplain distribution as 65% of the floodplain is located within Cook County. This may be due to the fact that the Cook County portion of the floodplain was already significantly developed when the first floodplain map products were produced by FEMA in the 1970s. Additionally, the limits of the floodplain within Cook County include the 100-year inundation areas recently identified by MWRD. The inundation mapping expanded the floodplain in some areas, thereby identifying more structures at risk of flooding. As depicted in **Figure 4-5**, there are approximately 1963 structures located within the Cook County FEMA mapped floodplain and an additional 852 structures located in the MWRD floodplain beyond the limits of the FEMA floodplain. The Lake County portion of the watershed has not been restudied, therefore, the floodplain boundary is based on the 1970s study, which reflects the hydrology, land use and drainage characteristics of the watershed in the 1970s rather than current conditions.

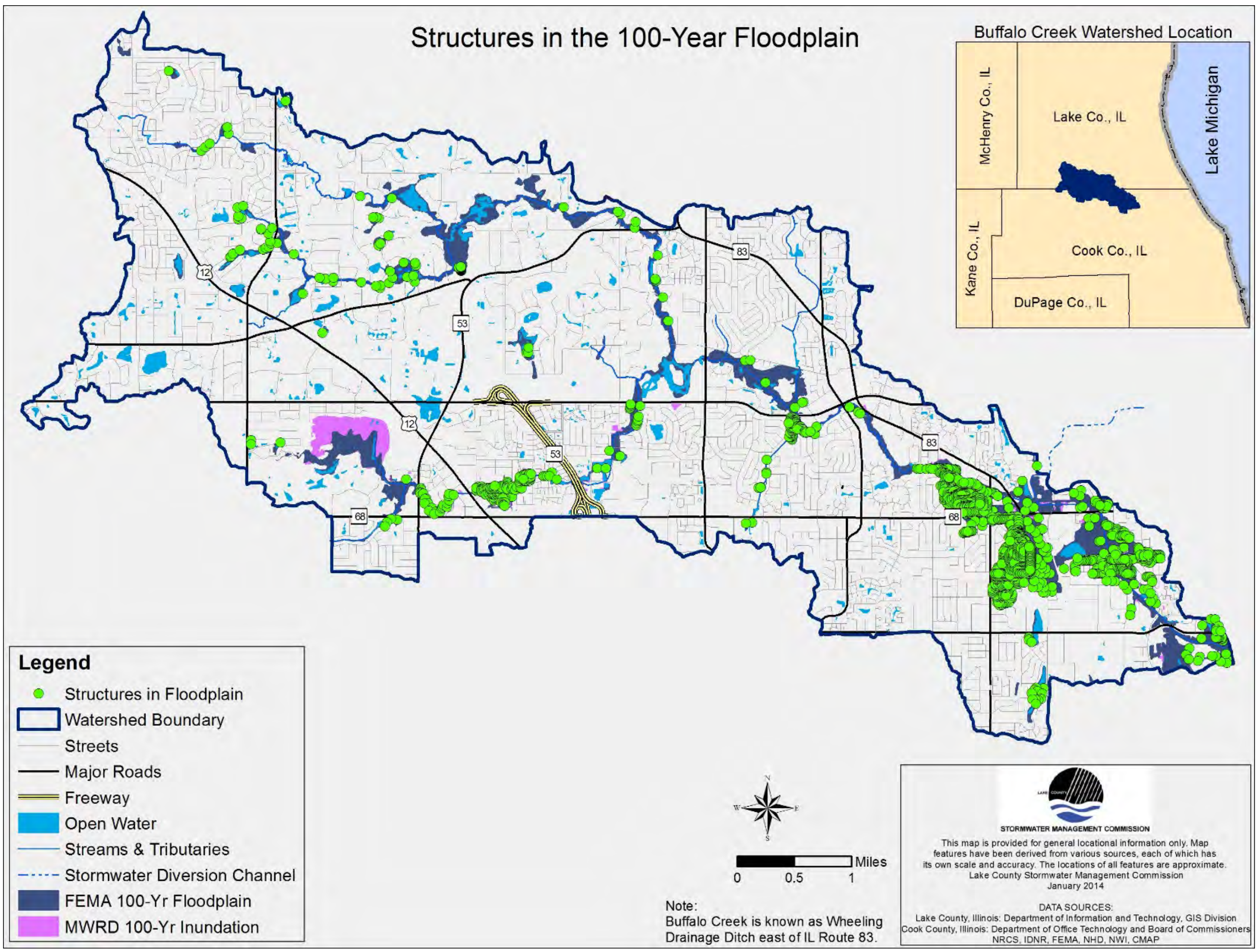


Figure 4-4: Structures in the 100-Year Floodplain and MWRD 100-Year Inundation.

Table 4-1: Structures Subject to Potential 100-Year Flooding

Structure, By Type	Number
Home	1,453
Recreation Facility	18
Garage	827
Shed	362
Business/Commercial	141
Apartments	73
Utility	3
Government	1
Other	9
Agriculture/Nursery	14
Total	2,901

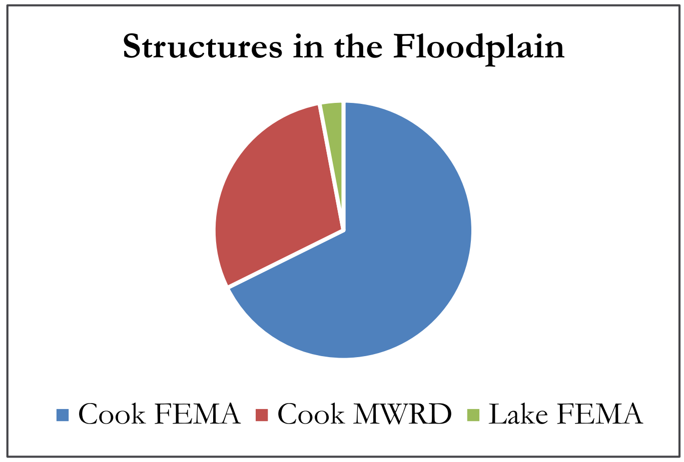


Figure 4-5: Structures in the 100-Year Floodplain by Data Source Type.

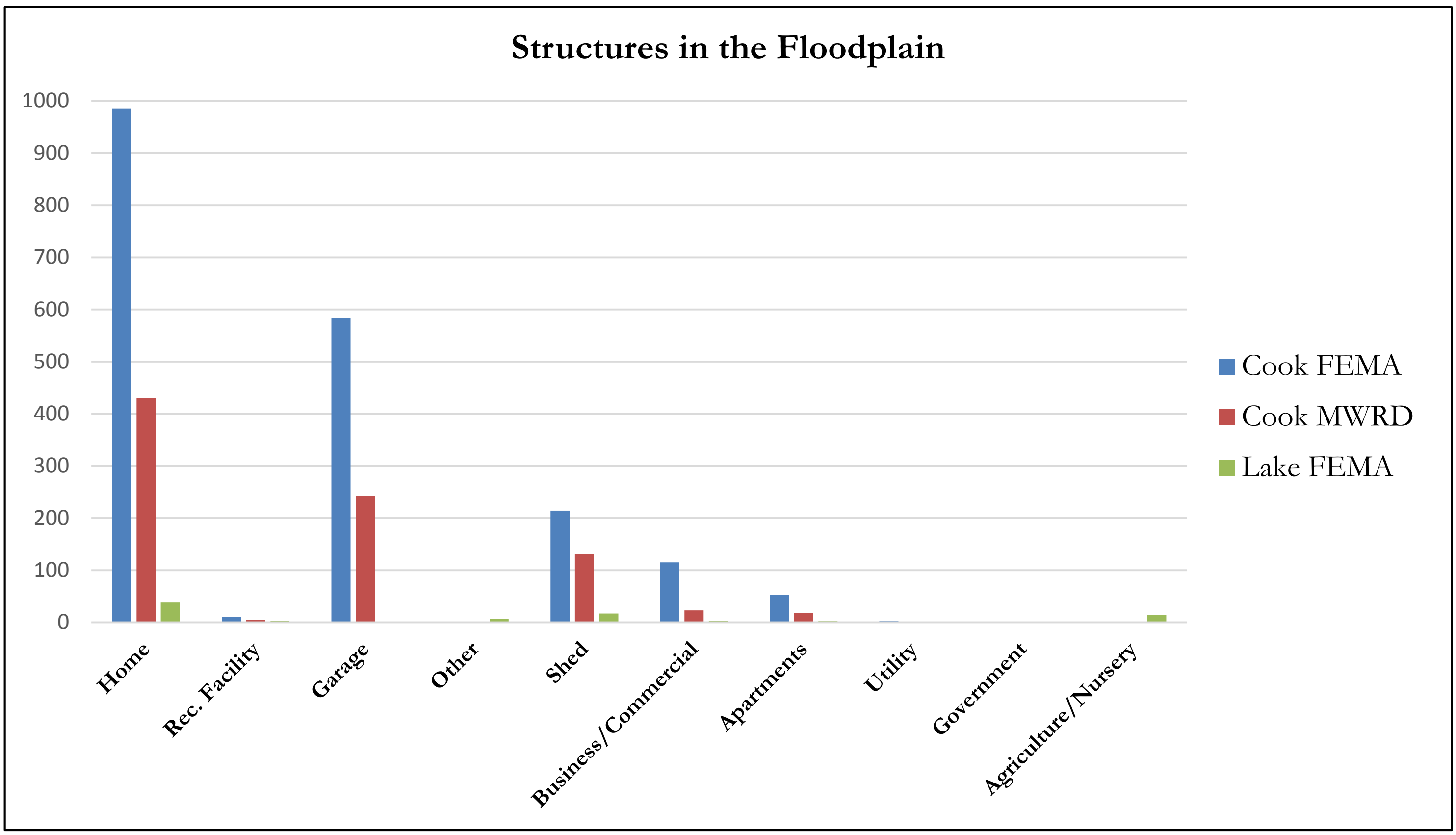


Figure 4-6: Structures in the Floodplain by Structure Type and Data Source Type.

4.2 Flood Problem Area

> ***Flood Problem Area****: Composed of 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.*
>
> ***Nuisance Flooding****: includes yard or open space flooding where it does not result in damage to a structure, loss of access, or loss of septic or utility function.*
>
> ***Depressional Storage Flooding****: Depressional storage flooding results from stormwater collecting in a depressional area of the landscape that either has no outlet for the water to drain, or an insufficiently sized outlet to efficiently drain the amount of collected run-off.*
>
> ***Local Drainage Problems****: Local drainage problems result from nearby development creating more stormwater run-off in a localized area than the drainage system can accommodate efficiently. May result from poorly located or designed developments that eliminate or alter the natural water storage or drainage system, or from inadequate drainage system infrastructure for the area serviced.*
>
> ***Overbank Flooding****: Overbank flooding is caused by water elevations that exceed the banks of a lake, river, stream or other channel and overflows onto adjacent lands.*

The countywide Flood Problem Areas Inventory (FPAI) conducted in 1995/1996, and updated in 2002, by SMC was used to identify current flood damage locations and assess potential ***flood problem areas*** in the Lake County portion of the watershed.

As part of the Detailed Watershed Plan (DWP), MWRD solicited input from stakeholders within the Cook County portion of the watershed. The DWP classifies ***flood problem areas*** based on reported problem areas and the results of the hydrologic and hydraulic modelling used to establish the 100-year inundation mapping. Problem areas were also classified by MWRD as either local or regional.

In 2014, SMC contacted the MWRD to get the Cook County flood problem area inventory. SMC also contacted local municipalities and townships to get their assistance in updating the flood problem areas inventory for the watershed. Sending out electronic and paper data forms and maps, SMC specifically requested that jurisdictions provide information on any new flood problem areas that needed to be added to the inventory, and also to provide an update on whether any flood mitigation activities have eliminated flood damage in an area that was previously mapped as a flood problem area.

The Flood Problem Area Inventory (FPAI) mapping was updated based on responses received. The majority of the MWRD sites were incorporated into the FPAI mapping or removed based on the input received. Of the 38 original MWRD sites, a total of 12 are still mapped, in addition to the FPAI update completed by SMC.

For Lake County FPAI inventory purposes, flood damage was categorized by type based on the cause of flooding. MWRD problem areas, not included in the SMC FPAI mapping, are not categorized in the same manner. The following types of flood damage occur in the Buffalo Creek watershed:

- ***overbank flooding*** from a river or stream;
- ***local drainage problems*** occur in areas where the stormwater system that has insufficient capacity to handle drainage from the surrounding neighborhood/built up area;
- ***depressional storage flooding*** occurs within a depressional area in the landscape that does not include a sufficient outlet for stormwater and therefore floods; or
- ***nuisance flooding*** includes yard or open space flooding that does not result in damage to a structure, loss of access, or loss of septic or utility function.

Areas that commonly experience only nuisance flooding are not included in the FPAI. **Table 4-2** summarizes the Flood Problem Area (FPA) locations per damage category.

In addition to the FPAI update, three additional FPA were identified in the Discovery Report for the Des Plaines River Watershed (HUC 8) based on information received from the Village of Palatine and have been included in this plan. A total of 54 flood problem sites in the watershed were identified in these efforts. **Table 4-3** and **Table 4-3a** define, and **Figure 4-7** illustrates the flood problem areas. FPA #17-34 is located in the watershed but it is caused by the Des Plaines River backwater flooding, therefore it is not addressed in this plan. There are 11 flood problem sites in Lake County and 43 in Cook County.

Table 4-2: Flood Problem Area Inventory Sites Damage Categories Summary.

FPAI Damage Type	Summary of Impacts in Buffalo Creek Watershed
Depressional Storage Flooding	Depressional flooding problems account for approximately 7% of the flood problem areas (a total of 3 locations). None of these depressional flood areas are located in mapped 100-year floodplains. Flood insurance is not required for properties located outside of mapped floodplains, therefore it is more likely that new homebuyers in these areas may not be aware of their flood risk, and will not be adequately protected from flood damage.
Local Drainage Problems	Approximately 53% of the flood problem areas are associated with local drainage problems (a total of 22 sites). Only 4 of the 22 sites are located in mapped 100-year floodplains. As with depressional flood locations, new homebuyers in the local drainage problem locations that are not mapped as floodplain may not be aware of the flood risk and be protected for flood damage losses by flood insurance.
Overbank Flooding	Overbank flooding problems account for approximately 40% of the flood problem areas (a total of 17 locations). The reported problems result in roadway flooding and closures, impact residential and non-residential structures (including a school) and utilities. All of the overbank flood problem areas are located in mapped 100-year floodplain.

Noteworthy: Flood Problem Area Identification System

SMC identified FPA ID numbers were assigned by SMC as part of their inventory efforts (e.g. 17-01). Several SMC FPA were not included in this watershed plan because they were found not meet FPA criteria. The more detailed numbering system was taken from MWRD's Detailed Watershed Plan. To ensure consistency between data sources none of the previously identified FPA, by either SMC or MWRD were re-numbered.

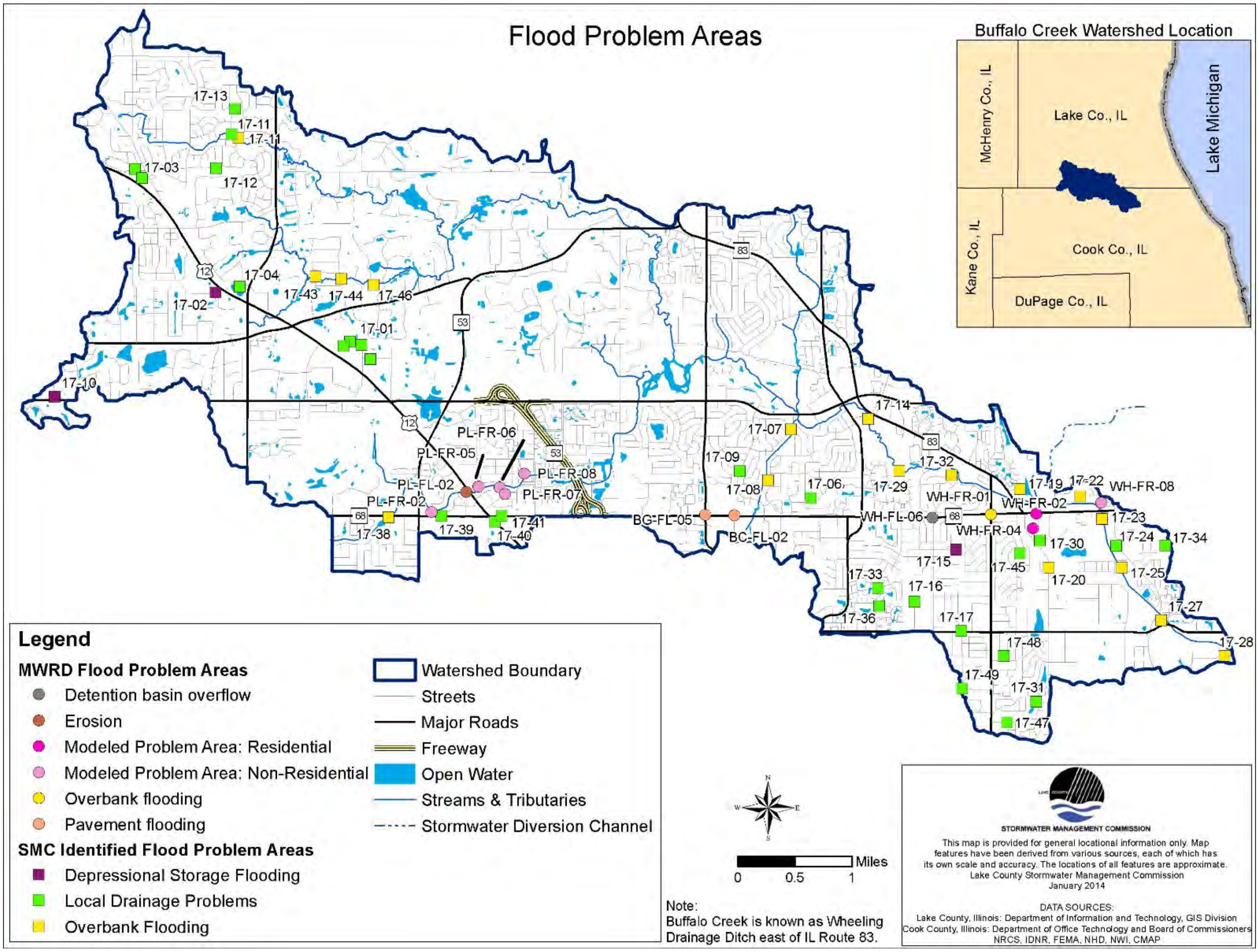


Figure 4-7: Flood Problem Areas.

Table 4-3: Flood Problem Area Inventory Sites

Flood Problem Area ID	County	Problem Category	Problem Description	Frequency
17-01	Lake	Local Drainage Problems	2 homes	Annually
17-01	Lake	Local Drainage Problems	Storm sewer upgrade 2013-14	Annually
17-01	Lake	Local Drainage Problems	Road only	Annually
17-02	Lake	Depressional Storage Flooding	3 structures and road	2-5 years
17-03	Lake	Local Drainage Problems	Yards of 8 homes in Pheasant Ridge Subdivision *	Very Heavy Rains
17-04	Lake	Local Drainage Problems	Yard and road	10-year event
17-06 WPDT-BG-FL-02	Cook	Local Drainage Problems	MacArthur Drive, yard flooding, water enters structures, stormwater improvements completed in 2011	UNK
17-07 WPDT-BG-FR-02	Cook	Overbank Flooding	White Pine Ditch overflows during heavy rains, St. Mary's Parkway upgraded in 2011	Heavy rains

17-08 WPDT-BG-FL-04	Cook	Overbank Flooding	Flooding of ~ 10 homes and White Pine Road, bank/berm work completed in 2011	Heavy rains
17-09 WPDT-BG-FL-03	Cook	Local Drainage Problems	Roads and homes, storm sewer upgraded, additional detention basin constructed	Heavy rains
17-10	Lake	Depressional Storage Flooding	1 home, overtop elevation higher than lowest floor of nearest home	June 2013
17-11	Lake	Overbank Flooding	Riley Lane overtopped ~2', inconsistent with FIRM	Heavy rains
17-11	Lake	Overbank Flooding	Stanton Drive overtopped ~2', inconsistent with FIRM	Heavy rains
17-12	Lake	Local Drainage Problems	Partridge Lane and ~13 homes impacted	Heavy rains
17-13	Lake	Local Drainage Problems	16 homes impacted in June 2013 storm event, sewer backup has occurred	Heavy rains
17-14 BUCR-CD-SM-04	Cook	Overbank Flooding	Farmland (incorporate flood reduction measures when site develops)	2-5 years
17-15	Cook	Depressional Storage Flooding	40 homes, 1 stormwater lift station, 1 sanitary lift station	11-50 years
17-16 BUCR-WH-FL-03	Cook	Local Drainage Problems	3 residential basements, first floor, roadway	2-5 years
17-17 BUCR-PH-FL-01	Cook	Local Drainage Problems	Hintz Road, Wheeling High School, well	2-5 years
17-19	Cook	Overbanking Flooding	Flooding of water tower and ComEd substation limits access	6-10 years
17-20 BUCR-WH-FR-03	Cook	Overbank Flooding	Wheeling Road floods, closed several times per year, construction of Levee 37 should improve/alleviate	2x per year
17-22	Cook	Overbank Flooding	School parking lot flooded	11-50 years
17-23 BUCR-WH-FL-02	Cook	Overbank Flooding	Dundee Road bridge and church parking lot, construction of Levee 37 should improve/alleviate	6-10 years
17-24	Cook	Local Drainage Problems	~20 residences, Oliver Wendell Holmes Middle School, Wolff Road closures in extreme events only, construction of Levee 37 should improve/alleviate	Extreme Events
17-25 BUCR-WH-FR-11	Cook	Overbank Flooding	50 homes (crawl space), Meadowbrook Ln, Nancy, Jeffrey Ave, and Oak Dr. Construction of Levee 37 should improve/alleviate	51+ years
17-27 BUCR-CD-SM-03	Cook	Overbank Flooding	Field flooding	2-5 years
17-28 BUCR-WH-FR-16	Cook	Overbank Flooding	Industrial Lane road flooding	2-5 years
17-29	Cook	Overbank Flooding	Streets and a retaining wall	Heavy rains
17-30	Cook	Local Drainage Problems	20-50 residences and school, 1st floor, crawl spaces, garages, limited/loss of access, roadway	Heavy rains
17-31 BUCR-WH-FL-05	Cook	Local Drainage Problems	7-10 multi-family buildings, limited to garages and roadway	11-50 years

17-32	Cook	Overbank Flooding	10-40 residential basements and crawlspaces, streets/loss of access	Heavy rains
17-33	Cook	Local Drainage Problems	50-100 residential units (basements, 1st floor, garage), storm sewer backup, standing water, limited roadway access	Heavy rains
17-34 BUCR-WH-FR-13	Cook	Local Drainage Problems	Mors Ave floods due to storm sewer backing up, storm sewer discharges to Des Plaines River, not Buffalo Creek	When Des Plaines River is high
17-36	Cook	Local Drainage Problems	Two apartment buildings (VIP apartments) - first floor water damage, roadway limited access	Heavy rains
17-38	Cook	Overbank Flooding	Flooding on East Dundee Road and Oak Street	Heavy rains
17-39	Cook	Local Drainage Problems	Flooding on East Dundee Road near Denise Drive	Heavy rains
17-40 BUCR-PL-FL-01	Cook	Local Drainage Problems	Overtopping of Rand Road	Heavy rains
17-41	Cook	Local Drainage Problems	Overtopping of Dundee Road	Heavy rains
17-43	Lake	Overbank Flooding	Buffalo Run Street closed	April 2009 May 2014
17-44	Lake	Overbank Flooding	Grove Drive closed	April 2009 May 2014
17-45	Cook	Local Drainage Problem	Yard and structure flooding, storm sewer surcharging.	Annually
17-46	Lake	Overbank Flooding	Floodwaters overflow bridge preventing access to/from 3 single family homes	Heavy rains
17-47	Cook	Local Drainage Problem	Robert Avenue and repetitive loss structure	< 10-year
17-48	Cook	Local Drainage Problem	Yards and homes, significant inundation	< 10-year
17-49	Cook	Local Drainage Problem	Yards and homes, significant inundation	< 10-year

*Watershed Management Board grant project 2014

Noteworthy: Cost of flood damages

The Detailed Watershed Plan for the Lower Des Plaines River watershed estimated damages due to flooding over a 50-year period that result from regional overbank flooding or erosion of a regional waterway for the Cook County portion of the Buffalo Creek watershed to be $68,203,000. Damages due to flooding from local waterways and storm sewer systems, and also damages not easily quantified in financial terms such as water quality, wetland, riparian, and habitat impact, loss of emergency access, and loss of business or operations due to limited transportation access, were not quantified. The USACE Phase 2 report indicates that the Average Annual Flood Damage (including residential and non-residential structures, their contents, and traffic impacts) for Buffalo-Wheeling Creek is $745,506 (2012 prices).

Table 4-3a: Flood Problem Area Inventory Sites, MWRD.

Flood Problem Area ID	County	Description	Year Frequency
BCTA-PL-FR-02	Cook	Dundee and Hicks Roads (Modeled Residential Problem Area)	100-year
BCTA-PL-FR-05	Cook	Laurel Drive (Modeled Residential Problem Area)	10-year
BCTA-PL-FR-06	Cook	East Lilly Court (Modeled Residential Problem Area)	5-year
BCTA-PL-FR-07	Cook	Capri Drive (Modeled Residential Problem Area)	5-year
BCTA-PL-FR-08	Cook	Green Lane North Apartment (Modeled Residential Problem Area)	100-year
BUCR-PL-FL-02	Cook	Sinkhole forming behind building	UNK
BUCR-WH-FR-02	Cook	Gaslight Shopping Center (Modeled Non-Residential Problem Area)	2-year
BUCR-WH-FR-01	Cook	Dundee Road & Elmhurst Road (Dunhurst Subdivision)	UNK
BUCR-WH-FR-04	Cook	South Wheeling Road (Modeled Residential Problem Area)	2-year
BUCR-WH-FR-08	Cook	6th Street (Modeled Residential Problem Area)	100-year
WPDT-BG-FL-05	Cook	Pavement flooding Illinois 68 at Old Arlington Heights Road	UNK
WPDT-BG-FL-02	Cook	Pavement flooding Illinois 68 at Arlington Heights Road	UNK
BUCR-WH-FL-06	Cook	Detention basin overflow	Heavy rains

4.3 Flood Damage Assessment

The FPAI and flood risk assessment identified structures that have been or may be damaged by flood events. In 2014, the SMC sent flood protection questionnaires to 1,408 property addresses within the floodplain or adjacent to the known Flood Problem Areas identified in the watershed at the time of the mailing. The questionnaire also requested more detailed information about the damage extent and frequency of flooding (See **Appendix G** for a copy of the questionnaire). The purpose was to identify those structures that are at risk of flooding so that watershed plan recommendations can be made that address flood damage reduction. Approximately 5% (77) of the mailings were undeliverable. Responses were returned from approximately 18% (237). The highest number of responses from the 237 questionnaires returned were from Wheeling and 90% (205) of all responses were single family residents. **Figure 4-8 through Figure 4-11** graphically present the survey results.

The following summary is based on 227 responses; as 10 of the responses did not include adequate information for analysis, or were located outside of the watershed. A total of 99 (44%) of the returned questionnaires reported flooding. Not surprisingly, residents in Wheeling also had the highest percent of flood damage reported based on the number of responses per community. Of the responses that reported flooding: 81% were located in the floodplain; 18% were located within FPA 17-13 in Lake Zurich; and only 1 response was not located in either the floodplain or a FPA. The majority of flood respondents indicated flooding was a result of overbank flooding, or in many instances of multiple causes. A significant portion (80%) of the structures that reported flooding had either a basement or a crawlspace. A total of 51 respondents who reported flooding had basements; of those 76% have finished basements.

A total of 64 of the 99 locations that reported flooding are located within or adjacent to previously identified FPA sites. Of these, 18 are associated with the Cedar Creek subdivision, FPA 17-13, in the Village of Lake Zurich. Twelve (12) of the 64 appear to be associated with FPA 17-32; although the FPA delineation does not include all respondent locations, indicating that the boundary of the FPA may need to be reassessed.

Two new FPAs were identified by flood questionnaire responses.

- FPA 17-45 was created to capture 14 responses received in Wheeling upstream of Wheeling Road.

- FPA 17-46 was created to depict an area affecting 3 single family homes along the South Branch of Buffalo Creek. Based on the responses received, during large flood events the single bridge access to these homes is overtopped preventing access to or from the homes.

Photographs of Cedar Creek Subdivision (FPA 17-13) in Lake Zurich, 2013. Courtesy of SMC.

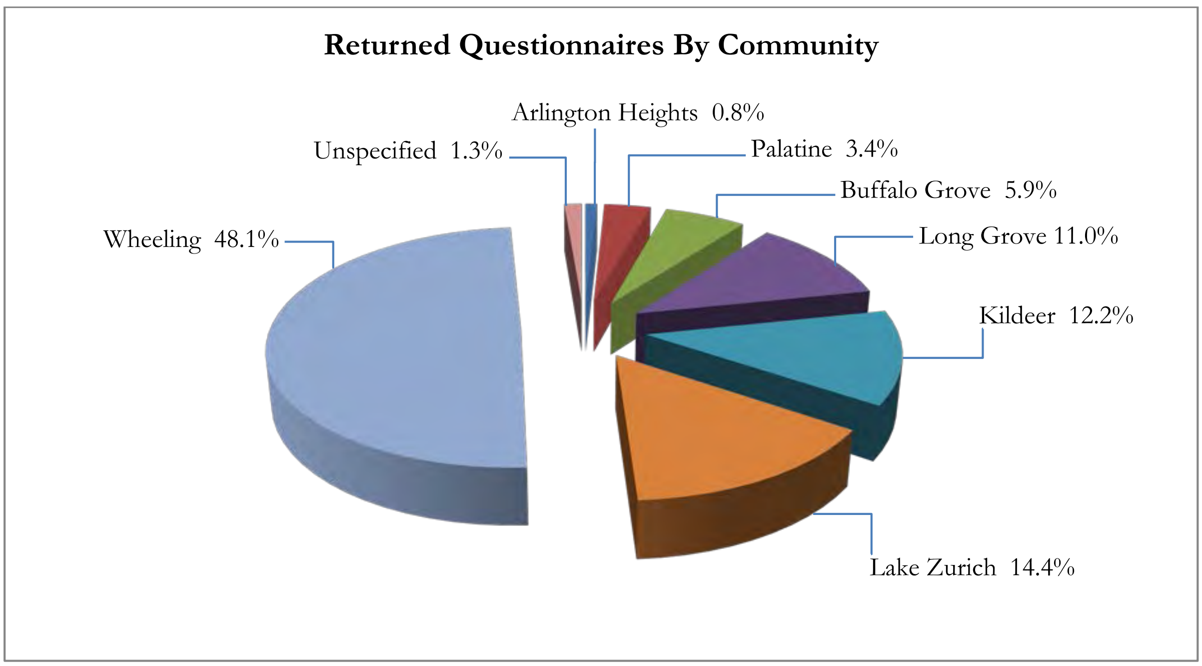


Figure 4-8: Distribution of Survey Respondents by Community.

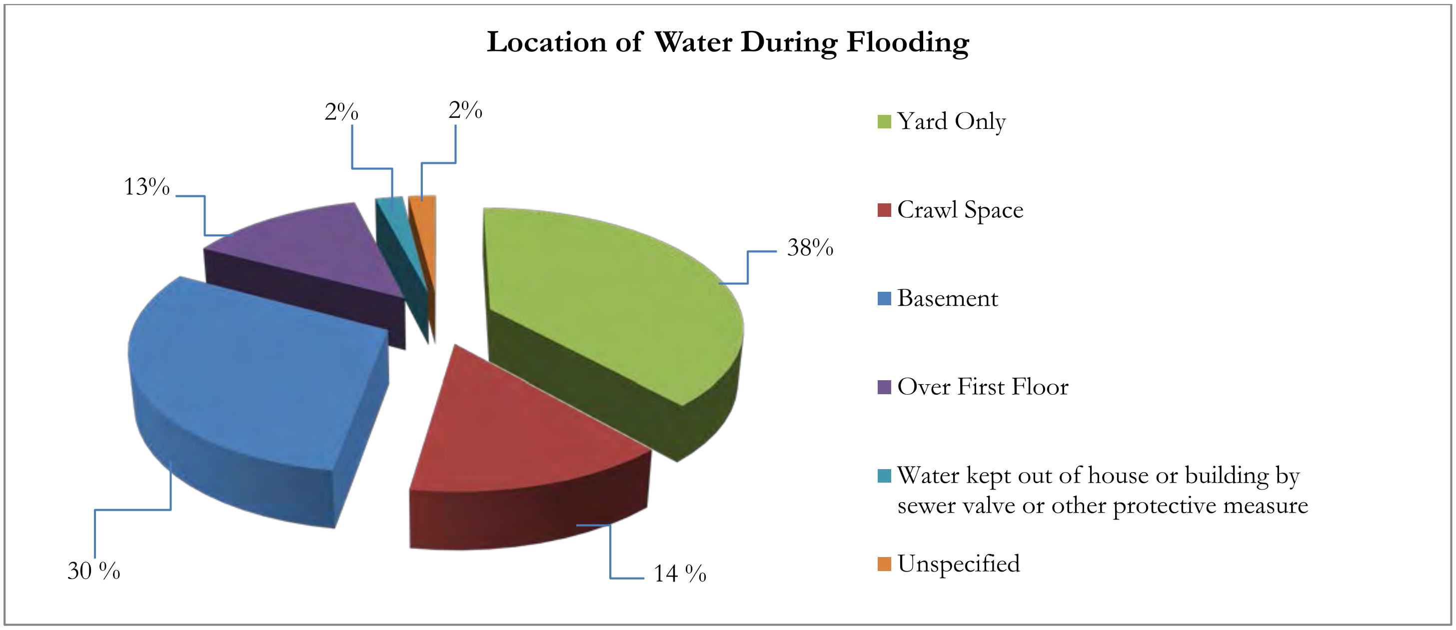


Figure 4-9: Reported Location of Water During Flooding.

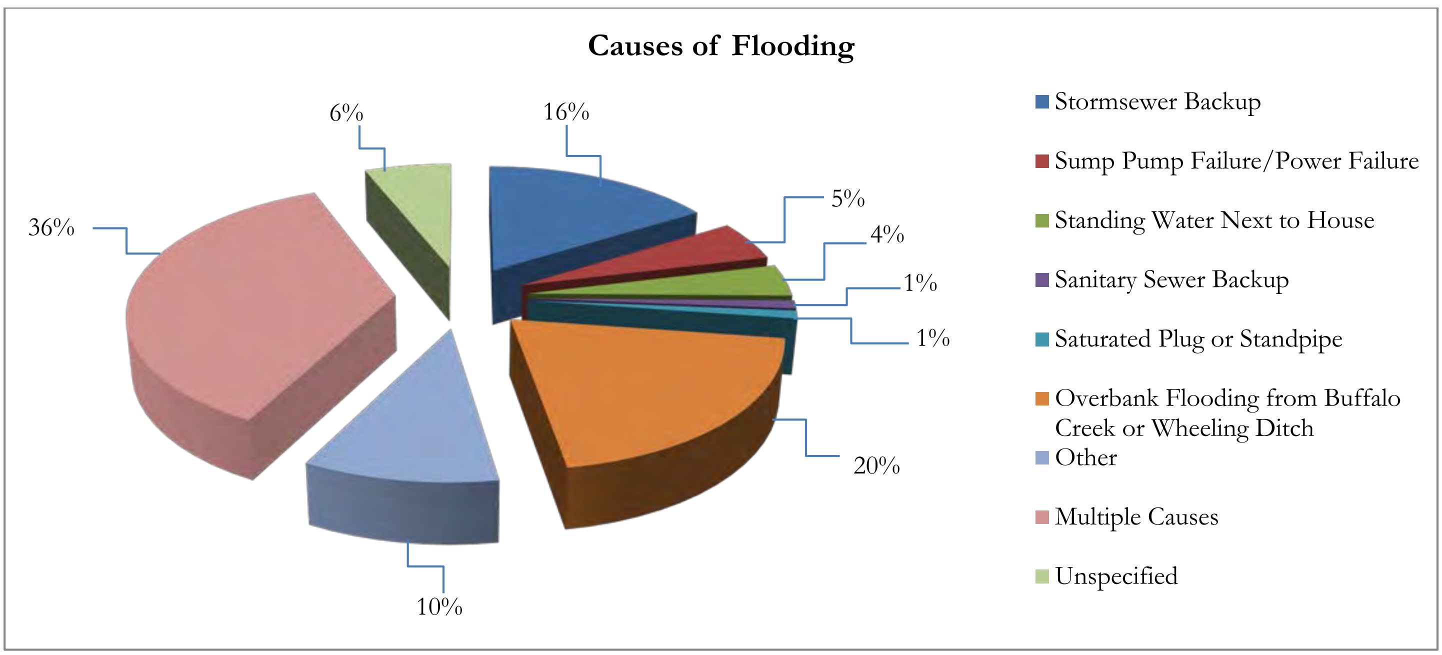


Figure 4-10: Reported Causes of Flooding.

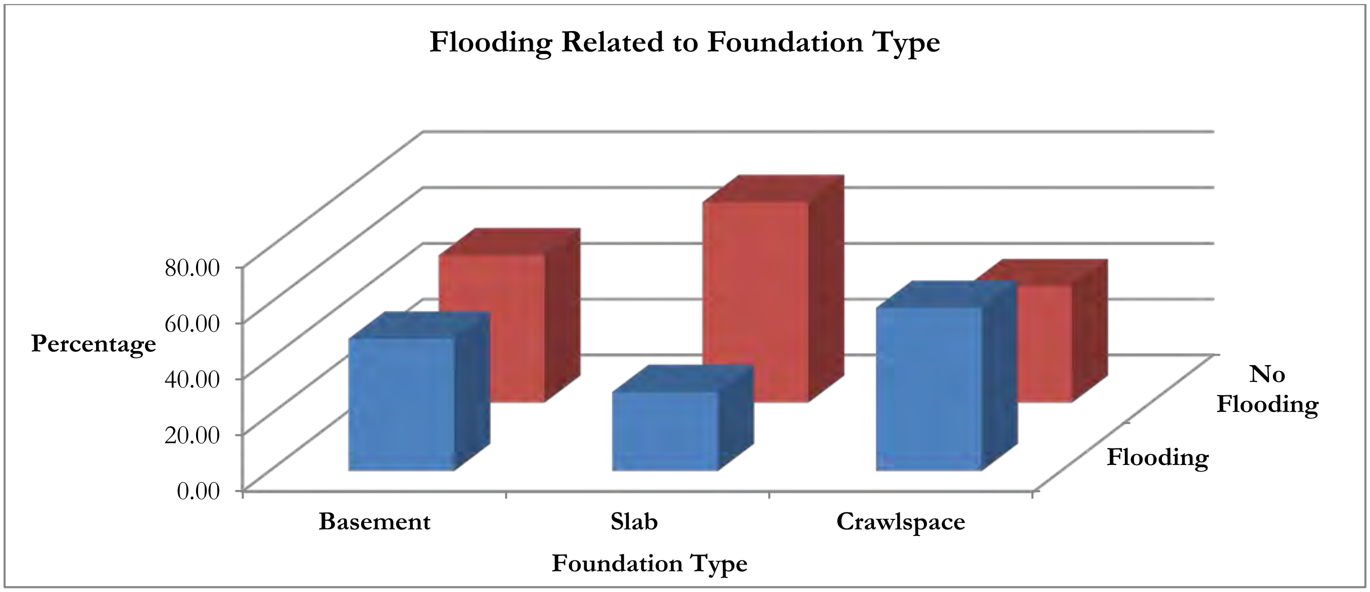


Figure 4-11: Reported Flooding Related to Foundation Type.

Noteworthy: USACE Des Plaines River Phases 1 & 2

The USACE initiated the Upper Des Plaines River Flood Damage Reduction Feasibility Study (Phase 1 Study) to address severe overbank flooding along the Upper Des Plaines River. Two particularly severe events in 1986 and 1987 together cost over $100 million in damages. The Phase 1 Study investigated plans for urban flood risk management in the Upper Des Plaines River watershed and recommended six projects to reduce mainstem flooding. Two (2) of the projects directly benefit the Buffalo Creek Watershed, as highlighted in bold text below.

- Van Patton Woods Lateral Storage in Wadsworth
- North Fork Mill Creek Dam Modification in Old Mill Creek
- **Buffalo Creek Reservoir Expansion in Buffalo Grove**
- Big Bend Lake Reservoir Expansion in Des Plaines
- **Levee 37 in Prospect Heights and Mount Prospect**
- Levee 50 in Des Plaines

Upon completion of the Phase 1 Study in 1999, the USACE began the Phase II Study. Phase 2 had two primary purposes: further reduction of flooding along the mainstem and tributaries, and environmental restoration of degraded ecosystems within the basin.

4.4 Flood Damage Reduction

Flooding and risk of flooding are fairly common in northeastern Illinois, primarily due to the impact of urban development, which increases impervious surfaces, increases the rate and volume of stormwater runoff, and modifies and builds in natural storage and floodplain areas. These factors, coupled with a relatively flat northeastern Illinois landscape where excess water tends to spread out over a wide area, have resulted in flooding problems. For this reason, it is important to preserve and not modify the existing flood storage capacity of the landscape including depressional areas, wetlands, and floodplains. In some cases this is not feasible as development may have already occurred in flood-prone areas. A more detailed approach to flood damage reduction is warranted in urbanized areas.

Flood damage reduction recommendations fall into two categories that include: 1) preventative measures; and 2) remedial measures.

4.4.1 Preventative Measures: Minimizing the Expansion of Flood Damage

Flood prevention techniques seek to prevent flooding problems before they occur. Techniques such as zoning and floodplain regulations seek to prevent flood damages by limiting development in areas where flooding is most likely to occur. Public land acquisition maintains open space as green infrastructure, preserving rainfall infiltration and natural storage areas. Several categories of flood prevention techniques involve runoff reduction. Runoff reduction techniques reduce flood damage potential at the source by decreasing the amount of runoff from a developed site. One category looks at improved infiltration on-site; the other uses alternative development techniques that include natural drainage measures and minimization of impervious surfaces.

4.4.1.1 Floodplain Zoning

A zoning ordinance regulates development by dividing the community into zones or districts and setting development criteria for each district. Zoning can be used to control where new development or redevelopment occurs, so that new flood problems are not created and existing flood problems are not exacerbated. Two zoning approaches can be used to prevent flood damage caused by development in flood-prone areas. They involve establishing separate zoning districts or using overlay zoning. Separate districts designate floodplain as a special zoning district that only allows 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.

4.4.1.2 Floodplain Regulations

In addition to zoning ordinances, regulations that restrict construction in floodplains are usually found in one or more of the following documents: subdivision ordinances, building codes, and/or separate stand-alone floodplain ordinances such as the Lake County Watershed Development Ordinance (WDO) and the Cook County Watershed Management Ordinance (WMO). 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 Ordinances establish flood protection standards for all structures. Individual communities can adopt floodplain regulations that are more restrictive than the minimum requirements of the WDO or WMO.

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.*

All Lake County communities must adhere to the standards required in the WDO as minimum development requirements for their community. All development in Regulatory Floodplains or flood-prone areas with greater than 20-acres tributary drainage, or any development that creates a wetland impact requires a WDO permit. The WDO restricts development in mapped floodways and limits development in the 100-year floodplain and preserves the carrying capacity of flood-prone areas. Compensatory storage must be provided for floodplain storage lost due to floodplain fill at a ratio of 1.2:1 for riverine floodplain and depressional storage areas that extend off-site; the ratio is 1:1 for depressional floodplain located primarily on-site.

In both Counties, the following structures must be elevated to prevent flood damages.

- new buildings (residential and non-residential) within or adjacent to the floodplain, and
- additions to existing buildings within or adjacent to the floodplain, and
- ***substantial improvements*** to existing buildings in the floodplain, and
- new buildings (residential and non-residential) or additions to existing buildings adjacent to a detention facility within or adjacent to the floodplain.

The specific design criteria vary based on the location, structure type, development type and County. In general the ***lowest floor*** of a structure should be elevated above the ***Flood Protection Elevation*** (FPE). Certain improvements may have ***lowest floor*** elevations below the FPE if they are adequately flood protected above the BFE. In effort to minimize the cost of compliance, ***substantial improvement*** and ***substantial damage*** are also captured within the building protection requirements.

Since the WDO and WMO apply to both new developments and redevelopment projects, the flood prevention provisions have the potential to improve conditions in redeveloped areas. In addition, although Buffalo Creek has areas of highly developed land use, there are still large areas within Lake County of undeveloped land that will fall under the WDO purview when developed.

Substantial Improvement: *The definition of substantial improvement is slightly different between the WDO and the WMO. In general, any repair, reconstruction, rehabilitation, addition, or other improvement to a building, the cost of which improvement equals or exceeds 50% of the market value of the current structure before the start of construction.*

Substantial Damage: *The definition of substantial damage is slightly different between the WDO and the WMO. In general, damage of any origin sustained by a building whereby the cost of restoring the building to its before-damaged condition would equal or exceed 50% of the market value of the building before damage occurred.*

Flood Protection Elevation (FPE): *The highest 100-year flood elevation (BFE) plus two foot of freeboard.*

Lowest Floor (WMO): *The lowest floor of the lowest enclosed area (including basement). An unfinished flood resistant enclosure, usable solely for parking of vehicles, or building access in an area other than a basement area is not considered a building's lowest floor; provided that it conforms to other Ordinance provisions and regulations.*

4.4.1.3 Runoff Reduction

Runoff reduction is divided into three broad categories. One category of techniques improves infiltration of precipitation at newly developed sites or for existing developed areas. Infiltration techniques may include natural landscaping with deep-rooted plants, permeable pavers or porous pavement, and bio-infiltration devices.

The second category of runoff reduction techniques involves implementing alternative site designs that incorporate non-structural practices like preserving the natural drainage system and reducing the amount of impervious surface in newly developed or redeveloped areas. Measures may include natural drainage features such as bioswales, reduction in areas of impervious pavement (for example: narrower street setbacks result in less driveway), alternative streetscapes that reduce and infiltrate runoff, alternative parking lot designs that infiltrate runoff such as pervious pavement and depressed landscape islands, and green roofs.

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 their Control Volume. These measures will decrease the volume and flow rate of stormwater that is discharged off a site thereby preventing future flood damage.

4.4.2 Remedial Measures: Alleviating Flood Damage

Flooding problems can generally be reduced or eliminated by both structural and non-structural means. Structural flood mitigation measures focus on reducing the probability of flooding (i.e., removing/reducing the ability of flood waters to reach a property/structure) while non-structural flood mitigation measures focus on reducing the consequences of flooding (i.e., flood-proofing a structure located in the floodplain).

Structural flood mitigation measures can be as simple as improving overland flow routes, increasing storm sewer capacity, or implementing other conveyance-related drainage improvements. Care should be taken when designing improved conveyance practices to insure that adjacent and downstream properties and waterways will not be negatively impacted by the increased flows. More complex structural flood mitigation measures may involve the construction of structures such as reservoirs, levees, and floodwalls to confine and/or re-delineate the flooding limits. Non-structural mitigation alternatives typically include practices such as acquisition or relocation of flood-prone structures, flood-proofing or implementation of ordinances/codes focused on runoff reduction techniques, which requires a more long-term and holistic approach to flood mitigation. Several common types of structural and non-structural mitigation measures are described below.

4.4.2.1 Heritage Park Flood Control Facility and Levee 37

The Heritage Park Flood Control Facility will provide compensatory storage for Levee 37, which was completed in August of 2015 by USACE, on the Des Plaines River. **Figure 4-12** shows the location of the Heritage Park and Levee 37 projects. The Heritage Park Flood Control Project was developed to meet the permitting requirements of IDNR as well as the goals of the MWRD, the Wheeling Park District, and the Village of Wheeling. Coordinating the needs of each of these parties resulted in the Heritage Park Flood Control Facility project, which includes local detention and floodplain compensatory storage, and improved recreational facilities.

The MWRD awarded the construction contract for the Heritage Park project in 2012 and construction was finalized in 2014. The USACE finalized construction of Levee 37, which will provide flood relief to approximately 600 homes and businesses along the Des Plaines River in Spring of 2015.

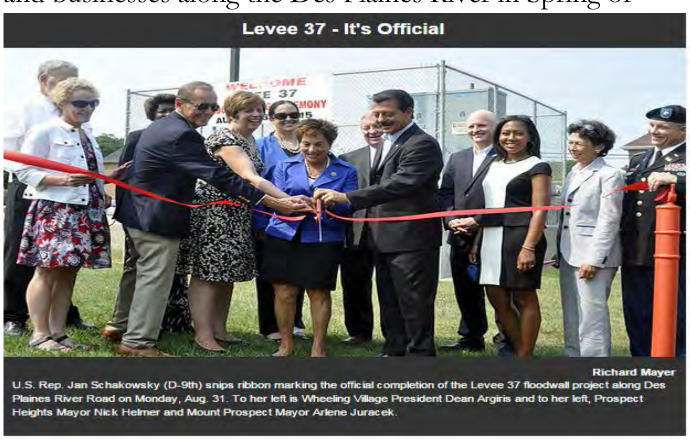


Photo of ribbon cutting ceremony at Levee 37 on August 31, 2015. Photo courtesy of Journal & Topics Newspapers, Des Plaines, Illinois.

Figure 4-12: Location of Heritage Park and Levee 37 Projects.

Figure 4-13: Potential Flooding with and without Levee 37. Images courtesy of MWRD.

4.4.2.2 Buffalo Creek Reservoir Expansion

The capacity of the Buffalo Creek Reservoir, between Arlington Heights Road and Schaeffer Avenue, is proposed to be expanded by MWRD (see **Figure 4-14**). The project also includes enhanced public access and existing trail improvements, native plant communities and stream bank stabilization. The project will include: an approximate 180 acre-foot expansion of reservoir capacity; constructing public access through the addition and re-alignment of existing trails around the reservoir; creating and enhancing native plant communities around the reservoir; and installing streambank stabilization measures within the tributaries entering Buffalo Creek Reservoir. As identified during the Des Plaines River Phase 1 & 2 studies, the purpose of the project is to provide additional stormwater storage to reduce flood damages along Buffalo Creek and the Des Plaines River as well as to provide improved public access to the Buffalo Creek Forest Preserve.

The project was originally proposed with 476 additional acre-feet of storage in 2011-12, but was put on hold pending resolution of landowner consideration. The revised project, which provides significantly less storage capacity than the original proposal design, is currently going through the permitting process. The public comment period, a part of the USACE Individual Permit Process, ended on May 27, 2015.

4.4.2.3 Structural Flood Mitigation Measures

Structural measures control or contain water and are generally designed to prevent floodwaters from reaching buildings and/or property. Structural alternatives generally include reservoirs, levees and floodwalls, diversions, stream channel conveyance improvements and drainage and storm sewer improvements. For large and/or complex structural flood mitigation alternatives, the projects are often costly to implement so local agencies and/or private land owners often request help from state or federal agencies such as the IDNR-Office of Water Resources (OWR), the USACE, and the US Department of Agriculture Natural Resources Conservation Service (NRCS).

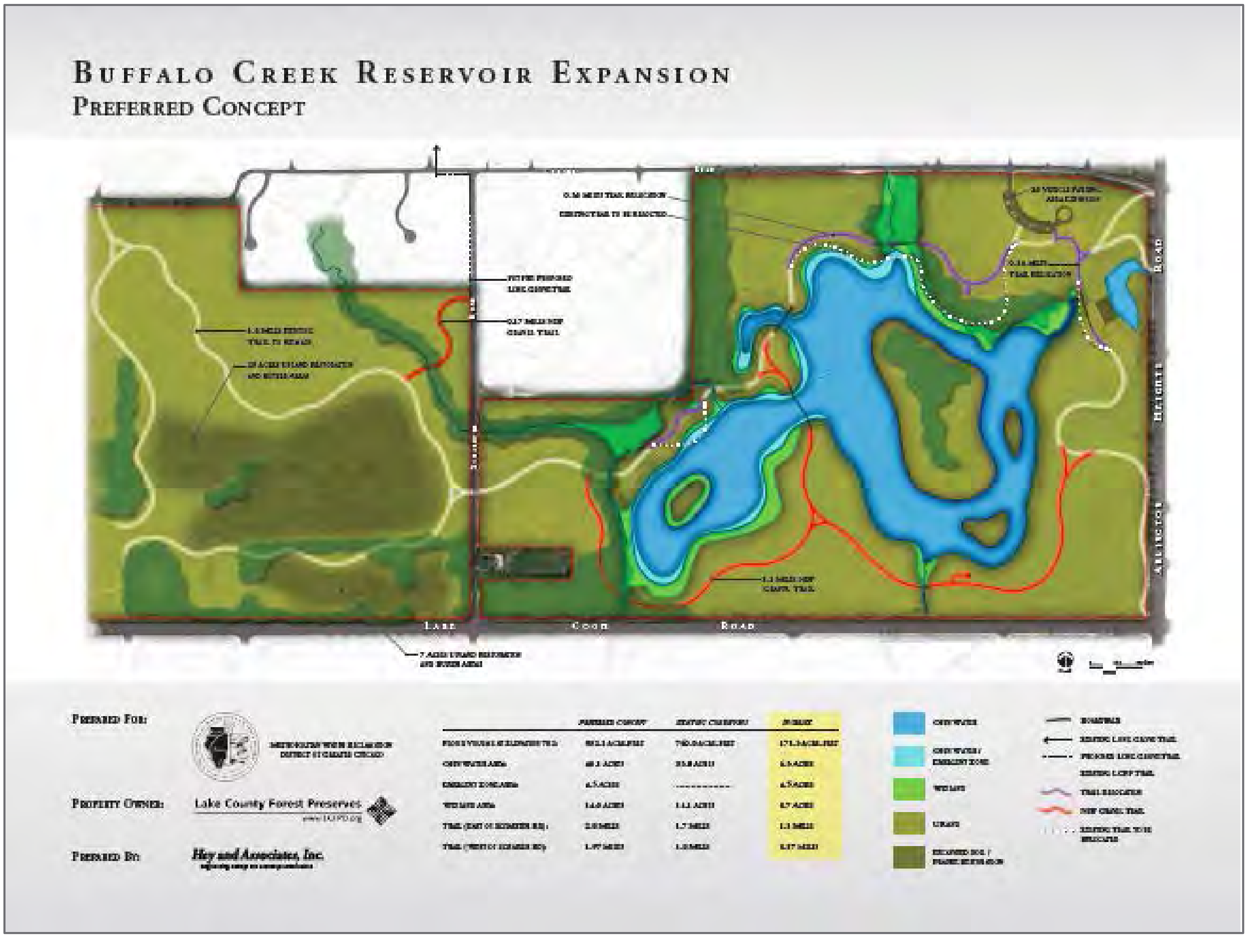


Figure 4-14: Buffalo Creek Reservoir Expansion Preferred Concept.

Since structural flood control is generally the most expensive type of mitigation measure in terms of installation time and costs, maintenance requirements and environmental impacts, a thorough assessment of alternatives should be conducted before choosing a structural flood control measure. The advantages and disadvantages of structural flood control techniques are discussed in **Table 4-4** (Association of State Floodplain Managers, 2007).

Table 4-4: 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 that no flood can ever reach them.
	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.

Reservoirs/Regional Detention: Reservoirs and regional detention are large structures that control flooding by holding high flows 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 and/or to provide water-based recreational benefits. In addition, wet or dry detention basins can serve multiple uses by doubling as parks or providing other open space uses.

The amount of land needed, coupled with the expense of construction, management and maintenance, limits the use of reservoirs. Additionally, reservoirs may fail to prevent floods that exceed their design levels; may eliminate the natural and beneficial functions of the floodplain; and may negatively impact water quality and aquatic habitat.

Detention Basins: Some localized flooding problems can be remedied by enlarging or adjusting flows through existing detention basins, or by constructing new basins. Detention basins are considered to be 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. Also, for very localized flood problems, a smaller detention basin may be the most economical solution. In addition, slowing release rates from new and existing detention basins can reduce the downstream flood risk and some of the impacts of short duration-high velocity events on the stream channel. Retrofitting older detention basins to improve functionality and/or storage volume, or constructing new detention basins are often viable flood mitigation alternatives, especially for smaller tributary areas (less than 100 acres).

Levees and Floodwalls: Earthen levees or concrete floodwalls are typically used to mitigate overbank flooding and are erected between the river and the properties to be protected. Levees and floodwalls confine water to the stream channel by artificially raising the banks. 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 without it.

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.

Barriers: Constructing barriers such as non-regulatory 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. Not considered engineered structures, berms are made by re-grading 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 non-regulatory since a barrier typically cannot be used to remove a structure or property from the Regulatory Floodplain.

As with levees, the use of low floodwalls and berms must also include a plan to install drainpipes and/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.

Improved Channel Conveyance: Channel conveyance improvements alter the channel so that more water is carried away at a faster rate. Improvements generally involve making the channel wider, deeper, smoother and/or straighter. Some channels in urban areas have also been lined with concrete or put in underground pipes.

Straightening, deepening and/or widening a stream or river channel, commonly referred to as channelization, has often been the common remedy for 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 in these circumstances making stream and channel maintenance very expensive.

Dredging is another type of conveyance improvement. It is frequently cost prohibitive due to the expense of disposing of the dredged material. In addition, unless in-stream and/or upstream tributary erosion are corrected, the dredged areas usually fill back in within a few years, and the process and expense have to be repeated.

Channel conveyance improvements such as channelization and dredging are considered to be environmentally destructive with respect to aquatic habitat and water quality and are frequently unsustainable.

Drainage Improvements: Drainage improvements can be in the form of open ditches, swales or storm sewers. Man-made ditches and storm sewers help drain areas where the surface drainage system is inadequate, or where underground drainageways may be safer or more practical. Particularly appropriate for depressions and low spots that will not drain naturally, 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, the construction of better defined and/or effective overland flow routes, and the use of mechanical measures such as pumps, backflow preventers, etc.

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. Drainage improvements may be designed in ways that do not degrade water quality, but many times have a negative impact related to the volume and quality of stormwater that they transport.

4.4.2.4 Non-Structural Flood Mitigation Measures

In addition to structural controls for flood mitigation, flooding problems can also be addressed using non-structural means. Some of the non-structural flood control techniques include flood-proofing, acquisition and removal of structures in the floodplain, elevation of a structure and relocation of a structure. More communities and county-wide agencies could get involved in non-structural flood mitigation programs such as acquisition of flood damaged structures by helping to identify repetitively flooded properties. In addition to being used for prevention, runoff reduction techniques may also be used by individual homeowners or neighborhood associations in retrofit projects such as installing rain gardens or dry wells to reduce localized flooding problems.

Structure Relocation: Moving a structure to higher ground is an extremely effective way to protect it from flooding. While almost any structure can be moved, this flood mitigation measure can be cost prohibitive depending on the type, condition and size of the structure as well as the requirements associated with securing a new site. Structure relocation can be cost effective where flooding is relatively severe and/or frequent. Although relocation can be expensive initially, in the long run, moving can be less costly than paying for repetitive flood damages or high flood insurance premiums. While relocation is typically the responsibility of the structure owner, government-sponsored loans or grants may be available for cost-share.

Buyouts/Acquisition: Like relocation, acquisition and removal ensures that structures in a flood-prone area will cease to be subjected to flood damage. The major difference is that acquisition typically is undertaken by a government agency, so the cost is not borne by the property owner. Following acquisition and removal, the open land may be converted to an appropriate permanent public use such as a park. Acquiring and clearing structures from the floodplain is not only the best long-term flood protection measure, it also is a way to convert 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.

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 significantly or eliminated entirely through structure elevation, there are some limitations to remaining in a flood-prone location. While the structure itself is sufficiently elevated to be protected from flood damage, flooding of surrounding areas and roads 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.

Flood-proofing: Flood-proofing measures can provide either 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. Wet flood-proofing allows water to enter the structure, but it minimizes the damage to the structure and its contents. Wet flood-proofing includes some of the least expensive and easiest mitigation practices to install. Although flood waters are not controlled, with wet flood-proofing damage can be greatly reduced.

- ***Dry Flood-proofing:*** Dry flood-proofing is a combination of practices that are used to make a building watertight so no flood waters enter the structure, including the basement and/or crawl space. FEMA and the USACE have various publications highlighting the range of practices that can be used to dry flood-proof a structure.
- ***Wet 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. Generally, this includes properly anchoring the structure, using flood resistant materials below the BFE, protection of mechanical and utility equipment, and use of openings or breakaway walls. At the very least, several low-cost steps can be taken to wet flood-proof a structure. 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.

Runoff Reduction: Examples of runoff reduction techniques that can be implemented in developed or developing areas include the use of natural landscaping, permeable pavement, rain gardens, green roofs, etc. Implementing these runoff reduction retrofits is generally the responsibility of individual property owners. These techniques typically do not have a significant impact when applied individually on a single site, but the cumulative effect when used at numerous sites throughout the watershed can result in significant flood reduction benefits. That being said, the timing associated with recognizing measurable flood reduction benefits make this flood mitigation measure more of a long-term complementary mitigation measure rather than an immediate flood mitigation alternative.

4.5 Existing Regional Flood Storage

4.5.1 Existing Flood Storage

Existing flood storage is defined as existing depressional areas that are presently storing 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. While not all areas in the watershed present flooding issues, downstream flood damage along both Buffalo Creek and the Des Plaines River is a chronic problem. Creating or enhancing storage would provide many benefits including reduced runoff to streams; thus, minimizing channel erosion and runoff. If designed and planted as a wetland restoration, storage areas would improve water quality and habitat as well as increase groundwater recharge. The criteria used to identify existing storage locations are summarized below.

Existing Flood Storage Areas Criteria:

- Include all existing open water (streams and lakes), wetlands, detention basins, and 100-year floodplains,

- Calculate estimated storage assuming 2 feet of storage volume at each location, and
- Minimum storage size of 1 acre-foot.

The locations identified in **Figure 4-15** range from 1 acre-foot to more than 475 acre-feet of storage, with a single storage area of 3,340 acre-feet along the stream corridor. Including the stream corridor there are 324 storage areas encompassing 3,003 acres (17% of the watershed) with an estimated storage of 6,000 acre-feet of water (**Table 4-5**). The actual storage volume is likely significantly greater, as many of these areas will have a flood depth greater than two feet during the base flood event.

Table 4-5: Statistics of Existing Storage Locations.

Statistic	Result
Locations	324
Mean	18.5 acre-feet
Mean (excluding main stream corridor)	5.7 acre-feet
Sum	6,006 acre-feet
Median	2.7 acre-feet
Range	1 – 3,339 acre-feet

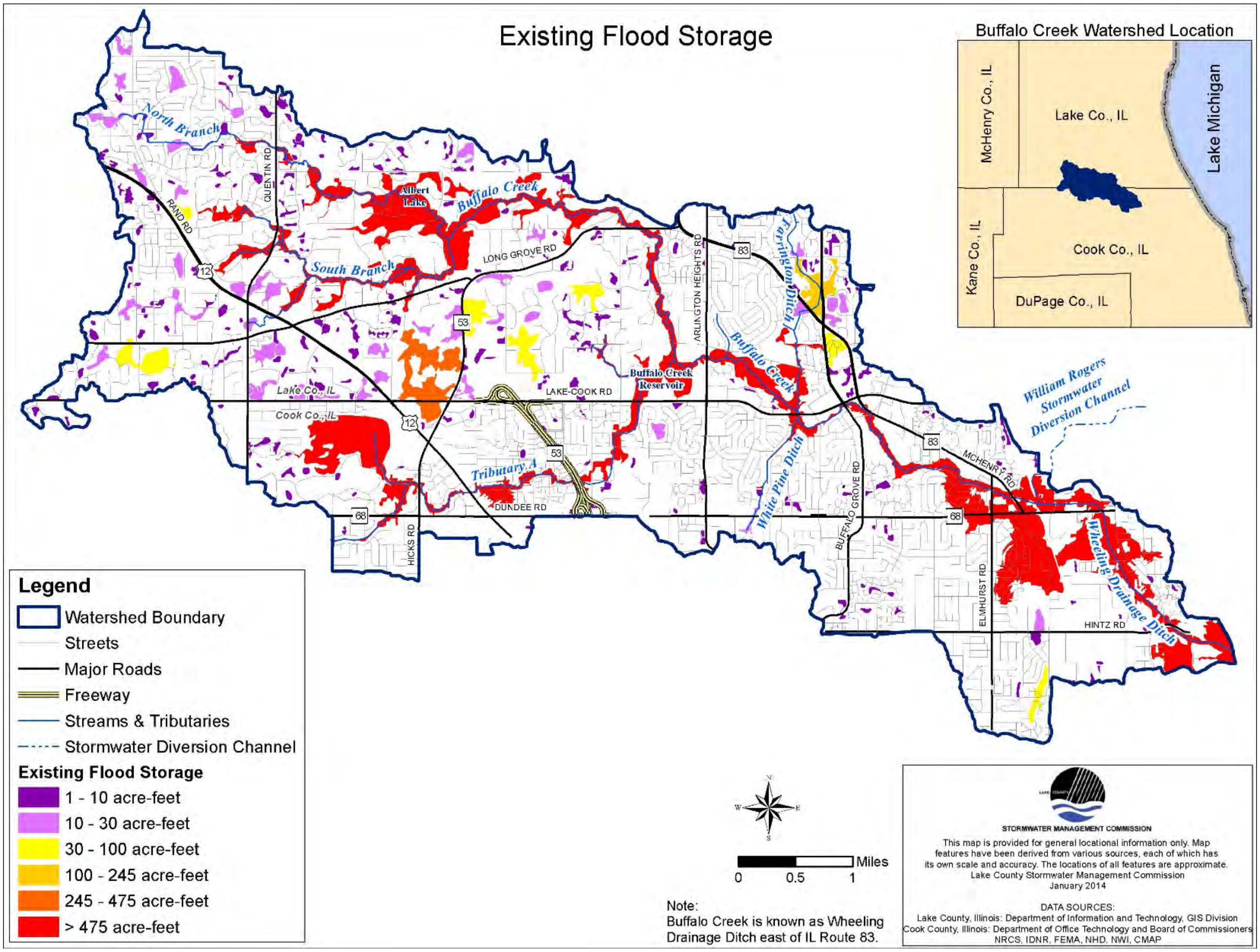


Figure 4-15: Existing Flood Storage Locations.

