DUPAGE COUNTY

Klein Creek

Watershed-Based Plan

August 2017

Love Blue. Live Green.

DuPage County Stormwater Management

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1. Introduction

Since the late 1980s, watershed organizations, tribes and federal, state and local agencies have been using a watershed approach to managing water quality in water bodies such as streams, rivers, lakes, wetlands and oceans. A watershed approach is a flexible framework for managing water resource quality and quantity within specified drainage areas, also known as watersheds. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology. The watershed planning process works within this framework by using a series of cooperative, iterative steps to characterize existing conditions, identify and prioritize problems, define management objectives, develop protection or remediation strategies and implement and adapt selected actions, as necessary. The outcomes of this process are documented or referenced in a watershed plan.

A watershed plan is a strategy that provides assessment and management information for a geographically defined watershed, including the analyses, actions, participants and resources related to developing and providing a timeframe for implementing the plan. The development of watershed plans requires a certain level of technical expertise and the participation of a variety of people with diverse skills and knowledge.

DuPage County Stormwater Management received a Section 319 grant from the Illinois Environmental Protection Agency (IEPA) to fund the development of five sub-watershed plans, including Winfield Creek, St. Joseph Creek, Sawmill Creek, Kress Creek and Klein Creek, which is the focus of this document (Figure 1). The purpose of the Klein Creek Watershed Plan is to develop recommendations to improve the quality of Klein Creek and its surrounding areas. Stakeholders input, long-term monitoring and regional, statewide and federal water quality goals drive both the development and eventual implementation of the plan.

Figure 1 Klein Creek

2. Klein Creek Watershed Planning Area

2.1 Planning Area

Klein Creek (IL_ GBKC -01) is a portion of HUC# 071200040802 flowing generally north to south through the northwest quadrant of DuPage County, Illinois. Klein Creek is a tributary, or sub-watershed, to the West Branch DuPage River (Figure 2). The headwaters of the West Branch DuPage River begin in northern DuPage County and run north to south through the County before converging with the East Branch DuPage River near Bolingbrook, Illinois in Will County to become the DuPage River. The DuPage River eventually meets with the Des Plaines and Kankakee Rivers in Channahon, Illinois to form the Illinois River.

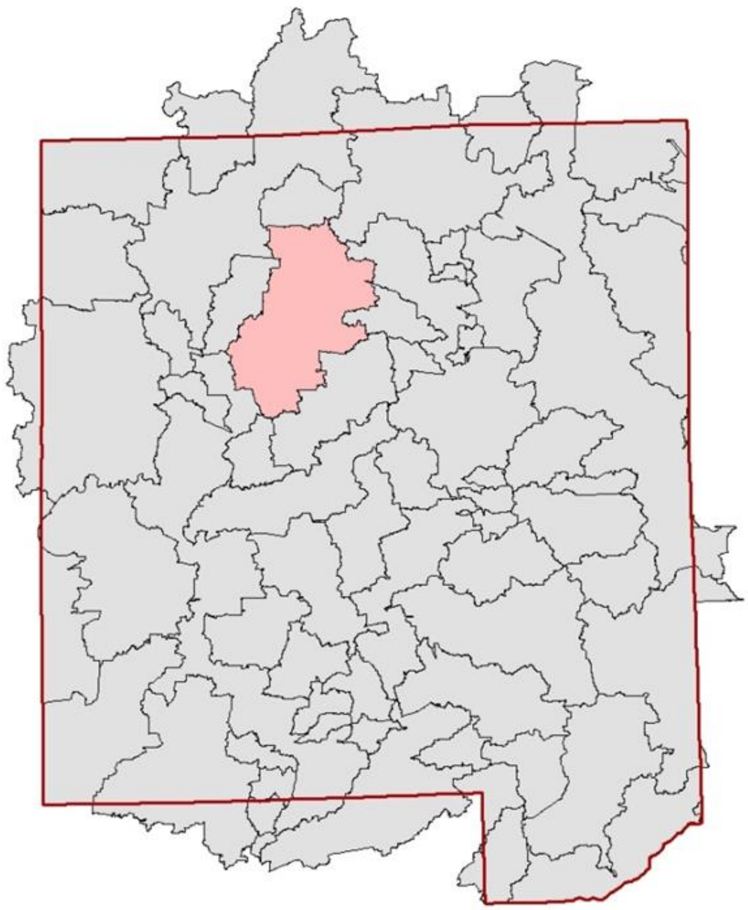

Figure 2 Klein Creek Watershed's location within the West Branch DuPage River Watershed

Klein Creek Watershed is a typical suburban area that drains a total of approximately 12.56 square miles in north central DuPage County. Shown in Figure 3, the watershed includes portions of the City of Wheaton, Village of Hanover Park, Village of Winfield, Village of Glendale Heights, Village of Bloomingdale, Village of Carol Stream and unincorporated DuPage County.

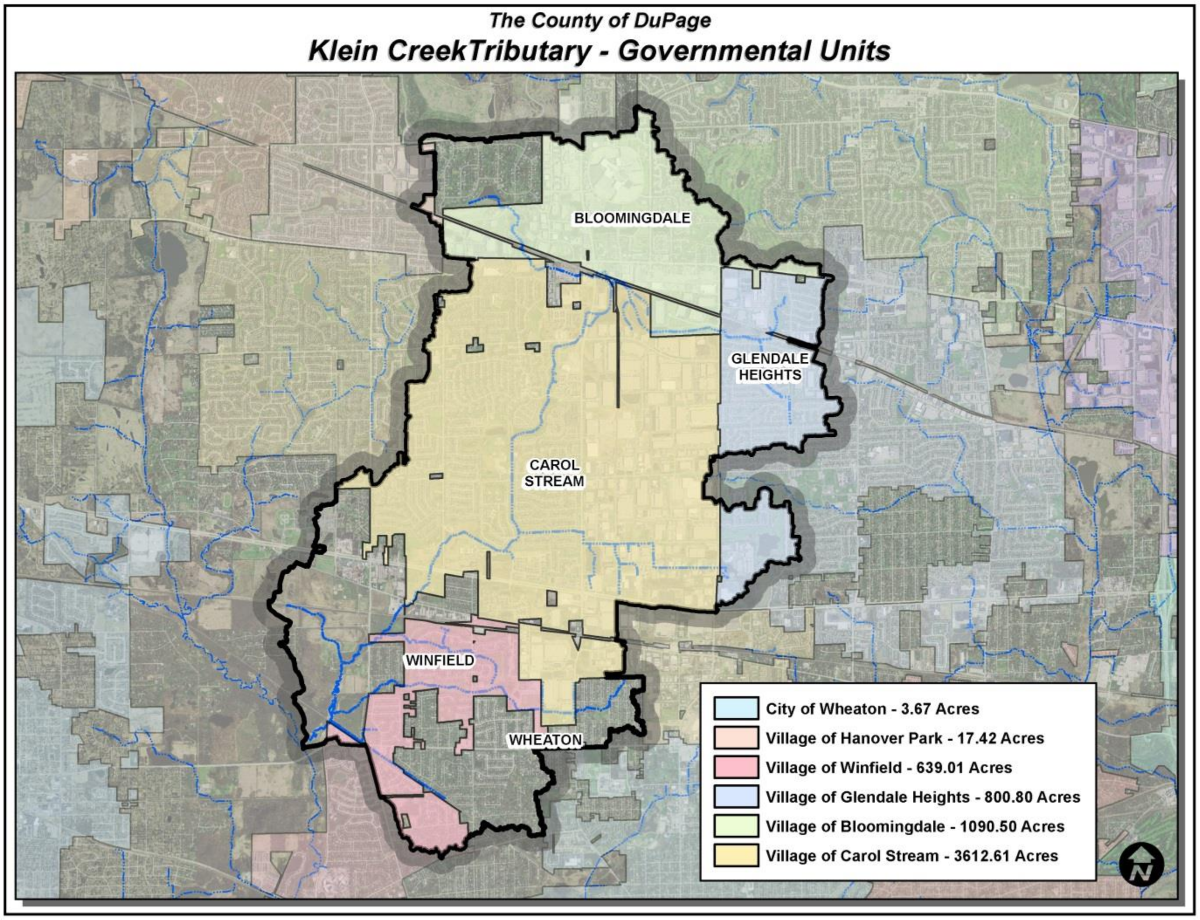

Figure 3 Municipal boundaries within the Klein Creek Watershed

As shown in Figure 4, Klein Creek begins as two branches in the northern end of the watershed. The creek flows generally southwest through Bloomingdale, Glendale Heights, and Carol Stream. The main watershed use is residential development (both single and multi-family), but there are also commercial zones, including Stratford Square Mall, clustered primarily around the major thoroughfares as well as an industrial areas within the east side of Carol Stream. Other uses include park districts, a forest preserve, golf courses and parks.

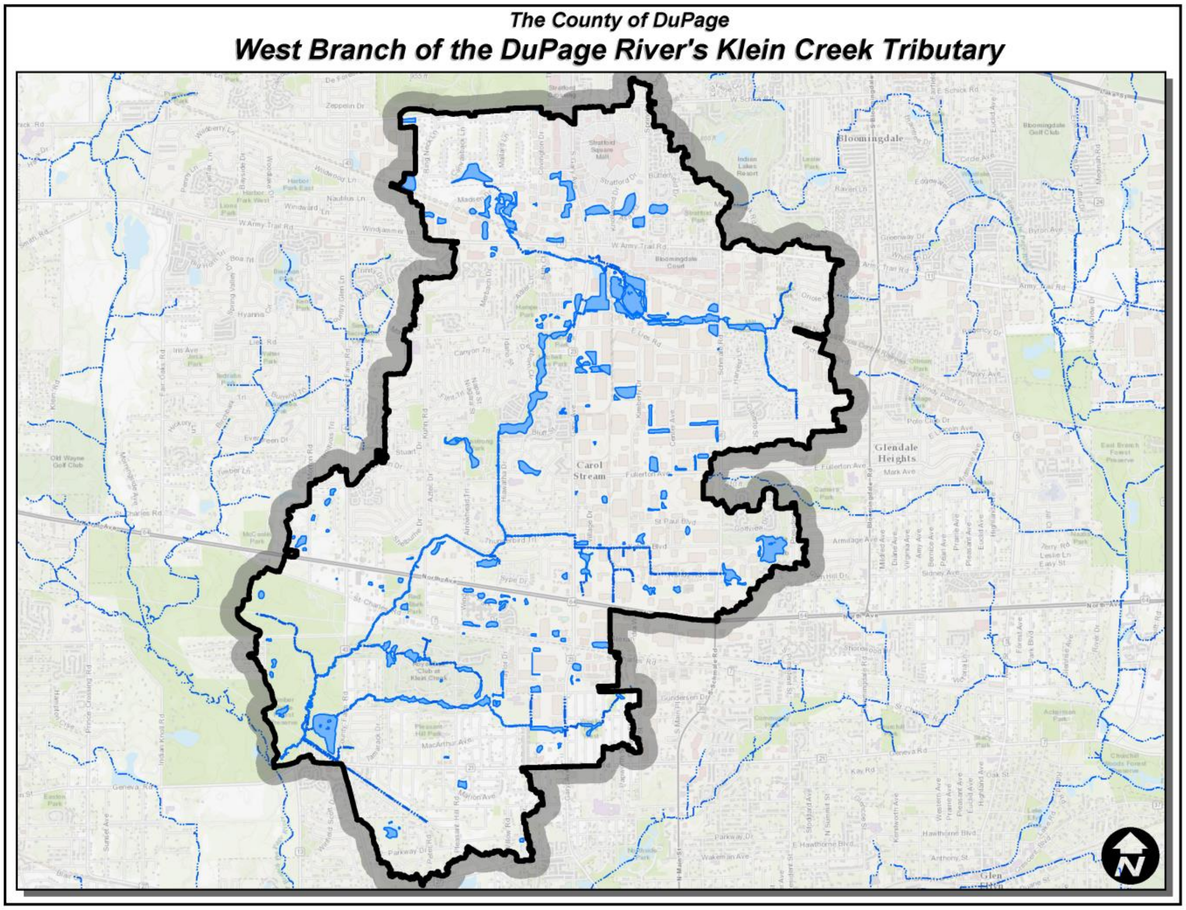

Figure 4 Klein Creek Watershed

For purposes of this watershed study, the Klein Creek watershed has been broken up into 5 subwatersheds (Figure 5). Klein Creek Subwatershed #1 consists of land area that drains directly to main stem Klein Creek as well as one small tributary to the southwest. Subwatershed #2 is at the south end of the watershed at the confluence with the main stem of the West Branch DuPage River. Subwatershed #3 is in the southeastern part of Klein Creek watershed. Subwatershed #4 is in the northeastern section of the watershed. Klein Creek subwatershed #5 is in the northwest corner of the watershed.

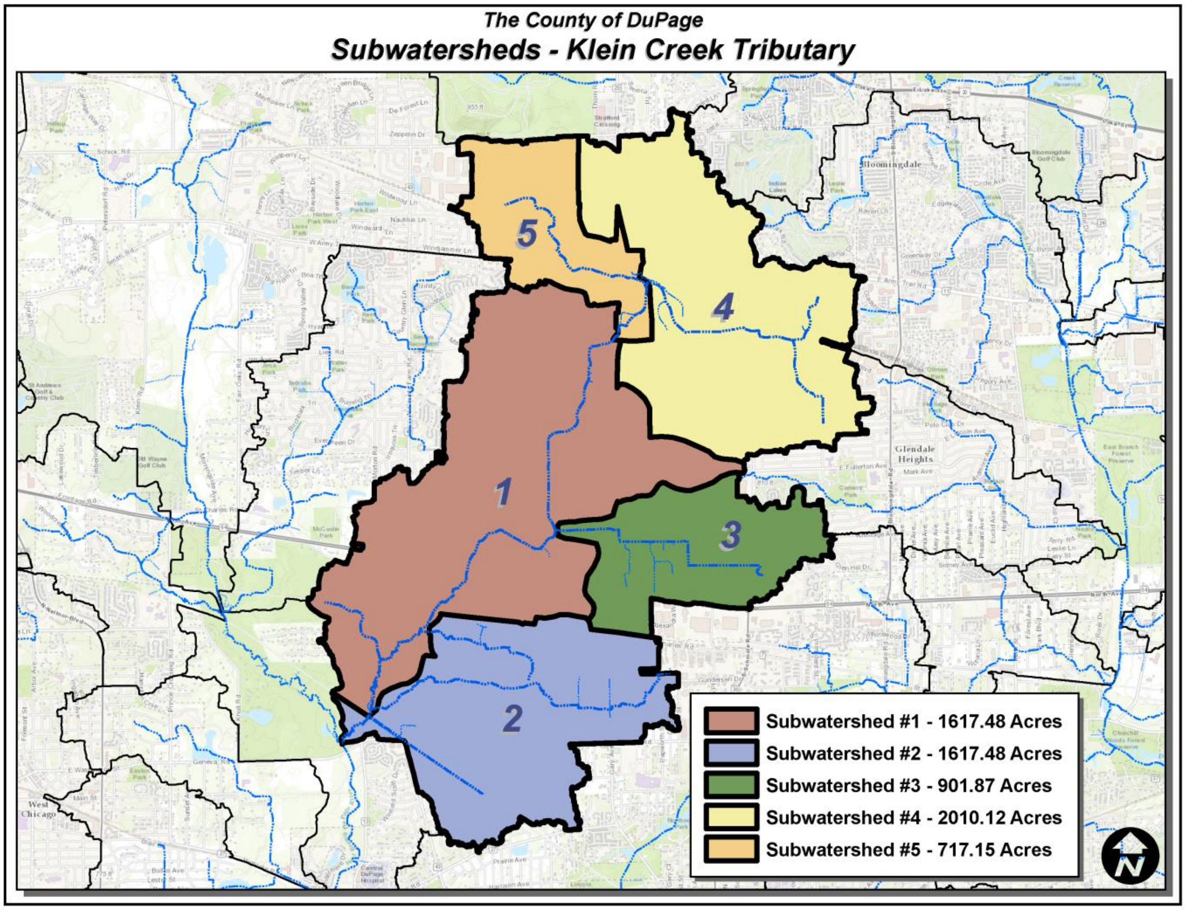

Figure 5 Sub-watersheds in Klein Creek Watershed

2.2 Local Stakeholders

To understand the Klein Creek Watershed better, DuPage County engaged in extensive community outreach. Input collected from local public agencies, non-profits, businesses and residents was integral in developing a detailed and holistic Plan highlighting existing needs and opportunities within the watershed. Further, the engagement during the development of the Plan will lay the groundwork for the later implementation of the Plan.

DuPage County took a multi-tiered approach to outreach, ranging from stakeholder involvement at the technical input through general residential engagement. An intergovernmental, multi-disciplinary Klein Creek Watershed Steering Committee led the Plan development process and contributed a large amount of technical details within the Plan. Leading the general outreach was DuPage County Stormwater Management's Communications Supervisor, in partnership with several local organizations.

2.2.1 Klein Creek Watershed Steering Committee

Early in the Plan development, DuPage County convened a Klein Creek Watershed Steering Committee. The group consisted of regional organizations, including several County departments, the Forest Preserve District of DuPage County (FPDDC), The Conservation Foundation (TCF), the DuPage River Salt Creek Workgroup (DRSCW), ComEd and the Illinois Department of Transportation (IDOT), as well as municipalities, park districts, school districts, townships and sanitary districts within the watershed. The

Steering Committee first assembled on September 18, 2015 to assist with basin assessments and other data required for the water quality assessments, then, in person and remotely, to provide input on the content of the Plan. This Committee, featured in Figure 6, was instrumental in forming the Plan and will be the guiding agencies in implementing projects, programs and policies recommended within the Plan.

Figure 6 Klein Creek Watershed Steering Committee members meet to discuss the plan

2.2.2 West Branch Watershed Protection Workgroup

In each of DuPage County's three major watersheds, the Stormwater Management Department, in partnership with The Conservation Foundation, organized groups to improve the health of the watershed. The West Branch Watershed Protection Workgroup consists of local public agencies, organizations, businesses and residents who all have the common goal of improving the West Branch DuPage River by becoming citizen advocates, applying for funding for sustainable projects and maintaining the watershed. Meeting biannually, County staff used the meeting on October 5, 2016 to introduce the Klein Creek Watershed Plan to the group and seek assistance in the water quality assessment. Staff provided subsequent updates via email and during the following March 9, 2017 meeting, both of which were held in the watershed. As environmental champions in the local community, this workgroup will be important to future implementation of the Plan.

2.2.3 Local Community Outreach

Figure 7 DuPage County water quality planning app.

Although prominent agencies and environmentally minded individuals may be the easiest targets when developing watershed plans, local residents, business owners and others are the key to identifying both localized water quality issues and solutions. DuPage County has a long-standing history of engaging local communities in the development and, as importantly, implementation of watershed plans. The Klein Creek Plan was no exception. DuPage County made an effort to engage with the broad watershed, as well as residents near the creek, using an interactive and socially driven web application to identify areas of the watershed in need of improvement, as well as potential spots for projects. Figure 7 shows a screenshot of this app.

DuPage County mailed 419 letters with an overview of the Plan, contact information and instructions on using the web application to all single-family homes within the floodplain defined by a 1% chance flood. Further, staff distributed several hundred targeted brochures to 34 local libraries, park districts, government buildings, non-profits and businesses with community boards within the watershed. The "Back to Basics" brochures provided basic – hence the name – information on watersheds, non-point source pollution and best management practices, in addition to a panel detailing the Klein Creek Watershed Plan and web application. Further, DuPage County's commitment to long-term sustainability within the Watershed will provide an opportunity for additional consultation and consideration of input from all community members.

Figure 8 DuPage County staff worked a community event in Downers Grove to elicit input during the planning process

2.3 Mission

Throughout the stakeholder engagement process, DuPage County was able to craft the mission of the Plan. This mission statement, defined below, then shaped the recommendations found in the Plan.

Mission Statement: To improve the quality of Klein Creek and the surrounding watershed to meet federal, statewide and regional water quality initiatives. Specifically, proposed recommendations found in the Plan will improve physical stream conditions, streamside cover, habitat and impoundments.

3. Watershed Resource Inventory

3.1 Demographics

For this study, DuPage County staff evaluated the population density, population growth rate, median age, median income and unemployment for the Klein Creek Watershed. This data was obtained through the U.S. Census Bureau.[1]

In the Klein Creek watershed median age ranges from 27-36 years to 44-53 years. In the southeast part of the watershed, populations are relatively younger, with medians in the 27-36 year old range. In the southern and central areas of the watershed, the median age of the population is 36-44 years old. In the northern end and near the southern part of the watershed median ages are older and range between 44-53 years.

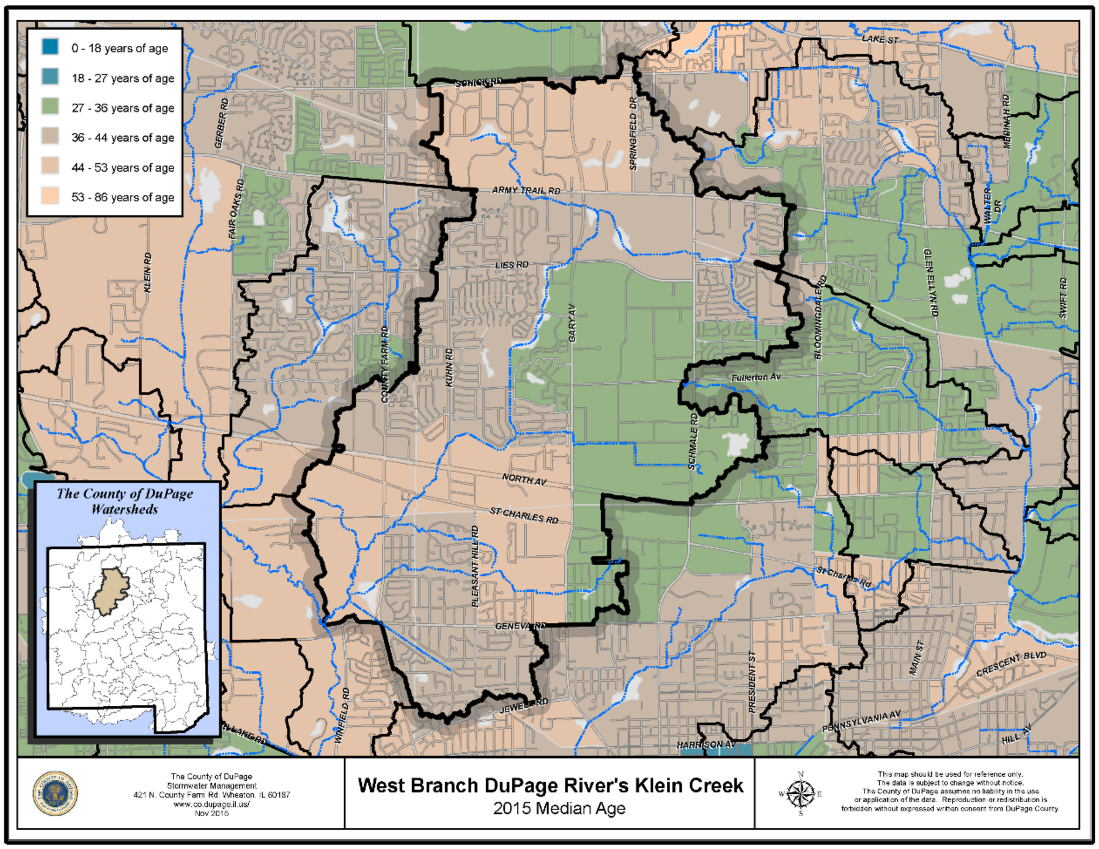

Figure 9 Klein Creek Median Age

The population density of the Klein Creek watershed ranges from 0- 100 people per square mile to 4,000 – 22,000 people per square mile (Figure 10). The lowest population density is within the Mallard Landing subdivision in an unincorporated area in the northwest corner of the watershed. This neighborhood consists of single-family homes with large yards. The highest population densities are northeast of the intersection of Army Trail Road and Springfield Drive, which is across the street from Stratford Square Mall. This neighborhood consists of townhomes, which are spaced close together. A larger pocket of

[1] https://www.census.gov/en.html

higher population density is in Carol Stream west of Gary Avenue and between North Avenue and Army Trail Road. In addition, Glendale Heights has another higher population density neighborhood north of Fullerton and east of Schmale Road.

Population growth rates in the Klein Creek watershed ranges from slightly decreasing (-1.25% - 0%) to slightly increasing (1.25%- 1.9%) as shown in Figure 11**.** In the central part of the watershed, the population is somewhat decreasing. While in a small area of Carol Stream and unincorporated DuPage County, the population is increasing.

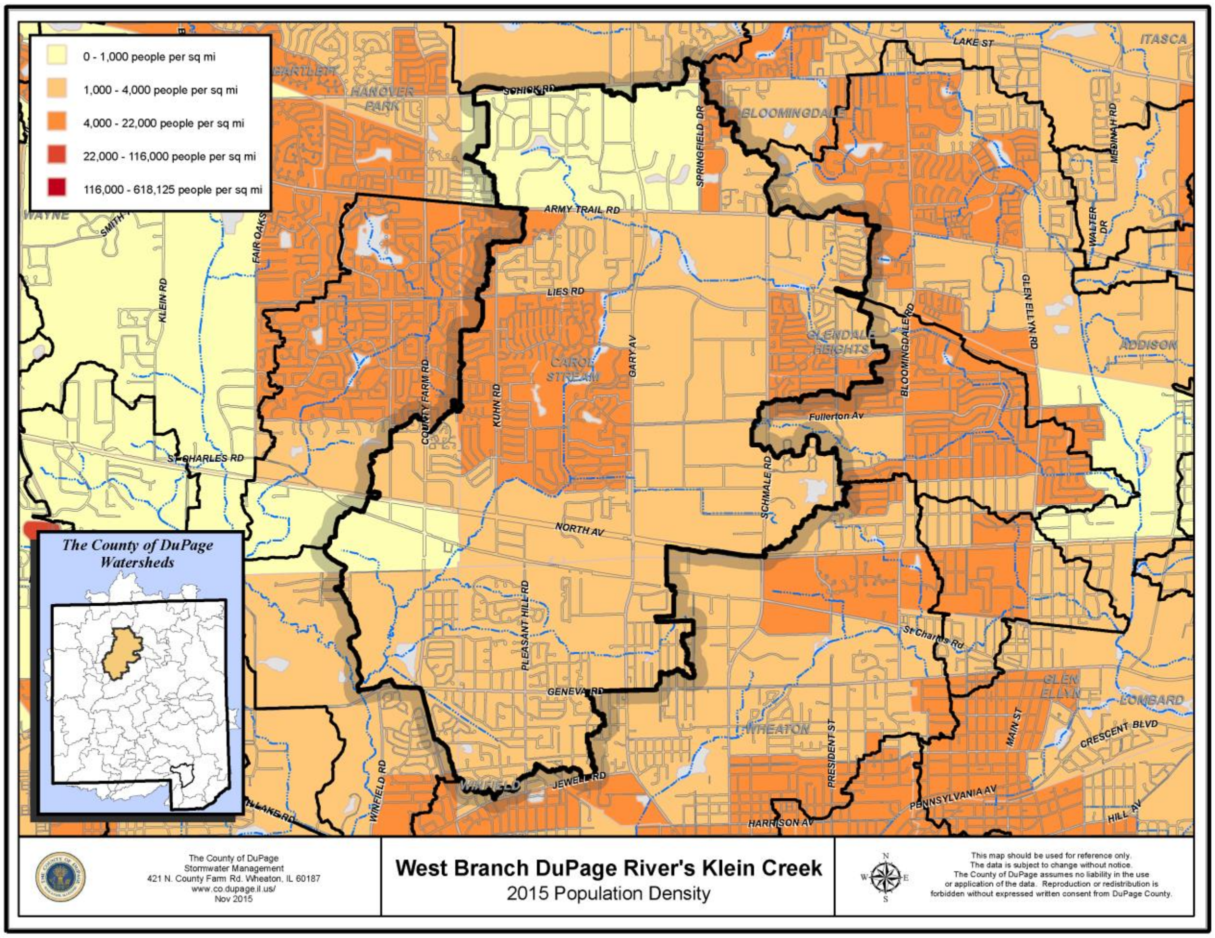

Figure 10 Klein Creek Population Density

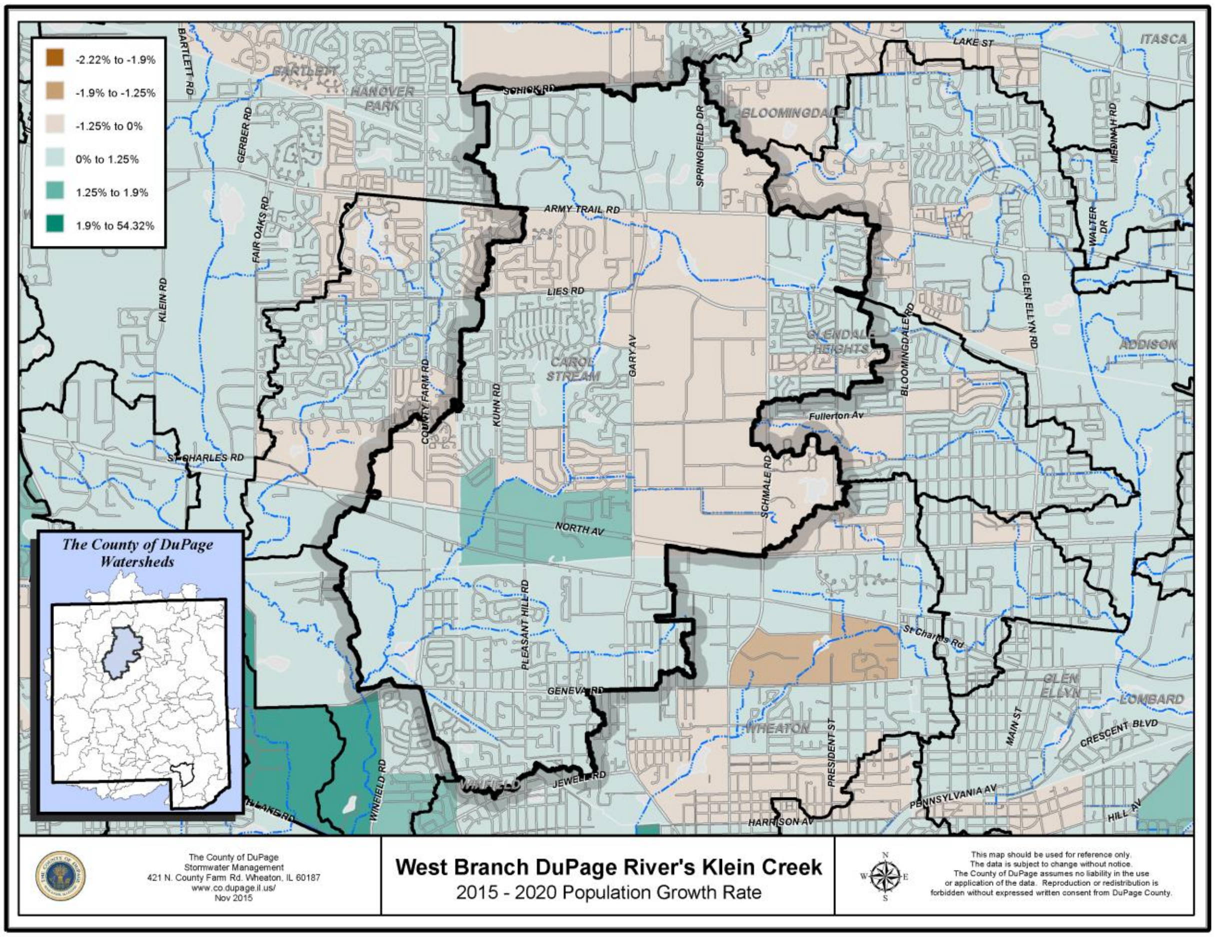

Figure 11 Klein Creek Population Growth

Median income (Figure 12) and unemployment rate (Figure 13) provide a snapshot of the economic condition of a region. Although DuPage County in general has a high median income as compared to the rest of the country, there are parts of the County with lower than average incomes. According to the U. S. Census, the median income in Illinois (2010-2014) was $57,166. Median income for the Klein Creek watershed is average to above average in comparison to the rest of the state. The areas with the lowest median income are north of North Avenue on the east side of the watershed within the limits of Carol Stream and Glendale Heights. The median income in these areas is between $43,000 and $73,000. The highest median income within the watershed is in the north, west and south sides of the watershed. The median income in these area significantly higher than the statewide average and is between $104,000 and $201,001.

The unemployment rate in Illinois is currently 6% according to the Bureau of Labor Statistics. The unemployment rate in Klein Creek watershed varies from a low of 0% - 17.6%. The lowest unemployment rates are contained in pockets in the north, central, and southern part of the watershed. The highest rate of unemployment in the watershed areas is in the southeast portion of the watershed south of North Avenue and east of Gary Avenue.

