Fox River Study Group

Fox River Ecosystem Partnership

Mill Creek Watershed-based Plan

Kane County, Illinois

September 2019

CMAP | HELPING COMMUNITIES PROSPER

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Acknowledgments

This project was made possible by Section 604(b) of the Clean Water Act, as amended, and the Illinois Environmental Protection Agency, Bureau of Water, who distributed funds to the Chicago Metropolitan Agency for Planning (CMAP). Appreciation is extended to Scott Ristau for providing grant administration, program management, and plan review. CMAP, the regional planning agency for the seven counties of northeastern Illinois and the delegated authority for the region's areawide water quality management plan, led the planning process. Contributing staff members were project manager Holly Hudson, Kelsey Pudlock and Jared Patton, as well as interns Blake Grigsby, Rebecca Yae, and Isabella Downes. The development of this plan would not have been possible without the significant contributions of project partners Kane County, notably Rob Linke, Jessica Mino, and Karen Miller; the Fox River Study Group, which provided funding assistance for HSPF modeling; the Fox River Ecosystem Partnership, which assisted with public information and outreach through their website and monthly e-newsletter; and all the organizations and their representatives participating on the plan's Steering Committee, highlighted below. Geosyntec Consultants calibrated the HSPF model for Mill Creek and conducted the existing conditions pollutant load analyses and best management practice pollutant load reduction and cost estimates. Great appreciation is also extended to the Geneva Park District's Peck Farm Park for hosting and all the members of the public who attended the open house and shared their knowledge and hopes for the Mill Creek watershed.

Project Steering Committee

Batavia Park District – Eric Lacher
Campton Township Parks & Open Space – Josh Nelson
City of Batavia – Scott Buening, Andrea Podraza
City of Geneva – Brian Schiber
City of St. Charles – Russell Colby, Ken Jay, Karen Young
Forest Preserve District of Kane County – Patrick Chess, Ben Haberthur
Friends of the Fox River – Art Malm, Gary Swick
Garfield Farm Museum – Jerry Johnson
Geneva Park District – Trish Burns, Jerry Culp
Kane County Farm Bureau – Steve Arnold
Kane-DuPage Soil & Water Conservation District – Ashley Curran, Patrick McPartlan
Mill Creek Special Service Area – William Earle
Mill Creek SSA, Advisory Board – Clare Fitzgerald, Mark Neville, Barry Stuedemann
St. Charles Park District – Chris Gingrich, Ryan Solomon
The Conservation Foundation – Trish Beckjord, Dan Lobbes
Village of Campton Hills – Ron Searle
Wasco Sanitary District – Thomas Bihun

Unless otherwise specified, all photos are by CMAP staff.

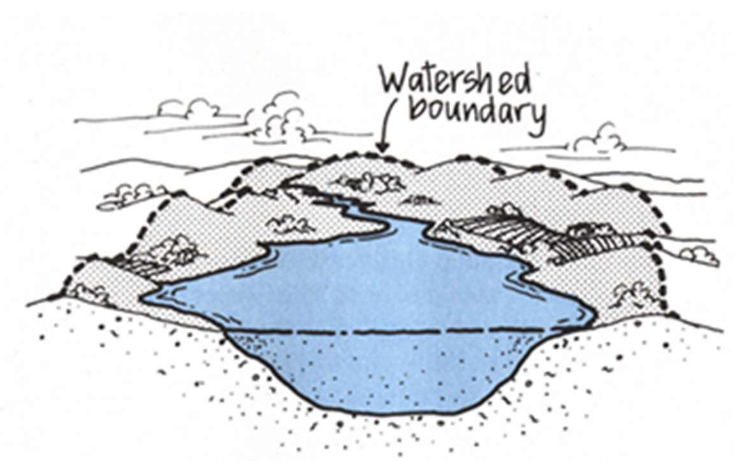
1. Introduction

1.1 Watershed-based Planning

Watershed planning is a public process involving all parties with an interest or "stake" in the environmental health and quality of life in the area at issue. A watershed – the land area from which precipitation or snowmelt and resulting surface runoff drain to a lake or river – serves as the organizational framework for thinking about, planning, and managing land use and other activities that affect both land and water resources.

Figure 1. Watershed boundary schematic.

A watershed is the land area from which rainwater and snowmelt drains into a body of water such as a stream or lake. Watershed boundaries are defined by nature and are largely determined by the surrounding topography or "lay of the land."



Watershed boundaries are defined by topography or the "lay of the land." Thus, the edge or boundary of a watershed is defined by the highest points and ridges of lake around the waterbody of interest (Figure 1).

Everyone lives in a watershed. It's our human activities within the watershed that affect local water quality and the waters of our downstream neighbors (Figure 2). Thus, watershed planning is commonly driven by the need to correct water pollution problems in streams and/or lakes. Planning can also focus on protecting water resources that are not currently impaired by any number of potential sources and causes of pollution. When remedy for water pollution and/or protection of water resources is sought, it is usually made possible by funding that stems from the Clean Water Act.[1] Such is the case with this plan.

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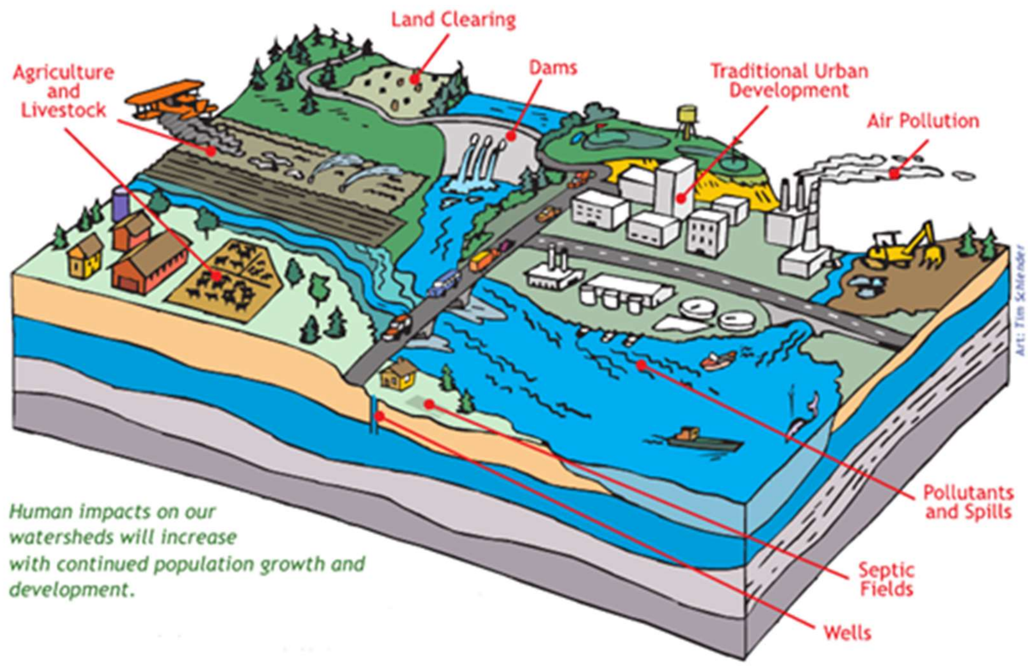
[1] Federal Water Pollution Control Act of 1972 (Public Law 92-500) as amended, also known as the Clean Water Act.

Figure 2. Human impacts on watersheds.



Source: Washington Dept. of Ecology

Supported by a Clean Water Act Section 604(b) planning grant from the Illinois Environmental Protection Agency (EPA), CMAP partnered with Kane County's Division of Environmental and Water Resources and Development and Community Services Department along with the Fox River Ecosystem Partnership and Fox River Study Group to prepare this plan and work with local stakeholders to develop planning, policy, educational, monitoring, and on-the-ground project recommendations that upon implementation will help improve and protect the water quality in Mill Creek, its tributaries, and the numerous wetlands, lakes, and ponds within the watershed as well as the Fox River downstream. This plan follows watershed-based planning guidelines established by the U.S. EPA[2,3] and Illinois EPA,[4] including the "nine minimum elements of a watershed-based plan" (see right column in Figure 3) in order for implementation projects to be eligible for Clean Water Act Section 319(h) grant funding.

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[2] U.S. EPA. Nonpoint Source Program and Grants Guidelines for States and Territories. Issued April 12, 2013. (https://www.epa.gov/sites/production/files/2015-09/documents/319-guidelines-fy14.pdf).

[3] U.S. EPA. 2008. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. (https://www.epa.gov/nps/handbook-developing-watershed-plans-restore-and-protect-our-waters)

[4] CMAP. 2007. Guidance for Developing Watershed Actions Plans in Illinois.

Figure 3. Watershed planning stages and associated "9 minimum elements" for meeting Section 319 grant requirements.

Illinois Model Watershed Planning Stages	Section 319 Components
1. Identify Stakeholders	a. Identification of causes and sources that will need to be controlled to achieve load reductions estimated within the plan
2. Develop Goals and Objectives	
3. Inventory Watershed Resources and Conditions	
4. Assess Waterbody/Watershed Problems	
5. Recommend Management Practices	b. Estimate of the load reductions expected for the management measures described in component
	c. Description of the nonpoint-source management measures that need to be implemented in order to achieve the load reductions estimated in component b; and identification of critical areas
	d. Estimate of the amounts of technical and financial assistance needed; costs; and the sources and authorities (e.g., ordinances) that will be relied upon to implement the plan
6. Develop Action Plan	e. Information and public education component; and early and continued encouragement of public involvement in the design and implementation of the plan
	f. Implementation schedule
7. Monitor Your Success	g. Description of interim, measurable milestones for determining whether NPS measures or other actions are being implemented
	h. Criteria to measure success and reevaluate the plan
	i. Monitoring component to evaluate effectiveness of implementation efforts over time.

Source: Guidance for Developing Watershed Action Plans in Illinois (CMAP 2007)

1.2 The Mill Creek Watershed Setting

The Mill Creek watershed lies within the Lower Fox River Subbasin[5] and is completely bound within Kane County (Figure 3) in northeastern Illinois. Mill Creek—a tributary of the Fox River—originates in a Campton Hills subdivision approximately a half mile west of the Campton Forest Preserve. The creek meanders southeast and junctures at the Fox River in the unincorporated area of Mooseheart. For this plan, the 31 square mile planning area is defined by the watershed boundary delineated by the Illinois State Water Survey (ISWS) for the Fox River Study Group (FRSG) as part of the development of HSPF (Hydrologic Simulation

[5] The Lower Fox Subbasin (HUC 07120004) is a part of the Upper Mississippi region (located within the Upper Illinois subregion). Major streams include the Fox River, Mill Creek, Blackberry Creek, and Big Rock Creek.

Program – Fortran) models for the Fox River Watershed.[6] The boundary closely follows the NRCS's HUC 12 Mill Creek Watershed (071200070105); however, ISWS refined it to account for urban constraints and stormwater systems (Figure 5). ISWS further subdivided the watershed into 10 subwatersheds for modeling purposes. CMAP delineated an 11th subwatershed in order to define the drainage area to Peck Lake, using the Peck Farm Park Extension Masterplan[7] and Kane County's 2-foot contours dataset as guidance (Figure 6, Table 1). Division of the watershed into subwatersheds allows for a more nuanced understanding of local conditions and improves consideration of best management practices in terms of where they will be most helpful.

[6] Singh, Jaswinder et al. "Fox River Watershed investigation: Stratton Dam to the Illinois River, phase II: hydrologic and water quality simulation models, part 1, methodology and procedure for development of HSPF models." *Illinois State Water Survey; Contract Report, 2007-02* (2007), https://www.ideals.illinois.edu/bitstream/handle/2142/94232/ISWSCR2007-02.pdf?sequence=1

[7] https://www.genevaparks.org/wp-content/uploads/2017/02/PFP-Master-Plan.pdf (last accessed June 2018).

Figure 4. Mill Creek watershed planning area within the Lower Fox River Subbasin.

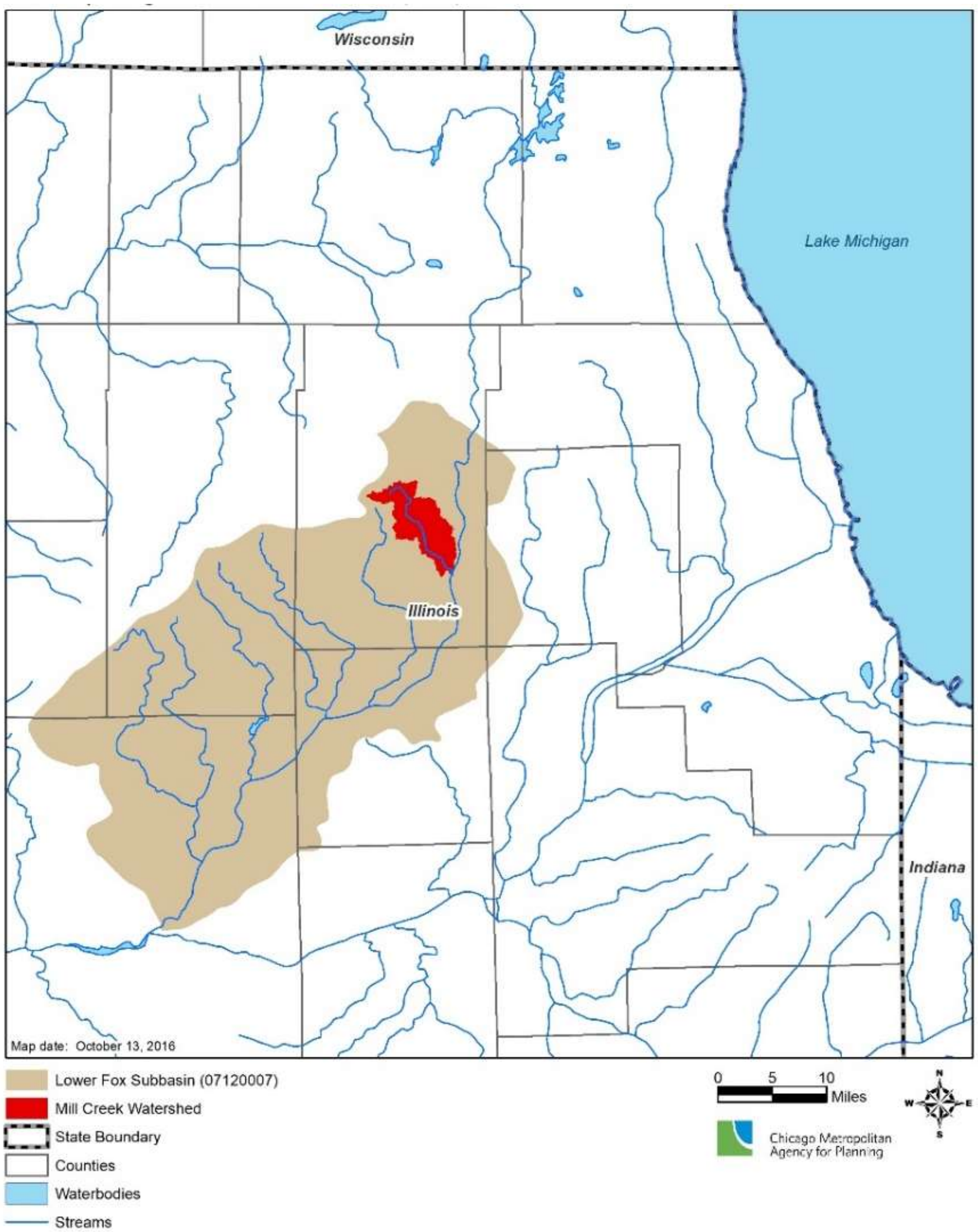


Figure 5. Comparison of the Mill Creek watershed planning area and the HUC 12 watershed boundary.

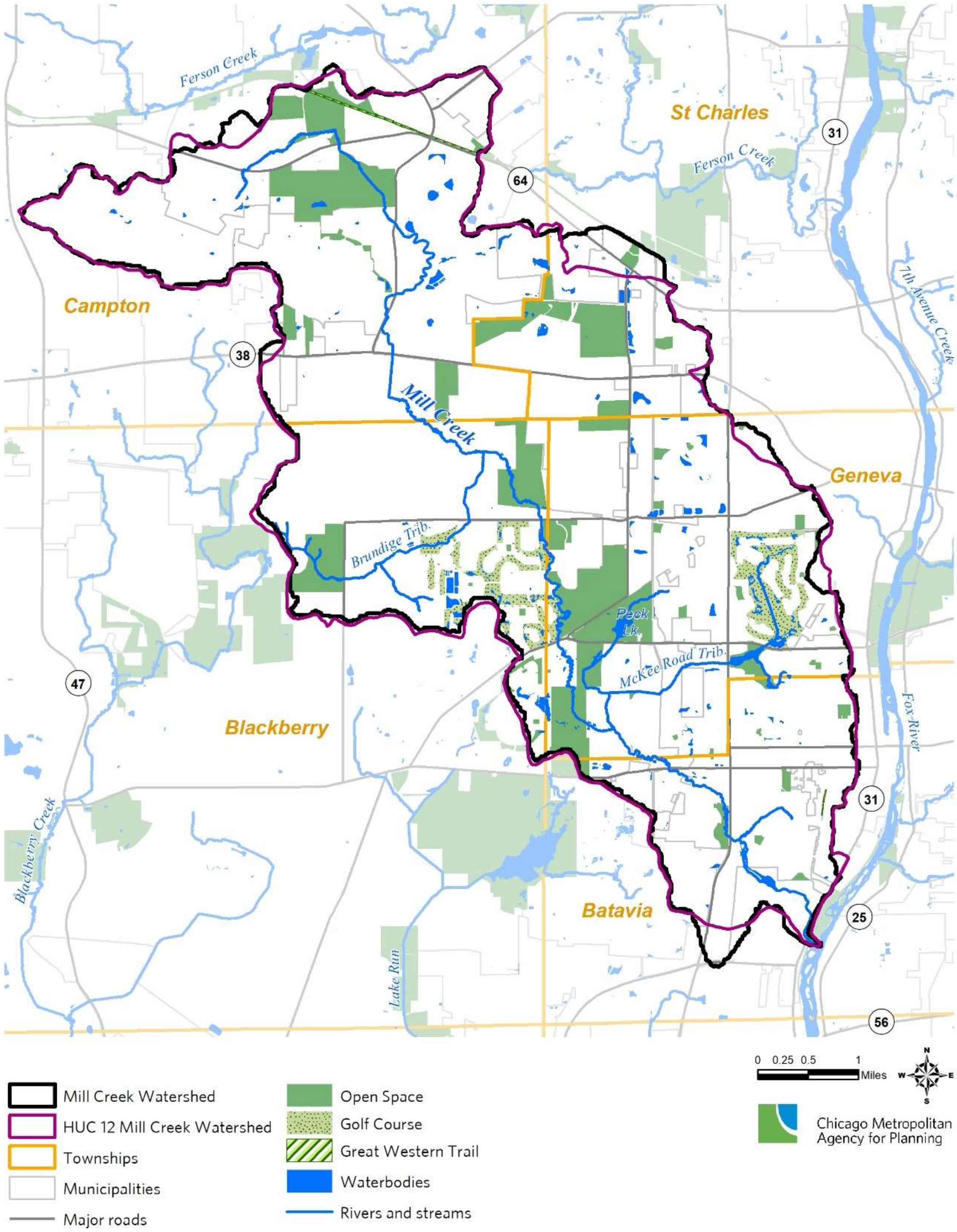


Figure 6. Mill Creek watershed and 11 subwatersheds.

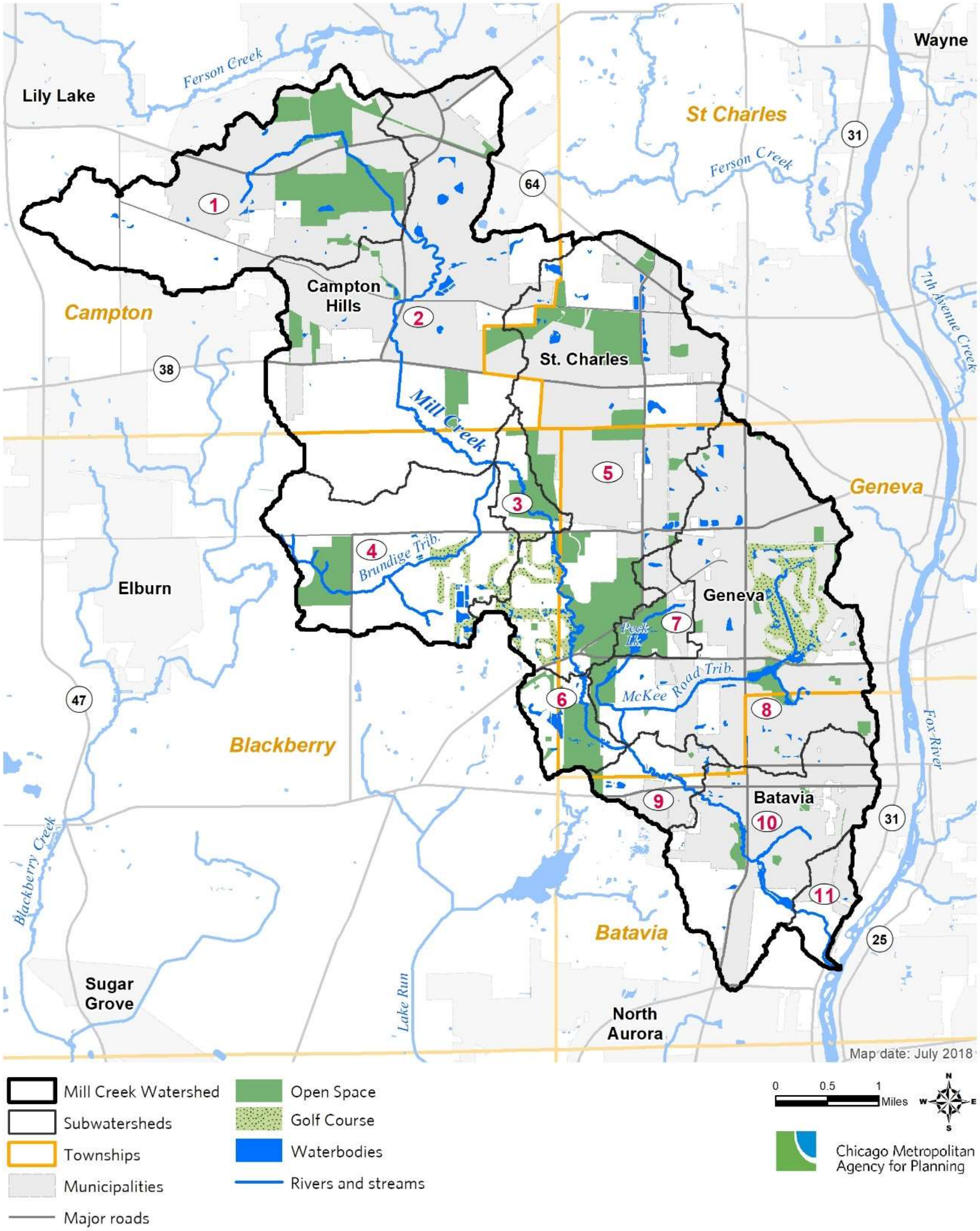


Table 1. Subwatersheds in the Mill Creek watershed.

#	*Subwatershed* *Name*	*Area* *Acres*	*Sq. miles*	*Percent of Planning Area*
1	Upper Campton	2,823.68	4.41	14.1
2	Lower Campton	4,232.93	6.61	21.2
3	Mill Crk Greenway	302.81	0.47	1.5
4	Brundige Tributary	1,961.10	3.06	9.8
5	West St. Charles/Geneva	3,976.02	6.21	19.9
6	Mill Crk Forest Pres	428.20	0.67	2.1
7	Peck Lake	348.49	0.54	1.7
8	McKee Road Tributary	3,422.51	5.35	17.1
9	Tanglewood	451.98	0.71	2.3
10	West Batavia	1,738.92	2.72	8.7
11	Les Arends	304.18	0.48	1.5
Totals		***19,990.8***	***31.2***	***100.0***

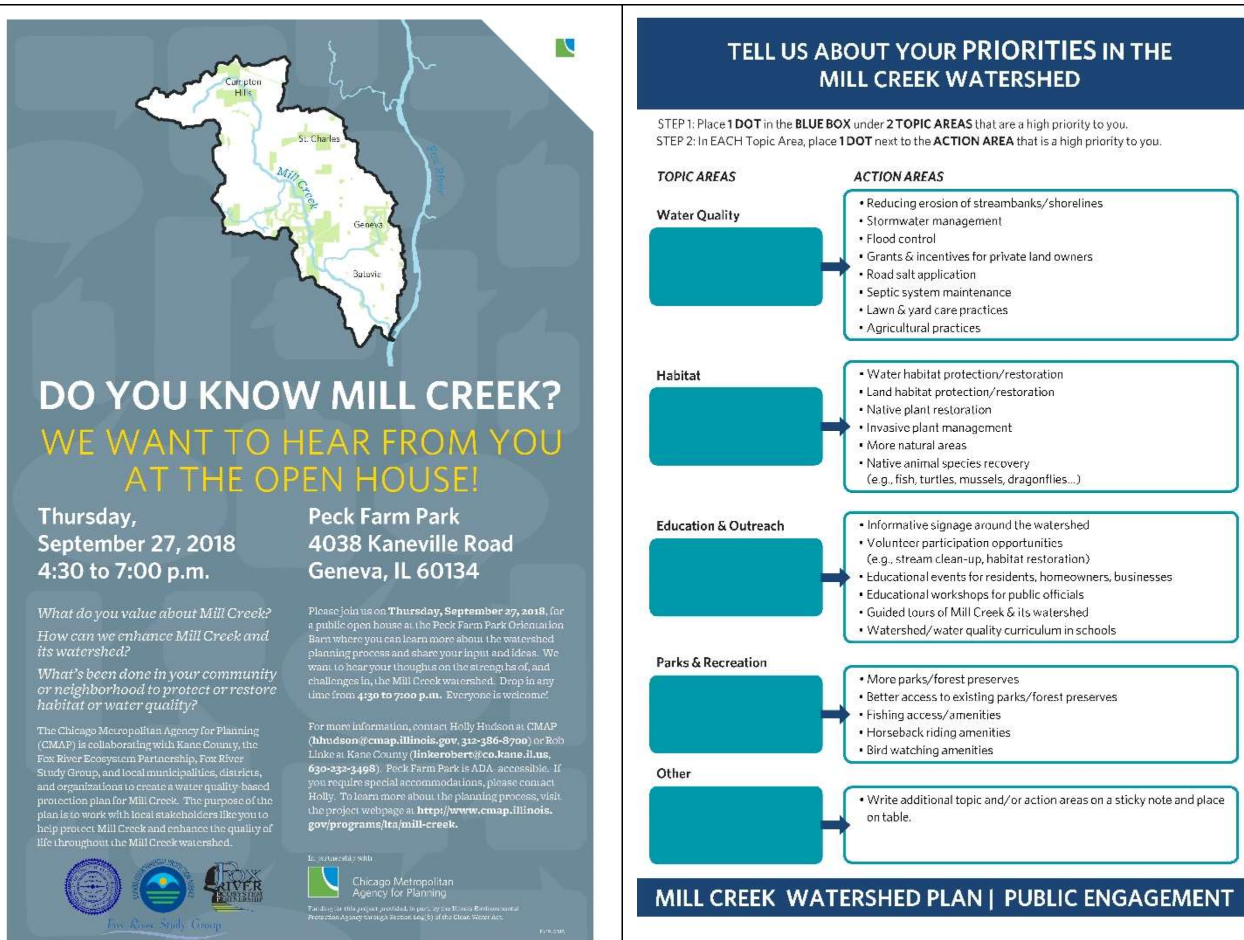
1.3 Mill Creek Watershed Public Engagement

A Mill Creek Watershed Steering Committee (SC) was formed in spring 2018, comprised of representatives invited from county and municipal governments; other organizations with significant land management, planning/policy, and/or education/outreach responsibilities; environmental groups; and others with a stake in the Mill Creek watershed. The SC played an important role in providing input on a watershed vision and goals, recommending outreach pathways to engage watershed residents and advertising public open houses, providing best management practice (BMP) opportunities, and contributing to overall plan development.

A kickoff meeting with the SC was held in July 2018. Kane County and CMAP staff presented background information regarding County planning initiatives and watershed-based planning requirements, and CMAP staff overviewed the watershed resource inventory. SC members participated in a visioning exercise and discussion of key issues and opportunities, and provided input regarding public outreach avenues and strategies.

A public open house was held in September 2018 at the Geneva Park District's Peck Farm Park. SC members helped with distribution of post cards and posters (Figure 7) throughout the watershed inviting the public to the event. At the open house, informational posters and several stations were set up whereby attendees could provide their comments regarding assets, challenges, current projects and activities, and opportunities in the watershed, as well as vote on topic areas (water quality, habitat, education and outreach, parks and recreation) and associated actions that were a priority to them (Figure 7).

Figure 7. Open house announcement poster (left) and priorities voting poster (right).



During spring and summer 2019, CMAP staff met with each SC member and their associated staff and representatives to document past and ongoing water-quality-related BMPs in the watershed; as well as identify new opportunities for planning, policy, public education, monitoring, and on-the-ground BMPs to help project and improve water and habitat quality.

The SC met again in August 2019 to review the list and mapped locations of everyone's on-the-ground/site-specific BMP submittals and learn about the assumptions made by CMAP and Kane County staff in developing watershed-wide BMP scenarios. The SC provided input on interim milestones for documenting progress as well as pollutant load reduction targets toward meeting plan goals of protecting and improving water quality in the Mill Creek watershed and downstream Fox River.

Throughout the plan development period, the Fox River Ecosystem Partnership (FREP) provided information and outreach services though their website and monthly Downstream e-newsletter. A webpage dedicated to the Mill Creek watershed plan (http://foxriverecosystem.org/MillCreek.htm) provided watershed planning news and updates, project documents, and contact information.

CMAP also hosted a Mill Creek watershed-based plan project webpage within the Local Technical Assistance program section of their website (https://www.cmap.illinois.gov/programs/lta/mill-creek). The page provides background and public engagement information, project documents, and contact information.

2.0 Problem Statement, Vision, and Goals

During the planning process, the Mill Creek Watershed Steering Committee developed a problem statement, vision statement, and several goals for the watershed.

Problem Statement: Surface waterbodies are impacted by a variety of nonpoint sources of pollution. Within the Mill Creek watershed, data indicates that Mill Creek fails to meet the primary contact water quality standard and thus does not attain all its designated uses due to both known and unknown causes of pollution which are often related to land use. Additionally, indices of fish community health indicate declining biotic integrity. Best management practices, programs, and policies must be identified and implemented by landowners and managers as resources allow to improve and protect water and habitat quality and to restore designated use attainment. A plan will be completed that outlines protective actions to address nonpoint source pollution and guide remedial activities during the following ten years.

Vision: The Mill Creek watershed will be a watershed in which private property owners and public agencies work cooperatively to maintain a functional and healthy system benefiting water quality, biodiversity, and humans.

Goal: Improve and protect the ecological integrity of surface water resources to attain or maintain designated uses of aquatic life support, fish consumption, primary contact, and aesthetic quality.

Goal: Protect, restore, expand, and maintain natural areas and open space and increase native aquatic and terrestrial plant and animal species diversity.

Goal: Raise public awareness and increase understanding of the impacts of land use and land/water management decisions on water and habitat quality, and further encourage implementation of watershed protection practices.

Goal: Build, strengthen, and support local partnerships and expertise to protect our streams, lakes, and wetlands via plan implementation.

Goal: Protect the quality and quantity of groundwater.

Goal: Reduce flooding and attendant streambank and shoreline erosion and infrastructure risk through initiatives to improve and protect water quality.

3. Watershed Resource Inventory

3.1 Local Governments and Districts

In northeastern Illinois, over 1,200 units of government collect revenues and provide services to the seven-county region's residents, businesses, and visitors. Portions of five municipalities and five townships are included in the Mill Creek planning area (Figure 8, Table 2). Municipal jurisdictions cover approximately 56 percent (17.5 square miles) of the planning area. Campton Hills encompasses the most land area at 6.0 square miles (19.2 percent) followed by Geneva, Batavia, and St. Charles at 5.1, 4.2, and 2.3 square miles, respectively. Just 3.4 acres of North Aurora falls within the watershed boundary. Among the five townships intersecting the planning area, Campton and Geneva Townships cover the most land area at 10.2 and 8.3 square miles, or 32.6 and 26.5 percent, respectively.

In addition to municipalities and townships, there are five library districts (Figure 9) that can play an important role in the education component of the plan. There are also five school districts, two community college districts, and 13 public or private elementary/secondary/ community college schools located within or intersecting the Mill Creek watershed (Figure 10). From a water quality perspective, there are four sanitary districts (covering municipal and unincorporated areas), two wastewater treatment facilities, one mosquito abatement district, and a county-wide soil and water conservation district (Kane-DuPage SWCD).[8] Additionally, there are primarily three park districts (Batavia, Geneva, and St. Charles), the Forest Preserve District of Kane County, and the Campton Township Open Space District which also have land management jurisdiction and offer public education and engagement opportunities within the watershed (Figure 11).

Table 2. Municipalities and townships within the Mill Creek watershed.

Jurisdiction	*Area (sq. miles)*	*Area (acres)*	*% of Planning Area*
Municipality			
Batavia	4.2	2,665.98	13.3
Campton Hills	6.0	3,832.77	19.2
Geneva	5.1	3,253.29	16.3
North Aurora	0.0	3.37	0.0
St. Charles	2.3	1,499.15	7.5
Totals	***17.6***	***11,254.6***	***56.3***

Jurisdiction	*Area (sq. miles)*	*Area (acres)*	*% of Planning Area*
Township			
Batavia	4.2	2,707.68	13.5
Blackberry	5.5	3,516.12	17.6
Campton	10.2	6,536.25	32.7
Geneva	8.3	5,297.71	26.5
St. Charles	3.0	1,933.05	9.7
Totals	***31.2***	***19,990.8***	***100.0***

[8] The Kane-DuPage SWCD provides technical information to individuals and groups on methods of soil and water conservation. The also provide natural resource inventory information on properties slated for zoning changes. For more information, see http://www.kanedupageswcd.org/about.htm

Figure 8. Municipalities and townships within the Mill Creek watershed.

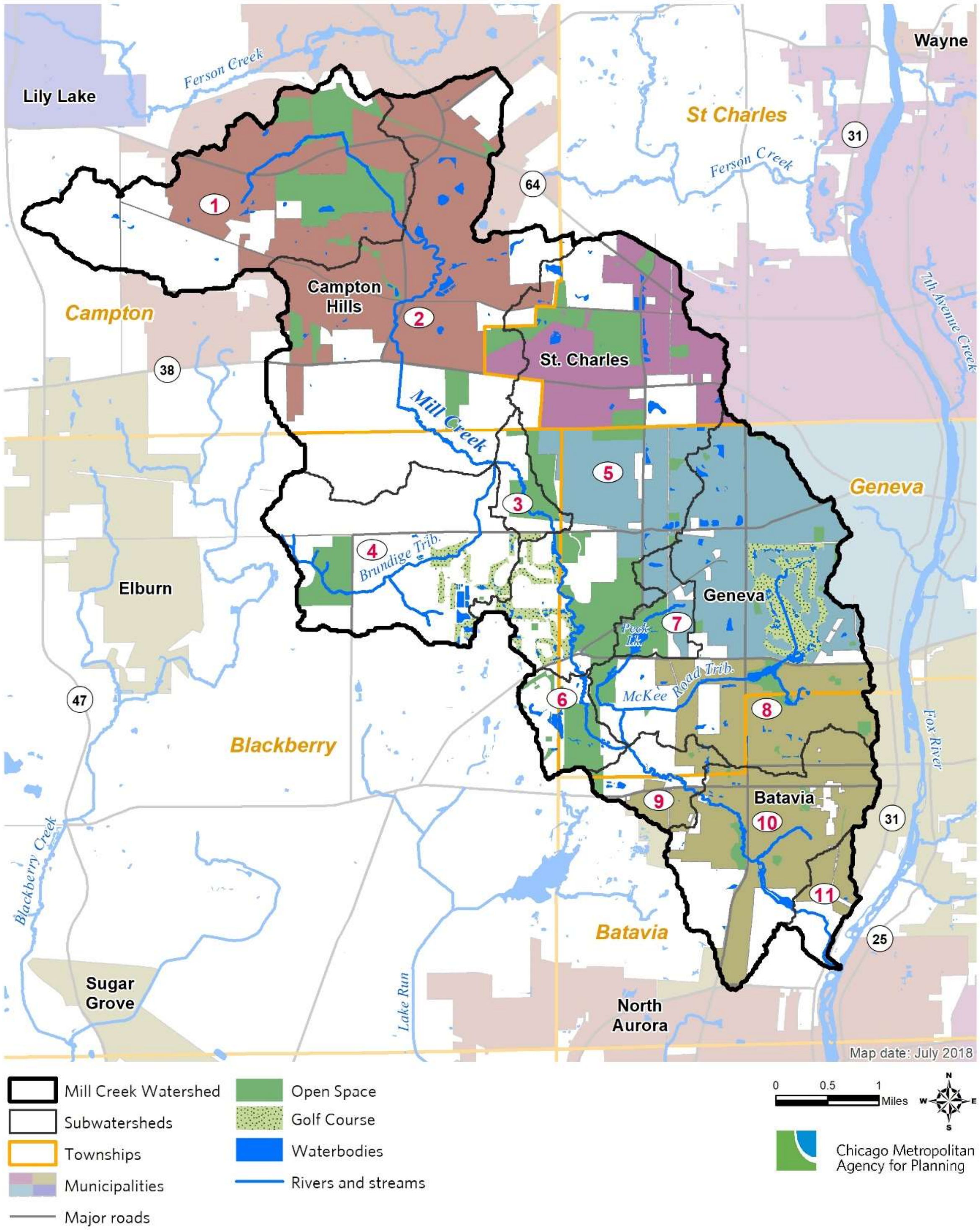


Figure 9. Library districts within the Mill Creek watershed.

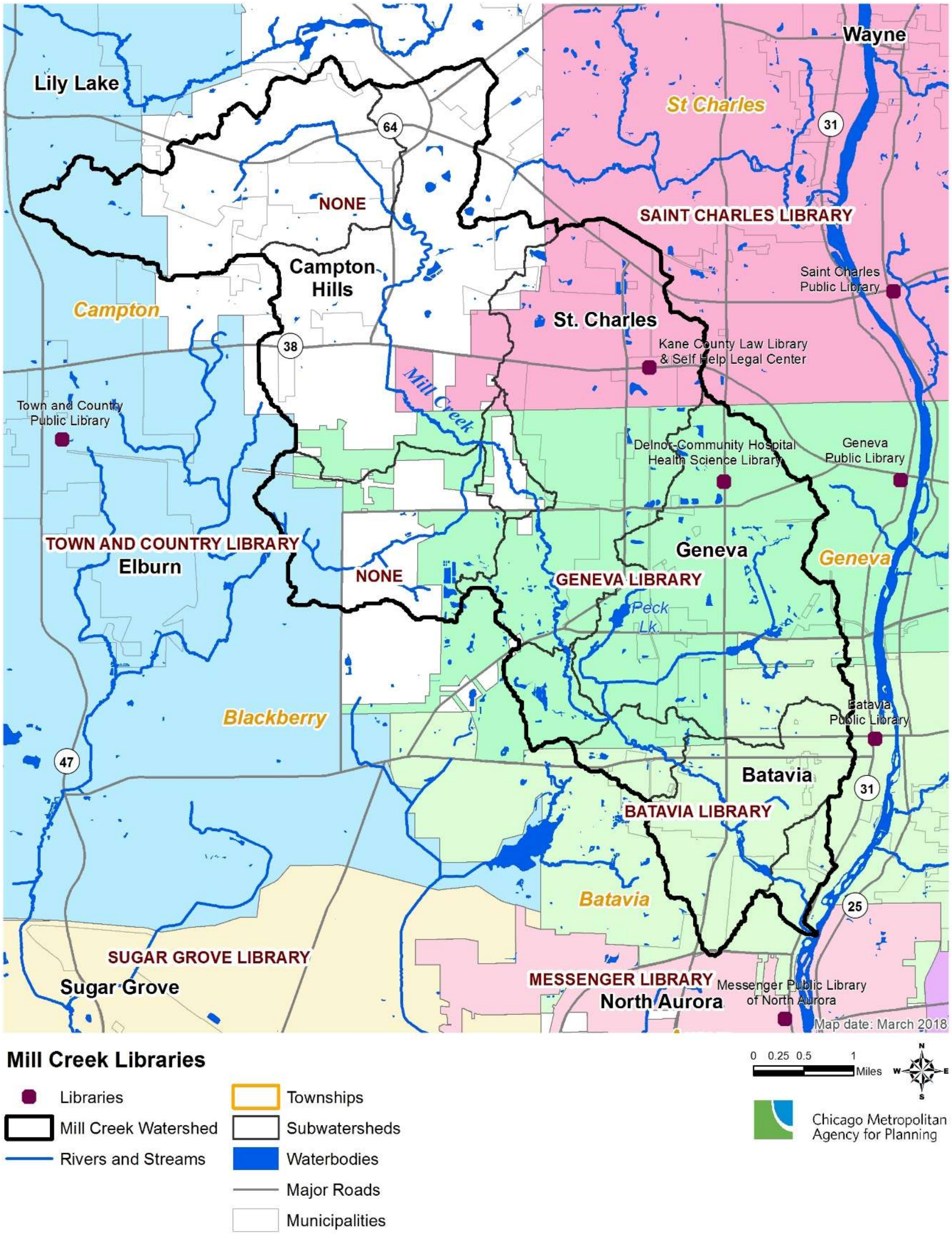


Figure 10. School districts within the Mill Creek watershed.

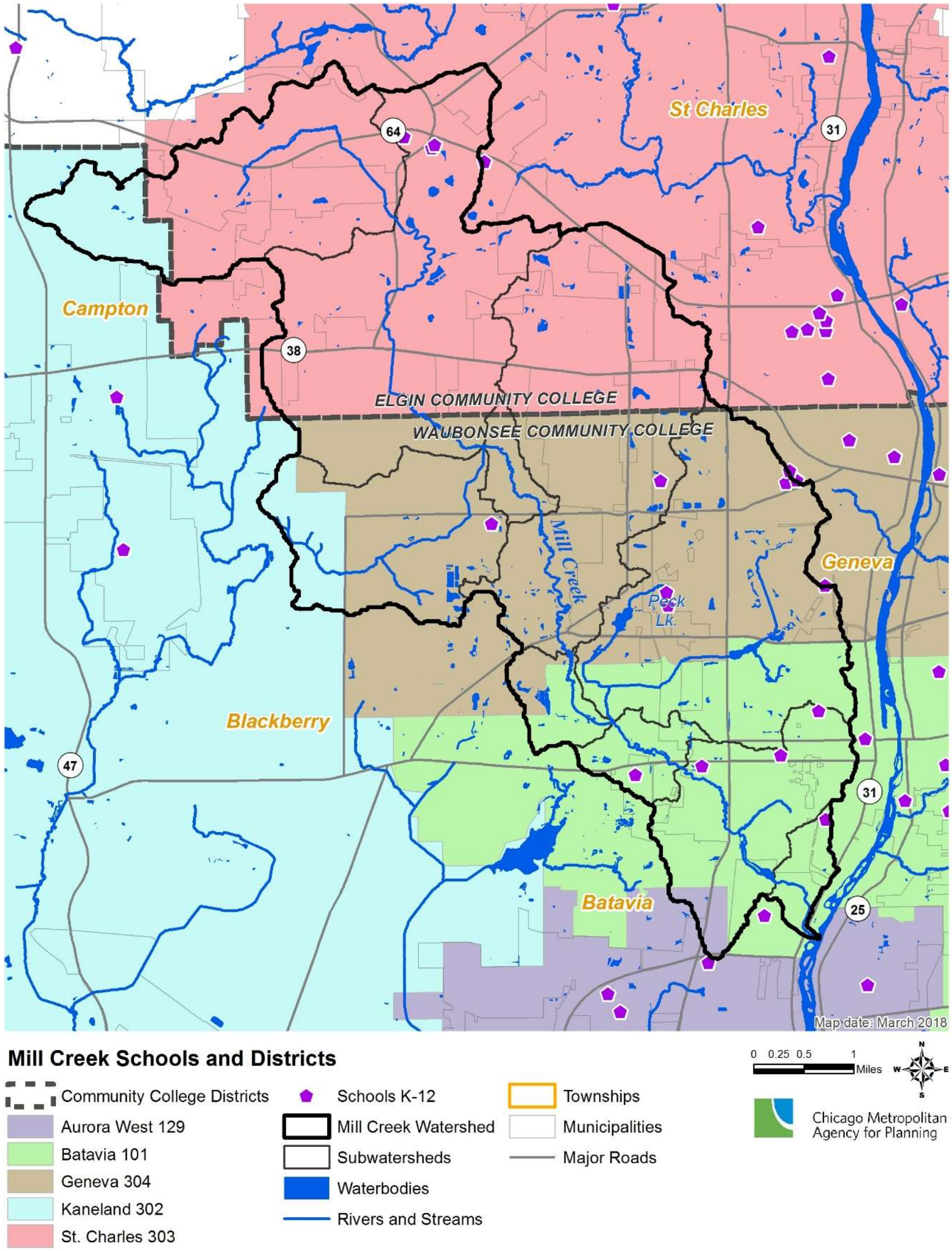
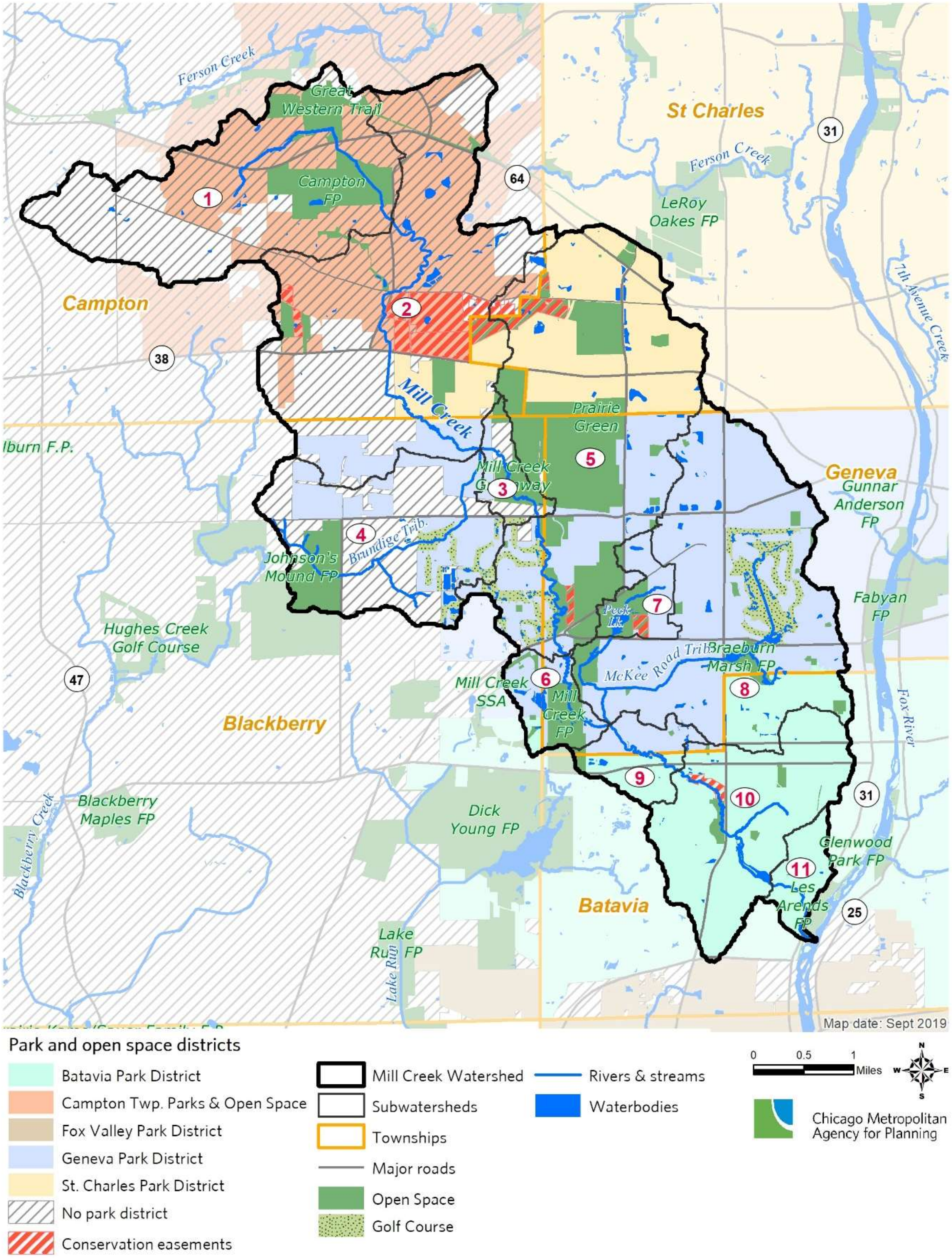


Figure 11. Park, forest preserve, and open space districts in the Mill Creek watershed.



3.2 Population and Demographics

Population (2010) in the Mill Creek watershed is estimated to be 47,383 which is a 48.4 percent increase from the 2000 population of 31,931.[9] The change in population was significantly greater than the 3.31 percent increase for the state of Illinois during the same interval. CMAP's GO TO 2040 comprehensive regional plan (updated version, October 2014) forecasts a population (in households) of 61,209 which is a 29.2 percent increase in growth. The difference in population over the intervening 30 years translates into a (linear) growth rate of approximately 4.8 percent per decade.[10] This is a substantial increase in estimated population growth in comparison to the region's growth rate of 0.95 percent over the last decade. The increase in growth also exceeds the 28.6 percent growth forecast (population in households in 2040) for the entire seven county region.[11]

Employment forecasts are similarly relevant in that growth will impact land use change, water use, water quality, and other factors. The revised GO TO 2040 forecast totals for the region estimate employment within the Mill Creek watershed to increase by 52.3 percent, whereas the region is expected to see a 28.6 percent increase by 2040.[12] Table 3 and Figures 10-13 present 2010 demographic data that characterize the Mill Creek watershed and surrounding region.

Table 3. Select demographic data for the Mill Creek watershed, Kane County, and CMAP region.

Characteristic	*Mill Creek Watershed*	*Kane Co.*	*CMAP Region*
Median age	43	36	37
< 19 years of age	29.0%	30.2%	26.7%
Age 35-49	22.3%	21.4%	20.7%
Age 65 & over	12.4%	11.2%	12.3%
Race/One Race/White	87.8%	58.2%	52.2%
Housing Tenure – Owner Occupied	28.4%	24.2%	23.1%

[9] U.S. Census Bureau census block data for 2000 and 2010. Estimates are based on all census blocks that intersect the planning area, and therefore, produces an overestimation of population.

[10] CMAP population and employment forecasts are based on subzone geography or a unit of geography that is different from census blocks or tracts. A subzone is equivalent to a quarter section. All the people in a subzone will be included in the forecast for the planning area despite "clipping" subzones that are intersected by the outer planning area boundary. Thus, a limited yet unknown number of people are included in the planning area forecast that technically will reside just outside of the planning area.

[11] Chicago Metropolitan Agency for Planning, *GO TO 2040 Update Appendix: Socioeconomic Forecast Update Overview*, 2014, http://www.cmap.illinois.gov/documents/10180/332742/Update+Socioeconomic+Forecast+FINAL.pdf/41d87400-d211-4763-b941-b487022d8032

[12] Ibid.

Figure 12. Population density in the Mill Creek watershed.

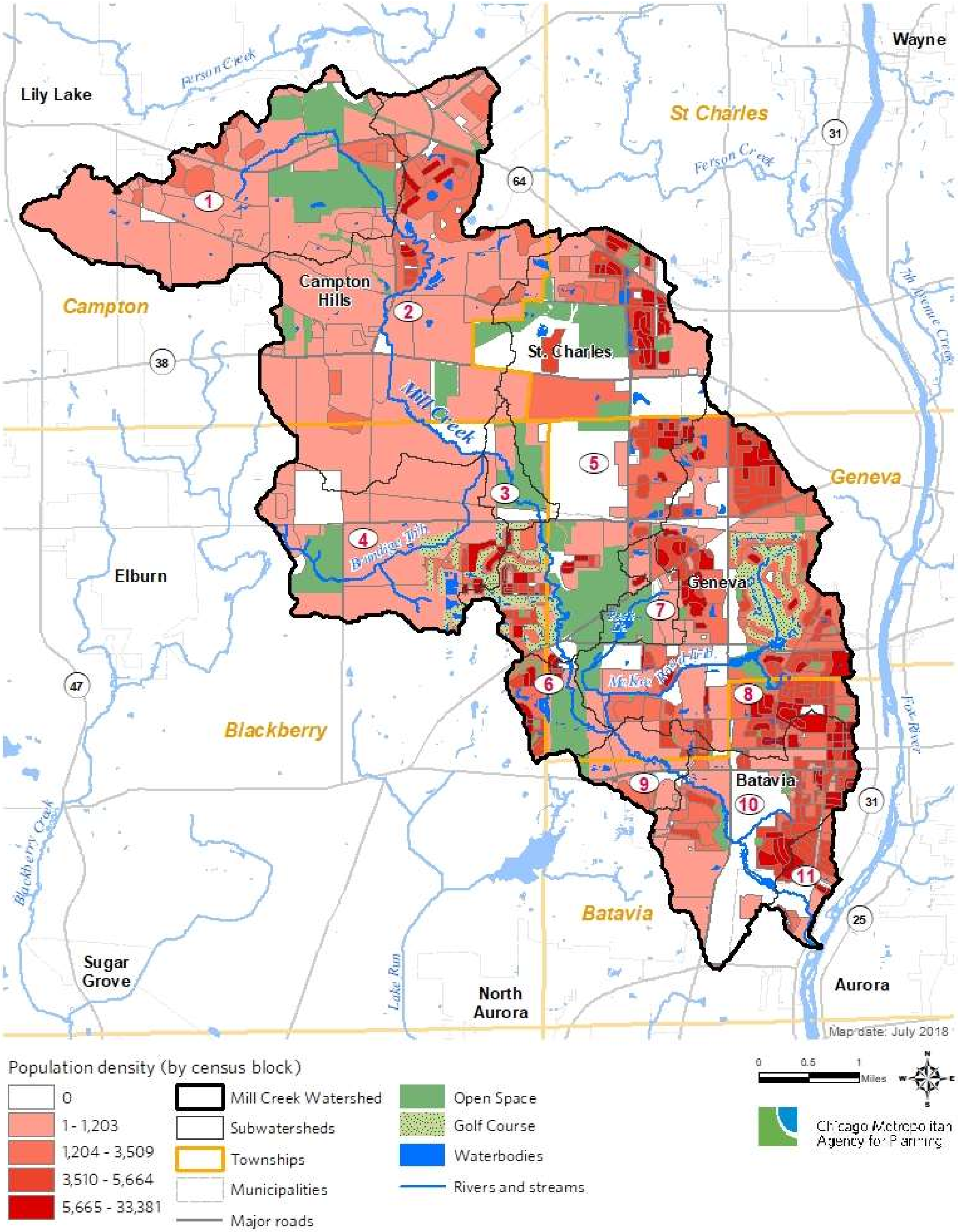


Figure 13. Median age in the Mill Creek watershed.

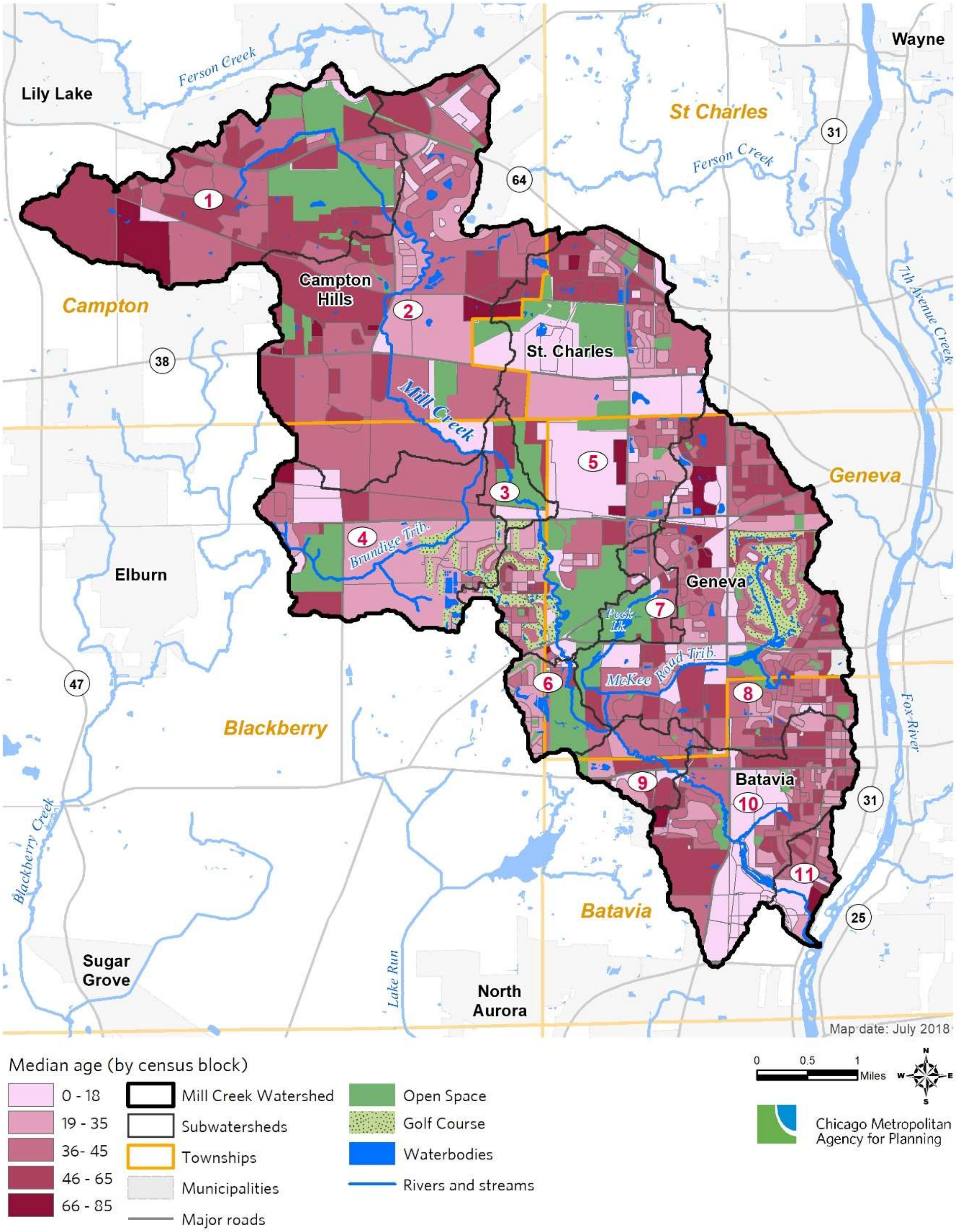


Figure 14. Median income in the Mill Creek watershed.

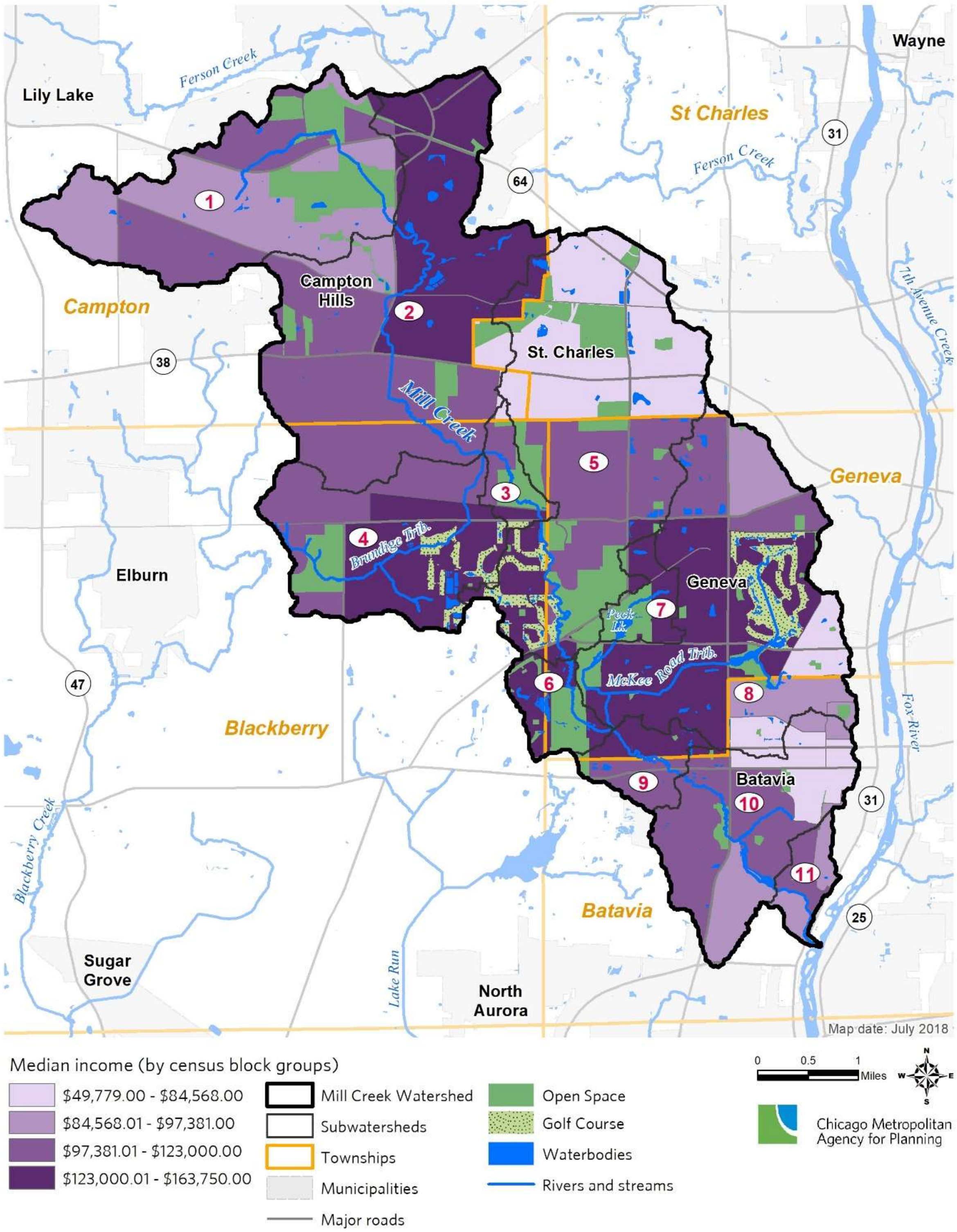
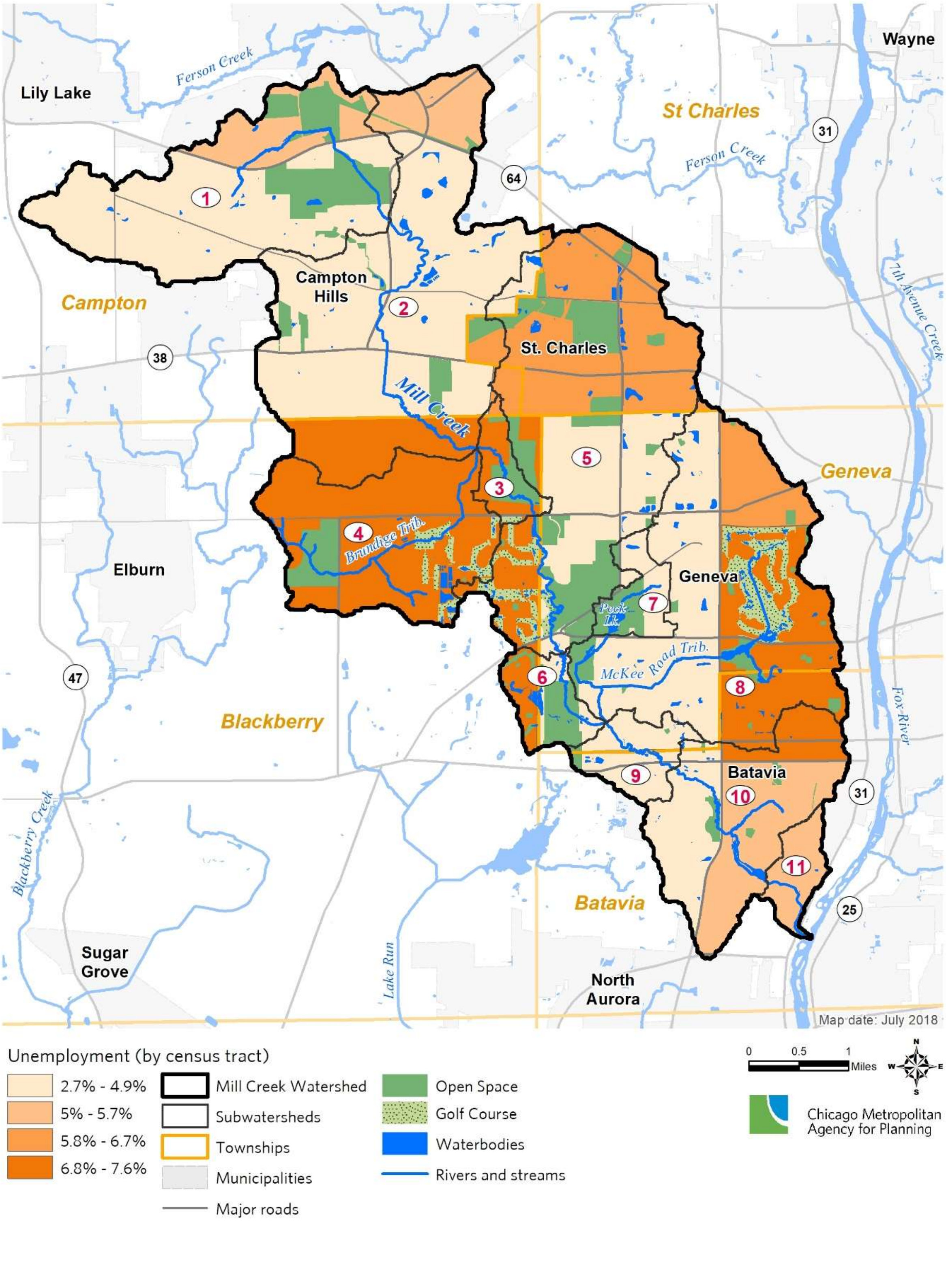


Figure 15. Unemployment in the Mill Creek watershed.



3.3 Physical and Natural Features

3.3.1 Climate

The Mill Creek area has a continental climate characterized by warm summers and cold winters. The average annual temperature is 48.7 degrees Fahrenheit, though seasonal temperatures vary considerably. January is the coldest month, with an average temperature of 21.6 degrees Fahrenheit (29.8˚F average high/13.4˚F average low). July is the warmest month, with an average temperature of 73.3 degrees Fahrenheit (83.7˚F average high/62.9˚F average low).[13]

Precipitation in the Mill Creek area is greatest during the summer and spring, though large storms occur year round. Winter precipitation averages 5.59 inches, while summer precipitation averages 12.58 inches. Average spring and fall precipitation levels are 10.18 and 9.41 inches, respectively. February is the region's driest month (1.55 inches) and August is the wettest month (4.8 inches).[14]

During the last 100 years, the region's climate has become warmer, wetter, and more variable. Across the Midwest, average temperatures have increased by one degree Fahrenheit since 1900,[15] and in northeastern Illinois, extreme precipitation events increased 30 percent from 1979 to 2009, compared to the previous 30-year period.[16] During the coming years, these trends are expected to continue and intensify. By 2100, the Chicago metropolitan area could see temperature increase of between two to seven degrees Fahrenheit, and precipitation increases of between two to four inches (mean result of 32 models).[17]

The region's climate affects water quality in several ways. The lengthy winter season, combined with the planning area's extensive road network, results in the widespread use of road salts,

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13 U.S. Department of Commerce, National Oceanic & Atmospheric Administration, *1981-2010 Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days*, *Station: Elgin, IL, US*, by National Climatic Data Center, Asheville, North Carolina, 2013. Requested and received on 02/09/2017.

14 Ibid.

15 "State Climate Summaries: Illinois," National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information, https://statesummaries.ncics.org/il.

16 P.Y. Groisman, R.W. Knight, & T.R. Karl, "Changes in intense precipitation over the central United States," 2012, Journal of Hydrometeorology, 13:47-66.

17 D.W. Pierce, D. R. Cayan, and B. L. Thrasher, 2014: Statistical downscaling using Localized Constructed Analogs (LOCA). Journal of Hydrometeorology, 15, 2558-85.

which negatively affect surface waters[18] and shallow groundwater aquifers.[19] Projected changes in the frequency and intensity of large storm events during the coming years will likely increase the amount of stormwater runoff entering local waterways. Stormwater runoff will also be warmer than in the past, which can degrade water quality and healthy habitats. Fens are particularly sensitive—an influx of warmer surface waters or fluctuations in the nearby water tables driven by an increase in temperature, precipitation, or drought can drastically alter a fen's ecosystem functions. Additionally, warmer, drier summers may result in more favorable conditions for damaging algae blooms in surface waters.

3.3.2 Topography

Elevation within the Mill Creek watershed ranges from a high of 1,019 feet above mean sea level (MSL) to a low of 640 feet MSL, for total relief of 372 feet. The highest elevations are generally in the northwest at the top of the watershed with the lowest elevations in the southeast along the McKee Road Tributary and the confluence of Mill Creek and the Fox River (Figure 16).

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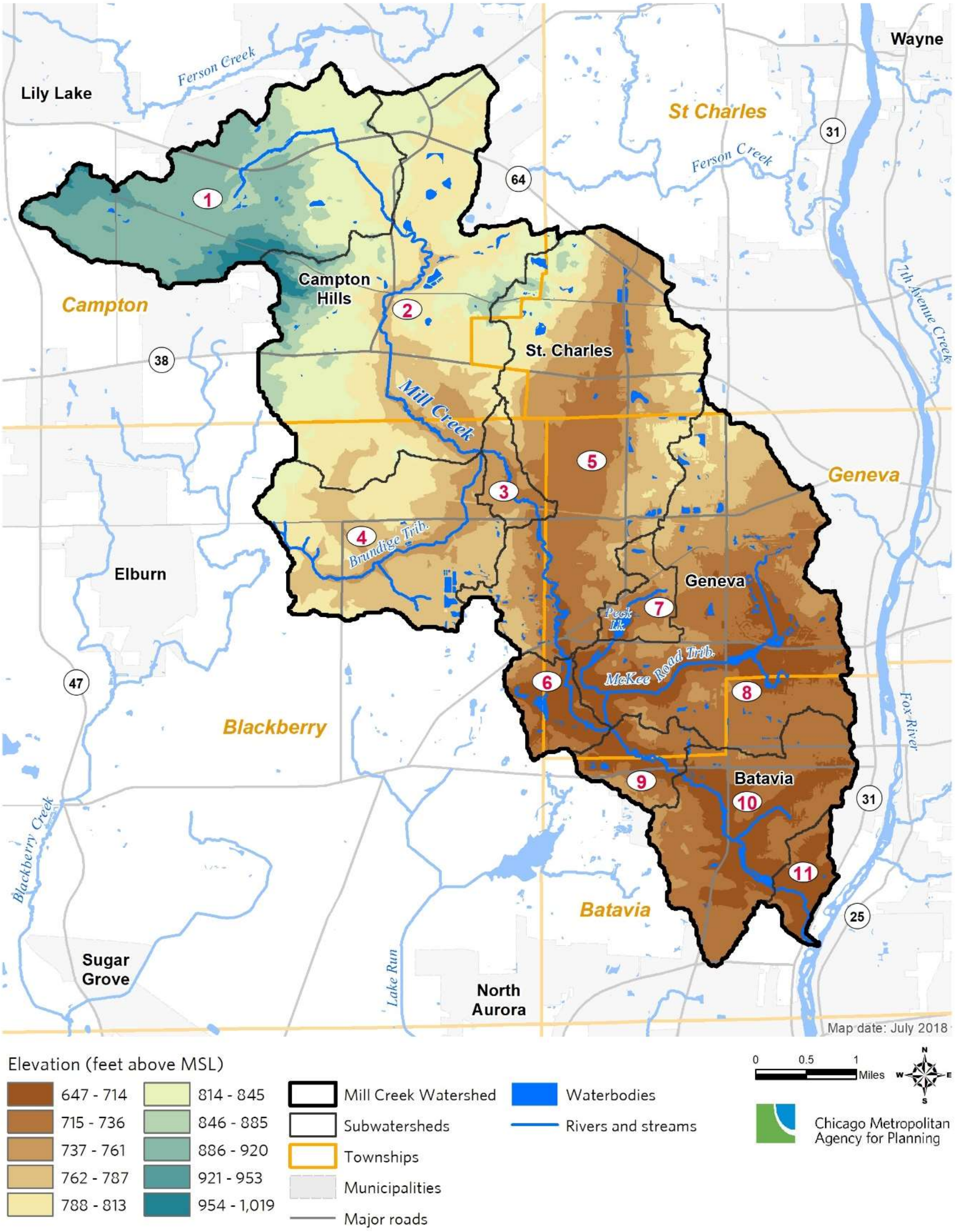
[18] Illinois Environmental Protection Agency, Bureau of Water, *Illinois Integrated Water Quality Report and Section 303(d) List, 2012*. Illinois: IEPA, 2012, http://www.epa.state.il.us/water/tmdl/303-appendix/2012/iwq-report-surface-water.pdf (accessed February 2, 2015)

[19] Walton R. Kelly and Steven D. Wilson, 2008. "An Evaluation of Temporal Changes in Shallow Groundwater Quality in Northeastern Illinois Using Historical Data," *Illinois State Water Survey, Center for Groundwater Science. Scientific Report 2008-01,* 2008.

Figure 16. Elevation in the Mill Creek watershed.



3.3.3 Local Hydrology

Water in the Mill Creek watershed generally flows from north-northwest to south-southeast. Mill Creek is a naturally meandering creek originating in a Campton Hills subdivision approximately one half mile west of the Campton Forest Preserve. Tributaries of Mill Creek include the Brundige Tributary and McKee Road Tributary. The Brundige Tributary initially flows southeast and curves northwest to meet with Mill Creek above (north of) the Mill Creek golf course. The McKee Road Tributary flows generally south and west through Geneva and meets with Mill Creek east of the Mill Creek Forest Preserve. Numerous ponds, wetlands, and stormwater detention basins also serve as storage features and conduits for watershed drainage. There is a USGS stream gauge on Mill Creek near Batavia (USGS 05551330) that has been in place since 1998,[20] providing precipitation, discharge, and gage height data.

3.3.4 Floodplains

A floodplain is defined as "any land area susceptible to being inundated by floodwaters from any source."[21] The 100-year floodplain or "base flood" encompasses an area of land that has a 1-in-100 chance of being flooded or exceeded within any given year; the 500-year floodplain has a 1-in-500 chance of being flooded or exceeded within any given year. Floodways are defined by the National Flood Insurance Program as "the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height."[22] Floodways are a subset of the 100-year floodplain (from a regulatory perspective), and carry the deeper, faster moving water during a flood event.

Prior to modern day floodplain and stormwater management regulations, development in the Mill Creek watershed and throughout the greater Chicago region has occurred in flood prone areas, such as floodplains, wetlands, and other low-lying areas. Before these flood prone areas were developed, they provided natural flood control in the watershed. While flooding is a natural process, the development of these lands places homes, businesses, and people in harm's way, and reduces the land's natural flood control capacity, thus pushing the water to areas that may not have flooded previously. In effect, flooding can result in property damage, streambank erosion, and degraded water quality. Thus, it is important that floodplains and their relationship to land use be considered in local plans and development codes.

Within the Mill Creek watershed, approximately 3.27 percent (653.59 acres or 1.02 square miles) and 6.38 percent (1,275.74 acres or 1.99 square miles) of the planning area falls within the floodway and 100-year floodplain, respectively (Table 4, Figure 17). An additional 0.31 percent

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[20] Data from the USGS stream gauge on Mill Creek near Batavia can be found at https://waterdata.usgs.gov/il/nwis/uv/?site_no=05551330&PARAmeter_cd=00065,00060.

[21] Federal Emergency Management Agency (FEMA), Floodplain Management Requirements, Appendix D: Glossary, FEMA, 2010, http://www.fema.gov/pdf/floodplain/nfip_sg_appendix_d.pdf

[22] Ibid.

(61.75 acres or 0.10 square miles) falls within the 500-year floodplain. A breakdown of floodplains by subwatershed will be determined once the boundaries are defined (Table 5). These calculations are based on a compilation of floodplain data CMAP received from the Federal Emergency Management Authority (FEMA) in 2015. Subwatershed #5 contains the most floodplains with 343.18 acres followed by subwatersheds #8 and #2 which contain 323.12 acres and 288.91 acres of floodplains, respectively.

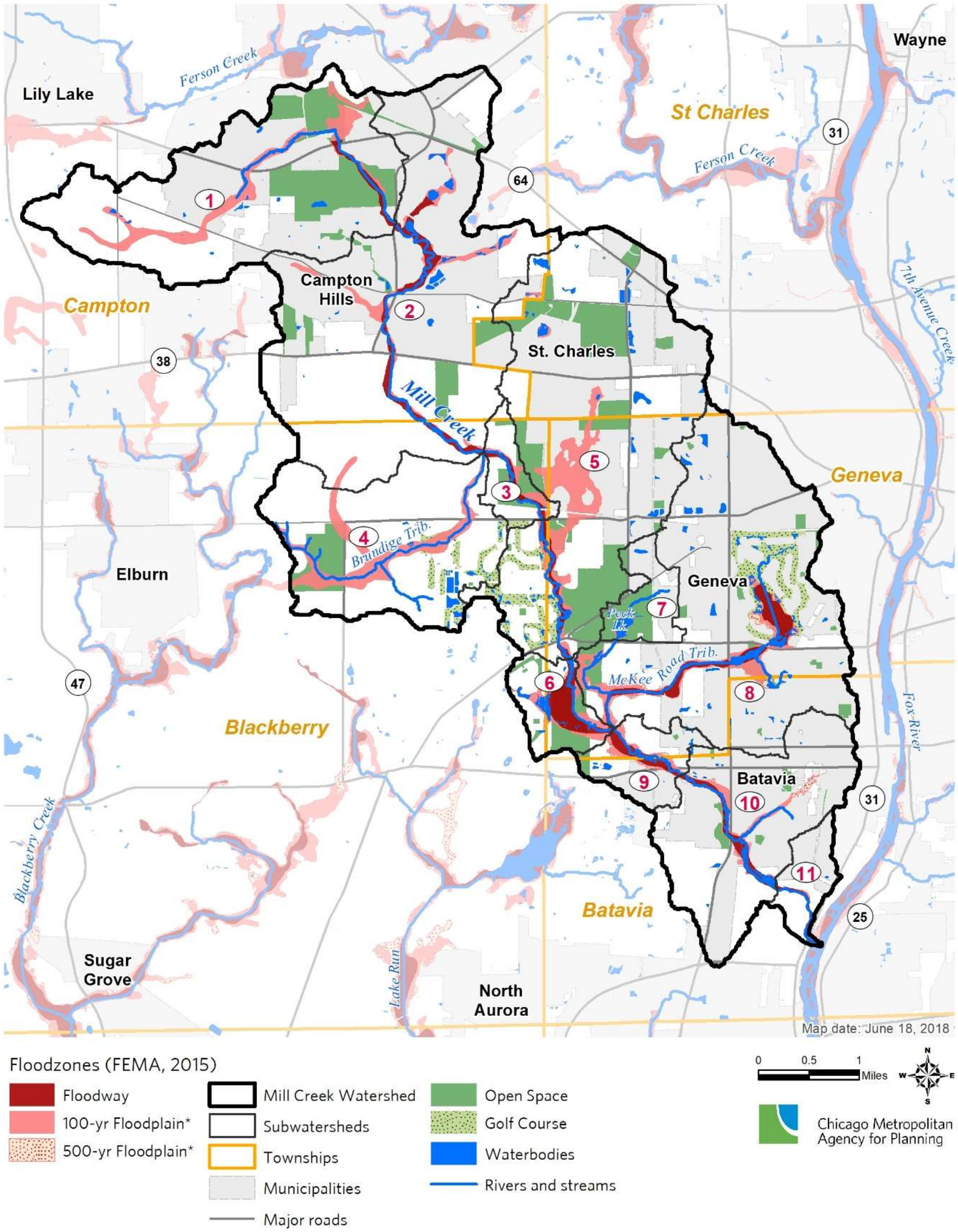
Table 4. Floodplains in the Mill Creek watershed.

Floodplain	*Area (acres)*	*Percent of Planning Area*
Floodway	653.59	*3.27*
100-year	1,275.74	6.38
500-year	61.75	0.31
Totals	***1,991.09***	***9.96***

Table 5. Floodplain acreage in Mill Creek subwatersheds.

Subwatershed #	*Floodway Area (acres)*	*Floodplain Area (acres)*		*Totals*
		100-yr Floodplain	***500-yr Floodplain***	
1	37.45	243.01	--	280.46
2	147.15	141.76	--	288.91
3	33.47	27.82	--	61.29
4	0.93	281.03	--	281.96
5	56.30	286.87	--	343.18
6	97.30	63.09	4.23	164.62
7	--	21.45	--	21.45
8	147.05	140.85	35.21	323.12
9	47.18	25.34	10.54	83.07
10	69.02	39.78	11.49	120.28
11	17.74	4.74	0.28	22.76
Totals	***653.59***	***1,275.74***	***61.75***	***1,991.09***

Figure 17. Floodplains in the Mill Creek watershed.



3.3.5 Ecoregion Geography

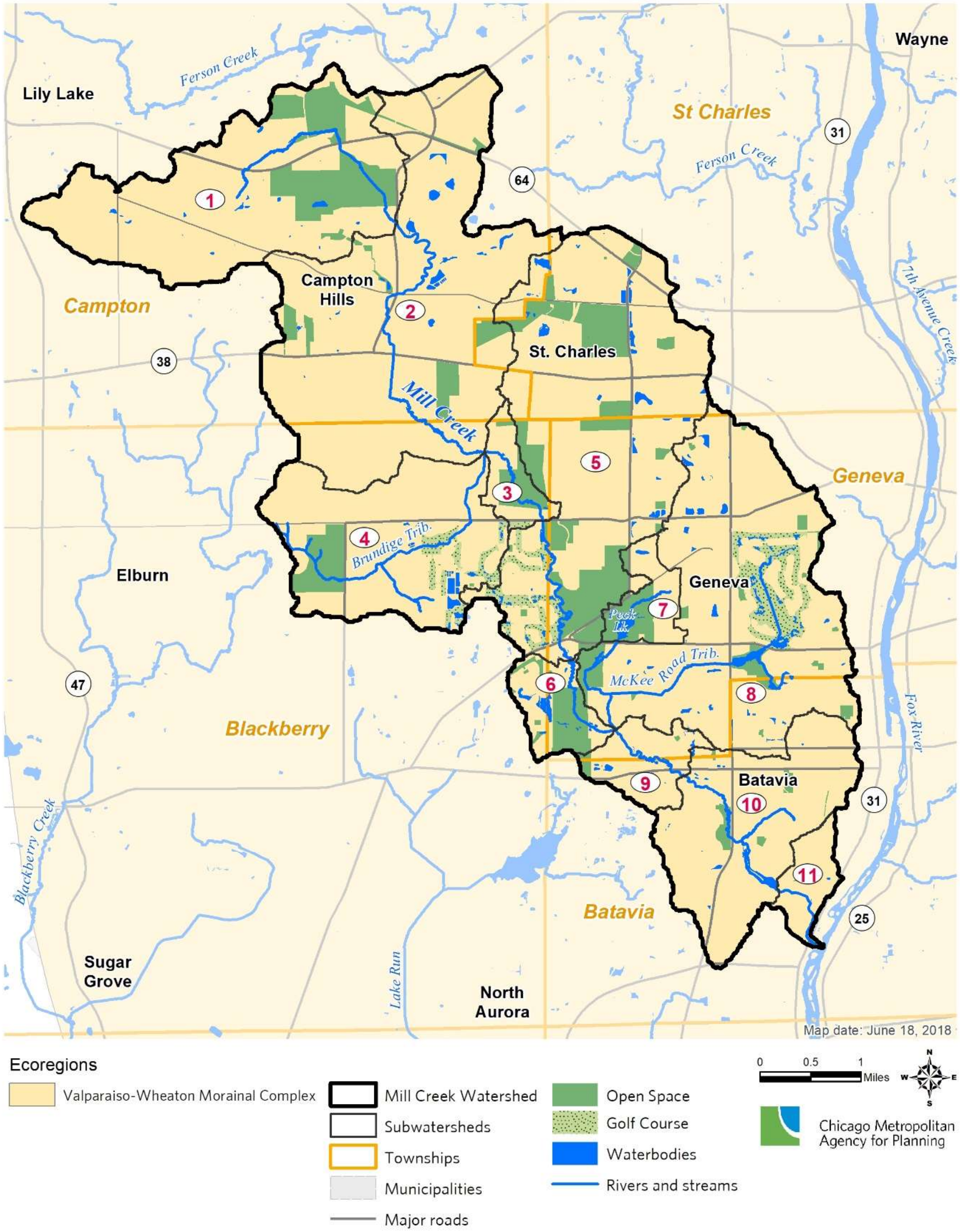
Ecoregions are large land areas where ecosystems are of a similar type, quality, and quantity. Generally, ecoregions are described at four levels, beginning with Level 1 (broadest), and ended with level IV (most specific). These groupings are organized according to a range of biotic and abiotic factors, including geology, physiography, climate, soils, hydrology, vegetation, and land use.[23] The Mill Creek watershed lies entirely within the Valparaiso-Wheaton Morainal Complex (Level IV) (Figure 18).[24] The Valparaiso-Wheaton Morainal Complex has a landscape shaped by glaciation: rolling till plains, moraines, outwash plains and a disconnected drainage system comprised of kettle holes, ravines, small lakes, and marshes.

Ecoregion maps are useful for the development of ecosystem management strategies, as they provide a concise framework for classifying a large range of factors important to both land use and ecology. While perhaps not as relevant here as within areas of greater spatial extent that also feature large federal or state land holdings, the information can be instructive nonetheless to more local land conservation efforts.

[23] US Environmental Protection Agency, Western Ecology Division, Models, Statistical Program and Data Sets: Ecoregion Maps. Available at http://www.epa.gov/wed/pages/ecoregions.htm

[24] US Environmental Protection Agency, Illinois Level III and Level IV Ecoregions, ftp://newftp.epa.gov/EPADataCommons/ORD/Ecoregions/il/il_map.pdf

Figure 18. Ecoregions within the Mill Creek watershed.



3.3.6 Surficial Geology

Surficial geology is important because it can help guide land use planning and land management practices. Understanding the composition of geologic materials can shed light on areas that are sensitive to contamination and in need of protection, potential aquifer recharge areas, land that is suitable for reservoirs, as well as drainage and weight bearing properties that are useful for siting future development and infrastructure.[25]

In Kane County, materials from the Quaternary geological period (2.6 million years ago to the present) overlie older Paleozoic bedrock, primarily Silurian limestone and dolomite or Ordovician shale.[26] The Cambrian-Ordovician bedrock forms a deep aquifer system, typically 800 to 1,500 feet deep, throughout the entire region that is heavily developed for groundwater pumping.[27] Quaternary materials are also a source of groundwater, forming shallow aquifers from which wells pump water. Quaternary materials include sand, gravel, peat and floodplain alluvium. The sand and gravel in Quaternary materials act as aquifers when they are saturated with water because their porosity and hydraulic conductivity are high, allowing water to flow freely.[28]

Figure 19 shows the Mill Creek watershed is primarily dominated by fine grain matrix of diamicton deposits as till and ice-marginal sediment—a product of surface deposits from the most recent glaciation, the Wisconsin Episode. In addition to diamicton deposits, fine grain sediment deposits in lakes as well as waterlain river sediments and wind-blown beach sands encompass Mill Creek. These are commonly found along the floodplains and channels of modern rivers and streams throughout Kane County.[29]

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[25] J.E. Bogner et al., "Geology for Planning in Northeastern Illinois: I. Geologic Framework, Project Goals, and Procedures," Illinois State Geological Survey, May 1976.

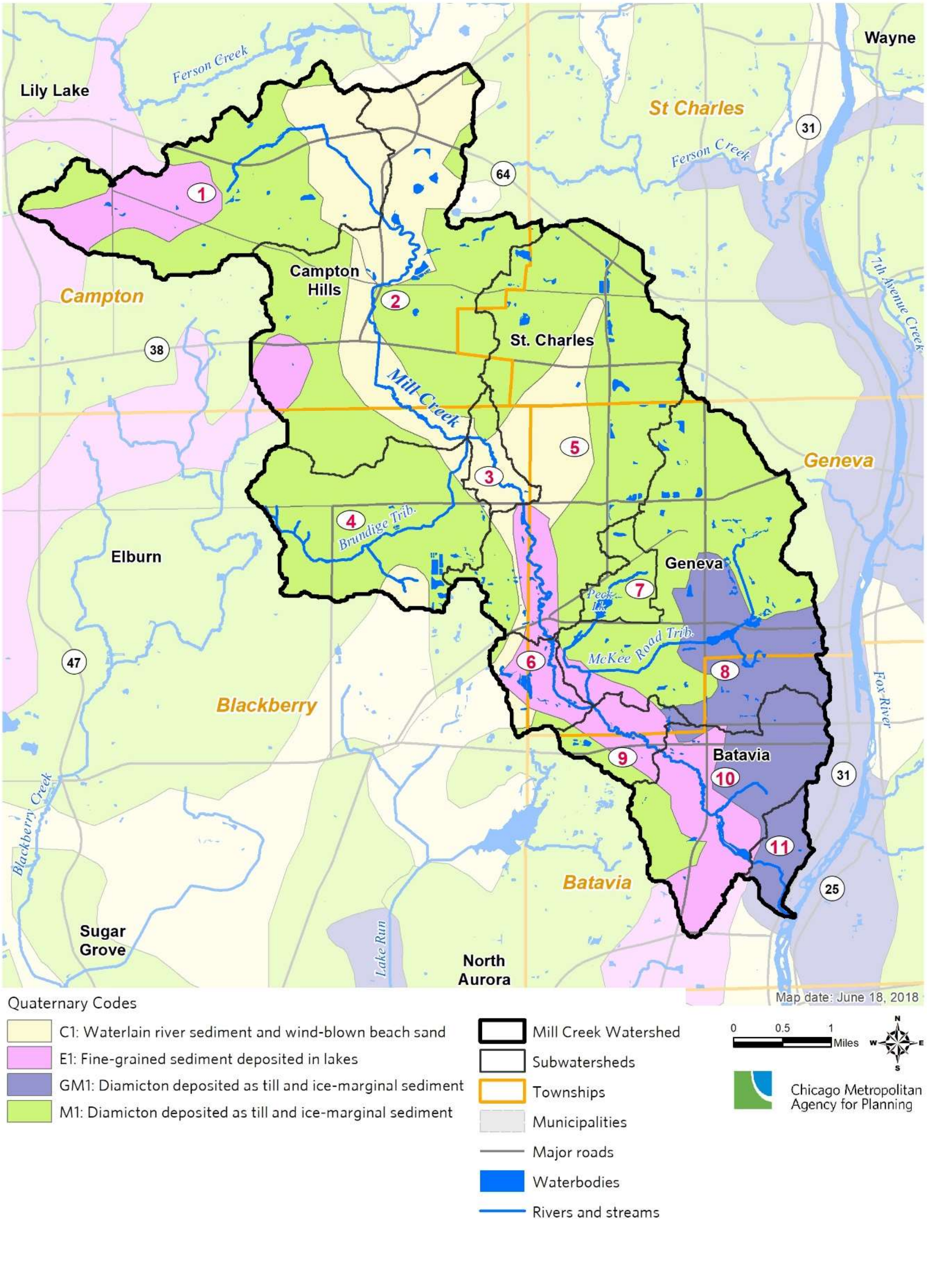
[26] Edward Mehnert. —Groundwater Flow Modeling as a Tool to Understand Watershed Geology: Blackberry Creek Watershed, Kane and Kendall Counties, Illinois.‖ Circular 576, Champaign, IL: ISGS, 2010. https://www.ideals.illinois.edu/bitstream/handle/2142/73427/c576.pdf?sequence=2

[27] Illinois State Water Survey, Prairie Research Institute: Archived Page: Northeastern Illinois and Groundwater Quality, https://www.isws.illinois.edu/groundwater-science/gs-archive/northeastern-illinois

[28] Illinois State Water Survey, Kane County water resources investigations: Final report on shallow aquifer potentiometric surface mapping, https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2007-06.pdf

[29] State of Illinois, Department of Natural Resources, Illinois State Geological Survey, *Surficial Deposits of Illinois*, IFGS OFS 2000-7: IDNR, 2000, http://isgs.illinois.edu/sites/isgs/files/maps/statewide/ofs2000-07.pdf

Figure 19. Surficial geology in the Mill Creek watershed.



3.3.7 Soils

For purposes of this watershed plan, hydrologic soils groups, hydric soils, soil drainage class, and highly erodible soils will be discussed. It is important to consider these types of soil classifications as they relate to land use/change and water quality. The soils data are obtained from the Soil Survey Geographic (SSURGO) Database produced by the U.S. Department of Agriculture – Natural Resources Conservation Service (NRCS)[30].

3.3.5.1 Hydrologic Soil Groups

Hydrologic soil groups (HSGs) feature similar physical and runoff characteristics. Along with land use, management practices, and hydrologic conditions, HSGs determine a soil's associated runoff curve number which is used in turn to estimate direct runoff from rainfall. This information is particularly useful to planners, builders, and engineers to determine the suitability of sites for projects and their design. Projects might include, for example, stormwater management systems and septic tank/field locations or more broadly, new neighborhood design.

The four hydrologic soil groups are described as A: soils with low runoff potential when wet / water is transmitted freely through the soil, B: moderately low runoff potential when wet / water transmission through the soil is unimpeded, C: moderately high runoff potential when wet / water transmission is somewhat restricted, and D: high runoff potential when wet / water movement through the soil is restricted or very restricted. If certain wet soils are able to be drained, they are assigned to dual HSGs (e.g., A/D, B/D) based on their saturated hydraulic conductivity and the water table depth when drained. The first letter refers to the drained condition and the second to an undrained condition (Table 6).

The majority of the Mill Creek watershed features group B and group C, approximately 43 and 21 percent, respectively (Table 6). The unclassified soils are those underlying waterbodies, gravel pits, and highly developed land complexes along commercial, industrial, and rail corridors. There is a significantly small amount of D soils present (23.78 acres or 0.1 percent of the planning area) and only 49.9 acres (0.2 percent of the planning area) of group A soils, located in the northwest portion of the planning area. Figure 20 illustrates a general pattern of HSG distribution, revealing that C and C/D soils are found in developed areas where runoff potential is moderately high.

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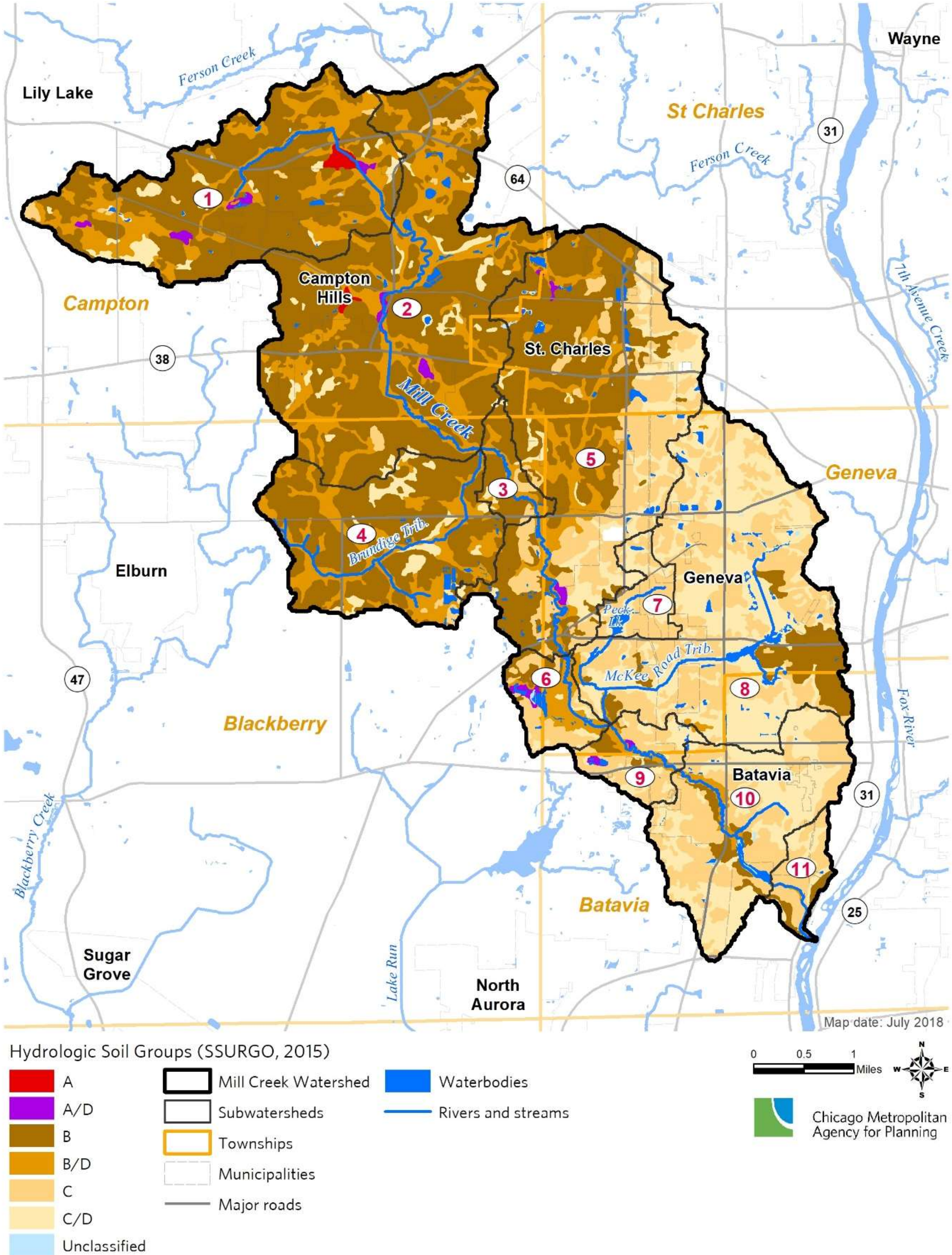
[30] "Soil Geography," USDA Natural Resources Conservation Service, Soils, last accessed October 17th, 2017, http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/geo/

Table 6. Characteristics and extent of hydrologic soil groups in the Mill Creek watershed.

Hydrologic Soil Group	*Definition/Characteristics*	*Area (acres)*	*Percent of Planning Area*
A	Soils have a low runoff potential when thoroughly wet. Water is transmitted freely through the soil.	49.9	0.2
A/D	The first letter applies to the drained condition and the second to the undrained condition.	116.3	0.6
B	Soils have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded.	8,524.1	42.6
B/D	The first letter applies to the drained condition and the second to the undrained condition.	3,304.7	16.5
C	Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted.	4,156.7	20.8
C/D	The first letter applies to the drained condition and the second to the undrained condition.	3,641.8	18.2
D	Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.	23.8	0.1
Unclassified	n/a	173.5	0.9
	Totals	***19,990.8***	***100.0***

Figure 20. Hydrologic soil groups in the Mill Creek watershed.