4.5.2 Regional Flood Storage Sites

A GIS analysis of the watershed was performed to identify regional storage locations within open/ partially open parcels in the watershed. Locations must be greater than 5 acres in size (e. g. providing a minimum of 10 acre-feet of storage). Storage areas associated with the stream corridor were excluded. Thirty-seven sites were identified based on the defined regional storage criteria, providing existing storage of an estimated 1,035 acre-feet (**Figure 4-16** and **Table 4-6**).

Table 4-6: Regional Flood Storage Statistics

Statistic	Result
Locations	37
Mean	28.0 acre-feet
Sum	1,035.75 acre-feet
Median	14.95 acre-feet
Range	10.13 – 187.62 acre-feet

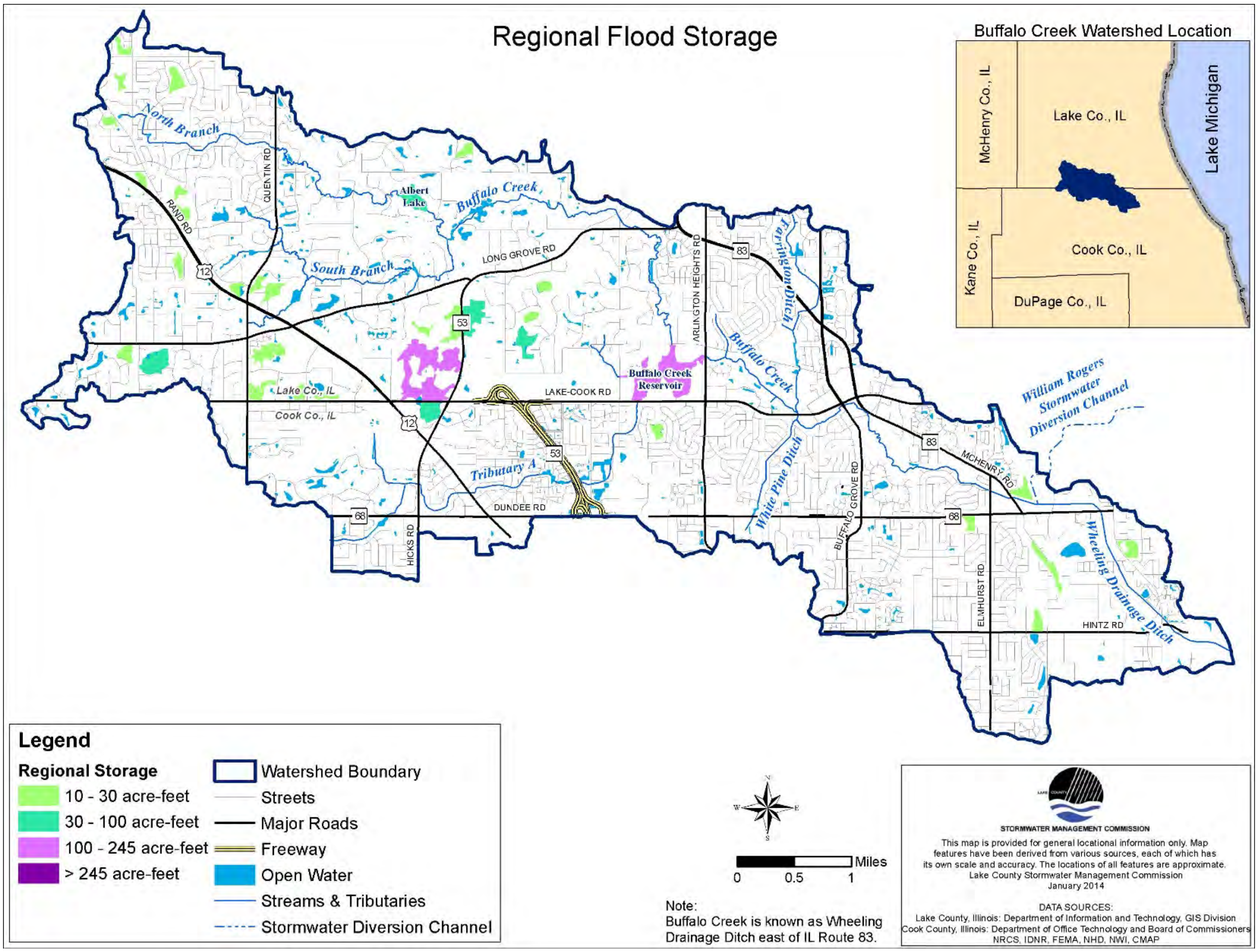


Figure 4-16: Regional Flood Storage Locations.

Chapter 5 Watershed Problems Assessment

5 Watershed Problems Assessment

This chapter of the report is a more detailed assessment of the problems identified in the Watershed Resource Inventory & Characterization chapter (**Chapter 3**). The following subsections describe how further analysis was used to assess how land use conditions are affecting the water quality, natural resources and flooding conditions in the Buffalo Creek Watershed. The watershed problems assessment section identifies several current and potential future problems in the watershed including:

- Impacts of land use change on aquatic resources.
- Water resources problems assessment.
- Jurisdictional coordination at the watershed level.

5.1 Land Use Impacts

Problem(s): A large proportion of waterbodies in the Buffalo Creek Watershed are known to be degraded. Degradation can take the form of physical alterations to the stream ecosystems, impairment to the biotic community and/or degraded water quality.

One of the greatest changes to the watershed has been the physical alteration of streams. Surveys of the streams of the Buffalo Creek Watershed demonstrate the extensive physical alterations that have occurred. The majority of the streams in the Buffalo Creek Watershed are channelized, experiencing streambank erosion, sedimentation, and/or have limited riparian vegetation. Water quality issues include total phosphorus, conductivity and fecal coliform concentrations that exceed target limits. These physical and chemical changes to streams of the watershed have resulted in impaired biotic communities.

The combination of physical, biological and chemical water quality impairments in the Buffalo Creek Watershed have resulted in the listing of 53 acres of lakes and 9 miles of impaired streams by the Illinois EPA on the 303(d) list. The portion of Buffalo Creek known as the Wheeling Drainage Ditch was not in the scope for the 2013 TMDL; thus it is not listed, although it is subject to the same impairments.

Likely Cause(s): Changes in hydrology and stormwater runoff characteristics (i.e., increased stormwater runoff rates, volumes, and pollutant loads) as the result of land use changes in the Buffalo Creek Watershed.

Assessment: Prior to European settlement the Buffalo Creek Watershed was covered primarily by prairies with scattered wet prairie, temperate deciduous forest and wetland. As European settlers entered the area these ecosystems were modified to accommodate agricultural practices. Forested areas were cleared for the lumber and agricultural land. Wetlands and wet prairies were eventually drained using extensive systems of drainage tile networks and ultimately converted to agricultural land. Fertile prairies were quickly plowed and replaced by monoculture crops. Prior to disturbance these ecosystems naturally functioned in concert as a natural community. The widespread disturbance of these ecosystems, most significantly the conversion of land to urban uses and impervious cover, in the Buffalo Creek Watershed has significantly altered the aquatic health of lakes and streams.

5.1.1 Effects of Land Use Change on Stormwater Quantity

The natural ecosystems that once covered the United States and the Buffalo Creek Watershed have been significantly altered. The deciduous forests and prairies that once covered the Buffalo Creek Watershed have been cleared and replaced by urban land uses. Removing these ecosystems alters the hydrologic processes of interception, evaporation and transpiration. The clearing of these natural ecosystems also increased the compaction of the soil, which ultimately reduces infiltration. The reduced infiltration of precipitation results in increases in stormwater runoff volumes.

Land use changes like those that have occurred in the Buffalo Creek Watershed alter the hydrology of entire stream networks. As described previously the extensive prairies of the Buffalo Creek Watershed have gradually been modified and are now replaced by a high concentration of impervious surfaces such as parking lots and roads. This loss of pervious cover reduces stormwater infiltration through the soil (Miller et al. 2014). **Figure 5-1** illustrates the relationship between impervious cover and surface runoff. **Figure 5-2** illustrates the increasing trend in flow at the USGS Buffalo Creek stream gauge station. Reduced infiltration ultimately:

- increases runoff and stream volume (Hawley and Bledsoe, 2011),
- increases the occurrence of small floods (Hollis, 1975; Braud et al., 2013), and
- reduces base flow in the streams and groundwater recharge (Simmons and Reynolds, 1982).

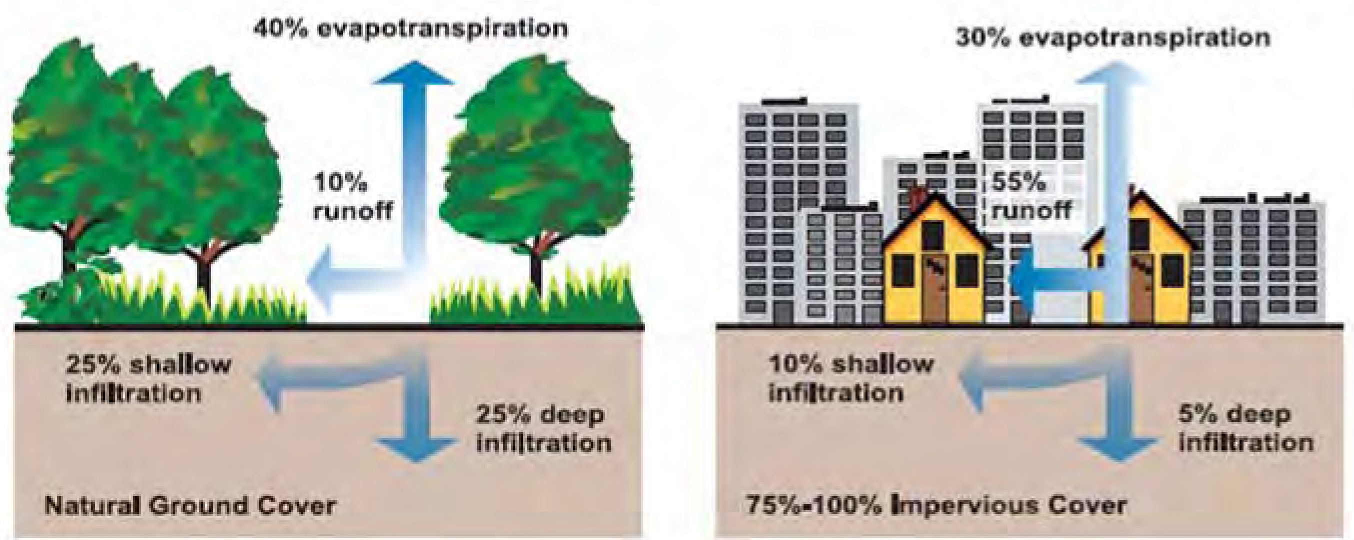


Figure 5-1: Relationship Between Impervious Cover and Surface Runoff. Source: U.S. Environmental Protection Agency.

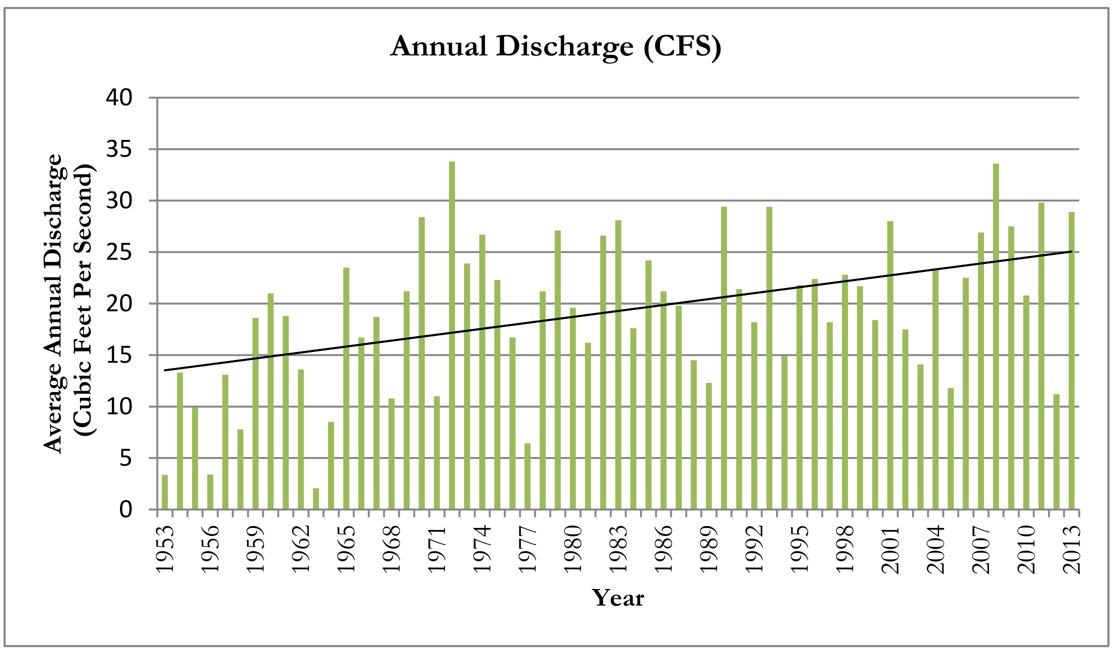


Figure 5-2: Average Annual Stream Flow (CFS), USGS Buffalo Creek Stream Gage.

5.1.2 Effects of Land Use Change on Stormwater Quality

The land use changes that have occurred in the Buffalo Creek have not only increased stormwater runoff volume, but have also changed stormwater runoff water quality. Roads, parking lots and other impervious surfaces that dominate the watershed today are known to increase stormwater runoff pollution. Polluted runoff from urbanized areas is known to degrade water quality causing oxygen depletion, fish kills, increased algae blooms and increased bacterial loads (Foley et al. 2005). Stormwater pollutants come from a variety of point and nonpoint sources, many of which are a direct or indirect result of land use change.

These non-point source pollutants include:

<u>Sediment:</u> The sources of sediment found in stormwater runoff are typically land-disturbing activities, atmospheric deposition, or surface or streambank erosion. Sediment particles can bind to other stormwater pollutants, such as nutrients, metals, hydrocarbons, and pesticides, and transport them into receiving streams, wetlands, and other aquatic resources. High sedimentation was noted in the North and South Branches of Buffalo Creek and the mainstem of Buffalo Creek, which is likely the result of the severe streambank erosion in these areas (see **Table 3-27**). Elevated phosphorus levels were found at all sampling locations (see **Table 3-38** through **Table 3-41**). During the rain event on June 26, 2013, levels of total suspended solids were recorded at 1,458-2,255 times more than the average level at two locations in the watershed (see **Table 3-43**).

<u>Nutrients:</u> The sources of nutrients found in stormwater runoff, which include nitrogen and phosphorus, are typically fertilizer use, pet and animal waste, leaves, grass clippings, sanitary sewer overflows, septic system discharges, and atmospheric deposition. Potential failing septic systems in Deer Park, Kildeer and Long Grove may contribute to elevated nutrient levels. During the rain event on June 26, 2013, levels of total phosphorus were recorded at 470-683 times more than the average level at two locations in the watershed (see **Table 3-43**).

<u>Bacteria:</u> The bacteria and other pathogenic organisms found in stormwater runoff, whose concentrations can exceed public health standards for contact recreation, are typically a result of pet and animal waste, sanitary sewer overflows, and septic system discharges. Potential failing septic systems in Deer Park, Kildeer and Long Grove, as well as high populations of geese and other wildlife in the area, may contribute to elevated bacteria levels. During the rain event on June 26, 2013, levels of fecal coliform were recorded at 1,186-2,400 times more than the average level at two locations in the watershed (see **Table 3-43**).

<u>Metals:</u> The heavy metals found in stormwater runoff (such as lead, zinc, copper, and cadmium) are typically a result of atmospheric deposition, vehicle wear, and use or handling at commercial, industrial, and hazardous waste sites. In the Buffalo Creek Watershed, heavy metals found in sediment were most likely generated from the old Lake Zurich sewage treatment plant. Elevated levels of copper, nickel, and mercury were found in sediment samples taken from Albert Lake in 2013 (see **Table 3-44**).

<u>Hydrocarbons:</u> The sources of hydrocarbons found in stormwater runoff are typically generated by vehicle wear/leakage, chemical spills, restaurant grease traps, and improper handling and disposal of waste oil and grease. Eighteen gas stations were identified in the Buffalo Creek Watershed (see **Figure 5-3**).

<u>Chlorides:</u> The sources of chlorides found in stormwater runoff are primarily winter sidewalk, driveway, roadway, and parking lot de-icing activities, although septic system discharges, where ion- exchange water softeners are served by such systems, may also be a source of chlorides. Water quality sampling conducted between 2012 and 2015 identified one area in Deer Park that had multiples samplings with high levels of chloride. The water sampling location is locate downstream of the Deer Park Town Center. Effort should be made to protect stormwater inlets from runoff from salt piles.

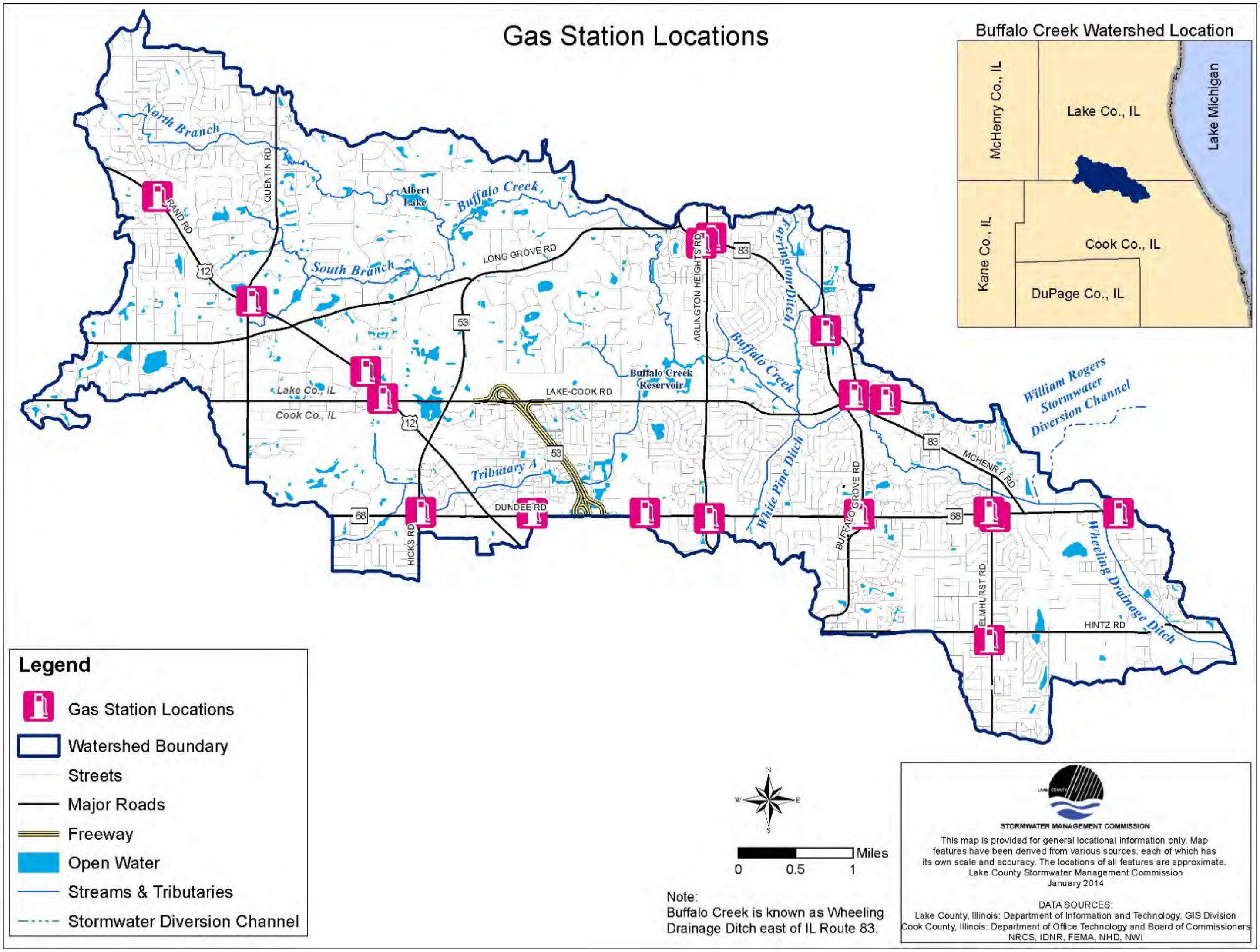


Figure 5-3: Location of Gas Stations in the Buffalo Creek Watershed.

5.1.3 Effects of Land Use Change on Stormwater Temperature

In addition to altered stormwater runoff quantity and quality, land use changes also have the potential to change stream water temperature. Portions of the Buffalo Creek Watershed that contain high concentrations of impervious surfaces that tend to retain heat may be contributors to higher stream temperatures. During precipitation events rainfall flows across these impervious surfaces, the heat from the impervious surface is partially transferred to the rainfall. This rainfall that now has its temperature increased enters stream networks through point and nonpoint sources. In urban areas the percent of impervious cover of an area has been identified as the key parameter controlling the warming of stormwater runoff (Sabouri et al. 2009). The removal of riparian vegetation in many areas of the Buffalo Creek Watershed further increases stream water temperature, because of limited shade to cool the stream water. Increased stream temperatures have the potential to decrease dissolved oxygen levels necessary for the survival of aquatic organisms, thus may be one of the influences on poor macroinvertebrate (aquatic insect) assemblages in Buffalo Creek waters. Data collected under the RiverWatch program between 1996 and 2014 (see **Chapter 3**) showed that stream quality in the assessed waters is generally poor. Water quality sampling conducted between 2013 and 2014 showed that water temperatures in the more developed, lower portion of the watershed are greater than the less developed, upper portion of the watershed (see **Chapter 3**).

5.1.4 Impacts on Aquatic Resources

The 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 Buffalo Creek Watershed. Additional information about these impacts is provided below.

Streambank Erosion: As stream channels enlarge (e.g., downcut and widen) in order 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 (Booth and Bledsoe 2009). Out of 23.3 miles of assessed streambank, approximately 16.6 miles were moderately eroded and 3.8 miles were severely eroded. The results indicate that nearly all stream reaches are moderately or severely eroded, suggesting that the stream channel may be adjusting to overall changes in watershed hydrology.

Increased Flooding: The increased stormwater runoff rates and volumes resulting from land use changes also cause an increase in the frequency, duration, and severity of overbank and extreme flooding events. These flooding events can cause property damage as well as endanger public health and safety (Booth and Bledsoe 2009). In 2013, heavy rain events overwhelmed the existing stormwater infrastructure and inundated neighbourhood homes and streets in the watershed. One of the most significantly impacted areas was the residences surrounding the Cedar Creek stormwater management facility in Lake Zurich.

Degradation of Habitat: The increased stormwater runoff rates and volumes resulting from land use changes scour stream beds and wash away valuable aquatic habitat. The increased sediment loads that result from land use changes, as well as from surface and streambank erosion, can also degrade aquatic habitat, filling in streambeds and destroying the important pool-riffle structure found in many healthy freshwater streams (Booth and Bledsoe 2009). Most reaches in the watershed have low or moderate sediment accumulation; see **Chapter 3**. Minimal sedimentation was observed in Farrington Ditch. High sedimentation was noted in the North and South Branches of Buffalo Creek and mainstem of Buffalo Creek during the 2013 stream survey, which is likely the result of the severe streambank erosion in these areas (see **Chapter 3**). The mainstem and the North Branch of Buffalo Creek, which both contain significant portions of natural stream channel, have more pool-riffle development than the constructed and channelized Farrington Ditch.

Decline in Wildlife Abundance and Diversity: When the increased stormwater runoff rates, volumes, and pollutant loads resulting from land use changes degrade habitat and water quality, the abundance and diversity of aquatic organisms found in freshwater streams may be significantly reduced. Sensitive "keystone" or "indicator" organisms that require high quality habitat may become stressed and be gradually replaced by organisms more tolerant of the degraded conditions (Booth and Bledsoe 2009). The Macroinvertebrate Biotic Index (MBI) calculated during the RiverWatch sampling events was high, indicating the presence of organisms that are tolerant to pollutant. The Ephemeroptera, Plecoptera and Trichoptera (EPT) species richness score was low, indicating the absence of species that are typically present in high quality streams.

5.1.5 Assessing the Impacts of Predicted Future Land Use Changes

Data presented in **Chapter 3** describes the predicted land use changes for the Buffalo Creek Watershed. Review of municipal comprehensive plans demonstrates that land use will be subject to change in the Buffalo Creek Watershed. The Buffalo Creek Watershed is expected to experience a reduction in agricultural and vacant lands, while commercial/retail, industrial and single family residential land uses are expected to increase (see **Table 5-1**). The predicted land use changes such as those described above have the potential to impact the water quality of waterbodies in the Buffalo Creek Watershed.

Studies have shown that land use has a direct effect on water quality. The greater amount of impervious area, the greater the pollution load it generates. Pollutants from a variety of diverse and diffuse sources collect on impervious surfaces and are flushed into rivers and streams when it rains. Lawns, driveways, rooftops, parking lots and streets are source areas for these pollutants, while the causes include vehicles, road surface applications, direct atmospheric deposition, fertilizer/pesticides/herbicides, litter, pet waste, vegetative decay and soil erosion. Urban runoff also carries pollutants such as oil and grease, metals, and pathogens like fecal coliform bacteria. Runoff from impervious surfaces can be 10 to 12 degrees warmer than runoff from land in a natural state, which combined with reduced summer flows results in higher in-stream water temperatures. Understanding the potential impacts that can occur as the result of future land use change can be used to develop management plans to avoid future degradation.

Table 5-1: Projected Land Use Change in the Buffalo Creek Watershed.

Land Use Class	2012 Total Area (acres)	Percent of Watershed	Projected 2020 Acres	Acre Change	% of Watershed	% Change Current to Future
Residential - Single Family	9,394	54.00%	9,743	349	56.01%	3.72%
Commercial/Retail	1,502	8.60%	1,697	195	9.76%	12.98%
Residential - Multi-Family	1,102	6.30%	1,102	0	6.33%	0.00%
Open Space – Conservation	1,085	6.20%	1,085	0	6.24%	0.00%
Industrial	753	4.30%	798	45	4.59%	5.98%
Open Space – Park	662	3.80%	662	0	3.81%	0.00%
Gov't/Institutional	512	2.90%	512	0	2.94%	0.00%
Vacant	783	4.50%	461	-322	2.65%	-41.12%
Open Space - Golf Course	329	1.90%	329	0	1.89%	0.00%
Wetland	285	1.60%	285	0	1.64%	0.00%
Open Water	263	1.50%	263	0	1.51%	0.00%
Transportation	214	1.20%	214	0	1.23%	0.00%
Utilities	100	0.60%	100	0	0.57%	0.00%
Agriculture - Greenhouse/Nursery	149	0.90%	84	-65	0.48%	-43.62%
Agriculture - Row Crop	209	1.20%	47	-162	0.27%	-77.51%
Cemetery	8	0.00%	8	0	0.05%	0.00%
Agriculture – Equestrian	44	0.30%	4	-40	0.02%	-90.91%

5.1.5.1 Buffalo Creek Watershed and the Impervious Cover Model

Impervious cover was estimated for the Buffalo Creek Watershed based on the existing land use classification. An impervious cover percentage was assigned to each land use based on estimates provided by SMC. The current land use of the Buffalo Creek Watershed has resulted in approximately 28% of the watershed consisting of impervious cover. Additional information regarding the calculation of impervious cover in the watershed can be found in **Appendix N**. The Center for Watershed Protection (CWP, 1998) has constructed a simple model, known as the Impervious Cover Model (ICM) that can be used to predict the health of streams and other aquatic resources based on the amount of impervious cover found within their watersheds. **Figure 5-4** demonstrates the relationship between the degree of impervious cover and stream quality. Based on the ICM, aquatic resources of the Buffalo Creek Watershed are expected to fall into the urban drainage category (see **Figure 5-4)**. Streams in this category have impaired biotic communities of fish, insects and other aquatic organisms. Stream channels in this category show signs of instability, downcutting, widening and streambank erosion. Aquatic habitat is also eliminated due to limited pool-riffle structure. As a result of these characteristics, streams of the Buffalo Creek Watershed are considered poor in terms of biological quality.

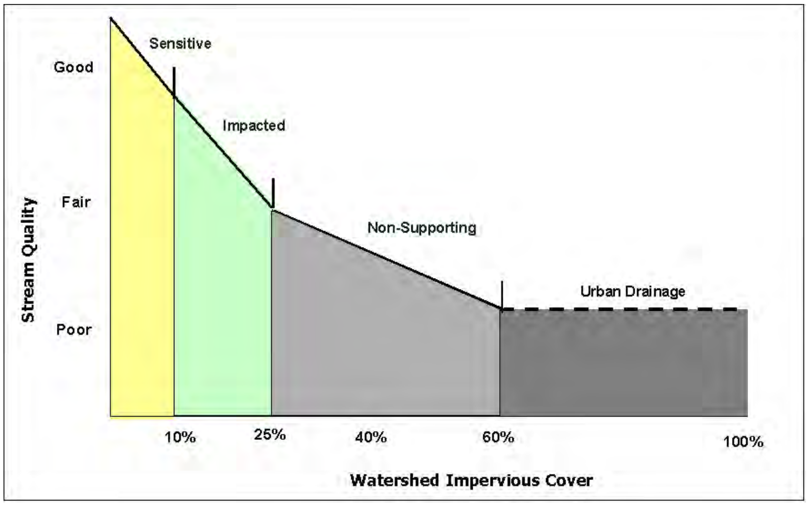


Figure 5-4: Diagram Demonstrating the Relationship between Impervious Cover and Stream Quality (CWP, 1998).

Impervious surfaces prevent rain from soaking into the ground, thus increasing flows during storms and reducing stream flows during dry periods. This leads to runoff that brings sediment, nutrients and contaminants into bodies of water (USEPA, www.epa.gov/ged/coralreef/models/ImperviousSurfaces.html). Common impervious surfaces are buildings, roads, parking lots and sidewalks. Impervious cover was broken down into four categories: 0-2.5% impervious, 2.5-10% impervious, 10-25% impervious, and 60-100% impervious, and displayed in **Figure 5-5**. **Table 5-2** presents the impervious cover estimates per land use type. Single family residential and commercial/retail land uses account for the largest amount of impervious cover (approximately 2,742 acres) in the watershed while cemeteries, vacant land and wetlands account for less than 1 acre of impervious cover.

The majority of the Buffalo Creek Watershed contains some degree of impervious cover. However, there are portions of the watershed that contain considerably less impervious cover than other areas. The Buffalo Creek Forest Preserve and Deer Grove Forest Preserve contain some of the largest areas of pervious cover in the Buffalo Creek Watershed. The remaining areas of pervious cover are located along tributaries in the Village of Long Grove, in areas zoned residential with a minimum lot size of 3-acres. Efforts should be made to protect these areas of pervious cover in Long Grove and minimize the conversion to impervious cover in the future.

The highest concentration of impervious cover is located in the lower portion of the Buffalo Creek Watershed and the commercial area along Rand Road in the Village of Deer Park (see **Figure 5-5**). The lower portion of the watershed contains considerably more commercial/retail land use. As demonstrated in **Figure 5-5** commercial/retail land uses develop into corridors that often follow the path of major transportation routes. For example, the portion of Dundee Road between Arlington Heights Road and Hicks Road and the portion of Rand Road from Dundee Road to Long Grove Road contain high concentrations of impervious surfaces as the result of commercial/retail land use. Implementing BMPs in these areas of the Buffalo Creek Watershed should be aimed at increasing runoff infiltration.

Table 5-2: Impervious Cover Area Estimates per Land Use Type.

Land Use Type	Total Acres	% Impervious Cover	Impervious Cover Estimate (Acres)
Residential - Single Family	9,393.52	18%	1,690.83
Commercial/Retail	1,501.57	70%	1,051.10
Residential - Multi-Family	1,101.51	70%	771.05
Industrial	753.3	70%	527.31
Gov't/Institutional	512.04	70%	358.43
Open Water	262.52	100%	262.52
Transportation	214.4	60%	128.64
Open Space - Park	661.81	5%	33.09
Open Space - Golf Course	328.82	8%	26.31
Open Space - Conservation	1,084.95	2%	21.7
Agriculture - Equestrian	44.09	25%	11.02
Agriculture - Row Crop	209.37	2.50%	5.23
Agriculture - Greenhouse/Nursery	149.23	2.50%	3.73
Utilities	99.83	2%	2
Cemetery	7.89	5%	0.39
Vacant	783.14	0%	0
Wetland	284.78	0%	0
Total	**17,393**	**28%**	**4,893**

The amount of impervious surface in the watershed is only expected to increase with the land use change that is predicted to occur in the coming years. The majority of the forecasted land use change is associated with new residential development (approximately 350 acres), which typically consists of 18% impervious cover (SMC). An additional 168 acres are predicted to be converted to retail/commercial/industrial uses, which typically consists of about 70% impervious cover. Although a relatively small percent of the total land use change, planned roadway expansion/ improvement projects may nonetheless have a significant impact on the aquatic resources of the Buffalo Creek Watershed, as roadways tend to accumulate significant quantities of non-point source pollutants that are flushed into receiving waters (streams and lakes) during rainfall events.

Looking to the future of the Buffalo Creek Watershed, it is important that proper regulations and policies be identified and adopted in order to control and minimize the impacts of predicted future land uses and increases in watershed impervious cover.

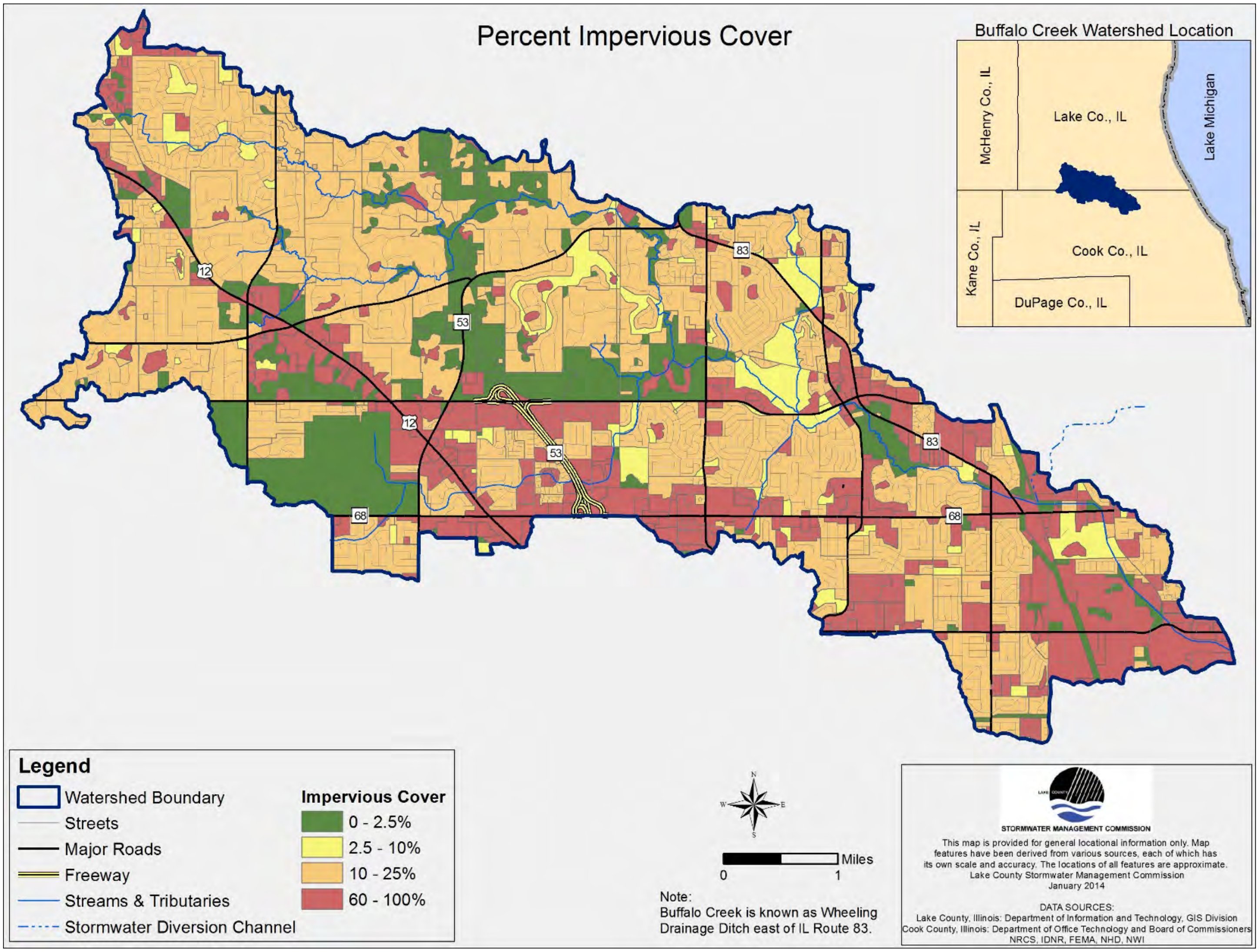


Figure 5-5: Impervious Cover in the Buffalo Creek Watershed.

Noteworthy: Urban Land Use – The Importance of Imperviousness

Urban land uses are different from other land uses in many ways that alter watershed hydrology and pollution runoff. Most importantly, urban land uses contain high concentrations of impervious surfaces. Impervious surfaces such as roads, parking lots and rooftops eliminate the infiltration of stormwater runoff into the soil. As a result of reduced infiltration urban land uses produce greater stormwater volumes, pollutant loads and water temperatures. Impervious cover consists of two categories: rooftops of buildings and transportations systems (e.g., roads, driveways and parking lots). Recent scientific literature indicates that the degree of impervious cover in a watershed can be used to predict stream quality. Research generally indicates that certain levels of impervious cover within a watershed represent thresholds for stream health. For example, at around 10% impervious cover, most indicators of stream health consistently shift from good to fair, and, at around 25% impervious cover, most indicators of stream health consistently shift from fair to poor (e.g., degraded water quality, significant decline in wildlife abundance and diversity). Putting all of this research together, the Center for Watershed Protection (CWP, 1998) has constructed a simple model, known as the Impervious Cover Model (ICM) that can be used to predict the health of streams and other aquatic resources based on the amount of impervious cover found within their watersheds. **Figure 5-4** demonstrates the relationship between the degree of impervious cover and stream quality.

The ICM classifies streams into three distinct categories: sensitive, impacted, and non-supporting. Streams falling into these categories can be expected to have the following characteristics:

Sensitive Streams: These streams typically have a watershed impervious cover of 0 to 10%. Consequently, they are typically of high quality, and typically have stable channels, excellent habitat, good to excellent water quality, and diverse communities of fish, insects, and other aquatic organisms. Since the amount of urban land use within their watersheds is so low, they are typically not exposed to the same "flashy" hydrology and other changes in stormwater runoff characteristics (e.g., increased stormwater runoff pollutant loads) that typically accompany watershed land use change. It should be noted that some streams with a watershed impervious cover of 0 to 10 located in agricultural areas may be impacted by farming practices and/or the installation of artificial drainage systems (e.g., drain tile systems) and, consequently, may not have all of the properties typically associated with a sensitive stream.

Impacted Streams: Streams in this category typically have a watershed impervious cover ranging from 11 to 25%, and show clear signs of degradation due to watershed land use change. Increased stormwater runoff rates and volumes begin to alter stream geometry, leading to stream downcutting and widening. Streambank erosion is typically clearly evident. Streambanks become unstable, and habitat the stream declines noticeably. As a result of increase stormwater runoff pollutant loads, stream water quality tends to shift into the fair category during both storm events and dry weather periods. Stream biodiversity tends to decline into the fair category, with the most sensitive fish, insects, and aquatic organisms disappearing from the stream.

Non-Supporting Streams: Once watershed impervious cover exceeds 25%, stream health typically declines significantly. Streams in this category essentially become a conduit for conveying stormwater runoff and can no longer support a diverse community of fish, insects, and aquatic organisms. Stream channels become highly unstable, and many stream reaches experience severe downcutting, widening, and streambank erosion. The pool and riffle structure needed to sustain a diverse fish community is diminished or eliminated entirely, and the stream substrate no longer provides habitat for aquatic insects or spawning habitat for fish. Water quality is consistently fair to poor. The biological quality of non-supporting streams is generally considered poor, and they are dominated by pollutant-tolerant insects and fish.

5.1.6 Reducing Land Use Impacts Through Development Regulations/Policy

One of the most significant and influential preventative measures that can be taken in the Buffalo Creek Watershed are policies and regulatory programs. The Buffalo Creek Watershed is located within two different counties, both with countywide ordinances with provisions related to stormwater, water quality, floodplain and natural resource protection. Countywide Ordinances (such as the ***Lake County Watershed Development Ordinance, WDO,*** and the ***Cook County Watershed Management Ordinance, WMO***) and local municipal ordinances benefit all watersheds in Lake and Cook Counties including the Buffalo Creek Watershed. But to maximize protection for the watershed, the Lake County Stormwater Management Commission (SMC), and the Metropolitan Water Reclamation District (MWRD) who administer the WDO and

Lake County Watershed Development Ordinance (WDO): Originally adopted in 1992 by SMC. Most recent revision was adopted by the Lake County Board on October 13, 2015. Revisions include major reformatting of the document in effort to make the Ordinance more user friendly, administrative clarifications, enhancements and new floodplain maps produced by the Federal Emergency Management Agency (FEMA).

Cook County Watershed Management Ordinance (WMO): This is the first Countywide Ordinance adopted in Cook County, effective date October 3, 2013. This Ordinance is administered by the MWRD.

WMO, along with local municipalities, should consider developing and administering watershed-specific regulation to meet goals and technical issues of concern in the watershed.

Frequently the appropriate measures of watershed protection are addressed most efficiently through non-degenerative practices rather than costly remediation after the problems become unavoidable. This watershed management plan does not include land use recommendations, because land use planning and development decisions are the right and responsibility of watershed municipalities and the Counties. But, this plan does consider the health of watershed 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. Negative indicators in the Buffalo Creek Watershed show that land use and land management practices have impacted the physical, chemical and biological health of streams and lakes in the watershed. Two types of regulatory and policy programs need to be periodically reviewed based on their potential to positively influence watershed health by preventing negative land development impacts. The first type of program relates to watershed development regulations and policy focused on stormwater management (i.e. the WDO and WMO); the second type is local ordinances and policy that direct development practices that influence impervious cover and drainage.

Photo of Farmington Pond 8, courtesy of Diane L. Kittle, Environmental Photographer.

The WMO was only recently adopted in Cook County. More stringent runoff volume reduction provisions, in addition to other enhancements to floodplain and water quality provisions were incorporated into the Lake County WDO in 2012. Therefore, it is unknown if the previous trend of increasing stormwater runoff volume and pollution will continue as development progresses and land use changes occur within the Buffalo Creek Watershed. Review of relevant ordinances will be needed to evaluate the effectiveness of policies, standards and regulations for new and redevelopment, and for land management as it pertains to stormwater runoff volume, detention, water quality, floodplains/floodways, and wetlands. Municipal review of local ordinances is necessary, to identify where opportunities for watershed-friendly development practices such as low impact development and green infrastructure may exist.

5.1.6.1 Stormwater Management

Both the WMO and the WDO determine the minimum requirements for development as a consistent standard county-wide. Therefore, changes in development policy and regulation related to water resources fall in the hands of MWRD, SMC and local enforcement officers.

The primary technical issues of concern in Buffalo Creek Watershed related to stormwater management are:

- Hydrologic changes have resulted in stream channel changes. Deepening and widening of the creek in some locations has created excessive erosion and sedimentation, debris loads and blockages and aquatic habitat impairments.
- Significant increases in impervious surface and resulting hydrologic changes are projected for areas that are currently agricultural or vacant land uses.

Watershed development concerns that were identified during stakeholder meetings and the development of this plan include:

- Stormwater management and flooding have been identified as a watershed concern that can be addressed in multiple ways such as:
    - Instituting more effective and consistent runoff volume reduction practices.
    - Floodplain preservation.
    - Review the detention volume/release rate requirements for the watershed and determine if unique conditions warrant adjustments or changes to storage and release regulations.
    - Ordinance and policy language can be reviewed and revised to ensure that stormwater disconnection and minimization of impervious surfaces are allowed by right.
    - Low impact development 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.
    - Unavoidable wetland loss should be mitigated within the watershed where the wetland impact/loss occurs.
- Water quality and impairments in Buffalo Creek, tributaries, lakes, and Buffalo Creek Reservoir have been identified as a major watershed concern. Local community ordinances can be reviewed and revised to insure that development codes do not preclude, but rather encourage BMPs to protect and improve water quality such as:
    - The use of native vegetation on public lands and in home and business landscaping.
    - Sustainable street designs (include 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 retention and harvesting.
- Site specific erosion issues were identified as a concern. Many of these erosion issues can be addressed with the following:
    - Stream corridor enhancements are not currently required as part of land development activities. 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.
    - Developing stream maintenance and restoration standards that can be applied throughout the watershed.

5.1.6.2 Local Municipal and County Policies and Ordinances

Additional avenues for policy and regulatory change are the responsibility of the counties and local municipalities in their land use plans, local subdivision ordinances, etc. Local municipal ordinances can positively or negatively affect watershed response, and may be the best avenue for incorporating watershed-specific development standards and practices that prevent flood damage and protect water quality. Following the policy direction of elected officials, local community staff has a significant role in preserving watershed health, and could assist developers in the site review process by assessing each new development site for proper BMP selection, and implementation of stormwater management practices that best minimize runoff volumes and velocities.

Noteworthy: Community Programs and Regulations Influence Watershed Health

There are many codes and ordinances that have an influence on the health and function of a watershed. **Table 5-3** includes typical types of codes and ordinances that can be evaluated and potentially changed or modified to help improve watershed conditions.

Table 5-3: Code or Ordinance Types with Ties to Watershed Health.

Code, Ordinance and Regulation Types With Ties To Watershed Health	
Erosion and Sediment Control Ordinances	Zoning Ordinance
Environmental Regulations (Buffers, Water Quality, Wetlands, Threatened/Endangered Species, etc.)	Subdivision Codes
Floodplain Regulations	Street Standards and Road Design
Stormwater Management & Drainage	Building and Fire Regulation Standards
Tree Protection and Landscaping	Public Fire Defence
Parking Requirements	Grading Ordinance

Planning and zoning guidance, effective enforcement of existing ordinances, as well as construction regulations provide 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 what type of development is allowed and where it can be located relative to natural resources. Other examples of planning/zoning forms of resource protection include riparian and wetland buffers, impervious area reduction, open space/greenway dedication, and conservation development.

Conservation and low impact development (LID) can have the potential to address current watershed issues and prevent future issues. 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). In addition, the Center for Watershed Protection and U.S. Environmental Protection Agency (USEPA) have self- appraisal checklists that watershed communities may use to evaluate their existing codes and ordinances to identify where regulatory changes and modifications can be made to improve the preservation and use of green infrastructure in the watershed. Adopting watershed-friendly codes and ordinances will elevate protection and enhancement of watershed resources. It is recommended that watershed communities 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 revisions to local ordinances that address watershed and/or site-specific water, natural resource and flooding issues not covered by county, regional or state program requirements.

Noteworthy: Conservation and Low Impact Development (LID)

County and local governments can work together to develop incentives for conservation and low impact development. 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 best management practices.

Communities may incorporate conservation and low impact development using several methods and strategies. Conservation development zoning could be applied to re-zoning 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 re-zoned 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 low impact development 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 bonus 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.

5.2 Water Resource Problems Assessment

In 2013, the Illinois EPA finalized a ***Total Maximum Daily Load*** (TMDL) study for Buffalo Creek (Des Plaines River/Higgins Creek Watershed 2013 TMDL Report) which found impairments to the water quality in Buffalo Creek, Albert Lake, Bishop Lake, Lucy Lake, and the Buffalo Creek Reservoir and placed them on the draft Illinois Integrated Water Quality Report and Section 303(d) (impaired waters) List (2014). Other lakes and streams assessed as part of the Illinois EPA's 305(b) monitoring report, but not determined to be impaired, include Wheeling Drainage Ditch, Green Lake, Brown's Lake, Acorn Lake, and Hidden Valley Lake. The waterbodies in the Buffalo Creek Watershed assessed in the Illinois EPA's 305(d) report and those listed as impaired on the Illinois EPA's Section 303(d) List are shown on **Figure 5-6**.

The identified impairments include dissolved oxygen (DO), fecal coliform, chloride, and phosphorus (total). While Bishop Lake and Lucy Lake were both listed as impaired, a TMDL has not been developed for them yet. **Table 5-4** includes a summary of pollutants and impairments for the Buffalo Creek Watershed. **Table 5-5** summarizes the targets that were used in the TMDL development for the Buffalo Creek Watershed.

Total Maximum Daily Load (TMDL): *Reports created by Illinois EPA for impaired waters based on severity of the water quality impairments. The majority of impaired waters do not yet have TMDL reports. Once the TMDL report is approved by the USEPA, the recommended strategies should be implemented by the affected MS4s.*

Carbonaceous Biochemical Oxygen Demand: *A method defined test measured by the depletion of dissolved oxygen by biological organisms in a body of water in which the contribution from nitrogenous bacteria has been suppressed.*

Nitrification: *The biological oxidation of ammonia or ammonium to nitrite followed by the oxidation of the nitrite to nitrate.*

Buffalo Creek is impaired due to high levels of fecal coliform and chlorides, and low DO. To address the DO impairment, Illinois EPA determined that ***Carbonaceous Biological Oxygen Demand*** (CBOD) and ammonia are the two pollutants that need to be controlled to improve the DO levels in the creek (Illinois EPA TMDL Report, 2013). Organic material such as leaves, bacteria, algae and various sorts of organic debris can enter waterbodies and decay. This is particularly prevalent when flow velocities decrease. These materials can decay in the water, and the decomposition uses oxygen to break down the organic material. CBOD is defined as the carbonaceous portion of the material. The decomposition of nitrogen materials (***nitrification***) also utilizes oxygen as ammonia is converted to nitrites and then nitrates.

Noteworthy: Chemical, Physical, and Biological Assessments

Pollutants are inputs into water bodies that can be monitored by collecting chemical data for parameters such phosphorus, TSS, and fecal coliform bacteria. Physical modifications to the water bodies also play a significant role in degrading streams and water quality as they can impair aquatic habitat. Water quality monitoring has evolved to rely on chemical monitoring, toxicological and biological assessment data. Detailed chemical monitoring provides information on conditions as a snapshot in time when assessed using grab samples (reflects water chemistry at the time the sample is collected) that is restricted to the selected analyses and constrained by available methodology and detection limits. Other basic chemical and physical parameters can be collected continuously over a period of time using in-stream probes such as the data sondes. Biological data, a survey of macroinvertebrates and fish, can be used to assess stream health over time as water quality and aquatic habitat affect the makeup of the animal communities in the stream. Biological assessments improve the chances of detecting effects of episodic events (e.g., spills), toxic non-point source pollution (e.g., pesticides), and cumulative and chronic pollution. Biological assessment data can also reflect the effects of unknown or unregulated chemicals (such as pharmaceuticals), non-chemical impacts, and habitat alterations.

Table 5-4: Water Quality Impairments for Buffalo Creek, Buffalo Creek Reservoir, Albert Lake, Bishop Lake and Lucy Lake.

Waterbody	TMDL Pollutant[1]	TMDL Impairment[2]	Aquatic Life Impairments Addressed	Aesthetic Quality Use Addressed	Recreational Use Addressed
Buffalo Creek (IL_GST)	Fecal coliform Chloride CBOD Ammonia (NH3)	Chloride Dissolved oxygen Fecal coliform	Chloride Dissolved oxygen		Fecal coliform
Buffalo Creek Reservoir (IL_SGC)	Total phosphorus	Dissolved oxygen Total phosphorus	Total phosphorus Total suspended solids Dissolved oxygen	Total phosphorus Total suspended solids Dissolved oxygen	
Albert Lake (IL_VGG)	Total phosphorus	Dissolved Oxygen	Total phosphorus Total suspended solids Dissolved oxygen	Total phosphorus Total suspended solids	
Bishop Lake (IL_UGJ)	Not yet developed	Not yet developed		Total phosphorus Total suspended solids	
Lucy Lake (IL_SGT)	Not yet developed	Not yet developed		Total phosphorus Total suspended solids Aquatic plants (macrophytes)	

[1] Taken from Table 1-1 of the Des Plaines River/Higgins Creek Watershed TMDL Report (May 2013)
[2] Taken from Table 1-2 of the Des Plaines River/Higgins Creek Watershed TMDL Report (May 2013)

Table 5-5: TMDL Targets for Buffalo Creek, Buffalo Creek Reservoir and Albert Lake.

Waterbody	Impairment	TMDL Target	Units
Buffalo Creek	Fecal coliform	<200	cfu/100 ml
	Dissolved Oxygen	>5.0 Mar-Jul >3.5 Aug-Feb	mg/L
	Chloride	<500	mg/L
Buffalo Creek Reservoir	Total Phosphorus	<0.05	mg/L
	Dissolved Oxygen	>5.0 Mar-Jul >3.5 Aug-Feb	mg/L
Albert Lake	Dissolved Oxygen	>5.0 Mar-Jul >3.5 Aug-Feb	mg/L

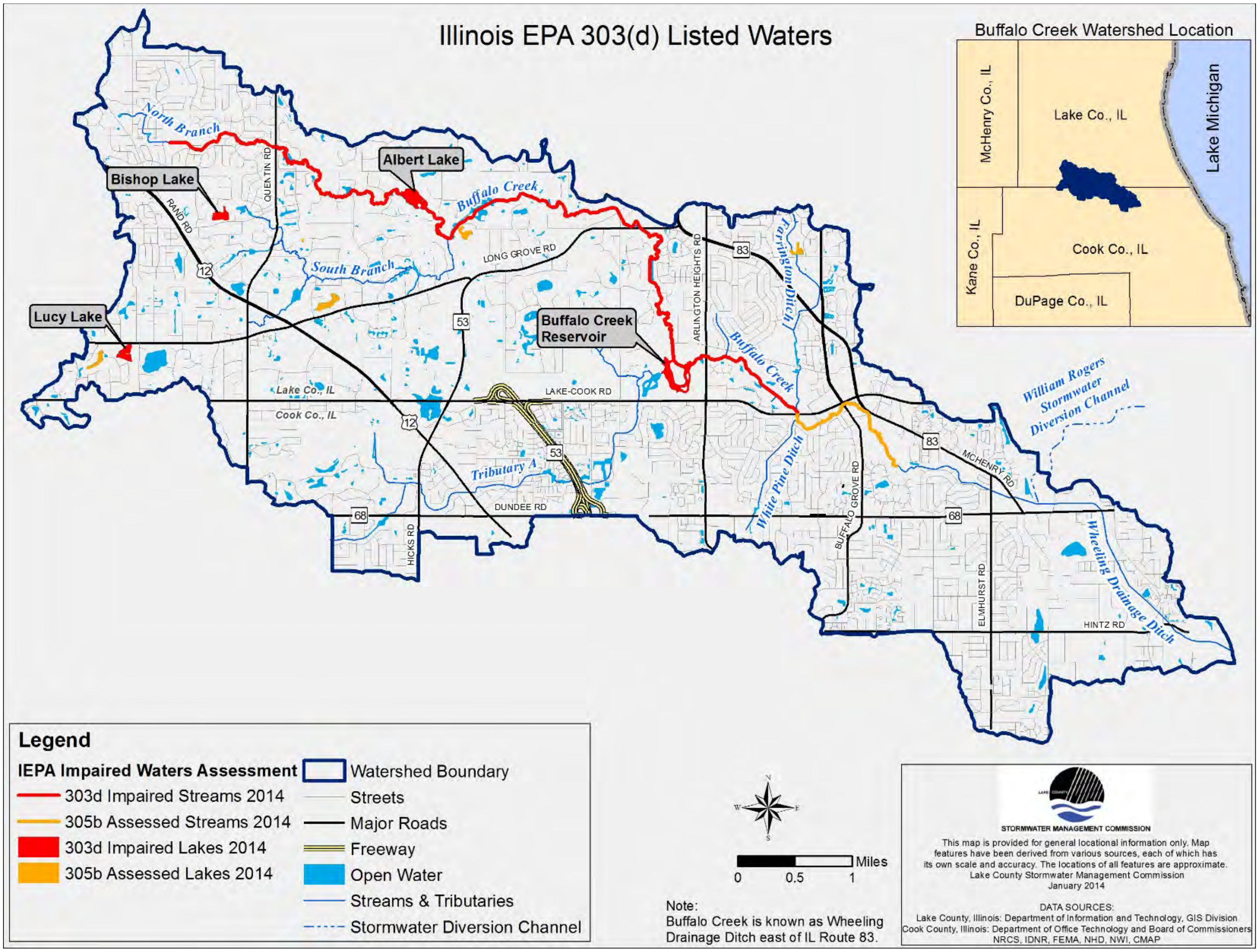


Figure 5-6: Illinois EPA Section 305(b) Assessed and 303(d) Listed Waters in the Buffalo Creek Watershed.

Noteworthy: Water Quality History

In 1948 the Federal Water Pollution Control Act was enacted to encourage water pollution control at the state and local levels. Between 1949 and 1969 the Cuyahoga River in Ohio caught fire 10 times. To better protect these public assets the 1948 Act was amended in 1972. "Clean Water Act" (CWA) became the Act's common name with amendments in 1972. The focus of the 1972 Act was to obtain fishable and swimmable waters and eliminate the discharge of point source pollutants into ***navigable waters*** (such as industrial and waste water treatment plant outfalls). This was the beginning of the ***National Pollutant Discharge Elimination System (NPDES)*** program. The Act was further refined in 1977, to extend deadlines and better define types of pollutants.

In 1987 the NPDES permit program was expanded to also regulate discharges from MS4s as point source discharges instead of non-point source discharges, as depicted on **Figure 5-7.**

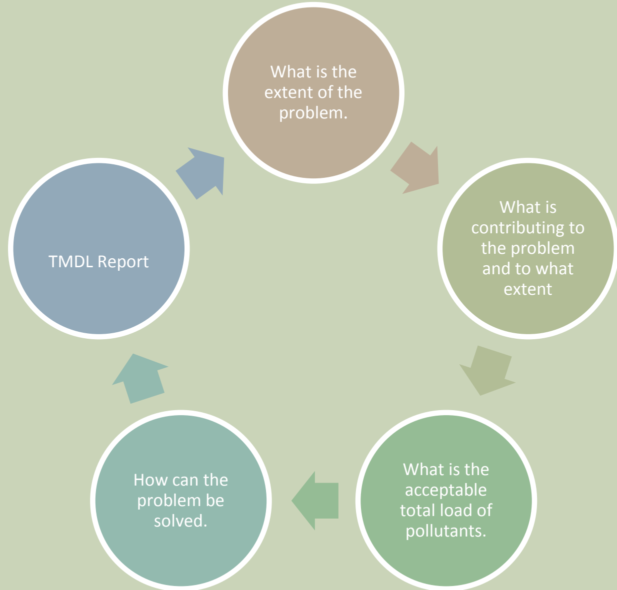


Figure 5-8: Pieces of an Illinois EPA TMDL Report. Graphic courtesy of J. Corona.

Photo of Cuyahoga River in Ohio. James Thomas, Cleveland Press collection, Source: Cleveland State University Library.

Photo of Cuyahoga River in Ohio. Source: Cleveland Plain Dealer.

Navigable Waters: *Waters that are subject to the ebb and flow of the tide, and those inland waters that are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce while the waterway is in its ordinary condition.*

National Pollution Discharge Elimination System (NPDES): *Permit program that controls water pollution by regulating point sources that discharge pollutants into waters of the United States. The NPDES program covers industrial, wastewater treatment plant and stormwater discharges from urbanized areas.*

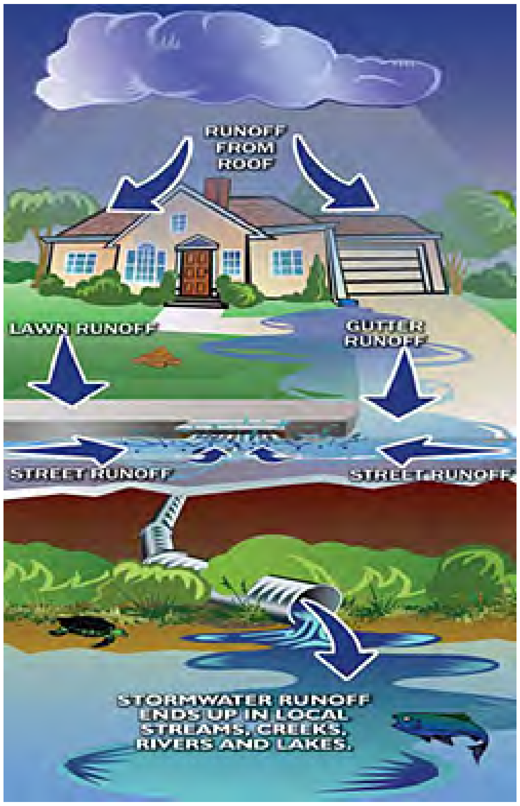


Figure 5-7: Depiction of an MS4 as a point source of pollution. Graphic courtesy of East Pikeland Township.

Noteworthy: National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4)

The NPDES permit process regulates the discharge from MS4s, construction sites and industrial activities based on amendments to the CWA in 1987 and the subsequent 1990 and 1999 regulations by the USEPA. In Illinois, the USEPA has delegated administration of the federal NDPES program to the Illinois EPA On December 20, 1999 the Illinois EPA issued a general NPDES Phase II permit for all MS4s. Under the General Permit each MS4 was required to submit a Notice of Intent (NOI) declaring compliance with the conditions of the permit by March 10, 2003. The original NOI describes the proposed activities and best management practices that occurred over the original 5-year period toward the ultimate goal of developing a compliant Stormwater Management Program. At the end of the 5th year (March 1, 2008) the components of the Stormwater Management Program were required to be implemented; per the ILR40 permit. The Illinois EPA reissued the ILR 40 permit on April 1, 2009 and expired in 2014. The new permit has yet to be released.

Additionally, under the General ILR10 permit also administered Illinois EPA, all construction projects that disturb greater than 1 acre of total land area are required to obtain an NPDES permit from Illinois EPA prior to the start of construction. Municipalities covered by the General ILR40 permit, are automatically covered under ILR10 30 days after the Illinois EPA receives the NOI from the municipality.

5.2.1 Lake Impairments

5.2.1.1 Water Quality

Four lakes in the Buffalo Creek Watershed have been listed on the Illinois EPA's 303(d) list of impaired waterbodies. Albert Lake is impaired for dissolved oxygen, total phosphorus and total suspended solids. The excess phosphorus present in Albert Lake has led to excess plant and algae growth. Excess nutrients have shifted Albert Lake into a hypereutrophic state, which makes the lake susceptible to winter fish kills. As a result of the poor water quality conditions present in Albert Lake, rough fish such as common carp dominate the fish community. Local water quality testing also confirmed high levels of total phosphorus as well as Chloride.

Buffalo Creek Reservoir is impaired for dissolved oxygen, total phosphorus and total suspended solids. Water samples from Buffalo Creek Reservoir indicate that there are enough nutrients present to promote the growth of nuisance plants and algae. While the Buffalo Creek Reservoir is not impaired for chloride according to the Illinois EPA, water samples taken in 2013 indicate that chloride concentrations in the Buffalo Creek Reservoir approach the allowable limit.

Based on the Illinois Integrated Water Quality Report and Section 303(d) List – Volume 1: Surface Water-2014, both Bishop Lake and Lucy Lake are fully supporting for aquatic life and not supporting for aesthetic quality. Both lakes were not assessed for fish consumption, primary contact, or secondary contact. The causes identified for the "not supporting" designation in both lakes were total suspended solids and total phosphorus. The source for Bishop Lake was identified as residential areas while the source for Lucy Lake was unknown.

5.2.1.2 Biological Impairments

Lakes can also have impaired water quality as a result of internal sources (i.e., carp, wind/wave action, invasive species, and having excessive or being devoid of aquatic vegetation). Aquatic plant diversity, an important part of a healthy ecosystem, was relatively poor in the lakes studied in 2013. The Floristic Quality Indices (FQI) values for Albert Lake and the Buffalo Creek Reservoir were just below the Lake County average (**Table 3-35**).