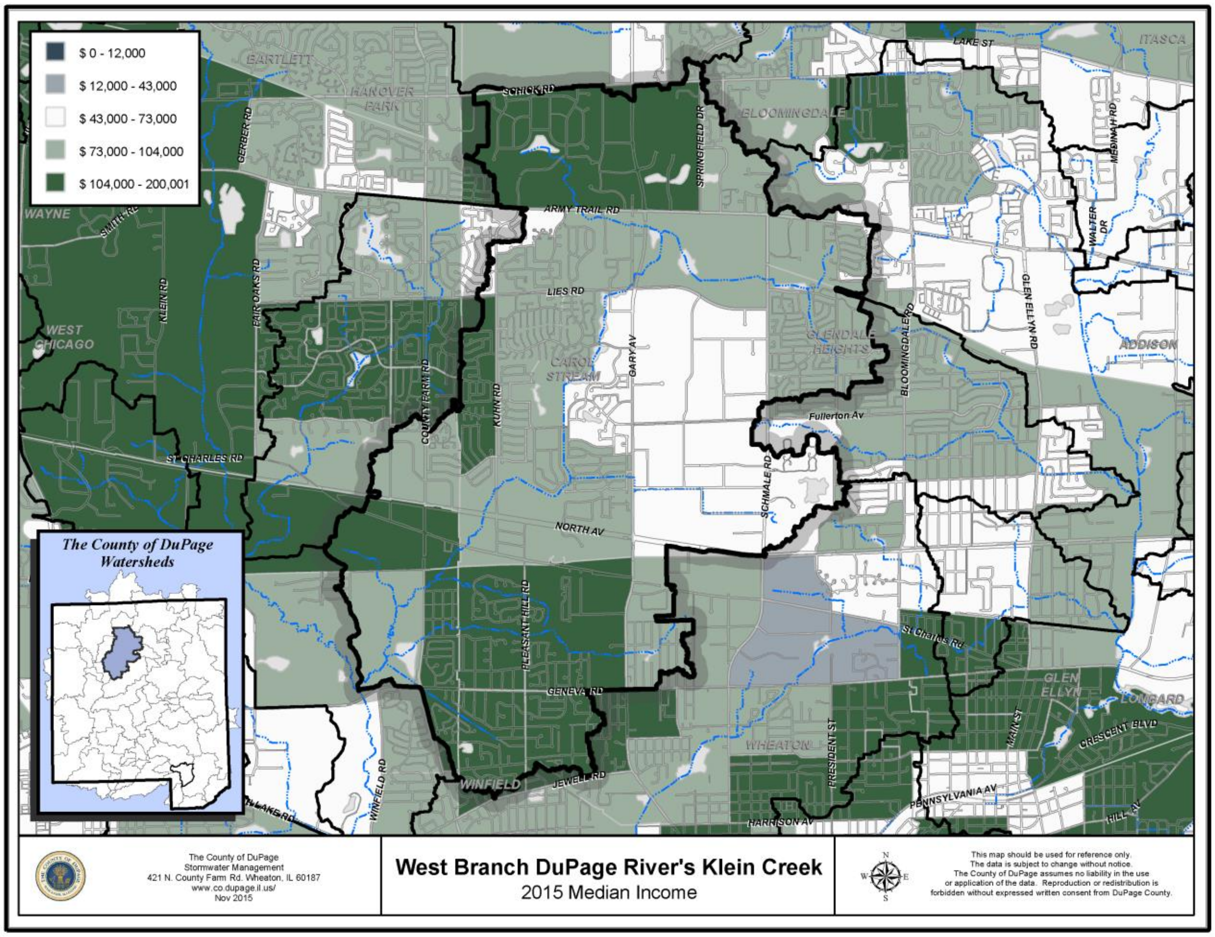

Figure 12 Klein Creek Median Income

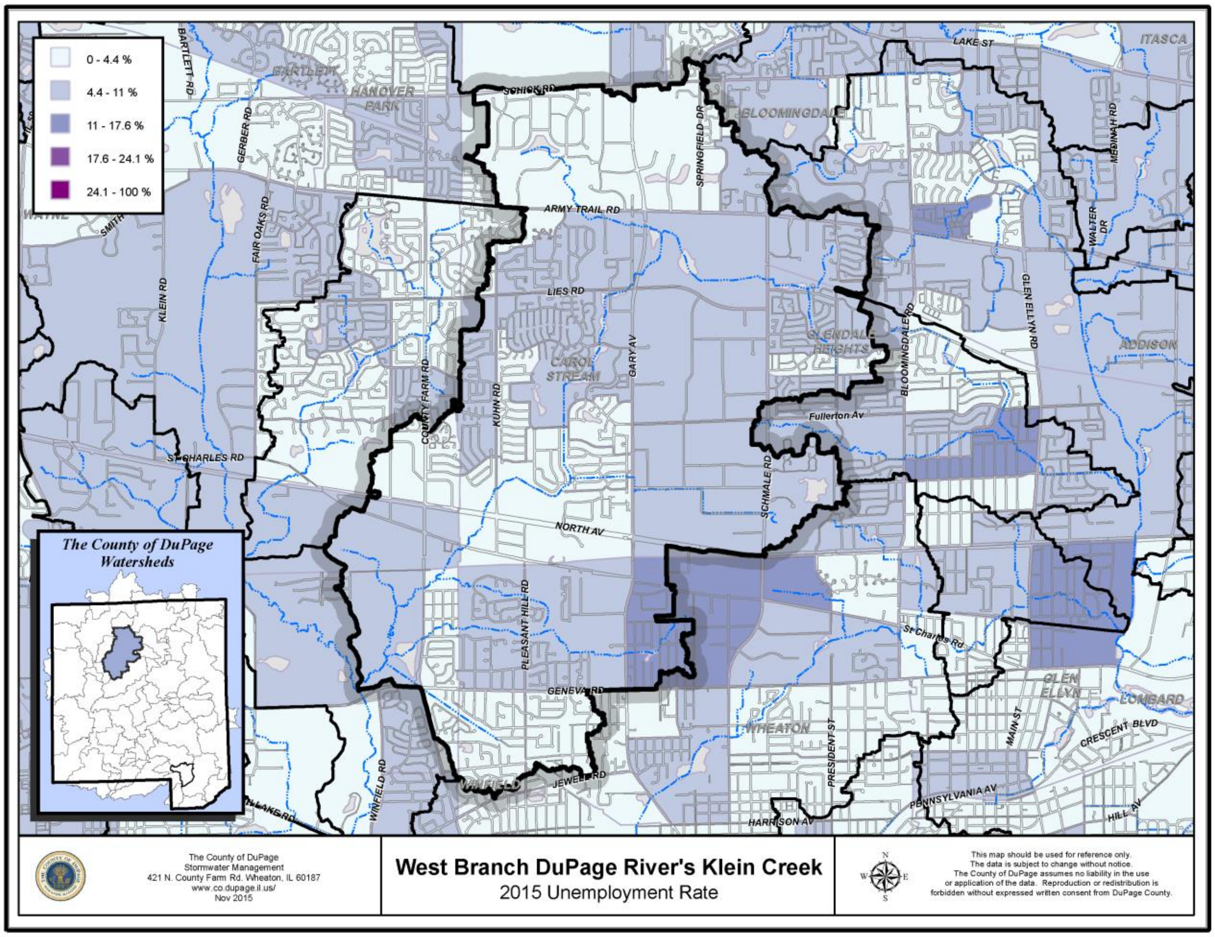

Figure 13 Klein Creek Unemployment Rate

3.2 Local Jurisdictions

The Klein Creek watershed is entirely within the limits of DuPage County, Illinois. The watershed spans over sections of Wayne Township, Bloomingdale Township, Winfield Township, and Milton Township. Portions of the Village of Bloomingdale, the Village of Carol Stream, the Village of Winfield as well as unincorporated DuPage County fall within the watershed limits. Nearly half (about 45%) of the watershed is within the Village of Carol Stream. All of these municipalities and townships are considered Municipal Separate Storm Sewer Systems, or MS4s, under the National Pollutant Discharge Elimination System (NPDES).

Klein Creek Watershed Governmental Units		
Municipalities	**Acreage**	**Percent of Watershed**
Bloomingdale	1090	13.56%
Carol Stream	3612	44.93%
Glendale Heights	800	9.95%
Unincorporated	1893	23.54%
Wheaton	3	0.04%
Winfield	639	7.95%
Townships	**Acreage**	**Percent of Watershed**
Bloomingdale	495	6.16%
Milton	1399	17.40%
Wayne	515	6.41%
Winfield	5631	70.04%
County		
DuPage	8040	100.00%

Table 1 Klein Creek Governmental Units

Permittee	Permit Number
Sovereign Packaging Group, Inc.	IL0063975
Carol Stream WRC	IL0026352
Lagrou Distribution System	IL0002402
Pleasant Ridge MHP	IL0037028
Bloomingdale, Village of	ILR400295
Carol Stream, Village of	ILR400308
DuPage County	ILR400502
Glendale Heights, Village of	ILR400342
Hanover Park, Village of	ILR400347
Wheaton, City of	ILR400470
Winfield, Village of	ILR400474

Table 2 MS4 Permittees

In addition to the jurisdictional boundaries, the Watershed contains through property owned by the State of Illinois, Forest Preserve District of DuPage County (FPDDC), and school and park districts. This requires multi-jurisdictional collaboration to resolve issues within the Watershed, specifically:

- For unincorporated areas within the Watershed, ***DuPage County*** oversees all zoning, drainage, permitting and the Countywide Stormwater Management and Flood Plain Ordinance

(Ordinance) enforcement[2]. In addition, DuPage County is responsible for certain roadways within the watershed, as well as stream maintenance.

- ***Municipalities*** are responsible for managing local zoning, drainage, permitting, drinking water, sewer service and Ordinance enforcement. Local municipalities are also responsible for local roadways, which includes road maintenance, snow removal, salt dispersal, litter removal, traffic flow, hydrological conveyance systems and ensuring overall road safety.
- The ***Illinois Department of Transportation*** (IDOT) and local ***Township Authorities*** also oversee some areas of roadway and the associated right of way within the Watershed. Like municipalities, they are responsible for upkeep of roadways under their jurisdiction.
- The ***DuPage County Health Department*** (DCHD) has countywide jurisdiction of private drinking wells and septic systems within unincorporated areas of DuPage County.
- The ***Forest Preserve District of DuPage County*** is responsible for the inspection and maintenance of all drainage ways, including streams and rivers, within their forest preserves.
- The ***Village of Carol Stream Public Works,*** the only wastewater treatment facility in the Watershed, is located along Klein Creek east of its confluence with the East Branch DuPage River. Carol Stream Public Works discharges its effluent directly into Klein Creek. As a Publically-Owned Treatment Works (POTW), they hold their own NPDES permit.

3.3 Physical & Natural Features

3.3.1 Climate

The climate of the Klein Creek is typical for northern Illinois. It is characterized by warm summers and cold winters with moderate precipitation year round. The average annual temperature is 49.9 degrees Fahrenheit. In summer, the average temperature is 71.9 degrees Fahrenheit with an average high temperature of 82.9 degrees Fahrenheit. During the winter, the average temperature is 26.1 degrees F with an average low temperature of 18 degrees Fahrenheit. (http://www.ncdc.noaa.gov/cdo-web/datatools/normals). The growing season in this area lasts from mid-April to mid-October lasting about 165 to 170 days in a normal year.

Average annual precipitation in the nearest National Oceanic and Atmospheric Administration (NOAA) recording station (West Chicago, DuPage Airport) is 36.91 inches. Summer is the wettest season, with an average rainfall of 12.61 inches in the summer months. The least amount of precipitation occurs in the winter months, with an average total of 4.45 average inches for winter.

[2] 2013. DuPage County Stormwater Management Planning Committee & Stormwater Management. DuPage County Countywide Stormwater And Flood Plain Ordinance https://www.dupageco.org/EDP/Stormwater_Management/Regulatory_Services/1420/

SEASON	• PRECIP (IN)	MIN TMP (°F)	AVG TMP (°F)	MAX TMP (°F)
Annual	36.91	39.8	49.9	60.1
Winter	4.45	18.0	26.1	34.2
Summer	12.61	60.9	71.9	82.9
Spring	10.29	37.9	49.0	60.0
Autumn	9.56	42.0	52.3	62.6

Table 3 Climate data for Chicago West Chicago Airport, IL US (courtesy of NOAA)

3.3.2 Topography

Topography of the Klein Creek watershed varies from a high point around 800 feet above sea level in the headwater areas in the northern and eastern boundaries of the watershed to the lowest point at the confluence with the main stem of the West Branch of the DuPage River, which is located in the Timber Ridge County Forest Preserve, part of the Forest Preserve District of DuPage County, which lies within an unincorporated portion of DuPage County just north of Geneva Road.

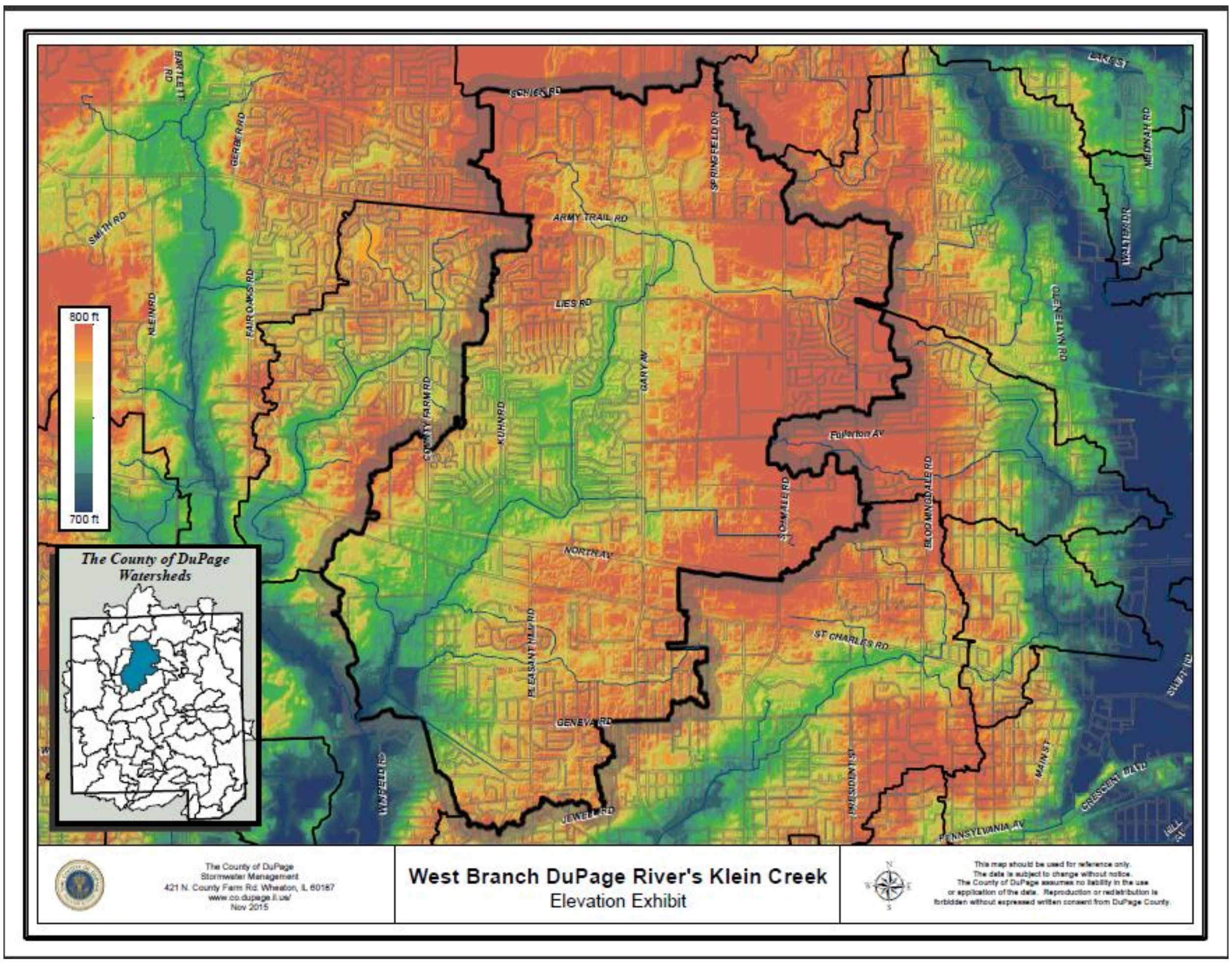

Figure 14 Klein Creek Topography

3.3.3 Geology

Like the rest of DuPage County, the geology of the Klein Creek Watershed was influenced heavily by the Wisconsin glaciation. As a result, the planning area is covered by less than 25 inches of loess, or windblown silt, as demonstrated in Figure 15**.** Loess coverage in northeastern Illinois is shallow in comparison to the rest of the state, which can have up to 300 inches of loess or more. Following glacial retreat, loess was blown across the landscape and eventually accumulated over glacial till. This till was deposited during the advancing glacial activity, which also caused the formation of moraines that cover the planning area.[3] Till is high in clay, thus causing much of the poor drainage that is characteristic of the region.[4] Loess deposits and the underlying till are the parent material for the fertile topsoil that developed over thousands of years by the tallgrass prairies.[5]

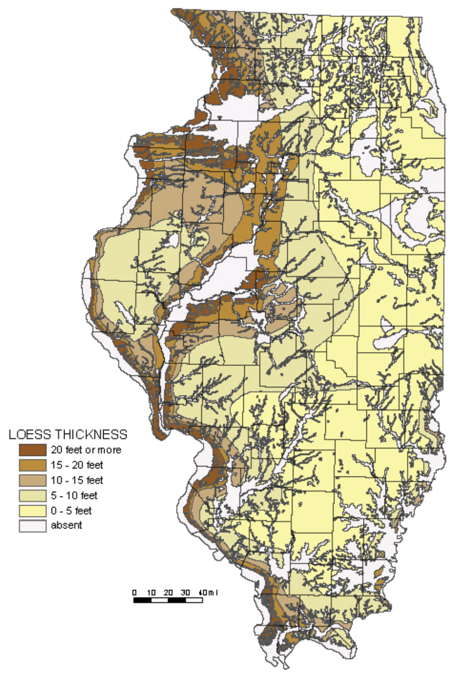

Figure 15 Illinois State Geologic Survey Loess thickness in Illinois

3.3.4 Soils

An evaluation of soils is essential when creating a water quality-based watershed plan. The ability of soils to retain water, support vegetation and provide active exchange sites for absorption of pollutants varies. Information regarding soil thickness, horizon depth, texture, structure, drainage characteristics, erosion potential and the location of the seasonally high water table should all be considered when planning projects that will impact stormwater. Soils support vegetation, infiltrate stormwater, serve as a

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[3] Hansel and Johnson, 1996. Wedron and Mason Groups: Lithostratigraphic Reclassification of Deposits of the Wisconsin Episode, Lake Michigan Lobe Area. Department of Natural Resources, Illinois State Geologic Survey Bulletin 104

[4] Mapes, D.R. 1979. Soil survey of Du Page and Part of Cook Counties, Illinois. University, of Illinois Agricultural Experiment Station Soil Report 108.

[5] Illinois State Geologic Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. Loess Thickness map http://isgs.illinois.edu/content/loess-thickness-map

base for construction, support wildlife and serve as stream and lakebeds in addition to many other purposes. When identifying potential locations for best management practices (BMPs), such as rain gardens or infiltration trenches, it is important to evaluate soil type to determine if and how well the practice will infiltrate stormwater.[6]

Soil formation occurs when a parent material deposited by earth forming geological processes is impacted by climate and organisms over time across a landscape of varying topography.[7] Mentioned before, the parent material is glacial till and loess in this region.

The soils in the Klein Creek Watershed are mainly silt loam and silty clay loam in texture, as evidenced in Table 4 Klein Creek Watershed soil series data., the soil series that make up the largest percentages of the watershed are the Verna and Elliot Silt Loam and Sahkum silty clay loam. Orthents constitute nearly 10% of the watershed. Orthents, or disturbed urban soils, comprise more than 21% of the land area, as shown in Figure 16. These soils are created when development and disturbance occurs to a point where the original soil no longer displays its characteristic properties. Consequently, the hydrologic soil group classification does not apply to these soils. The disturbance caused by development alters the soil profile from its original state; therefore, the classification is no longer accurate for the disturbed soil. Onsite, evaluations should always be conducted to verify mapped soil type as well as determine characteristics of a disturbed soil.

[6] Calsyn, 2001. Soil Survey of
Du Page County, Illinois. United States Department of Agriculture, Natural Resource Conservation Service. https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/illinois/.../Du_Page_IL.pdf

[7] Natural Resources Conservation Service’s (NRCS) soil survey of DuPage County (2001).

Klein Creek Tributary Soil Series			
Series Name	**Acres**	**% of watershed**	**Texure**
Ashkum	1127.66	14.03%	silty clay loam
Barrington	254.84	3.17%	silt loam
Beecher	71.82	0.89%	silt loam
Blount	22.24	0.28%	silt loam
Chenoa	91.93	1.14%	silty clay loam
Drummer	487.63	6.07%	silty clay loam
Dunham	12.45	0.15%	silty clay loam
Elliott	1132.86	14.09%	silt loam
Fox	14.55	0.18%	silt loam
Graymont	85.8	1.07%	silt loam
Grays	23.41	0.29%	silt loam
Grundelein	30.15	0.38%	silt loam
Harpster	3.53	0.04%	silty clay loam
Landfills	2.11	0.03%	
Markham	624.84	7.77%	silt loam
Martinton	105.86	1.32%	silt loam
Milford	145.61	1.81%	silty clay loam
Mundelein	239.71	2.98%	silt loam
Muskego	79.74	0.99%	muck
Orthents	785.02	9.76%	
Ozaukee	36.77	0.46%	silty clay loam
Peotone	212.89	2.65%	silty clay loam
Sawmill	28.36	0.35%	silty clay loam
Varna	1750.2	21.77%	silt loam
Waupecan	6.23	0.08%	silt loam
Water Feature	194.15	2.41%	

Table 4 Klein Creek Watershed soil series data.

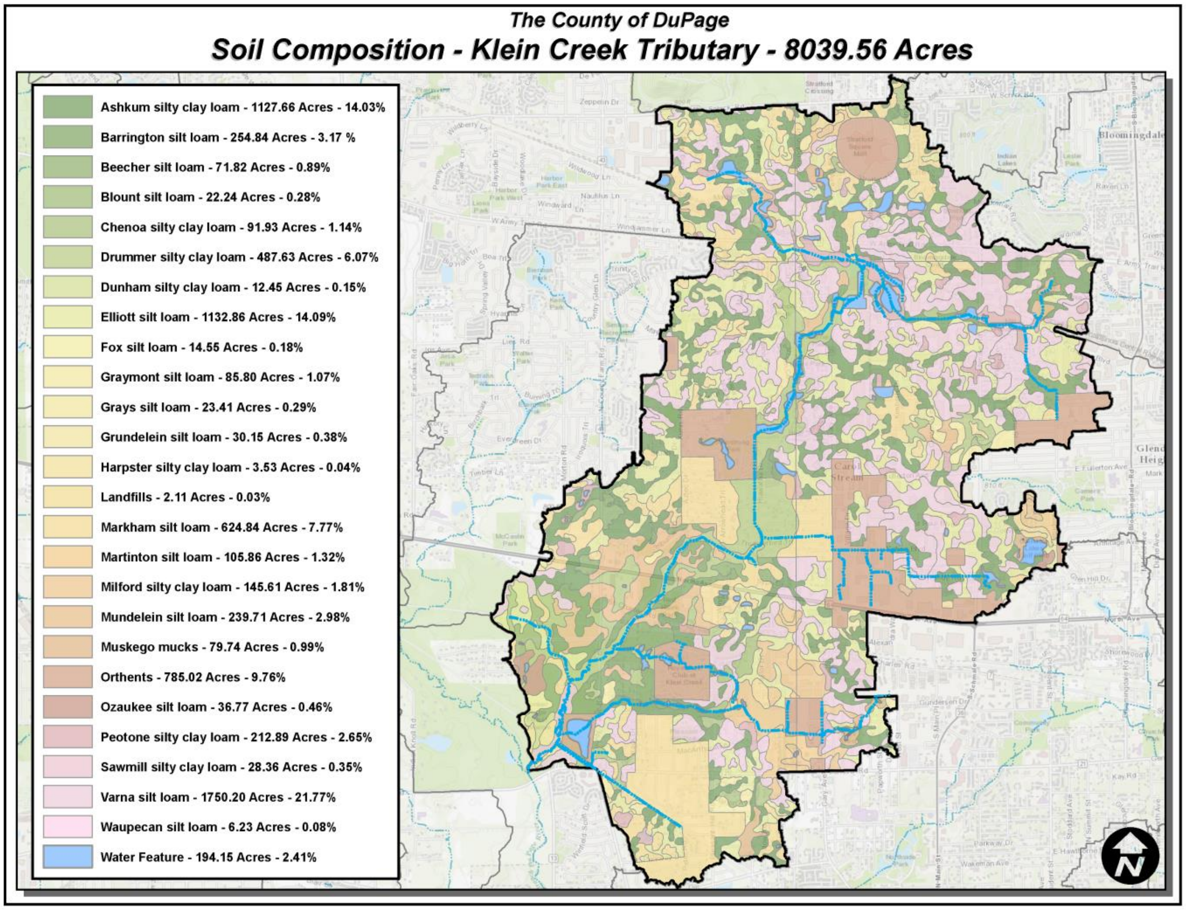

Figure 16 Soil series mapped in the Klein Creek watershed. (NRCS Soil Survey of DuPage County)

3.3.4.1 Hydric Soils

According to the NRCS definition, a hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Hydric soils are an indicator of present or historic wetlands. When comparing the hydric soil map (Figure 17) with DuPage County's current wetland map, it is evident that a large number of wetlands have been drained in the Klein Creek Watershed. As historic aerial photos from 1956 do not show these large wetland complexes, it can be inferred that the wetlands were drained during the installation of agricultural drain tiles nearly 200 years ago. If still in existence, these natural wetlands would have played a significant role in storing and slowly releasing floodwaters, providing essential habitat to wildlife and filtering stormwater before it entered the stream.

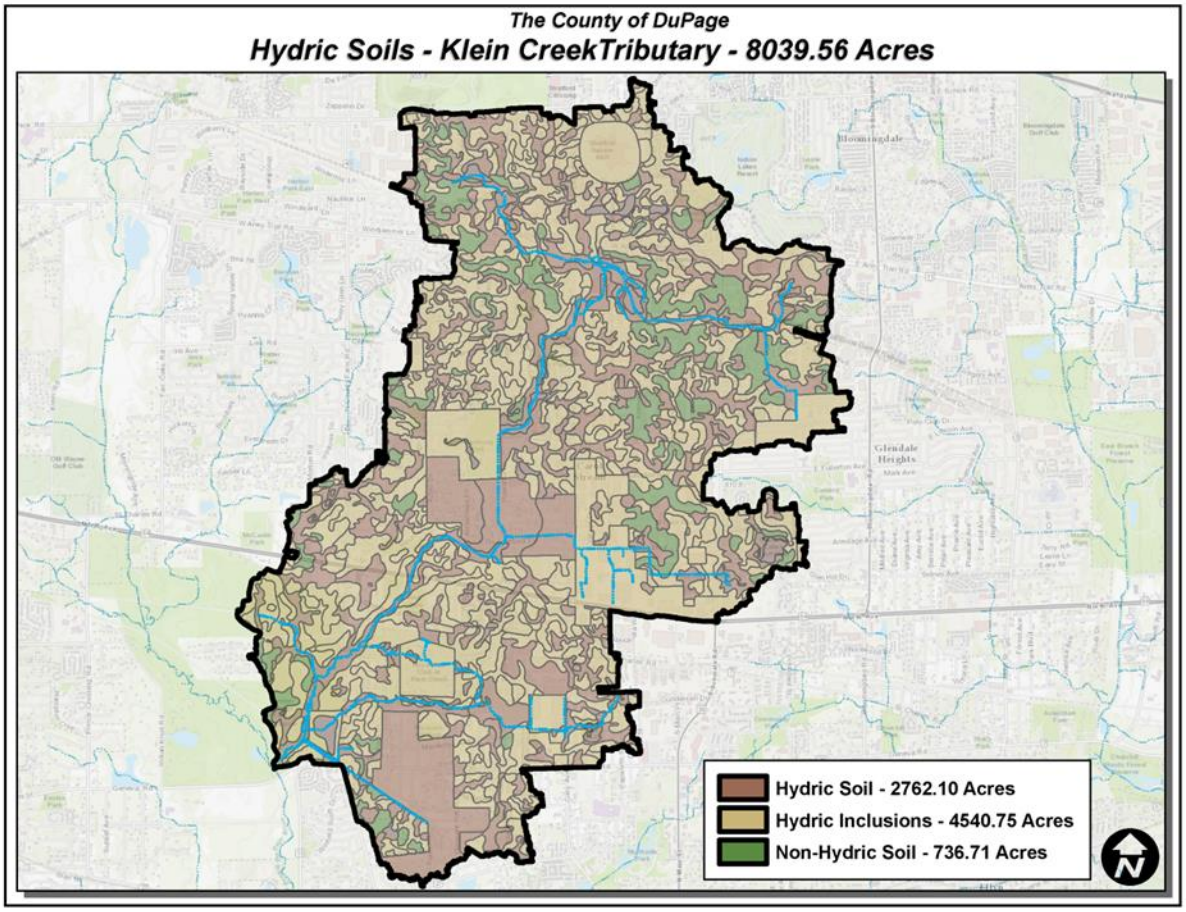

Figure 17 Hydric Soils

3.3.4.2 Soil Drainage Class

Hydrologic soil groups refer to the runoff potential of a soil.[8, 5] This is determined by depth to the seasonal high water table (SHWT), infiltration rate, permeability after prolonged wetting and depth to a very slowly permeable layer. Determination of hydrologic soil group does not consider the slope of a soil surface. The hydrologic soil groups are based on unfrozen soils without vegetation, and properties, such as soil texture and soil structure, affect the group. There are four hydrologic soil groups: A, B, C and D.

- ***Hydrologic Soil Group A*** consists of soils with low runoff potential when thoroughly wet. Water moves freely through the soil. The texture of these soils is sandy or gravelly with less than 10% clay and more than 90% sand.[9] Some finer textured soils may be included if they are well aggregated, of low bulk density, or have more than 35% rock fragment.[10]
- ***Hydrologic Soil Group B*** consists of soils with a moderately low runoff potential when thoroughly wet. The texture of these soils is usually loamy sand or sandy loam with between

[8] NRCS soil survey of DuPage County (2001).

[9] U.S. Department of Agriculture, Natural Resources Conservation Service. 2007. Part 630 Hydrology National Engineering Handbook. Chapter 7 Hydrologic Soil Groups): https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba

[10] National Engineering Handbook

10% to 20% percent clay and less than 50% to 90% sand. Some finer textured soils may be included if they are well aggregated, of low bulk density, or have more than 35% rock fragment.

- ***Hydrologic Soil Group C*** consists of soils with a moderately high runoff potential when thoroughly wet. The texture of these soils is typically loam, silt loam, sandy clay loam, clay loam and silty clay loam with between 20% to 40% clay and less than 50% sand. Some finer textured soils may be included if they are well aggregated, of low bulk density, or have more than 35% rock fragment.
- ***Hydrologic Soil Group D*** consists of soils with a high runoff potential when thoroughly wet. The texture of these soils is clayey with greater than 40% clay and less than 50% sand.

Determining the hydrologic soil group is essential in order to design BMPs and other infiltration practices or projects. For example, soils that are compacted, high in clay or fall in hydrologic soil group C or D may not infiltrate quickly enough to allow the BMP to be functional. On the other hand, soils in hydrologic soil group A or soil with high amounts of sand may infiltrate too quickly for BMPs to be effective. Infiltration that occurs too rapidly may not allow for filtering of pollutants by plant roots and soil before reaching the groundwater, which can lead to a potential contamination of groundwater. Table 5 shows the soil properties for the Klein Creek Watershed.

Hydrologic soil group classifications may not be accurate in regards to orthents. The disturbance caused by development alters the soil profile from its original state. Therefore, the classification is no longer accurate for the disturbed soil. An onsite investigation by a soil scientist should be conducted in areas mapped as orthents to determine if soil is appropriate for infiltration practices or projects.

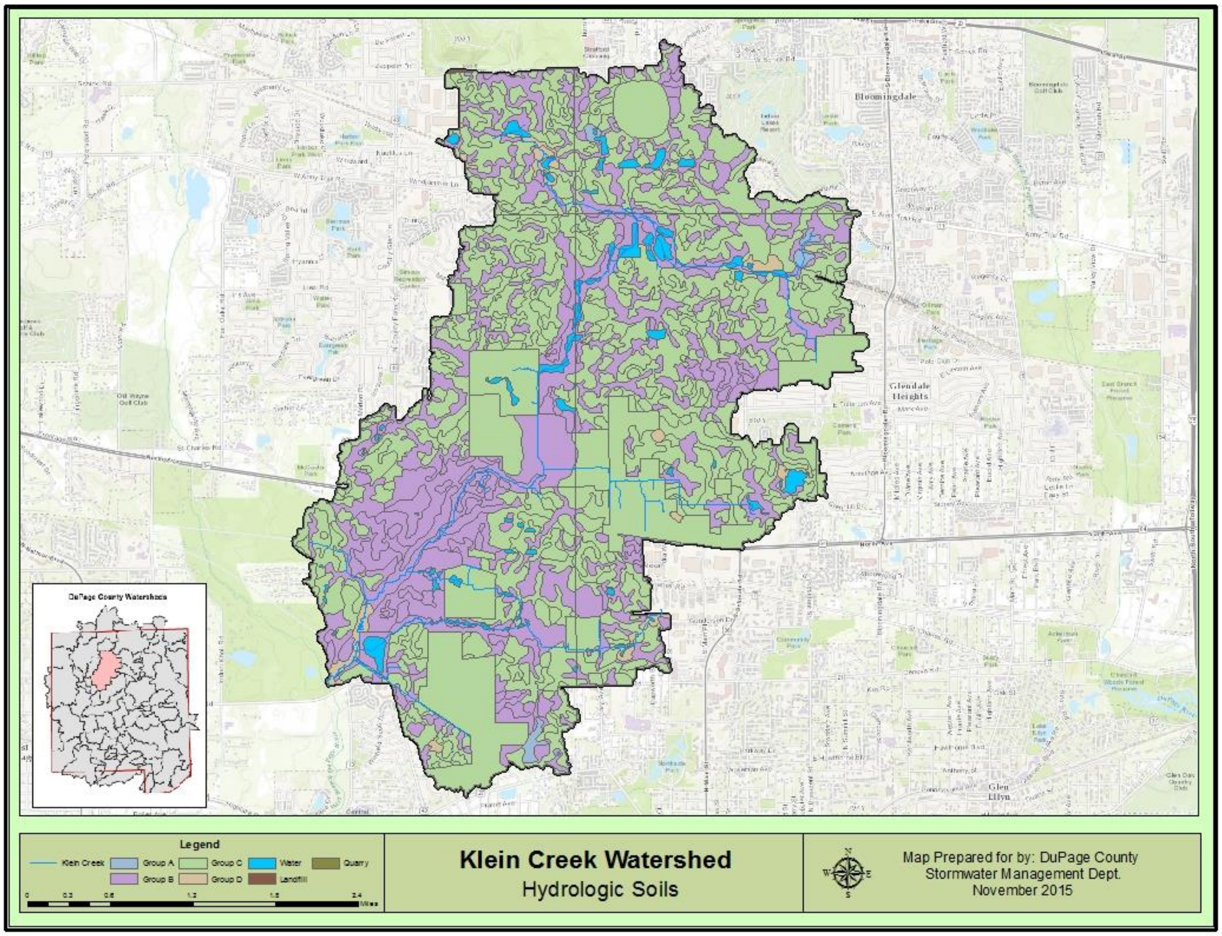

Figure 18 Hydrologic Soil Groups

Klein Creek Tributary Soil Series						
Series Name	**Hydric**	**Drainage Class**	**Hydrologic Soil Group**	**Runoff Potential**	**Infiltration Rate**	**Transmission Rate**
Ashkum	Y	Poorly Drained	B	Moderate	Moderate	Moderate
Barrington		Moderately Well Drained	B	Moderate	Moderate	Moderate
Beecher	N	Somewhat Poorly Drained	C	Moderate	Slow	Slow
Blount	N	Somewhat Poorly Drained	C	Moderate	Slow	Slow
Chenoa	N	Somewhat Poorly Drained	B	Moderate	Moderate	Moderate
Drummer	Y	Poorly Drained	B	Moderate	Moderate	Moderate
Dunham	Y	Poorly Drained	B	Moderate	Moderate	Moderate
Elliott	N	Somewhat Poorly Drained	C	Moderate	Slow	Slow
Fox		Well Drained	B	Moderate	Moderate	Moderate
Graymont		Moderately Well Drained	B	Moderate	Moderate	Moderate
Grays		Moderately Well Drained	B	Moderate	Moderate	Moderate
Grundelein	N	Somewhat Poorly Drained	B	Moderate	Moderate	Moderate
Harpster	Y	Poorly Drained	B	Moderate	Moderate	Moderate
Landfills						
Markham	N	Moderately Well Drained	C	Moderate	Slow	Slow
Martinton		Somewhat Poorly Drained	C	Moderate	Slow	Slow
Milford	Y	Poorly Drained	B	Moderate	Moderate	Moderate
Mundelein		Somewhat Poorly Drained	B	Moderate	Moderate	Moderate
Muskego	Y	Very Poorly Drained	A	Low	High	High
Orthents	N	Moderately Well Drained	C	Moderate	Slow	Slow
Ozaukee	N	Moderately Well Drained	C	Moderate	Slow	Slow
Peotone	Y	Very Poorly Drained	B	Moderate	Moderate	Moderate
Sawmill	Y	Poorly Drained	B	Moderate	Moderate	Moderate
Varna		Moderately Well Drained	C	Moderate	Slow	Slow
Waupecan	N	Well Drained	B	Moderate	Moderate	Moderate
Water Feature						

Table 5 Klein Creek Watershed soil properties

3.3.4.3 Highly Erodible Soils

The erodibility value of a soil (K) is a measure of its susceptibility to erosion. Erosion can occur as sheet erosion, a flat rate of erosion over the entire surface, or rill erosion, the concentration of erosive flows to a central low point that create small runnels through the soil. Several factors contribute to the K factor of a soil, including infiltration rate, water storage capacity, permeability, cohesiveness, structure and texture. Soil erodibility is one factor used in determining average annual soil loss (A) using the Revised Universal Soil Loss Equation (RUSLE).[11, 12]

Fragment free soil erodibility (Kf) is the estimated erodibility of the fine earth fraction of a soil. This is for particles less than 2 millimeters in size and does not include coarse fragments. A higher Kf indicates a

[11] RUSLE is calculated as: A=R x K x L x S x C x P, where:

A= Average annual soil loss
R= Rainfall runoff factor
K= Soil erodibility
L=Slope length factor
S= Slope steepness factor
C= Cover management factor
P= Erosion control practice factor

[12] 2016, United States Department of Agriculture- Agricultural Research Service. https://www.ars.usda.gov/southeast-area/oxford-ms/national-sedimentation-laboratory/watershed-physical-processes-research/docs/revised-universal-soil-loss-equation-rusle-welcome-to-rusle-1-and-rusle-2/)

soil has greater susceptibility to erosion. The fragment free soil erodibility of the Klein Creek Watershed is illustrated in Table 6.