3.3.5.2 Hydric Soils

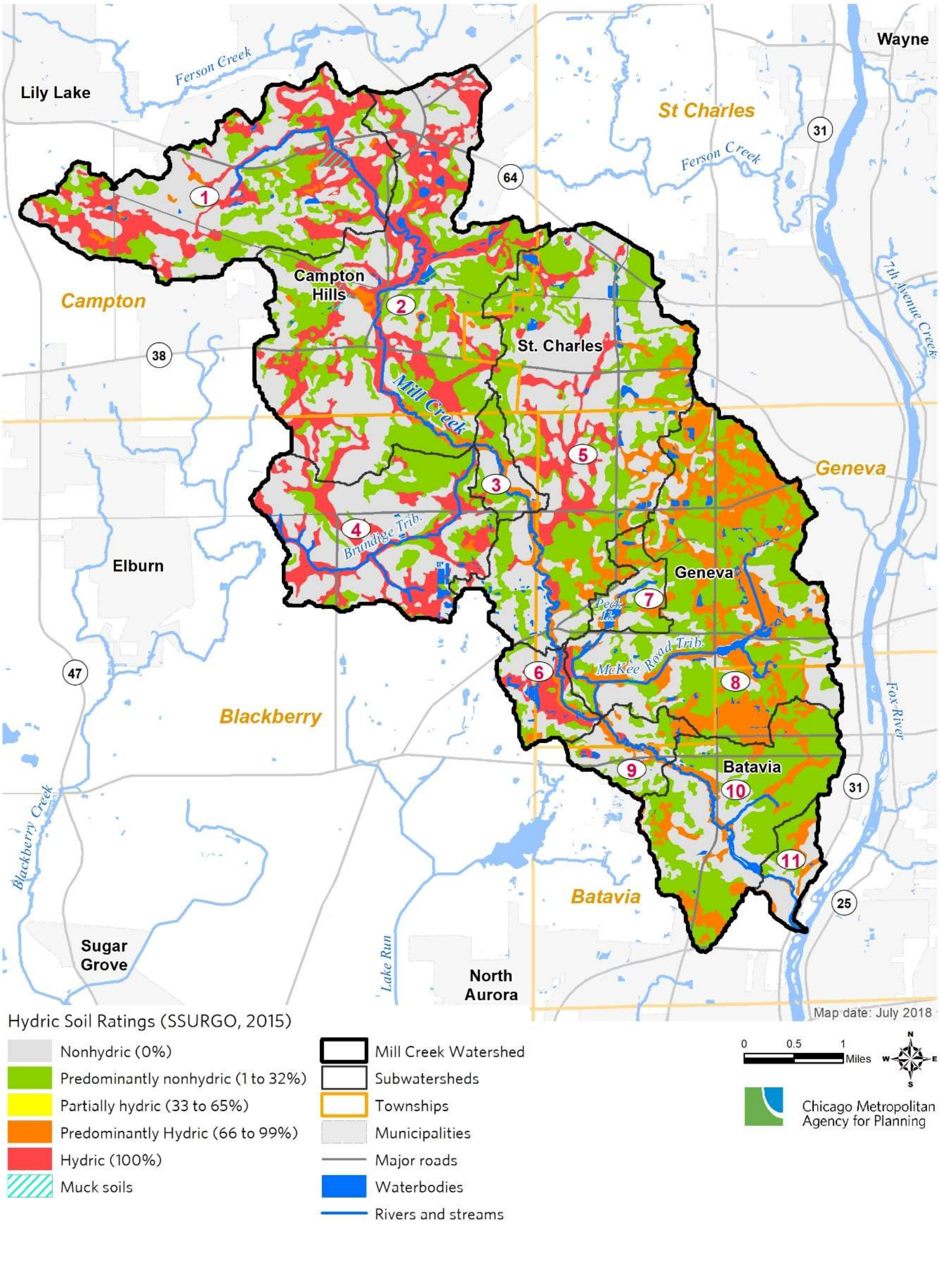
Hydric soils are those soils that developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation and are sufficiently wet in the upper part of the soil profile to develop anaerobic conditions during the growing season. The presence of hydric soils is used as one of three key criteria for identifying the historic existence of wetlands. Knowledge of hydric soils has both agricultural and nonagricultural applications including land use planning and conservation area planning. Much like an understanding of hydrologic soils groups, knowledge of the location and pattern of hydric soils can inform planners, builders, and engineers and influence their project design and location decisions.

The extent of hydric soils within the Mill Creek watershed is shown in Figure 21 and enumerated in Table 7. Nearly 40 percent of the Mill Creek watershed features "non-hydric" soils followed by approximately 33.5 percent of "predominantly nonhydric" soils. "Hydric" soils are distributed throughout the planning area, most commonly along stream and river corridors, and represent approximately 15.3 percent of the watershed. Muck soils—which are saturated for approximately 30 days in a normal year—are a subset of hydric soils and account for 0.2 percent of hydric soils.

Table 7. Hydric soil extent in the Mill Creek watershed.

Hydric Soil Class	*Area (acres)*	*Percent of Planning Area*
Nonhydric (0%)	7,914.4	39.59
Predominantly nonhydric (1 to 32%)	6,691.7	33.47
Partially hydric (33 to 65%)	0.0	0.0
Predominantly hydric (66 to 99%)	2,330.7	11.66
Hydric (100%)	3,054.0	15.28
Totals	***19,990.8***	***100.0***

Figure 21. Hydric soils in the Mill Creek watershed.



3.3.5.3 Soil Drainage Class

Soils are categorized in drainage classes based on their natural drainage condition in reference to the frequency and duration of wet periods.[31] The classes are Excessively Drained, Somewhat Excessively Drained, Well Drained, Moderately Well Drained, Somewhat Poorly Drained, Poorly Drained, and Very Poorly Drained.[32] The extent of soils in these drainage classes within the Mill Creek planning area is shown in Figure 22 and enumerated in Table 8.

Knowledge of soil drainage class has both agricultural and nonagricultural applications, including those related to stormwater and water quality. For example, the "Well Drained" and "Moderately Well Drained" drainage classes cover 60 percent of the Mill Creek watershed. These soils can indicate where infiltration BMPs may be best utilized. On the other hand, the "Somewhat Poorly Drained," "Poorly Drained," and "very Poorly Drained" drainage classes indicate soils that are wet at shallow depths over periodic or significantly long periods of time. These soils cover nearly 40 percent of the watershed, and are often prone to frequent ponding and flooding and can be associated with increased stormwater runoff and nonpoint source pollution. If farmed, these soils can also indicate areas that limit or exclude crop growth unless artificially drained

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[20] Soil Survey Staff, USDA-NRCS. *Soil Survey Geographic (SSURGO) Database, SSURGO 2.2.6 Table Column Descriptions*, dated June 26, 2012. Available online at http://soils.usda.gov/survey/geography/ssurgo/index.html (accessed March 26, 2013).

[21] Soil Conservation Service, Soil Survey Staff. *Soil Survey Manual*. USDA Handbook 18. Washington, D.C.: USDA NRCS, 1993. http://soils.usda.gov/ technical/manual/ (accessed September 14, 2011).

Figure 22. Soil drainage classes in the Mill Creek watershed.

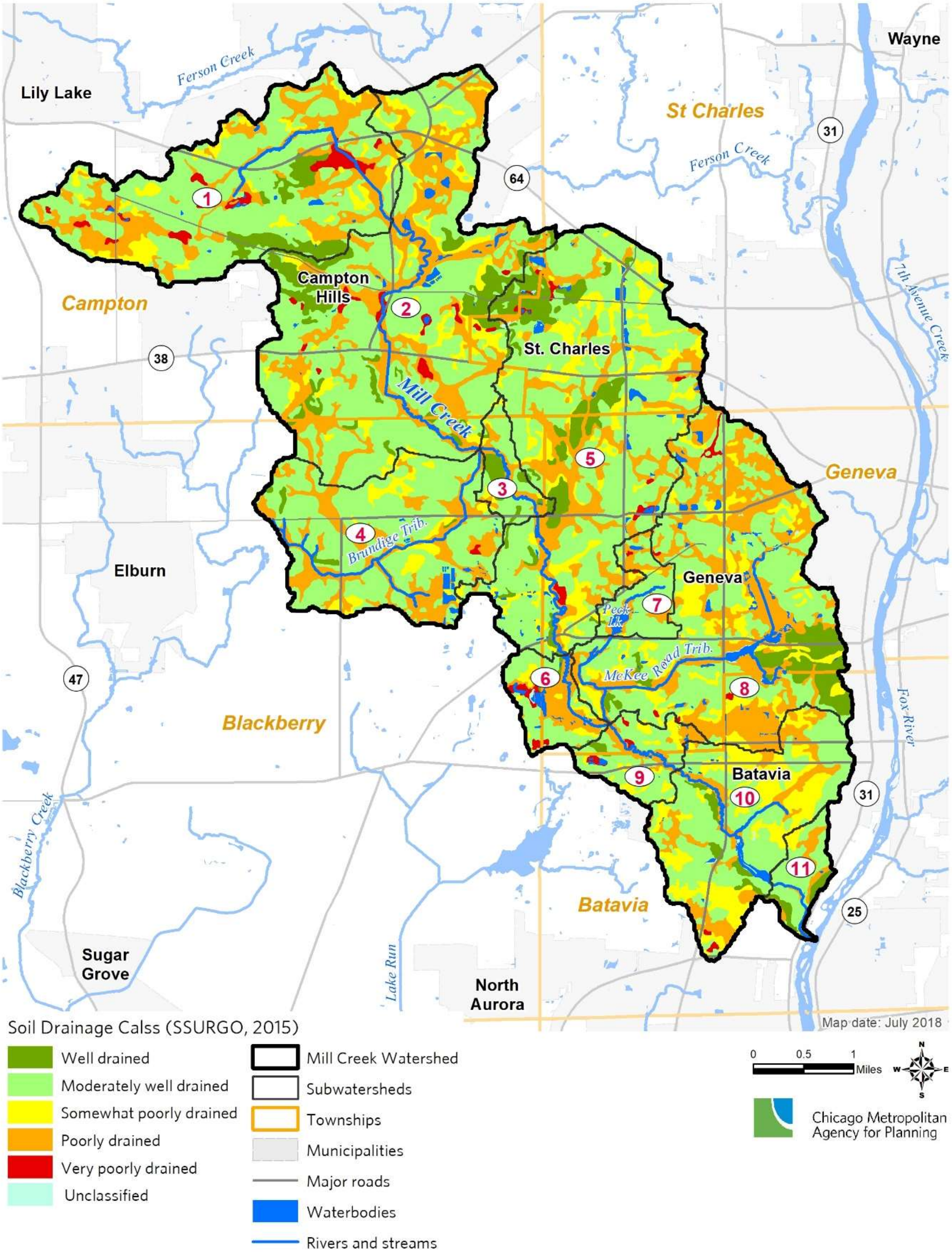

Table 8. Extent of soil drainage classes in the Mill Creek watershed.

Soil Drainage Class	*Area (acres)*	*Percent of Planning Area*
Somewhat excessively drained	0.00	0.0
Well drained	1,391.9	7.0
Moderately well drained	10,548.6	52.8
Somewhat poorly drained	2,493.9	12.5
Poorly drained	5,091.0	25.5
Very poorly drained	293.7	1.5
Unclassified	173.9	0.9
Totals	***19,990.8***	***100.0***

3.3.5.4 Highly Erodible Soils

The USDA – NRCS defines a highly erodible soil or soil map unit as one that has a maximum potential for erosion that equals or exceeds eight times the tolerable soil erosion rate (T).[33] The maximum potential erosion rate is determined using the formula RKLS/T (where R = the rainfall factor, K = erodibility value of the soil, and LS = the slope factor). If RKLS/T > 8, then the soil meets the criteria for a highly erodible soil.[34] All soil map units with "C" slopes or greater are considered highly erodible in Illinois.[35] Highly erodible soils are of concern because they are primarily located among the developed and lower portion of the Mill Creek watershed. Note that the maximum erosion potential is calculated without consideration of stream bank restoration or conservation management practices which can markedly lower the actual erosion rate.

Figure 23 illustrates the pattern of highly erodible soils in the Mill Creek watershed, covering 6,931.43 acres (34.7% percent). Also keep in mind that all soils can severely erode when excavated and stockpiled; thus, erosion control practices should be planned for any human disturbance of an area.

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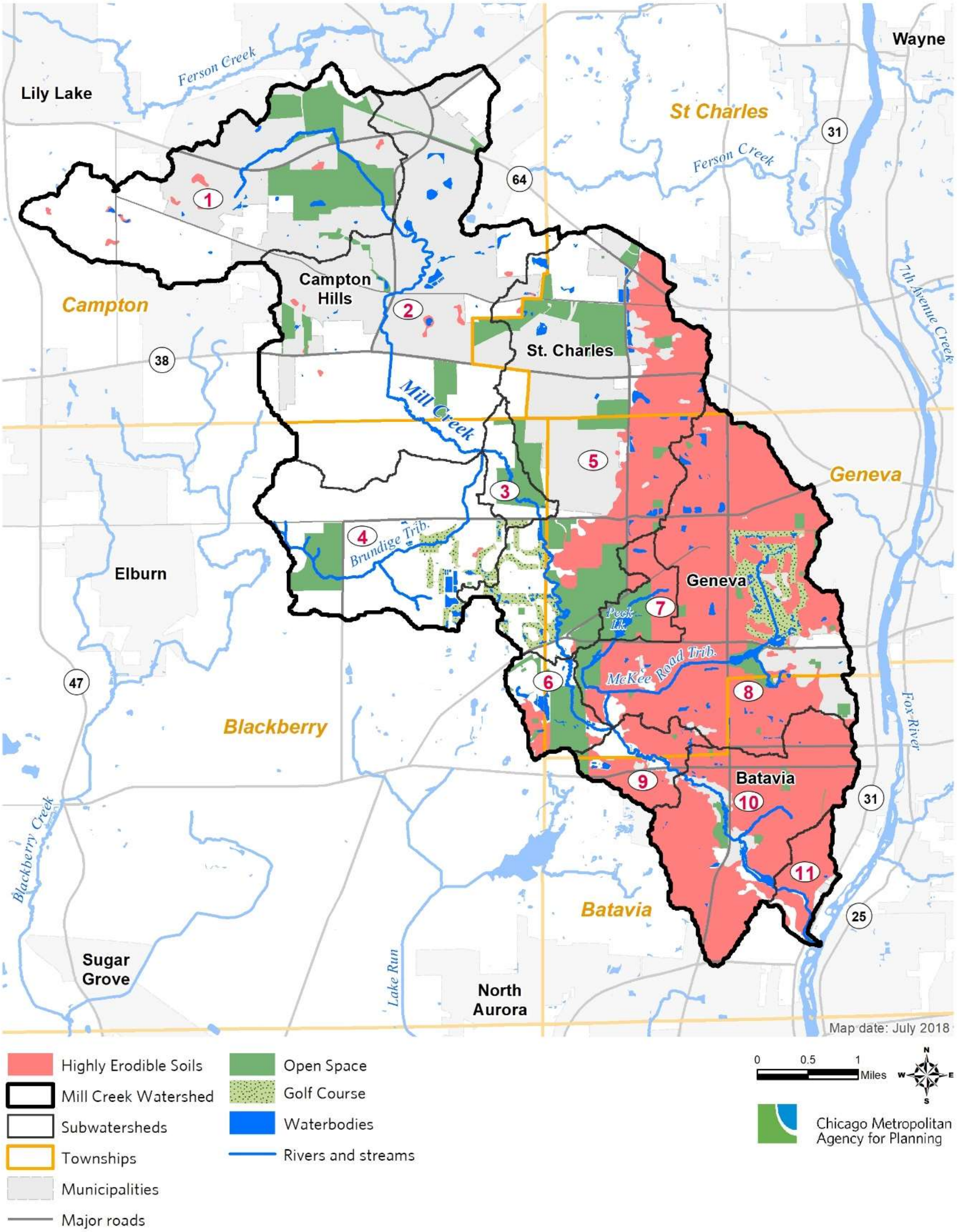
[33] The soil loss tolerance rate (T) is the maximum rate of annual soil loss that will permit crop productivity to be sustained economically and indefinitely on a given soil. Erosion is considered to be greater than T if either the water (sheet & rill) erosion or the wind erosion rate exceeds the soil loss tolerance rate. The NRCS uses the Universal Soil Loss Equation (USLE) to determine a soil's erosion rate by analyzing rainfall effects, characteristics of the soil, slope length and steepness, and cropping and management practices.

[34] "RI Soil Survey - Highly erodible soil map units," USDA Natural Resources Conservation Service, Rhode Island, last accessed October 17th, 2017, http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ri/soils/?cid=nrcs144p2_016637

[35] Bob Oja, McHenry-Lake County SWCD, personal communication, Nov. 24, 2014.

Figure 23. Highly erodible soils in the Mill Creek watershed.



3.3.8 Ecosystems

3.3.8.1 Wetlands

Wetlands provide social, economic, and ecological benefits to communities by cleaning polluted runoff before discharging to other surface waterbodies, recharging aquifers that are used as drinking water supplies, and providing temporary storage for rainfall to reduce flooding. At the regional landscape scale, wetlands are an integral part of the movement to conserve green infrastructure and thereby employ nature to help manage hydrology in the built environment. There are many other wetland functions that generate ecosystem services that are valued by society. Despite these benefits, the extent of America's wetlands continues to decline.[36]

Based on Kane County's ADID wetlands study, there are an estimated 1,567 acres of wetlands, 73.5 percent of which are high functioning wetlands (about six percent of the land area) within the Mill Creek watershed (Figure 24, Table 9). High functioning wetlands either have a high habitat value (HHQ) or high functional value for water quality (HFV). Wetlands that fall under the high habitat quality category include wetlands that exhibit high quality physical habitat and diverse aquatic life, support threatened or endangered species, and have received a high ratings through previous studies or evaluation methods (e.g., National Areas Inventory (NAI) or Index of Biotic Integrity (IBI)).[37] Wetlands that are considered high functioning for water quality exhibit stabilizing vegetation adjacent to perennial streams or waterbodies and display other physical characteristics that indicate its ability to retain sediments, remove and/or transform nutrients, or provide significant stormwater retention.[38]

The remaining wetlands that are present include: Upland area within wetlands, farmed wetlands, artificial ponds, and other wetlands (Table 9). The "other wetlands" classification accounts for 187.1 acres (0.9 percent) of the wetland coverage in the Mill Creek watershed followed by artificial ponds with 110.7 acres (approximately 0.6 percent). According to the ADID Study, "other wetlands" include all wetlands that were not considered to be 'high functional value wetlands' or 'high habitat value wetlands and high quality streams'.[39] The report also notes that this broad category encompasses wetlands that were relatively small (which does not equate to insignificant) and/or were not thoroughly evaluated because of project constraints. Of the 110.7 acres of artificial ponds, 89.5 acres intersect hydric soils polygons from the SSURGO soils layer.[40] This indicates that many of

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[36] "National Wetlands Inventory," U.S. Fish and Wildlife Service, Ecological Services, last accessed October 17, 2017, http://www.fws.gov/wetlands/Status-And-Trends-2009/index.html

[37] Kane County, *Advanced Identification of Wetlands (ADID): The Advanced Identification (ADID) Program*, http://dewprojects.countyofkane.org/adid/adid.htm

[38] Ibid.

[39] NIPC, USFWS Chicago Illinois Field Office, USEPA Region 5, Kane Co Department of Environmental Management, *Advanced Identification (ADID) Study Kane County, Illinois: Final Report*, August 2004, http://dewprojects.countyofkane.org/adid/ADIDreport.pdf

[40] Ibid.

the ponds have been placed in areas that were historically conducive to ponding. On a subwatershed level, #8 McKee Road Tributary and #2 Lower Campton subwatersheds have the most wetlands by total acreage within the Mill Creek Watershed, while #3 Mill Creek Greenway and #9 Tanglewood subwatersheds have the most wetland coverage relative to the size of the relative subwatershed (Table 10).

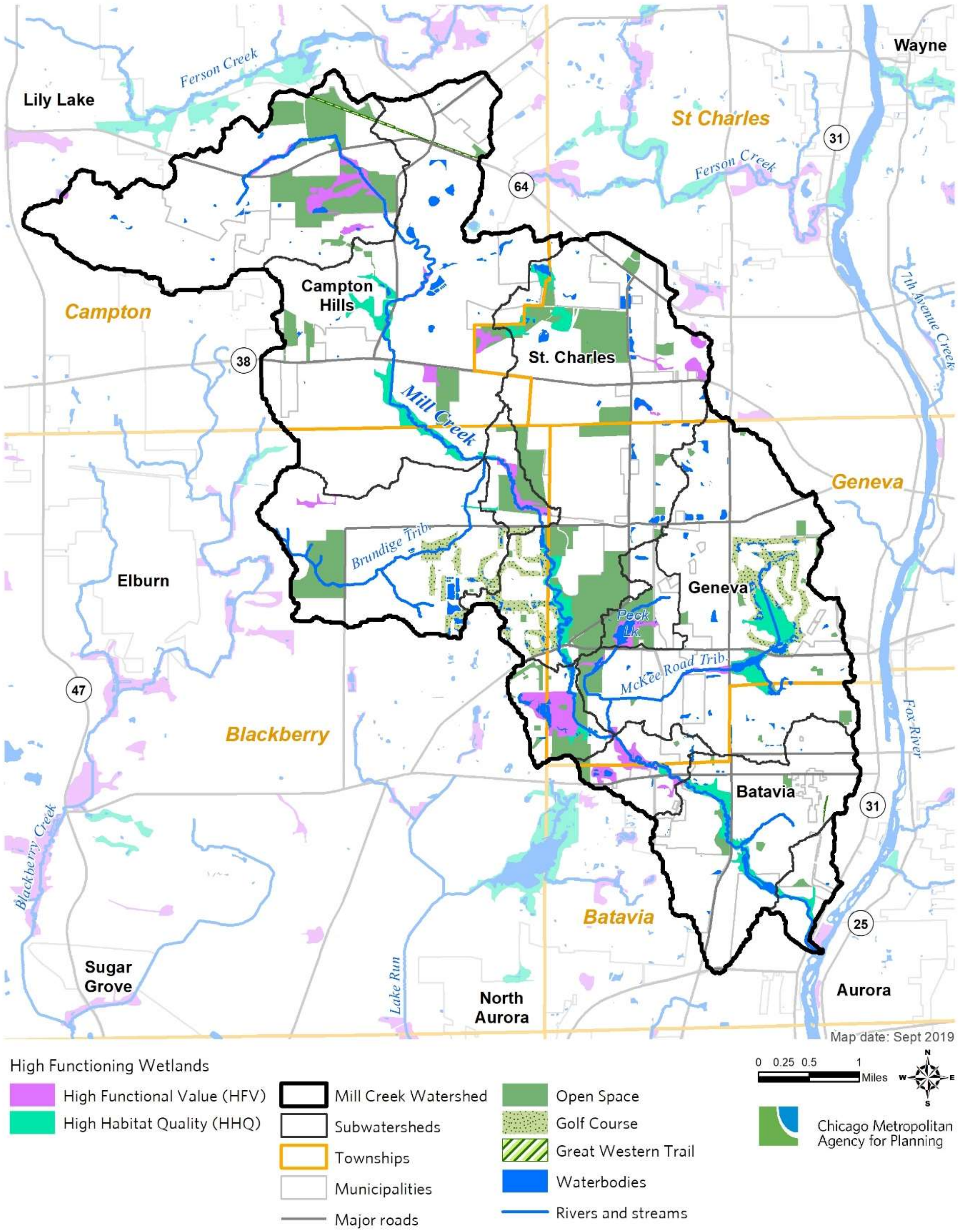
Table 9. Wetland types in the Mill Creek watershed.

Wetland Type	*Area (acres)*	*Percent of Planning Area*
High Habitat Quality (HHQ)	634.1	3.2
High Functional Value (HFV) -- Water quality/stormwater storage	517.7	2.6
Upland area within wetlands	101.5	0.5
Farmed wetlands	15.9	0.1
Artificial ponds	110.7	0.6
Other wetlands	187.1	0.9
Totals	**1,567.0**	**7.8**

Table 10. Wetland acreage by Mill Creek subwatershed.

Subwatershed #	*Subwatershed Name*	*Wetland Area (Acres)*	*Percent of Subwatershed*
1	Upper Campton	184.6	6.5
2	Lower Campton	275.7	6.5
3	Mill Creek Greenway	51.5	17.0
4	Brundige Tributary	51.6	2.6
5	West St. Charles/Geneva	267.9	6.7
6	Mill Creek Forest Preserve	136.0	31.8
7	Peck Lake	45.9	13.2
8	McKee Road Tributary	281.2	8.2
9	Tanglewood	90.9	20.1
10	West Batavia	144.8	8.3
11	Les Arends	37.1	12.2
Totals		**1,567.0**	**7.8**

Figure 24. Wetlands in the Mill Creek watershed.



3.3.8.2 Oak Communities

Prior to large-scale development, oak ecosystems (oak barrens, savannas, woodlands, and forests) covered much of Kane County.[41] Predevelopment land cover data from the 1830s indicate that the county was home to 125,974 acres of oak-dominated ecosystems.[42] By 1939, urban and agricultural development reduced the total size of the county's oak ecosystems to 26,113 acres. In 2010, there were 14,395 acres of oak ecosystems remaining in Kane County, a cumulative reduction of 89 percent from 1830. Oak-dominant ecosystems, especially oak savannas, are globally rare, and exist in just a few geographic regions in North America.

During this period (1830-2010), the Mill Creek watershed saw comparable reductions in its oak communities. The 1830s Public Lands Survey estimated the Mill Creek watershed to have 3,478 acres of oak ecosystems, representing 17.4 percent of the watershed. By 1939, 1,346.5 acres of oak communities remained. In 2010, only 671.6 acres of oaks remained intact, accounting for 3.4 percent of the watershed's planning area, a cumulative reduction of more than 80 percent from the 1830s (Figure 25, Table 11). Subwatersheds #1 and 2 are likely to have the greatest coverage of oak communities (Table 12).

Table 11. Oak communities in the Mill Creek watershed, 1830s to 2010.[43]

Year	*Area*		*Percent of watershed*
	(acres)	*(sq. miles)*	
2010	671.6	1.05	3.4
1939	1,047.2	1.60	5.2
1830s	3,478.4	5.40	17.4

[41] Chicago Wilderness, 2015. *Oak ecosystems recovery plan: Sustaining oaks in the Chicago wilderness region*. https://www.dnr.illinois.gov/conservation/IWAP/Documents/Chicago%20Wilderness%20Oak%20Ecosystem%20Recovery%20Plan.pdf.

[42] 1830s data reflects forested areas throughout Illinois in the early 1800s.

[43] Data was derived from: "Land Cover of Illinois in the Early 1800's," Illinois Natural History Survey (INHS), Prairie Research Institute, last accessed October 26, 2017, http://wwx.inhs.illinois.edu/resources/gis/glo/.

Figure 25. Oak ecosystems in the Mill Creek watershed, 1830s to 2010..

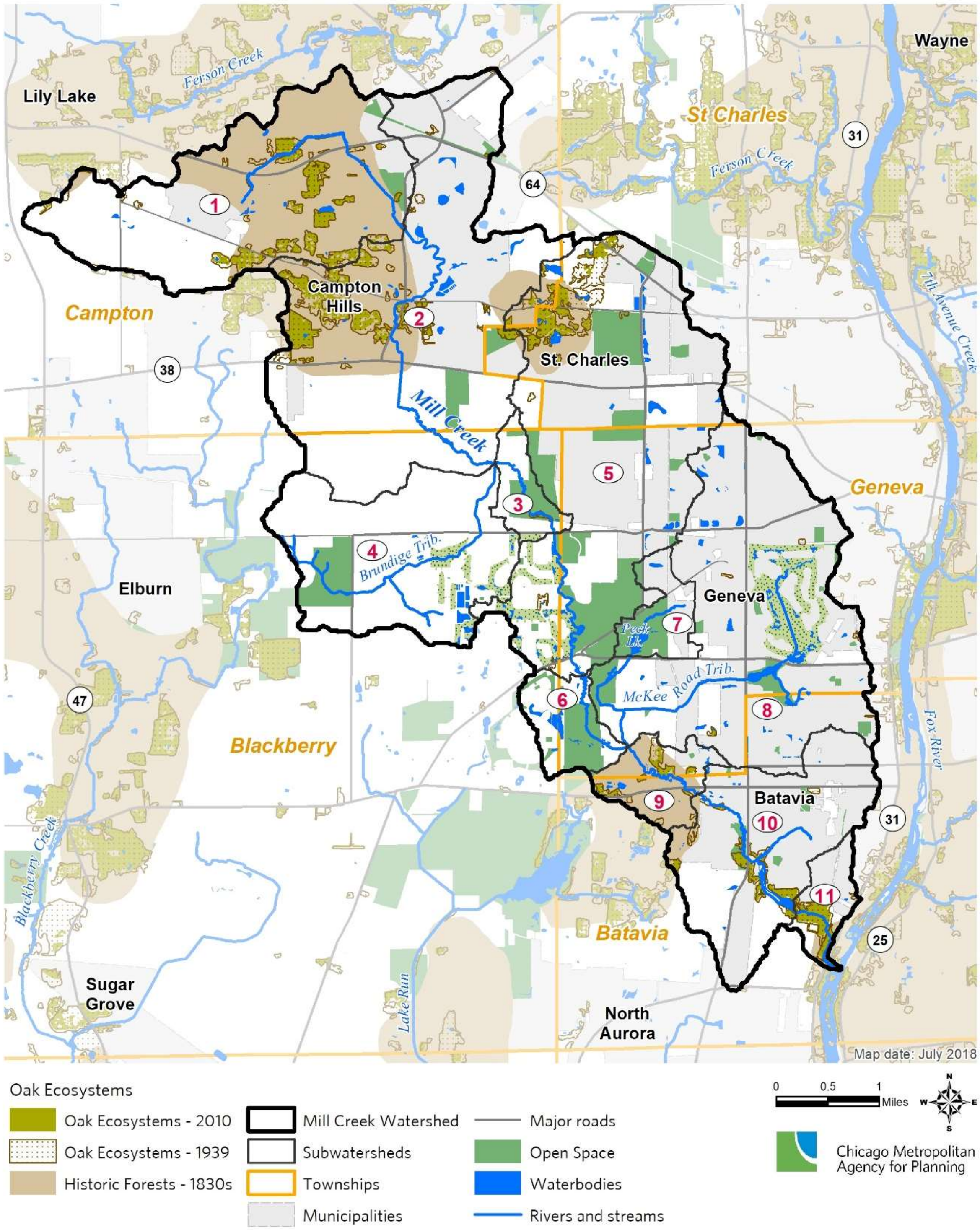


Table 12. Oak communities by Mill Creek subwatershed, 2010.

Subwatershed #	*Name*	*Oak Communities (acres)*
1	Upper Campton	179.1
2	Lower Campton	216.7
3	Mill Creek Greenway	4.3
4	Brundige Tributary	0.0
5	West St. Charles/Geneva	116.3
6	Mill Creek Forest Preserve	0.0
7	Peck Lake	0.0
8	McKee Road Tributary	1.8
9	Tanglewood	30.5
10	West Batavia	53.8
11	Les Arends	69.2

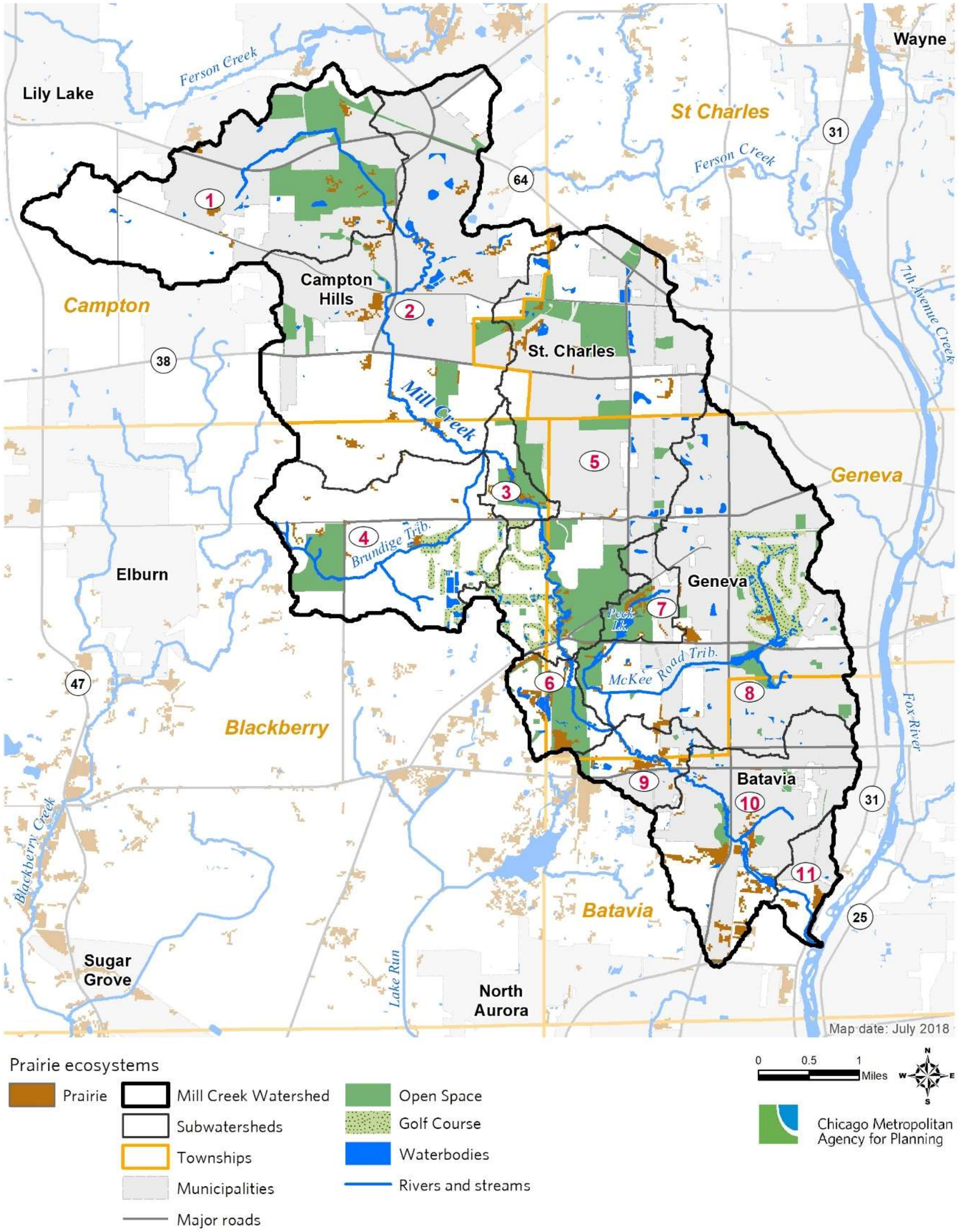
3.3.8.3 Prairie

Tallgrass prairie once covered much of both the Mill Creek planning area and the Midwest at large. Today, less than one percent of one percent (0.01%) of North America's original prairie remains. In the Mill Creek area, good examples can be found on properties owned and maintained by the Forest Preserve District of Kane County, including the Mill Creek Greenway and Campton Forest Preserves, the Geneva Park District at Peck Farm Park, and St. Charles Park District at Hickory Knolls. Native prairie landscapes are home to a wide range of deep-rooted prairie grasses that play a critical role in stormwater management, soil retention, and carbon sequestration. Table 13 and Figure 26 show the extent of prairie ecosystems in the Mill Creek watershed today based on the 2011 National Land Cover Dataset.

Table 13. Prairie ecosystems in the Mill Creek watershed, 2011.

Year	*Area* (acres)	*Area* (sq. miles)	*Percent of Planning Area*
2011	556.87	0.87	0.03

Figure 26. Prairie ecosystems in the Mill Creek watershed, 2011.



3.3.9 Threatened and Endangered Species

The Mill Creek watershed is home to eleven species that are included on Illinois' List of Endangered and Threatened Species (Table 14). There are three vertebrate animals, two invertebrate animals, four vascular plants, and two terrestrial communities. Identifying threatened and endangered species can help identify priority areas for habitat restoration as well as guide protection measures within the watershed.

Table 14. Threatened and endangered species in the Mill Creek watershed.

Vertebrates	Invertebrates	Vascular Plants	Terrestrial Communities
• Blanding's Turtle	• Purple Wartyback (mussel)	• Golden Sedge	• Well Drained Forest
• Black-crowned Night-Heron	• Spike (mussel)	• Snowberry	• Alkaline Moist Cliff, Lower Midwest Type
• Greater Redhorse		• Shadbush	
		• Royal Catchfly	

3.4 Land Use and Land Cover

3.4.1 Predevelopment Land Cover

The first formal survey of the study area was conducted through the U.S. Public Lands Survey (PLS) between 1837 and 1840.[44] The results of this survey have been further refined by the Morton Arboretum to provide a comprehensive view of the landscape prior to largescale development.

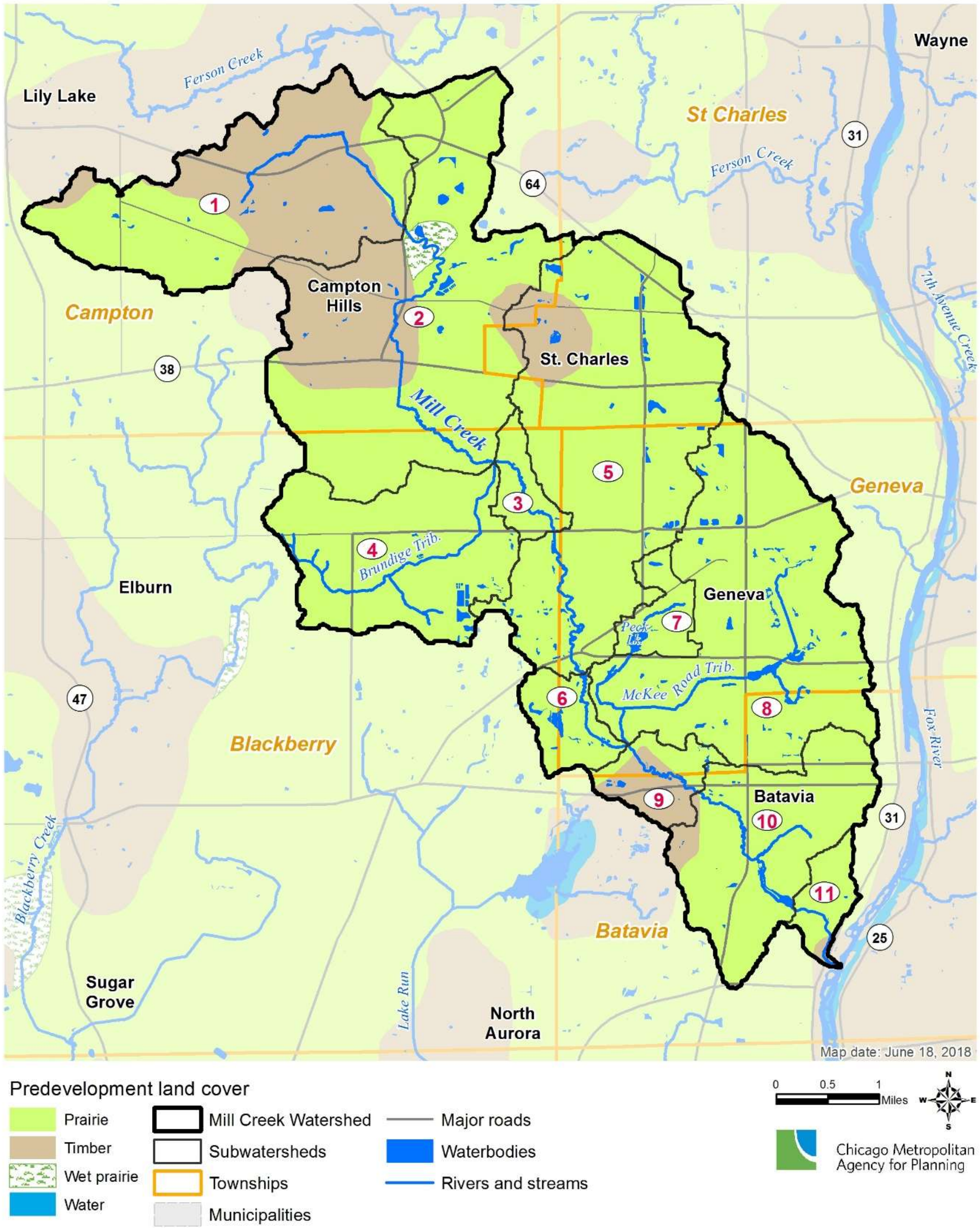
At the time of the survey, tallgrass prairie was the dominant ecosystem in much of the Mill Creek area, with pockets of forested lands in the north and south. Notably, Figure 27 shows that Mill Creek was once an intermittent stream with significantly fewer tributaries than exist today. This is likely due to the limited capacity of agricultural and urban landscapes to retain stormwater. Oak savannas were once common throughout the Chicago region, but the PLS did not identify savannas as a unique habitat type. Denser savannas were likely classified as forests, while open savannas were likely recorded as prairie. Table 15 provides a breakdown of predevelopment ecosystem types by average and percentage of the planning area.

Table 15. Predevelopment land cover in the Mill creek watershed.

Ecosystem type	*Area*		*Percent of planning area*
	(acres)	*(sq. miles)*	
Prairie	16,312	25.5	81.6
Wet Prairie	112	0.2	0.6
Timber	3,567	5.6	17.8
Totals	***19,991***	***31.3***	***100***

[44] "Land Cover of Illinois in the Early 1800's," Illinois Natural History Survey (INHS), Prairie Research Institute, last accessed October 26, 2017, http://wwx.inhs.illinois.edu/resources/gis/glo/

Figure 27. Predevelopment land cover in the Mill Creek watershed.



3.4.2 Current Land Use

Land use is classified using CMAP's parcel-based 2013 Land Use Inventory Classification Scheme. The land use scheme employs a new methodology and results in 57 categories of land use that are aggregated under five general categories: Urbanized, Agriculture, Open Space, Vacant or Under Construction, and Water.

For purposes of this plan, land use within the planning area is organized among twelve categories (Table 16 and Figure 28). Agriculture (27.9 percent) and residential (25.8 percent) land uses are the most dominant within the planning area. Open space is the third most common type of land use (18.8 percent) followed by transportation, communications, and utilities land uses at 11.6 percent.[45] Land use within each subwatershed study unit boundary was tabulated by the eleven categories as well (Table 17). Subwatershed units #8 and #2 have the most residential land uses (1,202.2 acres and 1,186.2 acres, respectively), while study units #2 and #1 have the most agricultural land uses (1,797.5 acres and 1,119.5 acres, respectively). Understanding the land use composition at this scale is useful for understanding and comparing pollutant loads generated from each subwatershed and targeting BMP strategies to reduce loads.

Table 16. Land use categories and extent within the Mill Creek watershed (2013).

Land Use Category	*Area (acres)*	*Area (sq. miles)*	*Percent of Planning Area*
Single Family Residential	5,077.2	7.933	25.4
Multi-family Residential	76.3	0.119	0.4
Commercial	682.9	1.067	3.4
Institutional	1,640.6	2.563	8.2
Industrial	188.2	0.294	0.9
Open Space	3,761.8	5.878	18.8
Agriculture	5,578.4	8.716	27.9
T/C/U*	2,324.5	3.632	11.6
Vacant	635.6	0.993	3.2
Under Construction	22.8	0.036	0.1
Unclassifiable	0.0	0.000	0.0
Water	2.4	0.004	0.0
Totals	**19,990.8**	**31.2**	**100.0**

*T/C/U = transportation, communications, and utilities;
*Unclassifiable/other includes right-of-ways and non-parcel areas.

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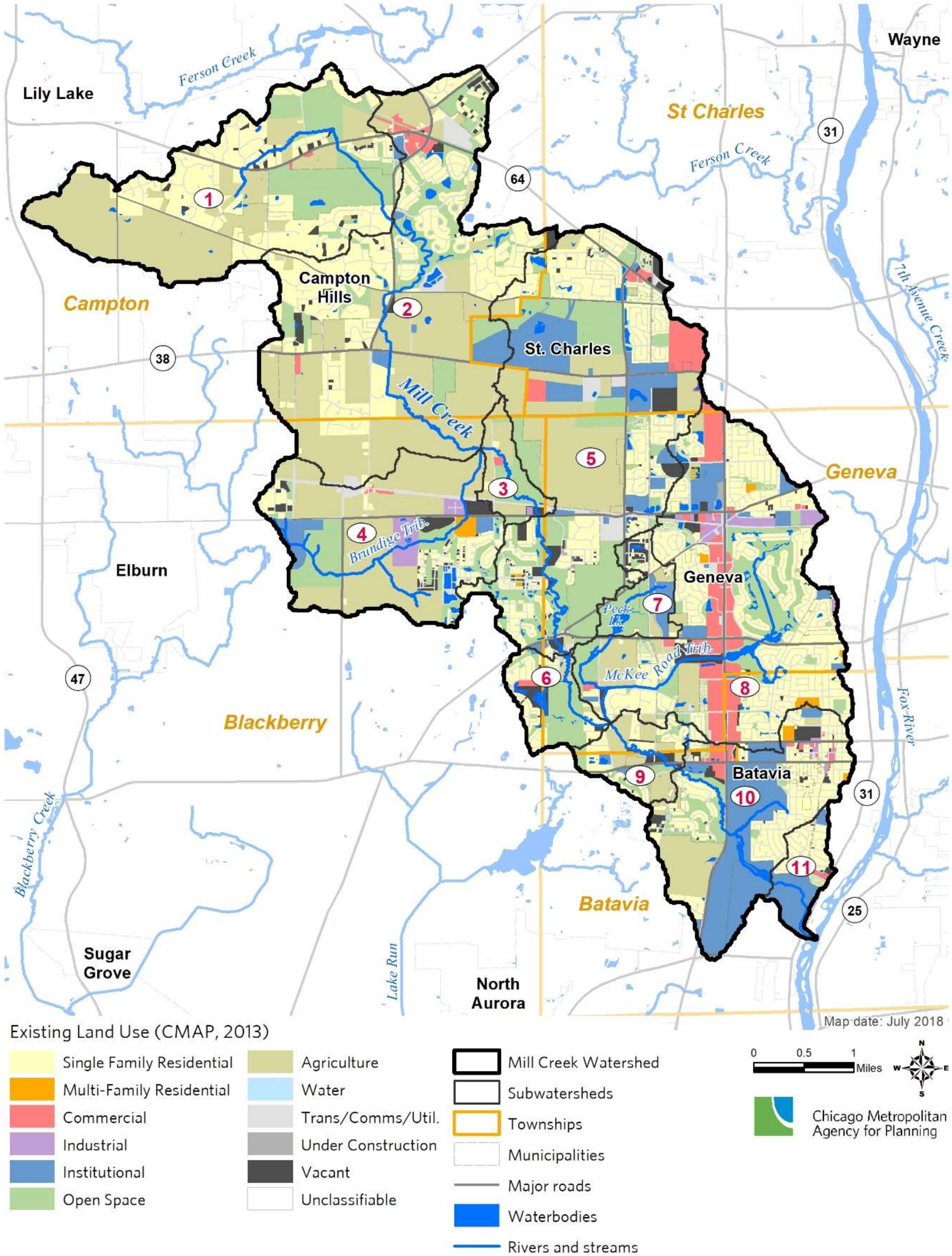
[45] Open Space and Vacant or Under Construction are two examples of land use that warrant explanation. Readers are encouraged to review a more detailed description of land-use categories at http://www.cmap.illinois.gov/data/land-use/inventory.

Table 17. Land use by subwatershed / study unit.

Land Use Category	Acres by Subwatershed / Study Unit #					
	1	2	3	4	5	6
Single Family	911.4	1,186.2	9.6	142.0	784.7	123.3
Multi-family				25.9	3.2	
Commercial	3.8	52.8	4.6	5.0	158.0	11.6
Institutional	6.4	103.4	0.6	91.3	445.3	2.8
Industrial			3.0	98.8		
Open Space	569.8	564.4	113.0	313.9	1,040.2	173.4
Agriculture	1,119.5	1,797.5	136.4	1,009.1	854.2	29.5
T/C/U*	169.3	432.9	26.4	190.2	530.1	40.4
Vacant	43.4	95.5	9.2	82.6	153.0	47.2
Under Construction		0.2		2.3	5.3	
Unclassifiable						
Water					2.1	
Totals	**2,823.7**	**4,232.9**	**302.8**	**1,961.1**	**3,976.0**	**428.2**

Land Use Category	Acres by Subwatershed / Study Unit #				
	7	8	9	10	11
Single Family	34.3	1,202.2	130.0	448.4	104.9
Multi-family		27.9		19.4	
Commercial		389.5		49.2	8.4
Institutional	64.2	176.7	25.9	587.1	136.9
Industrial		75.4		11.1	
Open Space	158.1	613.4	64.9	137.3	13.3
Agriculture	32.1	235.2	147.7	217.3	
T/C/U*	36.3	600.7	55.0	205.8	37.3
Vacant	23.5	88.7	28.5	61.0	2.9
Under Construction		12.8		2.2	
Unclassifiable				0.0	
Water					0.3
Totals	**348.5**	**3,422.5**	**452.0**	**1,738.9**	**304.2**

Figure 28. Land use in the Mill Creek watershed (2013).



3.4.2.1 Agriculture Composition

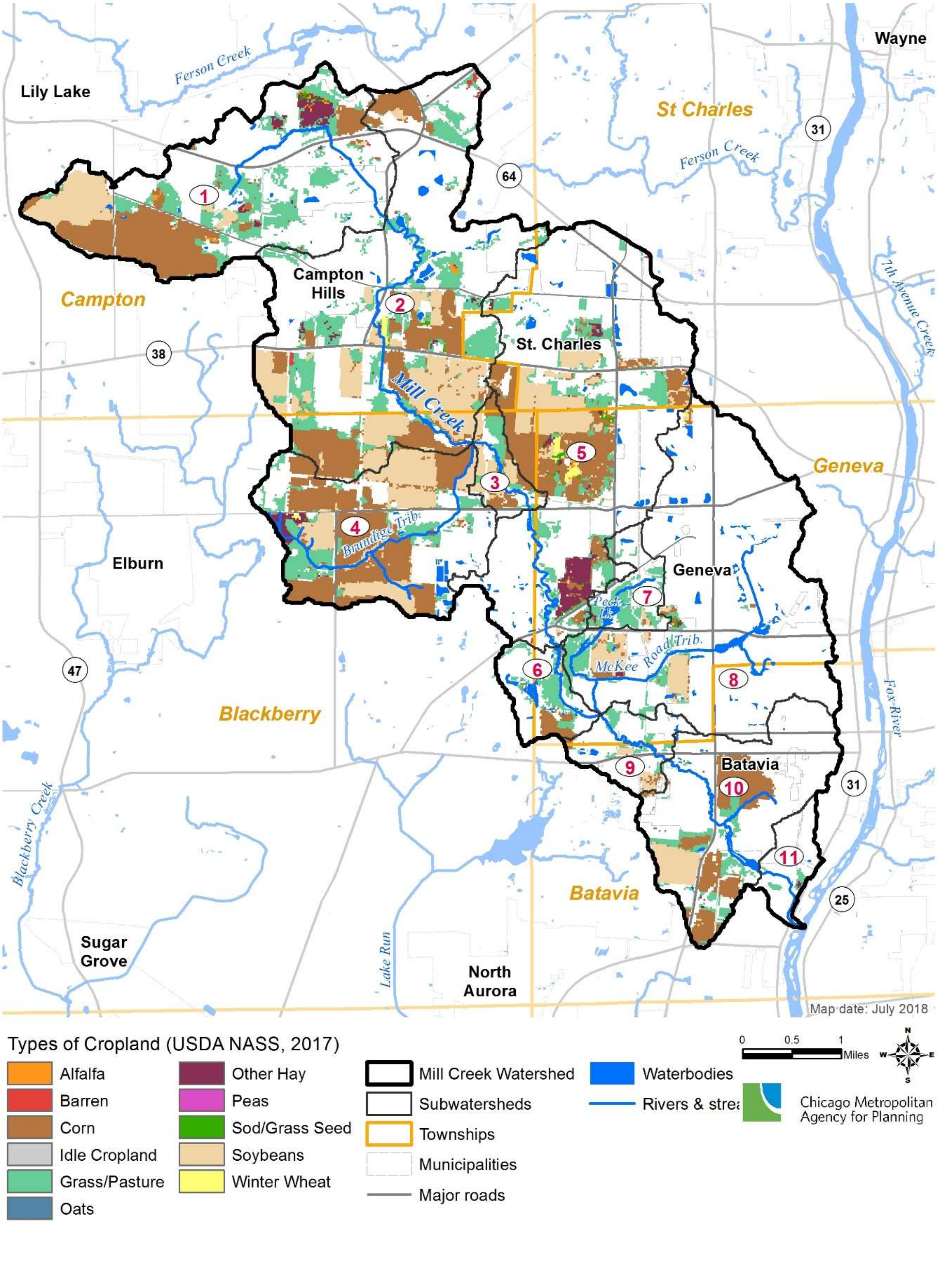
Agricultural land use is important in Kane County and constitutes nearly 28 percent of the Mill Creek planning area (Figure 29). Only residential land use (25 percent) comes close in spatial extent within the planning area. According to the USDA's National Agriculture Statistics Service, corn, grass/pasture, and soybeans are the most widely planted crops over a ten year period (Table 18). Identifying prominent crops in the watershed can offer insights on the pollutant associated with tillage and crop rotation.

Table 18. Crops grown in the Mill Creek watershed (2007-2017).

Cropland Type	*Area (acres[46]) by year*		
	2007	***2012***	***2017***
Alfalfa	50.4	86.1	18.7
Barren	54.2	26.5	33.4
Corn	2,906.7	3,472.9	2,798.2
Double crop: Winter wheat/soybeans	0.8	--	--
Fallow/idle cropland	34.1	26.7	1.6
Grass/pasture	3,524.3		2,204.2
Oats	10.8	1.3	1.1
Other crops	27.1		--
Other hay/non alfalfa	--	2.4	221.3
Peas	--	--	0.2
Potatoes	2.3	--	--
Sod/grass seed	--	0.02	25.6
Soybeans	1,309.6	1,473.1	1,988.6
Spring wheat	2.3		--
Sweet corn	--	0.2	--
Winter wheat	228.6	2.2	34.7
Totals	***8,073.9***	***8,151.2***	***7,328.0***

[46] CropScape will allow for pixel counting at the state, district, and county levels. Please note that differences will occur when comparing acreage statistics between CropScape and NASS official numbers, as pixel counting is usually downwardly biased when compared to official estimates. Counting pixels and multiplying by the area of each pixel will result in biased area estimates and should be consider raw numbers needing bias correction. Official crop acreage estimates at the state and county level are available at http://www.nass.usda.gov/.

Figure 29. Cropland by type in the Mill Creek watershed, 2017.



3.4.2.2 Open Space Reserve

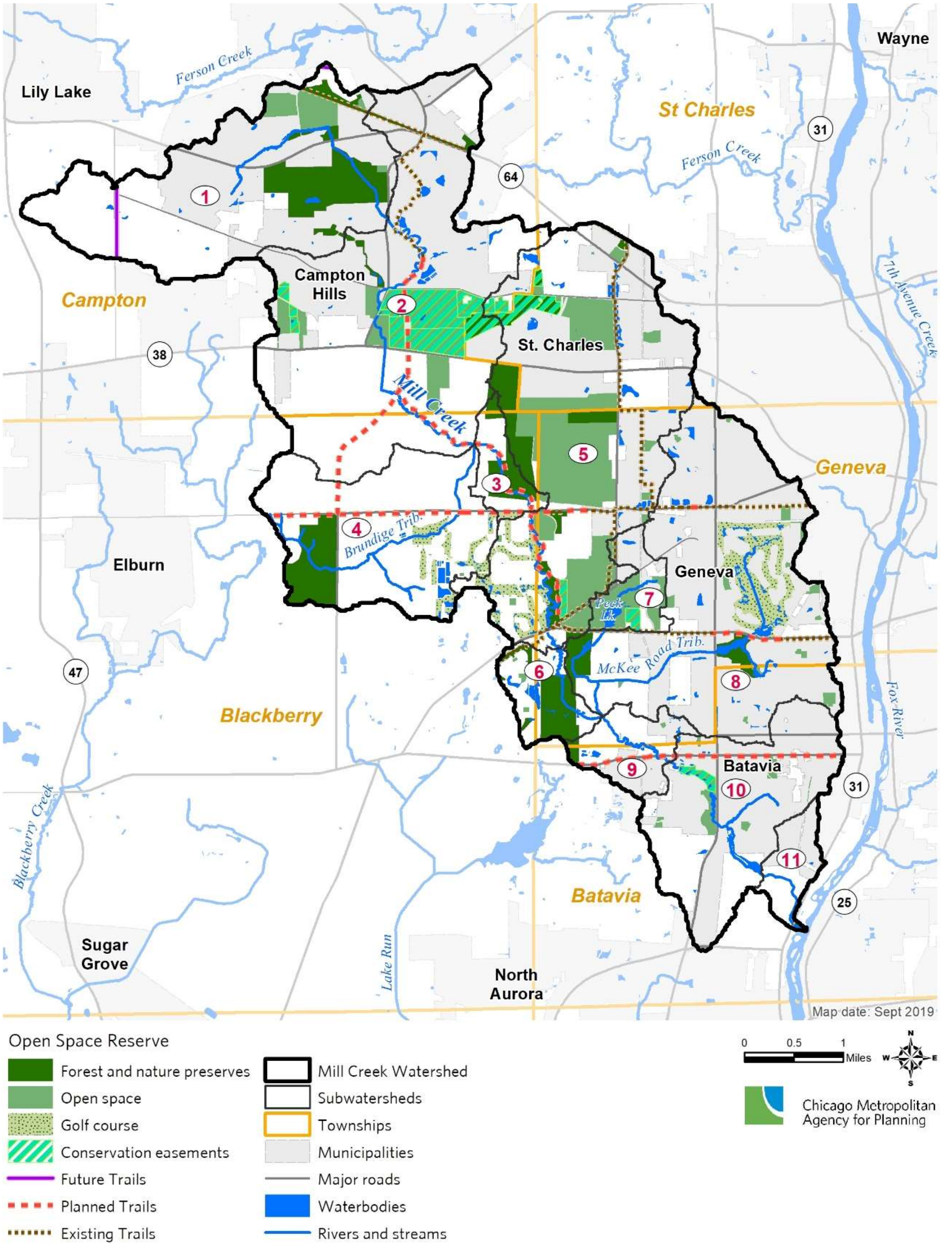
An open space reserve is an area of land and/or water that is protected or conserved such that development will not occur on that location at any time during the foreseeable future. Within the Mill Creek watershed, the reserve encompasses 4,126.2 acres of dedicated open space (Table 19). As shown in Figure 30, over a third of the reserve (approximately 1,500 acres) is owned and managed by municipal and township park districts and another third (approximately 1,357 acres) is owned and managed by the Forest Preserve District of Kane County (FPDKC). Other land holdings in the reserve include greenways and trails, private land protected by conservation easements, golf courses, and nature preserves owned or managed by the Illinois Department of Natural Resources (IDNR). Golf courses were included because many are located within the forest preserves. The open space reserve holdings were compiled from a variety of sources, including the Forest Preserve District of Kane County, the Illinois Department of Natural Resources, the National Conservation Easement Database, Prairie State Conservation Coalition/David Holman, and CMAP land use inventories.

Table 19. Open space reserve holdings in the Mill Creek watershed.[47]

Open Space Reserve	*Area (acres)*	*Percent of Planning Area*
Nature preserves (INPC)	116.1	0.6
Forest preserves (Kane County)	1,357.2	6.8
Parks (Municipal / Park District / Township)	1,500.3	7.5
Greenways and trails	24.3	0.1
Golf courses / other	573.1	2.9
Conservation easements	555.2	2.8
Totals	**4,126.2**	**20.6**

[47] The breakdown of the open space reserve by land holding is less than the total open space land use (18.8 percent) because 864.79 acres (4.3 percent of total open space land use) is dedicated to common open space in a residential development. Conservation easements are added and are not reflected in land use, however they only account for 0.9 percent of the open space reserve.

Figure 30. Open space reserve of the Mill Creek watershed.



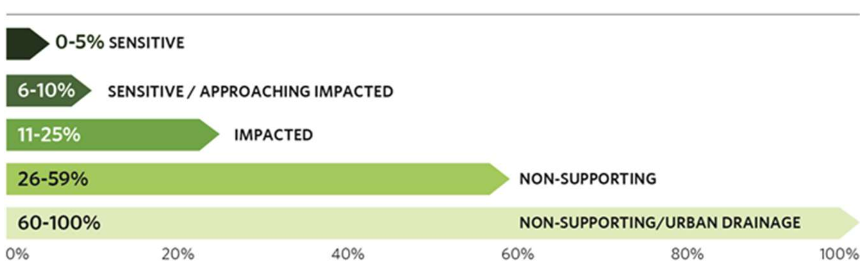
3.4.2.3 Impervious Surface

Impervious surface, that part of the landscape that is paved or covered with nonporous material (e.g., concrete, asphalt, roofs, etc.), prevents infiltration of rain and snowmelt and thus generates runoff and nonpoint source pollution. Impervious surface changes local hydrology which often leads to stream channel downcutting and widening. The resultant erosion of the streambank and streambed further aggravates water quality and can negatively impact land resources and infrastructure. Given the impacts of impervious surface on local hydrology, water quality, and other resources, this man-made feature of the landscape warrants special attention in any effort to protect or restore water quality.

The National Land Cover Database 2011 (NLCD 2011) is applied for the analyses featured in this plan.[48] The NLCD 2011 is the most recent Landsat-based, 30-meter resolution land cover database for the Nation. One product derived from these data is the NLCD 2011 Percent Developed Imperviousness. Each data point or pixel represents a remotely-sensed image of the Earth's surface—at a 30-meter resolution—that has an assigned value of imperviousness, ranging from 0 to 100 percent. Figure 32 displays the pattern and extent of impervious surface within the Mill Creek watershed.[49] Data analysis reveals that over 99 percent of the planning area is covered with varying degrees of imperviousness, 18.8 percent of which is completely impervious.

For purposes of this plan, impervious surface is best understood in the context of its impact on stream quality. The percent of impervious cover is a widely used metric for estimating stream health at the watershed scale.[50] Figure 31 illustrates the relationship between stream health and the degree of impervious surface.

Figure 31. Stream health categories relative to extent of impervious surface.



Source: Center for Watershed Protection (2003)

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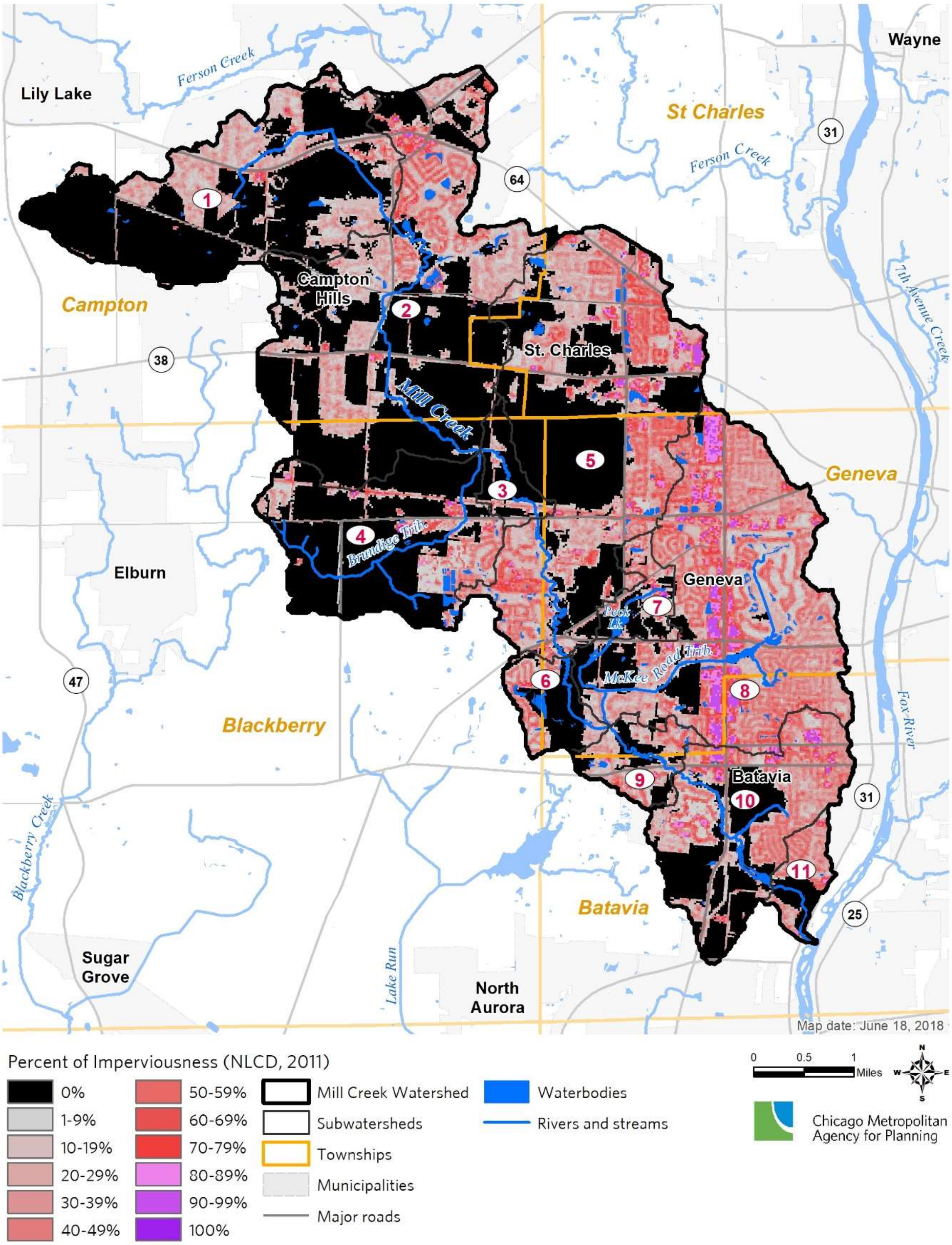
[48] "National Land Cover Database," Multi-Resolution Land Characteristics Consortium (MRLC), last accessed October 17, 2017, http://www.mrlc.gov/

[49] Pixels shaded black feature 0 percent impervious surface. Beginning with shades of gray – from light to dark – and then switching to shades of red – from pink to purple – pixels represent impervious surface from 1-100 percent.

[50] T.R. Schueler, "Is Impervious Cover Still Important? Review of Recent Research," *Journal of Hydrologic Engineering* 14, no. 4 (2009), 309-315.

Figure 32. Impervious surface (0-100%) in the Mill Creek watershed.

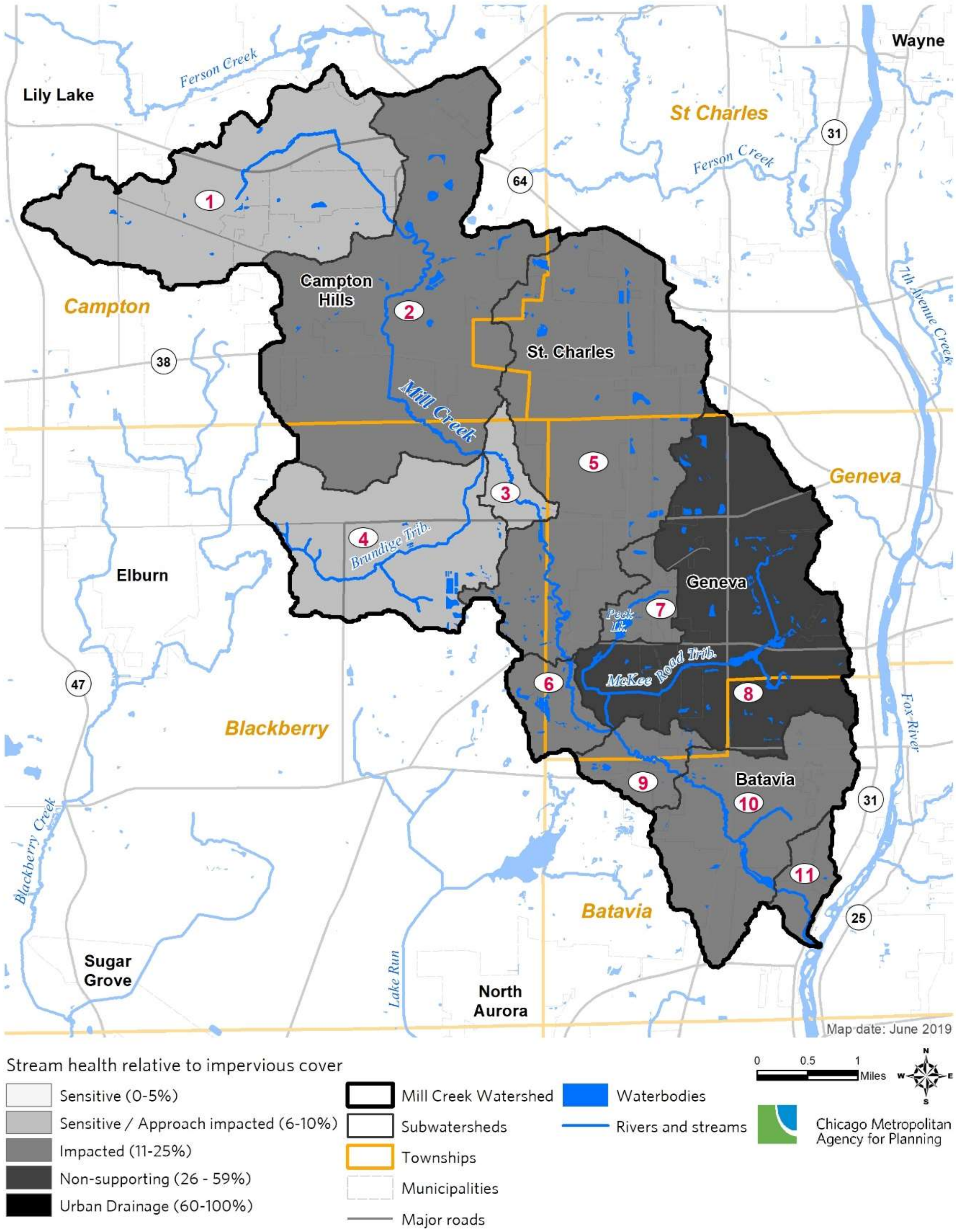


The relationship between impervious surface and stream quality is best examined at smaller units of geography, such as the subwatershed scale. More localized land areas of less spatial extent typically have more direct impacts on the overall health of nearby lakes and streams. Figure 33 and Table 20 shows the relationship between the impervious surface extent for the eleven subwatershed study units within the Mill Creek watershed and the resultant stream health category. The stream health for the majority of the subwatersheds falls under the 'Impacted' category. Study unity #8, which falls under the 'Non-supporting' category has the worst stream health relative to the watershed, while study units #1, 3, and 4 have the best stream health and fall under the 'Sensitive / Approaching Impacted' category.

Table 20. Impervious surface and relationship to stream health by study unit.

Sub'shed #	*Sub'shed Name*	*Area (ac)*	*Imperious Surface Area (ac)*	*Percent Impervious Surface*	*Stream Health Category*
1	Upper Campton	2,823.7	239.8	8.5	Sensitive / Approaching Impacted
2	Lower Campton	4,232.9	496	11.7	Impacted
3	Mill Crk Greenway	302.8	22.1	7.3	Sensitive / Approaching Impacted
4	Brundige Trib	1,961.1	165.3	8.4	Sensitive / Approaching Impacted
5	West St. Charles/ Geneva	3,976.0	863.5	21.7	Impacted
6	Mill Crk Forest Pres.	428.2	65.8	15.4	Impacted
7	Peck Lake	348.5	68.8	19.7	Impacted
8	McKee Rd Trib	3,422.5	1,260.60	36.8	Non-supporting
9	Tanglewood	452.0	95	21	Impacted
10	West Batavia	1,738.9	402.5	23.1	Impacted
11	Les Arends	304.2	75.9	24.9	Impacted
Totals		***19,990.8***	***3,755.20***	***18.8***	***Impacted***

Figure 33. Stream health as a function of the extent of impervious cover



3.4.3 Future Land Use

Assessing future land use across the watershed can provide a better estimate of future imperviousness as well as help prioritize and promote protection measures that will mitigate or reduce anticipated pollutant loads. The future land use of Mill Creek comprise the future land uses identified in county and municipal comprehensive plans and/or zoning maps (Figure 34).[51] It represents the types of uses and development that may come to fruition in the Mill Creek watershed by 2028.[52]

If the incorporated and unincorporated land within the Mill Creek watershed implements its collection of future land use plans, there will be substantial percentage of agricultural land that will shift to single family residential (a 55 percent increase) and commercial (a 45 percent increase) among other land use types (Table 21). This type of shift in land uses can increase impervious cover, and thus, pollutant loads entering Mill Creek and other waterbodies within the watershed. However, the residential development will likely bring a 29 percent increase in open space through common open space often found within single family subdivisions. A full breakdown of the future land use plan by subwatershed is provided in Table 22.

Table 21. Percent change between future and existing land use across the Mill Creek watershed.[53]

Land Use Category	*Existing Area (acres)*	*Future Area (acres)*	*Percent Change*
Single Family Residential	5,077.2	8,920.2	54.9
Multi-family Residential	76.3	86.2	12.2
Commercial	682.9	1,130.8	49.4
Institutional	1,640.6	1,558.4	-5.1
Industrial	188.2	276.3	37.9
Open Space	3,761.8	5,075.0	29.7
Agriculture	5,578.4	904.6	-144.2
T/C/U*	2,324.5	2,037.0	-13.2
Vacant	635.6	0.0	-200.0
Under Construction	22.8	0.0	-200.0
Unclassifiable	0.0	0.0	0.0
Water	2.4	2.4	0.0
Totals	**19,990.8**	**19,990.8**	**100.0**

51 Future land use categories varied by jurisdiction; therefore, all future land use layers were categorized using CMAP's 2013 land use inventory categories for consistency and comparison purposes.

52 Of the communities within the Mill Creek watershed, 2028 is the approximate year at which St. Charles and Geneva have planned for their communities.

53 The future land use layer inherently does not have vacant and under construction land uses.

Figure 34. Projected future land use in the Mill Creek watershed.

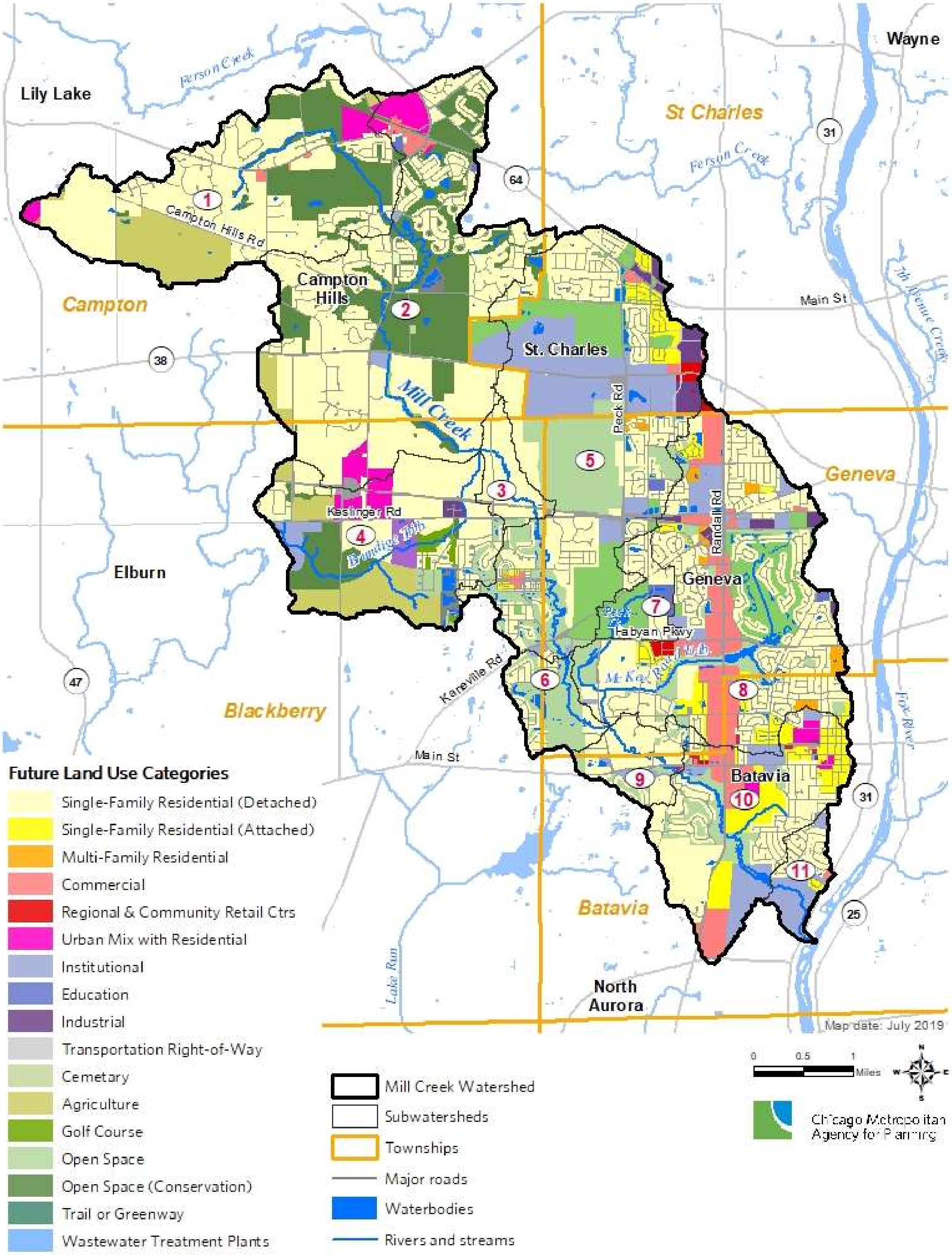


Table 22. Future land use by Mill Creek subwatershed.

	Acres by Subwatershed / Study Unit #					
Land Use Category	*1*	*2*	*3*	*4*	*5*	*6*
Single Family	1,504.7	2,168.6	158.1	639.5	1,158.6	132.8
Multi-family					11.6	
Commercial	89.7	219.5	3.1	96.4	53.3	
Institutional	0.9	84.5		93.0	725.5	4.3
Industrial				93.8	118.7	
Open Space	650.2	1,294.9	121.2	479.1	1,510.7	252.3
Agriculture	409.0	80.7	0.0	414.5	5.0	
T/C/U*	169.1	384.6	20.4	144.7	390.5	38.8
Vacant						
Under Construction						
Unclassifiable						
Water					2.1	
Totals	**2,823.7**	**4,232.9**	**302.8**	**1,961.1**	**3,976.0**	**428.2**

	Acres by Subwatershed / Study Unit #				
Land Use Category	*7*	*8*	*9*	*10*	*11*
Single Family	102.5	1,463.2	307.2	890.4	107.5
Multi-family		71.8		2.7	
Commercial		429.8	1.3	249.7	4.5
Institutional	57.4	205.8	30.9	202.4	146.2
Industrial		57.3		4.7	
Open Space	152.3	622.9	65.2	191.2	9.9
Agriculture					
T/C/U*	36.3	571.7	47.4	197.7	35.8
Vacant					
Under Construction					
Unclassifiable					
Water					0.3
Totals	**348.5**	**3,422.5**	**452.0**	**1,738.9**	**304.2**

3.4.3.1 Future Impervious Surface

The effects future development can have on a watershed are best illustrated through stream health relative to impervious cover projections that are based on the watershed's future land use. Using the future land use identified by the communities within the Mill Creek watershed, CMAP assigned impervious cover coefficients to each future land use category to estimate the watershed's future imperviousness. Impervious Cover coefficients (IC) vary by region, land use, and land cover. Coefficients used in the Mill Creek watershed were identified from a Center for Watershed report on impervious cover in the Chesapeake Bay Watershed, a USGS report on impervious surfaces, and an impervious surface coefficient guide from EPA's Office of Health Hazard Assessment.[54, 55, 56] Land use-specific coefficients were used from with the exception of water, wetlands, and crops, which used land cover-specific coefficients. Since agriculture is a primary land use within the Mill Creek watershed, future crops were accounted for by assuming any 2017 crops that overlapped with future open space and institutional land uses would be present in the future.[57] It was also assumed that existing water and wetlands would remain the same in the future.

The percent of imperviousness was then evaluated at the subwatershed scale in an attempt to understand future stream health using Schueler's method for measuring stream health (Figure 35. Stream health based on future imperviousness.).[58] Subwatersheds that are projected to see an increase in imperviousness that in 40 percent or greater than the existing imperviousness (in ascending order) are subwatershed #s 3, 4, 10, and 1 (Table 23). Although subwatershed #5 is only projected to increase its imperviousness by 2.4 percent, the increase was enough to shift it into the "Non-supporting" Stream Health category because its initial imperviousness was at the high end of the "Impacted" Stream Health category.

Moving into the future, constituents of the Mill Creek watershed should evaluate the effects future development can have on water quality. In an effort to mitigate negative impacts of imperviousness, municipalities should consider infill, low-impact, and/or cluster development

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[54] Center for Watershed Protection (2001), "Impervious Cover & Land Use in Chesapeake Bay Watershed," https://owl.cwp.org/?mdocs-file=5033

[55] Tilley, J.S., and Slonecker, E.T., 2006, Quantifying the Components of Impervious Surfaces: U.S. Geological Survey Open-File Report 2006-1008, 33 p.

[56] EPA, Office of Health Hazard Assessment (2008), "Impervious Surface Coefficients A tool for environmental analysis and management," https://oehha.ca.gov/media/downloads/ecotoxicology/fact-sheet/iscfacts072208_0.pdf

[57] Crops for 2017 are based on USDA's 2017 Cropland Data Layer from the National Agricultural Statistics Service. Since this is a raster dataset, there are likely discrepancies in the acreage because a selection of pixels at a 30 meter resolution for used to remove "erase" open space and institutional land uses from the future land use vector layer.

[58] The data and method used to calculate existing imperviousness as presented in Section 3.4.2.3 of this Plan uses USGS's NLCD Impervious land cover layer for 2016, whereas the analysis of future imperviousness primarily uses land use type; therefore, the method used to calculate future imperviousness was re-applied to CMAP 2013 land use for the Mill Creek watershed. Therefore, percent changes are based on acreages produced by the same method.

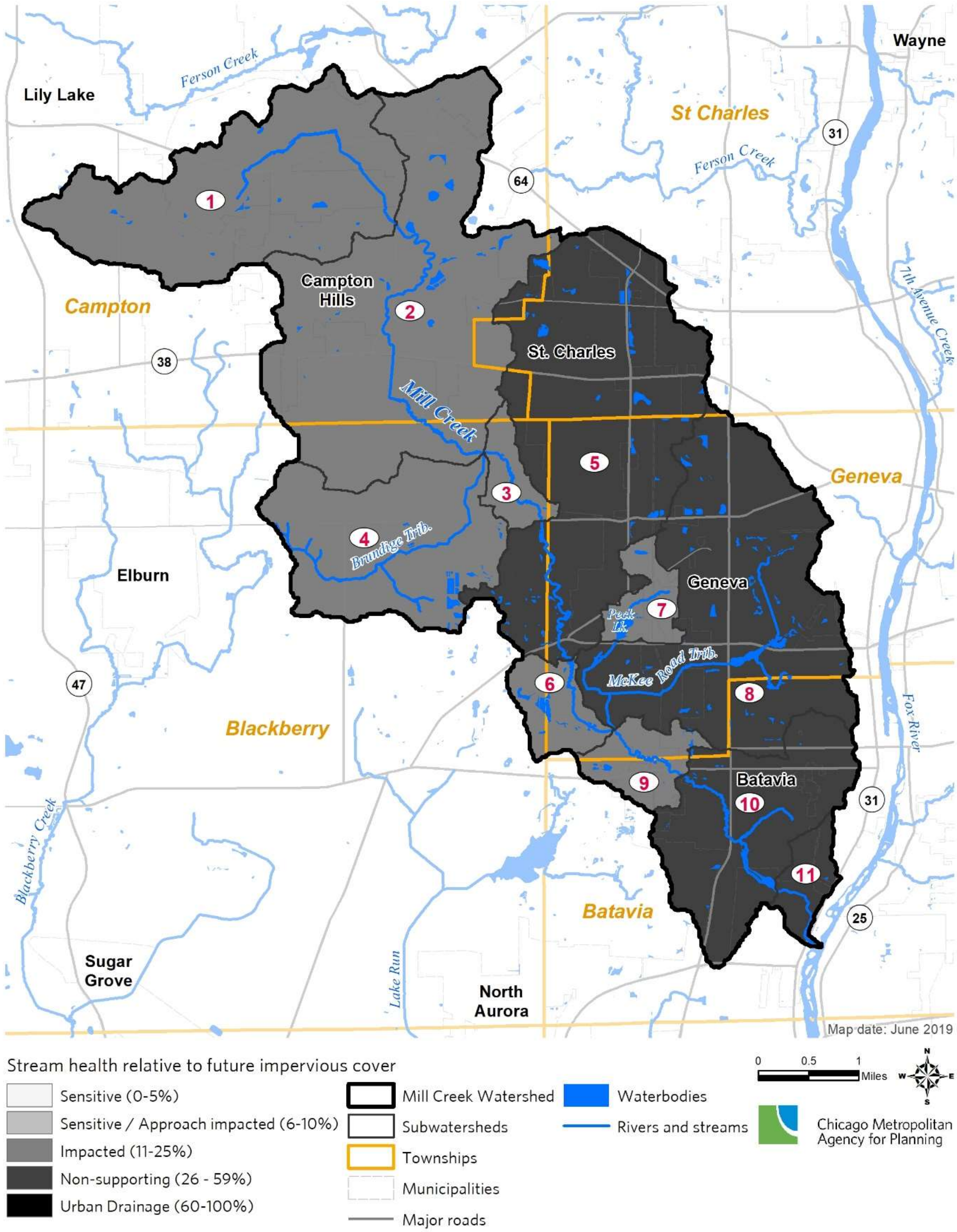
opportunities that promote water quality protection and preservation of agricultural and natural areas – land uses that have more permeable qualities than developed land uses. Land owners and managers can help with water quality protection by incorporating water quality BMPs into the existing landscape as well. Homeowner and businesses can install rain gardens and permeable pavement, farmers can restore wetlands and incorporate bioreactor buffers to agricultural land, and county and public works officials can add infiltration and vegetated swales along roads. Efforts like these can help mitigate pollutant loadings caused by a more developed watershed.

Table 23. Future Impervious surface and relationship to stream health by study unit.

Sub'shd #	*Area (ac)*	*Existing Impervious Surface Area[59] (ac)*	*Future Impervious Surface Area (ac)*	*Future Percent Impervious Surface*	*Percent Change (Existing & Future)*	*Future Stream Health Category*	*Stream Health Category Shift*
1	2,823.7	293.5	446.9	15.8	41.2	Impacted	Yes
2	4,232.9	697.4	835.1	19.7	17.7	Impacted	No
3	302.8	29.1	49.9	16.5	52.9	Impacted	Yes
4	1,961.1	234.5	364.4	18.6	43.1	Impacted	Yes
5	3,976.0	997	1,020.8	25.7	2.4	Non-supporting	Yes
6	428.2	78.8	93.4	21.8	16.9	Impacted	No
7	348.5	66.9	80.1	23.0	18.0	Impacted	No
8	3,422.5	1,374.80	1,482.8	43.3	7.4	Non-supporting	No
9	452.0	84.9	101.2	22.4	17.5	Impacted	No
10	1,738.9	437.6	677.2	38.9	42.7	Non-supporting	Yes
11	304.2	77.5	85.7	28.2	10.1	Non-supporting	Yes
Totals	***19,990.8***	***4,372.0***	***5,237.3***	***26.2***	***17.9***	***Non-supporting***	**Yes**

[59] Existing impervious surface area based on CMAP's 2013 land use for the Mill Creek watershed used the the future impervious surface methodology.

Figure 35. Stream health based on future imperviousness.



3.5 Water Resource Conditions

3.5.1 Surface Water Quality

3.5.1.1 Designated Uses, Assessment, and Impairment Status

The Illinois Integrated Water Quality Report (Integrated Report) and Section 303(d) List comprise a major source of information available for assessing stream health and identifying sources of impairment on the part of watershed planning initiatives statewide. These documents are released every two years by the Illinois Environmental Protection Agency (Illinois EPA), with the most recent Integrated Report issued in 2016. The purpose of the Integrated Report is to provide water quality data for both surface and ground waters and to fulfill Section 303(d) of the federal Clean Water Act and the Water Quality Planning and Management regulation at 40 CFR Part 130 for the State of Illinois.[60]

This watershed plan focuses on the surface water data as it relates to waterbodies within the Mill Creek watershed. The Integrated Report seeks to assess the extent to which waterbodies support a set of recognized designated uses. Each designated use has a related standard for which the designated use for that stream or lake is protected. Illinois EPA has seven possible designated uses; however, only five of those uses apply within the Mill Creek watershed. These are Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, and Aesthetic Quality. A waterbody is considered not fully supporting of a designated use if it does not meet the related standard. These standards are derived from several types of information including biological data, water chemistry, instream habitat, and toxicity data. Table 24 shows the three tier rating system associated with each standard.

Table 24. Levels of designated use attainment.

Level of use support	*General resource quality*	*Relationship to water quality standard*	*Impaired? (on 303(d) list)*
Fully Supporting	Good	Meets Standard	No
Not Supporting	Fair	Does not meet standard	Yes
Not Supporting	Poor	Does not meet standard	Yes

Waters found to be not fully supporting of any of the seven designated uses as an outcome of an assessment are said to be impaired and placed on the 303(d) List. Removing waterbodies from the 303(d) List is a main objective of watershed planning projects. Only a few waterbodies (stream segments) in the Mill Creek watershed have been assessed for water quality impairments (Figure 36). The following tables (Table 25 through Table 28) summarize the

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[60] Illinois Environmental Protection Agency, Bureau of Water, *Illinois Integrated Water Quality Report and Section 303(d) List, 2012*. Illinois: IEPA, 2012, http://www.epa.state.il.us/water/tmdl/303d-list.html, (accessed February 2, 2015).

designated uses, assessment status, impairment status, and causes and sources of impairment for waterbodies within the watershed as identified in the Integrated Report for 2016.[61]

Table 25. Specific assessment information for streams in the Mill Creek watershed, 2016.

AUID	Stream Name	Miles	Use Attainment	Causes	Sources
IL_DTZL-01	Mill Creek-North	3.34	X582, X583, N585, X590	400	177
IL_DTZL-02	Mill Creek-North	11.10	X582, X583, X585, X590	N/A	N/A

Table 26. Specific assessment information for lakes in the Mill Creek watershed, 2016.

AUID)	Lake Name	Acres	Use Attainment	Causes	Sources
IL_STE	Peck Lake	18.95	X582, X583, X585, X590	N/A	N/A

Table 27. Use support information for streams in the Mill Creek watershed, 2016.

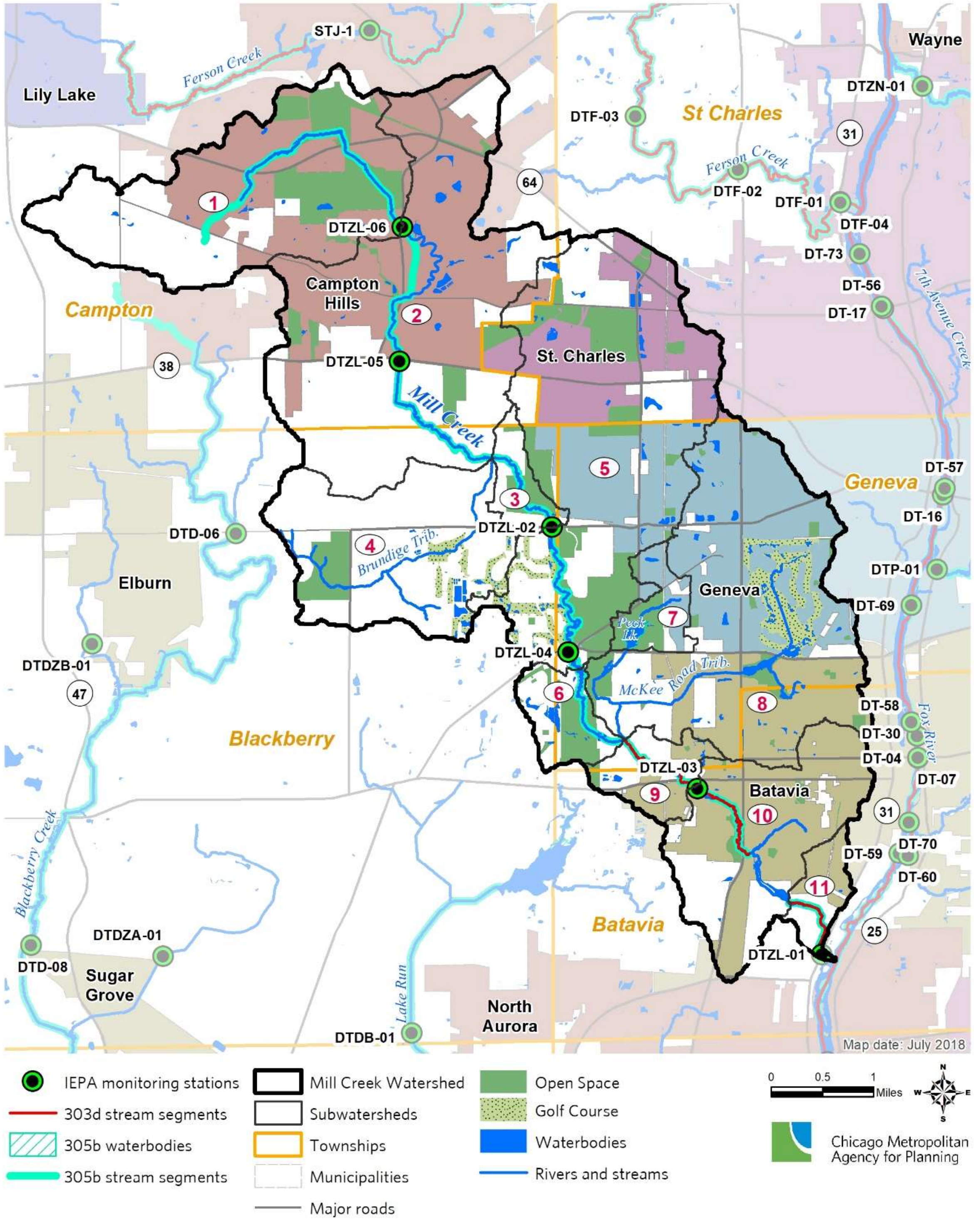
	Stream Miles			
Designated Use	Fully Supporting (F)	Not Supporting (N)	Insufficient Information (I)	Not Assessed (X)
Aquatic Life (582)	---	---	---	14.44
Fish Consumption (583)	---	---	---	14.44
Primary Contact (585)	---	3.34	---	11.10
Aesthetic Quality (590)	---	---	---	14.44
Total Stream Miles: 14.44				

Table 28. Use support information for lakes in the Mill Creek watershed, 2016.

	Lake Acres			
Designated Use	Fully Supporting (F)	Not Supporting (N)	Insufficient Information (I)	Not Assessed (X)
Aquatic Life (582)	---	---	---	18.95
Fish Consumption (583)	---	---	---	18.95
Primary Contact (585)	---	---	---	18.95
Aesthetic Quality (590)	---	---	---	18.95
Total Lake Acres: 18.95				

[61] Illinois Environmental Protection Agency, Integrated Water Quality Report and 303d Lists, 2016, http://www.epa.illinois.gov/topics/water-quality/watershed-management/tmdls/303d-list/index

Figure 36. Illinois EPA monitoring stations and waterbody impairment status in the Mill Creek watershed.



The following tables summarize the cause of the impairment (Table 29) and the source of the impairment (Table 30) for the one assessed stream segment within the Mill Creek planning area as identified in the 303(d) list (Appendix A-2) of the 2016 Integrated Report. The Clean Water Act requires that a Total Maximum Daily Load (TMDL) be developed for each pollutant of an impaired water body. However, no TMDL has been developed for the impaired segment (IL_DTZL-01) of Mill Creek.

Table 29. Causes of impairments for streams in the Mill Creek watershed, 2016.

Cause ID	Cause Of Impairment	305(b) Stream Miles Impaired	Percentage of Total 305(b) Stream Miles
400	Fecal Coliform	3.34	23.13
	Total Stream Miles: 14.44		

Table 30. Sources of impairment for streams in the Mill Creek watershed, 2016.

Source ID	Source Of Impairment	305(b) Stream Miles Impaired	Percentage of Total 305(b) Stream Miles
177	Urban Runoff/Storm Sewers	3.34	23.13
	Total Stream Miles: 14.44		

3.5.1.2 Other Biological Studies

Fish Assemblages

Fish surveys have been conducted in Mill Creek by Illinois DNR Region 2 streams biologists in 2004 and 2017. In July 2004, six locations were surveyed as part of Region 2's subwatershed intensive survey program. In 2017, one site (DTZL-03) was surveyed in August as part of the Fox River Basin Intensive Survey in cooperation with Illinois EPA, and three additional sites were surveyed in September at the request of CMAP (DTZL-01, -05, and -06). Summary data including IBI scores are provided in Table 31, and a species list is provided in Table 32.[62] Station locations can be seen in Figure 36. Of note, two species identified in the Illinois Wildlife Action Plan as "species of greatest conservation need"[63] were collected in Mill Creek: blacknose dace (*Rhinichthys atratulus*) and Iowa darter (*Etheostoma exile*) based on eight criteria including federal or state endangered or threatened species as well as rare populations, declining populations, and vulnerable habitat in Illinois. The Iowa darter is on the state's Threatened and Endangered species list as threatened.

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[62] Data provided by Stephen Pescitelli and Tristan Widloe, Illinois DNR Region 2 Streams Biologists, via email correspondence.

[63] See https://www.dnr.illinois.gov/conservation/IWAP/Pages/default.aspx and https://www.dnr.illinois.gov/conservation/IWAP/Documents/SGCN2015%20Appendix%201.pdf (accessed Aug. 2019).

Table 31. Fish species totals and IBI scores for Mill Creek stations, 2004 and 2017.

Station		2004		2017	
Code	Description	Total spp.	IBI	Total spp.	IBI
DTZL-01	downstream of Mooseheart dam	18	39	14	28
DTZL-02	Brundige Rd	14	36	---	---
DTZL-03	Tanglewood	9	25	11	20
DTZL-04	Fabyan Pkwy	11	27	---	---
DTZL-05	Garfield Farm	13	42	13	38
DTZL-06	Fox Mill	8	21	10	23

Table 32. Fish species collected at Mill Creek stations, 2017.

Common name	*Scientific name*	# collected
Carp	*Cyprinus carpio*	16
Golden shiner	*Notemigonus crysoleucas*	1
Creek chub	*Semotilus atromaculatus*	275
Hornyhead chub	*Nocomis biguttatus*	78
Central stoneroller	*Campostoma anomalum*	129
Suckermouth minnow	*Phenacobius mirabilis*	2
Blacknose dace	*Rhinichthys atratulus*	20
Common shiner	*Luxilius cornutus*	22
Spotfin shiner	*Cyprinella spiloptera*	31
Bluntnose minnow	*Pimephales notatus*	304
Bigmouth shiner	*Notropis dorsalis*	7
Quillback	*Carpiodes cyprinus*	30
White sucker	*Catostomus commersoni*	69
Yellow bullhead	*Ameiurus natalis*	41
Black bullhead	*Ameiurus melas*	12
Black crappie	*Pomoxis nigromaculatus*	4
Largemouth bass	*Micropterus salmoides*	34
Smallmouth bass	*Micropterus dolomieu*	12
Green sunfish	*Lepomis cyanellus*	96
Bluegill x Green sunfish hybrid	*Lepomis macrochirus x L. cyanellus*	2
Bluegill	*Lepomis macrochirus*	108
Longear sunfish	*Lepomis megalotis*	20
Johnny darter	*Etheostoma nigrum*	10
Fantail darter	*Etheostoma flabellare*	39
Iowa darter *T*	*Etheostoma exile*	1

Mussel Populations

In 2009, the Illinois Natural History Survey began a study of freshwater mussel populations at wadeable sites in 33 stream basins across Illinois in conjunction with the Illinois DNR / Illinois EPA intensive basin surveys. Streams in the Fox River basin were surveyed between 2010 and 2012,[64] including Mill Creek at station DTZL-01 in the Les Arends Forest Preserve. Table 33 provides the results of that survey.

Table 33. Mussel species collected at Mill Creek station DTZL-01, 2012.