5.2.1.3 Shoreline Erosion

The shoreline erosion assessment conducted in 2013 by LCHD-ES revealed that shoreline erosion decreased in Albert Lake since 2001 with approximately 78% of the shoreline having no erosion in 2013 and only 37% having no erosion in 2001. The 2013 shoreline erosion assessment also revealed that 60% of the Buffalo Creek Reservoir was exhibiting some degree of erosion, with 43% of the erosion either moderate (26%) or severe (17%). However, it should be noted that the amount of erosion in the Buffalo Creek Reservoir decreased since the last assessment in 2001. Shoreline erosion will impact the water quality of the lakes, biological productivity, and loss of shoreline and property.

5.2.2 Stream Impairments

Approximately nine miles of Buffalo Creek have been identified by the Illinois EPA as impaired. This 9-mile section of Buffalo Creek is impaired for chloride, dissolved oxygen, total suspended solids and fecal coliforms. However, many of the tributaries of Buffalo Creek are also known to have water quality issues. Water quality samples collected by the Buffalo Creek Watershed Pollutant Monitoring Program (PMP) indicate that the majority of streams in the watershed exceed target limits for total phosphorus, conductivity and fecal coliform. This analysis is based on samples that were taken in May and October of 2013-2014. Therefore, the potential exists that many of the streams in the watershed may be experiencing impairments from additional pollutants that have not yet been detected with the limited sampling that has taken place. Pollutant concentrations are highly variable both spatially and temporally. Future water quality programs should be designed with an understanding of the stochastic nature of stream ecosystems, with water samples at intervals that capture significant environmental events.

5.2.2.1 Channelization

Streams of the Buffalo Creek Watershed have been highly modified from their natural morphology. Approximately 20 miles or 71% of the streams in the Buffalo Creek Watershed have been channelized to some degree. Large stretches of streams in the watershed have been channelized in an attempt to increase flow and conveyance capacity. Historically streams were channelized in an attempt to reduce flooding. However, channelization of streams is detrimental to stream habitat. The channelization of streams modifies streambeds that would naturally have a sequence of pools and riffles. However, when streams are channelized, streambed and flow velocity tend to become uniform and the constructed stream channel form loses its ability to dissipate energy and adapt to erosive forces. These changes to the streambed and stream velocities reduces habitat for many aquatic organisms.

5.2.2.2 Hydraulic Structures and Debris Loadings

During the stream inventory of the Buffalo Creek Watershed all hydraulic structures such as bridges, culvert and dams were identified. Some of these hydraulic structures were identified as problems as the result of flow obstruction or due to erosion and/or overall deterioration. Approximately 10% of the 141 hydraulic structures in the Buffalo Creek Watershed have been identified as problems. In addition to hydraulic structures, areas of debris loading were identified during the stream inventory. Large debris and logjams can cause a variety of issues including restriction of flow, increased flooding and erosion. Approximately 29% of the debris loading areas are located in the stream reaches that are experiencing severe or very severe erosion. Therefore, many of the debris and logjams in the Buffalo Creek Watershed may be altering hydrology such that erosion is occurring at an accelerated rate. The restoration and/or removal of both problem hydraulic structures and debris/logjams would likely augment other restoration efforts where erosion and/or flooding issues are being addressed.

5.2.2.3 Erosion

The degree of streambank erosion was assessed during the stream inventory in 2013. Of the 23.3 miles of assessed streambank, 71% were determined to be moderately eroded and 16% severely eroded. Causes of streambank erosion can include the removal of streambank vegetation and increased runoff from impervious surfaces. Stream channels adjust to accommodate additional flow by increasing streambank erosion. Streambank erosion increases the amount of sediment that a stream must carry, which reduces the amount of light in the water available for plant growth, decreasing the supply of food for other organisms. Sediment from streambank erosion can suffocate organisms that live on or in the bed of the stream and damage sensitive tissues such as the gills of fish. Pesticides and fertilizers, frequently transported along with the eroding soil, contaminate and pollute downstream waterways, wetlands and lakes.

5.3 Causes and Sources of Pollution

Pollutant loading from a watershed is the sum of pollution from ***point sources*** and ***non-point sources***. Non-point source pollution is a primary concern related to water quality in the Buffalo Creek Watershed. Point sources are also contributors to the overall watershed pollutant loads; however, the primary focus of this plan is to address non-point sources. Based on the Illinois EPA's TMDL report and the results of local water quality testing, the pollutants of concern for the Buffalo Creek Watershed are fecal coliform, chloride, and phosphorus (total).

> ***Point Source Pollution:*** *Any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack.*
>
> ***Non-Point Source Pollution (NPS):*** *Pollution coming from many diffuse sources (such as lawns, streets, farm fields etc.) transported by rainfall or snowmelt moving over or through the ground.*

5.3.1 Point Source Pollution

Existing regulatory permit processes and enforcement largely handle point source pollution. There are two existing NPDES permitted point source facilities plus one historically permitting facility within the Buffalo Creek Watershed (**Figure 5-9).** All permitted facilities are subject to regulatory monitoring and reporting requirements, which are all public records.

5.3.1.1 Alden Long Grove Rehabilitation and Health Care Facility

The Alden Long Grove Rehabilitation and Health Care Facility in Long Grove operates a small sewage treatment plant that discharges its effluent into a tributary of Buffalo Creek, upstream of the Buffalo Creek Reservoir. This facility is permitted under the National Pollutant Discharge Elimination System (NPDES) Program and is required to monitor for carbonaceous biochemical oxygen demand (CBOD), suspended solids, pH, fecal coliform, and dissolved oxygen. Alden Long Grove Rehabilitation Center has a low median fecal coliform discharge value; however, discharge data from 2002-2008 indicates that the facility occasionally discharged high concentrations of fecal coliform to Buffalo Creek (Illinois EPA, 2013).

5.3.1.2 Camp Reinberg

Camp Reinberg in Palatine contains an on-site sewage treatment facility that was abandoned in 2014 with construction of the campgrounds. The site now connects to a sanitary sewer owned by the Village of Palatine. While in service, Camp Reinberg's sewage treatment facility discharged infrequently (Illinois EPA, 2013).

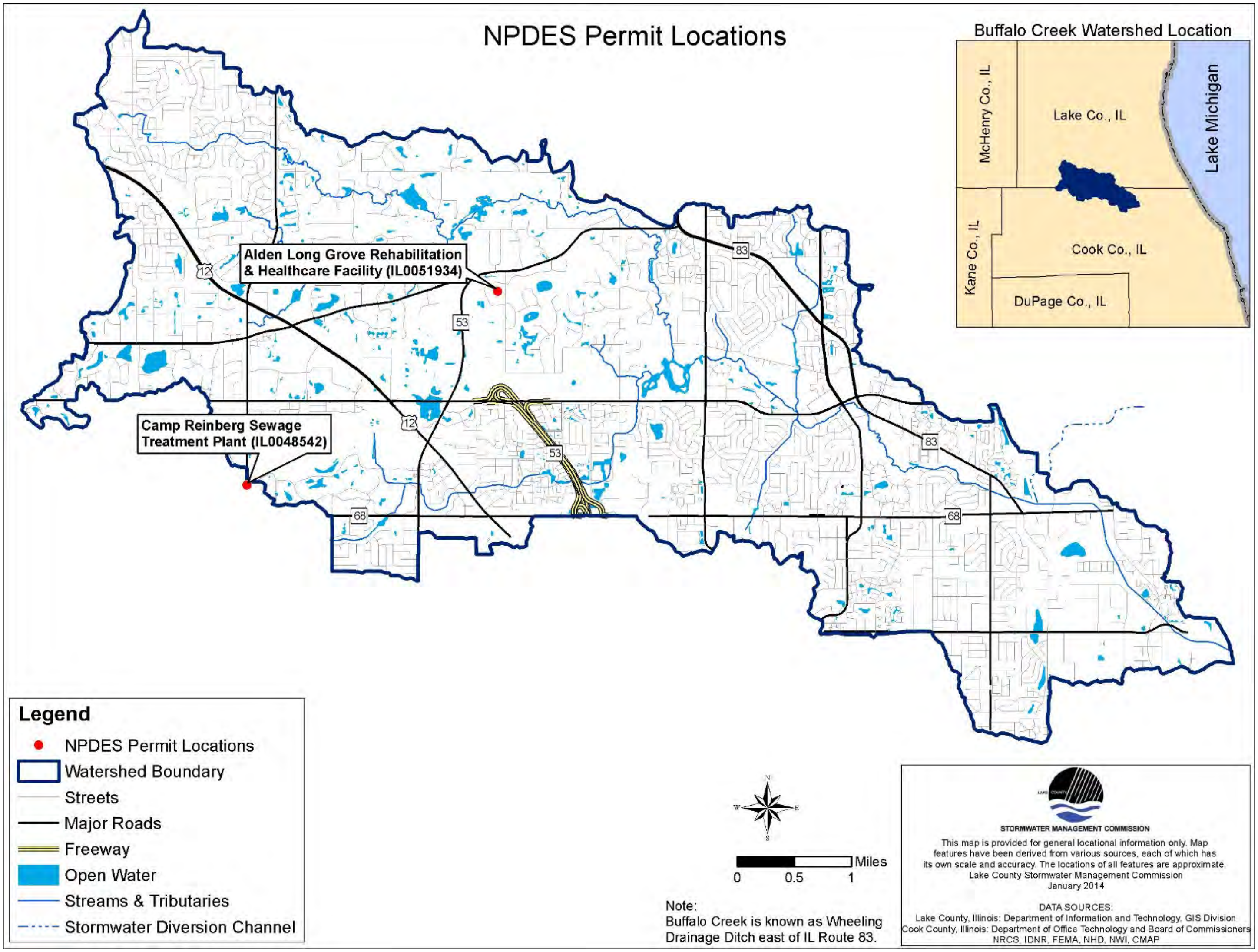


Figure 5-9: Location of NPDES Permitted Facilities in the Buffalo Creek Watershed.

5.3.1.3 Lake Zurich Sewage Treatment Plant

Historically, the southeast branch of the Lake Zurich Sewage Treatment Plant (STP) discharged into Buffalo Creek, upstream of Albert Lake, resulting in the high internal phosphorus loading in Albert Lake. The Lake Zurich STP was located on Old Mill Grove Road, south of Route 22 in Lake Zurich. The plant violated many permitted discharge limitations in the mid-eighties and was eventually closed. Several of these violations related to final effluent limitations and included biological oxygen demand violations (maximum concentration 250% over the permit limit), total suspended solids violations (maximum concentrations 1,000% over the permit limit), and fecal coliform violations (maximum concentration 3,430% over the permit limit). Although there is no record of phosphorus discharge into Buffalo Creek from the southeast plant of the Lake Zurich STP, phosphorus discharge from the northwest plant of the Lake Zurich STP into Flint Creek was permitted at a concentration of 1.0 mg/L. Assuming that the southeast plant had the same effluent concentration as the northwest, and given that the average discharge from the plant was 1.25 million gallons per day, approximately 10.4 pounds of phosphorus/day or

3,807 pounds/year were being discharged into Buffalo Creek (LCH-EES, 2001). By 1993, all plants in the Lake Zurich STP were closed and the water re-routed to a new Lake County STP facility outside Buffalo Grove.

In addition to the high phosphorus loading due the Lake Zurich STP, Albert Lake is also shallow as a result of the Lake Zurich STP effluent discharged several decades ago. Although this plant is no longer in service, Albert Lake still has a high sediment load as a result.

Storm Sewer: *A series of pipes designed to drain excess rain and groundwater from paved streets, parking lots, sidewalks, and roofs. Storm sewers drain the stormwater untreated into rivers or streams.*

MS4 Outfall: *Any point at which the MS4 discharges into a waterbody.*

Impervious Surface: *Any surface in the landscape that cannot effectively absorb or infiltrate rainfall.*

Organics: *Chemical compounds containing carbon, especially hydrocarbons.*

Organics: *Relating to or denoting compounds containing carbon (other than simple binary compounds and salts) and chiefly or ultimately of biological origin.*

5.3.1.4 Deer Park Town Center

Water quality testing performed by the BCCWP in 2013 and 2014 identified the Deer Park Town Center in Deer Park as a potential hotspot for chloride loading in the Buffalo Creek Watershed. Chloride concentrations at the sampling point located downstream of the Deer Park Town Center exceeded the Illinois EPA's general use standard limit of 500 mg/L in May 2013 (975 mg/L) and May 2014 (2,700 mg/L). Conductivity measurements taken at the same time for these locations showed high conductivity readings (4,165 µs/cm and 8,420 µs/cm, respectively). Conductivity readings over 1,500 µs/cm are considered high (USEPA, 1997). Conductivity and chloride are strongly correlated and therefore, conductivity can be used as a surrogate for chloride concentrations. Additional sampling conducted by the LCHD-ES and SMC in late winter 2014 and 2015 showed high conductivity readings at the same location.

5.3.1.5 Wet Weather Discharge Flow Conditions

MS4s are a potential source of pollutants in stormwater discharges. Pollutants such as nutrients, metals, and pathogens can be transported during precipitation events through ***storm sewers*** and discharged through ***MS4 outfalls***. **Figure 5-10** illustrates how stormwater flows through an MS4's storm sewer system and discharges from an outfall into a creek. These MS4s are covered under the ILR40 permit program, which authorizes the discharge of stormwater from MS4s. Fertilizers for lawns and other landscaping along with pet waste are a few of the substances that can be transported during rain events. ***Impervious surface*** stormwater runoff can contribute to a significant pollutant lo ad to waterbodies as the first flush can be heavily laden with ***organics***. The location of the storm sewer networks in the Buffalo Creek Watershed are shown on **Figure 5-11**.

Although there is a stormsewer network in Palatine and Prospect Heights, they are not reflected on the map as data was not available.

Figure 5-10: Municipal Storm Sewer System. Source: http://www.epa.ohio.gov/portals/35/cso/wet_weather_flow_graphic.jpg

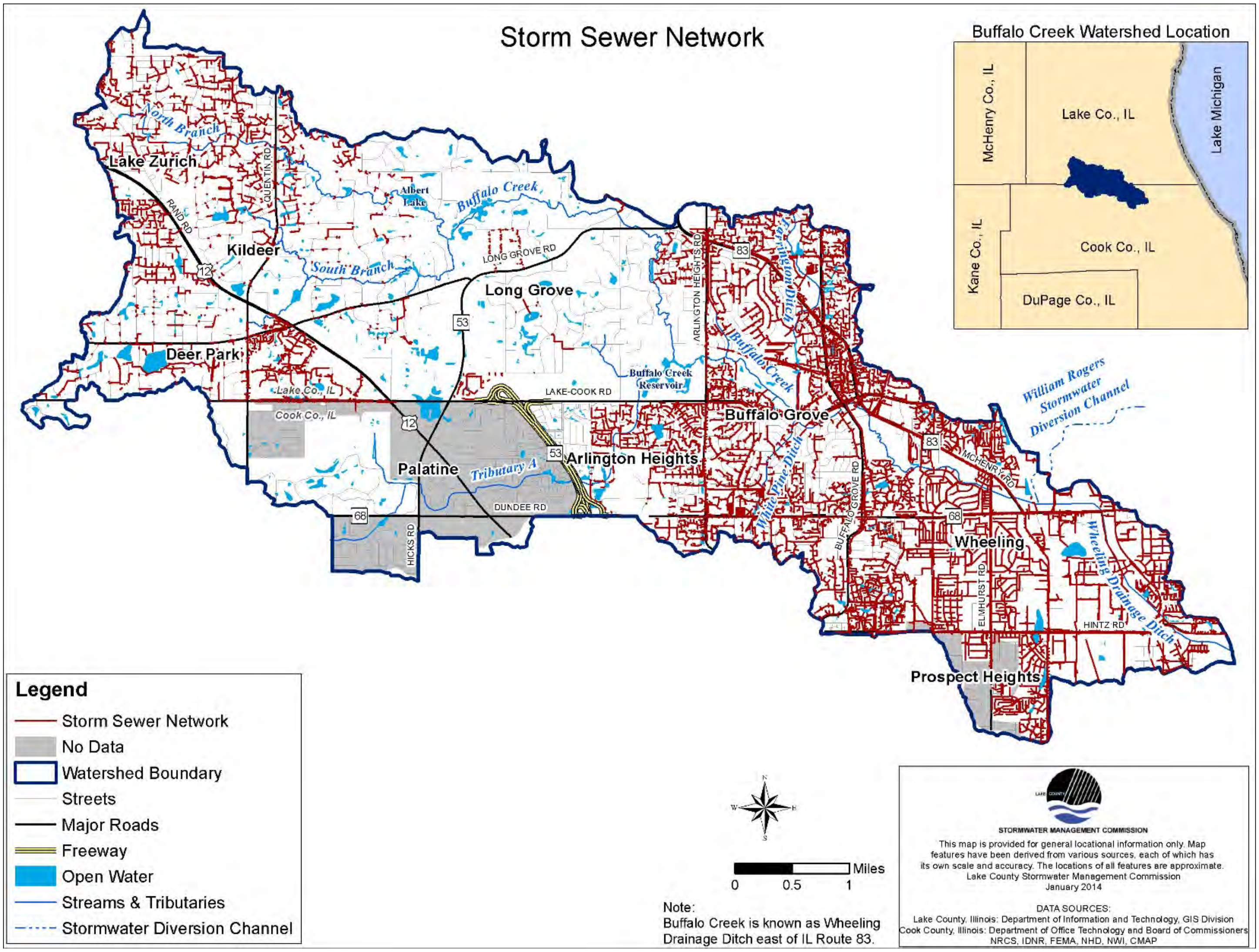


Figure 5-11: Location of Storm Sewer Networks in the Buffalo Creek Watershed.

5.3.2 Septic System Analysis

Portions of the Buffalo Creek Watershed are serviced by municipal sewer systems, while other portions of the watershed are on septic systems (**Figure 5-12**). The number of septic systems in each SMU was estimated using planimetric data and the location of sanitary sewers. Buildings located in areas without sewer systems where identified and assumed to contain a septic system. The number of buildings in each of these areas was then multiplied by an estimated septic system failure rate of 2%. **Table 5-6** displays the estimated number of buildings on septic and the estimated number of failing septic systems by SMU. There are potentially 2,652 septic systems in the watershed, with approximately 53 of those septic systems assumed to be failing at any given time (**Table 5-6**).

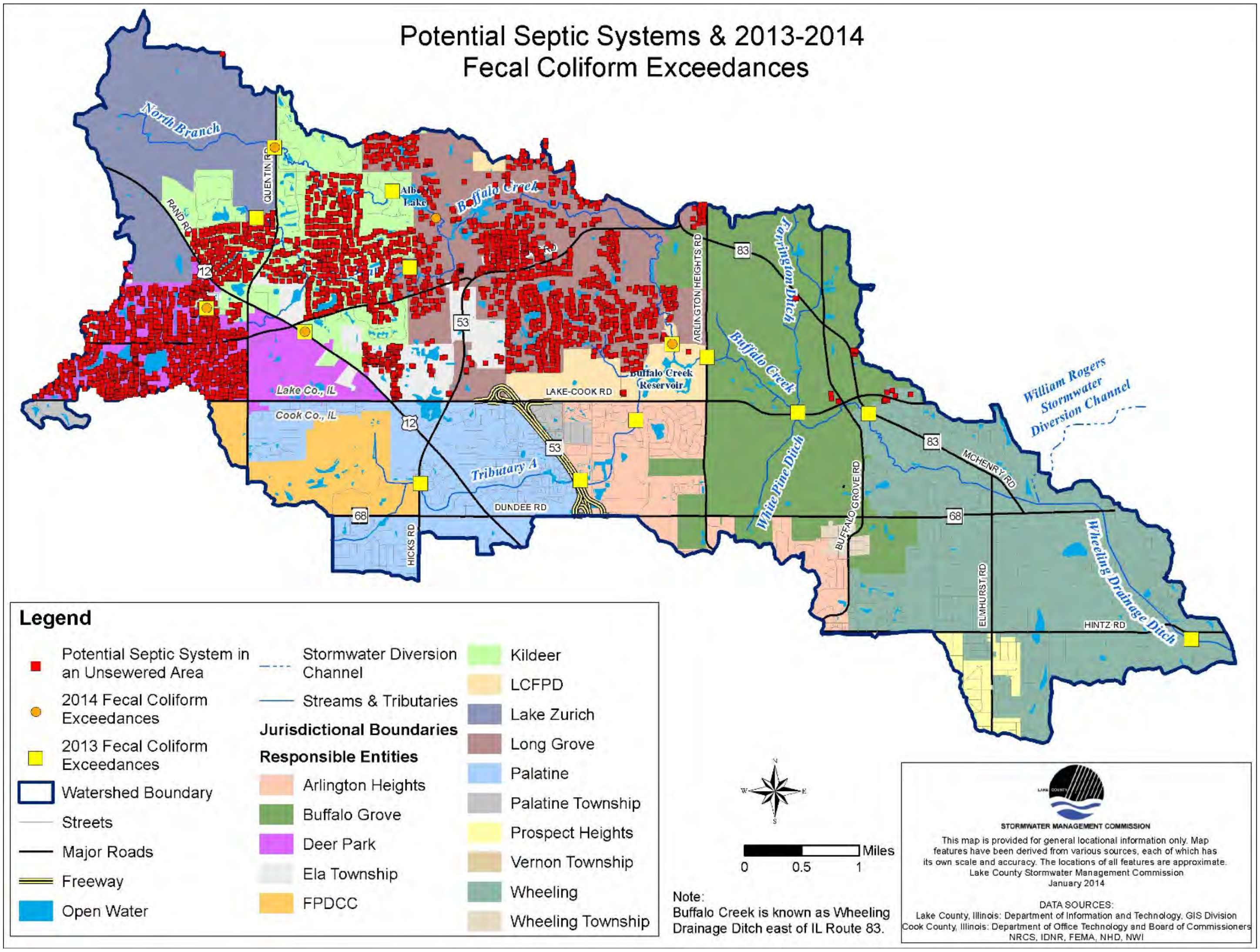


Figure 5-12: Potential Septic System Locations in the Buffalo Creek Watershed.

Table 5-6: Estimated number of buildings on septic systems and the estimated number of failing septic systems in the Buffalo Creek Watershed.

SMU	Estimated # of Buildings on Septic Systems	Estimated # of Failing Septic Systems
1A	0	0
1B	1	0.02
1C	190	3.8
1D	96	1.92
1E	0	0
2	461	9.22
3	566	11.32
4	399	7.98
5A	89	1.78
5B	119	2.38
5C	82	1.64
6A	38	0.76
6B	68	1.36
7	229	4.58
8A	0	0
8B	0	0
8C	160	3.2
9	114	2.28
10	23	0.46
11	2	0.04
12	0	0
13	8	0.16
14	5	0.1
15	0	0
16	0	0
17	0	0
18	2	0.04
19	0	0
20	0	0
21	0	0
22	0	0
23	0	0
TOTAL	**2,652**	**53.04**

Table 5-7 summarizes the estimated pollutant loading from failing septic systems for the entire watershed. Septic system loading for phosphorus, nitrogen, BOD and sediment was calculated using the pollutant model outlined in the next section. Assuming 2.43 people per septic system and an average of 0.15 billion CFU/person/day, it is estimated that failing septic systems may contribute an annual load of 7,057 billion CFU/year (**Table 5-7**).

Table 5-7: Septic System Analysis and Pollutant Loading.

Estimated # of Failing Septic Systems	Population per Septic System	Bacteria generated per person per day (billion CFU)	Annual Pollutant Load (billion CFU)
53.04	2.43	0.15	7,057

5.4 Pollutant Load Analysis

5.4.1 Methodology

The ***Spreadsheet Tool for Estimating Pollutant Load (STEPL)*** model, Version 4.1, was used to conduct the ***pollutant load analysis*** for the Buffalo Creek Watershed as a whole and by individual SMU. The model 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 best management practices (BMPs). STEPL computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, 5-day biological oxygen demand (BOD); and sediment delivery based on various land uses and management practices. STEPL does not calculate pollutant loads for chloride or fecal coliform. However, nutrient loads (nitrogen, phosphorus and BOD) and sediment loads are calculated for failing septic systems in the STEPL model.

The annual nutrient loading is calculated in STEPL based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The ***annual sediment load*** (sheet and rill erosion only) is calculated based on the ***Universal Soil Loss Equation*** (USLE) and the ***sediment delivery ratio***. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using estimated BMP efficiencies that are built into the STEPL model.

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 best management practices (BMPs). STEPL development is supported and funded by the EPA.*

Pollutant Load Analysis: *To identify and quantify a water body's sources of pollutants.*

Annual Sediment Load: *The yearly amount of the solid material that is transported by a natural agent, especially by a stream.*

Universal Soil Loss Equation (USLE): *A mathematical model that describes soil erosion processes composed of six factors to predict the long-term average annual soil loss (A). The equation (A=RKLSCP) includes the rainfall erosivity factor (R), the soil erodibility factor (K), the topographic factors (L and S) and the cropping management factors (C and P).*

Sediment Delivery Ratio: *The ratio of sediment yield of a drainage basin to the total amount of sediment moved by sheet erosion and channel erosion.*

Since chloride and fecal coliform bacteria loadings cannot be calculated in the STEPL model, two other methods were used to model these pollutants. Chloride was calculated using Schueler's Simple Method (1987), which is explained in further detail in **Appendix E**. Fecal coliform bacteria was calculated based on the following formula provided by the Lake County Health Department:

Annual Fecal Coliform Bacteria Load = S * EFR * P * C * 365 days

S = Number of septic systems

EFR = Estimated Failure Rate = 2%

P = Average population per septic system = 2.43 people

C = Concentration of bacteria generated per person per day = 0.15 billion CFU

It should be noted that all computation models have assumptions and limitations and that the model is designed as a planning tool. Therefore, the provided analytical results do not represent the exact pollution loads due to calibration and model limitations. For example, the source of phosphorus impairments in lakes may come from loads in internal sediments that are resuspended by carp or other disturbances. These loads are not calculated in the STEPL model. The relative and spatially-presented results are intended to assist in identifying locations potentially generating non-point source pollution that have the largest impact on water quality within the watershed. These areas can be targeted for BMP implementation providing the greatest water quality improvement benefit to the watershed.

The existing conditions land use data used in the STEPL model was CMAP's 2005 land use inventory that was updated by interpreting 2012 aerial imagery. Hydrologic soil group and soil erodibility data were taken from the NRCS Lake and Cook County soil surveys. Average subwatershed conditions were determined for each subwatershed for soils input requirements. The future conditions land use data used in STEPL was land use data derived through compilation of the comprehensive plans for communities within the watershed. The existing conditions soils and streambank data was maintained for the future land use conditions analysis. The detailed pollutant loading and reduction methodology can be found in **Appendix E**.

5.4.2 Pollutant Load Estimates

5.4.2.1 Existing Non-Point Source Loading

The existing non-point source pollutant load estimates for nitrogen, phosphorus, BOD, sediment, chloride and fecal coliform are presented in **Table 5-8** through **Table 5-10.** For all pollutants besides chloride and fecal coliform, this is the STEPL model's results for pollutant loads prior to any installation of conservation practices and other BMPs. Estimated loadings per acre were compiled by subwatershed management unit (SMU) for nitrogen, phosphorus, BOD, sediment, chloride and fecal coliform. Loading per pollutant was categorized by quartile, with each SMU receiving a ranking value of 1 (low levels) to 4 (higher levels). This analysis is graphically displayed in **Figures 5-13** through **5-18**.

Results show that urban land uses and streambank erosion contribute the highest annual levels of nitrogen and BOD. Residential land uses contribute the highest level of fecal coliform loadings.

Table 5-8: Existing Annual Non-Point Source Loading Results

Parameter	Model Results	Avg. – per Acre
Total Nitrogen (lbs./year)	208,033	12
Total Phosphorus (lbs./year)	33,459	2
BOD (lbs./year)	704,496	41
Sediment (ton/year)	22,299	1
Chloride (lbs./year)	24,545,450	1,411
Fecal Coliform (Billion CFU/year)	7,057	0.4

Table 5-9: Existing Annual Non-Point Source Pollutant Annual Loading By Land Use.

Land Use	Total Nitrogen Load (lbs/year)	Total Phosphorus Load (lbs/year)	BOD Load (lbs/year)	Sediment Load (tons/year)	Chloride (lbs/year)	Fecal Coliform (Billion CFU/year)
Urban	73,499	11,712	311,165	1,635	Not available[1]	
Cropland	296	66	578	19		
Pastureland	101,211	8,936	323,511	1,356		
Forest	12	6	28	0		
Water/Wetland	868	351	1,482	226		
Septic	1,649	646	6,733	0		
Streambank Erosion	30,499	11,742	60,998	19,062		
Total	**208,033**	**33,459**	**704,496**	**22,299**	**24,545,450**	**7,057**

[1] The STEPL model does not compute pollutant loads for chloride or fecal coliform bacteria. Methodology used to calculate chloride and fecal coliform bacteria pollutant loads can be found in Appendix E. Results for chloride and fecal coliform bacteria are provided per subwatershed unit and not by land use category.

Table 5-10: Existing Annual Non-Point Source Pollutant Annual Loading by SMU.

SMU	Nitrogen		Total Phosphorus		BOD		Sediment		Chloride		Fecal Coliform	
	Total (lbs)	lbs/ac	Total (lbs)	lbs/ac	Total (lbs)	lbs/ac	Total (tons)	tons /ac	Total (lbs)	lbs/ac	Billion CFU	Billion CFU/ac
1A	3,683	0.21	442	0.03	13,368	0.77	107	0.01	468,268	1,409	0	0
1B	6,578	0.38	828	0.05	23,424	1.35	224	0.01	888,798	1,455	3	0
1C	10,296	0.59	2,020	0.12	32,860	1.89	1,804	0.10	1,063,450	1,422	506	0.68
1D	3,923	0.23	508	0.03	13,532	0.78	135	0.01	524,145	1,305	255	0.64
1E	1,156	0.07	144	0.01	4,137	0.24	22	0.00	140,250	1,385	0	0
2	11,916	0.69	1,963	0.11	40,839	2.35	1,232	0.07	1,360,717	1,406	1,227	1.27
3	10,943	0.63	1,768	0.10	37,512	2.16	1,058	0.06	1,223,930	1,354	1,506	1.67
4	10,852	0.62	1,817	0.10	37,080	2.13	1,248	0.07	1,209,399	1,398	1,062	1.23
5A	3,059	0.18	572	0.03	9,581	0.55	461	0.03	335,551	1,084	237	0.77
5B	2,131	0.12	335	0.02	7,189	0.41	177	0.01	258,541	1,338	317	1.64
5C	3,370	0.19	577	0.03	11,183	0.64	431	0.02	373,685	1,389	218	0.81
6A	6,523	0.38	2,155	0.12	15,285	0.88	3,240	0.19	328,593	1,444	101	0.44
6B	1,666	0.10	424	0.02	4,686	0.27	514	0.03	211,722	1,455	181	1.24
7	3,518	0.20	645	0.04	11,571	0.67	475	0.03	724,066	1,434	609	1.21
8A	1,691	0.10	339	0.02	5,480	0.32	354	0.02	156,049	1,455	0	0
8B	2,632	0.15	340	0.02	9,615	0.55	90	0.01	484,660	1,444	0	0
8C	11,728	0.67	1,385	0.08	42,081	2.42	308	0.02	2,269,939	1,392	426	0.26
9	24,545	1.41	4,052	0.23	83,288	4.79	2,971	0.17	2,723,960	1,402	303	0.16
10	7,889	0.45	1,181	0.07	27,164	1.56	767	0.04	978,889	1,455	61	0.09
11	10,190	0.59	1,296	0.07	35,651	2.05	440	0.03	1,372,500	1,426	5	0.01
12	9,561	0.55	1,129	0.06	35,702	2.05	164	0.01	1,203,864	1,455	0	0
13	3,531	0.20	810	0.05	10,460	0.60	992	0.06	246,417	1,455	21	0.13
14	2,922	0.17	577	0.03	9,297	0.53	587	0.03	356,805	1,405	13	0.05
15	888	0.05	109	0.01	3,342	0.19	15	0.00	113,004	1,455	0	0
16	2,499	0.14	295	0.02	9,504	0.55	43	0.00	300,510	1,432	0	0
17	2,848	0.16	695	0.04	8,226	0.47	861	0.05	202,717	1,455	0	0
18	11,465	0.66	1,653	0.10	40,682	2.34	834	0.05	1,287,045	1,455	5	0.01
19	5,341	0.31	1,303	0.07	14,969	0.86	1,655	0.10	334,475	1,437	-	0
20	5,111	0.29	656	0.04	17,168	0.99	99	0.01	497,926	1,455	0	0
21	16,454	0.95	2,042	0.12	59,747	3.44	294	0.02	2,076,524	1,429	0	0
22	2,349	0.14	331	0.02	8,043	0.46	150	0.01	275,221	1,455	0	0
23	6,777	0.39	1,070	0.06	21,832	1.26	548	0.03	553,831	1,455	0	0
TOTAL	**208,033**	**12**	**33,459**	**2**	**704,496**	**41**	**22,299**	**1**	**24,545,450**	**1,468**	**7,057**	**0.4**

5.4.2.2 Future Non-Point Source Loading

The future conditions (2020) non-point source pollutant load estimates for nitrogen, phosphorus, BOD, sediment, chloride and fecal coliform are presented at the SMU level in **Table 5-11** through **5-13.** A summary comparing existing and future annual non-point source pollutant loads is presented in **Table 5-14**. Understanding the impacts of future development (and redevelopment) can inform planning and development decisions and can assist in mitigating water quality concerns before they arise. When comparing existing to future loading conditions, increases are minimal as the majority of the watershed is built-out. This also means that any incorporation of BMPs in the watershed will have a positive impact on water quality. In addition, for pollutants such as chloride, the application of BMPs such as pervious pavement within the watershed is a method to reduce chloride levels; however, significant chloride reduction needs to come from pollution prevention efforts. The same methodology used to rank existing pollutant loading by SMU was used for the future conditions. Since there was little to no change in future conditions, estimated pollutant load maps represent both existing and future estimated loads.

Noteworthy: Facts about Buffalo Creek Watershed Impairments

Chloride

- ✓ Essential for life (in low amounts)
- ✓ High concentrations from winter road salt
- ✓ Toxic to aquatic plants and animals
- ✓ Pollutes ground water and soil

Phosphorus

- ✓ Key nutrient essential for life
- ✓ Occurs naturally in soils and added to fertilizers
- ✓ Runoff carries phosphorus into streams and lakes
- ✓ Stimulates "blooms" of algae and bacteria
- ✓ High levels persist in lake sediments and may be resuspended by disturbance being "recycled" as a pollutant load

Fecal Coliform

- ✓ E. coli is an anaerobic bacterium that inhabits intestinal tracts of animals
- ✓ Fairly easy to test for
- ✓ Indicator of fecal contamination and possible risk of disease

Total Suspended Solids

- ✓ TSS are low density or too small to settle, e.g. silt, mud particles, algae, or industrial/municipal waste materials
- ✓ Measured by turbidity (lack of transparency)

Dissolved Oxygen

- ✓ Oxygen is required for respiration by all plants and animals
- ✓ DO is a measure of oxygen available in water
- ✓ Depleted DO means death for most aquatic plants, fish and macro-invertebrates

Biochemical Oxygen Demand

- ✓ BOD or CBOD is amount of DO consumed by micro-organisms, e.g. plants and animals (alive and dead), leaves and debris, fecal matter (pets, wild animals) and effluents of all types
- ✓ High BOD converts into low DO available for fish, macro-invertebrates and plants

Nitrogen (Ammonia)

- ✓ Nitrogen is a key nutrient essential for life
- ✓ There are many forms and chemical conversions, one form is ammonia which can pollute water
- ✓ Illinois EPA listed ammonia as a surrogate that needs to be controlled to prevent DO depletion
- ✓ Illinois EPA used Kjeldahl nitrogen as a test to measure all forms of nitrogen in water

Table 5-11: Future Annual Non-Point Source Loading Results

Parameter	Model Results	Avg. – Per Acre
Total Nitrogen (lbs./year)	208,391	12
Total Phosphorus (lbs./year)	33,580	2
BOD (lbs./year)	708,688	41
Sediment (ton/year)	22,304	1
Chloride (lbs./year)	25,183,779	1,448
Fecal Coliform (Billion CFU/year)	7,057	0.4

Table 5-12: Future Annual Non-Point Source Pollutant Annual Loading By Land Use.

Land Use	Total Nitrogen Load (lbs/year)	Total Phosphorus Load (lbs/year)	BOD Load (lbs/year)	Sediment Load (tons/year)	Chloride (lbs/year)	Fecal Coliform (Billion CFU/year)
Urban	73,856	11,833	315,357	1,640		
Cropland	296	66	578	19		
Pastureland	101,211	8,936	323,511	1,356		
Forest	12	6	28	0	Not available[1]	
Water/Wetland	868	351	1,482	226		
Failing Septic Systems	1,649	646	6,733	-		
Streambank Erosion	30,499	11,742	60,998	19,062		
TOTAL	**208,391**	**33,580**	**708,688**	**22,304**	**25,183,779**	**7,057**

[1] The STEPL model does not compute pollutant loads for chloride or fecal coliform bacteria. Methodology used to calculate chloride and fecal coliform bacteria pollutant loads can be found in Appendix E. Results for chloride and fecal coliform bacteria are provided per subwatershed unit and not by land use category.

Table 5-13: Future Annual Non-Point Source Pollutant Annual Loading by SMU.

SMU	Nitrogen		Total Phosphorus		BOD		Sediment		Chloride		Fecal Coliform	
	Total (lbs)	lbs/ ac	Total (lbs)	lbs/ ac	Total (lbs)	lbs/ac	Total (tons)	tons/ ac	Total (lbs)	lbs/ ac	Billion CFU	Billion CFU/ac
1A	3,697	11.12	444	1.33	13,467	40.51	107	0.32	468,268	1,409	0	0
1B	6,602	10.81	829	1.36	23,567	17,370.33	225	0.37	888,798	1,455	3	0
1C	10,325	13.81	2,024	2.71	33,084	12,223.82	1,805	2.41	1,063,449	1,422	506	0.68
1D	3,886	9.67	528	1.31	13,985	10,636.52	134	0.33	524,146	1,305	255	0.64
1E	1,156	11.42	144	1.43	4,137	2,902.32	22	0.22	140,250	1,385	0	0
2	12,016	12.42	1,972	2.04	41,551	20,388.20	1,233	1.27	1,360,717	1,406	1,227	1.27
3	10,955	12.12	1,770	1.96	37,618	19,208.83	1,058	1.17	1,223,930	1,354	1,506	1.67
4	10,834	12.52	1,824	2.11	37,205	17,650.08	1,248	1.44	1,209,400	1,398	1,062	1.23
5A	3,037	9.81	586	1.89	9,874	5,219.82	460	1.49	335,551	1,084	237	0.77
5B	2,115	10.94	345	1.78	7,407	4,151.20	176	0.91	258,541	1,338	317	1.64
5C	3,365	12.51	580	2.15	11,244	5,219.08	431	1.60	373,685	1,389	218	0.81
6A	6,520	28.66	2,156	9.48	15,303	1,614.95	3,240	14.24	328,593	1,444	101	0.44
6B	1,666	11.44	424	2.91	4,686	1,610.01	514	3.53	211,722	1,455	181	1.24
7	3,518	6.97	645	1.28	11,571	9,058.75	475	0.94	1,360,717	1,406	609	1.21

8A	1,691	15.76	339	3.16	5,480	1,736.10	354	3.30	156,049	1,455	0	0
8B	2,632	7.84	340	1.01	9,615	9,504.73	90	0.27	484,660	1,444	0	0
8C	11,761	7.21	1,391	0.85	42,430	49,729.71	308	0.19	2,271,615	1,393	426	0.26
9	24,578	12.65	4,056	2.09	83,524	40,013.45	2,971	1.53	2,723,960	1,402	303	0.16
10	7,881	11.71	1,182	1.76	27,139	15,454.46	767	1.14	978,889	1,455	61	0.09
11	10,190	10.59	1,296	1.35	35,651	26,468.57	440	0.46	1,372,500	1,426	5	0.01
12	9,579	11.58	1,131	1.37	35,744	26,157.99	165	0.20	1,203,864	1,455	0	0
13	3,533	20.86	810	4.78	10,479	2,190.32	992	5.85	246,417	1,455	21	0.13
14	2,907	11.45	576	2.27	9,313	4,103.07	587	2.31	356,805	1,405	13	0.05
15	888	11.43	109	1.40	3,342	2,389.99	15	0.19	113,004	1,455	0	0
16	2,499	11.90	295	1.40	9,504	6,772.37	43	0.21	300,510	1,432	0	0
17	2,844	20.41	695	4.99	8,209	1,646.46	861	6.18	202,717	1,455	0	0
18	11,465	12.96	1,653	1.87	40,682	21,780.19	834	0.94	1,287,045	1,455	5	0.01
19	5,407	23.22	1,309	5.62	15,432	2,745.28	1,656	7.11	334,475	1,437	-	0
20	5,152	15.05	666	1.95	17,367	8,926.93	100	0.29	497,926	1,455	0	0
21	16,463	11.33	2,044	1.41	59,790	42,501.11	294	0.20	2,076,524	1,429	0	0
22	2,378	12.57	338	1.79	8,182	4,583.50	151	0.80	275,221	1,455	0	0
23	6,853	18.00	1,083	2.85	22,106	7,768.07	550	1.44	553,831	1,455	0	0
TOTAL	**208,391**	**12**	**33,580**	**2**	**708,688**	**41**	**22,304**	**1**	**25,183,779**	**1,448**	**7,057**	**0.4**

Table 5-14: Current and Future Non-Point Source Pollutant Annual Loads Summary

Parameter	Existing		Future		Percent Change Compared to Existing Conditions
	Load	Average Per Acre	Load	Average Per Acre	
Total Nitrogen – (lbs/year)	208,033	12	208,391	12	0.17%
Total Phosphorus (lbs/year)	33,459	2	33,580	2	0.36%
BOD (lbs/year)	704,496	41	708,688	41	0.60%
Sediment (ton/year)	22,299	1	22,304	1	0.02%
Chloride (lbs/year)	24,545,450	1,411	25,183,779	1,448	4.08%
Fecal Coliform (billion CFU/year)	7,057	0.4	7,057	0.4	0.00%

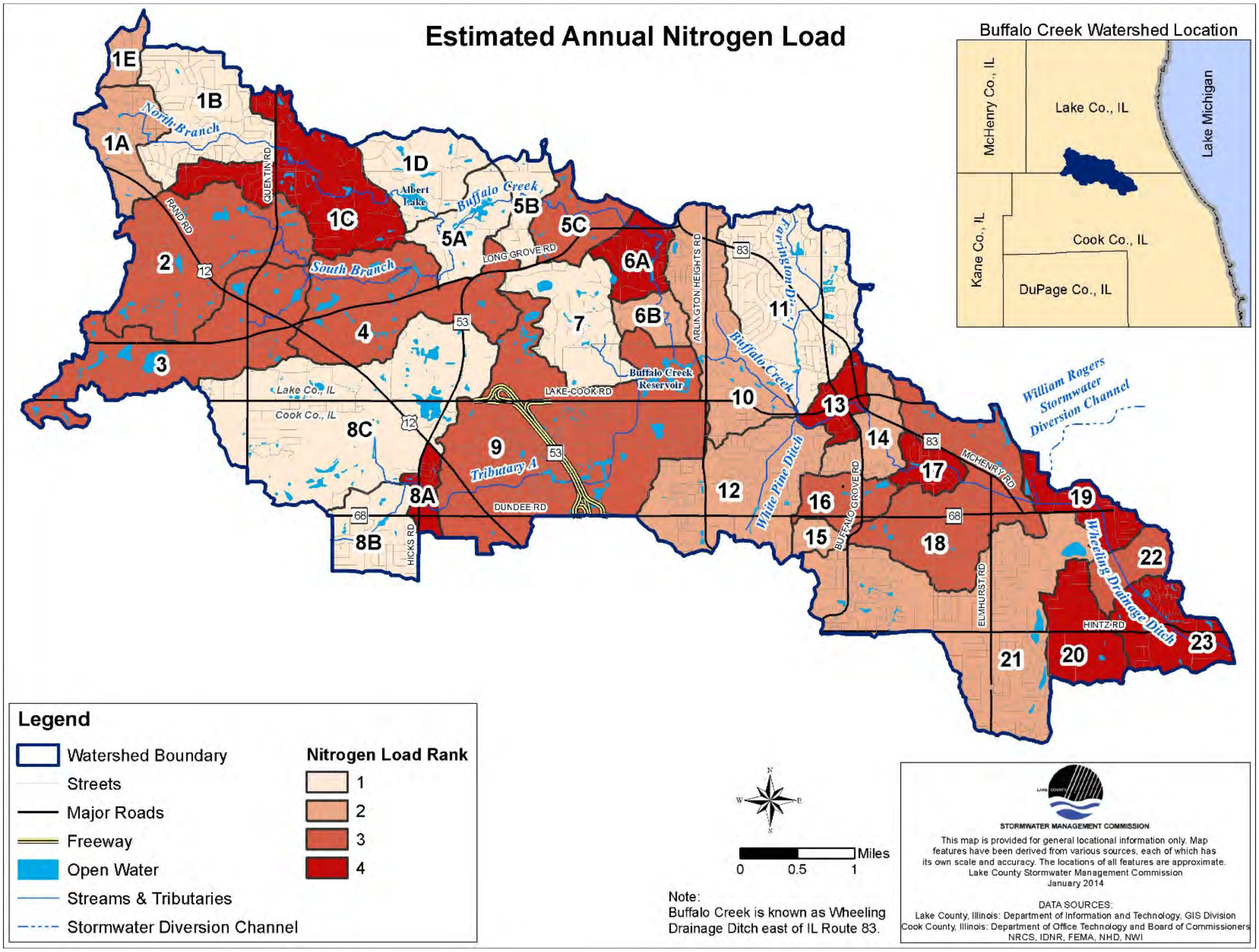


Figure 5-13: Estimated Nitrogen Load (pounds/year/acre) in the Buffalo Creek Watershed Per SMU.

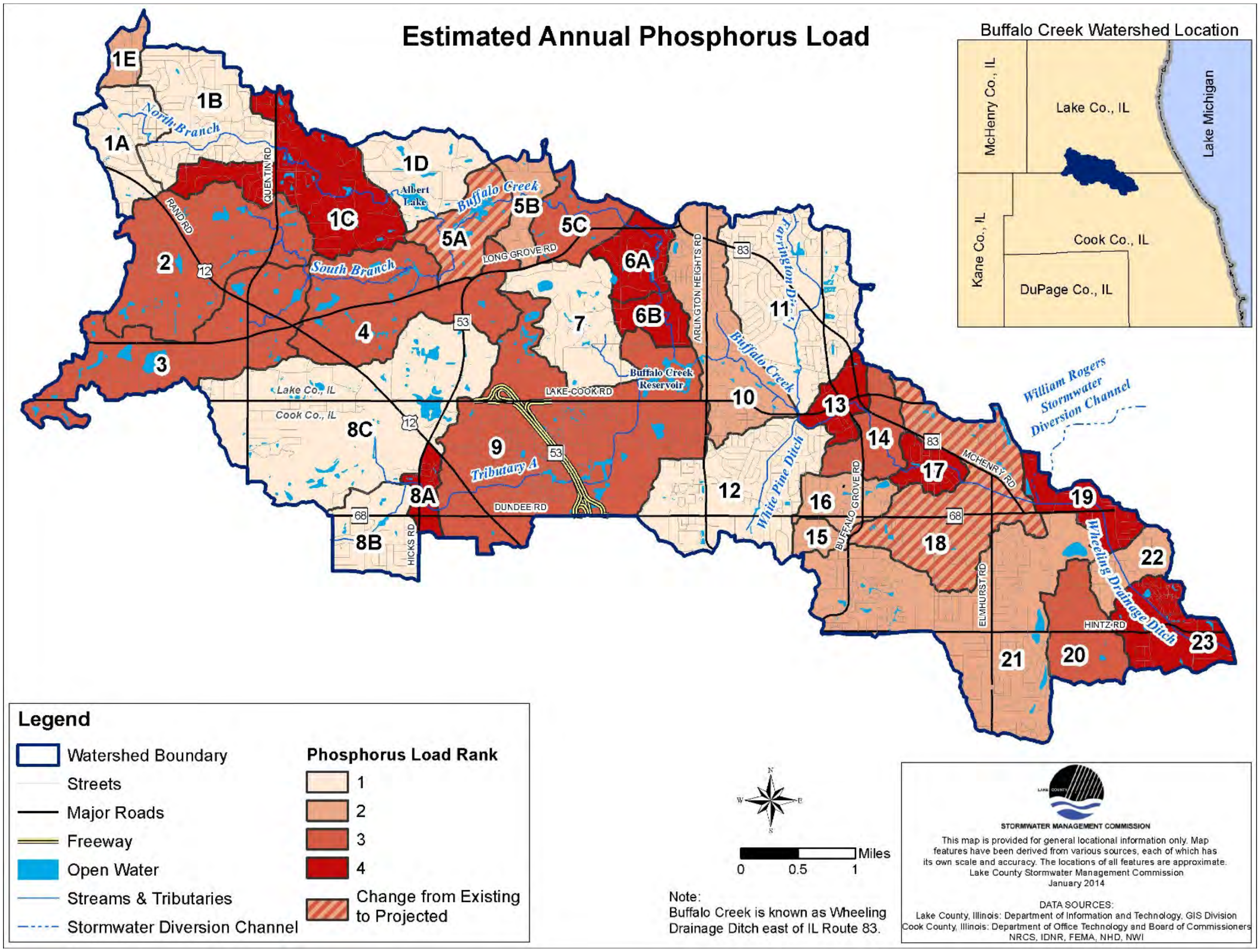


Figure 5-14: Estimated Phosphorous Load (pounds/year/acre) in the Buffalo Creek Watershed Per SMU.

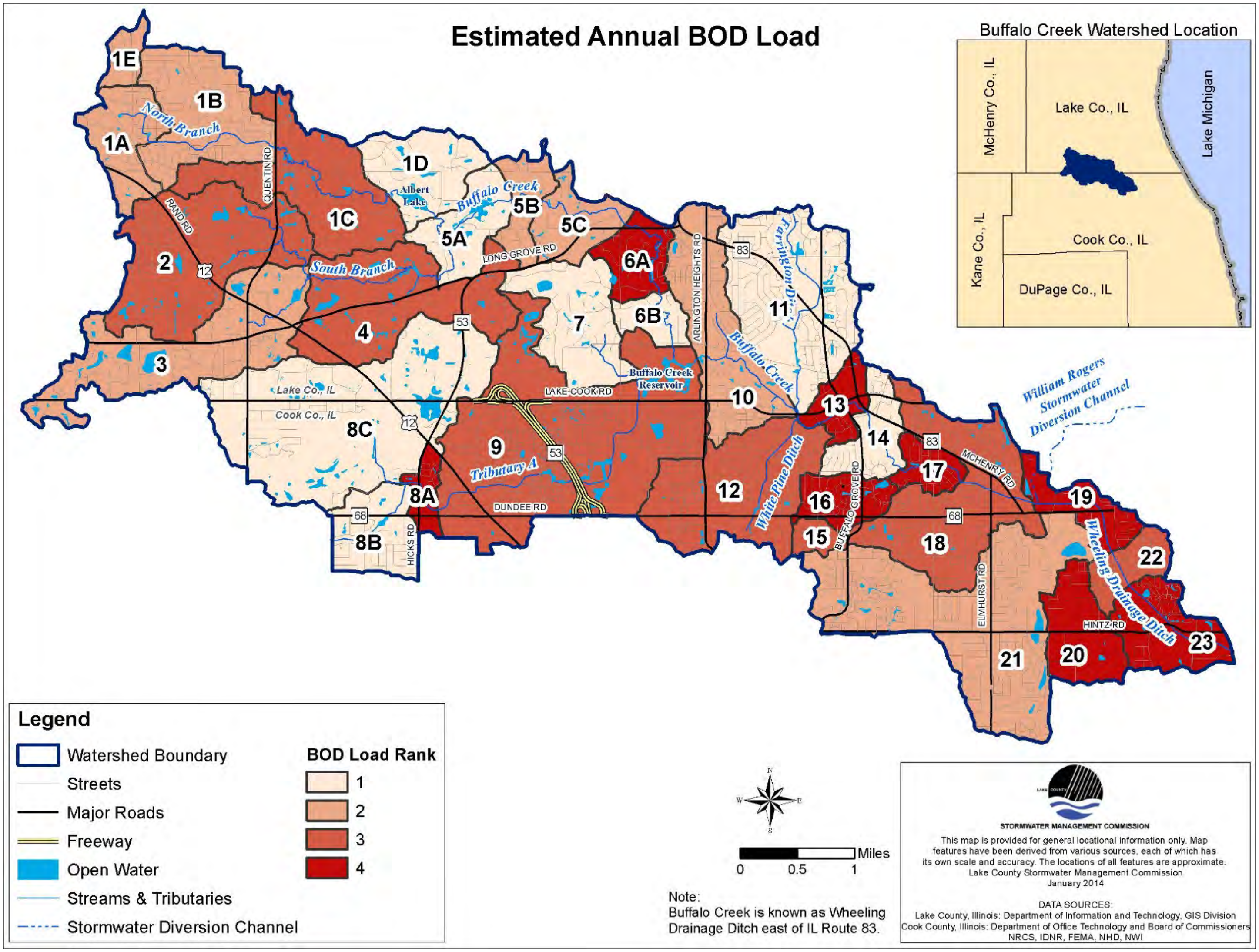


Figure 5-15: Estimated BOD Load (pounds/year/acre) in the Buffalo Creek Watershed Per SMU.

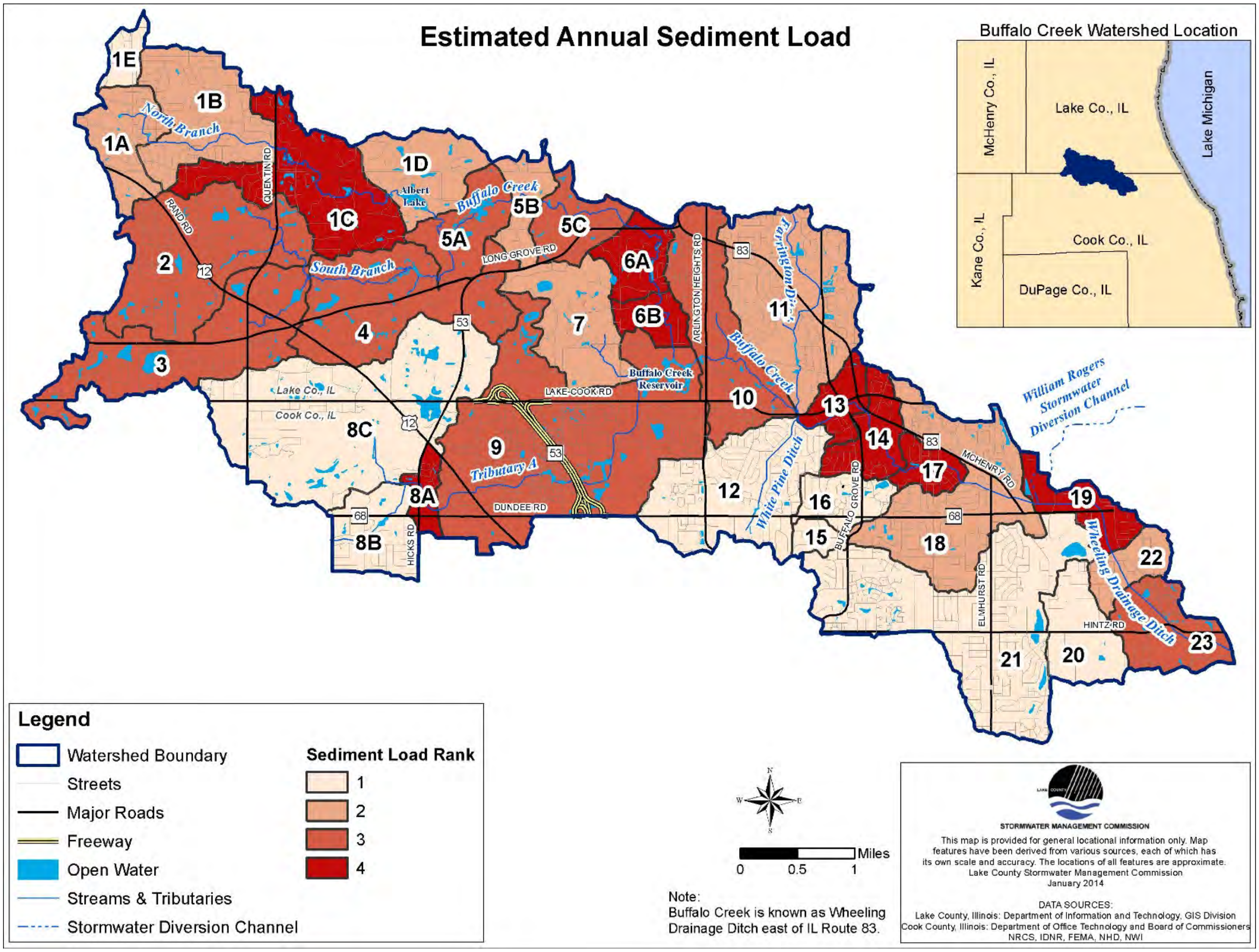


Figure 5-16: Estimated Sediment Load (tons/year/acre) in the Buffalo Creek Watershed Per SMU.

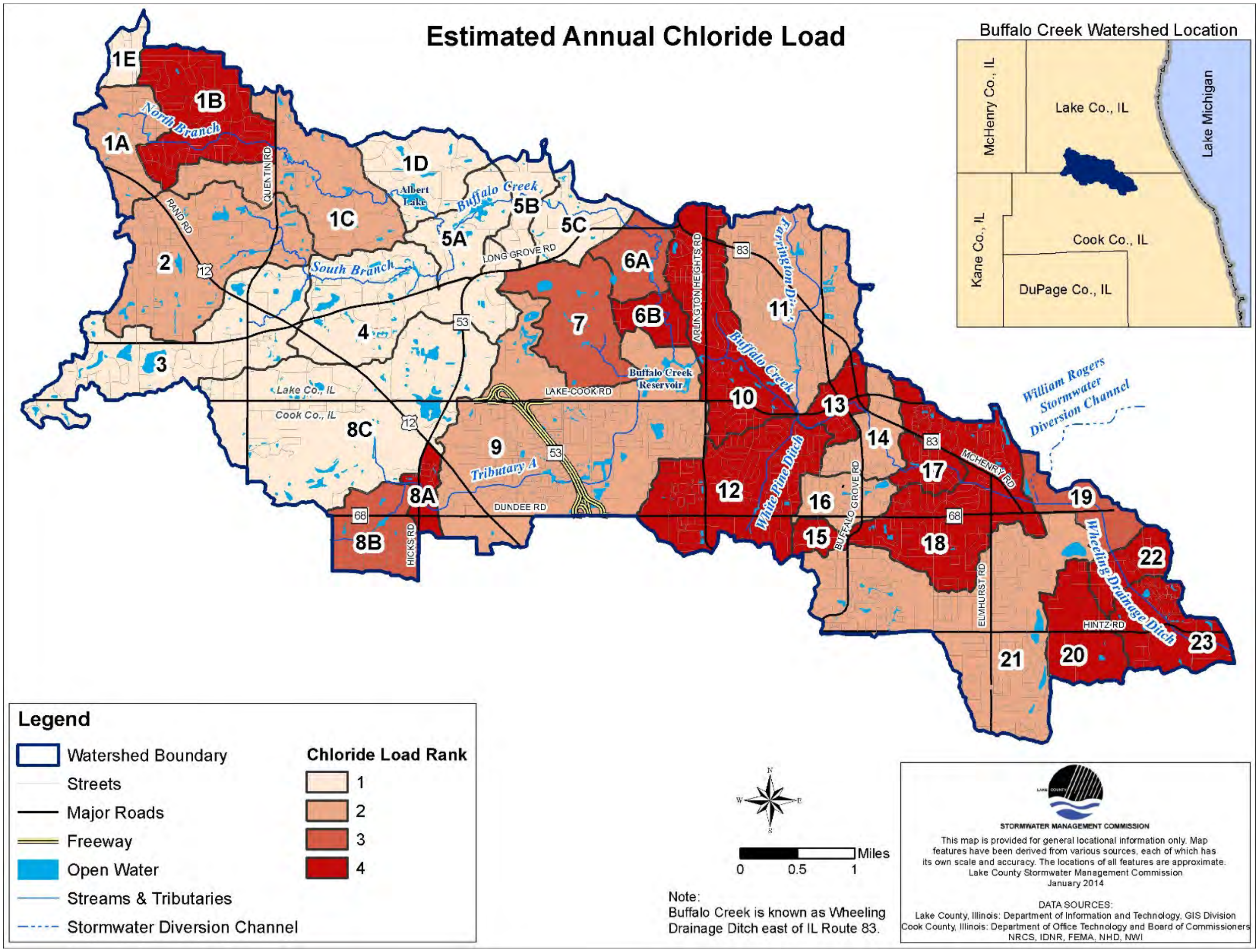


Figure 5-17: Estimated Chloride Load (pounds/year/acre) in the Buffalo Creek Watershed Per SMU.

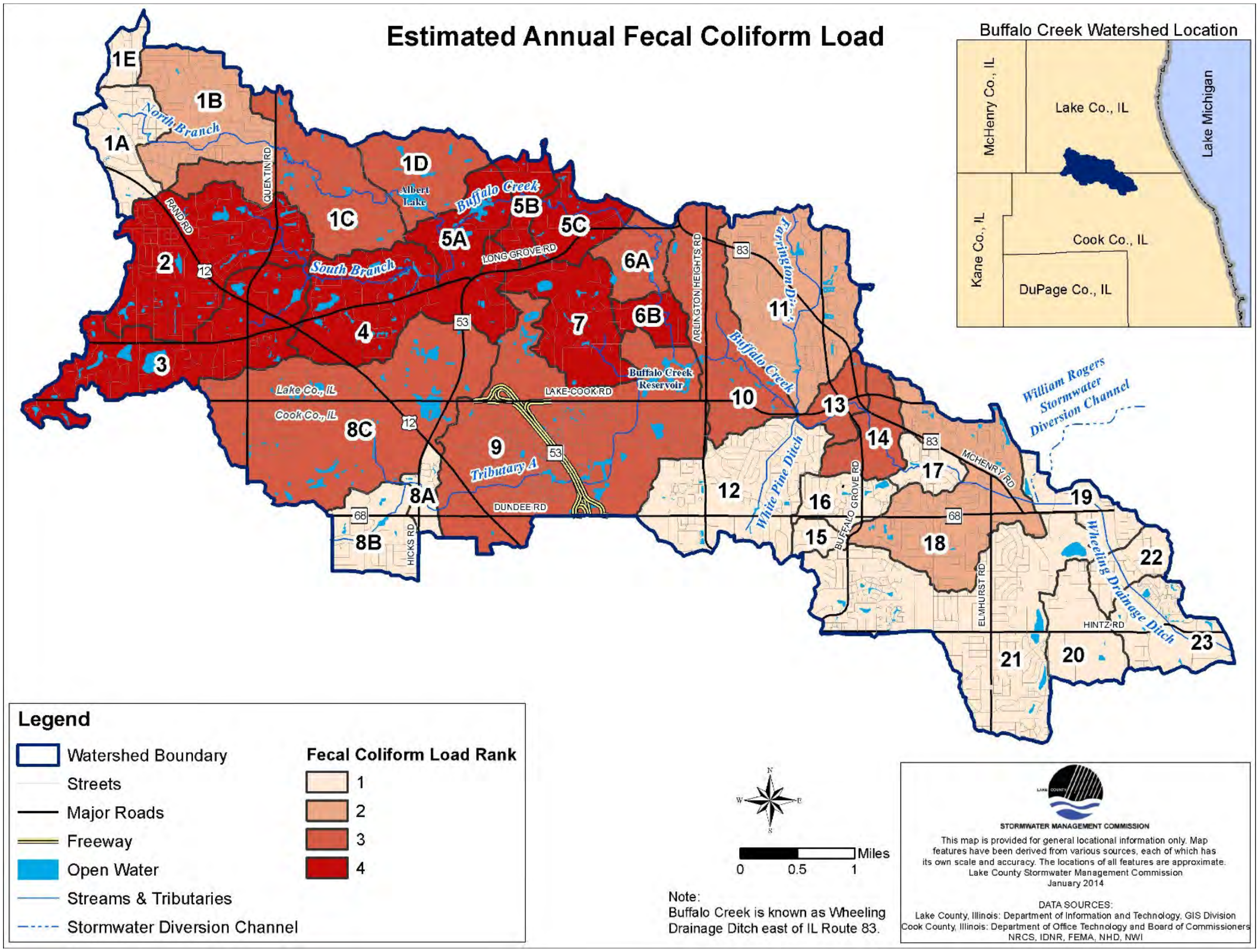


Figure 5-18: Estimated Fecal Coliform Load (Billion CFU/year/acre) in the Buffalo Creek Watershed Per SMU.

5.4.3 Hotspot Analysis

The cumulative results of the existing conditions pollutant loading analysis was used to develop a map of the watershed that depicts pollutant loading "hotspots". Hotspot SMUs were selected by examining pollutant load concentration (load/acre) for each pollutant. "Hotspots" were identified by assigning points to each SMU based on the results of the individual pollutant loading analysis of nitrogen, BOD, phosphorus, sediment, chloride and fecal coliform. Scores for each pollutant were assigned on a scale from 1 to 4 for each SMU based on quartiles (i.e. SMUs in the lower 25% received a score of 1 while SMUs in the upper 25% received a score of 4). Lower scores indicated a smaller pollutant load, while higher scores indicated a larger pollutant load.