Klein Creek Tributary Soil Series	
Series Name	**Soil Erodibility (Kf)**
Ashkum	0.43
Barrington	0.43
Beecher	0.49
Blount	0.55
Chenoa	0.49
Drummer	0.43
Dunham	0.55
Elliott	0.49
Fox	0.49
Graymont	0.43
Grays	0.49
Grundelein	0.37
Harpster	0.49
Landfills	NA
Markham	0.43
Martinton	0.32
Milford	0.37
Mundelein	0.43
Muskego	0.37
Orthents	0.32
Ozaukee	0.43
Peotone	0.37
Sawmill	0.43
Varna	0.43
Waupecan	0.43
Water Feature	NA

Table 6 Soil Erodibility

3.4 Land Use & Land Cover

Land use in the Klein Creek watershed is a mix of different types. The highest percentage is residential land use at 26.47% (Table 7). Industrial use in the Klein Creek watershed is a bit higher than typical for DuPage County due to the industrial sector on the east side of Carol Stream. Industrial use makes up nearly 15% of the watershed. Open space is makes up nearly 15% and includes Forest Preserve land as well as golf courses. Land use is discussed further in the Water Quality Assessment section of this document.

Land Use	Acreage	% of watershed
Agriculture	43.22	0.54%
Commercial	1202.15	14.95%

Industrial	1160.46	14.43%
Institutional	243.92	3.03%
Multi-Family	432.95	5.39%
Open Space	1182.16	14.70%
Residential	2128.11	26.47%
Transportation	1243.85	15.47%
Vacant	402.72	5.01%
Total	**8039.53**	**100.00%**

Table 7 Land Use in Klein Creek Watershed

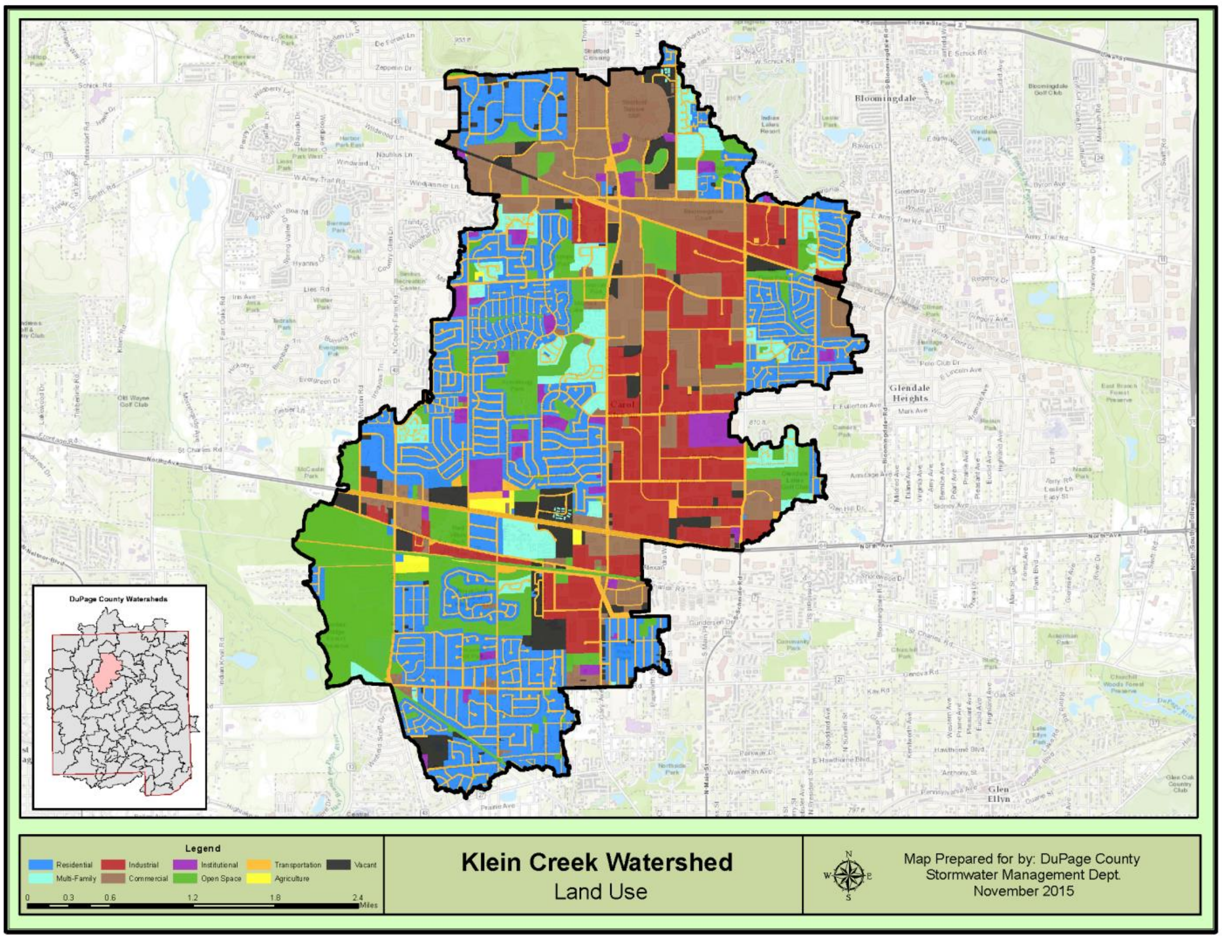

Figure 19 Land Use

3.4.1 Historical Land Cover

Like most Midwestern areas, the Klein Creek Watershed was originally a tallgrass prairie. Following European settlement of North America, the land became agricultural until the 1900s when residential developments became its main occupant, some areas quite dense by the mid-20th century as demonstrated in Figure 19.

By 2012, most of the remaining vacant land in the Watershed was developed to consist of relatively dense homes and small yards, along with commercial buildings and impervious surfaces to support this development, such as roads and parking lots. Any new development today consists of redeveloping already built upon land.

Figure 20 Typical land use in Klein Creek Watershed in 1956 (left) versus 2012 (right)

3.4.2 Impervious Surfaces

With development comes an increase in impervious surfaces, such as roads, driveways, sidewalks and rooftops, and the Klein Creek Watershed is no exception. Of the Watershed's approximately 8040 acres, more than 3019 acres – or 38% of the Watershed – has impervious cover (Figure 201). These surfaces cannot effectively absorb rainfall, meaning precipitation that falls on them is drained through engineered collection systems and discharged directly to nearby waterbodies. In addition to contributing to localized flooding by overloading sewer systems, this runoff carries with it non-point source pollutants that degrade receiving waters. In addition, high flows in the receiving waters can lead to erosion and damage to habitat, property and infrastructure.

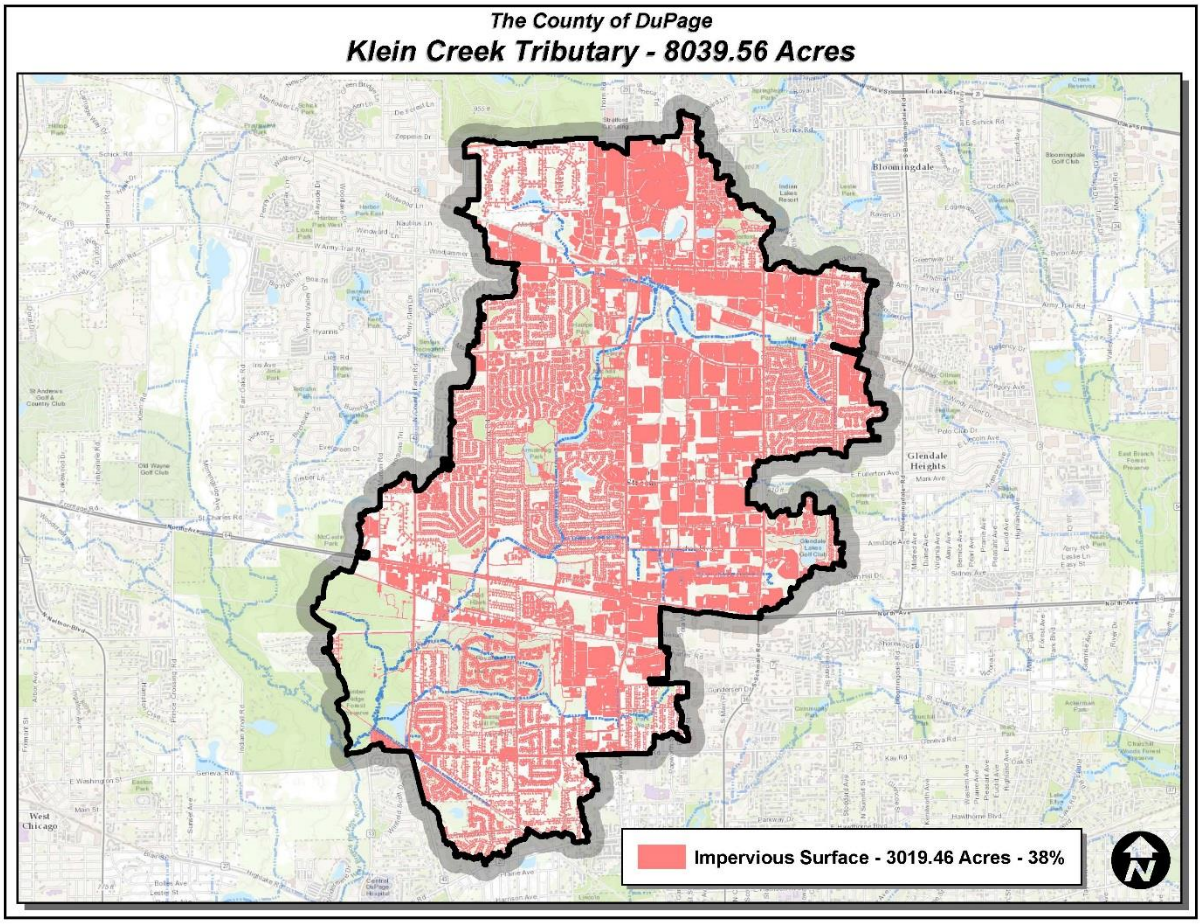

Figure 21 Impervious Surface Cover

Of particular concern is the amount of impervious road cover in the planning area with public roads occupying 325 lane miles within the Klein Creek Watershed. These roadways account for 38% - or 1161 acres – of the Watershed's total impervious cover (Table 8). A significant amount of polluted stormwater runoff generated in the Watershed is conveyed to Klein Creek and its tributaries along these transportation corridors.

Klein Creek		
Entity	***Lane Miles***	***Lane Acreage***
Bloomindale Township	9.03	32.83
DuPage County DOT	58.98	193.44
Illinois DOT	16.67	40.40
Milton Township	34.57	132.57
Village of Bloomingdale	26.69	93.06
Village of Carol Stream	114.03	430.42
Village of Glendale Heights	35.30	128.37

Village of Winfield	26.14	95.00
Wayne Township	4.08	14.83

Table 8 Roadway Impervious Surface Cover

Impervious cover can also have an effect on groundwater recharge, stream base flow and water quality. Recent studies have shown that groundwater recharge and water quality decrease as impervious cover increases. Figure 22 illustrates a direct relationship between the intensity of development, as indicated by the amount of impervious surface, and the degree of damage to aquatic life in the watershed. Specifically, the chart on the left shows a decline in where the macroinvertebrate community as watershed imperviousness approaches 10%, and the chart on the right shows fish species are impacted when imperviousness exceeds 15%. In general, stream quality degradation is noticeable when impervious cover in a watershed approaches 10%, and a stream becomes non-supportive of aquatic life when impervious cover is more than 25% (Figure 23).

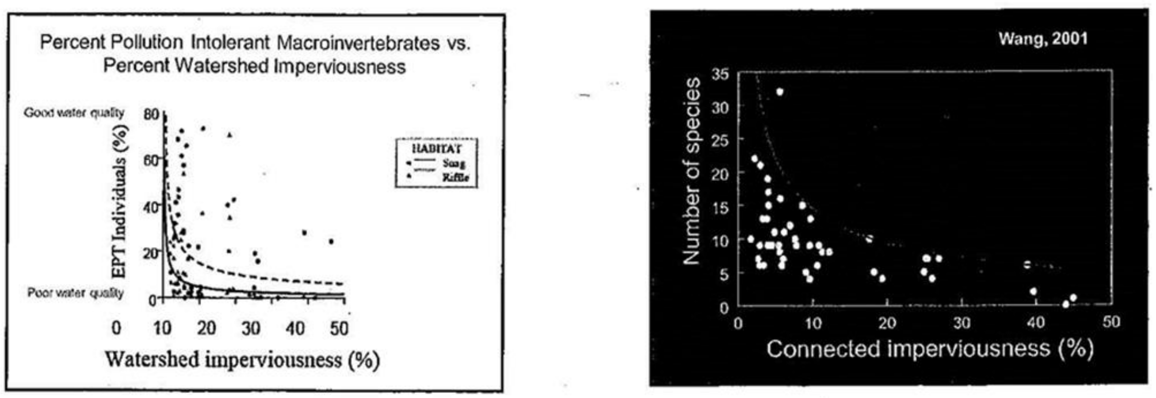

Figure 22 Comparison of impervious cover in a watershed to aquatic species.[13]

[13] Images taken from Meeting TMDL, LID and MS4 Stormwater Requirements: Using WinSLAMM to assess.

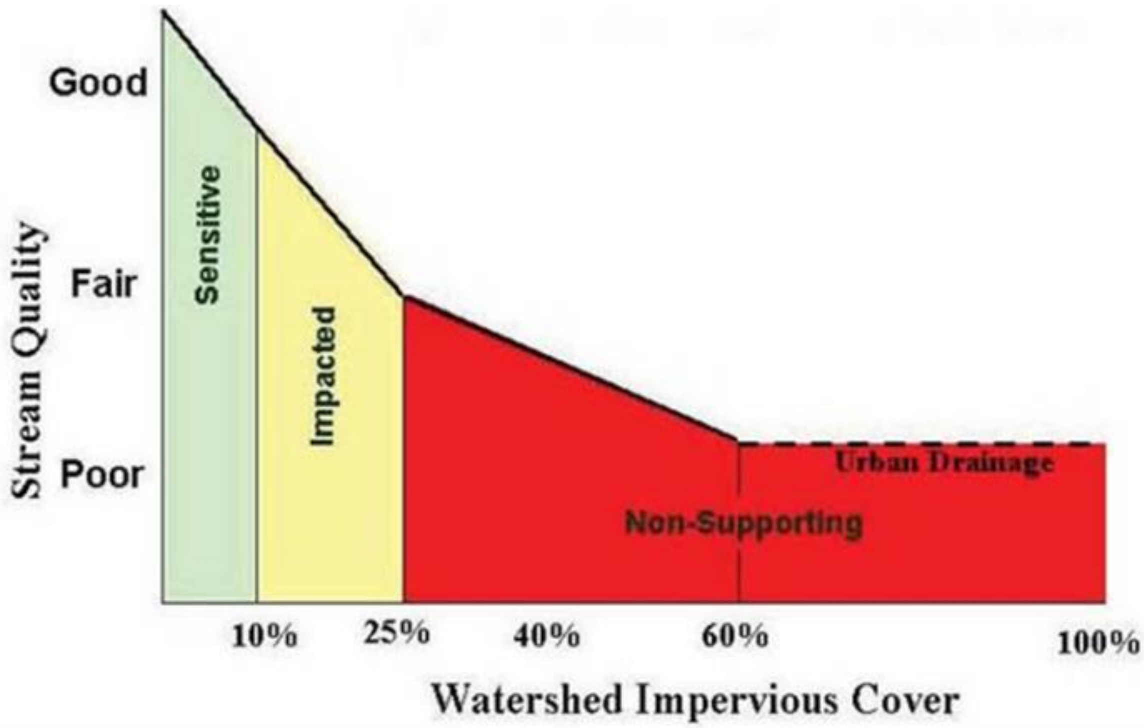

Figure 23 Comparison of stream quality to impervious cover in a watershed

3.4.3 Wetlands

Wetlands provide numerous benefits to the surrounding ecosystem. Wetlands filter nutrients into the soil and help to filter pollutants out of the water. Wetlands also control flooding by absorbing water runoff from storms. One acre of wetlands has the potential to store 1 to 1 ½ million gallons of floodwater.[14] Wetlands also contribute to groundwater supply by filtering stormwater runoff though the system to remove pollutants and returning it to the underground aquifers. Many species of animals and plants depend on wetlands for habitat and nourishment. Wetlands make up only an approximate 5% of land in the continental U.S., but almost 1/3 of plant species can be found in wetlands.[15]

There are around 544 acres of wetland in the Klein Creek watershed (Figure 24). This constitutes less than 7% of the land surface area. On the contrary, hydric soils- an indicator of wetlands - are found over 2762 acres of the watershed, which accounts for about 34% of the planning area. As discussed earlier, less than 20% of these historic wetlands remain today because of agricultural uses in the Watershed. More recently, developers buried streams in pipes and dug out wetlands for construction purposes.

[14] United States Environmental Protection Agency, 2001. Functions and Values of Wetlands Factsheet. EPA 843-F-01-002c. https://www.epa.gov/wetlands/wetlands-factsheet-series
[15] United States Environmental protection Agency, 2006. Economic Benefits of Wetlands Factsheet EPA 843-F-06-004. https://www.epa.gov/wetlands/wetlands-factsheet-series

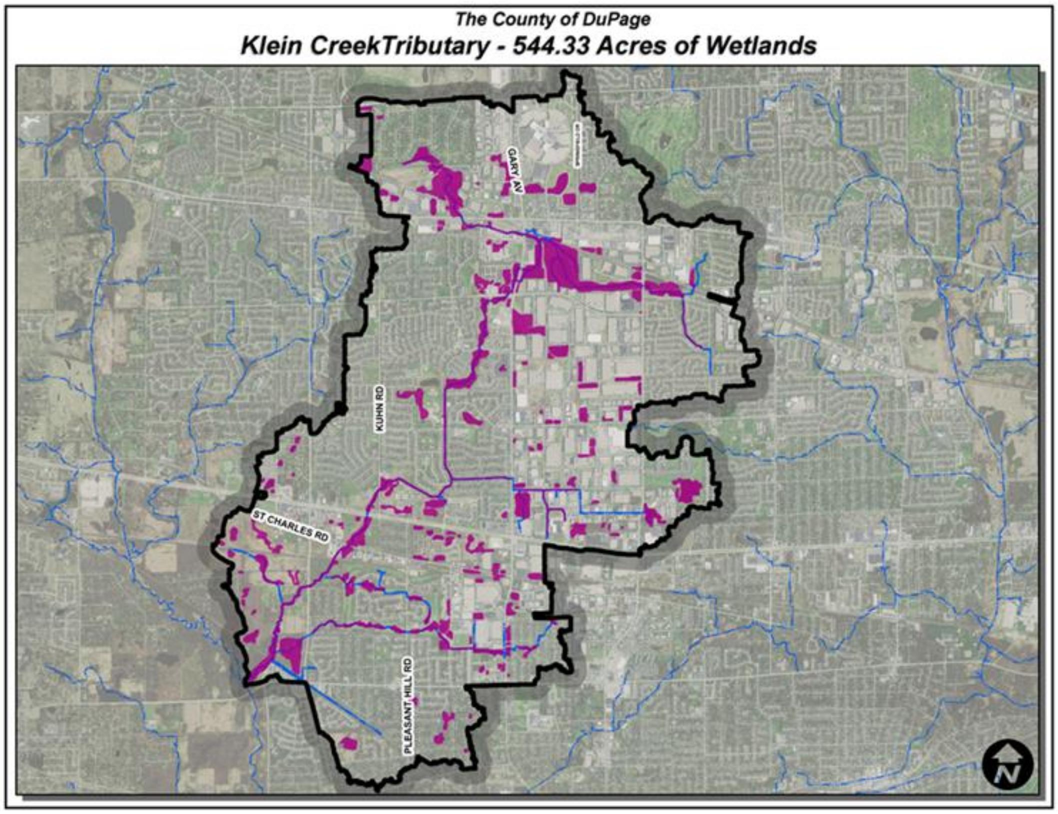

Figure 24 Klein Creek Watershed Wetland Inventory[16]

Of the wetlands that remain in the planning area, there are some critical wetlands found in the headwater areas north of Lies Road and east of Gary Avenue in Carol Stream, illustrated in Figure 24. Critical wetlands are those that have been identified by DuPage County as having the highest value by virtue of one or more high-ranking characteristics that result in a uniquely valuable environment. A headwater tributary to Klein Creek flows through this critical wetland complex.

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[16] Of the wetlands that remain, it is important to note that the DuPage County Wetland Map was created using National Wetland Inventory standards. Therefore, any Waters of the U.S. are mapped as wetlands regardless of jurisdictional status. Based on the NWI criteria excavated ponds, impoundments, and detention basins are all mapped as wetlands. These areas may not provide the same functions and water quality and habitat benefits as true wetlands.

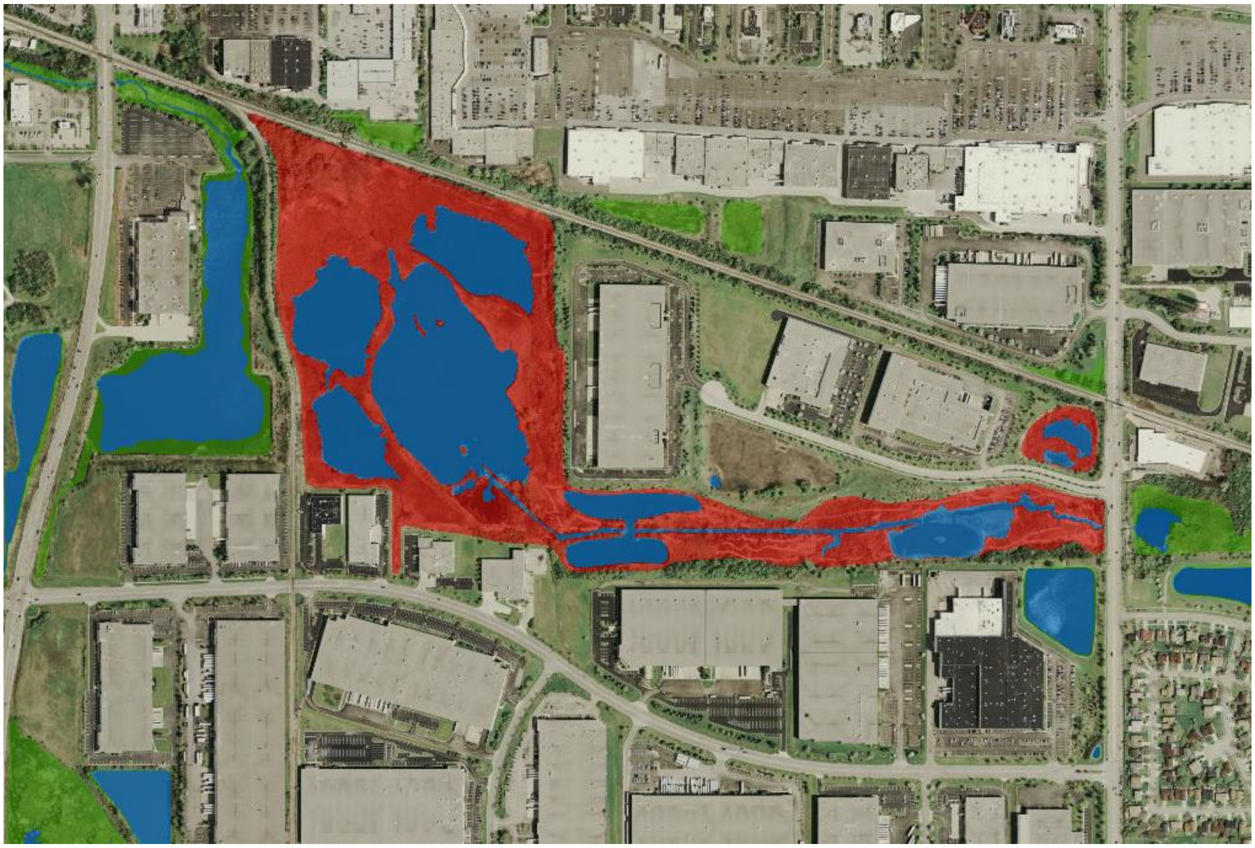
Figure 25 Critical Wetlands on Village of Carol Stream Property

3.4.4 Open Space

Another result of the significant development in the Klein Creek Watershed is a decrease in open space. The Watershed has just over 793 acres of open space, which is less than 10% of the surface area (Figure 30). On the bright side, public agencies own most of the existing open space, which limits future development and opens opportunity for inter-governmental cooperation on potential projects. Some of the notable open spaces in the planning area include:

- ***Timber Ridge Forest Preserve:*** Owned by the FPDDC, Timber Lake Forest Preserve is located in the near the confluence with the West Branch DuPage River, west of County Farm Road and south of North Avenue. This 1163-acre preserve, which is partially within the Klein Creek watershed, contains woodlands, savannas, prairies, wetlands and lakes, including Timber Lake. Open to the public for fishing, Timber Lake is home to largemouth bass, bluegill, channel catfish and crappie.[17]
- ***Armstrong Park:*** Located in subwatershed #1, Armstrong Park is a large recreational park owned by Carol Stream Park District. DuPage County Stormwater Management, in collaboration with the Village of Carol Stream and Carol Stream Park District constructed a flood control and water quality project at this location in 2014. The majority of the $12.5 million project was funded through disaster recovery funds from the Department of Housing and Urban Development. The project is a two-reservoir system that intakes water from the adjacent Klein

[17] www.dupageforest.org/Conservation/Forest_Preserves/Timber_Ridge.aspx

Creek during flood events. The first reservoir in the system is a smaller gravity-operated reservoir that takes in water over a fixed, concrete weir. Once elevations reach a certain height in the smaller reservoir, they are pumped to the larger reservoir. Each of the two large pumps can pump at a rate of 20,000 gallons per minute. Once elevations in Klein Creek recede, the larger reservoir is dewatered through a 60-inch siphon that bypasses that surrounding neighborhoods and distributes the water back to the creek downstream. In total, the reservoirs have a capacity to hold nearly 37 million gallons of floodwater. The project also offers environmental features with native plants treating the floodwater in both reservoirs, as well a wetland feature designed to collect and treat standing water outside of the basins.

Figure 26 Armstrong Park Flood Control and Water Quality Project

- ***Gary Kehoe Reservoir***: DuPage County Stormwater Management owns the Gary-Kehoe reservoir. The basin was constructed in 1999 to provide flood control as well as a water quality benefit as it is planted with native vegetation (Figure 27). The 140 acre-ft. capacity gravity controlled reservoir is located near and named after the intersection of Gary Avenue and Kehoe Blvd in Carol Stream. The reservoir includes a dam at the northwest corner of the reservoir. The dam is comprised of an earthen embankment that is approximately 20-feet high, and includes a concrete inflow spillway structure along Kehoe Blvd. As water surface elevations in the channel increase, water begins to spill over the concrete spillway into the reservoir. As water surface elevations decrease, the reservoir drains via gravity through an 18-inch diameter outlet culvert.

Figure 27 Gary-Kehoe Reservoir

- ***Red Hawk Park:*** Owned by the Carol Stream Park District in conjunction with the Forest Preserve District of DuPage County, this 42-acre park contains sports fields and a bike/ walking trail. Klein Creek runs through the middle of the park.

Figure 28 Red Hawk Park

- ***Village of Carol Stream Wetlands:*** Located on property owned by the Village of Carol Stream, this property contains about 50 acres of open space and wetland areas near the headwaters of Klein Creek.

Figure 29 Village of Carol Stream Wetlands

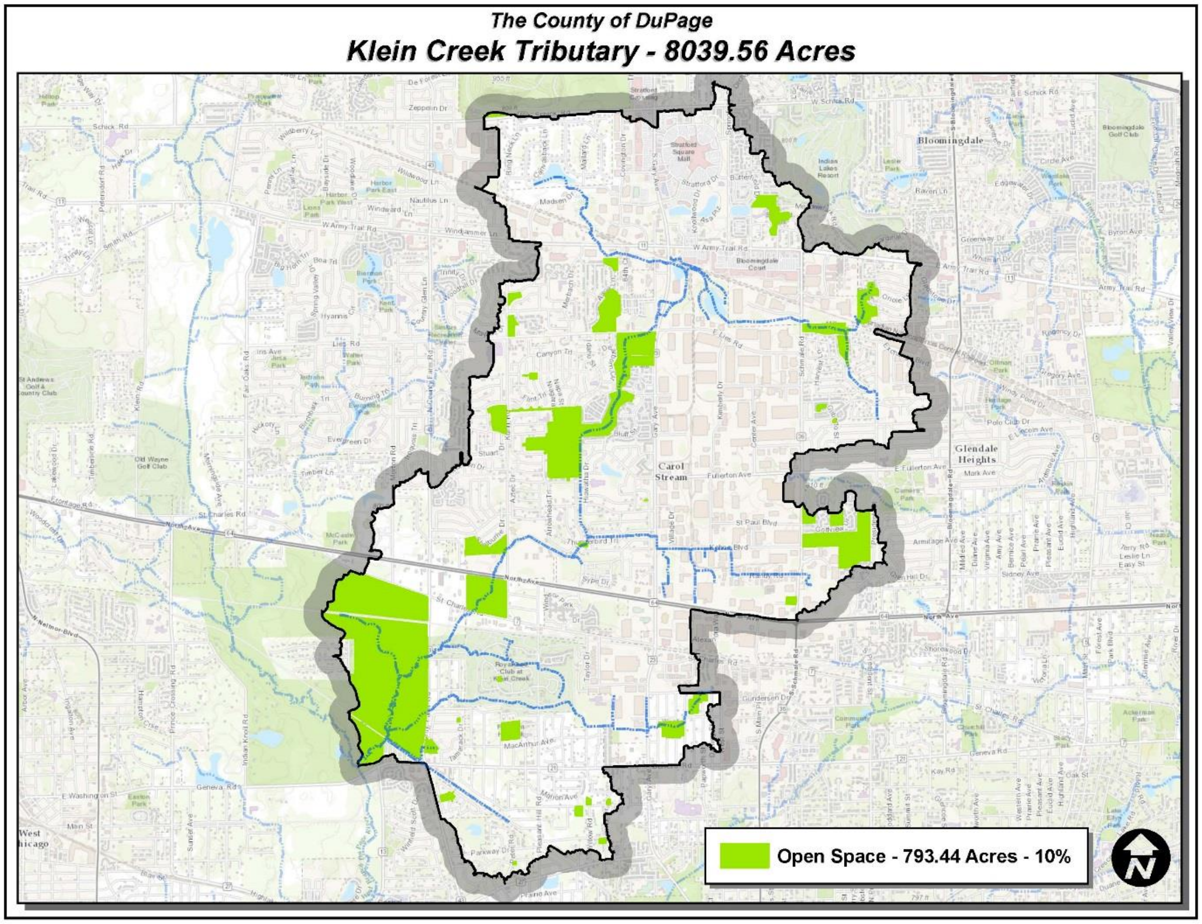

Figure 30 Klein Creek Watershed open space

3.5 Water Resource Conditions

3.5.1 Watershed Drainage System

As previously mentioned, the Klein Creek Watershed is located in the north central part of DuPage County and drains stormwater from four townships and five municipalities. The northern boundary of the Watershed is around Schick Road; the southernmost part of the watershed is Jewell Road; the furthest point east in the watershed is west of Bloomingdale Road; and the furthest point west is within Timber Ridge Forest Preserve. Eight different streams are tributary to Klein Creek, including WBKC001, WBKC002, WBKC003, WBKC004, WBKC005, WBKC006, WBKC007 and WBKC008. There are also several smaller tributaries that are generally labeled WBKC000.