Common name	***Scientific name***	***# live indiv. collected***
Elktoe	*Alasmidonta marginata*	R
White heelsplitter	*Lasmigona complanata*	D
Giant floater	*Pyganodon grandis*	10
Paper pondshell	*Utterbackia imbecillis*	2
Mapleleaf	*Quadrula quadrula*	1
Pocketbook	*Lampsilis cardium*	31
Lilliput	*Toxolasma parvum*	1
Ellipse	*Venustaconcha ellipsiformis* *	R
	Live individuals collected	45
	Live species collected	5
	Extant species	6
	Total species collected	8
	Mussel Community Index (MCI)	8
	Resource Classification	Moderate

D = dead shells, R = relict shells, Extant species = live + dead shell, Total species = live + dead + relict shell.
* = Illinois Wildlife Action Plan "species of greatest conservation need"

FPDKC staff conducted a mussel survey in through about 600 meters of Mill Creek at the southern end of Mill Creek Greenway Forest Preserve on August 16, 2019. They found 14 total mussels over 10.5 man-hours. The only species found were white heelsplitters (10) and giant floaters (4). No juveniles were noted. Using that information, when rated by the IDNR, the freshwater mussel resource value rates out at a 6, or of "limited" value.[65]

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[64] Schanzle, R.W., G.W. Kruse, J.A. Kath, R.A. Klocek, K.S. Cummings. 2004. The Freshwater Mussels (Bivalvia:Unionidae) of the Fox River Basin, Illinois and Wisconsin. Illinois Natural History Survey, Biological Notes, No. 141. https://www.ideals.illinois.edu/handle/2142/95902

[65] Patrick Chess, FPDKC, personal correspondence, August 30, 2019.

An informal walk by FPDKC staff in Mill Creek through the Deerpath conservation easement (an area just upstream of Randall Road) on August 13, 2019, found live white heelsplitters and Wabash pigtoe (*Fusconaia flava*). Relict shells were found for giant floater, Wabash pigtoe, round pigtoe (*Pleurobema sintoxia*), white heelsplitter, creek heelsplitter (*Lasmigona compressa*), and cylindrical papershell (*Anodontoides ferussacianus).*[66]

3.5.2 Physical Stream Conditions

CMAP staff conducted an inventory of physical conditions along the main stem Mill Creek during summer and early fall 2018. The inventory documented several elements including channel conditions (bank erosion, channel dimensions, bank vegetation), hydraulic structures (e.g., bridges, culverts), point discharges (e.g., pipes, ditches), substrate composition (e.g., gravel, sand, clay), water quality indicators (filamentous algae, oil and grease), types of fish habitat, observations of aquatic plants and animals, and vegetation types within the stream corridor. The stream inventory work utilized a field data form (Stream Inventory Report Form, SIRF, Appendix A) modified from a similar form initially developed and used by the Lake County Stormwater Management Commission (LCSMC), and following the stream assessment methodology utilized by LCSMC along with guidance provided by USDA-NRCS[67], the Center for Watershed Protection[68], and Ohio EPA[69].

For the field work, the stream was generally divided into approximate 1,500 – 2,500 foot sections or "reaches" based on relative homogeneity within a reach (e.g., sinuosity, adjacent land use/cover) and identifiable beginning and end points (e.g., road crossings) as initially determined from aerial photos. Mill Creek was divided into 41 reaches from its confluence with the Fox River to its headwaters in Campton Hills (Figure 37). The stream was always waded in an upstream direction. One SIRF was filled out for each reach. At the beginning and end of each reach, a GPS waypoint and representative photo were taken. A photo and GPS waypoint were also taken at each hydraulic structure, point discharge, debris blockage, and areas exhibiting a moderate or high degree of erosion. At three to four representative locations in each reach, measurements of bank height, bank slope, water depth, and top and bottom channel width were recorded along with a GPS waypoint. All GPS waypoint and photo numbers were recorded on the SIRF. Formal macroinvertebrate and fish surveys were not conducted, though staff did make note of any aquatic or terrestrial organisms they observed. This data was used for mapping several key stream condition aspects, descriptions of which follow below.

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[66] Patrick Chess, FPDKC, personal correspondence, Sept. 10, 2019.

[67] USDA-NRCS NWCC. 1998. Technical Note 99-1, Stream Visual Assessment Protocol.

[68] CWP. 2005. Unified Stream Assessment: A User's Manual, version 2.0.

[69] Ohio EPA. 2006. Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI). Technical Bulletin EAS/2006-06-01.

The stream inventory focused on the main stem of Mill Creek. Certain Mill Creek reaches, the two major tributaries (McKee Road Tributary and Brundige Tributary), as well as those that CMAP termed Peck Lake Drain (Tributary) and Mooseheart Tributary, were not readily accessible either due to private property restrictions or water depths too deep to wade. In summary, 31 of Mill Creek's 41 reaches were assessed in the inventory, accounting for 12.3 out of 15.9 miles of Mill Creek (Table 34).

Table 34. Total versus assessed stream miles in the Mill Creek watershed.

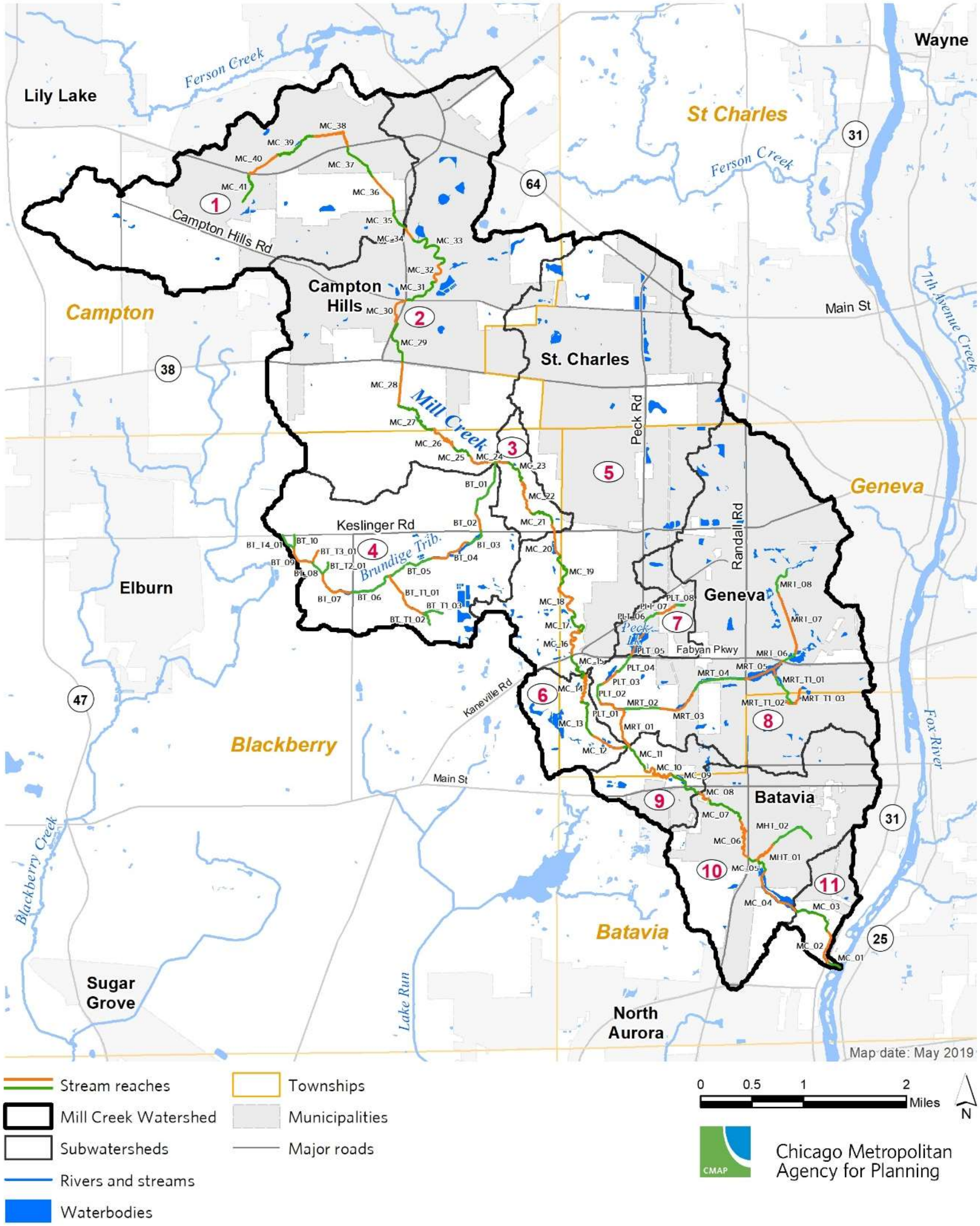
	Mill Creek	McKee Rd. Tributary	Brundige Tributary	Totals
Total stream miles	15.9	3.2	4.6	23.7
Stream miles assessed	12.3	0	0	12.3
Percent assessed	77.1%	0%	0%	51.9%

3.5.2.1 Stream Network

Mill Creek's headwaters lie in a Village of Campton Hills subdivision approximately a half mile west of the Campton Forest Preserve. The creek meanders in a generally southeast direction and junctures at the Fox River in the unincorporated area of Mooseheart.

Figure 37 displays the stream network divided into reaches, each with a standardized systematic code [MC = Mill Creek, MRT = McKee Road Tributary, BT = Brundige Tributary, PLT = Peck Lake Drain (Tributary), MHT = Mooseheart Tributary]. The stream line is based on a "Kane County's Creeks" shapefile provided by the Kane County GIS Technologies Department in December 2015.

Figure 37. Stream reaches in the Mill Creek watershed.



3.5.2.2 Channelization

Channelization indicates the straightening, deepening, and/or widening of a stream by humans. Channelization is done for a variety of reasons, including to improve the utility or economic use of riparian lands and floodplains, reduce upstream drainage or flooding problems, and to change the aesthetic character of the riparian zone.[70] However, channelization destroys in-stream and riparian habitat, disconnects the stream from its floodplain (contributing to increased downstream flooding), causes channel instability, and increases streambank erosion. In areas where the purpose of historical channelization no longer exits, these adverse consequences remain today. Opportunities for re-meandering and reconnecting the stream with its floodplain should be pursued wherever possible.

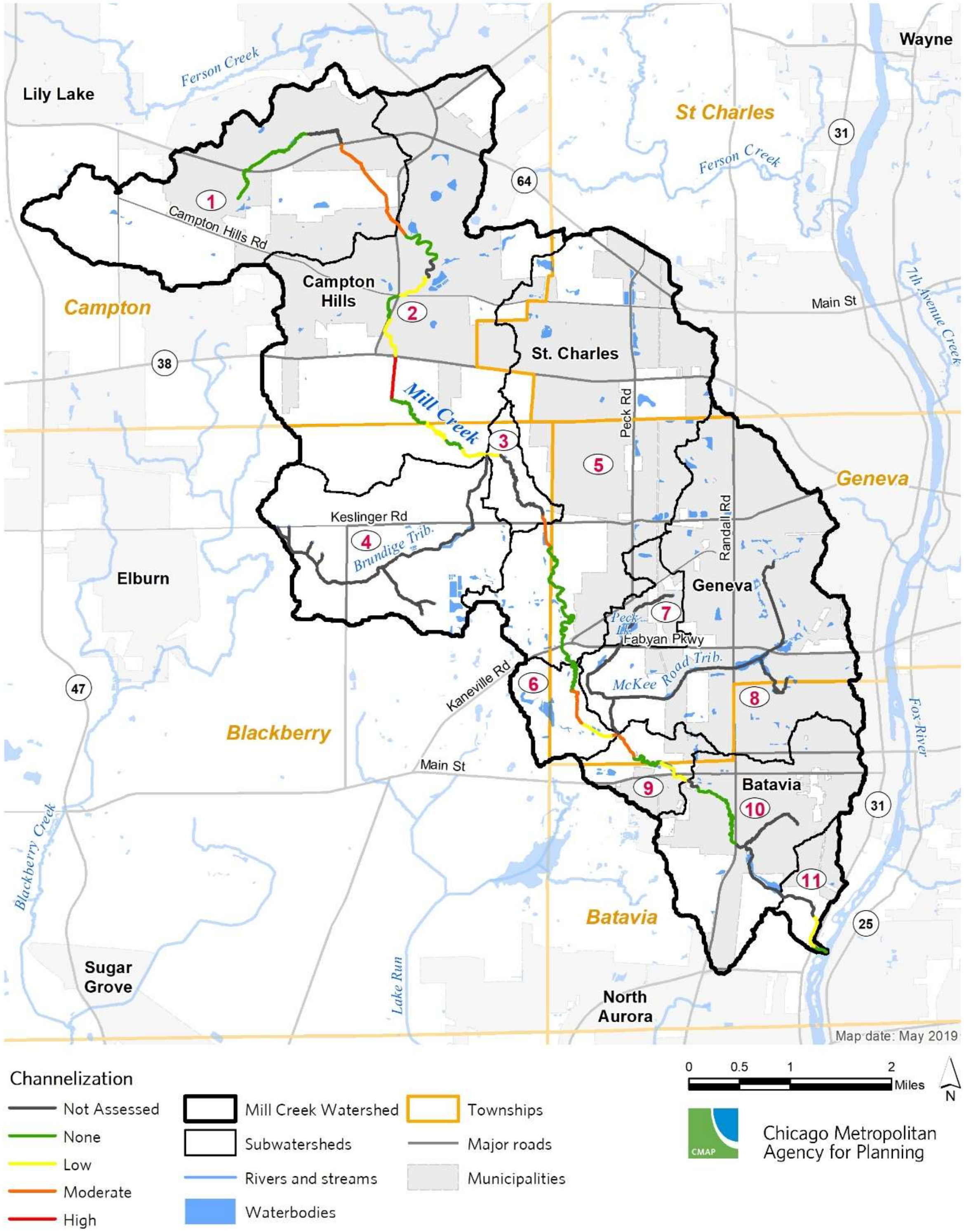
Figure 38 displays and Table 35 enumerates the degree of channelization for the assessed reaches of Mill Creek during the 2018 stream assessment.

Table 35. Degree of channelization for assessed stream reaches in the Mill Creek watershed, 2018.

Degree of Channelization	Mill Creek			
	# of Reaches	**Reach Length (ft)**	**Reach Length (mi)**	**% of Reach Length**
None	17	37,689	7.2	45.0%
Low	7	14,796	2.8	17.5%
Moderate	7	12,075	2.3	14.4%
High	1	2,177	0.4	2.6%
Not assessed	9	17,399	3.3	20.6%
Totals	***41***	***84,136***	***15.9***	***100%***

[70] Dreher, D. and L. Heringa. 1998. Restoring and Managing Stream Greenways: A Landowner's Handbook. Prepared by Northeastern Illinois Planning Commission for Chicago Region Biodiversity Council.

Figure 38. Degree of channelization for assessed stream reaches in the Mill Creek watershed, 2018.



3.5.2.3 Streambank Erosion

Streambank erosion is a natural process and contributes to the sinuous, meandering form often associated with natural stream channels. In relatively natural systems, there typically is a balance between the amount of material eroded from one streambank and the amount of sediment deposited on another. However, in urbanized or rapidly developing watersheds, changes in watershed hydrology can accelerate streambank erosion rates that lead to several problems. Erosion can cause physical water quality problems such as increased or excessive turbidity in the water. Erosion can also lead to sedimentation, which is the deposition of sediment within the stream channel. Sedimentation reduces the volume of water that can be conveyed and covers existing streambed materials such as gravel, which are important habitat for macroinvertebrates and fish. Additionally, erosion can lead to 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 downcutting and/or widening of the stream channel, which can contribute to loss of land, property, or structures.

The degree of bank erosion was assessed using the following classifications:

- **None/Minimal:** banks stable; banks low (at floodplain elevation); evidence of erosion or bank failure absent or minimal; little potential for future problems; less than 5% of bank affected.

- **Low:** Moderately stable; banks low (at floodplain elevation); infrequent, small areas of erosion mostly healed over or protected by roots extending to baseflow elevation; 5-33% bank has areas of erosion.

- **Moderate:** Moderately unstable; banks may be low but usually high; 33-66% of bank has areas of erosion (typically outside bends); high erosion potential during floods.

- **High:** Unstable; banks may be low but typicallyhigh; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 66-100% of bank with erosional scars.

Figure 39 displays the degree of bank erosion for the assessed reaches of Mill Creek during the 2018 stream assessment. In a few reaches, the right and left banks were different by one erosion level; thus, the worse case is displayed in the figure and enumerated in Table 36.

Figure 39. Degree of streambank erosion in assessed reaches of Mill Creek, 2018.

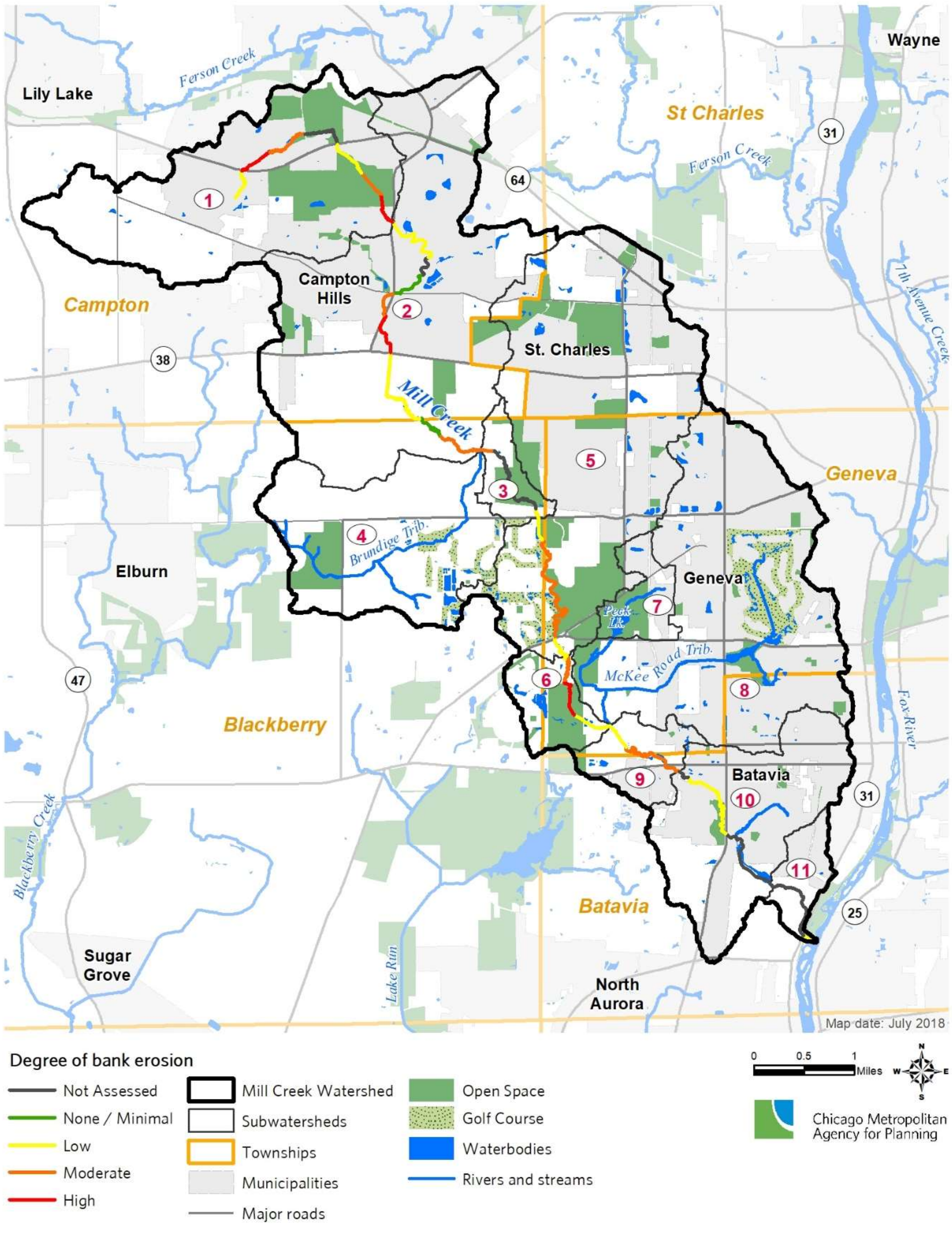


Table 36. Degree of bank erosion for assessed stream reaches in the Mill Creek watershed, 2018.

Degree of Bank Erosion	Mill Creek			
	# of Reaches	Reach Length (ft)	Reach Length (mi)	% of Reach Length
None/Minimal	2	4,451	0.8	5.3%
Low	13	26,779	5.1	31.9%
Moderate	12	25,296	4.8	30.2%
High	4	8,357	1.6	9.9%
Not assessed	10	19,253	3.6	22.8%
Totals	***41***	***84,136***	***15.9***	***100%***

3.5.2.4 Riparian Condition

Riparian condition can be measured by a thorough assessment of riparian buffers, which are the vegetated areas near a stream. Riparian buffers are comprised of grasses, grass-like forbs, shrubs, trees, or other vegetation growing along streams. Vegetated riparian buffers are important to stream health because they make streambanks more resistant to erosion, act as filters for runoff and pollutants, provide shade to the stream, offer habitat for wildlife, and can be important links in a watershed's green infrastructure network. Typically, the wider the buffer, the better the pollutant removal and habitat values it provides.[71]

The relative quality of vegetated riparian buffers of the Mill Creek watershed was visually assessed during the inventory, and the width was validated with high-resolution aerial imagery. The following guidance was used to assign a relative quality category for the left and right side of each reach:

- **Poor:** Width of riparian zone <10 feet; little or no native riparian vegetation due to human activities; stream prob. not hydrologically connected to floodplain.
- **Marginal:** Width of riparian zone 10-25 feet; human activities have impacted zone a great deal; likely degraded plant communities; stream may not be hydrologically connected to floodplain.
- **Fair:** Width of riparian zone >25-50 feet; human activities have impacted zone minimally; somewhat degraded plant communities; at least some hydrological connection to stream.
- **Good:** Width of riparian zone >50-100 feet; human activities (parking lots, roadbeds, lawns, crops) have not impacted zone; minimally degraded plant communities; stream hydrologically connected to floodplain (often wetlands).

[71] SEWRPC, 2010. *Managing the water's edge: Making natural connections*. Waukesha, WI. Accessed Jan. 30, 2018. http://www.sewrpc.org/SEWRPCFiles/Publications/ppr/rbmg-001-managing-the-waters-edge.pdf

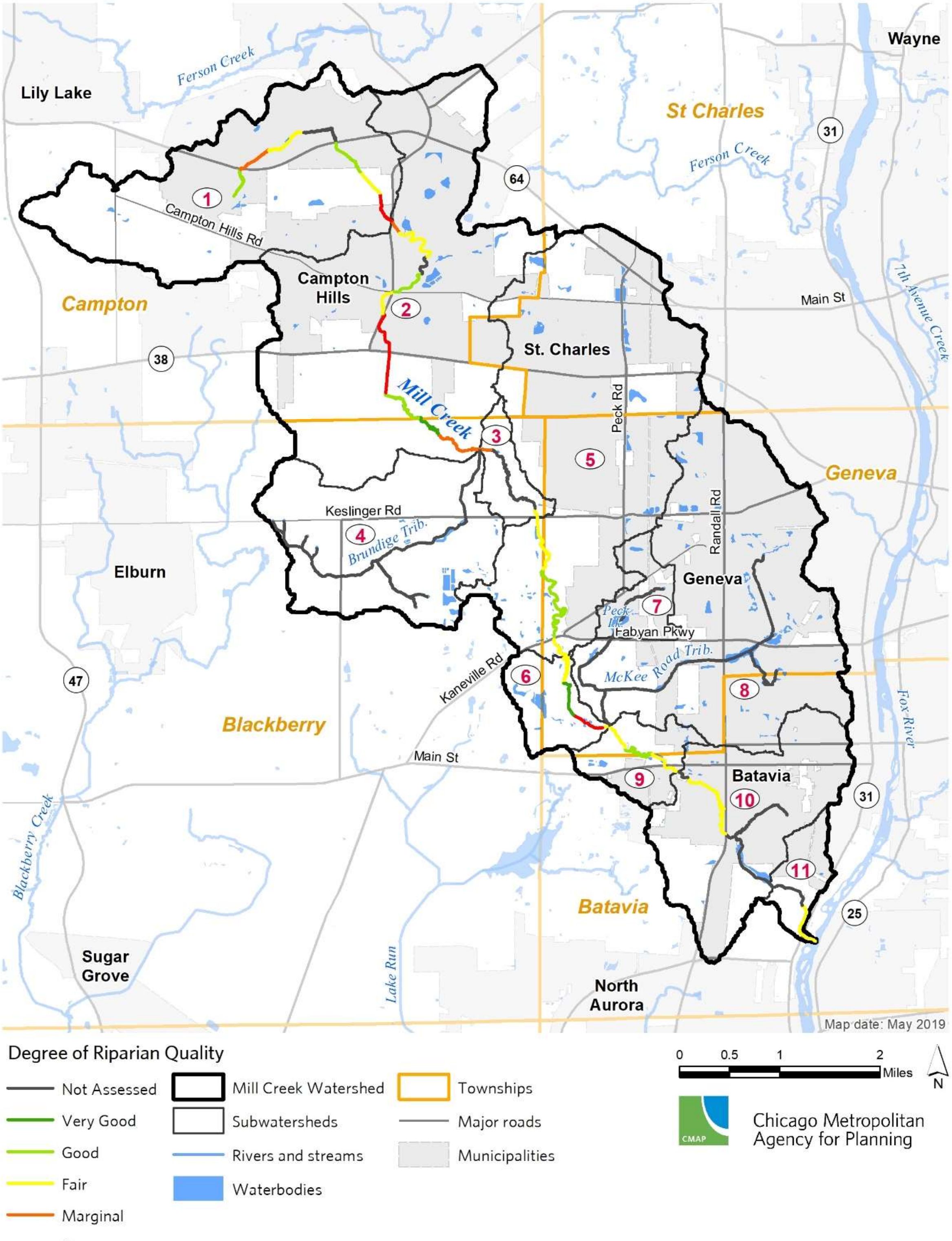
- **Very Good:** Width of riparian zone >100 feet; human activities (parking lots, roadbeds, lawns, crops) have not impacted zone; minimally degraded plant communities; stream hydrologically connected to floodplain (often wetlands).

Figure 40 displays the riparian zone quality for the assessed reaches of Mill Creek during the 2018 stream assessment. In a few reaches, the right and left banks were different by one level; thus, the worse condition is displayed in the figure and enumerated in Table 37.

Table 37. Average riparian buffer quality in the Mill Creek watershed, 2018.

Riparian Zone Quality	Mill Creek			
	# of Reaches	Reach Length (ft)	Reach Length (mi)	% of Reach Length
Poor	4	8,247	1.6	9.8%
Marginal	4	6,159	1.2	7.3%
Fair	14	29448	5.6	35.1%
Good	8	18459	3.5	22.0%
Very Good	2	4,424	0.8	5.3%
Not assessed	9	17,399	3.3	20.6%
Totals	***41***	***84,136***	***15.9***	***100%***

Figure 40. Average riparian condition for assessed reaches of Mill Creek, 2018.



3.5.3 Peck Lake

Peck Lake is located within the Geneva Park District's Peck Farm Park, which in turn is located in the southwest corner of the City of Geneva within in the south central portion of the Mill Creek watershed. The outlet stream, dubbed Peck Lake Drain for the purposes of this plan, joins the McKee Road Tributary about 0.9 miles downstream.

The lake's watershed encompasses about 348.5 acres (including the approximately 19 acre lake surface) (subwatershed #7 in Figure 6) and is comprised of about 45% open space, 39% developed (residential, institutional, roads), 9% agriculture, and 7% vacant (Table 17).

The land surrounding Peck Lake was historically farmed. Since purchase by the Geneva Park District in 1991, the park has largely been restored to prairie and wetland. Peck Lake itself was the subject of a project circa 2008 that restored its shoreline to wetland vegetation and surrounding riparian area to wet prairie and prairie vegetation. Currently, shoreline erosion is none to minimal, and the riparian buffer is no less than 100 feet wide (typically greater than 300-500 feet), providing excellent water quality benefits. An aerial image of the lake is provided in Figure 41, where the extensive vegetative buffer can be seen.

The lake serves as aquatic habitat for a variety of waterfowl, wading birds, fish, and amphibians, and is used by people for aesthetic enjoyment and outdoor education activities. No fishing or boating is permitted.

Very little water quality data is known to exist for Peck Lake. It was monitored on two dates as part of the VLMP in 1999, exhibiting low Secchi transparencies (6 to 9 inches) and high concentrations of suspended solids (57 mg/L), total phosphorus (0.200 mg/L), and chlorophyll *a* (30.5 ug/L) that may not be representative of current conditions.

Figure 41. Peck Lake as seen in April 2016 aerial imagery.

3.5.4 Stormwater Detention Basins

Stormwater detention is accomplished through a combination of green and grey infrastructure. Historic wetlands, ponds, and lakes that comprise a region's green infrastructure network are often the recipients of stormwater that is transferred through depressional areas such ditches, culverts, and other traditional gray infrastructure. Of these, some have no natural outlet while others spill downhill or are evacuated via a lift station. Some wetlands may not have direct stormwater inputs but receive overland flow from other waterbodies that receive piped stormwater. Other detention basins are purposefully built in conjunction with newer developments or redevelopment. Of this last type, some basins are normally dry (i.e., dry bottom) and others retain water year round (i.e., wet bottom) unless designed as infiltration basins.

CMAP and Kane County Division of Environmental & Water Resources (EWR) staff assessed detention basins within the Mill Creek watershed. Kane County EWR had previously developed an inventory of detention basins within the County using GIS data, aerial maps, permit records, and field visits. According to Kane County's datasets, there are 341 detention basins in the Mill Creek watershed (Table 38, Appendix C). The types of basins include dry bottom mesic prairie basins, dry bottom prairie basins, and dry bottom turf basins, as well as ponds and wetlands (Figure 42). When well-designed and in good condition, these basins play an important water quality role by retaining stormwater runoff and filtering and settling pollutants before slowly releasing the runoff.

CMAP staff assessed basins within the municipal limits of Batavia, Campton Hills, Geneva, and St. Charles; while Kane Co. EWR staff assessed those in unincorporated areas of the watershed. Observational data was entered into an ESRI ArcGIS Collector Application (app) created by Kane County GIS with the input of Kane Co. EWR and CMAP staff. The following aspects of each detention basin were confirmed and/or assessed:

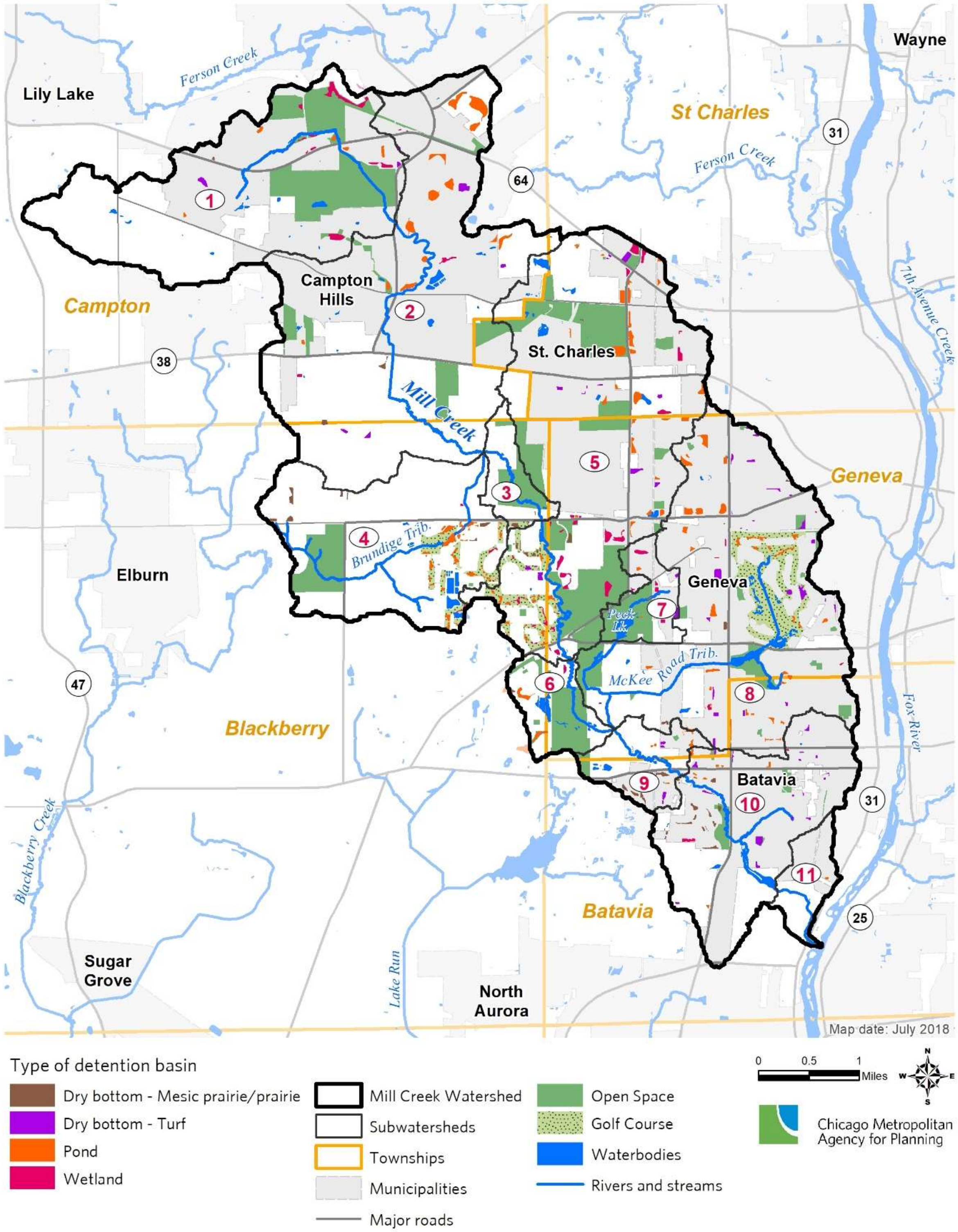
- Type of basin (wet, wet with extended dry detention, dry turf, dry naturalized, constructed wetland)
- On-stream (yes/no, stream name)
- Connected to Other Basins (yes/no, upstream/downstream)
- Side Slope Cover types (turf grass, native plants, invasive plants, rip rap, seawall)
- Side Slope Angle (horizontal : vertical)
- Buffer Width (native plants)
- Water's Edge Cover types (not applicable, turf grass, native/wetland plants, invasive plants, rip rap)
- Basin Bottom Cover types (unknown, turf grass, native/wetland plants, submersed aquatic vegetation, invasive plants, concrete-lined channel)
- Shoreline Erosion (not applicable, minimal, slight, moderate, high)
- Safety Shelf presence (yes/no/unknown) and Wetland Vegetation presence (yes/no)
- Short Circuiting (yes/no)
- Overall Water Quality Benefits Assessment (good, fair, poor)
- Management needs
- Retrofit opportunities within the basin and immediate contributing area

The location and type were confirmed, and the relative water quality benefit determined, for each detention basin within the Mill Creek watershed. Unless something unique or unusual was obvious, the assessment of overall water quality benefit – good, fair, poor – is largely a function of detention basin type. Retrofitting opportunities and management needs were also noted (Appendix C).

Table 38. Stormwater detention basins in the Mill Creek watershed, by political jurisdiction.

By Political Jurisdiction	*Detention Basin Type*				
	Dry-Mesic Prairie	*Dry-Prairie*	*Dry-Turf*	*Wetland*	*Pond*
Batavia	23	---	28	26	5
Campton Hills	---	1	5	15	10
Geneva	4	---	26	24	13
St. Charles	1		7	13	5
Kane County	24		11	68	32
Totals	**52**	**1**	**77**	**146**	**65**

Figure 42. Stormwater detention basins in the Mill Creek watershed.



3.5.5 Groundwater Supply and Quality

The Mill Creek watershed receives its water supply from shallow bedrock/gravel and sandstone aquifers, Kaneville and St. Charles, which range in thickness from 20 to 100 feet.[72] In 2002, Kane County contracted with the Illinois State Water Survey (ISWS) and Illinois State Geological Survey (ISGS) to assess surface water, geology, and groundwater within the County.[73] The study was prompted by probable shifts in climate change and impaired water quality, an escalated projected population growth and the surge in water demand that would likely ensue, as well as the legal and monetary constraints of seeking alternative water sources (e.g., Lake Michigan). The objectives of the study were to protect groundwater quality, preserve groundwater supply, develop a foundation upon which to base policy and management strategies for the region's water resources, and create a framework and baseline data for future studies.[74] Below are summaries of the major groundwater publications and geospatial datasets that were derived from this project.

3.5.5.1 Groundwater Studies

Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County and Northeastern Illinois (May 2009)

This is a study conducted by the ISWS that assessed groundwater resources supplying water to Kane County. The report synthesized available groundwater data and a set of computer models that simulated groundwater flow in regional and local aquifers, and quantified the components of the hydrologic cycle. It also assessed the impact of historical and projected pumping in the region.

Kane County Water Resources Investigations: Final Report on Shallow Aquifer Potentiometric Surface Mapping (August 2007)

A component of Kane County's comprehensive groundwater study was analyzing and mapping shallow aquifers across the County. This report presents and discusses how groundwater data was used to map and analyze the potentiometric surfaces of individual aquifers.[75,76] Analyses indicated that "withdrawals are likely to have locally influenced the head

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[72] Based on Kane County's major aquifer dataset (2018) and ISWS's source of water by municipality (2014).

[73] Illinois State Water Survey, Prairie Research Institute, Groundwater science, https://www.isws.illinois.edu/groundwater-science/illinois-water-inventory-program/water-resource-investigations-for-kane-county-illinois

[74] Ibid.

[75] Illinois State Water Survey, Kane County water resources investigations: Final report on shallow aquifer potentiometric surface mapping, https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2007-06.pdf

[76] This report is meant to replace Kane County's Interim Report on Shallow Aquifer Potentiometric Surface Mapping, which was completed in April 2005.

surfaces, particularly in east-central and southeastern Kane County," which encompasses the southern edge of the Mill Creek watershed.[77] The report also concluded that "areas of relatively low head in the shallow bedrock aquifer may reflect large withdrawals from the aquifer, hydraulically connected units, and/or areas of significant discharge to the Fox River," which may also be applicable to the Mill creek watershed.

Shallow Groundwater Sampling in Kane County, October 2003 (June 2005)
In October 2003, groundwater samples were collected from 75 shallow domestic and industrial wells. According to the report, the sampling revealed that the quality of shallow groundwater in Kane County is generally good, especially in the western and central thirds of the county.[78] This area encompasses the northern and western portions of the Mill Creek watershed (i.e., around the Village of Campton Hills). However, the groundwater quality on the eastern portion of the watershed is not comparable. ISWS also found that total dissolved solids (TDS) concentrations were significantly higher in samples from the three eastern quadrangles of the County. Chlorides and sulfates are two other pollutants found in samples for these three quadrangles that are of greatest concern because concentrations were above their drinking water standards.[79] The report also concludes that there likely has been a long history of TDS contamination in the eastern urban corridor of Kane County because of its high concentration levels and widespread presence, despite the slow rates at which groundwater moves through aquifers.[80]

3.5.5.2 Sensitive Aquifer Recharges Areas

Certain areas in the watershed are more vulnerable than others to aquifer contamination from a contaminant applied on or near the land surface. Classification of sensitivity ranges from Unit A-E with "A" having the highest potential for contamination and "E" having the lowest. Each classification is qualified by two characteristics: proximity to or distance from the land surface and the degree of aquifer thickness. Sensitivity to contamination increases the closer the aquifer is to the land surface and with greater aquifer thickness.[81]

This plan calls attention to two map unit classes. The Unit A class is defined as "areas where the upper surface of the aquifer is within 20 feet of the land surface and with sand and gravel or high-permeability bedrock aquifers greater than 20 feet thick." The Unit A class (High Potential

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[77] Illinois State Water Survey, *Kane County water resources investigations: Final report on shallow aquifer potentiometric surface mapping*, https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2007-06.pdf

[78] Illinois State Water Survey, *Shallow groundwater quality sampling in Kane County, October 2003*, June 2005, https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2005-07.pdf

[79] Ibid.

[80] Ibid.

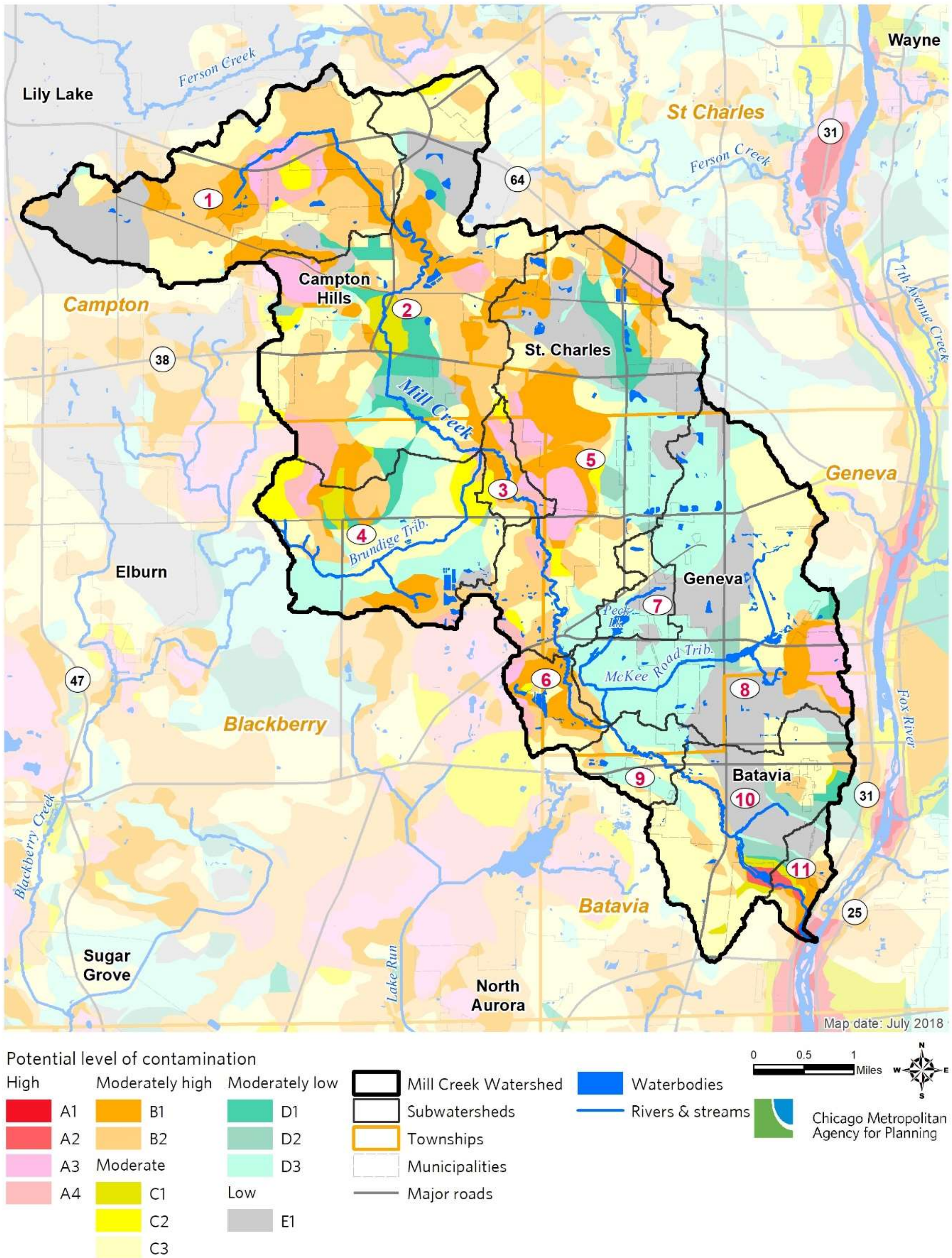
[81] ISGS. "Kane County Water Resources Investigations: Final Report on Geologic Investigations," by William S. Dey, Alec M. Davis, B. Brandon Curry, Donald A. Keefer and Curt C. Abert. ISGS Open File Series, 2007-7. Champaign, IL: ISGS, 2007. http://library.isgs.uiuc.edu/Pubs/pdfs/ofs/2007/ofs2007-07.pdf (accessed November 3, 2011).

for Aquifer Contamination) represents the area that is the most sensitive to contamination. The Unit B class (Moderately High Potential for Aquifer Contamination) should also be considered for planning purposes. While aquifers within the Unit B class are less thick than those classed under Unit A, they are similarly close to the land surface as Unit A aquifers and thus, as vulnerable to contamination based on that metric alone. Table 39 describes the continuum of Unit classes while Figure 43 illustrates the pattern of their distribution throughout the Mill Creek watershed.

Table 39. Aquifer classification and sensitivity to contamination.

MAP UNIT	POTENTIAL FOR CONTAMINATION	AQUIFER DESCRIPTION
A1	**High**	Aquifers are greater than 50 feet thick and are within 5 feet of the land surface.
A2	**High**	Aquifers are greater than 50 feet thick and are between 5 and 20 feet below the land surface
A3	**High**	Aquifers are between 20 and 50 feet thick and are within 5 feet of the land surface.
A4	**High**	Aquifers are between 20 and 50 feet thick and are between 5 and 20 feet below the land surface.
B1	**Moderately High**	Sand and gravel aquifers are between 5 and 20 feet thick, or high-permeability bedrock aquifers are between 15 and 20 feet thick, and either aquifer type is within 5 feet of the land surface.
B2	**Moderately High**	Sand and gravel aquifers are between 5 and 20 feet thick, or high-permeability bedrock aquifers are between 15 and 20 feet thick, and either aquifer type is between 5 and 20 feet below the land surface.
C1	**Moderate**	Aquifers are greater than 50 feet thick and are between 20 and 50 feet below the land surface.
C2	**Moderate**	Aquifers are between 20 and 50 feet thick and are between 20 and 50 feet below the land surface.
C3	**Moderate**	Sand and gravel aquifers are between 5 and 20 feet thick, or high-permeability bedrock aquifers are between 15 and 20 feet thick, and either aquifer type is between 20 and 50 feet below the land surface.
D1	**Moderately Low**	Aquifers are greater than 50 feet thick and are between 50 and 100 feet below the land surface.
D2	**Moderately Low**	Aquifers are between 20 and 50 feet thick and are between 50 and 100 feet below the land surface.
D3	**Moderately Low**	Sand and gravel aquifers are between 5 and 20 feet thick or high-permeability bedrock aquifers are between 15 and 20 feet thick and either aquifer type is between 50 and 100 feet below the land surface.
E1	**Low**	Sand and gravel or high-permeability bedrock aquifers are not present within 100 feet of the land surface.

Figure 43. Aquifer sensitivity to potential contamination in the Mill Creek watershed.



3.5.5.3 Leaking Underground Storage Tanks

Leaking underground storage tanks (UST) are a source of environmental contamination and threaten the quality and safety of groundwater as a source of drinking water. The Office of the State Fire Marshall regulates the daily operation and maintenance of underground storage tank systems, and the Illinois EPA becomes involved once a release (i.e., leak) has been reported to the Illinois Emergency Management Agency (IEMA). Following a tank release report to IEMA, Illinois EPA's Leaking UST section begins oversight of remedial operations.[82]

While leaking UST incidents are a concern wherever they occur, they are particularly relevant in an area of groundwater-dependent communities and private-well owners. Within the Mill Creek watershed, 26 leaking UST incidents were reported to IEMA from 1990 through 2014 (Table 40, Figure 44). The most incidents occurred in Geneva followed by unincorporated areas and Batavia. Illinois EPA's Leaking UST incident tracking database shows that remediation (clean up) was completed at 23 of the sites, a determination was made that a leak did not actually occur at two of the sites, and no information is available for three of the sites.

Knowledge of leaking UST sites and their clean-up status can work in favor of developing wellhead protection plans for existing community water supply wells. Wellhead protection plans can also reduce the vulnerability of wells to other potential sources of contamination.

An Underground Storage Tank Fund was established in 1989 to help owners and operators pay for cleaning up leaks from petroleum USTs. Illinois generates money for the leaking UST Fund through a $0.003 per gallon motor fuel tax and a $0.008 per gallon environmental impact fee, both of which are set to expire January 1, 2025. For more information regarding the status of leaking UST sites, readers are referred to the Leaking UST Incident Tracking database.[83]

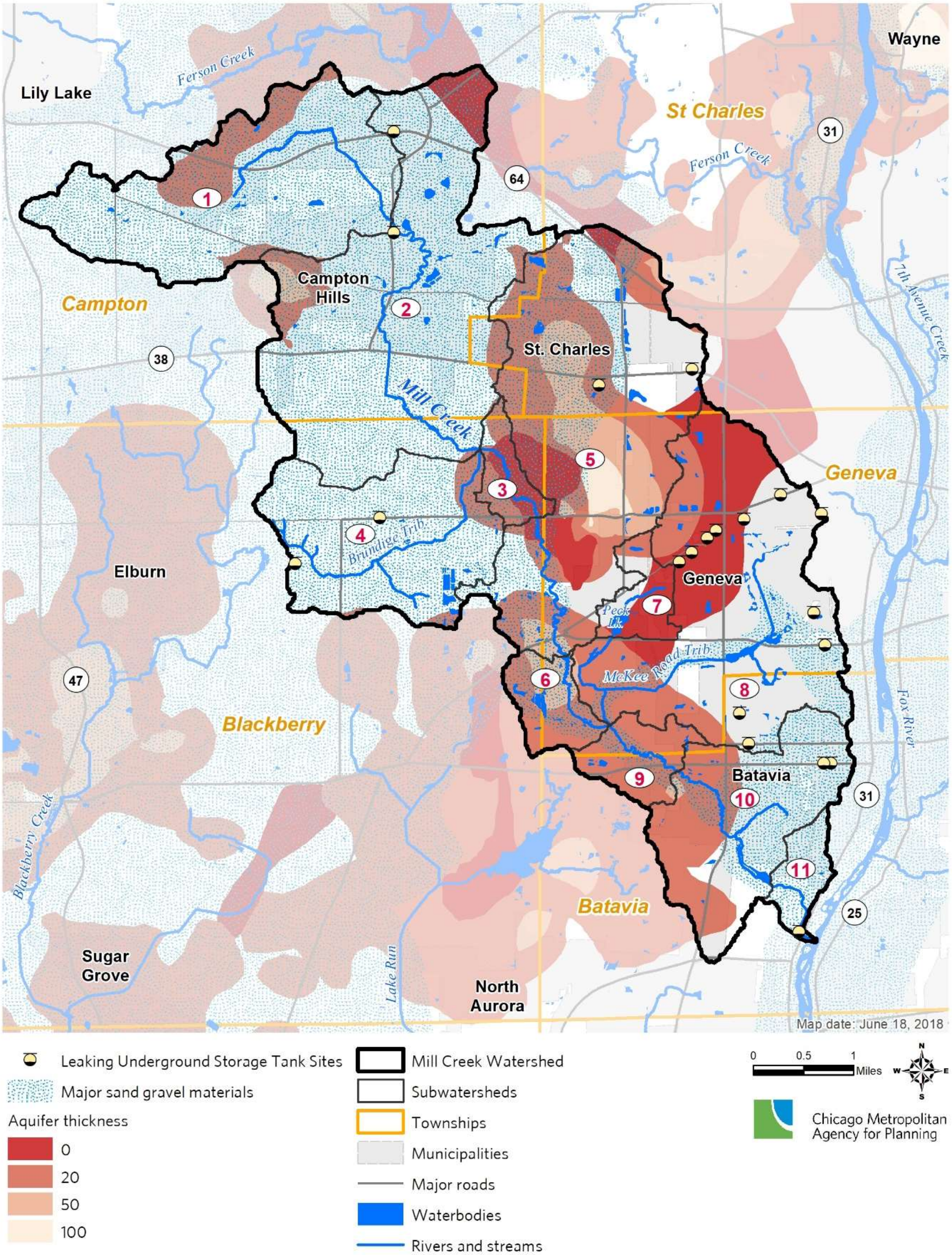
Table 40. Leaking UST incidents reported in the Mill Creek watershed, 1990-2014.

Jurisdiction	*# Leaking UST Incidents Reported*
Batavia	4
Campton Hills	2
St. Charles	2
Geneva	13
Unincorporated areas	5
Total	***26***

[82] "An Introduction to Leaking Underground Storage Tanks," Illinois Environmental Protection Agency, last accessed September 2019, https://www2.illinois.gov/epa/topics/cleanup-programs/lust/publications-regs/Pages/introduction.aspx

[83] "Leaking UST Database," Illinois Environmental Protection Agency, last accessed September 2019, https://www2.illinois.gov/epa/topics/cleanup-programs/bol-database/Pages/leaking-ust.aspx

Figure 44. Leaking UST incident locations and aquifer thickness in the Mill Creek watershed.



3.6 Pollutant Sources

3.6.1 Point Sources

3.6.1.1 National Pollutant Discharge Elimination System (NPDES) Program

The National Pollution Discharge and Elimination System (NPDES) program plays a key role in protecting and restoring water quality. Point sources are discrete conveyance systems, such as a pipe or drainage ditch, from which pollutants are directly transferred into nearby surface waters. The primary mechanism through which the Clean Water Act (CWA) regulates point source pollution is the NPDES permit program.[84]

Authorized under amendments made to the Clean Water Act in 1987, Illinois EPA issues permits—through delegation of authority by US EPA—to manage pollution entering waterbodies from a variety of point sources. Unless an NPDES permit is obtained, it is illegal to discharge pollutants into U.S. waters. Issued permits set discharge limits on the type and amount of pollutants—such as total suspended solids, ammonia nitrogen, fecal coliform, and phosphorus—that a point source can discharge into a given waterbody at any point in time.[85] They also require monitoring and reporting of pollutants and water quality indicators, such as dissolved oxygen (DO) and biological oxygen demand (BOD). Permits are commonly applicable to private and commercial industries, municipal wastewater facilities,[86] and public entities that have stormwater systems that discharge directly to a waterbody.[87] This may include wastewater treatment plants, industrial dischargers, concentrated animal feeding operations (CAFOs), combined sewer overflows (CSOs), sanitary sewer overflows (SSOs), and urban stormwater runoff discharged via a pipe.[88]

NPDES permits

There are 17 permitted dischargers of wastewater in the planning area (Figure 45). Collectively, they hold 22 discharge permits within the Mill Creek watershed. Twelve of the permit holders are private dischargers, and the remaining five are municipalities and townships. Saint Charles and Batavia have permits for their wastewater treatment facilities.

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[84] Clean Water Act (CWA), 33 U.S.C., §1342 (1972)

[85] Limits set by National Pollution Discharge and Elimination System permits are specific to the waterbody within in which the pollutant is discharged.

[86] The National Pollution Discharge and Elimination System permit program established effluent- and technology-based effluent limits, requiring wastewater treatment facilities to invest in cost-effective pollution prevention system to ensure that the pollutant load limits for a waterbody are met.

[87] Under the National Pollution Discharge and Elimination System Permit program, Illinois Environmental Protection Agency is responsible for reviewing and issuing general stormwater permit for Municipal Separate Storm Sewer Systems and combined sewer outfalls communities, as well as permits for Confined Animal Feeding Operations (CAFOs).

[88] "NPDES Permit Program Basics," U.S. EPA, last modified January 4, 2011, accessed October 12, 2011, http://cfpub.epa.gov/npdes/home.cfm? program_id=45.

Facility planning areas are also shown in Figure 45. A facility planning area (FPA) is the geography served by a wastewater treatment plant based on plant capacity, development plans, and other nearby FPAs. The FPA includes both the current sewer-service area as well as unsewered areas that are expected to be developed and served in the future. The Mill Creek watershed has five FPAs, which serve portions of Batavia, Campton Hills, and Geneva, St. Charles as well as some unincorporated areas west of Geneva and St. Charles.

MS4 Permits (NPDES stormwater program)

In addition to NPDES permits, the NPDES program helps regulate stormwater through Municipal Separate Storm Sewer Systems (MS4) permits. Although MS4 permits use best management practices to reduce the effects of stormwater runoff (a nonpoint source pollutant), they technically fall under the NPDES program because stormwater runoff ultimately gets discharged to surface waters via a pipe (point source). MS4 permits require dischargers—primarily municipalities, but also the Illinois Department of Transportation (IDOT), the Illinois Tollway, universities, counties, and townships—to develop a Stormwater Management Program and implement measures that improve the quality of the stormwater being discharged, such as education and street sweeping programs.[89] Within the Mill Creek watershed, all municipalities are MS4 communities.

The MS4 program was implemented in two phases. Phase I of this program was implemented in 1990 and applies to medium and large MS4s as well as certain counties with populations of 100,000 or more. Phase I MS4 permittees are regulated under individual permits and are informed by the regulations at 40 C.F.R. 122.26(d).[90] Phase II was implemented in 2003 and expanded the scope of storm sewer systems which are subject to NPDES.[91] Phase II applies to small MS4s[92] including smaller construction or industrial sites that are owned and operated in urbanized areas.[93] Industrial sites or construction activities that disturb one or more acres of land must obtain an NPDES permit before construction activities begin.[94] Most Phase II MS4 permittees are regulated under a general permit.

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[89] U.S. Environmental Protection Agency, Municipal Separate Storm Sewer System (MS4) Storm Water management Program (SWMP) 2017, https://www.epa.gov/tx/municipal-separate-storm-sewer-system-ms4-storm-water-management-program-swmp.

[90] U.S. EPA. *MS4 Permit Improvement Guide*. EPA 833-R-10-001. Washington, DC: U.S. EPA, 2010. https://www3.epa.gov/npdes/pubs/ms4permit_improvement_guide.pdf (accessed February 14, 2017).

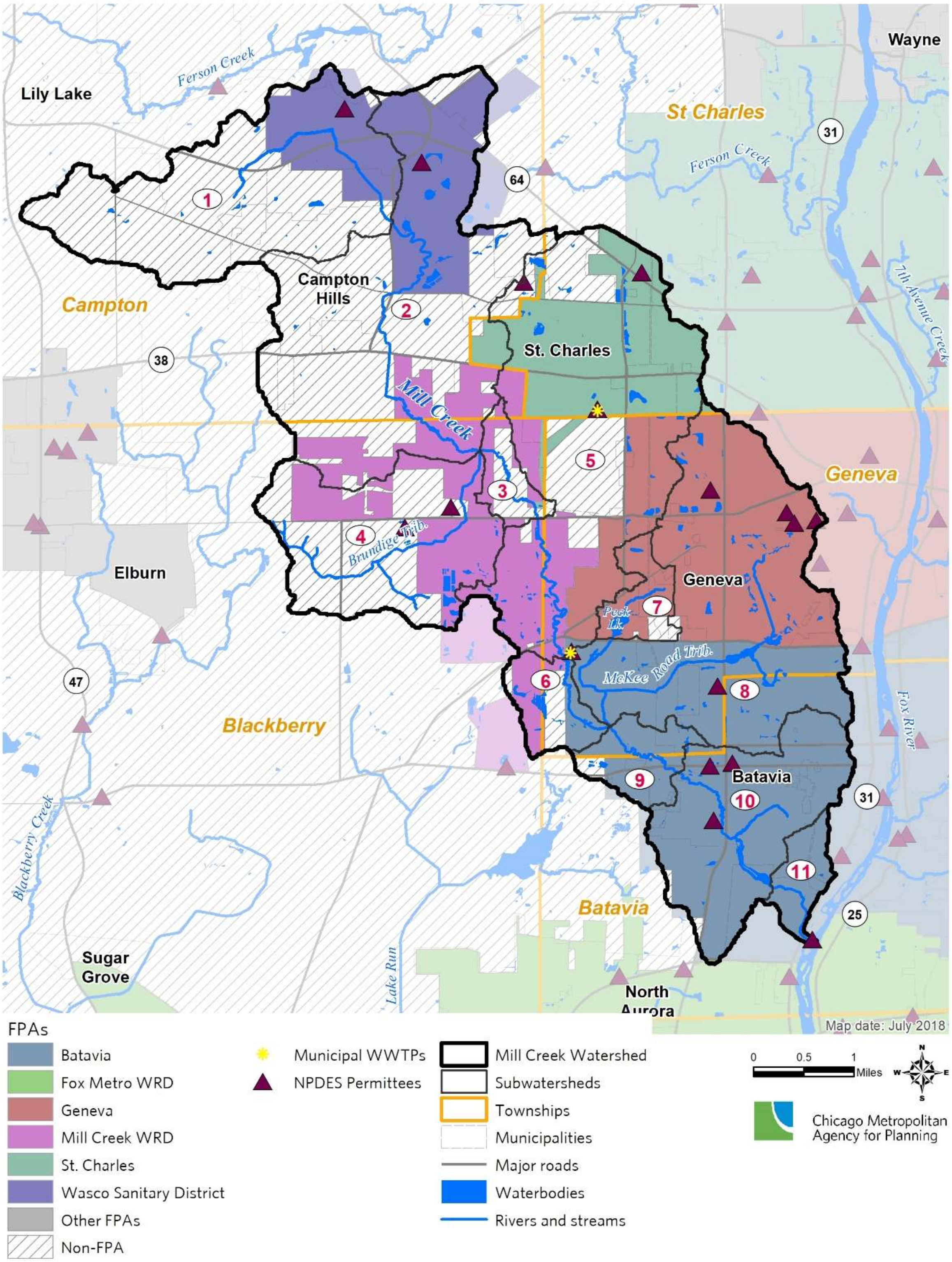
[91] "NPDES Stormwater Program," U.S. EPA, last modified January 4, 2011, accessed October 13, 2011, http://cfpub.epa.gov/npdes/home.cfm? program_id=6.

[92] Illinois EPA, Bureau of Water, MS4s Permittees, http://www.epa.state.il.us/water/permits/storm-water/ms4-status-report.pdf (accessed November 13, 2014)

[93] "NPDES Stormwater Program," U.S. EPA, last modified January 4, 2011, accessed October 13, 2011, http://cfpub.epa.gov/npdes/home.cfm? program_id=6.

[94] U.S. EPA. "Stormwater Phase II Final Rule: An Overview." EPA Report No. 833-F-00-001. Washington, D.C.: U.S. EPA, 2005. http://www.epa.gov/npdes/ pubs/fact2-0.pdf (accessed October 12, 2011).

Figure 45. FPAs and NPDES permittees in the Mill Creek watershed.



Under the terms of Phase II permits, industrial, construction, and MS4 Phase II permittees are required to implement certain practices that control pollution in stormwater runoff. To prevent the contamination of stormwater runoff, industrial and construction permittees must develop a stormwater pollution prevention plan, while MS4 permittees must develop a similar stormwater management program. Stormwater runoff carrying pollutants from impervious surfaces can degrade water quality when discharged untreated into local rivers and streams, as is often the case. Programs like Phase II that encourage planning and implementation on a watershed basis are therefore vital for protecting water quality from stormwater runoff from both large and small separate stormwater sewer systems as well as industrial and construction sites.

In Illinois, discharges from small MS4s are regulated under Illinois EPA's General NPDES Permit No. ILR40. The central feature of this permit is a requirement that MS4 operators develop, implement, and enforce a stormwater management program to reduce the discharge of pollutants. A Phase II permittee's stormwater management program must include six minimum control measures as outlined in 40 C.F.R. 122.34(b)[95]:

1. Public education and outreach on storm water impacts
2. Public involvement and participation
3. Illicit discharge detection and elimination
4. Construction site storm water runoff control
5. Post construction storm water management in new development and redevelopment
6. Pollution prevention / good housekeeping for municipal operations

In order to obtain coverage under the permit, permittees must submit to Illinois EPA a completed Notice of Intent (NOI)[96] describing its best management practices (BMPs) and measurable goals for each of the six minimum control measures. The NOI should also detail other program specifics and identify any arrangements made with others to share program responsibilities. Once coverage has been granted, a permittee must submit an annual report to Illinois EPA by June 1 which must include the following:

1. The status of compliance with the permit conditions, including an assessment of the BMPs and progress toward the measurable goals;
2. Results of any information collected and analyzed, including monitoring data;
3. A summary of the stormwater activities planned for the next reporting cycle;
4. A change in any identified best management practices or measurable goals; and

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[95] U.S. EPA. *MS4 Permit Improvement Guide*. EPA 833-R-10-001. Washington, DC: U.S. EPA, 2010. https://www3.epa.gov/npdes/pubs/ms4permit_improvement_guide.pdf (accessed February 14, 2017).

[96] Illinois EPA, Bureau of Water. Notice of Intent for New or Renewal of General Permit for Discharges from Small Municipal Separate Storm Sewer Systems – MS4's. http://www.epa.state.il.us/water/permits/storm-water/forms/notice-intent-ms4.pdf

5. If applicable, notice of relying on another governmental entity to satisfy some of the permit obligations.[97]

3.6.1.2 Stormwater Management Regulations/Ordinances

While state-administered MS4 permits provide some guidance for community stormwater management practices, most municipalities have also adopted or otherwise adhere to county stormwater management ordinances, which are primarily focused on managing the rate and volume of stormwater runoff.[98] These ordinances are based on foundational work on performance standards done by NIPC, CMAP's predecessor, in the 1980s. County ordinances can go beyond the standards for runoff control set by the state, by requiring stream buffers, green infrastructure practices, reduced or disconnected impervious surface area, and floodplain protection. County and municipal land use regulations (i.e., zoning and subdivision regulations) also govern, to some extent, the impact of development on water resources, though local requirements vary greatly in their level of scope and detail.

Kane County adopted a county-wide stormwater management ordinance in January 2002 to manage the impacts of urbanization on stormwater drainage, safeguard public health and safety, protect the environment, and support responsible land use decisions. The ordinance is enforced through the review and permit process for construction activities, particularly associated with new development, to promote and help achieve these objectives.

Kane County Division of Environmental and Water Resources is responsible for administering the ordinance and enforces its application in the unincorporated areas within the Mill Creek Watershed. Authority to administer and enforce the ordinance in the incorporated areas of the watershed has delegated to the municipalities. These communities – also known as "certified communities"—have adopted the ordinance at the municipal level and agreed to use qualified review specialists to review permit submittals. The County also has the Kane County Stormwater Management Planning Committee (KCSMPC) which was tasked with developing the original Stormwater Management Plan and coordinating the plan with adjoining counties. The Committee is made up of six members that each represent their respective Kane County Board District geography.

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[97] M. Novotney. Lake Co. Stormwater Management Commission. 2013. *Personal communication*. There are several other noteworthy requirements of the program, including: (1) annual program review as part of annual report preparation; and, (2) at least annual monitoring of receiving waters, use of indicators to gauge the effects of stormwater discharges on the physical/habitat-related aspects of receiving waters, and/or monitoring BMP effectiveness.

[98] County ordinances are the minimum standard to which municipalities must adhere, though they can adopt more stringent stormwater regulations.

In June 2019, the County adopted a revised edition of the stormwater ordinance to address shortcomings noted in the original ordinance that it reflect a more holistic approach to stormwater management and the environment. In addition to managing stormwater, the ordinance encompasses improved regulations that provide a water quality benefit to the residents, offers greater consistency across its application at the local level, and mirror industry standards.[99]

3.6.2 Nonpoint Sources

Addressing designated-use impairments within the planning area is one of the primary reasons for developing this watershed plan. Another reason is to protect good water quality and designated-use attainment where present in the planning area. Table 41 provides the known details of water quality assessments according to Illinois EPA and as published in their 2016 Integrated Report. Although there are two segments identified in the 2016 Integrated Report (IL_DTZL-01 and IL_DTZL-02), only the southern-most segment (IL_DTZL-02) has been assessed, and only for its primary contact designated use and based on only one sampling event.

In addition to the causes and sources of impairments identified by Illinois EPA in the 2016 Integrated Report, there are numerous other potential causes of impairment and sources of pollution impacting water resources in the Mill Creek watershed (listed in italics in Table 41). Recommendations made to mitigate and protect water quality from nonpoint source pollution will both yield local benefits and help improve water quality in Mill Creek and its tributaries as well as the Fox River downstream. Actions within the watershed impact water quality for communities downstream, including those that obtain their drinking water supply from the Fox River.

Table 41. Known and *potential* causes and sources of water pollution in the Mill Creek watershed.

Streams	
Causes of Impairment • Fecal coliform (400)	**Sources of Impairment** • Urban runoff / storm sewers (177)
Potential Causes of Impairment • *Alteration in streamside or littoral vegetative covers (84)* • *Alterations in wetland habitats (85)* • *Chloride (138)* • *Debris/Floatables/Trash (181)* • *Fish-Passage Barrier (228)*	**Potential Sources of Impairment** • *Animal Feeding Operations (NPS) (4)* • *Atmospheric Deposition – Toxics (10)* • *Channelization (20)* • *Contaminated Sediments (28)* • *Drainage/Filling/Loss of Wetlands (36)* • *Golf courses (45)*

[99] See Kane County Stormwater Management Ordinance, revised June 1, 2019 (https://www.countyofkane.org/FDER/Documents/waterOrdinances/adoptedOrdinance.pdf) and Kane County Stormwater Technical Guidance Manual (https://www.countyofkane.org/FDER/Documents/waterOrdinances/technicalManual.pdf).

• *Non-native Fish, Shellfish, or Zooplankton (313)* • *Oil and Grease (317)* • *Other flow regime alterations (319)* • *Sedimentation/Siltation (371)* • *Temperature, water (388)* • *Total Suspended Solids (TSS) (403)* • *Turbidity (413)* • *Nitrogen, Nitrate (452)* • *Phosphorus (Total) (462)* • *Cause Unknown (463)* • *Changes in Stream Depth and Velocity Patterns (500)* • *Loss of Instream Cover (501)*	• *Highway/Road/Bridge Runoff (Non-construction Related) (49)* • *Highways, Roads, Bridges, Infrastructure (New Construction) (50)* • *Impacts from Hydrostructure Flow Regulation/modification (58)* • *Industrial Point Source Discharge (62)* • *Irrigated Crop Production (66)* • *Loss of Riparian Habitat (77)* • *Managed Pasture Grazing (73)* • *Municipal (Urbanized High Density Area) (84)* • *Municipal Point Source Discharges (85)* • *Non-irrigated Crop Production (87)* • *Other Recreational Pollution Sources (95)* • *Site Clearance (Land Development or Redevelopment) (122)* • *Spills from Trucks or Trains (124)* • *Streambank Modifications/destabilization (125)* • *Unpermitted Discharge (Domestic Wastes) (130)* • *Source Unknown (140)* • *Dam or Impoundment (142)* • *Livestock (Grazing or Feeding Operations) (143)* • *Crop Production (Crop Land or Dry Land) (144)* • *Natural Sources (155)* • *Agriculture (156)* • *Inappropriate Waste Disposal (160)* • *Pesticide Application (161)* • *Runoff from Forest/Grassland/Parkland (181)*
Lakes	
Potential Causes of Impairment	**Potential Sources of Impairment**
• *Debris/Floatables/Trash (181)* • *Ammonia (Total) (308)* • *Non-native Aquatic Plants (312)* • *Non-native Fish, Shellfish, or Zooplankton (313)* • *Oxygen, Dissolved (322)* • *Polychlorinated biphenyls (348)* • *Sedimentation/Siltation (371)* • *Fecal Coliform (400)* • *Total Suspended Solids (TSS) (403)* • *Turbidity (413)* • *pH (441)* • *Nitrogen, Nitrate (452)* • *Phosphorus (Total) (462)* • *Cause Unknown (463)* • *Aquatic Plants (Macrophytes) (478)* • *Aquatic Algae (479)* • *Odor (520)*	• *Animal Feeding Operations (NPS) (4)* • *Atmospheric Deposition – Toxics (10)* • *Contaminated Sediments (28)* • *Golf courses (45)* • *Highway/Road/Bridge Runoff (Non-construction Related) (49)* • *Impacts from Hydrostructure Flow Regulation/modification (58)* • *Internal Nutrient Recycling (65)* • *Littoral/shore Area Modifications (non-riverine) (71)* • *Municipal (Urbanized High Density Area) (84)* • *Municipal Point Source Discharges (85)* • *On-site Treatment Systems (Septic Systems and Similar Decentralized Systems) (92)* • *Other Recreational Pollution Sources (95)* • *Other Turf Management (98)* • *Residential Districts (111)* • *Site Clearance (Land Development or Redevelopment) (122)* • *Streambank [Shoreline] Modifications/destabilization (125)* • *Waterfowl (134)* • *Wildlife Other than Waterfowl (136)* • *Yard Maintenance (138)* • *Natural Sources (155)* • *Agriculture (156)* • *Pesticide Application (161)* • *Impervious Surface/Parking Lot Runoff (164)* • *Unspecified Urban Stormwater (169)*

	• *Rural (Residential Areas) (176)* • *Urban Runoff/Storm Sewers (177)* • *Introduction of Non-native Organisms (Accidental or Intentional) (180)* • *Runoff from Forest/Grassland/Parkland (181)*

3.6.2.1 Nonpoint Source Pollutant Load Modeling

A critical step in providing recommendations within this plan is the identification of the different pollutant sources within the watershed and the relative magnitude of pollutant loads from those sources. For nonpoint source pollution, an effective method to estimate pollutant loads at the watershed scale is to use variable watershed characteristics that can affect pollutant load contributions, such as land cover, land use, and soils.

Spreadsheet Tool to Estimate Pollutant Loads (STEPL) modeling

The U.S. Environmental Protection Agency's (USEPA) planning level tool—Spreadsheet Tool to Estimate Pollutant Loads (STEPL)[100]—was used by CMAP staff to develop preliminary nonpoint source pollutant load estimates for total nitrogen, total phosphorus, biological oxygen demand (BOD), and sediment within the Mill Creek watershed.

Two of the primary inputs to STEPL are land cover and land use information. The land cover inputs used in this initial analysis were derived from the USGS's National Land Cover Data (2011), and the land use data was derived from CMAP's 2013 land use data. STEPL allows for a detailed breakdown of the broader urban land use category into categories such as commercial, single-family residential, institutional, etc., to develop more refined pollutant load estimates based on variable pollutant concentrations in stormwater runoff from these land uses.[101]

There are a few limitations to keep in mind regarding the use and capabilities of STEPL:

- STEPL was not used to analyze pollutant loads from streambank erosion at the watershed scale.
- STEPL does not account for drain tile contributions of pollutants.
- Pollutants from construction sites were not included in the analysis. Pollutant loads from construction sites can be highly variable and should be analyzed on a site-by-site basis and should be addressed through Illinois EPA's NPDES program for construction activities.

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[100] STEPL 4.4 (last updated 3/15/2018) (http://it.tetratech-ffx.com/steplweb/models$docs.htm)

[101] Land cover acreages are based on the size (30 meters) and number of pixels associated with each land cover type. This method helped determine the acreage for cropland, forest, pastureland, and a self-defined category: wetlands. However, it also overestimates the total acreage of the watershed planning area by 8.5 acres. Therefore, urban land use was determined by subtracting forest, pastureland, cropland, and wetland from the watershed land use acreage total (19,990.8 acres). When urban land cover was then broken down, cropland and water were not included with the assumption that they were captured by the land cover categories. The remaining acreage that did not fall under any of the detailed land use categories, was placed in open space.

- It is important to recognize that STEPL is not an in-stream response model and only estimates watershed pollutant loading based on coarse data, such as event mean concentrations.
- STEPL is not calibrated. Additional monitoring data and a more sophisticated watershed loading model would be required to develop a calibrated model for the Mill Creek watershed.

Nonetheless, STEPL serves as a useful planning-level tool for estimating relative contributions of different pollutant loads within the Mill Creek watershed. Table 42 outlines the preliminary estimates for the planning area. Table 43 as well as Figure 46 through Figure 49 show estimates by subwatershed.

Table 42. Nonpoint source pollutant load estimates by subwatershed (STEPL).

Sub's hed #	Nitrogen load		Phosphorus load		BOD load		Sediment load	
	lb/yr	lb/ac/yr	lb/yr	lb/ac/yr	lb/yr	lb/ac/yr	t/yr	t/ac/yr
1	10,070.4	3.6	2,157.5	0.8	28,794.5	10.2	812.8	0.3
2	17,839.8	4.2	3,527.9	0.8	52,412.1	12.4	1,135.5	0.3
3	1,405.6	4.6	311.3	1.0	3,575.1	11.8	147.5	0.5
4	9,620.6	4.9	2,015.5	1.0	26,113.5	13.3	794.7	0.4
5	18,185.5	4.6	3,232.1	0.8	57,968.3	14.6	844.1	0.2
6	1,441.4	3.4	245.6	0.6	4,670.4	10.9	61.4	0.1
7	1,374.6	3.9	248.2	0.7	4,338.5	12.4	74.2	0.2
8	17,913.8	5.2	2,894.4	0.8	62,650.0	18.3	540.3	0.2
9	1,908.0	4.2	323.5	0.7	6,076.5	13.4	75.7	0.2
10	8,322.0	4.8	1,422.7	0.8	28,275.4	16.3	340.2	0.2
11	1,137.6	3.7	188.7	0.6	4,083.9	13.4	29.5	0.1
Totals	***89,219.3***	***4.5***	***16,567.5***	***0.8***	***278,958.2***	***14.0***	***4,855.9***	***0.2***

Table 43. Nonpoint source pollutant load estimates by land use (STEPL).

Land Use Type	Nitrogen load		Phosphorus load		BOD load		Sediment load	
	lb/yr	lb/ac/yr	lb/yr	lb/ac/yr	lb/yr	lb/ac/yr	t/yr	t/ac/yr
Urban	64,654.8	4.9	10,330.3	0.8	226,875.5	17.2	1,536.5	0.1
Cropland	22,681.6	4.4	5,882.4	1.1	46,684.1	9.1	3,166.3	0.6
Pastureland	1,412.4	3.9	156.9	0.4	4,384.9	12.2	51.3	0.1
Forest	182.2	0.2	86.8	0.1	437.0	0.4	11.6	0.0
Wetlands	288.4	2.1	111.0	0.8	576.8	4.2	90.1	0.7
Feedlots	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Septic	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gully	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Streambank	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	***89,219.3***	***4.5***	***16,567.5***	***0.8***	***278,958.2***	***14.0***	***4,855.9***	***0.2***

Figure 46. Average annual total nitrogen (TN) loading rate by subwatershed (STEPL).

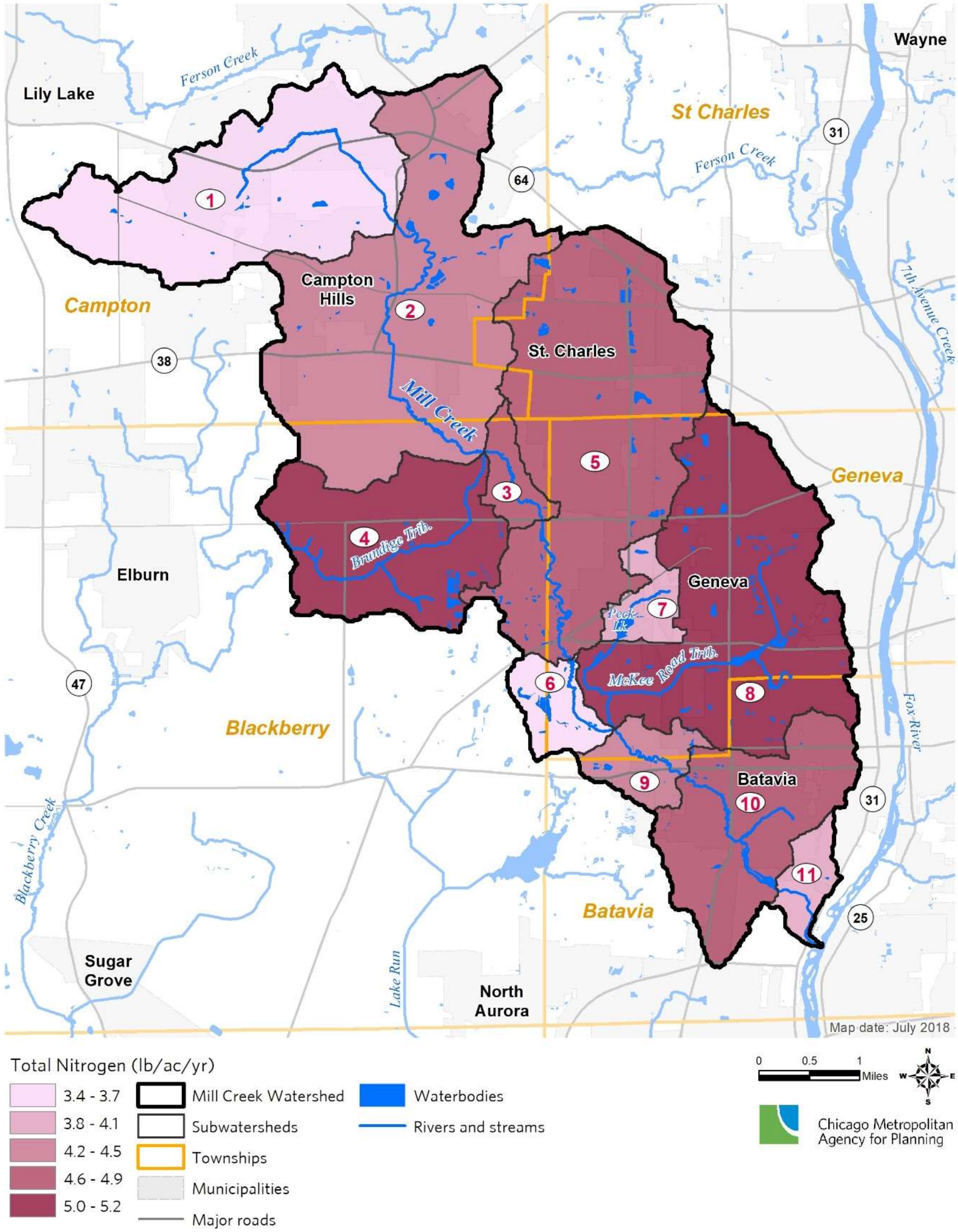


Figure 47. Average annual total phosphorus (TP) loading rate by subwatershed (STEPL).

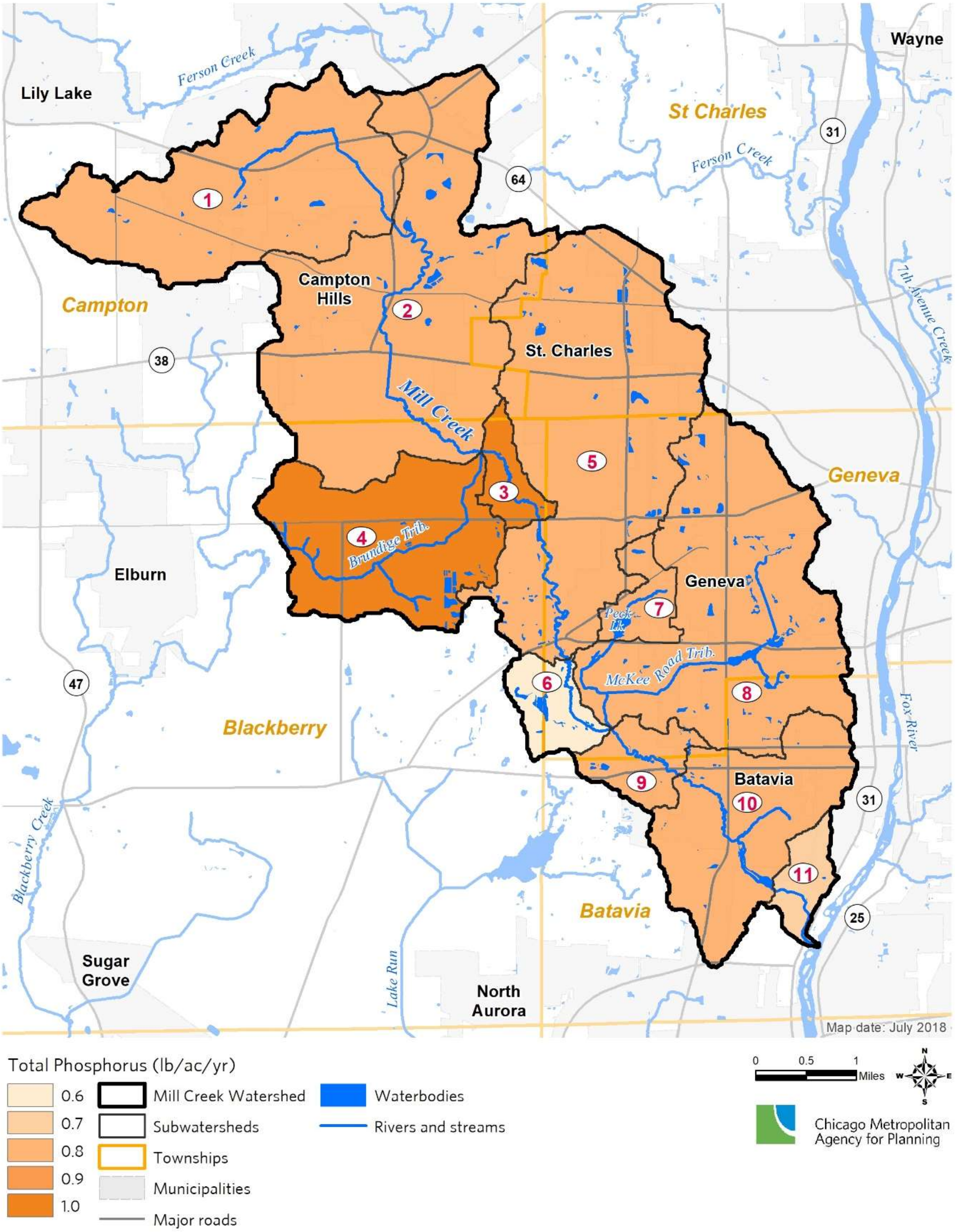


Figure 48. Average annual biological oxygen demand (BOD) loading rate by subwatershed (STEPL).

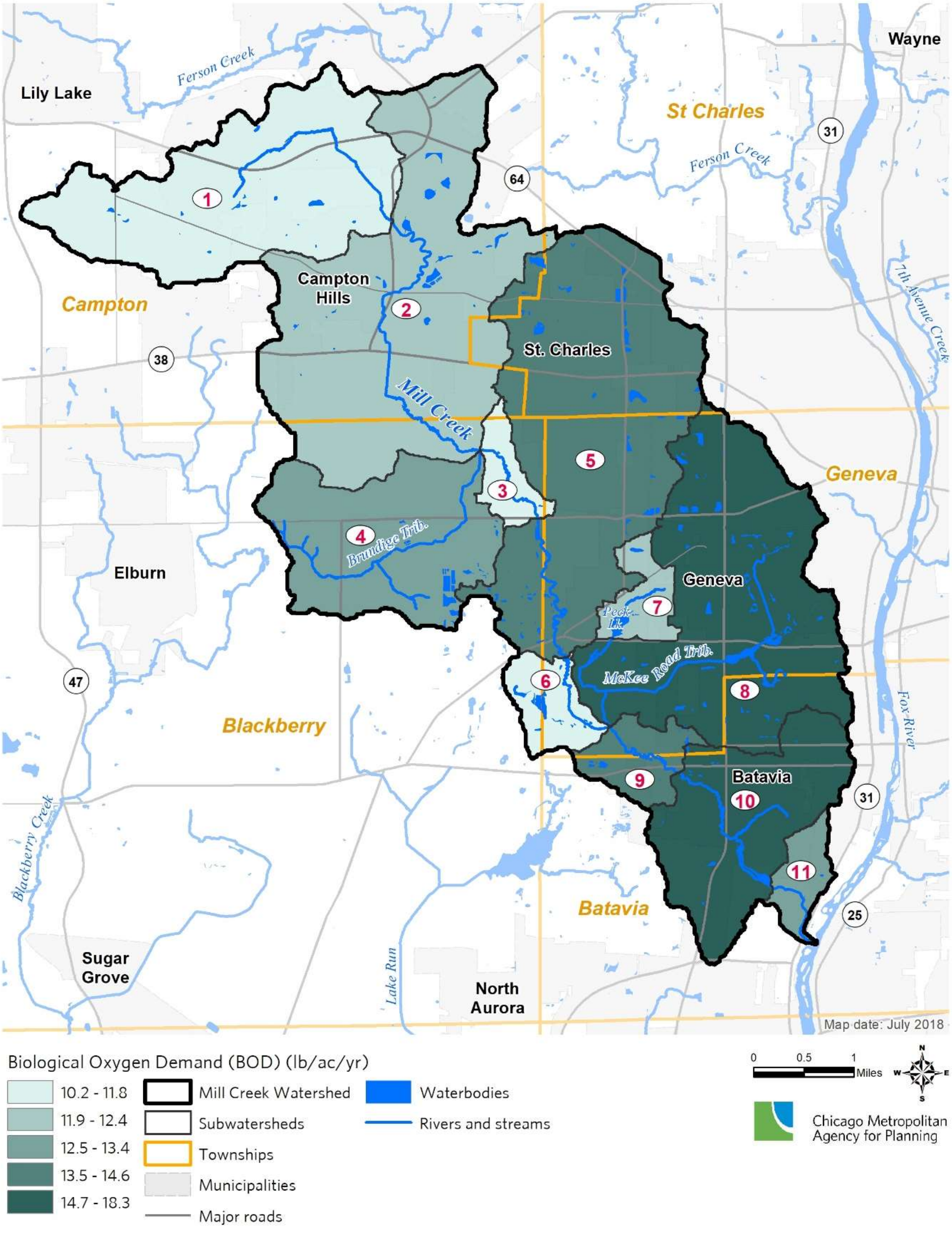
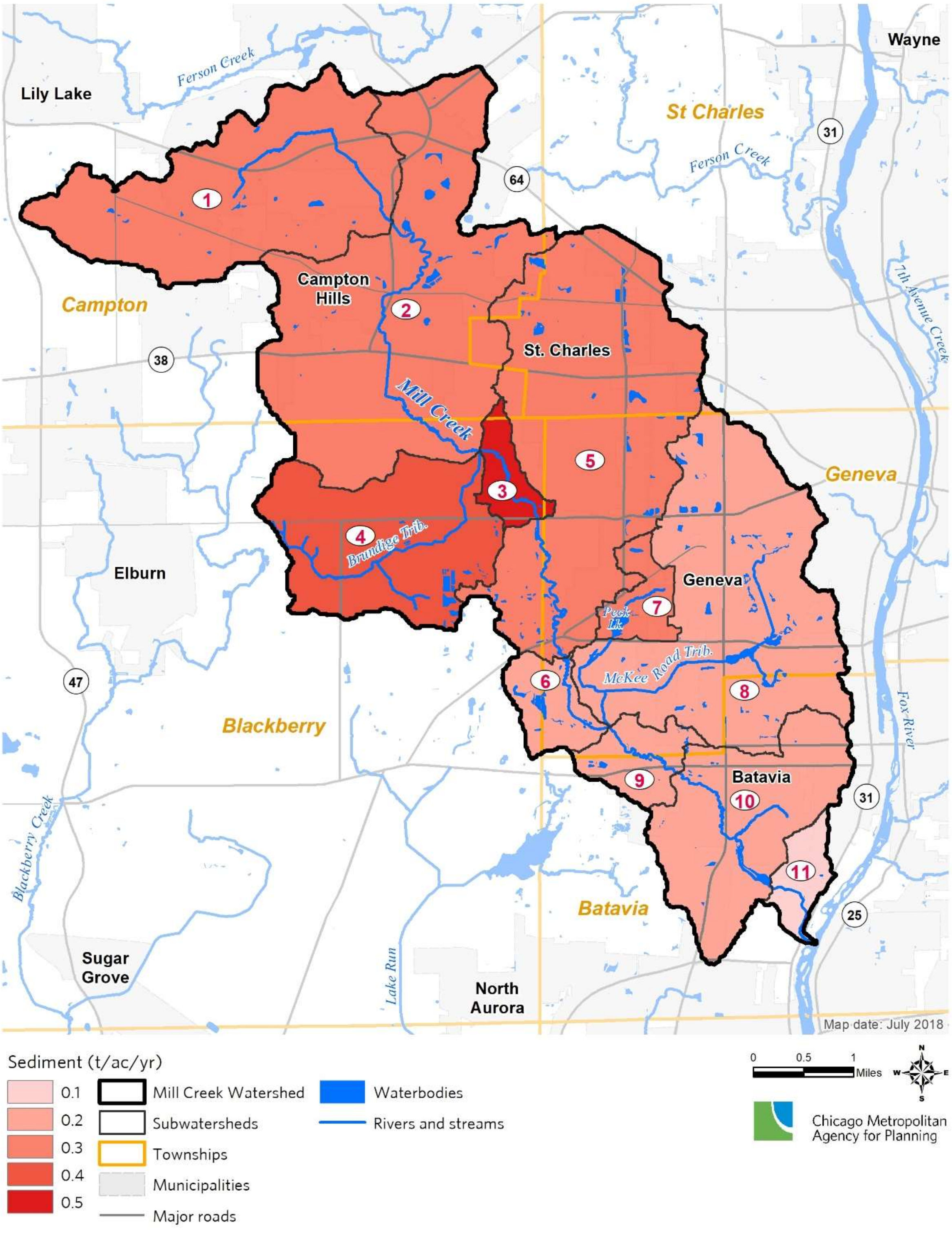


Figure 49. Average annual sediment loading rate by subwatershed (STEPL).



Hydrologic Simulation Program – Fortran (HSPF) modeling

The HSPF (Hydrologic Simulation Program–Fortran) model developed for the Fox River Study Group was calibrated for the Mill Creek watershed by Geosyntec Consultants. The model was used to estimate land use-based pollutant loadings for TN, TP, TSS, and fecal coliform (see Appendix D). CMAP grouped the HSPF load estimates from that model's 132 catchments into the 11 "ISWS subwatersheds" based on which HSPF catchment centroids fell within each of the 11 subwatershed units (Table 44).

Table 44. HSPF pollutant load estimates grouped by Mill Creek subwatershed.

Sub'shd #	Nitrogen Load		Phosphorus Load		Sediment (TSS) Load			Fecal Coliform Load	
	lb/ yr	lb/ac/ yr	lb/yr	lb/ac/ yr	lb/yr	lb/ac/ yr	T/ac/ yr	cfs*cfu/ 100mL/yr	cfs*cfu/ 100mL/ac/yr
1	34,186	12	1,696	0.6	1,284,350	455	0.2	29,002,289	10,271
2	192,686	46	9,466	2.2	7,663,127	1810	0.9	60,112,865	14,201
3	27,412	91	1,328	4.4	1,387,000	4580	2.3	5,143,136	16,985
4	15,021	8	738	0.4	312,165	159	0.1	13,106,418	6,683
5	199,359	50	9,865	2.5	7,771,976	1955	1.0	57,946,575	14,574
6	39,812	93	1,936	4.5	1,736,907	4056	2.0	2,750,616	6,424
7	870	2	53.4	0.2	13,947	40	0.0	5,629,741	16,155
8	64,807	19	3,945	1.2	2,343,813	685	0.3	80,896,988	23,637
9	54,024	120	2,733	6.0	2,112,332	4674	2.3	3,051,999	6,753
10	293,890	169	14,920	8.6	8,469,096	4870	2.4	34,684,771	19,946
11	126,126	415	6,317	20.8	4,819,941	15846	7.9	8,625,312	28,356
Totals	***1,048,192***	***52***	***52,998***	***2.7***	***37,914,653***	***1,897***	***0.9***	***300,950,711***	***15,054***

Note: Geosyntec also developed a framework plan that with further, future refinement could be used to help optimize locations for BMPs throughout the watershed to reduce pollutant loading (see Appendix D).

3.6.2.2 Streambank Erosion Pollutant Load Estimates

Pollutant loads from eroding streambanks were estimated using U.S. EPA's Spreadsheet Tool to Estimate Pollutant Loads (STEPL). Average eroding heights were estimated based on the 2018 stream inventory measurements for assessed reaches.[102] Lateral recession rates were assigned as the midpoint of each category as provided in STEPL (i.e., 0.03 for low, 0.13 for moderate, and 0.3 for high erosion reaches). Soil texture classes associated with each reach were determined using the NRCS SURRGO dataset. Results of the STEPL analysis are provided in Table 45.

Table 45. Streambank erosion pollutant load estimates.

Subwatershed		*Reach Length Assessed (ft)*	*Nitrogen Load (lb/yr)*	*Phosphorus Load (lb/yr)*	*BOD Load (lb/yr)*	*Sediment Load (T/yr)*
#	*Name*					
1	Upper Campton	9,473	549	212	1099	343
2	Lower Campton	20,048	312	120	623	178
3	Mill Crk Greenway	n/a	n/a	n/a	n/a	n/a
4	Brundige Trib	n/a	n/a	n/a	n/a	n/a
5	West St Charles / Geneva	12,391	192	74	384	120
6	Mill Crk FP	6,207	262	101	525	164
7	Peck Lake	0	n/a	n/a	n/a	n/a
8	McKee Rd Trib	0	n/a	n/a	n/a	n/a
9	Tanglewood	6,472	172	66	343	107
10	West Batavia	5,183	26	10	52	16
11	Les Arends	718	3	1	6	2
	Totals	***30971***	***201***	***77***	***401***	***125***

n/a = not available[99]

[102] Certain Mill Creek reaches (including those within Mill Creek Greenway), the two major tributaries (McKee Road Tributary and Brundige Tributary), as well as those that CMAP termed Peck Lake Drain (Tributary) and Mooseheart Tributary, were not readily accessible either due to private property restrictions or water depths too deep to wade, and thus were unable to be assessed for extent of bank erosion.

3.7 Land and Water Management Practices

3.7.1 Agriculture

There are no plans specifically dedicated to agriculture in the Mill Creek watershed. However, the county-wide comprehensive land use plan – the Kane County 2040 Plan -- details agricultural land management strategies for the county, including farmland protection. In 2001, the Kane County Board adopted the Agricultural Conservation Easement and Farmland Protection Program. The purpose of the program is to protect farmland through purchase or donation of development rights, or fee simple purchase of land. The program is driven by farmland owners voluntarily applying to sell future development rights to the county. Applications are reviewed and recommended to the County Board by the Kane County Agricultural Conservation Easement and Farmland Protection Commission. Once the county purchases the development rights, a conservation easement is placed on the property in perpetuity, restricting the land to farming uses.[103] In partnership with the USDA through the Federal Farmland Protection Program, more than 5,500 acres of prime farmland in 30 family owned farms have been permanently protected in the county through this voluntary program since 2001, and 1,500 more acres are on the waiting list.[104, 105]

3.7.2 Forest Management Plans

Two municipalities in the planning area—Campton Hills and St. Charles— as well as Kane County have plans relevant to forest management. Specifically, the Village of Campton Hills adopted a green infrastructure plan in 2010, the City of St. Charles adopted an Urban Forestry Management Plan in 2017, and Kane County adopted their green infrastructure plan in 2012. (See the next section, Comprehensive and other Local Plans, for more information about these plans.) Kane County is also a partner in implementing the Chicago Wilderness Oak Ecosystems Recovery Plan.[106] The Morton Arboretum, Openlands, Metropolitan Mayors Caucus, and CMAP, among other partners, have been encouraging communities to develop forest management plans through the Chicago Region Trees Initiative.[107]

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[103] https://www.countyofkane.org/FDER/Pages/2030/issues/agriculture.pdf (last accessed Sept. 2019).

[104] https://www.countyofkane.org/FDER/Pages/development/farmlandProtection.aspx (last accessed Sept. 2019).

[105] https://www.countyofkane.org/Documents/Quality%20of%20Kane/2040%20Plan/full2040Plan.pdf (last accessed Sept. 2019).

[106] https://www.chicagowilderness.org/page/OakEcosystemsFocus (last accessed Aug. 2019).

[107] https://www.mortonarb.org/chicago-region-trees-initiative (last accessed Aug. 2019).

3.7.3 Comprehensive and Other Local Plans

There are five municipalities located within the Mill Creek planning area. One of these municipalities—North Aurora—has just three acres within the watershed and thu s is not featured in the plan review. The other four municipalities—Batavia, Campton Hills, Geneva, and St. Charles—have all adopted comprehensive plans that may have significant implications for water quality in the Mill Creek watershed. Kane County, Campton Township, and the Forest Preserve District of Kane County also have adopted land use-based plans.