The scores for all pollutants were summed for each subwatershed, providing a ranking of subwatersheds by overall pollutant loading (see **Table 5-15**). Subwatersheds in the top 25% of overall scoring were identified as hotspots in the Buffalo Creek Watershed. Identical methodologies were utilized to predict future hotspots based on the predicted land-use changes in the watershed. Existing and future hotspot ranking were the same due to little predicted land use change.

Results of the hotspot analysis are presented in **Appendix F**. The spatial distribution of these parameter specific and cumulative hotspots is displayed in **Figure 5-19 through Figure 5-25**. The hotspot SMUs are areas that are generally dominated by impervious cover. SMUs with the lowest overall pollutant loading per acre generally contain a mixture of land uses including developed, forested, open water, wetlands, herbaceous, shrubland and cultivated.

Table 5-15: Pollutant Load Hotspot SMUs in the Buffalo Creek Watershed.

Parameter	Highest Ranked SMUs Existing Conditions	Highest Ranked SMUs Future Conditions	Cumulative Pollutant Loading Hotspot SMUs
Total Nitrogen (lbs/year)	1C, 20, 8A, 23, 17, 13, 19, 6A	1C, 20, 8A, 23, 17, 13, 19, 6A	1C, 6A, 6B, 19, 23, 8A, 13, 17
Total Phosphorus (lbs/year)	1C, 23, 6B, 8A, 13, 17, 19, 6A	1C, 23, 6B, 8A, 13, 17, 19, 6A	
BOD (lbs/year)	18, 20, 8A, 23, 17, 13, 19, 6A	18, 20, 8A, 23, 17, 13, 19, 6A	
Sediment (ton/year)	14, 1C, 8A, 6B, 13, 17, 19, 6A	14, 1C, 8A, 6B, 13, 17, 19, 6A	
Chloride (lbs/year)	1B, 6B, 8A, 10, 12, 13, 15, 17, 18, 20, 22, 23	1B, 6B, 8A, 10, 12, 13, 15, 17, 18, 20, 22, 23	
Fecal Coliform (Billion CFU/year)	5A, 5C, 7, 4, 6B, 2, 5B, 3	5A, 5C, 7, 4, 6B, 2, 5B, 3	

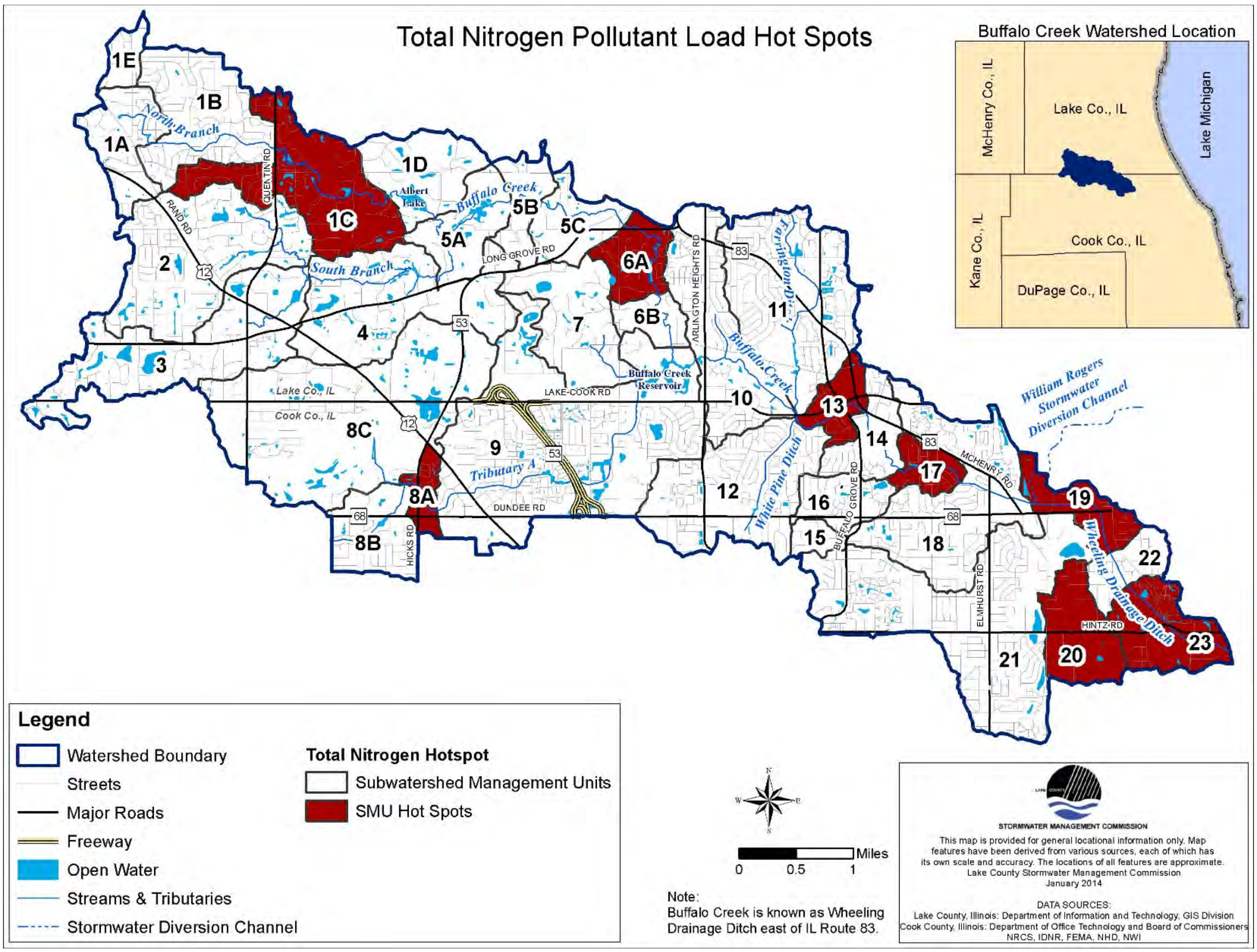


Figure 5-19: Nitrogen Load (pounds/year/acre) Hotspot in the Buffalo Creek Watershed Per SMU

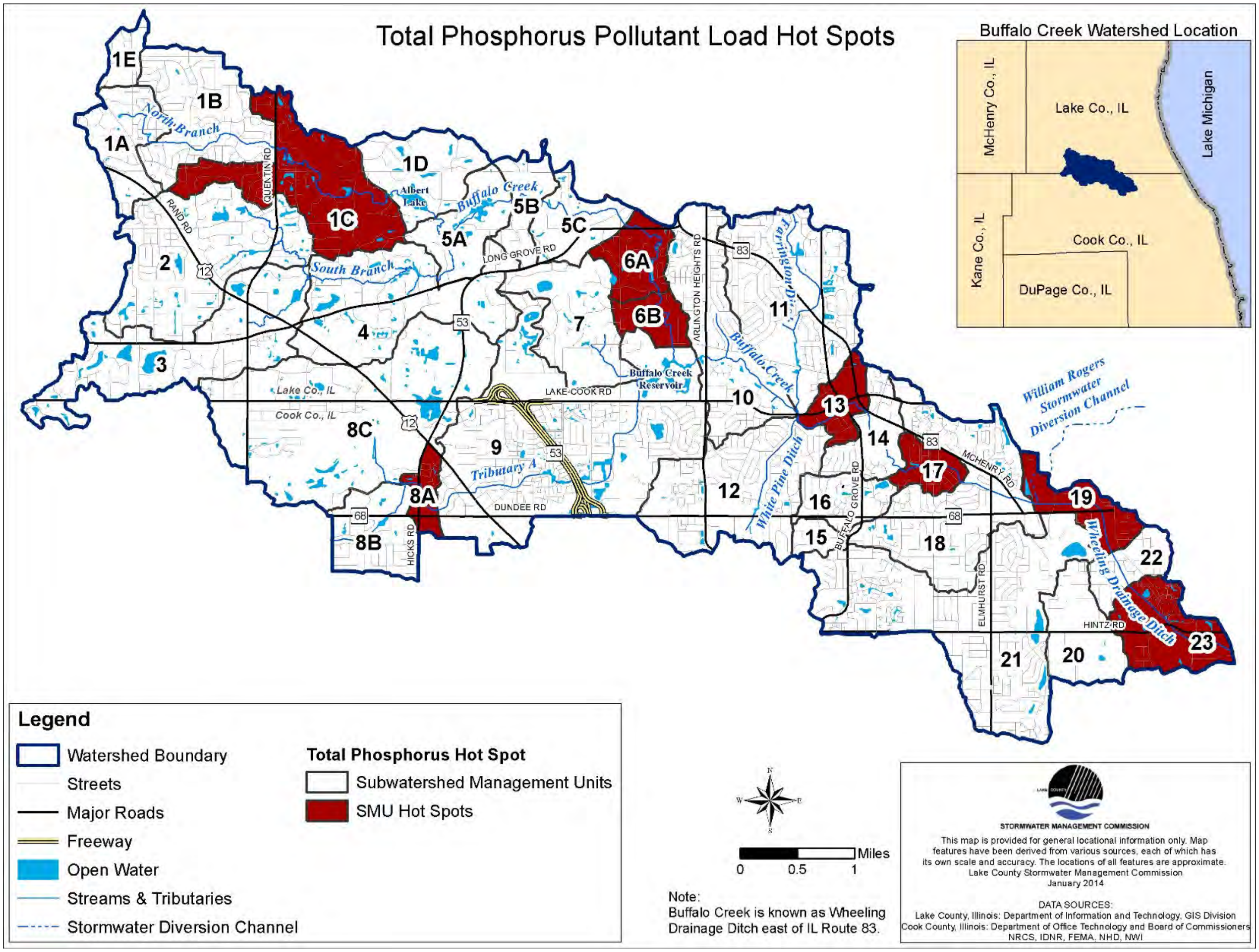


Figure 5-20: Phosphorous Load (pounds/year/acre) Hotspot in the Buffalo Creek Watershed Per SMU.

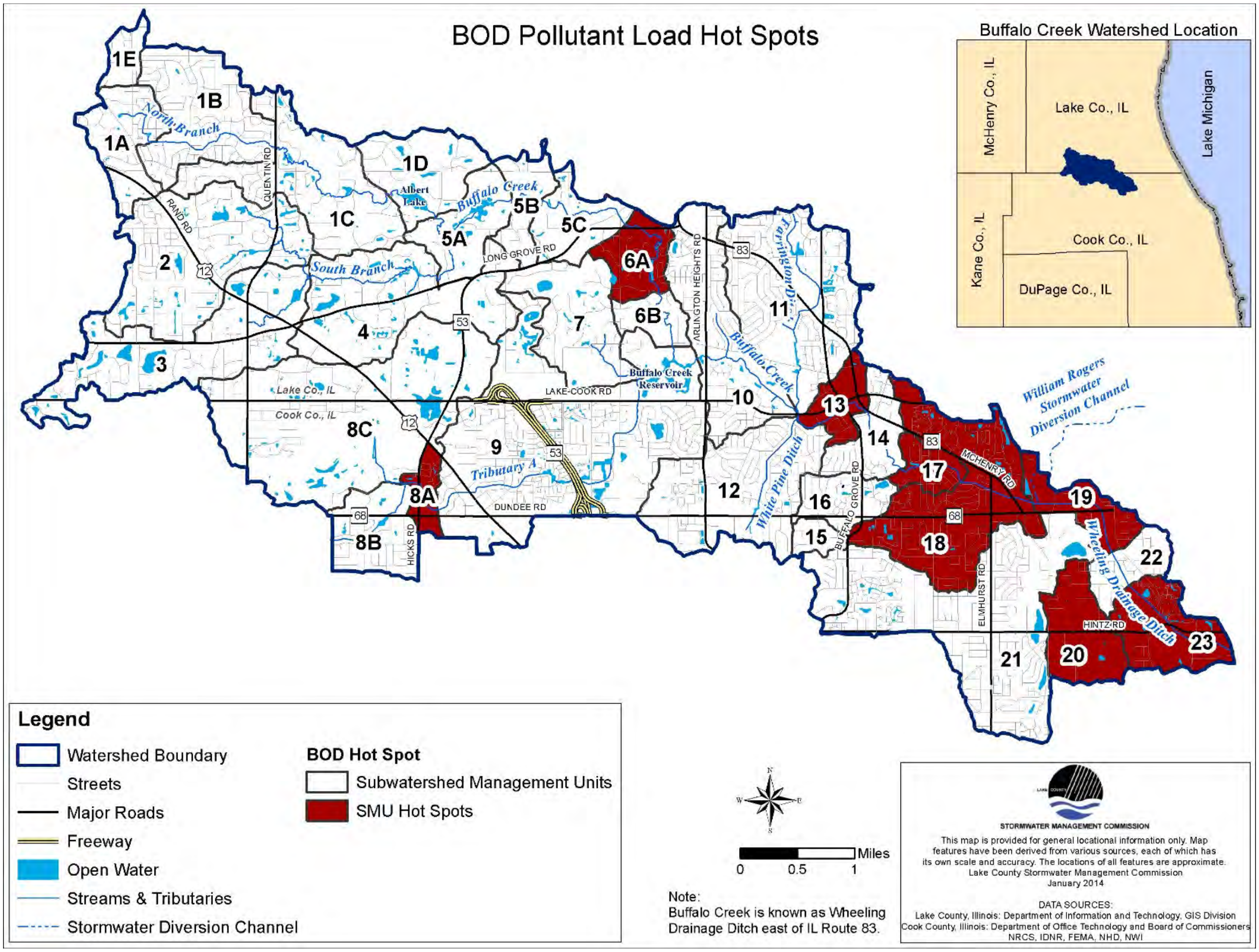


Figure 5-21: BOD Load (pounds/year/acre) Hotspot in the Buffalo Creek Watershed Per SMU.

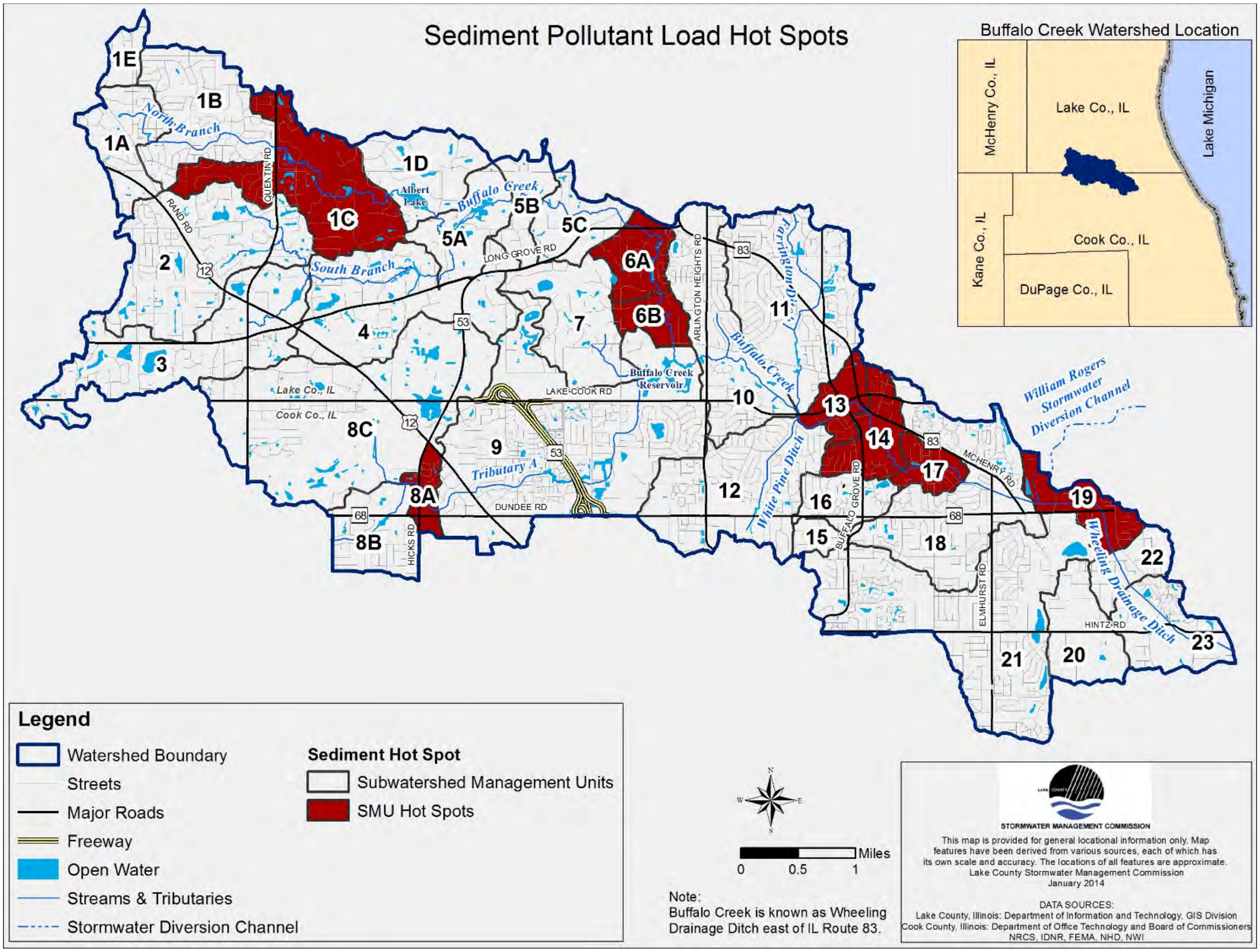


Figure 5-22: Sediment Load (tons/year/acre) Hotspot in the Buffalo Creek Watershed Per SMU.

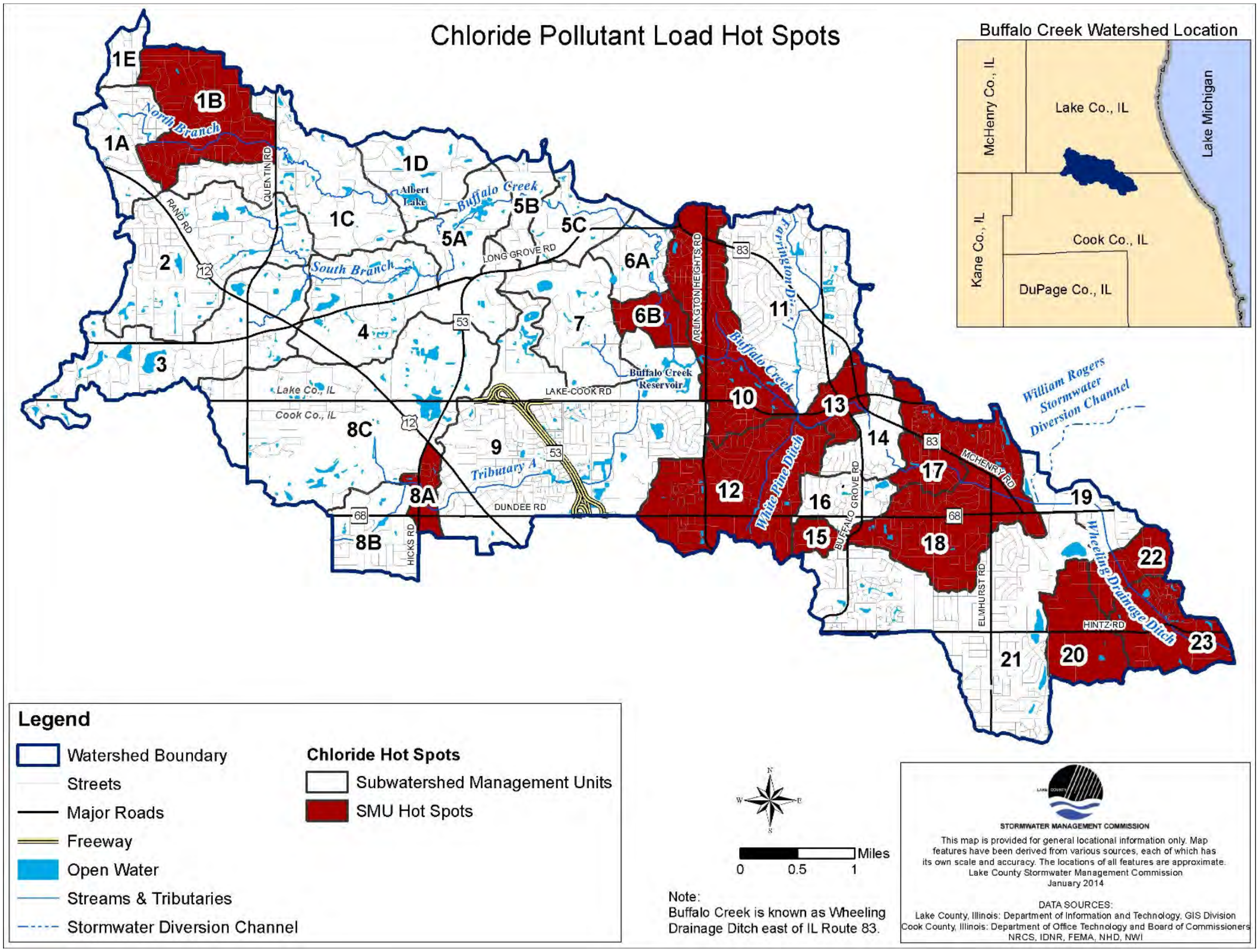


Figure 5-23: Chloride Load (pounds/year/acre) Hotspot in the Buffalo Creek Watershed Per SMU.

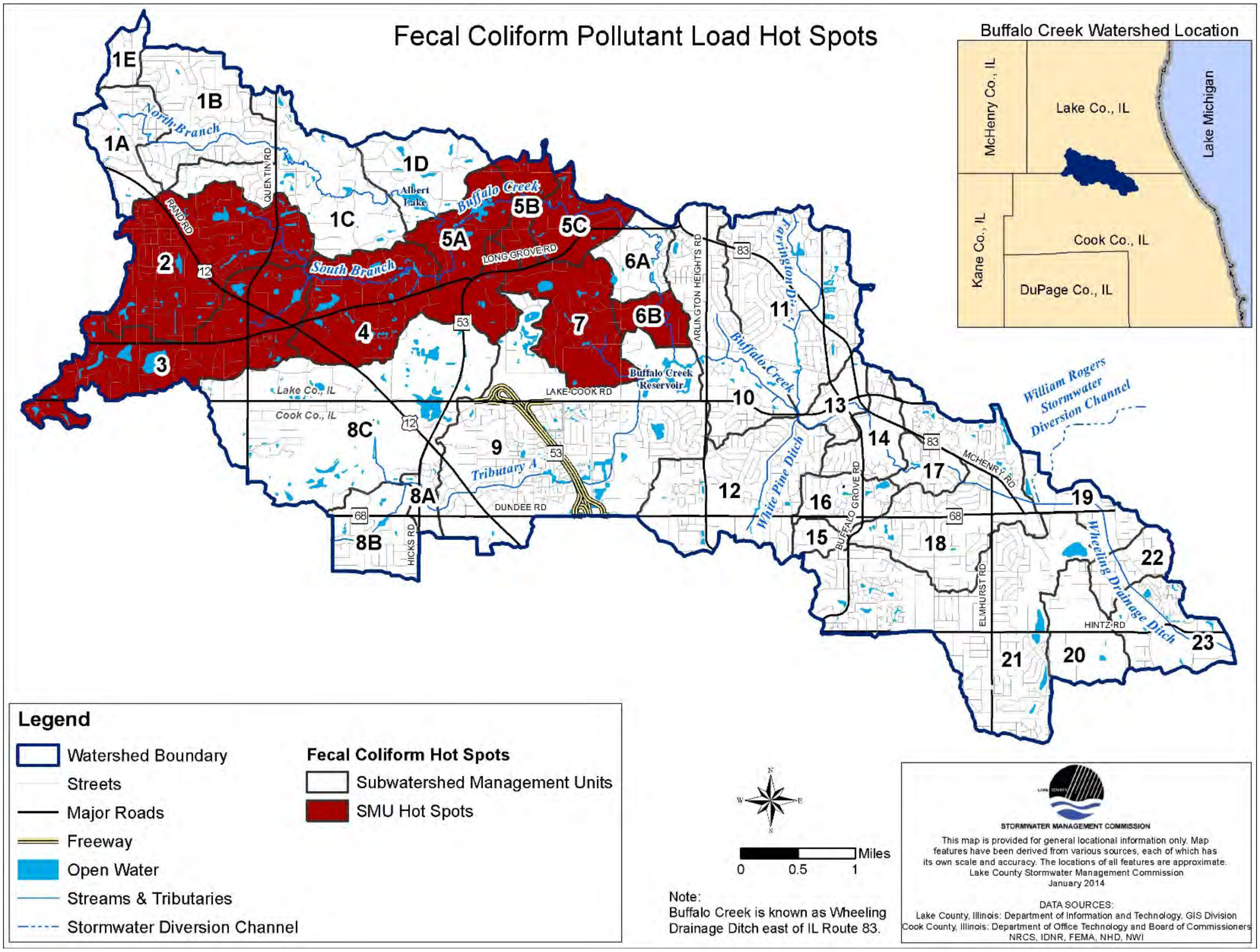


Figure 5-24: Fecal Coliform Load (Billion CFU/year/acre) Hotspot in the Buffalo Creek Watershed Per SMU.

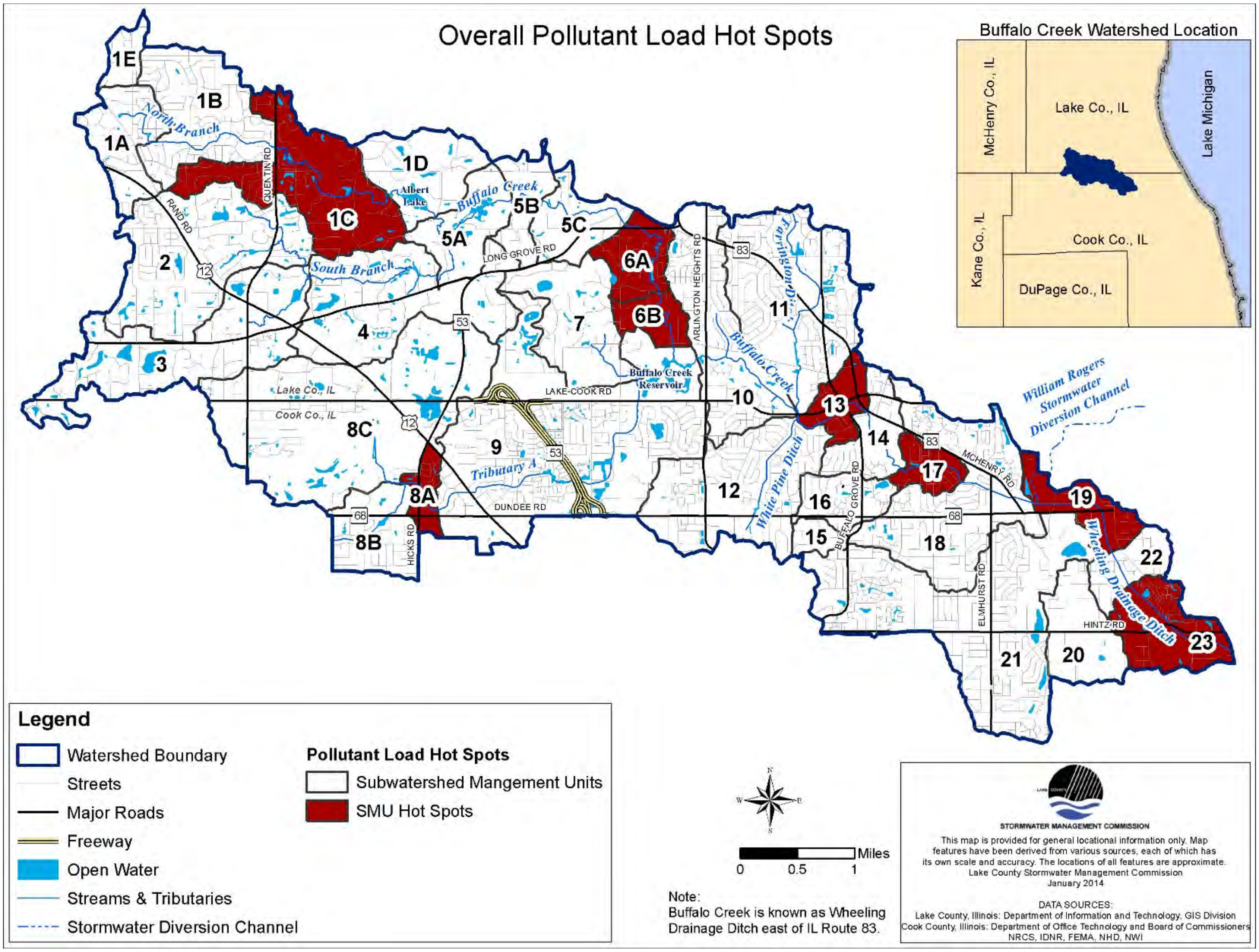


Figure 5-25: Cumulative Pollutant Load Hotspot SMUs.

5.4.4 Critical Areas Analysis

Critical areas are identified by SMU in the watershed. These critical areas are the areas that were determined to be best suited to focus implementation efforts to help achieve the non-point source pollutant reduction goals and objectives of the watershed plan. Critical areas represent SMUs that likely contribute to water quality problems in the watershed, and present opportunities where project implementation would provide the greatest value and benefit. Six criteria were analysed independently for each SMU (see **Table 5-16)** and then integrated into one metric. Scores ranged from 8 (lowest score) to 30 (highest score). The final scores and ranking are shown in **Table 5-17**.

The top five critical areas were SMU 6A, 19, 13, 1C and 17. All of the SMUs met some or all of the listed criteria, however only the top five SMUs were selected as priority critical areas. **Figure 5-26** presents the final critical areas SMU rankings.

Table 5-16: Critical Area Analysis Criteria.

Critical Area Criteria	Description
Future Land Use Change	Mitigating future development impacts is an important proactive strategy to address water quality and hydrologic issues before they become a problem. Understanding future development trends can assist stakeholders in making informed decisions related to land development and economic growth. SMU's received a score of 1 if the land use is predicted to change in the SMU and a score of zero if land use was not predicted to change. Scores ranged from 0 to 1.
Future Land Use Change on Highly Erodible Soil	SMU's were given scores based on predicted land-use change where future land-use change is expected to occur on highly erodible soils. SMUs received a score of 1 if the predicted land use change occurs on highly erodible soil and a zero if predicted land use change does not occur on highly erodible soil. Scores ranged from 0-1.
Streambank Erosion	Values were assigned to SMU's for streambank erosion based on the corresponding feet of severe or very severely eroded streambanks identified during the 2013 Stream Inventory. SMUs with no severe/very severe stream segments received a zero. SMUs with 1-2,999 linear feet of severe/very severe erosion received score of 1, 3,000-6,000 linear feet received a score of 2, and greater than 6,000 linear feet received a score of 3. Scores ranged from 0 to 3.
Water Quality Impairments	Values were assigned to each SMU for Water Quality Impairments based on the presence of an impaired water (per the Illinois EPA). Values were assigned to SMU's based on the number of impaired waters in the SMU. Scores ranged from 0 to 2.
Pollution Loading Hotspots	Values were assigned based on the sum of the normalized pollutant loads. Scores ranged from 5 to 25.
Estimated number of failing septic systems	The number of failing septic systems in each SMU was estimated by identifying the portions of the watershed not serviced by sanitary sewer systems and identifying the number of buildings in these areas using planimetric data. The total number of buildings in each SMU on septic systems was then multiplied by the estimated septic system failure rate (2%). Values were assigned based on the number of potential failing septic systems. SMUs with no failing septic systems received a score of 0. SMUs with 1 failing septic systems received a score of 1, 2 failing septic systems received a score of 2, and more than 2 failing septic systems received a score of 3. Score ranged from 0 to 3.

Table 5-17: Critical Area SMU Rankings.

SMU	Rank (1-32)	Final Score[1] (8-30)	SMU	Rank (1-32)	Final Score[1] (8-30)
6A	1	30	3	17	16
19	2	25	22	18	15
13	3	24	5C	19	15
1C	4	24	5B	20	13
17	5	23	16	21	12
9	6	21	12	22	12
23	7	20	15	23	12
8A	8	19	7	24	12
6B	9	19	5A	25	12
10	10	19	21	26	10
2	11	18	1A	27	10
14	12	16	8C	28	9
18	13	16	1D	29	9
20	14	16	8B	30	8
4	15	16	1E	31	8
1B	16	16	11	32	8

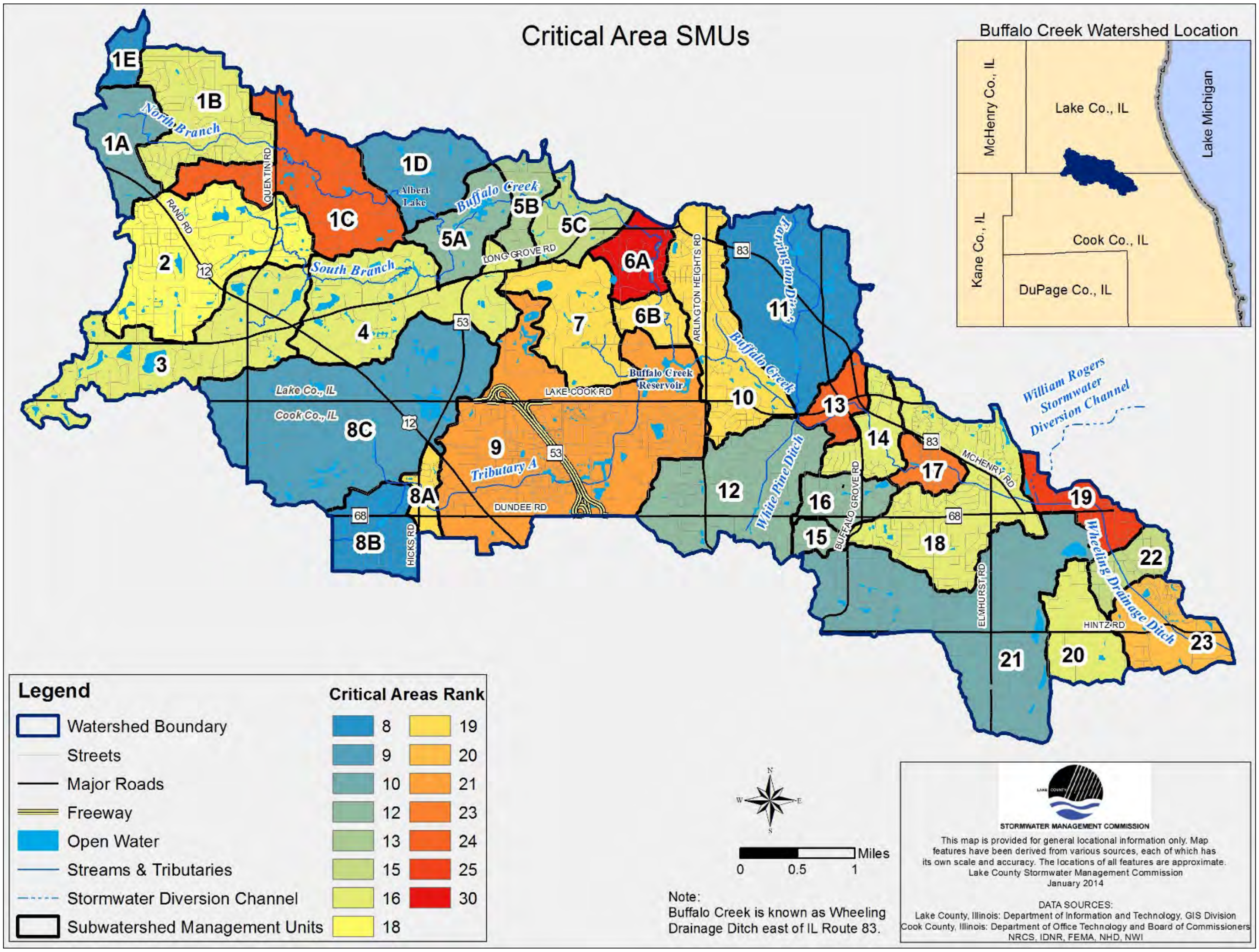


Figure 5-26: Critical Area SMU Rankings.

5.5 Watershed Jurisdictional Coordination

5.5.1 Issues to Be Addressed By a Coordinated Effort of Watershed Jurisdictions

The BCCWP stakeholders identified numerous issues that should be addressed at the watershed level. The following watershed issues could be addressed effectively with a coordinated effort of watershed jurisdictions with the support of private stakeholders.

- Water quality impairments of streams and lakes in the Buffalo Creek Watershed.
- The protection and restoration of natural resources.
- Flooding and stormwater management.
- Identification, promoting and supporting implementation of BMP projects.
- Erosion of streambanks and shorelines.
- Education and outreach regarding current watershed issues.

5.5.2 Watershed Roles and Responsibilities

This section describes watershed management and discusses ways to improve jurisdictional coordination among the primary responsible parties. Watershed management in the Buffalo Creek Watershed 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 and water management standards and incentives; education and outreach; and in-the-ground BMP projects.

Municipal and county governments (including both SMC and MWRD) share the greatest responsibility for watershed protection because they play a significant role in influencing and overseeing development impacts to the watershed through land use planning, land management and development policies and regulatory oversight. Transportation agencies are also influential. While transportation infrastructure improvements are necessary to accommodate a growing population and expanding business employment, roadway construction and post-construction operation and maintenance can have a significant influence on water resources. Roadway projects are not only initiated and maintained by municipalities and the counties in the watershed, but also by townships, the Illinois Department of Transportation (IDOT) and the Illinois Tollway Authority.

Other agencies and private entities with watershed or technical advisory roles include the Lake County Forest Preserve District, Cook County Forest Preserve District, park districts, North Cook County Soil and Water Conservation District and the McHenry-Lake County Soil and Water Conservation District. The forest preserve and park districts not only provide important recreation and educational opportunities, but also play a critical role in natural resource protection, particularly for rare or high quality habitat and threatened and endangered species. They protect and manage land that often contains wetlands, lakes, ponds, and streams that make up the natural drainage system green infrastructure. Soil and Water Conservation Districts provides technical resource assistance to the public and other regulatory agencies including soil erosion and sediment control inspections.

5.5.3 Watershed Development

Development practices that affect water resources (rivers, streams, lakes, isolated wetlands, and floodplains) are largely regulated by the Watershed Management Ordinance (WMO) in Cook County and the Watershed Development Ordinance (WDO) in Lake County along with county and municipal ordinances and land use plans. In addition to local regulations, the U.S. Army Corps of Engineers (USACE) regulates the fill of waters of the United States (including adjacent and connected wetlands. IDOT and the Illinois Tollway Authority design and construct roadways in the watershed. Although these agencies confer with local units of government, state and federal projects are not required to meet local regulatory requirements, but are governed by state and federal policies and regulations.

> ***Certified Community:*** *A community which has petitioned SMC and has been found by the SMC to be capable of enforcing an ordinance (or ordinances) which contain stormwater and Regulatory Floodplain management rules and regulations which are consistent with, or at least as stringent as the Lake County WDO.*
>
> ***Authorized Municipality:*** *A Cook County municipality authorized by the MWRD to issue watershed management permits within its corporate boundaries.*

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 may be 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, primarily for several specific floodplain and floodway provisions of the WDO for all communities.

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, certain modifications and/or 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 Intergovernmental Agreement (IGA) with the 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.

Table 5-18 presents the countywide ordinance permitting authority for municipalities in the Buffalo Creek Watershed. The Illinois Department of Natural Resources (IDNR) has floodplain/floodway regulatory and oversight authority within both counties. IDNR has delegated floodplain/floodway review authority to SMC for Lake County.

Table 5-18: Countywide Ordinance Permitting Authority for Municipalities in the Buffalo Creek Watershed.

Jurisdiction	Lake County WDO	Cook County WMO
Wheeling	Not Certified	Not Authorized
Buffalo Grove	Conditional Certification	Not Authorized
Long Grove	Certified	N/A
Kildeer	Certified	N/A
Palatine	N/A	Not Authorized
Lake Zurich	Certified	N/A
Deer Park	Certified	IGA to use WDO
Arlington Heights	N/A	Not Authorized
Prospect Heights	N/A	Not Authorized

5.5.4 In-The-Ground Projects

In-the-ground projects are encouraged and incentivized through adoption of a watershed management plan by local units of government. 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. Of particular importance for implementing projects identified in the watershed plan is the development of partnerships – stakeholder groups (homeowners associations, non-profit organizations, businesses, etc.), schools, community agencies and the like – to coordinate, fundraise, secure grants, and ultimately oversee project implementation. The experience and success that partnerships often gain from working together on a watershed project can influence regulatory changes and further cooperation among policy-makers.

The watershed action plan will identify 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 especially for studies/plans. Private entities as partners can also provide cost share for design, consulting, and construction work for projects, and/or in-kind BMP services such as seeding, planting, restoration work, trail construction, and interpretive education.

Nearly all watershed projects, including those developed through coordinated planning efforts, benefit from partnerships that share design, permitting, material, and labor costs. In some instances, project costs can be covered by cost-share grants, while on-going maintenance may be completed in partnership with a local jurisdiction. Partnerships involving one or more municipality, township, homeowner association, developer, county agency, lakes management group, landowners, and local, state and federal agencies are possible. 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 relationship building among partners who share a vested interest in how well their projects perform. Partnership on a first project may result in the establishment of an institutional relationship that results in implementing cooperative projects into the future.

5.5.5 Post-Construction Monitoring and Maintenance

Opportunities for establishing partnerships to improve monitoring and maintenance effectiveness and efficiency should also be explored. Some examples of shared maintenance activities for consideration include stream monitoring and maintenance, stormwater monitoring, road and parking lot de-icing, detention basin monitoring and maintenance and invasive plant management. Partnerships may be established to share technical expertise; develop maintenance guidelines or standards; share services, equipment or storage locations; or combine contracts with neighbouring jurisdictions for similar activities such as winter road maintenance and invasive plant management.

The Buffalo Creek stream assessment conducted for this watershed planning effort, along with input from the watershed planning stakeholder group, points out a strong need for better stream monitoring and maintenance of Buffalo Creek. The maintenance of streams is a shared responsibility between public agencies and individual landowners. In some instances, individual lot owners will have responsibility for 50-100 feet of creek on their home or business lots, while in other locations the Forest Preserve District or large farm owners may have thousands of linear feet of stream running through their properties. SMC and MWRD would be the lead entities responsible for working with landowners and other jurisdictions to develop and implement standards for stream maintenance. Individual MS4s (municipalities and townships) may want to coordinate a cooperative effort with private landowners to monitor stream reaches within their jurisdiction with support from SMC and MWRD.

Communication among relevant watershed jurisdictions is crucial to the successful sharing of services and responsibilities. This may include communication amongst transportation agencies forest preserves, SMC, MWRD, municipalities, townships, and the counties. Municipalities would take the lead on communicating with park districts, homeowner associations and private landowners within their jurisdiction. With the availability of the internet, the first order of communication should be to provide transparency by making the information on the work activities of each organization/jurisdiction available to all watershed partners and residents. While inter-jurisdictional coordination may entail doing business in a new or different way, the ultimate outcome should be more efficient, effective and sustainable achievement of watershed goals within a reasonable timeframe and at a reasonable cost. **Table 5-19** includes a summary of the issues identified in the watershed planning process that would be best addressed through coordinated partnership efforts.

Table 5-19. Issues to be Addressed with Watershed-level Coordination.

Issue	Strategies to address issue	Potential actions	Responsibility
Flooding and Stormwater Management	Porous pavement retrofits.	Promote through public/private BMP projects.	Municipalities Counties
	Installation of Low-Impact Development (LID) practices.	Review ordinances and land management standards to allow by right and set up voluntary incentive programs.	Municipalities Counties Park Districts
	Wetland mitigation/restoration.	Future potential watershed-specific policy.	SMC MWRD USACE Certified Communities
	Preserve landscape-scale green infrastructure corridors.	Incorporate green infrastructure network in land use plans. Set up partnership to fund and implement.	Municipalities FPD Park Districts
	Road improvement retrofit projects.	Incorporate stormwater BMPs.	IDOT CCDOT LCDOT Tollway Municipalities Townships
Water Quality Impairments	Pollution prevention education.	Coordinate with NPDES II program outreach.	Municipalities SMC MWRD
	Phosphorus fertilizer ban.	Adopt ban(s).	Municipalities Counties
	Reduce sodium chloride application with alternative practices and chemicals.	Form buying consortium to share equipment and reduce cost of alternative products.	Municipalities CCDOT LCDOT Townships Tollway
	Participate in Des Plaines River Watershed Workgroup (DRWW).	Each NPDES community/agency participates in work group.	Municipalities Townships County

	Coordinated NPDES II monitoring.	Watershed stakeholders collaborate on developing coordinated monitoring program.	Watershed Council Municipalities Townships DRWW MWRD
	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 CCDOT LCDOT Townships Tollway
Promoting and implementing green infrastructure	Installing neighbourhood and site-scale green infrastructure.	Review ordinances and land management standards to allow by right and set up voluntary incentive programs.	Municipalities MWRD SMC Counties
Natural resource/habitat protection and restoration	Habitat protection and restoration.	Restoration of hydrology and native plant communities in existing natural areas.	Park Districts CCFPD LCFPD Municipalities Townships
Site specific streambank erosion	Stream maintenance and restoration strategy.	Develop and adopt standards for stream maintenance.	SMC MWRD Municipalities Counties

5.6 Green Infrastructure

5.6.1 Green Infrastructure Benefits

The U.S. EPA defines Green Infrastructure as the use of natural hydrologic features to manage water and provide environmental and community benefits (www.water.epa.gov/infrastructure/greeninfrastructure). Green Infrastructure consists of practices that use vegetation and soil to manage rainwater where it falls. By integrating natural processes into the built environment, green infrastructure provides not only stormwater management, but also flood mitigation, economic benefits, air quality management, and much more. Green infrastructure can be looked at one two 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.

The Buffalo Creek Watershed plan addresses the condition and quality of water resources and flood damage in the watershed. Stormwater runoff is a major cause of water pollution and flooding in suburban watersheds like Buffalo Creek. Hard surfaces such as rooftops, driveways, parking lots, and streets generate stormwater runoff that conveys pollutants to wetlands, lakes, and streams, which are components of a natural drainage or green infrastructure system. Higher flows of stormwater can also cause erosion and flooding in urban streams, damaging habitat, property, and infrastructure. Since green infrastructure plays a significant role in how water moves in and on the landscape, it is an important element in the Buffalo Creek Watershed Plan for assessing current and planning for future conditions.

Local and regional scale green infrastructure work in concert to infiltrate and store precipitation, thereby reducing and treating stormwater at its source in addition to delivering many other environmental, social, and economic benefits. These benefits promote urban liveability. By improving the environment and preserving open space, green infrastructure supports sustainable communities.

5.6.2 Green Infrastructure Inventory

The Buffalo Creek Watershed Green Infrastructure Inventory was initiated by conducting an inventory of open and partially open parcels in the watershed. Aerial photographs, property parcels, and assessor records were used in GIS to classify the open parcels, partially open parcels, and developed parcels. Open parcels are defined as parcels with no built structures or impervious cover (including open water). Partially open parcels are defined as having a structure (building, parking lot) on a relatively small area of the larger parcel, thus still offering potential for the implementation of BMPs. Developed parcels are defined as being largely occupied by structures and/or impervious cover. In calculating acreages, open and partially open parcels may include open water, such as lakes or rivers. Open and partially open parcels are classified as either protected open space or unprotected; unprotected areas may be developed in the future.

5.6.2.1 Inventory Findings

The 17,393-acre Buffalo Creek Watershed contains 21,769 parcels. There are 20,900 developed parcels that cover 10,246 acres or 59% of the watershed. Developed parcels dominate the watershed, accounting for 96% of all parcels. The majority of the developed parcels in the watershed are single-family residential land use. Partially open parcels contain some development (often residences, farmsteads, and accessory buildings) but with acreage exceeding the surrounding minimum zoning. Partially open parcels may also include agricultural land, institutional sites, and deed-restricted areas or easements that contain stormwater detention or wetland areas. There are 277 partially open parcels in the watershed, covering 1,526 acres or 9% of the watershed. Open parcels are generally comprised of agricultural land, undeveloped land, common-ownership outlots and deed-restricted areas (such as detention basins and wetlands), public open space (such as parks and forest preserves), lakefront property, and open water. There are 642 open parcels in the watershed, covering 3,103 acres or 18% of the watershed. **Table 5-20** and **Figure 5-27** present the distribution of parcel types in the watershed.

Table 5-20. Open, Partially Open, and Developed Parcels.

Parcel Type	# of Parcels	% of Watershed (based on # of parcels)	Acres	% of Watershed (based on acreage)
Open Parcels	642	3%	3,103	18%
Partially Open Parcels	277	1%	1,526	9%
Developed Parcels	20,900	96%	10,246	59%
Gaps in parcel data & road ROW	NA	NA	2,518	14%
TOTAL	**21,769**	**100%**	**17,393**	**100%**

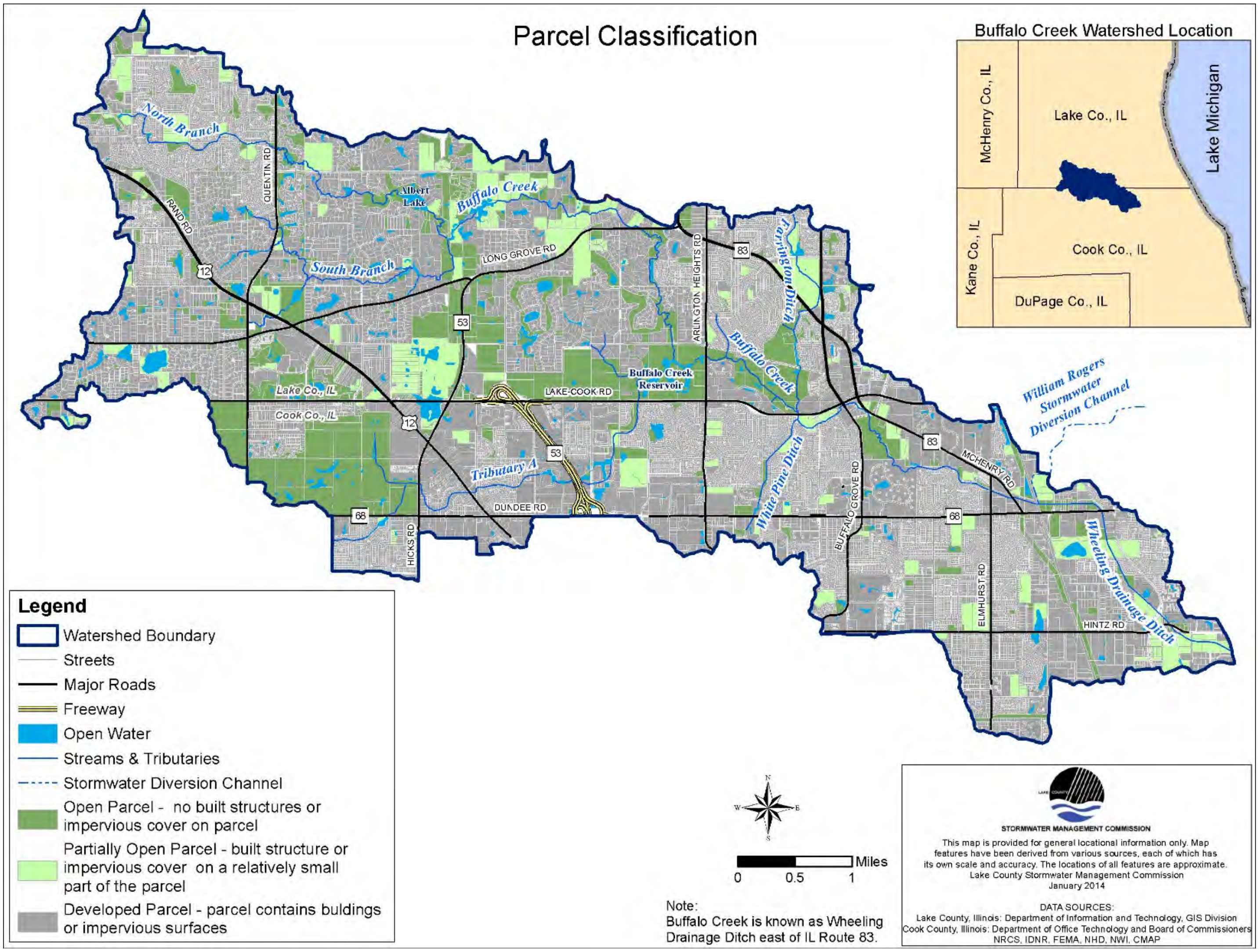


Figure 5-27. Open, Partially Open, and Developed Parcels in the Buffalo Creek Watershed.

5.6.2.2 Public and Private Ownership

Figure 5-27 demonstrates that the majority of the Buffalo Creek Watershed is developed. The vast majority of the developed land in the watershed is under private ownership (see **Table 5-21** and **Figure 5-28**). Partially open parcels are almost equivalent between public and private ownership, with slightly more partially open parcels under private ownership. Approximately two-thirds of the open parcels in watershed are under private ownership. However, the open parcels under private ownership are smaller than those under public ownership, which has more acreage that is open.

Table 5-21. Ownership of Open, Partially Open and Developed Parcels.

Ownership	Open Parcels		Partially Open Parcels		Developed Parcels	
	Acres	% of Open Parcels	Acres	% of Partially Open Parcels	Acres	% of Developed Parcels
Public	1,645	53%	631	41%	230	<1%
Private	1,458	47%	895	59%	10,016	99%

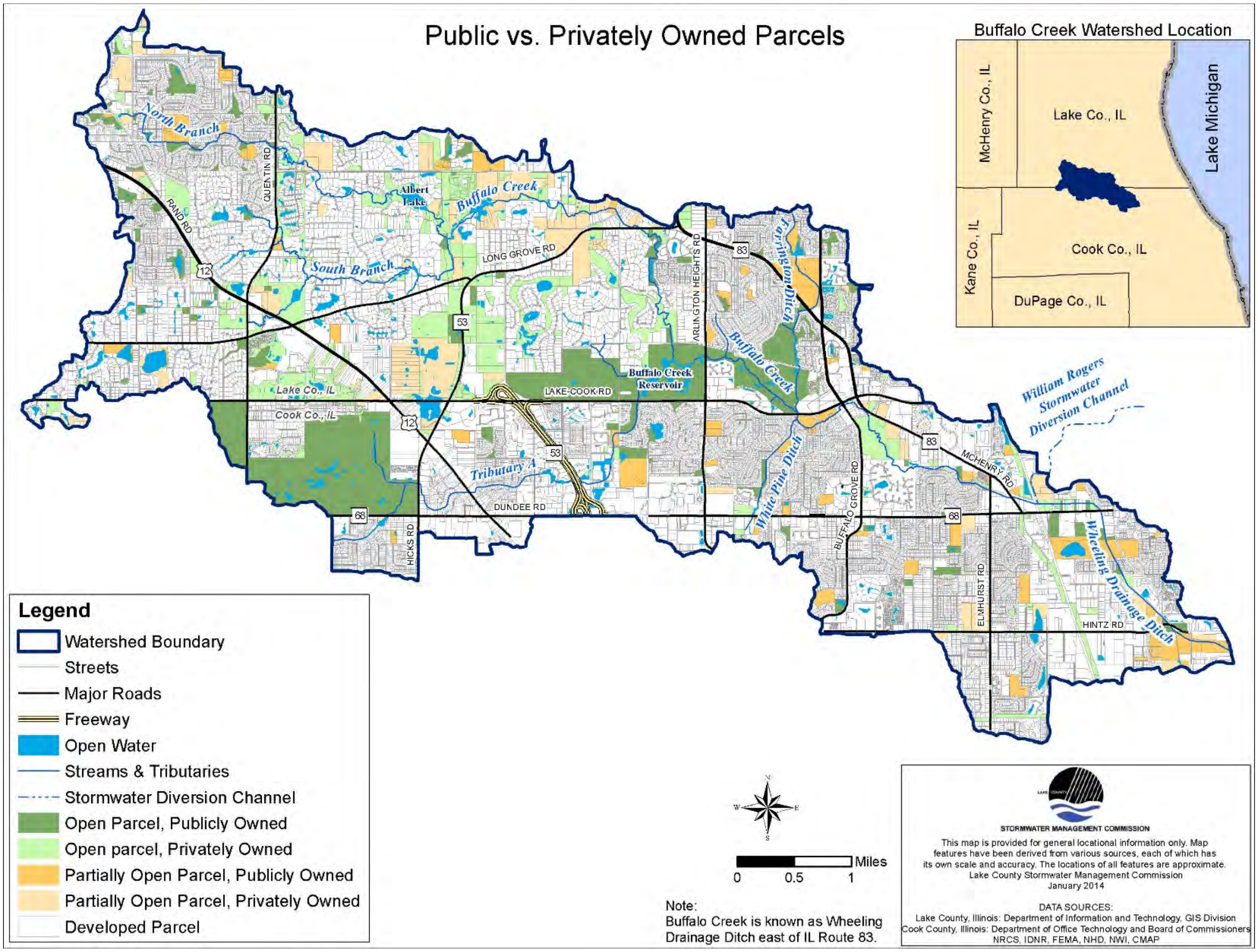


Figure 5-28: Public and Privately Owned Open and Partially Open Parcels in the Buffalo Creek Watershed.

Noteworthy: Open and Partially Open Space

Open space provides innumerable benefits to the watershed. The open space filters the air and water, reduces the volume and energy of surface water runoff, and provides wildlife habitat and recreation areas. These factors prove to be beneficial for social, economic, environmental and human health reasons. In addition, much of the open land is in the form of wetlands, thus maintaining the groundwater level while decreasing flooding potential (Environmental Protection Agency, 2009). Wetlands function similar to a kidney, where water runoff is collected, absorbed, and filtered prior to be slowly released into the aquifer. All of these positive factors are reduced and sometimes even irrevocably destroyed when urban and suburban development is mismanaged and poorly planned.

5.6.2.3 Protection Status

Green Infrastructure (GI) Network: Uses vegetation, soils, and natural processes to manage water and create healthier urban environments.

Protected open space differs from unprotected open space because it is permanently preserved as open space by outright ownership of a private or public body. The land is either permanently chartered as open land or is 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 poses a threat to 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 and habitat connectivity.

The Buffalo Creek Watershed Green Infrastructure inventory identified the number and size of protected parcels in the Buffalo Creek Watershed. All protected and unprotected parcels were then sorted as open parcels, partially open parcels or developed parcels. As previously mentioned, developed parcels are the most common parcel type in the Buffalo Creek Watershed. The largest quantity of protected parcels are found amongst open parcels (see **Table 5-22**). The second largest quantity of protected parcels can be found amongst partially open parcels (see **Table 5-22**). The open/partially open unprotected parcels (see **Figure 5-29**) located in close proximity to protected areas or along areas stream corridors will be key parcels for the development of a ***green infrastructure (GI) network***.

Table 5-22: Protection Status Summary of Buffalo Creek Watershed Parcels.

Protection Status	Open Parcels		Partially Open Parcels		Developed Parcels	
	Acres	% of Open Parcels	Acres	% of Partially Open Parcels	Acres	% of Developed Parcels
Protected	1,446	47%	655	43%	180	<1%
Unprotected	1,657	53%	871	57%	10,066	99%

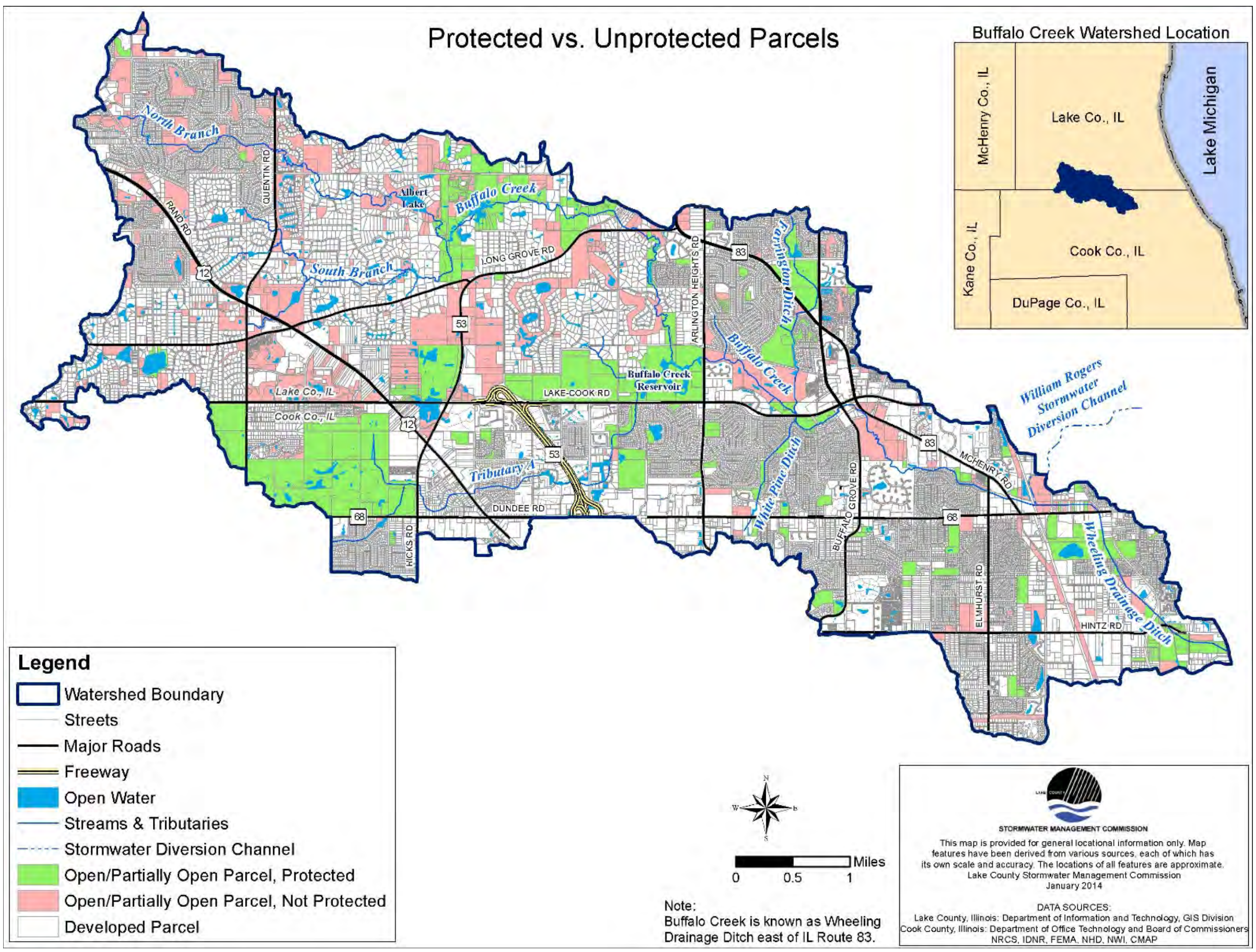


Figure 5-29: Protection Status of Open and Partially Open Parcels in the Buffalo Creek Watershed.

5.6.2.4 Parcel Prioritization Criteria

Once the inventory of open/partially open parcels was created, suggested additions to the GI Inventory were reviewed based on Buffalo Creek Watershed stakeholder feedback. Prioritization criteria were selected based on the benefits it would provide in meeting four goals (flood prevention/reduction, water quality improvement, stormwater management & drainage, and natural resources). **Table 5-23** contains a list of the stakeholder approved ranking criteria for open and partially open parcels that includes a matrix indicating the goals that are addressed by each criteria.

Table 5-23: Green Infrastructure Prioritization Criteria for the Buffalo Creek Watershed.

Ranking Criteria for Open & Partially Open Parcels	Flood Prevention/ Reduction	Water Quality Improvement	Stormwater Management & Drainage	Natural Resources
1. Parcels that intersect 100-year floodplain.	X		X	
2. Parcels within 0.5-miles of the headwaters.	X	X		X
3. Parcels that intersect with a wetland.	X	X		X
4. Parcels that intersect or adjoin 2.5 acres of drained hydric soils.	X	X	X	X
5. Parcels in a Subwatershed Management Unit where less than 10% of the SMU is existing wetland.	X	X		
6. Parcels within 0.5 miles of a known flood problem area.	X		X	
7. Parcels that are within 100 feet of a watercourse or lake.	X	X	X	X
8. Parcels intersecting with SMU's that are nonpoint source pollutant hotspots.		X		
9. Parcels that include or are adjoining to forest preserves, land trusts, parks, or privately/publicly protected open space.				X
10. Parcels that include or are adjoining to mapped high quality wetlands (ADID).	X	X	X	X
11. Parcels that include or are adjoining to Illinois Natural Areas Inventory sites or Nature Preserves.				X
12. Parcels that include or are adjoining to threatened and endangered species sites.				X

5.6.3 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 8. **Figure 5-30** depicts the parcel prioritization process.

> ***Geographic Information System (GIS):*** *a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface.*

After completion of the prioritization, parcels were categorized as 'high', 'medium' or 'low' priority based on natural breaks in the GIS data. 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 green infrastructure system, meaning that they possess the greatest capacity for Buffalo Creek Watershed protection or improvement by meeting multiple goals (flood prevention/reduction, water quality improvement, stormwater management & drainage and natural resources). The priority categorization was visually displayed and evaluated, and connector parcels were identified and manually categorized.