Klein Creek begins as two tributaries at the northern end of the watershed. WBKC006 begins near Canvasback Lane within a detention basin and flows southeast. WBKC007 starts in Glendale Heights north of Fullerton and flows northwest before converging with WBKC006 between the Canadian National / Illinois Central Railroad and Gary Avenue. From here Klein Creek mainstem begins and flows south through Carol Stream. Moving through industrial, residential, and multi-family properties, the stream is highly altered in this section due to impoundments, pipes, and on-line detention basins. Klein

Creek then heads south through Armstrong Park. As mentioned previously, during storm events, water can be diverted from Klein Creek into the Armstrong Park Flood Controls Facility. WBKC005 begins near Glendale Lakes Golf Club in the Village of Glendale Heights. Much of this tributary is contained within pipes beneath roadways. WBCK005 flows west before meeting with the mainstem near Thunderbird Trail. From here, Klein Creek flow generally southwest before meeting with WBKC just west of County Farm Road. WBKC004 flows through Timber Ridge Forest Preserve and converges with the mainstem within the Preserve. WBKC003 starts west of Gary Avenue and flows west through a residential area and Klein Creek Golf Club. WBKC003 and WBCK002 converge with the mainstem just before the confluence of Klein Creek with the West Brach DuPage River in Timber Ridge Forest Preserve.

Stormwater within the Klein Creek Watershed flows in a general north to south direction beginning near Army Trail Road. Tributaries to Klein Creek flow from the east and west. The creek continues south until reaching the West Branch of the DuPage River.

Of the estimated 113,836 linear feet of Klein Creek, approximately 11,088 feet – or 10% – of the stream length is piped (Figure 31). Much of the piped segments are within the more industrial use eastern part of the watershed, or within road and culvert crossings.

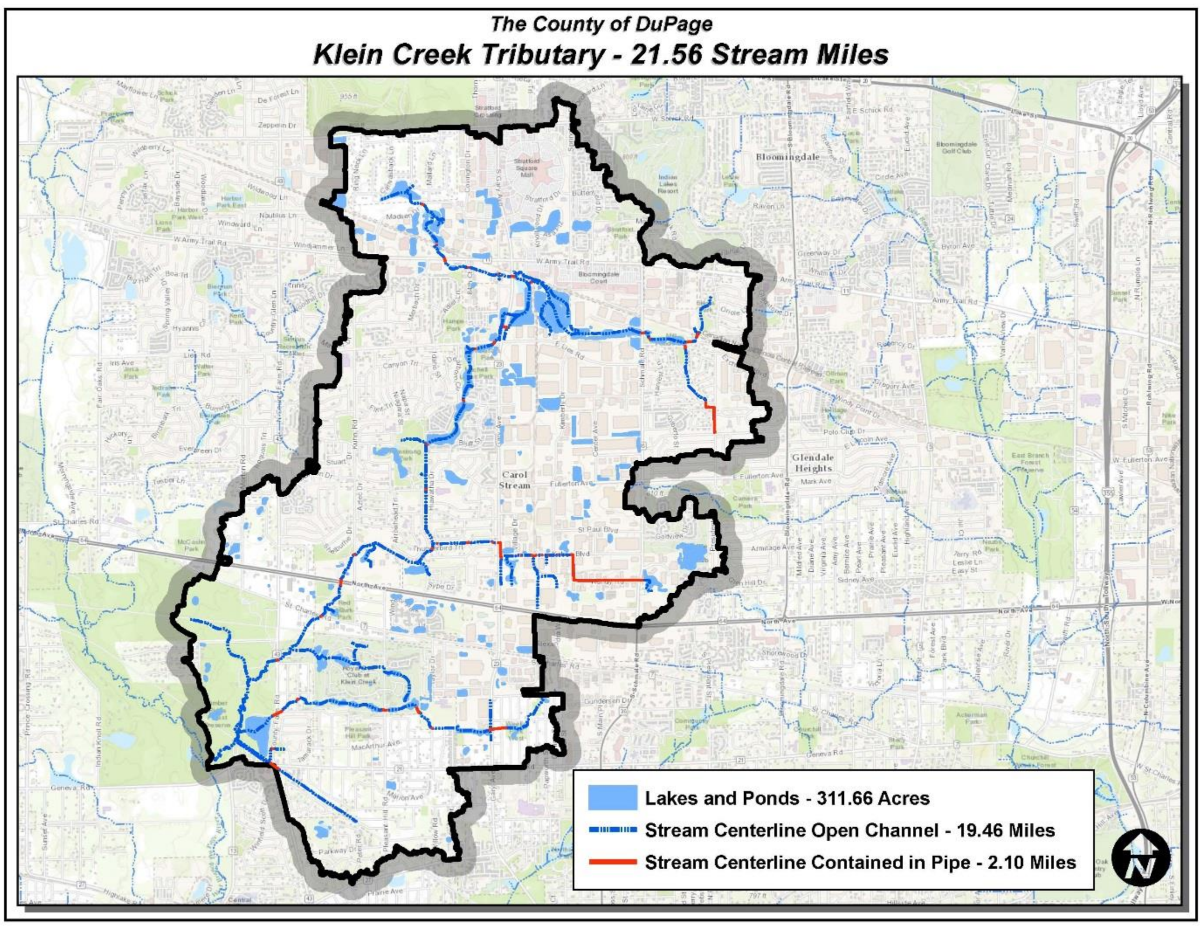

Figure 31 Piped stream segments of Klein Creek

Impoundments such as piped segments of stream, culvert crossings, and dams impact the movement of fish and aquatic life and also decrease dissolved oxygen levels. One dam has been identified within Klein Creek at Gary Kehoe Reservoir. As it is used for controlling levels in the facility, removal or modification is not feasible. However, as the area upstream of the Gary Kehoe facility consists of one main tributary contained largely within pipes, the dam likely has minimal effects of aquatic life of Klein Creek as a whole.

3.5.2 Physical Stream Conditions

During the development of the Plan, DuPage County staff performed stream assessments along Klein Creek and its tributaries, where possible, to identify sediment accumulation, streambank erosion, channelization and riparian buffer. Figure 32 shows the 23 data collection points and eight reaches, outlined above.

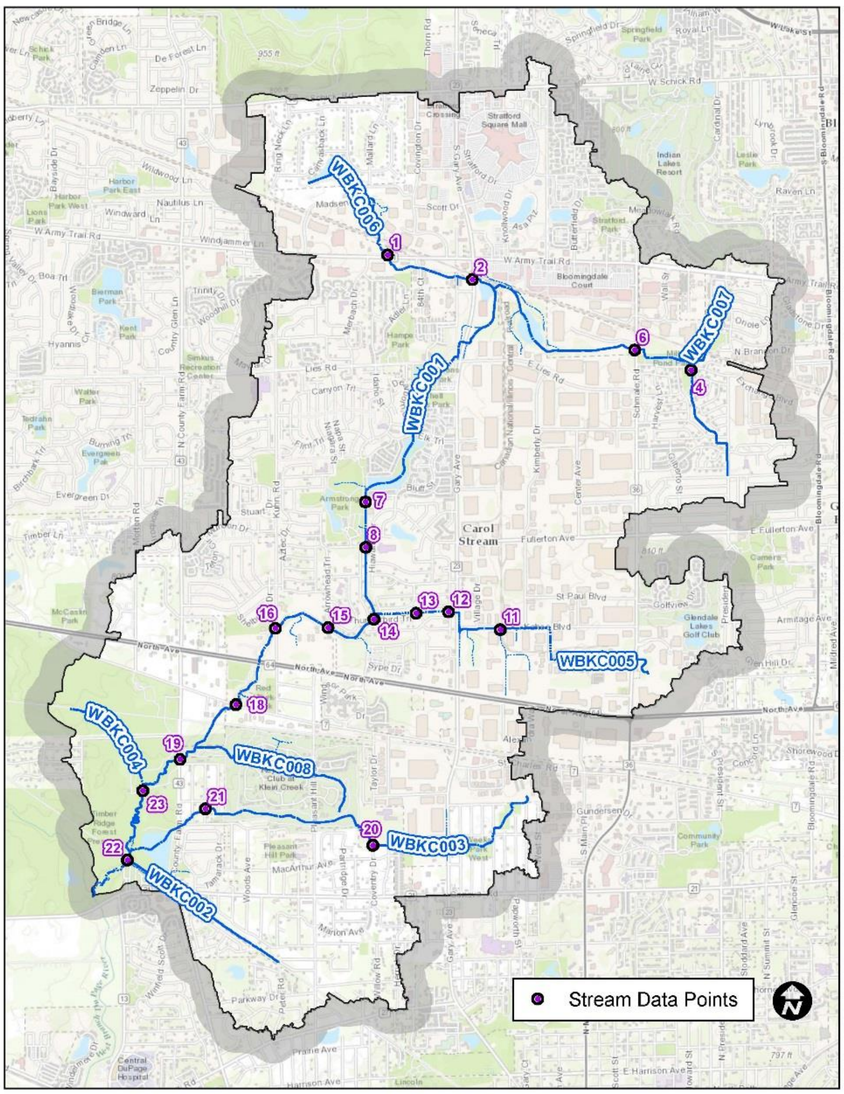

Figure 32 Stream assessment points for Klein Creek

3.5.2.1 Sediment Accumulation

Sediment transport is an important part of stream and river dynamics, but too much accumulation can deteriorate waterways. In the case of an urban stream like Klein Creek, streambank erosion that leaves soil exposed carries dislodged sediment downstream. Effects of sediment accumulation on a stream include decreased biodiversity, lowered quality of habitat, increased transfer of pollutants and increased biological oxygen demand.

DuPage County staff identified the degree of sediment accumulation at 23 data points by assessing silt deposits in pools, embedded riffles, mid-channel bars and islands, enlargement of point bars and deposition in areas above the streambank. The quality of these stream sections were then ranked on a four-point scale, ranging from no sediment accumulation to high sediment accumulation. As demonstrated in Figure 33, sediment accumulation for Klein Creek is moderate to high in many points of the stream.

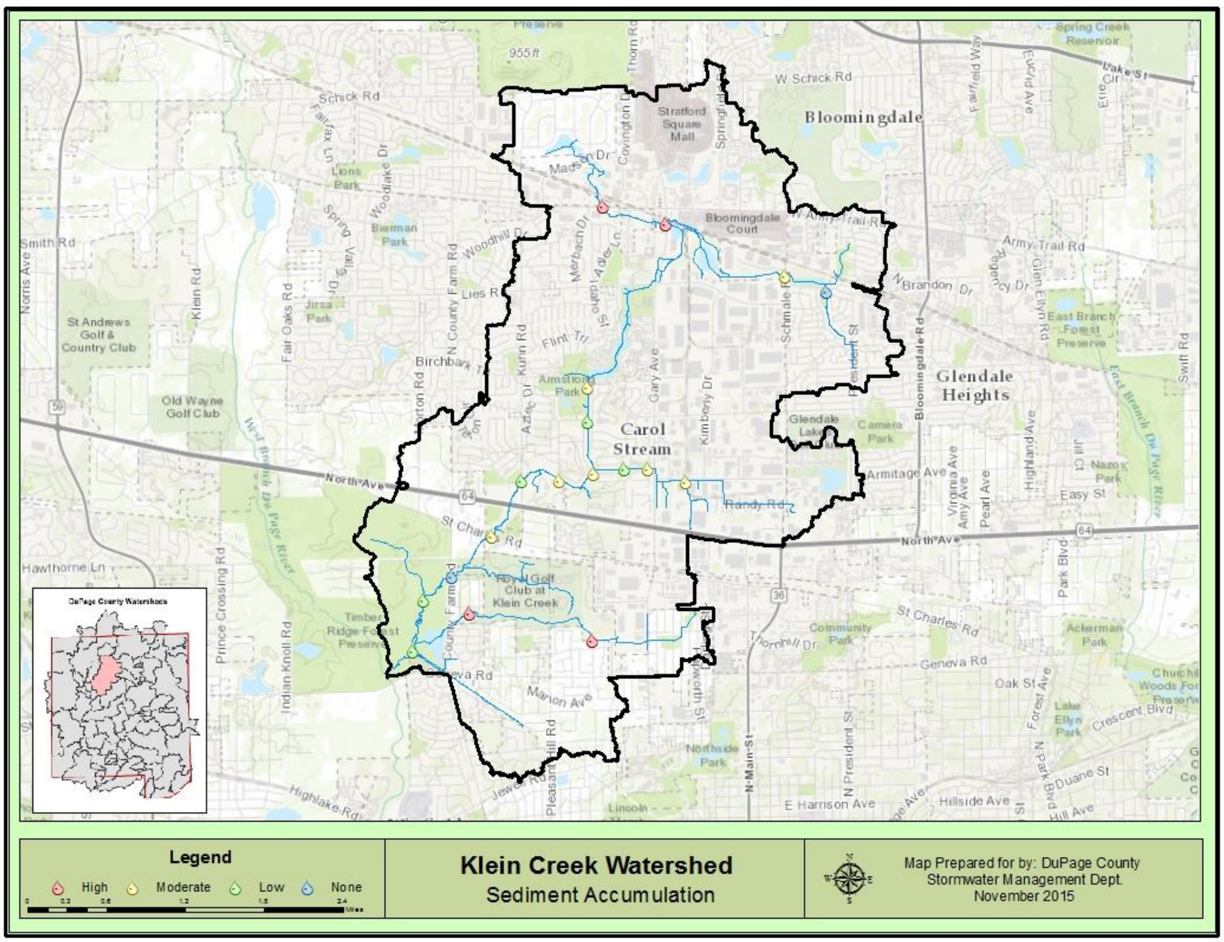

Figure 33 Sediment Accumulation along Klein Creek.

3.5.2.2 Streambank Erosion

Erosion is a natural process allowing for the continued renewal of rivers, streams, and creeks. However human interaction with the stream can cause this natural process to accelerate, and have negative impacts on water quality, flood control, and can inflict property damaged if not managed. A variety of factors impacts the erosion of streambanks including; soil type, slope, precipitation, vegetation cover and management practices.

Figure 34 Erosion along Klein Creek near Hiawatha Drive in Carol Stream

When assessing streambank erosion on Klein Creek, both sides of stream were evaluated at each of the 23 data points for erosion. Shown in Table 9, a total of 1,995 feet of streambank was reviewed for this study. Data points were assessed on a four-point scale ranging from no or minimal evidence of erosion or bank failure to very severe erosion where the bank is unstable and has evident “raw” areas because of extreme erosion. In total, 37.4% of the streambank assessed exhibited no erosion, meaning there is little potential for future problems in these areas. Another 44% has moderate erosion, meaning the bank was moderately stable with small areas of erosion. However, 18.6% has severe erosion, which leaves the bank relatively unstable and vulnerable for increased erosion. None of the banks assessed had very severe erosion. Figure 35 illustrates where moderate to severe erosion was found. Additional areas of erosion were noted during the watershed planning process by stakeholders, municipal representatives, and by reviewing previous studies and are shown later in this document.

Stream or Tributary Name	Reach Code	Stream Length Assessed (ft)	None or Low Erosion (ft/%)		Moderate Erosion (ft/%)		High Erosion (ft/%)	
Klein Creek	1	490	145	30%	255	52%	90	18%
Klein Creek	3	30	30	100%	0	0%	0	0%
Klein Creek	5	85	0	0%	25	29%	60	71%
Klein Creek	6	60	60	100%	0	0%	0	0%
Totals		**665**	**235**	**35%**	**280**	**42%**	**150**	**23%**

Table 9 Erosion Severities of Klein Creek Watershed

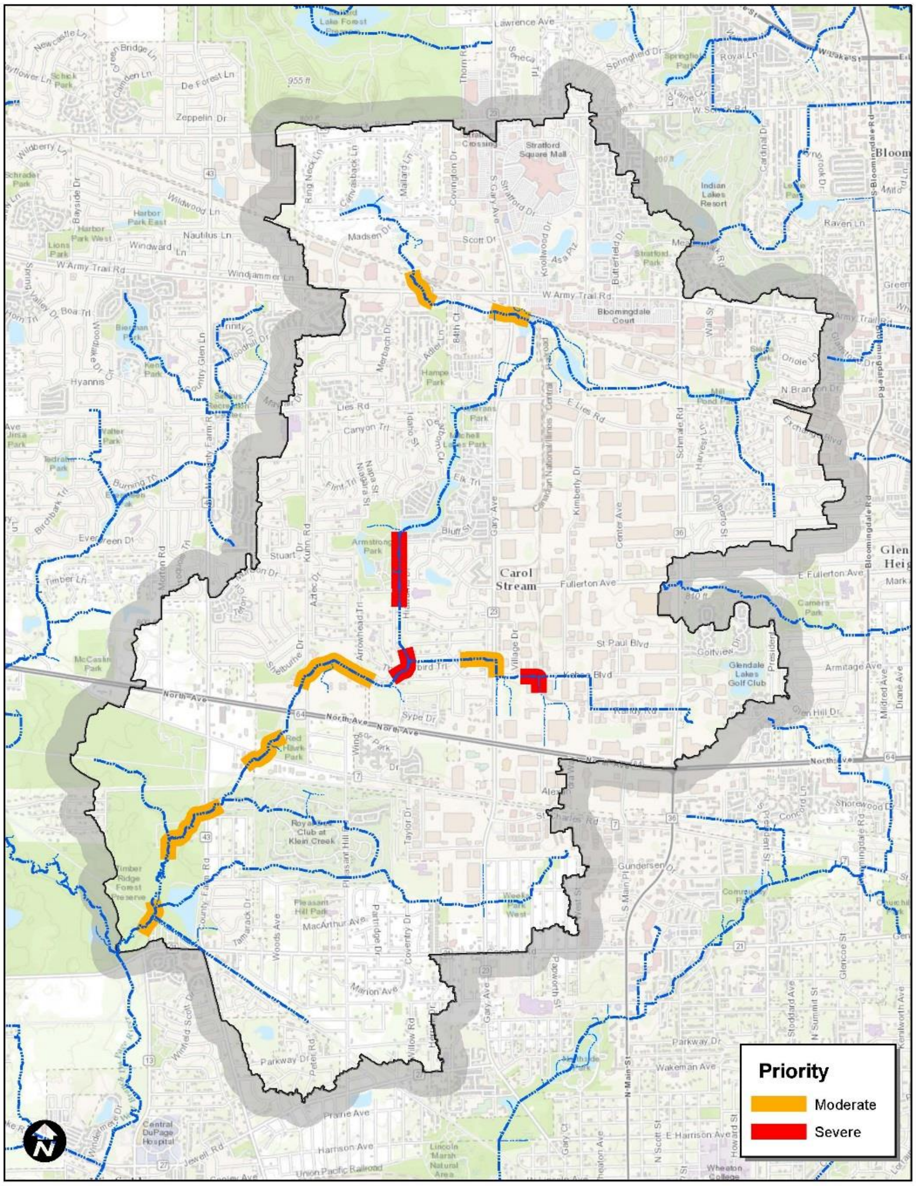

Figure 35 Stream Bank Erosion

3.5.2.3 Channelization

Channelization severely degrades water quality of a river or stream. Stream channelization can cause an increase in water velocity, streambank erosion and pollutant dispersion, while also negatively affecting aquatic habitat and, thus, biodiversity. As demonstrated in Figure 36, of the 23 Klein Creek sites assessed, most had little to no evidence of channelization, meaning there was a natural meander to the stream. One point exhibited moderate channelization, which is characterized by a straight channel with some concrete or armor. Shown in Table 10, only one point, comprising 8% of Klein Creek exhibited high channelization.

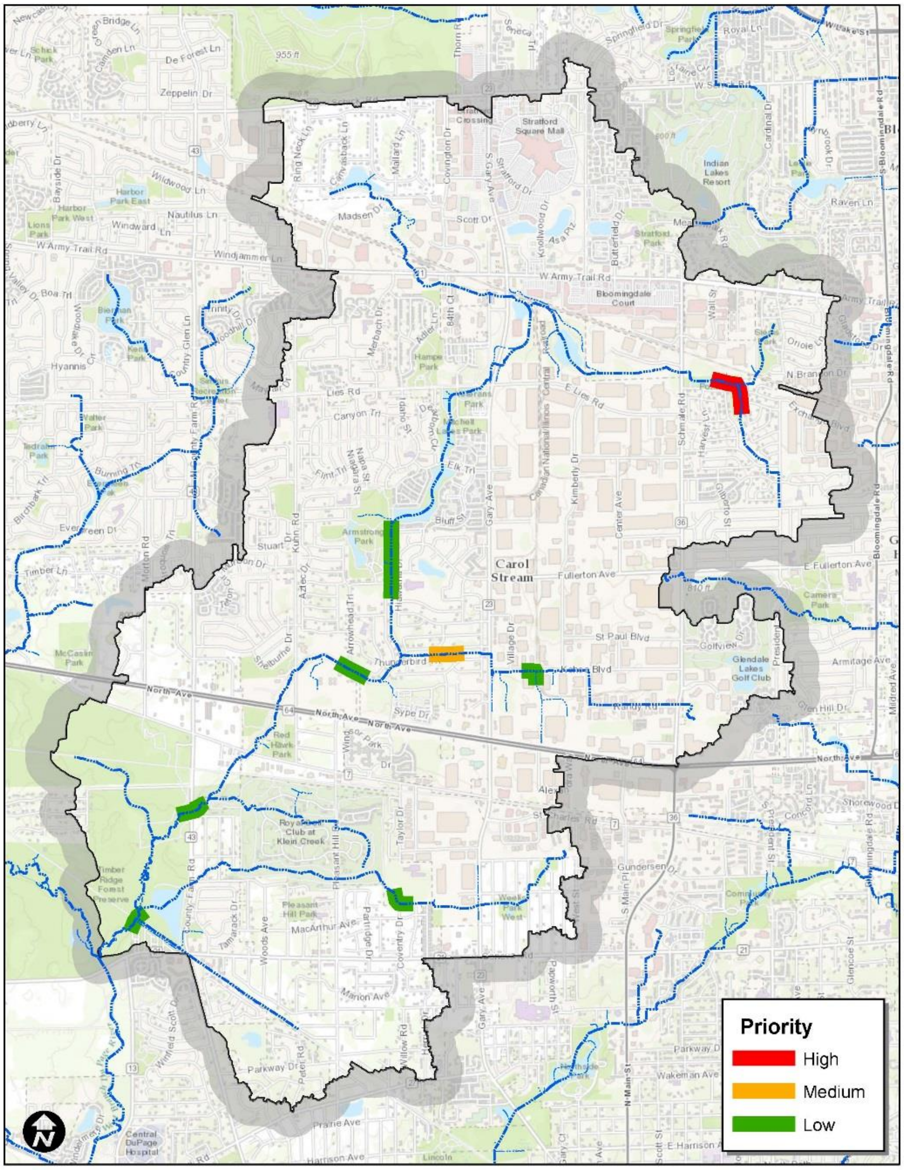

Figure 36 Channelization of Klein Creek

Stream or Tributary Name	Reach Code	Stream Length Assessed (ft)	None or Low Channelization (ft/%)		Moderate Channelization (ft/%)		High Channelization (ft/%)	
Klein Creek	1	490	365	74%	75	15%	50	10%
Klein Creek	3	30	30	100%	0	0%	0	0%
Klein Creek	5	85	85	100%	0	0%	0	0%
Klein Creek	6	60	60	100%	0	0%	0	0%
Totals		**665**	**540**	**81%**	**75**	**11%**	**50**	**8%**

Table 10 Klein Creek Channelization

3.5.2.4 Riparian Buffers

At each stream assessment location, the width of the riparian buffer was determined for each of the banks. For the purpose of this study, only naturally vegetated buffers were assessed as the DuPage Ordinance has established that mowed turf buffers provide little or no function to the stream system. In fact, these areas of maintained turf can actually contribute to water quality issues with pesticides, herbicides and grass clippings running into the adjacent stream.

As shown in Figure 37, the condition of the buffer varied throughout the Watershed, ranging from a high of more than 60 feet to a low of a zero-foot buffer. In some instances, developed area ran up to the edge of the stream. When considering the Watershed as a whole, the average riparian buffer width is 30 feet on either side of the stream.

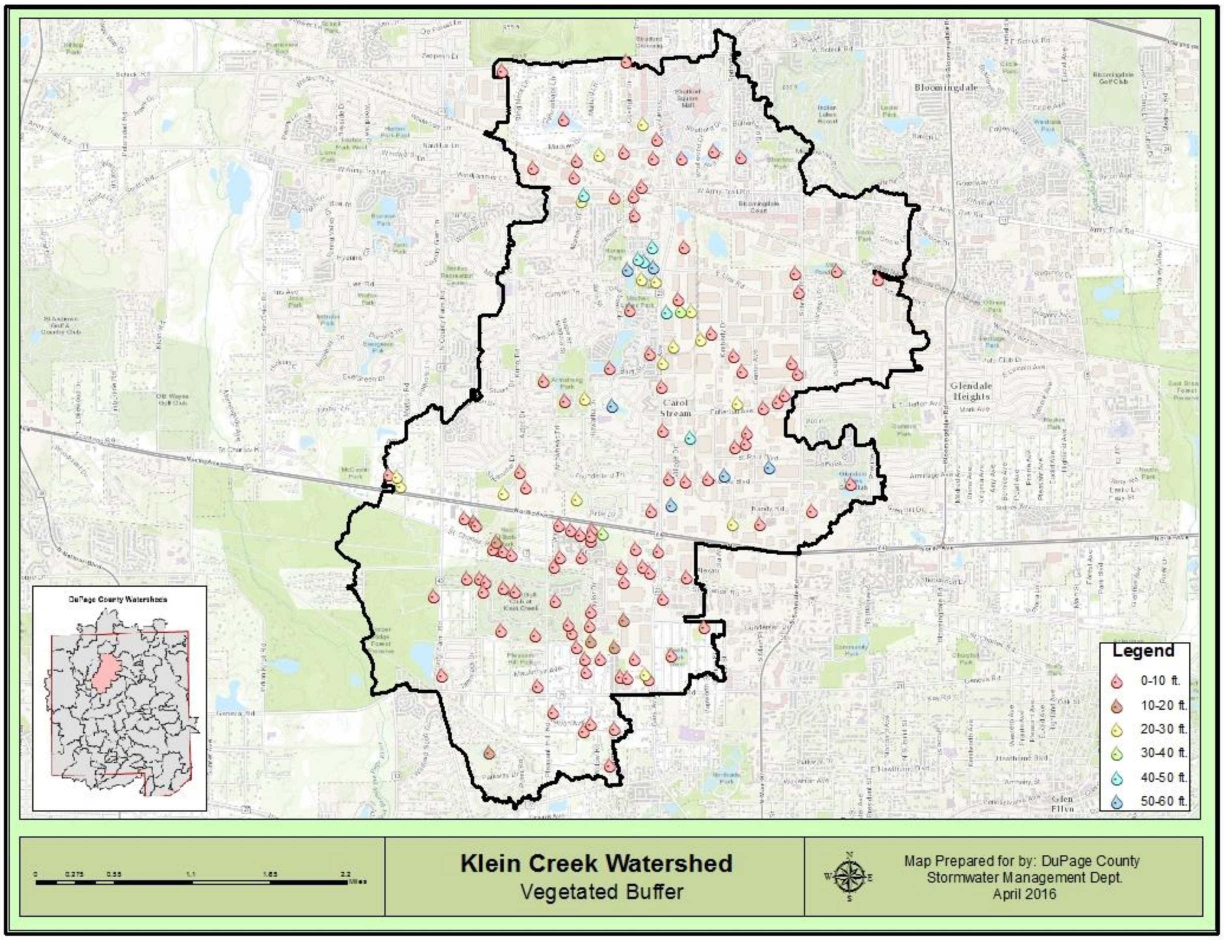

Figure 37 Vegetative Riparian Buffer Widths in Klein Creek

3.5.2.5 Overall Stream Condition

DuPage staff rated the condition of the Klein Creek riparian areas based on width, canopy cover, and riparian buffer condition. Results are shown in Table 11.

Stream or Tributary Name	Reach Code	Stream Length Assessed (ft)	Good Condition (ft/%)		Fair Condition (ft/%)		Poor Condition (ft/%)	
Klein Creek	1	490	190	39%	200	41%	100	20%
Klein Creek	3	30	15	50%	15	50%	0	0%
Klein Creek	5	85	0	0%	25	29%	60	71%
Klein Creek	6	60	60	100%	0	0%	0	0%
Totals		**665**	**265**	**40%**	**240**	**36%**	**160**	**24%**

Table 11 Overall Stream Condition of Klein Creek

3.5.3 Stormwater Detention Basins

In an attempt to create a comprehensive inventory of detention basins throughout the Klein Creek Watershed, DuPage County staff and partner municipalities identified basins throughout the study area using GIS data, aerial maps and field visits. Following basin identification, DuPage County staff physically assessed each of them, compiling the data into an ArcGIS Collector Application. The basin assessments included type, buffer and erosion. Staff then assessed the overall water quality benefit of each of the 320 basins (Figure 38), rating each good, fair or poor.

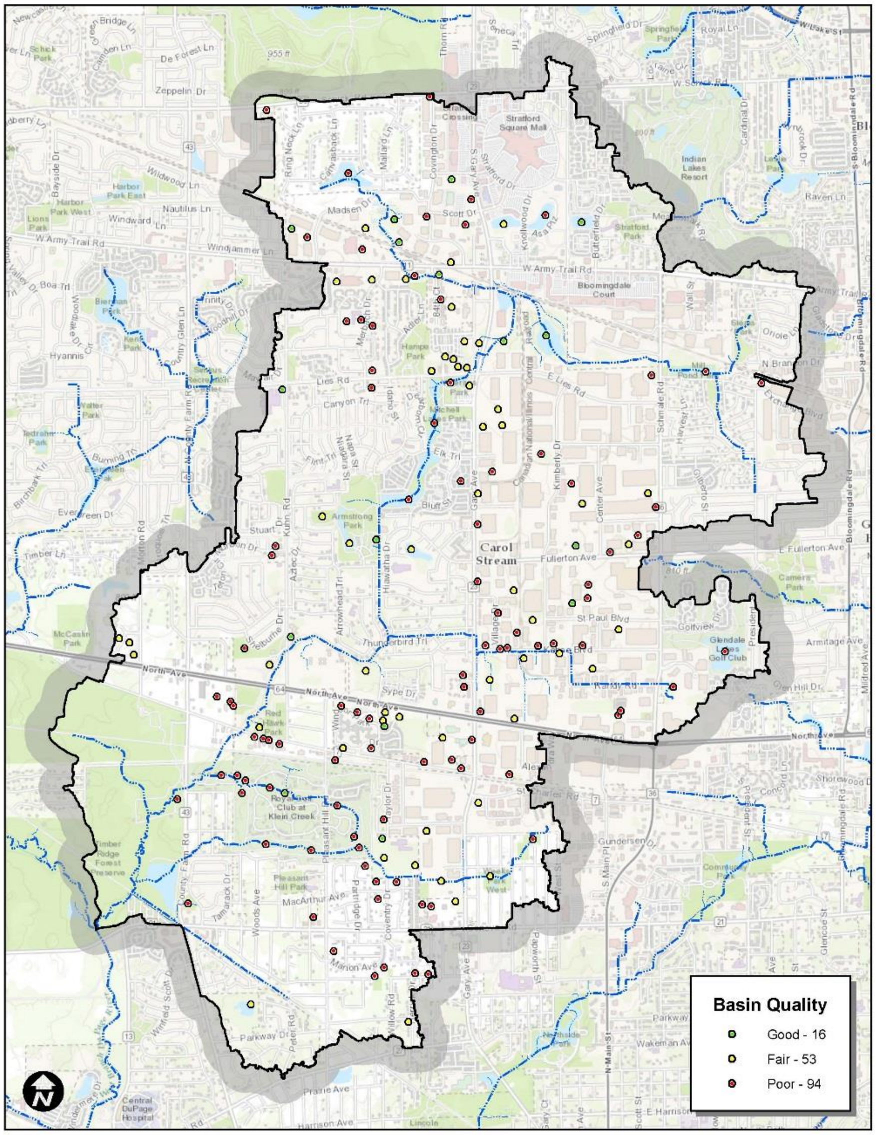

Figure 38 Types of Detention Basins in Klein Creek Watershed

The types of basins found in the watershed included dry naturalized, dry turf, wet, wet with extended dry and constructed wetland. When in good condition, these basins play an important role in water quality by retaining stormwater runoff and filtering pollutants before slowly releasing the runoff back into the stream. The indicators DuPage staff used to determine the water quality benefit of the basins included:

- Side slope cover
- Side slope angle
- Native plant buffer
- Waters' edge cover
- Basin bottom cover
- Shoreline erosion
- Safety shelf

- Sediment forebay
- Short circuit
- Inlet/outlet stilling basins
- Connection to other basins
- Basin uses and maintenance
- Retrofit opportunities

In total, staff categorized 199 basins within the watershed as poor, as shown in Table 12. Those basins were then compared to critical areas within the watershed to prioritize opportunities for retrofits.