Batavia

The Comprehensive Plan for the City of Batavia, adopted in December 2007 and last amended in November 2016,[108] highlights the importance of water quality in the Fox River and its tributaries, and details several goals and priorities intended to protect the river. Notably, the document supports the use of best management practices (BMPs) to reduce stormwater runoff and enhance water quality. The document also supports the expansion of wildlife corridors along waterways, and includes a map of high quality wetlands in the community, many of which are located along Mill Creek.

The plan's future land use section targets most of the land within City limits for low single family residential housing at a density of zero to one quarter dwelling units per acre. The plan also sets aside a significant portion of the City's extraterritorial jurisdiction (with the Mill Creek watershed) for parks and open space. Lastly, as transportation infrastructure plays an important role in protecting natural resources, the City could consider supporting and emphasizing alternative modes of transportation and transportation infrastructure as a means to preserving resources and reducing water pollution.

Village of Campton Hills

The 2012 Village of Campton Hills Comprehensive Plan[109] was developed in partnership with CMAP and features several recommendations relevant to the Mill Creek Watershed-based Plan. The document includes sections focused on both open space and water resources elements, which highlight the need to preserve and enhance the community's natural resources, highlighting the importance of the ecosystems services these assets provide.

The plan highlights fecal coliform as a specific threat to water quality in Mill Creek. Analysis conducted by the Illinois EPA suggests the elevated levels of fecal coliform are due to fecal material from humans or other warm-bodied animals, though no specific source has been identified. To address this and other threats to surface water, the plan calls for expanded wastewater planning, increased use of BMPs for stormwater retention, and the creation of new

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108 https://www.cityofbatavia.net/158/Comprehensive-Plan (last accessed July 2018).

109 https://www.villageofcamptonhills.org/DocumentCenter/View/74/Campton-Hills-Comprehensive-Plan-?bidId=

community groups to encourage better management of the community's surface and groundwater resources. Though the plan supports alternative modes of transportation, the connection between water quality and transportation infrastructure are not explicitly made.

A "Green Infrastructure in the Village of Campton Hills" report[110] was commissioned by the Village to provide local officials with a more comprehensive understanding of critical natural resources in the Campton Hills area, allowing developers and the Village to make better informed decisions about development and resources management. The document culminates in a series of maps identifying regulated Green Infrastructure and Natural Resource Evaluation Zones. Regulated Green Infrastructure includes wetlands, streams, mapped floodplains, public open space, and conservation easements. These areas are intended to be preserved and enhanced. Natural Resource Evaluation Zones include sensitive aquifer recharge areas, drinking water well recharge areas, wetland recharge areas, and upland wooded areas larger than five acres. Development proposals in these areas should be given a higher level of scrutiny to prevent serious environmental harm.

Campton Township

The Comprehensive Land Use Plan for Campton Township, revised on September 15, 2015,[111] was developed as a supplement to the Kane County 2030 Land Resource Management Plan. As a supplement, the plan largely focuses on preserving the township's open space and low-density, rural character. As of 2013, the township boasted approximately 1,272 acres of open space. The plan highlights the township's ambitious Open Space Plan, committing $47 million for further "acquisition and preservation of open space within the Township." The plan promotes density, lot size, and impervious surface standards that maintain the rural, open space character within private development as well. The plan also encourages a continuous greenbelt for biking and walking through the township.

The plan could be enhanced by identifying critical natural resources in maps of the township. In addition, it could give further consideration to standards protecting groundwater given the township's reliance on it as a source of water and the use of septic systems as a primary wastewater treatment process. Lastly, the plan could also briefly review the township's geographical and governmental relationship to its neighbors.

Geneva

The City of Geneva's most recent comprehensive plan was officially adopted in April of 2003.[112] The document includes a Parks and Open Space element, which details the City's vision for the management of natural lands in its planning area. The majority of the policy proposals

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[110] https://www.villageofcamptonhills.org/DocumentCenter/View/78/Green-Infrastructure-Report-?bidId=

[111] http://www.camptontownship.com/Main/Board/LandUse/Final_Campton_Township_Comprehensive_Plan_1_rev_9_30_15.pdf

[112] https://www.geneva.il.us/DocumentCenter/View/183/Comprehensive-Plan?bidId=

included in the plan focus on recreation and beatification, especially in residential areas and along transportation corridors. The plan also includes an ambitious proposal to develop the "Prairie Green Preserve as a watershed management demonstration project that incorporates prairie and wetland restoration, regional stormwater management, water quality enhancement, and passive recreation." Since the plan was adopted, the Prairie Green Preserve has become an important addition to the green infrastructure network in the Mill Creek watershed. On the other hand, the Future Land Use Plan included in the document targets the majority of the Mill Creek's watershed within the City's extra-territorial jurisdiction for single-family residential development. The plan should consider identifying natural resources and implementing methods to protect them.

The City of Geneva released a companion Bikeway Implementation Plan in 2005[113]. This document focusses primarily on bicycle connections between neighborhoods, the Fox River, and surrounding communities, but does include proposed multi-use trails to improve access to Peck Farm Park and the Prairie Green open space.

St. Charles

Approximately 1,500 acres of the City of St. Charles is located within the Mill Creek planning area. The City also has extraterritorial jurisdiction over a portion of unincorporated Kane County located southwest of the City limits.

The City of St. Charles' 2013 Comprehensive Plan[114] highlights these areas for a combination of open space and rural single family residential, which is characterized by large lot, single use development. The plan does not directly reference Mill Creek, but it does highlight the importance of green infrastructure tools for preserving water quality in the Fox River. It would be helpful if the plan were to include more visual tools such as maps to showcase its green infrastructure and future plans.

The St. Charles Urban Forestry Management Plan was completed in February 2017 and updated in March 2018[115]. The document sets several ambitious goals for the city's urban forest. These goals include conducting a comprehensive inventory of all city trees by 2020, achieving a 20-10-5 (family-genus-species) diversity profile by 2040, developing an acceptable and unacceptable tree species list, and reducing the presence of invasive/aggressive species, among others. The plan also includes an inventory of existing parkways trees in the city, as well as species-specific targets for 2040, and a comprehensive list of best practices for tree planting and maintenance.

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113 https://www.geneva.il.us/DocumentCenter/View/182/Bikeway-Implementation-Plan?bidId=

114 https://www.stcharlesil.gov/planning/comprehensive

115 https://www.stcharlesil.gov/sites/default/files/documents/04.05.17%20Urban%20Forestry%20Management%20Plan.pdf

The City of St. Charles also maintains a Stormwater Management Program Plan (SMPP), which was adopted in March 2009[116]. The document is designed to meet the minimum standards for the National Pollutant Discharge Elimination System (NPDES) Phase II Program. The overall goal of the SMPP is reduce the pollutant and stormwater discharge within the MS4 service area. To accomplish this goal, the document includes detailed procedures for reviewing, permitting, and inspecting construction activity, maintaining stormwater facilities conducting ongoing monitoring, and expanding public education and outreach among other strategies.

Kane County

Kane County adopted its current land use plan – Kane County 2040 Plan: Healthy People, Healthy Living, Healthy Communities – on May 8, 2012[117]. The document was is divided into three sections: Planning Framework, Planning Issues, and Implementation Strategy. The plan emphasizes the importance of preserving the county's rural character, with a specific focus on retaining agriculture and open space and ensuring the Fox River remains a high quality resource for drinking water and recreation. The plan also calls for greater recreational access to Mill Creek and other natural assets. Recent development includes the Mill Creek master planned community, which includes several hundred single family homes built around a series of parks and open spaces.

The Kane County 2040 Green Infrastructure Plan,[118] adopted by the Kane County Board in May 2012, is based on Kane County's legacy of open space and natural resource protection and was guided by the Green Infrastructure Vision developed by Chicago Wilderness. Green infrastructure supports native species, sustains air and water resources, and contributes to the health and quality of life for people and communities.

The Kane County 2040 Green Infrastructure Plan includes analysis of existing natural resources in the county and recommendations for green infrastructure priorities and approaches. The accompanying Green Infrastructure Map[119] illustrates these priorities as an interconnected system of natural areas and open spaces including woodlands,[120] wetlands, trails, and parks which are protected and managed for the ecological values and functions they provide to people and wildlife.

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[116] https://www.stcharlesil.gov/sites/default/files/green/watershed/cityofstcharlessmpp.pdf

[117] https://www.countyofkane.org/Documents/Quality%20of%20Kane/2040%20Plan/full2040Plan.pdf

[118] https://www.countyofkane.org/Documents/Quality%20of%20Kane/Final%20Version%20Kane%20County%20Green%20Infrastructure%20Plan.pdf

[119] https://www.countyofkane.org/Documents/Quality%20of%20Kane/Final_RPC_Draft_9_11_13_PDF.pdf

[120] The Map includes the remnant oak woodlands layer integrated into the Oak Ecosystem Recovery Plan developed by the Morton Arboretum and Chicago Wilderness.

The ultimate goal of the Kane County 2040 Green Infrastructure Plan is to lay the groundwork for green infrastructure planning and projects at the regional, community, neighborhood, and site levels addressing current issues of water resource management, biodiversity, conservation, water supply, public health, climate change, and economic development.[121] Several local governments include the Green Infrastructure Plan and Map as a guide in their planning activities.

The County's Natural Hazard Mitigation Plan was officially adopted in May 2015.[122] The plan highlights flooding, blizzards, and tornados as the most significant natural hazards facing communities in the area. Flooding in particular is a challenge for the county; flood-related Federal Disaster Declarations were made in 1993, 1996, 2007, 2008, and 2013. The plan classifies the Mooseheart Lake Dam as a class II dam, indicating that "failure has moderate probability for causing loss of life or may cause substantial economic loss in excess of that which would naturally occur downstream of the dam if the dam had not failed." Three other dams—the Fox Mill Lagoon Dam and the Eaglebrook Country Club Dams #1 and #2 are listed as class III dams, indicating a lower risk of property damage and loss of life from a failure.

Forest Preserve District of Kane County

The Forest Preserve District of Kane County updated its Comprehensive Master Plan in early 2018.[123] The document lays out the District's strategic priorities for the next five years, and provides cost estimates for each project. Within the study area, the plan calls for building new operations structures at both the Campton Forest Preserve and the Mill Creek Greenway. The plan also calls for conducting a system-wide Vegetation Inventory; the District's last inventory was conducted in 1978. Notably, the plan also highlights the need to reduce nonpoint source pollution in the Fox River watershed. To accomplish this goal, the District plans to institute an average of three new soil-conservation plans on District-owned row crop fields each year.

Greenest Region Compact

The Greenest Region Compact (GRC1)[124], launched in 2007 by the Metropolitan Mayors Caucus (MMC), is a comprehensive sustainability guide expected to coordinate community efforts

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[121] Information on the Kane County 2040 Green Infrastructure Plan was copied from the April 5, 2016, edition of Kane County Connects. https://kanecountyconnects.com/2016/04/countdown-to-earth-day-why-green-infrastructure-is-so-important-to-kane-county/

[122] http://www.kcoem.org/Documents/Mitigation/haz_mit_plan.pdf

[123] http://www.kaneforest.com/publications/masterPlan/MasterPlanUpdate_2018with2015.pdf

[124] Metropolitan Mayors Caucus (MMC). *Greenest Region Compact of Metropolitan Chicago.* MMC, 2007. Retrieved February 2017 from http://mayorscaucus.org/wp-content/uploads/2014/09/Greenest-Region-Compact_final.pdf

across the region. The Greenest Region Compact 2 (GRC2)[125] was then adopted in 2016 as an update to the original Compact. It is based on 30 local and nine regional or national sustainability plans. Forty-nine consensus sustainability goals were extracted from these plans to create the Compact. The goals pertain to climate, economic development, energy, land, leadership, mobility, municipal operations, sustainable communities, waste and recycling, and water. The Compact also provides a detailed framework of possible objectives and strategies from which a municipality can create a plan tailored to its needs. These achievements were used to help develop the GRC goals. Three municipalities in the study area—Batavia, Campton Hills, and Geneva—plus Kane County have adopted the Greenest Region Compact. In fact, Kane County was the first county in the CMAP region to adapt and then adopt the GRC, adopted by the County Board in April 2019. Analysis of GRC goals achieved or in progress by Kane County Government is being used to determine what goals to work on in the future.[126]

3.7.4 Local Ordinances

Through ordinances and codes, communities implement the vision established in their comprehensive plans by establishing detailed, enforceable regulations. Zoning is the most common ordinance that municipalities and counties use to direct land use, transportation, and development practices, with many also using subdivision, stormwater, water use, and parking ordinances to regulate specific aspects of development. Kane County and the four major municipalities in the Mill Creek watershed are encouraged to assess the extent to which their ordinances address issues relevant to water quality and natural resources. A questionnaire developed by CMAP asks whether current codes fully, mostly, minimally, or do not address particular aspects of stormwater drainage and detention, soil erosion and sediment control, floodplain management, stream and wetland protection, natural areas and open space, conservation design, landscaping, transportation, parking, water efficiency and conservation, and pollution prevention. The Center for Watershed Protection offers a Code and Ordinance Worksheet and accompanying scoring spreadsheet[127] to help communities evaluate their local development regulations that allow (or require) site developers to minimize impervious cover, conserve natural areas, and use runoff reduction practices to manage stormwater runoff.

3.7.5 Conservation Easement Programs

A conservation easement is a land protection tool that allows private and public property owners to preserve their land from inadvertent or intentional destruction of desired natural, scenic, historic, or agricultural characteristics. Restrictions placed in a conservation easement are tailored to each property and situation. For example, the easement may require the land to

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[125] Metropolitan Mayors Caucus (MMC). *Greenest Region Compact 2 of Metropolitan Chicago.* MMC, 2016. Retrieved February 2017 from http://mayorscaucus.org/wp-content/uploads/2016/03/The-Greenest-Region-Compact-2-FINAL.pdf

[126] Karen Miller, Kane County Development Dept., personal communication, August 2019.

[127] https://www.cwp.org/updated-code-ordinance-worksheet-improving-local-development-regulations/

remain in a natural, undisturbed condition or it may allow some limited use, such as farming or timber management. Easements can be placed on all or a portion of a landowner's property. For example, a stream and a prairie buffer along it could be specified in the easement, thereby allowing the remainder of the property to be developed. A conservation easement is permanent and is recorded like any other title interest, and stays with the land when it is transferred by sale, gift, or bequeath. A conservation easement may provide income, estate, and/or property tax benefits as well.[128] Conservation easements are typically not open to the public. Entering an area that is not open to the public subjects an individual to possible sanctions for trespass.

Organizations landowners in the Mill Creek watershed can work with to establish conservation easements include The Conservation Foundation (TCF), the Natural Land Institute, and the Illinois Nature Preserves Commission (INPC). Where there are high quality natural areas and habitats of endangered or threatened species, dedication or registration of such lands as an Illinois Nature Preserve, Land and Water Reserve, or Illinois natural heritage landmark can be made through the INPC.

Data from the National Conservation Easement Database indicate that there are 176.0 acres of land preserved through conservation easements within the Mill Creek watershed. There is one held by Campton Township and three held by the Campton Townships Open Space District. All easement areas are closed to the public. Campton Township staff are granted access to their site one time a year.

3.7.6 Road Maintenance Jurisdictions

While public roads are an essential component of the built environment, a significant amount of polluted stormwater runs off these surfaces and is conveyed along transportation corridors, either through underground stormwater conveyances or road side ditches. The vehicles that travel these roads are one source of pollutants (e.g., petroleum products, tire dust, heavy metals, etc.), as are winter deicing materials, most notably chlorides in road salt. Higher traffic volumes generally increase the amount of pollutants generated from public roads and also increase the likelihood of more intense winter maintenance activities (e.g., plowing and salting). A particular concern to surface waters and roadside vegetation is chlorides in road salt, due to its adverse impacts on aquatic organisms and both terrestrial and aquatic plant community composition.

There are approximately 445.6 lane miles (214.9 road miles) within the Mill Creek watershed (Figure 50). The traffic volumes of these roadways vary, as does the maintenance and pollutant loads generated. In addition to these public roadways, many other public and private entities maintain a vast network of roads, parking lots, sidewalks, and driveways.

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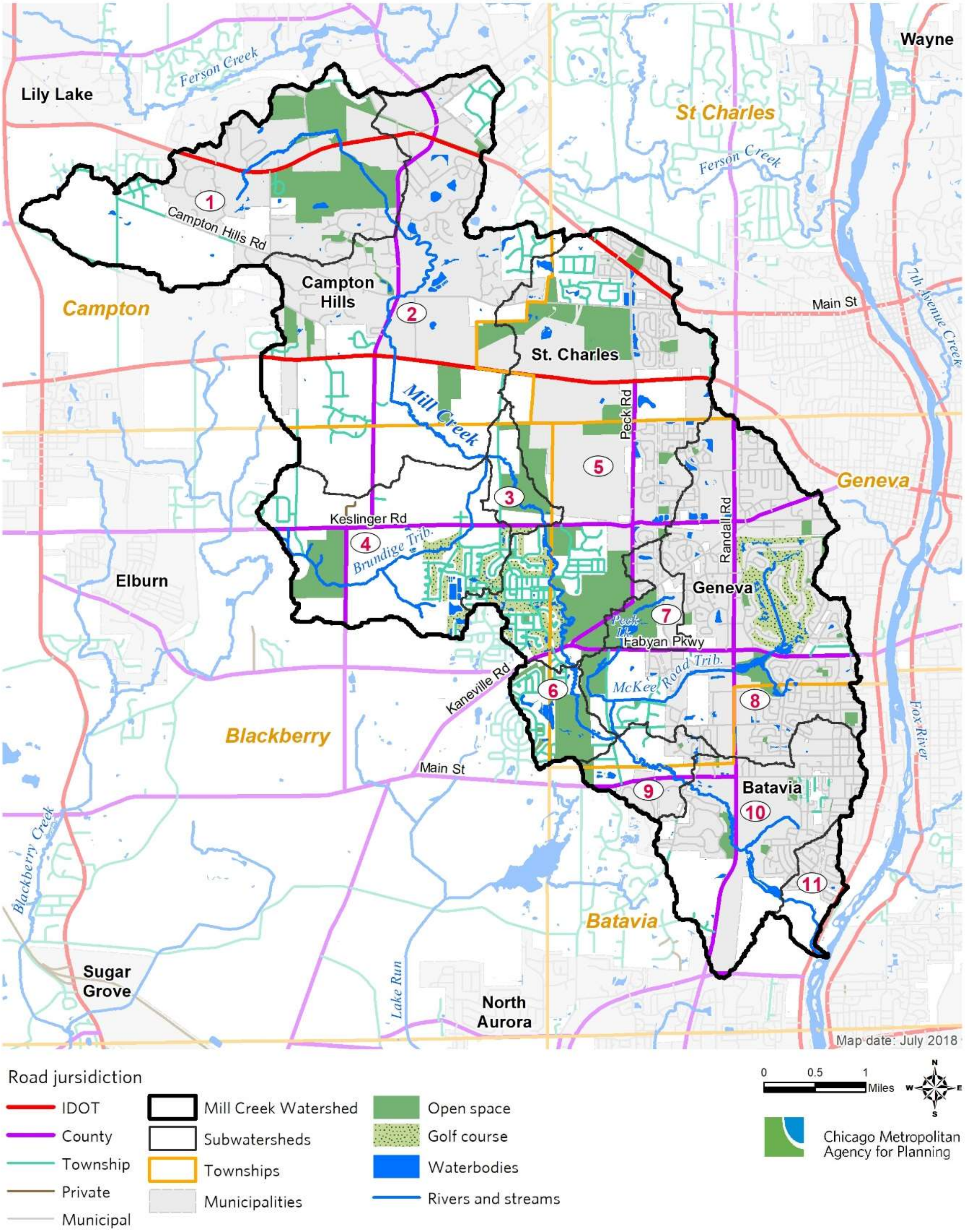
[128] "Conservation Easements," The Land Conservancy of McHenry County, accessed February 14, 2017, http://www.conservemc.org/what-we-do/preserve-land/conservation-easements

Typical roadway maintenance activities include street sweeping and catch basin cleaning, road surface maintenance, underground stormwater infrastructure repair, surface drainage (ditch) maintenance, roadside grass and weed control, and litter and road kill removal. These maintenance activities can help reduce and control the amount of pollutants, such as sediment and associated metals and nutrients, which are carried with stormwater. Routine street sweeping and catch basin cleaning are particularly important maintenance activities that remove pollutants that accumulate on public roads and in the stormwater conveyance systems before reaching nearby surface waters.

Figure 50. Roads by maintenance jurisdiction in the Mill Creek watershed.



3.7.7 Community Water Supply Wells, Setbacks, and Groundwater Restricted Use Areas

Municipalities or counties served by community water systems (CWS) are subject to the Illinois Groundwater Protection Act (IGPA; P.A. 85-0863).[129] Presently, three of the municipalities within the Mill Creek watershed planning area have CWS wells. Collectively, there are 23 CWS wells with 12 located in unincorporated areas. Municipalities with the most wells are Geneva followed by Campton Hills and St. Charles. The remaining 13 fall in unincorporated areas, and are managed by Batavia, Mill Creek Water Reclamation District, and the MA Center Chicago (Table 46, Figure 51). All of the 23 wells that exist in the watershed planning area are active with the exception of one that is being proposed just outside of St. Charles by the Mill Creek Water Reclamation District (WRD).

The IGPA requires that a minimum setback zone be established around all CWS wells in order to minimize aquifer contamination potential by restricting certain land-use activities. The setback zone is set depending on the sensitivity of the aquifer to possible contamination, either a minimum of a 200 foot radius for wells finished within a confined aquifer or a 400 foot radius for wells finished within an unconfined aquifer (Table 46, Figure 51). [130]

The IGPA also establishes a two-phase wellhead protection program for enhanced groundwater protection. Phase I establishes a 1,000 setback zone around community and non-community water supply wells. Phase II delineates a 5-year recharge area for the CWS well extending beyond 1000 feet of an existing wellhead protection area. Wellhead protection areas are not regulated; they are used for educational purposes.[131] In the Mill Creek watershed, Phase I and Phase II setback zones have been established (Figure 51). Phase I setback zones surround two wells on the western edge of Geneva. The Phase II setback zones primarily cover unincorporated areas and Geneva as well as portions of Campton Hills and St. Charles.

However, under 35 Ill. Adm. Code 742, municipalities have enacted groundwater ordinances to restrict the use of establishing new potable water supply wells that go through IEPA's review process. Groundwater restricted use boundaries also specify where new CWS wells are prohibited by local ordinance(s) because of the possible presence of groundwater

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[129] Illinois General Assembly, Illinois Groundwater Protection Act (IGPA; P.A. 85-0863), http://www.ilga.gov/legislation/ilcs/ilcs3.asp?ActID=1595&ChapterID=36, (accessed December 1, 2014).

[130] IEPA. "IGPA Maximum Setback Zones Community Water Supply Groundwater Quality Protection," http://www.epa.state.il.us/water/groundwater/maximum-setback-zones/ (accessed December 1, 2014).

[131] IEPA. "The Illinois Wellhead Protection Program Pursuant to Section 1428 of the Federal Safe Drinking Water Act SDWA," State of Illinois

contamination. However, it is possible that private potable water supply wells established prior to the ordinance adoption may still be operating in these areas.[132]

Table 46. Number of community water supply wells in the Mill Creek watershed.

Municipality	*# CWS Wells*	*# of confined aquifer wells (200 ft. setback)*	*# of unconfined aquifer wells (400 ft. setback)*
Batavia	--	--	--
Campton Hills[133]	2	2	--
Geneva	7	3	4
St. Charles[134]	2	2	--
North Aurora	--	--	--
Unincorporated			
Batavia	6	6	--
Mill Creek WRD	4	4	--
MA Center Chicago	2	2	--
Totals	**23**	**19**	**4**

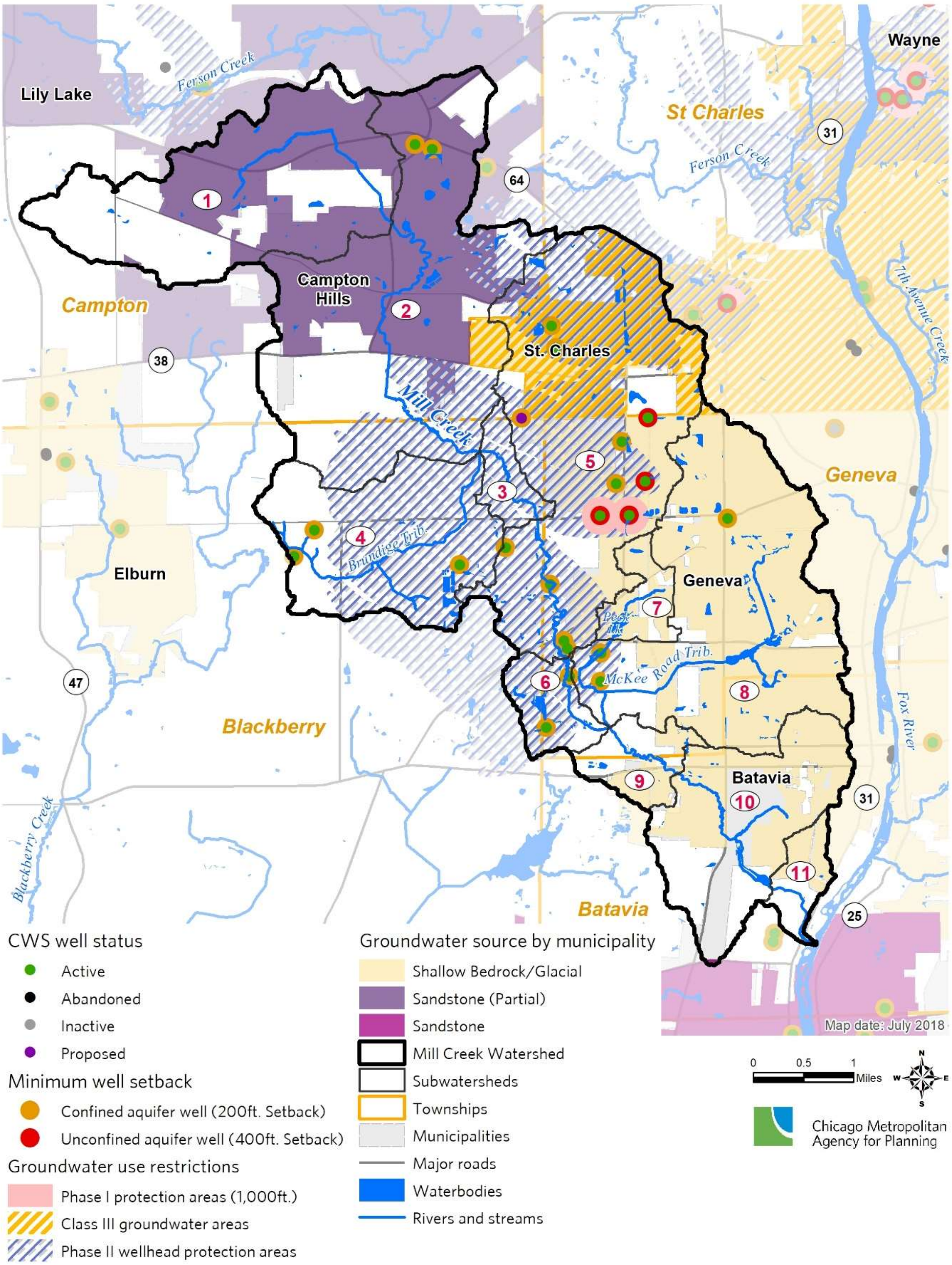
In addition to preventing aquifer contamination, there is a special designation—Class III Special Resource Groundwater—for protecting groundwater that may have an ecologically vital role, such as supporting a wetland or cave. More stringent standards may be developed to classify and protect areas which are deemed Class III. Figure 51 illustrates that this designation has been applied to the city limits of St. Charles.

[132] Illinois General Assembly, Part 742 - Tiered Approach to Corrective Action Objectives, ftp://www.ilga.gov/JCAR/AdminCode/035/035007420B02000R.html (accessed October 27, 2016).

[133] Campton Hills' water supply is managed and distributed by the Wasco Sanitary District.

[134] The two wells in St. Charles are for the Illinois Youth Center.

Figure 51. Community water supply wells and groundwater restricted use areas in the Mill Creek watershed.



3.8 Previous Watershed Planning and Implementation Activities

3.8.1 Water Quality-based Plans

Fox River Implementation Plan: A Plan to Improve Dissolved Oxygen and Reduce Nuisance Algae in the Fox River (The Fox River Study Group, 2015)

This report was developed by the Fox River Study Group (FRSG), in partnership with Illinois EPA, following a cooperative process lasting more than ten years. The plan's overarching goal is to create an innovative, stakeholder-driven approach to water quality improvement in the Fox River, with a specific focus on eliminating aquatic life impairments associate with dissolved oxygen, phosphorus, and nuisance algae. FRIP, as the plan is known, was designed as an alternative to the traditional Total Maximum Daily Load (TMDL) approach to water quality management. Key recommendations of the plan include widespread adoption of NPDES permits, the adoption of TMDLs for upstream segments of the river, and future study of dam removal alternatives for the Carpentersville and North Aurora Dams. The plan does not include numeric phosphorus load reductions for MS4s but does support future study of potential improvements to the region's MS4 systems. The report can be found at: http://www.foxriverstudygroup.org/FRIP/FRIP_12-17-15.pdf.

Peck Farm Park Extension Master Plan (Geneva Park District, July 2002).

The Peck Farm Park Extension Master Plan was a consultant-lead project commissioned by the Geneva Park District during the winter of 2001-2002. The document was created through a comprehensive outreach process involving local residents, community leaders, and various governmental entities, and sought to establish a vision for the expansion of the park from its 131 acre core to a full build out of 378 acres. The planning process included a comprehensive analysis of presettlement land cover, in addition to watershed, wetland, and soil mapping. The consultants used a scenario planning process to identify a final strategy that would preserve large tracks of open prairie, while also expanding active and passive recreational opportunities for the area's rapidly growing population.

Notably, the plan envisions Peck Farm Park to serve as a model for natural stormwater management techniques, strictly adhering to the belief that all stormwater that falls within the park's boundaries should stay within the park's boundaries. Native prairie grasses, restored wetlands, and strategically located bioswales would be central to achieving this goal. Because the park does not exist in an isolated system, the plan also calls for continued partnerships with surrounding landowners, and highlights an agreement with the neighboring middle school to use sand for deicing, rather than salt, in exchange for free access to park facilities.

3.8.2 Stormwater Management Plans

Kane County Stormwater Management Program Plan (Kane County Division of Environmental & Water Resources, 2018)

The Kane County Stormwater Management Program Plan (SMPP) was developed by the County and is intended to provide a comprehensive documentation of the County's program for implementing the requirements of the National Pollutant Discharge Elimination System (NPDES), as outlined by the United States Environmental Protection Agency (USEPA). Specifically, the document details the County's approach to:

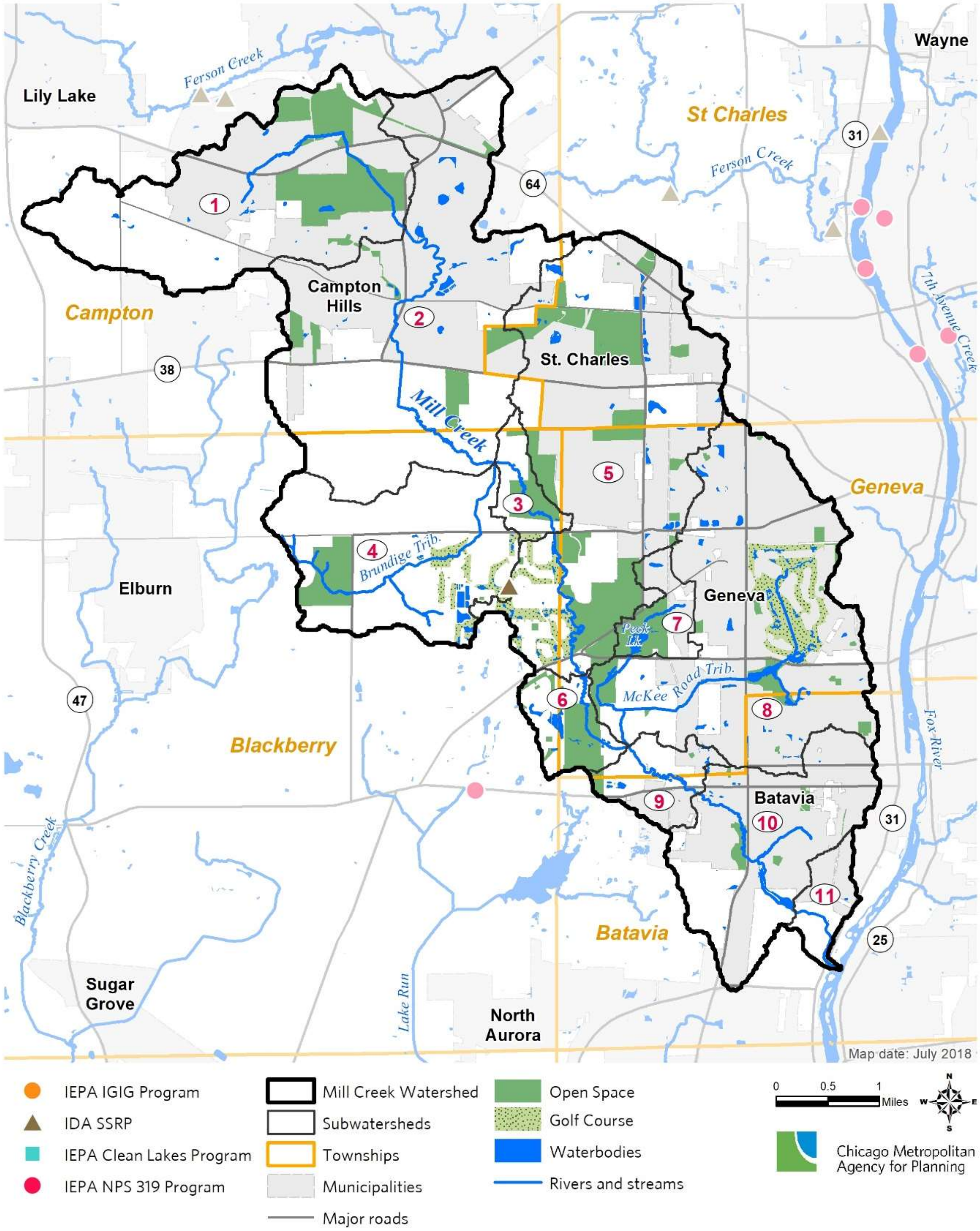
- Protecting receiving water from illicit discharges
- Managing stormwater quality planning throughout the County
- Reviewing, permitting, and inspecting NPDES construction activity
- Maintaining County facilities and performing day-to-day- operations
- Providing public education and outreach
- Training employees to implement and report program activities
- Continually monitoring and evaluating the program

3.8.3 Water Quality-based Implementation Projects

Illinois' Resource Management Mapping Service (RMMS) database[135] contained only one record of a project aimed at protecting or improving water quality in the Mill Creek watershed (Figure 52). This project, supported by the state's Streambank Stabilization and Restoration Program (SSRP) administered by the Illinois Department of Agriculture through county Soil and Water Conservation Districts, is located in subwatershed #4. There are a number of other SSRP- and Nonpoint Source Pollution Control "Section 319" Program-supported projects just outside of the Mill Creek watershed, including several along or near the Fox River.

[135] http://www.rmms.illinois.edu/RMMS-JSA (last accessed September 2017)

Figure 52. Water quality-based implementation projects within the Mill Creek watershed.



4. Watershed Protection Measures

4.1 Planning, Policy, and Programming

4.1.1 General Planning Recommendations

Comprehensive planning is one of the foundations of community-based watershed protection. By setting the community's vision for its long-term future, a comprehensive plan represents the opportunity to codify the importance that clean, protected surface and ground water holds for a city, village, township, or county. A comprehensive plan addresses the location, type, and framework for future development in a community, and informs the development controls of zoning, subdivision, stormwater, and related ordinances. It also informs supporting plans, such as open space, green infrastructure, and bicycle plans that provide specialized goals for implementing those aspects of the comprehensive plan's vision.

All four of the municipalities within the Mill Creek watershed have a comprehensive land use plan, as does Kane County and Campton Township (see Section 3.7.3). Each community will eventually need to update their comprehensive plan to reflect changing conditions over the coming years. As a general practice, municipalities should update their comprehensive plan every 10-12 years. Within the Mill Creek watershed, the Cities of Batavia (2007) and Geneva (2003) should consider updating their plans in the near future.

The following section describes some recommendations that communities should consider when they update or develop local plans to advance the goals of this watershed-based protection plan. Additionally, Appendix F provides a list of elements recommended for inclusion in comprehensive plans that potentially impact water quality and watershed health.

4.1.1.1 Align local plans and ordinances with best practices

Existing municipal plans within the planning area reflect the importance of resource protection and conservation goals to the communities. For example, Batavia's comprehensive plan supports the use of best management practices (BMPs) to reduce stormwater runoff and enhance water quality, the Campton Hills comprehensive plan highlights the need to preserve and enhance the community's natural resources and cites the importance of the ecosystems services these assets provide, Geneva cites the Prairie Green preserve as a watershed management demonstration project, and St. Charles' plan highlights the importance of green infrastructure tools for preserving water quality. The prominence of natural resource conservation as an overarching community goal shows that the will and commitment to advance environmental and water resource protection through planning and development ordinances exists within the planning area's communities. The following discussion provides some best practices that can be incorporated into future plans to achieve this goal.

Kane County plans provide an excellent framework for long-range planning and water resource protection.

The Kane County 2040 Plan incorporates the results of the Kane County Water Resources Investigations (2009) prepared by the Illinois State Water Survey, supports the efforts of CMAP to implement the Northeastern Illinois Regional Water Supply/Demand Plan – Water 2050 (2010), and emphasizes the need to integrate water resources with land-use decision making. The 2040 Plan addresses a regional approach to water supply planning, water resources in Kane County, water conservation and drought planning, water resource driven land use decisions, and integrated water resource planning.[136]

The ultimate goal of the Kane County 2040 Green Infrastructure Plan is to lay the groundwork for green infrastructure planning and projects at the regional, community, neighborhood, and site levels addressing current issues of water resource management, biodiversity, conservation, water supply, public health, climate change and economic development. As green infrastructure technology advances and becomes more widespread, the opportunity increases for monetary and property savings while enhancing quality of life and preserving the natural resources of Kane County.[137]

Kane County Stormwater Management Ordinance offers avenue for coordinated updates.

Each municipality within the planning area has adopted the Kane County Stormwater Management Ordinance (last revised June 2019). Because the municipalities have adopted the same ordinance, they have the same core set of regulations on these topics and can update them through county action rather than piecemeal revisions at the local level. The countywide Ordinance has undergone several revisions since its initial adoption in 2002. The Ordinance has always included requirements for stream and wetland protection. The Ordinance also has strongly promoted (but not mandated) implementation of a runoff volume reduction hierarchy[138]. To address water quality and runoff volume reduction, the ordinance requires evaluation and implementation of the following design elements "to the maximum extent practicable":

- Wet detention facilities and stormwater wetlands
- Infiltration basins
- Infiltration strips
- Filter strips

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[136] Karen Miller, Kane Co. Development Dept., personal correspondence, Sept. 2019.

[137] *Ibid.*

[138] Runoff volume reduction hierarchy refers to various techniques used together on a development site to reduce stormwater runoff in order to keep runoff volumes and rates as close as possible to pre-development conditions. Techniques include preserving natural features and natural streams and drainageways on the site, minimizing impervious surfaces, conveying stormwater through vegetated channels, using natural landscaping instead of turf grass, and utilizing structures that provide both water quality and quantity control.

- Vegetated swales

In practice, however, very few developments in the planning area have incorporated water quality or volume reduction designs, except for practices associated with naturalized detention basins. The most recent revisions to the countywide Ordinance (2018) have added specific requirements for runoff volume reduction.

Update comprehensive plans every 10-12 years, incorporating watershed protection elements.

The review of local plans found that each municipality has a comprehensive plan, although a couple of them would benefit from an update as real estate markets have changed considerably since adoption in the early 2000s. A new plan would better reflect current market conditions in most cases. The existing plans share a concern with orderly development patterns, and most highlight the protection of natural and water resources. However, they contain few policies designed to limit impacts in areas that see development and pay little attention to the role of transportation and parking policies in protecting water resources.

Select updates that communities could incorporate in future comprehensive plans include:
- Be explicit about clean water as a goal and an aspect of community vision
- Encourage native vegetation to stabilize streambanks and filter stormwater runoff
- Preserve and increase street trees
- Design streets and parking lots to support their regular functions without creating unnecessary impervious surface and stormwater runoff
- Encourage narrow, connected streets that can accommodate anticipated traffic volumes without requiring unnecessarily wide roadways
- Encourage the use of green stormwater infrastructure in street design
- Encourage green parking lots with integrated stormwater management and fewer, narrower spaces and shared parking to minimize impervious surfaces, and integrated stormwater management
- Emphasize conservation design, infill development, and alternative transportation to reduce overall greenfield development

Create and update supplemental subarea and topical plans.

- Open space plans
  - Incorporate Kane County Green Infrastructure Map into local comprehensive plans and ordinances.

- Natural resource plans
  - Communities should identify their natural resources and open space areas. Creating and refining a local green infrastructure map that incorporates and adds to the Kane County Green Infrastructure Map will allow communities to identify natural resource areas and protect them from development impacts using buffers and other controls. Identified natural areas could be protected via strict development

prohibitions or through flexible zoning that allows for clustering around sensitive natural areas. These regulatory protections should be combined with the efforts of the FPD of Kane County, park districts, townships, and other local governments to acquire key parcels of open space. Municipalities should also identify opportunities to work with The Conservation Foundation to plan for creative ways to protect natural areas via conservation easements, purchases, and donations.
    - Management plans should be required for designated natural areas with performance criteria, identified responsible parties, and revenue sources.

- Greenways and trails/bike plans
    - Trail projects can be a good way to protect greenways that also function as natural resource areas and connections between larger areas of open space. Integrating the Kane County Green Infrastructure Plan into trails planning can help municipalities align these investments.

Update zoning, subdivision, stormwater management, and water conservation ordinances.

Updating municipal and county ordinances is a key step in implementing long-range plans. As a community creates new plans, it should update its ordinances with policies and regulations that help implement the long-term vision the plans express. Ordinances can also be updated independently of new plans to reflect new policy priorities that have developed in the interim. In addition to the example provided by Kane County's ordinances, several model ordinances developed by CMAP and its predecessor agency, the Northeastern Illinois Planning Commission (NIPC), offer guidance for communities looking to implement best practices. Other examples from around the country are available via Internet search as well.

To help assess the extent to which local ordinances address issues relevant to water quality and natural resources, communities are encouraged to utilize either a questionnaire developed by CMAP or a Code and Ordinance Worksheet (COW) from the Center for Watershed Protection. The CMAP questionnaire, available upon request, asks whether current codes fully, mostly, minimally, or do not address particular aspects of stormwater drainage and detention, soil erosion and sediment control, floodplain management, stream and wetland protection, natural areas and open space, conservation design, landscaping, transportation, parking, water efficiency and conservation, and pollution prevention. The COW and accompanying scoring spreadsheet[139] helps communities evaluate their local development regulations that allow (or require) site developers to minimize impervious cover, conserve natural areas, and use runoff reduction practices to manage stormwater runoff.

- Model ordinance references include:
    - Model Water Use Conservation Ordinance (CMAP, 2010)
    - Conservation Design Resource Manual (NIPC, 2003)

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[139] https://www.cwp.org/updated-code-ordinance-worksheet-improving-local-development-regulations/

  - Model Stormwater Drainage and Detention Ordinance (NIPC, 1994)
  - Model Soil Erosion and Sediment Control Ordinance (NIPC, 1991)
  - Model Floodplain Ordinance for Communities within Northeastern Illinois (NIPC, 1996)
  - Model Stream and Wetland Protection Ordinance (NIPC, 1988)

- Select updates that could be included in ordinance revisions:
  - Adopt conservation design elements
  - Encourage or require conservation design in zoning and subdivision ordinances
  - Use density bonuses to encourage conservation design that goes beyond requirements.
  - Encourage use of native vegetation rather than turf grass in landscaping ordinances. Native vegetation is especially important in open spaces, riparian areas, and stormwater detention basins.
  - Include language that protects trees during development and construction activities and requires replacement of trees that cannot be avoided.
  - Parking:
    - Encourage/require integration of pervious surfaces, including permeable pavement and landscaped areas, with diversion of stormwater runoff to landscaped areas.
    - Remove any aspects of codes that require full curbs around landscaped islands; encourage drainage to landscaped islands using curb cuts; incorporate bioinfiltration facilities.
    - Allow and encourage shared parking, smaller parking stalls, and other alternative parking management to reduce total number of parking spots.
  - Encourage reduction in road salt application through "sensible salting" practices.
  - Discourage use of coal tar-based sealants.

4.1.1.2 Coordinate efforts to advocate for bike trails, public transportation

- Transportation planning, including projects for both motorized and non-motorized modes, can be done much more effectively when it is coordinated over a larger area with a bigger population.

- Communities should work with Kane County, the FPD of Kane County, and park districts to leverage the resources of a larger population to advance goals that transcend municipal and township boundaries.

4.1.1.3 Develop agricultural resource conservation plans and nutrient management plans

Farm owners and operators are encouraged to take advantage of the Conservation Technical Assistance (CTA) Program offered by the USDA-NRCS.[140] An NRCS employee, such as the local District Conservationist out of the St. Charles office, can help with resource assessment, practice design, resource monitoring, or follow-up of installed practices. A conservation plan can be developed which can serve as a springboard for those interested in participating in USDA financial assistance programs or other federal, state, and local financial assistance and conservation easement programs. Assistance can help land users:

- Maintain and improve private lands and their management
- Implement better land management technologies
- Protect and improve water quality and quantity
- Maintain and improve wildlife and fish habitat
- Enhance recreational opportunities on their land
- Maintain and improve the aesthetic character of private land
- Explore opportunities to diversify agricultural operations and
- Develop and apply sustainable agricultural systems

At a minimum, agricultural producers are encouraged to develop a "nutrient management plan." A nutrient management plan is a type of conservation plan that identifies the nutrient needs of a given crop or crops to minimize nutrient runoff while still producing good yields. For livestock operations, a "comprehensive nutrient management plan" will document practices and strategies for managing livestock manure and disposal of organic by-products.[141]

4.1.2. General Policy Recommendations

4.1.2.1 Incorporate green infrastructure designs

As part of the formal capital improvement program, it is recommended that communities institute a policy to use the Kane County 2040 Green Infrastructure Plan and Map as a guide to incorporate green infrastructure designs. Watershed communities should implement examples and other similar projects over a reasonable schedule and fully integrate green infrastructure concepts into their existing infrastructure rehabilitation and replacement programs. To facilitate the implementation of this recommendation, watershed communities are encouraged to collaborate on the development of a consistent and structured mechanism to guide this process.

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[140] https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/ (last accessed August 2019)

[141] https://www.nrcs.usda.gov/wps/portal/nrcs/detail/il/water/resources/?cid=nrcseprd510211 (last accessed August 2019)

About 50 percent of the Mill Creek watershed is already developed, and there will be substantial demands for the rehabilitation and replacement of public infrastructure and facilities over time. These infrastructure needs should be routinely evaluated for opportunities to replace traditional gray infrastructure with green infrastructure that can help to solve existing stormwater quantity and quality problems. The following are a subset of example opportunities for when green infrastructure could be integrated into infrastructure rehabilitation projects:

- During roadway resurfacing or sidewalk/curb work, install improved catch basins.
- Work on roads with open drainage or room in the right-of-way also present opportunities to direct runoff into small wetland treatment areas or rain gardens and bioswales.
- Parking lot resurfacing or reconstruction may provide an opportunity to direct runoff to pervious areas, particularly filter strips and bioinfiltration areas rather than into the storm sewer system.
- Permeable paving should be investigated as an option to conventional paving where pavement is being replaced in parking lots and local roads.
- Opportunities may exist for improving the water quality improvement function of existing detention basins (i.e. outlet reconfiguration, concrete channel removal, etc.) during stormwater infrastructure maintenance or improvement projects.

Facilities such as police and fire stations, libraries, schools, city/village halls, park and forest preserve district, and public works facilities provide opportunities to incorporate green infrastructure alternatives that are highly visible to the public. Communities that embrace green infrastructure for retrofit and replacement projects, as well as public facilities like police and fire stations, will serve as role models for the type of development they want to see in their communities. At the same time, these projects may create a unique sense of place that could provide the community with a marketing advantage in attracting desirable development as the current recession eases. Lastly, the communities will realize cost-savings due to longer life cycles of green technology.[142]

4.1.3 General Programming Recommendations

4.1.3.1 Coordinate efforts to leverage existing and develop new programs to educate and involve watershed residents

Numerous organizations and agencies are active in providing educational opportunities and events for people who live, work, and play in the Mill Creek watershed. It is recommended that a coalition be formed and a work strategy be developed within the first three years after

[142] A useful resource for the incorporation of green infrastructure into rehabilitation and expansion project is provided at the Low Impact Development Center's web site at http://www.lowimpactdevelopment.org/greenstreets/index.htm

completion of this watershed plan, followed by implementation of the work strategy. Suggested coalition representatives include Kane County Water Resources, FPD of Kane County, Batavia, Geneva and St. Charles Park Districts, Campton Township Open Space District, Batavia Environmental Commission, Geneva Natural Resources Committee, FOFR, FREP, KDSWCD, library districts, school districts, and other interested parties.

4.1.3.2 Coordinate efforts to manage invasive vegetation

With the ever present onslaught of invasive vegetation, the coordination of management efforts between public land management agencies as well as private landowners would provide an avenue for improved effectiveness in reducing populations over time. It is recommended that a coalition be formed and a work strategy be developed within the first three years after completion of this watershed plan, followed by implementation. Suggested coalition members would include the FPD of Kane County, Batavia, Geneva and St. Charles Park Districts, Campton Township Open Space District, Kane County Division of Transportation, the township highway districts, and private landowner representatives (including homeowners associations, school districts, and institutions).

4.2 BMP Implementation Projects

The following BMPs are recommended to reduce nonpoint source pollutant runoff throughout the Mill Creek watershed, with a particular focus in critical areas. Some of these solutions may be implemented at a localized level, such as green stormwater retrofits on private property or municipal parcels, while others may require collaboration among county, township, municipal, and other partners, such as stream channel restoration.

4.2.1 Urban Stormwater Infrastructure Retrofits[143]

The practices described below are intended to provide examples of projects that should be implemented in developed areas of the watershed to allow for improved pollutant removal and/or stormwater volume reductions. Many of the recommendations focus on retrofit opportunities.

It is important to emphasize that incorporating BMPs into new construction is much more cost-effective and efficient than retrofitting existing systems. Site stormwater BMPs, beyond naturalized detention basins, should be incorporated at the time of initial design and built during initial construction. This approach offers the most options, providing the engineer with more flexibility and cost-effective solutions. The Kane County Stormwater ordinance and the municipal ordinances that follow its requirements provide strong support for the implementation of stormwater BMPs to specifically address the pollutants of concern in the Mill Creek watershed and greater Fox River basin.

[143] Portions of this section modified from contributions to the Lower Salt Creek Watershed-based Plan (CMAP 2018) by Mary Beth Falsey, DuPage Co. Stormwater Management.

A variety of urban BMPs could be used throughout the watershed, many of which could provide multiple benefits. This plan proposes the installation of bioretention (and biofiltration) and infiltration facilities, vegetated swales/bioswales, permeable and porous pavements, detention basin retrofits, hydrodynamic separators, and building retrofits – such as planter boxes and green roofs – as the primary retrofit practices.[144] Three objectives guided the identification of such "green infrastructure" urban retrofit projects included in this plan:

- Manage stormwater at the source;
- Use plants and soil to absorb, slow, filter, and cleanse runoff; and
- Recommend stormwater facilities that are simple, cost-effective, and enhance community aesthetics.

4.2.1.1 Infiltration Practices

Infiltration practices are designs that enhance the absorption of runoff through a soil matrix. These practices slow and retain stormwater runoff to facilitate pollutant removal. Increasing the time it takes for water to reach a nearby waterbody in smaller storm events also results in lower storm elevations and overland runoff that can cause localized flooding. Slowing runoff allows excess sediment and debris to drop out and water to seep into the soil. Slowing runoff and allowing for infiltration also reduces peak flows, thereby helping to reduce streambank erosion and improve water quality. Infiltration practices recommended throughout the Mill Creek watershed include:

- ***Bioretention facilities*** (including smaller r***ain gardens***) are excavated or natural depressions that collect, filter, and infiltrate runoff from surrounding impervious areas. They normally consist of a ponding area, mulch layer, amended soils, and plantings. Larger facilities are often constructed adjacent to commercial or public buildings while rain gardens are typically sized for residential yards. A specialized bioretention system that incorporates trees and shrubs into curb inlet boxes to treat stormwater before it enters the storm sewer system are the Filterra Bioretention Systems.
- ***Bioswales*** are vegetated channels that slow and filter pollutants from runoff. Pollutant removal ability increases when swales are planted with native vegetation as opposed to mowed turf grass. Rock check dams can be added to slow the flows through the swale, further increasing removal rates. They are commonly found along streets where existing roadside ditches can easily be converted to bioswales.
- ***Infiltration trenches*** are excavated trenches filled with rock. Stormwater runoff is directed to these trenches where it is retained within the void space and slowly

[144] Stormwater BMPs are routinely grouped into categories based upon their unit processes. However, there is no set standard for grouping BMPs, nor should they be isolated into any single category when their use is evaluated. Individuals evaluating the use and applicability of BMPs should tailor the design to blend the benefits of various BMPs. For example, a vegetated swale (which provides settling and filtration of suspended solids by flowing through the surface vegetation) could be modified to include amended soil in the bottom of the swale along with check dams to improve infiltration and filtration through the soil media (which is a process more commonly associated with bioretention).

infiltrates through the soil. One benefit of an infiltration trench is that it is completely underground and can be covered with turf grass, allowing it to blend in with surrounding lawn areas. A combination bioswale with infiltration trench can be used along roadway areas that experience frequent or long-standing flooding.

- ***Green roofs*** refer to vegetation being planted on the roof of a building. The roof is covered with a waterproof membrane and growing medium which allow for the establishment of vegetation. The system allows stormwater to be captured, infiltrated, and eventually evapotranspirated back into the atmosphere, thereby reducing runoff and the pollutants that are carried with it.
- ***Tree wells or planter boxes*** are ideal for infiltration in urban landscapes where space is limited. They consist of depressed planting beds that capture and infiltrate runoff from surrounding roads, sidewalks, and parking lots. They are completely contained within an impermeable structure with an underdrain. The boxes can be comprised of a variety of materials such as brick or concrete, and are filled with gravel on the bottom, planting soil media, and vegetation.

Pollutant removal rates of infiltration practices can vary, but overall they are among the most efficient at removing pollutants due to the fact that all of the stormwater in smaller rain events is captured and infiltrated into the soil, eliminating runoff.

4.2.1.2 Impervious Surface Reduction

Converting impervious surfaces to permeable surfaces is an excellent way to reduce runoff volume and velocity, as well as treat stormwater. Permeable pavement in its many variations contains small voids that allow water to pass through to a stone base where runoff is retained and some sediments (TSS), metals, and oils are adsorbed or filtered out before allowing the stormwater to infiltrate into the ground or be conveyed through an underdrain system. Porous asphalt and porous concrete are poured in place, while pavers are typically precast and installed in an interlocking array to create the surface. The use of permeable pavement in lieu of conventional pavement surfaces reduces the runoff volume and flow rates while maintaining functionality. Permeable pavement can be applied in residential, municipal, school, commercial, and industrial areas as an alternative to traditional impermeable surfaces like sidewalks and parking lots.

Permeable pavers at the St. Charles Park District's Hickory Knolls Discovery Center driveway and parking lot.

Permeable pavements typically are applied to infiltrate stormwater. If underlying soils prohibit infiltration, an underdrain system will likely be required. The paving surface, subgrade, and installation requirements of permeable pavements are more complex than those for conventional asphalt or concrete surfaces.

Nonetheless, these pavements are particularly cost effective where land values are high and where flooding or icing is a problem.

When converting impervious surfaces is not an option, finding ways to disconnect impervious surfaces from one another can go a long way. Examples include disconnecting gutter downspouts from storm sewers, separating sidewalks from streets with parkways, and using flat or concave instead of mounded landscape features in between walkways and parking spaces.

4.2.1.3 Detention Basin Retrofits

Both dry and wet stormwater detention basins are common throughout the Mill Creek watershed. Nearly half of the basins are of older designs, either dry basins vegetated with turf grass with little to no water quality treatment, or wet basins with no wetland shelf and turf covered, often steeper side slopes that are eroding and thereby doing a poor job of removing pollutants from stormwater runoff.

Modifying a detention basin for improved water quality involves many variables and takes a site-specific design approach. The following basin retrofits can offer big improvements to water quality within the basin and to downstream receiving waters.

- ***Naturalized bottom*** – This retrofit involves modifying the design of a dry turf-bottom basin or traditional wet basin to incorporate sections of native mesic prairie and/or wetland vegetation as appropriate. These pond retrofits often feature a meandering low flow channel to handle low flows while allowing water to inundate the basin as needed. Wetland bottom ponds offer one of the highest levels of pollutant control, as well as the elimination of erosion, excessive algae growth, and overabundant Canada goose populations.
- ***Wetland shelf*** – Doubling as a safety feature, wetland shelves are made from soil and extend into the permanent pool from the traditional bank of a wet detention pond. They are usually constructed no more than 6 inches below the normal water level and planted with native wetland vegetation. Wetlands in a detention basin absorb nutrients and protect the shoreline from eroding by buffering wind, waves, and ice. Native vegetation can also deter goose populations that prefer turf and an unobstructed waters' edge.
- ***Forebay*** – A forebay is a smaller, closed basin at a wet detention basin's inlet. A forebay acts as a settling basin, allowing sediments in the inflowing stormwater to settle out before entering the main basin and helping to prevent bottom sediments within the detention pond from being re-suspended by high flows. Forebays extend the life of the pond and make sediment removal easier.
- ***Native vegetation on the slopes*** – Native vegetation refers to species native to northeastern Illinois. Once established, native vegetation -- particularly herbaceous species with deep and complex root systems – can reduce erosion, eliminate the need for fertilizers, deter geese, and filter and trap pollutants from overland flow.

- ***Constructed wetland detention --*** Constructed wetland detention basins pull together the use of native vegetation slopes, sediment forebays, and a wetland bottom into the most effective basin design for filtering pollutants. Mimicking the pollutant removal mechanisms of natural wetlands, these carefully engineered facilities feature varying wetland depths and permanent pools.

A wetland detention pond can remove up to 20% of nitrogen, 44% of phosphorus, 77% of BOD, and 63% of TSS. Retrofitting a dry detention pond with native vegetation can more than double its removal efficiency of phosphorus and TSS, while nitrogen and BOD removals are increased by more than 50%.[145]

4.2.1.4 Hydrodynamic Separators

Hydrodynamic separators – commonly known as oil and grit separators – are manufactured structures designed to reduce the amount of oil, grease, and sediment reaching waterways. They are placed within the storm sewer system, typically within a catch basin, and rely on gravity to capture the pollutants that will settle and float. Pollutant removal effectiveness varies widely among these proprietary devices. Particle size distribution is an important factor to consider when choosing a device. Many pollutants attach to fine particles such as silts, clays and colloids, and these finer particles contribute much of the sediment in DuPage County. Hydrodynamic separators are most effective when they are designed to target and treat runoff from small, frequent rain events. They should be designed to treat a specific storm runoff volume and to prevent resuspension of pollutants in higher events. Devices must be maintained regularly in order to be continuously effective.

Oil and grease separators are designed specifically to treat roadway runoff for oil, grease, floatables, and sediment. Manufacturer specifications vary, but a typical oil and grit separator can remove more than 97% of oil from the first flush runoff from roadways. Installation of these practices over even 2% of the watershed could have a measurable impact, particularly when located along major thoroughfares and in high traffic and parking areas.

4.2.2 Stream Channel and Riparian Buffer Restoration

4.2.2.1 In-Stream and Streambank Practices

Eroding streams can be a significant source of sediment as well as sediment-bound nutrients. Eroding stream banks and downcutting channels can also detrimentally affect property and infrastructure. Remedial actions to address channel stability concerns require a detailed understanding of the processes causing the channel instability and need to account for the severity of the channel instability. For example, an exposed stream bank may be the result of bank erosion by stream flows or may be caused by downcutting of the stream channel and

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[145] National Pollutant Removal Performance Database, Illinois Green Infrastructure Study, approved watershed plans (CMAP Boone-Dutch Creek), and STEPL.

subsequent slumping of the stream bank. Moderate cases of stream bank instability may be addressed through relatively simple methods, including minor grading and establishment of deep-rooted vegetation and/or materials such as riprap as opposed to mowed turf grass. Areas with severe erosion will typically require more involved evaluation and remedies.

Stream restoration projects focus on improving channel sinuosity, installing natural features such as riffles and pools, stabilizing eroding streambanks, removing concrete-lined channels, and daylighting enclosed stream sections. Water quality benefits of stream restoration projects include reducing streambank erosion, trapping suspended sediment, re-oxygenating the water column, and reconnection to the floodplain. In-channel restoration also provides habitat that supports the propagation of fish and macroinvertebrates.

Streambank stabilization involves regrading of bank slopes and using deep rooted native vegetation and/or materials such as riprap or woody debris to stabilize stream, river, or ditch banks in order to protect them from erosion or sloughing. Stream stabilization has numerous benefits including:

- Stabilization of banks and shorelines, preventing further erosion and degradation;
- Water quality improvement by reducing sediment loads in surface waters;
- Maintenance of capacity of waterways to handle floodwaters, preventing flood damage to utilities, roads, buildings and other facilities;
- Reduction of expenses for dredging accumulated sediment from lakes and drainage ditches;
- Enhancement of habitat for fish and other aquatic species by improving water quality and moderating water temperature; and
- Creation of riparian habitat for wildlife.

To estimate potential pollutant load reductions for a watershed-wide scenario, 20% of the assessed, eroding streambanks were assumed to be stabilized, and thus a 20% reduction of the existing pollutant load (see Section 3.6.2.2) was calculated (Table #).

Stream stabilization/restoration costs vary by a number of factors including location, severity, and accessibility. Cost can range from $50/linear foot (rural, low severity, easy access) to $300/linear foot (urban private land, high severity, limited access) based on various sources such as the USDA Forest Service, Virginia Department of Environmental Quality, the Water Quality Extension at the University of Illinois, and Geosyntec projects.[146] To derive an estimated implementation cost, an average cost of $150/linear foot was applied.

[146] Craig Clarkson, Geosyntec Consultants. 2016. Personal communication.

Table 47. Watershed-wide streambank stabilization pollutant load reduction and cost estimates.

	Subwatershed	*Stream Length Stabilized (ft)*	*Nitrogen Reduct. (lb/yr)*	*Phosphorus Reduct. (lb/yr)*	*BOD Reduct. (lb/yr)*	*Sediment Reduct. (t/yr)*	*Estimated Cost* ($)*
1	Upper Campton	1895	110	42	220	69	$ 284,190
2	Lower Campton	4010	62	24	125	36	$ 601,440
3	Mill Crk Greenway	n/a	n/a	n/a	n/a	n/a	-
4	Brundige Trib	n/a	n/a	n/a	n/a	n/a	-
5	West St Chas / Geneva	2478	38	15	77	24	$ 371,730
6	Mill Crk FP	1241	52	20	105	33	$ 186,210
7	Peck Lake	n/a	n/a	n/a	n/a	n/a	-
8	McKee Rd Trib	n/a	n/a	n/a	n/a	n/a	-
9	Tanglewood	1294	34	13	69	21	$ 194,160
10	West Batavia	1037	5	2	10	3	$ 155,490
11	Les Arends	144	1	0	1	0	$ 21,540
	Total	**2475**	**40**	**15**	**80**	**24**	**$1,814,760**

* $150/linear foot applied
n/a = not assessed

4.2.2.2 *Culvert Modification*

Road culvert crossings can restrict streamflow, inhibit fish passage, and contribute to low dissolved oxygen levels. Existing culverts should be fully evaluated to determine where these restrictions exist and to propose retrofits to expand culvert size and/or place them at lower elevations to allow unrestricted flow and fish passage, while at the same time minimizing losses to infrastructure and adjacent property and maintaining public safety. One resource providing assessment and design guidance for stream crossings is available from New Hampshire.[147]

4.2.2.3 *Riparian Buffer Establishment and Restoration*

Riparian buffers are vegetated areas next to streams, lakes, and ponds that protect the waterbody from nonpoint source pollution, promote bank stabilization, and provide aquatic and wildlife habitat. Ideally, riparian buffers should be composed of native vegetation including grasses or trees, or both. Riparian corridors have been impacted throughout the Mill Creek watershed by human activities. Some of these activities include turf grass management up to the stream or pond shore, trash and yard waste disposal, agricultural uses, and degradation caused by woody and herbaceous invasive vegetation.

[147] See New Hampshire Stream Crossing (Culvert) Assessment Protocol and Designing Stream Crossings for the 21st Century at https://www.des.nh.gov/organization/divisions/water/wetlands/streams_crossings.htm (last accessed Sept. 2019).

The establishment of new riparian buffers in the watershed will likely present challenges, given that the buffer areas are generally impacted in order to meet the needs of the property owners. However, numerous opportunities exist within the watershed where buffers can be established. Numerous opportunities also exist for improving the water quality and habitat function of existing vegetated buffers through invasive species management and native vegetation diversification.

4.2.3 Stream Maintenance

Reaches of Mill Creek and its tributaries are in need of debris and trash removal that contributes to overbank flooding, streambank erosion, and sediment deposition. While removal of excess debris is often necessary, some amount of large woody debris is important, since it provides fish habitat and substrate for the aquatic insects that break down organic matter in the stream.

It is recommended that Mill Creek watershed communities work cooperatively with Kane County, park districts, the Forest Preserve District, school districts, HOAs, and private land owners in the long-term ecological management of stream corridors including adjacent wetlands and upland natural areas. In particular, watershed stakeholders should work cooperatively to design and implement a regular stream debris monitoring, reporting, and maintenance program that balances improved conveyance with habitat considerations.[148] This effort should entail the enlistment of ecologists, biologists, and engineers from organizations operating within the watershed in providing on-going input into the stream maintenance program activities. This input should include evaluations of maintenance needs and the methods employed for the maintenance activities. The implementation of appropriate soil erosion and sediment control measures is also a critical consideration for stream maintenance activities.

Kane County Water Resources could consider development of a citizen reporting application whereby the public can report and submit photos of waterway issues such as stream debris jams, streambank erosion, yard waste or garbage dumped along streams, illegal discharges into waterways and waterbodies, and other water quality issues. The DuPage County "Citizen Reporter" app[149] serves as one example. Another example of a reporting tool is the FPD of Kane County's recently developed "Kane Forest Notify" that allows users to report issues through the FPD's website.[150]

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[148] An example of a stream maintenance program that claims to address both conveyance and habitat concerns is provided at: http://www.scwa.ca.gov/stream-maintenance-program/

[149] See https://gis.dupageco.org/CitizenReporter/ and https://gis.dupageco.org/CitizenReporter/info/ (accessed Sept. 2019).

[150] http://www.kaneforest.com/notify.aspx (accessed Sept. 2019).

4.2.4 Restored and Unrestored Natural Areas

Within the watershed are substantial areas where invasive brush species have overtaken former "natural" areas. The brush species – primarily non-native bush honeysuckle, buckthorn, and autumn olive, along with aggressive trees such as box elder and Siberian elm – tend to create dense understory canopies within woodlands. They also create stress for native oaks and hickories and greatly reduce the potential for native tree reproduction, thereby impacting the long-term health and viability of native woodlands. These same species can overtake grasslands, old pastures, remnant prairies, and wetland edges. Their aggressive growth behavior creates nearly impenetrable thickets and produces a very dense shade cover that, over time, virtually eliminates herbaceous ground cover. As a consequence, bare soil exists under the invasive brush thickets. This increases the erosion potential of underlying soils, both during heavy warm season thunderstorms and during the dormant season (typically mid-November through mid-April) when leaf cover is off.

A study in Toowoomba, Australia[151] found that for large storm events, bare soil areas produced sediment loads higher than roads, parking lots, roofs, or grass. Studies in Michigan[152] and Indiana[153] found similar results, with the study in Indiana producing an event mean concentration of 4000 mg/L for TSS. Along with sediment transport, loadings of other contaminants are expected to increase as particle-bound contaminants are washed away with sediment. The Indiana study found that bare soil areas had similar nutrient loadings as agricultural land.

Based on discussions with stakeholders, on-the-ground site visits, and review of aerial photos, these brush-infested landscapes occur extensively within land use areas mapped as open space, vacant, and low-density residential. But because their occurrence is widely variable within these land use categories, there is no simple way of representing their locations on a watershed scale. Such a representation could potentially be done with an intense field analysis effort combined with aerial photo interpretation, but that effort is beyond the resources available for this watershed plan.

Nonetheless, in order to provide some estimate of the potential pollutant load reduction for a watershed-wide scenario from woodland restoration projects, a 10% reduction in the estimated pollutant loading from the "Forest" land use type was assumed; thus, 18.2 lb/year nitrogen load

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[151] I.M. Brodie and M.A. Porter. 2006. "Stormwater particle characteristics of five different urban surfaces." *University of Southern Queensland*.

[152] A.U. Syed and R.S. Jodoin. 2006. "Estimation of Nonpoint-Source Loads of Total Nitrogen, Total Phosphorus, and Total Suspended Solids in the Black, Belle, and Pine River Basins, Michigan, by Use of the PLOAD Model." US Geological Survey Scientific Investigations Report 2006-5071, pg 42.

[153] V3 Companies. 2008. "Elkhart River Watershed Management Plan." Appendix J: Pollution Load Model Documentation for Critical Areas.

reduction, 8.7 lb/year phosphorus load reduction, 43.7 lb/year BOD load reduction, and 1.2 tons/year sediment load reduction.

4.2.5 Denitrifying Bioreactors and Saturated Buffers

Drain tiles are prevalent throughout the agricultural (and rural residential) portions of the Mill Creek watershed, the discharges from which can be a significant source of nitrogen.[154] Research has shown that denitrifying bioreactors (a.k.a. woodchip bioreactors) can significantly reduce nitrogen (N) levels from drain tile discharge.[155] A bioreactor consists of a constructed trench designed to receive drain tile discharge. It is filled with a carbon source, such as wood chips, that serve as a substrate for soil microorganisms (bacteria) that break down nitrates in the drain tile discharge via denitrification or other biochemical processes. A design goal is typically 50-80% removal of the inflowing N load.[156] In addition to the water quality improvement benefits of this BMP, bioreactors do not take agricultural land out of production, cause no decrease in drainage effectiveness, require little or no maintenance, and can last for up to 20 years.[157]

The use of bioreactors in Illinois has been limited to date. The Illinois Nutrient Loss Reduction Strategy calls for bioreactors on half of all tile-drained acres, but as of 2016, there were so few bioreactors in Illinois that no results could be reported from a 2016 survey of 1,900 agricultural producers across the state who have at least 100 acres of land in field crops.[158] Thus, there are numerous opportunities to install additional woodchip bioreactors.

A recently formed Edge-of-Field partnership program between the Illinois Farm Bureau, Illinois Land Improvement Contractors of America (LICA), USDA-NRCS, the University of Illinois College of Agricultural, Consumer, and Environmental Sciences (ACES), aims to install and study the effectiveness of five woodchip bioreactors in different Illinois locations. So far, three bioreactors have been installed under this partnership with the collaboration of local landowners: one in Henry County in 2017[159], one in Bureau County in 2018,[160] and another in

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[154] Kalita P., A. Algoazany, J. Mitchell, R. Cooke, and M. Hirschi. 2006. Subsurface Water Quality from a Flat Tile-Drained Watershed in Illinois, USA. Agriculture, Ecosystems and Environment 115:183-193.

[155] Jaynes D., T. Kaspar, T. Moorman, and T. Parkins. 2008. In Situ Bioreactors and Deep Drain-Pipe Installation to Reduce Nitrate Losses in Artificially Drained Fields. J. Environ. Qual. 37:429-436.

[156] http://www.wq.illinois.edu/dg/Equations/trifold_Bioreactor.pdf (accessed Dec. 2015).

[157] https://engineering.purdue.edu/watersheds/conservationdrainage/bioreactors.html (accessed Dec. 2015).

[158] http://draindrop.cropsci.illinois.edu/index.php/illinois-nutrient-loss-reduction-strategy-survey-results/ (accessed June 2019).

[159] https://farmweeknow.com/story-ifb-partners-focus-woodchip-bioreactor-nutrient-plan-0-165017 (accessed June 2019).

[160] https://farmweeknow.com/story-breaking-new-ground-bureau-county-farmers-install-first-bioreactor-0-178391 (accessed June 2019).

Kane County in 2018.[161] The Kane County installation at the Meissner Prairie-Corron Forest Preserve (in Campton Township in the Ferson-Otter Creek watershed) is the northernmost bioreactor in the state.

Saturated buffers are another potential conservation practice for improving drain tile discharge water quality. A saturated buffer is a modified vegetated buffer whereby drain tile discharge is distributed laterally through the buffer rather than routed directly to the receiving stream or ditch. It's here underground in the raised water table that much of the N is removed from the drain tile water via denitrification, microbial immobilization, and direct uptake by the vegetation. An additional benefit can be the reduction in the speed and volume of water entering the waterway, thus helping to attenuate flood flows. Several demonstration research projects are underway in the Midwest and results are positive,[162] with N removal potentially approaching 100 percent.[163]

Similar to the Edge-of-Field partnership, a Saturated Buffer Partnership recently formed to install and research saturated buffers throughout Illinois. This five year partnership is comprised of the Illinois Farm Bureau, Illinois LICA, USDA-NRCS, and Southern Illinois University - College of Agricultural Sciences. Their first installation was completed in March 2019 near Lake Shelbyville in Moultrie County.[164]

In the Mill Creek watershed, it is recommended that at least one demonstration project for each of these practices be implemented. It is suggested that Kane County Water Resources, Kane County Farm Bureau, Kane-DuPage SWCD, USDA-NRCS, and Huddleston-McBride Drainage Contractors collaborate to identify project sites and willing landowners, for a cumulative, target treatment drainage area of 60 – 200 acres. In Iowa, bioreactor installation costs have ranged from $7,000 - $10,000 to treat drainage from about 30 to more than 100 acres.[165] The Kane County installation cost approximately $15,000 including the drain tile investigation, materials, and construction labor, not including "volunteer labor" by the partners involved in planning the project. Limited information on saturated buffer costs indicates they are comparable to

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[161] https://farmweeknow.com/story-demonstration-site-conservation-option-kane-county-bioreactor-aids-more-water-0-180693 (accessed June 2019).

[162] https://efotg.sc.egov.usda.gov/references/public/IA/Saturated_Buffer_739_FS_2015_01.pdf (accessed Feb. 2016).

[163] http://web.extension.illinois.edu/iwrc/pdf/presentations/2012/7.%20Biomass%20Crops%20to%20Enhance%20Water%20Quality/3%20Jaynes_Saturated_Buffers.pdf (accessed Feb. 2016).

[164] https://farmweeknow.com/story-moultrie-county-farm-puts-saturated-buffer-designs-test-0-187788 and https://www.illica.net/2019-saturated-buffer-partnership (accessed June 2019).

[165] Christianson, L. and M. Helmers. 2011. Woodchip Bioreactors for Nitrate in Agricultural Drainage. Iowa State University Extension Publication. PMR 1008. https://store.extension.iastate.edu/Product/Woodchip-Bioreactors-for-Nitrate-in-Agricultural-Drainage (accessed Dec. 2015).

other N removal practices.[166] Thus, the cost for two demonstration project(s) is estimated at $40,000.

4.2.6 Watershed-wide BMP Scenarios

To allow for potential projects that may be imagined in the future and were not specifically submitted by stakeholders as a site-specific BMP (see section 4.2.7), scenarios were chosen to estimate the potential load reductions from a selection of urban retrofit, agricultural, and land restoration practices distributed throughout the Mill Creek watershed. Stakeholders have discretion of where such BMP projects may be installed in the watershed.

Kane County and CMAP staff considered the applicability of each BMP type for each of the 11 primary subwatersheds based on various factors including land use type (agricultural, residential, commercial, industrial, institutional), potentially available public and private open space, road cross section type (rural vs. curb and gutter), extent of the stream corridor, and extent of flat roofs. The BMP distributions by subwatershed are displayed in Table 48.

Pollutant load reduction estimates were calculated by Geosyntec with a spreadsheet watershed model by using literature estimates of pollutant removal efficiencies.[167] Pollutant removal rates are displayed in Table 49 and BMP drainage area ratios and unit costs are displayed in Table 50. A summary of the pollutant load reduction and cost estimates by subwatershed are displayed in Table 51. See Appendix H for a description of Geosyntec's methods.

The reader should recognize the use of pollutant removal efficiencies, or percent removal, to estimate pollutant load reductions has several shortcomings.[168] As a result, the estimates derived from the analyses described above do not represent absolute expected results from the implementation of BMPs recommended in this plan and are only gross planning-level estimates. BMP costs were developed from cost information derived through various Geosyntec projects and Internet searches for other sources including the USEPA, USDA-NRCS, several university Extension services, and Milwaukee Metropolitan Sewer District.

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[166] http://web.extension.illinois.edu/iwrc/pdf/presentations/2012/7.%20Biomass%20Crops%20to%20Enhance%20Water%20Quality/3%20Jaynes_Saturated_Buffers.pdf (accessed Feb. 2016).

[133] The model was developed by Geosyntec in large part based on a study performed in 1993 by Tom Price of NIPC for the Lake County Stormwater Management Commission. A similar approach was used in the 2005 Thorn Creek Watershed-based Plan Addendum and 2016 Boone-Dutch Creek Watershed-based Plan.

[168] As Jones et al. writes, "[p]ercent removal is primarily a function of influent quality. In almost all cases, higher influent pollutant concentrations into functioning BMPs result in reporting of higher pollutant removals than those with cleaner influent. In other words, use of percent removal may be more reflective of how 'dirty' the influent water is than how well the BMP is actually performing." Jones, J.E., J. Clary, E. Strecker, and M. Quigley. 2008, "15 Reasons You Should Think Twice Before Using Percent Removal to Assess BMP Performance," *Stormwater*, January-February 2008.

Table 48. Watershed-wide BMP distributions by Mill Creek subwatershed.

BMP Type	*unit*	*Subwatershed #*					
		1	*2*	*3*	*4*	*5*	*6*
Bioretention Facility	sq ft	0	17500	0	25000	50000	10000
Rain Garden	sq ft	36400	51600	0	6000	174200	4800
Infiltration Trench	ft	8000	7200	1000	n/a	3600	3000
Vegetated Swale	ac	0	1.1	0.7	0.9	2.3	0.7
Filter Strip / Riparian Buffer / Field Border	ac	1	5.5	3	7	7	1
Pervious & Porous Pavement / Pavers	sq ft	60,000	60,000	n/a	85,000	250,000	40,000
Dry Detention Basin Retrofit	ac	4.1	9.3	0.1	0	15	0
Wet Detention Basin Retrofit	ac	0.2	1.5	0.0	1.0	3.8	0.5
Tree Box Filter	#	0	10	0	0	33	0
Hydrodynamic Separator	#	2	8	1	6	26	2
Green Roof	ac	0.1	0.5	0.1	5.7	5.7	0
Denitrifying Bioreactor	#	5	5	3	5	4	1
Saturated Buffer	ft / #	4,000 / 8	4,000 / 8	2,000 / 4	4,000 / 8	3,000 / 6	1,000 / 2
Riparian Corridor Restoration	ac	10.6	6	9.2	5.1	6.8	9.4
Prairie Restoration	ac	10	26	3	5	23	10
Wetland Restoration	ac	35	15	2	55	10	1

BMP Type	*unit*	*Subwatershed #*				
		7	*8*	*9*	*10*	*11*
Bioretention Facility	sq ft	10000	45000	5000	42500	5000
Rain Garden	sq ft	1400	52200	6000	21800	4600
Infiltration Trench	ft	0	4000	3300	5300	2700
Vegetated Swale	ac	0.5	2.3	0.5	2	0.1
Filter Strip / Riparian Buffer / Field Border	ac	0.5	2.2	2.8	3.8	0.7
Pervious & Porous Pavement/ Pavers	sq ft	42,000	260,000	12,200	122,200	7200
Dry Detention Basin Retrofit	ac	2.9	27	3.2	13.4	2.4
Wet Detention Basin Retrofit	ac	0.1	4.1	0.4	0.5	0.1
Tree Box Filter	#	13	23	2	5	3
Hydrodynamic Separator	#	3	27	3	27	6
Green Roof	ac	1.4	16.8	0.3	3.7	0.4
Denitrifying Bioreactor	#	0	2	1	6	0
Saturated Buffer	ft / #	500 / 1	1,500 / 3	1,000 / 2	4,500 / 9	0
Riparian Corridor Restoration	ac	5.1	1.2	2.7	15.2	6
Prairie Restoration	ac	10	64	15	45	3
Wetland Restoration	ac	0	20	1	20	1

Table 49. BMP pollutant removal rates.

BMP Type	*Pollutant % Removal*				*Data sources*
	N	*P*	*TSS*	*FC*	
Bioretention Facility	68	66	65	61	WERF Int'l BMP Database[169]
Rain Garden	80	77	95	*10*	Minnesota Stormwater Research
Infiltration Trench	60	55	90	*10*	NH Stormwater BMP Removal Efficiency
Vegetated Swale	55	47	51	53	WERF Int'l BMP Database
Filter Strip / Riparian Buffer / Field Border	19	52	52	*10*	WERF Int'l BMP Database
Pervious & Porous Pavement/ Pavers	55	41	72	*10*	WERF Int'l BMP Database
Dry Detention Basin Retrofit	33	30	29	24	WERF Int'l BMP Database
Wet Detention Basin Retrofit	0	4	55	7	WERF Int'l BMP Database
Tree Box Filter	15	15	99	10	NH Stormwater BMP Removal Efficiency
Hydrodynamic Separator	10	42	27	0	NH Stormwater BMP Removal Efficiency
Green Roof	25	25	72	*10*	Default STEPL values
Denitrifying Bioreactor	30	0	0	*10*	Average of research values from Internet search
Saturated Buffer	42	20	0	*10*	Average of research values from Internet search
Riparian Corridor Restoration	89	80	*10*	*10*	Review of Riparian Buffer Zone Effectiveness[170]
Prairie Restoration	73	82	*10*	*10*	Nutrient removal by prairie filter strips in agricultural landscapes[171]
Wetland Restoration	24	48	72	78	How effective are created or restored freshwater wetlands for nitrogen and phosphorus removal?[172]

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[169] WERF International Stormwater BMP Database: 2016 BMP Performance Summaries. Calculated based on average reduction in volume and event mean concentration.

[170] Review of Riparian Buffer Zone Effectiveness. MAF Technical Paper No: 2004/05. Prepared by Stephanie Parkyn for MAF Policy. Sept. 2004.

[171] Zhou, X., et al. Nutrient removal by prairie filter strips in agricultural landscapes. J. Soil and Water Conservation, v. 69, No. 1, Jan/Feb 2014.

[172] Land, M. et al. How effective are created or restored freshwater wetlands for nitrogen and phosphorus removal? A systematic review protocol. Environmental Evidence, 2:16, 2013.

Table 50. BMP design drainage area ratios and unit cost assumptions.

BMP Type	*unit*	*Ratio*	*Cost/unit*
Bioretention Facility	sq ft	30	$40
Rain Garden	sq ft	10	$12
Infiltration Trench	ft	50	$50
Vegetated Swale	ac	4	$1,045,440
Filter Strip / Riparian Buffer / Field Border	ac	50	$200
Pervious & Porous Pavement/ Pavers	sq ft	10	$12
Dry Detention Basin Retrofit	ac	50	$5,000
Wet Detention Basin Retrofit	ac	2	$5,000
Tree Box Filter	#	0.25	$15,000
Hydrodynamic Separator	#	5	$20,000
Green Roof	ac	1	$522,720
Denitrifying Bioreactor	#	40	$30,000
Saturated Buffer	#	25	$2,000
Riparian Corridor Restoration	ac	50	$6,000
Prairie Restoration	ac	2	$2,500
Wetland Restoration	ac	10	$10,500

Table 51. Watershed-wide BMP pollutant load reduction, summary by subwatershed.

Subwatershed		*Nitrogen Reduction (lb/yr)*	*Phosphorus Reduction (lb/yr)*	*Sediment Reduction (t/yr)*	*FC Reduction (cfu/yr)*	*Estimated Cost ($)*
1	Upper Campton	14,226	552	117	1.20E+14	
2	Lower Campton	36,416	1,634	431	1.20E+14	
3	Mill Crk Greenway	53,173	2,301	355	3.14E+13	
4	Brundige Trib	6,893	301	38	9.04E+13	
5	West St Chas / Geneva	50,065	2,521	489	1.50E+14	
6	Mill Crk FP	50,694	2,237	221	1.43E+13	
7	Peck Lake	1,638	87	5	3.30E+13	
8	McKee Rd Trib	19,252	1,106	259	3.19E+14	
9	Tanglewood	30,593	1,601	335	1.34E+13	
10	West Batavia	239,443	10,890	1584	2.47E+14	
11	Les Arends	127,291	6,158	788	4.54E+13	
	Total	**629,685**	**29,387**	**4,620**	**1.18E+15**	

4.2.7 Chloride Reduction Strategies

Typical BMPs are limited in their ability to remove chloride. As a result, the preferred approach for addressing chloride loading within the watershed is through source reduction. The primary approach to address chloride in the Mill Creek watershed is to target chloride loadings from roadway deicing and snow removal activities on public and private roads and parking lots.

It is recommended that public snow removal agencies and private landowners and their contractors working within the watershed evaluate and implement alternative roadway snow and ice management methods. This may include the use of alternative products that have lower or no chloride content to supplement road salt usage, such as beet juice. Alternative approaches of snow and ice management should also be included, such as pretreatment of road surfaces with liquid anti-icing products in advance of winter storm events to prevent ice from binding with pavement and pre-wetting solid deicing materials to minimize bounce and scatter. Mechanical snow removal is still the most effective manner of snow and ice management. Public safety is of the utmost importance in the evaluation of alternative snow and ice management methods. Therefore, snow removal agencies should carefully evaluate the effectiveness of alternative products and approaches.

To help local communities in this regard, Kane County Water Resources has held a "Roads Deicing Workshop" annually for several years, presented by The Conservation Foundation (TCF) to promote alternatives to conventional roadway deicing practices and guide the implementation of alternatives to reduce chloride runoff. Further, it is recommended that Kane County Water Resources work with TCF to develop a survey questionnaire to gather information from public agencies across the county in order to better understand current deicing and snow removal practices as well as to have a starting point for tracking changes in methodologies and estimating changes in chloride application and associated loadings. Hosting a second workshop each year for private contractors, who conduct much of the snow removal for privately owned parking lots, is also a recommendation.

4.2.8 Site-Specific BMPs

More than 130 potential site-specific best management practice (BMP) opportunities were identified throughout the Mill Creek watershed by stakeholders (Figure 53, Appendix G). CMAP staff conducted one-on-one meetings with steering committee members and other local stakeholders to discuss and identify potential BMP opportunities. From May through August 2019, staff met with City of Batavia's Committee of the Whole and Environment Commission, interested citizens in the City of Geneva, Kane-DuPage Soil & Water Conservation District, Forest Preserve District of Kane County (both the Natural Resource Management and Environmental Education divisions), Campton Township Open Space, Batavia Park District, St. Charles Park District (both the Natural Resource Management and Education divisions), Mill Creek Special Service Area, Village of Campton Hills, Geneva Park District, Mill Creek Water Reclamation District, Garfield Farm Museum, City of Batavia, City of Geneva, City of St. Charles, Kane Co. Farmland Protection program, The Conservation Foundation, Fox River Study Group, Kane Co. Farm Bureau, Friends of the Fox River, Lake Charlotte HOA, Fox River

Study Group, Kane Co. Planning Division, and Kane Co. Environment and Water Resources Dept.

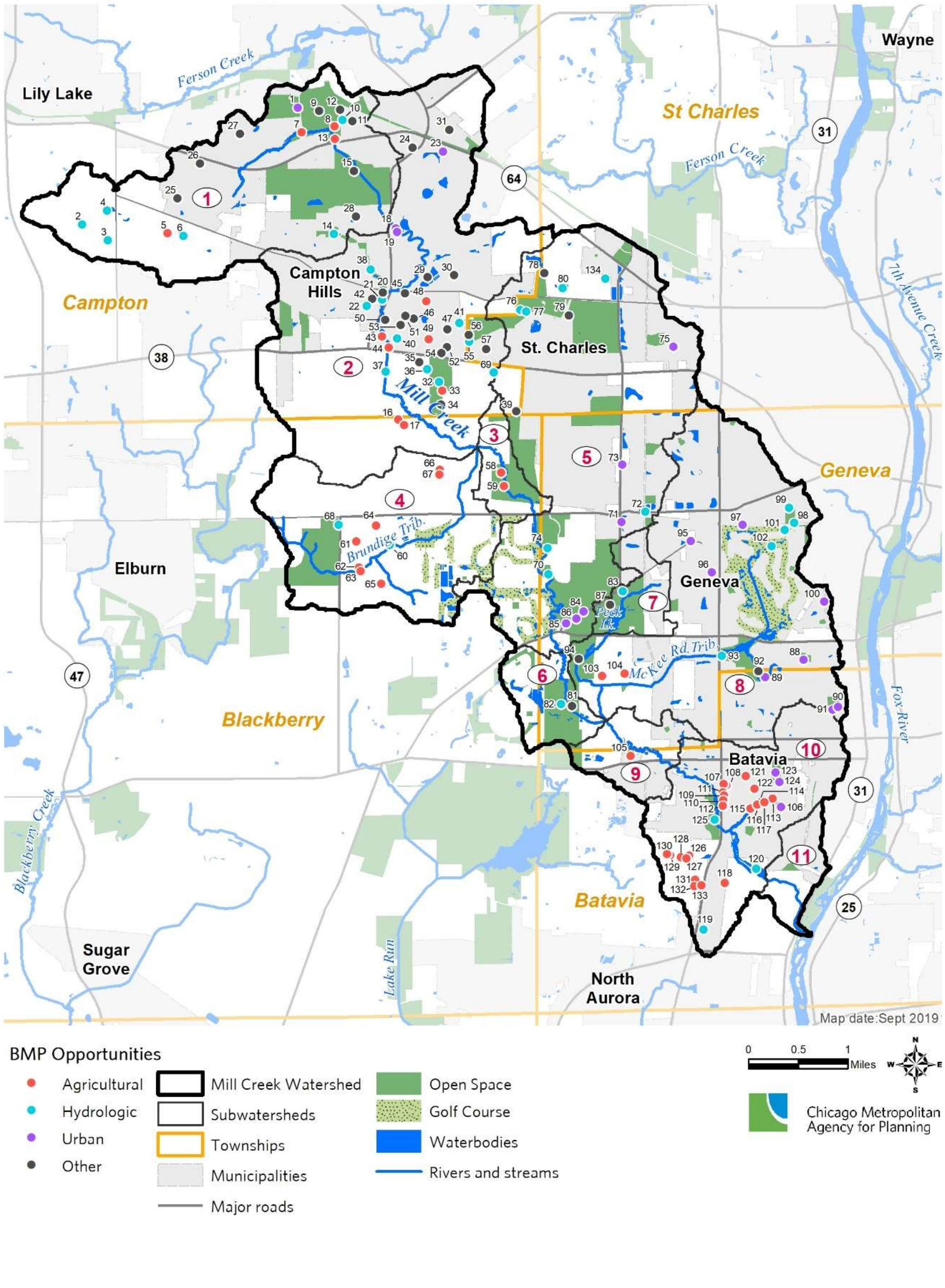
Agricultural BMPs identified included grassed waterways, filter strips/riparian buffers, saturated buffers, constructed wetlands, and conservation planning. Urban BMPs included filter strips, riparian buffers, prairie and oak ecosystem restoration, vegetated swales/bioswales, bioinfiltration/bioretention facilities, detention basin retrofits, permeable pavement, and education and outreach. Hydrologic BMPs included streambank and shoreline protection, stream channel restoration (re-meandering, daylighting), and wetland restoration.

Geosyntec Consultants estimated potential pollutant reductions for the following BMP types: bioretention, dry and wet detention basin retrofit, grassed waterway, vegetated swale, filter strip, infiltration trench, porous/permeable pavements, and prairie, woodland, and wetland restoration. See Appendix H for a description of their methods. A summary of pollutant load reductions and planning level costs by subwatershed is provided in Table 52.

Table 52. Site-specific BMP pollutant load reduction and cost estimates, summary by subwatershed.

Subwatershed		*Nitrogen Reduct. (lb/yr)*	*Phosphorus Reduct. (lb/yr)*	*Sediment Reduct. (t/yr)*	*Fecal coliform Reduct. (cfu/yr)*	*Estimated Cost ($)*
1	Upper Campton	3,067	129	61	7.77E+12	$2,423,359
2	Lower Campton	3,568	177	58	8.26E+12	$6,314,950
3	Mill Crk Greenway	91	3	1	7.39E+10	$2,758
4	Brundige Trib	3,200	124	69	1.07E+13	$400,064
5	West St Chas / Geneva	2,150	66	43	9.69E+12	$19,946,113
6	Mill Crk FP	213	8	2	2.29E+11	$687,500
7	Peck Lake	79	3	2	2.28E+11	$2,976,825
8	McKee Rd Trib	2,280	435	105	5.11E+12	$12,350,136
9	Tanglewood	7	0	0	8.36E+09	$852
10	West Batavia	1,080	58	49	2.57E+12	$2,640,487
11	Les Arends	N/A	N/A	N/A	N/A	N/A
	Total	**15,736**	**1,004**	**391**	**4.47E+13**	**$47,743,043**

Figure 53. Site-specific BMP opportunities in the Mill Creek watershed.



4.2.9 Summary of Watershed-wide and Site-specific BMP Implementation Projects

Table 53 presents the compilation of the waterside-wide and site-specific BMP types identified in this plan, along with their associated pollutant load reduction and implementation cost estimates. As can be seen, there can be significant reductions in pollutant loads, although the costs to retrofit the built environment and restore natural areas to improve and protect water quality can be astounding. This puts into perspective the importance of putting into place effective plans, policies, codes, and practices to protect our land and water resources prior to land development even more compelling.

Table 53. Summary of watershed-wide and site-specific BMP projects' estimated pollutant load reductions and costs.

BMP Type	Scenario	Est. Qty.	Unit	N Reduc. (lb/yr)	P Reduc. (lb/yr)	Sed. Reduc. (t/yr)	FC Reduc. (cfu/yr)	Estimated Cost ($)
Bioretention Facility	WW	210,000	sq ft	7187	356	117	3.65E+13	$ 8,400,000
Rain Garden	WW	359,000	sq ft	3,589	174	79	3.23E+12	$ 4,308,000
Infiltration Trench	WW	38,100	ft	3,509	162	97	2.42E+12	$ 1,905,000
Grass-lined Channel (vegetated swale/ bioswale)	WW	11	ac	1,768	76	29	9.39E+12	$ 11,604,384
Filter Strip - Ag	WW	16	ac	6,160	750	358	2.53E+13	$ 3,240
Filter Strip - Urban	WW	18	ac	18,064	2,452	907	3.13E+13	$ 3,660
Pervious and Porous Pavements	WW	938,600	sq ft	6,495	251	149	8.92E+12	$ 11,263,200
Dry Detention basin retrofit	WW	77	ac	90,546	4,238	1348	4.18E+14	$ 387,000
Wet detention basin retrofit	WW	12	ac	212	30	11	7.18E+11	$ 61,254
Tree Box Filter	WW	89	#	184	9	22	9.90E+11	$ 1,335,000
Hydrodynamic Separators	WW	111	#	4,979	1,063	229	0.00E+00	$ 2,220,000
Green Roof	WW	35	ac	388	20	19	1.57E+12	$ 18,138,384
Denitrifying Bioreactor	WW	32	ac	25,420	0	0	4.35E+13	$ 960,000
Saturated Buffer	WW	25,500 / 51	ft / #	34,354	820	0	4.29E+13	$ 102,000
Riparian Corridor Restoration	WW	80	ac	356,763	16,006	749	1.43E+14	$ 480,000
Prairie Restoration	WW	214	ac	23,039	1,322	54	1.84E+13	$ 535,000
Wetland Restoration	WW	160	ac	47,029	1,660	809	3.98E+14	$ 1,680,000
Streambank Protection	WW	13,000	ft	302	116	186	0	$ 1,814,760

BMP Type	Scenario	Est. Qty.	Unit	N Reduc. (lb/yr)	P Reduc. (lb/yr)	Sed. Reduc. (t/yr)	FC Reduc. (cfu/yr)	Estimated Cost ($)
Bioretention Facility	SS	15.2 / 662,112	ac / sq ft	2,226	74	44	1.20E+13	$ 14,918,947
Cistern	SS	2	#	0	0	0	0	$ 60,000
Constructed Wetland	SS	7.5	ac	232	9	5	4.45E+11	$ 78,750
Dredging	SS	8,500	cy	0	0	0	0	$ 350,000
Filter Strip - Ag	SS	9.4	ac	438	24	12	1.00E+12	$ 862,314
Filter Strip - Urban	SS	4.2	ac	279	7	4	6.65E+11	$ 418,979
Geothermal system	SS	2	#	0	0	0	0	$ 110,000
Grassed Waterway	SS	17.1	ac	899	59	49	1.29E+12	$ 32,387
Grass-lined Channel (vegetated swale/bioswale)	SS	1.5	ac	40	2	1	9.98E+10	$ 2,936,469
Infiltration Trench	SS	140	ft	8	0	0	4.50E+10	$ $15,743
Oak Ecosystem / Woodland Restoration	SS	34	ac	459	21	1	1.06E+11	$ 204,000
Pervious and Porous Pavements	SS	27.3 / 1.19 M	ac / sq ft	152	7	4	1.91E+11	$ 14,745,931
Prairie Restoration	SS	178	ac	1,139	65	3	4.28E+11	$ 847,500
Salinity and Sodic Soil Management	SS	85	ac	0	0	0	0	$ 40,000
Saturated Buffer	SS	3,300 / 2.3	ft / ac	176	4	0	1.06E+11	$ 6,000
Shoreline Protection	SS	7,580	ft	12	5	8	0	$ 1,093,000
Stream Channel Restoration (remeandering)	SS	2660	ft	10	4	6	0	$ 798,000
Stream Channel Restoration (conv. CCLC)	SS	1.7	ac	273	248	40	0	$ 3,021,200
Stream Channel Stabilization	SS	150	ft	9	1	1	5.23E+10	$ 127,362
Streambank Protection	SS	2,600	ft	9	4	6	0	$ 735,000
Wetland Acquisition	SS	12.3	ac	0	0	0	0	$ 93,400
Wetland Enhancement	SS	5.5	ac	132	5	3	7.78E+11	$ $57,750
Wetland Restoration	SS	321.3	ac	9,244	465	206	2.74E+13	$ 6,843,710
TOTALS				**645,725**	**30,509**	**5,556**	**1.23E+15**	**$ 113,597,324**

Notes:		
SS = site specific	ac = acre	N = nitrogen
WW = watershed-wide	ft = feet	P = phosphorus
n/a = not applicable	# = number	Sed. = sediment
	lb = pounds	FC = fecal coliform
	t = tons	Reduc.=- reduction
	cfu = colony forming units	

4.3 Public Information, Education, and Outreach

Community engagement, education, and outreach are essential components of any watershed protection efforts. Such activities are crucial to the implementation of a watershed plan since they:

- Raise awareness of local water resource issues and foster support for solutions;
- Provide tools to help motivate changes in behavior among stakeholders and other targeted audiences;
- Provide engaged stakeholders with the necessary tools to become watershed stewards and help implement the watershed plan;
- Leverage partnerships among stakeholders and other public and private entities to implement watershed recommendations.

Effective education and outreach is crucial to a watershed plan's success since many watershed problems often result from human actions and solutions. Furthermore, the general public is often unaware of the impact their day-to-day activities have on watershed health and solutions are often voluntary. Education and outreach activities can help raise awareness of threats to local water resources and help motivate changes in behavior to improve watershed health and water quality.