5.6.4 Overall Prioritization-A Green Infrastructure Network

Figure 5-31 and Table 5-24 display the results of the priority parcel ranking for all criteria that were described in **Table 5-23**. Parcels with eight or more total points were categorized as high priority parcels. Parcels with total scores between 5 and seven 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. There are 164 parcels totalling 1,738 acres that have been categorized as high priority parcels. The majority of the parcels in this category are public lands such as parks and forest preserves. Medium priority parcels are the most prevalent of the three categorizes. There are 387 parcels totalling 2,002 acres that have been categorized as medium priority parcels. Medium priority parcels are scattered throughout the Buffalo Creek Watershed, with many medium priority parcels located in close proximity to high priority parcels. Low priority parcels are the second most prevalent of the three categorizes. There are 373 parcels totalling 885 acres that have been categorized as low priority.

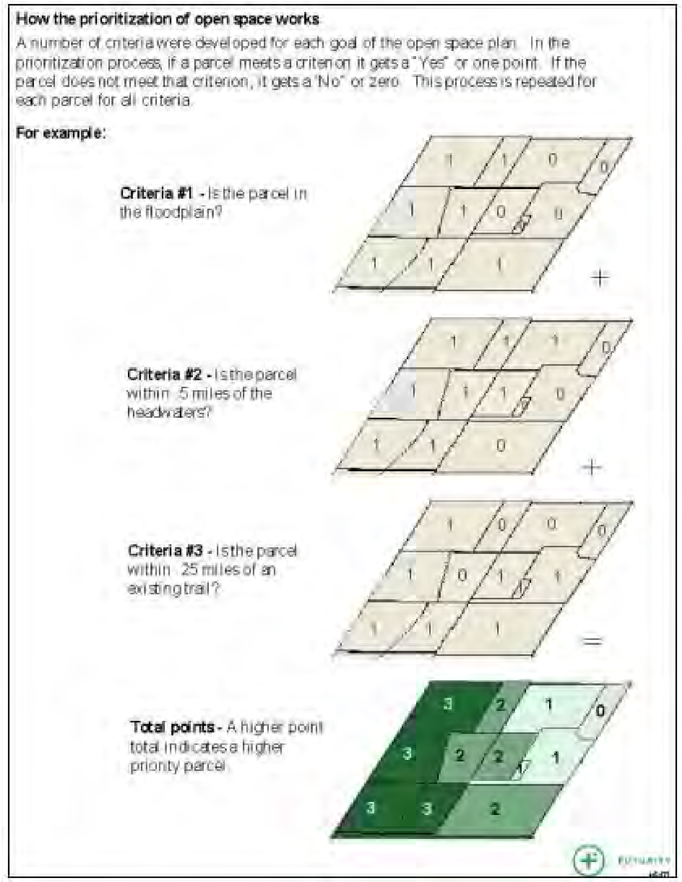


Figure 5-30: Green infrastructure Parcel Prioritization Process (Futurity Inc., Christy SF 2005).

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 watershed, some of these parcels are important as connectors between higher priority parcels. A series of medium priority parcels form a corridor from the Buffalo Creek Reservoir north and east along Buffalo Creek. There are also a series of medium and low priority parcels that form a corridor southward associated with Hicks Road and then along Lake Cook Road back to the Buffalo Creek Reservoir.

Table 5-24: Results of Priority Parcel Ranking Priority

	High Priority (8+ points)	Medium Priority (5-7 points)	Low Priority (0-4 points)
No. of Parcels	164	387	373
Acres	1,738	2,002	885

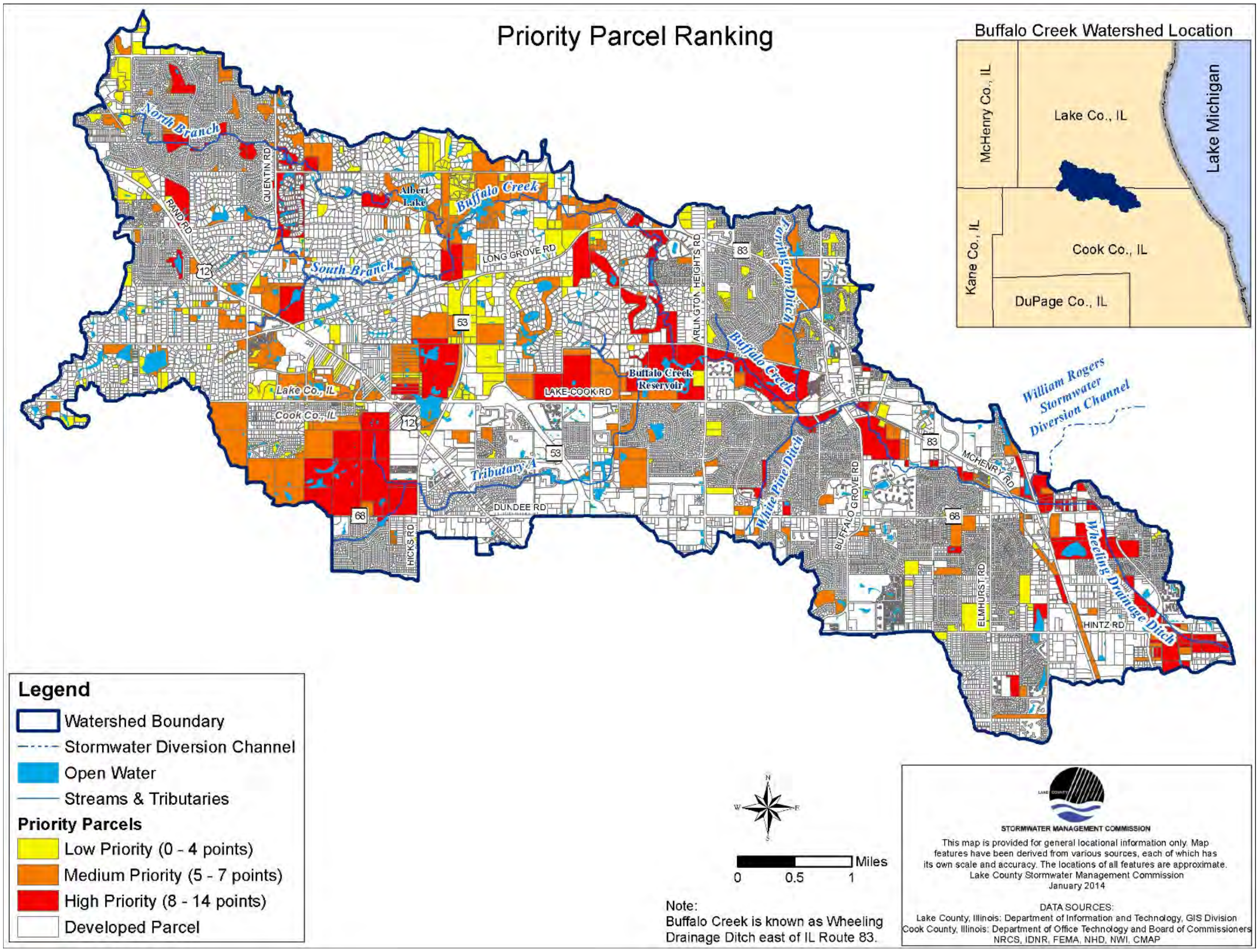


Figure 5-31: Priority Parcel Ranking for Green Infrastructure Network.

While high priority parcels only account for 10% of the Buffalo Creek Watershed, their protection and enhancement will be an integral part of the restoration of the watershed. 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 of the open or partially open parcels in the watershed are classified as medium priority parcels. Medium priority parcels are scattered throughout the watershed, but are often located in proximity to high priority parcels and stream corridors. These medium priority parcels with existing protection provide excellent opportunities for a variety of green infrastructure practices. Lastly, low priority parcels account for a large portion of the watershed open space. Scattered low priority open areas are important opportunity sites for stormwater green infrastructure practices and should be considered for local stormwater infiltration BMPs.

Utilizing the high and medium priority parcels, a Green Infrastructure Network (see **Figure 5-32)** for the Buffalo Creek Watershed was developed. Areas such as waterways, wetlands, natural ecosystems, parks, and open spaces were linked together to form the Green Infrastructure Network. Where necessary, partially developed and developed parcels were included as "connector parcels" to link these areas together.

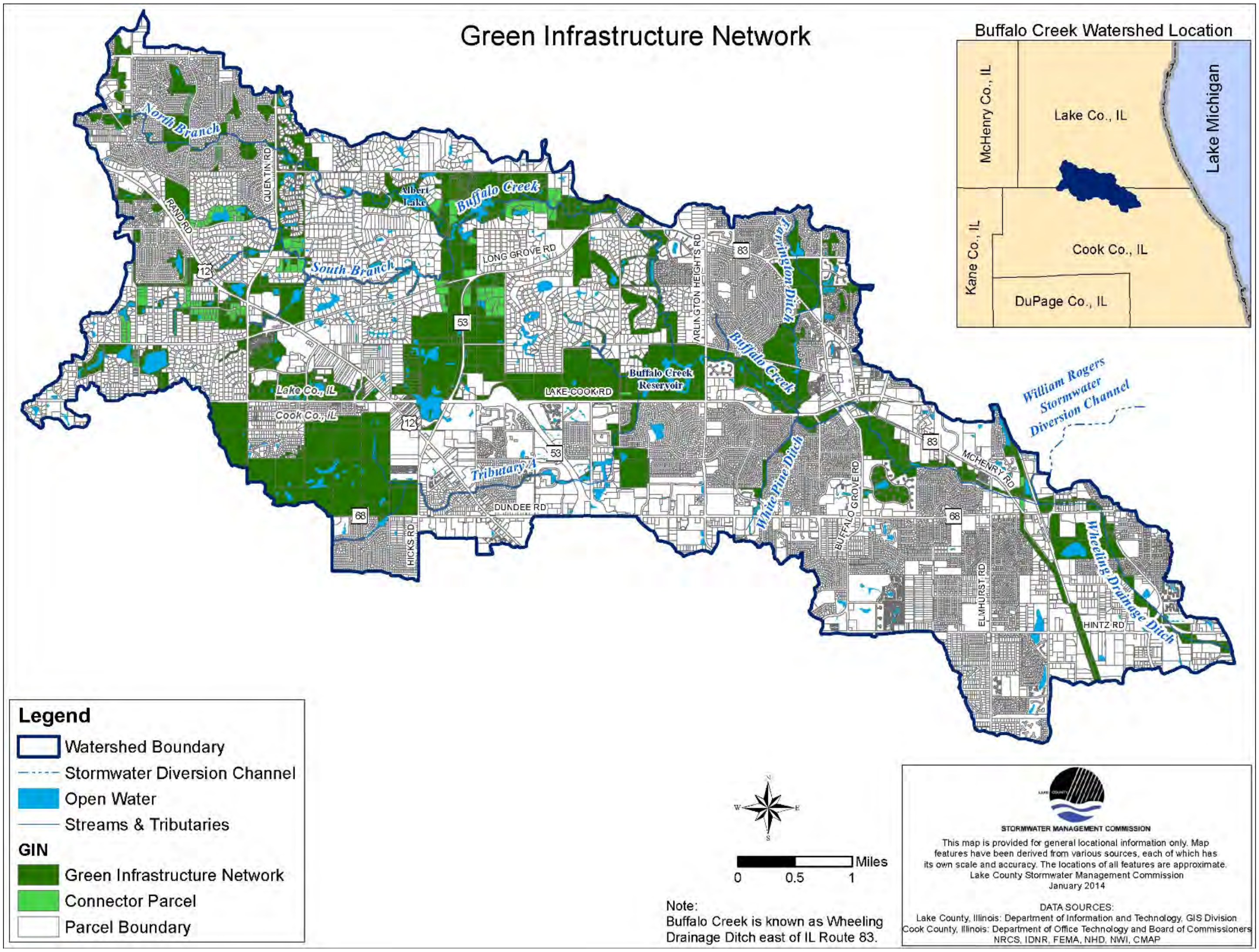


Figure 5-32: Buffalo Creek Watershed Green Infrastructure Network.

In order for the goals of the watershed plan to be achieved, the Buffalo Creek Green Infrastructure Network will need to be implemented across multiple jurisdictions. In many cases this with will require significant coordination and planning amongst 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/or 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 high and medium priority unprotected parcels that are located within the stream corridor of Buffalo Creek and its tributaries to protect and improve water quality and stream condition. 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 watershed by strategically implementing stormwater green infrastructure practices on these sites.

5.6.5 Local Green Infrastructure BMPs

Stormwater runoff is a major cause of water pollution in urban areas. Conventional stormwater infrastructure seeks to quickly drain stormwater to rivers and streams, increasing peak flow and flood risk. Green infrastructure BMP's are practices that are designed to mimic natural hydrologic features. These green infrastructure BMP's manage water and provide a multitude of environmental and community benefits. Green infrastructure practices include BMP's such as naturalized detention facilities, vegetated swales, porous pavement, rain gardens, green roofs, and rain barrels.

The Buffalo Creek watershed is largely urbanized with 67% of the parcels being classified as developed. Therefore, the implementation of green infrastructure BMPs on developed parcels will be integral to the accomplishment of the goals described in **Chapter 1**. Funding should be sought to implement green infrastructure practices wherever feasible. **Table 5-25** describes potential funding sources for green infrastructure practices.

Table 5-25: List of Potential Funding Sources for Green Infrastructure BMP's.

Source	Description
EPA Clean Water Act Nonpoint Source Grant (Section 319 Grants)	Under Section 319, states, territories, and Indian tribes receive grant money which supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of projects that have been implemented.
National Fish and Wildlife Foundation Chi-Cal Rivers Fund	The Chi-Cal Rivers Fund is a public-private partnership working to restore the health, vitality and accessibility of the waterways in the Chicago and Calumet region by supporting green stormwater infrastructure, habitat enhancement, and public-use improvements.
EPA Clean Water State Revolving Fund	Funds water quality protection projects for wastewater treatment, stormwater management, nonpoint source pollution control, and watershed and estuary management.
HUD Community Development Block Grant Program	Program that works to ensure decent affordable housing, provide services to the most vulnerable in our communities, and create jobs through the expansion and retention of businesses. CDBG-financed projects could incorporate green infrastructure into their design and construction.

Chapter 6 Prioritized Action Plan

6 Prioritized Action Plan

Prior to **Chapter 6**, a variety of Best Management Practices (BMPs) have been discussed as potential options for the mitigation of pollutant issues in the Buffalo Creek Watershed. In this chapter, specific recommendations are made to meet the goals of the watershed plan, including the identification of specific locations for BMPs in the watershed. This chapter presents specific recommended action items developed jointly by the watershed stakeholders, Lake County Stormwater Management Commission (SMC), Lake County Health Department (LCHD), Metropolitan Water Reclamation District of Greater Chicago (MWRD), and the consultant planning team to meet the goals of this plan. The critical implementation partners for the watershed are identified in Section 6.1.

There are three primary types of action plan recommendations presented in this chapter: 1) programmatic actions, 2) "hotspot" or critical area actions, and 3) site-specific project 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 Plan as outlined in **Chapter 2**.
2) "Pollutant Load Hotspot Analysis" identifies critical catchments to focus actions. These areas include the eight hotspot catchments identified in **Chapter 5**. Actions implemented in these critical areas will provide the greatest value and benefit to the watershed.
3) The "Project Specific Actions" address site-specific project opportunities or issues that have been identified throughout the watershed. Site-specific projects were identified through the stream and detention basin inventories, or by local stakeholders and agency staff. 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, and stakeholder input.

For each of the 6 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.

i. Priority was assigned to each of the recommended actions and classified as H (high), M (medium) or L (low). Classifications were based on multiple factors including lead partners, land ownership, cost and technical requirements. Medium and low priority projects should not be disregarded because, in many cases, while assessed funding availability, technical assistance, or other shortcomings may result in an action being classified as medium or low priority today, circumstances or conditions may change with time to make these actions feasible and desirable. This watershed plan is considered a living document that can be updated and adapted as conditions and priorities change.

ii. Lead and support partners are those organizations or agencies that have the greatest potential to implement each recommended action.

iii. Timeframe refers to the period of time in which the recommended action could be implemented. Timeframe is classified into three categories including:

   a. S (Short = 1-5 years)
   b. M (Medium = 6-10 years)
   c. L (Long = 10+ years)

Chapter 7 outlines an implementation strategy for the Action Plan, and **Chapter 8** identifies outreach and education recommendations that will provide watershed stakeholders with the knowledge and skills necessary to implement the watershed plan.

6.1 Implementation Partners

In various sections of the prioritized action plan there will be parties that will be suggested as ***lead partners*** or ***supporting partners***. **Table 6-1** provides a list of partners that are referenced throughout the prioritized action plan along with a general description of their responsibilities. Implementation partners do not necessarily have the resources at this time to complete a recommendation, but through coordination with other partners, grant funding, more these recommendations can be become a reality.

Lead Partners: *Identify the lead public or private landowner, agency or other stakeholder with the greatest potential to implement the action.*

Supporting Partners: *Include parties that could be involved in assisting the action implementation related to regulation, permitting, coordination, technical needs, and funding assistance.*

Table 6-1: Implementation Partners in the Buffalo Creek Watershed.

Abbreviation	Responsible Party	General Responsibility
BACT	Barrington Area Conservation Trust	Promote Conservation@Home, green infrastructure in Municipalities near Deer Grove Forest Preserve.
BCCWP	Buffalo Creek Clean Water Partnership	Coordinate watershed plan implementation, education and outreach.
CMAP	Chicago Metropolitan Agency for Planning (previously NIPC)	Technical and planning assistance, training and funding assistance.
CBL	Corporation and Business Landowners	Grounds management and maintenance.
CL	Conserve Lake County	Conservation@Home program and private land conservation easements.
CCBZ	Cook County Building and Zoning	Permitting for unincorporated areas, natural resources and drainage system management.
CCPD	Cook County Planning and Development	Land use planning for unincorporated areas.
CCDPH	Cook County Department of Public Health	Permits for well and private sewage disposal systems in Cook County.
DH	Developers and Homebuilders	Land development, stormwater management system design and construction.
DRWW	Des Plaines River Watershed Workgroup	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 IEPA 303(d) impaired waters list.
DOT	Departments/Divisions of Transportation, including State, Illinois Tollway, County, Municipal and Township Highway and Streets Departments	Maintain, design and construct roadways in the watershed including stream, lake and wetland crossings.
FEMA	Federal Emergency Management Agency	National Flood Insurance Program, floodplain mapping and enforcement, and mitigation funding.
FPDCC	Forest Preserve District of Cook County	Manage and maintain green infrastructure, natural areas and open space.
Illinois EPA	Illinois Environmental Protection Agency	Water resource monitoring, pollution regulation and control, technical assistance and project funding.
IEMA	Illinois Emergency Management Agency	Flood and disaster planning, emergency response, and hazard mitigation.
ISWS	Illinois State Water Survey	Flood risk modeling and floodplain mapping.

HOA/POA	Homeowners Associations/Property Owners Associations	Management of common areas and natural and constructed drainage systems.
LA	Lake Associations	Lake management for water quality and recreational land.
LCFPD	Lake County Forest Preserve District	Manage and maintain green infrastructure, natural areas and open space.
LCHD	Lake County Health Department	Monitor, manage and provide technical support for water resources.
LCPW	Lake County Public Works Department	Manages water and wastewater facilities in Lake County.
LCPBD	Lake County Planning, Building and Development	Land use planning and permitting for unincorporated areas, natural resources and system management.
SMC	Lake County Stormwater Management Commission	Technical and financial assistance for flooding, watershed planning and water quality.
M	Municipalities	Land use and development, technical and financial support and drainage system management.
MWRD	Metropolitan Water Reclamation District	Controls municipal sewer construction permits outside the city of Chicago. Administers the Watershed Management Ordinance.
NWC	Northwest Water Commission	Provides member municipalities of Arlington Heights, Buffalo Grove, Palatine and Wheeling with potable water.
NRCS/SWCD	Natural Resource Conservation Service/Soil and Water Conservation District	Provide natural resource management technical and financial assistance.
PD	Parks and Recreation Districts	Management and maintenance of parks and open space.
PRL/RL	Private Residential/Riparian Landowner	Land management and maintenance including stream channels and riparian corridors.
T	Townships	Road maintenance and support for watershed improvement projects.
TOLLWAY	Illinois State Toll Highway Authority	Road building and maintenance. A proposed tollway extension would cross the Buffalo Creek watershed in Lake County.
USACE	U.S. Army Corps of Engineers	Wetland protection and regulation, and wetland restoration funding.
USDA	U.S. Department of Agriculture	Farmland and natural resource technical and financial assistance.
USEPA	U.S. Environmental Protection Agency	Water Resource monitoring, pollution regulation and control, project funding and technical assistance.
USFWS	U.S. Fish and Wildlife Service	Threatened and endangered species protection, technical and funding assistance for habitat restoration.
WWT	Wastewater Treatment Facilities	Maintain wastewater treatment regulatory standards.

6.2 Programmatic Action Plan

The programmatic action plan section provides a broad range of recommendations that can be implemented throughout the Buffalo Creek Watershed. These recommendations are categorized by watershed plan goal actions, as policy or regulatory actions or as catchment-based actions. The goal categorized action recommendations have been developed based on the goals and objectives of the watershed plan, as described in **Chapter 2**. Some of these actions are directed to enhancements of community or agency policies and programs, while others reflect categories or types of BMPs that should be implemented broadly throughout the watershed. In addition, many of the BMPs are recommended for implementation at specific watershed locations in the site-specific action plan. Policy and regulatory action recommendations target changes in policy, regulations or standards that should be considered to improve watershed conditions. Catchment-based action recommendations identify remedial BMPs for the subwatershed management units (SMUs) that are estimated to be contributing the largest pollutant loads as a consequence of land use.

6.2.1 Programmatic Recommendations by Watershed Plan Goal

Goal 1: Water Quality: Improve and protect water quality (physical, biological and chemical health), eliminate impairments and non-point source pollution and implement land development and management practices to prevent pollution.

Outcome: Waterbodies are not impaired (fully support designated uses) and future pollution is prevented, have healthy lakes, streams, and wetlands.

Table 6-2: Programmatic Action Plan for Goal 1: Water Quality

Action	Other Goals	Priority	Lead Partners	Supporting Partners	Time Frame
1-A. Create/restore wetlands to filter runoff and improve water quality.	2,3	H	PRL, PD, LCFPD, FPDCC, CMAP	NRCS/SWCD, IL EPA, USACE, SMC, MWRD, TOLLWAY	M
1-B. Establish/enhance filter strips and buffers along stream corridors, drainageways, wetlands, lakes, and other high quality areas.	2,3	H	PRL/RL, CMAP	USDA, NRCS/SWCD, IL EPA, IDNR, TOLLWAY	S, M, L
1-C. Communities consider ordinances or policy to limit the availability/use of fertilizers with phosphorus by homeowners in urban areas.	5	H	M, CC, LC	CCHD, LCHD, CCPW, LCPW	S
1-D. Develop outreach and consider a cost-share mechanism to help private property owners fix failing septic systems.		L	M, CCHD, LCHD	IL EPA	M, L
1-E. Implement a watershed wide water quality monitoring program to assess whether water quality standards are being met and to evaluate watershed implementation effectiveness.	6	M	M, CCHD, LCHD, SMC, DRWW	IL EPA, FPDCC, LCFPD	S, M, L
1-F. Support and continue Lake County Health Department and IEPA's Volunteer Lake Monitoring Programs.	3	M	CCHD, LCHD	IL EPA, CMAP, M	S, M, L
1-G. Stabilize eroding streambanks, toe, and side slopes using bioengineering practices with deep-rooted native vegetation.	3	H	MWRD, PD, FPDs, PRL/RL	USACE, IDNR, IL EPA, SMC	S
1-H. Stabilize eroding lake and detention basin shorelines. Refer to Lake Reports for Albert Lake and Buffalo Creek Reservoir shoreline restoration recommendations see: http://health.lakecountyil.gov/Population/LMU/Pages/Lake-Reports.aspx. Consider replacing rip-rap, concrete and turf grass shorelines with deep-rooted native landscaping and bioengineering practices.	3	H	DH, CBL, HOA/POA, PD	M, IDNR, SMC, IL EPA	S
1-I. Establish and publish watershed-wide recommended guidance for winter de-icing BMPs, including road salt application rates and methods, with the goal of reducing the volume of road salt use by 20% while maintaining safe travel conditions. Perform outreach to applicators.	5,6	H	DOT, CC, LC, CBL, DRWW, MWRD	M, T, IL EPA, CCHD, LCHD, SMC, CMAP	M
1-J. Encourage new infrastructure improvement projects to incorporate runoff reduction and water quality designs and BMPs.	4,5	M	M, DOT, LC, CC, CMAP	IL EPA, SMC, MWRD, TOLLWAY	S, M, L
1-K. Where feasible, retrofit existing swales and open drainageways to infiltrate runoff with natural landscaping.	2,4,5	M	HOA/POA, CBL, DOT, PD	DH, IDNR, SMC, IL EPA, MWRD	M

1-L. Stabilize and retrofit stormwater outfall structures and the associated streambanks and channel.	2,4,5	M	M, T, DOT, HOA/POA, MWRD, CMAP	SMC, CC, LC, TOLLWAY	M
1-M. Maintenance of detention basins; including stabilizing eroding inlets and outlets, removing excess woody vegetation and invasive species, addition of native plant species and cleaning inlets/outlets.	2,5	M	HOA/POA, CBL, M, CMAP	IL EPA, SMC, CC, LC, DOT, MWRD, TOLLWAY	M
1-N. Plan and implement stormwater green infrastructure practices in medium priority GI parcels	2, 3, 4	M	M, CC, LC	SMC, IL EPA, IDNR, MWRD	M

Goal 2: Flooding: Reduce flooding and runoff through increased storage and infiltration of stormwater.

Outcome: Stormwater runoff is reduced and flooding is reduced or eliminated for all but the most severe storms (100 year events).

Table 6-3: Programmatic Action Plan for Goal 2: Flooding

Action	Other Goals	Priority	Lead Partners	Supporting Partners	Time Frame
2-A. Modify, retrofit, or eliminate man-made hydraulic restrictions along the stream corridors to promote natural stream morphology.	1,3	H	PRL, HOA/POA, DOT, MWRD, M	USACE, IDNR, SMC, CC, LC, IDNR	S
2-B. Require in-watershed mitigation for any floodplain or wetland permitting to maintain storage capacity. This may require the establishment of a wetland mitigation bank in the watershed.	1,3	M	SMC, USACE, MWRD, CMAP	M, CC, LC, TOLLWAY	S, M, L
2-C. Develop and implement a regular stream inspection and maintenance program throughout the watershed. Remove accumulated debris (woody and otherwise) to maintain conveyance and reduce flood and scour damage.	1	H	SMC, MWRD, M, PD	IDNR, LCFPD, FPDCC	S
2-D. National Flood Insurance Program (NFIP) communities consider participation in the Community Rating System (CRS) program to mitigate flood damage and reduce flood insurance rates for residents.		M	M, LC, CC	IDNR	M
2-E. Mitigate flood damages by installing green infrastructure practices to infiltrate runoff and by creating additional flood storage.	1,3,4	M	PRL, M, SMC, CC, LC, MWRD, HOA, POA, PD, T	IDNR, DOT, USACE, LCFPD, CCFPD	M, L
2-F. Mitigate flood damages with property protection measures such as wet or dry flood-proofing and purchasing flood insurance.		H	PRL, CBL	SMC, MWRD	S, M
2-G. Mitigate flood damages by elevating at-risk structures and consider opportunities for voluntary buyouts of repetitively flood-damaged buildings.		H	PRL, CBL	SMC, MWRD, IEMA	M, L
2-H Update Floodplain Studies and Mapping for Streams of High Concern (Figure 4-3). Evaluate models with respect to LOMC clusters.		H	FEMA	SMC, MWRD, IDNR, ISWS	M

2-I Development of Flood Stage Maps to show varying depths of flooding and respective area of inundation, in coordination with the LCAHMP.		M	SMC, MWRD	LC, CC	M
2-J Development of Property Protection Checklists, pre- and post-disaster for use by all agencies for properties exposed to flood damage and severe storms, in coordination with the LCAHMP.		M	SMC, MWRD	LC, CC	M

Goal 3: Natural Resources: Protect, enhance & restore natural resources (soil, water, plant communities, fish and wildlife) through the expansion of green infrastructure reserves and environmental corridors, maintaining hydrology and buffers for high quality areas, and employing good natural resource management practices.

Outcome: Natural resources are protected, enhanced or restored.

Table 6-4: Programmatic Action Plan for Goal 3: Natural Resources

Action	Other Goals	Priority	Lead Partners	Supporting Partners	Time Frame
3-A. Permanently preserve additional lands as conservation areas with associated recreational uses.	1,2	H	FPDCC, LCFPD, PD, CC, LC	IDNR	S, M, L
3-B. Restore and manage existing preserved lands to natural ecosystem health and function through restoring hydrology and native vegetation and managing invasive species.	1,2	M	FPDCC, LCFPD, PD, CC, LC, CMAP	IDNR, SMC, MWRD, TOLLWAY	S, M, L
3-C. Develop environmental corridor and trail connections between new and existing forest preserves on private land.	1,2	H	FPDCC, LCFPD, CC, LC, CMAP	DOT, PD, M, TOLLWAY	S, M, L
3-D. Restore stream channels, streambeds, and aquatic habitat to a healthy condition. This includes in-stream habitat features, such as natural channel substrates and pools & riffles to improve water quality and aquatic biodiversity.	1,2	H	PRL/RL, FPDCC, LCFPD, PD	USACE, IDNR, IL EPA, M, SMC, MWRD	S
3-E. For moderately and severely eroded stream reaches, develop a stream restoration plan and cost estimate.	1	H	PRL/RL, FPDCC, LCFPD, PD	SMC, MWRD, IDNR, IL EPA, NRCS/SWCD, M,	S
3-F. If not already completed, develop lake management plans/diagnostic studies that address water quality, invasive species, fisheries and recreational use.	1	M	IDNR	CCHD, LCHD, POA/HOA, PRL	M
3-G. On private lands, work with non-profit organizations and USDA programs such as Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Wetlands Reserve Program (WRP) and Environmental Quality Incentives Program (EQIP) to restore/enhance natural areas.	1,2	M	PRL, AG,	IDNR, USDA, NRCS/SWCD	L
3-H. Consider installation of stream and road crossings for pedestrians and wildlife in road construction projects, such as Quentin Road and Tollway construction.	1,2	M	FPDCC, LCFPD, CC, LC, CMAP	USACE, IDNR, IL EPA, M, SMC, MWRD, TOLLWAY	L

3-I. Consider protection of natural resources in new development or redevelopment areas.	1,2	M	FPDCC, LCFPD, CC, LC, CMAP	USACE, IDNR, IL EPA, M, SMC, MWRD, TOLLWAY	L

Goal 4: Green Infrastructure: Use a system of both site specific stormwater green infrastructure practices and regional greenways and trails to protect and connect natural resource areas and to provide recreational opportunities.

Outcome: Site level and regional green infrastructure system is established and maintained across the watershed.

Table 6-5: Programmatic Action Plan for Goal 4: Green Infrastructure

Action	Other Goals	Priority	Lead Partners	Supporting Partners	Time Frame
4-A. Consider restoring and enhancing disregarded or under-utilized space at commercial, industrial and residential developments and parklands (e.g. fenced property perimeters and common grounds) with stormwater green infrastructure practices.	1,2,3	H	M, HOA/POA, CBL, PD, DOT	IL EPA, MWRD, SMC	L
4-B. Restore and preserve pre-development hydrology by using deep-rooted native vegetation and native trees wherever possible for landscaping. This will also benefit water quality by reducing the need for fertilizers and pesticides.	1,2,3	H	CBL, PRL/RL, PD, DOT	M, CCPD, LCPD, CC, LC, SMC	S
4-C. Land planning jurisdictions such as municipalities, counties, park districts, etc. adopt a Green Infrastructure Plan based on the watershed Green Infrastructure Plan to use as a tool in prioritizing and implementing green infrastructure preservation, restoration and installation programs.	1,2,3	M	M, CCPD, LCPBD, CMAP	FPDCC, LCFPD, SMC, IDNR, MWRD, TOLLWAY	L
4-D. Clearly identify and designate areas prioritized in the Green Infrastructure Plan as green infrastructure conservation areas in county, park district, municipal and regional comprehensive plans and maps.	1,2,3	M	M, CC, LC, CMAP	IDNR	M
4-E. Avoid development in and installation of gray infrastructure through high priority green infrastructure system parcels wherever possible.	1,2,3	H	M, CC, LC, DOT, CMAP	TOLLWAY	S,M,L

Goal 5: Smart Development: Guide new development and redevelopment design and practices to protect or enhance existing water resources, natural resources and open space.

Outcome: New development and redevelopment occurs without impairing water resources, natural resources and open space.

Table 6-6: Programmatic Action Plan for Goal 5: Smart Development

Action	Other Goals	Priority	Lead Partners	Supporting Partners	Time Frame
5-A. Keep areas of the watershed that have high infiltration soil types (see **Figure 3-7**) as undisturbed open space.	1,2,3	M	M, CC, LC	SMC, MWRD	S, M, L
5-B. Require or incentivize the use of native landscaping in open space areas of new development.	1,2,3	M	M, CC, LC, CMAP	SMC, MWRD, TOLLWAY	S, M, L

5-C. Install stormwater green infrastructure BMPs in new developments. Reduce sole use of centralized detention ponds and replace with distributed infiltration-based stormwater management systems using bioretention practices. Consider applying lot-level infiltration practices in addition to overall development practices with a goal of keeping all of the precipitation that falls on a lot either infiltrated or evaporated at the lot level.	1,2,3	H	DH, CBL, CC, LC, M, CMAP	SMC, MWRD, TOLLWAY	M
5-D. Incorporate naturalized stream restoration as part of new developments where applicable.	1,3	M	M, CC, LC, DH, CBL, CMAP	SMC, MWRD, TOLLWAY	M
5-E. Development review jurisdictions require that developers demonstrate measures taken to minimize impervious surfaces (i.e. parking ratios, multi-level parking, permeable surface parking, reduced street widths, sidewalks on one side of street, etc.).	1,2,3	H	M, CC, LC	SMC, MWRD	S,M,L
5-F. Retrofit curb and gutter areas along roadways, parking lots and other impervious surfaces to allow stormwater to enter swales or other naturalized drainageways. Use porous pavement or retrofit raised landscape beds adjacent to impervious surfaces to depressed landscaping as parking lots are being refurbished to reduce stormwater runoff.	1,2,3	H	DOT, DH, CBL, M, CC, LC	SMC, MWRD	S,M,L

Goal 6: Education, Outreach, Coordination and Implementation: Provide watershed stakeholders with the knowledge, skills and motivation needed to implement the watershed plan. Watershed stakeholders include (but are not limited to) residents, property owners, property owner associations, government agencies and jurisdictions, and developers.

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

Table 6-7: Programmatic Action Plan Goal 6: Education, Outreach, Coordination & Implementation

Action	Other Goals	Priority	Lead Partners	Supporting Partners	Time Frame
6-A. Implement the Education and Outreach strategy. Form a watershed council to meet quarterly, monitor plan implementation and review strategy.	1,2,3,4,5	H	BCCWP, SMC	SMC, MWRD, CCHD, LCHD, CC, M, LC	S,M,L
6-B. Watershed Signage: • Install signage on primary roads that communicate the watershed boundaries to the public. Include stream name signs at all stream crossings. • Incorporate watershed signage and information at public properties such as forest preserves and public parks. • Consider adding distinctive watershed signs with watershed name as an addition to street sign posts on frequently travelled roadways.	1,2,3,4,5	M	DOT, M, T, CCFPD, LCFPD, PD	BCCWP, SMC, MWRD	M
6-C. Promote Conservation@Home, bioswales, rain gardens etc. in targeted neighbourhoods to reduce stormwater runoff and gulley formation (especially at Deer Grove Forest Preserve).	4	M		BCCWP, FPDCC BACT, CL	M

6-D. Update and distribute the previously developed watershed flyer that educates the public about the watershed, watershed issues, improvement goals and the importance of watershed health.	1,2,3,4,5	L	BCCWP	LCHD, SMC, M, T, MWRD	S
6-E. Salt Use: • Provide education and outreach to municipalities and private property owners and managers who retain contractors for salt application and snow removal to encourage lower application rates, and limit unnecessary salt application. • Train every salt applicator on Winter Maintenance BMPS through Lake County Workshops or potential new workshops for Cook County applicators.	1,2,3,4,5	M	CC, LC, M	SMC, CCHD, LCHD, MWRD	S
6-F. Provide education and outreach to homeowners with septic systems.	1,2,3,4,5	M	LCHD, MWRD, SMC		S
6-G. Provide education and training to riparian landowners related to best practices for stream restoration and channel maintenance.	1,2,3,5	M	SMC, SWCD, MWRD, BCCWP	M, T, CC, LC, PD	S
6-H. Educate residents about invasive species and how to identify them and manage them to prevent their spread.	3	L	FPDCC, LCFPD, PD, M	IDNR	S
6-I. Encourage homeowner association participation in watershed implementation by providing them with information on funding opportunities and support with project development.	1,2,3,4,5	M	BCCWP	SMC, MWRD, CCHD, LCHD, CC, M, LC	M
6-J. Provide workshops for the public and specifically residents and businesses 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. Provide educational materials through direct mailing to floodplain property owners and FPA residents.	2	M	MWRD, SMC, CC, LC, M	FEMA, IEMA, CC EMA, LC EMA	S
6-K. Work with schools, teachers and other institutions in the watershed to provide education about the watershed. Work with schools to develop a natural area demonstration site for education and recreational opportunities.	1,2,3	M	BCCWP	CCHD, LCHD, SMC, CC, LC, MWRD	M
6-L. Educate riparian landowners to avoid disposal or burning of yard waste in the stream or riparian buffer, which adds excess nutrients to the stream system and kills the plant buffer that stabilizes the streambanks and filters runoff to the stream. Properly dispose of yard and pet wastes, household chemicals and trash. Do not dispose of these in storm sewers, roadside swales or the stream.	1,3	M	SMC, MWRD, CCHD, PRL,RL, CL, BACT	M, CC, LC	S

6.2.2 Regulatory and Policy Actions

This Plan does not include land use recommendations, because land use planning and development decisions are the right and responsibility of watershed municipalities and the County. But, this plan does consider the health of watershed 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 often encourages or requires design approaches that unintentionally neglect preserving and enhancing watershed health. Local regulating entities should be encouraged to provide incentives for design approaches and development and redevelopment standards, codes and ordinances that allow watershed development innovation that reduces flood damage, improves water quality and preserves 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). In addition, **Appendix K** includes a self-appraisal checklist that watershed communities may use to evaluate their existing codes and ordinances to identify where regulatory changes and modifications can be made to improve the preservation and use of green infrastructure in the watershed.

During the watershed planning process, stakeholders identified opportunities for policy and regulatory changes to benefit the watershed and address flooding, water quality and natural resource concerns. Recommended opportunities for policy and regulatory review and modification based on stakeholder input during planning sessions devoted to identifying issues and opportunities, development of plan objectives, and identifying education and outreach needs are included in the following list of potential regulatory and policy issues combined with regulatory and policy issues related to pollution impairments and sustainable transportation practices identified through the watershed assessment process. Recommended actions are included in **Table 6-9**. Issues and practices to be addressed include:

Development and Stormwater Runoff

- Local land development standards should:
  - Allow and incentivize Low Impact Development standards/practices.
  - Offset the effect 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.
  - Reduce the rates and volume of runoff from new development – maintain pre-development hydrology.
- Lake County and watershed municipalities will revise watershed development/subdivision ordinances to include credits or incentives for infiltration of precipitation.
- Establish rain garden program(s).
- Communities and the county enact ordinances and standards for sump pump and downspout discharges to be directed to lawn or rain gardens and infiltrated.

Pollution Prevention

- 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.
- Regulate and limit the use of lawn chemicals, such as nitrogen fertilizers and pesticides, and tar for seal coating asphalt surfaces.

- Reduce phosphorus loads by watershed municipalities and the county passing an ordinance that bans the use of fertilizer with phosphorus unless a soil test indicates it is needed.
- 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.

Monitoring and Stream Maintenance

- Develop and implement a watershed monitoring program to collect and monitor water quality and biological data on a regular basis.
- Establish institutional stream maintenance program and standards using the American Fisheries Society standards as guidelines.

Wetlands and Floodplains

- Maintain riparian and depressional floodplain and wetlands to maximize flood storage and conveyance.
- Restore and create wetlands where feasible with a minimum target of 10% wetland per Subwatershed Management Unit.

Green Infrastructure

- Identify and preserve open space as green infrastructure or greenways to promote flood damage reduction, water quality improvement, natural resource protection and wetland restoration.
- 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.

Transportation Sustainability Practices

- Use I-LAST Scoring System for all new roadway expansion and extension projects.
- Use practices that reduce runoff volume from roads and parking lots (reduce pavement extent, use porous pavement where appropriate, infiltrate runoff where appropriate).
- Use practices that capture and treat runoff.
- Route roadways to avoid waters and wetlands where possible.
- Include environmentally friendly stream crossings that protect aquatic habitat.
- Consider wildlife crossings in transportation design.
- Monitor and maintain BMPs post-construction.
- Conduct street sweeping and inlet cleaning.

Table 6-8 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 6-8: 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 utilize low impact development design and green infrastructure practices.	H	M, LCPBD, CCBZ, CCDOT, LCDOT, IDOT	SMC, MWRD
RP-2	Encourage the use of green infrastructure stormwater BMPs for detention credit.	M	CCBZ, LCPBD, M	SMC, MWRD
RP-3	Provide programs with incentives to retrofit existing developed areas with green infrastructure BMPs such as rain gardens.	H	CCBZ, LCPBD, M	SMC, MWRD, IL EPA
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, CCBZ, LCPBD	
RP-5	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, CCDOT, LCDOT, IDOT, T, LCFPD, CCFPD	SMC, LCHD, MWRD, IL EPA
RP-6	Ban the use of fertilizer with phosphorus unless a soil test indicates it is needed.	H	M, CCBZ, LCPBD	
RP-7	Investigate limiting or banning the use of coal tar seal-coating products and lawn pesticides known to runoff and pollute waters.	M	M, CC, LC	
RP-8	In compliance with Illinois EPA, establish total suspended sediment (TSS) or other numerical water quality performance standard for new developments and redevelopment in Cook County and Lake County.	M	SMC, MWRD	M, CCBZ, LCPBD
RP-9	Participate in a coordinated watershed monitoring program to collect and monitor water quality and biological data on a regular basis.	M	M, TLCFPD, CCFPD, MWRD	SMC, DRWW
RP-10	Cooperatively establish, adopt and implement stream maintenance standards in conformance with American Fishery Society guidelines.	M	SMC, M, MWRD	LCHD, LCFPD, CCFPD
RP-11	Review effectiveness of wetland regulations and develop watershed-specific provisions if needed.	L	SMC, MWRD, USACE	M, CCBZ, LCPBD
RP-12	Require in-watershed (Buffalo Creek) mitigation for all wetland impacts.	H	SMC, MWRD, USACE	
RP-13	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.	M	SMC, MWRD, M, LCPBD, CCBZ	FEMA
RP-14	Adopt and prioritize green infrastructure elements and support implementation of these elements through local land use plans, policies and maps.	H	M, CCBZ, LCPBD	SMC, MWRD, LCFPD
RP-15	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).	H	Tollway, IDOT, M, T, CCDOT, LCDOT,	LCPBD, LCFPD
RP-16	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	IDOT, M, LCDOT, CCDOT, Tollway, T	

6.2.3 Catchment-Based Actions Based on Pollutant Load Hotspot SMU

Pollutant Load Hotspot SMUs of the Buffalo Creek watershed were identified using the analysis described in **Chapter 5**. The Hotspot SMUs of the Buffalo Creek watershed are displayed in **Figure 6-1**. The criteria that led to each area being identified as being a hotspot are listed in **Table 6-9** along with a list of general BMPs that can be used to reduce pollutant loads from these critical SMUs. While the recommended actions listed in **Table 6-9** are not defined geographically, site specific recommendations are describe in greater detail in Section 6.4.

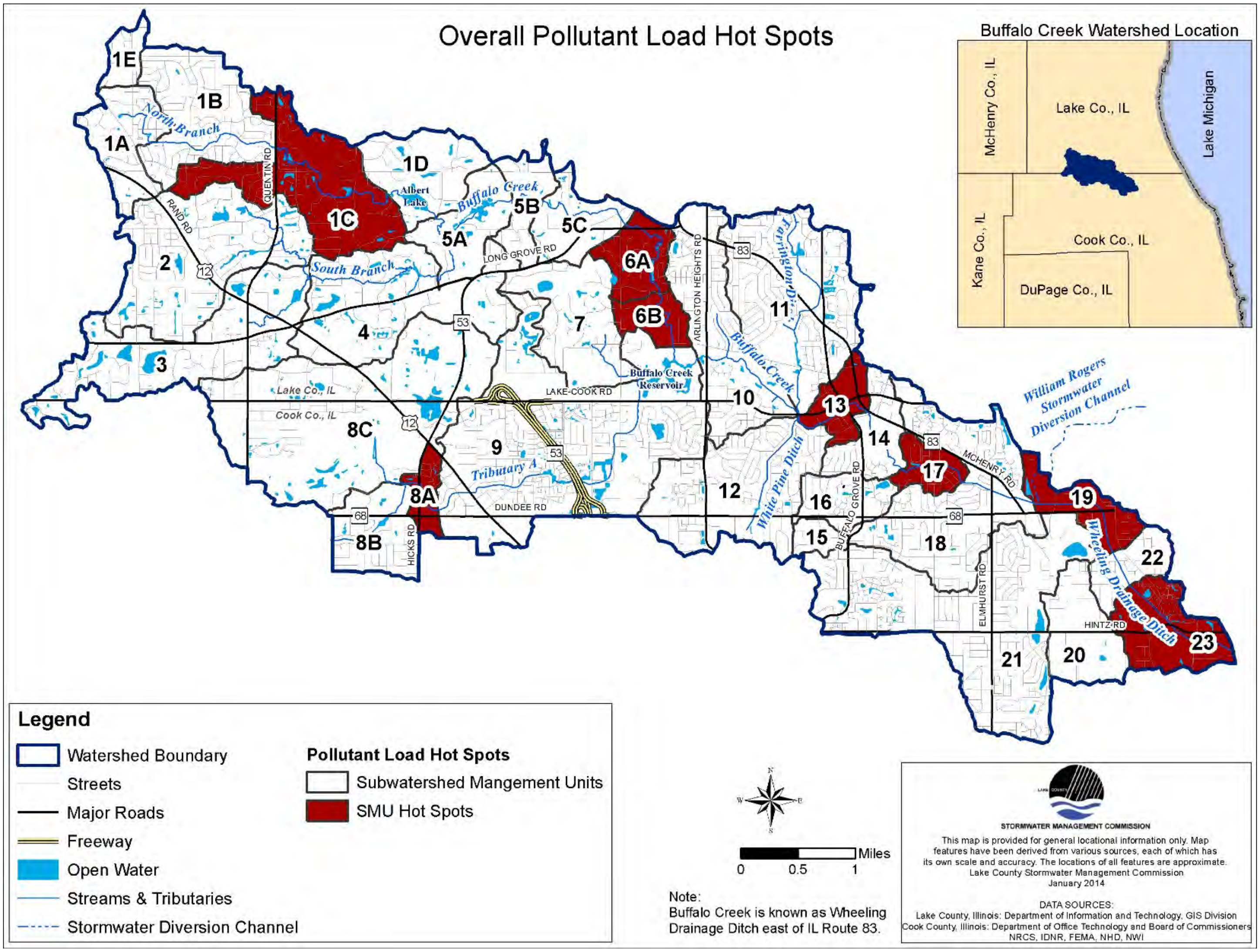


Figure 6-1: Pollutant Load Hotspot SMUs in the Buffalo Creek Watershed.

Table 6-9: Pollutant Load Hotspot SMUs by Jurisdictional Area in the Buffalo Creek Watershed.

Hotspot SMU	Critical Area Issues	Jurisdiction	Recommended BMPs
1C	Pollutant Loading Streambank Erosion Land-Use Change Land-Use Change on HES Failing Septic Systems	Village of Kildeer Village of Lake Zurich Ela Township	Streambank Stabilization Logjam/Debris Removal Wetland Restoration Detention Basin Retrofit Phosphorus-Free Fertilizer Future LID
6A	Pollutant Loading Streambank Erosion Land-Use Change Failing Septic Systems	Village of Long Grove Village of Buffalo Grove Vernon Township	Streambank Stabilization Logjam/Debris Removal Stream Buffer Installation Detention Basin Retrofit Phosphorus-Free Fertilizer Future LID
6B	Pollutant Loading Streambank Erosion Land-Use Change Failing Septic Systems	Village of Long Grove Village of Buffalo Grove Vernon Township	Streambank Stabilization Logjam/Debris Removal Stream Buffer Installation Detention Basin Retrofit Phosphorus-Free Fertilizer Future LID
8A	Pollutant Loading	Village of Palatine Palatine Township Deer Grove Preserve	Stream Buffer Installation Detention Basin Retrofit Phosphorus Free Fertilizer Future LID
13	Pollutant Loading Streambank Erosion Land-Use Change	Village of Buffalo Grove Vernon Township Wheeling Township	Streambank Stabilization Logjam/Debris Removal Pervious Pavement Retrofit Detention Basin Retrofit Phosphorus-Free Fertilizer Future LID
17	Pollutant Loading Land-Use Change	Village of Wheeling Wheeling Township	Logjam/Debris Removal Stream Buffer Installation Prairie Restoration Detention Basin Retrofit Phosphorus-Free Fertilizer Future LID
19	Pollutant Loading Streambank Erosion Impervious Cover Land-Use Change	Village of Wheeling Wheeling Township	Streambank Stabilization Logjam/Debris Removal Stream Buffer Installation Prairie Restoration Pervious Pavement Retrofit Detention Basin Retrofit Phosphorus-Free Fertilizer Future LID
23	Pollutant Loading Land-Use Change	Village of Wheeling Wheeling Township	Prairie Restoration Stream Buffer Installation Detention Basin Retrofit Phosphorus-Free Fertilizer Future LID

6.3 Site-Specific Action Plan

The site-specific action plan identifies potential projects in specific locations throughout the Buffalo Creek Watershed. Projects included in the plan have been recommended to address watershed issues and achieve the goals developed by Buffalo Creek stakeholders. The site-specific action plan is presented in two sections:

1. Regional/watershed-level actions directed towards:
    a. Pollutant loading hotspots or critical areas.
    b. Flood problem areas.
    c. Potential regional storage locations.
    d. Potential wetland restoration/enhancement locations.
2. Smaller-scale site-specific actions organized by jurisdiction directed towards:
    a. Stream maintenance and restoration.
    b. Lake shoreline recommendations.
    c. Detention basin maintenance and retrofits.
    d. Reduction in impervious area.
    e. Prairie and forest restoration.

A combination of methods were used to in identify site-specific projects, which are listed below.

- Direct stakeholder input.
- Detention basin inventory.
- Stream inventory and assessment.
- Lake shoreline inventory and assessment.
- Flood problem area inventory.
- Flood storage area analysis.
- GIS analysis and water quality modeling.
- Green infrastructure analysis.
- 2015 Final Report Region 5 Wetland Management Opportunities and Marketing Plan: Select Watersheds in the Lower Fox and Des Plaines River Watersheds prepared by Tetra Tech (R5WMO).

SMC's stream and detention basin inventories were utilized to identify stream reaches with streambank erosion, little or no stream buffer, problem discharge structures, problem hydraulic structures and excess debris; and detention basins with shoreline erosion, inadequate buffers, problem inlets and outlets or general maintenance needs. The results of the Lake Inventories conducted by the Lake County Health Department were utilized to identify areas with lake shoreline erosion. The location of prairie, forest and wetland restoration projects were identified using existing land-use data, historical land cover data and the R5WMO Report. Pervious pavement project locations were identified using existing land-use and impervious cover datasets. The location of these projects was selected based on site specific conditions.

These recommendations serve only as a starting point for watershed implementation projects. It is designed to be a "kick start" to move quickly into implementation. As the plan is implemented and adapted over time, it is expected that additional projects will develop as the planning and implementation process continues.

The more regional recommendations, including Flood Problem Area Mitigation, Potential Regional Storage Locations and Potential Wetland Restoration and Enhancement Locations are described in Sections 6.3.1 through 6.3.3 respectively. Site-Specific Best Management Projects are identified by jurisdictional location in Section 6.3.4. Recommended BMPs include detention basin retrofits, repair of problem discharge locations and hydraulic structures, stream buffers, streambank stabilization, pervious pavement, prairie restoration, forest restoration and logjam-debris removal.

6.3.1 Flood Problem Area Inventory Mitigation

6.3.1.1 Reducing Flooding at Flood Problem Area Sites

As described in **Chapter 4**, SMC has completed a Flood Problem Areas Inventory (FPAI) of the Buffalo Creek Watershed for flood hazard mitigation. Additionally, MWRD identified Flood Problem Areas as part of the Detailed Watershed Plan for the Cook County portion of the watershed. A Flood Problem Area (FPA) is composed of one or more structures that are damaged by flooding. Structures include transportation and utility infrastructure as well as buildings. The 54 FPAs identified in the watershed are depicted on **Figure 4-7**. The recommendations are shown in **Figure 6-2** and **Table 6-10**.

The 54 locations in the flood problem inventory were evaluated to determine if flood mitigation measures were appropriate. As part of this Plan, mitigation projects were prioritized as high (H), medium (M) and low (L)**.** The prioritization was made by evaluating the type of flooding problem reported (roadway, structural, etc.), the number of impacted structures and the frequency of the flooding problems.

- A high priority (H) was given to 9 flood problem areas that reported structural flooding on an annual or more frequent basis.
- A medium priority (M) was given to 16 flood problem areas reported to have less frequent but more recent structural flooding as well as the one flood problem area reported to have annual roadway flooding.
- A low priority (L) was given to the remaining 19 flood problem areas reported.

> ***Noteworthy:* Project Specific Actions**
>
> Site-specific watershed projects/actions include urban BMPs (such as pervious pavement), detention basin retrofits, problem hydrologic/hydraulic structure modification, flood mitigation solutions, stream buffers, streambank and lake bank stabilization, logjam/debris removal, wetland preservation/restoration and creation priorities, discharge structure retrofits, hydraulic structure retrofits, forest restoration and prairie restoration.

- A verify (V) priority was given to 10 flood problem areas that were reported to have been mitigated to some degree. Improvements have been completed to reduce or eliminate the flood damage; however a significant rain event has not yet occurred to verify the success of the mitigation.

Although the FPAI is a good source for information on locations where flooding is known to occur in the watershed, it is likely not all-inclusive of problem areas, and it lacks the necessary site-specific detailed information (detailed topography, flooding depths, etc.) needed to accurately assess flood damages and associated recommended mitigation alternatives. Typically, a detailed flood study or drainage analysis in combination with some level of engineering design and property owner input is required to determine the most feasible and cost-effective flood mitigation measures for a specific problem area. Recommendations are based on a brief review performed by a professional engineer and the flood mitigation recommendations are general in nature.

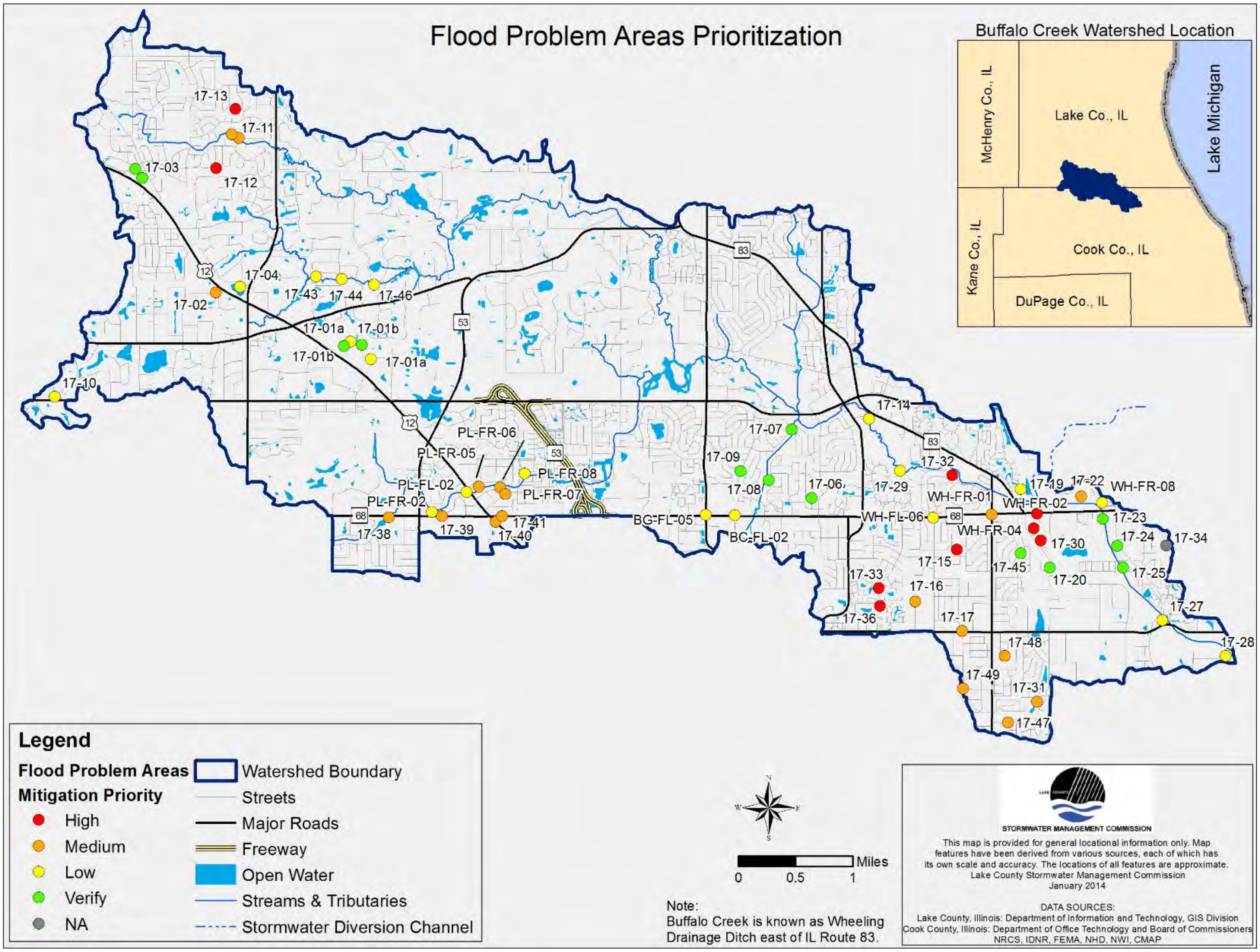


Figure 6-2: Flood Problem Area Locations and Ranking

Table 6-10: Flood Problem Area Locations and Ranking

Flood Problem Area ID	Jurisdiction	Mitigation Category	Proposed Concept	Estimated Cost	Priority
17-01a	Ela Township	Capacity	Storm sewer upgrades.	$10,000-20,000	L
17-01b	Ela Township	Capacity	Storm sewer upgrades completed in 2013-2014.	Completed	V
17-02	Ela Township	Buy Out	Acquisition and removal of three properties. A FEMA Hazard Mitigation Grant Program (HMGP) application has been submitted.	$834,450	M
17-03	Lake Zurich	Basin Retrofit	Fall 2014 WMB Project.	Completed	V
17-04	Kildeer	Capacity	Engineering Plan initiated.	UNK	L
17-06 (WPDT-BG-FL-02)*	Buffalo Grove	Capacity	Stormwater improvement plan completed in 2011.	Completed	V

17-07 (WPDT-BG-FR-02)	Buffalo Grove	Capacity / Conveyance	Stormwater improvement plan completed in 2011; includes 60" culvert replaced with 5' x 7' box culvert.	Completed	V
17-08 (WPDT-BG-FL-04)	Buffalo Grove	Capacity and Erosion	Streambank stabilization and bike path improvement plan completed in 2011.	Completed	V
17-09 (WPDT-BG-FL-03)	Buffalo Grove	Capacity	Stormwater improvement plan completed in 2011. Storm sewer upgraded, additional detention basin constructed.	Completed	V
17-10	Deer Park	Flood-proofing / Basin Retrofit	Consultant prepared an analysis in September 2013.	UNK	L
17-11	Lake Zurich	Capacity & Study	Upgrade structure under Riley and Stanton Drives. Update floodplain study; observed flood heights inconsistent with FIRM.	$150,000-250,000	M
17-12	Lake Zurich	Study	Drainage study completed. Implementation scheduled for 2016.	$15,000-25,000	H
17-13	Lake Zurich	Design and construct/or Buy-Out	Drainage Study Completed February 2014	$2.95M	H
17-14 (BUCR-CD-SM-04)	Wheeling	Protection	When site develops, incorporate measures to improve/preserve storage potential.	None	L
17-15	Wheeling	Study	Perform detailed stormwater analysis and develop concept/preliminary engineering level report that identifies 2-3 solutions.	$40,000-50,000	H
17-16 (BUCR-WH-FL-03)	Wheeling	Capacity	Upgrade storm sewer system. Undersized storm sewer backs up into low lying areas causing overtopping of upstream storage basins.	$40,000-50,000	M
17-17 (BUCR-PH-FL-01)	Wheeling	Investigate / Study	Inconsistent reports. Village of Wheeling indicated 2-5 year frequency, while MWRD indicates flooding hasn't occurred since 2003. Perform detailed stormwater analysis to identify flooding extent and identify potential solution.	$10,000-20,000	M
17-19	Wheeling	Study	This location is identified as a potential regional storage location. Perform detailed stormwater analysis to identify flooding extent and identify potential solution to maintain access to ComEd substation and provide additional regional storage.	$15,000-25,000	L
17-20 (BUCR-WH-FR-03)	Wheeling	Conveyance	As described in **Chapter 4**, the construction of Heritage Park Flood Control Facility and Levee 37 is anticipated to reduce or eliminate flood damages in the area upstream of the Levee; potentially resolving the FPA.	Completed	V
17-22	Wheeling	Evaluate	Identify potential re-grading options to maintain flood storage and protect school facilities.	$10,000-20,000	M

17-23 (BUCR-WH-FL-02)	Wheeling	Conveyance	As described in **Chapter 4**, the construction of Heritage Park Flood Control Facility and Levee 37 is anticipated to reduce or eliminate flood damages in the area upstream of the Levee; potentially resolving the FPA.	Completed	V
17-24	Wheeling	Conveyance	As described in **Chapter 4**, the construction of Heritage Park Flood Control Facility and Levee 37 is anticipated to reduce or eliminate flood damages in the area upstream of the Levee; potentially resolving the FPA.	Completed	V
17-25 (BUCR-WH-FR-11)	Wheeling	Conveyance	As described in **Chapter 4**, the construction of Heritage Park Flood Control Facility and Levee 37 is anticipated to reduce or eliminate flood damages in the area upstream of the Levee; potentially resolving the FPA.	Completed	V
17-27 (BUCR-CD-SM-03)	Wheeling	Conveyance	Maintenance of stream corridor. Removal of Dam 1 by the USACE may reduce impacts.	UNK	L
17-28 (BUCR-WH-FR-16)	Wheeling	Evaluate	Identify potential re-grading/capacity options to maintain flood storage and provide greater flood protection to roadway.	$10,000-20,000	L
17-29	Wheeling	Study	Village is preparing a stormwater management plan to address this location.	UNK	L
17-30	Wheeling	Study	Village is preparing a stormwater management plan to address this location.	UNK	H
17-31 (BUCR-WH-FL-05)	Wheeling	Study / Basin Retrofit	This location is identified as a potential detention basin retrofit. Perform detailed stormwater analysis to identify flooding extent and identify potential retrofit solution.	$25,000-50,000	M
17-32	Wheeling	Study	Village is preparing a stormwater management plan to address this location.	UNK	H
17-33	Wheeling	Study	Village is preparing a stormwater management plan to address this location.	UNK	H
17-34 (BUCR-WH-FR-13)	Wheeling	None	Although the FPA is located in the watershed, the Des Plaines River is the cause of flooding.	UNK	NA
17-36	Wheeling	Study	Village is preparing a stormwater management plan to address this location.	UNK	H
17-38	Palatine	Evaluate	Evaluate capacity under Oak Street, East Dundee Road and the bike path. Compare observed flood heights with FIS. Identify additional modeling or design efforts based on evaluation.	$10,000-20,000	M
17-39	Palatine	Evaluate	Investigate upgrade structure under East Dundee Road and/or raising roadway to decrease flood depths.	$10,000-15,000	M

17-40 (BUCR-PL-FL-01)	Palatine	Study	Perform stormwater analysis and develop concept/preliminary engineering level report.	$10,000-20,000	M
17-41	Palatine	Study	Perform stormwater analysis and develop concept/preliminary engineering level report.	$10,000-20,000	M
17-43	Kildeer	Evaluate	Investigate upgrade structure under Buffalo Run Street and/or raising roadway to decrease flood depths.	$10,000-20,000	L
17-44	Kildeer	Evaluate	Investigate upgrade structure under Grove Drive and/or raising roadway to decrease flood depths.	$10,000-20,000	L
17-45	Wheeling	Conveyance	As described in **Chapter 4**, the construction of Heritage Park Flood Control Facility and Levee 37 is anticipated to reduce or eliminate flood damages in the area upstream of the Levee; potentially resolving the FPA.	Completed	V
17-46	Kildeer	Evaluate	Investigate upgrade structure under Andover Drive and/or raising roadway to decrease flood depths to ensure safe ingress/egress to structures.	$10,000-20,000	L
17-47	Palatine	Study	Perform stormwater analysis and develop concept/preliminary engineering level report. Consider flood protection recommendations for repetitive loss structure.	$10,000-20,000	M
17-48	Palatine	Study	Perform stormwater analysis and develop concept/preliminary engineering level report.	$10,000-20,000	M
17-49	Palatine	Study	Perform stormwater analysis and develop concept/preliminary engineering level report.	$10,000-20,000	M
BCTA-PL-FR-02 and 8	Palatine	Develop Plans	Increase conveyance on Buffalo Creek from Hicks Road to Lynda Road and Laurel Drive to Baldwin Road. Replace 4 culverts, 45 A-F reservoir for mitigation storage (MWRD recommendation).	Total Project $8.5M	L
BCTA-PL-FR-05, 6 & 7	Palatine	Develop Plans	Increase conveyance on Buffalo Creek from Hicks Road to Lynda Road and Laurel Drive to Baldwin Road. Replace 4 culverts, 45 A-F reservoir for mitigation storage (MWRD recommendation).	Total Project $8.5M	M
BUCR-PL-FL-02	Palatine	Evaluate	Identify cause of sinkhole.	$5,000-15,000	L
BUCR-WH-FR-02	Wheeling	Develop Plans	Multiple different resolutions identified by MWRD.	UNK	H
BUCR-WH-FR-01	Wheeling	Conveyance	Multiple different resolutions identified by MWRD.	UNK	M
BUCR-WH-FR-04	Wheeling	Develop Plans	Multiple different resolutions identified by MWRD.	UNK	H

BUCR-WH-FR-08	Wheeling	Develop Plans	Multiple different resolutions identified by MWRD.	UNK	L
WPDT-BG-FL-05	Buffalo Grove	Evaluate	Evaluate if this is still a FPA. Last reported incident reported by IDOT 10/17/98.	$5,000-10,000	L
WPDT-BG-FL-02	Buffalo Grove	Evaluate	Evaluate if this is still a FPA. Last reported incident reported by IDOT 10/13/01	$5,000-10,000	L
BUCR-WH-FL-06	Wheeling	Study	Perform detailed stormwater analysis, including existing pump design, and develop concept/preliminary engineering level report that identifies 2-3 solutions.	$15,000-25,000	L

6.3.2 Potential Regional Storage Locations

Potential storage locations were identified through 2 different approaches. One approach is based on the floodwater storage assessment completed by the USACE as part of the Des Plaines River Phase 1 Study. The second approach was to further refine the regional storage analysis described in Section 4.5.