Political Jurisdiction	# of Basins	Detention Basin Type				Water Quality Benefit		
		Wet	Dry	Wet w/ Extended dry	Constructed Wetland	Good	Fair	Poor
Bloomingdale	43	19	13	0	11	15	11	17
Carol Stream	200	52	95	18	35	19	60	121
Glendale Heights	7	4	2	1	0	0	0	7
Hanover Park	1	1	0	0	0	0	0	1
Unincorporated	35	14	11	5	5	1	8	26
Wheaton	2	0	2	0	0	0	0	2
Winfield	32	18	6	5	3	2	5	25
Total	320	108	129	29	54	37	84	199

Table 12 Detention Basin Assessments in Klein Creek Watershed

3.5.4 Groundwater Evaluation

Groundwater is a valuable natural resource. Although much of DuPage County receives drinking water from Lake Michigan, there are 1239 residences, particularly in unincorporated areas within the Klein Creek Watershed that receive drinking water from private groundwater wells (Figure 39). Contamination of this groundwater is serious because of the risk to human health and the environment, but also because cleanup of groundwater is very difficult, if not impossible. Even if the source is eliminated, contamination in the groundwater can persist for long periods. According to the Illinois Groundwater Protection Act (IGPA), the ongoing contamination of Illinois' groundwater will adversely affect the health and welfare of its citizens, as well as the economic viability of the state.[18]

[18] http://www.ilga.gov/legislation/ilcs/ilcs3.asp?ActID=1595&

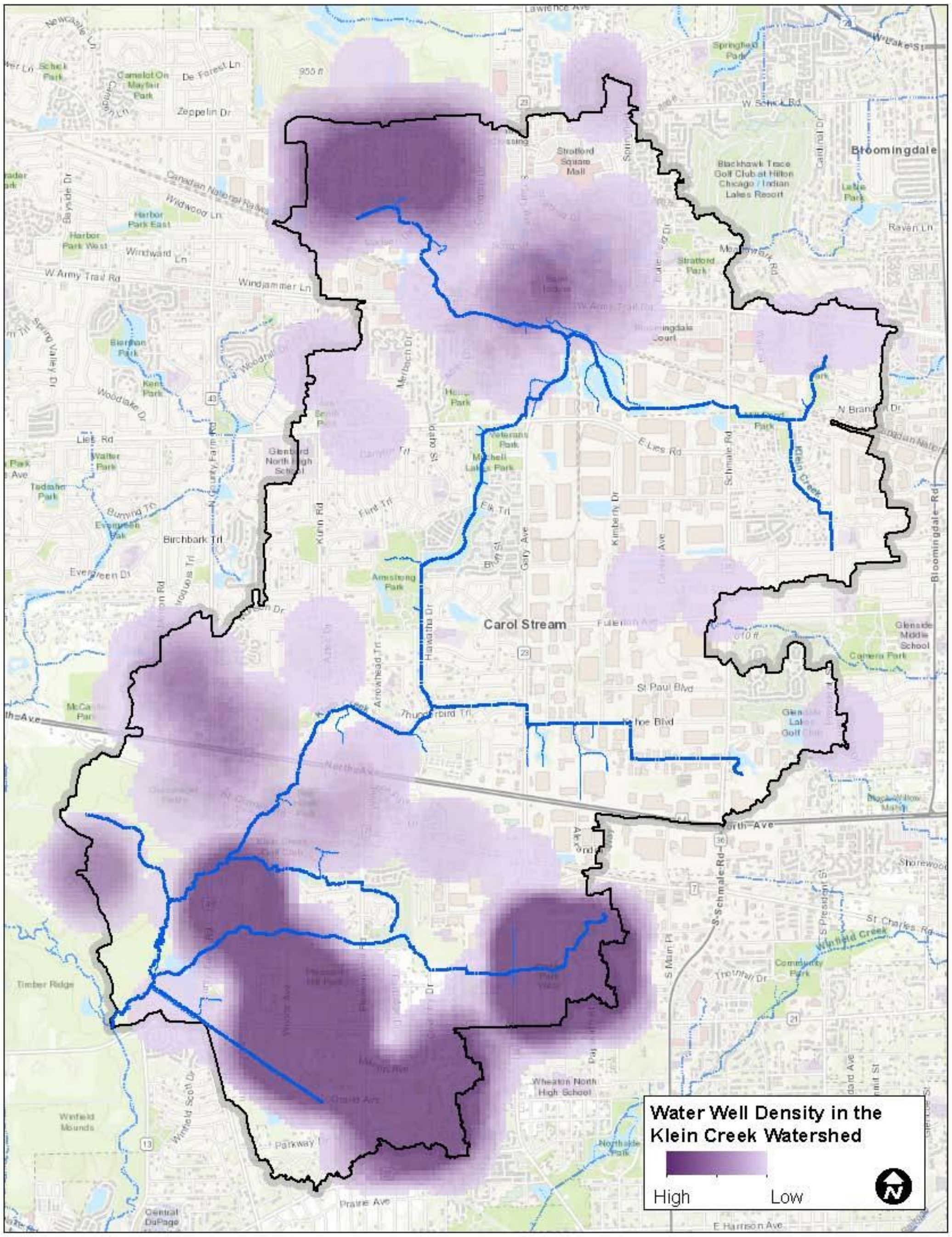

Figure 39 Density of private well water sources in Klein Creek Watershed.[19]

Groundwater also feeds many of the County's natural resources, including wetlands, streams, springs, ponds and a few lakes. As such, DuPage County is located in one of four priority groundwater protection planning regions.[20] The IEPA established the priority areas by reviewing recharge area mapping, groundwater pumping data, population affected, water supply characteristics and solid waste planning efforts, among other factors. For this reason, recharge of aquifers is necessary.

[19] http://www.rmms.illinois.edu/RMMS-JSAPI/

[20] Illinois Groundwater Protection Program, established under Section 17.2 of the IGPA

As shown in Figure 40, the principle aquifer under DuPage County is the Silurian-Devonian aquifer. However, many people interact with surficial aquifer systems found in sand and gravel found at or near the surface and alluvium along streams and rivers.[21]

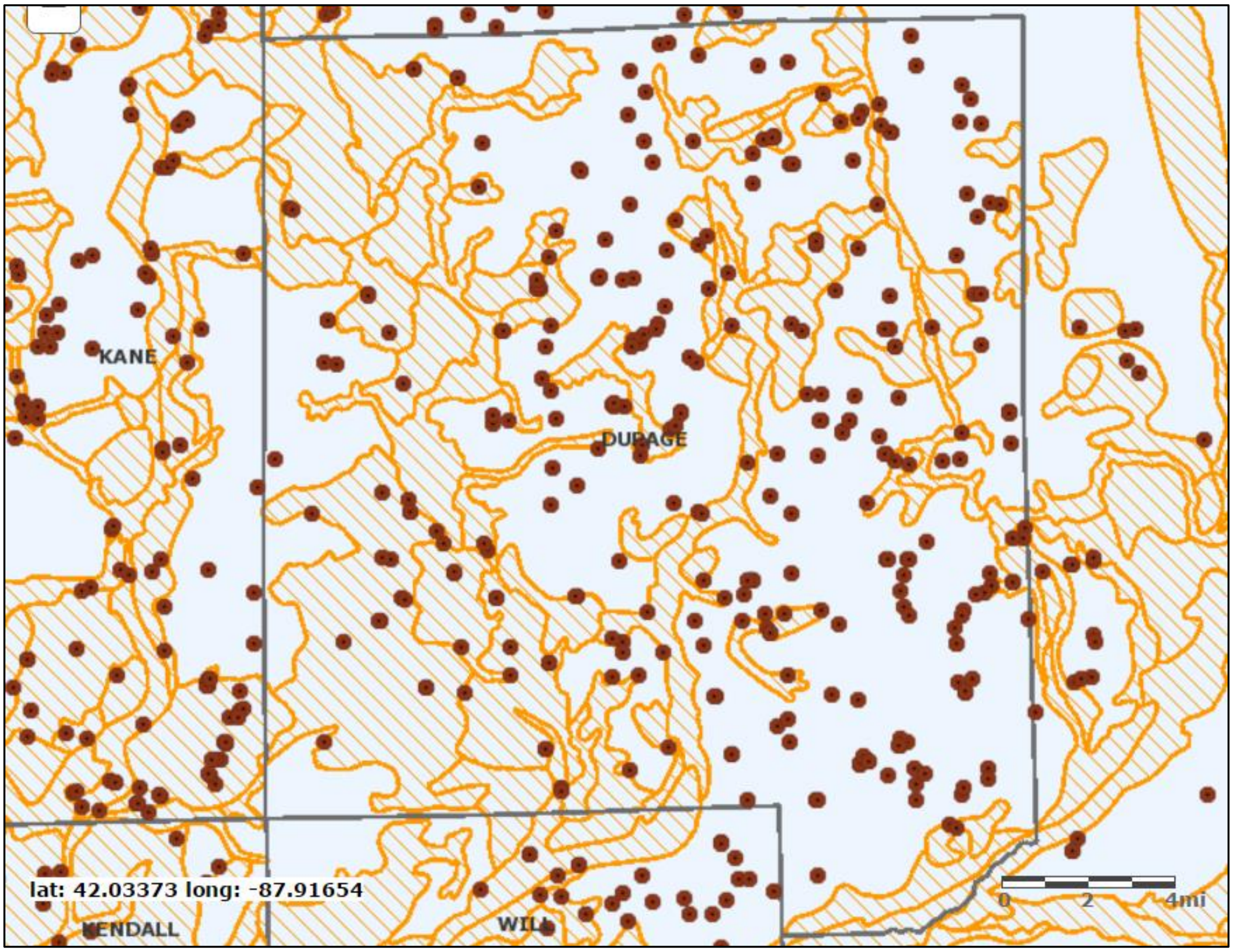

Figure 40 Potential aquifers (orange) and community wells (brown) in DuPage County.[22]

Under the DuPage County Stormwater Ordinance, development that triggers the need for volume control is also required to treat runoff for pollutants. Infiltration is a commonly used practice as it can provide both volume and pollutant control in one practice. However, the Ordinance recognizes that certain soils may not have pollutant removal capabilities due to high permeability. In order to protect groundwater from inadvertent contamination, the following are prohibited from installing infiltration practices onsite:

- Fueling and maintenance areas
- Areas within 400 feet of a public well
- Sites containing contaminants of concern as identified by the EPA or IEPA
- Development sites with soils in hydrologic soil group A
- Areas with a seasonally high water table within 2 feet of the surface

[21] https://pubs.usgs.gov/ha/730k/report.pdf

[22] Less than 50 feet deep. http://www.rmms.illinois.edu/RMMS-JSAPI/

3.5.5 Surface Water Quality

3.5.5.1 Designated Uses, Assessment & Impairment Status

Every two years, in accordance with Sections 305(b) and 303(d) of the federal Clean Water Act (CWA), the IEPA reports to the USEPA on the quality of Illinois surface water (i.e. lakes, streams and wetlands) and groundwater resources (Section 305(b)) and provide a list of those waters where their designated uses are deemed 'impaired' (Section 303(d)). There are seven designated uses in Illinois; however, only five of those uses apply within the Klein Creek Watershed. These designated uses are aquatic life, fish consumption, primary contact, secondary contact and aesthetic quality.

Klein Creek was first added to Illinois' §303(d) list in 2012 as assessment unit IL_GBKC-01, which extends approximately 3.38 miles from the bridge crossing at Illini Drive downstream until the confluence with West Branch DuPage River. Figure 41 identifies the waterbodies that IEPA has listed as impaired in accordance with Section 303(d) of the Federal Clean Water Act (CWA).

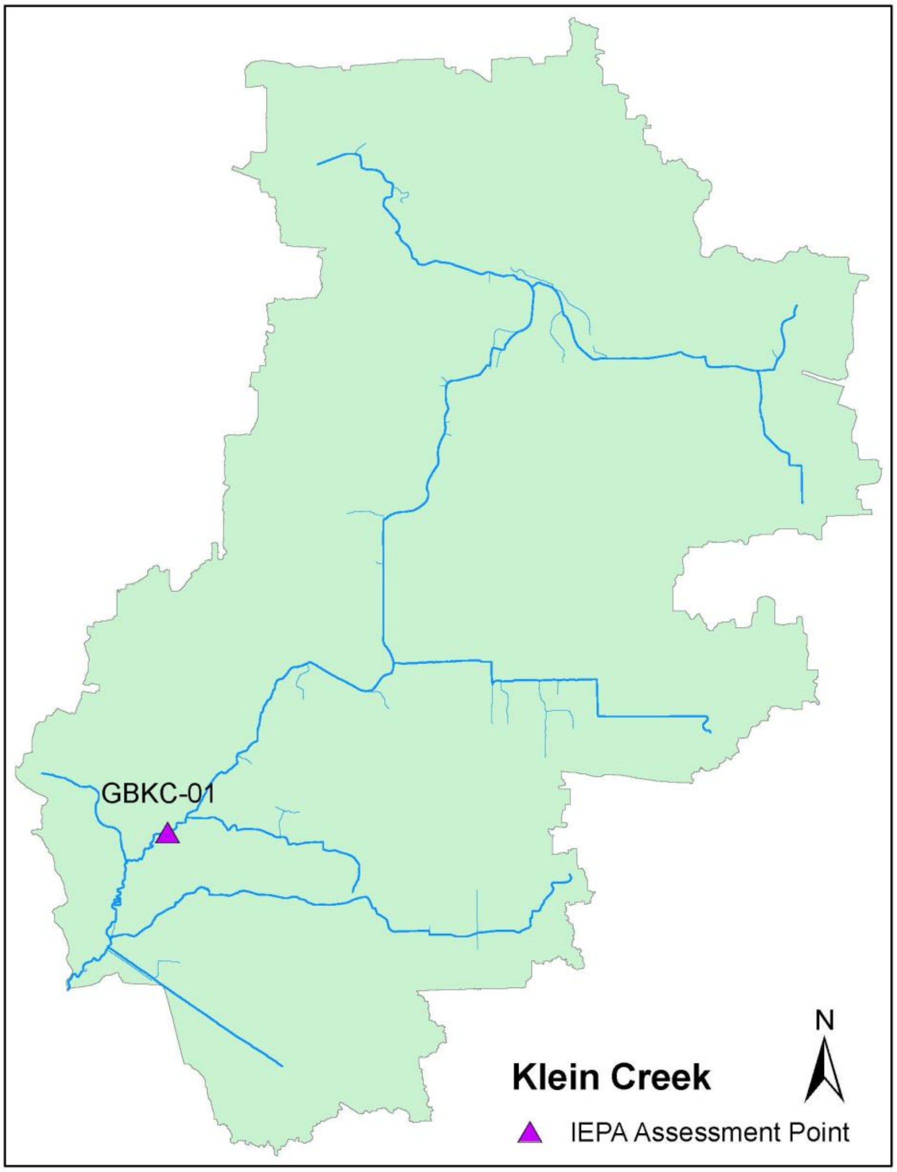

Figure 41 IEPA monitoring site GBKC-01

Klein Creek (IL_GBKC-01) has been assessed for water quality impairments. Currently, Klein Creek is listed as not supporting the aquatic life use. Alteration of streamside vegetative cover, changes in stream depth and velocity patterns, and other flow regime alterations are recognized as causes of the aquatic life impairment. However, IEPA has determined that the aquatic life use impairment is not caused by a pollutant, but instead is caused by other types of pollution (i.e., habitat related conditions). Water column data was available and revealed no violation of an Illinois Water Quality Standard criterion for a pollutant. In addition, a review of permits, watershed information, and other source data indicated no potential pollutant impairments of support for the aquatic life use. The reason for the impairment is explained by the presence of degraded habitat or other non-pollutant causes. Channelization, loss of riparian habitat, and impounded waters are suspected sources of the noted causes. Table 13 summarizes the designated uses, assessment status and impairment status of Klein Creek (IL_GBKC-01), as identified in the Illinois Integrated Water Quality Report and Section 303(d) List

(Integrated Report) for 2016. Table 15 summarizes the causes and sources of impairment for Klein Creek (IL_GBKC-01), as identified in Appendix B-2 of the 2016 Integrated Report.

Designated Use	**Use ID**[23]	**Assessed in 2016 Integrated Report**	**Use Attainment**
Aquatic Life	582	Yes	Not Supporting
Fish Consumption	583	No	N/A
Primary Contact	585	No	N/A
Secondary Contact	586	No	N/A
Aesthetic Quality	590	No	N/A

Table 13 IEPA's Klein Creek 2016 determination of designated uses

Waterbody	**Assessment Unit ID**	**Size**	**Causes of Impairment(s)**	**Sources of Impairment(s)**
Klein Creek	IL_GBKC-01	3.38 miles	Alteration in stream-side or littoral vegetative covers; changes in stream depth and velocity patterns; and other flow regime alterations.	Channelization; loss riparian habitat; and dam or impoundment.

Table 14 Assessment Information for waterbodies in the Klein Creek Watershed

IEPA assesses aquatic life designated uses with four separate categories – streams, freshwater lakes, Lake Michigan and indigenous aquatic life. These categories are labeled “Fully Supporting” or “Not Supporting” when the assessment is completed by using biological, water chemistry and habitat data. The “Fully Supporting” label means the category is in good condition whereas the “Not Supporting” label means the category is in fair or poor condition.

To assess aquatic life uses in streams, the three biological indices used are the fish Index of Biotic Integrity (fIBI), the macroinvertebrate Index of Biotic Integrity (mIBI), and the Macroinvertebrate Biotic Index (MBI). These indices are compiled into decision matrices with water quality data and physical habitat information compiled from the Intensive Basin Survey, Ambient Water Quality Monitoring Network or Facility-Related Stream Survey programs. Once all the available information is included in the decision matrices, IEPA determines if the stream is impaired for aquatic life use and if impaired, to what degree.

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[23] Use IDs correspond to the following: Aquatic Life (582), Fish Consumption (583), Primary Contact (585), Secondary Contact (586), and Aesthetic Quality (590).

3.5.5.2 Other Stream Studies

In October 2009, the IEPA finalized the DuPage River/Salt Creek Watershed TMDL Stage 1 Report[24] which describes the initial stages in development of a Total Maximum Daily Load (TMDL) for 17 impaired waterbodies throughout the watershed. A TMDL is an estimation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. It assesses contributing point and nonpoint sources to identify pollution reductions necessary for designated use attainment. Pollutant reductions are then allocated to contributing sources, thus triggering the need for pollution control and increased management responsibilities among sources in the watershed.

In response to concerns about the TMDL that was being developed, a local group of communities, Publically Owned Treatment Works (POTWs) and environmental organizations, organizing under the DRSCW, came together to better determine the stressors to the aquatic systems through a long-term water quality monitoring program, and, ultimately, develop and implement viable remediation projects. The DRSCW began collecting data throughout the West Branch DuPage River watershed in 2006 and established two monitoring stations to collect chemical, biological and habitat information along Klein Creek. As shown in Figure 42, the three monitoring points along Klein Creek are: adjacent to Hiawatha Drive at 1,200 feet downstream from Illini Drive (WB19) and approximately 0.29 miles downstream of the N. County Farm Road bridge crossing (WB16).

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[24] AECOM. 2009. Document No. : 10042-003-501. http://www.epa.illinois.gov/Assets/iepa/water-quality/watershed-management/tmdls/reports/dupage-river-salt-creek/stage1.pdf

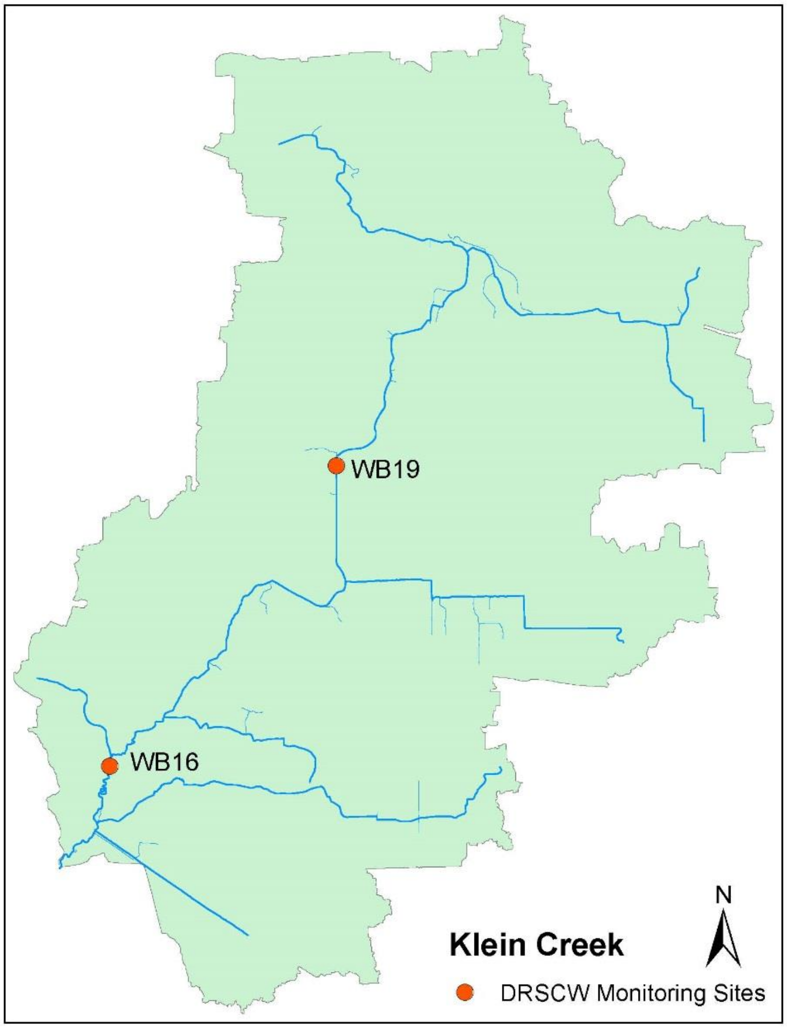

Figure 42 DRSCW monitoring sites along Klein Creek

At each of these collection points, fIBI (Figure 43), mIBI (Figure 44) and Qualitative Habitat Evaluation Index (QHEI) (Figure 45) data was collected in 2006, 2009 and 2012. In 2006, WB19 was considered severely impaired and WB16 was just above severely impaired in regards to the fIBI scores. In 2009, the reverse was found. WB19 was severely impaired while WB16 just barely received a moderately imparied rating. In 2012, both sites were considered impaired in terms of fIBI ratings. For both monitoring locations, Klein Creek at each evaluation year has been considered moderately impaired. Monitoring station WB16 had a “good” QHEI in each year, while the upstream datapoint WB19 was “fair” during each evaluation year.

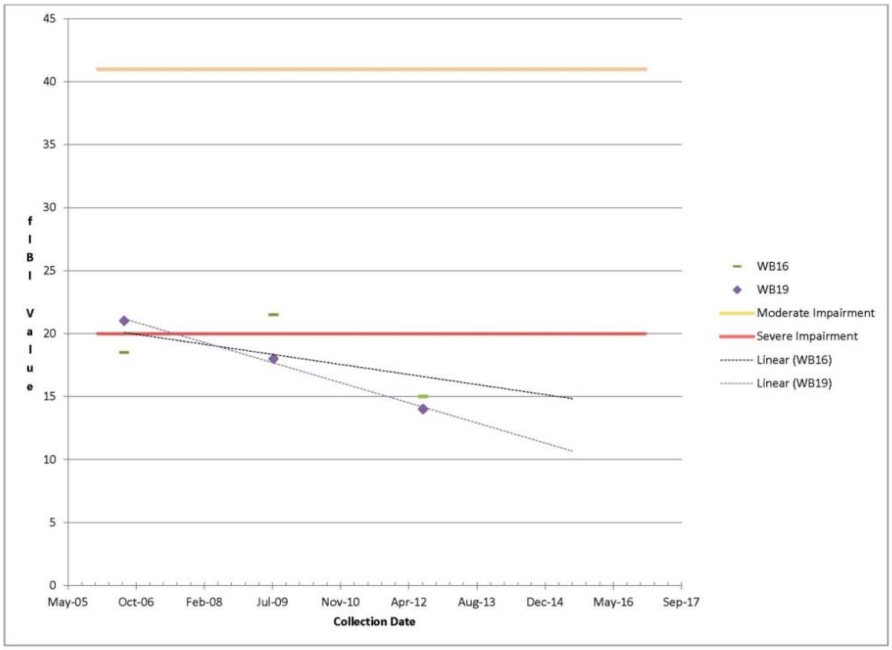

Figure 43 fIBI scores for Klein Creek

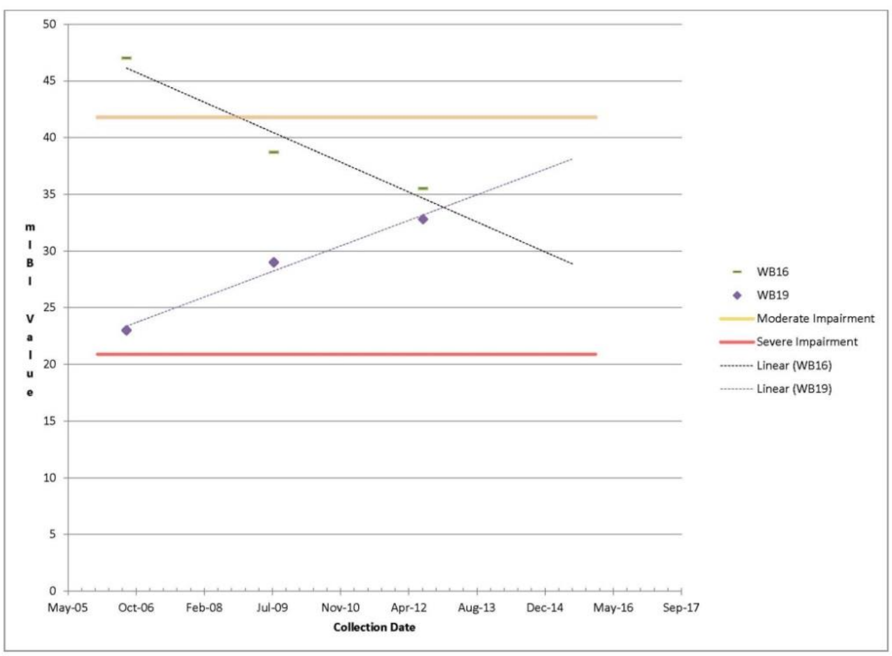

Figure 44 mIBI scores for Klein Creek

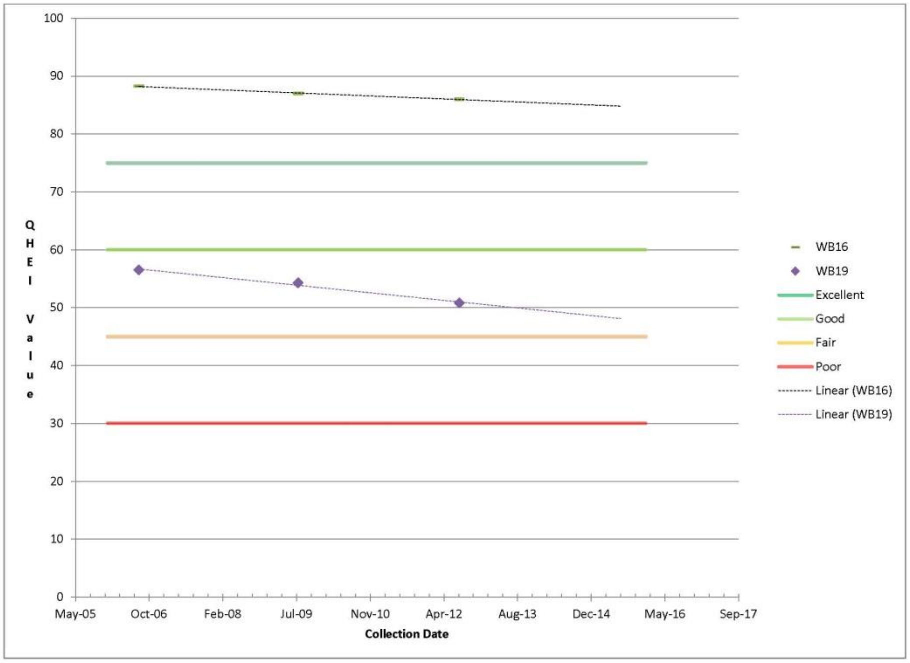

Figure 45 QHEI scores for Klein Creek

Bioassessment surveys of Klein Creek were completed in 2006, 2009 and 2012. As shown in Table 15, the monitoring indicated poor physical stream condition, typical of a degraded urban stream. The assessment identified a need to restore the habitat within the stream and riparian corridor to allow for increased assimilative capacity.

Station	Proximate Stressor(s)	Project Description	Project Objective
WB16		Habitat restoration	Increase assimilative capacity
WB19	Lack of pool and riffle sequence(s); Poor substrate and channel condition	Habitat restoration	Increase assimilative capacity

Table 15 DRSCW's bioassessment conclusions

3.5.6 Citizen Reporter Web Application

The DuPage County Citizen Reporter App was launched in May 2016.[25] The intent of this web-based GIS application is to collect observations from DuPage County citizens on water quality impairments or concerns. These observations can then be used for the purpose of identifying water quality practices or projects for watershed planning efforts. The public can view the observations and "vote" if they agree with the report. Photos and comments can also be attached to these reports.

In an effort to engage the citizens of the Klein Creek Watershed, an informational flyer was sent to each resident or property owner within the floodplain of the Klein Creek Watershed. Mailings were sent to all properties within the Klein Creek floodplain encouraging residents to use the app or contact us by email or phone to share observations on Klein Creek. A total of 3 responses were received. As detailed in Table 16, observations include stream erosion and water quality issues.

[25] http://gis.dupageco.org/CitizenReporter/

Type of Impairment	Number of Reports
Stream Blockage	
Sediment	
Streambank Erosion	2
Water Quality Issues	1
Illegal Dumping	
Garbage	
Other	
Total	**3**

Table 16 Citizen Reports from DuPage County's reporter web application

3.6 Pollutant Sources

3.6.1 Nonpoint Sources

The primary goal of this watershed plan is to prompt a reduction of designated-use impairments Klein Creek. Table 17 lists the causes of impairment as determined in the 303(d) list, along with a list of sources of these impairments. Recommendations to reduce the primary nonpoint source pollutants and, thus, improve the quality are described in the next section.

Cause of Impairment 303(d) Aquatic Life Impairment	***Source of Impairment 303(d) Aquatic Life Impairment***
Alteration in stream-side or littoral vegetative covers	Channelization
Changes in stream depth and velocity patterns	Loss of Riparian Habitat
Other flow regime alterations	Impoundments (Culvert Crossings/Dams)
Cause of Impairment (Perceived)	***Source of Impairment (Perceived)***
Fecal Coliform Mercury PCBs Phosphorus Nitrogen Sedimentation/Siltation Loss of Instream Cover pH Chloride Temperature Nitrogen Debris/Floatables/Trash Petroleum Hydrocarbons Oil & grease	Atmospheric Deposition Contaminated Sediments Habitat Modification Highway/Road/Bridge Runoff (Non-Construction Related) Loss of Wetlands, Drainage & filling Industrial Point Source Discharge Municipal (Urbanized High Density Area) Herbicide Application Pesticide Application Roadway Deicing Changes in stream flow due to hydraulic and hydrologic alteration from surrounding development Streambank erosion

Dissolved Oxygen Total Suspended Solids Aquatic Algae	Municipal point source discharges Site clearance (land development or redevelopment) Streambank modifications/destabilization Source unknown Urban runoff/ storm sewers

Table 17 Causes and sources of degraded water quality in the Klein Creek Watershed

3.6.1.1 Nonpoint Source Pollutant Load Modeling

Although the IEPA has not identified pollutants of concern within Klein Creek, based on the perceived impairments by DuPage County staff, pollutants within Klein Creek may include BOD, TSS, TN and TP due to the nature of the urbanized landscape. In order to develop a successful plan for reducing pollutants in waterways, it is necessary to evaluate the entire watershed to determine the nonpoint sources that are contributing to these issues. Pollutant load modeling will give a fuller picture of pollutants entering the stream from urban runoff.

The EPA developed a pollutant load estimation model that has been used widely throughout this region for obtaining pollution loads at a watershed scale. This model, the Spreadsheet Tool to Estimate Pollutant Loads (STEPL), estimates background or pollutant loads from existing land uses. STEPL can also determine potential reductions to these pollutant loads through implementation of water quality projects and practices. For the Klein Creek watershed, STEPL was used to generate background nonpoint source loads for TN, TP, TSS and BOD.

STEPL estimates pollutant loads based on land use information entered into the model. Each sub-watershed is evaluated individually, and then this information can be broadened into the entire watershed. DuPage County land use data – clipped to sub-watershed boundaries – serves as the baseline information for this evaluation. STEPL contains pre-determined pollutant loads determined for specific land uses, and it can be used for agricultural, forest or urban land. As the Klein Creek watershed is in a developed “suburban” area, only urban land uses were used. Figure 46 through Figure 49 map the background pollutant loads of TN, TP, TSS and BOD for existing land use in the Klein Creek Watershed.