There are a number of strategies that may be appropriate to conduct successful outreach and education campaigns. This section of the plan identifies the types of targeted audiences, priority education topics, potential outreach activities, and partners to help implement these actions.

4.3.1 Resources for Watershed Information and Education Outreach Campaigns

There are many resources available to assist in developing an effective watershed information and education outreach campaign. U.S. EPA's *Getting in Step: a Guide for Conducting Watershed Outreach Campaigns* (2003)[173] and CMAP and Illinois EPA's *Guidance for Watershed Action Plans in*

[173] U.S. EPA's *Getting In Step: Outreach Series* webpage provides guidance documents and a video, training module, and webcast. See https://cfpub.epa.gov/npstbx/getinstep.html (last accessed August 2019).

Illinois (2007) are two recommended sources. Not-for-profit organizations provide information, outreach materials, volunteer opportunities, workshops, and/or other resources applicable to watershed protection. These organizations include the nationally renowned Center for Watershed Protection (CWP) and Center for Neighborhood Technology (CNT) along with a wide range of local organizations such as The Conservation Foundation (TCF), Kane County Division of Environmental and Water Resources, Forest Preserve District of Kane County, Kane-DuPage Soil & Water Conservation District (SWCD), Kane County Farm Bureau, University of Illinois-Extension, Northern Kane County Wild Ones, Fox River Ecosystem Partnership (FREP), Friends of the Fox River (FOFR), Sierra Club, Batavia Environmental Commission and Geneva Natural Resource Committee, among others.

4.3.2 Tools to Conduct a Successful Outreach Campaign

4.3.2.1 Establishing a Sense of Place

People will feel more connected and protective of a place, in this case local watersheds, if they know when they are in that place and why it is special. There are many features within the Salt Creek Watershed planning area including rich and rare ecosystems, regional trails, vast scenic landscapes, and both urban and rural character that help make these watersheds a special place. Outreach activities should be designed to help foster a sense of place among community members and visitors.

4.3.2.2 Identifying and Understanding the Audience

Identifying the targeted audience (s) based on their ability to implement actions of the watershed plan is an essential first step in conducting a successful outreach campaign. Once identified, targeted audiences should be broken down into the smallest segment possible to achieve the best results. Messaging should be created that resonates with the targeted audience and inspires them to act. Targeted audiences for future outreach campaigns include the following:

- **Volunteers**: local residents, environmental organizations interested in managing water resources within the watershed.
- **Residents and Landowners:** local residents, homeowners associations, businesses, institutions, civic organizations.
- **Government officials and agencies:** municipalities, townships, counties, forest preserve and conservation districts, park districts, schools, library districts, drainage districts.
- **Land and resource managers and organizations:** environmental organizations, homeowners associations, lake management associations, business and institutional facility managers, nurseries, agricultural producers, environmental organizations, special interest groups.
- **Developers:** contractors, consultants, developers, and homebuilders working in the watershed.
- **Students:** primary and secondary schools in the planning area.

Knowing some information about the target audience(s) is essential. Campaign audiences have varied values and beliefs, and they will not necessarily be the same as those implementing the watershed plan. The following is a list of a few questions that are important to know about the target audience(s), before education and outreach activities begin:

- What does the audience know already?
- What are their existing beliefs and perceptions?
- How does the audience receive messages and information?
- What will make the audience change their behavior?
- Other important factors include education, age, culture, and religion.

In order to create a successful education and outreach campaign, it is necessary to understand the audience(s). What causes the audience to engage in the behaviors we want to change? How can we most effectively convey that message to them? How can we motivate the audience(s) to change? The understanding of the audience can be completed at the same time or subsequent to identifying the audience(s). Surveys, focus groups, and even simple observations can lead to a greater understanding of the audience and a successful campaign.

4.3.2.3 Setting Outreach Priorities for Targeted Audiences

Once the targeted audience has been identified and understood, outreach priorities and activities for targeted audiences should be identified. These should directly support the watershed management plan's goals thereby aiding successful plan implementation. Stakeholders identified the following goals, which serve as priority topics for education and outreach activities.

- Improve and protect the ecological integrity of surface water resources to attain or maintain designated uses of aquatic life support, fish consumption, primary contact, and aesthetic quality.
- Protect, restore, and expand natural areas and increase native aquatic and terrestrial plant and animal species diversity.
- Reduce flooding and attendant streambank and shoreline erosion and infrastructure risk through initiatives to improve and protect water quality.
- Continue to build, strengthen, and support local partnerships and expertise to protect streams, lakes, and wetlands via plan implementation.
- Continue to raise public awareness and increase understanding of the impacts of land use and land/water management decisions on water and habitat quality, and further encourage implementation of watershed protection practices.

4.3.2.4 Choosing Message Formats and Delivery Methods

There are a number of communication tools to help support successful outreach campaigns. Each may be customized to support the education effort and help foster relationships and a sense of community, build understanding, and motivate people to action. A number of formats may be used including those listed in Table 54.

4.3.2.5 Selecting Program Activities for Targeted Audiences

Once the targeted audience has been identified and outreach priorities, messages, and delivery formats determined, an outreach strategy should be developed. It should include priority topics, targeted audiences, vehicles to communicate the messages, and potential partners to lead information and education outreach efforts. Several information and education opportunities to support each of this plan's goals are summarized in Table 55.

Table 54. Communication tools for education and outreach campaigns.

Printed	*Electronic*	*Visuals*	*Events*	*Other*
• Brochures • Posters • Flyers • Mail surveys • Fact sheets • Manuals & other technical resources • News releases • Newsletters • Bumper stickers • Promotional items	• Websites • Social media (e.g., Facebook, Twitter) • Bulletin boards • Watershed wikis • Web syndications (podcasts, RSS feeds) • Public service announcements (TV, radio) • Picture Post*	• Signage • Exhibits • Demonstration projects • Bulletin boards • Presentations • Storm drain stenciling	• Focus groups • Field trips • Classes/ Workshops • Cleanup events • Restoration field days • Hands on events • Public hearings & meetings	• future Mill Creek watershed group • Partnerships (e.g., FREP, FOFR, TCF) • Cooperative agreements • Local ordinances • Comprehensive plans

Table 55. Existing and potential information and education opportunities by Mill Creek Watershed-based Plan goal.

Targeted Audience	*Existing and Potential Opportunities*	*Potential Partners*
Goal: Improve and protect the ecological integrity of surface water resources to attain or maintain designated uses of aquatic life support, fish consumption, primary contact, and aesthetic quality.		
-Residents -Businesses -Schools	**Conservation@Home** and **Conservation@Work** encourages use of ecofriendly landscapes among landowners. The program recognizes the importance of native plants and their effect on water resources. The Conservation Foundation (TCF) provides a detailed guide to making and maintaining rain gardens and rain barrel installation. They also sell discounted rain barrels year round.	-The Conservation Foundation (TCF)
-Residents -Businesses -Schools	**Kane County Recycles** program: Kane County produces an Annual Green Guide and hosts an information-filled website to encourage recycling, reducing consumption, reuse of materials, and composting. The County provides a residential	-Kane County

	electronics recycling program via permanent drop off locations and monthly events. Similarly, a number of communities within the watershed offer a recycling program and recycling services for residents.	
-Volunteers -Students	Friends of the Fox River (FOFR) volunteers can get their feet wet at water quality monitoring through the **Fox River Watershed Monitoring Network** training workshop which offers stream monitoring training for volunteers.	-Friends of the Fox River (FOFR) -education partners
-Volunteers -Students	Through the **Illinois River Watch Program**, volunteers can become "citizen scientists" and conduct habitat and biological surveys on streams. The macroinvertebrates collected are used as bio-indicators of water quality.	-The National Great Rivers Research and Education Center
-Volunteers	FOFR partners with local communities to conduct Fox River and tributary **stream cleanup events**. The events involve volunteers helping to clean up the rivers and streams by picking up garbage and debris in and along the local waterways.	-FOFR -local communities
-Volunteers -Students	Increase citizen knowledge through the **Illinois Volunteer Lake Monitoring Program** (VLMP). Data used from the program is used to document water quality impacts to local lakes and aid in lake management decision-making.	-Illinois EPA -CMAP
-Residents -Landowners -Businesses -Students -Volunteers	The **Fox River Ecosystem Partnership** (FREP) hosts a website that includes educational resources about watersheds and how residents, landowners, and businesses can protect water resources. FREP also hosts monthly meetings and "lunch and learns" where watershed protection programs and restoration projects are highlighted and visited.	-Fox River Ecosystem Partnership (FREP)
-Residents -Landowners -Businesses	The **WaterSense Program** promotes the need for water efficiency by offering alternatives to use less water with water efficient products.	-US EPA -Northwest Water Planning Alliance
Goal: Protect, restore, and expand natural areas and increase native aquatic and terrestrial plant and animal species diversity.		
-Residents -Landowners -Businesses -Volunteers	The **Forest Preserve District of Kane County** (FPDKC) seeks to protect, restore, and expand natural areas within Kane County. The FPDKC offers a number of education and special events aimed at its mission (including volunteer work days in local preserves) and owns or manages numerous natural areas.	-Forest Preserve District of Kane County
-Residents -Landowners -Businesses -Volunteers	The **St. Charles Park District** (STPD), Geneva Park District (GPD), and Batavia Park District (BPD) seeks to protect, restore, and expand natural areas within their service areas. They offer a number of education and special events aimed at its mission (including volunteer work days), and own or manage numerous natural areas.	-St. Charles, Geneva, & Batavia Park Districts

-Residents -Landowners -Businesses -Volunteers	The **Campton Township Open Space District** seeks to protect, restore, and expand natural areas within Campton Township. The District offers a number of education and special events aimed at its mission and owns or manages numerous natural areas.	-Campton Twp Open Space
Goal: Reduce flooding and attendant streambank and shoreline erosion and infrastructure risk through initiatives to improve and protect water quality.		
-Residents -Landowners -Government Officials -Government Agencies	Meetings, local government websites, school websites, newsletters, email blasts, workshops, demonstration projects, public meetings, streambank and shoreline assessments.	-Elected Officials -Park & forest preserve districts -Non-Profit Groups -Landscape Contractors -Homeowner's Associations
-Government Officials -Government Agencies	Develop a regional floodplain management plan. Potential benefits of the plan include: reduction of flood damage costs to communities; improvement of riparian vegetation, wildlife habitat and water quality; retention of natural beauty in the area.	-FEMA
-Government Officials -Government Agencies	Develop a local stormwater or floodplain management plan. Potential benefits of the plan include: reduction of flood damage costs to communities; improvement of riparian vegetation, wildlife habitat and water quality; retention of natural beauty in the area.	-Kane County -Municipalities
-Government Officials -Government Agencies	County, municipal, and township newsletters may be used by local governments to tie the educational component of their MS4 program to this watershed plan and its implementation such that collaborative efforts might benefit from a consistent message and efficiencies to be gained from cooperation.	-Elected Officials -Illinois EPA
-Volunteers -Residents -Landowners -Government Officials -Government Agencies -Land Resource Managers -Developers	Targeted mailings, county/municipal websites, homeowner's association workshops, handouts at permit facilities, local codes, ordinances	-Elected Officials -Kane County -CMAP

Goal: Build, strengthen, and support local partnerships and expertise to protect our streams and lakes via plan implementation.		
-Government Officials -Government Agencies -Land Resource Managers -Non-Profit Organizations	CMAP's **Local Technical Assistance (LTA) Program** provides assistance to local governments, nonprofits, and intergovernmental organizations to address sustainable development.	-CMAP
-Government Officials -Government Agencies	Municipal/Technical Training in the form of a variety of workshops that teach BMPs for stormwater management and stream restoration.	-TCF -Kane County
-Volunteers -Residents -Students	Environmental and nature related professional development training/workshops that provide educators information about natural resources, as well as supplement materials and instructional methods to incorporate into lessons with students. The trainings/ workshops are meant to promote stewardship of natural resources.	-Environment and Nature Training Institute for Conservation Education (ENTICE) -Illinois Dept. of Natural Resources' (IDNR) Division of Education
-Volunteers -Residents -Students	The Mighty Acorns® program incorporates classroom curriculum, hands-on restoration activities, and exploration as it seeks to provide children with multiple, meaningful, sustained interactions with the land. Classes adopt a natural area in their community and visit it throughout the school year in order to participate in stewardship activities. Each field trip is preceded by a classroom lesson on related ecological concepts.	-TCF
-Volunteers -Residents -Students	The Kane-DuPage Soil & Water Conservation District (SWCD) provides several outreach programs for K- 12 classrooms, home schools, and boy/girl scout groups. Programs are interdisciplinary, aligned to the state learning standards, and can be designed to meet the needs of classroom curriculum. Possible outreach program topics include, but are not limited to, changing landscapes, land and water conservation, soils, trees, and stewardship.	-Kane-DuPage SWCD
-Volunteers	Water Sentinels is a Sierra Club program that deals with water related issues across the country. The program explores the ways in which waterways are impacted by pollution, climate, and development, while also actively working to empower	-Sierra Club

	local activists with accurate information and training them in water-quality monitoring techniques and grassroots advocacy.	
-Municipalities	The Fox River Study Group (FRSG) monitors water quality at the mouth of several Fox River tributaries. Mill Creek should be added to that monitoring program.	-Fox River Study Group (FRSG)
Goal: Raise public awareness and increase understanding of the impacts of land use and land/water management decisions on water and habitat quality, and further encourage implementation of watershed protection practices.		
-Students -Residents -Landowners -Government Officials -Government Agencies	Print, Electronic, Visuals, Events, and other tools (see table below)	-Municipalities -Townships -Library Districts -Park & Forest Preserve Districts -Primary & Secondary Schools -SWCDs -CMAP -TCF
-Residents -Landowners -Businesses	Storm Drain Stenciling is a social marketing technique used to educate and remind the public not to dump waste into storm drains in order to avoid runoff and to help keep our waterways clean.	-TCF -Residents -HOAs -School Groups -Scouting Groups -Church Groups -Service Organizations
-Residents -Landowners -Teachers -Students -Gov't Officials -Gov't Agencies	Clean Water for Kane is a campaign that promotes the Kane County mission to protect and enhance the quality of streams and rivers within the county. The social media campaign platforms provide updates, newsletters, and educational resources about stormwater and local waterways, and how residents, landowners, and businesses can protect them.	-Kane County
-Residents -Landowners -Businesses -Students -Volunteers	The Fox River Ecosystem Partnership (FREP) hosts a website that includes educational resources about watersheds and how residents, landowners, and businesses can protect water resources. FREP also hosts monthly meetings and "lunch and learns" where watershed protection programs and restoration projects are highlighted and visited.	-Fox River Ecosystem Partnership (FREP)
-Schools -Businesses -Churches -Park Districts -Library Districts	Picture Posts are wooden markers installed in natural areas that help guide visitors to photograph a location in different orientations at different times. Photos are dated, geotagged, uploaded, and shared to allow for environmental monitoring, as well as to increase public awareness of a site. Picture Posts	-Kane County -Municipalities -Park & Forest Preserve Districts

-Municipal Organizations -Non-Profit Organizations	are accessible to anyone, and are easy to install, use and maintain.	

4.3.3 Outreach and Education Recommendations and Cost Estimate

Several recommendations for public information, education, and outreach activities within the Mill Creek watershed area are listed below.

1. A watershed "coalition" or "partnership" should be formed to leverage momentum from the planning process and help encourage plan implementation and continue efforts toward reaching the plan's goals. It just takes one person or organization to get things started and keep folks engaged.
2. Local governments and conservation-oriented organizations and agencies should promote the Mill Creek Watershed-based Plan and its recommendations in either special or regularly occurring communications with members and residents, and become active members of the aforementioned watershed group.
3. CMAP should issue a press release about the Mill Creek Watershed-based Plan upon approval by Illinois EPA.
4. A social survey(s) is recommended to help determine barriers to and pathways for greater stakeholder participation in or adoption of watershed/water quality protection-related actions. As an example, the Nippersink Watershed Association conducted such a community survey, which they then followed up with outreach and education plan and activities guided by the survey results.[174]
5. County, township, and municipal governments should create a dialogue with neighborhood and/or homeowner's associations to raise awareness of stormwater management issues and responsibilities, in collaboration with local conservation-oriented organizations, educational providers, and stormwater professionals. Workshops on maintaining stormwater BMPs should be offered for HOAs and other property owners responsible for their maintenance.
6. County, township, and municipal governments should promote installation of rain gardens, rain barrels, and other property-level green infrastructure practices (such as riparian buffers and permeable pavements) by neighborhood and/or homeowner's associations and local businesses, in collaboration with local conservation-oriented organizations, educational providers, and professionals in the field.
7. Local governments and nongovernmental organizations alike should promote

[174] See http://www.nippersink.org/report.htm (accessed June 2019).

   a. use of phosphorus-free lawn fertilizer by homeowners and other private individuals who maintain their lawns (i.e., noncommercial or non-for-hire applicators),
   b. use of on-demand water softeners by homeowners and other private individuals and businesses,
   c. a pet waste disposal campaign.
8. The Kane County Department of Health should conduct a septic system maintenance campaign, collaborating with local governments and nongovernmental organizations.
9. Municipal and other local government staff should incorporate NWPA recommendations and related requests for data sharing and information.
10. Kane County should continue to offer their "sensible salting workshops" and conduct campaigns to encourage workshop participation and ongoing implementation.

The cost of developing, conducting, and analyzing a social survey to help determine barriers to and pathways for greater stakeholder participation, including municipal involvement and agricultural BMP implementation, is estimated at $15,000 to $20,000.[175]

Development of outreach and education work strategies, programs, campaigns, workshops, displays, websites, materials, etc. is estimated at $5,000 per "event." If each municipality, township, and park, open space, and forest preserve district within the Mill Creek watershed, plus Kane County, the Kane-DuPage SWCD, and Kane Co. Farm Bureau were to develop and implement two "events" over the next 10 years, that would total 34 events, and thus $170,000 is estimated as a watershed-wide budget starting point. Partnerships with local organizations (e.g., TCF, FREP, FOFR, Sierra Club), schools, and libraries are encouraged. It is recommended that stakeholders develop a more detailed education work strategy during the first two years of plan implementation.

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[175] Aaron Thompson, Assistant Professor and Land Use Specialist, Univ. of Wisconsin – Stevens Point, March 2016. *Personal communication*.

4.4 Funding and Technical Assistance

Plan implementation is largely based on the availability of funding and/or technical assistance for implementation projects and other plan recommendations. Table 56 describes several potential grant funding and technical assistance resources that may be used to assist with plan implementation.

Table 56. Funding and technical assistance resources.

Program	*Funding Agency*	*Funding Amount*	*Eligibility*	*Eligible Activities*	*Website*
Clean Water State Revolving Fund (CWSRF) *and* Drinking Water State Revolving Fund (DWSRF)	USEPA *in partner-ship with* Illinois EPA *(see below)*	Loan program	Local gov't, individuals, citizens (septic systems), not-for-profit groups	Green projects, wastewater treatment, NPS, watershed management, restoration and protection of groundwater.	https://www.epa.gov/cwsrf https://www.epa.gov/drinkingwatersrf
Water Pollution Control Loan Program (WPCLP)	Illinois EPA	Loan program	Typically local gov't	Wastewater infrastructure improvements and stormwater–related projects that benefit water quality [e.g., green infrastructure, water and energy efficiency improvements, other environmentally innovative activities as directed by federal law (see 33 U.S. code 1274)]	https://www2.illinois.gov/epa/topics/grants-loans/state-revolving-fund/Pages/default.aspx
Public Water Supply Loan Program (PWSLP)	Illinois EPA	Loan program	Typically local gov't	Drinking water infrastructure improvements	
Wetland Program Development Grants	USEPA	n/a	States, tribes, local gov'ts, interstate associations, intertribal consortia	Projects that promote the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys and studies to protect, manage, and restore wetlands.	https://www.epa.gov/wetlands/wetland-program-development-grants
North American Wetlands Conservation Act – Standard Grants	USFWS	$100,001-$1,000,000+ with at least 1:1 matching funds	Tribal, State, or local unit of gov't, non-governmental organization, or individual	Long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats for the benefits of all wetlands-associated migratory birds	https://www.fws.gov/birds/grants/north-american-wetland-conservation-act/standard-grants.php

Program	*Funding Agency*	*Funding Amount*	*Eligibility*	*Activities Funded*	*Website*
North American Wetlands Conservation Act – Small Grants	USFWS	Up to $100,000 with at least 1:1 matching funds	Tribal, State, or local unit of gov't, non-governmental organization, or individual	Long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats for the benefits of all wetlands-associated migratory birds	https://www.fws.gov/birds/grants/north-american-wetland-conservation-act/small-grants.php
Environmental Education Grants	USEPA	Up to 75% of project costs; max. award set each cycle ($91,000 in 2016)	Local, state or tribal education agency, environmental agency, college or university, non-profit org.	Environmental education projects that promote environmental awareness and stewardship. Projects may design, demonstrate, and/or disseminate environmental education practices, methods, or techniques.	https://www.epa.gov/education/environmental-education-ee-grants
5 Star Wetland and Urban Waters Restoration Grant Program	Nat'l Fish & Wildlife Fndtn	$10,000 - $40,000	Non-profit 501(c) orgs, state gov't agencies, local & municipal gov'ts, Indian tribes, educational institutions	Environmental education and training for students, conservation corps, youth groups, citizen groups, corporations, landowners and government agencies through projects that restore wetlands and streams.	http://www.nfwf.org/fivestar/Pages/home.aspx
Brownfields Assessment Grants	USEPA	Up to $200,000 or $350,000 with grant limit waiver. $1,000,000 if a coalition of three or more eligible applicants apply under the name of one coalition member.	State gov't agencies, local & municipal gov'ts, Indian tribes	The inventory, characterization, and assessment of brownfields sites contaminated by petroleum and hazardous substances, pollutants, or contaminants (including hazardous substances co-mingled with petroleum), as well as conducting planning and community outreach related to brownfield site assessment.	https://www.epa.gov/brownfields/types-brownfields-grant-funding
Brownfields Revolving Loan Fund Grants	USEPA	Revolving Loan Fund Program	State gov't agencies, local & municipal gov'ts, Indian tribes	Capitalize on a revolving loan fund or to provide subgrants for cleanup activities at brownfield sites contaminated by petroleum and hazardous substances, pollutants, or contaminants (including hazardous substances co-mingled with petroleum)	

Program	*Funding Agency*	*Funding Amount*	*Eligibility*	*Activities Funded*	*Website*
Brownfields Cleanup Grants	USEPA	Up to $200,000 20% cost share per site requirement (max 3 sites)	Non-profit 501(c) orgs, state gov't agencies, local & municipal gov'ts, Indian tribes. Applicant must have sole ownership of brownfield site.	Cleanup activities at brownfield sites contaminated by petroleum and hazardous substances, pollutants, or contaminants (including hazardous substances co-mingled with petroleum)	https://www.epa.gov/brownfields/types-brownfields-grant-funding
Brownfields Area Wide Planning Grants	USEPA	Not specified. Funding available every other year	State gov't agencies, local & municipal gov'ts, Indian tribes	Development of an area-wide plan for a specific area affected by high priority brownfield site(s) in need of assessment, cleanup, and redevelopment.	
Conservation Stewardship Program (CSP)	USDA - NRCS	Not more than $200,000	Private & tribal ag lands, grass-land, range-land, pasture-land, non-industrial private forest land	Helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities.	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/
Environmental Quality and Incentives Program (EQIP)	USDA - NRCS	Advance payment of up to 50%	Agricultural producers	Planning and implementation of conservation practices.	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
Conservation Innovation Grants (CIG)	USDA - NRCS	Up to $75,000 under state component	non-Federal governmental or nongovern-mental orgs, Native American Tribes, individuals	Projects targeting innovative on-the-ground conservation, including pilot projects and field demonstrations.	
Healthy Forests Preserve Program	USDA - NRCS	50%, 75% or 100% of the enrolled land/ cost of cons. practice. Funding based on 10- or 30-year contract	Private landowners	The program offers 10-year restoration agreements and 30-year permanent easements for specific conservation actions.	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/forests/

Program	Funding Agency	Funding Amount	Eligibility	Activities Funded	Website
Emergency Watershed Protection Program (EWP)	USDA - NRCS	Up to 75% of the construction cost of emergency measures	Public and private landowners re presented by a project sponsor (e.g., city county, conservation district, Native American tribe)	Watershed impairments incl. Debris-clogged stream channels; Undermined and unstable streambanks; Jeopardized water control structures and public infrastructures; Wind-borne debris removal; and Damaged upland sites stripped of protective vegetation by fire or drought	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/
Pre-Disaster Mitigation Grant Program	FEMA	Not specified	States, U.S. territories, tribes, local gov'ts	Implementation of a sustained pre-disaster natural hazard mitigation program	https://www.fema.gov/pre-disaster-mitigation-grant-program
Section 319(h) Nonpoint Source Pollution Control Financial Assistance Program	Illinois EPA	Up to 60% of eligible project costs; minimum 40% local match requirement in cash and/or in-kind services. No set limit on awards.	Any entity that has legal status to accept funds from the state of Illinois, incl. state & local gov'ts, non-profit orgs, citizen & environmental groups, individuals, businesses.	Funds may be used for the development, update, and implementation of watershed-based management plans including the development of information/education programs and for the installation of best management practices.	https://www2.illinois.gov/epa/topics/water-quality/watershed-management/nonpoint-sources/Pages/grants.aspx
Illinois Green Infrastructure Program	Illinois EPA	Small: $75,000 Retention: $750,000 CSO: $3M *When funding appropriated*	Any entity eligible to receive funds from the state, and the project is in a MS4 community.	Implementation of green infrastructure BMPs that are designed to improve water quality to lakes, rivers and streams through managing stormwater to reduce flows and remove pollutants.	https://www2.illinois.gov/epa/topics/grants-loans/water-financial-assistance/Pages/igig.aspx
Streambank Cleanup and Lakeshore Enhancement (SCALE)	Illinois EPA	$3,500 *When funding available*	Any entity eligible to receive funds from the state.	Provides funds to assist groups that have established a recurring stream or lakeshore cleanup.	https://www2.illinois.gov/epa/topics/water-quality/surface-water/scale/Pages/default.aspx
Lake Education Assistance Program (LEAP)	Illinois EPA	$500 *When funding available*	Schools, colleges, universities, not-for profit organizations	Projects & activities that enhance lake & lake watershed education of teachers, students, organizations, or the community	https://www2.illinois.gov/epa/topics/water-quality/surface-water/Pages/leap.aspx

Program	*Funding Agency*	*Funding Amount*	*Eligibility*	*Activities Funded*	*Website*
Illinois Clean Lakes Program	Illinois EPA	Phase 1: $75,000 Phase 2: $300,000 *When funding appropriated*	Owners/man-agers of lakes that have public access.	Two types of grants are awarded: Phase I identifies problems & sources of pollution. Phase II grants support implementation or procedures recommended in the Phase I report to improve water quality.	https://www2.illinois.gov/epa/topics/water-quality/monitoring/Pages/inland-lakes.aspx#il2
Water Quality Management Planning	Illinois EPA	No set limit on awards	Regional public comprehensive planning organizations and other entities	Projects that determine the nature, extent, & causes of point & NPS water pollution; develop WQ mngmnt plans; develop technical & administrative guidance tools for water pollution control; develop preliminary designs for BMPs to address WQ problems; implement administrative water pollution controls; educate the public about the impact & importance of water pollution control.	https://www2.illinois.gov/epa/topics/water-quality/watershed-management/wqmp/Pages/grants.aspx
Open Space Lands Acquisition & Development (OSLAD) *and* federal Land & Water Conservation Fund (LWCF)	Illinois DNR	Up to 50% of approved costs Maximum $750,000/ acquisition $400,000 development (OSLAD only) *When funding appropriated*	Local units of gov't	Acquisition and/or development of public outdoor recreation/natural areas and facilities	https://www.dnr.illinois.gov/aeg/pages/openspacelandsaquisitiondevelopment-grant.aspx
Illinois Schoolyard Habitat Action Grant Program	Illinois DNR	Up to $1000	Teachers, nature center personnel, and youth group leaders for pre-K through 12th grade students	Enhancing or establishing and maintaining a schoolyard habitat plot, butterfly garden, rain garden, wetland, nesting platform or watering station; designing/building a bird feeding station; and constructing/installing bat roosting boxes.	https://www.dnr.illinois.gov/education/Pages/GrantsSHAG.aspx

Program	*Funding Agency*	*Funding Amount*	*Eligibility*	*Activities Funded*	*Website*
Sustainable Agricultural Grant Program	Illinois DOA	Up to $10,000 for individuals Up to $20,000 for units of government, non-profits, institutions.	Organizations, governmental units, educational institutions, non-profit groups, individuals	Practices are aimed at maintaining producers' profitability while conserving soil, protecting water resources and controlling pests through means that are not harmful to natural systems, farmers or consumers.	https://www2.illinois.gov/sites/agr/Resources/Conservation/Pages/default.aspx#h3
Stream Bank Stabilization & Restoration Program	Illinois DOA; Kane-DuPage SWCD	When funding available. Cost share required.	Proposals must be sponsored by local SWCD	Streambank stabilization using vegetative or other bio-engineering techniques	http://www.kanedupageswcd.org/conservation.htm#SSRP
Local Technical Assistance (LTA) Program	CMAP	Graduated local contribution requirement	Local gov'ts, nonprofits, intergovern-mental organizations	Technical assistance is provided to address local issues including landuse, transportation, housing, natural environment, economic growth and community development.	http://www.cmap.illinois.gov/programs/LTA
American Water Environmental Grant Program	Ameri-can Water	Up to $10,000	Municipalities, non-profits, schools	Source water and watershed protection projects (e.g., watershed cleanup, habitat restoration, stream buffer restoration, wellhead protection, hazardous waste collection, surface or groundwater protection education)	https://amwater.com/corp/customers-and-communities/environmental-grant-program
Green Region Program	ComEd	Up to $10,000 50% match requirement	Public agencies w/in ComEd's service territory	Open space planning, acquisition, or improvements for local parks, natural areas, and recreation resources.	https://openlands.org/planning/greenregion/
Great Urban Parks Campaign - Green Stormwater Infrastructure Community Outreach and Education Grant	Nat'l Recrea-tion & Park Assoc.	$10,000	Local, municipal, or regional agency; Tribal community; or affiliated 501(c)(3) nonprofit organization	Innovative community engagement strategies that effectively empower the community to influence the design of a green stormwater infrastructure project that best suits their needs, while also benefiting the local environment.	https://www.nrpa.org/our-work/partnerships/initiatives/water-conservation/great-urban-parks-campaign-pilot-projects/

5. Monitoring Success

Although there is considerable merit in producing a watershed-based plan, actual protection and improvement in water quality in the Mill Creek Watershed will be a result of implementing the plan's various project, program, planning, policy, and I/E outreach recommendations. Improving water quality will happen over time and with considerable effort by all with a stake in watershed health including residents, local governments, agencies, organizations, and the business community.

5.1 Implementation Schedule

Table 57. General 10-year plan implementation schedule.

Task	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Year 10*	*(Year 11)*
Establish a formal watershed group, meet bi-annually or quarterly	X	X	X	X	X	X	X	X	X	X	X
Conduct outreach to elected officials & general public about the Mill Creek Watershed-based Plan, including funding & tech assist opportunities	X	X	X	X	X	X	X	X	X	X	
Identify a series of plan recommendations to implement	X	X	X	X	X	X	X	X	X	X	
Identify available grant funding and tech assistance programs	X	X	X	X	X	X	X	X	X	X	
Develop and submit grant and tech assistance applications	X	X	X	X	X	X	X	X	X	X	
Implement on-the-ground, policy, planning, and education and outreach projects and programs		X	X	X	X	X	X	X	X	X	
Keep track and report progress to [the watershed group]	X	X	X	X	X	X	X	X	X	X	
Communicate success stories	X	X	X	X	X	X	X	X	X	X	
Evaluate accomplishments		X		X		X		X		X	
Update the watershed-based plan										X	X

Note: the Lower Fox River watershed is among the Section 319 plan implementation priority watersheds in Illinois for FFY 2021 (applications due to Illinois EPA by 8/1/2020).[176] If Illinois EPA maintains their five year rotating basin priority system, the Lower Fox will be a plan development priority in FFY 2024 and FFY 2029 (applications due by 8/1/2023 and 8/1/2028, respectively) and a plan implementation priority again in FFY 2026 and FFY 2031 (applications due by 8/1/2025 and 8/1/2030, respectively).

5.1.1 Interim Measureable Milestones

Plan recommendations will require local commitments, resources, and collaboration for implementation success. One requirement of a watershed-based plan is to establish interim measurable milestones for determining whether NPS pollution management measures and other actions are being implemented. Table 58 identifies such milestones and ties them to goals that stakeholders established during the planning process. Stakeholders will evaluate progress towards measurable milestones on an annual basis such that it will become clear where improvements and/or changes to an approach or the plan itself are needed. It is important, therefore, for a clear sense of progress to be documented. The Kane County Environmental and Water Resources Department will collaborate with watershed stakeholders to identify processes currently in place to document BMPs implemented and develop a repository (e.g., database) for the data.

Table 58. Interim measureable milestones (cumulative).

Goal	*Indicator*	*Two-year milestone*	*Five-year milestone*	*Ten-year milestone*
Improve and protect the ecological integrity of surface water resources to attain or maintain designated uses of aquatic life support, fish consumption, primary contact,	Acres of bioretention / bioinfiltration / rain gardens		3	11
	Acres of grassed-lined channels / veg. swales / bioswales		1	5
	Acres of permeable or porous pavements / pavers		5	19
	Feet of infiltration trenches		3,800	15,300
	Acres of new filter strips / field borders / riparian buffer		3	14
	Acres of restored riparian corridor		8	32
	Acres of constructed wetland		4	8
	Acres of restored wetland		48	193

[176] Illinois EPA. 2016. Nonpoint Source Pollution Control Priority Watersheds. https://www2.illinois.gov/epa/Documents/iepa/water-quality/watershed-management/Priority%20Watersheds%202016.pdf#search=priority%20watersheds (accessed June 2019).

and aesthetic quality	Acres of restored prairie		39	157
	Acres of restored oak ecosystems / woodlands		14	27
	Lin. ft. streambank / stream channel stabilization / restoration		2,200	8,800
	Acres of detention basin retrofits		9	36
	No. of public road maintenance jurisdictions applying at an average rate of less than 300 lbs per lane mile		5	10
	No. of hydrodynamic separators		11	44
	No. of tree box filters		9	36
Goal	***Indicator***	***Two-year milestone***	***Five-year milestone***	***Ten-year milestone***
Protect, restore, and expand natural areas and open space, and increase native aquatic and terrestrial plant and animal species diversity	Acres placed in new, permanent conservation status	10	40	200
	Acres of restored wetland		48	193
	Acres of restored prairie		39	157
	Acres of restored oak ecosystems / woodlands		14	27
	No. of restoration workday volunteers	100	150	200
	No. of local governments (county, township, municipal) whose comprehensive plan supports local and regional green infrastructure	4	5	6
	No. of HOAs maintaining their natural areas	10	20	50
Goal	***Indicator***	***Two-year milestone***	***Five-year milestone***	***Ten-year milestone***
Raise public awareness and increase understanding of the impacts of land use and land/water management decisions on	No. of municipalities whose comprehensive plans/updates support water quality protection in new and retrofit design practices			4
	No. of municipalities whose ordinance updates improve water quality protections			4
	No. of workshops made available to road salt applicators	4	10	20

water and habitat quality, and further encourage implementation of watershed protection practices	No. of public road maintenance departments participating in "sensible-salting" training / retraining workshops	10	10	10
	No. of private contractors participating in "sensible-salting" training / retraining workshops	30	40	50
	No. of institutions participating in "sensible-salting" training / retraining workshops	10	15	20
	No. of new Conservation@Home and Conservation@Work properties	10	20	40
	No. of stream cleanup events	2	6	15
	No. of stream cleanup event participants	20	60	150
	No. of stream sites monitored by FOFR or RiverWatch volunteers	1	2	4

Goal	*Indicator*	*Two-year milestone*	*Five-year milestone*	*Ten-year milestone*
Build, strengthen, and support local partnerships and expertise to protect our streams, lakes, and wetlands via plan implementation	No. of presentations made to elected officials	10	20	30
	No. of presentations made to stakeholder groups	5	10	20
	No. of public events where water quality outreach & education provided	5	10	20
	No. of organizations involved in plan implementation	10	20	30

Goal	*Indicator*	*Two-year milestone*	*Five-year milestone*	*Ten-year milestone*
Protect the quality and quantity of groundwater	No. of communities becoming WaterSense (WS) partners as recommended by NWPA		5	10
	No. of local jurisdictions adopting NWPA or similar outdoor lawn watering ordinance		5	10
	No. of public jurisdictions applying at an average rate of less than 300 lbs per lane mile		5	11
	No. of workshops made available to road salt applicators	4	10	20

	No. of public road maintenance departments participating in “sensible-salting” training / retraining workshops	10	10	10
	No. of private contractors participating in “sensible-salting” training / retraining workshops	30	40	50
	No. of institutions participating in “sensible-salting” training / retraining workshops	10	15	20
Goal	***Indicator***	***Two-year milestone***	***Five-year milestone***	***Ten-year milestone***
Reduce flooding and attendant bank erosion and infrastructure risk through initiatives to improve and protect water quality	Acres of impervious surface reduction		10	30
	Acres of floodplain reconnection		10	20
	Acres of green roof		4	14
	No. of cisterns installed			2

5.2 Criteria for Determining Progress

Gauging progress and success with the plan depends largely on how many of the plan recommendations are implemented. Progress made with implementing BMP recommendations should eventually translate to improved water quality and subsequent attainment of designated uses and/or water quality standards.

Monitoring pollutant load reductions and biological index scores will be the primary criterion by which progress can be judged. Table 59 identifies criteria of determining progress within five and ten-year timeframes to reflect the fact that it will take time to see improvements manifest in response to plan implementation.

Another important criterion for determining progress will be delisting of a waterbody due to use attainment as documented in the biennial integrated water quality reports. Thus, improvements in water quality should result in greater use attainment and/or delisting [Section 303(d)] in the 2028 Integrated Report].

Table 59. Criteria for determining progress in load reductions and attaining or maintaining water quality standards or criteria.

Criteria	*Current Load (HSPF), Score, or Rating*	*Target within 5 years*	*Target within 10 years*
Watershed-wide			
Nitrogen load reduction	1,048,192 lb/yr	5% load reduction = 52,410 lb/yr	15%* load reduction = 157,229 lb/yr
Phosphorus load reduction	52,998 lb/yr	10% load reduction = 5,300 lb/yr	25%* load reduction = 13,250 lb/yr
Sediment load reduction	18,957 t/yr	10% load reduction = 1,896 t/yr	25% load reduction = 4,739 lb/yr
Fecal coliform load reduction	300,950,711 cfs*cfu/100mL/yr	5% load reduction = 15,047,536 cfs*cfu/100mL/yr	10% load reduction = 30,095,071 cfs*cfu/100mL/yr
Waterbody-specific			
Mill Creek – DTZL-01 – downstream of Mooseheart dam			
fIBI score	28 (2017)	≥ 28	≥ 33
mIBI score	n/a	set baseline	maintain
QHEI score	n/a	set baseline	maintain
Stream Rating for Integrity	n/a	set baseline	maintain
Stream Rating for Diversity	n/a	set baseline	maintain
Mill Creek – DTZL-02 – Brundige Rd			
fIBI score	36 (2004)	≥ 36	≥ 41
mIBI score	n/a	set baseline	maintain
QHEI score	n/a	set baseline	maintain
Stream Rating for Integrity	n/a	set baseline	maintain
Stream Rating for Diversity	n/a	set baseline	maintain

*percent reduction matches Illinois Nutrient Reduction Strategy year 2025 goal

5.3 Monitoring to Evaluate Effectiveness

A robust water quality monitoring regime is required to evaluate the effectiveness of BMP implementation. It will be important to keep track of BMPs implemented in the various subwatershed study units to help explain any changes that occur or treads that emerge in water quality parameters or aquatic life indices.

As described in section 3.6.2.1, the STEPL model that CMAP used to determine baseline or background pollutant loads is not calibrated nor validated from water quality and/or land-use pollutant runoff data in the planning area, but it could nonetheless be used to roughly estimate TN, TP, TSS, and BOD load reductions associated with BMP implementation.

The HSPF model that Geosyntec calibrated for Mill Creek and used to determine background pollutant loads of TN, TP, TSS, and fecal coliform (Appendix D), and subsequently to estimate load reductions for applicable site-specific BMPs as identified by stakeholders in this plan, would be the better choice for modeling pollutant reduction from applicable implemented, on-the-ground nonpoint source pollution reduction projects.

> **Recommendation:** Seek funding to allow Geosyntec to apply the BMP framework outlined during this planning process. This work would include identifying prioritized parcels based on the screening criteria; creating a shared online data table for data entry; providing an updated version of six NCHRP Report 792 spreadsheet tools and user guidance for those tools; performance, cost, and cost-effectiveness results for six BMPs type/size combinations; and a shared online data table for collaboration on alternatives analysis.

Water Quality Monitoring

Monitoring of water quality and aquatic life response will largely depend on the following agencies, organizations, and programs:

Illinois EPA and Illinois DNR - Every five years, Illinois EPA and Illinois DNR collaborate on a Fox River Basin survey collecting stream water and sediment quality, macroinvertebrate, fish, and habitat data (last survey in 2017, next in 2022). However, while Illinois DNR has conducted fish population surveys at several locations in Mill Creek upon special request (in 2004 and 2017), Illinois EPA has not collected any water quality, macroinvertebrate, or habitat data in Mill Creek. In fact, very little water quality data exists for the creek.

> **Recommendation:** Illinois EPA and Illinois DNR include Mill Creek in the Fox River Basin survey every five years, beginning in 2022, at stations DTZL-01 and DTZL-02. Further, supplemental fish surveys at stations DTZL-03, 04, 05, and 06 are recommended.

Fox River Study Group – At several Fox River tributaries, water samples are collected monthly [by member WWTP staff] and analyzed at the Fox River Water Reclamation District lab in Oswego. However, Mill Creek is not included in this program.

> **Recommendation:** Include Mill Creek in the FRSG's tributary sampling program.

Sierra Club Water Sentinels – Since 1996, the local Sierra Club chapter, Valley of the Fox, has conducted quarterly monitoring of the chemical and physical water quality of ten Fox River tributaries including Mill Creek. Their most recent report, Creeks of the Middle Fox River: 2016 Progress Report, was based on data collected between 2005 and 2015. Since then, it appears that no sampling has been conducted.

Recommendation: Reestablish the Valley of the Fox Water Sentinels sampling program. The group is encouraged to collaborate with the Mill Creek watershed group, FRSG, and FOFR to confirm the historical sampling locations and parameters, as well as identify other locations where additional data could be useful. The Water Sentinels also are encouraged to develop an Illinois EPA-approved QAPP so that sampling results can benefit FRSG's work and be used by Illinois EPA for their biennial assessment.

Fox River Watershed Monitoring Network / Illinois RiverWatch Network – Volunteers adopt a stream site in their community and conduct habitat and biological surveys, including the collection and identification of macroinvertebrates. The FRWMN program is coordinated by Friends of the Fox River (FOFR).[177] The RiverWatch Network program is coordinated by the National Great Rivers Research and Education Center.[178]

Recommendation: Interested volunteers are encouraged to coordinate with the Mill Creek watershed group and Valley of the Fox Water Sentinels to identify locations where macroinvertebrate data would be especially informative.

Social Indicator Monitoring

Recommendation: A survey to assess the public's awareness of stormwater runoff, its impacts upon local streams, rivers, lakes, and wetlands, and current behaviors regarding water resource protections is suggested. This would ideally be followed by development of outreach materials and an outreach campaign, and then a subsequent up survey to measure if there has been any improvement in public knowledge and changes in behavior regarding water resource protections. Collaboration between the members of the Mill Creek watershed group could leverage resources.

[177] https://friendsofthefoxriver.org/get-involved/monitoring/ (accessed June 2019).

[178] http://www.ngrrec.org/Riverwatch/ (accessed June 2019).

Appendix A – Stream Inventory Report Form

FOX RIVER WATERSHED STREAM INVENTORY REPORT FORM *(CMAP, rev Aug. 7, 2018)*

STREAM NAME:______**MILL CREEK – Kane Co.**________Reach ID:________________ DATE: _______________

INVESTIGATORS & ORGANIZATION(S):____

GPS unit BRAND & MODEL:____Magellan Meridian Platinum____MAP DATUM: WGS84 COORD Sys: Lat/Long

GAGING STATION: USGS 05551330 MILL CREEK NEAR BATAVIA, IL Most Recent Instantaneous Values:

TIME: _______________ GAGE HEIGHT (FT): ________________ DISCHARGE (CFS):________________

RECENT WEATHER (incl. Precip.in past week) ____

CURRENT WEATHER: ____ Approx. AIR TEMP.(°F)_____

Approx. REACH LENGTH (FT) (use GIS or meas. on aerial photo):__________________ Start TIME:_____________

Describe REACH BOUNDARY START (Downstream end):____

GPS Waypoint #________(enter Reach ID comment in GPS unit) facing Upstream: Photo # _______

Describe REACH BOUNDARY FINISH (Upstream end):____

GPS Waypoint #________(enter Reach ID comment in GPS unit) facing Downstrm: Photo # _______

End TIME:______________

A. INSTREAM CHANNEL CONDITIONS

FLOW (Circle appropriate choice):

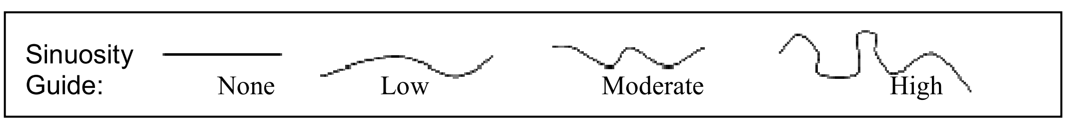
NONE	LOW	MODERATE	NORMAL/FULL	HIGH
Very little water in channel and mostly present as standing pools	Water fills 25-75% of the available (bankfull) channel, and/or riffle substrates are mostly exposed	Water fills >75% of the available (bankfull) channel; or <25% of channel substrate is exposed	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed	Water levels are higher than the base of both banks

Is the stream CHANNELIZED?: NO_____ YES _____ If Yes: LOW_____ MODERATE_____ HIGH_______

If Yes: **Pilot Channel Formed?:** NO_____ YES ______.

Bankfull Sinuosity (also look at aerial photo)**:** NONE_____ LOW____ MODERATE____ HIGH____

Baseflow Sinuosity: NONE____ LOW____ MODERATE____ HIGH____



Pool / Riffle Development?: NONE____ LOW (< ⅓ of reach)____ MODERATE (⅓–⅔)____ HIGH (> ⅔)____

Stream Bottom Composition (circle all that apply; estimate % of reach for each if poss. -- at least the dominant types)

BOULDER (>10")______ BLDR/SLABS______ COBBLE (2.5-10")______ GRAVEL (0.1-2.5")_______

SAND (gritty)______ SILT (fine, greasy)_______ BEDROCK(>car)______

HARDPAN (slick, gummy)______ DETRITUS (sticks, woods, leaves)_______ MUCK (black, fine, flocc.)______

ARTIFICIAL ______ Describe:_______________________________________

Comments: ____.

How stable does it feel walking in the stream?:

NOT STABLE (weight is not supported, quickly sink and should not walk in this stream reach) ______.
LOW STABLITY (can walk in the stream, but will sink several inches if stand still) ______.
MODERATELY STABLE (sink only an inch or two, easy to walk)______.
VERY STABLE (don't sink at all into the stream bottom)_______

Does the water look murky / cloudy? NO______ YES _______ If Yes: Low_____ Moderate_____ High_______

Water Color: CLEAR______GREEN______BROWN_______ TEA (clear, naturally stained)______ GRAY______

MILKY______OTHER (specify):________________________ Comments: ______________________________

Do Rocks on the Stream Bottom Feel Slippery or Slimy?: NO_____ YES _____.

Water Odor (check all that apply): NONE______SEWAGE______FISHY_____GAS_______ CHLORINE______

ROTTEN EGGS______ PERFUME_____ OTHER (specify):__________________.

Comments: ____.

Grease or Oil on the Water Surface?: NO_____ YES _____ **In Bottom Sediment?**: NO____ YES _____

Foam on the Water Surface?: NO_____ YES _____

Comments: ____

Cross Sections: How wide is the stream? How high are its banks? How deep is the water?

(Measure at 3–4 locations: 1 near start of reach, 1 near end of reach, 1–2 in between. Take photos looking upstream.)

GPS Waypoint #	Left bank PHOTO #	Right bank PHOTO #	Thalwag WATER DEPTH (ft)	Bottom CHANNEL WIDTH (ft)	Top (Bankfull) CHANNEL WIDTH (ft)	Left BANK HEIGHT (ft)	Right BANK HEIGHT (ft)
Averages:							

Are there Mid-Stream Bars and Islands (deposited sediment)**?:** YES:_______ NO: _______

How much sediment has accumulated / been deposited in this channel reach? (Circle appropriate choice):

NONE	LOW	MODERATE	HIGH
Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment depositions	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 20-50% of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected, sediment deposits at obstructions, constrictions and bends; moderate deposition of pools prevalent	Heavy deposits of fine material, increase bar development; more than 80% bottom changing frequently, pools almost absent due to substantial sediment deposition

Beaver Activity?: NONE_________ LOW ___________MODERATE_________HIGH_____________

Beaver Dams?: NO______YES ______ If Yes: Number of dams:_______________

Beaver Den (dug into streambank)**?:** NO____YES ____ UNSURE____

or **Beaver Lodge?:** NO______YES ______ UNSURE____

Instream Cover for Fish (Check all that apply. Take photos of good examples):

UNDERCUT BANKS______ OVERHANGING VEGETATION____ ROOTWADS______ ROOTMATS______

LOGS/WOODY DEBRIS____POOLS OVER 28" DEEP_______ BOULDERS_________

AQUATIC PLANTS_________ If Aq Plants: Submersed_______Floating leaved _______ Emergent ______

OXBOW/BACKWATER AREAS______COMMENTS:____

Presence of Logs or Woody Debris in Stream:

NONE _____ LOW (Occasional) _____ MODERATE (Common) _____ HIGH (Abundant) _____

Presence of Debris Blockages within the stream reach:

NONE _____ LOW (Occasional) _____ MODERATE (Common) _____ HIGH (Abundant) _____

Record GPS location and take photo of significant **Debris Blockages** and **Beaver Dams:**

GPS Waypt #	Photo #	Side of Channel (L / R / Cntr)	Aspect of Photo (Looking UP / Downstream)	Notes (e.g., if significantly blocking flow or not, if could remove using hand tools or need backhoe, accessibility)

Presence of Trash in Stream:

NONE _____ LOW (Occasional) _____ MODERATE (Common) _____ HIGH (Abundant) _____

Types of trash (check all materials that apply):

PLASTIC________ PAPER_____ METAL_____ GLASS_____ APPLIANCES_______ MEDICAL ______

CONSTRUCTION ______ YARD WASTE ______TIRES_____OTHER AUTOMOTIVE ______

OTHER(describe): ________________________

Comments: ____

B. HYDRAULIC STRUCTURES: Manmade structures (**Types** include low head dams, weirs, road and railroad bridges, road culverts) or natural geological formations (e.g., rocky ledge) that span the stream. Record GPS location, take photo(s), describe each hydraulic structure, and assess if barrier to fish passage.

GPS Waypt #	Photo #	Aspect of Photo (Looking UP / Downstream)	Type & Material of Structure	Barrier to fish passage? (Y/N/Maybe)	Clearance (diameter / distance to streambed)	Notes

C. DISCHARGE POINTS: **Types** include pipes (storm sewers, drain tiles), ditches, swales, gullies, tributaries that flow/discharge into the stream. Record GPS location, take photo, and describe each discharge point (see more guidance below table):

GPS Waypt #	Photo #	Side of Channel (L/R/Cntr)	Aspect of Photo (Looking UP / Downstream)	Type & Material	Flow	Dimensions (inches)	Notes

Discharge Points *continued*							
GPS Waypt #	Photo #	Side of Channel (L/R/Cntr)	Aspect of Photo (Looking UP / Downstream)	Type & Material	Flow	Dimensions (inches)	Notes

Pipe materials = concrete, corrugated metal, PVC, clay, plastic, brick
Flow = None, Minimal (trickle), Slight, Moderate, High
Dimensions: For pipes = diameter;
For ditches, swales, gullies, tributaries = width from bank to bank across top of channel

COMMENTS (e.g., suspicious effluent/discharges, etc.):____
____
____

D. STREAM BANK AREA CONDITIONS

Artificial Bank Protection -- How much of the reach length is covered by artificial materials**?:**

Left Bank: NONE____ LOW (up to ⅓)____ MODERATE (⅓–⅔)____ HIGH (⅔+)____

Type of material (check all that apply): ROCK RIP-RAP____ POURED CONCRETE ____ ASPHALT_____.

STEEL_______ WOOD/TIMBERS______ BROKEN CONCRETE/BRICKS______ OTHER (specify): ___________.

Right Bank: NONE____ LOW (up to ⅓)____ MODERATE (⅓–⅔)____ HIGH (⅔+)____

Type of material (check all that apply): ROCK RIP-RAP____ POURED CONCRETE ____ ASPHALT_____.

STEEL_______ WOOD/TIMBERS______ BROKEN CONCRETE /BRICKS _______ OTHER (specify): ________.

Comments:____

Record GPS location, take photo, and describe **Artificial Bank Protection Areas**:

GPS Waypt #	Photo #	Side of Channel (L / R)	Aspect of Photo (Looking UP / Downstream)	Notes

Artificial Bank Protection Areas *continued*				
GPS Waypt #	Photo #	Side of Channel (L / R)	Aspect of Photo (Looking UP / Downstream)	Notes

Degree of Bank Erosion (Check appropriate choice for LEFT and RIGHT bank, looking upstream. Document threatened structures.):

	NONE / MINIMAL	LOW	MODERATE	HIGH
	Banks stable; banks low (at floodplain elev.); evidence of erosion or bank failure absent or minimal; little potential for future problems; less than 5% of bank affected.	Moderately stable; banks low (at floodplain elev.); infrequent, small areas of erosion mostly healed over or protected by roots extending to baseflow elev.; 5-33% bank has areas of erosion.	Moderately unstable; banks may be low but usu. high; 33-66% of bank has areas of erosion (typ. outside bends); high erosion potential during floods.	Unstable; banks may be low but typ. high; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 66-100% of bank with erosional scars.
Left Bank				
Right Bank				

Comments: ____

Record GPS location, take photo and measurements of **MODERATE** and **HIGH Erosion Areas**:

GPS Waypt #	Photo #	Side of Channel (L / R)	Aspect of Photo (Looking UP / Downstream)	Bank Height (ft)	Bank Length (ft)	Notes

Streamside Vegetation (within 10 ft of stream, facing upstream)

Predominant Vegetation: Estimate the % along each bank that is covered by the types of vegetation below:

Left Bank: NONE___UNMOWED GRASS____LAWN____WETLAND___TREES____ SHRUB____

CROP____ HERBACEOUS____Comments: (e.g., inv.spp.):________________________________

Right Bank: NONE___UNMOWED GRASS____LAWN____WETLAND___TREES____ SHRUB____

CROP ____ HERBACEOUS____Comments (e.g., inv. spp.):________________________________

Predominant Tree/Shrub Species along Banks (check all that apply):

Hardwoods incl. oak, cherry, elm, cottonwood, dogwood, locust, maple. Conifers incl. pine, spruce, fir, cedar.

WILLOWS______ BOX ELDER______HARDWOODS_____ CONIFERS_____

BUCKTHORN_____ HONEYSUCKLE_____OTHER (specify)______________________________

Comments: ____

Quality of Riparian Zone (Vegetated Buffer): Is there a band of unmowed grasses, forbs, shrubs, or trees covering or extending outward from the streambank itself? Is it comprised of native or invasive species? Is the stream connected to its floodplain? Estimate extent of reach length for each category:

	Poor	Marginal	Fair	Good	Very Good
	Width of riparian zone <10 feet; little or no native riparian vegetation due to human activities; stream prob. not hydrologically connected to floodplain	Width of riparian zone 10-25 feet; human activities have impacted zone a great deal; likely degraded plant communities; stream may not be hydrologically connected to floodplain	Width of riparian zone >25-50 feet; human activities have impacted zone minimally; somewhat degraded plant communities; at least some hydrological connection to stream	Width of riparian zone >50-100 feet; human activities (parking lots, roadbeds, lawns, crops) have not impacted zone; minimally degraded plant communities; stream hydrologically connected to floodplain (often wetlands)	Width of riparian zone >100 feet; human activities (parking lots, roadbeds, lawns, crops) have not impacted zone; minimally degraded plant communities; stream hydrologically connected to floodplain (often wetlands)
Left Bank					
Right Bank					

COMMENTS:____

Presence of Logs or Woody Debris in Riparian Zone (loose, floatable, woody material that could potentially cause debris jams at bridges and culverts during high flow events):

NONE _____ LOW (Occasional) _____ MODERATE (Common) _____ HIGH (Abundant) _____

COMMENTS: ____

Presence of Trash in Riparian Zone:

NONE _____ LOW (Occasional) _____ MODERATE (Common) _____ HIGH (Abundant) _____

Types of Trash (check all materials that apply):

PLASTIC________ PAPER______ METAL_____ GLASS______ APPLIANCES________ MEDICAL ______

CONSTRUCTION ______ YARD WASTE ______TIRES ______ OTHER AUTOMOTIVE:______

OTHER (describe): __________________ Comments:________________________________

Spoil Piles on Banks?: **Left Bank:** NO____ YES_____ Notes: ______________________________

Right Bank: NO____ YES_____ Notes: ______________________________

Stream Cover / Canopy: Estimate how much of the channel would be **shaded** during mid-day during the summer when vegetation would be at full leaf-out (check appropriate % range):

0 – 25%____ 25 – 50%_____ 50 – 75% _____ 75 – 100%____

Comments:____

Floodplain Land Use & Land Cover (within 100 year floodplain; percentages to be determined using GIS)

LAND USE (check all that apply, circle dominant types):

LEFT BANK: AGRICULTURAL:______ RESIDENTIAL:_________COMMERCIAL:______

MANUFACTURING: _______ INSTITUTIONAL: _______ OPEN SPACE - Recreational:_______

OPEN SPACE – Golf Course:_____ OPEN SPACE - Conservation:_____ OTHER (describe): ____________

Cpmments:____

RIGHT BANK: AGRICULTURAL:______ RESIDENTIAL:________COMMERCIAL:______

MANUFACTURING: _______ INSTITUTIONAL: _______ OPEN SPACE - Recreational:_______

OPEN SPACE – Golf Course:_____ OPEN SPACE - Conservation:_____ OTHER (describe): ____________

Comments:____

LAND COVER (check all that apply, circle dominant types):

LEFT: IMPERVIOUS______UNMOWED GRASS______LAWN______WETLAND_____ TREES_____

SHRUB____ CROP_____ OTHER HERBACEOUS VEGETATION_____ OPEN WATER_____

Comments:____

RIGHT: IMPERVIOUS_____UNMOWED GRASS______LAWN______WETLAND_____ TREES_____

SHRUB____ CROP_____ OTHER HERBACEOUS VEGETATION_____ OPEN WATER_____

Comments:____

E. REACH ACCESSIBILITY (circle applicable category):

Good	Fair	Difficult
Open area in public ownership, sufficient room to stockpile materials, easy stream access for heavy equipment using existing roads or trails.	Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or far from stream.	Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas available to stockpile and/or located a great distance from stream. Specialized heavy equipment required.

Comments: ____

____

F. AQUATIC AND TERRESTRIAL ORGANISMS: (note any that were observed within/along the stream)

(e.g., fish, frogs, turtles, snails, mussels, aquatic insects, ducks, herons, muskrats, deer, etc. Take photos as can.)

____

____

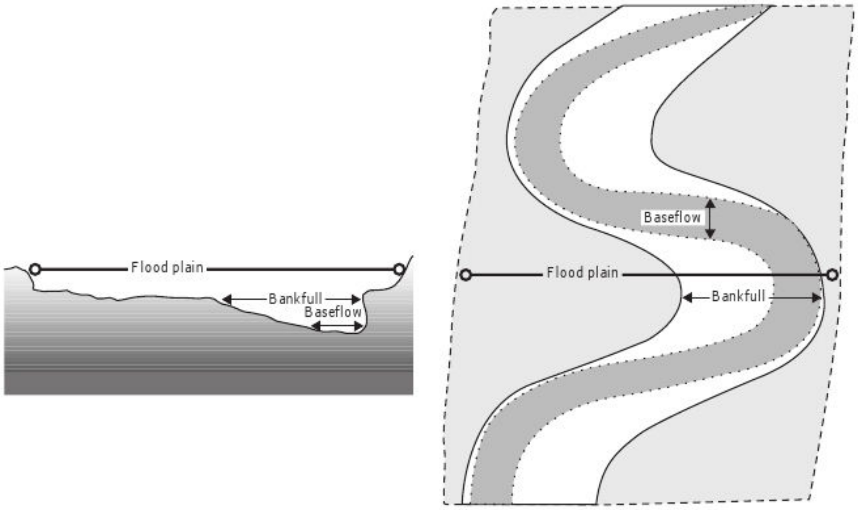
____

G. ADDITIONAL PHOTOS

GPS Waypt #	Photo #	Description

H. ADDITIONAL NOTES (e.g., potential restoration or clean-up projects, items for further investigation, people you met…)

Figure 3 Baseflow, bankfull, and flood plain locations (Rosgen 1996)



Appendix B – Stream Reach Assessment Data

Table B-1. Mill Creek stream assessment data for channelization, riparian quality, and bank erosion by reach, 2018.

Reach ID	*Length (Ft)*	*Degree of Stream Condition*							
		Channelization	*Sedimentation*	*Riparian Quality (Left Bank)*	*Riparian Quality (Right Bank)*	*Riparian Quality (Average)*	*Erosion (Left Bank)*	*Erosion (Left Bank)*	*Erosion (Average)*
MC_01	718	NA	Low	Fair	Fair	Fair	Low	Low	Low
MC_02	1,854	Low	Low	Fair	Fair	Fair	Not assessed	Not assessed	Not assessed
MC_03	2,439	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed
MC_04	3,023	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed
MC_05	1,452	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed
MC_06	2,780	NA	Moderate	Good	Fair	Fair	Low	Low	Low
MC_07	2,403	NA	Moderate	Fair	Fair	Fair	Low	Low	Low
MC_08	730	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed
MC_09	2,017	Low	Low	Fair	Fair	Fair	Moderate	Moderate	Moderate
MC_10	2,621	NA	Low	Very Good	Good	Good	Moderate	Moderate	Moderate
MC_11	1,834	Moderate	Low	Fair	Fair	Fair	Low	Low	Low
MC_12	1,789	Low	Low	Poor	Marginal	Poor	Low	Low	Low
MC_13	2,110	Moderate	Low	Very Good	Very Good	Very Good	High	Moderate	High
MC_14	2,308	NA	Low	Fair	Fair	Fair	Moderate	Low	Moderate
MC_15	1,860	NA	Low	Fair	Good	Fair	Low	Low	Low
MC_16	2,417	NA	Low	Good	Very Good	Good	Moderate	Low	Moderate
MC_17	1,867	NA	Low	Good	Very Good	Good	Moderate	Low	Moderate
MC_18	2,198	NA	Low	Good	Very Good	Good	Moderate	Low	Moderate
MC_19	2,259	NA	Low	Fair	Fair	Fair	Moderate	Moderate	Moderate
MC_20	1,790	Moderate	Moderate	Fair	Fair	Fair	Low	Low	Low
MC_21	1,654	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed
MC_22	2,234	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed
MC_23	1,476	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed
MC_24	2,233	Low	Low	Marginal	Marginal	Marginal	Moderate	Low	Moderate
MC_25	1,195	NA	Low	Fair	Marginal	Marginal	Moderate	Low	Moderate
MC_26	2,314	Low	Low	Very Good	Very Good	Very Good	None	None	None

Reach ID	*Length (Ft)*	*Degree of Stream Condition*							
		Channelization	*Sedimentation*	*Riparian Quality (Left Bank)*	*Riparian Quality (Right Bank)*	*Riparian Quality (Average)*	*Erosion (Left Bank)*	*Erosion (Left Bank)*	*Erosion (Average)*
MC_27	3,062	NA	Moderate	Good	Good	Good	None	Low	Low
MC_28	2,177	High	Low	Poor	Poor	Poor	Low	Low	Low
MC_29	2,452	Low	Low	Poor	Marginal	Poor	High	High	High
MC_30	1,667	NA	Moderate	Good	Fair	Fair	Low	Moderate	Moderate
MC_31	2,137	Low	Low	Good	Good	Good	None	None	None
MC_32	1,398	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed
MC_33	3,444	NA	Moderate	Fair	Fair	Fair	Low	Low	Low
MC_34	765	Moderate	None	Marginal	Marginal	Marginal	Low	Low	Low
MC_35	1,829	Moderate	Low	Poor	Marginal	Poor	High	High	High
MC_36	1,530	Moderate	Low	Marginal	Good	Fair	Moderate	Low	Moderate
MC_37	2,217	Moderate	Moderate	Very Good	Good	Good	Low	Low	Low
MC_38	2,993	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed
MC_39	2,984	NA	Low	Fair	Fair	Fair	Moderate	Moderate	Moderate
MC_40	1,966	NA	Moderate	Marginal	Marginal	Marginal	High	High	High
MC_41	1,940	NA	Low	Good	Good	Good	Low	Low	Low

Appendix C – Detention Basin Assessment Information and Retrofit Opportunities

Table C-1. Mill Creek watershed detention basin inventory and assessment information including retrofit opportunities.

Basin Code	*Political Jurisdiction*	*Basin Type*	*Year Built*	*Retrofit Opportunities*	*Maintenance Needs*	*Water Quality Benefit*	*Latitude*	*Longitude*
1-1	Campton Hills	Pond	1994			Fair	41.926388	-88.445248
1-2	Campton Hills	Dry Bottom - Turf	1979	Work with homeowners to replace turf in lower section with low profile pollinator mix		Poor	41.931222	-88.441737
1-3	Campton Hills	Dry Bottom - Prairie	1994		Burn/herbicide for cattail management	Fair	41.934531	-88.439736
1-4	Campton Hills	Pond	1994				41.938658	-88.430717
1-5	Campton Hills	Wetland	1995		Campton Township Open Space to continue burn management for cattails	Fair	41.942035	-88.422924
1-6	Campton Hills	Wetland	2003		Burn/herbicide to control nuisance trees	Fair	41.937346	-88.422588
1-7	Campton Hills	Wetland	2003			Fair	41.935452	-88.421714
1-8	Campton Hills	Wetland	2003		Burn/herbicide to manage invasive species	Fair	41.935989	-88.420557
1-9	Campton Hills	Wetland	2003		Burn/herbicide for management	Good	41.937812	-88.420539
1-10	Campton Hills	Pond	2003		Burn/herbicide for management	Good	41.937458	-88.416507
1-11	Campton Hills	Wetland	1992		Burn/herbicide management to control phragmites, cattails & reed canary grass	Fair	41.923278	-88.416049
1-12	Campton Hills	Wetland	2003		Cut/herbicide sandbar willows choking shorelines	Good	41.943576	-88.414870
1-13	Campton Hills	Pond	2004		Continue burn/herbicide management	Good	41.935967	-88.414188
1-14	Kane Co.	Wetland	2003				41.944721	-88.411327
1-15	Campton Hills	Wetland	2003			Good	41.933612	-88.407113

Basin Code	Political Jurisdiction	Basin Type	Year Built	Retrofit Opportunities	Maintenance Needs	Water Quality Benefit	Latitude	Longitude
1-16	Campton Hills	Pond	2003		Burn/herbicide for cattail management	Good	41.935587	-88.407101
1-17	Campton Hills	Dry Bottom - Turf	1999	Replace turf bottom with pollinator mix		Poor	41.936120	-88.404130
1-18	Campton Hills	Dry Bottom - Turf	2000	Replace turf bottom with pollinator mix		Poor	41.933745	-88.404062
2-1	Kane Co.	Wetland	2003		Burn/herbicide for cattail management	Fair	41.903346	-88.423091
2-2	Campton Hills	Pond	2003		Burn/herbicide for cattail management	Fair	41.908164	-88.422417
2-3	Kane Co.	Dry Bottom - Mesic Prairie	1988		Burn/herbicide for phragmites and cattail management	Fair	41.896600	-88.418282
2-4	Kane Co.	Dry Bottom - Turf	1989	Replace turf bottom with pollinator mix		Poor	41.895342	-88.414433
2-5	Kane Co.	Dry Bottom - Turf	1979	Convene neighbors to replant turf bottom with pollinator mix		Poor	41.894680	-88.409857
2-6	Kane Co.	Dry Bottom - Mesic Prairie	1994		Continue annual burns; needs herbicide maintenance for phragmites and cattails	Good	41.904897	-88.406934
2-7	Campton Hills	Pond	1994			Fair	41.916239	-88.406101
2-8	Campton Hills	Wetland	2000		Burn/herbicide for cattail management	Fair	41.938676	-88.403878
2-9	Campton Hills	Dry Bottom - Turf	1994	Replace turf bottom with pollinator mix		Poor	41.938498	-88.402382
2-10	Campton Hills	Pond	2003			Good	41.916167	-88.402179
2-11	Campton Hills	Pond	1999			Good	41.924699	-88.401805
2-12	Campton Hills	Pond	2002			Good	41.920090	-88.399056
2-13	Campton Hills	Pond	1999			Good	41.929273	-88.397388
2-14	Campton Hills	Pond	1998			Good	41.934829	-88.396422
2-15	Campton Hills	Wetland	2000			Good	41.920040	-88.394772

Basin Code	Political Jurisdiction	Basin Type	Year Built	Retrofit Opportunities	Maintenance Needs	Water Quality Benefit	Latitude	Longitude
2-16	Campton Hills	Pond	1994			Good	41.930844	-88.394182
2-17	Kane Co.	Pond	2005				41.942904	-88.393018
2-18	Campton Hills	Dry Bottom - Turf	1996	Replace turf bottom with pollinator mix		Poor	41.930409	-88.391566
2-19	Kane Co.	Pond	2005				41.939147	-88.389500
2-20	Kane Co.	Pond	2005				41.942175	-88.388615
2-21	Campton Hills	Pond	2003			Good	41.922876	-88.385603
2-22	Kane Co.	Dry Bottom - Turf	1994			Poor	41.919136	-88.383935
2-23	Kane Co.	Pond	1993			Good	41.922816	-88.383888
3-1	Kane Co.	Dry Bottom - Mesic Prairie	1995			Good	41.881841	-88.381613
3-2	Kane Co.	Dry Bottom - Turf	1997				41.882262	-88.379060
3-3	Kane Co.	Dry Bottom - Mesic Prairie	2005		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.883567	-88.377720
4-1	Kane Co.	Dry Bottom - Mesic Prairie	2003		Burn/herbicide for cattail management	Good	41.882553	-88.428133
4-2	Kane Co.	Dry Bottom - Mesic Prairie	2003		Burn/herbicide for management	Fair	41.882676	-88.424910
4-3	Kane Co.	Dry Bottom - Mesic Prairie	2003		Burn/herbicide for management	Good	41.886033	-88.424617
4-4	Kane Co.	Dry Bottom - Mesic Prairie	2005		Burn/herbicide for management; remove nuisance trees	Fair	41.886268	-88.414968
4-5	Kane Co.	Dry Bottom - Mesic Prairie	2005		Burn/herbicide for management; remove nuisance trees	Fair	41.885982	-88.413900

Basin Code	*Political Jurisdiction*	*Basin Type*	*Year Built*	*Retrofit Opportunities*	*Maintenance Needs*	*Water Quality Benefit*	*Latitude*	*Longitude*
4-6	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding. must treat cattails / phragmites	Fair	41.877814	-88.398693
4-7	Kane Co.	Wetland	2007		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.874200	-88.398032
4-8	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.876061	-88.397746
4-9	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.873232	-88.397690
4-10	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.872606	-88.395463
4-11	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.881408	-88.395409
4-12	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.874476	-88.395217
4-13	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.881201	-88.394657
4-14	Kane Co.	Pond	2002		Continue native vegetation burning & spot herbiciding; must treat phragmites	Poor	41.868651	-88.394464
4-15	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.867297	-88.394399

Basin Code	*Political Jurisdiction*	*Basin Type*	*Year Built*	*Retrofit Opportunities*	*Maintenance Needs*	*Water Quality Benefit*	*Latitude*	*Longitude*
4-16	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.879671	-88.394133
4-17	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding. must treat phragmites	Good	41.877264	-88.393100
4-18	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding	Good	41.880218	-88.392422
4-19	Kane Co.	Pond	2007			Fair	41.882100	-88.392138
4-20	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.867525	-88.392114
4-21	Kane Co.	Wetland	1992	Excavate wetland bottom and replant with native wetland plants	Mow reed canary grass	Fair	41.884695	-88.391854
4-22	Kane Co.	Pond	2007			Fair	41.881466	-88.391844
4-23	Kane Co.	Pond	2000		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.868075	-88.391768
4-24	Kane Co.	Wetland	2002		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.869781	-88.391626
4-25	Kane Co.	Pond	2007			Good	41.880497	-88.391513
4-26	Kane Co.	Pond	2007		Continue native vegetation burning & spot herbiciding	Good	41.879638	-88.391411
4-27	Kane Co.	Pond	2002		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.870668	-88.391342
4-28	Kane Co.	Pond	2007			Good	41.881252	-88.390450
4-29	Kane Co.	Pond	2007			Fair	41.881988	-88.390003

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4-30	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.874765	-88.389996
4-31	Kane Co.	Dry Bottom - Mesic Prairie	2011		Continue native vegetation burning & spot herbiciding	Good	41.879685	-88.389450
4-32	Kane Co.	Pond	2007			Good	41.881741	-88.388906
4-33	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.875840	-88.387957
4-34	Kane Co.	Dry Bottom - Mesic Prairie	2001			Good	41.881923	-88.387544
4-35	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.875003	-88.387437
4-36	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.874200	-88.386925
4-37	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.874520	-88.386142
4-38	Kane Co.	Wetland	1996				41.878204	-88.385929
4-39	Kane Co.	Wetland	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.873825	-88.385812
4-40	Kane Co.	Wetland	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites		41.873986	-88.385356
4-41	Kane Co.	Wetland	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.874223	-88.385239

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4-42	Kane Co.	Pond	1996			Good	41.881292	-88.384674
4-43	Kane Co.	Pond	1996			Good	41.882114	-88.384397
4-44	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding	Good	41.880418	-88.384369
5-1	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.872208	-88.385837
5-2	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.871081	-88.384500
5-3	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.867814	-88.383219
5-4	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.865895	-88.383110
5-5	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.870577	-88.382961
5-6	Kane Co.	Wetland	1996			Good	41.877173	-88.381961
5-7	Kane Co.	Dry Bottom - Mesic Prairie	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Good	41.879314	-88.381398
5-8	Kane Co.	Dry Bottom - Mesic Prairie	1996				41.878799	-88.381249
5-9	Kane Co.	Wetland	1995		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.870833	-88.381130
5-10	Kane Co.	Dry Bottom - Mesic Prairie	1996				41.878026	-88.380863

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5-11	Kane Co.	Wetland	1995		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.871342	-88.380828
5-12	Kane Co.	Dry Bottom - Mesic Prairie	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Good	41.879084	-88.380566
5-13	Kane Co.	Wetland	1995		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.871413	-88.379987
5-14	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.867371	-88.379587
5-15	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.865587	-88.379502
5-16	Kane Co.	Pond	1995		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.871236	-88.379443
5-17	Kane Co.	Dry Bottom - Mesic Prairie	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Fair	41.877726	-88.379439
5-18	Kane Co.	Dry Bottom - Turf	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Fair	41.875647	-88.379091
5-19	Kane Co.	Wetland	1998		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.864950	-88.378374
5-20	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.871551	-88.378082

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5-21	Kane Co.	Dry Bottom - Mesic Prairie	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Fair	41.877574	-88.378070
5-22	Kane Co.	Wetland	1997		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.867379	-88.378005
5-23	Kane Co.	Pond	1996		Continue controlled burns to manage native vegetation	Good	41.870956	-88.377953
5-24	Kane Co.	Dry Bottom - Turf	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Fair	41.875904	-88.377645
5-25	Kane Co.	Wetland	1998			Fair	41.864856	-88.377540
5-26	Kane Co.	Dry Bottom - Mesic Prairie	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Fair	41.878141	-88.377360
5-27	Kane Co.	Dry Bottom - Mesic Prairie	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Fair	41.877490	-88.377200
5-28	Kane Co.	Dry Bottom - Mesic Prairie	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Fair	41.875355	-88.377111
5-29	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.871544	-88.377054
5-30	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.867479	-88.376935
5-31	Kane Co.	Dry Bottom - Mesic Prairie	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Fair	41.878265	-88.376759

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5-32	Kane Co.	Dry Bottom - Turf	2000				41.874483	-88.376750
5-33	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Fair	41.877196	-88.376551
5-34	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.866329	-88.376258
5-35	Kane Co.	Pond	1996		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.864717	-88.376187
5-36	Kane Co.	Wetland	2007		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.862943	-88.376043
5-37	Kane Co.	Wetland	1999			Good	41.868452	-88.375871
5-38	Kane Co.	Pond	1993				41.864864	-88.375439
5-39	Kane Co.	Wetland	2007		Burn/herbicide for cattail management	Good	41.864019	-88.374855
5-40	Kane Co.	Wetland	2006		Continue native vegetation burning & spot herbiciding.	Fair	41.882039	-88.374806
5-41	Kane Co.	Pond	1994		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.871343	-88.374684
5-42	Kane Co.	Pond	1993		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.865012	-88.374626
5-43	Kane Co.	Wetland	1995		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.866884	-88.374306

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5-44	Kane Co.	Wetland	1994		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.869321	-88.373922
5-45	Kane Co.	Pond	1994		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.870053	-88.373772
5-46	Kane Co.	Dry Bottom - Mesic Prairie	1993		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.865566	-88.373695
5-47	Kane Co.	Wetland	1999		Continue native vegetation burning & spot herbiciding	Fair	41.863609	-88.373460
5-48	Kane Co.	Wetland	1994		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.869147	-88.373459
5-49	St. Charles	Dry Bottom - Turf	2005	Naturalize basin bottom		Poor	41.901560	-88.373020
5-50	Kane Co.	Wetland	2006		Continue native vegetation burning & spot herbiciding; must treat phragmites	Fair	41.876553	-88.372990
5-51	Kane Co.	Wetland	2006		Continue native vegetation burning & spot herbiciding. treat reed canary grass	Good	41.881001	-88.372647
5-52	Kane Co.	Wetland	2005			Good	41.874676	-88.372121
5-53	Kane Co.	Wetland	2005			Good	41.873154	-88.371597
5-54	Kane Co.	Dry Bottom - Mesic Prairie	2008		Continue native vegetation burning & spot herbiciding; treat reed canary grass	Fair	41.879926	-88.371060
5-55	St. Charles	Pond	2004		Manage invasive vegetation	Good	41.909467	-88.370994
5-56	Kane Co.	Wetland	2004		Burn/herbicide for cattail management	Fair	41.883101	-88.370626

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5-57	Kane Co.	Wetland	1979		Continue native vegetation burning & spot herbiciding. treat reed canary grass	Fair	41.882226	-88.370043
5-58	Kane Co.	Pond	2014				41.922120	-88.369872
5-59	Kane Co.	Pond	2004	Replant basin bottom with native wetland species		Poor	41.883065	-88.369789
5-60	Kane Co.	Pond	2014				41.921927	-88.369600
5-61	Kane Co.	Dry Bottom - Turf	1989	Consider excavating water quality channel through bottom	Burn/herbicide management to control phragmites	Fair	41.883057	-88.369071
5-62	Kane Co.	Dry Bottom - Mesic Prairie	2010				41.911440	-88.369003
5-63	Kane Co.	Dry Bottom - Mesic Prairie	2010				41.911359	-88.368603
5-64	St. Charles	Dry Bottom - Turf	2004	Naturalize basin bottom		Poor	41.900825	-88.368434
5-65	St. Charles	Pond	2000			Good	41.901731	-88.367814
5-66	St. Charles	Wetland	2003		Manage invasive vegetation; diversify wetland vegetation	Good	41.902048	-88.365246
5-67	St. Charles	Pond	2002	Establish wetland shelf, riparian buffer		Fair	41.920703	-88.364772
5-68	St. Charles	Pond	2006		Burn, cut, and herbicide to manage woody overgrowth on shoreline	Fair	41.899708	-88.364342
5-69	St. Charles	Dry Bottom - Turf	2002	Rectify short circuiting, naturalize at minimum around outlet		Poor	41.920227	-88.363859
5-70	Geneva	Wetland	2006		Continue burn/herbicide management; eliminate cattail shoreline	Good	41.872774	-88.363829

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5-71	Geneva	Wetland	2005		Continue native vegetation burning & spot herbiciding.	Good	41.880254	-88.363798
5-72	St. Charles	Dry Bottom - Turf	2002	Naturalize basin bottom		Poor	41.920606	-88.363404
5-73	Kane Co.	Pond	2007	Stabilize shoreline & add outlet control structure		Poor	41.901714	-88.362040
5-74	St. Charles	Pond	2005	Establish diverse wetland shelf vegetation	Control invasive reed canary grass and woody vegetation; reduce/eliminate carp	Fair	41.906915	-88.361889
5-75	Geneva	Wetland	2005		Continue native vegetation burning & spot herbiciding.	Good	41.879959	-88.361443
5-76	St. Charles	Pond	1997			Fair	41.914703	-88.360981
5-77	St. Charles	Dry Bottom - Turf	2001	Naturalize basin bottom		Poor	41.920432	-88.360149
5-78	St. Charles	Pond	1997	Stabilize entire shoreline toe (wetland veg, buffer 5-10 ft.); address short-circuiting		Fair	41.918279	-88.359950
5-79	St. Charles	Pond	1997	Establish native vegetated buffer, 5 ft. wide		Fair	41.914903	-88.359669
5-80	St. Charles	Pond	1997	Stabilize entire shoreline (establish wetland shelf, native vegetation buffer 10 ft. wide)		Fair	41.916765	-88.359590
5-81	St. Charles	Pond	2000	Add vegetated wetland shelf	Continue invasive vegetation management; consider removing crab apple trees within buffer zone	Good	41.911358	-88.359574
5-82	Geneva	Pond	1995			Fair	41.880579	-88.359334

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5-83	St. Charles	Pond	1999	Add vegetated wetland shelf	Continue invasive vegetation management; consider removing crab apple trees within buffer zone	Good	41.908660	-88.359307
5-84	Geneva	Pond	1994			Fair	41.882051	-88.359105
5-85	Geneva	Wetland	2003		Continue controlled burn/herbicide management	Good	41.872562	-88.359071
5-86	St. Charles	Pond	1999		Continue buffer management; clean up landscape waste dumping near NE corner;	Good	41.906832	-88.359014
5-87	Geneva	Pond	1997			Good	41.893088	-88.358925
5-88	Geneva	Pond	2005			Fair	41.896840	-88.358803
5-89	St. Charles	Wetland	2001		Continue invasive vegetation management	Good	41.921542	-88.358540
5-90	Geneva	Dry Bottom - Turf	1994	Replace turf bottom with pollinator mix		Poor	41.889660	-88.358447
5-91	Kane Co.	Pond	1992		Manage native vegetated side slopes	Good	41.900264	-88.358128
5-92	St. Charles	Wetland	2005		Manage invasive vegetation; diversify wetland vegetation	Fair	41.920615	-88.356937
5-93	Geneva	Pond	2003			Fair	41.883602	-88.355773
5-94	Geneva	Dry Bottom - Turf	2002		Burn/herbicide for phragmites and cattail management	Fair	41.887703	-88.354368
5-95	Geneva	Pond	1997	Stabilize shoreline toe and side slopes with native vegetation		Fair	41.888549	-88.354302
5-96	St. Charles	Pond	2009		Manage invasive vegetation	Good	41.916816	-88.353983
5-97	Kane Co.	Dry Bottom - Turf	1996	Replace invasive species with native mesic prairie plants	Remove teasel, thistle, and other noxious weed species	Fair	41.900415	-88.353768
5-98	St. Charles	Pond	2011		Manage invasive vegetation	Good	41.920011	-88.353666

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5-99	Geneva	Pond	1998		Needs native vegetation burning & spot herbiciding; treat cattails	Good	41.883667	-88.353341
5-100	Kane Co.	Wetland	2005			Good	41.898115	-88.353044
5-101	Geneva	Pond	2000	Stabilize shoreline & side slopes with native vegetation			41.897113	-88.352641
5-102	St. Charles	Wetland	2006	Diversify wetland shelf/perimeter vegetation, establish diverse prairie vegetated buffer	Manage invasive vegetation: cattails, phragmites, purple loosestrife, willows	Good	41.906343	-88.349936
5-103	St. Charles	Wetland	2006	Diversify wetland vegetation, establish native prairie vegetated buffer	Control invasive vegetation including phragmites and woody vegetation	Fair	41.909654	-88.349895
5-104	Geneva	Pond	2000	Stabilize shoreline toe and side slopes with native vegetation		Fair	41.897101	-88.348888
5-105	St. Charles	Pond	2017	Diversify wetland shelf vegetation; establish native vegetation buffer- 5 ft. wide	Manage cattails lining shoreline (5-10 ft width)	Good	41.899347	-88.347581
5-106	St. Charles	Pond	2017	Consider installing more diverse emergent and aquatic veg. also covert lower 10ft of side slope from turf to native veg	Manage cattails lining shoreline	Good	41.898156	-88.346697
5-107	St. Charles	Wetland	2017	Diversify wetland vegetation beyond bulrush, spike rush species present	Manage cattails throughout basin bottom	Good	41.902930	-88.346386
5-108	St. Charles	Pond	2000	Diversify/establish native prairie vegetation on side slopes		Fair	41.901380	-88.345449

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6-1	Kane Co.	Pond	1999		Continue native vegetation burning & spot herbiciding	Good	41.858088	-88.383409
6-2	Kane Co.	Wetland	1999			Good	41.857951	-88.382023
6-3	Kane Co.	Pond	1999		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.857440	-88.380060
6-4	Kane Co.	Pond	2002		Continue native vegetation burning & spot herbiciding	Good	41.849747	-88.379754
6-5	Kane Co.	Pond	2003		Continue native vegetation burning & spot herbiciding	Good	41.851706	-88.376948
6-6	Kane Co.	Wetland	1999		Continue native vegetation burning & spot herbiciding; must treat phragmites	Good	41.861180	-88.372013
7-1	Geneva	Dry Bottom - Mesic Prairie	1997		Continue burn/herbicide management	Good	41.869017	-88.363514
7-2	Geneva	Pond	2003			Good	41.875562	-88.357850
7-3	Geneva	Wetland	2005		Spot herbicide to remove cattails	Fair	41.877951	-88.357398
7-4	Kane Co.	Pond	1988				41.868616	-88.357352
7-5	Kane Co.	Pond	1988		Continue burn/herbicide management	Good	41.871303	-88.355739
7-6	Geneva	Wetland	1994		Continue burn/herbicide management	Good	41.869109	-88.354627
7-7	Geneva	Wetland	2005		Continue burn/herbicide management	Good	41.873418	-88.354472
7-8	Geneva	Wetland	2005		Continue burn/herbicide management	Fair	41.872560	-88.354355
7-9	Geneva	Wetland	2005		Continue burn/herbicide management	Good	41.868030	-88.353112

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7-10	Geneva	Dry Bottom - Turf	2005		Continue burn/herbicide management	Fair	41.869228	-88.350554
7-11	Geneva	Dry Bottom - Turf	2007	Replace turf bottom with native vegetation		Poor	41.874654	-88.350466
8-1	Kane Co.	Dry Bottom - Turf	2004	Replace turf bottom with native wetland prairie vegetation		Poor	41.856223	-88.365221
8-2	Batavia	Pond	1990			Good	41.861402	-88.355847
8-3	Batavia	Dry Bottom - Mesic Prairie	1997				41.853430	-88.352713
8-4	Geneva	Pond	1993	Replant shoreline slopes with native vegetation		Fair	41.881167	-88.348900
8-5	Geneva	Pond	1997	Replant side slopes with native vegetation		Fair	41.890868	-88.348725
8-6	Geneva	Pond	2000	Replant side slopes with native vegetation		Fair	41.891786	-88.348444
8-7	Geneva	Pond	1998	Consider wetland plugs at toe for stabilization & habitat		Good	41.883811	-88.348248
8-8	Batavia	Pond	1997				41.852272	-88.348094
8-9	Geneva	Pond	1993	Stabilize shoreline edge with native vegetation		Fair	41.878414	-88.347570
8-10	Geneva	Pond	1998	Consider wetland plugs at toe for stabilization & habitat		Fair	41.883826	-88.346153
8-11	Geneva	Pond	2000	Stabilize shoreline toe with emergent wet plants and native vegetation on side slopes		Fair	41.894062	-88.345120
8-12	Batavia	Pond	2003	Stabilize shoreline toe with native wetland plants		Fair	41.855587	-88.345021
8-13	Geneva	Dry Bottom - Turf	1994	Replace turf bottom with native vegetation		Poor	41.868329	-88.344342

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8-14	Batavia	Wetland	2000		Continue burn/herbicide management for cattails	Fair	41.855648	-88.344206
8-15	Batavia	Pond	2000	Stabilize shoreline toe with native wetland plants		Fair	41.858365	-88.343999
8-16	Batavia	Pond	2003	Stabilize shoreline toe with native wetland plants		Fair	41.856034	-88.343856
8-17	Batavia	Pond	2000	Stabilize shoreline toe with native wetland plants		Fair	41.860955	-88.343666
8-18	Batavia	Dry Bottom - Turf	1999	Replace turf bottom with native wetland prairie vegetation		Poor	41.857712	-88.343455
8-19	Geneva	Pond	1989	Replace turf side slopes with native vegetation		Fair	41.869461	-88.343454
8-20	Batavia	Dry Bottom - Turf	1999	Remove cattails and plant bottom with native vegetation		Fair	41.850529	-88.343280
8-21	Batavia	Dry Bottom - Turf	1999	Replace turf bottom with pollinator mix		Poor	41.854625	-88.342956
8-22	Geneva	Wetland	1994		Burn/herbicide for management	Good	41.877142	-88.342785
8-23	Geneva	Dry Bottom - Turf	2000	Replant turf bottom with native vegetation		Poor	41.874790	-88.342596
8-24	Geneva	Pond	1990		Continue controlled burns to manage native vegetation	Good	41.884157	-88.341583
8-25	Geneva	Dry Bottom - Mesic Prairie	1996	Replant with native mesic prairie vegetation	Eliminate cattails	Poor	41.882081	-88.341349
8-26	Geneva	Dry Bottom - Mesic Prairie	1994	Replace turf, cattail, and phragmites bottom with wet-prairie plants		Poor	41.867391	-88.341159
8-27	Geneva	Pond	2002		Burn/herbicide for cattail management	Fair	41.891180	-88.341143

Basin Code	*Political Jurisdiction*	*Basin Type*	*Year Built*	*Retrofit Opportunities*	*Maintenance Needs*	*Water Quality Benefit*	*Latitude*	*Longitude*
8-28	Geneva	Wetland	2005		Burn/herbicide for phragmites and cattail management	Fair	41.879277	-88.341143
8-29	St. Charles	Dry Bottom - Mesic Prairie	2001	Establish diverse wet prairie vegetation and excavate retention for better water quality	Burn/herbicide for phragmites and cattail management	Fair	41.898167	-88.341143
8-30	Batavia	Pond	1997	Stabilize toe and side slopes with native vegetation		Fair	41.852690	-88.340064
8-31	Geneva	Dry Bottom - Turf	1999				41.897018	-88.339956
8-32	Geneva	Dry Bottom - Turf	2003				41.883632	-88.339921
8-33	Geneva	Dry Bottom - Turf	1989				41.891483	-88.339875
8-34	Batavia	Dry Bottom - Turf	2005		Burn/herbicide for management	Fair	41.848719	-88.339720
8-35	Geneva	Pond	1991			Good	41.879412	-88.338711
8-36	Geneva	Dry Bottom - Turf	1989	Replace turf bottom with mesic-prairie plants	Eliminate cattails in low flow channel	Poor	41.881355	-88.338209
8-37	Batavia	Dry Bottom - Turf	1996	Replace turf bottom with pollinator mix		Poor	41.854845	-88.337579
8-38	Geneva	Wetland	2016				41.881166	-88.337044
8-39	Batavia	Pond	1991	Plant native vegetation along select sections of side slopes		Fair	41.854854	-88.337017
8-40	Geneva	Dry Bottom - Turf	1999				41.895943	-88.336429
8-41	Geneva	Pond	1991			Fair	41.880038	-88.336229
8-42	Geneva	Dry Bottom - Turf	1979				41.891077	-88.336192

Basin Code	*Political Jurisdiction*	*Basin Type*	*Year Built*	*Retrofit Opportunities*	*Maintenance Needs*	*Water Quality Benefit*	*Latitude*	*Longitude*
8-43	Batavia	Dry Bottom - Turf	1999				41.849589	-88.336136
8-44	Batavia	Pond	1991	Plant native vegetation along select sections of side slopes		Fair	41.854664	-88.335902
8-45	Geneva	Dry Bottom - Turf	1994				41.882493	-88.335733
8-46	Geneva	Pond	1991				41.878530	-88.335329
8-47	Geneva	Dry Bottom - Turf	1989				41.894852	-88.335215
8-48	Geneva	Pond	1991			Fair	41.879973	-88.334169
8-49	Geneva	Dry Bottom - Turf	1989				41.894803	-88.333204
8-50	Batavia	Pond	1989		(Appears to be aggressively managed by HOA)	Good	41.851012	-88.332786
8-51	Geneva	Pond	1991	Work with golf course to establish native vegetated slopes on part of shoreline		Fair	41.878563	-88.332722
8-52	Batavia	Pond	1996	Stabilize eroding shorelines, establish wetland edge vegetation, establish native vegetated buffer 5-10 ft. wide		Poor	41.853897	-88.332134
8-53	Geneva	Dry Bottom - Turf	1972				41.886988	-88.331613
8-54	Batavia	Pond	1993		(Appears to be aggressively managed by HOA)	Good	41.851045	-88.330782
8-55	Geneva	Pond	1991		Continue burn/herbicide maintenance of native vegetated side slopes	Fair	41.878263	-88.330408
8-56	Geneva	Dry Bottom - Turf	1989				41.890862	-88.330329

Basin Code	*Political Jurisdiction*	*Basin Type*	*Year Built*	*Retrofit Opportunities*	*Maintenance Needs*	*Water Quality Benefit*	*Latitude*	*Longitude*
8-57	Batavia	Pond	1996	Assess short circuiting		Fair	41.853463	-88.330151
8-58	Batavia	Pond	1980	Stabilize eroding shorelines, establish wetland shelf, establish native vegetated buffer 5-10 ft wide	Stop mowing to water's edge	Poor	41.859181	-88.330064
8-59	Geneva	Pond	1991		Continue native vegetation maintenance	Good	41.878075	-88.329783
8-60	Batavia	Pond	1988	Stabilize eroding shorelines, establish native vegetated buffer	Stop mowing to edge	Poor	41.860597	-88.329671
8-61	Batavia	Dry Bottom - Turf	1994	Naturalize part of basin bottom near north		Poor	41.856177	-88.329364
8-62	Geneva	Dry Bottom - Mesic Prairie	2007				41.888192	-88.328964
8-63	Geneva	Dry Bottom - Turf	1990	Replace turf bottom with native vegetation		Poor	41.872224	-88.328848
8-64	Batavia	Pond	1980	Stabilize eroding shorelines, establish native vegetated buffer	Stop mowing to water's edge	Poor	41.859997	-88.328729
8-65	Geneva	Dry Bottom - Turf	2000				41.886157	-88.328630
8-66	Geneva	Dry Bottom - Turf	2000				41.887898	-88.328378
8-67	Geneva	Pond	1990			Fair	41.868310	-88.327992
8-68	Geneva	Pond	1991		Continue native vegetation maintenance	Fair	41.880231	-88.327751
8-69	Geneva	Pond	1990			Fair	41.867449	-88.326823
8-70	Geneva	Dry Bottom - Turf	1990	Replace turf bottom with native vegetation		Poor	41.872145	-88.326334

Basin Code	*Political Jurisdiction*	*Basin Type*	*Year Built*	*Retrofit Opportunities*	*Maintenance Needs*	*Water Quality Benefit*	*Latitude*	*Longitude*
8-71	Geneva	Dry Bottom - Turf	1993				41.881770	-88.326228
8-72	Batavia	Dry Bottom - Wooded	1988	Yes	Manage invasive woody & herbaceous vegetation including reed canary grass, bare soil in basin bottom and tree understory	Fair	41.836650	-88.342618
8-72	Geneva	Dry Bottom - Turf	1992	Replace turf bottom with native vegetation		Poor	41.879495	-88.324239
8-73	Geneva	Wetland	2017				41.883723	-88.323704
8-74	Geneva	Dry Bottom - Turf	1996	Replace turf bottom with native vegetation		Poor	41.880447	-88.323375
8-75	Geneva	Pond	1979	Needs coordinated effort by homeowners to stabilize shoreline with natives		Fair	41.868115	-88.321960
8-76	Geneva	Dry Bottom - Turf	1997				41.871082	-88.321895
8-77	Geneva	Dry Bottom - Turf	1987				41.869922	-88.320029
8-78	Batavia	Wetland	1999	Diversify wetland vegetation (some river rush present)	Manage invasive species: purple loosestrife, sandbar willows, reed canary grass around perimeter; cattails throughout center; bare soil on n slope	Fair	41.861885	-88.318788
9-1	Batavia	Dry Bottom - Mesic Prairie	2004			Good	41.844102	-88.360523
9-2	Batavia	Dry Bottom - Mesic Prairie	2004			Good	41.843235	-88.358505

Basin Code	Political Jurisdiction	Basin Type	Year Built	Retrofit Opportunities	Maintenance Needs	Water Quality Benefit	Latitude	Longitude
9-3	Batavia	Dry Bottom - Mesic Prairie	2004			Good	41.843014	-88.357266
9-4	Batavia	Dry Bottom - Mesic Prairie	2004			Good	41.842296	-88.356771
9-5	Batavia	Dry Bottom - Mesic Prairie	2004			Good	41.840985	-88.356507
9-6	Batavia	Wetland	2001			Good	41.845622	-88.355273
9-7	Batavia	Dry Bottom - Mesic Prairie	2003			Good	41.844423	-88.355206
9-8	Kane Co.	Pond	2008				41.850177	-88.354891
9-9	Batavia	Dry Bottom - Mesic Prairie	2015			Good	41.844244	-88.354564
9-10	Batavia	Dry Bottom - Turf	1997				41.850010	-88.353221
9-11	Batavia	Dry Bottom - Mesic Prairie	2002			Good	41.846039	-88.353215
9-12	Batavia	Dry Bottom - Turf	2015			Good	41.842030	-88.353173
9-13	Batavia	Dry Bottom - Turf	1997				41.850549	-88.353170
9-14	Batavia	Dry Bottom - Turf	2015			Good	41.843035	-88.352930
9-15	Batavia	Pond	2015			Good	41.844746	-88.352231
9-16	Batavia	Dry Bottom - Mesic Prairie	2015			Good	41.844804	-88.350867
9-17	Batavia	Dry Bottom - Mesic Prairie	2002			Good	41.845348	-88.350382
9-18	Batavia	Pond	1997	Replant side slopes with native vegetation		Fair	41.850420	-88.347638

Basin Code	Political Jurisdiction	Basin Type	Year Built	Retrofit Opportunities	Maintenance Needs	Water Quality Benefit	Latitude	Longitude
10-1	Batavia	Dry Bottom - Mesic Prairie	2004			Good	41.839049	-88.355349
10-2	Batavia	Dry Bottom - Mesic Prairie	2005		Continue burn/herbicide management	Good	41.836926	-88.352649
10-3	Batavia	Dry Bottom - Mesic Prairie	2005		Continue burn/herbicide management	Good	41.837605	-88.352398
10-4	Kane Co.	Dry Bottom - Turf	1991	Replace turf bottom with prairie pollinator mix		Poor	41.827432	-88.350379
10-5	Batavia	Dry Bottom - Mesic Prairie	2002			Good	41.844821	-88.350004
10-6	Batavia	Dry Bottom - Mesic Prairie	2001			Good	41.839017	-88.348747
10-7	Batavia	Wetland	2005		Continue burn/herbicide management	Good	41.836565	-88.348256
10-8	Batavia	Pond	1997	Replant side slopes with native vegetation		Fair	41.849134	-88.347552
10-9	Batavia	Dry Bottom - Mesic Prairie	2001			Good	41.841324	-88.347084
10-10	Batavia	Pond	1994			Good	41.846068	-88.347029
10-11	Batavia	Dry Bottom - Mesic Prairie	2001			Good	41.839849	-88.346984
10-12	Batavia	Dry Bottom - Turf	1994	Replant turf bottom with native vegetation		Poor	41.847334	-88.346951
10-13	Batavia	Pond	1994			Good	41.845532	-88.346871
10-14	Batavia	Dry Bottom - Mesic Prairie	2000			Good	41.838194	-88.345375
10-15	Batavia	Pond	1994	Replant shorelines with native vegetation		Fair	41.845409	-88.345073
10-16	Batavia	Dry Bottom - Mesic Prairie	2000			Good	41.838296	-88.344800

Basin Code	*Political Jurisdiction*	*Basin Type*	*Year Built*	*Retrofit Opportunities*	*Maintenance Needs*	*Water Quality Benefit*	*Latitude*	*Longitude*
10-17	Batavia	Dry Bottom - Turf	1994			Good	41.843477	-88.344702
10-18	Kane Co.	Pond	1983			Fair	41.826974	-88.344480
10-19	Batavia	Dry Bottom - Mesic Prairie	2001			Good	41.840337	-88.344164
10-20	Batavia	Dry Bottom - Mesic Prairie	2000			Good	41.835492	-88.343672
10-21	Batavia	Dry Bottom - Mesic Prairie	2000			Good	41.841493	-88.343634
10-22	Batavia	Dry Bottom - Mesic Prairie	2001		Continue burn/herbicide management	Good	41.845158	-88.343385
10-23	Batavia	Dry Bottom - Mesic Prairie	2000			Good	41.838926	-88.343258
10-24	Batavia	Dry Bottom - Turf	1989	Replant turf bottom with native vegetation		Poor	41.849262	-88.343101
10-25	Batavia	Pond	1989			Good	41.847232	-88.342689
10-26	Batavia	Dry Bottom - Mesic Prairie	2001			Good	41.841188	-88.342244
10-27	Batavia	Pond	1989			Fair	41.847200	-88.341694
10-28	Batavia	Wetland	1996				41.847310	-88.339754
10-29	Batavia	Dry Bottom - Turf	1979	Replant turf bottom with prairie pollinator mix		Poor	41.847455	-88.336821
10-30	Batavia	Dry Bottom - Turf	1996	Replace turf bottom with native vegetation		Poor	41.832870	-88.334985
10-31	Batavia	Dry Bottom - Turf	1996	Replace turf bottom with native vegetation		Poor	41.836508	-88.334629
10-32	Batavia	Pond	2009			Good	41.847385	-88.332679
10-33	Batavia	Dry Bottom - Turf	2007				41.845640	-88.332315
10-34	Batavia	Wetland	2008			Fair	41.849501	-88.329141

Basin Code	*Political Jurisdiction*	*Basin Type*	*Year Built*	*Retrofit Opportunities*	*Maintenance Needs*	*Water Quality Benefit*	*Latitude*	*Longitude*
10-35	Batavia	Dry Bottom - Mesic Prairie	1987		Park District should continue with burn/herbicide management	Good	41.843563	-88.328608
10-36	Batavia	Dry Bottom - Turf	1988	Work with city to convert turf bottom to prairie pollinator mix		Poor	41.839724	-88.328305
10-37	Batavia	Dry Bottom - Turf	1995	Replace turf bottom with prairie pollinator mix		Poor	41.842992	-88.328118
10-38	Batavia	Dry Bottom - Turf	1989	Replace turf bottom with prairie pollinator mix		Poor	41.838485	-88.327595
10-39	Batavia	Dry Bottom - Turf	1990	Replace turf bottom with prairie pollinator mix		Poor	41.843247	-88.327028
10-40	Batavia	Dry Bottom - Turf	1989	Consider installing prairie pollinator mix in small portion of basin bottom		Poor	41.848114	-88.326808
10-41	Batavia	Dry Bottom - Turf	1991	Consider installing prairie pollinator mix in small portion of basin bottom		Poor	41.849212	-88.326464
10-42	Batavia	Dry Bottom - Turf	1995	Replace turf bottom with prairie pollinator mix		Poor	41.843159	-88.326163
10-43	Batavia	Dry Bottom - Turf	2000	Improve filtration		Poor	41.852554	-88.325362
10-44	Batavia	Dry Bottom - Turf	1989	Talk to residential landowners about converting lower part to pollinator mix		Poor	41.839691	-88.325151
10-45	Batavia	Dry Bottom - Turf	2000	Consider installing prairie pollinator mix in small portion of basin bottom		Poor	41.845636	-88.324166
10-46	Batavia	Dry Bottom - Turf	1995	Consider installing prairie pollinator mix in small portion of basin bottom		Poor	41.845009	-88.324040

Basin Code	*Political Jurisdiction*	*Basin Type*	*Year Built*	*Retrofit Opportunities*	*Maintenance Needs*	*Water Quality Benefit*	*Latitude*	*Longitude*
10-47	Batavia	Dry Bottom - Turf	1995	Consider installing prairie pollinator mix in small portion of basin bottom		Poor	41.848555	-88.323627
10-48	Batavia	Dry Bottom - Turf	1998	Consider installing prairie pollinator mix in small portion of basin bottom		Poor	41.845680	-88.323259
10-49	Batavia	Dry Bottom - Turf	1998				41.849086	-88.323069
10-50	Batavia	Dry Bottom - Turf	2000	Consider installing prairie pollinator mix in small portion of basin bottom		Poor	41.845391	-88.322067
10-51	Batavia	Dry Bottom - Turf	1999	Consider installing prairie pollinator mix in small portion of basin bottom		Poor	41.846081	-88.321346
10-52	Batavia	Dry Bottom - Turf	1996	Consider installing prairie pollinator mix in small portion of basin bottom		Poor	41.844494	-88.321323
11-1	Batavia	Dry Bottom - Turf	1990			Poor	41.831186	-88.326466
11-2	Batavia	Dry Bottom - Turf	1990	Replace turf bottom with prairie pollinator mix		Poor	41.829654	-88.323779
11-3	Batavia	Pond	1990			Good	41.831039	-88.321623
11-4	Batavia	Wetland	2007				41.837875	-88.320704

Appendix D – HSPF Model Update for Mill Creek

Geosyntec consultants

1420 Kensington Road, Suite 103
Oak Brook, Illinois 60523
PH 630.203.3340
FAX 630.203.3341
www.geosyntec.com

Memorandum

Date: June 29, 2019

To: Holly Hudson, Chicago Metropolitan Agency for Planning (CMAP) and Rob Linke, Kane County

Copies to: Illinois Environmental Protection Agency

From: Karoline Qasem, Rishab Mahajan, and Adrienne Nemura, Geosyntec Consultants

Subject: HSPF Model Update for Developing a Watershed-Based Plan for Mill Creek

INTRODUCTION

The purpose of this Technical Memorandum is to document the update of an existing Hydrologic Simulation Program Fortran (HSPF) watershed model for Mill Creek, Kane County, Illinois, to support the development of a watershed-based plan. The model will be used to evaluate the performance of proposed best management practices (BMPs) and other controls for different time scales (daily, seasonally, annually). The memo also documents the development of Geosyntec's BMP prioritization framework to optimize the least cost mix of BMP types, locations, and sizes to meet targeted load reductions.