A total of 13 out of the 41 potential floodwater storage sites identified by the USACE during Phase 1 were classified as high priority locations in **Table 6-11**. Another 18 sites were determined to be potentially feasible projects at a local level, although not recommended by the USACE. One of these projects is the expansion of the Buffalo Creek Reservoir, which is being actively pursued as a joint project by MWRD and the Lake County Forest Preserve District. This project is described in more detail in Section 4.4.2.2 of **Chapter 4**.

In addition to the locations identified by the USACE, potential storage locations were also identified based on the regional storage analysis described in **Chapter 4**. Potential storage locations consist of regional storage areas without mapped wetlands. Seven additional potential regional storage locations were identified as part of the watershed plan analysis, for a total of 38 potential regional storage locations. Storage volumes less than or greater than those indicated below, are likely based on the creation of more detailed engineering plans, as volumes are based on a maximum of 2 feet of bounce. All potential storage areas are depicted on **Figure 6-3** and action recommendations for only those sites deemed to be High or Medium priority are listed on **Table 6-11**. A detailed description of the methodology used to evaluate potential regional storage locations as part of this Plan can be found in **Appendix H**.

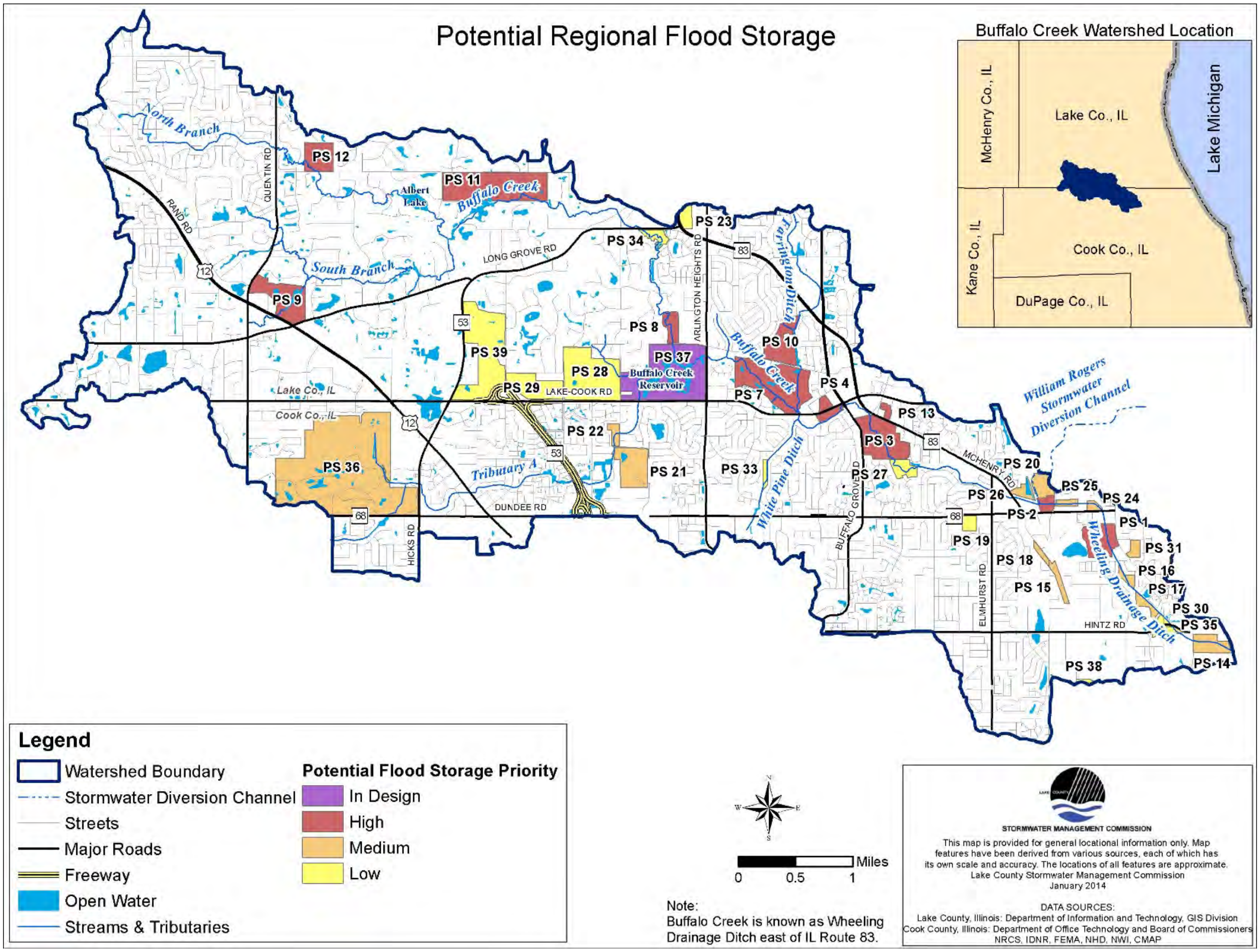


Figure 6-3: Potential Storage Areas

Table 6-11: Potential Regional Flood Storage Areas

Unique ID	Action	Project Size	Jurisdiction	Priority
PS37	Potential storage location.	180 acre feet	Unincorporated Cook County	In Design
PS8	Potential storage location.	10 acre feet	Unincorporated Cook County	H
PS9	Potential storage location.	20 acre feet	Unincorporated Lake County	H
PS10	Potential storage location.	25 acre feet	Village of Buffalo Grove	H
PS4	Potential storage location.	10 acre feet	Village of Buffalo Grove	H
PS7	Potential storage location.	25 acre feet	Village of Buffalo Grove	H
PS12	Potential Storage location.	25 acre feet	Village of Kildeer	H
PS11	Potential storage location.	50 acre feet	Village of Long Grove	H
PS1	Potential storage location.	5 acre feet	Village of Wheeling	H
PS2	Potential storage location.	10 acre feet	Village of Wheeling	H
PS3	Potential storage location.	50 acre feet	Village of Wheeling	H

PS13	Potential storage location.	10 acre feet	Village of Wheeling	H
PS36	Potential storage location.	50 acre feet	LCFPD	M
PS21	Potential storage location.	20 acre feet	Village of Arlington Heights	M
PS22	Potential storage location.	10 acre feet	Village of Arlington Heights	M
PS14	Potential storage location.	10 acre feet	Village of Wheeling	M
PS15	Potential storage location.	5 acre feet	Village of Wheeling	M
PS16	Potential storage location.	10 acre feet	Village of Wheeling	M
PS17	Potential storage location.	10 acre feet	Village of Wheeling	M
PS18	Potential storage location.	10 acre feet	Village of Wheeling	M
PS19	Potential storage location.	20 acre feet	Village of Wheeling	M
PS20	Potential storage location.	15 acre feet	Village of Wheeling	M
PS24	Potential storage location.	10 acre feet	Village of Wheeling	M
PS25	Potential storage location.	12 acre feet	Village of Wheeling	M
PS31	Potential storage location.	16 acre feet	Village of Wheeling	M

6.3.3 Potential Wetland Restoration and Enhancement Locations

Potential wetland restoration sites in the watershed are based on the findings of the 2015 Final Report Region 5 Wetland Management Opportunities and Marketing Plan: Select Watersheds in the Lower Fox and Des Plaines River Watersheds prepared by Tetra Tech (R5WMO).

The R5WMO completed an inventory of pre-settlement and existing wetlands. A subset of pre-settlement wetlands (those wetlands that no longer exist but appear to be restorable) were identified as Potentially Restorable Wetlands (PRW). The report did not take into consideration land use, property ownership, or other land-use related limitations to restoration. The report also included the Watershed-based Preliminary Assessment of Wetland Functions (W-PAWF) of each PWR based on 12 functional indicators. Each indicator was assigned a High, Moderate, or Low level of significance. Equally weighted composite scores range from a low of 12 (low functional significance for all indicators) to a high of 36 (high functional significance for all indicators).

The Potential Restoration Sites reflect areas at least 5-acres in size on undeveloped and partially undeveloped parcels. These sites are a subset of the R5WMO PRW and have been ranked High, Medium, and Low priority based on the W-PAWF composite score (26-33 = High, 18-25= Medium, 13-17= Low). Sites with the highest potential function would provide the greatest benefit.

In February 2001, SMC completed the Des Plaines River Wetland Restoration Study (DPRWRS, 2001) that identified potential wetland restoration sites in the entire Des Plaines River watershed, including the Buffalo Creek Watershed. The study used the following criteria to locate and assess wetland restoration sites:

- Greater than 16 acres in size.
- Within 50 meters of NIPC greenway and/or trail.
- Within NIPC or SMC's "open space" category or in Lake County Forest Preserve ownership.

The DPRWRS study identified 114 potential wetland restoration sites in the Des Plaines River Watershed Wetland Restoration Study area, including 6 sites in the Buffalo Creek Watershed. All six of the DPRWRS sites coincide with the potential restoration sites identified through the R5WMO analysis describe above.

The potential enhancement sites are aexisting wetlands at least 5-acres in size on undeveloped and partially undeveloped parcels. These sites are subset of the R5WMO Existing Wetlands and have been ranked High, Medium, and Low priority based on the W-PAWF composite score (13-17 for High, 18-21 for Medium, 22-25 for Low). This ranking is in contrast to the ranking of the wetland restoration sites discussed above, the lower the W-PAWF composite score the higher rank for potential wetland enhancement. Sites with a composite score of 26 or higher are not recommended to be enhanced. Potential wetland enhancement and restoration areas are depicted on **Figure 6-4** and **Table 6-12**.

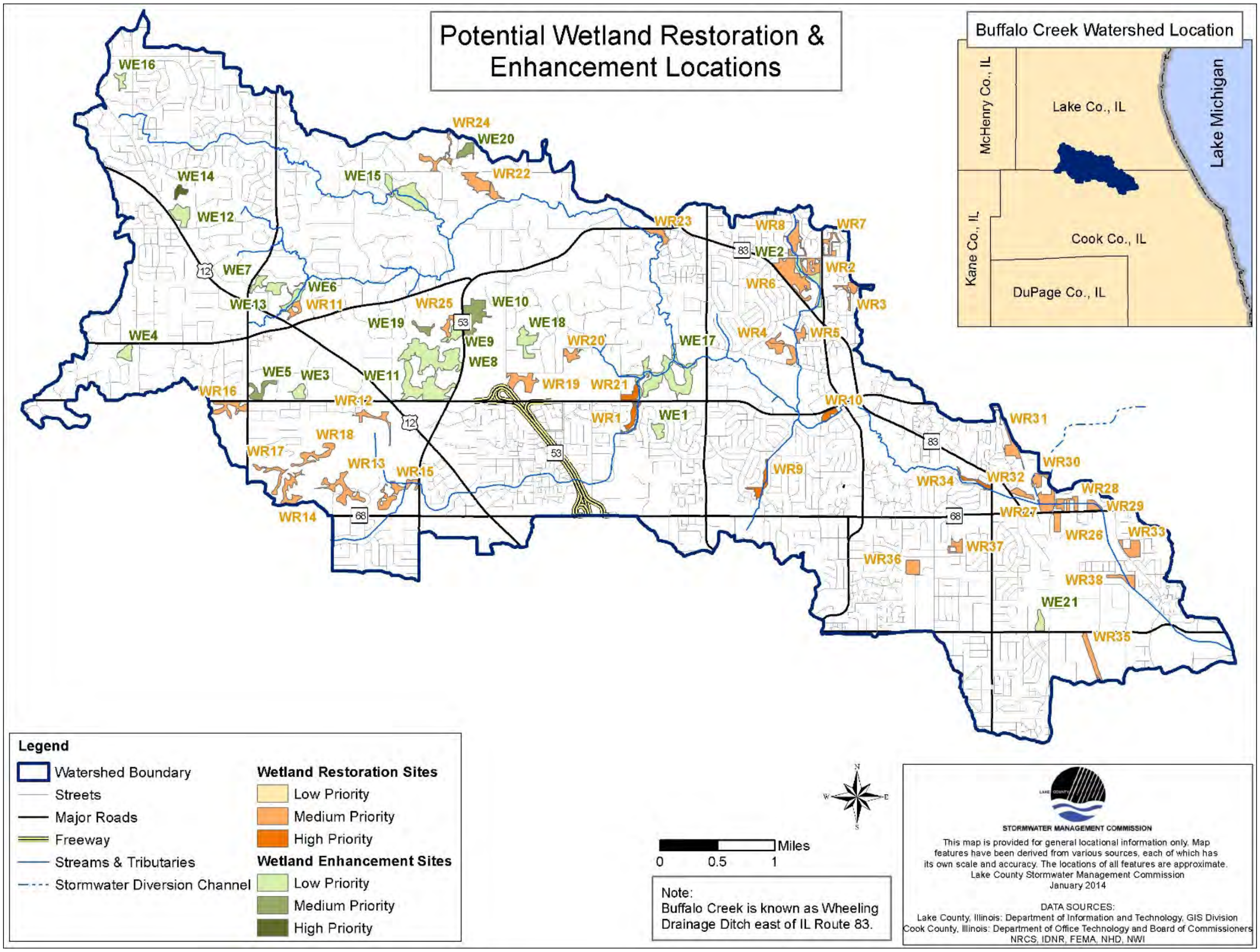


Figure 6-4: Potential Wetland Restoration and Enhancement Locations

Table 6-12: Potential Wetland Restoration and Enhancement Locations

Unique ID	Action	Project Size	Jurisdiction	Priority
WE1	Wetland Enhancement	6.9	Village of Arlington	L
WE2	Wetland Enhancement	13.8	Village of Buffalo Grove	L
WE3	Wetland Enhancement	7.4	Village of Deer Park	L
WE4	Wetland Enhancement	8.0	Village of Deer Park	L
WE5	Wetland Enhancement	9.8	Village of Deer Park	M
WE6	Wetland Enhancement	10.5	Ela Township	L
WE7	Wetland Enhancement	5.3	Ela Township/Village of Kildeer	L
WE8	Wetland Enhancement	50.3	Ela Township/Village of Long Grove	L

WE9	Wetland Enhancement	9.8	Ela Township/Village of Long Grove	L
WE10	Wetland Enhancement	24.9	Ela Township/Village of Long Grove	M
WE11	Wetland Enhancement	40.6	Ela Township/Village of Long Grove	L
WE12	Wetland Enhancement	14.0	Village of Kildeer	L
WE13	Wetland Enhancement	7.7	Village of Kildeer	L
WE14	Wetland Enhancement	5.2	Village of Kildeer	H
WE15	Wetland Enhancement	32.6	Village of Kildeer /Village of Long Grove	L
WE16	Wetland Enhancement	5.2	Village of Lake Zurich	L
WE17	Wetland Enhancement	58.7	LCFPD	L
WE18	Wetland Enhancement	15.4	Village of Long Grove	L
WE19	Wetland Enhancement	5.2	Village of Long Grove	M
WE20	Wetland Enhancement	7.6	Village of Long Grove	M
WE21	Wetland Enhancement	6.6	Village of Wheeling	L
WR1	Wetland Restoration	8.5	Arlington Heights Village	M
WR2	Wetland Restoration	9.8	Buffalo Grove Village	M
WR3	Wetland Restoration	7.7	Buffalo Grove Village	M
WR4	Wetland Restoration	15.2	Buffalo Grove Village	H
WR5	Wetland Restoration	5.2	Buffalo Grove Village	M
WR6	Wetland Restoration	29.9	Buffalo Grove Village	H
WR7	Wetland Restoration	6.0	Buffalo Grove Village	M
WR8	Wetland Restoration	13.2	Buffalo Grove Village	M
WR9	Wetland Restoration	9.1	Buffalo Grove Village	M
WR10	Wetland Restoration	5.4	Buffalo Grove Village	M
WR11	Wetland Restoration	5.8	Ela Township	M
WR12	Wetland Restoration	8.4	FPDCC	M
WR13	Wetland Restoration	19.3	FPDCC	H
WR14	Wetland Restoration	13.3	FPDCC	M
WR15	Wetland Restoration	16.3	FPDCC	H
WR16	Wetland Restoration	12.2	FPDCC	M
WR17	Wetland Restoration	7.9	FPDCC	M
WR18	Wetland Restoration	12.6	FPDCC/Palatine Village	M
WR19	Wetland Restoration	15.0	LCFPD	M
WR20	Wetland Restoration	6.2	LCFPD	M
WR21	Wetland Restoration	6.4	LCFPD	M
WR22	Wetland Restoration	19.9	Long Grove Village	H
WR23	Wetland Restoration	6.1	Long Grove Village	M
WR24	Wetland Restoration	9.6	Long Grove Village	M
WR25	Wetland Restoration	5.9	Long Grove Village/Ela Township	M
WR26	Wetland Restoration	6.0	Wheeling Village	M
WR27	Wetland Restoration	14.2	Wheeling Village	M
WR28	Wetland Restoration	9.4	Wheeling Village	M
WR29	Wetland Restoration	5.5	Wheeling Village	M
WR30	Wetland Restoration	7.4	Wheeling Village	M

WR31	Wetland Restoration	12.9	Wheeling Village	M
WR32	Wetland Restoration	5.5	Wheeling Village	M
WR33	Wetland Restoration	10.9	Wheeling Village	M
WR34	Wetland Restoration	5.3	Wheeling Village	M
WR35	Wetland Restoration	10.8	Wheeling Village	M
WR36	Wetland Restoration	9.3	Wheeling Village	M
WR37	Wetland Restoration	6.5	Wheeling Village	M
WR38	Wetland Restoration	8.2	Wheeling Village	M

Noteworthy: Wetland Functional Assessment

The Watershed-based Preliminary Assessment of Wetland Functions (W-PAWF) is an approach that classifies wetlands based on the significance of their functions (USFWS 2010). A wetland function is a natural, physical, and/or biological process that occurs within the wetland. Wetland function can, to some extent, be linked to physical and biological processes within the waterways and other ecosystems connected to the wetland. Functional significance is only meant as a method to classify and rank wetlands for their ability to perform natural processes. The 12 functions evaluated in the R5WMO analysis include:

1) Floodwater Storage
2) Stream flow Maintenance
3) Nutrient Transformation
4) Sediment and other particulate retention
5) Shoreline Stabilization
6) Stream Shading
7) Fish Habitat
8) Waterfowl and Waterbird Habitat
9) Shorebird Habitat
10) Interior Forest Bird Habitat
11) Amphibian Habitat
12) Influence of Groundwater on Stream Recharge

6.3.4 Site Specific Best Management Projects by Jurisdictional Area

The following action recommendations are coded by project type category (**Table 6-13**). A summary of site specific recommendations is provided in **Table 6-14**. Actions and projects are summarized with maps and tables by jurisdictions. Within the Jurisdictional sections, actions that address Pollutant Load Hotspot SMUs are bolded. There are nearly 622 site-specific action recommendations, spanning 18 separate jurisdictions. Flood problem mitigation, potential flood storage and wetland enhancement/restoration project locations were previously shown on **Figure 6-2**, **Figure 6-4** and **Figure 6-5**.

The following section provides site specific recommendations for projects in the Buffalo Creek Watershed. Recommended projects have been separated by jurisdiction in **Table 6-15** through **Table 6-26**. The location of recommended projects is displayed in **Figure 6-75** through **Figure 6-16**.

Table 6-13: Site Specific Action Categories.

Project Specific Action Category	ID Code	Description
Detention basin retrofit/maintenance	D	Detention basin retrofit recommendations are based on a basin survey completed by SMC. These projects include bottom dredging, native plantings, aeration, debris/sediment removal, invasive plant removal, maintenance and actions to improve basin function.
Discharge structure retrofits	DS	Detention basin structures that need maintenance or replacement.
Forest restoration	FR	Locations determined to be suitable for forest restoration based on a review of existing land-use data and historical land cover data.
Problem discharge locations	PD	Problem discharge points are any direct discharges to tributaries and creeks that should be evaluated and/or repaired.

Problem hydrologic impediments	PH	Hydrologic impediments are any notable issues that impede the conveyance and function of the waterway. These locations identified by SMC staff during the 2013 stream inventory and typically include problem hydraulic structures or logjam-debris removal.
Pervious pavement	PP	Locations determined to be suitable for pervious pavement based on a review of existing land-use data and historical land cover data. Pervious pavement areas less than 2 acres were listed as Medium priorities, areas greater than 2 acres were listed as Low priority (based on cost and feasibility).
Prairie restoration	PR	Locations determined to be suitable for prairie restoration based on a review of existing land-use data and historical land cover data.
Stream buffers	SB	Construction of buffer areas with native vegetation adjacent to streams.
Streambank stabilization	NA	Stream segments (identified with the stream segment ID number from the stream inventory) determined to be suitable for streambank stabilization/restoration.

Table 6-14: Site Specific BMP Project Summary.

Site Specific BMP Type	# of Projects	Area	Estimated Total Cost
Detention Basin Retrofit/Maintenance	288	346 acres	$3,460,000
Discharge Structure Retrofit	51	N/A	$1,020,000
Hydraulic Structure Retrofit	14	N/A	$280,000
Logjam-Debris Removal	74	N/A	$148,000
Stream Buffers	59	61 acres	$183,000
Streambank Stabilization	11	42,511 linear feet	$3,613,435
Pervious Pavement	28	35 acres	$1,528,730
Wetland Restoration	38	387 acres	$3,870,000
Wetland Enhancement	21	345 acres	$1,035,000
Prairie Restoration	27	233 acres	$714,000
Forest Restoration	11	44 acres	$132,000
Total # of Projects	**622**	**N/A**	**$15,984,165**

6.3.4.1 Unincorporated Lake County – Action Recommendations

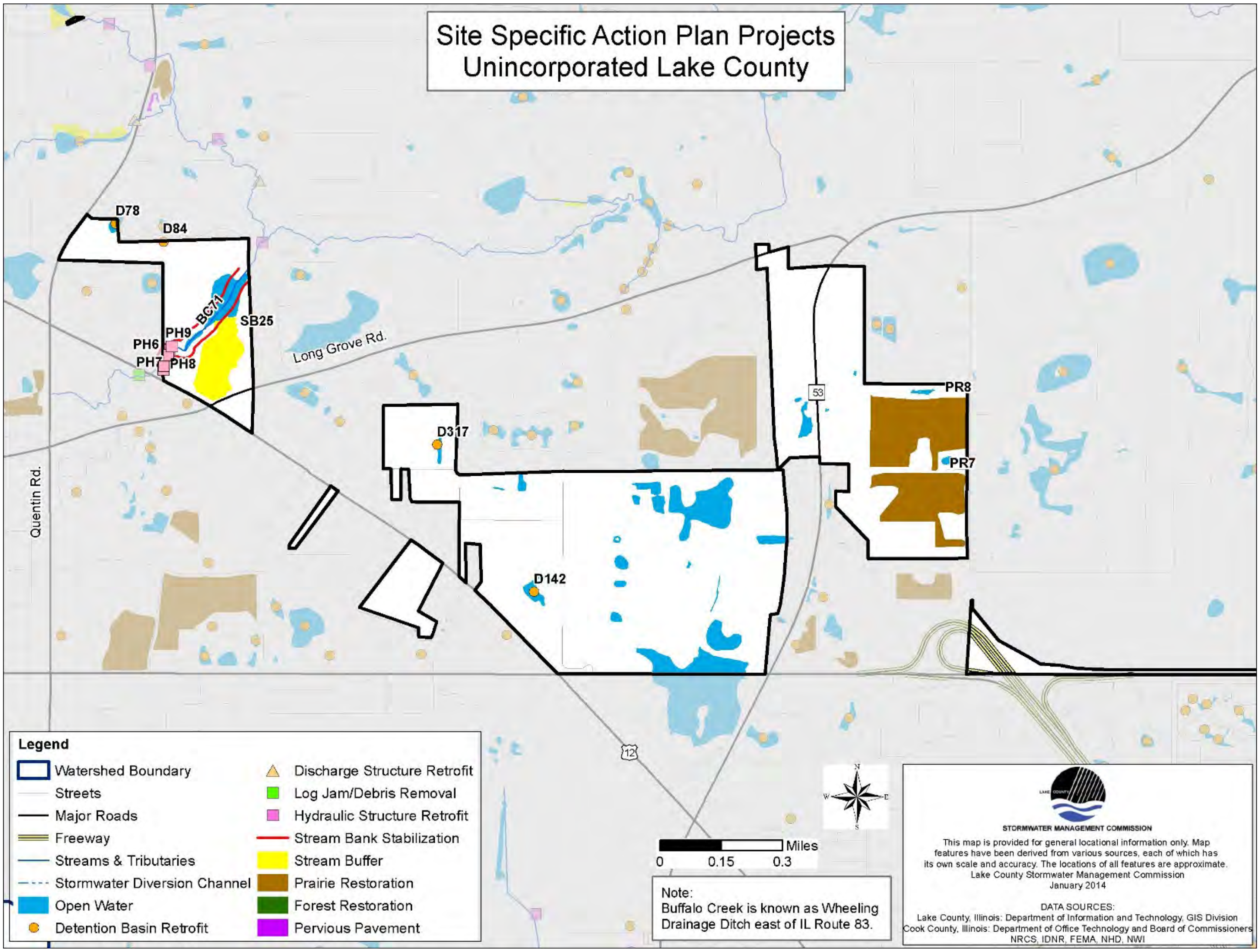


Figure 6-5: Site Specific Projects in the Unincorporated Areas of Lake County.

Table 6-15: Site Specific Project Summary for Unincorporated Areas of Lake County.

Unique ID	Action	Project Size	Basin Name	Priority
D78	Install aerator, stop using copper sulfate, and plant native vegetation on banks and in shallow water.	0.60 ac	Hidden Valley of Kildeer Pond 1	M
D84	Clear outlet of debris and plant native vegetation on slopes and banks.	0.17 ac	Hidden Valley of Kildeer Pond 3	M
D142	Remove invasive vegetation and replace with natives on basin bottom, slopes, and banks.	1.11 ac	UNK	M
D317	Perform assessment for potential detention basin retrofit.	0.90 ac	UNK	L
BC71	Streambank stabilization, Ela Township.	3,294 linear feet	N/A	M
SB25	Stream Buffer, 1 location.	9.84 ac	N/A	M

PH6-9	**Logjam-debris removal, Ela Township.**	**4**	**N/A**	**L**
PH6-9	Replace/reconnect pipe sections and stabilize.	4	N/A	M
PR7	Prairie restoration.	15.4 ac	N/A	L
PR8	Prairie restoration.	21.5 ac	N/A	L

6.3.4.2 Unincorporated Cook County – Action Recommendations

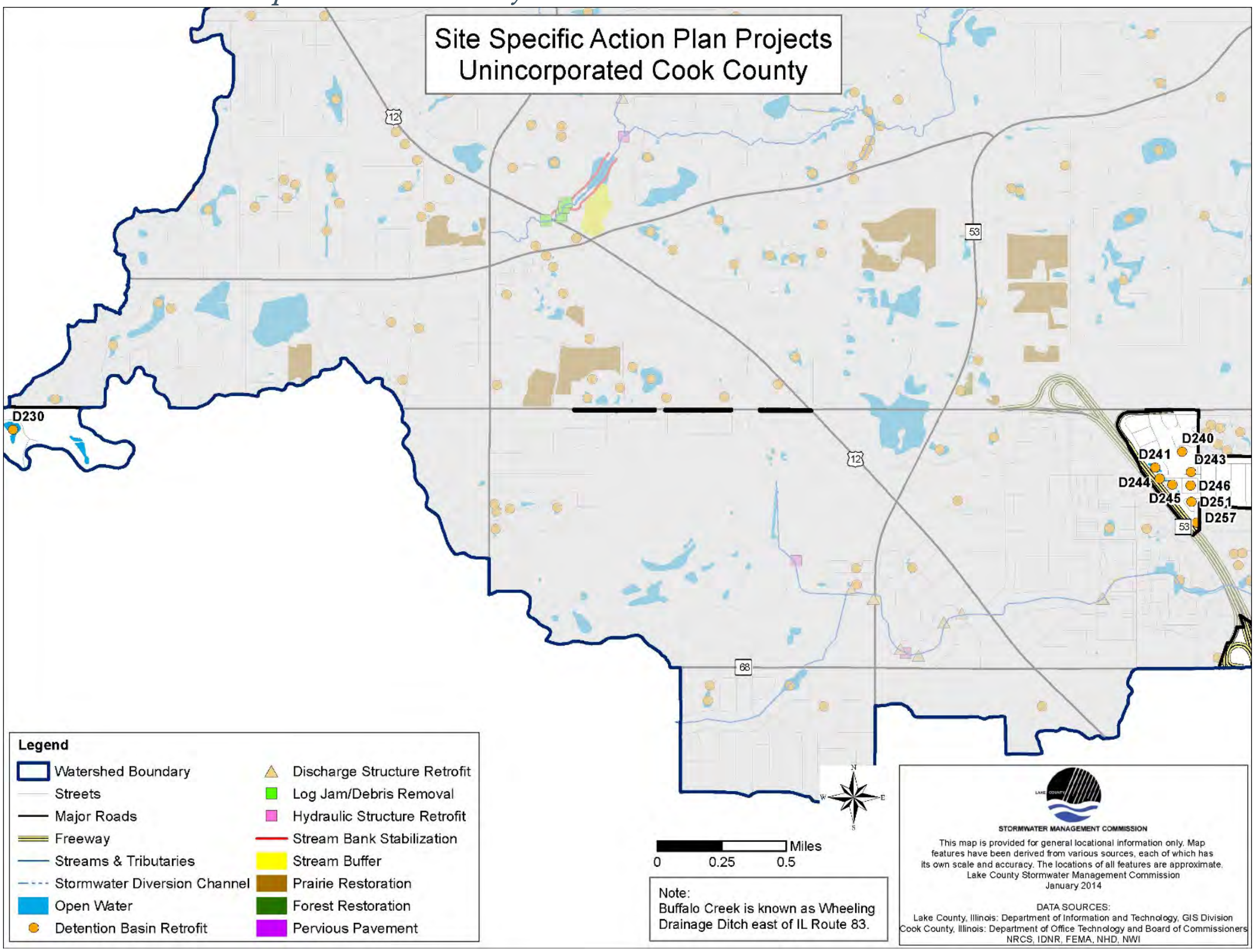


Figure 6-6: Site Specific Projects in the Unincorporated Areas of Cook County.

Table 6-16: Site Specific Project Summary for Unincorporated Areas of Cook County.

Unique ID	Action	Project Size	Basin Name	Priority
D230	Clean inlets 1 and 3 of debris. Remove invasive vegetation on basin bottom, slopes and banks and plant natives.	1.83 ac	UNK	H
D240	Disconnect downspout, remove turf grass, plant native vegetation on slopes and banks, remove excess litter and debris.	0.52 ac	UNK	M
D241	Perform assessment for potential detention basin retrofit.	0.55 ac	UNK	L
D243	Disconnect downspout, clear blockage from inlet 1, dredge basin, remove invasive species and plant natives.	0.11 ac	UNK	H

D244	Clear outlet of buildup, remove invasive species, plant native vegetation on slopes and bottom.	0.09 ac	UNK	H
D245	Disconnect downspouts, remove buildup from inlets 1 and 4, plant native vegetation on slopes and banks.	0.21 ac	UNK	M
D246	Disconnect downspouts, remove invasive species and turf grass, plant native vegetation on slopes and bottom, and clear inlet 3 (clogged).	0.12 ac	UNK	M
D251	Remove riprap and turf grass and plant native vegetation on slopes.	0.07 ac	UNK	M
D257	Disconnect downspout, remove riprap and plant native vegetation on slopes.	0.03 ac	UNK	M

6.3.4.3 Lake County Forest Preserve District – Action Recommendations

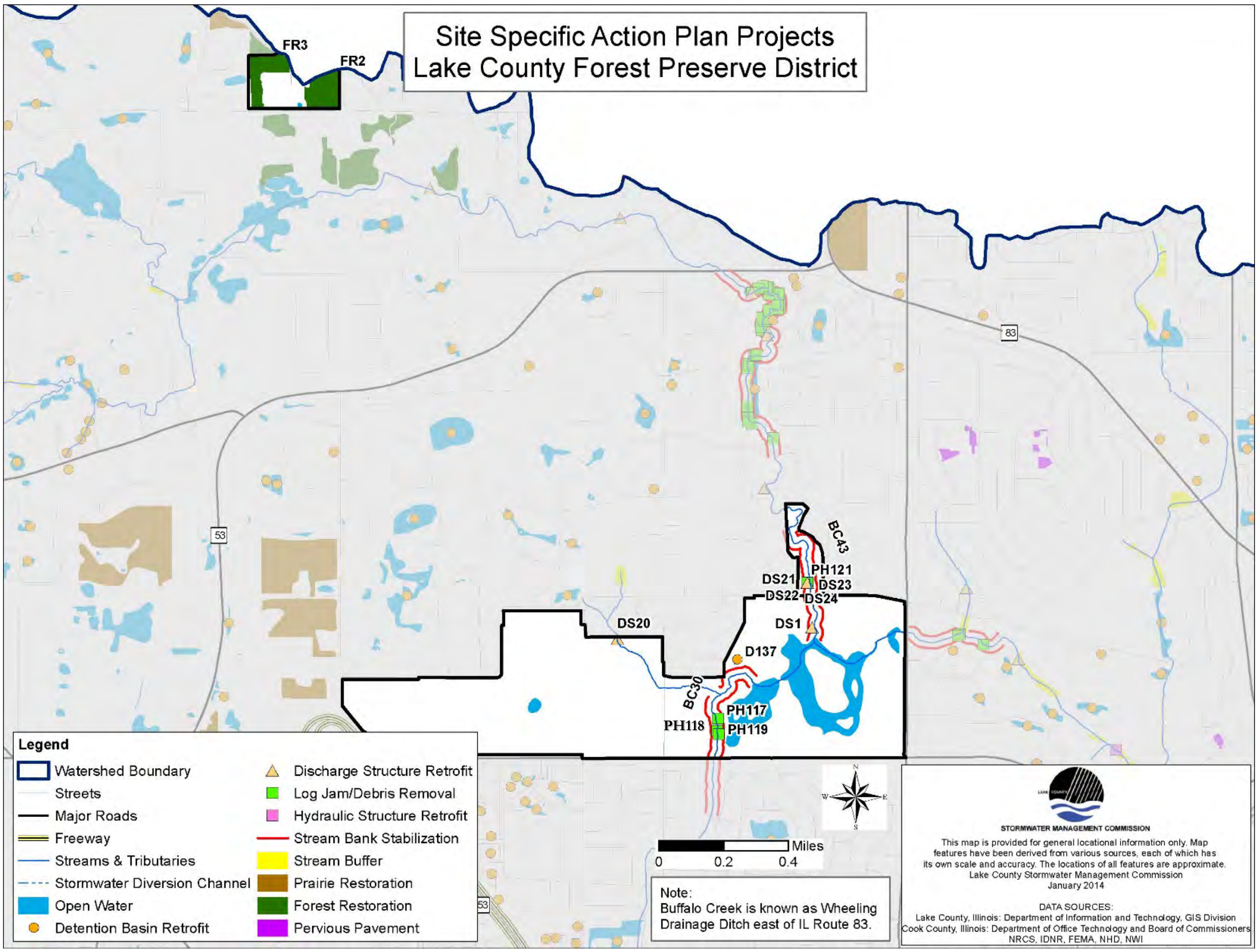


Figure 6-7: Site Specific Projects in the Lake County Forest Preserve District.

Table 6-17: Site Specific Project Summary for Lake County Forest Preserve District.

Unique ID	Action	Project Size	Basin Name	Priority
D137	Plant native vegetation on slopes.	0.32 ac	UNK	M
BC30	Streambank stabilization.	3,660 linear feet	N/A	M
BC43	**Streambank stabilization.**	**4,146 linear feet**	**N/A**	**H**
DS1	Repair/replace submerged and buried outlet.	1	N/A	M
DS20	Evaluate source tile, repair/remove.	1	N/A	M
DS21-24	Repair broken pipes.	4	N/A	M
PH117, PH118, PH119, PH121	Logjam/debris removal.	4	N/A	L
FR2	Forest restoration in Heron Creek Forest Preserve	6.11 ac	N/A	L
FR3	Forest restoration in Heron Creek Forest Preserve	6.48 ac	N/A	L

6.3.4.4 Cook County Forest Preserve District – Action Recommendations

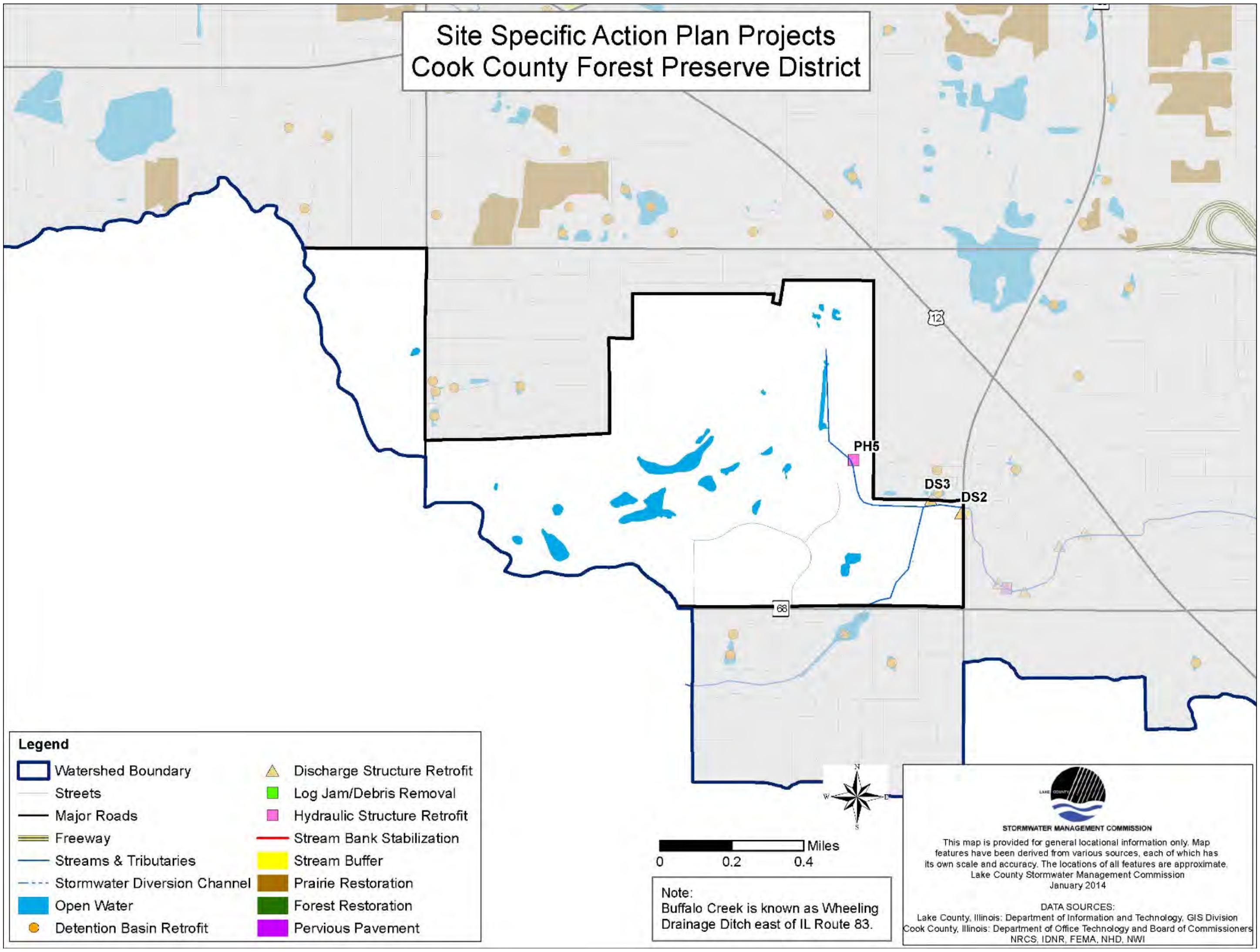


Figure 6-8: Site Specific Projects in the Cook County Forest Preserve District.

Table 6-18: Site Specific Project Summary for Cook County Forest Preserve District.

Unique ID	Action	Project Size	Basin Name	Priority
DS2	**Repair/replace cracked and eroded outlet.**	**1**	**N/A**	**M**
DS3	**Repair/replace outlet.**	**1**	**N/A**	**M**
PH5	Replace culvert.	1	N/A	M

6.3.4.5 Village of Arlington Heights – Action Recommendations

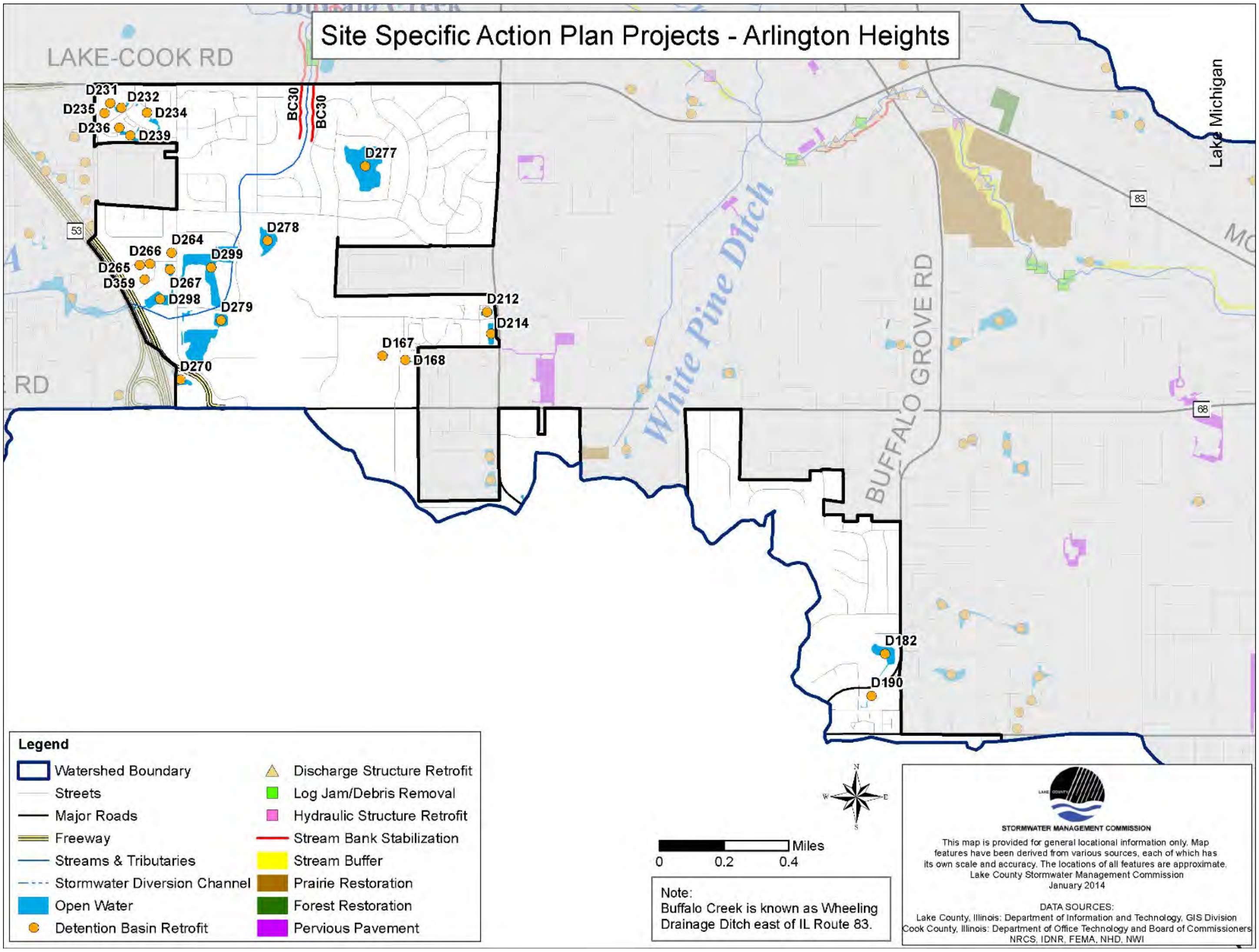


Figure 6-9: Site Specific Projects in the Village of Arlington Heights.

Table 6-19: Site Specific Project Summary for Village of Arlington Heights.

Unique ID	Action	Project Size	Basin Name	Priority
D167	Replace inlet 3, plant native vegetation instead of turf grass on slopes.	0.23 ac	UNK	H
D168	Plant native vegetation on slopes and bottom, remove concrete channel.	0.09 ac	UNK	H
D182	Remove invasive species and plant native vegetation on slopes and banks.	1.69 ac	UNK	H
D190	Remove riprap on banks and plant native vegetation on slopes and banks.	0.17 ac	UNK	M
D212	Remove turf grass and riprap; and plant native vegetation on slopes, banks, and channel inlet 2. Increase size of outlets.	0.37 ac	UNK	M
D214	Disconnect downspouts; remove riprap and turf grass; plant native vegetation on slopes and banks; and increase size of outlet structure.	0.71 ac	UNK	M
D231	Disconnect downspout and plant native vegetation on slopes.	0.22 ac	UNK	L
D232	Install additional riprap at inlet 3; plant native vegetation on banks; and disconnect downspout.	0.30 ac	UNK	M

D234	Replace riprap with native vegetation on the slopes and disconnect downspout.	0.50 ac	UNK	M
D235	Disconnect downspout; plant native vegetation on slopes; and clear inlet 8 of buildup.	0.13 ac	UNK	M
D236	Plant native vegetation on slopes and disconnect downspout.	0.11 ac	UNK	M
D239	Plant slopes with native vegetation and repair inlets 6, 7, and 8.	0.48 ac	UNK	H
D264	Reconnect segments of inlet 1 and plant slopes with native vegetation.	0.16 ac	UNK	M
D265	Plant native vegetation on slopes.	0.11 ac	UNK	M
D266	Dredge excess sediment and plant native vegetation on slopes.	0.10 ac	UNK	M
D267	Install aerator by outlet; replace inlet 1; and plant native vegetation on slopes.	0.45 ac	UNK	M
D270	Perform assessment for potential basin retrofit.	0.86 ac	UNK	L
D277	Increase outlet size; remove turf grass; and plant native vegetation on slopes and banks.	7.12 ac	UNK	M
D278	Remove riprap, turf grass, and retaining walls and plant native vegetation on slopes.	1.93 ac	UNK	M
D279	Remove invasive species, woody vegetation, and turf grass and plant native vegetation on slopes and banks.	0.98 ac	UNK	M
D298	Remove riprap; plant native vegetation on slopes; replace inlet 3; and reconnect inlets 4 and 5.	2.08 ac	UNK	M
D299	Remove riprap and invasive species; plant native vegetation; clear inlet 7 of clogging; and replace inlet 6.	6.46 ac	UNK	M
D359	Plant native vegetation along banks; disconnect sump pump and downspout; and replace inlet 2.	0.10 ac	UNK	M
BC30	Streambank stabilization.	1,845 linear feet	N/A	M

6.3.4.6 Village of Buffalo Grove – Action Recommendations

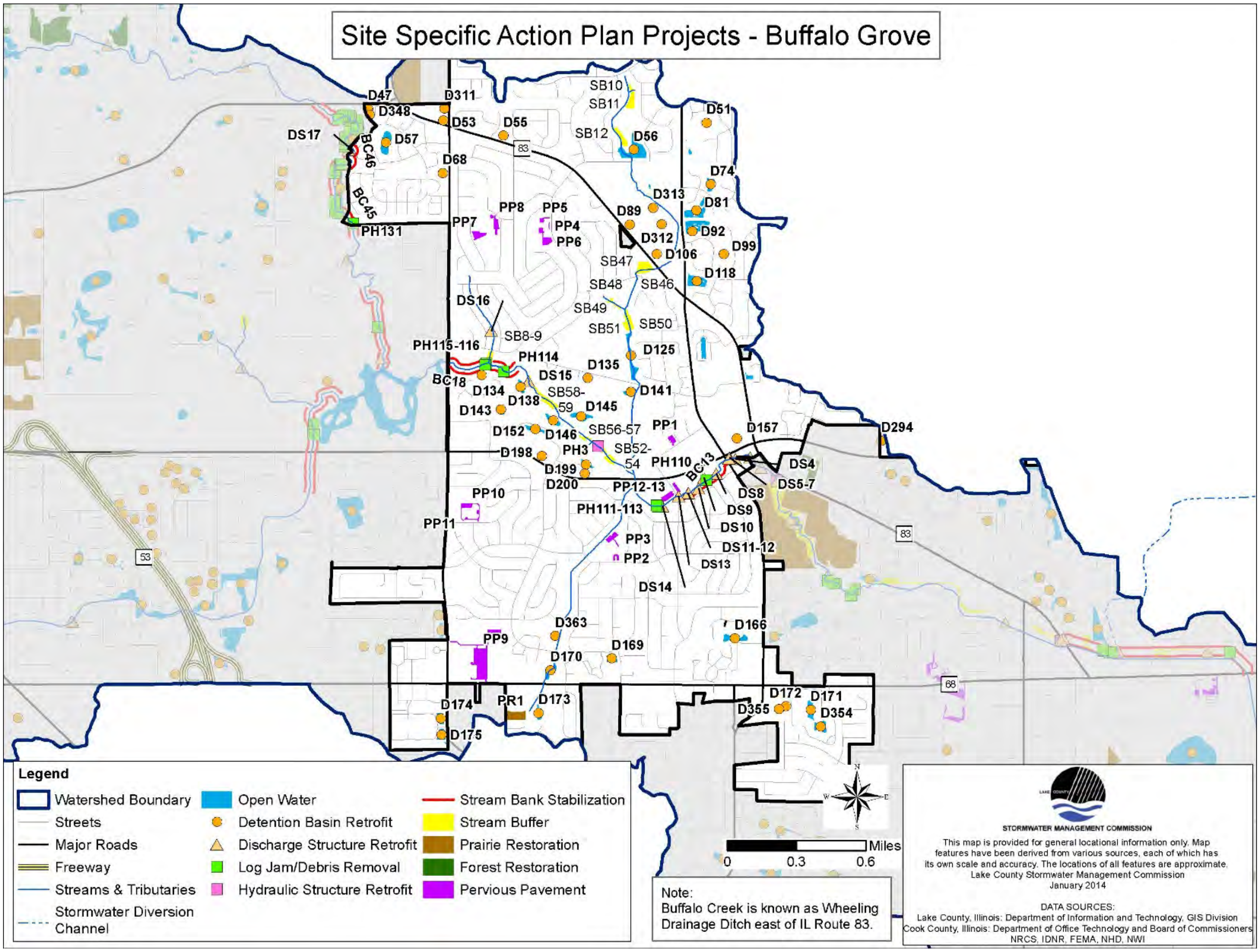


Figure 6-10: Site Specific Projects in the Village of Buffalo Grove.

Table 6-20: Site Specific Project Summary for the Village of Buffalo Grove.

Unique ID	Action	Project Size	Basin Name	Priority
D47	**Install aerator and plant native vegetation on banks**	**0.17 ac**	**Crossings Pond 2**	**M**
D51	Disconnect sump pumps and downspouts.	4.66 ac	Westchester Estates Pond 1	L
D53	Plant native vegetation on slopes; replace inlet 1; refill soil around outlet A; clear inlets 2-4 of build-up; and fix aerator.	0.15 ac	LaSalle Bank Professional Center Pond	M
D55	Plant slopes and bottom with native vegetation.	0.54 ac	Spoerlein Farm Pond	H
D56	Replace outlet; remove riprap from banks; and replace with native vegetation	4.26 ac	Green Lake Park Pond	M
D57	Reduce slope of banks to 3:1; plant native vegetation on banks; and install an aerator on north end.	2.14 ac	Crossings Pond 1	M
D68	Plant slopes and banks with native vegetation.	0.5 ac	Concord Place Pond	L

D74	Clear inlet 2 and 4 of debris; replace inlet 5; remove riprap and turf grass; plant native vegetation; and disconnect sump.	0.88 ac	Hidden Lake Village Pond 1	M
D81	Remove riprap and turf grass and plant native vegetation on slopes.	2.19 ac	Hidden Lake Village Pond 2	M
D89	Replace invasive species with native vegetation; clear inlets 1, 2, and 3 and outlet A of debris.	1.67 ac	Rylko Park Pond 1	H
D99	Replace inlet 3 and plant native vegetation where woody vegetation used to be.	3.96 ac	Cherborough Pond 3	L
D106	Remove invasive species and plant native vegetation on slopes and bottom.	1.49 ac	Rylko Park Pond 2	M
D118	Replace outlet A and plant native vegetation where woody vegetation used to be.	2.08 ac	UNK	L
D125	Remove invasive species; plant native vegetation; and install aerator on south end of the basin.	2.50 ac	Willow Stream Park Pond	M
D134	Disconnect downspouts and plant slopes with native vegetation.	0.35 ac	Lexington Glen Pond	M
D135	Remove riprap and plant native vegetation along banks.	0.10 ac	Roseglen Pond	M
D138	Replace inlets 2 and 4 and plant native vegetation on banks.	0.80 ac	Buffalo Grove Golf Course Pond 1	M
D141	Plant slopes with native vegetation and install aerator on north side.	0.90 ac	Buffalo Grove Golf Course Pond 4	M
D143	Fix aerator; remove riprap; and plant native vegetation on banks.	0.52 ac	Buffalo Grove Business Park Pond 2	M
D145	Replace inlet 3; perform maintenance on native vegetation and remove invasive species.	1.30 ac	Buffalo Grove Golf Course Pond 3	M
D146	Replace inlet 3 and outlet; perform maintenance of native vegetation on bank; and remove invasive species.	0.90 ac	Buffalo Grove Golf Course Pond 2	M
D152	Plant banks with native vegetation and reconnect sections of inlet 1.	0.92 ac	Buffalo Grove Business Park Pond 1	M
D157	**Plant native vegetation on slopes; install riprap in front of inlet 1; and clear litter out of basin.**	**1.28 ac**	**Buffalo Grove Town Center Pond 2**	**H**
D166	Plant slopes with native vegetation.	1.29 ac	UNK	M
D170	Reduce slope to 3:1 and plant native vegetation on rest of slope.	1.13 ac	UNK	L
D171	Plant slopes with native vegetation and increase size of outlets.	1.12 ac	UNK	M
D172	Reduce slopes to 3:1; plant native vegetation on slopes; and clear litter.	0.50 ac	UNK	M
D173	Remove woody vegetation, invasive species, and turf grass; and plant native vegetation on slopes and bottom.	0.42 ac	UNK	H
D174	Remove riprap and turf grass and plant native vegetation on slopes and banks.	0.77 ac	UNK	M
D175	Remove riprap and turf grass; plant native vegetation on slopes; and stop mowing.	0.91 ac	UNK	M
D198	Plant slopes with native vegetation.	0.31 ac	UNK	M

D199	Plant native vegetation along banks and install aerator on the east segment.	0.62 ac	UNK	M
D200	Install an aerator and plant native vegetation along banks.	0.09 ac	UNK	M
D294	Plant native vegetation on slopes and replace inlet 1.	0.09 ac	UNK	M
D311	Disconnect downspout; plant turf grass slopes with native vegetation; and install an aerator.	0.22 ac	UNK	M
D312	Clear inlet 1 of debris; plant native vegetation; and remove invasive species.	0.56 ac	UNK	H
D313	Clear inlet 1 of debris; remove sediment buildup from outlet A; and plant native vegetation on slopes and bottom.	0.33 ac	UNK	H
D348	**Install FES on inlet 1 and plant slopes with native vegetation.**	**0.04 ac**	**UNK**	**L**
D354	Plant native vegetation on slopes and increase outlet size.	1.23 ac	UNK	M
D355	Replace inlet 2; reduce slope to 3:1 and plant native vegetation on slopes.	0.20 ac	UNK	M
D363	Remove low flow bypass by installing an inlet on south side; remove turf grass; and plant native vegetation on slopes and bottom.	1.71 ac	UNK	H
BC13, BC18, **BC45**	**Streambank stabilization.**	**5,262 linear feet**	**N/A**	**M**
BC46	**Streambank stabilization.**	**495 linear feet**	**N/A**	**H**
SB8-12, SB46-54, SB55-59	Install stream buffer at 19 locations.	9.91-ac	N/A	M
DS4	**Investigate thick brown discharge for possible illicit discharge.**	**1**	**N/A**	**H**
DS5	**Investigate thick iron-like discharge for possible illicit discharge.**	**1**	**N/A**	**H**
DS6	**Investigate thick iron-like discharge for possible illicit discharge.**	**1**	**N/A**	**H**
DS7	**Investigate thick iron-like discharge for possible illicit discharge.**	**1**	**N/A**	**H**
DS8	**Repair/replace outlet.**	**1**	**N/A**	**M**
DS9	**Replace outlet.**	**1**	**N/A**	**M**
DS10	**Repair/replace outlet.**	**1**	**N/A**	**M**
DS11	**Clean out pipe and replace outlet.**	**1**	**N/A**	**M**
DS12	**Determine if pipe system is abandoned. Clean out pipe if operational or abandon appropriately.**	**1**	**N/A**	**L**
DS13	**Repair/replace outlet**	**1**	**N/A**	**M**
DS14	Further evaluate/investigate.	1	N/A	M
DS15	Determine if pipe system is abandoned. Clean out pipe if operational or abandon appropriately.	1	N/A	L
DS16	Repair/replace outlet.	1	N/A	M

DS17	Replace outlet.	1	N/A	M
PH3, PH110-116	Logjam/debris removal.	8	N/A	L
PH3	Remove remnants of old concrete bridge.	1	N/A	L
PP1	Pervious pavement retrofit at Buffalo Grove Police Department.	0.50 ac	N/A	M
PP2	Pervious pavement retrofit at Buffalo Grove Park District.	0.29 ac	N/A	M
PP3	Pervious pavement retrofit at Buffalo Grove Park District.	0.81 ac	N/A	M
PP4	Pervious pavement retrofit at Willow Grove Elementary.	0.07 ac	N/A	M
PP5	Pervious pavement retrofit at Willow Grove Elementary.	0.30 ac	N/A	M
PP6	Pervious pavement retrofit at Willow Grove Elementary.	1.04 ac	N/A	M
PP7	Pervious pavement retrofit at Ivy Hall Elementary School.	0.90 ac	N/A	M
PP8	Pervious pavement retrofit at Ivy Hall Elementary School.	0.96 ac	N/A	M
PP9	Pervious pavement retrofit at Buffalo Grove High School.	6.76 ac	N/A	L
PP10	Pervious pavement retrofit at Buffalo Grove High School.	1.15 ac	N/A	M
PP11	Pervious pavement retrofit at Copper Middle School.	0.11 ac	N/A	M
PP12	**Pervious pavement retrofit at Copper Middle School.**	**0.77 ac**	**N/A**	**M**
PP13	**Pervious pavement retrofit at Buffalo Grove Park District.**	**0.38 ac**	**N/A**	**M**
PR1	Prairie restoration.	1.9 ac	N/A	L

6.3.4.7 Village of Deer Park – Action Recommendations

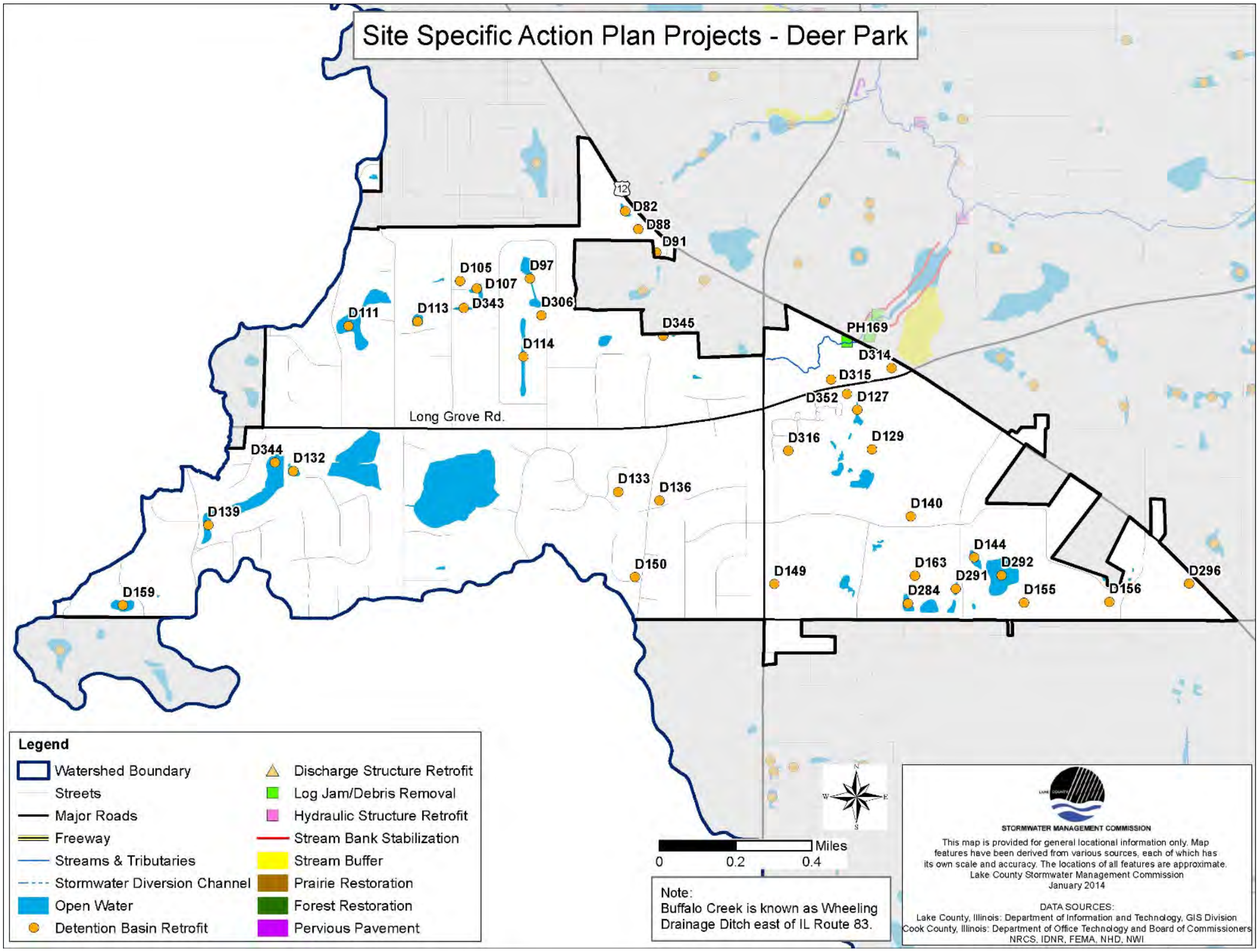


Figure 6-11: Site Specific Projects in the Village of Deer Park.

Table 6-21: Site Specific Project Summary for the Village of Deer Park.