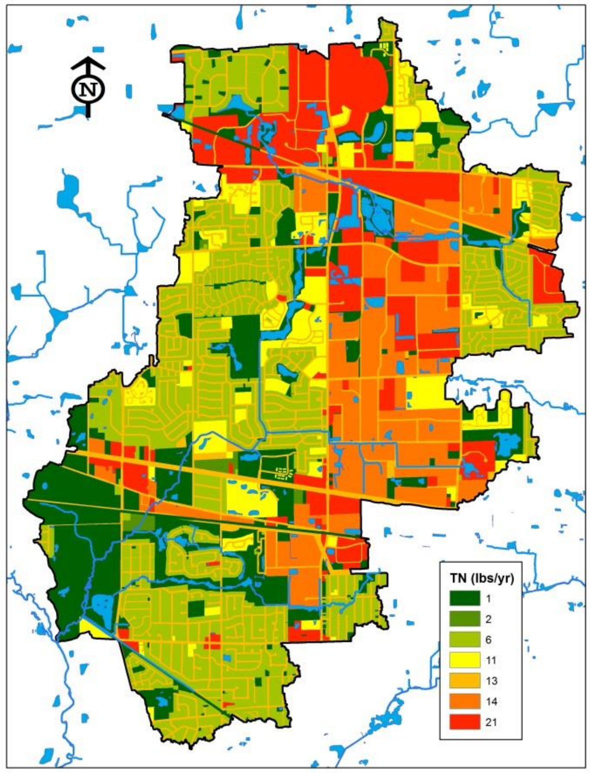

Figure 46 TN concentrations based on land use within Klein Creek Watershed

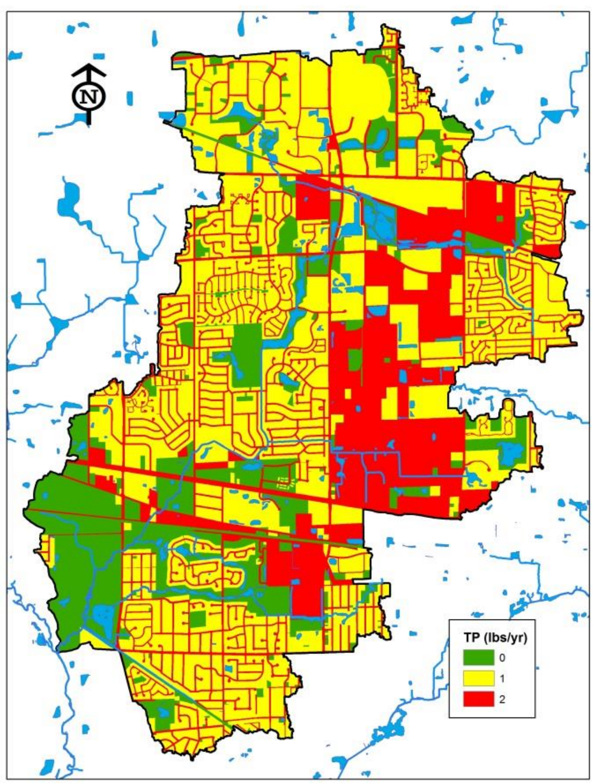

Figure 47 TP concentrations based on land use within Klein Creek Watershed

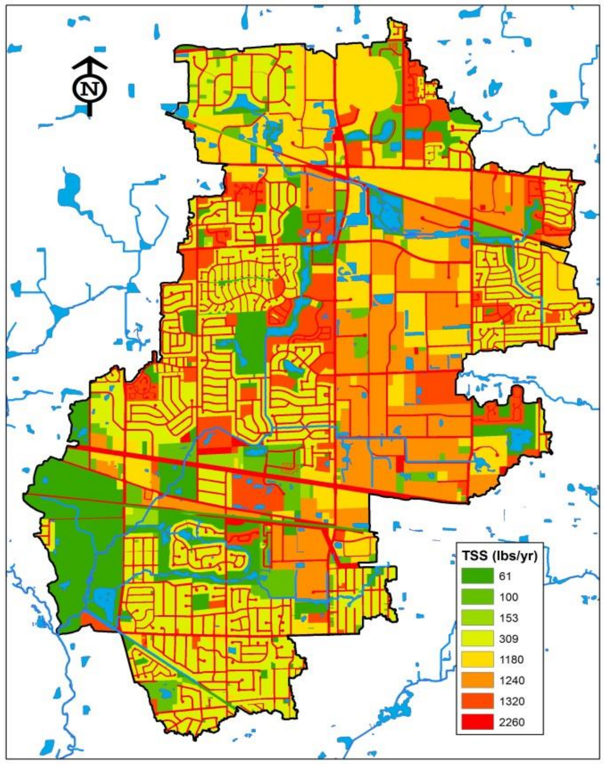

Figure 48 TSS concentrations based on land use within Klein Creek Watershed

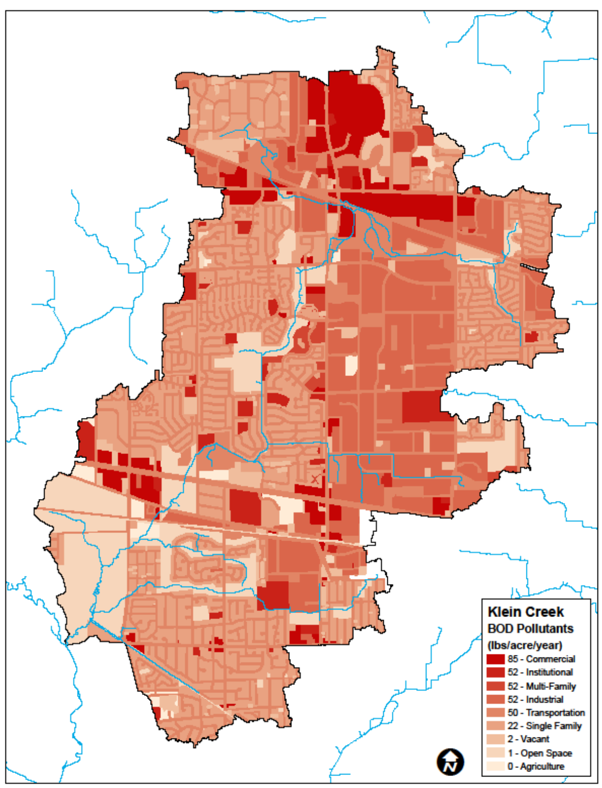

Figure 49 BOD based on land use within Klein Creek Watershed

As highlighted in tables 18-21, pollutant load estimates show that the most pollutants per acre are originating in sub-watersheds #1 and #4, which encompasses the western portion of the watershed along the mainstem as it travels through the Village of Carol Stream as well as the northeast tributaries within Carol Stream, Bloomingdale, and Glendale Heights where there are concentrated commercial and industrial land uses. TSS, TN and TP loads are most concentrated along roadways, industrial areas and dense residential and commercial areas. Sources contributing to high BOD loads include high-density land uses such as commercial, institutional, multi-family and industrial areas. These land use types typically contain a high ratio of impervious area and less open space.

Sub-Watershed	Commercial	Industrial	Institutional	Transportation	Multi-Family	Residential	Agriculture	Vacant	Open Space	Total
1	608	1,438	787	1,016	2,883	2,767	1485	181	141	11,306
2	237	961	261	2	1355	2,030	890	116	60	5,912
3	411	2815	256	196	314	241	507	54	4	4,798
4	2,204	3959	157	545	325	1,157	1326	225	0	9,898
5	615	974	75	0	19	630	488	197	7	3,005
Totals	4,075	10,147	1,536	1,759	4,896	6,825	4,696	773	212	34,919

Table 18 TN loads by land use (lbs/yr) for each of Klein Creek's sub-watersheds

Sub-Watershed	Commercial	Industrial	Institutional	Transportation	Multi-Family	Residential	Agriculture	Vacant	Open Space	Total
1	119	221	134	168	530	512	247	16	18	1,965
2	46	148	44	0	249	376	148	11	4	1,026
3	80	433	44	32	58	45	84	5	0	781
4	430	609	27	90	60	214	221	20	0	1,671
5	115	150	13	0	4	117	81	18	1	499
Totals	790	1,561	262	290	901	1,264	781	70	23	5,942

Table 19 TP loads by land use (lbs/yr) for each of Klein Creek's sub-watersheds

Sub-Watershed	Commercial	Industrial	Institutional	Transportation	Multi-Family	Residential	Agriculture	Vacant	Open Space	Total
1	9	44	17	25	59	102	49	5	0	310

2	4	30	6	0	28	75	30	4	0	177
3	6	87	5	5	6	9	17	2	0	137
4	33	122	3	13	7	43	44	7	0	272
5	9	30	2	0	0	23	16	6	0	86
Totals	357	968	201	122	660	391	0	12	3	982

Table 20 TSS loads by land use (t/yr) for each of Klein Creek's sub-watersheds

Sub-Watershed	Commercial	Industrial	Institutional	Transportation	Multi-Family	Residential	Agriculture	Vacant	Open Space	Total
1	2,814	5,177	3399	3,148	12,944	12,505	3118	484	378	43,967
2	1,099	3460	1,127	6	6082	9,174	1869	310	78	23,205
3	1,899	10135	1106	608	1,410	1,087	1064	145	11	17,465
4	10,197	14254	680	1,689	1,459	5,230	2785	599	0	36,893
5	2,722	3506	324	0	86	2,844	1024	526	18	11,050
Totals	18,731	36,532	6,636	5,451	21,981	30,840	9,860	2,064	485	132,580

Table 21 BOD loads by land use (lbs/yr) for each of Klein Creek's sub-watersheds

3.6.1.2 Streambank Erosion Pollutant Load Estimates

DuPage County staff estimated pollutant loads from eroding streambanks by using STEPL. The stream assessment field data (section 3.e.2) was used in the model to calculate pollutant volumes contributed by bank erosion.

	TN (lbs/yr)	TP (lbs/yr)	BOD (lbs/yr)	Sediment (t/yr)
Background Runoff Rates	53,614	8,619	18,9447	1,371
Streambank Erosion Caused Pollutant Loads	3.7	1.4	7.4	2.3
Total Background Loads	53,618	8,620	189,455	1,373

Table 22 Streambank erosion pollutant load estimates

3.6.1.3 Nonpoint Source Pollutants of Concern

As previously noted, the recommendations found in the Klein Creek Watershed will surround restoring the physical characteristics of the stream channel and surrounding riparian environment in addition to reducing TN, TP, TSS and BOD loads. A description of each of these pollutants of concern follows.

3.6.1.3.1 Total Nitrogen (TN)

Phosphorus and nitrogen are primary nutrients that have the ability to pollute waterways even though they are naturally present in aquatic ecosystems in addition to their presence from anthropogenic sources. Nitrogen compounds are vital for water resources, the atmosphere and in the life processes of all plants and animals. The three forms of N found in water are ammonia (NH_3), nitrites (NO_2) and nitrates (NO_3). Typically, N enters waterways as ammonia from industrial and municipal sewage effluent, septic systems, animal waste and from fertilizers. A common example of ammonia introduction to streams is from an over application of fertilizers; plants and crops only use the amount of N they need and any extra that is applied is wasted and flows into streams after rain events, which is called runoff. In the United States, 89% of TN inputs into the Mississippi River come from agricultural runoff and drainage.[26] These TN loadings contribute to the Gulf of Mexico's "dead zone," which occurs annually due to eutrophication. Eutrophication is an excessive amount of nutrients in a body of water that can cause excessive plant growth, which, in turn, limits the amount of available oxygen for aquatic animals and macroinvertebrates (hypoxia).

Nutrients in stormwater can cause nitrate contamination in groundwater aquifers as well. Nitrates in drinking water are a health concern because excess levels can cause methemoglobinemia, known as "blue baby" disease and may also serve as an indicator for other contaminants. While most of DuPage County's potable water originates from Lake Michigan and/or municipal deep aquifer wells, which are largely immune to nitrate contamination by DuPage County land-use practices, significant residential areas of the County still rely on the shallow aquifer for potable water. Historically, with proper fertilizer application practices, serious nitrate contamination of the shallow aquifer has not been an issue in DuPage.

3.6.1.3.2 Total Phosphorous (TP)

Phosphorus is critical for plant and algal growth, but in excessive amounts, it contributes to increased algae growth that significantly impacts DO and impairs aquatic communities. Phosphorus sources include sewage treatment plants, some industrial discharges, fertilizers from lawns or agricultural fields, waterfowl feces, septic systems and atmospheric deposition. Runoff from urban lawns includes phosphorus, some of which is infiltrated and adsorbed to the surface of sediments that is carried by storm sewers and overland flow into waterways.

Streams are less sensitive than ponds to phosphorus loading because of the continuous movement of the water. The rate at which the water moves and the rate at which organic forms (bacteria, fungi, algae and aquatic plants) can absorb nutrients determines the expressed productivity. In areas where there are dams, water is backed up behind spillways, excessive nutrients can accumulate and nuisance conditions can be created. Excessive algal growth can also reduce the available supply of oxygen on the upstream side of the dam. In aquatic systems, like streams, other factors such as temperature and available light can also influence expressed productivity.

Phosphorus is the nutrient in short supply (limiting nutrient) in most fresh waters, so even slight increases in phosphorus can have a negative cascading effect on water quality like accelerated plant growth, algae blooms, low DO and fish and invertebrate die offs.

Illinois does not currently have a numeric standard for phosphorus in streams; however, the State of Illinois does have a narrative standard that mandates that aquatic communities "shall be free from unnatural algal growth."

3.6.1.3.3 Total Suspended Solids (TSS)

TSS is measured in mg/L as the dry weight after water is filtered and can consist of solids like soil particles, plant matter, sewage, industrial waste and other fine particulate matter. These particles can pose problems for water quality with physical-chemical effects and their effects on aquatic biota (USEPA, 1977; USEPA, 2003). Concentrations of TSS scatter light in the water column (known as

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[26] U.S. Environmental Protection Agency (2007) Hypoxia in the Northern Gulf of Mexico: an update by the EPA Science Advisory Board. EPA-SAB-08-003. Washington (D.C.): U.S. Environmental Protection Agency

turbidity) which may inhibit aquatic organisms from finding food, affect gill function, affect spawning beds, and may even bury aquatic invertebrates and fish larvae. Suspended solids absorb heat from sunlight, which increases water temperature and subsequently decreases levels of DO (warmer water holds less oxygen than cooler water). Photosynthesis also decreases, since less light penetrates the water. As plants and algae produce less oxygen, there is a further drop in DO levels. Organic and inorganic pollutants readily adsorb to soils and other suspended solids and easily transport throughout aquatic systems. This transportation of pollutants increases exposure rates to aquatic organisms.

TSS is used as a water quality indicator and if measurements of 116 mg/L or greater are found in an Illinois stream, that stream is potentially impaired. There are an estimated 1,004 miles of impaired Illinois streams and 117,388 acres of Illinois lakes potentially impaired by TSS.[27]

3.6.1.3.4 Biological Oxygen Demand (BOD)

BOD is measured to determine the amount of dissolved oxygen used in an aquatic ecosystem by microorganisms. Byproducts of plant and animal wastes and domestic and industrial wastewaters are typical sources of compounds that have high levels of BOD. Elements of these wastewaters that contain BOD are feces, urine, detergents, fats, oils and grease, etc. Waters with high levels of BOD may see water quality problems like low levels of dissolved oxygen and fish die-offs.

Prolonged exposure to low dissolved oxygen levels may not directly kill aquatic life but may significantly increase their susceptibility to other environmental stressors and diseases. Dissolved oxygen concentrations affect growth rates, swimming ability, susceptibility to disease and the relative ability to endure other environmental stressors and pollutants. The most critical conditions related to dissolved oxygen deficiency in natural waters occur during summer months when temperatures are high and the solubility of oxygen is at a minimum; however, additional protection is generally provided through criteria for dissolved oxygen in the spring months that correspond to the spawning and nursery season for select aquatic life.

Algae plays a significant role in dissolved oxygen levels in waterbodies. Where both nitrogen and phosphorus are plentiful, algal growth is encouraged causing blooms to occur. When the algae die, the degradation of their biomass consumes oxygen lowering the dissolved oxygen levels in the water column and impacting the health of aquatic life.

3.6.2 Point Sources

Under the Water Quality Act of 1987, the EPA established the NPDES program to limit point source pollution to waterways. In Illinois, the IEPA enforces the NPDES program, which was rolled out in two phases. Published in 1990, Phase 1 regulates discharges from industrial activities, medium and large MS4 communities and construction sites 5 acres or larger. Medium MS4s have a population of 100,000 to 249,999. Large MS4s have a population of 250,000 or greater. In the Klein Creek Watershed, only the DGSD holds an NPDES Phase 1 permit, meaning they must limit discharge of specific pollutants, including BOD, TSS, ammonia nitrogen, fecal coliform and phosphorous.

Phase 2, which was published in 1999 and went into effect March 2003, expanded the regulations to include discharges from small MS4s and construction sites 1 to 5 acres in size. Small MS4s are those with

[27] IEPA. 2016. Illinois Integrated Water Quality Report And Section 303(d) List. Water Resource Assessment Information and List of Impaired Waters. Illinois Environmental Protection Agency.

populations under 100,000, not covered under Phase 1. NPDES Phase 2 requires all small MS4s obtain NPDES permits and implement the six minimum control measures, which are:

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

All but one DuPage County municipality, as well as all townships and unincorporated areas, are considered small MS4s under NPDES. Currently, each MS4 in the Klein Creek Watershed holds its own NPDES Permit No. ILR40 with the IEPA, and, therefore, is required to define best management practices (BMPs) and goals for each of the minimum control measures, to be reported annually. DuPage County assists other permit holders by providing several of the six minimum control measures on a regional scale.

In addition to the NPDES program, the DuPage County Stormwater Management Plan provides the foundation for future watershed planning efforts, the Ordinance and water quality improvements throughout the County. It was established in recognition of the critical need to limit the reoccurrences of extensive flood damages within the County. Development has historically caused increases in flood risk, flood damage and environmental degradation. The DuPage County Stormwater Management Planning Committee implemented the plan to reverse that trend. It responds to the opportunity inherent in State of Illinois P.A. 85-905, which authorizes regional stormwater management in northeastern Illinois counties. It also recognizes the integrated nature of the watershed system and the need to consider stormwater management planning on a watershed basis. The plan consolidates the stormwater management framework throughout DuPage County into a united, countywide structure; sets minimum countywide standards for floodplain and stormwater management; and provides for countywide coordination for the management of stormwater runoff in both natural and manmade drainage ways and storage.

3.7 Land Management Practices

3.7.1 Conservation Easement Programs

Throughout DuPage County, The Conservation Foundation runs the Natural Areas Assurance Program for Developments, which provides assurance to municipalities, regulators, future occupants and communities that natural areas and open space within a development is protected from further development and those natural resources and functions will be maintained forever.

The Conservation Foundation works with the developer and the regulatory agency to execute a two-step process. The first step is to protect the natural areas and open space within the development with a conservation easement. This restriction is recorded on the deed and takes away the development rights on that portion of the land. The second part of the process is to put in place financial mechanisms to provide adequate funding for the long-term ecological management of the natural areas and open space in accordance to an approved management plan. This funding is often accomplished through annual assessments of property owners with a backup special service area tax in place if necessary. The Natural Areas Assurance Program has resulted in healthy and aesthetically pleasing natural areas that are an amenity to the community and help maintain or even increase property values in both residential and commercial developments.

3.7.2 Local Ordinances

As previously mentioned, DuPage County developed a comprehensive Ordinance to regulate stormwater management activities countywide. Adopted in 1991 and last revised in 2013, the principal purpose of the Ordinance is to promote effective, equitable, acceptable and legal stormwater management measures.

The Ordinance establishes a minimum level of regulatory compliance that a municipality or unincorporated portion of the County must meet. The Ordinance not only outlines countywide stormwater regulations, but also establishes a process that allows communities within DuPage County to enforce these regulations individually while following the same provisions. Pursuant to the authority established in 55 ILCS 5/5-1062, the provisions of the Ordinance may be enforced by a community once they have adopted a stormwater management ordinance consistent with, and at least as stringent as, the County's Ordinance or when they have duly adopted the provisions of the countywide Ordinance.

Several communities have waived their legal authority to enforce the Ordinance, either partially or wholly, within their jurisdiction. In these communities, the County conducts either some (partial waiver communities) or all (non-waiver communities) aspects of the permitting process for development sites subject to the Ordinance requirements. Table 23 shows the waiver status of municipalities within the Klein Creek Watershed. DuPage County staff offers numerous services for the communities, including permit submittal review and post-construction inspections at sites containing wetland, buffer, riparian enhancement and wetland mitigation. As the Ordinance has been adopted into DuPage County's County Code, it serves as the regulatory mechanism for enforcement of these requirements. Development securities can be drawn upon in the event of non-compliance, and legal action through the State's Attorney's Office may also be applied.

Community	Stormwater Ordinance Waiver Status
Bloomingdale	Partial Waiver
Carol Stream	Full Waiver
Glendale Heights	Partial Waiver
Hanover Park	Partial Waiver
Winfield	Partial Waiver
Unincorporated	Non Waiver

Table 23 Ordinance waiver status of Klein Creek Watershed communities

3.7.3 Local Planning Documents

Regionally, the Klein Creek Watershed is included within Chicago Wilderness' Green Infrastructure Vision, which guides open space and sustainable development throughout the greater Chicagoland region. The Chicago Metropolitan Agency for Planning (CMAP) is in the process of developing their On To 2050 plan – a follow up to their Go To 2040 plan – that outlines regional initiatives, notably stormwater management, open space and environmental.

In DuPage County, the Klein Creek study area falls under the regional jurisdiction of DuPage County's Stormwater Management Plan and Ordinance, both of which guide local development, projects and flood control management within the floodplain. This area is also subject to an ongoing U.S. Army Corps of Engineers (USACOE) study of the entire DuPage River Watershed to identify flood control improvements within it.

Many of the municipalities within the Klein Creek Watershed have developed comprehensive plans. However, as new comprehensive plans can be developed every few years, each municipality should be contacted for the most recent planning information.

4. Watershed Protection Measures

4.1 Best Management Practices & Programs

Used watershed-wide, with a particular focus in critical areas, the following BMPs are recommendations to reduce the key nonpoint source pollutants stressing Klein Creek. Some of these solutions may be implemented at a localized level, such as green retrofits on private property, while others may require DuPage County's involvement, such as a dam removal.

4.1.1 BMP Projects

4.1.1.1 Green Infrastructure

According to the EPA, green infrastructure "reduces and treats stormwater at its source while delivering environmental, social, and economic benefits." Green infrastructure refers to using the existing vegetation and soils on a site to manage water rather than focusing on transporting the water offsite as is common in traditional "gray infrastructure" Examples of green infrastructure generally fall under one of the following three categories, infiltration practices, impervious surface reduction and rainwater harvesting.

4.1.1.1.1 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 water body in smaller storm events also results in lower storm elevations and overland runoff that can cause localized flooding. Slowing runoff causes excess sediment and debris to drop out and to allow water to seep into the soil. Slowing runoff and allowing for infiltration reduces peak flows thereby reducing streambank erosion to improve water quality. Infiltration practices recommended throughout the Klein Creek Watershed include:

- ***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 as existing roadside ditches can easily be converted to bioswales. Bioswales are proposed for 1-2% of the watershed.
- ***Rain gardens*** and **bioretention facilities** are excavated or natural depressions that collect runoff from surrounding impervious areas and allow it to infiltrate. They are often constructed in residential yards or adjacent to commercial buildings. Rain gardens or bioretention are proposed for 2.5 – 5% of the watershed.

- ***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 infiltrates through the soil. One benefit of an infiltration trench is that it is completely underground and can be covered with turf grass, making it blend in with surrounding lawn areas. Infiltration trenches are proposed over 1% of the watershed.
- ***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 then 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.[28] Filterra tree boxes, or equivalent, are proposed over 1% of the watershed.

Pollutant removal rates of infiltration practices can vary, but overall they are among the most efficient at removing pollutants due to the fact the all of the stormwater in smaller events is captured and infiltrated into the soil, eliminating runoff. This plan proposes utilizing infiltration practices over approximately 5.5 to 9% of the watershed.

4.1.1.1.2 Impervious Surface Reduction

Converting impervious surface to a surface of permeable soil and vegetation is an excellent way to reduce runoff volume and velocity, as well as treat it. Permeable pavement is a paved surfaces that infiltrates, treats and/or stores rainwater where it falls. Permeable pavement may be constructed from pervious concrete, porous asphalt, interlocking grid pavers or other materials. These pavements are particularly cost effective where land values are high and where flooding or icing is a problem. Permeable pavements reduce runoff and capture TSS, metals and oils.

When converting all impervious surfaces is not an option, finding ways to disconnect impervious surfaces from one another can go a long way. Examples include disconnecting gutters 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. This plan proposes conversion from asphalt to permeable pavers over 2.5% of the watershed tributary area.

4.1.1.1.3 Rainwater Harvesting

The use of rain barrels and cisterns are encouraged in Klein Creek watershed to reduce runoff at the source. Rain barrels are storage containers that are located above ground. They capture runoff from the gutters of a structure and store water so it can be later used to water landscaping and gardens. Cisterns function in the same way as rain barrels, but are usually larger, placed underground and evacuated by pump. Cisterns and rain barrels should be emptied prior to rainfall to reduce runoff volume.

4.1.1.2 Detention Basin Retrofits

Many of the detention basins in Klein Creek Watershed are typical of construction from the last century and do a poor job of removing pollutants from the water before releasing them. Some of the basins may even degrade water quality further. Modifying a detention pond for improved water quality involves

[28] https://www.epa.gov/green-infrastructure/what-green-infrastructure

many variables and takes a site-specific design approach. The following basin retrofits can offer big improvements to water quality in the pond and downstream.

- ***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 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 water edges.
- ***Forebay.*** A forebay is a smaller, closed basin at the ponds inlet. A forebay acts as a sediment basin and helps to prevent sediment in the detention pond from being re-suspended by high flows. Forebays also extend the life of the pond and makes sediment control easier.
- ***Native vegetation on the slopes***. Native vegetation includes species native to northeastern Illinois. Once established, native vegetation can reduce erosion, eliminate the need for fertilizers, deter geese and filter pollutants from overland flow.
- ***Wetland bottom.*** This retrofit involves building up the bottom of a wet detention basin with soil to just below the water surface. The bottom is then planted with native wetland vegetation. These pond retrofits often feature a meandering low flow channel to handle flows, but allow water to inundate the wetland 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 goose populations.
- ***Constructed wetland detention.*** Constructed wetland detention basins pull together the use of native slopes, forebay and 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 depths of wetland, permanent pools and vegetation.

Detention basin retrofits are proposed for between 2.5% of the drainage area of subwatershed #2 and #4 and 5% of subwatersheds #1, #3 and #5. 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%. Pollutant removal rates were based on published research.[29]

4.1.1.3 Riparian Buffer Enhancement

Mentioned earlier, the Klein Creek Watershed has overall poor riparian buffers, which should be increased watershed-wide. In addition, areas with existing low quality riparian zones represent potential buffer restoration sites. Riparian and wetland buffer environments should be protected, restored, increased and managed to optimize their benefits to waterways.

Acreage and quality of riparian buffers can be increased by replacing traditional landscapes and impervious surfaces with well-managed native ecosystems. Riparian areas are vital to the health of the stream ecosystem by providing a natural filter for nonpoint source pollutants. Wide floodplains also reduce flood damage by allowing waterways to expand and shift away from buildings and infrastructure. Unlike maintained turf grass, native vegetation is resilient to large flood events and can tolerate periods of high flows and high water, holding in the soil even after a storm event.

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

Healthy streams need healthy riparian ecosystems to provide the many different types of food for organisms, shade to moderate temperatures and provide opportunities for evapotranspiration and infiltration. Overhanging vegetation and leaves from trees shade waterways and create habitat variety both on the bank and in the water. As the vegetation breaks down, it becomes a part of the water column and food chain.

4.1.1.4 Wetland Restoration

Wetlands and their buffers play an important role in supporting the health and resilience of a watershed. Wetlands act as enormous rain gardens that treat pollutants, reduce runoff and moderate water temperature, among many other benefits. Unlike an open water pond, wetlands store more water in soils and plants release water into the air as vapor, as such, they are said to have more stormwater storage capacity than a traditional basin of equal size. Wetlands and their buffers provide the substrate for a complex web of organic and inorganic processes. The products of these ecosystems, which then flow downstream, are crucial resources for a properly functioning riverine ecosystem and riparian environment. By performing these functions, wetlands improve water quality and biological health of streams and lakes located downstream while helping to protect public safety.

With a goal to improve the current inventory and quality of wetlands and wetland buffers in the Klein Creek Watershed, recommendations include increasing the acreage of new wetland and improving the quality of existing wetland and wetland buffer. Wetlands have an enormous capacity to store excess water from a storm event, enhanced by evapotranspiration and storage in soils. The stored water is slowly released over time through smaller surface outlets or down through the soils to become groundwater, which results in replenished groundwater and cooler in-stream water temperature. Wetlands also filter sediments and nutrients in runoff, provide necessary wildlife habitat and help maintain stable water, temperature and chemistry levels in streams.

4.1.1.5 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.

Five-year goals for the watershed include installation of oil and grit separators along roadways to treat 1% of the watershed. 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 1% of the watershed can have a measurable impact to Klein Creek, particularly when located along major thoroughfares and high traffic areas.

4.1.1.6 In-Stream Restoration

Stream restoration projects focus on improving channel sinuosity, installing natural features such as riffles and pools, and replacing mud substrates with cobbles Water quality benefits of stream restoration projects include reducing streambank erosion, trapping suspended sediment, and re-oxygenating the water column. In-channel restoration also provide habitat that supports the propagation of fish and macroinvertebrates.

Streambank stabilization involves using vegetation, soil 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:

- Stabilizes banks and shores, preventing further erosion and degradation;
- Improves water quality by reducing sediment loads in surface waters;
- Helps maintain the capacity of waterways to handle floodwaters, preventing flood damage to utilities, roads, buildings and other facilities;
- Reduces expenses for dredging accumulated sediment from lakes and drainage ditches;
- Enhances habitat for fish and other aquatic species by improving water quality and moderating water temperature; and
- Creates riparian habitat for terrestrial wildlife.

The Stream Assessments conducted by DuPage County staff found a lack of pool and riffle sequences throughout Klein Creek. Future stabilization projects should include stream structure additions, such as pool and riffle sequences, for improved habitat.

4.1.1.7 Dam and Culvert Modification

Dam modifications or removals are gaining popularity for their cost-effective benefits to streams and rivers. They inherently return the waterway and its ecosystem to its natural flow. The Klein Creek Watershed has dam identified within the Gary Kehoe Flood Control Facility. As this dam is associated with regulating water levels in this facility, removal or modification is not feasible. However, the tributary upstream to this facility is mainly contained within pipes so removal would have a minor effect or water quality or aquatic life.

Culvert crossings can also restrict streamflow, inhibit fish passage, and contribute to low dissolved oxygen levels. Existing culverts should be evaluated to determine where these restrictions exist and proposed retrofits to expand culvert size and/ or place them at lower elevations to allow unrestricted flow and fish passage.

4.1.1.8 Streambank Stabilization

Unstable streambanks cause multiple problems for property owners, the health of the creek itself and other waterbodies downstream. Streambank erosion can cause an unstable streambank, leading to lost property or danger to structures and infrastructure. Eroding streambanks is a direct source of pollutants, dumping excess sediment and other pollutants, into the water. Streambank erosion often causes degradation of the stream channel and disconnection of the creek to its floodplain. When the creek becomes low in the landscape, it must contain flows of more volume and velocity within its banks, usually causing further streambank damage and deteriorating conditions.

With cooperation from the property owners, creek banks will be stabilized where needed using bio-engineered practices wherever possible to provide to a more gradual slope to Klein Creek. Vegetation in the floodplain will be converted to native species where practical. Projects to reduce streambank erosion stressors include increasing healthy native wetland, wetland buffer and riparian environments, modification of the channel to support stable banks and a healthy base flow and the reduction of stormwater runoff in the watershed. Replacing invasive species identified along Klein Creek with deep-rooted native vegetation will contribute to the bank stabilization effort. Educational materials will be made available to the property owners as part of a targeted educational campaign to encourage public understanding of the importance of a healthy stream and riparian corridor.

In addition, sections of the Klein's Creek channel were lined with concrete in previous attempts at stabilization of the banks. Removal of concrete lining in the channel will restore the natural stream functions and habitat while reducing the effects of the channelization on downstream properties. Stretches of Klein Creek have been highlighted for stabilization projects following input from stakeholders as well as the stream assessment conducted by DuPage County staff. This type of project can also be applied on a watershed wide scale as additional areas are located.

4.1.1.9 Daylighting

Sections of Klein Creek and its tributaries are enclosed in pipes. When a stream is restored to a bed and bank channel, open to the air and sunlight, it is referred to as "daylighting" the stream. In urban areas, it is most common to see the headwaters of streams enclosed in pipe, usually because narrow channels and a smaller tributary make it easier to do so. Although there is no erosion in the pipe to worry about, pipes often cause more problems for water quality and stream health than they solve in convenience.

Headwater streams are an important part of the stream system. [30] Aside from providing nutrient, sediment and flood control, they also support a stable base flow and produce essential food sources for downstream reaches. Enclosing a stream often removes floodplain storage, increases velocity and (indirectly) erosion downstream and eliminates habitat along with many biological processes. Daylighting projects will restore natural streams from piped reaches, allowing headwater streams to re-access the floodplain.

4.1.2 BMP Programs

4.1.2.1 Street Sweeping

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.

The need for sweeping can vary depending on the volume of traffic, presence of parkway trees and proximity to pedestrian traffic, homes and businesses. Based on data from the Center for Watershed Protection, pollutant removal rates from street sweeping can be improved by implementing vacuum style sweepers rather than mechanical sweepers.[31] Additional information should be obtained from

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[30] Ohio EPA epa.ohio.gov/dsw/wqs/headwaters/index

[31] Neely et al. 2008. Deriving Reliable Pollutant Removal Rates for Municipal Street Sweeping and Storm Drain Cleanout Programs in the Chesapeake Bay Basin. Center for Watershed Protection. http://owl.cwp.org/mdocs-posts/lawn-_deriving_reliable_polllution_removal_rates/)

municipalities in regards to street sweeper types, volume of traffic per roadway, as well as proximity to trees and public spaces.

Catch basin cleanout is another important roadway maintenance activity for improving water quality. Pollutant removal rates can be improved by increasing the frequency of cleanouts throughout the watershed as well as by identifying and prioritizing cleanouts in catch basins that have the highest sediment accumulation rates. In addition, agencies can consider sharing services, including street sweepers and catch basin cleanout trucks, to increase sweeping and catch basin cleanout schedules.

4.1.2.2 Stream Maintenance

Debris build up in streams can block flows ultimately contributing to overbank flooding and erosion. Stream maintenance programs can occur on several levels ranging DuPage County on-call contracts to remove large obstructions to the annual DuPage River Sweep where volunteers remove trash and debris from waterways countywide.

4.1.3 Watershed-Wide BMP Projects & Programs

Table 24 includes the projects and programs described above on a watershed-wide scale. The next section discusses site-specific projects, but, for the purpose of the Klein Creek Watershed Plan, investors will have discretion of where some of the BMP projects may be installed in the watershed.

Sub-watershed	BMP	Sub-watershed Treated	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	BOD Reduction (lbs/yr)	Sediment Reduction (t/yr)	Estimated Cost
1	Bioretention	2.5%	242.61	50.7	NA	NA	$4,226,191
	Bioswale	3.0%	231.06	49.4325	NA	11.48	$2,668,050
	Infiltration Trench	2.5%	192.55	31.6875	932.37	9.56	$4,226,191
	Oil & Grit Separators	1.0%	7.70	1.2675	NA	0.64	$128,000
	Permeable Pavers	2.5%	346.59	57.0375	NA	9.56	$3,173,363
	Dry Wells	2.5%	192.55	31.6875	932.37	9.56	$4,226,191
	Filterra	1.0%	52.37	17.745	NA	3.66	na
	Detention Basin Retrofit	5.0%	154.04	55.77	1678.26	16.58	$3,153,150
Total			**1419.48**	**295.33**	**3542.99**	**61.03**	**$21,801,136**
2	Bioretention	5.0%	323.06	67.36	NA	NA	$8,452,382
	Bioswale	2.0%	102.56	21.892	NA	4.61	$1,778,700
	Infiltration Trench	1.0%	51.28	8.42	257.29	2.30	$1,690,476
	Oil & Grit Separators	1.0%	5.13	0.842	NA	0.38	$64,000
	Permeable Pavers	2.5%	230.76	37.89	NA	5.76	$3,173,363
	Dry Wells	1.0%	51.28	8.42	257.29	2.30	$1,690,476
	Filterra	1.0%	34.87	11.788	NA	2.20	na
	Detention Basin Retrofit	2.5%	77.02	18.524	578.91	4.99	$1,576,575
Total			**875.96**	**175.14**	**1093.49**	**22.55**	**$16,849,398**

3	Bioretention	5.0%	239.90	48.24	NA	NA	$4,714,934
	Bioswale	2.0%	76.16	15.678	NA	3.28	$992,200
	Infiltration Trench	1.0%	38.08	6.03	188.36	1.64	$942,987
	Oil & Grit Separators	1.0%	3.81	0.603	NA	0.27	$64,000
	Permeable Pavers	2.5%	171.36	27.135	NA	4.10	$1,770,175
	Dry Wells	0.5%	19.04	3.015	94.18	0.82	$471,493
	Filterra	1.0%	25.89	8.442	NA	1.57	$0
	Detention Basin Retrofit	5.0%	154.04	26.532	847.60	7.10	$3,153,150
Total			**728.29**	**135.68**	**1130.14**	**18.76**	**$8,955,790**
4	Bioretention	2.5%	237.67	46.9	NA	NA	$5,253,336
	Bioswale	1.0%	75.45	15.2425	NA	3.20	$1,105,500
	Infiltration Trench	1.0%	75.45	11.725	378.69	3.20	$2,101,334
	Oil & Grit Separators	1.0%	7.55	1.1725	NA	0.53	$64,000
	Permeable Pavers	2.5%	339.53	52.7625	NA	7.99	$3,944,625
	Dry Wells	0.5%	37.73	5.8625	189.35	1.60	$1,050,667
	Filterra	1.0%	51.31	16.415	NA	3.05	na
	Detention Basin Retrofit	2.5%	77.02	27.885	852.06	6.92	$1,576,575
Total			**901.69**	**177.97**	**1420.10**	**26.48**	**$13,519,463**
5	Bioretention	2.5%	81.27	16.26	NA	NA	$1,873,951
	Bioswale	1.0%	25.80	5.2845	NA	1.13	$394,350
	Infiltration Trench	1.0%	25.80	4.065	127.62	1.13	$749,580
	Oil & Grit Separators	1.0%	2.58	0.4065	NA	0.19	$640,000
	Permeable Pavers	2.5%	116.10	18.2925	NA	2.81	$1,407,113
	Dry Wells	0.5%	12.90	2.0325	63.81	0.56	$374,790
	Filterra	1.0%	17.54	5.691	NA	1.08	na
	Detention Basin Retrofit	5.0%	154.04	17.886	574.31	4.88	$3,153,150
Total			**436.03**	**69.92**	**765.74**	**11.76**	**$5,439,784**
Grand Total			**4361.45**	**854.02**	**7952.46**	**140.59**	**$53,046,108**

Table 24 Watershed-wide BMP projects

4.1.4 Site-Specific BMP Projects

Although each of the BMP projects described above can help to improve levels of TN, TP, TSS and BOD in Klein Creek, some are more critical than others in certain portions of the watershed. Based on land use, sub-watersheds #1 and #4 are the most critical because of industrial and commercial land uses. Sub-watersheds #2, #3 and #5 are not as critical; however, implementing BMPs there will have a positive effect on the watershed as a whole. As physical stream modifications are the main impairment in the Klein Creek Watershed, in-stream restoration projects to stabilize banks and improve in-stream structure will provide the most benefit.