Background

Mill Creek is a tributary of the Fox River that drains an area of 31 square miles in Kane County along a length of 15 miles. The Chicago Metropolitan Agency for Planning (CMAP) definition of the Mill Creek planning area follows closely the National Resources Conservation System 12-digit Hydrologic Unit Code (HUC 12) watershed 071200070105 with slight modifications to account for stormwater systems and urban areas (Figure 1).

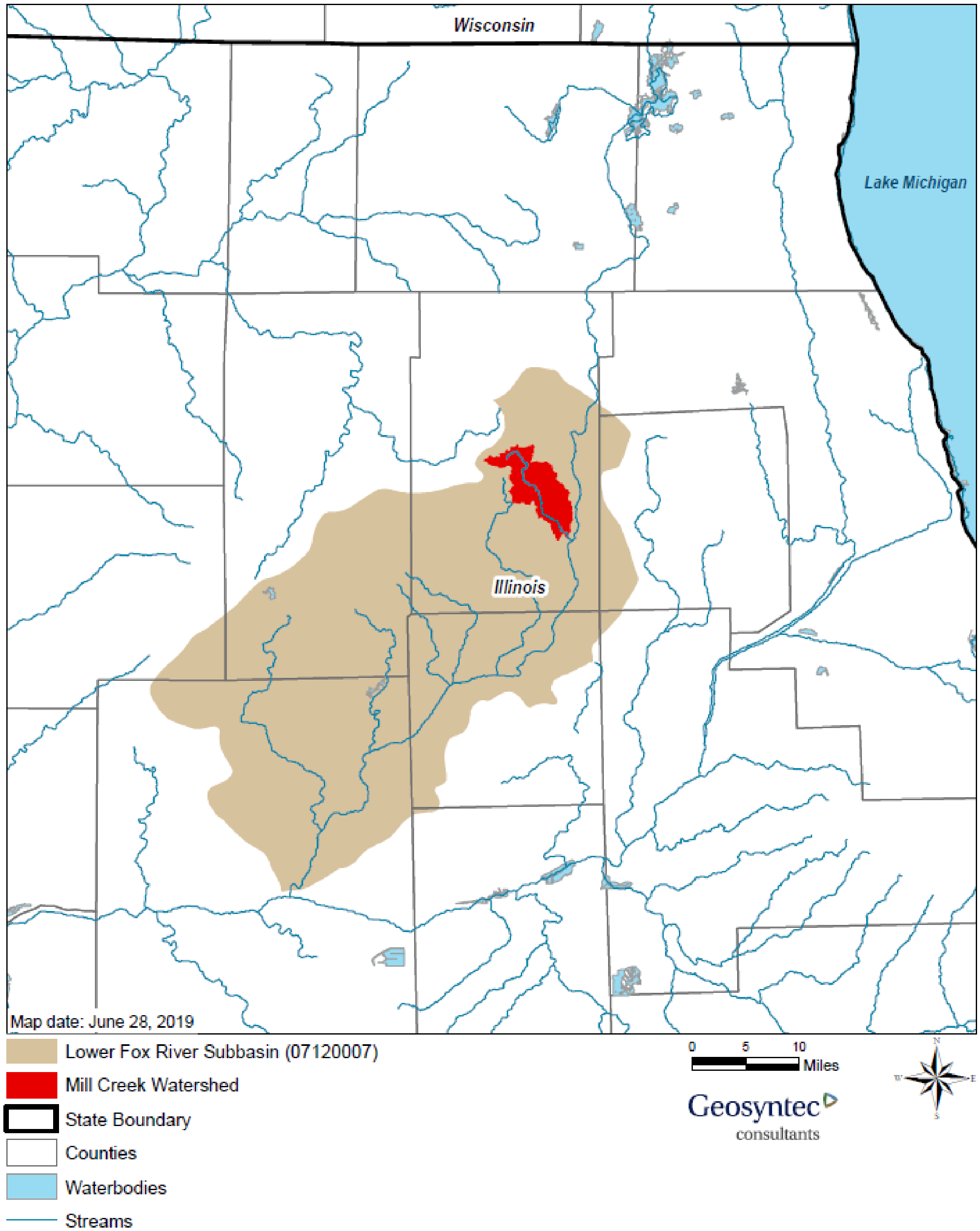


Figure 1: Mill Creek Watershed Planning Area within the Lower Fox River Subbasin

PREVIOUS WATERSHED MODEL

The Illinois State Water Survey (ISWS) developed watershed models for the Fox River tributaries, including Mill Creek, using the HSPF modeling platform. These watershed models were part of a long-term planning effort by the Fox River Study Group (FRSG) for improving water quality of the Fox River system (Baratosova, 2007). The HSPF model for the Mill Creek watershed was developed for the time period of October 1990 to September 2011 and simulates phosphorus, nitrogen, and sediment loading from the watershed for existing land use. The Mill Creek watershed was delineated into 11 hydrologically connected subwatersheds with areas ranging from 305 to 4,264 acres as shown in Figure 2.

The major data inputs into the watershed model include the following:

- Precipitation: DuPage Airport Aurora Meteorological Station
- Elevation: U.S. Geological Survey (USGS) National Elevation Dataset (2005)
- Land use: Illinois Interagency Landscape Classification Project or IILCP (IDOA, 2003)

The Mill Creek HSPF model used calibrated model parameters from the Blackberry Creek and Poplar Creek HSPF models. The Mill Creek HSPF model does a fair job of simulating the observed flows at USGS Gauge #05551330, Mill Creek near Batavia, IL with Nash-Sutcliffe model Efficiency coefficient (NSE) of 0.37. The model underpredicts the observed peak flows and overpredicts the low flows.

Geosyntec had previously extended the model simulation period from 2011 to 2016 as part of Fox River Water Quality Model Update work for the FRSG. This was done to help ensure that the loads calculated are representative of existing conditions.

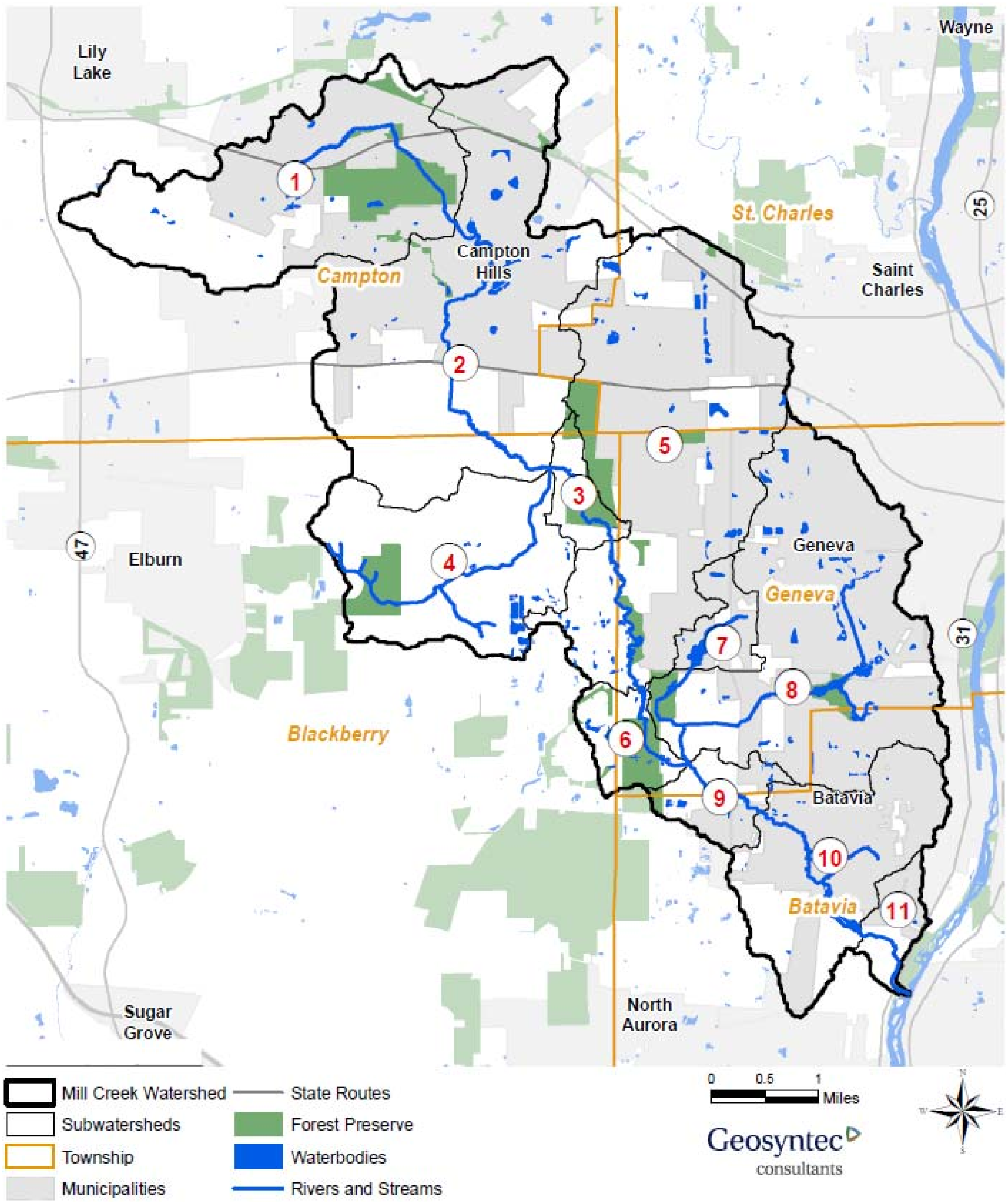


Figure 2: Mill Creek Watershed and ISWS HSPF Model Subwatersheds

MODEL UPDATE

Geosyntec updated the HSPF model for the Mill Creek watershed for CMAP and Kane County to provide an effective tool for watershed planning. The updates included incorporating newer datasets for land use, topography, and soils; updating the meteorological data; and updating the model segmentation and reach network. Geosyntec also added simulation of fecal coliform and calibrated the model to recent observed flow and water quality data.

Data

The data used for the update of the HSPF model are briefly described below.

Land Use

The model was updated with CMAP's 2013 land use dataset which includes 60 land use categories (Appendix 1). This dataset is a parcel-based inventory where parcels were dissolved into common land use types. The dataset also has polygons for non-parcel areas (i.e., roads, right-of-way) which are assigned general classifications based on supplemental reference datasets.

Topography

As part of the HSPF model update, topography data is needed to further delineate the subwatersheds. The 2008 2-foot Digital Elevation Model (DEM) data that was provided by Kane County was used for watershed delineation. The DEM data was created from Light Detection and Ranging (LiDAR) data from the Illinois Geospatial Data Clearing House Portal.

Soils

Soil data was downloaded from the United States Department of Agriculture (USDA) Web Soil Survey.

Meteorology

Meteorological data are one of the most important inputs for continuous simulation models. Model capability to predict the hydrologic response and fate and transport of pollutants is highly influenced by the meteorological data. HSPF requires hourly precipitation, air temperature, dew point, cloud cover, wind speed, solar radiation, and evapotranspiration. The metrological stations located in the vicinity of the Mill Creek watershed are shown in Figure 3. These stations include:

- DuPage Airport Automated Surface Observing System (ASOS) Station (KDPA)

- Aurora Municipal Airport ASOS Station (KARR)
- USGS Gauge 05551330 Mill Creek near Batavia, IL (precipitation only)
- Illinois Climate Network St. Charles Station (STC)

Geosyntec assessed the use of the above stations during model calibration.

Model Segmentation and Reach Network

Subwatershed Delineation

Subwatersheds in Mill Creek watershed were initially based on previously delineated watershed in the ISWS model. Watershed delineation was performed with Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) using DEM, National Hydrology Dataset streamlines, and pour points at areas of interest (e.g., Peck Lake). Due to the large size of the LiDAR dataset, watershed delineation was performed for each one of the 10 ISWS subwatershed boundaries separately and then combined in ArcGIS.

The resulting subwatershed delineation was further refined using the other available data such as storm drain networks, culvert information, and topography in consultation with CMAP and Kane County.

The updated watershed delineation for Mill Creek consists of 129 subwatersheds and is shown in Figure 4. The area of the subwatersheds ranges from 8.1 acres to 506 acres. The average subwatershed area is 151.5 acres. The Peck Lake drainage has a total of three subwatersheds with areas of 93, 80, and 79 acres.

Reach Hydraulics

In HSPF, stream reaches are represented by one-dimensional fully mixed reactors. Reaches are simulated by relationships between reach discharge, surface area, and depth to storage volume using Functional Tables (FTables).

In the current watershed-based model, BASINS default FTables were used to simulated stream reaches. The default FTables assume a double-trapezoidal stream cross section with the upper trapezoid representing the floodplain and the lower trapezoid representing the channel. BASINS applies predetermined regressions against drainage areas to estimate key geometry parameters while other geometry parameters are determined using multipliers based on typical channel shape.

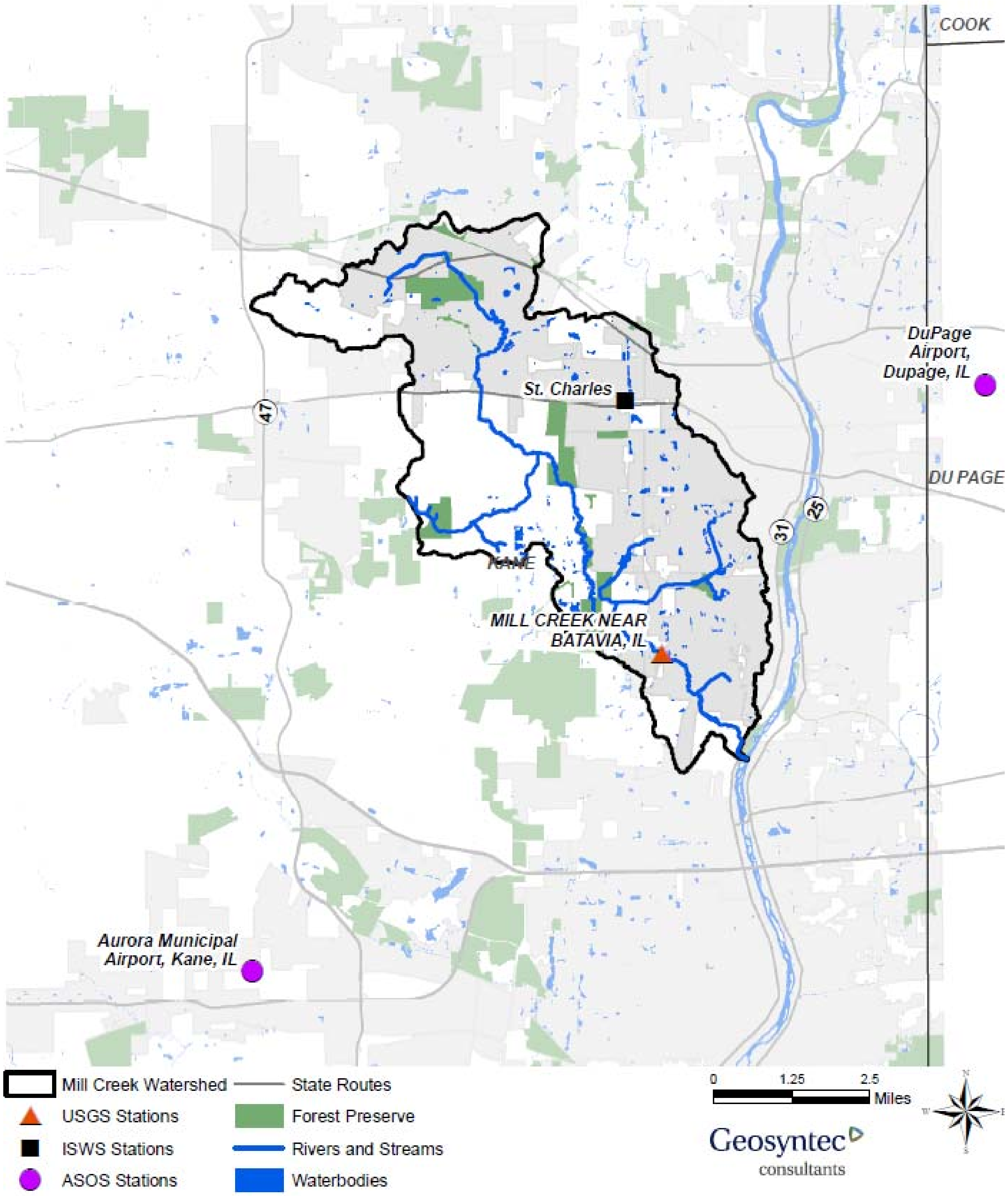


Figure 3: Available Meteorological Stations

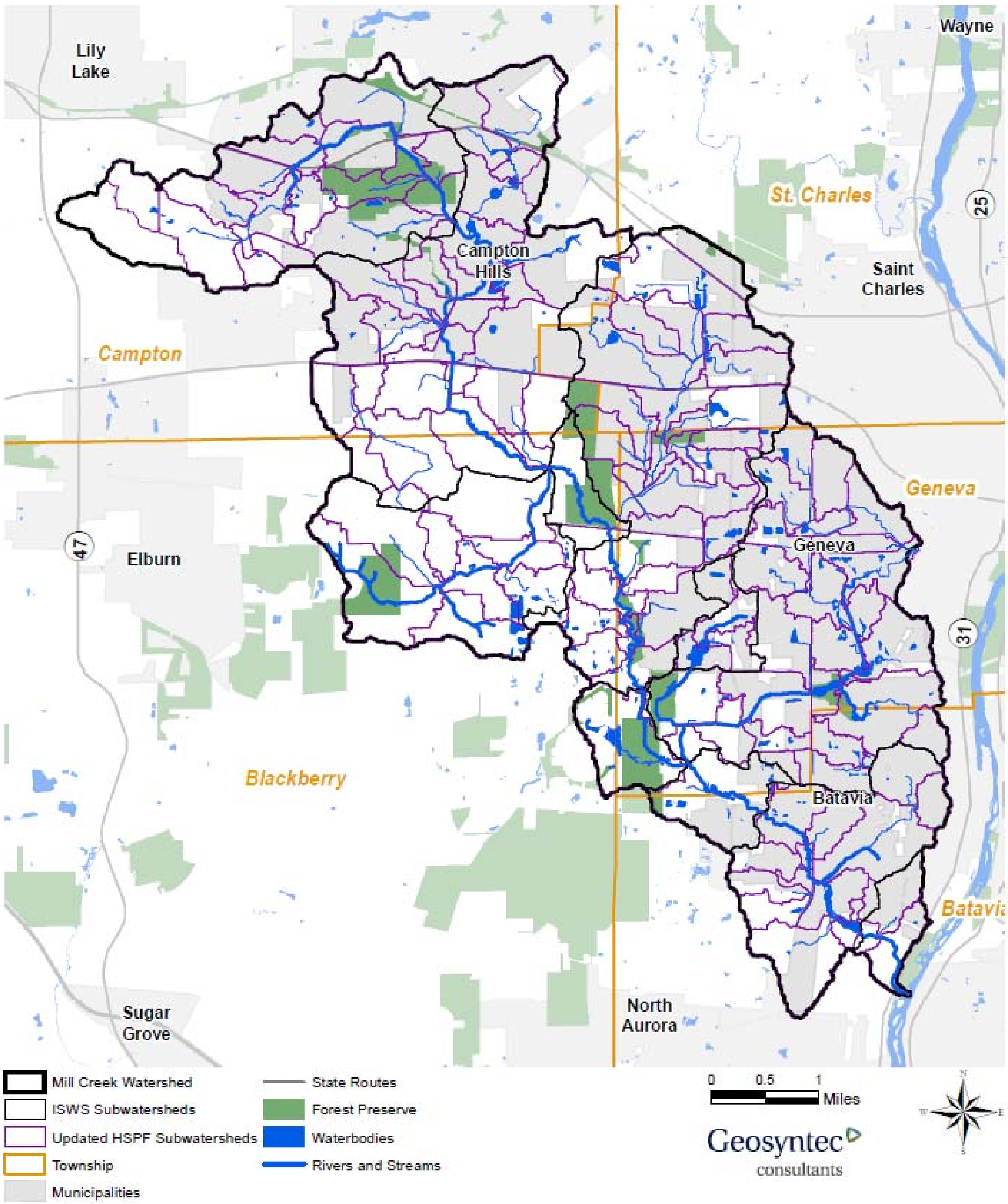


Figure 4: Mill Creek Subwatershed Delineation

MODEL CALIBRATION

The updated HSPF model was run for the period of July 2010 to December 2016. The simulated flows, sediment, and water quality (i.e., fecal coliform, total nitrogen, total phosphorus) were compared with observed flow and water quality data. Model results were in the range of observed data.

For model calibration, multiple hydrology and water quality data sources were investigated including: USGS, FRSG Database, Water Quality Portal, and Illinois Environmental Protection Agency. For the period of simulation of 2011 to 2016, flow data is available at USGS Gauge #05551330, Mill Creek near Batavia, IL. Water quality data is available at FRSG Station 15 for the period of July 2010 to September 2016. The locations of these stations are shown in Figure 5.

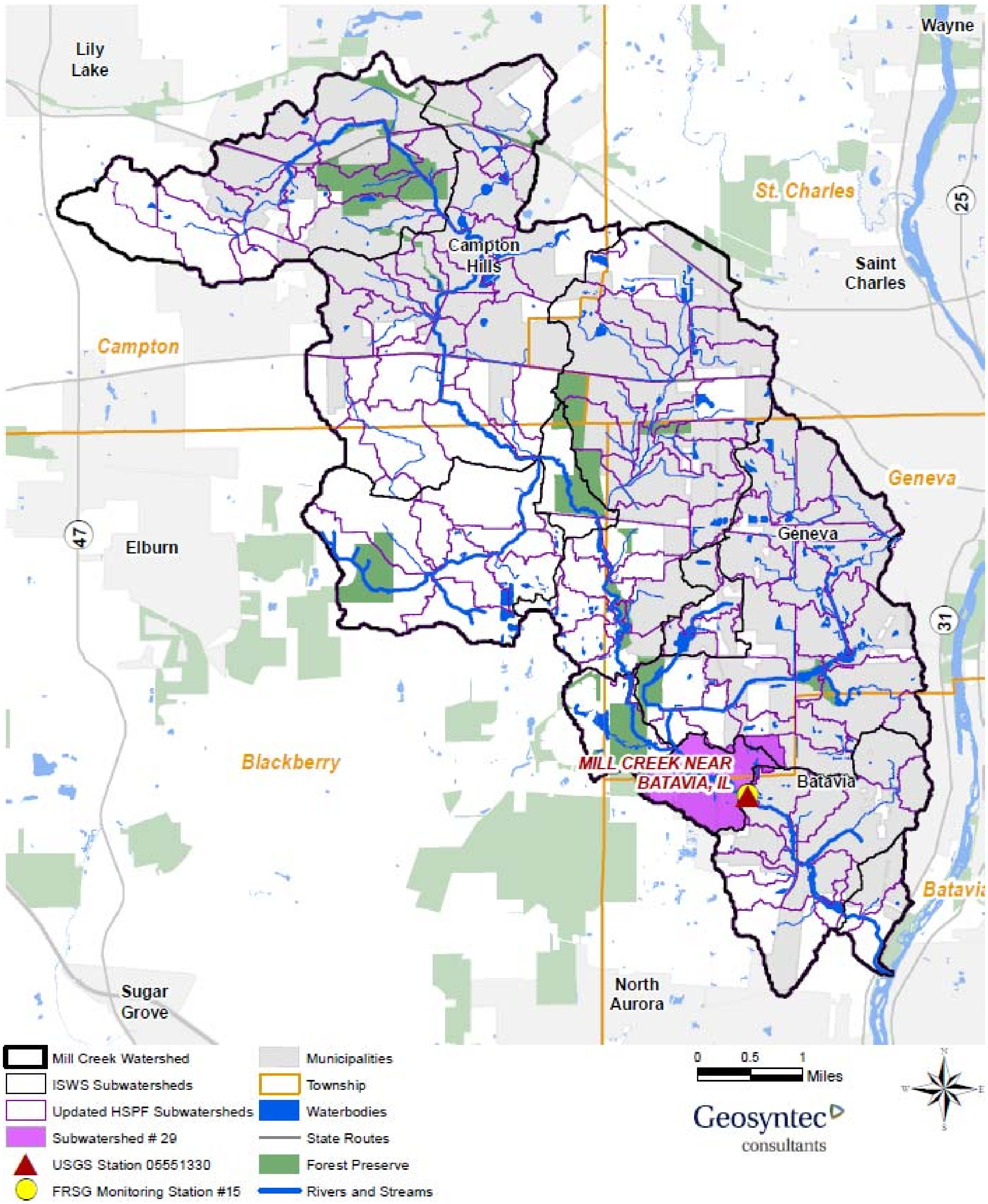


Figure 5: Available observed Data Stations for Model Calibration

HYDROLOGY CALIBRATION

Calibration Procedure

Different sources of precipitation data (ISWS, USGS, ASOS) were investigated to test for better model calibration. ISWS data showed much higher precipitation data compared to the two ASOS stations (i.e., KDPA and KARR). The KDPA ASOS station resulted in the best calibration results.

Calibration Results

Figure 6 shows the time series comparison of model simulated daily flows for subwatershed #29 with the observed flow at USGS Gauge 05551330 for a representative year (2013). The comparison of simulated model results with observed data for other years is included in Appendix B. A flow duration of simulated and observed flows for the period of 2011 to 2016 is shown in Figure 7. The results show that the highest flows are slightly overpredicted, while the lowest flows (<1 cfs) are overpredicted. Table 1 presents a summary of flow calibration statistics compared to recommended HSPF criteria. Results are reasonable for a planning level model that is calibrated using minimal precipitation and flow data.

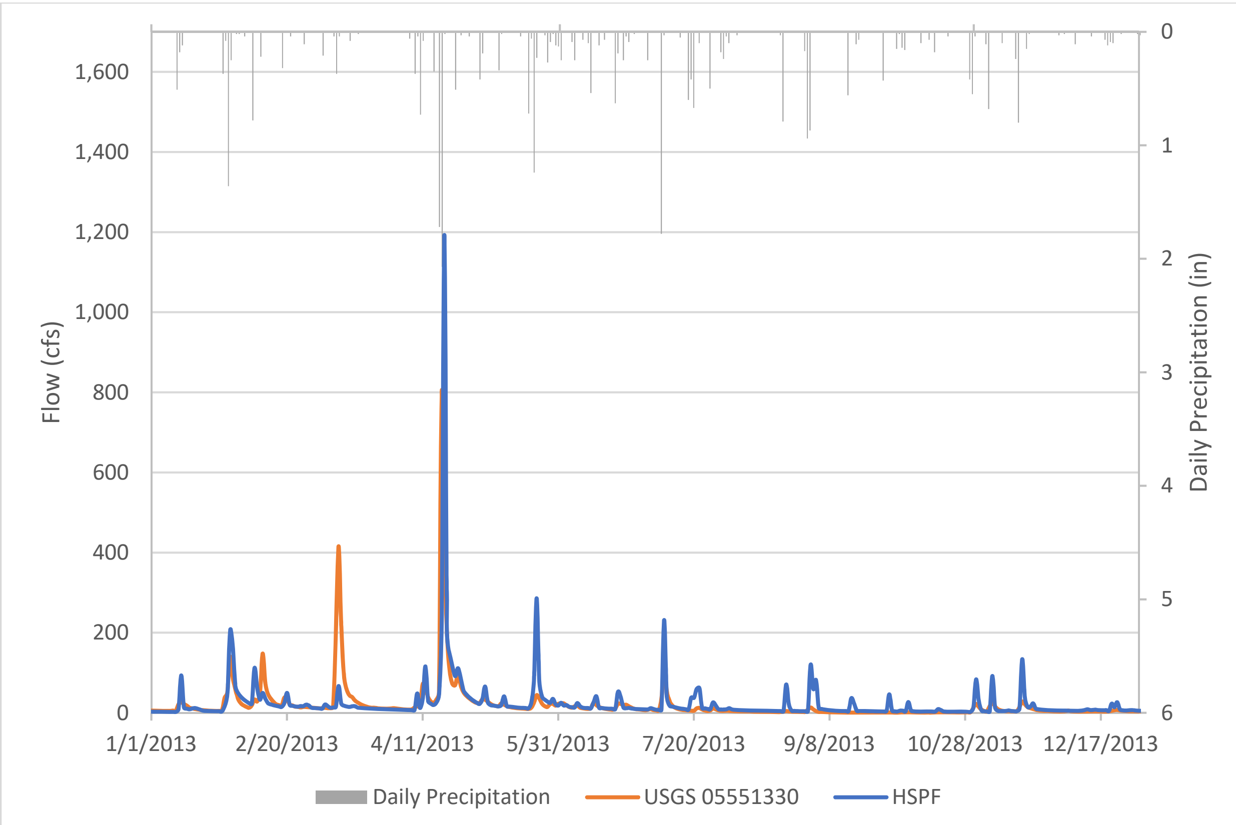


Figure 6: 2013 Simulated and observed Stream Flow at Subwatershed #29

Table 1: Simulated Flow Statistics for Subwatershed #29

Error	Current	Criteria
Error in total volume (%)	3.6	10.0
Error in 10% highest flows (%)	12.6	15.0
Error in 25% highest flows (%)	8.2	10.0
Error in 50% highest flows (%)	3.3	10.0
Error in 50% lowest flows (%)	5.7	10.0
Error in 25% lowest flows (%)	50.0	15.0
Error in 10% lowest flows (%)	265.2	20.0
Error in low-flow recession	0.0	0.0

Error in storm volumes (%)	-15.7	15.0
Seasonal volume error (%)	23.1	20.0
Error in average storm peak (%)	2.2	15.0
Summer volume error (%)	18.1	20.0
Winter volume error (%)	-5.1	15.0
Summer storm volume error (%)	-2.5	15.0
Winter storm volume error (%)	-23.4	15.0

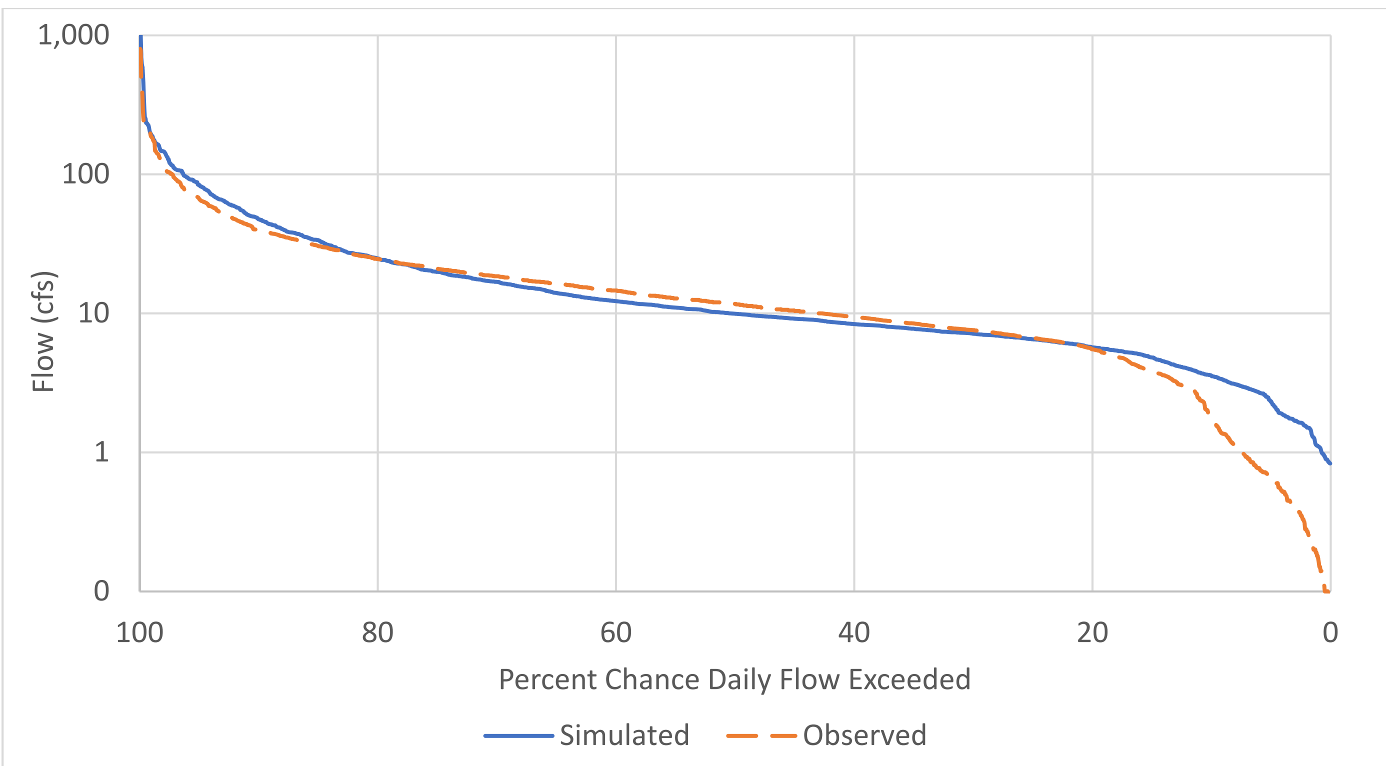


Figure 7: Simulated and Observed Flow Duration Curves

WATER QUALITY CALIBRATION RESULTS

For water quality calibration, FRSG water quality data at station # 15 was compared with HSPF simulated results for subwatershed #29.

Figure 8, Figure 9 and Figure 10 show a comparison of simulated and observed load duration curves for total phosphorus, nitrate-nitrite, and fecal coliform. The simulated concentration for total phosphorus and nitrate-nitrite match the observed data reasonably well except for some periods when the concentrations are underpredicted as compared to the observed data. The underprediction may be due to a lack of observed data to calibrate the model in the upper reaches of the watershed. The model reflects the variability in observed fecal coliform data.

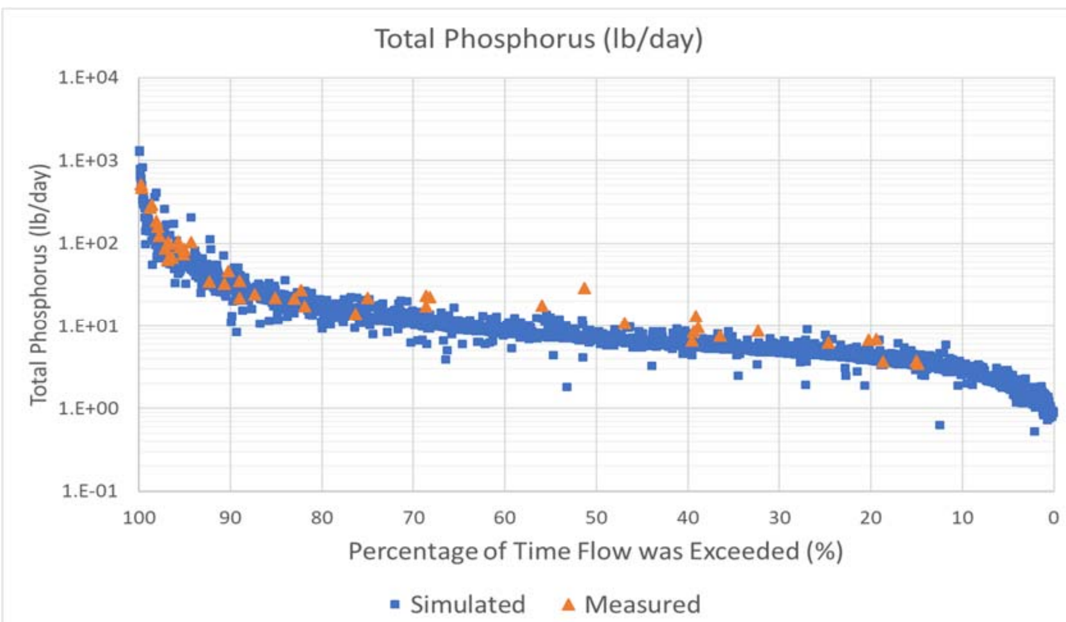


Figure 8: Total Phosphorus Loads at Subwatershed #29

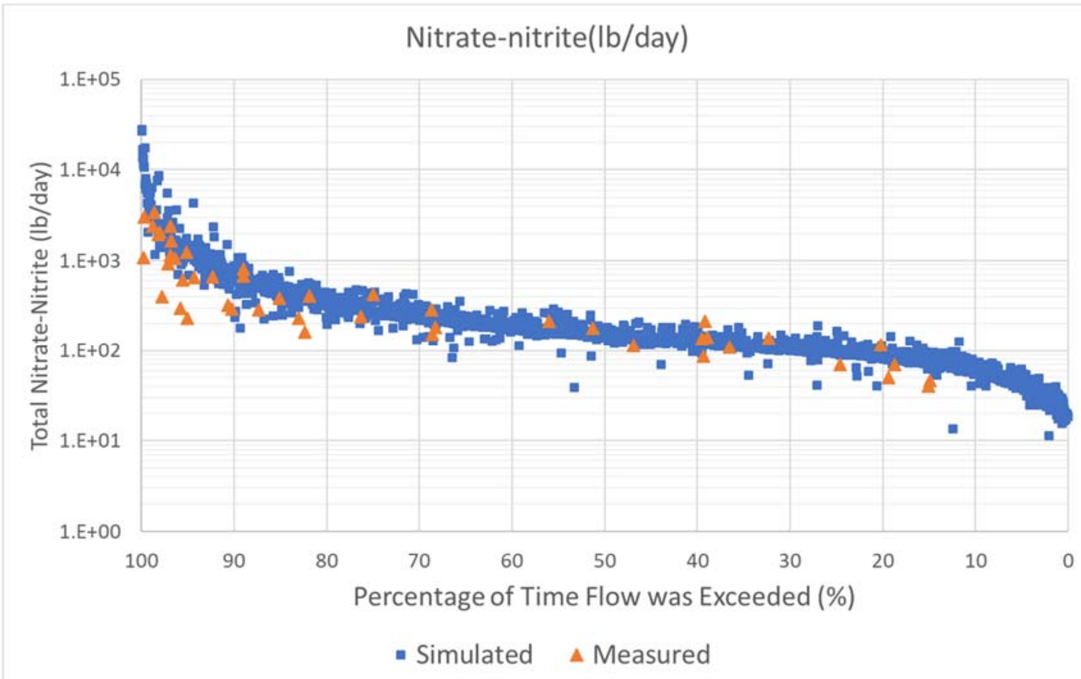


Figure 9: Nitrate Nitrite Loads at Subwatershed #29

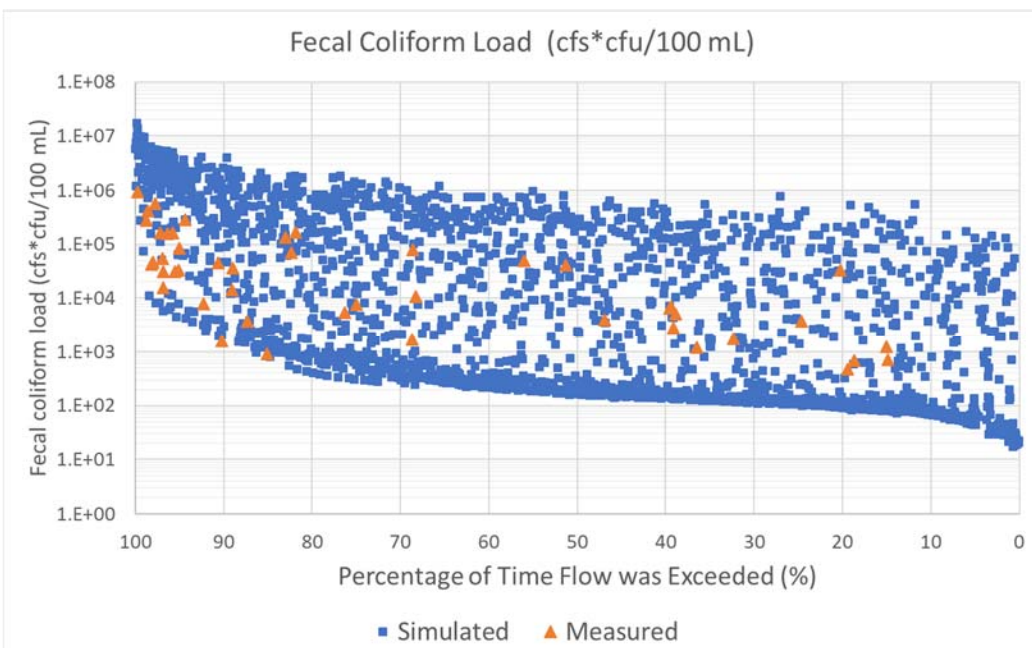


Figure 10: Fecal Coliform Loads at Subwatershed #29

SUBWATERSHEDS LOADS

Average annual subwatershed loads were calculated for total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS), and fecal coliform. The following figures shows Mill Creek subwatersheds colored coded based on the loading of TN, TP, TSS, and fecal coliform, respectively. Overall, results show that main stems subwatersheds have much higher TN and TP loads.

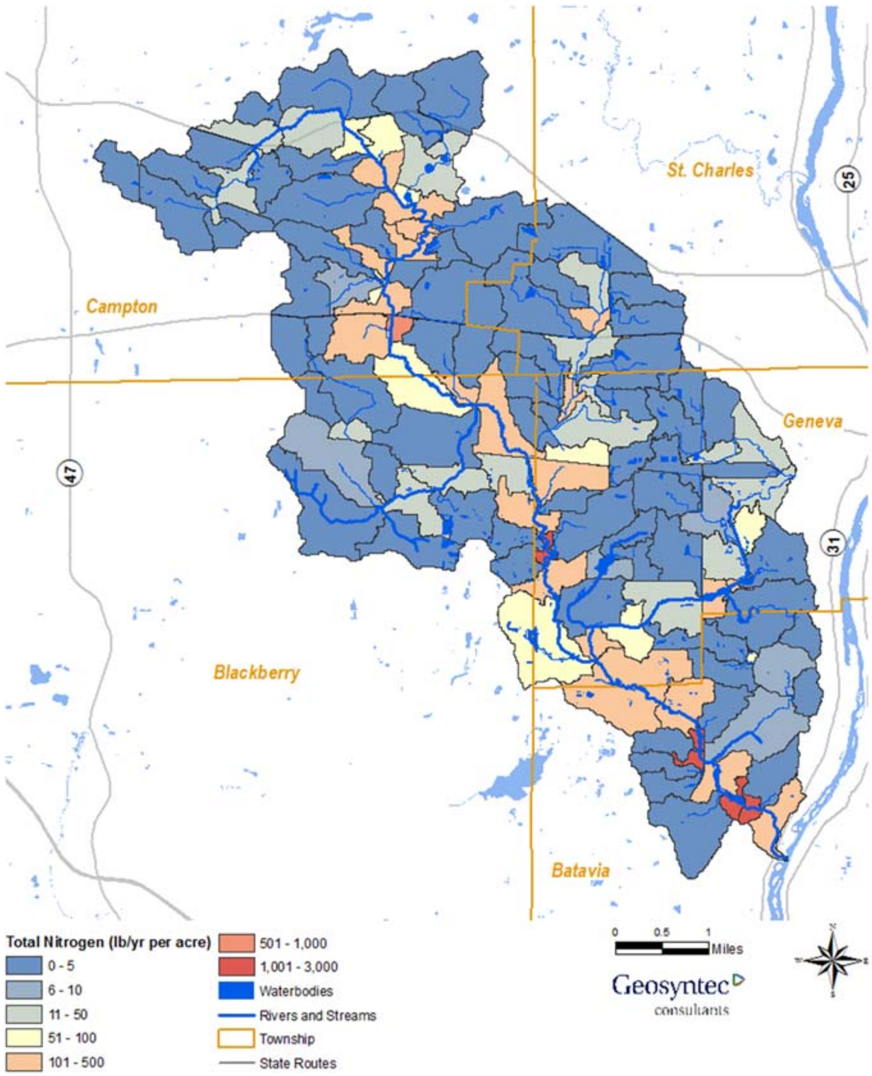


Figure 11: Unit Area Average Annual Total Nitrogen Load

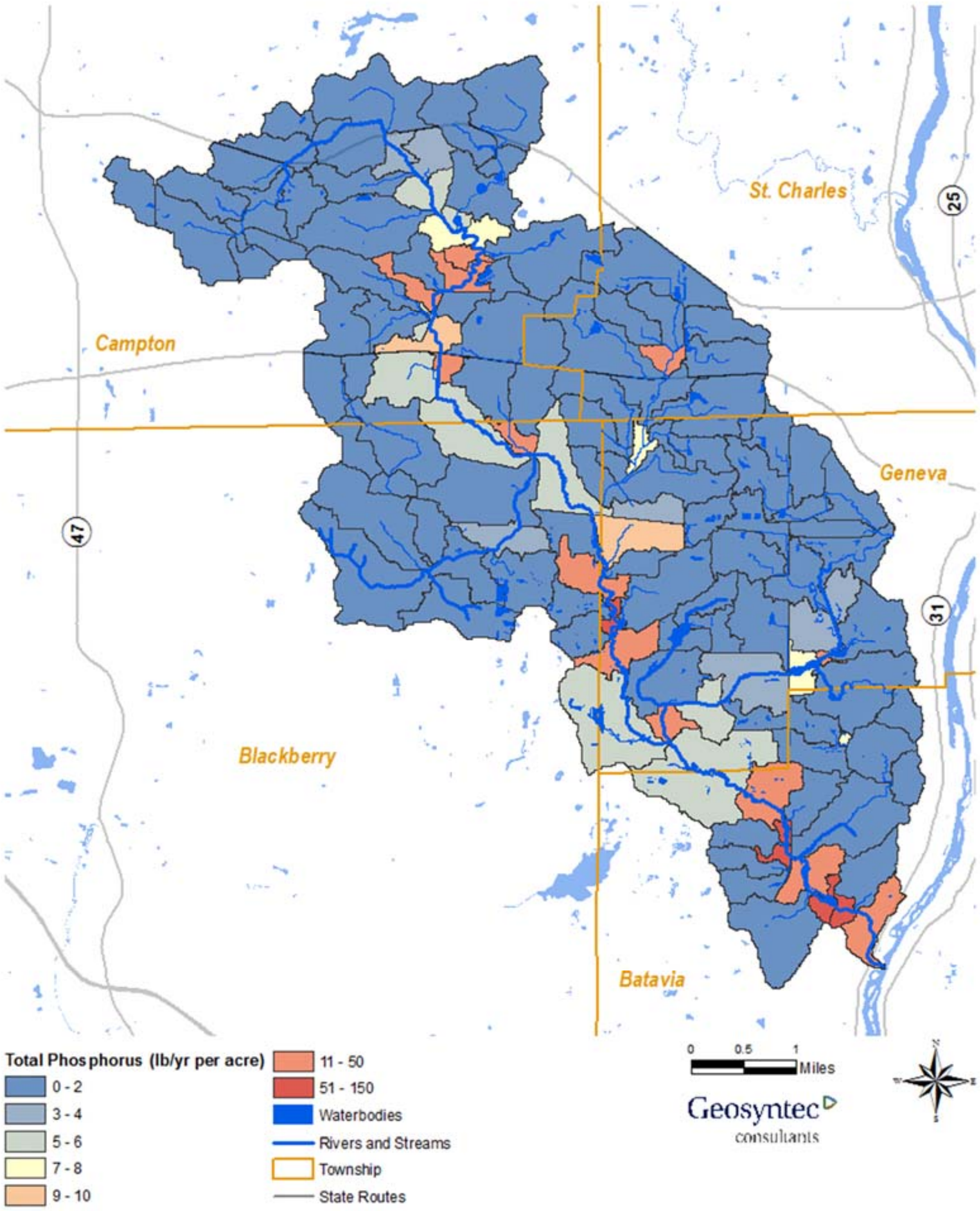


Figure 12: Unit Area Average Annual Total Phosphorus Load

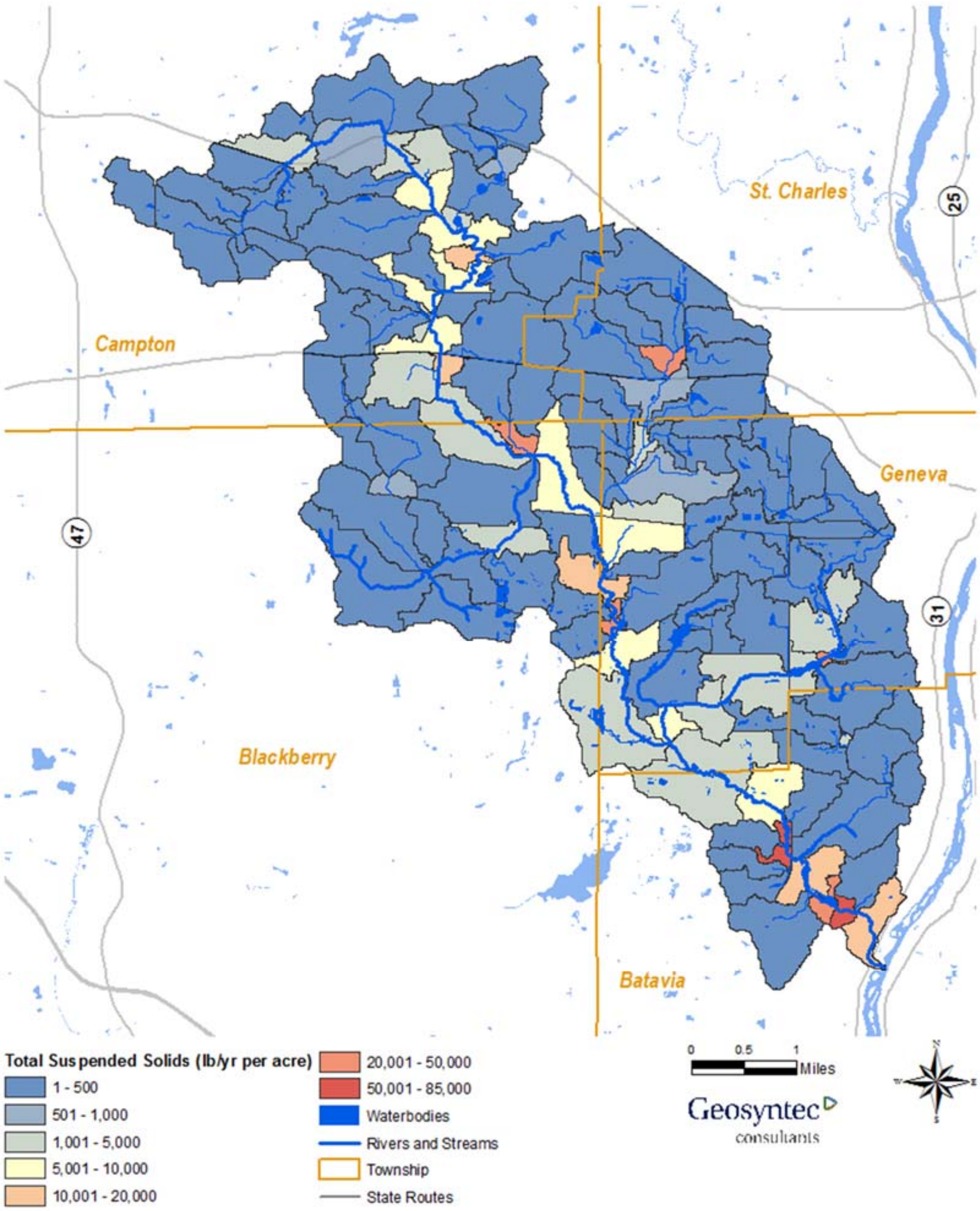


Figure 13: Unit Area Average Annual Total Suspended Solids Load

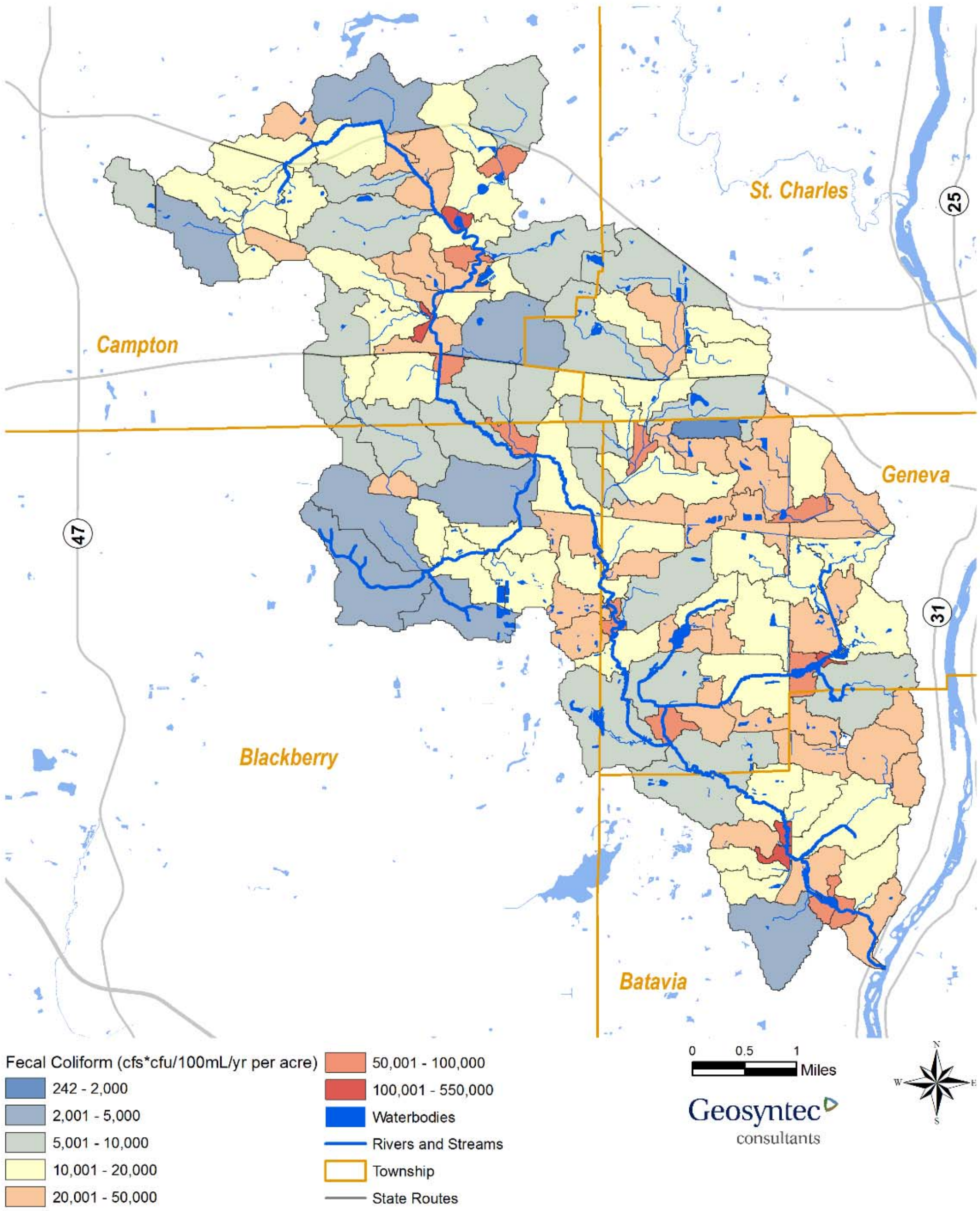


Figure 14: Unit Area Average Annual Fecal Coliform Load

BMP OPTIMIZATION FRAMEWORK

Geosyntec developed a Best Management Practice (BMP) prioritization framework to determine the least cost mix of BMP types, locations, and sizes to meet a certain goal such as pollutant load reduction. An overview of the framework is shown in Figure 15. The framework utilizes the output from a pollutant loading model such as HSPF as well as existing water quality impairment to prioritize the catchment in terms of loading reduction needed. It then identifies parcels and right-of-way segments with potential feasibility and suitability for BMPs based on the parcel level data for ownership, land use, elevation, slope and percent imperviousness. The priority catchment is overlaid over the identified parcel to create an initial list of suitable BMPs in the priority catchment. A focused desktop characterization is then conducted to screen the initial level of BMPs to assess suitability based on the detailed site characteristics. Finally, the framework calculates the whole life cycles costs for each identified suitable parcel BMP opportunity. The outcome of this framework is a table of suitable BMP locations with estimates of feasibility, cost, and effectiveness for different BMP options for the identified sites. A detailed description of the framework is provided in the slides included in Appendix C.

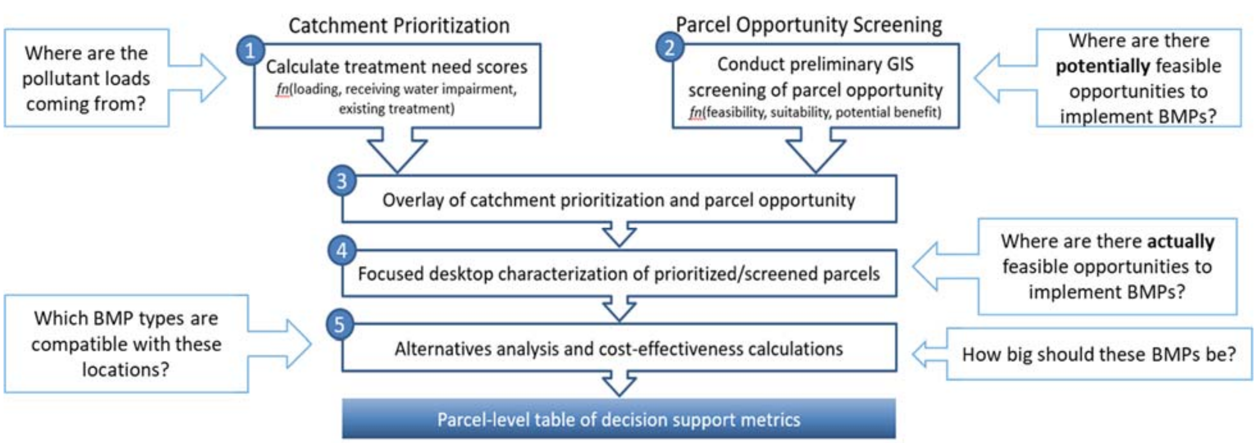


Figure 15: Overview of BMP Prioritization Framework

SUMMARY AND CONCLUSIONS

An existing HSPF watershed-based model of the Mill Creek watershed was updated to support development of a watershed-based plan for Mill Creek. The HSPF model was calibrated to available flow and water quality data. Overall, results showed that the model was able to capture data variations with slight underpredictions for some parameters which is reasonable for a planning-level model.

REFERENCES

Baratosova (2007). Validation of Hydrologic Model Parameters, Brewster Creek, Ferson Creek, Flint Creek, Mill Creek, and Tyler Creek Watersheds. Fox River Watershed Investigation: Stratton Dam to the Illinois River., Phase 2, Part 3. Developed for Fox River Study Group.

Donigian (2002). Watershed Model Calibration and Validation: The HSPF Experience. Aqua Terra Consultants.

APPENDICES

A. Final Mill Creek subwatersheds and Hydrologic Response Units (HRU) list

B. Time series plots for simulated and observed flow data for the years 2011, 2012, 2014, 2015 and 2016.

C. PowerPoint slides describing the BMP Prioritization Framework.

* * * * *

Appendix A

Appendix A
HSPF Final Subwatersheds

Sub-Watershed ID	Down Stream Sub-watershed ID	Area (ac)
900	817	244.4
800	827	353.4
804	833	394.0
827	804	118.0
805	804	121.6
806	827	133.4
807	804	168.5
833	835	129.8
809	811	168.2
810	835	241.3
811	835	151.9
812	823	74.5
823	835	40.3
835	836	44.8
813	823	97.6
814	838	223.9
839	799	101.1
838	839	35.9
815	839	90.1
816	799	100.0
817	824	300.3
824	828	132.4
818	824	73.0
819	829	276.3
820	828	100.6
828	834	32.4
821	834	104.7
834	300	134.8
700	602	506.4
600	610	164.7
601	610	83.5
602	609	170.1
603	609	129.1
610	613	326.0
604	611	100.3
609	611	18.7
605	611	89.4
611	613	27.9
613	614	132.6
606	611	95.1
614	502	44.4
607	614	302.1
500	502	159.3

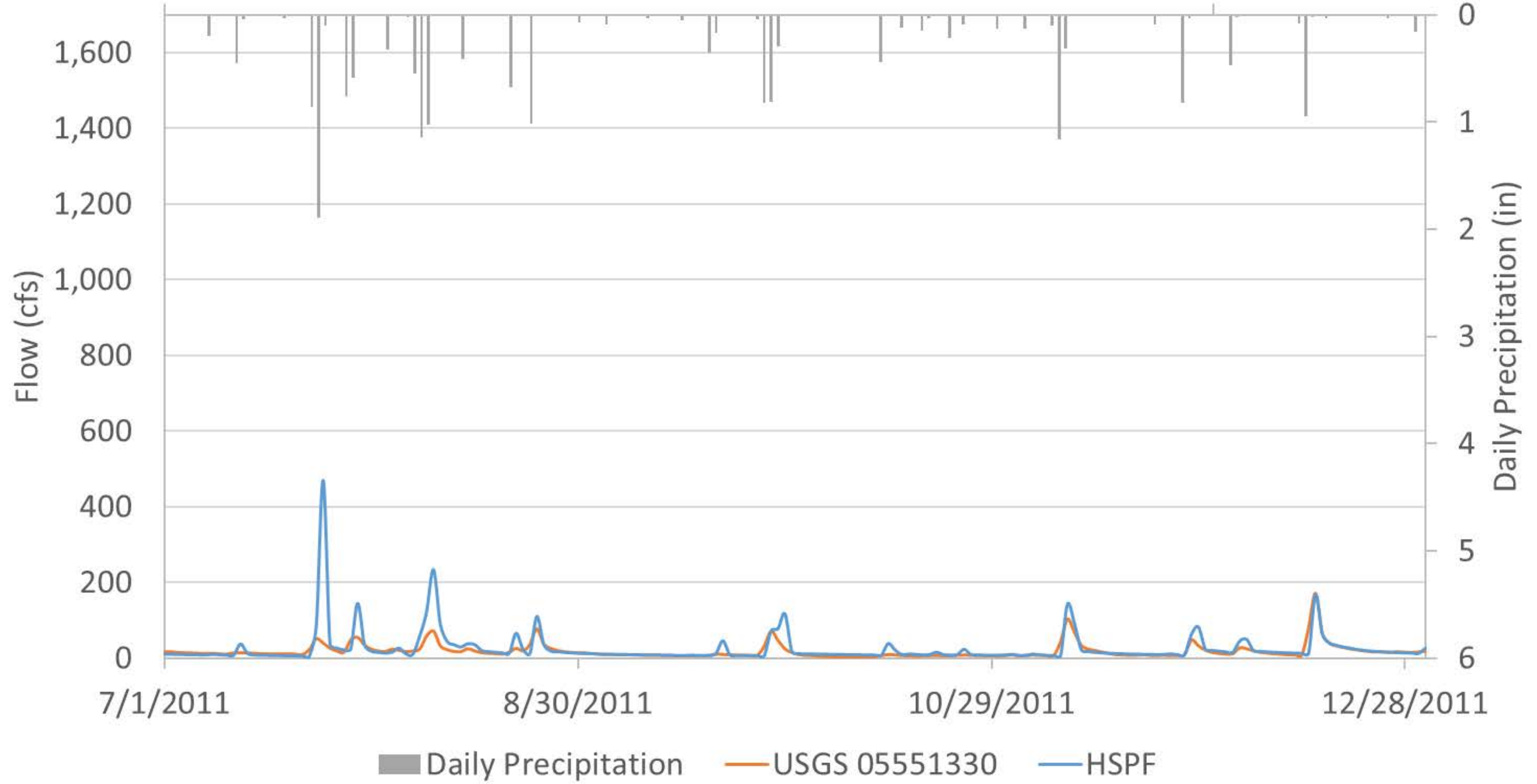
Appendix A
HSPF Final Subwatersheds

Sub-Watershed ID	Down Stream Sub-watershed ID	Area (ac)
501	0	143.2
502	501	35.3
400	421	118.5
402	423	146.9
401	421	162.5
423	429	153.7
421	423	54.5
403	422	122.5
404	429	80.8
405	422	176.4
406	424	168.1
422	408	149.0
408	411	79.6
407	419	93.0
409	430	217.6
412	427	222.4
411	427	127.2
410	419	79.6
419	433	231.6
428	430	69.1
413	428	343.8
427	428	12.0
430	431	240.9
431	419	120.3
414	600	85.2
417	420	89.1
418	420	127.0
416	431	71.3
433	700	62.6
420	600	8.1
300	700	415.3
200	212	361.2
202	209	346.4
203	209	103.9
204	209	437.8
210	200	129.1
209	210	162.7
205	210	195.1
206	209	236.0
1000	1022	340.6
1001	1020	81.2
1020	1022	190.0
1003	1024	99.0

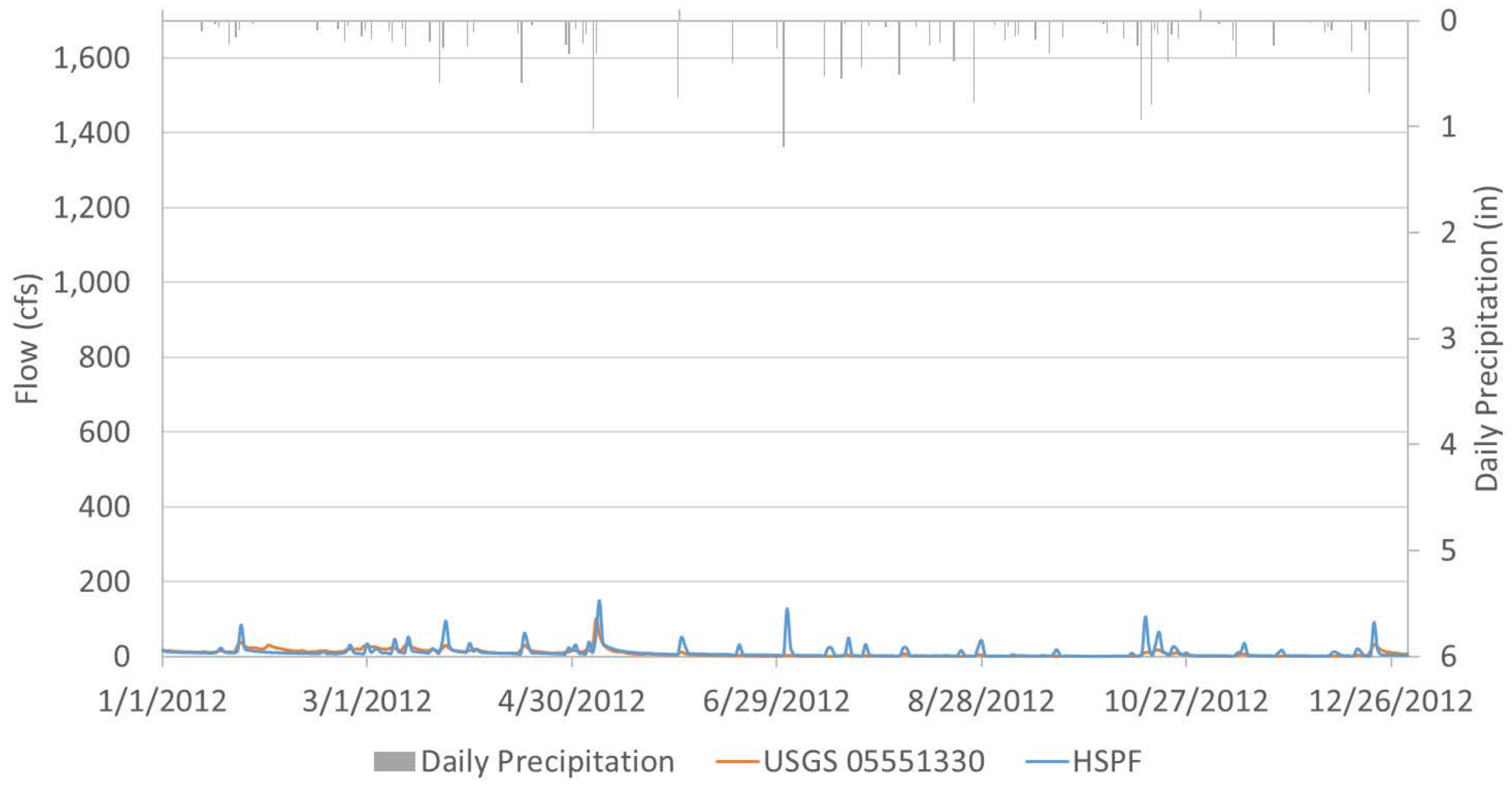
Appendix A
HSPF Final Subwatersheds

Sub-Watershed ID	Down Stream Sub-watershed ID	Area (ac)
1022	1024	71.6
1019	1020	118.2
1004	1019	136.9
1008	1014	125.4
1005	1024	133.1
1018	1019	144.6
1006	1018	113.5
1024	13	101.5
1007	1017	155.0
1010	1015	258.5
1009	1024	344.4
1011	1016	67.4
1013	1015	69.3
10	34	319.5
11	34	193.1
34	36	55.8
12	36	187.1
13	31	149.2
14	31	361.2
17	35	97.6
31	33	43.2
16	32	179.0
35	38	71.6
15	33	64.7
33	35	79.2
20	28	187.5
28	32	123.2
18	39	65.6
19	40	360.7
32	35	18.1
39	40	101.1
22	29	146.2
23	41	194.8
40	41	40.1
25	29	67.1
24	30	159.7
26	30	151.7
41	200	271.8
29	37	309.5
27	37	91.8
30	200	48.8
37	202	55.0
419	433	79.3

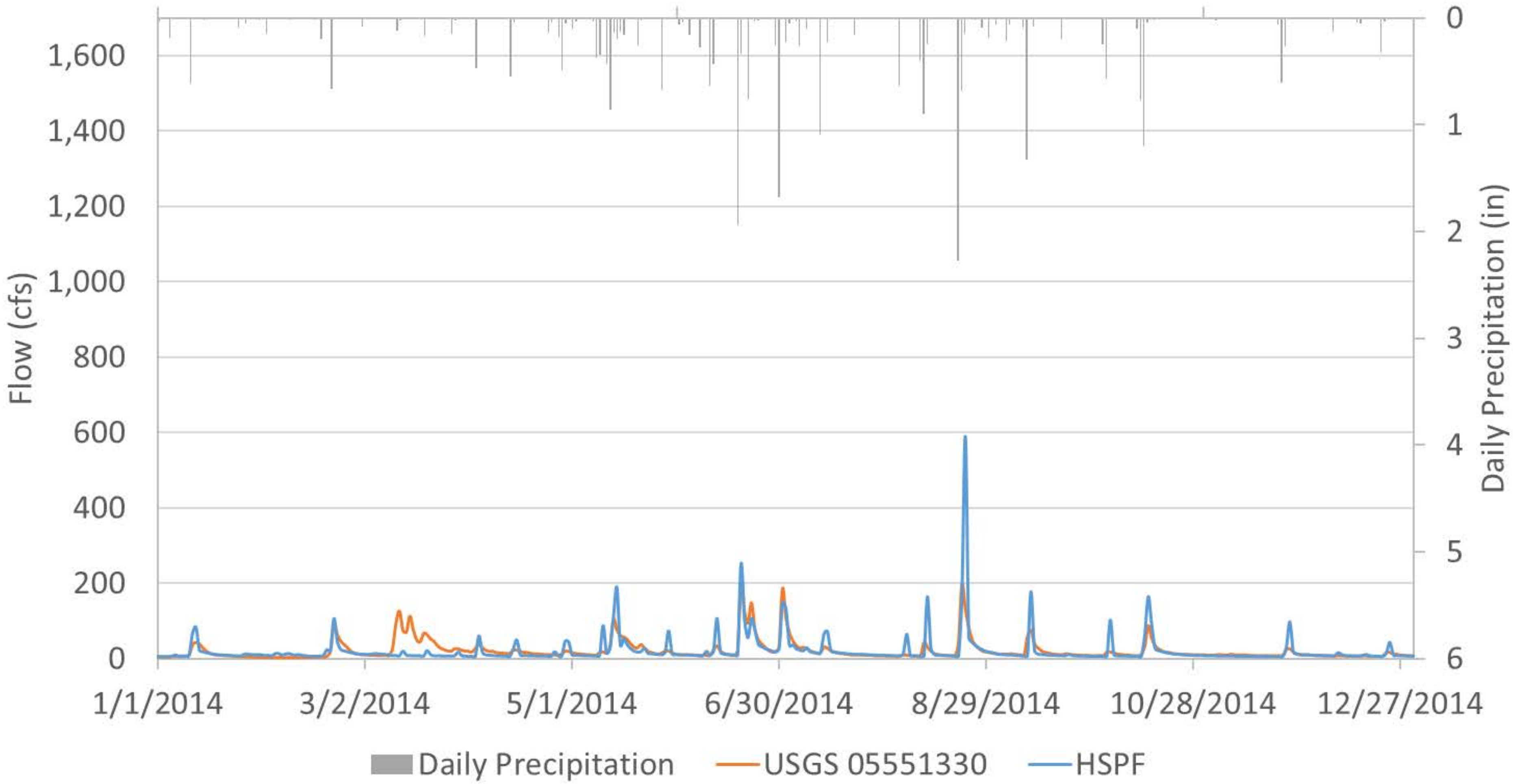
Appendix B



Flow (cfs)
1,600
1,400
1,200
1,000
800
600
400
200
0
Daily Precipitation (in)
0
1
2
3
4
5
6
7/1/2011
8/30/2011
10/29/2011
12/28/2011
Daily Precipitation
USGS 05551330
HSPF



Flow (cfs)
Daily Precipitation (in)
1,600
1,400
1,200
1,000
800
600
400
200
0
0
1
2
3
4
5
6
1/1/2012
3/1/2012
4/30/2012
6/29/2012
8/28/2012
10/27/2012
12/26/2012
Daily Precipitation
USGS 05551330
HSPF



Flow (cfs)
1,600
1,400
1,200
1,000
800
600
400
200
0
Daily Precipitation (in)
0
1
2
3
4
5
6
1/1/2014
3/2/2014
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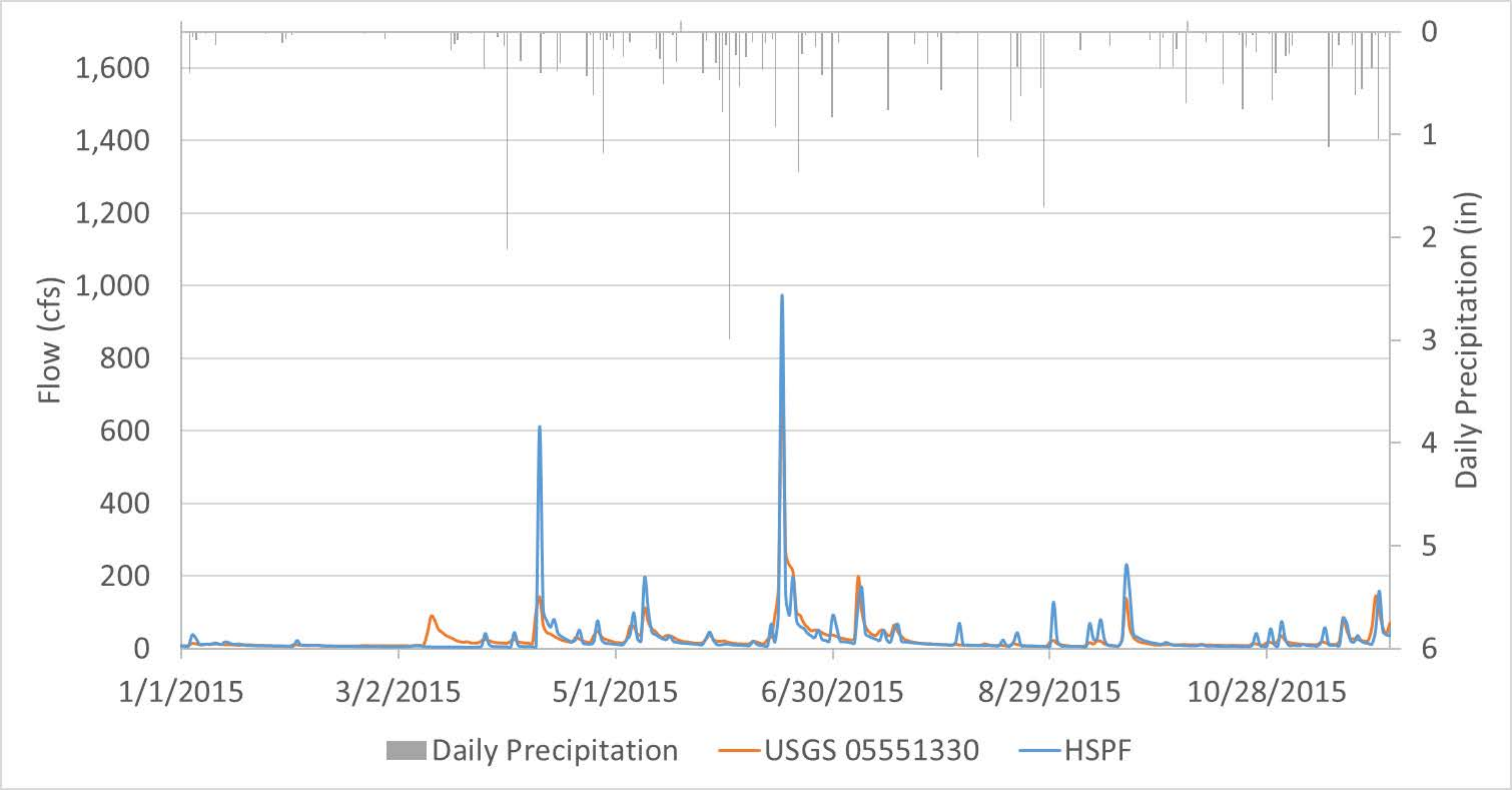
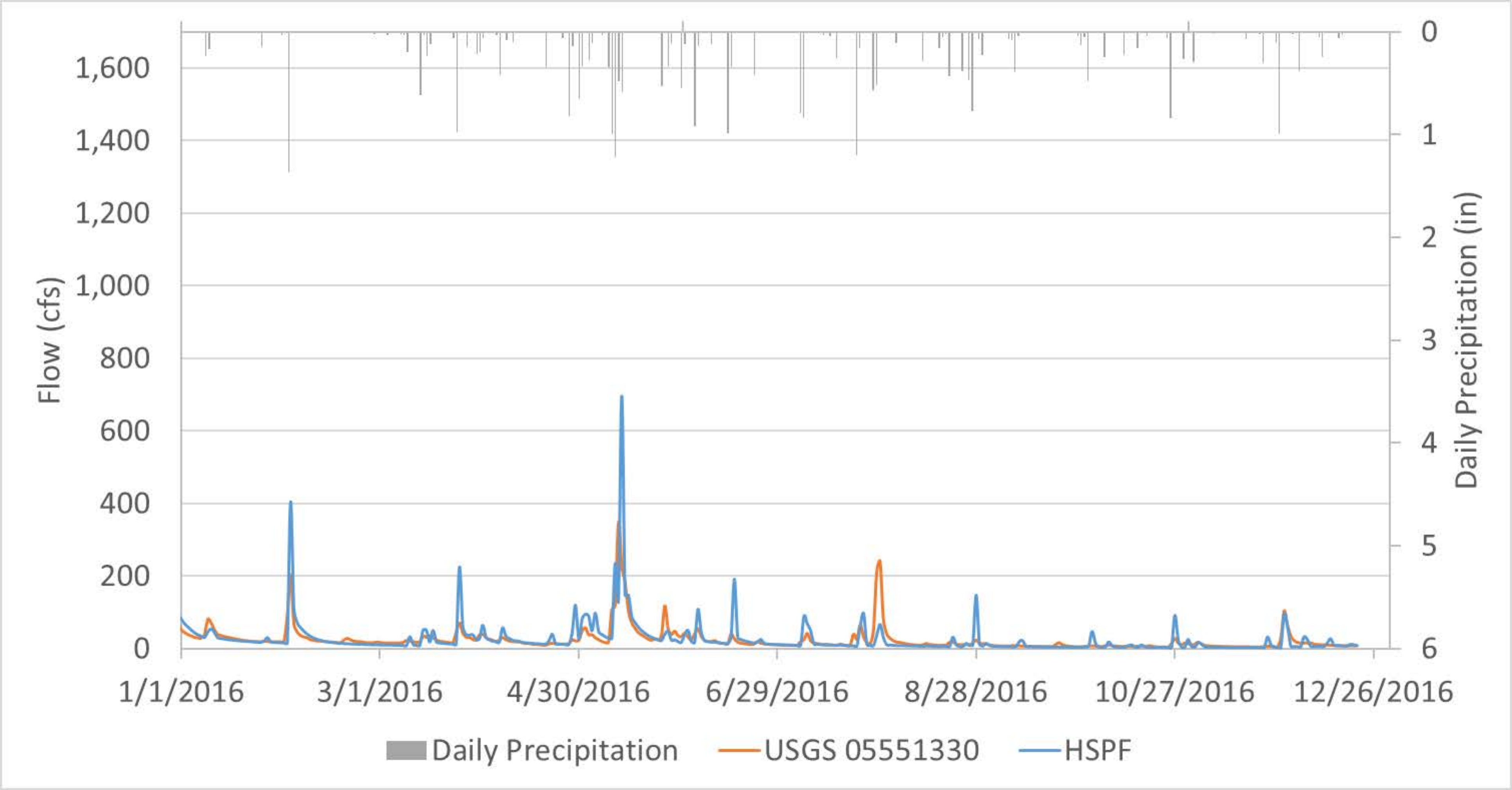
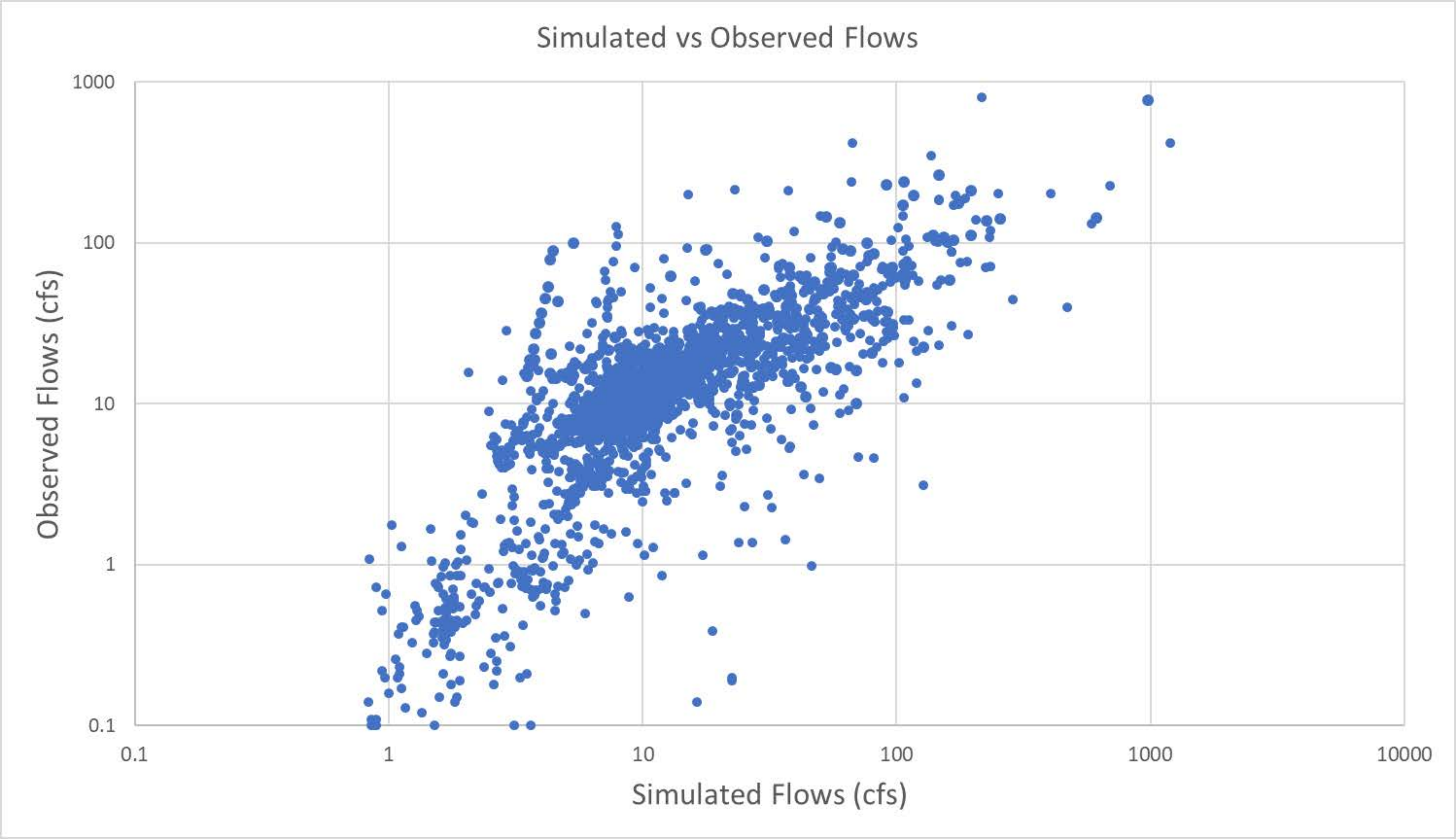
6/30/2014
8/29/2014
10/28/2014
12/27/2014
Daily Precipitation
USGS 05551330
HSPF

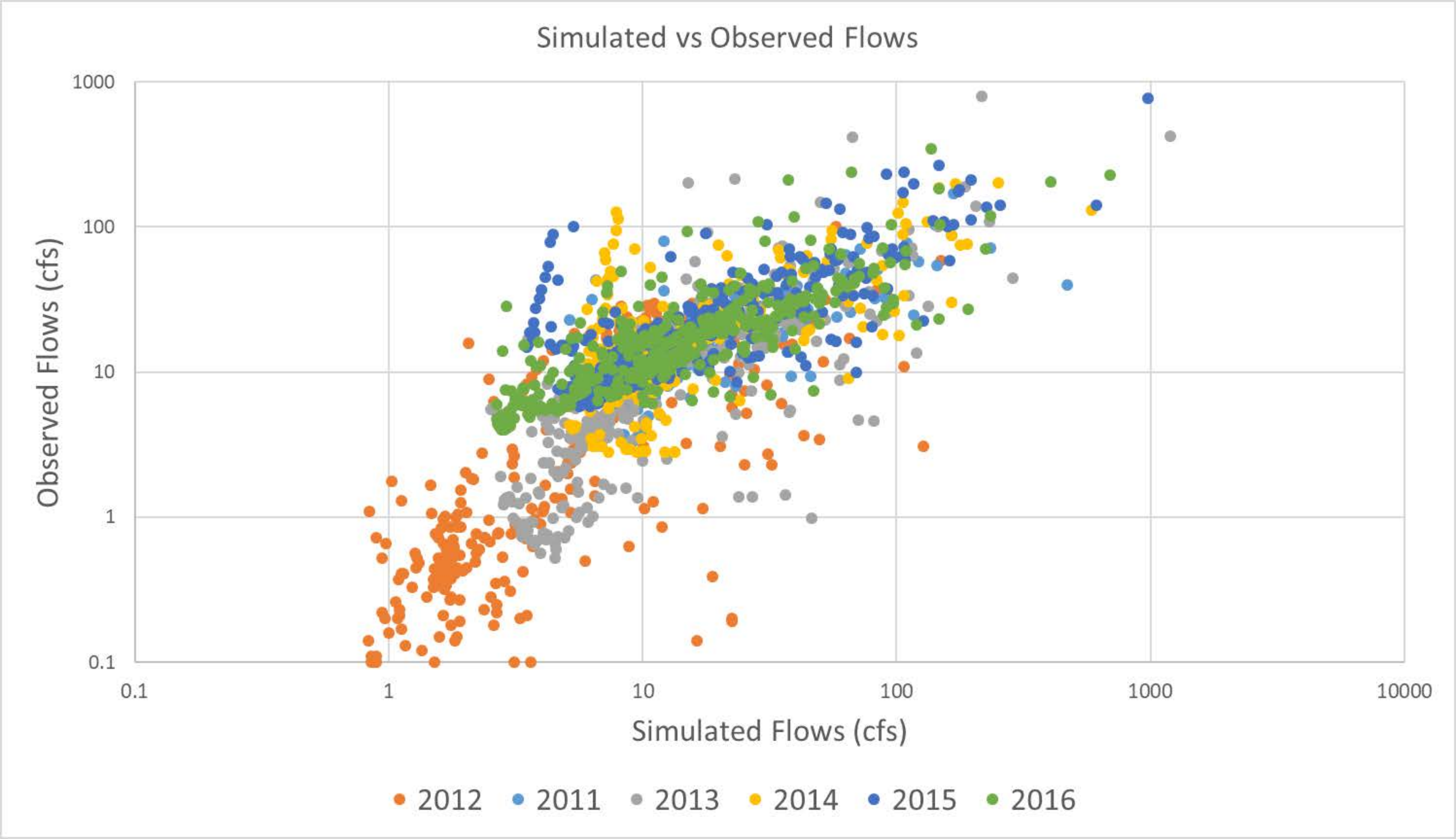


Flow (cfs)
1,600
1,400
1,200
1,000
800
600
400
200
0
Daily Precipitation (in)
0
1
2
3
4
5
6
1/1/2015
3/2/2015
5/1/2015
6/30/2015
8/29/2015
10/28/2015
Daily Precipitation
USGS 05551330
HSPF



Flow (cfs)
1,600
1,400
1,200
1,000
800
600
400
200
0
Daily Precipitation (in)
0
1
2
3
4
5
6
1/1/2016
3/1/2016
4/30/2016
6/29/2016
8/28/2016
10/27/2016
12/26/2016
Daily Precipitation
USGS 05551330
HSPF


Simulated vs Observed Flows
Observed Flows (cfs)
1000
100
10
1
0.1
0.1
1
10
100
1000
10000
Simulated Flows (cfs)



Simulated vs Observed Flows
Observed Flows (cfs)
1000
100
10
1
0.1
0.1
1
10
100
1000
10000
Simulated Flows (cfs)
2012
2011
2013
2014
2015
2016

Appendix C

Geosyntec consultants

Development of BMP Optimization Framework

Presented to CMAP on January 4, 2019

Overview

- Orientation and thought process
- Framework and example demonstrations
- Next steps for framework application

Orientation and Thought Process

Geosyntec consultants

Optimization/Prioritization Objectives

What is the least cost mix of BMP types, locations, and sizes to meet a certain goal (e.g., pollutant load reduction)?

More manageable components of this question:

1. Approximately how much area do we need to treat to meet our goals?
2. In what locations would BMPs tend to have the best return on investment /cost-effectiveness?
3. What BMP types are higher priority? How does this vary by the type of opportunity?
4. Is there a “knee of the curve” range in BMP sizing that we should try to stay within?