Unique ID	Action	Project Size	Basin Name	Priority
D82	Install aerator; replace inlets 1 and 2; fill soil around inlet 2 and plant native vegetation on banks.	0.29 ac	Rand 12 Centre Pond 1	H
D88	Perform assessment.	0.22 ac	Rand 12 Centre Pond 2	L
D91	Remove invasive species from wetland and plant native wetland vegetation.	0.32 ac	Sturm Pond 1	H
D97	Fix 3rd aerator and plant native vegetation along banks.	1.35 ac	Swansway Ponds Pond	L
D105	Plant slopes with native vegetation.	0.14 ac	Country Corners Pond 1	L
D107	Replace riprap and turf grass with native vegetation and install aerator.	0.50 ac	Country Corners Pond 2	M
D111	Disconnect downspouts and sump pump and plant native vegetation on slopes.	4.09 ac	Deerpath Estates Pond 2	L

D113	Install aerator in east part of basin and plant native vegetation on channel inlets and slopes.	0.87 ac	Country Corners Pond 3	M
D114	Plant slopes with native vegetation; remove steel wall and slope; install aerator at north end of basin, and replace inlet 3.	1.36 ac	Swansway Pond	H
D127	Remove invasive species and plant native vegetation.	1.97 ac	Deer Park Town Center Pond 2	M
D129	Plant slopes with native vegetation; clear inlets 6 and 9 of debris; and replace inlet 1.	5.17 ac	Deer Park Town Center Pond 3	M
D132	Plant banks with native vegetation.	0.43 ac	Lies Pond	M
D133	Remove bypass; install FES inlets and outlets; and plant slopes and bottom with native vegetation.	0.84 ac	Dover Pond Detention Pond	H
D136	Remove invasive species and plant native vegetation.	0.40 ac	Deer Valley Estates Pond	M
D139	Disconnect downspouts; plant banks with native vegetation; install another aerator by outlet; and replace outlet with a larger size pipe.	1.06 ac	Oak Ridge Pond	M
D140	Plant slopes with native vegetation and clear inlets 4 and 5 of debris.	0.74 ac	Deer Park Town Center Pond 9	M
D144	Perform assessment.	0.84 ac	Motorola - Deer Park Pond 1	L
D149	Remove invasive species, install larger outlet; and plant slopes and banks with native vegetation.	1.19 ac	Deer Park Office Center Pond 1	M
D150	Plant more native vegetation along banks.	0.11 ac	Deer Valley Highlands Pond 2	L
D155	Remove invasive species; plant native vegetation; clear outlet A; and reattach outlet A grate.	4.94 ac	Motorola - Deer Park Pond 5	H
D156	Clear outlet A; remove invasive species; and plant native vegetation on slopes and banks.	1.05 ac	Motorola - Deer Park Pond 6	H
D159	Disconnect downspout.	0.95 ac	Park Hill Countryside Estates Pond 1	H
D163	Perform assessment for potential detention basin retrofit.	1.05 ac	Deer Park Office Center Pond 4	L
D284	Disconnect downspout; clear outlet of debris; and reattach grate	0.74 ac	UNK	L
D291	Install inlet on south side.	0.27 ac	UNK	L
D292	Clear inlet 2 of debris; remove invasive species; and plant native vegetation.	4.26 ac	UNK	H
D296	Remove woody vegetation; plant area with native vegetation; and install an aerator.	0.29 ac	UNK	H
D306	Perform assessment for potential detention basin retrofit.	0.81 ac	UNK	L
D314	Remove invasive species and plant native vegetation.	0.17 ac	UNK	M
D315	Remove invasive species; plant native vegetation; and clear outlet A of buildup.	0.26 ac	UNK	H
D316	Remove invasive species and plant native vegetation.	0.55 ac	UNK	L
D343	Disconnect downspout and install aerator.	0.21 ac	UNK	M
D344	Disconnect downspouts and sump pump, and plant slopes with native vegetation.	4.75 ac	UNK	H

D345	Replace inlet 1; refill soil around inlet 1; remove invasive species; and plant native vegetation.	0.13 ac	UNK	H
D352	Clear inlet 1 of debris and remove invasive species.	0.11 ac	UNK	H
PH169	Logjam/debris removal.	1	N/A	L
PR2	Prairie restoration.	18.1 ac	N/A	L
PR3	Prairie restoration.	9.1 ac	N/A	L
PR4	Prairie restoration.	2.4 ac	N/A	L
PR5	Prairie restoration.	8 ac	N/A	L
PR6	Prairie restoration.	10.6 ac	N/A	L

6.3.4.8 Village of Kildeer – Action Recommendations

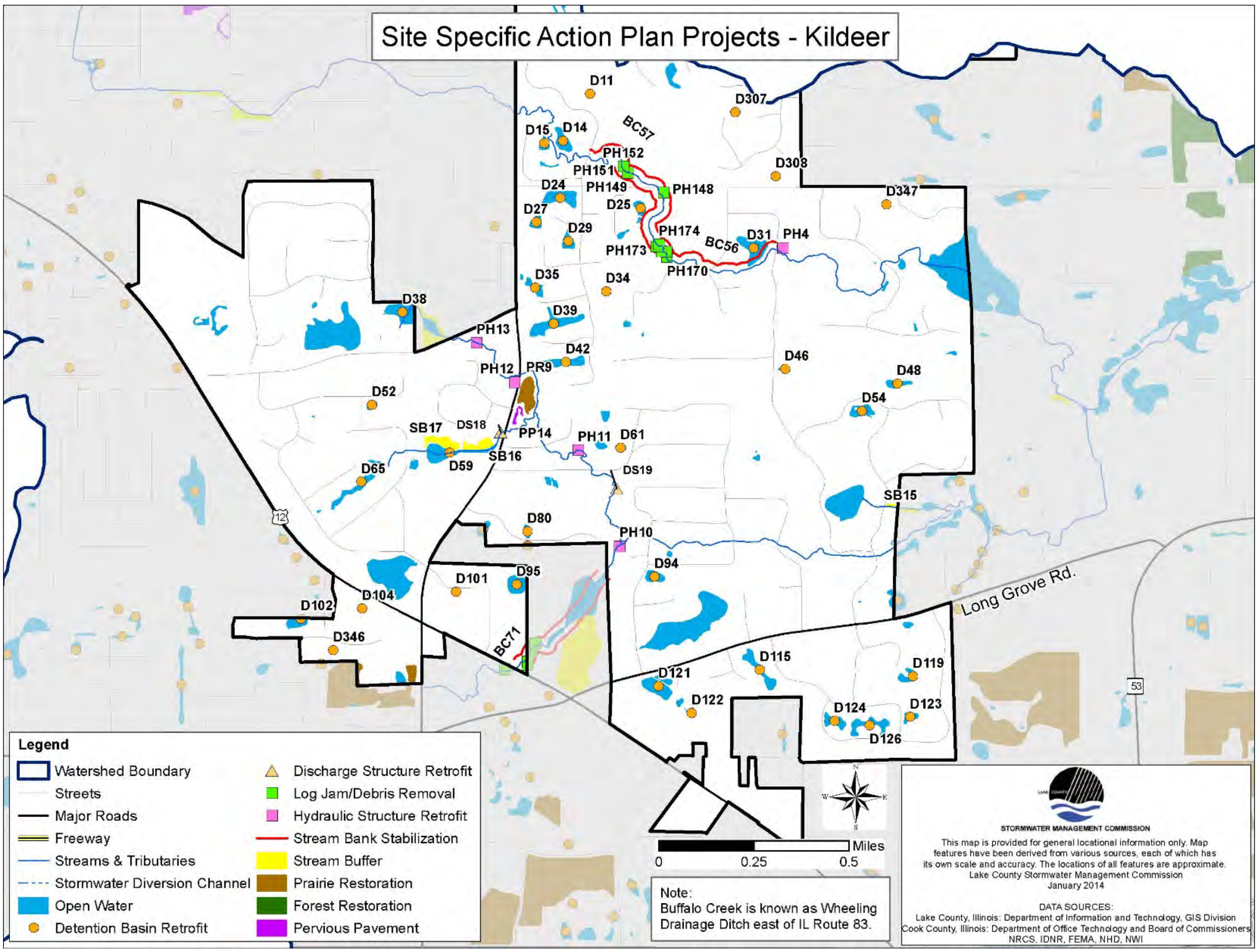


Figure 6-12: Site Specific Projects in the Village of Kildeer.

Table 6-22: Site Specific Project Summary for the Village of Kildeer.

Unique ID	Action	Project Size	Basin Name	Priority
D11	Perform assessment for potential detention basin retrofit.	2.34 ac	Prairie Creek of Kildeer Pond 3	L
D14	Perform assessment for potential detention basin retrofit.	1.10 ac	Prairie Creek of Kildeer Pond 5	L
D15	Perform assessment for potential detention basin retrofit.	0.50 ac	Prairie Creek of Kildeer Pond 4	L
D24	**Disconnect downspout and sump pump; install an aerator; realign outlet A's grate; reattach grate inlet 2; clear sediment from inlet 1 and replant banks with native vegetation.**	**1.81 ac**	**Ponds of Killdeer Pond 9**	**H**
D25	**Plant slopes and banks with native vegetation.**	**0.60 ac**	**Hickory Hills Pond 1**	**L**
D27	**Clear inlet 3 and 5 of debris and add additional riprap in front of inlets 1, 2, and 3. Remove turf grass and plant native vegetation.**	**0.56 ac**	**Ponds of Killdeer Pond 8**	**H**
D29	**Clear inlet of debris; remove invasive species and plant native vegetation.**	**0.74 ac**	**Ponds of Killdeer Pond 6**	**H**
D31	Perform assessment for potential detention basin retrofit.	2.19 ac	Farmington Pond 8	L
D34	**Plant basin with native vegetation.**	**0.83 ac**	**Ponds of Killdeer Pond 5**	**H**
D35	Clear outlet A of debris; clear banks of invasive species and plant native vegetation.	0.71 ac	Ponds of Killdeer Pond 3	M
D38	Replace turf grass with native vegetation. Install aerator.	2.05 ac	Bishops Ridge Pond 1	M
D39	Disconnect sump pump; fix grate inlet 1; remove invasive species and plant native vegetation along banks.	2.36 ac	Ponds of Killdeer Pond 2	M
D42	Remove woody vegetation and invasive species; and plant native vegetation.	1.25 ac	Ponds of Killdeer Pond 1	M
D46	Perform assessment for potential detention basin retrofit.	0.19 ac	Farmington Pond 9	L
D48	**Replace outlet A and plant native vegetation (could install on test of slope).**	**0.67 ac**	**Farmington Pond 1**	**M**
D52	Perform assessment for potential detention basin retrofit.	0.34 ac	Pine Valley - Kildeer Pond 5	L
D54	**Remove turf grass from banks and invasive species from inlet 2. Plant native vegetation on slopes and inlet 2.**	**1.03 ac**	**Farmington Pond 5**	**L**
D59	Remove invasive species and plant native vegetation along banks.	2.29 ac	Pine Valley - Kildeer Pond 1	M
D61	Plant native vegetation along banks and install aerator.	0.24 ac	Boschome Farm Pond 3	L
D65	Disconnect downspout; remove woody vegetation and plant native vegetation along banks.	2.00 ac	Pine Valley - Kildeer Pond 3	H
D80	Disconnect downspouts and plant native vegetation on slopes.	0.34 ac	Hidden Valley of Kildeer Pond 2	L
D94	Plant banks and outlet A with native vegetation.	0.80 ac	Farmington Pond 7	M
D95	Perform assessment for potential detention basin retrofit.	1.34 ac	L.B. Anderson Pond	L
D101	Perform assessment for potential detention basin retrofit.	0.25 ac	UNK	L
D102	Replace invasive species in wetland with native wetland vegetation.	0.99 ac	Sturm Pond 2	L

D104	Disconnect downspout and plant slopes with native vegetation.	0.25 ac	UNK	M
D115	Plant native vegetation where turf grass currently exists; install aerator in the southern portion of the basin; and disconnect sump pump.	1.42 ac	Prestonfield Pond 4	M
D119	Disconnect downspout; replace outlet A; remove invasive species; and plant native vegetation.	0.73 ac	Meadows of Killdeer Pond 1	M
D121	Clear litter from the basin; remove invasive species; and plant native vegetation.	2.16 ac	Shops at Kildeer Shopping Center Pond 2	M
D122	Clear debris and litter from the basin; install an aerator; remove invasive species; and reattach grate on inlet.	0.17 ac	Shops at Kildeer Shopping Center Pond 5	H
D123	Install aerator on east side; plant native vegetation on banks in place of riprap and turf grass.	0.42 ac	Prestonfield Pond 2	M
D124	Plant banks and inlet 2 with native vegetation.	0.69 ac	Prestonfield Pond 1	L
D126	Clear inlets 2 and 3 of sediment; install aerator near the outlet; and plant native vegetation along banks.	1.66 ac	Prestonfield Pond 3	H
D307	**Clear inlet 1 of debris and sediment; remove invasive species; and plant native vegetation.**	**0.60 ac**	**UNK**	**H**
D308	**Clear outlet A of debris; remove invasive species from banks; and plant native vegetation.**	**1.36 ac**	**UNK**	**H**
D346	Remove woody vegetation from east side; clear outlet A of debris; and plant basin with native vegetation.	0.79 ac	UNK	H
D347	Clear inlet 2 of debris; stop mowing outlet vegetation; remove invasive species; and plant native vegetation.	1.58 ac	UNK	H
BC56, BC57, BC71	**Streambank stabilization.**	**6,623 linear feet**	**N/A**	**M**
SB15-17	Install stream buffer at 3 locations.	2.37 ac	N/A	M
DS18	Clean out structure and evaluate for retrofit.	1	N/A	M
DS19	Evaluate source drain tile and SESC solutions.	1	N/A	M
PH147-149, PH151-152, PH170, PH173-174	Logjam/debris removal.	7	N/A	L
PH4	**Evaluate and repair/replace.**	**1**	**N/A**	**M**
PH10	Evaluate and remove.	1	N/A	L
PH11	Evaluate and remove.	1	N/A	L
PH12	Clean out culvert.	1	N/A	M
PH13	Clean out culvert.	1	N/A	M
PP14	Pervious pavement retrofit at Village of Kildeer Police Department.	0.29 ac	N/A	M
PR9	Prairie restoration.	1.9 ac	N/A	L

6.3.4.9 Village of Lake Zurich – Action Recommendations

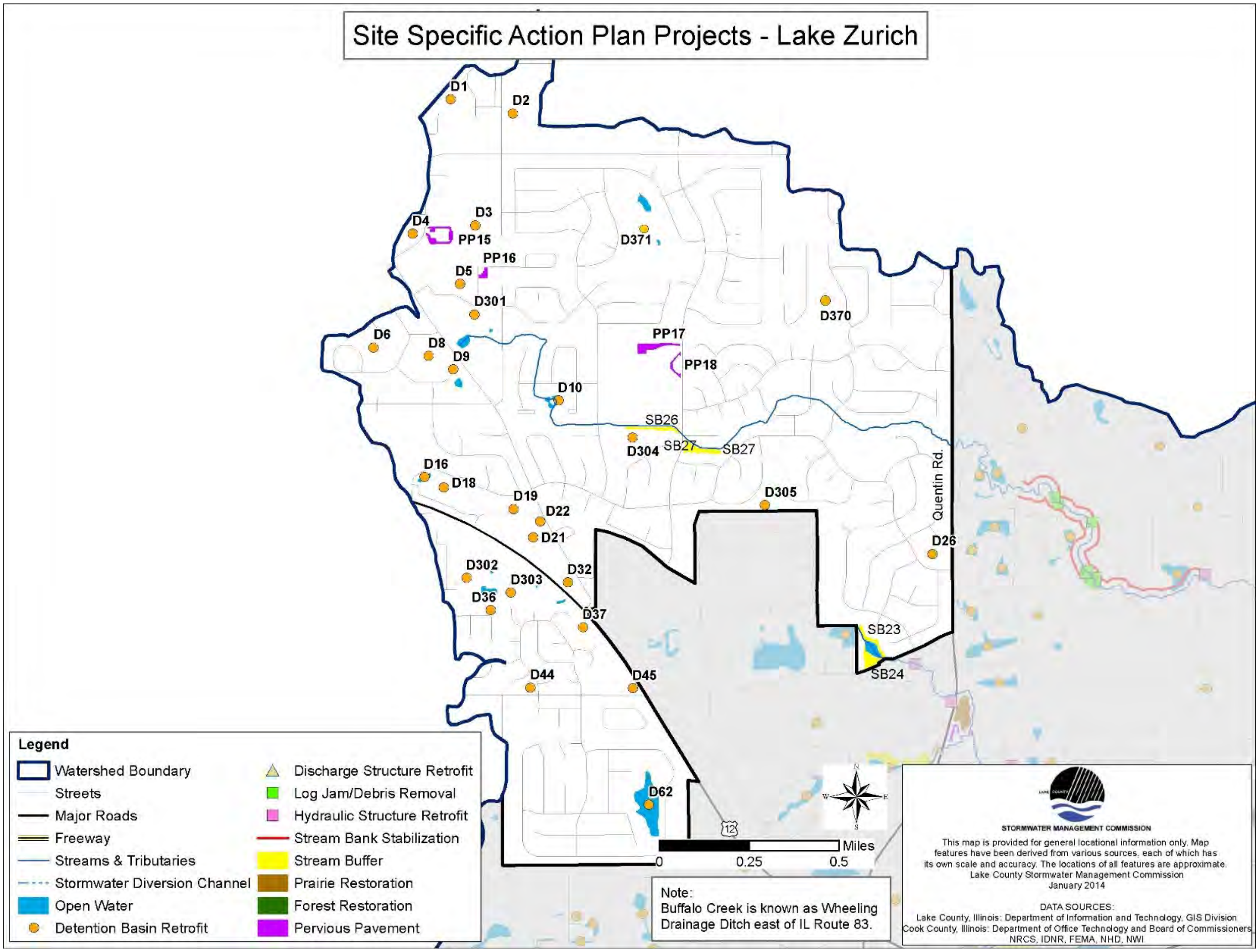


Figure 6-13: Site Specific Projects in the Village of Lake Zurich.

Table 6-23: Site Specific Project Summary for the Village of Lake Zurich.

Unique ID	Action	Project Size	Basin Name	Priority
D1	Dredge lake bottom and plant native aquatic vegetation.	0.25 ac	Landings of Lake Zurich Pond 2	M
D2	Perform assessment for potential detention basin retrofit.	0.36 ac	UNK	L
D3	Remove woody vegetation and plant slopes and bottom with native vegetation.	0.32 ac	UNK	H
D4	Perform assessment for potential detention basin retrofit.	0.29 ac	Ela Library Pond	L
D5	Remove invasive species and turf grass; and replace with native vegetation and aquatics.	1.63 ac	Good Shepherd Pond	M
D6	Perform assessment for potential detention basin retrofit.	1.55 ac	Heatherleigh Pond 1	L
D8	Install aerator.	4.45 ac	Heatherleigh Pond 2	L
D9	Remove aquatic invasive species and replace with native vegetation.	0.33 ac	Heatherleigh Pond 3	M

D10	Perform assessment for potential detention basin retrofit.	0.59 ac	Red Bridge Farm Pond	L
D16	Install aerator.	0.32 ac	Deerpath Court Retail Center Pond 3	M
D18	Perform assessment for potential detention basin retrofit.	0.71 ac	Deerpath Court Retail Center Pond 4	L
D19	Plant slopes and bottom with native vegetation. Remove low flow bypass.	1.04 ac	Villa Lucerne Pond	M
D21	Remove woody vegetation.	4.18 ac	Plaza on the Pond 1	M
D22	Install aerator; remove woody vegetation; and install RCP outlet to adjacent basin.	0.08 ac	UNK	H
D26	**Clear inlet 3 and 5 of debris; install riprap in front of inlets 1, 2, and 3; remove turf grass and plant native vegetation.**	**2.90 ac**	**Chestnut Corners Pond 1**	**H**
D32	Clear inlet 2 of debris; remove turf grass and invasive species; plant native vegetation.	0.55 ac	Plaza on the Pond 2	H
D36	Clear all inlets of debris and sediment. Plant banks and bottom with native vegetation.	0.77 ac	Chasewood North Pond 1	H
D37	Plant native vegetation on slopes and bottom. Install riprap areas in front of inlets 1 and 2.	0.84 ac	Sparrow Ridge Park Pond	H
D44	Remove low flow bypass; install RCP inlets and outlets on bank; plant slopes and bottom with native vegetation.	0.29 ac	UNK	H
D45	Clear debris and sediment from inlet 1; plant slopes and bottom with native vegetation.	0.20 ac	Courtyard of Lake Zurich Pond	H
D62	Plant banks with native vegetation; install aerator; and install an inlet on south bank to fix short-circuit.	4.50 ac	Village of Lake Zurich Pond	H
D301	Install aerator.	0.18 ac	UNK	L
D302	Clear inlet 2 of debris.	0.89 ac	UNK	L
D303	Install aerator; clear inlet 1 of debris.	0.36 ac	UNK	M
D304	Remove invasive species and plant native vegetation.	4.45 ac	UNK	H
D305	Perform assessment for potential detention basin retrofit.	0.74 ac	UNK	L
D370	Cedar Creek Stormwater Facility retrofit. Includes basin excavation, inlet modifications, replacement of turf grass with native vegetation, installation of bioswales.	8.0 ac	Cedar Creek Stormwater Management Facility	H
D371	Old Mill Grove Stormwater Management Facility retrofit. Includes increasing storage capacity and restricting stormwater flow in the downstream tributaries of Cedar Creek. This must be done in unison with the Cedar Creek Stormwater Facility improvements.	35	Old Mill Grove Stormwater Management Facility	H
SB23-24, SB26-27	Install stream buffer at 4 locations.	3.65 ac	N/A	M
PP15	Pervious pavement retrofit at Lake Zurich Police Department.	0.94 ac	N/A	M
PP16	Pervious pavement retrofit at Lake Zurich Fire Station.	0.33 ac	N/A	M
PP17	Pervious pavement retrofit at Sarah Adams Elementary School.	1.04 ac	N/A	M
PP18	Pervious pavement retrofit at Sarah Adams Elementary School.	0.30 ac	N/A	M

6.3.4.10 Village of Long Grove – Action Recommendations

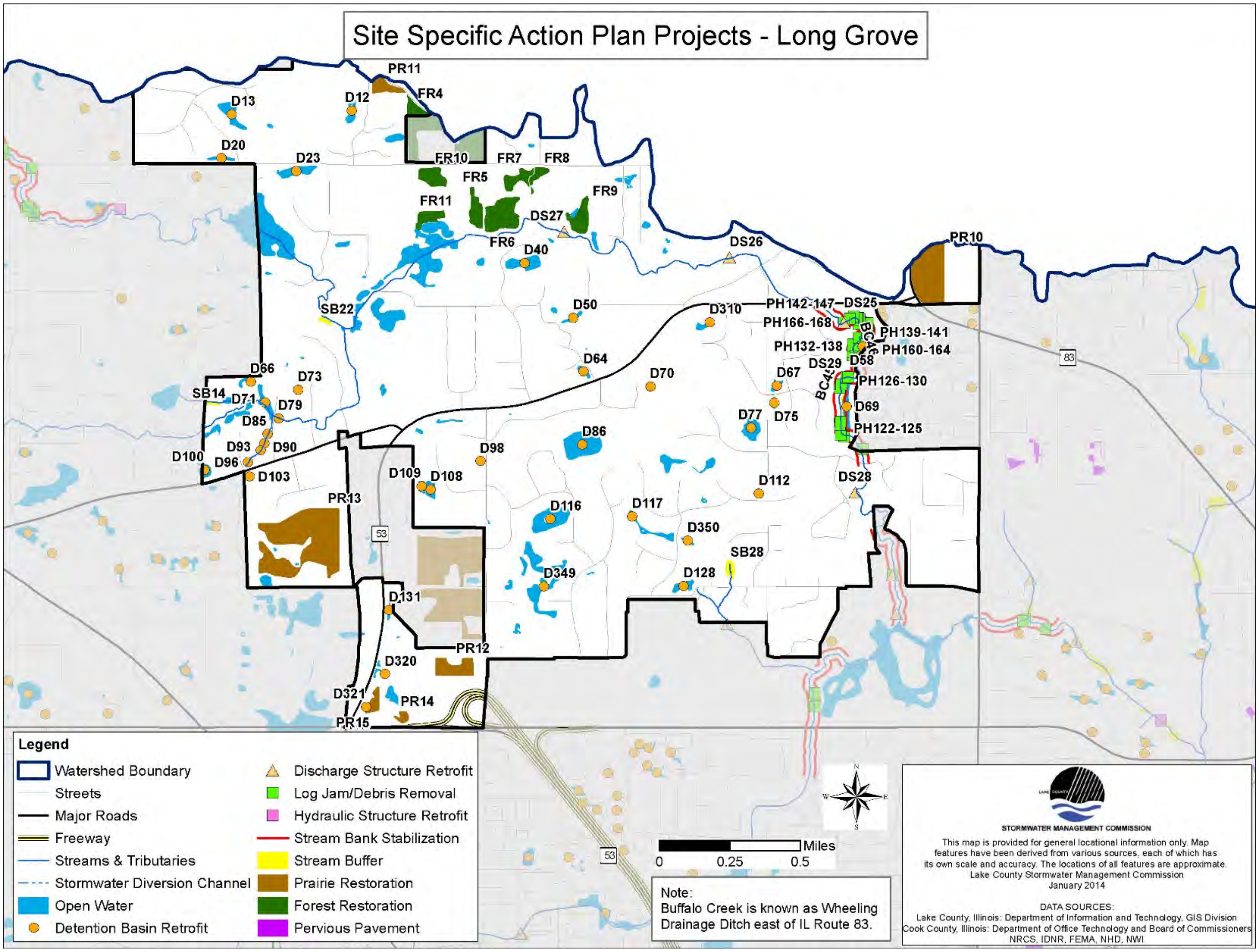


Figure 6-14. Site Specific Projects in the Village of Long Grove

Table 6-24: Site Specific Project Summary for the Village of Long Grove.

Unique ID	Action	Project Size	Basin Name	Priority
D12	Perform assessment for potential detention basin retrofit.	1.46 ac	Glenstone Pond 3	L
D13	Perform assessment for potential detention basin retrofit.	2.51 ac	Beaver Creek Estates Pond 1	L
D20	Plant native vegetation on banks. Replace inlet 2.	0.79 ac	Beaver Creek Estates Pond 2	M
D23	Perform assessment for potential detention basin retrofit.	2.32 ac	Deerwood Estates Pond	L
D40	Perform assessment for potential detention basin retrofit.	2.99 ac	Mardan Lake Pond 1	L
D50	Perform assessment for potential detention basin retrofit.	0.65 ac	Victorian Oak Estates Pond 2	L
D58	**Plant native vegetation on slopes; replace inlets 1 and 2; install riprap in front of inlet 2; and disconnect sump.**	**0.58 ac**	**Bridgewater Farm Park Pond**	**M**
D64	Increase power of southern aerator; plant slopes and inlet 2 with native vegetation.	0.48 ac	Victorian Oak Estates Pond 3	M
D66	Perform assessment for potential detention basin retrofit.	0.59 ac	Willow Valley Pond 1	L

D67	Perform assessment for potential detention basin retrofit.	0.67 ac	Bridgewater Farm Pond 2	L
D69	**Remove duckweed; replace inlet B; remove debris and sediment from inlet 5; and plant slopes with native vegetation.**	**2.38 ac**	**Crossings Park Pond**	**M**
D70	Perform maintenance of native vegetation, including removal of invasive species.	0.73 ac	Country Club Woods Pond	H
D71	Reduce slope to 3:1; plant native vegetation on banks; replace inlet 2; and disconnect downspout.	1.77 ac	Bennington Pond 3	M
D73	Clear vegetation from outlet.	0.15 ac	Bennington Pond 4	M
D77	**Replace wall on north end; replace inlet 3; and plant native buffer around wall.**	**2.67 ac**	**Hillcrest Country Club Pond**	**M**
D79	Plant native vegetation along bank.	0.37 ac	Bennington Pond 5	M
D85	Fix 2nd aerator; replace turf grass and riprap with native vegetation.	0.22 ac	Bennington Pond 6	M
D86	Disconnect sump pump; replace walls and riprap with dirt and native vegetation.	6.77 ac	Yankee Lake	M
D90	Perform assessment for potential detention basin retrofit.	0.05 ac	Bennington Pond 7	L
D93	Install aerator; remove retaining wall and plant native vegetation.	0.11 ac	Bennington Pond 8	M
D96	Install aerator; plant native vegetation on banks; and remove woody vegetation.	0.23 ac	Willow Valley Pond 4	H
D98	Remove turf grass; plant native vegetation on slopes; and kill algae.	0.07 ac	Maple Hill Nursing Center Pond	M
D100	Install aerator in the center of pond; plant native vegetation along banks; and install better outlet system.	1.24 ac	Farmington Pond 4	M
D103	Plant slopes and bottom with native vegetation; and clear sediment from outlet A.	0.51 ac	Kildeer Glen Pond	H
D108	Perform assessment for potential detention basin retrofit.	1.20 ac	Wyncrest of Long Grove Pond 1	L
D109	Perform assessment for potential detention basin retrofit.	0.58 ac	Wyncrest of Long Grove Pond 2	L
D112	**Install aerator.**	**0.58 ac**	**Country Club Meadows of Long Grove Pond 4**	**L**
D116	Plant slopes with native vegetation; replace inlet 2; reconnect parts of inlet 3; and install additional riprap on inlet 2.	5.19 ac	Sentinal Lake	M
D117	Remove invasive species and replace with native vegetation.	1.69 ac	Country Club Meadows of Long Grove Pond 5	L
D128	Remove invasive species and woody vegetation from banks and plant native vegetation.	1.20 ac	Country Club Meadows of Long Grove Pond 8	M
D131	Perform assessment for potential detention basin retrofit.	0.38 ac	UNK	L
D310	Install aerator.	1.54 ac	UNK	L
D320	Plant slopes with native vegetation.	1.94 ac	UNK	M
D321	Perform assessment for potential detention basin retrofit.	0.67 ac	UNK	L
D349	Disconnect downspouts and plant banks with native vegetation.	7.19 ac	UNK	M

D350	Replace invasive species and woody vegetation with native vegetation.	0.32 ac	UNK	H
BC45	Streambank stabilization.	3,882 linear feet	N/A	M
BC46	**Streambank stabilization.**	**4,142 linear feet**	**N/A**	**H**
SB13-14, SB22, SB28	Install stream buffer at 4 locations.	2.6 ac	N/A	M
DS21	Repair / replace.	1	N/A	L
DS22	Repair / replace.	1	N/A	L
DS23	Repair / replace.	1	N/A	L
DS24	Repair / replace.	1	N/A	L
DS25	Repair / replace.	1	N/A	L
DS26	Remove riprap blockage and evaluate.	1	N/A	H
DS27	Investigate rusty discharge and replace pipe.	1	N/A	L
DS28	Evaluate.	1	N/A	L
DS29	Replace.	1	N/A	M
PH122-130, PH132-142, PH147, PH160-164, PH166-168	Logjam / debris removal.	28	NA	L
PR10	Prairie restoration.	13.8 ac	N/A	L
PR11	Prairie restoration.	2.7 ac	N/A	L
PR12	Prairie restoration.	4.7 ac	N/A	L
PR13	Prairie restoration.	31.3 ac	N/A	L
PR14	Prairie restoration.	1 ac	N/A	L
PR15	Prairie restoration.	1.8 ac	N/A	L
FR5	Forest restoration.	3.2 ac	N/A	L
FR6	Forest restoration.	7.7 ac	N/A	L
FR7	Forest restoration.	2.8 ac	N/A	L
FR8	Forest restoration.	1.5 ac	N/A	L
FR9	Forest restoration.	3.9 ac	N/A	L
FR4	Forest restoration.	1.9 ac	N/A	L
FR10	Forest restoration.	3.4 ac	N/A	L
FR11	Forest restoration.	2.6 ac	N/A	L

6.3.4.11 Village of Palatine – Action Recommendations

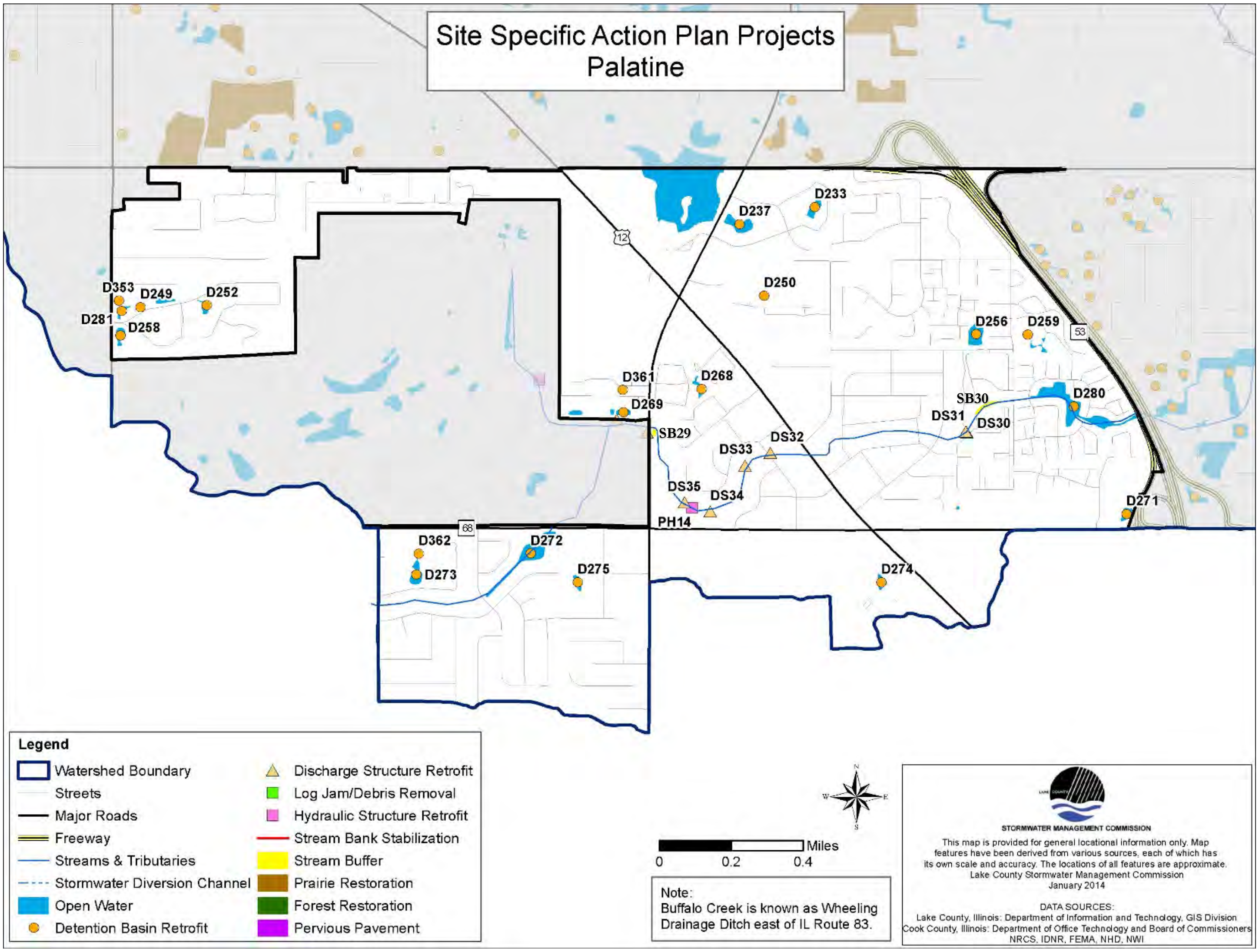


Figure 6-15: Site Specific Projects in the Village of Palatine.

Table 6-25: Site Specific Project Summary for the Village of Palatine.

Unique ID	Action	Project Size	Basin Name	Priority
D233	Disconnect downspout; replace inlet 1; remove buildup from inlets 2, 3, and 4; reduce slope to 3:1 or less; and plant native vegetation on slopes.	0.78 ac	UNK	H
D237	Disconnect downspout; replace inlet 2; and plant slopes with native vegetation.	1.38 ac	UNK	M
D249	Remove buildup from inlet 1; dredge basin to remove excess sediment.	0.09 ac	UNK	M
D250	Repair aerator; remove turf grass; clear inlet 1; dredge basin; and plant native vegetation on slopes and banks.	0.23 ac	UNK	M
D252	Remove invasive species and plant native vegetation.	0.58 ac	UNK	M
D256	Disconnect downspouts; reconnect inlet 2 segments; reduce slope to 3:1; and plant native vegetation on slopes.	1.42 ac	UNK	M
D258	Fix aerator and increase size of outlet.	0.54 ac	UNK	L

D259	Plant native vegetation along banks; disconnect sump pump and downspout; and replace inlet 2.	0.12 ac	UNK	M
D268	Perform assessment for potential detention basin retrofit.	0.38 ac	UNK	L
D269	**Increase outlet size; replace riprap and woody vegetation with native vegetation.**	**0.39 ac**	**UNK**	**M**
D271	Reduce initial slope from 2:1 to 3:1 (or 4:1); remove turf grass; plant native vegetation on slopes; reconnect inlet segments; remove sediment from outlet; and increase outlet size.	0.47 ac	UNK	M
D272	Increase size of outlet and plant native vegetation on slopes.	3.22 ac	UNK	L
D273	Remove turf grass from slopes and plant native vegetation.	0.89 ac	UNK	M
D274	Clear litter; remove turf grass; plant native vegetation on slopes and banks.	0.45 ac	UNK	M
D275	Install aerators to remove algae and duckweed.	0.42 ac	UNK	M
D280	Dredge basin; replace sections of retaining walls; replace inlets 6, 9, 15, 16, 17; clear inlets 4 and 17 of debris; and install trash grate on inlet 13.	4.80 ac	UNK	H
D281	Dredge basin to remove excess sediment; plant native vegetation on slopes and banks; install an inlet on southern portion of basin; and disconnect sump pump and downspout.	0.29 ac	UNK	M
D353	Remove invasive species and plant native vegetation on slopes and bottom.	0.11 ac	UNK	L
D361	Remove low flow bypass and stilling basin; plant native vegetation on slopes and bottom.	0.23 ac	UNK	H
D362	Remove turf grass and plant native vegetation on slopes and banks.	0.13 ac	UNK	M
SB29-30	**Install stream buffer.**	**0.60 ac**	**N/A**	**M**
DS30	Evaluate.	1	N/A	L
DS31	Clean out and evaluate.	1	N/A	L
DS32	Replace.	1	N/A	L
DS33	Repair / replace.	1	N/A	L
DS34	Remove debris blockage.	1	N/A	L
DS35	**Repair / replace.**	**1**	**N/A**	**L**
PH14	Remove wooden footbridge.	1	N/A	L

6.3.4.12 Village of Wheeling – Action Recommendations

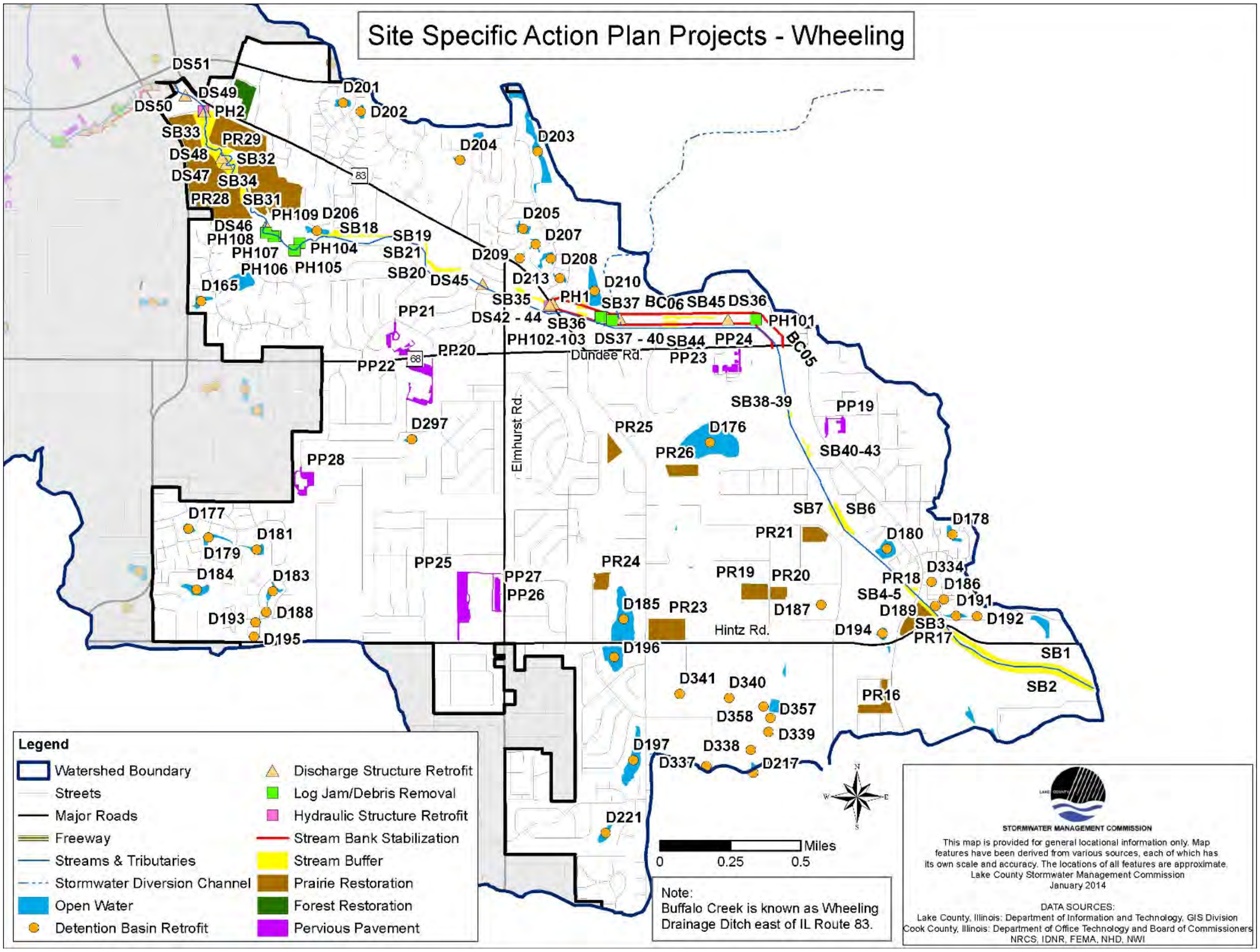


Figure 6-16: Site Specific Projects in the Village of Wheeling.

Table 6-26: Site Specific Project Summary for the Village of Wheeling.

Unique ID	Action	Project Size	Basin Name	Priority
D165	Plant native vegetation on slope.	0.94 ac	UNK	M
D176	Perform assessment for potential detention basin retrofit.	12.3 ac	UNK	L
D177	Disconnect downspout; remove riprap; and plant native vegetation on slopes.	0.65 ac	UNK	M
D178	**Disconnect downspout; remove riprap; plant native vegetation on banks.**	**0.76 ac**	**UNK**	**M**
D179	Disconnect downspout; replace inlets 1, 4, and 5; clear inlet 7 of debris; remove riprap slopes and plant native vegetation, install aerator on east segment.	1.00 ac	UNK	H
D180	**Remove riprap and invasive species; plant native vegetation on slopes.**	**2.24 ac**	**UNK**	**M**
D181	Replace outlet; plant banks and slopes with native vegetation.	0.98 ac	UNK	M

D183	Replace inlet 4; plant native vegetation on slopes and banks; stop mowing slopes.	0.79 ac	UNK	M
D184	Remove riprap siding and plant native vegetation.	1.60 ac	UNK	M
D185	Remove woody vegetation and plant native vegetation on slopes.	6.92 ac	UNK	M
D186	**Plant native vegetation on slopes after removing invasive turf grass.**	**0.07 ac**	**UNK**	**M**
D187	**Remove riprap, invasive species and turf grass on banks; plant native vegetation on slopes.**	**0.37 ac**	**UNK**	**M**
D188	Plant native vegetation on slopes; replace inlets 2 and 4; and fix aerator.	0.34 ac	UNK	M
D189	**Remove debris from outlet; replace inlet 1; replant slopes with native vegetation.**	**0.26 ac**	**UNK**	**M**
D191	**Plant native vegetation on slopes; disconnect sump pump and downspout.**	**0.45 ac**	**UNK**	**L**
D192	**Disconnect sump pump; plant native vegetation on slopes; and repair aerator.**	**0.11 ac**	**UNK**	**L**
D193	Remove walls and reduce slope to 3:1; plant native vegetation on slopes and banks.	0.07 ac	UNK	M
D194	**Fix aerator; plant native vegetation on slopes; and replace inlet 5.**	**0.72 ac**	**UNK**	**M**
D195	Perform assessment for potential detention basin retrofit.	0.13 ac	UNK	L
D196	Remove woody vegetation; reduce initial slope to 3:1; plant native vegetation on slopes and banks.	3.16 ac	UNK	M
D197	Reduce slope to 3:1; plant native vegetation on slopes; remove litter; clear outlet; clear inlet 4 and reconnect segments.	4.07 ac	UNK	H
D201	Disconnect downspouts; plant slope with native vegetation; evaluate inlet replacement.	0.75 ac	UNK	M
D202	Remove riprap and invasive species; plant native vegetation on banks.	0.65 ac	UNK	M
D203	Remove woody vegetation and invasive species; plant native vegetation on slopes and bottom; and install aerator on the open water.	3.77 ac	UNK	H
D204	Run aerator at night; replace inlet 3; and plant native vegetation on slopes.	0.43 ac	UNK	M
D205	Remove retaining walls; reduce slope banks to 3:1; plant native vegetation on slopes; and clear inlet 2.	0.87 ac	UNK	M
D206	**Reduce slope to 3:1; install aerators; plant native vegetation on slopes; and replace inlets 1 and 2.**	**0.92 ac**	**UNK**	**H**
D207	Remove retaining wall; reduce slope to 3:1; plant native vegetation on slopes.	0.56 ac	UNK	M
D208	Fix the aerator and replace inlet 3.	0.95 ac	UNK	M
D209	Remove riprap; reduce slope to 3:1; and plant native vegetation on slopes.	0.36 ac	UNK	M
D210	Perform assessment for potential detention basin retrofit.	3.15 ac	UNK	L
D213	Reduce slope to 3:1; remove litter and woody vegetation; plant native vegetation on slopes.	0.39 ac	UNK	H
D217	Install riprap in front of inlet 3; plant native vegetation on slopes and bottom; stop mowing.	2.06 ac	UNK	H
D221	Disconnect sump pump; remove turf grass; and plant native vegetation on slopes and banks.	1.17 ac	UNK	L

D297	Remove invasive species and plant native vegetation on slopes, banks, and bottom.	0.46 ac	UNK	M
D334	Perform assessment for potential detention basin retrofit.	0.24 ac	UNK	L
D337	Remove concrete channel and blockage in outlet; plant native vegetation on slopes and bottom.	0.70 ac	UNK	H
D338	Remove turf grass and plant native vegetation on slopes and bottom.	0.45 ac	UNK	M
D339	Perform assessment for potential detention basin retrofit.	0.71 ac	UNK	L
D340	Perform assessment for potential detention basin retrofit.	0.24 ac	UNK	L
D341	Remove turf grass and replace with native vegetation.	0.27 ac	UNK	M
D357	Stop mowing; remove turf grass; and plant native vegetation.	0.93 ac	UNK	M
D358	Remove turf grass; plant native vegetation; and install riprap in front of inlet 1.	0.49 ac	UNK	H
BC05, BC06	**Streambank stabilization.**	**9,161 linear feet**	**N/A**	**M**
SB1-7, SB18-21, **SB31-45**	**Steam buffer at 26 locations.**	**31.73 ac**	**N/A**	**M**
DS36	Replace structure and pipe.	1	N/A	M
DS37	Evaluate.	1	N/A	L
DS38	Replace and stabilize.	1	N/A	M
DS39	Clean out.	1	N/A	M
DS40	Remove vegetation from immediately downstream of outlet.	1	N/A	L
DS41	Remove sediment, debris and geotextile netting. Evaluate.	1	N/A	L
DS42	Repair / replace.	1	N/A	M
DS43	Clean out / replace.	1	N/A	L
DS44	Evaluate.	1	N/A	L
DS45	Evaluate.	1	N/A	L
DS46	Evaluate and remove or replace.	1	N/A	L
DS47	Remove vegetation from swale.	1	N/A	L
DS48	Remove vegetation and excavate sediment/sand.	1	N/A	L
DS49	Repair / replace.	1	N/A	L
DS50	**Repair.**	**1**	**N/A**	**L**
DS51	**Repair / replace.**	**1**	**N/A**	**L**
PH104-109	**Logjam / debris removal.**	**6**	**N/A**	**L**
PH1	Repair / replace.	1	N/A	M
PH2	Remove sediment and evaluate.	1	N/A	H
PP19	**Pervious pavement retrofit at Oliver W. Holmes Middle School.**	**1.31 ac**	**N/A**	**M**
PP20	Pervious pavement retrofit at Jack London Middle School.	3.48 ac	N/A	L
PP21	Pervious pavement retrofit at Eugene Field Elementary.	0.96 ac	N/A	M
PP22	Pervious pavement retrofit at Eugene Field Elementary.	0.90 ac	N/A	M

PP23	**Pervious pavement retrofit at Wheeling Police Department.**	**0.36 ac**	**N/A**	**M**
PP24	**Pervious pavement retrofit at Wheeling Police Department.**	**1.41 ac**	**N/A**	**M**
PP25	Pervious pavement retrofit at Wheeling High School.	5.35 ac	N/A	L
PP26	Pervious pavement retrofit at Wheeling High School.	1.58 ac	N/A	M
PP27	Pervious pavement retrofit at Wheeling High School.	0.32 ac	N/A	M
PP28	Pervious pavement retrofit at Booth Tarkington Elementary School.	2.03 ac	N/A	L
PR16	**Prairie restoration.**	**3.7 ac**	**N/A**	**L**
PR17	**Prairie restoration.**	**4.3 ac**	**N/A**	**L**
PR19	Prairie restoration.	3.5 ac	N/A	L
PR20	Prairie restoration.	1.6 ac	N/A	L
PR21	Prairie restoration.	2.7 ac	N/A	L
PR23	Prairie restoration.	6.3 ac	N/A	L
PR24	Prairie restoration.	2 ac	N/A	L
PR25	Prairie restoration.	1.8 ac	N/A	L
PR26	Prairie restoration.	2.9 ac	N/A	L
PR28	Prairie restoration.	27.8 ac	N/A	L
PR29	Prairie restoration.	32.2 ac	N/A	L
FR1	Forest restoration.	4.4 ac	N/A	L

Chapter 7 Plan Implementation and Evaluation

7 Plan Implementation and Evaluation

This chapter identifies a strategy and details for transitioning from watershed planning to plan implementation. This chapter also presents important mechanisms to evaluate whether the goals and objectives of the watershed plan are being met with implementation of the plan.

How readily this plan is used and implemented by watershed stakeholders is one indicator of its success. Improvement in watershed resources is another indicator. Successful plan implementation will require significant cooperation and coordination among watershed stakeholders to secure project funding and to efficiently and effectively move the action plan from paper to watershed improvement practices.

This chapter conveys more technical details about the expected results of putting action recommendations in place and the cost of plan implementation. It presents a plan for monitoring and evaluating plan implementation as a way to determine progress towards watershed goals and objectives. Finally, it outlines a required schedule and provides a "score card" outlining time based milestones and corresponding measurement indicators. This watershed plan can be considered a living document and has the flexibility for stakeholders to make revisions over time that reflect shifts in stakeholder priorities or watershed conditions.

7.1 Estimate of Pollution Load Reductions and Targets

Pollution loading estimates were determined for the Buffalo Creek Watershed using the USEPA Spreadsheet Tool for Estimating Pollutant (STEPL) and the Region 5 Model (Spreadsheet), which is described in greater detail in **Chapter 5**. STEPL computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, 5-day biological oxygen demand (BOD); and sediment delivery based on various land uses and management practices. STEPL does not calculate pollutant loads for chloride or fecal coliform. However, nutrient loads (nitrogen, phosphorus and BOD) and sediment loads are calculated for failing septic systems in the STEPL model. Since chloride and fecal coliform bacteria loadings cannot be calculated in the STEPL model, two other methods were used to model these pollutants.

It should be noted that all computation models have assumptions and limitations and that the model is designed as a planning tool. Therefore, the provided analytical results do not represent the exact pollution load reductions due to calibration and model limitations. For example, the source of phosphorus impairments in lakes may come from loads in internal sediments that are resuspended by carp or other disturbances. These loads are not calculated in the STEPL model. The relative and spatially-presented results are intended to assist in identifying locations potentially generating non-point source pollution that have the largest impact on water quality within the watershed. These areas can be targeted for BMP implementation providing the greatest water quality improvement benefit to the watershed.

Pollutant load reduction estimates based on watershed plan implementation were also estimated using the STEPL model. The pollutant load reduction estimates reflect implementation of the site-specific best management practice recommendations summarized in the action plan (**Chapter 6**). Pollutant load reduction estimates can be used to quantify the water quality benefits of project implementation; and can identify which practices result in the greatest benefits to water quality.

Nonpoint source pollutant reduction estimates were calculated only for the site specific project BMPs where land treatment areas could be estimated. Note that additional pollution prevention practices will need to be instituted in the watershed in order to meet the recommended waste load allocations in the Des Plaines River/Higgins Creek Watershed TMDL Report. These watershed-wide pollution prevention practices in the programmatic action plan are not located to a specific site; therefore they are not included in the results of the pollutant load reduction model for the site-specific BMP projects presented below. In addition, a number of the proposed site specific projects do not have reduction efficiencies available within the functionality of the STEPL model; therefore, pollution reduction benefits for these BMPs are not reflected in the pollution reduction estimates.

Table 7-1 includes each of the proposed BMP project types, the number of projects of each type, and identifies the best management practices that have associated pollutant load reduction estimates that could be calculated based on the STEPL model.

Table 7-1: Pollutant Load Reduction Capabilities for each Type of Site Specific BMP.

Site-Specific Action Plan BMP Type	Number of BMP Projects	Project Area	Included in STEPL Load Reduction Estimates
Discharge Structure Retrofit	51	N/A	No
Hydraulic Structure Retrofit	14	N/A	No
Detention Basin Retrofit	288	436 acres	No
Stream Buffers	59	61 acres	Yes
Streambank Stabilization	11	42,511 linear feet	Yes
Pervious Pavement	28	35 acres	Yes
Wetland Restoration	38	387 acres	Yes
Wetland Enhancement	21	345 acres	No
Prairie Restoration	27	233 acres	Yes
Forest Restoration	11	44 acres	Yes
Logjam-Debris Removal	74	N/A	No
Total # of Projects	**622**		

There are eleven categories of site specific projects that have been identified in the Buffalo Creek Watershed. Six of these project categories have pollutant reduction efficiencies available (**Table 7-1**). There are 622 site specific projects identified in the Buffalo Creek Watershed action plan, 162 of which have pollutant reduction estimates calculated using the STEPL model. **Table 7-2** presents the site specific BMP load reductions for the Buffalo Creek Watershed.

It should be noted that pollutant load reductions were not calculated for chloride and fecal coliform bacteria due to the limitations of the STEPL model (refer to **Chapter 5**) and are therefore not included in **Table 7-2** through **Table 7-4**. A literature review was conducted to determine the pollutant reduction capability (for chloride and fecal coliform) of BMPs. It has been shown that media filters and retention ponds are the most effective BMP for reducing bacterial loads (Clary, 2007). Since pervious pavement functions similar to a media filter, we can anticipate reductions in fecal coliform loads from implementation of this BMP. Studies also show that wetland basins can significantly reduce bacterial loads (Geosyntec Consultants, 2014).

Infiltration practices (such as pervious pavement) utilize porous materials to facilitate infiltration of stormwater into the ground. Stormwater is channelled into the infiltration practice where it is temporarily stored before it penetrates the underlying soil. Infiltration into the soil facilitates the removal of pollutants from stormwater through chemical and bacterial degradation, absorption, adsorption and filtering. Studies have demonstrated that properly functioning infiltration practices have a pollutant removal efficiency of 90-99% for trace metals and 90-98% for bacteria (Gulliver, 2010). Chloride does not act in the same manner as most pollutants. Since soil is not effective at removing most salts, the chloride flows straight through the soil and the concentration is only reduced through dilution with surface water or groundwater (Braga, 2004). Therefore, the only practical way to reduce chloride loads in the Buffalo Creek Watershed is through a reduction in winter salt use.

Table 7-2: Site Specific BMP Load Reductions for the Buffalo Creek Watershed[1].

BMP	Size	Nitrogen Reduction (lbs/year)	Phosphorus Reduction (lbs/year)	BOD Reduction (lbs/year)	Sediment Reduction (tons/year)
Streambank Stabilization	42,511 linear feet	9,628	3,708	19,259	6,018
Wetland Restoration	387 acres	419	93	3,124	27
Prairie Restoration	233 acres	561	124	1,465	48
Forest Restoration	44 acres	87	18	239	8
Pervious Pavement	35 acres	162	21	0	3
Stream Buffers	61 acres	112	16	468	5
TOTAL		**10,969**	**3,980**	**24,55**	**6,315**

[1]Pollutant loads for chloride and fecal coliform were not calculated due to the limitations of the STEPL model.

7.1.1 Pollutant Load Reductions by SMU Catchment

The total pollutant load reduction aggregated by pollutant category for each SMU catchment is displayed in **Table 7-3**. There are eight SMU catchments that have been identified as critical in the Buffalo Creek watershed and are shown in bold in **Table 7-3**. SMU 6A was identified in **Chapter 4** as the highest priority SMU and the SMU with the largest contribution of pollutants per acre in the watershed. The site specific BMPs that have been identified in SMU 6A are estimated to reduce the total nitrogen load by 3,799 pounds per year, phosphorus load by 1,464 pounds per year, BOD load by 7,615 pounds per year, and sediment load by 2,374 tons per year.

For all catchments, streambank stabilization provides the greatest pollution reduction potential. Stabilizing 21,435 linear feet of streambanks in critical SMU catchments would reduce the nitrogen load by 4,814 lbs/year, phosphorus load by 1,855 lbs/year, BOD load by 9,631 lbs/year and sediment load by 3,009 tons/year. These estimated reductions are only taking into account the stabilization of severe or very severely eroded streambanks. Therefore, stabilization of additional moderately eroded streambanks would further reduce nonpoint source pollutants in critical catchments.

Table 7-3: Estimated Pollutant Load Reduction for Site Specific BMPs Aggregated by SMU Catchment[1, 2].

SMU Catchment	Nitrogen Reduction (lbs/year)	Phosphorus Reduction (lbs/year)	BOD Reduction (lbs/year)	Sediment Reduction (tons/year)
1A	2	0	0	0
1B	8	1	5	0
1C	**1394**	**537**	**2788**	**871**
1D	33	7	132	3
1E	4	1	0	0
2	9	1	39	0
3	463	169	1003	269
4	67	18	156	7
5A	23	5	65	2
5B	34	6	104	3
5C	0	0	0	0
6A	**3799**	**1464**	**7615**	**2374**
6B	164	63	327	102
7	3	1	21	0
8A	0	0	1	0
8B	0	0	0	0

8C	222	47	813	17
9	1144	437	2348	706
10	230	80	457	114
11	46	10	198	2
12	41	6	36	1
13	**384**	**146**	**773**	**235**
14	208	53	495	21
15	0	0	0	0
16	0	0	0	0
17	**4**	**0**	**14**	**0**
18	579	210	1435	317
19	**1707**	**652**	**3639**	**1044**
20	33	8	243	2
21	45	6	39	1
22	18	3	105	1
23	70	11	278	3

[1]Pollutant loads for chloride and fecal coliform were not calculated due to the limitation of the STEPL model.
[2]Bolded catchments indicate critical area SMUs.

7.1.2 Comparison of Pollutant Load Reductions vs. Total Pollutant Loading Estimates

Installing recommended site specific best management practices will have positive benefits on water quality. As previously noted in **Table 7-2**, expected non-point source pollutant load reductions from identified BMP project locations will result in significant pollutant reductions. Comparing these results to the total modelled watershed pollution loading, a moderate percentage reduction in pollution can be expected with the implementation of site-specific BMPs as shown in **Table 7-4**.

Table 7-4: Pollutant Load Reduction Targets for Site Specific Best Management Practices (BMP) Projects[1]

Parameter	Total Modelled Annual Pollution Loading	Expected Annual Load Reductions with Implementation of BMPs	% Reduction in Overall Loads
Total Nitrogen (lbs/year)	107,217	10,989	10%
Total Phosphorus (lbs/year)	24,342	3,980	17%
BOD (lbs/year)	379,257	24,555	6%
Sediment (tons/year)	21,006	6,315	30%

[1]Pollutant loads for chloride and fecal coliform were not calculated due to the limitation of the STEPL model.

7.2 Financial and Technical Resource Needs

Implementation of this Plan will 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 and, especially, funding. **Table 7-5** summarizes the estimated amount of funding required for initial implementation of the site specific practices recommended in the action plan. Initial costs reflect the cost of installing and/or establishing the BMP, and do not account for administration, project management or costs for ongoing management and maintenance. Therefore, the total cost of implementing these site specific projects is likely to be greater than estimated in **Table 7-5**. Cost estimates for non-water quality BMPs, such as flood mitigation projects, are provided in **Chapter 6** (see **Table 6-10)**.

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, and state funding sources, and the types of projects funded under the various programs, is provided in **Table 7-6**. 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 financial resources will be required to implement this Plan. If fully implemented, however, the quality of the watershed lakes, stream reaches and wetlands could be significantly improved.

Cost estimates are generated from a combination of technical experience and previous watershed plans. Cost assumptions used in this plan are outlined in **Appendix J**. Cost estimates are generalized for watershed-scale planning purposes and these estimates should not be used to estimate costs for individual site-specific projects, as costs will range significantly. The estimates also do not account for pollutant load reductions from programmatic (non-site-specific) action items or Education and Outreach and Policy/Regulation best management practices since direct impacts are not easily determined. Therefore these costs could vary significantly if extensive education and policy changes are implemented.

Table 7-5: Cost Estimates for Each Site Specific BMP Type.

BMP Type	# of Projects	Size	Unit cost	Estimated Total Cost[1]
Bank Stabilization	11	42,511	$85/foot	$3,613,435.00
Wetland Restoration	38	387	$10,000/acre	$3,870,000.00
Wetland Enhancement	21	345	$3,000/acre	$1,035,000.00
Prairie Restoration	26	233	$3,000/acre	$699,000.00
Forest Restoration	11	44	$3,000/acres	$132,000.00
Pervious Pavement	28	35	$43,678/acre	$1,528,730.00
Stream Buffers	59	61	$3,000/acre	$183,000.00
Detention Basin Retrofits	238	276	$10,000/acre	$2,760,000.00
Hydraulic Structure Retrofits	14	N/A	$20,000 each	$280,000.00
Discharge Structure Retrofits	51	N/A	$20,000 each	$1,020,000.00
Logjam/Debris Removal	74	N/A	$2,000 each	$148,000.00
			Total	**$15,269,165.00**

[1]Cost estimates for non-water quality BMPS are not included in this table. Refer to **Chapter 6** for flood mitigation cost estimates.

As previously noted in **Table 7-2**, expected non-point source pollutant load reductions from identified BMP project locations will result in the following potential pollutant reductions: 6,315 tons/year of sediment, 10,969 pounds/year of nitrogen, 3,980 pounds/year of phosphorus, and 24,555 pounds/ year of BOD. These values represent the potential if each and every project is implemented; in reality, only a percentage of these reductions will be realized due to financial and logistical limitations related to actual implementation.

Table 7-6: Available Funding Sources

Source	Description
United States Environmental Protection Agency (U.S. EPA) Clean Water Act Non-point Source Grant (Section 319 Grants) administered by Illinois Environmental Protection Agency (Illinois EPA)	Under Section 319, states, territories, and Indian tribes receive grant money which supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of projects that have been implemented. Grant provides up to 60% cost-share for eligible projects/activities that reduce nonpoint source pollution.
Lake County Stormwater Management Commission (SMC) Grant Programs	Watershed Management Board (WMB) grants provide up to 50% cost-share for projects that address flood damage mitigation, water quality improvement and natural resources enhancement within Lake County. Up to $67,000 is available for the Des Plaines Watershed annually for matching grants. Flood mitigation/reduction criteria receive the greatest weight in determining funding awards. The $100,000/year Stormwater Infrastructure Repair Fund (SIRF) can assist local units of government in resolving interjurisdictional drainage and flooding related

	problems (i.e., stormwater management system infrastructure needs). The SIRF program is a 50/50 cost share match for SIRF eligible projects in Lake County. SMC offers small grants of $500 for stream and river clean-up projects. Using federal and state matching grants, SMC offers a voluntary buyout program for repetitively flood damaged structures in Lake County. Buyouts are typically 75% federal and 25% local cost share for qualified structures.
Five Star and Urban Waters Restoration Grant Program (National Fish and Wildlife Foundation/U.S. EPA)	Funding Available per Application: $20,000-$50,000 Match Requirement: Minimum 1:1 local match required
National Fish and Wildlife Foundation Chi-Cal Rivers Fund	The Chi-Cal Rivers Fund is a public-private partnership working to restore the health, vitality and accessibility of the waterways in the Chicago and Calumet region by supporting green stormwater infrastructure, habitat enhancement, and public-use improvements.
United States Environmental Protection Agency (U.S. EPA) Clean Water State Revolving Fund	Funds water quality protection projects for wastewater treatment, stormwater management, non-point source pollution control and watershed and estuary management.
Metropolitan Water Reclamation District of Greater Chicago	Flood prone property purchases
Environmental Solutions for Communities (National Fish and Wildlife Foundation)	Funding Available per Application: ~$25,000-$50,000 (maximum request) Match Requirement: Minimum 1:1 local match required
Urban Water Management (Surdna Foundation)	Federally-recognized not-for-profit organizations are eligible applicants. Funds available to create pilot projects or expand promising projects in cities and metro areas that demonstrate innovative stormwater management practices. Particularly interested in cities responding to federal regulatory action regarding stormwater management. Also seek green infrastructure solutions that create quality jobs, businesses, and other equitable economic benefits and engage the community in design decisions.
HUD Community Development Block Grant Program	Program that works to ensure decent affordable housing, provide services to the most vulnerable in our communities, and create jobs through the expansion and retention of businesses. CDBG-financed projects could incorporate green infrastructure into their design and construction.