In addition to proximity to critical areas, DuPage staff assessed BMPs based on their benefit – or how much they may reduce a pollutant of concern – and feasibility. With any government planning effort, public land will not only be the most feasible for projects, but it is generally the largest amount of land in an area. Therefore, for the purpose of this study, projects are recommended in each of the sub-watersheds using this prioritization process of need, benefit and feasibility.

Using this prioritization process and to achieve the goal pollutant load reductions, BMP projects were recommended at both watershed-wide and site-specific levels. Watershed-wide projects are recommended throughout the sub-watersheds with the site at the discretion of the property owner, planner or other implementing entity. Site-specific projects are generally those of highest priority where they are in a polluted catchment area, are on public land and would generate a great benefit. The following sections outline each of these site-specific projects by sub-watershed. Appendices A and B list each project along with estimate load reductions.

4.1.4.1 Sub-Watershed #1

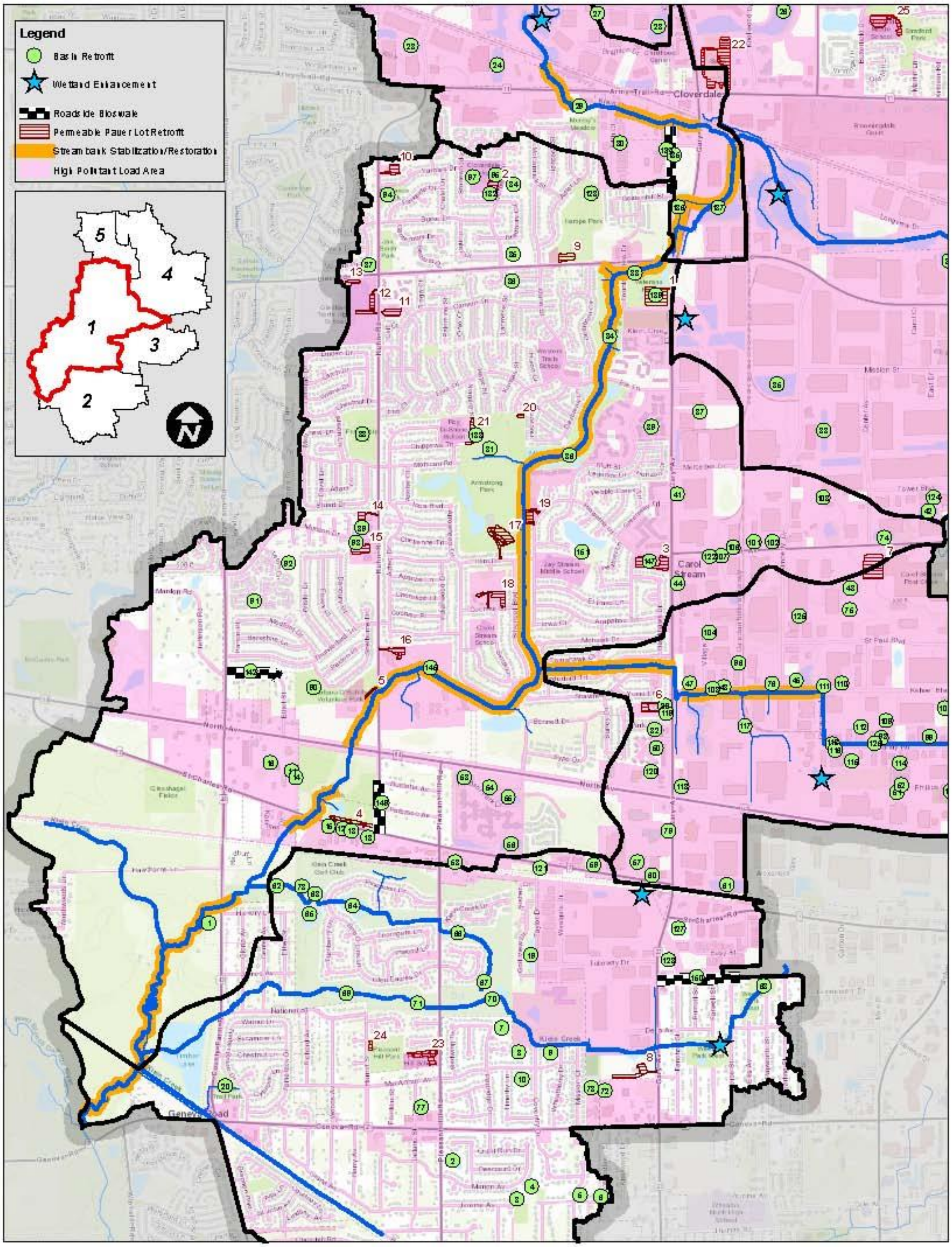

Figure 50 Site-specific BMP projects in Klein Creek sub-watershed #1

4.1.4.2 Sub-Watershed #2

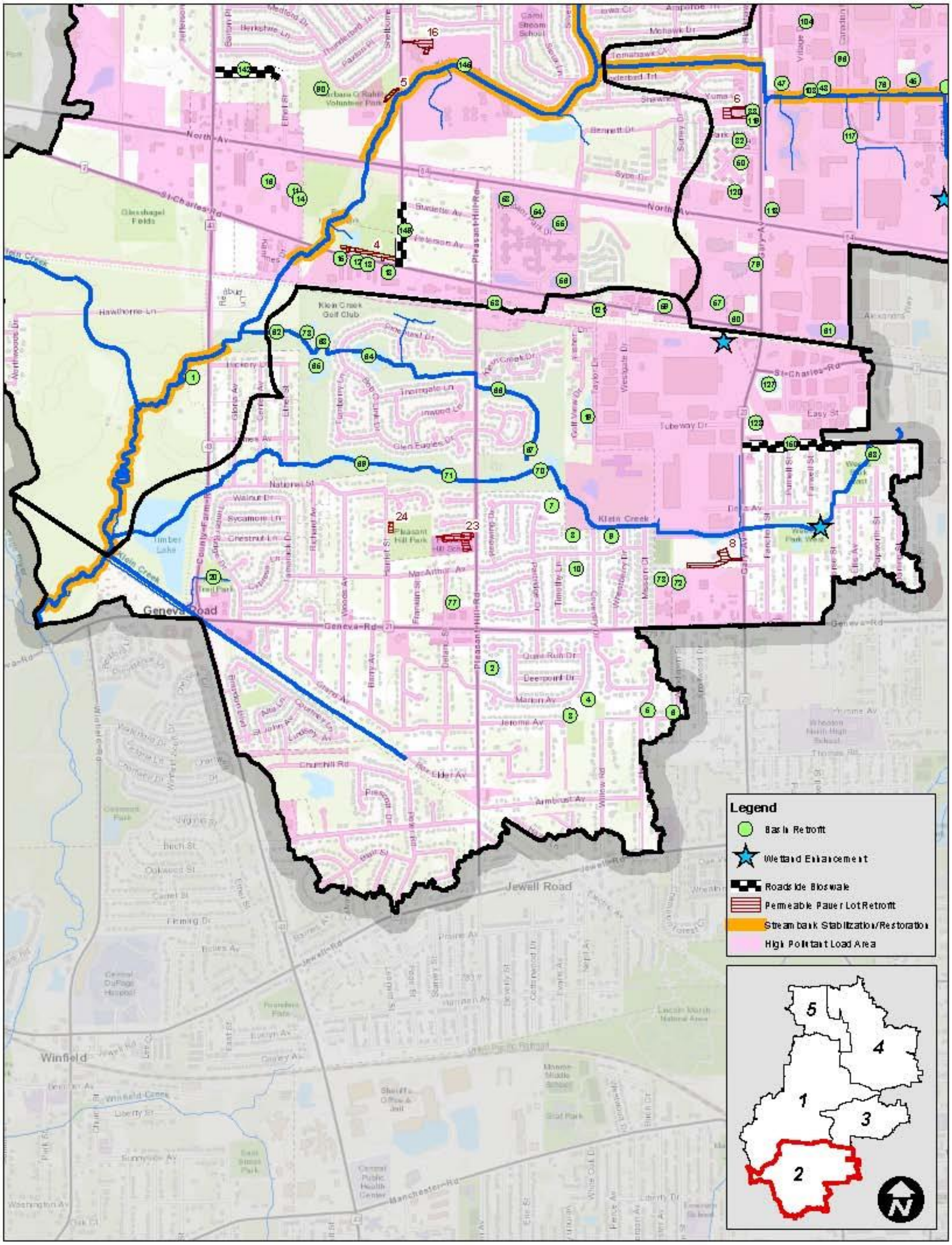

Figure 51 Site-specific BMP projects in Klein Creek sub-watershed #2

4.1.4.3 Sub-Watershed #3

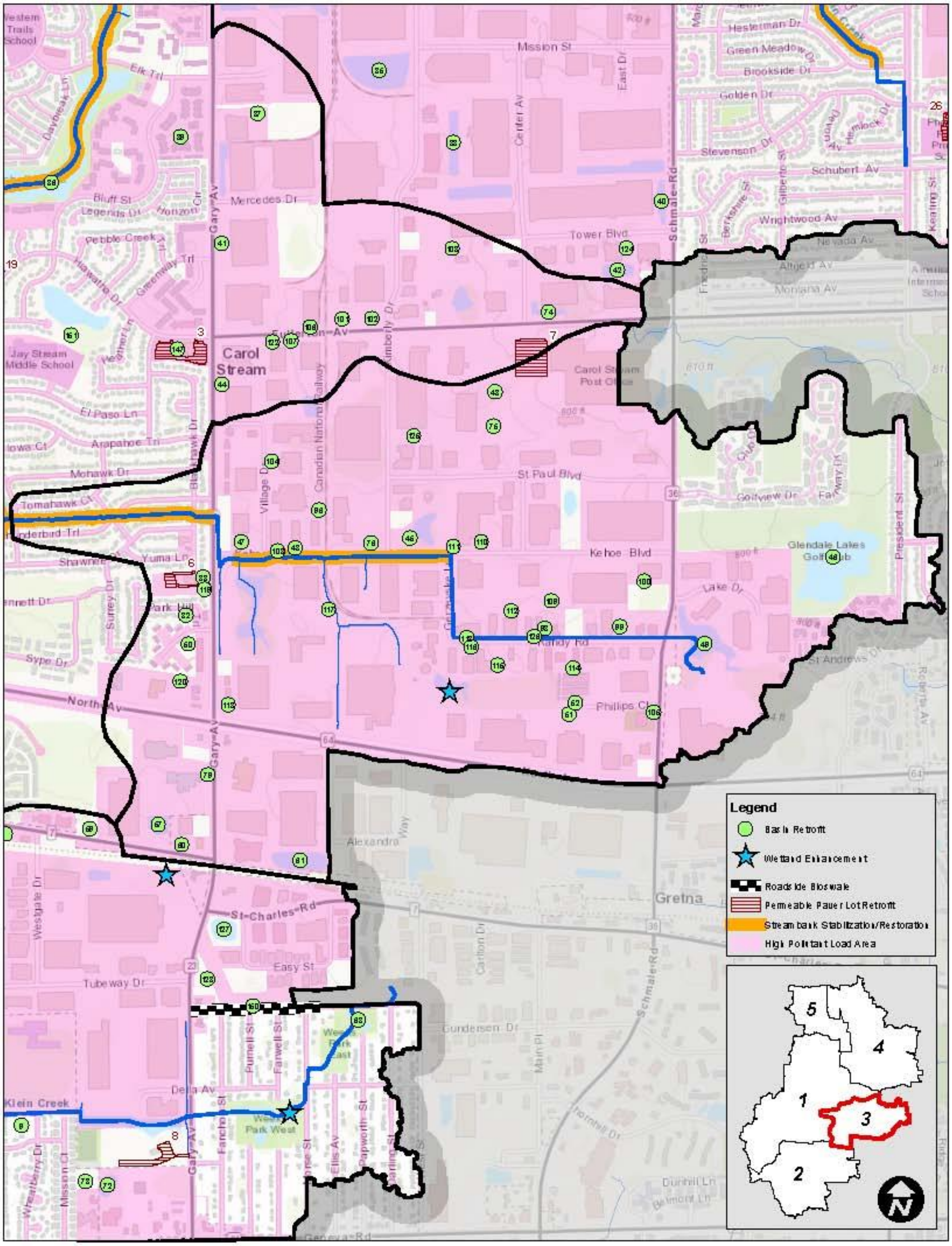

Figure 52 Site-specific projects in Klein Creek sub-watershed #3

4.1.4.4 Sub-Watershed #4

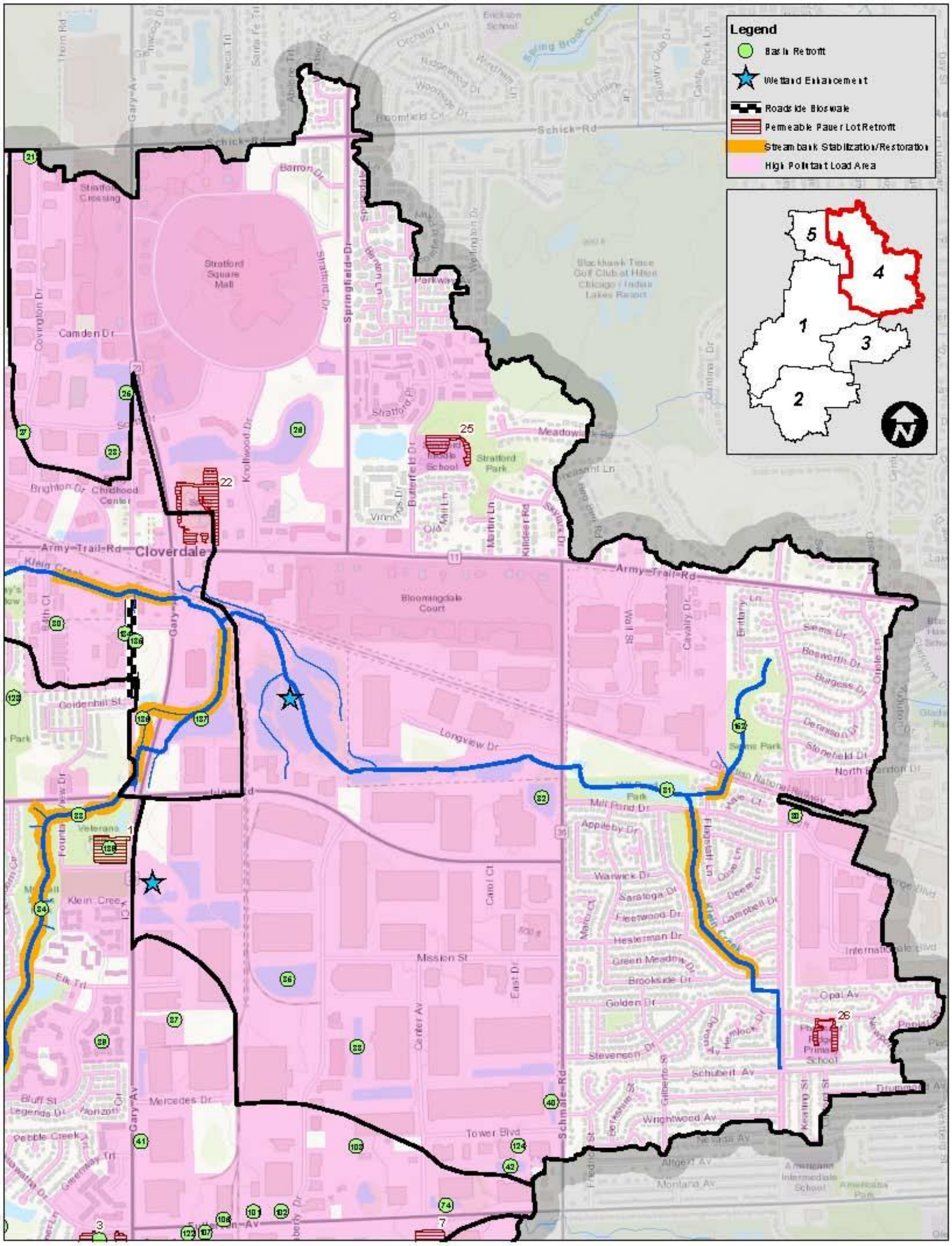

Figure 53 Site-specific projects in Klein Creek sub-watershed #4

4.1.4.5 Sub-Watershed #5

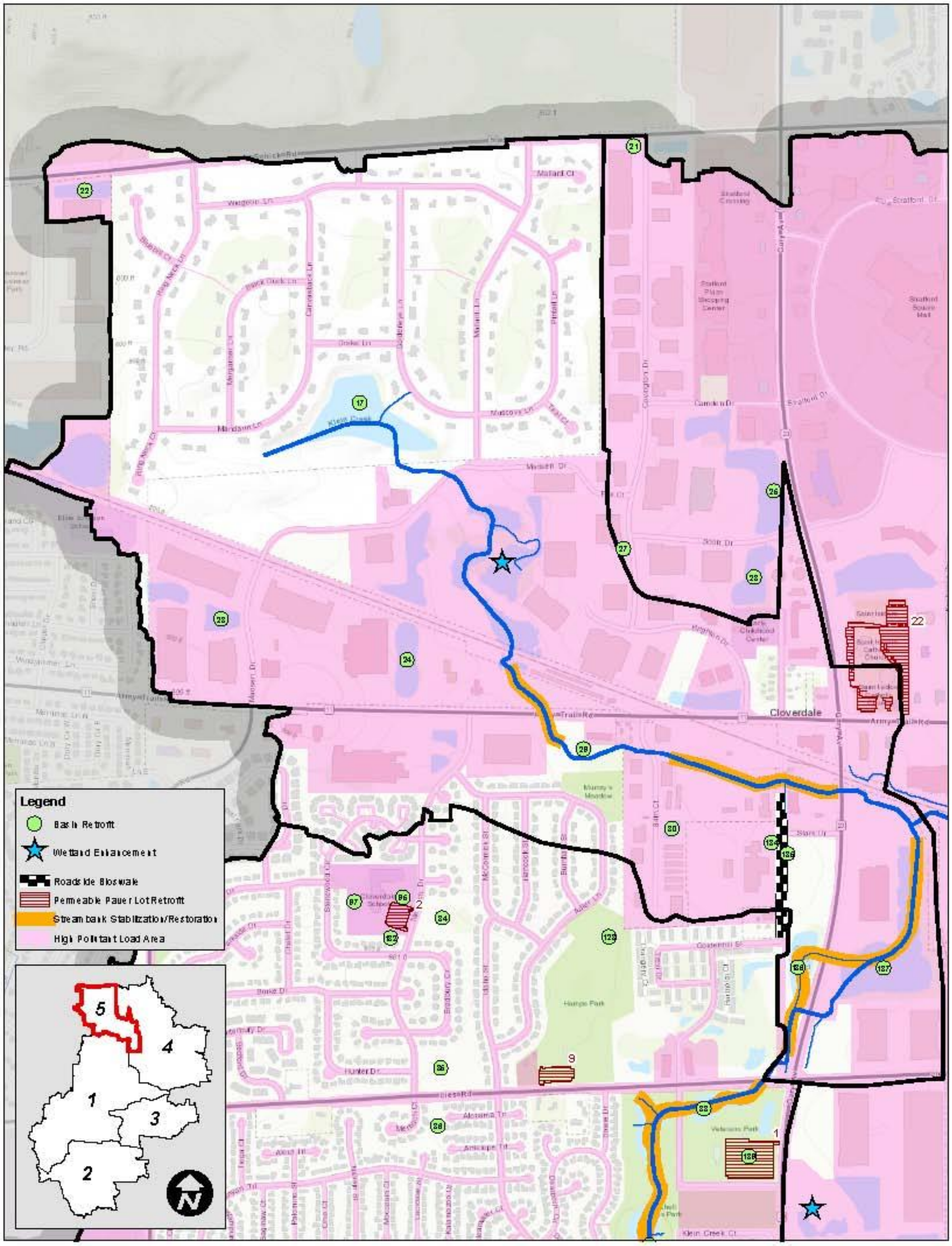

Figure 54 Site-specific projects in Klein Creek sub-watershed #5

4.2 Planning, Policy & Programming

4.2.1 Open Space Protection

Protecting open spaces and sensitive natural areas within and adjacent to cities can mitigate the water quality and flooding impacts of urban stormwater while providing recreational opportunities for city residents. Natural areas that are particularly important in addressing water quality and flooding include riparian areas, wetlands and steep hillsides.

4.2.2 Align Ordinances with Best Practices

Oftentimes, municipal, homeowner association and other ordinances or codes do not account for green infrastructure projects. For example, many "weedy plant" ordinances restrict the height of plants a homeowner may have on the property, which may inhibit the use of native vegetation or rain gardens.

Working with Geosyntec, DuPage County has already developed a guidance document and checklist for municipalities to self-audit their ordinances.[32] In addition, CMAP offers technical assistance programs that may be of use for communities who wish to audit their ordinances, as it is often a time-consuming endeavor.

4.2.3 Watershed Planning

Continued watershed planning efforts, on both a local and regional level, to identify localized projects, programs and practices to improve the quality of Klein Creek are recommended. To date, DuPage County has studied nearly 60% of the County for flood control improvements, and a long-term goal is to integrate water quality components into each of the plans. Clear, concise and goal-oriented planning ensures long-term viability of projects despite changing political climate, staff turnover and other issues that deter initiatives.

4.3 Public Information, Education & Outreach

To carry out the recommendations within the Plan successfully, DuPage County will need to build on the stakeholder engagement garnered during the Plan development, which staff may accomplish, at least, partially using existing networks and resources. Throughout the years, DuPage County has developed a robust and comprehensive water quality outreach program, from which the Klein Creek Watershed can and does benefit. The County hosts or sponsors 13 annual water quality programs ranging from an Adopt-a-Stream program to technical education for government staff. The County also developed 27 pieces of outreach, primarily targeted at residents, including brochures, public service announcements and a monthly e-newsletter. If not already in use, stakeholders should be using these existing outreach pieces throughout the watershed.

In addition, DuPage County has an array of local partner organizations focused on preserving and enhancing local watersheds. Several of these partners have existing ties within the Klein Creek Watershed, specifically The Conservation Foundation and SCARCE, a local youth education non-profit. The Conservation Foundation has a "Conservation in Our Community" program that targets five communities annually to encourage residents and businesses to use sustainable practices, including native landscaping, water conservation and reducing source of non-point source pollution. The Village of Carol Stream in Klein Creek is currently working through this program. Further DuPage County is a

[32] www.dupageco.org/swm

funding sponsor of The Conservation Foundation's Conservation@Home and Work, rain barrel and the annual DuPage River Sweep – all of which aim to improve the integrity of waterways countywide.

SCARCE is a DuPage County partner in educating teachers, students and local organizations about watersheds. DuPage County also developed a Water Quality Flag in partnership with SCARCE that awards institutions for engaging in a series of educational trainings and hands-on activities, as well as installing green infrastructure on site. Several schools within the Klein Creek Watershed have earned flags with more anticipated next school year.

Throughout outreach in local communities, residents become more aware of water quality concerns within their watershed. While DuPage County and many stakeholder organizations are active in reaching out to the residents and businesses within the Klein Creek Watershed, additional targeted efforts could be made in the following areas:

- Inform residents, particularly those with property located within in the Klein Creek floodplain, on the techniques to assess and maintain septic systems;
- Educate property owners and landscaping businesses on topics pertaining to lawn care, including fertilizer practices, composing and yard waste disposal;
- Facilitate water conservation and reuse efforts through the education and amendment of municipal codes that would otherwise make such efforts prohibited;
- Establish or expand waste collection events, particularly for household chemical waste and automobile fluids; and
- Develop campaigns to eliminate the discharge of chemicals into the storm sewer system, including oils, paints and waters recently treated with aquatic pesticides.

Table 25 includes recommendation on how to reach target audiences within the Klein Creek Watershed.

Print	Electronic	Workshops
Newsletters	Websites	Presentations
News Releases	Emails	Events
Brochures	Twitter	Field Trips
Fact Sheets	Facebook	Meetings
Direct Mail	PSAs	Conferences
Surveys	Surveys	Open House
		Surveys

Table 25 Tools and mediums for reach target audiences within the Klein Creek Watershed

4.4 Summary of BMP Projects & Programs

Table 26 provides a comprehensive overview of the BMP projects described previously in this section. Again, these are all measures any stakeholder within the Klein Creek Watershed may utilize to improve the quality of the creek, depending on funding, expertise and other factors.

BMP Type	Scenario	Est. Qty.	Units	N Red. (lb/yr)	P Red. (lb/yr)	BOD Red. (lb/yr)	Sed. Red. (T/yr)	Estimated Cost ($)
Bioretention / Rain Gardens	WW	23.46	ac	1124	229	na	na	$24,520,795
Detention Basin Retrofits	WW	32.34	ac	616	146	4531	40	$12,612,600
Detention Basin Retrofits	SS	248	ac	4453	1165	30,463	286	$90,526,500

Education & Outreach	WW	4	#	na	na	na	na	$20,000
Bioswale	WW	12.62	ac	511	107	na	24	$6,938,800
Bioswale	SS	0.54	ac	119	25	na	5	$344,700
Filter Strip	SS	2.47	ac	15	2	69	0.75	$95,200
Infiltration Trench	WW	9.29	ac	383	62	1,884	18	$9,710,569
Dry Wells	WW	7.47	ac	313	51	1,537	15	$7,813,619
Tree Well/ Filterra	WW	6.86	ac	182	60	na	11	na
Oil & Grit Separator	WW	21.25	#	27	4	na	2	$960,000
Permeable & Porous Pavements	SS	8	ac	70	11	na	2	$6,304,800
Permeable & Porous Pavements	WW	17.16	ac	1,204	193	na	30	$13,468,638
Streambank Stabilization	WW	46,925	ft	259	98	518	161	$11,637,500
Streambank Stabilization	SS	665	na	3.7	1.4	7.4	2.3	$166,250
Wetland Restoration	SS	20	ac	na	na	na	na	$7,796,100
Totals				**9,280**	**2,154**	**39,009**	**597**	**$192,916,071**

Table 26 Summary of projects with pollutant load reductions and cost.[33]

4.5 Summary of Pollutant Loads & Potential BMP Pollutant Load Reductions

Table 27 provides potential pollutant load reductions for each of the BMP projects described above. Although all of these projects are recommended for attaining the measure able goals outlined in section 5.3, the totality of these projects exceed the goals.

BMP	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	BOD Reduction (lbs/yr)	Sediment Reduction (ton/yr)
Site-Specific				
Streambank Stabilization	3.7	1.4	7.4	2.3
Detention Basin Retrofits	4453	1165	30463	286
Bioswales	119	25	na	5
Filter Strips	15	2	69	0.75
Permeable Pavers	70	11	na	2
Watershed-Wide				
Streambank Stabilization	259	98	518	161
Bioretention	1124	229	na	na
Bioswale	511	107	na	24
Infiltration Trench	383	62	1,884.00	18
Dry Wells	313	51	1,537.00	15

[33] ac = acre
SS = site specific
WW = watershed-wide
N/A = not applicable
ft = feet

Tree Wells/ Filterra	182	60	na	11
Oil & Grit	27	4	na	2
Permeable Pavers	1204	193	na	30
Detention Basin Retrofit	616	146	4531	40
Background Rates	53,618	8,620.00	189,455	1,373.00
Total Reduction	**9,280**	**2,154**	**39,009**	**597**
Percent Reduction	**17%**	**25%**	**21%**	**43%**

Table 27 Watershed-wide and site-specific projects and pollutant load reductions (5-year estimate)

4.6 Funding Opportunities

The projects, programs and other measures recommended in the Klein Creek Watershed Plan are largely dependent on the availability of funding for design, construction and implementation of the recommendations. Although nearly any entity within the watershed could be eligible for funding, much of the financial burden will fall on public entities, such as DuPage County, local municipalities and the FPDDC, as they have the technical expertise to carry out the preferred alternatives, or suite of recommended projects and programs to improve Klein Creek. For others, regional groups, such as CMAP, offer technical assistance grants to assist with plan implementation. Table 28 includes a complete list of funding and technical resources.

Program	Funding Agency	Funding Amount	Eligibility	Activities Funded	Website
Clean Water State Revolving Fund (CWSRF)	U.S. EPA	Loan	Corporations, partnerships, governmental entities, tribal governments, or state infrastructure financing authority	Flood & storm damage reduction, environmental restoration, feasibility analysis, environmental review, permitting, development and design work, construction, etc.	https://www.epa.gov/cwsrf
Section 319(h) Grant Program	IEPA	Up to 60% of project cost	State and local government, watershed organizations, citizen and environmental groups, land conservancies or trusts, public and private profit and non-profit organizations, universities and colleges	Nonpoint source (NPS) pollution control projects; ie., Development of a Watershed Based Plan, Total Maximum Daily Load (TMDL) or Load Reduction Strategy (LRS), Best Management Practice (BMP) implementation, etc.	http://www.epa.illinois.gov/topics/water-quality/watershed-management/nonpoint-sources/grants/index
Local Technical Assistance Program	CMAP	N/A	Chicago-area governments, non-profits, and intergovernmental organizations	Planning activities that coincide with CMAP's "GO TO 2040" initiative	http://www.cmap.illinois.gov/programs-and-resources/lta

Water Quality Improvement Program Grant	DuPage County	Up to 25% reimbursement to project aspects with a water quality benefit	Open to all DuPage County entities	Projects providing a regional water quality benefit, ie., stream bank stabilization, habitat improvements, riparian buffer rehabilitation, etc.	https://www.dupageco.org/EDP/Stormwater_Management/Water_Quality/1312/
Wetland Program Development Grants	U.S. EPA	N/A	States, tribes, local governments, interstate associations, and intertribal consortia	Projects that promote the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys and studies relating to water pollution	https://www.epa.gov/wetlands/wetland-program-development-grants#past-grants
5 Star Wetland and Urban Waters Restoration Grants	U.S. EPA	$10,000 - $40,000	Non-profit 501(c) organizations, state government agencies, local and municpal governments, Indian tribes and 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	https://www.epa.gov/wetlands/5-star-wetland-and-urban-waters-restoration-grants#Applying
Streambank Cleanup and Lakeshore Enhancement (SCALE)	IEPA	Up to $3,500	Groups with established and recurring stream or lakeshore cleanups	Implementation of streambank or lakeshore cleanup events	http://www.epa.illinois.gov/topics/water-quality/surface-water/scale/index
Pre-Disaster Mitigation Grant Program (PDM)	FEMA	N/A	States, U.S. territories, tribes, and local governments	Implementation of a sustained pre-disaster natural hazard mitigation program	https://www.fema.gov/pre-disaster-mitigation-grant-program
Emergency Watershed	USDA	Up to 75% of project cost	Public and private landowners sponsored by a legal subdivision of the	Debris removal, reshaping and protection of eroded banks, correcting drainage facilities, preventing	https://www.nrcs.usda.gov/wps/portal/nrcs/det

Protection Program (EWP)			State, e.g.; city, county, general improvement district, conservatoin district, or tribal organization	erosion, repairing conservation practices	ail/national/programs/landscape/ewpp/?cid=nrcs143_008258
North American Wetlands Conservation Act (Small Grants)	U.S. FWS	Up to $100,000 with at least matching funds from partner	Tribal, State, or local unit of government, non-governmental organization, or an 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
North American Wetlands Conservation Act (Standard Grants)	U.S. FWS	$100,001-$1,000,000+ with partners matching at a rate of at least two-to-one	Tribal, State, or local unit of government, non-governmental organization, or an 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
National Conservation Innovation Grants	USDA - NRCS	Up to $2,000,000	Tribal, State, or local unit of government, non-governmental organization, or an individual	Conservation measures and water management technologies on a watershed-based, regional, multi-state, or nationwide scale	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/
State Conservation Innovation Grants	USDA - NRCS	N/A	Tribal, State, or local unit of government, non-governmental organization, or an individual	Conservation measures and water management technologies in Illinois	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/
Illinois Green Infrastructure Grant for Stormwater Manage	IEPA	N/A	Applicable entrants within a MS4 community	Implementation of green infrastructure BMPs to improve stormwater water quality and remove pollutants	http://www.epa.illinois.gov/topics/grants-loans/water-financial-assistance/igig/index

ment (IGIG)					
Environmental Quality and Incentives Program (EQIP)	USDA - NRCS	Up to $450,000	Landowners with eligible land-types	Implementation and planning of conservation practices that improve natural resources on agricultural land and non-industrial private forestland	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
Healthy Forests Reserve Program	USDA - NRCS	N/A	Landowner (private or Indian tribes) or landowner approval	Restore, enhance, and protect forestland resources through multi-year easements	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/forests/
Open Space Lands Acquisition and Development Grant / Land and Water Conservation Fund Grant	Illinois DNR	Up to $750,000 for acquisition projects; up to $400,000 for development & renovation	Illinois government agencies	Land acquisition for parks, water frontage, nature study and natural resource preservation	https://www.dnr.illinois.gov/AEG/Pages/OpenSpaceLandsAquisitionDevelopment-Grant.aspx
Sustainable Agricultural Grant Program	Illinois Department of Agriculture	Up to $10,000 for individuals; up to $20,000 for all others	Government, organization, institution, non-profit, or individuals with an understanding of sustainable ag practices	Research, education, and on-farm projects that address a part of the Sustainable Agriculture Act	https://www.agr.state.il.us/C2000/common/SAguidelines.pdf

Table 28 Water quality funding opportunities

5. Implementation of Watershed Plan

The purpose of a watershed plan is to provide recommendations in the form of policy, programs and projects that may improve the health of the Klein Creek Watershed. In order to elicit a noticeable improvement in the stream, DuPage County will need cooperation of its local partners in implementing the initiatives identified in the plan. Stakeholders include local public agencies, residents, businesses, non-profits, schools and other organizations.