Proposed Optimization/ Prioritization Thought Process

Hierarchy of Questions	Rationale/Implicit Assumptions
Where are pollutant loads coming from?	• Ask this question early ➔ make better use of time by evaluating BMPs in locations where loads are higher and there is not existing treatment
Where are there feasible opportunities to implement BMPs?	• Ask this question early ➔ make better use of time by evaluating BMPs where indicators suggest they may be more feasible • The cost of land acquisition and/or conveyance to sites with unsuitable characteristics can overwhelm other considerations • Site screening can be supported by initial GIS methods, but requires more in-depth analyses (both desktop and field effort) to determine feasibility • Effort invested to determine BMP retrofit feasibility at the parcel level yields “durable” knowledge (i.e., this info is still useful if goals or available info change)
Which BMP types are compatible with these locations?	• Ask this after parcels are identified ➔ once site attributes are known, the possible menu of BMPs is much smaller • Two to three BMP options per site is typically enough; simple alternative analysis methods are adequate (and provide valuable transparency)
How big should these BMPs be?	• Ask this last ➔ sizing influences cost and performance, but potentially to a lesser degree than parcel feasibility/suitability • Avoid conducting BMP sizing optimization without determining feasibility

Objective of Framework Development

- Outline a phased framework to develop a list of prioritized project opportunities with adequate information to support plan development
  - Starting with HSPF- and GIS-based screening and parcel prioritization
  - Followed by more in-depth research and analysis
  - Resulting in a table of project attributes with feasibility, cost, and performance estimates

- Describe and demonstrate an efficient screening method to prioritize parcels for further research and analysis
  - Describe use of HSPF model output
  - Describe use of native and derived parcel metrics

- Describe methods to conduct parcel-level BMP selection, sizing, and cost-effectiveness analysis
  - Present considerations focused desktop parcel characterization
  - Identify tools for analysis of BMP cost and performance

Proposed Optimization/ Prioritization Thought Process

Key outcome of overall prioritization framework to support plan development

Parcel No	Parcel Attributes	Tributary Area Metrics	BMP Type	BMP Size	Volume Treated and Reduced	Capital Cost ($)	Whole Lifecycle Cost, ($/yr)	Total Nitrogen (TN) Load Reduction (lb/yr)	TN Cost-Effectiveness Ratio ($/lb TN removed)	…

Potential uses of table for plan development:

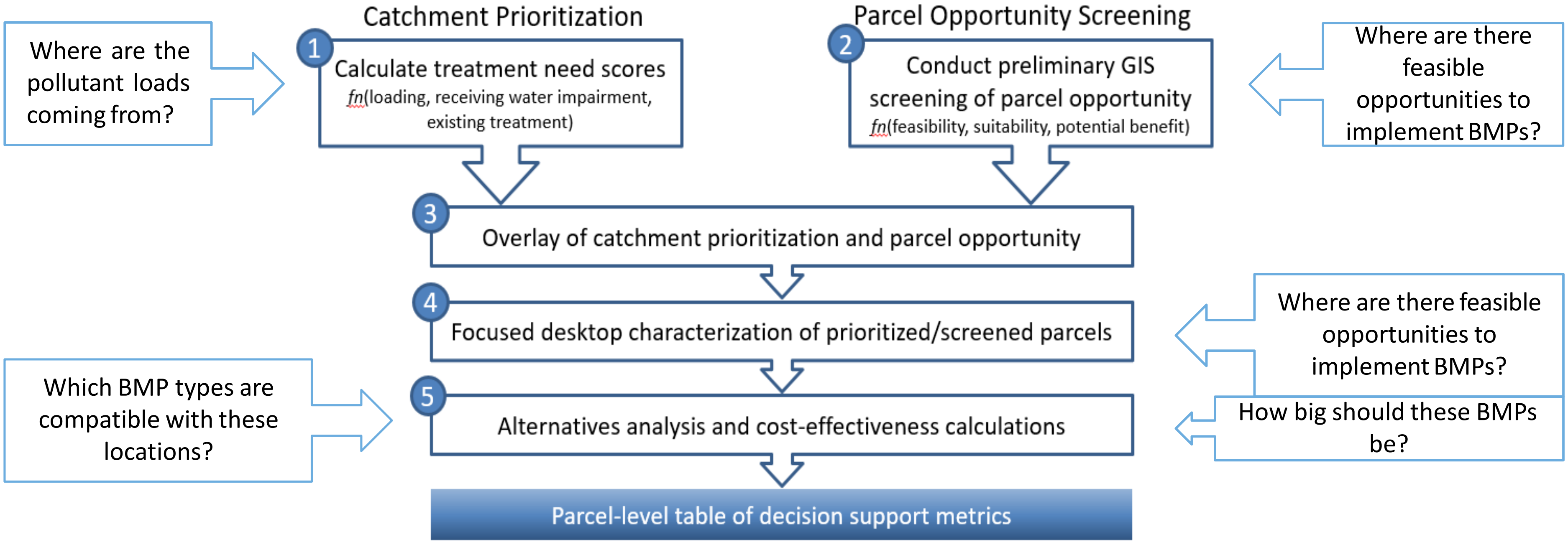
- Sort by cost-effectiveness ratio
- Move down list until the sum of load removal meets goals
- Filter by location, ownership type, or other factors
- Add new opportunities as they are identified
- Remove items as they are constructed or are found to be infeasible

Caveats

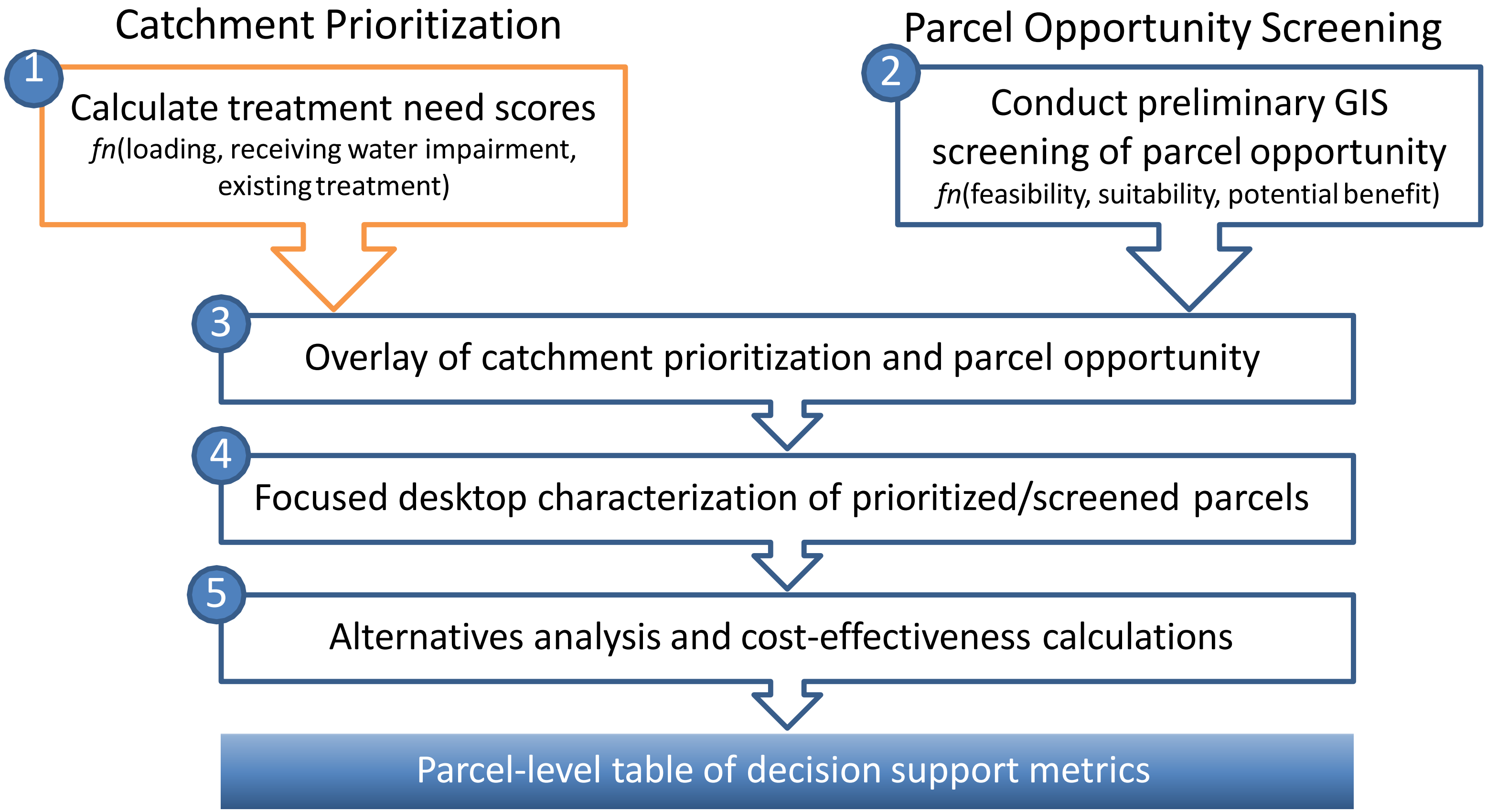
- Demonstration results are preliminary
  - Pending inventory of existing BMPs
  - Pending update of HSPF model
  - Pending input on weighting factors, metrics, and screening thresholds
- Application of the framework is a separate scope of work

Framework and Example Demonstrations

Overall Framework - Overview



1. Catchment Prioritization



1. Catchment Prioritization - Inputs

- Goal
  - Quantify unmet treatment need at a catchment level
- Inputs
  - Shapefile of catchments delineated by topography and drainage networks
  - HSPF model annual average results for each catchment:
    - TN load per acre per year
    - Total phosphorus (TP) load per acre per year
    - Total suspended solids (TSS) load per acre per year
    - Fecal coliform load per acre per year
  - Boolean field indicating downstream TN, TP, TSS or fecal coliform impairments for each catchment
  - Table attribute containing ID of catchment immediately downstream from each catchment (dendritic, so each has only one)

1. Catchment Prioritization - Operations

- Catchment Prioritization Index (CPI calculation)
  - Pollutant Catchment Prioritization Index (PCPI) = normalized load per acre of each pollutant for each catchment
    - e.g. Total nitrogen PCPI = $TN_{Catchment\ X}$ [load/acre] / Max TN [load/acre]
  - Weight PCPIs by pollutants and sum:
    - Assign pollutants weighting factors:
    - Multiply each PCPI by its pollutant factor
      - Total $PCPI_X$ = Sum over pollutants($PCPI_X$*$Factor_X$)
  - Weight by downstream impairments
    - Multiply Total PCPI by 2 for each downstream impairment[1]

[1] currently only impairment is FC

  - CPI = normalized PCPI scaled by 5
    - CPI_X = (Total $PCPI_X$ / Max Total PCPI) * 5
    - Round to the nearest integer

Pollutant	Example Weighting Factor
Nitrogen	10
Phosphorus	10
TSS	10
Fecal Coliform	5

1. Catchment Prioritization - Operations

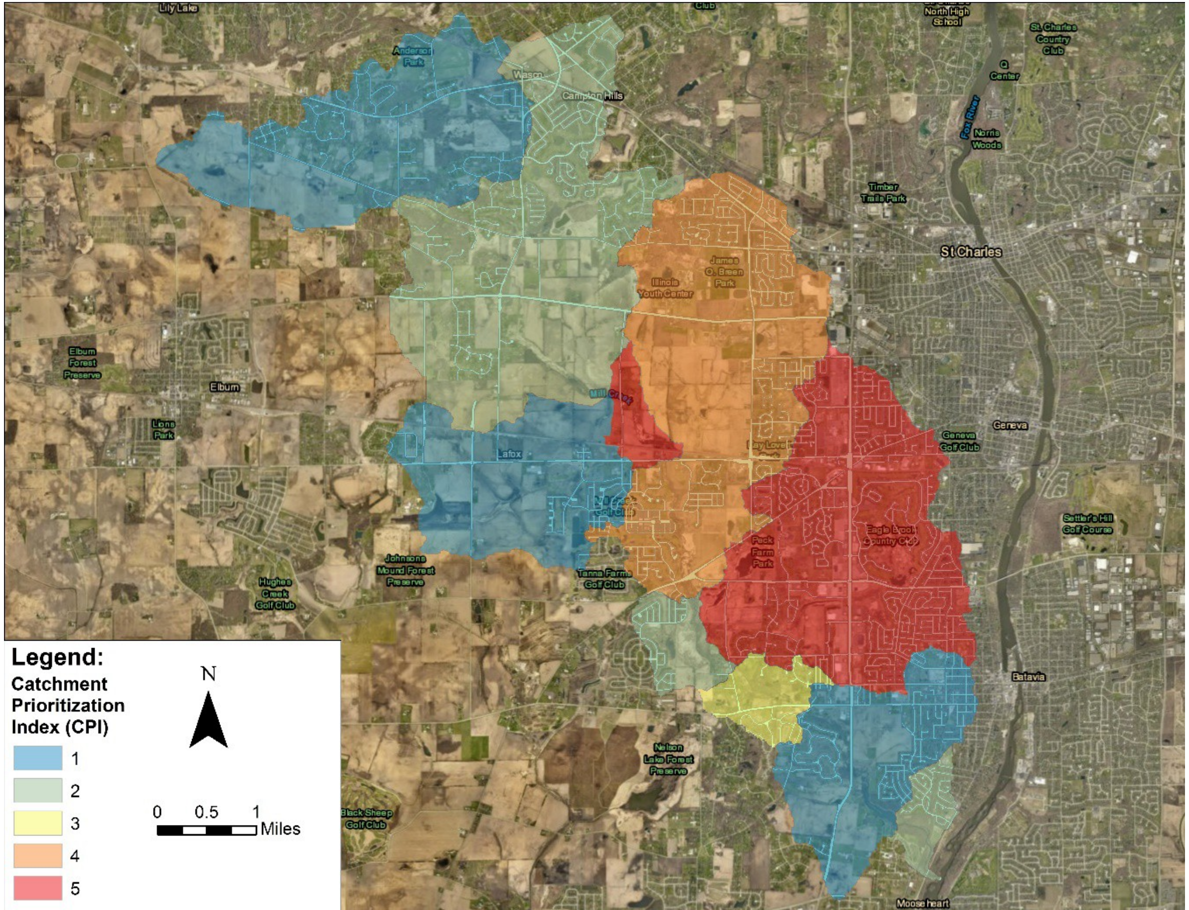
- Catchment Prioritization Index (CPI calculation) cont.
  - Since the goal is to quantify the unmet treatment need, the location and type of existing BMPs is needed
    - Stormwater detention facility data will be obtained from Kane County
      - Work with the County to identify which of these already includes treatment
      - Develop approximate approach to determine area conveyed to existing BMPs
  - Catchments that have more area treated by existing BMPs will have a reduced CPI score

1. Catchment Prioritization - Operations

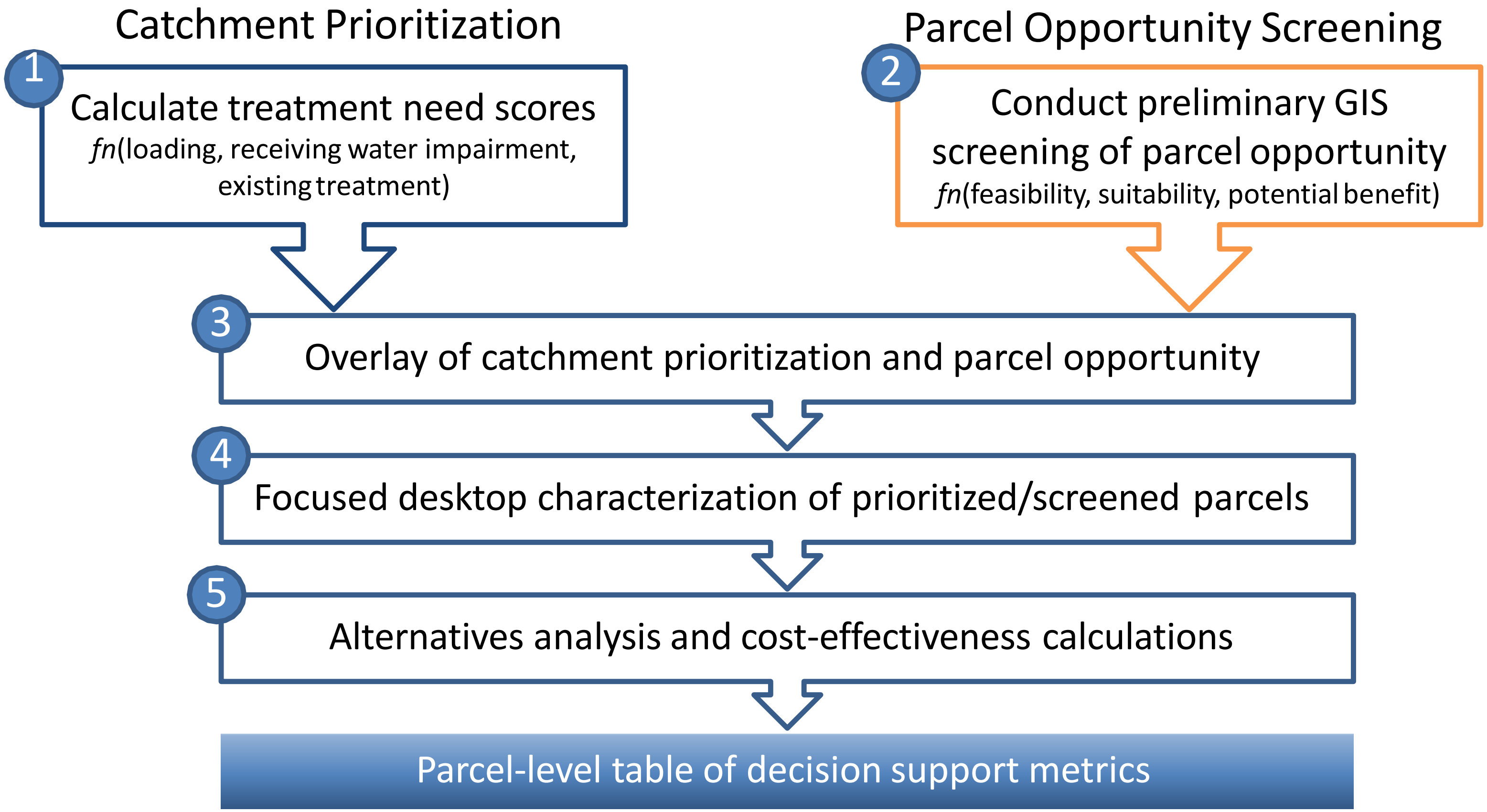
- A Nodal CPI score allows for further prioritization of catchments downstream of high priority catchments
- Nodal Catchment Prioritization Index (NCPI) calculation
  - Identify network upstream of each catchment
    - Script uses downstream catchment field to compile list of all upstream catchments for each
  - Weight upstream CPIs by area of catchment and sum:
    - Weighted upstream CPI_X = Sum over upstream catchments(CPI*area)
  - Divide by total area of upstream catchments
    - $NCPI_X$ = Weighted upstream CPI_X / Sum over upstream catchments(area)

NOTE: The current catchment resolution is too coarse for this method to provide meaningful results. But with finer catchment delineations, this method of results visualization should be useful.

1. Catchment Prioritization - Output



2. Parcel Opportunity Screening



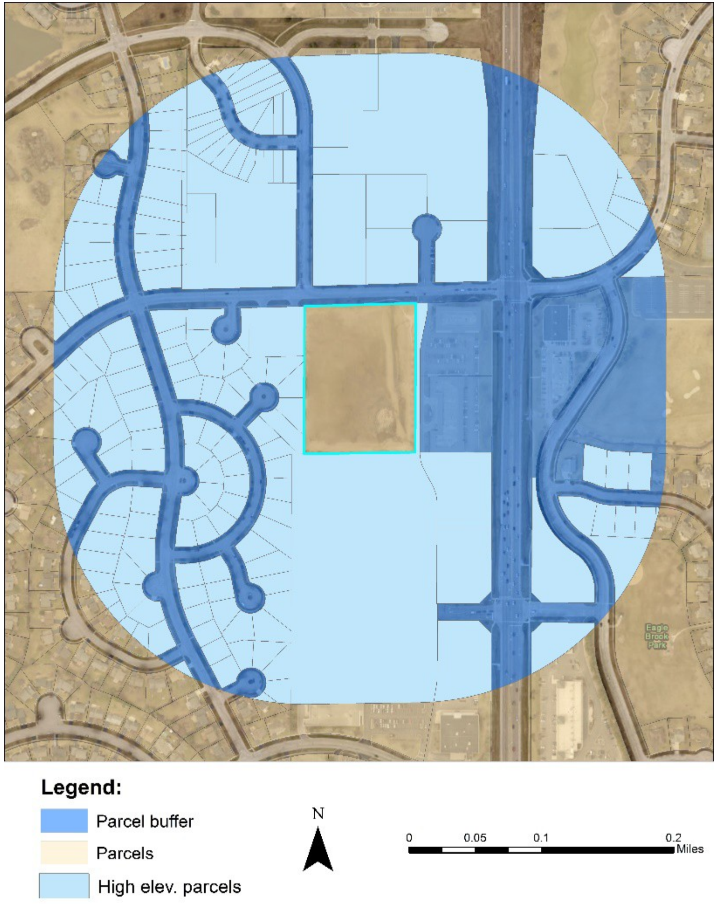
2. Parcel Opportunity Screening - Inputs

- Goal
  - Identify parcels and right of ways with potential feasibility and suitability for BMPs
- Raw and Derived Inputs
  - Parcels shapefile constructed from tax lot geometries
    - Native tax lot attributes
    - Parcel ownership category (City, Township, County, State, Federal; interpreted from owner names)
    - Area
    - Land use (based overlay with land use layer)
    - Elevation (based on digital elevation model, DEM)
    - Average slope (based on DEM)
    - Percent imperviousness (based on National Land Cover Dataset, NLCD)
  - ROW shapefile
    - Split into smaller segments at logical breaks in road type
    - Area
    - Percent imperviousness (based on NLCD)

2. Parcel Opportunity Screening - Operations

- Parcels:
  - Spatial geoprocessing to summarize the surrounding area
    - In GIS, each parcel given a buffer of 1,000 ft to create a new shapefile
      - For a typical parcel, the buffer area is about 100 acres
    - Scripting in Python, GeoPandas used to overlay the buffers with the original parcel shapefile
      - Total area in buffer
      - Total impervious area in buffer
      - Area in buffer higher than parcel
      - Impervious area in buffer higher than parcel
    - Rationale: This is a rough, but consistent, method for estimating potential tributary area that does not depend a detailed, connected storm drain network
      - Use this to flag parcels that are surrounded by denser development and are lower than the surrounding development

2. Parcel Opportunity Screening - Example



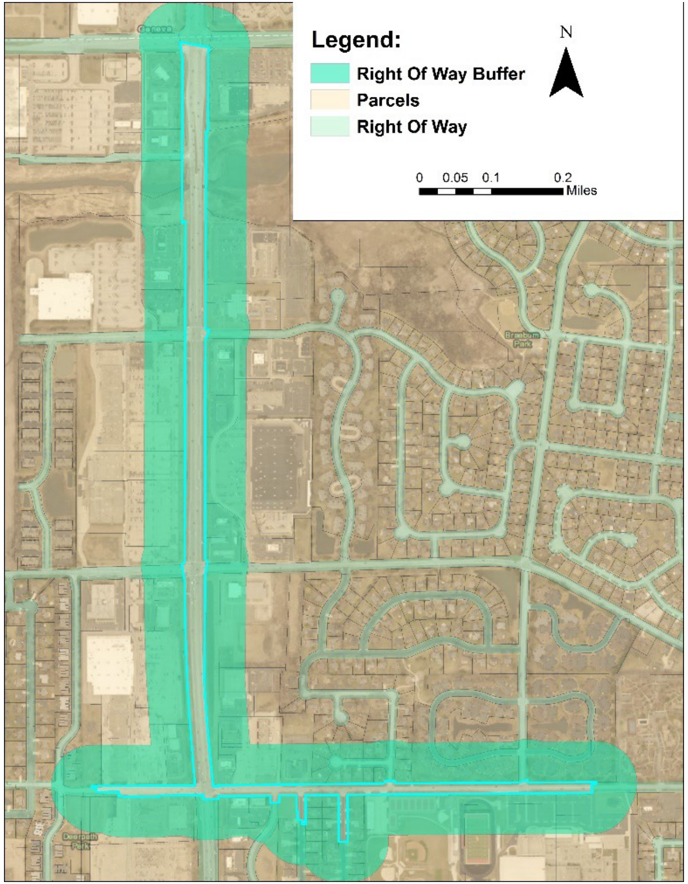
- Likely a useful parcel
  - Large
  - Dry
  - Low point

Overlay Area (ac)	Impervious Area (ac)	High Elev Area (ac)	High Elev Imp Area (ac)
90	46	79	41

2. Parcel Opportunity Screening - Operations

- Right of ways (ROWs):
  - Spatial geoprocessing to summarize roadway segments and their surrounding area:
    - In GIS, each ROW given a buffer of 300 ft (approx. one block) to create a new shapefile
    - Scripting in Python, GeoPandas used to overlay the ROW buffers with the parcel shapefile
      - Parcel + roadway area in buffer
      - Parcel plus roadway impervious area in buffer
    - Sorted parcel land uses into 5-6 broad types:
      - Commercial, agriculture, residential, industrial, government, open space
    - Calculated majority land use by area within each buffer

2. Parcel Opportunity Screening - Example



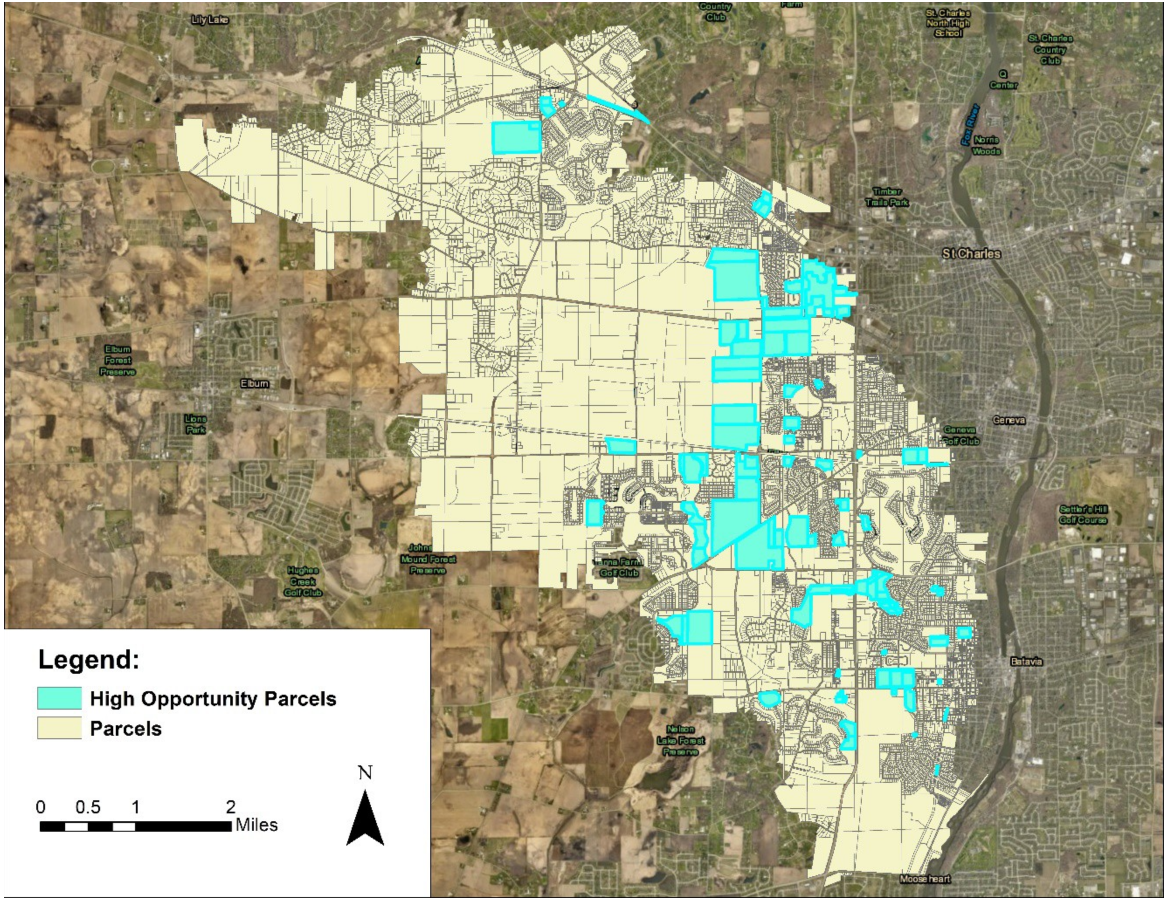
- Likely a useful right of way
  - High imperviousness
  - Urban

Majority Land Use	Combined ROW and Buffer Imperviousness (%)	Impervious Area (ac)
Commercial	60	90

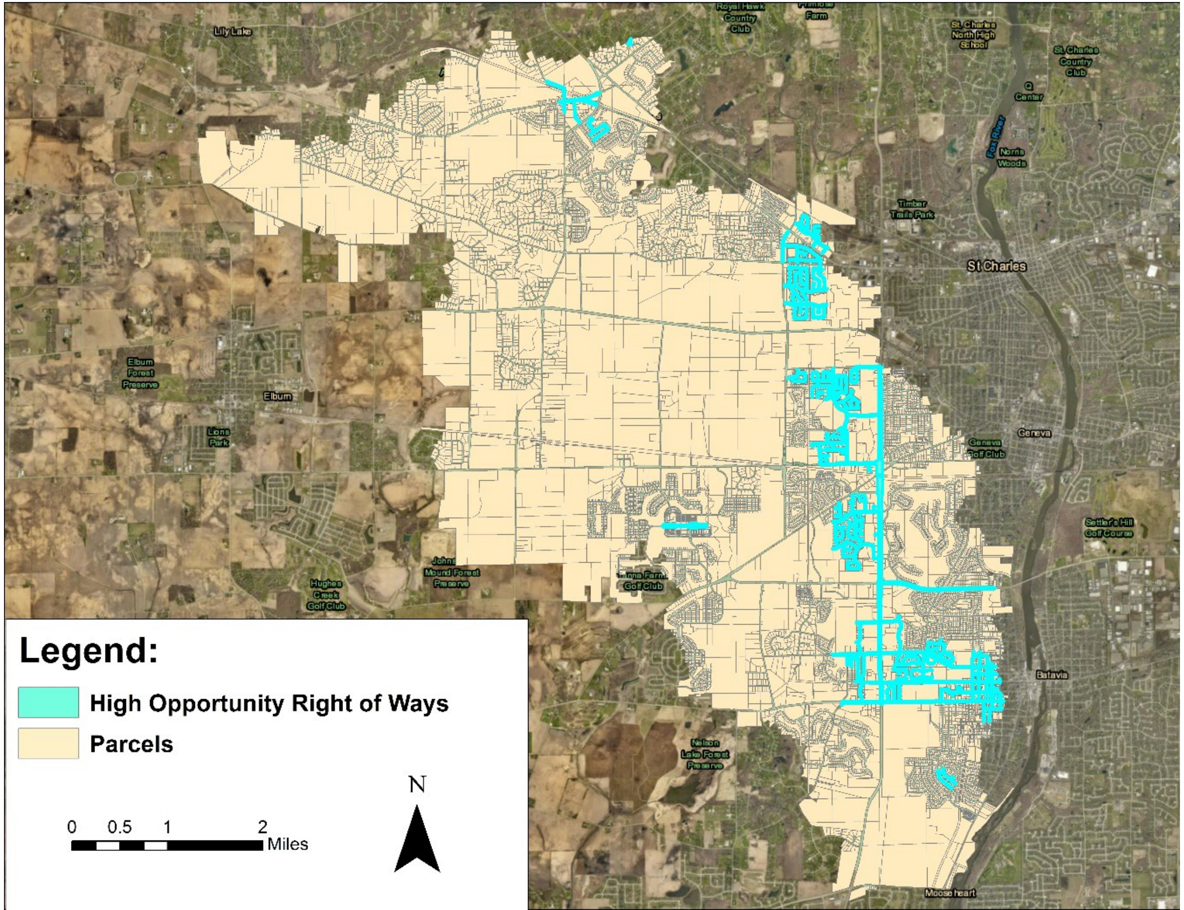
2. Parcel Opportunity Screening Thresholds

- Parcels – High Priority Thresholds
  - Owned by local government (city, county, township, school district, park district, etc.), AND
  - Slope < 5%, AND
  - Area > 0.5 ac, AND
    - Higher elevation impervious area in buffer > 15 acres OR
    - Total impervious area in buffer > 30 acres
- Right of Ways – High Priority Thresholds
  - Area > 0.5 ac, AND
    - Surrounding dominant land use is commercial, industrial, institutional, high density residential or mixed AND imperviousness > 30% OR
    - Total Imperviousness > 40%

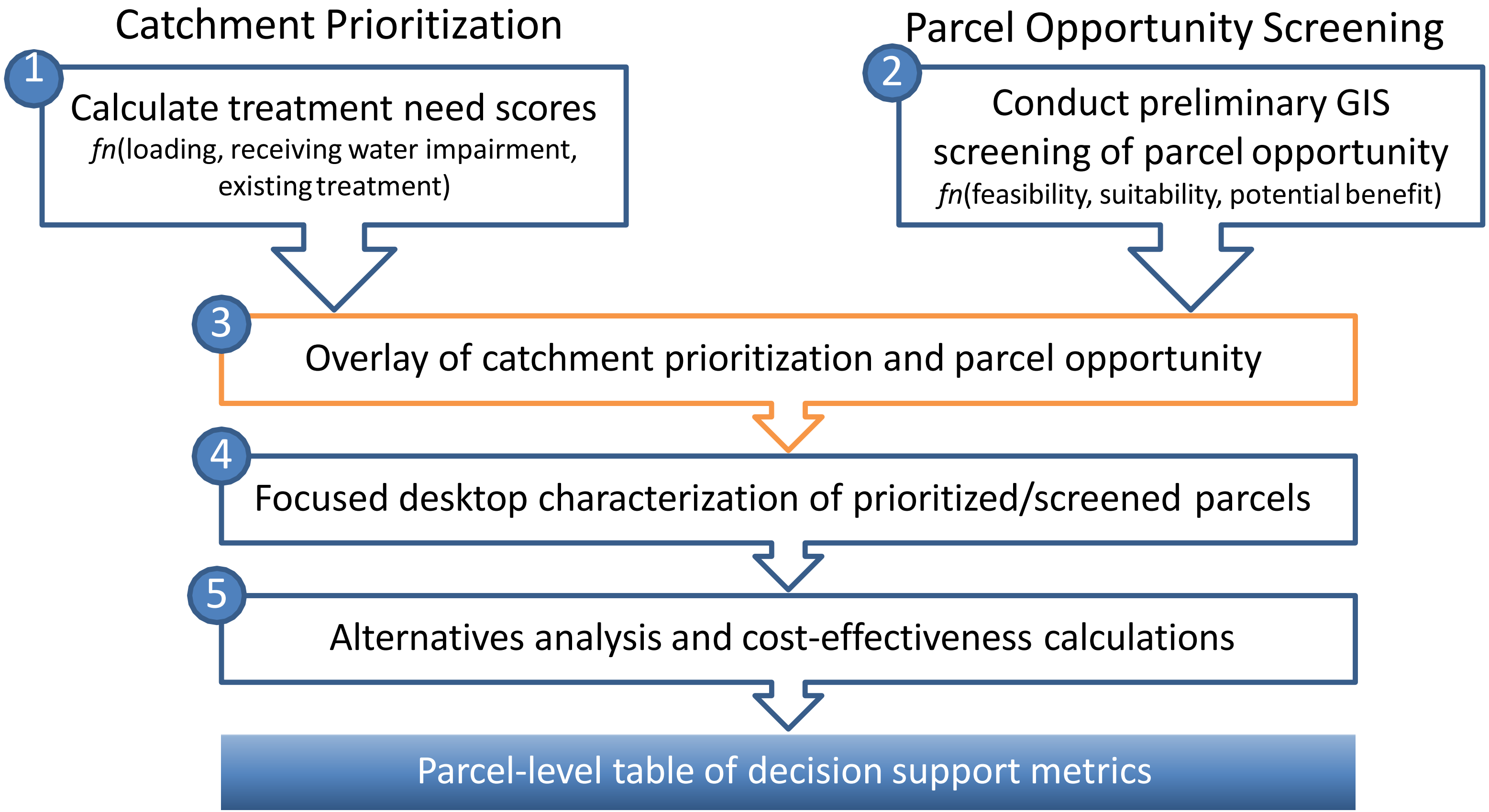
2. Parcel Opportunity Screening – Outputs: High Opportunity Parcels



2. Parcel Opportunity Screening – Outputs: High Opportunity Right of Ways



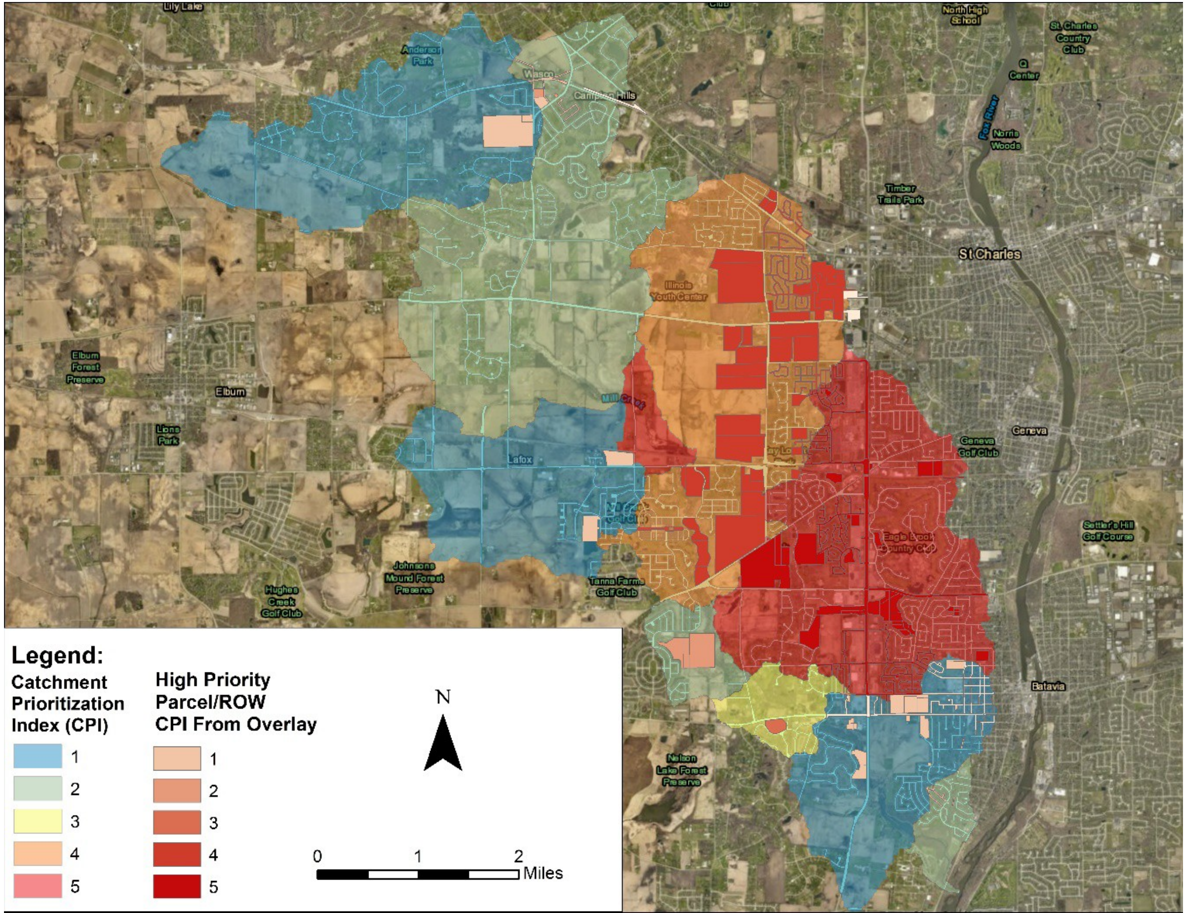
3. Overlay of catchment prioritization and parcel opportunity



3. Overlay of catchment prioritization and parcel opportunity - inputs

- Goal
  - Identify high opportunity parcels and right of ways in high priority catchments
- Inputs
  - Catchment prioritization index (CPI) shapefile (Step 1)
  - High opportunity parcels shapefile (Step 2)
  - High opportunity ROWs shapefile (Step 2)

3. Overlay of catchment prioritization and parcel opportunity - outputs

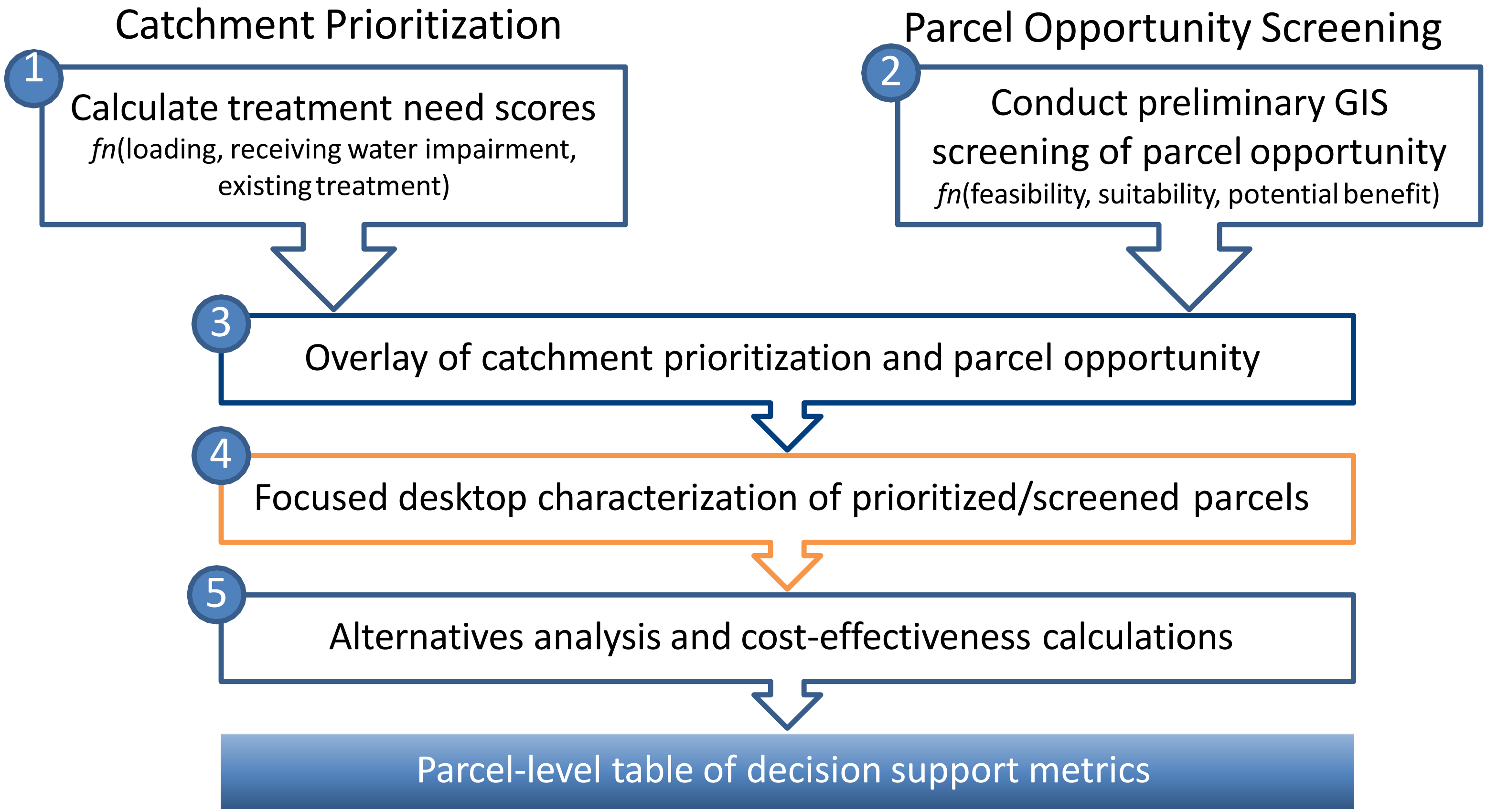


3. Overlay of catchment prioritization and parcel opportunity - outputs

Example tabular summary of Step 3 results

CPI Score	High Opportunity Regional BMP Parcel Count	1000 ft Buffered Impervious Tributary Area (ac)	High Opportunity ROW Segments Count	300 ft Buffered Impervious Tributary Area (ac)	Total Buffered Impervious Tributary Area (ac)
5	36	976	19	666	1642
4	36	786	13	269	1055
3	1	16	1	10	26
2	6	127	3	65	192
1	23	391	10	230	621

4. Conduct desktop parcel characterization



4. Conduct desktop parcel characterization

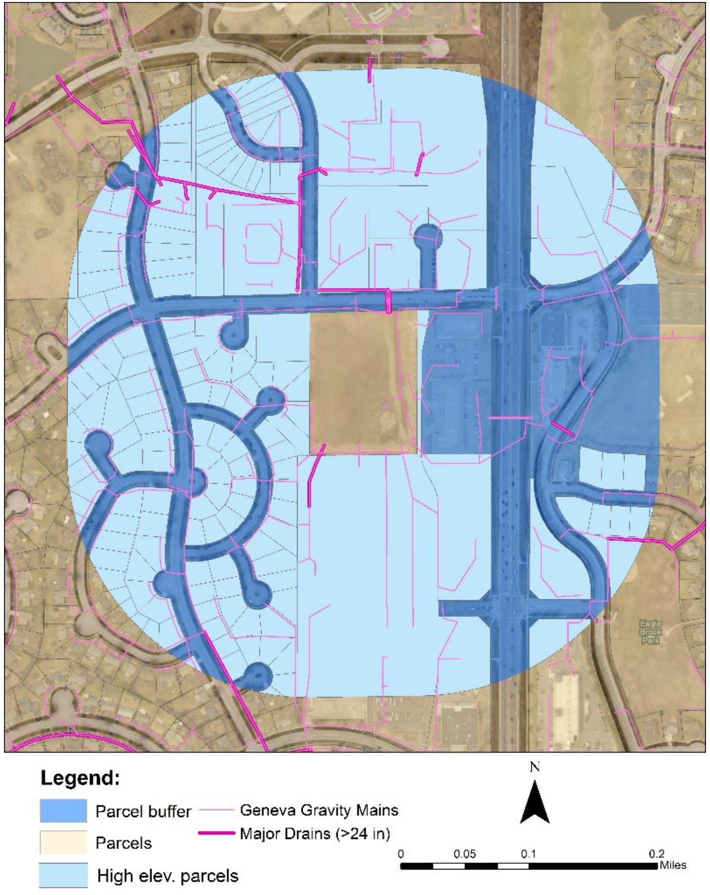
- **Inputs:**
  - Screened parcel list for priority subwatersheds
  - DEM, storm drain data, other utilities, parcel data, aerial photography, Google StreetView
- **Operations:**
  - Tributary area delineation and spatial analysis to characterize drainage area attributes
  - Parcel area measurements to determine feasible BMP area
  - Synthesis of other information from manual inspection
- **Output:**
  - Standard characterization table (metrics on next slide)
  - Key field-level data acquisition needs

4. Conduct desktop parcel characterization

- Tributary Area
- Imperviousness
- Land Use
- Existing Treatment
- Feasible BMP Area
  - Considering existing uses of site
- BMP Excavation Depth
  - Considering the depth of the tributary storm drain
- Maximum BMP Effective Storage Depth
  - Considering elevation of the discharge point from the BMP
- Soil and Hydrogeologic Conditions
  - High GW, infiltration feasibility, ability to maintain permanent pool
- Utility Conflicts
  - Narrative or standard scoring approach
- BMP Suitability
  - H,M,L matrix by BMP type
- Other feasibility/suitability information
  - Narrative
- Field data needs
  - e.g., storm drain invert elev., utility locations

A standardized format helps coordinate efforts by multiple parties to build a master list of opportunity screening results

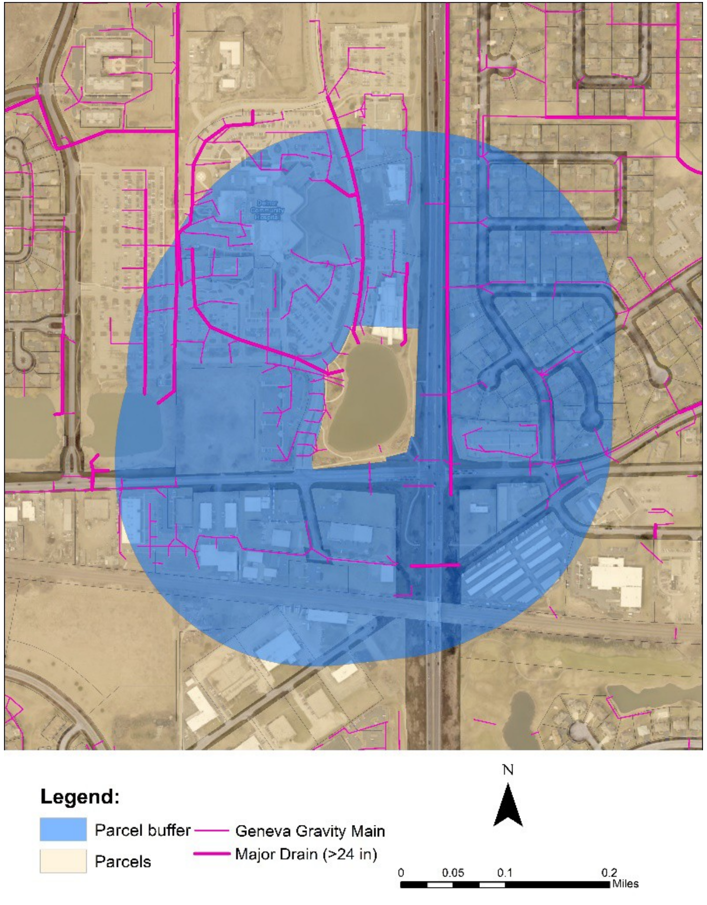
4. Conduct desktop parcel characterization



Example of a potentially feasible parcel that desktop screening can help verify:

- Proximity to storm drains
- No visible existing treatment

4. Conduct desktop parcel characterization



Questionable parcels

- Will likely be flagged as high opportunity but require further investigation
  - The Kane County existing BMP dataset will help identify which parcels are already managed

4. Conduct desktop parcel characterization

Site visit needed to confirm potential for treatment

5. Alternatives Analysis and Whole Lifecycle Cost and Performance Analysis

Catchment Prioritization

1. Calculate treatment need scores
fn(loading, receiving water impairment, existing treatment)

Parcel Opportunity Screening

2. Conduct preliminary GIS screening of parcel opportunity
fn(feasibility, suitability, potential benefit)

3. Overlay of catchment prioritization and parcel opportunity

4. Focused desktop characterization of prioritized/screened parcels

5. Alternatives analysis and cost-effectiveness calculations

Parcel-level table of decision support metrics

5. Alternatives Analysis and Whole Lifecycle Cost and Performance Analysis

- **Inputs:**
  - Tributary area parameters
  - Compatible BMP types based on parcel characterization results and professional judgment
  - Reasonably feasible BMP footprints and volumes
- **Operations:**
  - Define 2 to 3 BMP type options with 2 sizing options
    - For example, full available footprint and half of available footprint
  - Estimate load reduction performance
  - Estimate whole lifecycle costs
- **Output:**
  - Table of load reductions and whole lifecycle costs by parcel
  - Will include most suitable BMPs for each parcel – user will have to pick

5. Alternatives Analysis and Whole Lifecycle Cost and Performance Analysis

- Resources for this step:
  - NCHRP Report 792: Whole Lifecycle Cost and Performance of Stormwater BMPs
    - Bioretention (with and without underdrains)
    - Dry Detention Ponds
    - Wet Ponds
    - Swales
    - Sand Filters
    - Grass Filter Strip
  - Land use runoff concentrations estimated from HSPF
  - NRCS hydrologic soil group shapefile

NCHRP 792 Whole Lifecycle Cost Tools

NCHRP Sand Filter Evaluation Tool

Project Title	Test Run
Project Location	Kane County, Illinois
Company	Kane County and CMAP

PROJECT LOCATION AND CLIMATE SELECTION | PROJECT OPTIONS | TRIBUTARY AREA ATTRIBUTES | BMP PARAMETERS | RESULTS SUMMARY REPORT | SUPPORTING DATA | WHOLE LIFE CYCLE COSTS SUMMARY

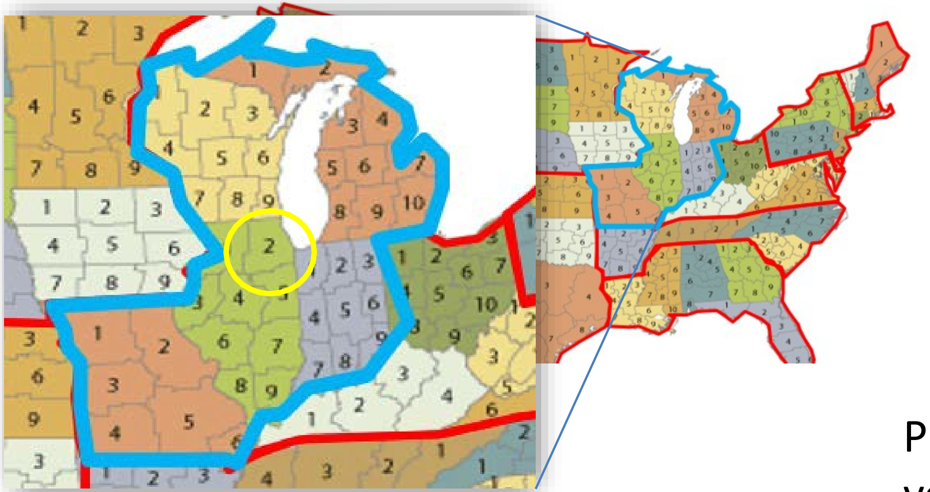
States within Selected Region	Rain Gages Available in State
Illinois	[2] NORTHEAST - CHICAGO MIDWAY AP 3SW

COOP ID	111577
Elevation , feet	620
85th Percentile, 24-Hour Storm Depth, inches	0.90
95th Percentile, 24-Hour Storm Depth, inches	1.50
Average Annual Precipitation Depth, inches	36.4

Step 3: If available, override the existing data and provide project specific rain data

Project Location 85th Percentile, 24-Hour Storm Depth (in)	0.9
Project Location Average Annual Precipitation Depth (in)	36.4

Note: Default precipitation statistics and the project-specific precipitation statistics are for reference and scaling purposes only; they do not imply a BMP size used for performance analysis. The user enters the BMP sizing parameters to be analyzed on the Project Design tab.



Precipitation and ET are based on 30 years at Midway Airport (1980-2009)

Tool can be downloaded at this link

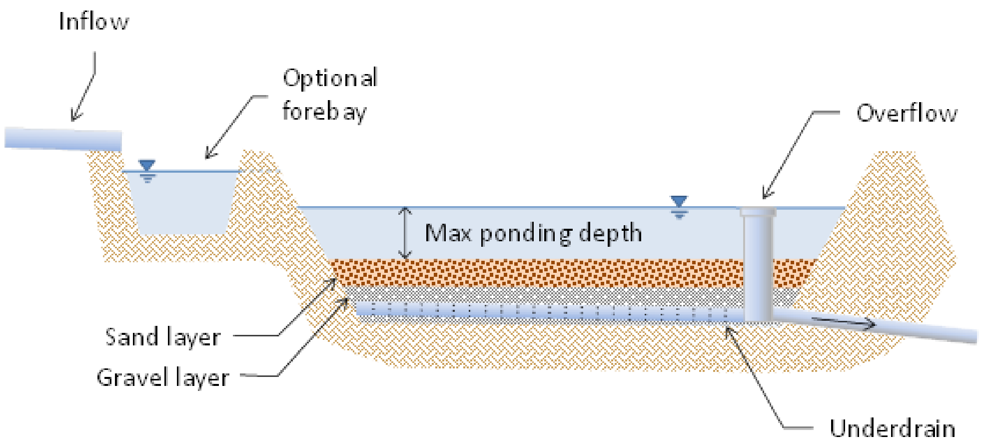
Tributary Area Attributes

Step 1: Provide data describing the tributary area of the project		
Tributary Area Input Parameters	**Value**	**Guidance**
Tributary Area (acres)	20	Enter the total area tributary to the BMP
Impervious Area (%)	70	All impervious area is assumed to be directly connected within the BMP tributary area; adjust imperviousness to account for disconnection if present (Value entered as an integer [e.g. 80 for 80%])
Tributary Area Soil Type (Hydrologic Soil Group)	Sandy Clay Loam (C)	Select the soil type that is most representative of the tributary area to the BMP
Calculated Runoff Coefficient	0.43	This runoff coefficient is calculated based on a Two-line regression model of the volumetric runoff coefficient (Rv) (Granato, 2010), where Rv(%<55) = imperviousness (%) × 0.225 + 0.05, Rv(%>55) = imperviousness (%) × 1.14 - 0.371
User-Provided Runoff Coefficient	0.6	Enter a site-specific runoff coefficient if available. If no value is entered here, the calculated runoff coefficient will be used.

Tributary Area Runoff Reference Values	Value	Guidance
Reference 85th Percentile, 24-Hour Storm Depth, inches	0.90	Per project-specific user input; for reference purposes only.
Reference Runoff from 85th Percentile Storm Event, cu-ft	39,200	Volume is based on the calculated volumetric runoff coefficient or the user-entered runoff coefficient, if entered. For refereence only.
Reference Average Annual Precipitation Depth, inches	36.4	Per project-specific user input; for reference purposes only.
Reference Average Annual Runoff Volume, cu-ft	1,584,000	Volume is based on the calculated volumetric runoff coefficient or the user-entered runoff coefficient, if entered. For refereence only.

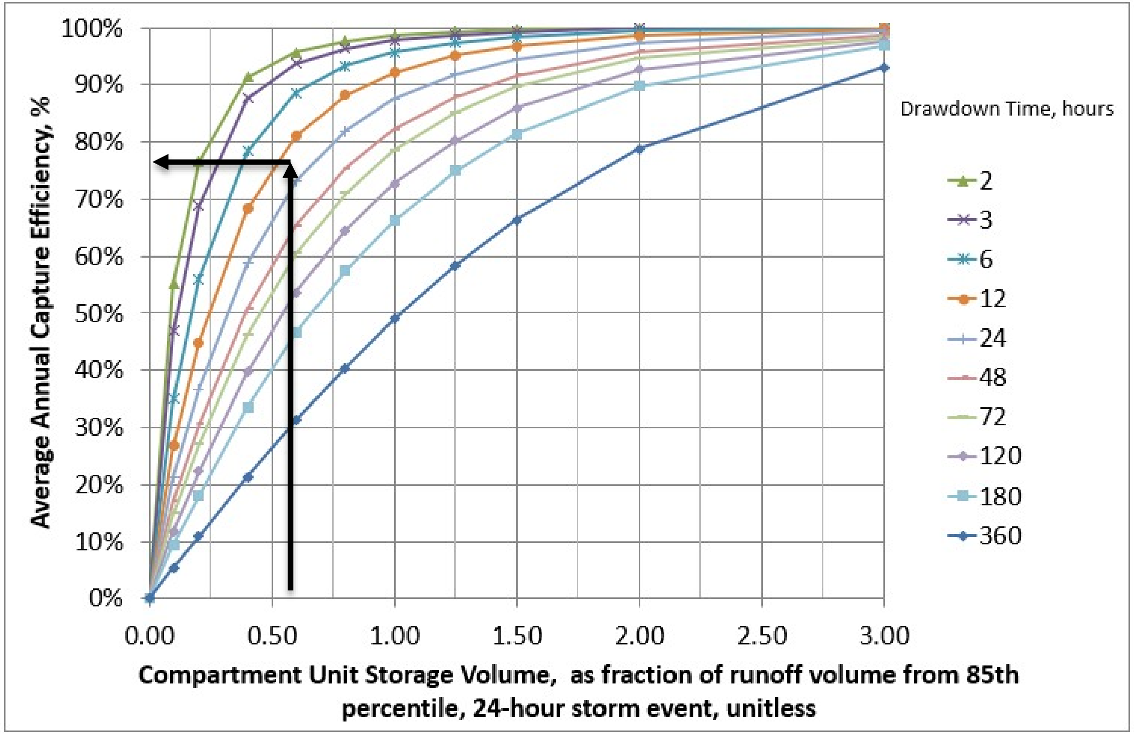
The tools requires simple characteristics of the tributary watershed

Primary Sand Filter Design Parameters	Value	Guidance
Storage Volume (cu-ft)	30,000	Enter the total storage volume provided by the ponding depth
Max Ponding Depth (ft)	3	Ponding depth is equal to the elevation of the overflow above the surface of the media
Media Thickness (ft)	2	The thickness of the sand or media layer provided
Media Filtration Rate (in/hr)	2	The rate at which water will infiltrate through the sand or media



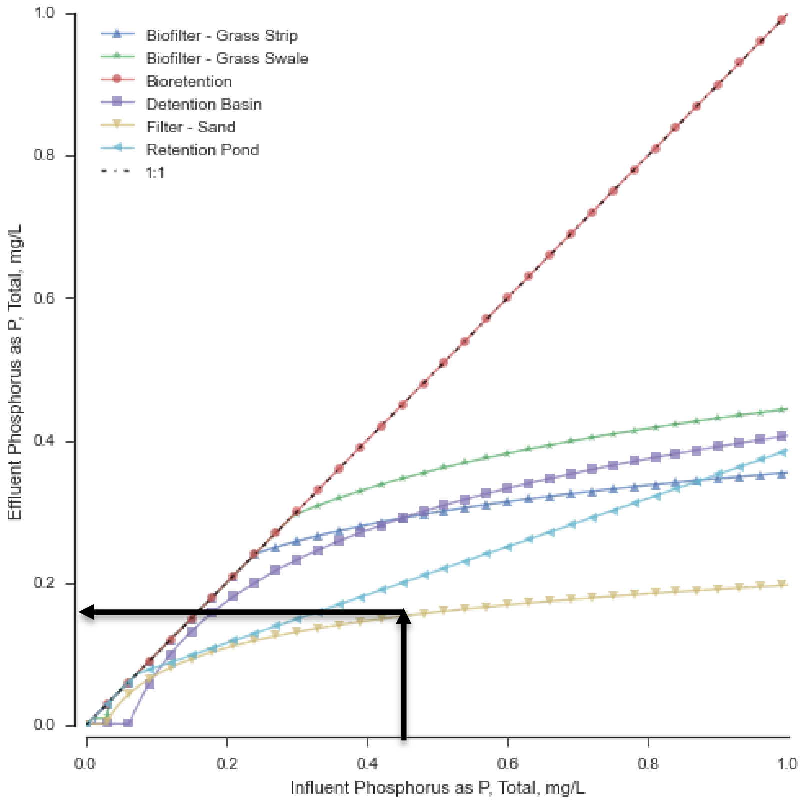
The tools requires conceptual design parameters that can be relatively efficiently estimated for alternatives

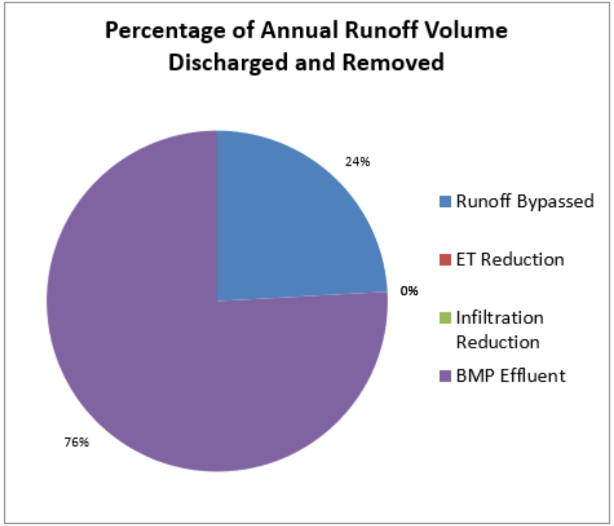
Nomographs derived from 30-year continuous SWMM simulations are used to estimate capture efficiency and volume reduction

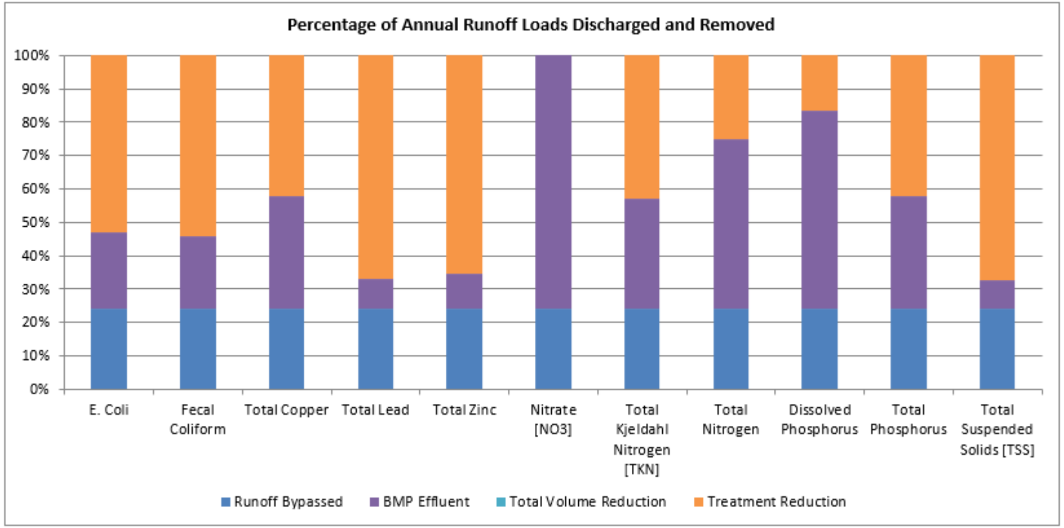


Influent-effluent regressions from the International Stormwater BMP Database are used to estimate effluent concentration

Note: HSPF land use runoff concentrations can be used instead of default highway influent concentrations



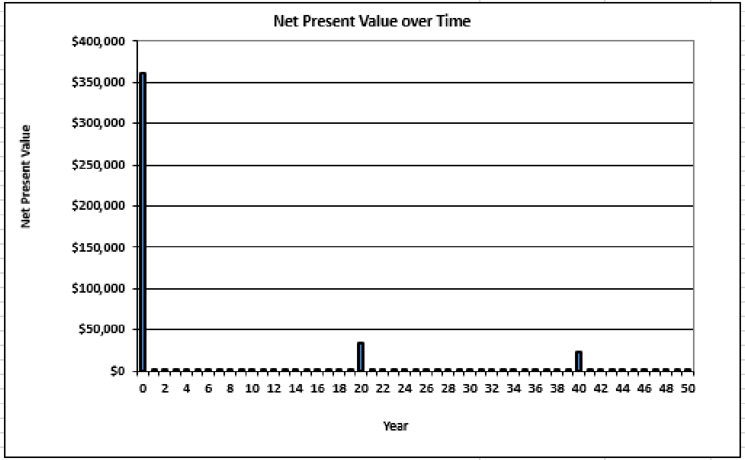


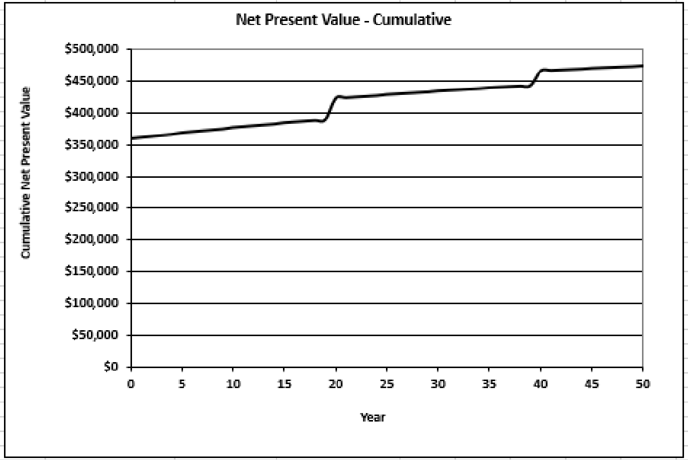


Results are summarized in terms of long term capture efficiency, volume reduction, load removal, and whole effluent concentration

Capital Costing Method	Line Item Engineer's Estimate
Assumed Level of Maintenance	M
Estimated Capital Cost, $ (2013)	$360,437
Estimated NPV of Design Life Maintenance Costs, $ (2013)	$68,593
Estimated NPV of Design Life Whole Life Cycle Cost, $ (2013)	$429,030
Estimated Annualized Whole Life Cycle Cost, $/yr (2013)	$17,161

Totals are based on design life with routine and major maintenance.





Whole lifecycle cost estimates are developed based on line-item costing methods (adapted from earlier WERF research) with ability to override unit costs or quantity calculations

Hydrologic Performance ($$/cu-ft removed)		Pathogens ($$/10^12 CFU removed)		Metals ($$/lb removed)			Nutrients ($$/lb removed)					Sediment ($$/lb removed)
Volume Reduction	Volume Capture	E. Coli	Fecal Coliform	Total Copper	Total Lead	Total Zinc	Nitrate [NO3]	Total Kjeldahl Nitrogen [TKN]	Total Nitrogen	Dissolved Phosphorus	Total Phosphorus	Total Suspended Solids [TSS]
N/A	$0.0143	$1.19	$0.81	$9,845	$5,866	$1,397	N/A	$174	$192	$4,229	$930	$1.85

Based on average annual load reduction and annualized lifecycle cost, the cost per unit of load reduction can be calculated for use in project ranking

Master BMP Opportunity Table

Parcel No	Parcel Attributes	Scenario	Tributary Area Metrics	BMP Type	BMP Size (ac-ft)	Volume Treated and Reduced (ac-ft/yr)	Capital Cost ($)	WLC Cost ($/yr)	Total Nitrogen (TN) Load Reduction (lb/yr)	TN Cost Effect Ratio ($/lb TN removed)	…
	Area, ownership, etc.	Preferred or backup	Area, % imp, land use	Dry pond, wet pond, bioretention, swale							

Next Steps for Framework Application

Geosyntec consultants

Next Steps to Apply Framework

1. Apply CPI calculations to updated HSPF results from the refined watershed delineations
2. Receive and analyze existing stormwater facility data from Kane County and apply to revise CPI scores
3. Refine scripts for CPI calculations and parcel and ROW analysis
4. Receive input on and revise opportunity screening thresholds
   – Consider interactive web map to allow adjustable thresholds (e.g., slider bars)
5. Consider additional data layers potentially useful for desktop parcel screening (e.g., other utility layers, planned development)
6. Develop workflow for collaboration on parcel screening and alternatives analysis

Review of Objectives

- Outline a phased framework to develop a list of prioritized project opportunities with adequate information to support plan development
  - Starting with HSPF- and GIS-based screening and parcel prioritization
  - Followed by more in-depth research and analysis
  - Resulting in a table of project attributes with feasibility, cost, and performance estimates

- Describe and demonstrate an efficient screening method to prioritize parcels for further research and analysis
  - Describe use of HSPF model output
  - Describe use of native and derived parcel metrics

- Describe methods to conduct parcel-level BMP selection, sizing, and cost-effectiveness analysis
  - Present considerations focused desktop parcel characterization
  - Identify tools for analysis of BMP cost and performance

QUESTIONS?

Geosyntec consultants

Appendix E – Comprehensive Plan Review Checklist

Comprehensive Plan Questions

Created from U.S. EPA's Water Quality Scorecard

Plan title:

Date adopted:

Web link:

Reviewer name, email, phone:

Brief summary of plan/Notes:

Does the plan....		Y/N	Notes	Plan section
Natural Resources				
1	identify and map critical natural resource areas? (if yes, what? e.g., steep slopes, wildlife habitat, forests, drinking water source areas)			
2	contain a natural resource protection element with goals calling for preservation of identified critical natural resource areas?			
3	identify key natural resource areas for protection in jurisdiction's parks and open space plan?			
4	establish and enforce areas which are available for development and which lands are a priority for preservation?			
Water Resources				
5	map and identify critical water resource areas?			
6	contain a water quality protection element with goals calling for protection of identiied water bodies and other water resource areas such as wetlands?			
7	identify key critical water resource areas for protection in jurisdiction's parks and open space plan?			
8	outline protection measures for source water protection areas through land use controls and stewardship activities?			
9	identify and map aquifer recharge/source water areas and/or wellheads and recommend protective measures?			
Open Space				
10	identify adequate open space in both developed and greenfield areas of the community?			
11	contain an open space/parks element that recognizes the role of open space in sustainable stormwater management?			
Trees				
12	include tree preservation and replacement as community goals?			
13	support the planting of street trees by all private and public development projects?			

Does the plan....		Y/N	Notes	Plan section
Development Type and Location				
14	direct development to previously developed areas?			
15	identify potential brownfield and greyfield sites and support their redevelopment?			
16	direct growth to areas with existing infrastructure, such as sewer, water, and roads?			
17	Are mixed-use and transit-oriented developments allowed or encouraged?			
18	identify appropriate areas for higher-density mixed-use developments (e.g., at transit stops) and recommend policies to encourage their development?			
Transportation / Parking				
19	emphasize alternative modes of transportation (walking, biking, and transit) to reduce vehicle miles traveled and width and prominence of roads/streets?			
20	call for distributing traffic across several parallel streets, reducing the need for high capacity streets with wide rights-of-way?			
21	include or recommend the creation of a formal bicycle/pedestrian master plan?			
22	recommend supporting “safe routes to school” programs or other pedestrian/bike safety initiatives?			
23	recommend improvements to walking/biking conditions			
24	promote green infrastructure practices in street design?			
25	recognize the advantages to reduced parking requirements generally and specifically for mixed-use and transit-oriented developments?			
26	recommend alternative, flexible approaches to meeting parking demands (e.g., shared parking, counting on-street spaces towards site parking requirements)?			
27	recommend provision of bicycle parking spaces/storage lockers and concomitant reduction in vehicle parking space requirements?			
28	recognize transportation demand management as an approach to reducing vehicle miles traveled and parking requirements?			
29	call for landscaping in parking lots to help reduce stormwater runoff?			

Appendix F – Watershed-wide BMP Scenarios Pollutant Load Reductions

Table F-1. Nitrogen load reduction by BMP type by subwatershed (lb/yr).

BMP type		Subwatershed #											Totals
		1	2	3	4	5	6	7	8	9	10	11	
Bioretention Facility		0	372	0	92	1,191	451	24	427	249	3,494	887	7,187
Rain Garden		96	431	0	9	1,630	85	1	195	117	704	321	3,589
Infiltration Trench		119	338	96	0	190	299	0	84	363	963	1,059	3,509
Vegetated Swale		0	111	143	16	259	149	6	103	118	778	84	1,768
Filter Strip (Ag)		138	2,412	2,676	0	0	930	25	0	2,878	6,443	2,562	18,064
Filter Strip (Urban)		108	342	0	84	1,595	483	27	661	163	2,690	342	6,495
Pervious and Porous Pavement		982	7,057	154	0	12,755	0	252	9,143	5,692	39,314	15,198	90,546
Dry Detention basin retrofit		1	27	0	3	73	18	0	32	18	32	9	212
Wet detention basin retrofit		0	17	0	0	63	0	3	18	8	33	43	184
Tree Box Filter		14	182	46	24	662	96	8	274	160	2,374	1,139	4,979
Hydrodynamic Separators		0	6	2	11	73	0	2	85	8	163	38	388
Green Roof		861	2,728	3,330	471	2,446	1,158	0	487	1,279	12,660	0	25,420
Denitrifying Bioreactor		1,206	3,820	3,885	659	3,210	2,026	55	639	2,239	16,616	0	34,354
Saturated Buffer		7,025	12,142	41,160	1,747	15,874	42,925	1,159	1,806	14,231	117,365	101,330	356,763
Riparian Corridor Restoration		210	1,726	405	57	1,711	1,408	76	1,896	2,334	11,552	1,662	23,039
Prairie Restoration		3,466	4,707	1,276	2,979	3,516	666	0	2,800	736	24,264	2,619	47,029
Wetland Restoration		0	0	0	742	4,816	0	0	603	0	0	0	6,160
Totals	**lb/yr**	**14,226**	**36,416**	**53,173**	**6,893**	**50,065**	**50,694**	**1,638**	**19,252**	**30,593**	**239,443**	**127,291**	**629,685**

Table F-2. Phosphorus load reduction by BMP type by subwatershed (lb/yr).

BMP type		Subwatershed #											Totals
		1	2	3	4	5	6	7	8	9	10	11	
Bioretention Facility		0	18	0	4	58	21	1	25	12	173	43	356
Rain Garden		5	20	0	0	78	4	0	11	6	34	15	174
Infiltration Trench		5	15	4	0	9	13	0	5	17	45	49	162
Vegetated Swale		0	5	6	1	11	6	0	5	5	33	4	76
Filter Strip (Ag)		0	0	0	88	575	0	0	87	0	0	0	750
Filter Strip (Urban)		19	322	349	0	0	123	4	0	396	889	349	2,452
Pervious and Porous Pavement		4	13	0	3	60	18	1	30	6	103	13	251
Dry Detention basin retrofit		44	317	7	0	577	0	13	501	263	1,821	695	4,238
Wet detention basin retrofit		0	4	0	0	10	2	0	5	2	5	1	30
Tree Box Filter		0	1	0	0	3	0	0	1	0	2	2	9
Hydrodynamic Separators		3	38	9	5	138	20	2	69	34	506	239	1,063
Green Roof		0	0	0	1	4	0	0	5	0	8	2	20
Denitrifying Bioreactor		0	0	0	0	0	0	0	0	0	0	0	0
Saturated Buffer		28	89	89	16	76	47	1	18	54	402	0	820
Riparian Corridor Restoration		313	536	1,773	78	707	1,882	59	97	647	5,354	4,561	16,006
Prairie Restoration		12	95	22	3	95	77	5	128	133	658	93	1,322
Wetland Restoration		119	161	43	102	121	23	0	117	26	857	91	1,660
Totals	**lb/yr**	**552**	**1,634**	**2,301**	**301**	**2,521**	**2,237**	**87**	**1,106**	**1,601**	**10,890**	**6,158**	**29,387**

Table F-3. Sediment load reduction by BMP type by subwatershed (lb/yr).

BMP type		Subwatershed #											Totals
		1	2	3	4	5	6	7	8	9	10	11	
Bioretention Facility		0	14,203	0	1,832	44,639	18,634	474	14,921	9,379	98,061	32,617	234,761
Rain Garden		4,343	20,317	0	213	75,448	4,339	32	8,397	5,460	24,402	14,558	157,509
Infiltration Trench		6,783	20,143	7,418	0	11,079	19,269	0	4,572	21,337	42,152	60,712	193,464
Vegetated Swale		0	4,037	6,812	298	9,286	5,899	107	3,449	4,241	20,868	2,950	57,947
Filter Strip (Ag)		0	0	0	49,073	597,766	0	0	69,776	0	0	0	716,615
Filter Strip (Urban)		14,107	256,023	370,288	0	0	106,875	1,360	0	301,241	502,873	261,905	1,814,672
Pervious and Porous Pavement		5,445	17,967	0	2,299	82,350	27,501	735	31,809	8,444	104,030	17,330	297,909
Dry Detention basin retrofit		32,443	242,821	6,923	0	430,817	0	4,423	288,014	193,105	994,643	503,669	2,696,859
Wet detention basin retrofit		148	3,042	0	179	8,133	2,164	15	3,305	1,966	2,722	984	22,656
Tree Box Filter		0	4,468	0	0	16,220	0	339	4,199	2,065	6,351	10,774	44,418
Hydrodynamic Separators		1,477	19,498	6,463	1,321	69,706	11,192	427	26,885	16,899	187,078	117,539	458,485
Green Roof		39	650	345	669	8,150	0	106	8,922	901	13,673	4,179	37,635
Denitrifying Bioreactor		0	0	0	0	0	0	0	0	0	0	0	0
Saturated Buffer		0	0	0	0	0	0	0	0	0	0	0	0
Riparian Corridor Restoration		30,093	54,161	239,353	4,076	69,508	207,251	2,637	7,376	62,589	384,934	435,330	1,497,307
Prairie Restoration		1,094	9,388	2,872	163	9,135	8,290	211	9,441	12,518	46,192	8,707	108,011
Wetland Restoration		137,879	194,980	68,934	64,561	142,987	29,844	0	106,213	30,043	739,074	104,479	1,618,994
Totals	**lb/yr**	**233,852**	**861,698**	**709,408**	**124,684**	**1,575,225**	**441,258**	**10,867**	**587,278**	**670,189**	**3,167,052**	**1,575,733**	**9,957,243**
	t/yr	***117***	***431***	***355***	***62***	***788***	***221***	***5***	***294***	***335***	***1584***	***788***	***4,979***

Table F-4. Fecal coliform load reduction by BMP type by subwatershed (cfu/yr).

BMP type	Subwatershed #											Totals
	1	2	3	4	5	6	7	8	9	10	11	
Bioretention Facility	0.00E+00	2.58E+12	0.00E+00	1.75E+12	7.95E+12	7.44E+11	1.91E+12	1.09E+13	3.12E+11	9.07E+12	1.31E+12	3.65E+13
Rain Garden	2.35E+11	4.13E+11	0.00E+00	2.28E+10	1.50E+12	1.94E+10	1.45E+10	6.85E+11	2.03E+10	2.53E+11	6.53E+10	3.23E+12
Infiltration Trench	3.88E+11	4.33E+11	5.10E+10	0.00E+00	2.33E+11	9.09E+10	0.00E+00	3.94E+11	8.39E+10	4.61E+11	2.88E+11	2.42E+12
Vegetated Swale	0.00E+00	8.16E+11	4.41E+11	3.17E+11	1.84E+12	2.62E+11	4.81E+11	2.80E+12	1.57E+11	2.15E+12	1.31E+11	9.39E+12
Filter Strip (Ag)	0.00E+00	0.00E+00	0.00E+00	5.80E+12	1.32E+13	0.00E+00	0.00E+00	6.29E+12	0.00E+00	0.00E+00	0.00E+00	2.53E+13
Filter Strip (Urban)	1.41E+12	9.60E+12	4.44E+12	0.00E+00	0.00E+00	8.80E+11	1.13E+12	0.00E+00	2.07E+12	9.59E+12	2.16E+12	3.13E+13
Pervious and Porous Pavement	3.88E+11	4.81E+11	0.00E+00	3.23E+11	2.16E+12	1.62E+11	4.36E+11	3.41E+12	4.14E+10	1.42E+12	1.02E+11	8.92E+12
Dry Detention basin retrofit	1.36E+13	3.82E+13	3.49E+11	0.00E+00	6.64E+13	0.00E+00	1.54E+13	1.82E+14	5.56E+12	7.96E+13	1.75E+13	4.18E+14
Wet detention basin retrofit	9.98E+09	7.71E+10	0.00E+00	2.38E+10	2.02E+11	1.20E+10	8.26E+09	3.36E+11	9.12E+09	3.51E+10	5.50E+09	7.18E+11
Tree Box Filter	0.00E+00	8.73E+10	0.00E+00	0.00E+00	3.10E+11	0.00E+00	1.47E+11	3.29E+11	7.38E+09	6.31E+10	4.64E+10	9.90E+11
Hydrodynamic Separators	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Green Roof	2.81E+09	1.75E+10	2.96E+09	9.45E+10	2.14E+11	0.00E+00	6.33E+10	9.61E+11	4.43E+09	1.87E+11	2.47E+10	1.57E+12
Denitrifying Bioreactor	5.63E+12	6.98E+12	3.55E+12	3.31E+12	6.02E+12	7.04E+11	0.00E+00	4.58E+12	5.91E+11	1.21E+13	0.00E+00	4.35E+13
Saturated Buffer	5.63E+12	6.98E+12	2.96E+12	3.31E+12	5.64E+12	8.80E+11	1.13E+12	4.29E+12	7.38E+11	1.14E+13	0.00E+00	4.29E+13
Riparian Corridor Restoration	1.55E+13	1.05E+13	1.48E+13	4.14E+12	1.32E+13	8.80E+12	1.13E+13	5.72E+12	2.22E+12	3.79E+13	1.86E+13	1.43E+14
Prairie Restoration	5.63E+11	1.81E+12	1.78E+11	1.66E+11	1.73E+12	3.52E+11	9.05E+11	7.32E+12	4.43E+11	4.54E+12	3.71E+11	1.84E+13
Wetland Restoration	7.68E+13	4.08E+13	4.62E+12	7.11E+13	2.93E+13	1.37E+12	0.00E+00	8.92E+13	1.15E+12	7.88E+13	4.82E+12	3.98E+14
Totals cfu/yr	**1.20E+14**	**1.20E+14**	**3.14E+13**	**9.04E+13**	**1.50E+14**	**1.43E+13**	**3.30E+13**	**3.19E+14**	**1.34E+13**	**2.47E+14**	**4.54E+13**	**1.18E+15**

Appendix G – Site-specific BMPs and Associated Landowners, Location Coordinates, and Pollutant Load Reduction and Cost Estimates

Table G-1. Site-specific BMPs with landowner, potential partners, and location coordinates.

Subwatershed #	*Map #*	*CMAP ID*	*BMP Category*	*BMP Type*	*BMP Code*	*Landowners*	*Potential Partners*	*Latitude*	*Longitude*
1	1	CH-03	Urban	Bioretention Facility (retrofit)	800	Vlg Campton Hills		41.941707	-88.422692
1	2	CT-01	Hydrologic	Wetland Restoration	657 or 999	Private (mult.)	NRCS, KDSWCD	41.924685	-88.464744
1	3	CT-02	Hydrologic	Wetland Restoration	657 or 999	Private (mult.)	NRCS, KDSWCD	41.922393	-88.459668
1	4	CT-03	Hydrologic	Wetland Restoration	657 or 999	Private (mult.)	NRCS, KDSWCD	41.926679	-88.459844
1	5	CT-04	Agriculture	Grassed Waterway	412	Private (mult.)	NRCS, KDSWCD	41.923390	-88.448037
1	6	CT-05	Hydrologic	Wetland Restoration	657 or 999	Private (mult.)	NRCS, KDSWCD	41.923030	-88.444919
1	7	CT-06	Agriculture	Filter Strip	393	Private	KDSWCD	41.938109	-88.421914
1	8	CT-07	Agriculture	Filter Strip	393	Campton Twp	NRCS, KDSWCD	41.939002	-88.415462
1	9	CT-08	Other	Prairie Restoration	643	Campton Twp		41.941247	-88.418504
1	10	CT-09	Hydrologic	Wetland Restoration	657 or 999	Private	NRCS, KDSWCD	41.939942	-88.413952
1	11	CT-10	Other	Prairie Restoration	643	Private		41.939780	-88.411995
1	12	CT-11	Other	Restoration Plan	3	Campton Twp, private	FPDKC	41.941408	-88.414416
1	13	FPD-01	Agriculture	Filter Strip	393	FPDKC	NRCS, KDSWCD	41.937186	-88.415386
1	14	FPD-02	Hydrologic	Wetland Restoration (w/ Brush Management)	657 or 999 (314)	FPDKC	Vlg Campton Hills, Campton Twp	41.923339	-88.415619
1	15	FPD-13	Other	Education	1	FPDKC	Campton Twp	41.932513	-88.411675
2	16	BBT-07	Agriculture	Grassed Waterway	412	Private	NRCS, KDSWCD	41.896321	-88.403037
2	17	BBT-08	Agriculture	Grassed Waterway	412	Private	NRCS, KDSWCD	41.895520	-88.401827
2	18	CH-01	Urban	Filter Strip	835	Fox Mill Master HOA	Vlg Campton Hills	41.924139	-88.403550

Subwatershed #	*Map #*	*CMAP ID*	*BMP Category*	*BMP Type*	*BMP Code*	*Landowners*	*Potential Partners*	*Latitude*	*Longitude*
2	19	CH-02	Urban	Filter Strip	835	Fox Mill Master HOA	Vlg Campton Hills	41.923627	-88.403287
2	20	CH-04	Other	Wetland Acquisition	6	Private	Campton Historic Ag Lands	41.914822	-88.406053
2	21	CH-05	Hydrologic	Wetland Restoration	657 or 999	Private	Campton Historic Ag Lands	41.913794	-88.406222
2	22	CH-06	Hydrologic	Wetland Restoration	657 or 999	Campton Woods HOA		41.912835	-88.409217
2	23	CH-07	Urban	Bioretention Facility	800	Fox Mill Master HOA	Vlg Campton Hills	41.935306	-88.394311
2	24	CH-08	Other	Planning	3	Vlg Campton Hills, Kane Co Health Dept	Homeowners	41.935897	-88.400273
2	25	CH-09	Other	Monitoring	2	Vlg Campton Hills, Kane Co Health Dept	Homeowners	41.928495	-88.446163
2	26	CH-10	Other	Education & Outreach campaign	1	Vlg Campton Hills, Kane Co Health Dept	Homeowners	41.933557	-88.441716
2	27	CH-11	Other	Technical Assistance	4	Vlg Campton Hills, Kane Co Health Dept	Homeowners	41.937875	-88.433949
2	28	CH-12	Other	Education & Outreach campaign	1	Vlg Campton Hills, Campton Twp, Kane Co EWR	Homeowners	41.925876	-88.411337
2	29	CH-13	Other	Monitoring	2	Wasco SD		41.917048	-88.397351
2	30	CH-14	Other	Salinity and Sodic Soil Mgmt.	610	Wasco SD, private	NRCS, KDSWCD	41.917331	-88.392153
2	31	CH-15	Other	Salinity and Sodic Soil Mgmt.	610	Wasco SD, private	NRCS, KDSWCD	41.938502	-88.393137

Subwatershed #	*Map #*	*CMAP ID*	*BMP Category*	*BMP Type*	*BMP Code*	*Landowners*	*Potential Partners*	*Latitude*	*Longitude*
2	32	CT-12	Hydrologic	Wetland Restoration	657 or 999	Campton Twp	FPDKC, NRCS, KDSWCD	41.901791	-88.395057
2	33	CT-13	Agriculture	Grassed Waterway	412	Campton Twp	FPDKC	41.900529	-88.394434
2	34	CT-14	Other	Prairie Restoration	643	Campton Twp	FPDKC	41.898528	-88.394657
2	35	CT-15	Other	Wetland Acquisition	6	Private	FPDKC	41.904648	-88.398977
2	36	CT-16	Hydrologic	Wetland Restoration	657 or 999	FPDKC, private	Campton Twp	41.903622	-88.397368
2	37	CT-17	Hydrologic	Stream Channel Restoration	9	Private (mult.)	KDSWCD, NRCS	41.903300	-88.405469
2	38	FPD-03	Hydrologic	Wetland Restoration (w/ Brush Management)	657 or 999 (314)	FPDKC	Vlg Campton Hills, Campton Twp	41.918119	-88.408475
2	39	FPD-05	Other	Prairie Restoration	643	FPDKC		41.897501	-88.380063
2	40	GF-01	Hydrologic	Wetland Restoration	657 or 999	Campton Historical Ag Lands	NRCS, KDSWCD	41.908107	-88.403228
2	41	GF-02	Hydrologic	Wetland Restoration	657 or 999	Campton Historical Ag Lands	NRCS, KDSWCD	41.910375	-88.391175
2	42	GF-03	Other	Prairie Restoration	643	Campton Historical Ag Lands	NRCS, KDSWCD	41.913909	-88.408144
2	43	GF-05	Agriculture	Saturated Buffer (w/ Filter Strip)	604 (393)	Campton Historical Ag Lands	NRCS, KDSWCD	41.908387	-88.406181
2	44	GF-06	Agriculture	Saturated Buffer (w/ Filter Strip)	604 (393)	Campton Historical Ag Lands	NRCS, KDSWCD	41.906782	-88.404897
2	45	GF-07	Other	Oak Ecosystem Restoration	643	Campton Historical Ag Lands	NRCS, KDSWCD	41.914677	-88.401722
2	46	GF-08	Other	Oak Ecosystem Restoration	643	Campton Historical Ag Lands	NRCS, KDSWCD	41.911019	-88.400025
2	47	GF-09	Other	Oak Ecosystem Restoration	643	Campton Historical Ag Lands	NRCS, KDSWCD	41.909428	-88.393457
2	48	GF-10	Agriculture	Conservation Technical Assistance	n/a	Campton Historical Ag Lands	NRCS, KDSWCD	41.913558	-88.397547

Subwatershed #	*Map #*	*CMAP ID*	*BMP Category*	*BMP Type*	*BMP Code*	*Landowners*	*Potential Partners*	*Latitude*	*Longitude*
2	49	GF-11	Agriculture	Nutrient Management Plan	590	Campton Historical Ag Lands	NRCS, KDSWCD	41.908005	-88.397069
2	50	GF-12	Other	Restoration Plan	3	Campton Historical Ag Lands	NRCS, KDSWCD	41.910820	-88.405569
2	51	GF-13	Other	Cistern	12	Campton Historical Ag Lands	NRCS, KDSWCD	41.911387	-88.401677
2	52	GF-14	Other	Cistern	12	Campton Historical Ag Lands	NRCS, KDSWCD	41.906881	-88.393559
2	53	GF-15	Other	Geothermal system	n/a	Campton Historical Ag Lands		41.910100	-88.402591
2	54	GF-16	Other	Geothermal system	n/a	Campton Historical Ag Lands		41.905983	-88.394586
2	55	SCPD-01	Hydrologic	Wetland Restoration	657 or 999	St Chas Pk District	IDNR-INPC	41.907668	-88.389238
2	56	SCPD-02	Other	Oak Ecosystem Restoration	643	St Chas Pk District	IDNR-INPC	41.908655	-88.389311
2	57	SCPD-06	Other	Conservation Design & Restoration Plan	3	State of Illinois	SCPD, IDNR-INPC	41.906575	-88.385938
3	58	FPD-06	Ag	Grassed Waterway	412	FPDKC	NRCS, KDSWCD	41.888585	-88.382969
3	59	FPD-07	Ag	Saturated Buffer (w/ Filter Strip)	604 (393)	FPDKC		41.886649	-88.382383
4	60	BBT-01	Hydrologic	Wetland Restoration	657 or 999	Private (mult.)	NRCS, KDSWCD	41.878005	-88.404711
4	61	BBT-02	Ag	Grassed Waterway	412	Private	NRCS, KDSWCD	41.878555	-88.411183
4	62	BBT-03	Ag	Filter Strip	393	Private	NRCS, KDSWCD	41.874768	-88.410641
4	63	BBT-04	Ag	Filter Strip	393	Private	NRCS, KDSWCD	41.874200	-88.410301
4	64	BBT-05	Ag	Conservation Technical Assistance	4	Private (mult.)	NRCS, KDSWCD	41.880838	-88.407328
4	65	BBT-06	Ag	Nutrient Management Plan	590	Private (mult.)	NRCS, KDSWCD	41.872382	-88.406298
4	66	BBT-09	Ag	Grassed Waterway	412	Private (mult.)	NRCS, KDSWCD	41.888963	-88.394894

Subwatershed #	*Map #*	*CMAP ID*	*BMP Category*	*BMP Type*	*BMP Code*	*Landowners*	*Potential Partners*	*Latitude*	*Longitude*
4	67	BBT-10	Ag	Grassed Waterway	412	Private (mult.)	NRCS, KDSWCD	41.888325	-88.395015
4	68	FPD-09	Hydrologic	Wetland Restoration	657 or 999	FPDKC	NRCS, KDSWCD	41.880955	-88.414620
5	69	FPD-04	Hydrologic	Wetland Restoration	657 or 999	FPDKC	NRCS, KDSWCD	41.903195	-88.384456
5	70	FPD-08	Hydrologic	Wetland Restoration	657 or 999	FPDKC	NRCS, KDSWCD	41.873774	-88.373750
5	71	GE-01	Urban	Bioretention Facility (retrofit)	800	Brentwood Ponds HOA		41.881393	-88.359482
5	72	GE-02	Hydrologic	Wetland Enhancement	998	Fisher Farms HOA		41.882895	-88.354869
5	73	GE-03	Urban	Bioretention Facility (retrofit)	800	Private		41.889736	-88.359377
5	74	GT-01	Hydrologic	Wetland Restoration	657 or 999	Private	NRCS, KDSWCD	41.877599	-88.373901
5	75	SC-01	Urban	Pervious & Porous Pavements	890	Kane County Fair		41.906942	-88.349406
5	76	SCPD-03	Hydrologic	Wetland Restoration	657 or 999	St Charles Pk District	IDNR-INPC	41.912288	-88.379296
5	77	SCPD-04	Hydrologic	Wetland Restoration	657 or 999	St Charles Pk District	IDNR-INPC	41.912032	-88.378100
5	78	SCPD-05	Other	Woodland Restoration	643	St Charles Pk District	IDNR-INPC	41.917617	-88.374581
5	79	SCPD-07	Other	Education Work Strategy/Plan	3	SCPD	FPDKC, GPD, BPD	41.911465	-88.369751
5	80	SCT-01	Urban	Filter Strip	835	Private (mult.)	HOA	41.915469	-88.371023
5	80	SCT-01	Hydrologic	Shoreline Protection	580			41.915469	-88.371023
5	134	SCT-02	Hydrologic	Streambank Protection	580 or 995	Private (mult.)	St Charles Twp, Kane Co	41.916827	-88.362692
6	81	FPD-10	Other	Prairie Restoration	643	FPDKC		41.854618	-88.369118

Subwatershed #	*Map #*	*CMAP ID*	*BMP Category*	*BMP Type*	*BMP Code*	*Landowners*	*Potential Partners*	*Latitude*	*Longitude*
6	82	FPD-11	Hydrologic	Wetland Restoration	657 or 999	FPDKC	NRCS, KDSWCD	41.854873	-88.371293
7	83	GPD-01	Hydrologic	Stream Channel Stabilization, Streambank Protection	584, 580 or 995	Geneva Pk District		41.871293	-88.359286
7	84	GPD-02	Urban	Grass-lined Channel (bioswale)	840	Geneva Pk District		41.868362	-88.366904
7	85	GPD-03	Urban	Filter Strip	835	Geneva Pk District		41.866629	-88.370258
7	86	GPD-04	Urban	Grass-lined Channel (bioswale)	840	Geneva Pk District		41.867338	-88.368257
7	87	GPD-05	Other	Education	1	Geneva Pk District	FPDKC, SCPD, BPD	41.869362	-88.361760
8	88	BA-01	Urban	Bioretention Facility (retrofit)	800	City of Batavia	HOA, Batavia PD, Geneva PDEC	41.861345	-88.324037
8	89	BPD-01	Urban	Pervious & Porous Pavements	890	Batavia Pk District		41.858783	-88.331539
8	90	BPD-04	Urban	Infiltration Trench	845	Batavia Pk District		41.854463	-88.317316
8	91	BPD-05	Urban	Pervious & Porous Pavements	890	Batavia Pk District		41.854048	-88.318435
8	92	BPD-06	Other	Education & Outreach	1	Batavia PD, Geneva PD, FPDKC	Batavia Parks Foundation, Geneva PD Foundation, Batavia EC, Geneva NRC	41.859655	-88.332830
8	93	FPD-12	Hydrologic	Wetland Restoration	657 or 999	FPDKC	NRCS, KDSWCD	41.861904	-88.339991
8	94	FPD-14	Other	Education	1	FPDKC		41.861431	-88.367822
8	95	GE-04	Urban	Bioretention Facility	800	IDOT	City Geneva	41.878654	-88.346023

Subwatershed #	*Map #*	*CMAP ID*	*BMP Category*	*BMP Type*	*BMP Code*	*Landowners*	*Potential Partners*	*Latitude*	*Longitude*
8	96	GE-05	Urban	Bioretention Facility (retrofit)	800	City of Geneva		41.874082	-88.341946
8	97	GE-06	Urban	Filter Strip	835	IDOR, UP RR	City Geneva, adjacent business owners	41.880996	-88.335878
8	98	GE-07a	Hydrologic	Stream Channel Restoration	9	City of Geneva	Geneva Pk District	41.881295	-88.325861
8	99	GE-07b	Hydrologic	Stream Channel Restoration	9	Private (mult.), HOA	City Geneva	41.883465	-88.326875
8	100	GE-08	Urban	Grass-lined Channel (bioswale)	840	Private		41.869820	-88.319991
8	101	GE-09	Hydrologic	Dredging	7	Private	City Geneva	41.880242	-88.327742
8	102	GE-10	Hydrologic	Dredging	7	Private	City Geneva	41.877882	-88.330286
8	103	GT-02	Ag	Grassed Waterway	412	Private	NRCS, KDSWCD	41.858971	-88.363297
8	104	GT-03	Ag	Grassed Waterway	412	Private	NRCS, KDSWCD	41.859325	-88.358875
9	105	BA-19	Ag	Grassed Waterway	412	City of Batavia	NRCS, KDSWCD	41.847344	-88.357717
10	106	BA-02	Urban	Bioretention Facility (retrofit)	800	City of Batavia	HOA, Batavia EC, Batavia HS	41.839877	-88.328421
10	107	BA-03	Ag	Grassed Waterway	412	Mooseheart	NRCS, KDSWCD	41.843266	-88.339637
10	108	BA-04	Ag	Grassed Waterway	412	Mooseheart	NRCS, KDSWCD	41.843057	-88.339037
10	109	BA-05	Ag	Grassed Waterway	412	Mooseheart	NRCS, KDSWCD	41.841594	-88.339525
10	110	BA-06	Ag	Grassed Waterway	412	Mooseheart	NRCS, KDSWCD	41.840902	-88.339640
10	111	BA-07	Ag	Constructed Wetland	656	Mooseheart	NRCS, KDSWCD	41.842055	-88.339745
10	112	BA-08	Ag	Grassed Waterway	412	Mooseheart	NRCS, KDSWCD	41.840044	-88.339774
10	113	BA-09	Ag	Grassed Waterway	412	Mooseheart	NRCS, KDSWCD	41.841132	-88.330044
10	114	BA-10	Ag	Grassed Waterway	412	Mooseheart	NRCS, KDSWCD	41.840565	-88.332361
10	115	BA-11	Ag	Grassed Waterway	412	Mooseheart	NRCS, KDSWCD	41.839640	-88.334325
10	116	BA-12	Ag	Filter Strip	393	Mooseheart	NRCS, KDSWCD	41.840256	-88.333038
10	117	BA-13	Ag	Filter Strip	393	Mooseheart	NRCS, KDSWCD	41.840584	-88.331642
10	118	BA-14	Ag	Grassed Waterway	412	Mooseheart	NRCS, KDSWCD	41.828833	-88.339341

Subwatershed #	*Map #*	*CMAP ID*	*BMP Category*	*BMP Type*	*BMP Code*	*Landowners*	*Potential Partners*	*Latitude*	*Longitude*
10	119	BA-15	Hydrologic	Wetland Restoration	657 or 999	Mooseheart	NRCS, KDSWCD	41.822031	-88.343518
10	120	BA-16	Hydrologic (Urban)	Shoreline Protection (including Riparian buffer)	580 (835)	Mooseheart	NRCS, KDSWCD	41.830910	-88.333260
10	121	BA-17	Ag	Conservation Technical Assistance	4	Mooseheart	NRCS, KDSWCD, KCFB	41.844401	-88.335287
10	122	BA-18	Ag	Nutrient Management Plan	590	Mooseheart	NRCS, KDSWCD, KCFB	41.842543	-88.333566
10	123	BPD-02	Urban	Pervious & Porous Pavements	890	Batavia Pk District		41.844938	-88.329484
10	124	BPD-03	Urban	Pervious & Porous Pavements	890	Batavia Pk District		41.843513	-88.328726
10	125	BPD-07	Hydrologic (Urban)	Streambank Protection (including lunker structures)	580	Batavia Pk District	Batavia Parks Foundation	41.838041	-88.341339
10	126	BT-01	Ag	Filter Strip	393	Private	NRCS, KDSWCD	41.832826	-88.346322
10	127	BT-02	Ag	Filter Strip	393	Private	NRCS, KDSWCD	41.832412	-88.346815
10	128	BT-03	Ag	Grassed Waterway	412	Private	NRCS, KDSWCD	41.832602	-88.347958
10	129	BT-04	Ag	Grassed Waterway	412	Private	NRCS, KDSWCD	41.832873	-88.349991
10	130	BT-05	Ag	Grassed Waterway	412	Private	NRCS, KDSWCD	41.833050	-88.350591
10	131	BT-06	Ag	Grassed Waterway	412	Private	NRCS, KDSWCD	41.829274	-88.345180
10	132	BT-07	Ag	Grassed Waterway	412	Private	NRCS, KDSWCD	41.828384	-88.345304
10	133	BT-08	Ag	Constructed Wetland	656	Private	NRCS, KDSWCD	41.828467	-88.343911

Table G-2. Site-specific BMPs with estimated quantities, pollutant load reductions, and costs.