7.3 Next Steps for Plan Implementation

Many watershed planning projects encounter their greatest challenges once they reach the implementation stage. Implementation of projects across entire watersheds often requires communication and coordination between multiple jurisdictions and partners. Effective implementation also requires technical and financial resources to complete each action item. An extensive list and description of partners whose participation will be important in implementing this watershed plan is included in **Appendix M** of this report. Due to the diversity of recommended projects and the location of projects across multiple jurisdictions, coordination among watershed stakeholders is important, and technical and financial assistance may need to be obtained from several sources. Key partners for coordinating plan implementation include the Buffalo Creek Clean Water Partnership (BCCWP), watershed municipalities, Lake County Stormwater Management Commission (SMC), the Metropolitan Water Reclamation District (MWRD), park and forest preserve districts and both state and local transportation agencies.

A list of potential partners for site specific and programmatic projects is provided in **Chapter 6**. Because coordination among partners and funding sources will require significant time, prioritization of actions is essential. **Table 7-7** identifies immediate priority steps for successful implementation of the Buffalo Creek Watershed Plan.

Table 7-7: Buffalo Creek Watershed Implementation Priorities.

Priority	Recommended Strategy or Action
#1	Maintain the Buffalo Creek Clean Water Partnership organization and determine specific year-1 implementation actions.
#2	Identify funding and technical assistance to implement recommendations identified in the action plan.
#3	Develop concept level plans and budgets for proposed grant funded projects.
#4	Apply for applicable grants and secure additional funding.
#5	Coordinate available programs, policy changes, local initiatives and those programs where private landowners are responsible for signing up.
#6	Adopt the plan, incorporating the recommendations in the watershed plan into existing programs, activities, and budgets.
#7	Coordinate plan implementation with local and state transportation agency projects.

7.4 Watershed Monitoring Plan

The purpose of the monitoring plan for the Buffalo Creek Watershed is to assess the overall implementation success of best management practices, programs and policies. This can be accomplished by conducting the following actions:

1. Track implementation of management measures in the watershed.

   Tracking the implementation of plan recommendations can be used to address the following monitoring goals:

   - Determine the extent to which plan recommendations and practices have been implemented over time compared to actions needed to meet water quality targets.
   - Establish a baseline from which decisions can be made regarding the need for additional incentives for implementation efforts.
   - Measure the extent of voluntary implementation efforts.

2. Estimate or monitor the effectiveness of management measures.

   - Reduction in flood damage over time
   - Reduction in pollutant levels at monitoring sites and identified “hotspots”
   - Improvement in floristic quality and wildlife biodiversity based on stream sampling and bird surveys

3. Continued periodic water quality monitoring of lakes and streams.

This section includes a proposed monitoring plan and also focuses on organizational monitoring or monitoring of project implementation.

7.4.1 Water Quality Monitoring Plan

Water quality has been identified by stakeholders as a key objective in the Buffalo Creek Watershed. A holistic water quality monitoring program will be necessary in the future to track potential water quality improvements. The purpose of the recommended monitoring strategy for the Buffalo Creek Watershed is to continue to assess the condition and health of the watershed in a consistent and on-going manner. The strategy allows for evaluation of the overall health of Buffalo Creek Watershed streams over time. Another key purpose is to assess the effectiveness of plan implementation projects, and their cumulative watershed-scale contribution towards achieving the goals and objectives of the plan. Lastly, the monitoring data will be used to identify potential pollution “hotspots” that may require additional investigation or study to assess the causes and sources of pollution and biological impairments.

Monitoring environmental criteria is the most effective way to measure progress toward meeting water quality goals. The watershed plan committee specifically developed a water quality goal with associated objectives during the development of goals and objectives for the plan (**Chapter 2**). The ongoing lead partners for monitoring water quality will be IL EPA, MWRD in Cook County and the newly formed Des Plaines River Watershed Workgroup (DRWW) for Lake County. MWRD monitored water quality at Buffalo Creek Ambient Water Quality Monitoring Station WW_12 located at Lake Cook road for 40 years. Ongoing monitoring at this station was discontinued from the MWRD monitoring program in 2012, but was temporarily reactivated by MWRD at the request of the BCCWP for the duration of the watershed planning period. Most recently, MWRD agreed to monitor 12 parameters at this site through October 2015, but does not anticipate continued monitoring at this location.

The DRWW is a voluntary, dues paying organization with a mission to bring together a diverse coalition of stakeholders to work together to improve water quality in the Des Plaines River and its tributaries in a cost effective manner to meet Illinois EPA requirements. Membership of the DRWW consists of communities with municipal separate stormwater systems (MS4s), Publically Owned Treatment Works (POTWs), and other interested parties. The DRWW initiated an extensive water chemistry monitoring program in September of 2015, and anticipates the addition of biological, sediment and flow monitoring in 2016. Four Buffalo Creek locations are included in the draft DRWW monitoring strategy. One of the four locations is the former MWRD WW_12 monitoring station.

Indictors are identified for each objective to ascertain whether the water quality objectives are being met. Specific values can be set as a target for each indicator to represent the desired conditions that will meet the water quality objective. Targets can be based on water quality criteria, on data analysis, reference conditions, literature values, or expert examination of water quality conditions to identify values representative of conditions that support "Designated Uses" (Illinois EPA 2005) and biological integrity/quality. Evaluation of the progress towards meeting targets indicates whether implemented BMPs are effective. If implemented BMPs are determined to be ineffective, the implementation approach should be reconsidered or changed altogether. **Table 7-8** includes specific indicator and target values that may be used to meet the objectives related to the water quality goal developed for this plan.

Table 7-8: Indicators and Targets to Meet Water Quality Goal & Objectives.

Goal 1	Water Quality Indicator and Target Value
Improve and protect water quality (physical, biological, and chemical health), eliminate impairments and non-point source pollution, and implement land development and management practices to prevent pollu-	Waterbodies are not impaired (fully support designated uses) and future pollution is prevented, have healthy lakes, streams, and wetlands.
Objective	**Water Quality Indicator and Target Value**
a. 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 lakes and Buffalo Creek. Target public and private snow plowing operators.	Chloride (road salt): less than 500 mg/l (based on state standard) Macroinvertebrate Biotic Index (MBI): Less than 7.5 Index of Biotic Integrity: Greater than 31 All communities in the watershed are aware of best management application timing, methods and rates and of de-icing alternatives to road salt.
b. Reduce actions that cause phosphorous to be released into the waterways such as erosion and fertilizers with phosphorus. Watershed municipalities and counties pass ordinances banning the use of fertilizers with phosphorus unless a soil test indicates it is needed. Strict adherence to the soil erosion and sediment control provisions of the Lake County Watershed Development Ordinance, Cook County Watershed Management Ordinance and the Illinois EPA National Pollutant Discharge Elimination Permit Storm Water Permit for Construction Site Activities (ILR10).	Meet the water quality standard established by the state for phosphorus. (Illinois standard is 0.05 mg/L for phosphorus in lakes.)

c. Identify and eliminate sources of fecal coliform.	All streams meet state water quality standards. Fecal Coliform: Less than 200 CFU/100mL.
d. Maintain, expand and restore high quality riparian buffers where needed along and around streams, lakes and wetlands to protect/improve water quality and biological health of waters.	Will meet the chemical, biological, and physical water quality standards established by Illinois EPA.
e. Reduce pollution caused by dissolved and suspended solids and sediment accumulation in surface waters and wetlands by: • addressing all areas designated as "very severe erosion" in the Stream and Basin Inventory within 5 years. • addressing all areas designated as "moderate erosion" in the Stream and Basin Inventory within 10 years, and • preventing land development-related erosion using construction and post-construction best management practices.	Total Suspended Solids: Less than 750 mg/L. Turbidity: Less than 20 Nephelometric Turbidity Units (based on literature values).
f. Perform a complete stream and basin inventory every 10 years.	Watershed Plan is modified to address changing conditions in the watershed.
g. Reform permitting requirements, provide incentives/cost share program, and promote pollution and stormwater runoff reduction programs (such as Conservation @Home) to result in retrofitting/implementing best management practices that reduce pollution and infiltrate stormwater.	Policy/permit requirements prevent water quality from worsening.
h. Restore stream channels to geomorphology and in stream habitat that supports good aquatic biological quality.	Macroinvertebrate Biotic Index (MBI): Less than 7.5 Index of Biotic Integrity: Greater than 31 Dissolved Oxygen: Greater than 6.0 mg/L.
i. Develop standards and guidelines for Green Infrastructure.	Communities in watershed support implementation of Green Infrastructure BMPs in their community.

7.4.2 Water Quality and BMP Effectiveness Monitoring

Many local agencies and municipalities track program successes and implementation to satisfy internal and permit reporting requirements. Tracking implementation at the watershed level is rarely conducted unless local agencies are 1) willing to provide the information and 2) a formal request is made from local stakeholders. This only occurs if a watershed group or interested entity is active in the area. In the Buffalo Creek Watershed, the BCCWP could work with the appropriate parties to voluntarily establish a monitoring program to track watershed plan implementation. This may include a periodic report that summarizes BMPs currently in place and the work stakeholders have completed to implement best practices. This report would form the baseline from which to measure success and monitor plan implementation.

The following sections provide specific direction for effective organizational monitoring, including a "score card" system that stakeholders can refer to when trying to determine next steps or actions and for tracking success or identifying areas of the plan that need to be revisited.

Qualitative Habitat Evaluation Index (QHEI): *The qualitative habitat evaluation index (QHEI) is a quantitative assessment of physical characteristics of a sampled stream. By combining evaluations of QHEI and IBI, scientists can gain a perspective of both the physical and biological conditions of a particular stream site. This comprehensive assessment is critical for evaluating disturbance and land use practices.*

Index of Biotic Integrity (IBI): *The IBI is based on fish surveys with the rating dependent of the abundance and the composition of 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.*

Macroinvertebrate Biotic Index (MBI): *The MBI is designed to evaluate water quality by measuring the types of benthic macroinvertebrates found in a stream. These bottom dwelling creatures can tolerate different levels of pollution and are therefore a good indicator of water quality.*

As funding allows, actual environmental monitoring data should be collected on a 3-5 year cycle to assess the performance of BMPs for meeting water quality targets and ultimately milestones and project goals. The DRWW monitoring program, combined with Illinois EPA's water quality assessment and lake assessments completed on a rotating cycle every 5 years by the LCHD for Albert Lake and Buffalo Creek Reservoir will be used to evaluate changes in water quality over time. These assessments can be used to determine the overall effectiveness of multiple BMPs on water quality in the watershed.

The effectiveness of an individual BMP can also be evaluated. It is usually necessary to collect and analyze water quality, biological samples, or habitat quality data to determine a BMP's effectiveness. This can be accomplished by either measuring the concentration of a particular parameter in the influent and effluent for the BMP or measuring baseline and post implementation values. BMP effectiveness monitoring can be performed using several methods. BMP monitoring should be conducted by environmental consultants or community staff trained in various BMP monitoring methods. A desired outcome may be an:

> observed pollutant removal efficiency,

> increased infiltration capability, or

> water quality improvement.

Water quality improvement includes an increase in other physical parameters such habitat value as measured by the ***Qualitative Habitat Evaluation Index (QHEI)***. QHEI is a quantitative assessment of physical characteristics of a sampled stream similar to ***Index of Biotic Integrity (IBI)*** biological data for fish. QHEI represents a measure of in-stream geography. By combining evaluations of QHEI and IBI, researchers can gain a well-rounded perspective of both the physical and biological conditions of a particular stream site. This comprehensive assessment is critical for evaluating disturbance and land use practices.

In addition to defining the pollutant removal efficiency of BMPs, it is important to monitor the hydraulic performance and morphological changes resulting from implementation of BMPs. 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 flow and morphological impacts.

Supplemental morphological measurements of the stream channel such as bank height, channel width, and other parameters should be conducted prior to BMP implementation and evaluated yearly after implementation or after significant rain events.

One potential problem with in-stream indicators is the issue of isolating dependent variables. There are likely many variables influencing the quality of the habitat, so making conclusions with regard to one specific constituent should be done with caution. It should be noted however that the indicators mentioned are excellent for assessing overall changes in a watershed's condition due to BMP implementation and changes in management measures, but don't necessarily identify which BMPs are most effective.

Water quality monitoring should also occur in different locations (not specific to individual BMPs) in the watershed to help document the sources of pollutants and reduction of pollutants following multiple BMP implementation. These locations include lakes and stream branches.

The following section indicates where water quality monitoring should be implemented, by whom, and how often it should be conducted. **Figure 7-1** depicts existing and recommended locations within the Buffalo Creek Watershed where water quality data should be collected and monitored in the future. **Figure 7-1** does not depict recommended sampling locations related to specific BMPs. This monitoring will come later as projects are implemented. **Table 7-9** provides a summary of monitoring categories and considerations.

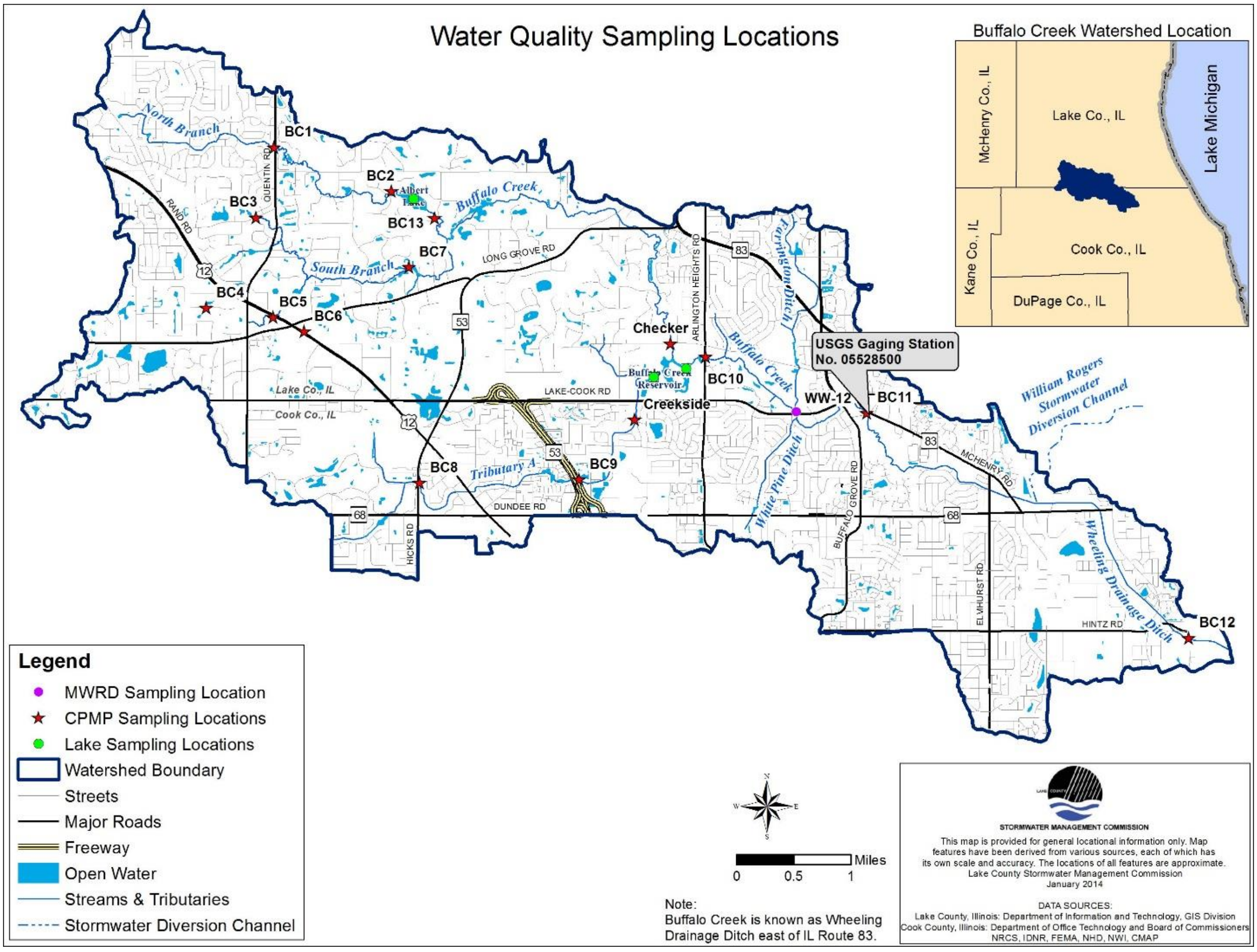


Figure 7-1: Recommended Water Quality Sampling Locations.

Table 7-9: Summary of Monitoring Categories and Considerations.

Monitoring Category	Summary of Considerations
Streamflow	USGS and MWRD maintain a functioning stream flow gage in the watershed. Utilize gage data to develop baseline hydrograph and evaluate trends.
Ambient water quality	Jurisdictions should participate in the DRWW Water Quality Monitoring Program or develop and implement a water quality monitoring program within the watershed.
Physical and biological assessment	BCCWP stakeholders continue with the River Watch program or develop and implement a monitoring program for habitat, macroinvertebrates, and fish.
BMP effectiveness	Monitoring BMP effectiveness of specific practices or clusters of practices.
Lake County Health Department: Lake Monitoring	Incorporate quantifiable and spatial monitoring of aquatic invasive species in lakes
Illinois Volunteer Lake Monitoring Program	Collect storm-event water quality samples from all lake inlets as part of program. Conduct a lake nutrient balance assessment and evaluate available phosphorus in lake sediment.
Storm event runoff monitoring	Evaluate pollutant concentrations from impervious surfaces by conducting water quality sampling during high runoff/flow/storm events.
Winter chloride monitoring	Program to monitor chlorides during the winter and spring seasons.

7.4.3 Streamflow Monitoring

Since 1952 the USGS has been continuously monitoring the discharge in Buffalo Creek at a sampling site (Latitude: 42°09'07", Longitude: 87°57'28") near Wheeling, Illinois. This USGS sampling site (05528500) also has continuous stage height data since 1993. It is recommended that the USGS sampling station be maintained into the future to allow for accurate estimates of pollutant loading.

7.4.4 Water Quality Monitoring in Streams

It is recommended that annual water quality monitoring take place during spring stormflow conditions and summer baseline conditions. There are already multiple stream sampling locations that have been created for the Pollutant Monitoring Program (PMP) (discussed in **Chapter 3**), which established baseline conditions in the watershed between 2013 and 2014. Ideally, the water quality sampling locations used in the PMP should be maintained and are listed below. The DRWW plans to monitor water chemistry at or near the WW-12, Checker Road, Creekside Park and the Buffalo Creek confluence with the Des Plaines at Route 21 Milwaukee Ave seven (7) times annually. DRWW also plans to collect and analyze biological and sediment chemistry data at these locations at a frequency that remains to be determined.

- WW12 – Buffalo Creek north of Lake Cook Road (MWRD monitoring site)
- Checker Road – North of Buffalo Creek Reservoir at Checker Road
- Creekside Park – Southwest of Buffalo Creek Reservoir at W. Lake Cook Road
- BC1 – Buffalo Creek at Quentin Road
- BC2 – Buffalo Creek upstream of Albert Lake at N. Tall Oaks Drive
- BC3 – Buffalo Creek at W. Cuba Road
- BC4 – Buffalo Creek near Wooded Ridge Drive
- BC5 – Buffalo Creek at US 12 (SE side)

- BC6 – Buffalo Creek at US 12 (NW side)
- BC7 – Buffalo Creek near Lexington Lane
- BC8 – Buffalo Creek at Hicks Road
- BC9 – Buffalo Creek near N. Wilke Road
- BC10 – Buffalo Creek downstream of reservoir at Arlington Heights Road
- BC11 – Buffalo Creek at McHenry and Aptakisic Roads (USGS stream gage)
- BC12 – Wheeling Drainage Ditch between E. Hintz Road and Chicago Executive Airport
- BC13 – Buffalo Creek downstream of Albert Lake at Deerwood Drive

Table 7-10: Baseline Water Quality Analysis Parameter for the Buffalo Creek Watershed.

Parameter	Benchmark Indicators
Total Phosphorus	Less than 0.05 mg/L
Total Suspended Sediment (TSS)	Less than 750 mg/L
Turbidity	Less than 20 NTU
Chloride	Less than 500 mg/L
Fecal Coliform Bacteria	Less than 200 CFU/100mL
Dissolved Oxygen	Greater than 6.0 mg/L
Temperature	Less than 90°F
pH	Between 6.5-9.0
Flow	N/A

Table 7-10 includes the minimum parameters that should be considered for monitoring. Quantitative benchmarks that indicate impairment conditions are also illustrated in **Table 7-10**. Continuation of a water quality monitoring program is important in order to evaluate trends and changes in water quality over time. Parameters such as total phosphorus, total suspended sediment, chloride, and fecal coliform bacteria should be analyzed considering flow volumes in order to make relative comparisons, as concentrations of pollutants vary with flow volumes.

7.4.5 Stream Bioassessment

It is recommended that biological and habitat assessments be conducted on an annual basis, but at minimum every 5 years, in the Buffalo Creek Watershed. **Table 7-11** displays the typical biological and habitat assessments techniques that can be used for various stream bioassessments.

7.4.6 Lake Benthos Monitoring

A limited amount of benthos sampling data is currently available for Albert Lake and the Buffalo Creek Reservoir. It is recommended that further benthos samples be taken from each of these lakes. Each benthos sample should be tested for polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), phosphorus, chloride, and excess sediment. Common sources of PAHs and chloride are roadways. Sources of phosphorus runoff include residential areas, agricultural areas, and golf courses. If pollutant levels of lake sediments are found to be high, actions should be considered to remove the existing materials and also implement BMPs to reduce future deposition of these pollutants.

Table 7-11: Recommended Stream Bioassessment Metrics for the Buffalo Creek Watershed.

Metric	Definition	Benchmark Indicators
Fish Index of Biotic Integrity (fIBI)	Index based on the presence of fish species and their tolerances to degraded stream conditions.	Exceptional (50-60) Very good (49-42) Good (41-34) Fair (33-27) Poor (26-17) Very Poor (<17)
Macroinvertebrate Biotic Index (MBI) and Macroinvertebrate Index of Biotic Integrity (mIBI)	Index based on the presence of macroinvertebrate species and their tolerances to degraded stream conditions.	Excellent (MBI <5.0) Good (MBI 5.0-5.9) Fair (MBI 6.0-7.5) Poor (MBI 4.6-8.9) Very Poor (MBI > 8.9)
Qualitative Habitat Evaluation Index (QHEI)	Index that incorporates substrate, instream cover, channel morphology, riparian zone, bank erosion and riffle/pool condition.	Excellent (>70) Good (55-69) Fair (43-54) Poor (30-42) Very Poor (<17)
Stream Condition Index (SCI)	Index that incorporates macroinvertebrate community, habitat and water quality components to grade stream quality.	Exceptional (>70) Good (49.4-69.8) Fair (24.6-49.2) Poor (0-24.5)
Mussels	Live and dead mussels collected and species and populations indicative of stream conditions. Consider adopting additional monitoring protocols for invasive Dreissenid species (zebra and quagga mussels) if evidence suggests a need.	Qualitative based on species diversity, population and live and dead specimens.
Channel Morphology	Establish fixed cross-section and longitudinal profile of channel along a 1,500 foot long fixed reach. Monitor regularly to assess changes in the channel.	Entrenchment ratio Width/depth bankfull Bed material Cross-sectional area Water slope

7.4.7 BMP Effectiveness Monitoring

Implementing the recommend BMPs will not automatically achieve the goals and objectives presented in the Buffalo Creek Watershed Plan. Continued monitoring should be considered at previously established sites. Monitoring should be conducted by consultants or local agencies that are experienced in monitoring the effectiveness of the chosen BMP.

The most effective method for monitoring BMPs is to monitor upstream of the practice and then monitor downstream of the practice. It is also recommended that water samples be taken prior to BMP installation to create a baseline level that can be compared against post construction BMP installation.

In addition to reducing pollutant runoff a number of BMP practices are designed to reduce the volume of water that is discharged into streams, improve the physical condition of the stream, and improve the biological integrity of the stream. Commonly used methods for monitoring these parameters can be found in **Table 7-9**.

7.4.8 RiverWatch Volunteer Program

The Illinois RiverWatch program seeks to engage Illinois citizens by training them as Citizen Scientists. In this program Citizen Scientists are trained to conduct habitat biological surveys as a measure of water quality. The RiverWatch program was initially designed by the Illinois Department of Natural Resources (IDNR) to conduct long-term, comprehensive assessments of natural environments in Illinois. In 2006 the program was transferred to the National Great Rivers Research and Education Center (NGRREC). The mission of the RiverWatch program is to safeguard the future of Illinois rivers and streams through stewardship, education, and sound science. RiverWatch utilizes volunteers to collect quality assured data on wadeable streams and fosters coordination among groups involved in similar monitoring effects.

The BCCWP should continue to recruit volunteers to the RiverWatch program. Coordination should take place with the RiverWatch program to ensure that pre- and post BMP installation surveys are completed. This data has the potential to provide an additional measure of BMP effectiveness. While the RiverWatch monitoring program provides valuable data about macroinvertebrates and habitat, the data collected by the RiverWatch program should in no way replace assessments by professionals. Data collected by the RiverWatch program should be used in combination with data collected by consultants and/or agencies.

7.4.9 Lake Monitoring

The Buffalo Creek Watershed contains two named lakes over 10 acres that were described in greater detail in **Chapter 3**. Albert Lake and the Buffalo Creek Reservoir are valuable natural resources and certainly play a role in the water quality of the Buffalo Creek Watershed. These lakes provide recreational value to the watershed, while also providing ecological services that benefit downstream waterbodies.

The Lake Management Unit of the Lake County Health Department has been collecting water quality data on the lakes of the county since the 1960's. Currently, twelve to fourteen (12-14) different lakes each year are being studied and data collected on temperature, dissolved oxygen, phosphorus, nitrogen, solids, pH, alkalinity, conductivity, water clarity, the 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. Albert Lake and the Buffalo Creek Reservoir were assessed by the LCHD in 2001 and 2013 (**Table 7-12**).

Table 7-12: Monitoring Activities at each of the Named Lakes >10 Acres in the Buffalo Creek Watershed.

Lake	VLMP Years Assessed	VLMP Monitoring Status	LCHD Reports	Invasive/Nuisance Species
Albert Lake	-	Inactive	2001, 2013	Common carp Purple loosestrife Reed canary grass Buckthorn
Buffalo Creek Reservoir	2012, 2013, 2014	Active	2001, 2013	Curlyleaf pondweed Buckthorn Common reed Multiflora rose Purple loosestrife Reed canary grass

In addition to the LCHD lake monitoring program there is the Illinois Volunteer Lake Monitoring Program (VLMP), which was established 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/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 7-13**. The continued collection of data by the VLMP in the Buffalo Creek Watershed will be valuable to the BCCWP for identifying trends.

Table 7-13: Description of the Three 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 plates installed near boat launches.
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.

The BCCWP should continue to support and provide assistance to these lake management organizations in order to provide improved diagnostic capabilities. Long-term datasets collected by the LCHD and the VLMP will allow the BCCWP the ability to assess the impacts of BMPs that are installed in the watershed on and upstream of Albert Lake and the Buffalo Creek Reservoir.

7.5 Evaluating Plan Performance and Programmatic Monitoring

Monitoring performance towards goals and objectives is an essential part of every watershed planning effort. The following section describes recommendations for tracking the implementation activities of Buffalo Creek Watershed stakeholders.

7.5.1 Evaluating Plan Implementation Performance

In order to monitor progress towards meeting the six goals presented in **Chapter 2**, an organizational system should be developed for each jurisdiction. The development of an organizational system would allow each jurisdiction the ability to track its progress towards goals. The following recommendations are included to help track progress towards goals.

- In the early stages of the plan implementation process, the BCCWP should plan to meet at least quarterly to discuss watershed activities and progress towards goals. A list of proposed, completed, and in-progress actions should be tracked for each jurisdiction.
- The Watershed 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 after 10-years. 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 watershed issues of higher priority.
- The BCCWP should request each major project partner in the watershed to provide an annual update on implementation, which could be in the form of a "scorecard" that tracks progress towards goal objectives via measureable milestones. The scorecard system is presented in section 8.5.2. It is an easy and effective way to compile and track progress in the watershed in a measureable 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 planning 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, tracking changes/modifications are anticipated based on usability and changes in priority throughout implementation.

7.5.2 Measureable Milestones and Scorecard System

Interim measurable milestones are directly tied to the watershed 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 watershed plan determine which indicators should be monitored to assess the success of the watershed plan. 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 macro-invertebrate health. Social indicators can be measured using demographic data or for example the number of landowners adopting conservation practices.

7.5.2.1 Score Cards

A "scorecard" system was developed for each of the six (6) plan goals that were outlined in **Chapter 2** and are located in **Appendix L**. This system was designed to track progress toward action plan goals. 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 BCCWP 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. It is possible that milestones may be partially met during evaluation. Below is the scorecard for system for evaluating progress:

A = Met or exceeded milestone(s)

B = Milestone(s) 75% complete

C = Milestone(s) 50% complete

D = Milestone(s) 25% complete

F = No progress towards milestone(s)

Score card milestones are based on short term (1-5 years), medium term (6-10 years) and long term (10+ years) objectives. An example of progress indicators and milestones for the Buffalo Creek Watershed are presented in **Table 7-14**. The milestones and "score cards" can be used to identify and track plan implementation to ensure that progress is being made towards achieving the plan goals and to make corrections as necessary.

Table 7-14: Example Indicators and Milestones for Each Goal.

Goal	Indicator	2-yr Milestone	5-yr Milestone	10-yr Milestone
1) Water Quality Improvement	Linear feet of streambanks stabilized	2,000	5,000	10,000
2) Reduce Flooding	Number of flooding issues addressed	5	10	15
3) Protect, Enhance, and Restore Natural Resources.	Acres of natural resources that have been protected, restored or enhanced	111	222	333
4) Connect Natural Areas	Acres of natural areas that have been connected	20	40	60
5) Guide New Developments	Number of new developments incorporating green infrastructure stormwater best management practices	1	3	6

7.5.3 Implementation Schedule

Implementing best management practices should occur immediately where willing landowners or other interested stakeholders have been identified. A general implementation schedule is presented in **Table 7-15**; however, more detailed implementation time frames are included in **Chapter 7** for each action item and in the score card systems in **Appendix L**.

Table 7-15: Buffalo Creek Watershed General Implementation Schedule.

Task	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
BCCWP to determine short term goals.	X									
BCCWP to develop an annual work plan.	X	X	X	X	X	X	X	X	X	X
Identify funding and technical assistance to provide for watershed coordination and implement recommendations identified in the action plan.	X	X	X	X						
Submit grant applications to applicable granting agencies and secure additional funding sources for plan implementation.	X	X	X	X	X	X	X	X		
Coordinate available programs, policy changes, local initiatives, and those programs that private landowners are responsible for signing up for.	X	X	X	X	X	X	X	X	X	
Project planning, site surveys, project design, and budget development.		X	X	X	X	X	X	X	X	
Prioritizing and incorporating the recommendations in the watershed plan 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
Outreach programs to communicate successes.	X	X	X	X	X	X	X	X	X	X
Evaluate accomplishments.	X	X	X	X	X	X	X	X	X	X

Chapter 8 Table of Contents

8 Education and Outreach

This chapter provides a strategy for information, education, and public involvement to address watershed topics and issues. The education and outreach strategy provides messaging and motivation for each target audience to help us achieve our goals and realize our vision for Buffalo Creek:

"Our Vision is that Buffalo Creek will be a sustainable watershed success story with reduced erosion, improved water quality, thriving wildlife, decreased flooding and the beauty of native vegetation. This will be accomplished through collaborative and inclusive community and agency partnerships."

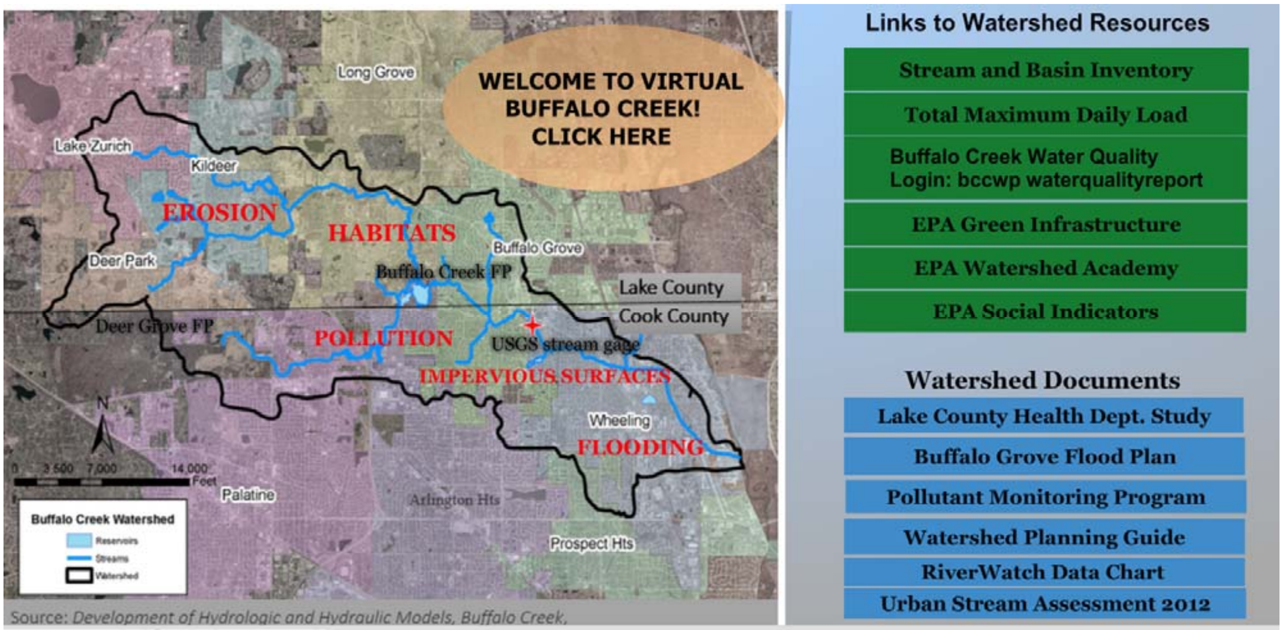
8.1 Introduction

Watershed problems are the collective result of many individual actions that may not be widely understood to be harmful. The general public is often unaware of the environmental impact of their day-to-day activities. Solutions to issues are often voluntary and require effective public support and willing participation. This can only happen when stakeholders become engaged in watershed stewardship activities and change behaviors that adversely affect watershed resources. Encouragement to change behaviors must be tied to personal values and perceived benefits in order to answer the question "What's in it for me?". A basic understanding of watershed issues and how individual and collective actions can play a role in protecting water quality and other natural resources helps provide the motivation and basis for changing social behaviors, addressing issues, and ultimately achieving our vision.

A range of education and outreach strategies may be appropriate for various target audiences. These can range from a watershed-wide pollutant reduction campaign, to implementation of community green infrastructure or streambank stabilization projects, down to targeted one-on-one outreach, for example, in the case of neighbourhoods with excessive runoff that is causing severe erosion in their local forest preserve.

The USEPA's "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" was used in the development of the Buffalo Creek Watershed Education and Outreach Strategy. This guidance recommends a six-step approach for developing and implementing an education and outreach program. The publication "Getting in Step: A Guide for Conducting Watershed Outreach Campaigns" describes each of the six steps in detail:

1. Define driving forces, goals and objectives.
2. Identify and analyze the target audiences.
3. Create the messages for each audience, clearly articulating what actions they should take.
4. Package the message to various audiences.
5. Distribute the messages.
6. Evaluate the Information and Education program.



Screenshot of The Virtual Buffalo Creek page at www.buffalocreekcleanwater.org. Videos present watershed issues and links to other watershed resources.

8.2 Education and Outreach Goal and Objectives

At stakeholder meeting #5, the following goal and objectives related to education and outreach were discussed and approved by stakeholders:

GOAL #6: Provide watershed stakeholders with knowledge, skills and motivation needed to implement the watershed plan. Watershed stakeholders include (but are not limited to) residents, property owners, property owner associations, government agencies and jurisdictions, and developers.

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

Objectives:

All watershed residents will know "what a watershed is" and what watershed they live in.

a. Homeowner associations, municipalities and businesses are knowledgeable about proper maintenance of detention basins and other stormwater drainage system features and take responsibility for appropriately maintaining them.

b. Improve knowledge of stormwater best management practices by collaborating with College of Lake County and Lake County Stormwater Management Commission (SMC) and other potential education partners to provide training for targeted stakeholders.

c. Provide training on aquatic plant management and water quality improvement practices to result in good lake management.

d. Minimize phosphorous releases thru education about yard landscaping, picking up pet waste and reduction of soil erosion.

e. Expand the use of the green infrastructure approach to site planning and design and stormwater best management practices by educating transportation agencies, developers, plan commissions, park districts and village boards.

f. Minimize flood impacts by providing information on flood mitigation and prevention to residents located in flood-prone areas and the general public.

g. Provide training for riparian landowners on best practices for stream restoration and riparian property maintenance that will result in restoring the conveyance of Buffalo Creek to its intended capacity.

h. Reduce the amount of road salt used for winter maintenance by promoting and providing training opportunities for public and private winter maintenance providers on best snow and ice removal practices.

i. Educate the general public on the importance of watershed health (water quality, flood prevention, green infrastructure, and nonpoint source pollution) to the economy of the communities in the watershed.

j. Promote implementation of watershed plan action recommendations by working with stakeholders to develop a pipeline of watershed projects and funding sources for each of them.

A film crew from the University of Illinois shoots video at Buffalo Creek Forest Preserve. They are viewable on the Virtual Buffalo Creek web page at www.buffalocreekcleanwater.org.

8.3 Target Audiences/Partner Organizations

The audience for specific education and outreach activities includes organizations, watershed residents, the general public, and professionals within the watershed community. There is a wide range in the level of understanding of watershed issues and the need for further education and outreach. The intent is to be responsive to existing partners, attract stakeholders that have not previously participated in watershed improvement activities, and to align messages with their knowledge level and motivations.

From the day Buffalo Creek Clean Water Partnership (BCCWP) was formed, it has benefitted from the support of many partner organizations and their dedicated professionals. They have provided generous support and have resources that will be critical as the Watershed Plan is finalized and implemented. Education and outreach partners include the following entities.

8.3.1 Local Government Officials and Agencies

Continued support from local governments and public landowners will be critical to implement the education and outreach strategy by committing to projects on public lands and by communicating with and motivating residents to participate in watershed improvement. BCCWP will ask the communities to adopt the watershed plan and actively support and participate in the education process.

8.3.2 Residents

Many residents in the Buffalo Creek watershed have participated in one or more meetings or events sponsored by BCCWP. BCCWP will need to reach out to inform, educate, and motivate citizens through the Education and Outreach Plan and partner with village programs across the watershed in order to achieve its vision and goals.

8.3.3 Riparian and Lakeshore Landowners

Certain landowners have a disproportionate impact 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. These include homeowner and lake-owner associations (HOAs/LOAs), single family residences, commercial and multifamily residential properties, owners of undeveloped land, railroads, and utility companies located in floodplain or along streams, lakes, and wetlands. These are critical locations because they contribute to problems or hold the key for solutions. Therefore, the riparian property owners should be targeted for special attention in the Education and Outreach Plan.

8.3.4 Schools and Youth Groups

Outreach and education programs and messages targeted to school and youth groups are needed in order to achieve sustainable improvements over time. Youth is where the behaviors needed to effect long term changes and improvement in watershed conditions will take hold in the shortest time and with the greatest effect. 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 taking action to improve watershed conditions.

8.3.5 Developers, Homebuilders and Contractors

Developers, homebuilders and contractors may adversely affect watershed conditions in the design and development process and should comply with a variety of best development standards, regulations, codes, and ordinances to protect watershed resources.

8.3.6 Consultants and Contractors Working in the Watershed

A number of engineering, environmental, and other consultants have participated in stakeholder meetings and provided their expertise to the BCCWP. The Watershed Plan will provide them with resources to share with their clients and support for prioritization of future projects. Their help will be needed to bring outreach and education messages to their clients to provide motivation and secure funding for best management practices (BMPs) and watershed improvements far into the future.

8.3.7 Landscapers/Lawn Care and Snow Removal Contractors

Landscaping 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 and winter maintenance providers.

8.4 Messages

The various target audiences will need to hear different messages or the same message in different ways through a variety of delivery mechanisms, as determined by this Plan and through the initial contact with target audiences mentioned above. A number of strategies for crafting and delivering messages for watershed information and education are provided below and by the watershed stakeholder committee in **Table 8-1**. Single issue messages tend to be simple and effective, though messages can also be crafted to address multiple issues such as the link between hydrology and stream health.

Examples of messages that will be used as part of this Plan include the following:

- What is Nonpoint Source Pollution and how can each one of us help to reduce it?
- Harvest, Reuse, Recycle Your Rainwater
- Restore Our Streams, One Drop At A Time
- Natural Landscapes Are More Resilient and Cost Less in the Long Run
- Connect to the Green Infrastructure Network
- Protect Yourself – Buy Flood Insurance

- Check Floodplain Maps Before You Buy or Build
- Use Only What You Need (Fertilizer Nutrients)
- Stream Restoration Can Reduce Sediment, Phosphorus and Nitrogen
- Less Salt Saves Money and Stream Life

Outreach messages will be most effective if multiple partners utilize the messages in communications and publications with a goal of "immersing" the watershed community in a topic over a short term such as six months to a year. Refer to **Table 8-1** for complete messaging by target audience.

Table 8-1: Message by Target Audience

Objective	Target Audience	Education and Outreach Action Steps/Materials
All watershed residents will know "what a watershed is" and what watershed they live in.	• General public	• Watershed plan • Watershed signage • Buffalo Creek and Village websites
Homeowner Associations, municipalities and businesses are knowledgeable about proper maintenance of detention basins and other stormwater drainage system features and take responsibility for appropriately maintaining them.	• Municipalities • Landowners of detention/retention basins	• Landowner Guides • Workshops • Detention Basin inventory website • Watershed green infrastructure plan
Improve knowledge of stormwater best management practices by collaborating with College of Lake County and SMC to provide training for targeted stakeholders.	• General public • Municipalities	• Education programs developed in collaboration with College of Lake County, SMC, Forest Preserves and other partner organizations
Provide training on aquatic plant management and water quality improvement practices to result in good lake management.	• Municipalities • Landowners along wetlands and riparian corridors	• Stream inventory web site • Lake reports provided by Lake County Health Department • Watershed green infrastructure plan • Landowner Guides and resources
Minimize phosphorous releases thru education about yard landscaping, picking up pet waste and reduction of soil erosion.	• Municipalities • All landowners • Landscape contractors • Golf courses	• Education campaigns • Phosphate fertilizer restrictions • Buffalo Creek and community websites
Expand the use of the green infrastructure approach to site planning and design and stormwater best management practices by educating transportation agencies, developers, plan commissions, Park Districts and Village Boards.	• Municipalities • Land use planners • Transportation agencies • Developers • Park Districts	• Watershed Plan Green Infrastructure Inventory and Network • Webinars and workshops • Information provided on community and agency websites
Minimize flood impacts by providing information on flood mitigation and prevention to flood prone property owners and the general public.	• Municipalities • Landowners in flood prone areas	• Education campaigns and direct mail • Targeted campaign based on flood survey data • Stormwater utility promotion • Buyouts and flood mitigation programs • Rain barrels and rain gardens

Provide training for riparian landowners on best practices for stream restoration and maintenance that will restore the conveyance of Buffalo Creek to its intended capacity.	• Municipalities • Riparian landowners	• Stream inventory web site • Watershed Plan Green Infrastructure Inventory and Network • Landowner Guides and resources • Buffalo Creek and community websites
Reduce the amount of road salt used for winter maintenance by promoting and providing training opportunities for public and private winter maintenance providers.	• Municipalities • Transportation agencies • Private landowners • Private snow removal operators	• Training sessions offered by Lake County SMC/Health Department • Alternative deicing product literature • Model municipal and transportation agency snow removal policies and procedures
Educate the general public on the importance of watershed health (water quality, flood prevention, green infrastructure and non-point source pollution) to the economy of the communities in the watershed.	• General public • Municipalities	• Education campaigns • Watershed plan meetings • Presentations at board meetings • Buffalo Creek and Municipal web sites • Media development and distribution Utility bill "stuffers" • School and Youth Programs • Watershed sponsored events • Monitoring programs • Habitat restoration workdays
Promote the watershed plan recommendations by working with stakeholders to develop a pipeline of watershed projects and funding sources for each of them.	• Lake County SMC • MWRD • Municipalities • Park Districts • Forest Preserves • All Landowners • Grant Funding Organizations	• Watershed Plan Green Infrastructure Inventory and Network • Stream and Basin inventory website • Information on grants and support opportunities

8.5 Partner Organizations

Several education and outreach programs are currently being implemented by other organizations that Buffalo Creek watershed stakeholders may take advantage of via the following resources:

8.5.1 SMC

SMC provides pollution prevention and non-point source BMP information and workshops as a component of the NPDES program and an annual homeowner association workshop. SMC provides training opportunities and brochures on a variety of watershed topics; provides cost-share grant funding; and sponsors a voluntary buyout program for flood prone properties.

8.5.2 MWRD

MWRD has sponsored large projects in the Buffalo Creek watershed, including the reservoirs at Buffalo Creek Forest Preserve and the Heritage Park project in Wheeling. MWRD has many programs in place, including a stream maintenance/restoration program, discounted rain barrel sales and exhibits at green fairs and other events.

8.5.3 Lake County Health Department (LCHD)

LCHD has provided invaluable support for water quality monitoring and surveys of lakes in the watershed, including winter-time monitoring of chloride levels. With several water quality professionals, a lab and legal authority to address pollution releases, LCHD is a valuable partner for watershed health.

8.5.4 Buffalo Grove Environmental Action Team

The Buffalo Grove Environmental Action Team (BG EAT) is a community-based organization sponsored by the Buffalo Grove Park District. BG EAT conducts habitat workdays at Rylko Park and has received grant funding for stream clean-up events at the park. BG EAT also provides volunteers and equipment for the RiverWatch program. RiverWatch has been an important early outreach program for BCCWP and has provided important data about populations of macro-invertebrates that are indicators of stream health.

Photo courtesy of Jeff Weiss. Volunteers from the Buffalo Grove Environmental Action Team were trained to act as Citizen Scientists for the River Watch program.

8.5.5 Deer Grove Natural Area Volunteers

Deer Grove Natural Area Volunteers is a volunteer stewardship group. Deer Grove Forest Preserve is largely located within the Buffalo Creek Watershed and was the first Cook County Forest Preserve. BCCWP co-sponsors and members lead workdays to remove invasive plants, monitor plant and animal populations. The annual Earth Day Event has attracted more than 200 volunteers in recent years. Earth Day includes tours of the mitigated wetlands and other restoration projects at the site. Deer Grove volunteers also harvest, clean, mix, and sow native seeds; monitor bird, butterfly, frog, dragonfly and fish populations; and work with adjoining landowners to reduce the effects of stormwater runoff which is causing erosion and gullying in sensitive areas within the Preserve.

8.5.6 Barrington Area Conservation Trust and Conserve Lake County

Barrington Area Conservation Trust and Conserve Lake County are land trusts that offer a landscape certification program for watershed-friendly management practices such as native landscaping, rain gardens and rainwater harvesting for Lake County residents as part of a program called Conservation@Home.

8.5.7 Des Plaines River Watershed Workgroup

The Des Plaines River Watershed Workgroup (DRWW) is developing a water quality monitoring program for the Des Plaines River watershed, including Buffalo Creek. Meetings include a program with featured speakers on water quality issues.

8.5.8 Illinois Environmental Protection Agency (Illinois EPA)

Illinois EPA has provided valuable support in the form of grant funds for watershed planning, plan review and maps for the BCCPW web site.

8.5.9 Chicago Metropolitan Agency for Planning (CMAP)

CMAP is the land use planning organization for northeastern Illinois. With several professionals on staff who are knowledgeable about watershed issues and planning, CMAP has been a valuable partner to BCCWP.

8.5.10 North Cook Soil and Water Conservation District

The North Cook Soil and Water Conservation District provides information, education and guidance in the conservation and wise use of resources. The District has provided input for several proposed projects and monitored construction projects along the Buffalo Creek channel.

8.5.11 Des Plaines River Watershed Workgroup

The Des Plaines River Watershed Workgroup (DRWW) is developing a water quality monitoring program for the Des Plaines River watershed, including Buffalo Creek. Meetings include a program with featured speakers on water quality issues.

8.5.12 Ancient Oaks Foundation of Lake Zurich

The Ancient Oaks Foundation of Lake Zurich is a grass-roots group of Lake Zurich residents dedicated to the preservation of Lake Zurich's natural areas through education, volunteerism, supporting funding and long-term planning.

8.5.13 Other partner organizations

Organizations that are target audiences, such as Villages, Townships and Park Districts may also be responsible for implementing the watershed plan recommendations. Each partner should couple plan implementation efforts with parallel efforts to inform and educate.

8.6 Existing Media Outreach Assets

BCCWP volunteers have already created several outreach tools that will be used to support the Education and Outreach Plan. They include:

8.6.1 Print media

- Watershed brochure: A Buffalo Creek brochure provides an overview map of the watershed, information about watershed issues and ways for residents to make a difference. The brochure will be updated to support the review, approval and implementation of the watershed plan.
- Newspaper articles: BCCWP has worked with reporters and photographers resulting in publication of several articles about BCCWP meetings and issues. This is an important element of our Education and Outreach Plan that will continue as the plan goes through the review and implementation process.
- Newsletter articles: BCCWP has submitted articles for publication to SMC, RiverWatch and corporate newsletters. While to date the messages have been general, over time they will be focused on actions to address watershed issues to support the plan.

8.6.2 Electronic tools and media

- Email contact list: BCCWP maintains an email contact list has more than 200 contacts for meeting notices and other watershed-related communications.

- Website: BCCWP maintains a website at www.buffalocreekcleanwater.org. In addition to publicizing meetings and events, the web site features Virtual Buffalo Creek and links to many documents and relevant sites.
- Virtual Buffalo Creek: This is an interactive tour, with videos that describe watershed issues and links to key sites within the watershed.
- Water quality monitoring reports and data: this information can be accessed from the BCCWP web site.
- SMC Stream and Basin Inventory: Completed in 2013, the inventory includes assessments and photographs of erosion severity, debris jams, problem discharges and hydraulic structures and stormwater storage basins across the watershed in a geodatabase and interactive map environment. It can be accessed from the Virtual Buffalo Creek page of the BCCWP website and will be promoted for use by land managers and planners throughout the watershed.

8.6.3 Visuals

- BCCWP founder Jeff Weiss produced six 2- to 3-minute videos on the Virtual Buffalo Creek web page, with support from the University of Illinois at Urbana Champaign. They are viewable as standalone YouTube videos.
- BCCWP has several large mounted maps of the Buffalo Creek watershed
- A poster "A Day in the Life of an Urban Stream" was exhibited at the Illinois Water 2014 and 2015 Wild Things conferences.
- A range of watershed presentations that were shown at stakeholder meetings are accessible from the BCCWP website.

8.6.4 Personal contacts

- BCCWP stakeholder meetings are held at least quarterly at various sites around the watershed and provide a structure for getting updates on projects and events, stakeholder input into the watershed planning process and presentations from guest speakers and watershed professionals. Ongoing meetings will transition from planning to a "watershed counsel" that will guide implementation following approval of the watershed plan.
- BCCWP leaders make presentations to Village board meetings and Park District workshops. These presentations are often attended by members of the press and public who might not otherwise hear about watershed issues. They may also get play on local access television.
- BCCWP leaders have also presented to the 2015 Wild Things Conference and Sierra and garden club groups.
- RiverWatch is a key volunteer activity, in which more than 20 volunteers have participated. BCCWP volunteers monitor five sites. Professional biologists attend and improve the accuracy of the data collected from this program. Ongoing RiverWatch monitoring will look for positive impacts on water quality as the plan is implemented.
- Habitat workdays and the Deer Grove Earth Day event have provided opportunity for hands-on experience in restoring degraded ecosystems.
- BCCWP has manned a booth at the Buffalo Grove Green Fair, Buffalo Grove Days, and other programs such as Movies in the Preserves, in order to raise awareness and recruit new members.
- Outreach to a high school Environmental Club and a local Boy Scout troop has resulted in participation at watershed events.

8.6.5 Other

- BCCWP has co-sponsored events that have led to publicity and our logo being placed where it can create public awareness.

- BCCWP leaders have proposed specific project ideas and grant opportunities to stakeholders for BMP's. More of this will be done in the course of Plan implementation.
- BCCWP leaders have written letters of support for stakeholders that have led to successful grant applications.

8.7 Implementation

The following are general guidelines for implementing the education and outreach strategy. More detailed recommendations for addressing the specific Buffalo Creek watershed issues are included in the Watershed Action Plan (**Chapter 7**) and **Table 8-2**.

8.7.1 General Guidance

General guidelines for education and outreach include the following:

- Use words that the public can understand that speak to their values and priorities.
- Keep messages 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 for example: storms, streams, land management, flooding and the urban landscape and streets.
- Develop multiple messages for topic areas as needed: one broad message for the general public and a series of more specifically targeted messages for specific audiences along the creek (e.g., landowners, business owners, and municipalities.)
- Identify and provide for the different 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, and restoration and management of riparian buffers. Develop a similar "menu" of topics for each target audience.
- Coordinate the information and education strategy with partner organizations to combine efforts, achieve economies of scale, tap into networks, share costs, and ensure a consistent message.
- All materials and messages should promote the local watershed groups with contact information and "how to get involved" information.
- Work to correct perception problems, such as Buffalo Creek being viewed as a drainage ditch rather than as a resource and community asset to be protected, enhanced, and enjoyed.
- Information about basic watershed science education (e.g., biology, the water cycle, stream ecology) may be needed when the audience has little knowledge about the creek, lakes, wetlands or watershed.
- Be sure to link the issue to the audience and inform the audience about actions they can specifically 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.

Table 8-2: Existing/ongoing tools and delivery mechanisms developed by Buffalo Creek Clean Water Partnership

Print	Electronic	Visuals	Personal contact	Other
Watershed Brochure	Email Contact List	Videos	Stakeholder Meetings	Partnerships and Support Partner Education Programs
Newsletter Articles	Web Site	Buffalo Creek Poster	Board Presentations	Event Co-sponsors
Newspaper Articles	Virtual Buffalo Creek	Watershed Presentation	Exhibits	Letters of Support
	Monitoring Reports		RiverWatch and lake monitoring training	Grants
	Stream & Basin Survey		Habitat Workdays and Stream Clean-ups	
	Meeting Presentations		Green Fairs, Festivals	
	Flood Survey		School/Youth Outreach	

8.7.2 Media and Marketing Campaign

The BCCWP does not have current funding sources to launch a professional media or marketing campaign; a professional campaign would be an appropriate strategy for several of the proposed audiences and messages. This plan will be a key asset for education and outreach. Copies will be accessible through the BCCWP and other web sites. The Executive Summary will include highlights of this Education and Outreach Strategy to create awareness and inspire action.

Additional ideas that have been used by other watershed groups that should be considered include the following:

- Design and install watershed road signs at stream crossings and at watershed boundaries: "You are entering the Buffalo Creek Watershed. Please help protect our stream."
- Create and implement a public relations and marketing campaign to include advertisements and outreach via local newspapers, village newsletters, homeowner association newsletters and community meetings.
- Create a media kit and identify media outlets (radio, TV, newspaper, websites)
- Distribute and post watershed map/poster/brochures that include pollution control strategies, watershed principles, and interesting facts about the watershed
- Use paid advertising (direct mail, newspaper ads, cable or local access TV commercials) targeted to streamside landowners and residents.
- Send email "alerts" to municipalities regarding water-related conferences, information, and strategies.

8.7.3 Direct Mailing and Outreach

SMC sponsored a flood survey mailing, which generated a good response and useful information about flooding and flood-prone properties in the Buffalo Creek watershed. Due the high cost of mailings, this is not seen as a primary outreach method. However, messages and information about watershed issues can be delivered as "stuffers" in water bills. Other ideas for education and outreach include the following:

- Materials targeted to landowners and businesses along the creeks should be designed to help them understand riparian systems, streambanks, and buffers, and how to manage land and riparian areas appropriately including septic system inspections and upgrades when necessary. Likewise for targeting lakeshore property owners.
- Individual quick-read "issue fact sheets" on watershed issues can be periodically sent to municipal officials as well as other leaders and decision-makers who have limited time for reading and absorbing important information.

- One-on-one outreach on watershed issues and improvement efforts, especially to municipal officials and other local decision makers.
- Survey (email, mail, telephone) of stakeholders to assess current state of awareness of watershed issues, knowledge and practice of positive social behaviors.
- Design a set of simple BMP manuals for your various target audiences: residents, streamside landowners, lake owners, homeowner associations, business, municipalities, schools, and industries.
- Disseminate a guide for responsible stormwater management in the watershed, such as a pamphlet for landowners that describes simple, small scale practices, working with a land trust partner, such as BACT or Conserve Lake County. This guide may also be posted and promoted by watershed communities and agencies such as the park and forest preserves and SMC and MWRD.

8.7.4 Public Involvement, Stewardship, and Community Events

In addition to the stewardship activities that BCCWP already leads and promotes, other watershed groups have used the following activities to promote education and outreach. Various watershed groups may want to adopt one or more of these activities for implementation in Buffalo Creek watershed.

- Emphasize direct involvement opportunities such as stream clean-up events, watershed bus tours, stream walks, rain garden walks, restoration projects, and hands-on learning events. Hold special events for public officials and staff.
- Create a self-guided tour of the watershed highlighting scenic spots, natural areas, wetlands, trails, and areas of concern such as streambank erosion sites, stormwater outfalls, and urban runoff sites.
- Develop a recognition program for watershed improvement efforts of industry, business, schools, citizens, elected officials, and environmental groups implementing watershed improvement projects.
- Hold an annual award ceremony and publish a directory of outstanding watershed management projects.
- Develop a storm drain stencilling or button campaign. Distribute door hangers to explain storm drain stencilling efforts.
- Develop an "Adopt a Stream" program whereby an individual or group accepts responsibility for managing a specific stream reach.
- Arrange site visits and install interpretive signs at BMP installation sites.
- Establish a hotline or notification system to report fly dumping or illicit sanitary sewer or septic connections.

Photo courtesy of Friends of Deer Grove. BCCWP sponsors and leads volunteer habitat stewardship work at Deer Grove Forest Preserve

8.7.5 Primary and Secondary Education

In addition to the school and youth outreach and stewardship activities that BCCWP already supports, other watershed groups have promoted education and outreach to this audience include the following approaches:

- Create a hands-on watershed curriculum, including watershed ecology and non-point source pollution training for teachers, home-based educators, field trips, chemical test kits, nets, sampling equipment, and wildlife identification books. The Soil and Water Conservation Districts may help sponsor these.
- Hold workshops for teachers, home-based educators, and an annual student congress.
- Maintain a group of trained student and teacher volunteers and create service learning opportunities such as clean ups and monitoring for students annually.

8.7.6 Demonstration Projects with Educational Signage

BCCWP leaders have proposed several projects to stakeholders, including municipal rain gardens and shoreline stabilization projects. Other watershed groups have used demonstration projects such as parking lot bio-filters, residential rain gardens, stream restoration/stabilization to promote education and outreach. While capital projects are typically expensive, they can provide both direct physical improvement as well as public education.

8.8 Evaluating the Outreach Plan

Evaluation provides a feedback mechanism for ongoing improvement of the education and outreach effort and for assessing whether the effort is successful. It also builds support for further funding. Appendix L provides a Report Card for evaluating the success of the Outreach Plan.

Metrics should be customized to meet the particular needs of the parties responsible for implementing an education and information campaign. For a number of these programs, baseline information should be collected before the outreach activities begin and checked periodically throughout the outreach campaign to help measure progress and effectiveness.

Actual reduction in impairment of water quality in the Buffalo Creek watershed is perhaps the best indicator of outreach effectiveness. While it is difficult to attribute water quality improvement to specific programs or actions, there is little doubt that increased understanding and public involvement in the watershed is essential to watershed improvement.

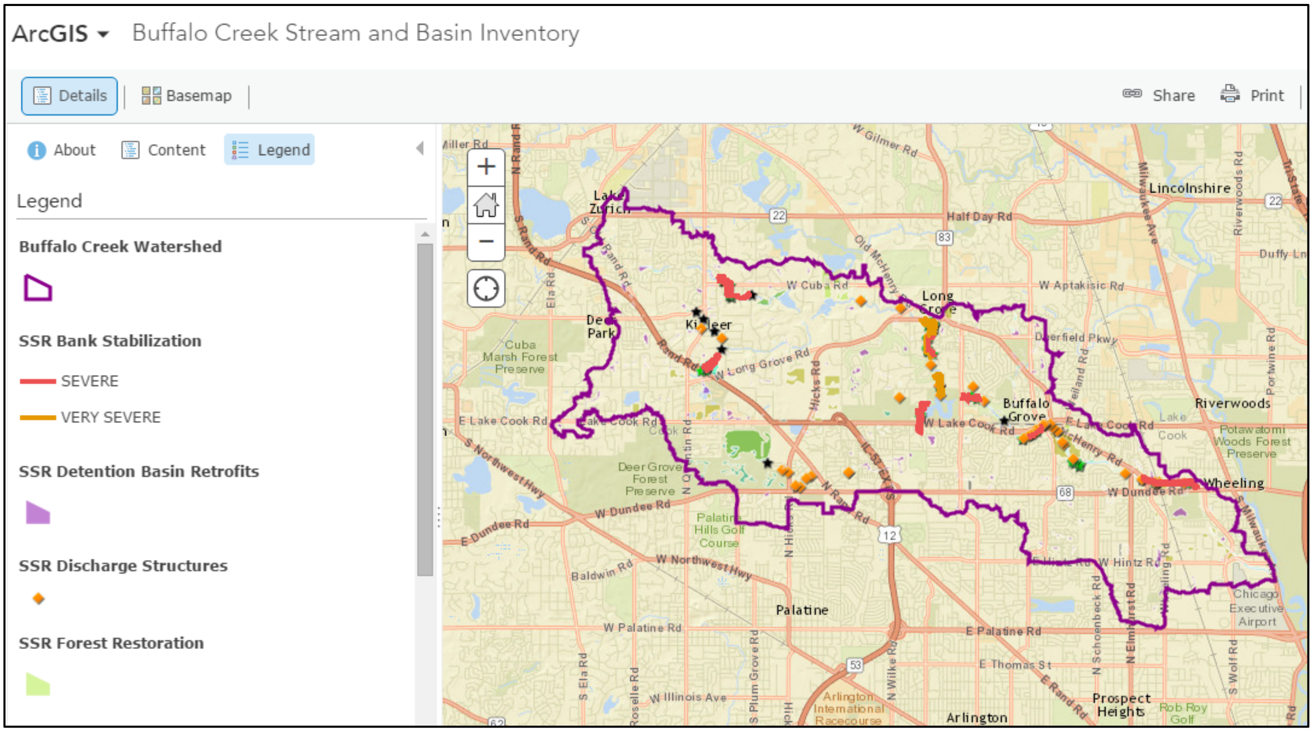
8.9 Watershed Information and Education Resources

There are a number of resources that include effective 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/

These and other organizations provide downloadable resources that can be customized for the Buffalo Creek Watershed.

Although some financial cost-share may be required from public or private grant sources for larger educational activities such as training workshops and demonstration projects, many of the activities and tools covered in this education toolbox can be incorporated into the established work activities, projects, and education programs identified in **Table 8-3** within existing budgets.



Screenshot of the watershed geo-database. Created from data collected during the 2013 stream and basin inventory, the public can link from www.buffalocreekcleanwater.org and use the data to assess watershed conditions.

Table 8-3: Future tools and delivery mechanisms

Print	Electronic	Visuals	Personal contact	Other
Watershed plan	Watershed Plan	Watershed Signage	Plan Workshops	Ordinance Reviews
Utility Bill Inserts	Village Newsletters	Presentations	Neighbourhood Canvass	Stormwater Utility Support
Media Kit	Village Websites	Demonstration Projects	Watershed Tours	Des Plaines River Watershed Workgroup (DRWW)
Fact Sheets	Electronic Surveys	Displays	Training Sessions	Regional and Local Plans
	Social Media	Museum/Library Exhibit	Nature Walks	Social indicators survey
			Conservaton@Home Certification	List of Funding Sources

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