5.1 Implementation Schedule

Table 29 provides general guidance on implementing initiatives found in the Klein Creek Watershed Plan, for both DuPage County and its partners. The implementation schedule follows DuPage County Stormwater Management's process for implementing flood control projects found in watershed plans. Appendix B provides a description of the proposed practice as well as project sponsors responsible for initiating the project.

Task	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Engage stakeholders about the Klein Creek Watershed Plan, notably projects and funding opportunities.	X									
Identify preferred alternatives among the recommended implementations, considering cost and benefit.		X								
Identify appropriate funding opportunities for preferred alternatives.			X	X	X	X	X	X		
Submit grant applications for preferred alternatives.			X	X	X	X	X	X		
Implement preferred alternatives.					X	X	X	X	X	X
Monitor the progress and success of the preferred alternatives, particularly with respect to pollutant load reductions.				X	X	X	X	X	X	X
Evaluate successes and failures, and communicate those to stakeholders.								X	X	X
Update water quality-based watershed plan for new conditions.										X

Table 29 Klein Creek Watershed Plan 10-year implementation schedule.

5.2 Interim Measurable Milestones

Milestones are specific, measureable, achievable, relevant and time-sensitive subtasks needed to achieve an overall goal; in this case, implement a BMP. As outlined in Table 30, these milestones are categorized as short-term (1 to 5 years) or long-term (5 to 10 years). Stakeholders may adjust these milestones to document progress – or lack thereof – to identify progress or areas in need of improvement.

Acres	Indicator	Two-Year Milestone	Five-Year Milestone	Ten-Year Milestone
Improve and protect the ecological integrity of the surface water resources.	Acres of impervious surface reduction	-	5	10
	No. of green infrastructure practices	10	15	20

	Acres of restored wetland	0	2	5
	Acres of new wetland	-	2	5
	No. of detention basin retrofits	5	10	20
	No. of hydrodynamic separators	3	6	10
Build on partnerships with local stakeholders to foster sustainable programs, policy and re-development.	No. of ordinance updates	-	1	2
	No. of plans created and/or updated	5	7	10
	No. of partners carrying out BMP projects	2	4	8
	No. of meetings with stakeholders	6	15	30
	No. of organizations in Steering Committee	4	6	8
Reduce bank erosion and increase daylighting, where possible, to improve and protect in-stream water quality.	Linear feet of daylighting	-	-	100
	Acres of new riparian buffer	2	5	10
	Acres of restored riparian buffer	5	10	15
	Acres of in-stream restoration	2	5	10
	Linear feet streambank stabilization	2,000	6,000	12,000
Raise public awareness on the impacts of land management practices on water quality to prompt behavioral change.	No. of events and presentations	10	20	50
	No. of conservation@home/work properties	5	10	20
	No. of outreach materials distributed	500	1,000	2,000
	No. of Adopt-a-Stream groups	2	4	8
	No. of River Sweep participants	100	200	500
Preserve and connect open space, particularly near waterbodies.	Acres of open space created (i.e. buyouts)	-	5	10
	Acres of floodplain restored and/or protected	-	2	5
	Acres added to conservation easement	-	1	3
	No. of communities who adopt open space plan	-	1	2

Table 30 Milestones for determining success in carrying out Klein Creek Watershed Plan.

5.3 Criteria for Determining Progress

The primary criterion by which progress will be measured within the Klein Creek Watershed Plan is through measuring pollutant load reductions, specifically TN, TP, TSS and BOD. Table 31 summarizes the goal reductions for each of the pollutants of concern over 5 years and 10 years. Ultimately, this pollutant load reduction will result in attainment of aquatic life and other designated uses.

Criteria	Current Load, Score or Rating	Five-Year Target	Ten-Year Target
Nitrogen (Total) Load Reduction	53618 lb/yr	5% Load Reduction = 536 lb/yr (2,681 lb total)	15% Load Reduction = 804 lb/yr (8043 lb total)
Phosphorus (Total) Load Reduction	8620 lb/yr	10% Load Reduction = 172 lb/yr (862 lb total)	25% Load Reduction = 215 lb/yr (2,155 lb total)
Sediment Load Reduction (TSS)	1373 ton/yr	10% Load Reduction = 27 tons/yr (137 ton total)	25% Load Reduction = 34 tons/yr (343 ton total)
BOD Load Reduction	189455 lb/yr	5% Load Reduction = 9,712 lb/yr (1,942 lb total)	15% Load Reduction = 2,913 lb/yr (29,134 lb total)
fIBI Scores	WB16 - 15	WB16 - > 20	WB - > 25
	WB19 - 14	WB19 - > 20	WB19 - >25
mIBI Scores	WB16 - 36	WB16 - > 40	WB16 - > 45
	WB19 - 33	WB19 - >35	WB19 - >40
QHEI Scores	WB16 - 86	WB16 - >86	WB16 - >86
	WB19 - 51	WB19 - > 55	WB19 - > 60

Table 31 Klein Creek Watershed Plan criteria for determining progress.[34]

5.4 Monitoring to Evaluate Effectiveness

In alignment with the previously mentioned criterion, water quality monitoring is the primary tool used to evaluate the effectiveness of Klein Creek Watershed Plan implementation efforts. To ensure accuracy, this requires all BMPS are also tracked throughout the Watershed. Long-term monitoring of these BMPs will be necessary to determine whether Klein Creek is both attaining designated uses and meeting water quality standards. In addition, monitoring provides vital information to update remedial actions as necessary. Several agencies offer various levels of water quality monitoring in the Klein Creek Watershed, including:

[34] Percent reduction matches Illinois Nutrient Reduction Strategy year 2025 goal.

- ***DuPage County:*** The County is responsible for implementing a monitoring and assessment program as part of the NPDES permit. In the upcoming permit cycle. DuPage County supports and contributes to the DuPage River Salt Creek Workgroup ambient monitoring of waterways.
- ***DRSCW:*** Chemical (water column), fish, mussel, macroinvertebrate and habitat monitoring efforts along Klein Creek to track how restoration efforts have improved biological index and habitat scores. Chemical monitoring includes total suspended solids, total nitrogen, total phosphorus, fecal coliform, chlorides, and oil and grease.
- ***IEPA:*** The Surface Water Section of the IEPA monitors the quality of surface waters in Illinois, including Klein Creek. Monitoring efforts include water and sediment chemistry, physical characteristics and stream structure, clarity, macroinvertebrate and fish populations and habitat quality. Surface water monitoring is funded through the USEPA as part of the Clean Water Act to work toward achieving the goal of fishable and swimmable waters throughout the nation.
- ***FPDDC:*** The Forest Preserve District of DuPage County conducts stream monitoring as part of the Office of Natural Resources Aquatics Monitoring & Research Program. This bio-assessment monitoring includes fish, macroinvertebrate and mussel surveys as well as water chemistry analysis using Sondes and surveys of physical stream characteristics such as cross section, pebble counts and longitudinal profiles.
- ***Volunteer Programs:*** The DuPage County Adopt-A-Stream program allows for local businesses, schools, churches, student groups, organizations, watershed associations and volunteer groups to do their part in restoring and maintaining local streams. DuPage County asks groups who wish to Adopt-A-Stream to commit to that section of stream for two years and engage in two stream cleanups each year. Groups may choose to go beyond the minimum requirements by regularly monitoring water quality, recording illicit discharge or engaging in streambank enhancement projects.

Although monitoring during implementation of the Klein Creek Watershed Plan is vital to its success, monitoring of the BMPs will ensure long-term success to the vitality of Klein Creek. In particular, habitat restoration that provides a desirable environment for macroinvertebrates and other stream biota is critical to improving aquatic life and meeting water quality standards. Monitoring both during and after construction will be required for all in-stream and bank stabilization projects. This is critical in assessing whether projects are functioning, as well as determining if future habitat restoration plans need to be adjusted. All such projects will need to be monitored for evidence of erosion and scour and native vegetation success and stabilization for up to 3 to 5 years after implementation.

List of Acronyms

BMP(s): Best Management Practice(s)

BOD: Biological Oxygen Demand

CMAP: Chicago Metropolitan Association of Planning, http://www.cmap.illinois.gov/

DCSM: DuPage County Stormwater Management, http://www.dupageco.org/swm/

DCHD: DuPage County Health Department: http://www.dupagehealth.org/

DCSM Plan: DuPage County Stormwater Management Plan, http://www.dupageco.org/EDP/Stormwater_Management/1163/

DCSMPC: DuPage County Stormwater Management Planning Committee

DRSCW: DuPage River/Salt Creek Workgroup, http://www.drscw.org/

DuDOT: DuPage County Division of Transportation

FPDDC: Forest Preserve District of DuPage County, http://www.dupageforest.org/

GIS: Geographic Information System

GIV: Chicago Wilderness' Green Infrastructure Vision, http://www.cmap.illinois.gov/livability/sustainability/open-space/green-infrastructure-vision

HOA: Homeowners Association

IDNR: Illinois Department of Natural Resources

IDOT: Illinois Department of Transportation, http://www.idot.illinois.gov/

IEPA: Illinois Environmental Protection Agency, http://www.epa.illinois.gov/index

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

MRWQ: Mean Rated Wildlife Quality

MS4(s): Municipal Separate Storm Sewer System(s)

NWI: National Wetland Inventory

NPDES: National Pollutant Discharge Elimination System

NRCS: Natural Resources Conservation Service, http://www.nrcs.usda.gov

Ordinance: DuPage County Countywide Stormwater and Flood Plain Ordinance,

http://www.dupageco.org/EDP/Stormwater_Management/Regulatory_Services/1420/

PAH(s): Polycyclic aromatic hydrocarbon(s)

POTW: Publically Owned Treatment Works

SI: State of Illinois

TCF: The Conservation Foundation, http://theconservationfoundation.org/

TKN: Total Kjeldahl Nitrogen

TMDL: Total Maximum Daily Load

TN: Total Nitrogen

TP: Total Phosphorous

TSS: Total Suspended Solids

USACOE: United States Army Corps of Engineers, http://www.usace.army.mil/

USEPA: United States Environmental Protection Agency, http://www.epa.gov/

USGS: United States Geological Survey, http://www.usgs.gov/

Appendix A

Klein Creek Watershed									
Total Watershed Area (ac)		ac							
Existing N Loading		lb/yr							
Existing P Loading		lb/yr							
Existing BOD Loading		lb/yr							
Existing TSS Loading		t/yr							
				Pollutant Load Removals					
Pond ID	**Current Condition**	**Proposed Condition**	**Size of Pond**	**N (lb/yr)**	**P (lb/yr)**	**BOD (lb/yr)**	**TSS (t/yr)**	**Priority**	**Total Estimated Cost**
1	wet bottom	wetland detention	0.25	3	1	30	0.26	1	$97,500
2	wet bottom	wetland detention	2.36					3	$920,400
3	dry bottom	native basin	0.23					3	$73,600
4	dry bottom	native basin	0.67					2	$214,400
5	wet bottom	wetland detention	0.56					1	$218,400
6	dry bottom	native basin	0.17					3	$54,400
7	dry bottom	native basin	2.9					3	$928,000
8	dry bottom	native basin	0.96					3	$307,200
9	dry bottom	native basin	0.93					3	$297,600
10	dry bottom	native basin	1.23					3	$393,600
11	wet bottom	wetland detention	0.87	5	2	59	0.53	1	$339,300
12	wet bottom	wetland detention	0.14	1	0	15	0.13	2	$54,600
13	wet bottom	wetland detention	0.52	4	1	45	0.40	2	$202,800
14	wet bottom	wetland detention	0.15	1	0	15	0.13	2	$58,500
15	wet bottom	wetland detention	0.1	1	0	15	0.13	2	$39,000
16	wet bottom	wetland detention	0.47	7	2	74	0.66	1	$183,300
17	wet bottom	wetland detention	12.21	367	130	4082	36.34	2	$4,761,900
18	dry bottom	native basin	0.1	7	1	30	0.30	3	$32,000
19	wet bottom	wetland detention	1.63					1	$635,700
20	dry bottom	native basin	3.05	220	44	891	9.11	2	$976,000
21	wet bottom	wetland detention	0.2	3	1	30	0.26	2	$78,000
22	wet bottom	wetland detention	1.9	15	5	163	1.45	2	$741,000
23	wet bottom	wetland detention	1.6	20	7	223	1.98	1	$624,000
24	wet bottom	wetland detention	3.36	45	16	505	4.49	2	$1,310,400
25	wet bottom	wetland detention	5.94	141	50	1574	14.01	1	$2,316,600
26	wet bottom	wetland detention	9.12	321	114	3578	31.85	2	$3,556,800
27	wet bottom	wetland detention	0.18	3	1	30	0.26	2	$70,200
28	wet bottom	wetland detention	3.08	23	8	252	2.25	2	$1,201,200
29	wet bottom	wetland detention	0.5						$195,000
30	wet bottom	wetland detention	0.63	5	2	59	0.53	1	$245,700
31	wet bottom	wetland detention	7.18					2	$2,800,200
32	wet bottom	wetland detention	4.08	25	9	282	2.51	1	$1,591,200
33	wet bottom	wetland detention	3.33					1	$1,298,700
34	wet bottom	wetland detention	10.91					2	$4,254,900
35	wet bottom	wetland detention	7.65	52	18	579	5.15	1	$2,983,500
36	wet bottom	wetland detention	20.92					2	$8,158,800

37	wet bottom	wetland detention	0.7	5	2	59	0.53	2	$273,000
38	wet bottom	wetland detention	2.3	24	8	267	2.38	2	$897,000
39	wet bottom	wetland detention	0.41	15	5	163	1.45	2	$159,900
40	wet bottom	wetland detention	1.59	31	11	341	3.04	2	$620,100
41	dry bottom	native basin	1.26	44	9	178	1.82	2	$403,200
42	wet bottom	wetland detention	1.51	9	3	104	0.93	2	$588,900
44	wet bottom	wetland detention	0.38	8	3	89	0.79	2	$148,200
45	wet bottom	wetland detention	3.8	17	6	193	1.72	1	$1,482,000
46	wet bottom	wetland detention	17.15					2	$6,688,500
47	wet bottom	wetland detention	1.93	9	3	104	0.93	2	$752,700
48	dry bottom	native basin	0.1	7	1	30	0.30	2	$32,000
49	wet bottom	wetland detention	9.67	260	92	2895	25.77	3	$3,771,300
50	wet bottom	wetland detention	0.75	9	3	104	0.93	2	$292,500
51	wet bottom	wetland detention	0.7	9	3	104	0.93	2	$273,000
52	dry bottom	native basin	0.31	11	2	45	0.46	2	$99,200
56	wet bottom	wetland detention	1.9	24	8	267	2.38	2	$741,000
57	wet bottom	wetland detention	1.07	12	4	134	1.19	2	$417,300
58	wet bottom	wetland detention	0.1	1	0	15	0.13	1	$39,000
59	wet bottom	wetland detention	0.41	8	3	89	0.79	1	$159,900
60	wet bottom	wetland detention	0.47	5	2	59	0.53	2	$183,300
61	wet bottom	wetland detention	3.05	40	14	445	3.96	1	$1,189,500
62	wet bottom	wetland detention	0.4					1	$156,000
63	wet bottom	wetland detention	1.23					1	$479,700
64	wet bottom	wetland detention	3.11					1	$1,212,900
65	wet bottom	wetland detention	2.63					1	$1,025,700
66	wet bottom	wetland detention	1.71					1	$666,900
67	wet bottom	wetland detention	1.47					1	$573,300
68	wet bottom	wetland detention	1.28	56	20	623	5.55	1	$499,200
69	wet bottom	wetland detention	4.96					1	$1,934,400
70	wet bottom	wetland detention	4.38					1	$1,708,200
71	wet bottom	wetland detention	2.68					1	$1,045,200
72	wet bottom	wetland detention	0.9	8	3	89	0.79	2	$351,000
73	wet bottom	wetland detention	1.57					1	$612,300
74	wet bottom	wetland detention	0.7	13	5	148	1.32	2	$273,000
76	wet bottom	wetland detention	0.8	9	3	104	0.93	2	$312,000
77	wet bottom	wetland detention	0.27	4	1	45	0.40	2	$105,300
78	dry bottom	native basin	0.95	29	6	119	1.21	1	$304,000
79	dry bottom	native basin	0.34	18	4	74	0.76	2	$132,600
80	wet bottom	wetland detention	1.39	12	4	134	1.19	2	$542,100
81	native bottom	native basin	5.95	1049	212	4246	43.40	1	$1,904,000
82	dry bottom	native basin	0.43	15	3	59	0.61	1	$137,600
84	dry bottom	native basin	2.21	125	25	505	5.16	1	$707,200
85	dry bottom	native basin	2.65	114	23	460	4.70	1	$848,000
86	wet bottom	wetland detention	0.76					3	$296,400

87	dry bottom	native basin (remove concrete channel)	1.12					3	$436,800
88	dry bottom	native basin	8.17	242	49	980	10.02	1	$2,614,400
89	dry bottom	native basin	0.42	11	2	45	0.46	1	$134,400
90	dry bottom	native basin	8.02	389	78	1574	16.09	1	$2,566,400
91	wet bottom	wetland detention	0.5					3	$195,000
92	wet bottom	wetland detention	1.17					1	$456,300
93	dry bottom	native basin	0.3	15	3	59	0.61	2	$96,000
94	dry bottom	native basin	1.45	81	16	327	3.34	1	$464,000
95	dry bottom	native basin	0.33	15	3	59	0.61	1	$105,600
96	dry bottom	native basin	0.55	26	5	104	1.06	2	$176,000
97	dry bottom	native basin	1.46	15	3	59	0.61	1	$467,200
98	dry bottom	native basin	0.32	11	2	45	0.46	2	$102,400
99	dry bottom	native basin	0.3	7	1	30	0.30	2	$96,000
100	dry bottom	native basin	0.72	15	3	59	0.61	3	$230,400
103	dry bottom	native basin	1.56	11	2	45	0.46	2	$499,200
104	dry bottom	native basin	0.41	11	2	45	0.46	2	$131,200
105	wet bottom	wetland detention	0.11					1	$42,900
106	dry bottom	native basin	0.2	11	2	45	0.46	2	$64,000
107	dry bottom	native basin	0.2	11	2	45	0.46	2	$64,000
108	dry bottom	native basin	0.14	7	1	30	0.30	2	$44,800
109	wet bottom	wetland detention	0.34	3	1	30	0.26	2	$132,600
110	wet bottom	wetland detention	1.23					2	$479,700
111	dry bottom	native basin	0.43	26	5	104	1.06	2	$137,600
112	wet bottom	wetland detention	0.18	9	3	104	0.93	2	$70,200
113	wet bottom	wetland detention	0.2					2	$78,000
114	dry bottom	native basin	0.16	4	1	15	0.15	2	$51,200
115	dry bottom	native basin	0.15	7	1	30	0.30	2	$48,000
116	dry bottom	native basin	0.1	4	1	15	0.15	2	$32,000
117	wet bottom	wetland detention	0.47					2	$183,300
118	dry bottom	native basin	0.06	4	1	15	0.15	2	$19,200
120	wet bottom	wetland detention	0.44	9	3	104	0.93	2	$171,600
121	dry bottom	native basin	0.29	7	1	30	0.30	2	$92,800
122	dry bottom	native basin	0.15	7	1	30	0.30	2	$48,000
101/102	wet bottom	wetland detention	1.95	16	6	178	1.59	2	$760,500
43/75	dry bottom	native basin	4.15	106	21	430	4.40	2	$1,328,000
53/54/55	wet bottom	wetland detention	3.94	28	10	312	2.78	2	$1,536,600
83/119	dry bottom	native basin	0.62	15	3	59	0.61	2	$198,400
123	parking lot	permeable pavers	0.8	5	1	17	0.12	2	$628,000
124	dry bottom	native basin	0.55	0	0	0	0.00	2	$176,000
125	dry bottom	native basin	1.05	0	0	0	0.00	2	$336,000
126	ditch	bank stabilization	2030	0	0	0	0.00	1	$438,500
127	wet bottom	wetland detention	1.72	57	20	640	5.73	1	$675,700
128	wetland	wetland enhancement	3.29	0	0	0	0.00	3	$46,060
132	parking lot	permeable pavers	1.2	7	1	na	0.18	3	$972,300

133	parking lot	permeable pavers	0.6	10	2	na	0.26	3	$470,400
134	turf swale	bioswale	0.1	7	1	na	0.32	3	$55,300
135	turf swale	bioswale	0.08	2	0	na	0.09	3	$44,900
136	wet bottom	wetland creation and stream restoration	2.9	0	0	0	0.00	3	$1,579,500
137	wet bottom	wetland creation and stream restoration	13.8	0	0	0	0.00	3	$5,425,600
139	parking lot	permeable pavers	2.6	19	3	na	0.49	3	$2,038,600
142	turf swale	bioswale	0.01	34	7	na	1.57	2	$46,200
145	parking lot	permeable pavers	0.8	5	1	na	0.12	3	$627,300
147	parking lot	permeable pavers	2	23	4	na	0.60	1	$1,568,200
149	turf swale	bioswale	0.2	67	14	na	3.08	1	$110,500
150	turf swale	bioswale	0.15	9	2	na	0.40	1	$87,800
151	wet bottom	filter strip/ shoreline buffer	2.47	15	2	69	0.75	1	$95,200
		Total pollutant load removal		**4395**	**1145**	**29823**	**280**		**$107,029,660**

Appendix B

Map ID	Municipality	Ownership	Name of Basin	Stakeholder/ Partners	Proposed Project	Current Condition
1	Unincorporated DuPage County	Public	Klein Creek Farm	FPDDPC	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
2	Unincorporated DuPage County	Private	Wheaton Crossing	HOA	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
3	Unincorporated DuPage County	Private	Wheaton Crossing	HOA	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
4	Unincorporated DuPage County	Private	Wheaton Crossing	HOA	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
5	Unincorporated DuPage County	Public	Wheaton Park District- Herrick Drive	Wheaton Park District	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
6	Unincorporated DuPage County	Private	Coventry Place Unit 2	HOA	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
7	Unincorporated DuPage County	Private	Wheaton Ridge	HOA	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
8	Unincorporated DuPage County	Private	James Place	HOA	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
9	Unincorporated DuPage County	Private	Fieldsworth	HOA	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
10	Unincorporated DuPage County	Private	James Place	HOA	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
11	Unincorporated DuPage County	Public	Wayne Township Facility	Wayne Township	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
12	Unincorporated DuPage County	Private	St. Charles Road, west of Kuhn	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
13	Unincorporated DuPage County	Private	SWC of St. Charles Road and Kuhn Ave	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
14	Unincorporated DuPage County	Private	St. Charles Road	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
15	Unincorporated DuPage County	Private	St. Charles Road	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
16	Unincorporated DuPage County	Private	North Avenue	Private	Convert wet basin to constructed wetland detention basin with native vegetation. Remove concrete lined swale and convert to native vegetation	Wet
17	Unincorporated DuPage County	Private	Mallard Lake	HOA	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet

18	Unincorporated DuPage County	Private	St. Charles Road	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
19	Winfield	Private	Fischer Farm	HOA	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
20	Winfield	Public	Timber Ridge Dr	Village of Winfield	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
21	Bloomingdale	Private	Covington Dr	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
22	Hanover Park	Private	Schick Rd	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
23	Bloomingdale	Private	Madsen Dr	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
24	Bloomingdale	Private	Army Trail Rd	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
25	Bloomingdale	Private	Scott Dr	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
26	Bloomingdale	Private	Stratford Circle Pond	Private/ Village of Bloomingdale	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
27	Bloomingdale	Public	School Dist 93- Covington Dr	School District 93/ Village of Bloomingdale	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
28	Bloomingdale	Private	Scott Dr	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
29	Carol Stream	Private	Army Trail Rd	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
30	Unincorporated DuPage County	Private	84th Ct	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
31	Glendale Heights	Public	Mill Pond	Village of Glendale Heights	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
32	Carol Stream	Public	Schmale Rd	Village of Carol Stream	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
33	Carol Stream	Public	Veterans Park	Village of Carol Stream	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
34	Carol Stream	Public	Mitchell Lakes	Carol Stream Park District	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet

35	Carol Stream	Public	Carol Point Pond 2	Village of Carol Stream	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
36	Carol Stream	Public	Mitchell Lakes	Village of Carol Stream	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
37	Carol Stream	Private	Gary Avenue	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
38	Carol Stream	Private	Center Avenue	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
39	Carol Stream	Private	Gary Avenue	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
40	Carol Stream	Private	Schmale Rd	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
41	Carol Stream	Private	Gary Avenue	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
42	Carol Stream	Private	Tower Blvd	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
43	Carol Stream	Public	USPS Carol Stream	USPS	Cease mowing and plant native vegetation to increase infiltration and increase pollutant removal	Dry Naturalized Basin
44	Carol Stream	Private	Gary Avenue	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
45	Carol Stream	Private	Kehoe and Kimberly	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
46	Glendale Heights	Public	Glendale Lakes Golf Club	Village of Glendale Heights	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
47	Carol Stream	Private	Village and Kehoe	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
48	Carol Stream	Private	Kehoe Blvd	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
49	Glendale Heights	Private	Schmale and Lake Dr	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
50	Carol Stream	Private	Quail Run South / Glenwood Point	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
51	Carol Stream	Private	Phillips Ct	Private	Convert to constructed wetland detention basin with native vegetation	Dry Naturalized Basin
52	Carol Stream	Private	Phillips Ct	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin

53	Carol Stream	Private	Windsor Park	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
54	Carol Stream	Private	Windsor Park	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
55	Carol Stream	Private	Windsor Park	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
56	Carol Stream	Private	Windsor Park Dr	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
57	Carol Stream	Private	St Charles Rd and Gary Ave	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
58	Unincorporated DuPage County	Private	St Charles Road and Pleasant Hill	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
59	Carol Stream	Private	St Charles Road	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
60	Carol Stream	Private	St Charles Road and Gary Ave	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
61	Carol Stream	Private	Alexandria Way	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
62	Winfield	Private	Klein Golf Club	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
63	Winfield	Private	Klein Golf Club	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
64	Winfield	Private	Klein Golf Club	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
65	Winfield	Private	Klein Golf Club	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
66	Winfield	Private	Klein Golf Club	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
67	Winfield	Private	Klein Golf Club	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
68	Unincorporated DuPage County	Public	Weeks Park	Carol Stream Park District	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
69	Winfield	Private	Klein Golf Club	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet

70	Winfield	Private	Klein Golf Club	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
71	Winfield	Private	Klein Golf Club	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
72	Winfield	Private	Gary and Geneva	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
73	Winfield	Private	Klein Golf Club	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
74	Carol Stream	Private	Fullerton and Center	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
75	Carol Stream	Public	USPS Carol Stream	Public	Cease mowing and plant native vegetation to improve infiltration and increase pollutant filtration	Dry Basin
76	Carol Stream	Private	Kehoe Blvd	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet with Extended Dry Detention
77	Winfield	Private	Delano St	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
78	Winfield	Private	Mission Ct	HOA	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
79	Carol Stream	Private	Gary Avenue	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
80	Glendale Heights	Private	Exchange Blvd	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
81	Carol Stream	Public	Armstrong Park North Basin	Carol Stream Park District	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
82	Carol Stream	Public	Park Hill	Village of Carol Stream	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
83	Carol Stream	Private	St. Andrews United Methodist Church North	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
84	Carol Stream	Public	Merbach Drive	Village of Carol Stream	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
85	Carol Stream	Public	Merbach Drive	Village of Carol Stream	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
86	Carol Stream	Public	Merbach Court	Village of Carol Stream	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin

Appendix B

87	Carol Stream	Public	Lies and Kuhn	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
88	Carol Stream	Public	Friendship Park	Village of Carol Stream	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
89	Carol Stream	Public	The Park Northeast	Village of Carol Stream	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
90	Carol Stream	Public	Barbara O'Rahily Volunteer Park	Village of Carol Stream	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
91	Carol Stream	Private	Essen Ct	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
92	Carol Stream	Private	Munson and Kuhn	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
93	Carol Stream	Private	Lutheran Church of the Master	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
94	Carol Stream	Public	Sundance Park	Village of Carol Stream/ Village of Carol Stream	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
95	Carol Stream	Public	Clover Elementary East	School Distirct 93	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
96	Carol Stream	Private	Kehoe Blvd	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
97	Carol Stream	Public	Cloverdale Elementary West	School District 93/ Village of Carol Stream	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
98	Carol Stream	Private	Randy Rd	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
99	Carol Stream	Private	Randy Rd	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
100	Carol Stream	Private	Schmale	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
101	Carol Stream	Private	Kimberly and Fullerton	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
102	Carol Stream	Private	Kimberly and Fullerton	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
103	Carol Stream	Private	Kimberly and Fullerton	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin

104	Carol Stream	Private	Village	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
105	Carol Stream	Private	Schmale and Phillips Ct	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
106	Carol Stream	Private	Fullerton	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
107	Carol Stream	Private	Fullerton	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
108	Carol Stream	Private	Kehoe Blvd	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
109	Carol Stream	Private	Randy Rd	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
110	Carol Stream	Private	Kehoe Blvd	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
111	Carol Stream	Private	Kehoe and Gorzevske	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
112	Carol Stream	Private	Randy Rd	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
113	Carol Stream	Private	Gorzevske Ln	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
114	Carol Stream	Private	Kehoe Blvd	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
115	Carol Stream	Private	North and Gary	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
116	Carol Stream	Private	North Avenue	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
117	Carol Stream	Private	St Charles Rd	Private	Convert wet basin with turf grass slopes to constructed wetland detention basin with native vegetation	Wet
118	Carol Stream	Private	Fullerton	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
119	Carol Stream	Private	Kimberly and Fullerton	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
120	Carol Stream	Private	St. Paul	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin

121	Carol Stream	Private	Windsor Park Ln	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
122	Carol Stream	Private	Gary Avenue	Private		
123	Carol Stream	Public	Hampe Park	Carol Stream Park District	Replacement of asphalt parking lot with permeable pavers to provide infiltration of runoff to minimize pollutant loads	Parking Lot
124	Carol Stream	Private	Tower Blvd	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
125	Carol Stream	Private	St Paul Blvd	Private	Retrofit dry-bottom turf basin to native vegetation to improve infiltration and increase pollutant uptake	Dry Turf Basin
126	Carol Stream	Public	Kehoe ditch	Village of Carol Stream	Streambank stabilization	Eroded ditch
127	Carol Stream	Public	Day Lily Pond	Village of Carol Stream	Convert wet bottom pond to created wetland to improve filtration, infiltration, and pollutant uptake	Constructed wetland
128	Carol Stream	Private	Gary Ave wetland	Private/ Com Ed	Wetland enhancement to improve nutirent uptake and infiltration	wetland enhancement
132	Carol Stream	Public	Cloverdale School	School District 93/ Village of Carol Stream	Replacement of asphalt parking lot with permeable pavers to provide infiltration of runoff to minimize pollutant loads	Parking Lot
133	Carol Stream	Public	Chippewa Trail	Village of Carol Stream	Replacement of asphalt roadway and parking lot with permeable pavers and/ or retrofit parking islands to bioswales to provide infiltration of runoff and filtration and uptake of nutrients	Parking lot and roadway
134	Carol Stream	Public	Old Gary Rd	Village of Carol Stream	Retrofit turf swale to native plant bioswale to improve filtration and infiltration and reduce erosion	Roadside swale
135	Carol Stream	Public	Old Gary Rd	Village of Carol Stream	Retrofit turf swale to native plant bioswale to improve filtration and infiltration and reduce erosion	Roadside swale
136	Carol Stream	Public	Old Gary Pond/ Klein Creek	Village of Carol Stream	Conversion of wet-bottom ponds to a meandering stream channel with created wetland areas to provide infiltration, filtration and pollutant uptake	Wet Basin
137	Carol Stream	Private	Klein Creek/ Stark Farm Pond	Private	Conversion of wet-bottom ponds to a meandering stream channel with created wetland areas to provide infiltration, filtration and pollutant uptake. Culvert modification	Wet Basin
139	Carol Stream	Public	Ross Ferraro Town Center	Village of Carol Stream	Replacement of asphalt parking lot with permeable pavers to promote infiltration	Parking Lot
142	Carol Stream	Public	Vale Road	Village of Carol Stream	Retrofit turf swale to native plant bioswale to improve filtration and infiltration and reduce erosion	Roadside swale
145	Carol Stream	Public	Kuhn Road Fire Station #1	Village of Carol Stream	Replacement of asphalt parking lot with permeable pavers to promote infiltration	Parking Lot
147	Carol Stream	Public	Village Hall	Village of Carol Stream	Replacement of asphalt parking lot with permeable pavers and/ or retrofit islands with bioswales and rain gardens to provide infiltration, filtration, and pollutant uptake	Parking Lot

149	Carol Stream	Public	Kuhn Road swale	Village of Carol Stream	Retrofit turf swale to native plant bioswale to improve filtration and infiltration and reduce erosion	Roadside swale
150	Carol Stream	Public	Doris Ave swale	Village of Carol Stream	Retrofit turf swale to native plant bioswale to improve filtration and infiltration and reduce erosion	Roadside swale
151	Carol Stream	Public	Jay Stream School pond	School District 93/ Village of Carol Stream	Native prairie vegetation alogn the Jay Stream pond shoreline to provide improved infiltration and filtration	Pond