Subwatershed #1 – Upper Campton										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (cfu/yr)**	**Estimated Cost ($)**
1	Bioretention Facility (retrofit)	Urban	2.1	ac	NCHRP Tool	100.3	4.9	1.4	2.77E+11	1,438,179
2	Wetland Restoration	Hydrologic	15	ac	Pollution Reduction Efficiency	337.3	12.1	6.9	9.37E+11	157,500
3	Wetland Restoration	Hydrologic	4	ac	Pollution Reduction Efficiency	188.5	6.8	3.9	5.62E+11	42,000
4	Wetland Restoration	Hydrologic	4	ac	Pollution Reduction Efficiency	307.9	11.2	6.3	9.38E+11	42,000
5	Grassed Waterway	Ag	0.8	ac	Pollution Reduction Efficiency	144.6	9.1	7.9	1.50E+11	1,515
6	Wetland Restoration	Hydrologic	7	ac	Pollution Reduction Efficiency	352.1	12.7	7.2	9.77E+11	73,500
7	Filter Strip	Ag	0.5	ac	NCHRP Tool	93.3	6.1	3.4	1.84E+11	48,679
8	Filter Strip	Ag	1.4	ac	NCHRP Tool	19.9	1.1	0.3	5.91E+10	125,807
9	Prairie Restoration	Other	40	ac	Pollution Reduction Efficiency	246.3	13.9	0.5	8.89E+10	100,000
10	Wetland Restoration	Hydrologic	8	ac	Pollution Reduction Efficiency	337.3	12.1	6.9	9.37E+11	84,000
11	Prairie Restoration	Other	50	ac	Pollution Reduction Efficiency	160.6	9.6	0.4	6.63E+10	125,000
12	Restoration Plan	Other	148	ac	n/a	n/a	n/a	n/a	n/a	10,000
13	Filter Strip	Ag	0.5	ac	NCHRP Tool	8.3	0.5	0.1	2.17E+10	48,679
14	Wetland Restoration (w/ Brush Management)	Hydrologic	13	ac	Pollution Reduction Efficiency	770.4	28.8	15.3	2.57E+12	136,500
15	Education	Other	1	#	n/a	n/a	n/a	n/a	n/a	20,000
Subwatershed #1 Totals						**3,066.9**	**128.9**	**60.6**	**7.77E+12**	**2,453,359**

Subwatershed #2 – Lower Campton										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (CFU/yr)**	**Estimated Cost ($)**
16	Grassed Waterway	Ag	0.5	ac	Pollution Reduction Efficiency	18.4	1.1	1.0	1.73E+10	947
17	Grassed Waterway	Ag	0.45	ac	Pollution Reduction Efficiency	7.4	0.5	0.4	7.38E+09	852
18	Filter Strip	Urban	0.8	ac	NCHRP Tool	9.2	0.5	0.2	2.78E+10	66,196
19	Filter Strip	Urban	0.7	ac	NCHRP Tool	48.3	2.1	0.9	1.51E+11	61,978
20	Wetland Acquisition	Other	1.3	ac	n/a	n/a	n/a	n/a	n/a	12,000
21	Wetland Restoration	Hydrologic	1.3	ac	Pollution Reduction Efficiency	25.0	0.9	0.5	4.19E+10	13,650
22	Wetland Restoration	Hydrologic	27	ac	Pollution Reduction Efficiency	771.0	29.0	15.8	2.60E+12	283,500
23	Bioretention Facility	Urban	2.5	ac	NCHRP Tool	823.2	46.3	16.8	3.24E+12	1,705,221
24	Planning	Other	1	#	n/a	n/a	n/a	n/a	n/a	10,000
25	Monitoring	Other	1	#	n/a	n/a	n/a	n/a	n/a	10,000
26	Education & Outreach campaign	Other	1	#	n/a	n/a	n/a	n/a	n/a	20,000
27	Technical Assistance	Other	1	#	n/a	n/a	n/a	n/a	n/a	20,000
28	Education & Outreach campaign	Other	1	#	n/a	n/a	n/a	n/a	n/a	20,000
29	Monitoring	Other	1	#	n/a	n/a	n/a	n/a	n/a	20,000
30	Salinity and Sodic Soil Mngmnt	Other	50	ac	n/a	n/a	n/a	n/a	n/a	20,000
31	Salinity and Sodic Soil Mngmnt	Other	35	ac	n/a	n/a	n/a	n/a	n/a	20,000
32	Wetland Restoration	Hydrologic	20	ac	Pollution Reduction Efficiency	157.2	5.6	3.0	4.15E+11	210,000
33	Grassed Waterway	Ag	0.7	ac	Pollution Reduction Efficiency	22.7	1.4	1.0	2.83E+10	1,326
34	Prairie Restoration	Other	50	ac	Pollution Reduction Efficiency	111.1	6.3	0.3	4.19E+10	125,000

Map #	BMP Type	BMP Category	Est. Qty.	Unit	Pollutant Reduction Calculator	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (t/yr)	Fecal Col. Reduction (CFU/yr)	Estimated Cost ($)
35	Wetland Acquisition	Other	11	ac	n/a	n/a	n/a	n/a	n/a	81,400
37	Stream Channel Restoration	Hydrologic	2660	ft	STEPL	10.0	3.8	6.2	n/a	798,000
38	Wetland Restoration (w/ Brush Management)	Hydrologic	12	ac	Pollution Reduction Efficiency	324.2	12.3	6.5	1.22E+12	126,000
39	Prairie Restoration	Other	165	ac	Pollution Reduction Efficiency	458.3	26.1	1.1	1.73E+11	412,500
40	Wetland Restoration	Hydrologic	4	ac	Pollution Reduction Efficiency	18.1	0.6	0.4	3.26E+10	42,000
41	Wetland Restoration	Hydrologic	3	ac	NCHRP Tool	72.8	10.0	2.4	3.43E+09	2,097,280
42	Prairie Restoration	Other	11	ac	Pollution Reduction Efficiency	104.5	6.3	0.3	4.40E+10	27,500
43	Saturated Buffer (w/ Filter Strip)	Ag	0.9	ac	Pollution Reduction Efficiency	74.9	1.9	0.0	4.95E+10	2,000
44	Saturated Buffer (w/ Filter Strip)	Ag	0.7	ac	Pollution Reduction Efficiency	37.2	0.9	0.0	1.99E+10	2,000
45	Oak ecosystem restoration	Other	6.5	ac	Pollution Reduction Efficiency	100.7	4.7	0.2	2.72E+10	39,000
46	Oak ecosystem restoration	Other	5.5	ac	Pollution Reduction Efficiency	24.9	1.1	0.1	6.09E+09	33,000
48	Conservation Technical Assistance	Ag	375	ac	n/a	n/a	n/a	n/a	n/a	1,500
49	Nutrient Management Plan	Ag	375	ac	n/a	n/a	n/a	n/a	n/a	1,500
50	Restoration Plan	Other	1	#	n/a	n/a	n/a	n/a	n/a	10,000
51	Cistern	Other	1	#	n/a	n/a	n/a	n/a	n/a	30,000
52	Cistern	Other	1	#	n/a	n/a	n/a	n/a	n/a	30,000
53	Geothermal system	Other	1	#	n/a	n/a	n/a	n/a	n/a	55,000
54	Geothermal system	Other	1	#	n/a	n/a	n/a	n/a	n/a	55,000

Map #	BMP Type	BMP Category	Est. Qty.	Unit	Pollutant Reduction Calculator	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (t/yr)	Fecal Col. Reduction (CFU/yr)	Estimated Cost ($)
55	Wetland Restoration	Hydrologic	18	ac	Pollution Reduction Efficiency	35.6	1.1	0.5	3.85E+10	189,000
56	Oak Ecosystem Restoration	Other	3	ac	Pollution Reduction Efficiency	55.7	2.3	0.1	7.66E+09	18,000
57	Conservation Design & Restoration Plan	Other	60	ac	n/a	n/a	n/a	n/a	n/a	20,000
Subwatershed #2 Totals						**3,568.4**	**176.7**	**58.2**	**8.26E+12**	**6,751,350**

Subwatershed #3 – Mill Creek Greenway										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (CFU/yr)**	**Estimated Cost ($)**
58	Grassed Waterway	Ag	0.4	ac	Pollution Reduction Efficiency	27.6	1.8	1.5	3.69E+10	758
59	Saturated Buffer (w/ Filter Strip)	Ag	0.7	ac	Pollution Reduction Efficiency	63.9	1.6	0.0	3.69E+10	2,000
Subwatershed #3 Totals						**91.5**	**3.4**	**1.5**	**7.39E+10**	**2,758**

Subwatershed #4 – Brundige Tributary										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (CFU/yr)**	**Estimated Cost ($)**
60	Wetland Restoration	Hydrologic	15	ac	Pollution Reduction Efficiency	392.9	14.6	8.2	1.35E+12	157,500
61	Grassed Waterway	Ag	2.5	ac	Pollution Reduction Efficiency	44.2	2.8	2.4	5.06E+10	4,735
62	Filter Strip	Ag	1	ac	NCHRP Tool	60.2	3.4	1.4	1.56E+11	96,142
63	Filter Strip	Ag	1.2	ac	NCHRP Tool	105.8	5.7	2.5	2.70E+11	108,008
64	Conservation Technical Assistance	Ag	580	ac	n/a	n/a	n/a	n/a	n/a	2,320
65	Nutrient Management Plan	Ag	580	ac	n/a	n/a	n/a	n/a	n/a	2,320
66	Grassed Waterway	Ag	0.7	ac	Pollution Reduction Efficiency	32.0	2.0	1.8	3.22E+10	1,326
67	Grassed Waterway	Ag	0.45	ac	Pollution Reduction Efficiency	8.6	0.5	0.5	8.66E+09	852
68	Wetland Restoration	Hydrologic	3	ac	Pollution Reduction Efficiency	2,556.7	95.2	52.8	8.87E+12	31,500
Subwatershed #4 Totals						**3,200.4**	**124.2**	**69.5**	**1.07E+13**	**404,704**

Subwatershed #5 – West St. Charles / Geneva										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (CFU/yr)**	**Estimated Cost ($)**
69	Wetland Restoration	Hydrologic	4	ac	Pollution Reduction Efficiency	53.3	2.0	1.1	1.76E+11	42,000
70	Wetland Restoration	Hydrologic	16	ac	Pollution Reduction Efficiency	334.8	13.4	6.9	1.87E+12	168,000
71	Bioretention Facility (retrofit)	Urban	1.5	ac	NCHRP Tool	213.2	2.4	4.2	1.34E+12	1,710,717
72	Wetland Enhancement	Hydrologic	5.5	ac	Pollution Reduction Efficiency	132.0	5.4	2.8	7.78E+11	57,750
73	Bioretention Facility (retrofit)	Urban	2.8	ac	NCHRP Tool	329.7	6.5	6.8	1.91E+12	3,154,205
74	Wetland Restoration	Hydrologic	10	ac	Pollution Reduction Efficiency	488.5	19.5	9.9	2.69E+12	105,000
75	Pervious & Porous Pavements	Urban	26	ac	Pollution Reduction Efficiency	124.8	6.0	3.6	1.64E+11	14,043,744
76	Wetland Restoration	Hydrologic	4	ac	Pollution Reduction Efficiency	213.1	7.9	4.2	7.27E+11	42,000
77	Wetland Restoration	Hydrologic	1	ac	Pollution Reduction Efficiency	213.1	0.3	0.2	1.50E+10	10,500
78	Woodland Restoration	Other	9	ac	Pollution Reduction Efficiency	19.3	0.8	0.0	2.85E+09	54,000
79	Education Work Strategy/Plan	Other	1	#	n/a/	n/a/	n/a/	n/a/	n/a/	10,000
Subwatershed #5 Totals						**2,150.3**	**66.5**	**43.2**	**9.69E+12**	**19,956,113**

Subwatershed #6 – Mill Creek Forest Preserve										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (CFU/yr)**	**Estimated Cost ($)**
81	Prairie Restoration	Other	23	ac	Pollution Reduction Efficiency	57.8	3.1	0.1	1.40E+10	57,500
82	Wetland Restoration	Hydrologic	60	ac	Pollution Reduction Efficiency	154.9	4.8	2.1	2.15E+11	630,000
Subwatershed #6 Totals						**212.7**	**7.9**	**2.2**	**2.29E+11**	**687,500**

Subwatershed #7 – Peck Lake										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator.**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (CFU/yr)**	**Estimated Cost ($)**
83	Stream Channel Stabilization, Streambank Protection	Urban	0.1	ac	NCHRP Tool	8.8	0.5	0.6	5.23E+10	127,362
84	Grass-lined Channel (bioswale)	Urban	0.6	ac	NCHRP Tool	2.4	0.2	0.1	2.12E+10	1,343,568
85	Filter Strip	Urban	1.4	ac	NCHRP Tool	44.6	1.3	0.5	1.54E+11	147,600
86	Grass-lined Channel (bioswale)	Urban	0.8	ac	NCHRP Tool	23.7	1.3	0.4	0.00E+00	1,358,295
87	Education	Other	1	#	n/a	n/a	n/a	n/a	n/a	20,000
Subwatershed #7 Totals						**79.5**	**3.3**	**1.5**	**2.28E+11**	**2,996,825**

Subwatershed #8 – McKee Road Tributary										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator.**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (CFU/yr)**	**Estimated Cost ($)**
88	Bioretention Facility (retrofit)	Urban	0.5	ac	NCHRP Tool	173.6	1.1	3.5	1.07E+12	477,895
89	Pervious & Porous Pavements	Urban	0.1	ac	Pollution Reduction Efficiency	0.3	0.0	0.0	1.88E+08	54,014
90	Infiltration Trench	Urban	140	ft	NCHRP Tool	8.3	0.0	0.1	4.50E+10	15,743
91	Pervious & Porous Pavements	Urban	0.5	ac	Pollution Reduction Efficiency	23.1	1.1	0.6	2.52E+10	270,072
92	Education & Outreach	Other		#						20,000
93	Wetland Restoration	Hydrologic	50	ac	NCHRP Tool	1,087.0	162.3	43.8	6.14E+10	2,097,280
94	Education	Other		#						20,000
95	Bioretention Facility	Urban	0.5	ac	NCHRP Tool	6.1	0.4	0.1	4.03E+10	703,939
96	Bioretention Facility (retrofit)	Urban	4.8	ac	NCHRP Tool	439.8	12.0	8.7	3.29E+12	5,364,822
97	Filter Strip	Urban	1.2	ac	NCHRP Tool	152.0	2.6	1.7	3.13E+11	108,008
98	Stream Channel Restoration	Hydrologic	0.5	ac	Pollution Reduction Efficiency	77.3	70.0	8.8	0.00E+00	854,900
99	Stream Channel Restoration	Hydrologic	1.2	ac	Pollution Reduction Efficiency	195.8	177.5	31.3	0.00E+00	2,166,300
100	Grass-lined Channel (bioswale)	Urban	0.1	ac	NCHRP Tool	13.9	0.8	0.4	7.86E+10	234,607
101	Dredging	Hydrologic	1.2	ac						150,000
102	Dredging	Hydrologic	2.1	ac						200,000
103	Grassed Waterway	Ag	0.9	ac	Pollution Reduction Efficiency	27.6	1.8	1.5	4.95E+10	1,705
104	Grassed Waterway	Ag	0.45	ac	Pollution Reduction Efficiency	74.9	5.1	4.3	1.32E+11	852
Subwatershed #8 Totals						**2,279.7**	**434.6**	**104.9**	**5.11E+12**	**12,740,136**

Subwatershed #9 – Tanglewood										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (CFU/yr)**	**Estimated Cost ($)**
105	Grassed Waterway	Ag	0.45	ac	Pollution Reduction Efficiency	6.5	0.4	0.4	8.36E+09	852
Subwatershed #9 Totals						**6.5**	**0.4**	**0.4**	**8.36E+09**	**852**

Subwatershed #10 – West Batavia										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator.**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (CFU/yr)**	**Estimated Cost ($)**
106	Bioretention Facility (retrofit)	Urban	0.5	ac	NCHRP Tool	140.0	0.8	2.8	8.70E+11	363,969
107	Grassed Waterway	Ag	0.3	ac	Pollution Reduction Efficiency	4.5	0.3	0.2	4.19E+09	568
108	Grassed Waterway	Ag	2.4	ac	Pollution Reduction Efficiency	113.8	7.5	6.0	1.72E+11	4,546
109	Grassed Waterway	Ag	0.3	ac	Pollution Reduction Efficiency	2.5	0.2	0.1	2.33E+09	568
110	Grassed Waterway	Ag	0.4	ac	Pollution Reduction Efficiency	3.2	0.2	0.2	2.92E+09	758
111	Constructed Wetland	Ag	2.5	ac	Pollution Reduction Efficiency	50.9	1.9	1.0	2.22E+11	26,250
112	Grassed Waterway	Ag	0.3	ac	Pollution Reduction Efficiency	1.7	0.1	0.1	1.58E+09	568
113	Grassed Waterway	Ag	0.5	ac	Pollution Reduction Efficiency	218.7	15.3	12.2	4.40E+11	947
114	Grassed Waterway	Ag	0.6	ac	Pollution Reduction Efficiency	9.9	0.6	0.5	9.22E+09	1,136

Map #	BMP Type	BMP Category	Est. Qty.	Unit	Pollutant Reduction Calculator.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (t/yr)	Fecal Col. Reduction (CFU/yr)	Estimated Cost ($)
115	Grassed Waterway	Ag	0.2	ac	Pollution Reduction Efficiency	4.7	0.3	0.2	3.74E+09	379
116	Filter Strip	Ag	1.2	ac	NCHRP Tool	38.6	2.1	1.3	6.78E+10	106,228
117	Filter Strip	Ag	1.4	ac	NCHRP Tool	56.3	2.4	1.5	1.08E+11	130,554
118	Grassed Waterway	Ag	0.9	ac	Pollution Reduction Efficiency	53.7	3.3	2.6	5.83E+10	1,705
119	Wetland Restoration	Hydrologic	6	ac	Pollution Reduction Efficiency	53.0	1.9	1.0	1.70E+11	63,000
120	Shoreline Protection	Hydrologic	6700	ft	STEPL	10.7	4.1	6.7		1,005,000
121	Conservation Technical Assistance	Ag	500	ac						2,000
122	Nutrient Management Plan	Ag	500	ac						2,000
123	Pervious & Porous Pavements	Urban	0.5	ac	Pollution Reduction Efficiency	1.1	0.0	0.0	5.63E+08	270,072
124	Pervious & Porous Pavements	Urban	0.2	ac	Pollution Reduction Efficiency	2.7	0.1	0.1	1.37E+09	108,029
125	Streambank Protection	Hydrologic	1000	ft	STEPL	6.0	2.3	3.5		300,000
126	Filter Strip	Ag	0.6	ac	NCHRP Tool	13.8	0.8	0.3	3.59E+10	54,612
127	Filter Strip	Ag	1.6	ac	NCHRP Tool	42.2	2.2	1.1	9.78E+10	143,606
128	Grassed Waterway	Ag	0.3	ac	Pollution Reduction Efficiency	7.5	0.5	0.4	7.54E+09	568
129	Grassed Waterway	Ag	0.2	ac	Pollution Reduction Efficiency	12.5	0.8	0.7	1.23E+10	379
130	Grassed Waterway	Ag	0.4	ac	Pollution Reduction Efficiency	3.1	0.2	0.2	2.79E+09	758
131	Grassed Waterway	Ag	0.6	ac	Pollution Reduction Efficiency	6.2	0.4	0.3	6.24E+09	1,136

Map #	BMP Type	BMP Category	Est. Qty.	Unit	Pollutant Reduction Calculator.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (t/yr)	Fecal Col. Reduction (CFU/yr)	Estimated Cost ($)
132	Grassed Waterway	Ag	1.4	ac	Pollution Reduction Efficiency	42.4	2.7	2.3	4.72E+10	2,652
133	Constructed Wetland	Ag	5	ac	Pollution Reduction Efficiency	180.6	7.2	3.8	2.22E+11	52,500
Subwatershed #10 Totals						**1,080.0**	**58.1**	**49.0**	**2.57E+12**	**$2,644,487**

Subwatershed #11 – Les Arends										
Map #	**BMP Type**	**BMP Category**	**Est. Qty.**	**Unit**	**Pollutant Reduction Calculator**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (t/yr)**	**Fecal Col. Reduction (CFU/yr)**	**Estimated Cost ($)**
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Subwatershed #11 Totals						**0**	**0**	**0**	**0**	**$0**

Appendix H – BMP Load Reduction Estimation

1420 Kensington Road, Suite 103
Oak Brook, Illinois 60523
PH 630.203.3340
FAX 630.203.3341
www.geosyntec.com

Memorandum

Date: September 30, 2019

To: Holly Hudson, Chicago Metropolitan Agency for Planning (CMAP) and
Rob Linke, Kane County

Copies to: Illinois Environmental Protection Agency

From: Rishab Mahajan and Adrienne Nemura, Geosyntec Consultants

Subject: Estimated Load Reductions from Implementation of Best Management Practices in the Mill Creek Watershed

INTRODUCTION

The purpose of this Technical Memorandum is to document the estimated load reduction from the implementation of proposed best management practices (BMPs) in the Mill Creek watershed, Kane County, Illinois, to support the development of a watershed-based plan.

Background

Mill Creek is a tributary of the Fox River that drains an area of 31 square miles in Kane County along a length of 15 miles. The Chicago Metropolitan Agency for Planning (CMAP) definition of the Mill Creek planning area follows closely the National Resources Conservation System 12-digit Hydrologic Unit Code (HUC 12) watershed 071200070105, with slight modifications to account for stormwater systems and urban areas (Figure 1).

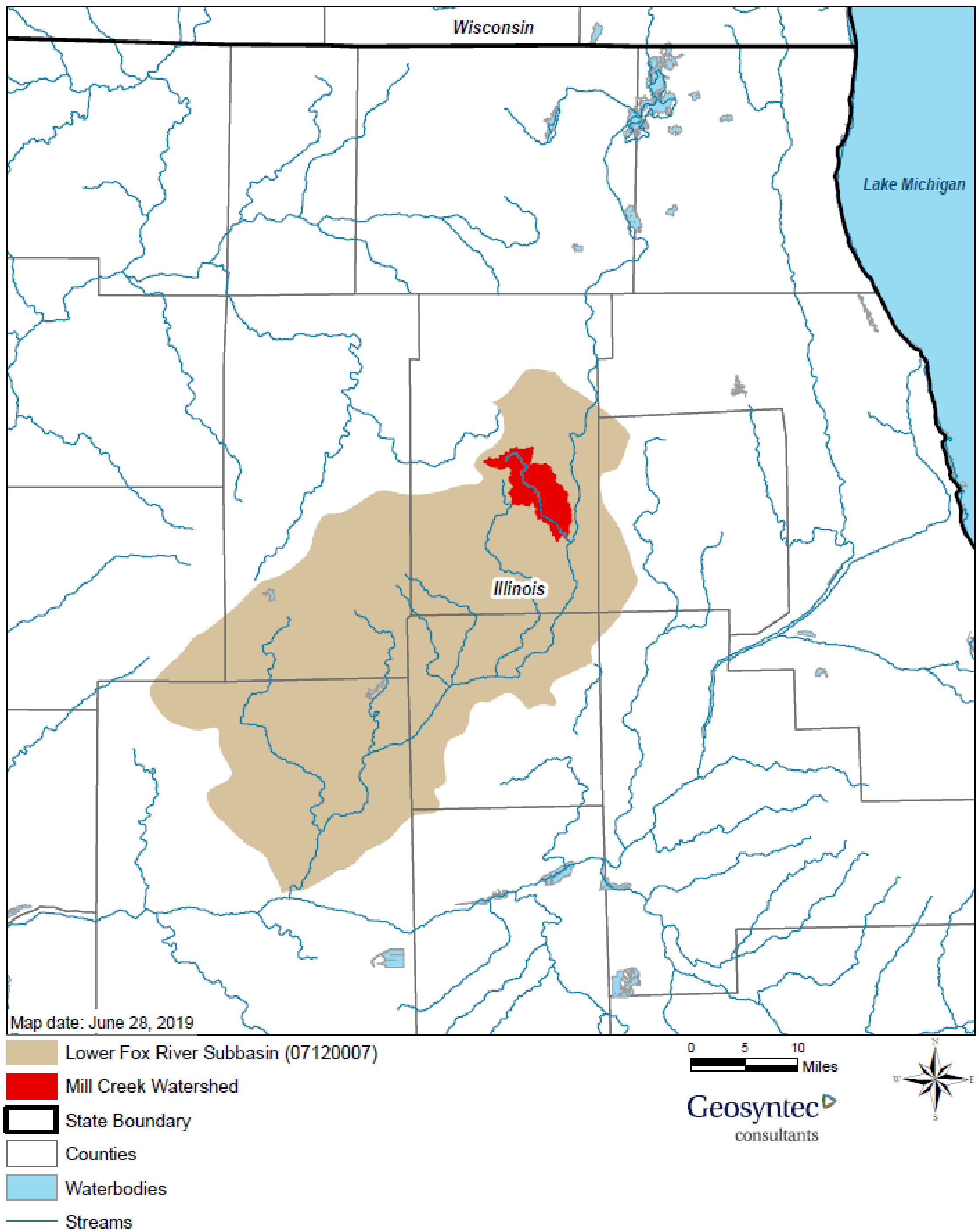


Figure 1: Mill Creek Watershed Planning Area within the Lower Fox River Subbasin

EXISTING WATERSHED LOADS

Geosyntec updated an existing watershed model of the Mill Creek watershed to support development of a watershed-based plan for Mill Creek (Geosyntec 2018). The watershed model was calibrated to available flow and water quality data. The watershed model was used to estimate the daily flows and loads for Total Nitrogen (TN), Total Phosphorus (TP), Total Suspended Solids (TSS), and Fecal Coliform for the period of 2011 to 2016.

LOAD REDUCTION STRATEGIES

The Mill Creek Watershed-Based Plan being developed by CMAP will recommend the implementation of various BMPs to reduce nonpoint source pollutant runoff throughout the Mill Creek watershed, with a focus in critical areas. CMAP developed site-specific BMPs in consultation with Kane County and other stakeholders in the watershed. In addition to the site-specific BMPs, CMAP also developed watershed-wide BMP scenarios to allow for other potential projects that may be considered in the future.

Watershed-Wide BMPs

Watershed-wide BMPs represent future potential projects that were not specifically submitted by stakeholders as a site-specific BMP. The projects may be implemented anywhere in the watershed at the discretion of the stakeholders. Table 1 presents CMAP's distribution of different BMPs in the subwatersheds of Mill Creek.

Site-Specific BMPs

CMAP developed a total of ninety-nine (99) site-specific BMPs in consultation with Kane County and other stakeholders. CMAP recommended a variety of BMPs that could be implemented in the urban portion of the watershed such as bioretention and infiltration facilities, bioswales, porous and permeable pavements, filter strips, and grass-lined channels. Recommendations for hydrologic BMPs, that primarily serve to reduce runoff volume, include wetland restoration, wetland enhancement, and stream channel restoration. Agricultural BMPs recommended for the Mill Creek watershed include grassed waterways, constructed wetlands, filter strips, prairie restoration, saturated buffers (with filter strips), oak ecosystem restoration.

CMAP delineated the areas draining to each of the site-specific BMPs using ESRI's ArcHydro tools based on CMAP's regional 15 foot resolution digital terrain model. All delineated catchments were checked against a series of layers – high-resolution aerial, contours, a highly detailed overland stream grid, and available storm sewer data. Manual adjustments were made as necessary. A summary of site-specific BMPs is provided in Appendix A.

Table 1 : Watershed-wide BMP distributions by Mill Creek subwatershed.

		ISWS Subwatershed #										
BMP type	**units**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Bioretention Facility (IUM 800, sq ft)	sq ft		17,500		25,000	50,000	10,000	10,000	45,000	5,000	42,500	5,000
Rain Garden (IUM 897, sq ft)	sq ft	36,400	51,600		6,000	174,200	4,800	1,400	52,200	6,000	21,800	4,600
Infiltration Trench (IUM 847, ft)	ft	8,000	7,200	1,000		3,600	3,000		4,000	3,300	5,300	2,700
Vegetated Swale (aka Grass-lined Channel, IUM 840, ac)	ac		1.1	0.7	0.9	2.3	0.7	0.5	2.3	0.5	2	0.1
Filter Strip (Urban: IUM 835, ac)	ac	1	5.5	3			1	0.5		2.8	3.8	0.7
Pervious and Porous Pavement (IUM 890, sq ft)	sq ft	60,000	60,000		85,000	250,000	40,000	42,000	260,000	12,200	122,200	7,200
Dry Detention basin retrofit (no IUM code, ac)	ac	4.1	9.3	0.1	0	15	0	2.9	27	3.2	13.4	2.4
Wet detention basin retrofit (no IUM code, ac)	ac	0.2	1.5	0.0	1.0	3.8	0.5	0.1	4.1	0.4	0.5	0.1
Tree Box Filter (no IUM code, #)	#		10			33		13	23	2	5	3
Hydrodynamic Separators (no IUM code, #)	#	2	8	1	6	26	2	3	27	3	27	6
Green Roof (IEPA #11, ac)	ac	0.1	0.5	0.1	5.7	5.7		1.4	16.8	0.3	3.7	0.4
Denitrifying Bioreactor (NRCS 605, #)	#	5	5	3	5	4	1		2	1	6	
Saturated Buffer (NRCS 604, ft)	#	8	8	4	8	6	2	1	3	2	9	
Riparian Corridor Restoration (no code, ac)	ac	11	6	10	5	7	10	5	2	3	15	6
Prairie Restoration (NRCS 643, ac)	ac	10	26	3	5	23	10	10	64	15	45	3
Wetland (farmed) Restoration (NRCS 657, IUM 999; ac)	ac	35	15	2	55	10	1		20	1	20	1
Filter Strip (Ag: NRCS 393, ac)	ac				7	7			2.2			

LOAD REDUCTION ESTIMATION

Geosyntec estimated the load reduction for TN, TP, TSS, and Fecal Coliform loads from the implementation of recommended watershed-wide and site-specific BMPs.

Watershed-Wide BMPs

Geosyntec estimated the load reduction from watershed-wide BMP scenarios using a spreadsheet model. The watershed-wide BMPs do not have a specific location in the watershed and hence the drainage area to the watershed-wide BMP was estimated using the literature values of the ratio of drainage area to the BMP size. Table 2 presents the drainage area ratios for the various BMP types. Existing loads to each of the watershed-wide BMP types were estimated by multiplying the drainage area with the annual average load per acre for the subwatershed. Pollutant load reduction estimates for the implementation of watershed-wide BMPS were calculated using literature estimates of pollutant removal efficiencies. Table 3 provides the pollutant removal efficiencies for different BMP types for TN, TP, TSS, and Fecal Coliform.

Site-Specific BMPs

The HSPF model for the Mill Creek watershed was used to calculate the annual average load per acre for different Hydrological Response Units (HRUs) which represent a combination of land use, soil type, and slope. Existing loads for site-specific BMPs were estimated by overlaying the BMP drainage area over the HRUs' coverages.

Load reductions for urban BMPs were estimated by using the National Cooperative Highway Research Program (NCHRP) spreadsheet tool. The tool was developed for evaluating the performance of urban BMPs. The tool requires input of runoff concentration, volume, and BMP design data. The runoff volume and concentration for TN, TP, TSS, and Fecal Coliform for each BMP were calculated using the HSPF watershed model output. BMP design information such as length, width, and storage volume were provided by CMAP. The NCHRP tool was used to calculate the load reduction for bioswales, filter strips, infiltration trenches, and bioretention facilities. The NCHRP tool utilizes nomographs, derived from 30-year continuous Stormwater Management Model (SWMM) simulations, to estimate capture efficiency and volume reduction (Figure 2). The tool utilizes the influent-effluent regressions from the International Stormwater BMP Database to estimate effluent concentration (Figure 3). An example application of the NCHRP tool is provided in Appendix B.

Load reductions for BMPs that are not be handled by the NCHRP tool were estimated in the similar fashion as watershed-wide BMPs using pollutant removal efficiencies.

Table 2: Assumed Drainage Area Ratios for Various BMP Types in Watershed-Wide Scenarios

BMP Type	Drainage Area to BMP Size Ratio	Source*
Bioretention Facility (IUM 800, sq ft)	30	1
Rain Garden (IUM 897, sq ft)	10	2
Infiltration Trench (IUM 847, ft)	50	2
Vegetated Swale (aka Grass-lined Channel, IUM 840, ac)	4	1
Filter Strip (Ag: NRCS 393, ac; Urban: IUM 835, ac)	50	2
Pervious and Porous Pavement (IUM 890, sq ft)	10	1
Dry Detention basin retrofit (no IUM code, ac)	50	1
Wet detention basin retrofit (no IUM code, ac)	2	2
Tree Box Filter (no IUM code, #)	0.25	3
Hydrodynamic Separators (no IUM code, #)	5	4
Green Roof (IEPA #11, ac)	1	2
Denitrifying Bioreactor (NRCS 605, #)	40	2
Saturated Buffer (NRCS 604, ft)	25	5
Riparian Corridor Restoration (no code, ac)	50	2
Prairie Restoration (NRCS 643, ac)	2	2
Wetland Restoration (NRCS 657, IUM 999; ac)	10	6
Filter Strip (Ag: NRCS 393, ac)	50	2

*Sources
1 - CMAP (2016)
2 - Value estimated by Rob Linke, Kane County
3- Filterra Manufacture Specification
4- Minnesota Department of Agriculture (2017)
5- Soil and Water Conservation District
6- Value based on site-specific BMP in Mill Creek Watershed

Table 3: Pollutant Removal Efficiencies for Various BMP Types

BMP Type	Pollutant Removal Rates (%)				Source**
	TN	TP	TSS	FC	
Bioretention Facility (IUM 800, sq ft)	68	66	65	61	1,2
Rain Garden (IUM 897, sq ft)	80	77	95	10*	3
Infiltration Trench (IUM 847, ft)	60	55	90	10*	3
Vegetated Swale (aka Grass-lined Channel, IUM 840, ac)	55	47	51	53	1,2
Filter Strip (Urban: IUM 835, ac)	19	52	52	10*	1,2
Pervious and Porous Pavement (IUM 890, sq ft)	55	41	72	10*	1,2
Dry Detention basin retrofit (no IUM code, ac)	33	30	29	24	1,2
Wet detention basin retrofit (no IUM code, ac)	19	52	55	7	1,2
Tree Box Filter (no IUM code, #)	15	15	99	10*	4
Hydrodynamic Separators (no IUM code, #)	10	42	27	0	4
Green Roof (IEPA #11, ac)	25	25	72	10*	5
Denitrifying Bioreactor (NRCS 605, #)	30	0	0	10*	7
Saturated Buffer (NRCS 604, ft)	42	20	0	10*	6
Riparian Corridor Restoration (no code, ac)	89	80	10*	10*	8
Prairie Restoration (NRCS 643, ac)	73	82	10*	10*	9
Wetland Restoration (NRCS 657, IUM 999; ac)	69	48	72	78	10
Filter Strip (Ag: NRCS 393, ac)	27	65	86	10*	3

*No literature reported values found. Conservative value.
**Sources
1 - Geosyntec Consultants and Wright Water Engineers (2011)
2 - Geosyntec Consultants and Wright Water Engineers (2017)
3 - Minnesota Department of Agriculture (2017)
4 - New Hampshire Department of Environmental Services (2008)
5 - Tetra Tech Inc. (2018)
6 - Ohio State University Extension
7 - University of Illinois at Urbana-Champaign
8 - Parkyn S. (2004)
9 - Zhou et. al (2014)
10 - Land et. al (2016)

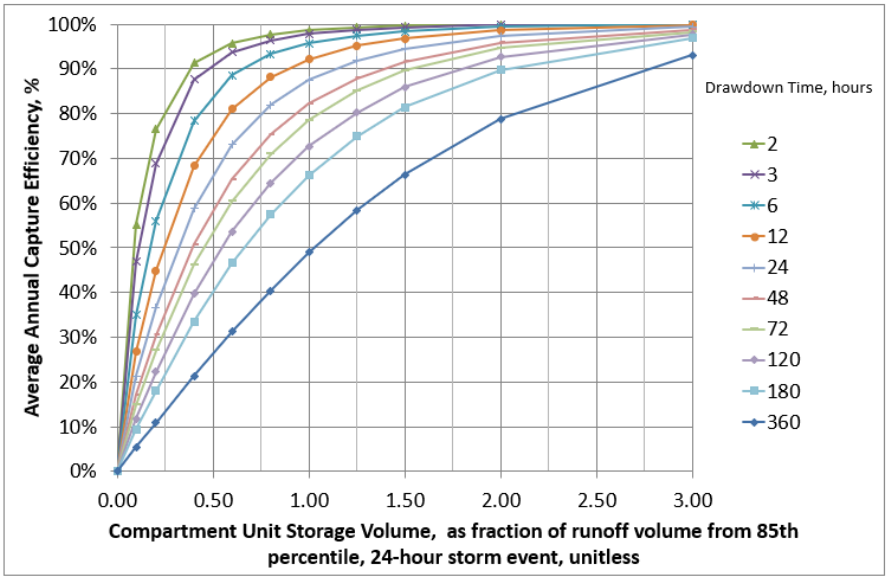


Figure 2 : Nomograph for Annual Capture Efficiency as Function of the Runoff Volume into the BMP

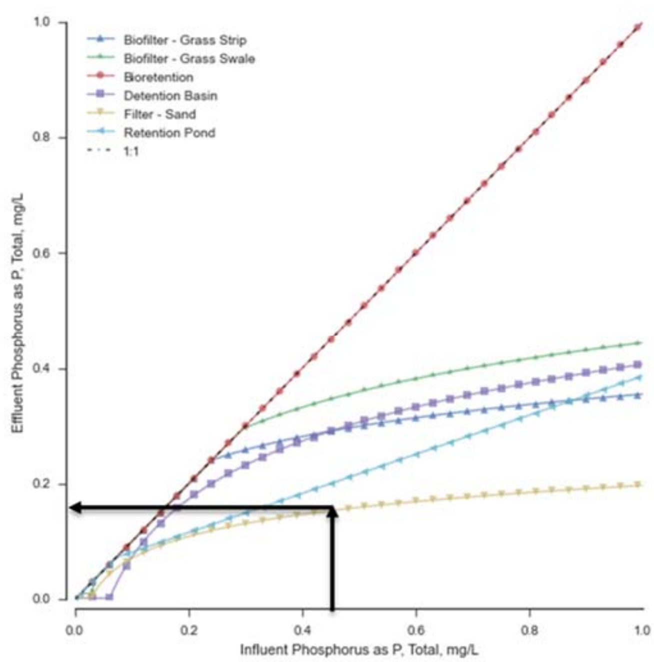


Figure 3: Example of Influent-Effluent Relationship for Total Phosphorus Derived from International Stormwater BMP Database

COSTS

Geosyntec estimated costs for the implementation of watershed-wide and site-specific BMPs.

Watershed-Wide BMPs

Geosyntec estimated the cost for watershed-wide BMPs based on unit costs obtained from literature. Table 4 presents the units costs for different types of BMPs.

Site-Specific BMPs

The NCHRP spreadsheet tool also includes the ability to estimate capital, maintenance, and Whole Life-Cycle Cost (WLC) for BMPs. The cost for the BMP includes the capital cost as well as the maintenance costs. The capital cost includes construction costs and various associated costs which are calculated based on line item cost estimates. The tool utilizes nationally-derived average costs which are sufficient for planning purposes. The maintenance costs are assumed similar for a particular type of BMP and would depend on the frequency of routine and intermittent maintenance. For planning purposes, a medium level of maintenance was assumed to calculate the maintenance costs. The tool calculates WLC by utilizing standard accounting techniques such as Net Present Value (NPV) to refer future costs to the present times. Additional details for the WLC method used in the tool are provided in the NCHRP (2014). The NCHRP tool calculates costs for year 2013 which were increased by a factor of 1.1 to account for inflation.

Costs for BMPs that are not handled by the NCHRP tool were estimated using the unit costs presented in Table 4.

Table 4: Unit Costs for Various BMP Types

BMP Type	Unit	Cost/Unit	Source
Bioretention Facility (IUM 800, sq ft)	sq ft	$40	2
Rain Garden (IUM 897, sq ft)	sq ft	$12	2
Infiltration Trench (IUM 847, ft)	ft	$50	2
Vegetated Swale (aka Grass-lined Channel, IUM 840, ac)	ac	$1,045,440	1
Filter Strip (Urban: IUM 835, ac)	ac	$200	6
Pervious and Porous Pavement (IUM 890, sq ft)	sq ft	$12	7
Dry Detention basin retrofit (no IUM code, ac)	ac	$40	1
Wet detention basin retrofit (no IUM code, ac)	ac	$25	1
Tree Box Filter (no IUM code, #)	#	$15,000	3
Hydrodynamic Separators (no IUM code, #)	#	$20,000	3
Green Roof (IEPA #11, ac)	ac	$522,720	2
Denitrifying Bioreactor (NRCS 605, #)	#	$30,000	2
Saturated Buffer (NRCS 604, ft)	#	$2,000	5
Riparian Corridor Restoration (no code, ac)	ac	$6,000	2
Prairie Restoration (NRCS 643, ac)	ac	$2,500	2
Wetland Restoration (NRCS 657, IUM 999; ac)	ac	$10,500	6
Filter Strip (Ag: NRCS 393, ac)	ac	$200	1

*Sources
1 - CMAP (2016)
2 - Value estimated by Rob Linke, Kane County
3 - US EPA Factsheet
4 - Minnesota Department of Agriculture (2017)
5 - Soil and Water Conservation District (SWCD)
6 - Kane-DuPage SWCD Practice Component List
7 - University of Maryland Fact Sheet Adjusted for Inflation

RESULTS

Estimates of load reductions from the recommended watershed-wide and site-specific BMPs in the Mill Creek watershed are summarized below.

Watershed-Wide BMPs

Table 5 summarizes estimated load reductions and costs for watershed-wide BMPs for each subwatershed. The estimated percentage reduction in TN and TP load from the implementation of all watershed-wide BMPs is 60% and 55% respectively. TSS and Fecal Coliform loads would be reduced by approximately 24% and 16% respectively. The cost for the implementation of watershed-wide BMPs is estimated to be around sixty-three million dollars.

Site-Specific BMPs

Estimated load reductions from the implementation of site-specific BMPs are summarized in Appendix C The estimated percentage reduction in TN and TP load from the implementation of all site specific BMPs is 1.5% and 1.9% respectively. TSS and Fecal Coliform loads would be reduced by approximately 2% and 0.5% respectively. The cost for the implementation of watershed-wide BMPs is estimated to be around forty five million dollars.

Table 5: Estimated Load Reduction and Costs for Watershed-Wide BMPs

ISWS Subwatershed #	Name	Nitrogen Reduction (lb/yr)	Phosphorus Reduction (lb/yr)	Sediment Reduction (tons/yr)	Fecal Coliform Reduction cfu/yr	Estimated Cost ($)
1	Upper Campton	14,226	552	117	1.20E+14	$2,298,000
2	Lower Campton	36,416	1,634	431	1.20E+14	$4,571,000
3	Mill Crk Greenway	53,173	2,301	355	3.14E+13	$1,041,000
4	Brundige Trib	6,893	301	38	9.04E+13	$6,952,000
5	West St Chas / Geneva	50,065	2,521	489	1.50E+14	$14,107,000
6	Mill Crk FP	50,694	2,237	221	1.43E+13	$2,005,000
7	Peck Lake	1,638	87	5	3.30E+13	$2,504,000
8	McKee Rd Trib	19,252	1,106	259	3.19E+14	$18,371,000
9	Tanglewood	30,593	1,601	335	1.34E+13	$1,459,000
10	West Batavia	239,443	10,890	1,584	2.47E+14	$8,994,000
11	Les Arends	127,291	6,158	788	4.54E+13	$1,012,000
Total		**629,685**	**29,387**	**4,620**	**1.18E+15**	**$63,314,000**
Percent Reduction in Total Load		**60%**	**55%**	**24%**	**16%**	

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APPENDICES

A. Summary of Site-Specific BMPs provided by CMAP

B. Example Application of NCHRP Tool to Estimate Load Reduction from Site-Specific BMPs

C. Estimate of Load Reductions from Site-Specific BMPs

APPENDIX A : SUMMARY OF SITE-SPECIFIC BMPS PROVIDED BY CMAP

CMAP_ID	Location	Subshd_Nam	Category	Type	BMP_Size_A	BMP_Lngth_	StorDepth_	StorVol_Ac	FlowAr_SqF	Drainage Area
					acres	feet	ft	acre-feet	sq.ft	acres
BA-01	N of Parkview Dr, Batavia (d	McKee Rd Trib	Urban	Bioretention Facility (retrofi	0.5	0	2	1	0	61
BA-02	NW Danforth & Millview Dr	West Batavia	Urban	Bioretention Facility (retrofi	0.5	0	1.5	0.75	0	53
BA-03	Mooseheart, SE of Randall F	West Batavia	Ag	Grassed Waterway	0.3	0	0	0	12000	5
BA-04	Mooseheart, SE of Randall F	West Batavia	Ag	Grassed Waterway	2.4	0	0	0	105600	93
BA-05	Mooseheart, SE of Randall F	West Batavia	Ag	Grassed Waterway	0.3	0	0	0	15000	3
BA-06	Mooseheart, SE of Randall F	West Batavia	Ag	Grassed Waterway	0.4	0	0	0	17100	3
BA-07	Mooseheart, SE of Randall F	West Batavia	Ag	Constructed Wetland	2.5	0	1.5	3.75	0	16
BA-08	Mooseheart, SE of Randall F	West Batavia	Ag	Grassed Waterway	0.3	0	0	0	11700	2
BA-09	Mooseheart, NW of Millviev	West Batavia	Ag	Grassed Waterway	0.5	0	0	0	21000	156
BA-10	Mooseheart, NW of Millviev	West Batavia	Ag	Grassed Waterway	0.6	0	0	0	27000	10
BA-11	Mooseheart, NW of Millviev	West Batavia	Ag	Grassed Waterway	0.2	0	0	0	10500	5
BA-12	Mooseheart, NW of Millviev	West Batavia	Ag	Filter Strip	1.2	0	0	0	50100	23
BA-13	Mooseheart, NW of Millviev	West Batavia	Ag	Filter Strip	1.4	0	0	0	62400	24
BA-14	Mooseheart, E of Randall Rd	West Batavia	Ag	Grassed Waterway	0.9	0	0	0	39000	52
BA-15	Mooseheart, NE of Randall	West Batavia	Hydrologic	Wetland Restoration	6	0	1	6	0	19
BA-19	NE of Wenmoth Rd & Main	Tanglewood	Ag	Grassed Waterway	0.45	0	0	0	19500	7
BBT-01	SE of Keslinger Rd & Bunker	Brundige Trib	Hydrologic	Wetland Restoration	15	0	1	15	0	143
BBT-02	SE of Keslinger Rd & Bunker	Brundige Trib	Ag	Grassed Waterway	2.5	0	0	0	108000	46
BBT-03	E of Bunker Rd, N side of Br	Brundige Trib	Ag	Filter Strip	1	0	0	0	45000	20
BBT-04	E of Bunker Rd, S side of Bru	Brundige Trib	Ag	Filter Strip	1.2	0	0	0	51000	36
BBT-07	E of LaFox Rd	Lower Campton	Ag	Grassed Waterway	0.5	0	0	0	21000	20
BBT-08	E of LaFox Rd	Lower Campton	Ag	Grassed Waterway	0.45	0	0	0	19800	8
BBT-09	NE of LaFox & Keslinger Rds	Brundige Trib	Ag	Grassed Waterway	0.7	0	0	0	30000	35
BBT-10	NE of LaFox & Keslinger Rds	Brundige Trib	Ag	Grassed Waterway	0.45	0	0	0	19500	9
BPD-01	Braeburn Park & Preserve -	McKee Rd Trib	Urban	Pervious & Porous Pavemer	0.1	0	0	0	0	0
BPD-02	Engstrom Park - north parki	West Batavia	Urban	Pervious & Porous Pavemer	0.5	0	0	0	0	1
BPD-03	Engstrom Park - south parki	West Batavia	Urban	Pervious & Porous Pavemer	0.2	0	0	0	0	2
BPD-04	Memorial Park - SE corner b	McKee Rd Trib	Urban	Infiltration Trench	0.005	140	4	0.02	210	9
BPD-05	Memorial Park - parking lot	McKee Rd Trib	Urban	Pervious & Porous Pavemer	0.5	0	0	0	0	7
BT-01	W of Randall Rd	West Batavia	Ag	Filter Strip	0.6	0	0	0	24000	4
BT-02	W of Randall Rd, E of Deerp	West Batavia	Ag	Filter Strip	1.6	0	0	0	69000	17
BT-03	W of Randall Rd, E of Deerp	West Batavia	Ag	Grassed Waterway	0.3	0	0	0	14100	8
BT-04	W of Randall Rd, E of Deerp	West Batavia	Ag	Grassed Waterway	0.2	0	0	0	10800	14
BT-05	W of Randall Rd, E of Deerp	West Batavia	Ag	Grassed Waterway	0.4	0	0	0	15600	3
BT-06	W of Randall Rd, E of Deerp	West Batavia	Ag	Grassed Waterway	0.6	0	0	0	27900	7
BT-07	W of Randall Rd, E of Deerp	West Batavia	Ag	Grassed Waterway	1.4	0	0	0	63000	40
BT-08	adjacent to W side of Randa	West Batavia	Ag	Constructed Wetland	5	0	1.5	7.5	0	52
CH-01	Fox Mill subdiv, immed E of	Lower Campton	Urban	Filter Strip	0.8	0	0	0	35000	2

CMAP_ID	Location	Subshd_Nam	Category	Type	BMP_Size_A	BMP_Lngth_	StorDepth_	StorVol_Ac	FlowAr_SqF	Drainage Area
					acres	feet	ft	acre-feet	sq.ft	acres
CH-02	Fox Mill subdiv, immed E of	Lower Campton	Urban	Filter Strip	0.7	0	0	0	32500	9
CH-03	immed W of Brown Rd	Upper Campton	Urban	Bioretention Facility (retrofi	2.1	0	1.5	3.15	0	38
CH-05	Mill Crk corridor to W of La	Lower Campton	Hydrologic	Wetland Restoration	1.3	0	1	1.3	0	9
CH-06	Campton Woods subdiv SW	Lower Campton	Hydrologic	Wetland Restoration	27	0	1.5	40.5	0	230
CH-07	SE of North Ave & LaFox Rd	Lower Campton	Urban	Bioretention Facility	2.5	0	1.5	3.75	0	283
CT-01	Campton Twp, NW of Beith	Upper Campton	Hydrologic	Wetland Restoration	15	0	1	15	0	133
CT-02	Campton Twp, N of Beith R	Upper Campton	Hydrologic	Wetland Restoration	4	0	1	4	0	73
CT-03	Campton Twp, W of Anders	Upper Campton	Hydrologic	Wetland Restoration	4	0	1	4	0	113
CT-04	Campton Twp, E of Anderso	Upper Campton	Ag	Grassed Waterway	0.8	0	0	0	33000	145
CT-05	Campton Twp, S of Campto	Upper Campton	Hydrologic	Wetland Restoration	7	0	2	14	0	138
CT-06	Campton Twp, W of Brown	Upper Campton	Ag	Filter Strip	0.5	0	0	0	21000	55
CT-07	Campton Twp, E of Brown R	Upper Campton	Ag	Filter Strip	1.4	0	0	0	60000	8
CT-08	Campton Twp, E of Brown R	Upper Campton	Other	Prairie Restoration	40	0	0	0	0	113
CT-09	Campton Twp, E of Brown R	Upper Campton	Hydrologic	Wetland Restoration	8	0	1	8	0	76
CT-10	Campton Twp, E of Brown R	Upper Campton	Other	Prairie Restoration	50	0	0	0	0	56
CT-12	Campton Twp, Mongerson	Lower Campton	Hydrologic	Wetland Restoration	20	0	1.5	30	0	68
CT-13	Campton Twp, Mongerson	Lower Campton	Ag	Grassed Waterway	0.7	0	0	0	30000	29
CT-14	Campton Twp, Mongerson	Lower Campton	Other	Prairie Restoration	50	0	0	0	0	48
FPD-01	Campton F.P., north of Nort	Upper Campton	Ag	Filter Strip	0.5	0	0	0	21000	4
FPD-02	Campton F.P. - 2 parcels - U	Upper Campton	Hydrologic	Wetland Restoration (w/ Br	13	0	1	13	0	236
FPD-03	Campton F.P. - 2 parcels - U	Lower Campton	Hydrologic	Wetland Restoration (w/ Br	12	0	1	12	0	96
FPD-04	Mill Creek Greenway - SE co	West St Chas/Geneva	Hydrologic	Wetland Restoration	4	0	1	4	0	20
FPD-05	Mill Creek Greenway - east	Lower Campton	Other	Prairie Restoration	165	0	0	0	0	198
FPD-06	Mill Creek Greenway - west	Mill Crk Greenway	Ag	Grassed Waterway	0.4	0	0	0	16050	29
FPD-07	Mill Creek Greenway - west	Mill Crk Greenway	Ag	Saturated Buffer (w/ Filter S	0.7	1000	3	2.1	30000	42
FPD-08	Mill Creek SSA, S of Dobson	West St Chas/Geneva	Hydrologic	Wetland Restoration	16	0	1.5	24	0	98
FPD-09	Johnson's Mound F.P.	Brundige Trib	Hydrologic	Wetland Restoration	3	0	1.5	4.5	0	902
FPD-10	Mill Creek F.P. - east of Mill	Mill Crk FP	Other	Prairie Restoration	23	0	0	0	0	30
FPD-11	Mill Creek F.P. - west of Mil	Mill Crk FP	Hydrologic	Wetland Restoration	60	0	1.5	90	0	96
FPD-12	Braeburn Marsh F.P.	McKee Rd Trib	Hydrologic	Wetland Restoration	50	0	1.5	75	0	992
GE-01	Brentwood subdiv, SE Keslir	West St Chas/Geneva	Urban	Bioretention Facility (retrofi	1.5	0	2	3	0	40
GE-02	NW Keslinger Rd & Peck Rd	West St Chas/Geneva	Hydrologic	Wetland Enhancement	5.5	0	2.5	13.75	0	35
GE-03	Westhaven subdiv, NW We	West St Chas/Geneva	Urban	Bioretention Facility (retrofi	2.8	0	2.5	7	0	69
GE-04	NE Kaneville Rd & Lewis Rd	McKee Rd Trib	Urban	Bioretention Facility	0.5	0	3	1.5	0	1
GE-05	SW Fargo Blvd & Randall Rd	McKee Rd Trib	Urban	Bioretention Facility (retrofi	4.8	0	2.5	12	0	63
GE-06	along E side Randall Rd & N	McKee Rd Trib	Urban	Filter Strip	1.2	0	0	0	51000	14
GE-07a	Concrete lined channel S of	McKee Rd Trib	Hydrologic	Stream Channel Restoration	0.5	0	0	0	20600	68
GE-07b	Concrete lined channel N of	McKee Rd Trib	Hydrologic	Stream Channel Restoration	1.2	0	0	0	52200	243

CMAP_ID	Location	Subshd_Nam	Category	Type	BMP_Size_A	BMP_Lngth_	StorDepth_	StorVol_Ac	FlowAr_SqF	Drainage Area
					acres	feet	ft	acre-feet	sq.ft	acres
GE-08	Allendale subdiv, E of Pheas	McKee Rd Trib	Urban	Grass-lined Channel (bioswa	0.1	0	0	0	4500	8
GF-01	NW of Rt 38 & Garfield Rd	Lower Campton	Hydrologic	Wetland Restoration	4	0	1.5	6	0	8
GF-02	E side of property, depressi	Lower Campton	Hydrologic	Wetland Restoration	3	0	1	3	0	48
GF-03	W side of property, SW of C	Lower Campton	Other	Prairie Restoration	11	0	0	0	0	36
GF-05	SW area of property, W side	Lower Campton	Ag	Saturated Buffer (w/ Filter S	0.9	1300	3	2.7	39000	57
GF-06	SW area of property, E side	Lower Campton	Ag	Saturated Buffer (w/ Filter S	0.7	1000	3	2.1	30000	25
GF-07	W & E of Garfield Rd & alon	Lower Campton	Other	Oak ecosystem restoration	6.5	0	0	0	0	31
GF-08	E of Garfield Rd, N of cemet	Lower Campton	Other	Oak ecosystem restoration	5.5	0	0	0	0	8
GF-09	along fence rows	Lower Campton	Other	Oak ecosystem (Savanna) re	10	0	0	0	0	81
GPD-01	Peck Farm Pk, S side Kanevi	Peck Lake	Urban	Grass-lined Channel (bioswa	0.1	0	0	0	4500	15
GPD-02	Peck Farm Pk, along N side	Peck Lake	Urban	Grass-lined Channel (bioswa	0.6	0	0	0	27000	0
GPD-03	Peck Farm Pk, along N side	Peck Lake	Urban	Filter Strip	1.4	0	0	0	60000	4
GPD-04	Peck Farm Pk, along S side K	Peck Lake	Urban	Grass-lined Channel (bioswa	0.8	0	0	0	36000	31
GT-01	Mill Creek SSA, NW of Dobs	West St Chas/Geneva	Hydrologic	Wetland Restoration	10	0	1.5	15	0	148
GT-02	SW of Fabyan Pkwy & Wenr	McKee Rd Trib	Ag	Grassed Waterway	0.9	0	0	0	37500	7
GT-03	SW of Fabyan Pkwy & Wenr	McKee Rd Trib	Ag	Grassed Waterway	0.45	0	0	0	19500	63
SC-01	Kane Co fairgrounds gravel	West St Chas/Geneva	Urban	Pervious & Porous Pavemer	26	0	0	0	0	35
SCPD-01	near W side Land & Water F	Lower Campton	Hydrologic	Wetland Restoration	18	0	1	18	0	22
SCPD-02	W side Land & Water Reser	Lower Campton	Other	Oak ecosystem (woodland?	3	0	0	0	0	23
SCPD-03	"large pothole" in central ar	West St Chas/Geneva	Hydrologic	Wetland Restoration	4	0	2	8	0	71
SCPD-04	small pothole"" in central a	West St Chas/Geneva	Hydrologic	Wetland Restoration	1	0	2	2	0	5
SCPD-05	N parcel of Land & Water R	West St Chas/Geneva	Other	Oak ecosystem (woodland?	9	0	0	0	0	9
SCT-01	Lake Charlotte - along S sho	West St Chas/Geneva	Urban	Filter Strip	0.1	0	0	0	5000	13
Total										

APPENDIX B: ESTIMATE OF LOAD REDUCTIONS FROM SITE-SPECIFIC BMPS

NCHRP BMP Evaluation Tool V.1.0 for Windows

Readme Notes

1	Tool inputs are intended to be populated sequentially (i.e., Project Location, Project Options, then Project Design).Inputs on previous tabs can later be modified by skipping backward and forward, however skipping forward as part of the initial tool parameterization will result in an undesirable user experience and potentially introduce errors.
2	Either the navigation buttons or the tabs can be used to navigate through this workbook.
3	The user is responsible for ensuring that input parameters are reasonable. **Negative numbers are never reasonable for populating the Tool and will not return valid results**.
4	The user should review default assumptions and confirm that they are valid for the intended site and BMP design.
5	Where dropdown boxes are available for input parameters, values must be selected from the dropdown menu. The Tool cannot accept custom inputs for these fields.
6	The Tool allows flexibility for the user to enter a wide range of input parameters representing a wide range of BMP designs and treatment options. In some cases, guidance is provided within the Tool regarding acceptable ranges of parameters. The user is responsible for selecting reasonable input parameters.
7	It is possible to enter inputs that are outside of acceptable ranges. Please observe error messages and see the key to error messages below.
8	The Tool requires macros to be enabled. If macros are not enabled, the Tool will not function.
9	The Tool is intended to be operated with Excel set to "Auto Calculate" mode; not "Manual Calculate" mode. To change this setting, go to the "Formulas" ribbon and select "Calculation Options".
10	Please read the User's Guide before using the Tool.
11	Any changes to the structure of this workbook (tab names, inserting or deleting columns or rows, etc.) will render the Tool non-functional. Several precautions were taken to prevent this kind of action, but it is ultimately the user's responsibility to maintain a functional workbook. The user may create new worksheets for the purpose of calculations and notes, but any other structural changes must be avoided.
12	The workbook is saved as a Template file (.xltm). Opening the file by double-clicking will create a new macro-enabled workbook (.xlsm) that can be saved by the user without the risk of over-writing the template. If the user would like to edit the template, first open Excel and then navigate to the .xltm file.

13 Many cells and sheets in this workbook are protected. To unprotect/protect a sheet, go to "Review" or "File" and click the appropriate selection. The password is "NCHRP". Again, it is the user's responsibility to maintain a functional workbook.

Key to Warning Messages

The Tool produces warning messages in certain circumstances.

Example Warning Message	Explanation
Hiding these parameters will reset all concentrations to their default values. Do you wish to continue?	The tool provides the user with the ability to modify some of the default parameters. Some of these parameters should only be modified based on supporting data or best professional judgment, such as influent concentrations. In many of these cases, in addition to supplemental parameters, the user inputs are hidden. Showing the parameters opens them up to modification, while hiding resets them back to their defaults.
You have selected to use the default influent concentration. Please change your selection to override this value.	Once the water quality constituent influent concentrations are unhidden, the user must select each constituent that they want to modify from the default value.

Key to Error Messages

The Tool produces error messages in certain circumstances.

Example Error Message	Explanation
The Impervious Area (%) can not be greater than 100%	All impervious area is assumed to be directly connected within the BMP tributary area. Thus, an impervious area greater than 100% suggests an area greater than the tributary area.

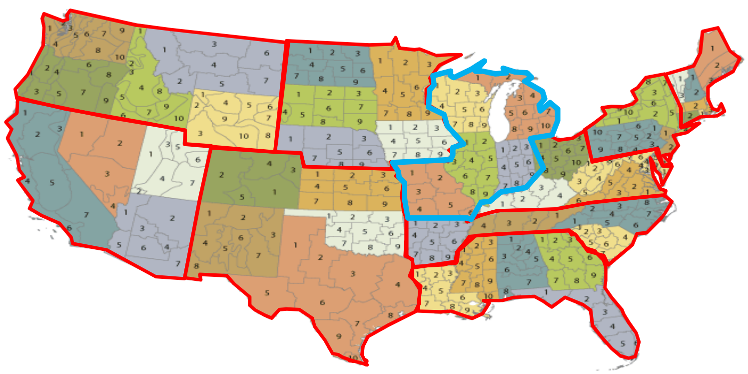
The Planting Media Filtration Rate is restricting the flow. Update the additional parameters if not intended.	For some combinations of input parameters, the planting media filtration rate can control the performance of a bioretention BMP rather than the underlying soil infiltration rate. This warning is intended to let you know when this occurs. This is not an invalid design scenario if that is what the user intends.
The Design Drawdown Time can not be less than 24 hours.	Certain tools require a parameters to be within a specific range for normal functionality.
Warning: Infiltration rate is too low to use this BMP. RESULTS ARE NOT ACCURATE. Reduce depth of infiltration storage or select other BMP that has a lower depth of infiltration storage; use underdrains if applicable.	The Tool does not provide valid estimates when infiltration storage drawdown times are greater than 360 hours. In general, when you see this warning, the BMP design is not suitable for the soil conditions (i.e., too great of a water depth and/or too low of an infiltration rate).

NCHRP Bioretention Evaluation Tool

Project Title	Mill Creek Watershed Plan Development
Project Location	Mill Creek, IL
Company	Geosyntec Consultants

Project Location and Climate Selection

Step 1: Select the Region your Project is Located



Step 2: Select the State your project is located and the rain gage closest to the project

States within Selected Region	Rain Gages Available in State
Illinois	[2] NORTHEAST - CHICAGO MIDWAY AP 3SW

COOP ID	111577
Elevation , feet	620
85th Percentile, 24-Hour Storm Depth, inches	0.90
95th Percentile, 24-Hour Storm Depth, inches	1.50
Average Annual Precipitation Depth, inches	36.4

Step 3: If available, override the existing data and provide project specific rain data

Project Location 85th Percentile, 24-Hour Storm Depth (in)	0.9
Project Location Average Annual Precipitation Depth (in)	36.4

Note: Default precipitation statistics and the project-specific precipitation statistics are for reference and scaling purposes only; they do not imply a BMP size used for performance analysis. The user enters the BMP sizing parameters to be analyzed on the Project Design tab.

Key

User Steps
Headings and Descriptions
User Entered Data
Reference Data; do not edit cells

NCHRP Bioretention Evaluation Tool

Project Title

Project Location

Company

Project Options

Key

User Steps	Default Data (editable)
Headings and Descriptions	Guidance
User Entered Data	

Step 1: View/Edit Highway Runoff Concentrations

Pollutant Loads

Would you like to view/edit the highway runoff concentrations for the project?	yes

Pollutant of Concern	Use Default?
Total Suspended Solids (mg/L)	no
Total Zinc (ug/L)	yes
Total Lead (ug/L)	yes
Total Copper (ug/L)	yes
Total Nitrogen (mg/L)	TN = TKN + NO3
Total Phosphorus (mg/L)	no
Nitrate [NO3] (mg/L)	no
Total Kjeldahl Nitrogen [TKN] (mg/L)	no
Dissolved Phosphorus (mg/L)	no
Fecal Coliform (col/100mL)	no
Escherichia Coli [E. Coli] (col/100mL)	yes

Step 2: Select Primary Cost Inputs

Cost Inputs	Value
Location Adjustment Factor (100 = nationwide average)	100

Expected Level of Maintenance (H = High, M = Medium, L = Low)	M
Design Life (years)	20
Discount Rate (%)	5
Inflation Rate for labor and materials (%)	5
Local Sales Tax (%)	6.25

Would you like to view/edit the capital cost inputs?	no
Would you like to view/edit the maintenance cost inputs?	no

Mill Creek Watershed Plan Development

Mill Creek, IL

Geosyntec Consultants

Influent Concentration	Guidance
92	Provide influent concentrations known or select "yes" to use the default influent concentrations
190	
44	
41.8	
2.25	
0.13	
2.25	
0.00	
0.14	
782,073	
6,025	

Guidance

Enter the location scaling factor from RSMeans or other reference to adjust for local costs as a percentage of nationwide average; if not known, enter 100

http://www.rsmeansonline.com/

Enter the level of maintenance expected to be provided. Refer to Section 5.4 of the main report for guidance on selecting a maintenance level.
Enter the design life of the BMP in years.
Enter the discount rate to be used in whole lifecycle cost analysis.
Enter the inflation rate to be used in whole lifecycle cost analysis.
Enter the local sales tax, including state and local taxes.

Selecting Yes will expose the Capital Cost input tab for optional user override of default parameters.
Selecting Yes will expose the Maintenance Cost input tab for optional user override of default parameters.

NCHRP Bioretention Evaluation Tool

		Key	
Project Title	Mill Creek Watershed Plan Development	User Steps	Default data; editing allowed with rationale
Project Location	Mill Creek, IL	User Entered Data	Guidance
Company	Geosyntec Consultants	Reference Data; do not edit cells	Warnings

Tributary Area Attributes

Step 1: Provide data describing the tributary area of the project

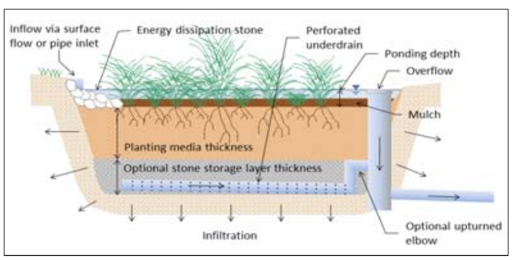
Tributary Area Input Parameters	Value	Guidance
Tributary Area (acres)	61	Enter the total area tributary to the BMP
Impervious Area (%)	39.5	All impervious area is assumed to be directly connected within the BMP tributary area; adjust imperviousness to account for disconnection if present (Value entered as an integer [e.g. 80 for 80%])
Tributary Area Soil Type (Hydrologic Soil Group)	Sandy Clay Loam (C)	Select the soil type that is most representative of the tributary area to the BMP
Calculated Runoff Coefficient	0.22	This runoff coefficient is calculated based on a Two-line regression model of the volumetric runoff coefficient (Rv) (Granato, 2010), where Rv(%<55) = imperviousness (%) × 0.225 + 0.05, Rv(%>55) = imperviousness (%) × 1.14 - 0.371
User-Provided Runoff Coefficient	0.32	Enter a site-specific runoff coefficient if available. If no value is entered here, the calculated runoff coefficient will be used.

Tributary Area Runoff Reference Values	Value	Guidance
Reference 85th Percentile, 24-Hour Storm Depth, inches	0.90	Per project-specific user input; for reference purposes only.
Reference Runoff from 85th Percentile Storm Event, cu-ft	64,530	Volume is based on the calculated volumetric runoff coefficient or the user-entered runoff coefficient, if entered. For refereence only.
Reference Average Annual Precipitation Depth, inches	36.4	Per project-specific user input; for reference purposes only.
Reference Average Annual Runoff Volume, cu-ft	2,607,000	Volume is based on the calculated volumetric runoff coefficient or the user-entered runoff coefficient, if entered. For refereence only.

Bioretention Conceptual Design Parameters

Step 2: Provide data describing the BMP design

Primary Bioretention Design Parameters	Value	Guidance	Default Values
Storage Volume (cu-ft)	43560	Enter the total storage volume provided by the bioretention (including ponding, planting media, and stone reservoir storage)	User-entered
Underlying Soil Design Infiltration Rate (in/hr)	0.2	A default infiltration rate has been provided based on the soil type selected for the tributary area. If a localized site infiltration rate is available, it should override this default data. If the system is lined with an impermeable barrier, enter zero.	By tributary soil type; recommend user override with site data
Underdrain Present?	yes	Underdrains should be considered if infiltration rates are not adequate to drain the system in a reasonable time. The elevation of the underdrain can be specified in the default parameters section.	A and B Soils: No C and D Soils: Yes
Ponding Depth (ft)	1.5	Ponding depth is equal to the elevation of the overflow above the surface of the planting media	1



Additional Bioretention Design and Reference Parameters	Value	Guidance	Default Values
Planting Media Thickness (ft)	2	Thickness of engineered planting media (aka bioretention soil media), excluding mulch layer.	2
Stone Reservoir Thickness (ft)	1	Inclusive of choking stone layers if present. Note; Stone Reservoir Thickness must be greater than the Underdrain Discharge Elevation from bottom of the stone reservoir.	1
Underdrain Discharge Elev. from bottom of stone reservoir (ft)	0.5	Elevation above the bottom of the facility at which water begins to discharge from the underdrain system. This can be controlled by the elevation or the underdrain or by an inverted elbow design. Value is ignored if no underdrain is used.	0.5
Planting Media Filtration Rate (in/hr)	2	Enter the filtration rate of the planting media that is characteristic of long term average conditions. Or, if the rate of filtration through the system will be controlled by an underdrain outlet control (preferred), then enter the average outlet controlled rate.	2
Soil Freely Drained Storage (in/in)	0.2	Enter the storage provided by the soil that is associated with freely drained conditions, generally calculated as the surplus of water that exceeds the field capacity and is below saturation	0.2
Soil Suction Storage (in/in)	0.15	Enter the storage provided by the soil after the soil is freely drained by gravity, this is the volume of water available to plants and is lost to ET.	0.15
Crop coefficient of Vegetation	0.7	Enter the crop coefficient of the vegetation being planted, which will be used to represent the potential ET available	0.7
Stone Freely Drained Storage (in/in)	0.4	Enter the available porosity in the stone reservoir.	0.4
BMP Length/width ratio (L:1W)	2	For example: For BMP that is 60 feet long by 20 feet wide, enter 3	2
Mulch depth above Planting Media Layer (ft)	0.25	Included in water quality volume calculations	0.25
Mulch porosity (in/in)	0.5	Included in water quality volume calculations	0.5
Pea Gravel Depth within Stone Reservoir (ft)	0.25	The Pea Gravel is for cost calculations only and is included in the stone reservoir depth for volume calculations	0.25
Freeboard depth (ft)	1	The storage depth above the water quality volume. Value is neglected in estimating treatment volumes as overflow/bypass is assumed to begin when the water quality storage volume has been exhausted. However, is included in cost calculations.	1
Horizontal/vertical side slope ratio (H:1V)	3	For example: For a side slope of 4 horizontal feet per 1 vertical foot, enter 4	3
Approximate Total Footprint to Top of Freeboard, sq-ft	17,640	This footprint accounts for freeboard above ponding, assuming a rectangular shape; actual dimensions may vary.	Calculated
Calculated Drawdown Time of Surface Ponding, hours	9	For Reference Purposes Only: For bioretention, a target of 3 to 24 hours is typically recommended.	Calculated

NCHRP Bioretention Evaluation Tool

Project Title	Mill Creek Watershed Plan Development
Project Location	Mill Creek, IL
Company	Geosyntec Consultants

Results Summary Report

Summary of Modeled Scenario

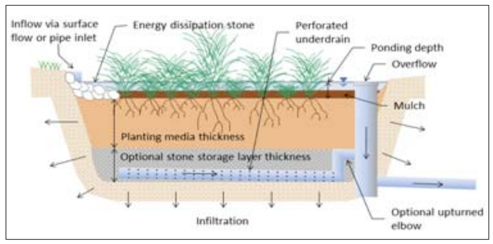
The modeled scenario consists of a tributary area of 61 acres at 39.5% impervious, draining to a Bioretention BMP.
Analysis is based on the [2] NORTHEAST - CHICAGO MIDWAY AP 3SW gage, in Illinois, with Project Location 85th percentile, 24-hour storm depth of 0.90 inches, and Project Location average annual precipitation depth of 36.4 inches.

Summary of Primary Conceptual Design Parameters

Bioretention

Storage Volume (cu-ft)	43,560
Underlying Soil Design Infiltration Rate (in/hr)	0.2
Underdrain Present?	yes
Ponding Depth (ft)	1.5
Planting Media Thickness (ft)	2
Stone Reservoir Thickness (ft)	1
Approximate Total Footprint to Top of Freeboard, sq-ft	17,640

See "Project Design" tab for detailed inputs



Summary of Whole Lifecycle Cost Results

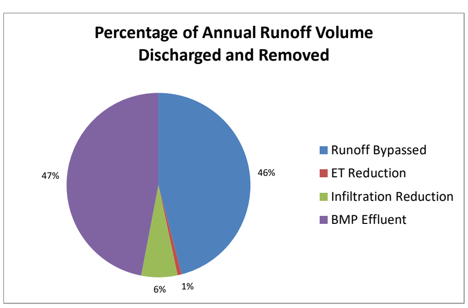
Capital Costing Method	Line Item Engineer's Estimate
Assumed Level of Maintenance	M
Estimated Capital Cost, $ (2013)	$434,450
Estimated NPV of Design Life Maintenance Costs, $ (2013)	$46,680
Estimated NPV of Design Life Whole Life Cycle Cost, $ (2013)	$481,130
Estimated Annualized Whole Life Cycle Cost, $/yr (2013)	$24,056.49

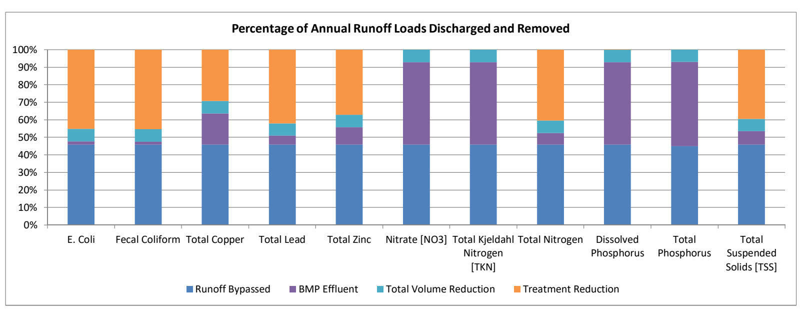
Costs are based on design life with routine and major maintenance.

Summary of Volume and Pollutant Load Performance

Volume and Pollutant Load Performance	Average Annual Volume, cf/yr	Percent of Baseline Runoff Volume, %	Average Annual Pollutant Loads										
			Pathogens (CFU/yr)		Metals (lb/yr)			Nutrients (lb/yr)					Sediment (lb/yr)
			E. Coli	Fecal Coliform	Total Copper	Total Lead	Total Zinc	Nitrate [NO3]	Total Kjeldahl Nitrogen [TKN]	Total Nitrogen	Dissolved Phosphorus	Total Phosphorus	Total Suspended Solids [TSS]
Baseline Average Annual Runoff	2,607,391	-	4.449E+16	5.774E+18	6.797	7.175	30.910	365.60	0.16	365.80	22.79	21.74	14900.0
Runoff Bypassed	1,198,000	45.9%	2.044E+16	2.653E+18	3.123	3.297	14.200	168.00	0.07	168.00	10.47	9.99	6850.0
BMP Captured	1,409,391	54.1%	2.405E+16	3.121E+18	3.674	3.878	16.708	197.62	0.09	197.73	12.32	11.75	8054.0
Total Volume Reduction	184,700	7.1%	3.151E+15	4.090E+17	0.481	0.508	2.190	25.90	0.01	25.91	1.61	1.54	1055.5
ET Reduction	18,900	0.7%	-	-	-	-	-	-	-	-	-	-	-
Infiltration Reduction	165,800	6.4%	-	-	-	-	-	-	-	-	-	-	-
Treatment Reduction	-	-	2.007E+16	2.622E+18	1.993	3.012	11.478	0.00	0.00	147.72	0.00	0.00	5878.5
BMP Effluent	1,224,691	47.0%	8.200E+14	9.040E+16	1.200	0.358	3.040	172.00	0.08	24.10	10.70	10.70	1120.0
Total Discharge	2,422,691	92.9%	2.126E+16	2.743E+18	4.323	3.655	17.240	340.00	0.15	192.10	21.17	20.69	7970.0
BMP Load Reduction	-	-	2.323E+16	3.031E+18	2.474	3.520	13.668	25.62	0.01	173.63	1.62	1.05	6934.0
% Annual BMP Load Reduction	-	-	52%	52%	36%	49%	44%	7%	7%	47%	7%	5%	47%

Annualized Cost Per Unit of Performance	Hydrologic Performance ($$/cu-ft removed)		Pathogens ($$/10^12 CFU removed)		Metals ($$/lb removed)			Nutrients ($$/lb removed)					Sediment ($$/lb removed)
	Volume Reduction	Volume Capture	E. Coli	Fecal Coliform	Total Copper	Total Lead	Total Zinc	Nitrate [NO3]	Total Kjeldahl Nitrogen [TKN]	Total Nitrogen	Dissolved Phosphorus	Total Phosphorus	Total Suspended Solids [TSS]
Whole Lifecycle Cost per Unit, annualized (2013 dollars)	$0.13	$0.02	$1.04	$0.01	$9,724	$6,834	$1,760	$939	$2,091,978	$139	$14,860	$22,883	$3.47





Summary of Average Water Quality Concentrations

Average Influent and Effluent Quality Summary Table	Average Annual Concentration										
	Pathogens (CFU/100ml)		Metals (µg/L)			Nutrients (mg/L)					Sediment (mg/L)
	E. Coli	Fecal Coliform	Total Copper	Total Lead	Total Zinc	Nitrate [NO3]	Total Kjeldahl Nitrogen [TKN]	Total Nitrogen	Dissolved Phosphorus	Total Phosphorus	Total Suspended Solids [TSS]
Influent Concentration	6025	782073	41.76	44.08	189.93	2.25	0.00	2.25	0.14	0.13	91.53
Treated Effluent Concentration	236	26062	15.70	4.68	39.81	2.25	0.00	0.32	0.14	0.14	14.68
Whole Effluent Concentration*	3099	399896	28.59	24.16	114.04	2.25	0.00	1.27	0.14	0.14	52.68

* Accounting for treated effluent quality, bypass effluent quality, capture efficiency and volume reduction. If no underdrain, there is no treated effluent and the concentrations are reported as "NA - Not Applicable".

NCHRP Bioretention Evaluation Tool

Project Title	Mill Creek Watershed Plan Development
Project Location	Mill Creek, IL
Company	Geosyntec Consultants

Supporting Data from Continuous Simulation Lookup Database

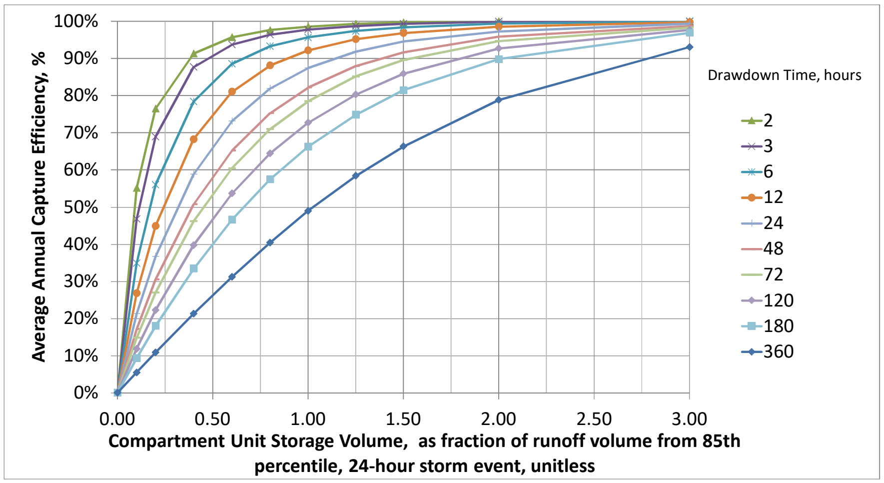
Rain Gage Used for Nomograph Development

Rain Gage ID	111577
State	Illinois
Climate Division and Name	[2] NORTHEAST - CHICAGO MIDWAY AP 3SW
Elevation, feet	620
85th Percentile, 24-hour Storm Depth, inches	0.90
95th Percentile, 24-hour Storm Depth, inches	1.50
Average Annual Precipitation, inches	36.4

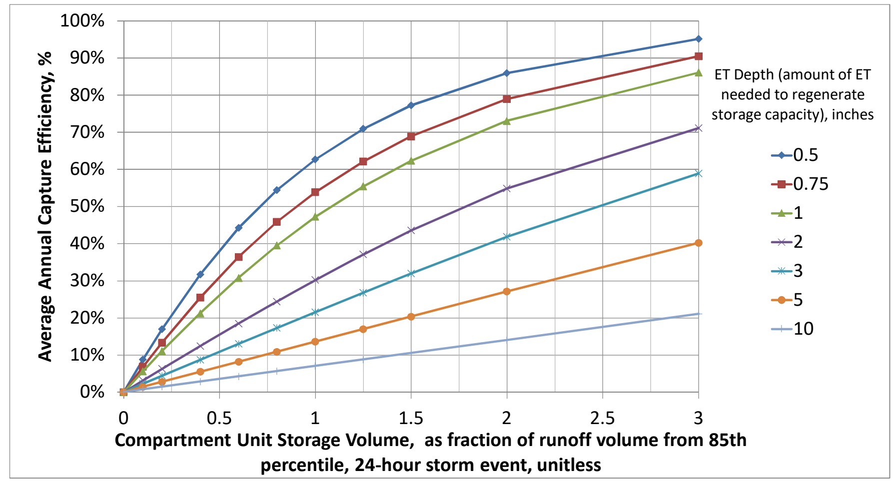
Project Data Used to Localize Model Results

Project Location 85th Percentile - 24 hour storm depth (in)	0.9
Project Location Annual Average Precipitation Depth (in)	36.4

Supporting Drawdown Nomograph, from SWMM Continuous Simulation



Supporting ET Nomograph, from SWMM Continuous Simulation



These charts represent graphical depictions of the long term continuous simulation model results used in the Tool calculations

NCHRP Bioretention Evaluation Tool

Project Title	Mill Creek Watershed Plan Development
Project Location	Mill Creek, IL
Company	Geosyntec Consultants

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N

Whole Life Cycle Costs Summary

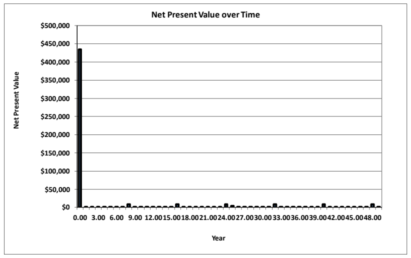
CAPITAL COSTS	Total Cost
Total Facility Base Cost	$284,419
Total Associated Capital Costs (e.g., Engineering, Land, etc.)	$150,031
Capital Costs	$434,450

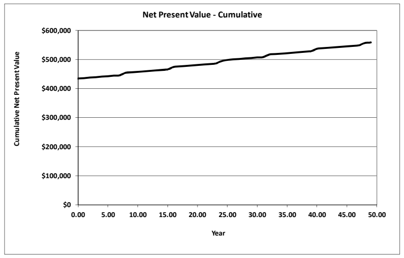
REGULAR MAINTENANCE ACTIVITIES	Years between Events	Total Cost per Visit	Total Cost per Year
Inspection, Reporting & Information Management	1	$280	$280
Vegetation Management with Trash & Minor Debris Removal	1	$1,380	$1,380
add additional activities if necessary	0	$0	$0
add additional activities if necessary	0	$0	$0
Totals, Regular Maintenance Activities			$1,660

CORRECTIVE AND INFREQUENT MAINTENANCE ACTIVITIES (Unplanned and/or >3yrs. betw. events)	Years between Events	Total Cost per Visit	Total Cost per Year
Corrective Maintenance	8	$6,740	$843
Sediment Management	25	$2,580	$103
add additional activities if necessary	0	$0	$0
Totals, Corrective & Infrequent Maintenance Activities			$946

Capital Costing Method	Line Item Engineer's Estimate
Assumed Level of Maintenance	M
Estimated Capital Cost, $ (2013)	$434,450
Estimated NPV of Design Life Maintenance Costs, $ (2013)	$46,680
Estimated NPV of Design Life Whole Life Cycle Cost, $ (2013)	$481,130
Estimated Annualized Whole Life Cycle Cost, $/yr (2013)	$24,056

Totals are based on design life with routine and major maintenance.





APPENDIX C: ESTIMATE OF LOAD REDUCTIONS FROM SITE-SPECIFIC BMPS

CMAP_ID	FlowAr	Drainage Area	Nitrogen Reduction	Phosphorus Reduction	Sediment Reduction	Fecal Coliform Reduction	Capital Cost	Whole Life Cycle Cost/yr	Calculation
		acres	lb/yr	lb/yr	ton/yr	CFU/yr	$	$	
BA-01	0	61	174	1	3	1.07E+12	$477,895	$26,462	NCHRP Tool
BA-02	0	53	140	1	3	8.70E+11	$363,969	$20,766	NCHRP Tool
BA-03	12000	5	4	0	0	4.19E+09	$568		Pollution Reduction Efficiency
BA-04	1E+05	93	114	7	6	1.72E+11	$4,546		Pollution Reduction Efficiency
BA-05	15000	3	2	0	0	2.33E+09	$568		Pollution Reduction Efficiency
BA-06	17100	3	3	0	0	2.92E+09	$758		Pollution Reduction Efficiency
BA-07	0	16	51	2	1	2.22E+11	$26,250		Pollution Reduction Efficiency
BA-08	11700	2	2	0	0	1.58E+09	$568		Pollution Reduction Efficiency
BA-09	21000	156	219	15	12	4.40E+11	$947		Pollution Reduction Efficiency
BA-10	27000	10	10	1	0	9.22E+09	$1,136		Pollution Reduction Efficiency
BA-11	10500	5	5	0	0	3.74E+09	$379		Pollution Reduction Efficiency
BA-12	50100	23	39	2	1	6.78E+10	$106,228	$5,682	NCHRP Tool
BA-13	62400	24	56	2	1	1.08E+11	$130,554	$6,655	NCHRP Tool
BA-14	39000	52	54	3	3	5.83E+10	$1,705		Pollution Reduction Efficiency
BA-15	0	19	53	2	1	1.70E+11	$63,000		Pollution Reduction Efficiency
BA-19	19500	7	7	0	0	8.36E+09	$852		Pollution Reduction Efficiency
BBT-01	0	143	393	15	8	1.35E+12	$157,500		Pollution Reduction Efficiency
BBT-02	1E+05	46	44	3	2	5.06E+10	$4,735		Pollution Reduction Efficiency
BBT-03	45000	20	60	3	1	1.56E+11	$96,142	$5,278	NCHRP Tool
BBT-04	51000	36	106	6	2	2.70E+11	$108,008	$5,753	NCHRP Tool
BBT-07	21000	20	18	1	1	1.73E+10	$947		Pollution Reduction Efficiency
BBT-08	19800	8	7	0	0	7.38E+09	$852		Pollution Reduction Efficiency
BBT-09	30000	35	32	2	2	3.22E+10	$1,326		Pollution Reduction Efficiency
BBT-10	19500	9	9	1	0	8.66E+09	$852		Pollution Reduction Efficiency
BPD-01	0	0	0	0	0	1.88E+08	$54,014		Pollution Reduction Efficiency
BPD-02	0	1	1	0	0	5.63E+08	$270,072		Pollution Reduction Efficiency
BPD-03	0	2	3	0	0	1.37E+09	$108,029		Pollution Reduction Efficiency
BPD-04	210	9	8	0	0	4.50E+10	$15,743	$3,355	NCHRP Tool
BPD-05	0	7	23	1	1	2.52E+10	$270,072		Pollution Reduction Efficiency
BT-01	24000	4	14	1	0	3.59E+10	$54,612	$3,617	NCHRP Tool
BT-02	69000	17	42	2	1	9.78E+10	$143,606	$7,177	NCHRP Tool
BT-03	14100	8	7	0	0	7.54E+09	$568		Pollution Reduction Efficiency
BT-04	10800	14	13	1	1	1.23E+10	$379		Pollution Reduction Efficiency
BT-05	15600	3	3	0	0	2.79E+09	$758		Pollution Reduction Efficiency
BT-06	27900	7	6	0	0	6.24E+09	$1,136		Pollution Reduction Efficiency
BT-07	63000	40	42	3	2	4.72E+10	$2,652		Pollution Reduction Efficiency
BT-08	0	52	181	7	4	2.22E+11	$52,500		Pollution Reduction Efficiency
CH-01	35000	2	9	1	0	2.78E+10	$66,196	$4,080	NCHRP Tool

CMAP_ID	FlowAr	Drainage Area	Nitrogen Reduction	Phosphorus Reduction	Sediment Reduction	Fecal Coliform Reduction	Capital Cost	Whole Life Cycle Cost/yr	Calculation
		acres	lb/yr	lb/yr	ton/yr	CFU/yr	$	$	
CH-02	32500	9	48	2	1	1.51E+11	$61,978	$3,912	NCHRP Tool
CH-03	0	38	100	5	1	2.77E+11	$1,438,179	$74,476	NCHRP Tool
CH-05	0	9	25	1	1	4.19E+10	$13,650		Pollution Reduction Efficiency
CH-06	0	230	771	29	16	2.60E+12	$283,500		Pollution Reduction Efficiency
CH-07	0	283	823	46	17	3.24E+12	$1,705,221	$87,828	NCHRP Tool
CT-01	0	133	337	12	7	9.37E+11	$157,500		Pollution Reduction Efficiency
CT-02	0	73	188	7	4	5.62E+11	$42,000		Pollution Reduction Efficiency
CT-03	0	113	308	11	6	9.38E+11	$42,000		Pollution Reduction Efficiency
CT-04	33000	145	145	9	8	1.50E+11	$1,515		Pollution Reduction Efficiency
CT-05	0	138	352	13	7	9.77E+11	$73,500		Pollution Reduction Efficiency
CT-06	21000	55	93	6	3	1.84E+11	$48,679	$3,380	NCHRP Tool
CT-07	60000	8	20	1	0	5.91E+10	$125,807	$6,465	NCHRP Tool
CT-08	0	113	246	14	1	8.89E+10	$100,000		Pollution Reduction Efficiency
CT-09	0	76	337	12	7	9.37E+11	$84,000		Pollution Reduction Efficiency
CT-10	0	56	161	10	0	6.63E+10	$125,000		Pollution Reduction Efficiency
CT-12	0	68	157	6	3	4.15E+11	$210,000		Pollution Reduction Efficiency
CT-13	30000	29	23	1	1	2.83E+10	$1,326		Pollution Reduction Efficiency
CT-14	0	48	111	6	0	4.19E+10	$125,000		Pollution Reduction Efficiency
FPD-01	21000	4	8	1	0	2.17E+10	$48,679	$3,380	NCHRP Tool
FPD-02	0	236	770	29	15	2.57E+12	$136,500		Pollution Reduction Efficiency
FPD-03	0	96	324	12	7	1.22E+12	$126,000		Pollution Reduction Efficiency
FPD-04	0	20	53	2	1	1.76E+11	$42,000		Pollution Reduction Efficiency
FPD-05	0	198	458	26	1	1.73E+11	$412,500		Pollution Reduction Efficiency
FPD-06	16050	29	28	2	1	3.69E+10	$758		Pollution Reduction Efficiency
FPD-07	30000	42	64	2	0	3.69E+10	$2,000		Pollution Reduction Efficiency
FPD-08	0	98	335	13	7	1.87E+12	$168,000		Pollution Reduction Efficiency
FPD-09	0	902	2557	95	53	8.87E+12	$31,500		Pollution Reduction Efficiency
FPD-10	0	30	58	3	0	1.40E+10	$57,500		Pollution Reduction Efficiency
FPD-11	0	96	155	5	2	2.15E+11	$630,000		Pollution Reduction Efficiency
FPD-12	0	992	1087	162	44	6.14E+10	$2,097,280	$130,745	NCHRP Tool
GE-01	0	40	213	2	4	1.34E+12	$1,710,717	$88,103	NCHRP Tool
GE-02	0	35	132	5	3	7.78E+11	$57,750		Pollution Reduction Efficiency
GE-03	0	69	330	7	7	1.91E+12	$3,154,205	$160,278	NCHRP Tool
GE-04	0	1	6	0	0	4.03E+10	$703,939	$37,764	NCHRP Tool
GE-05	0	63	440	12	9	3.29E+12	$5,364,822	$270,809	NCHRP Tool
GE-06	51000	14	152	3	2	3.13E+11	$108,008	$5,753	NCHRP Tool
GE-07a	20600	68	77	70	9	0.00E+00	$854,900		Pollution Reduction Efficiency
GE-07b	52200	243	196	177	31	0.00E+00	$2,166,300		Pollution Reduction Efficiency

CMAP_ID	FlowAr	Drainage Area	Nitrogen Reduction	Phosphorus Reduction	Sediment Reduction	Fecal Coliform Reduction	Capital Cost	Whole Life Cycle Cost/yr	Calculation
		acres	lb/yr	lb/yr	ton/yr	CFU/yr	$	$	
GE-08	4500	8	14	1	0	7.86E+10	$234,607	$10,817	NCHRP Tool
GF-01	0	8	18	1	0	3.26E+10	$42,000		Pollution Reduction Efficiency
GF-02	0	48	73	10	2	3.43E+09	$2,097,280	$130,745	NCHRP Tool
GF-03	0	36	104	6	0	4.40E+10	$27,500		Pollution Reduction Efficiency
GF-05	39000	57	75	2	0	4.95E+10	$2,000		Pollution Reduction Efficiency
GF-06	30000	25	37	1	0	1.99E+10	$2,000		Pollution Reduction Efficiency
GF-07	0	31	101	5	0	2.72E+10	$39,000		Pollution Reduction Efficiency
GF-08	0	8	25	1	0	6.09E+09	$33,000		Pollution Reduction Efficiency
GF-09	0	81	258	12	1	6.18E+10	$60,000		Pollution Reduction Efficiency
GPD-01	4500	15	9	1	1	5.23E+10	$127,362	$6,527	NCHRP Tool
GPD-02	27000	0	2	0	0	2.12E+10	$1,343,568	$55,175	NCHRP Tool
GPD-03	60000	4	45	1	1	1.54E+11	$147,600	$7,337	NCHRP Tool
GPD-04	36000	31	24	1	0	0.00E+00	$1,358,295	$55,764	NCHRP Tool
GT-01	0	148	489	19	10	2.69E+12	$105,000		Pollution Reduction Efficiency
GT-02	37500	7	28	2	1	4.95E+10	$1,705		Pollution Reduction Efficiency
GT-03	19500	63	75	5	4	1.32E+11	$852		Pollution Reduction Efficiency
SC-01	0	35	125	6	4	1.64E+11	$14,043,744		Pollution Reduction Efficiency
SCPD-01	0	22	36	1	0	3.85E+10	$189,000		Pollution Reduction Efficiency
SCPD-02	0	23	56	2	0	7.66E+09	$18,000		Pollution Reduction Efficiency
SCPD-03	0	71	213	8	4	7.27E+11	$42,000		Pollution Reduction Efficiency
SCPD-04	0	5	213	0	0	1.50E+10	$10,500		Pollution Reduction Efficiency
SCPD-05	0	9	19	1	0	2.85E+09	$54,000		Pollution Reduction Efficiency
SCT-01	5000	13	24	1	1	1.89E+10	$35,197	$2,840	NCHRP Tool
Total			15705	992	372	4.47E+13	$45,117,043		

233 South Wacker Drive, Suite 800
Chicago, Illinois 60606
312-454-0400
info@cmap.illinois.gov
www.cmap.illinois.gov

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