Hickory Creek Watershed Planning Group

Hickory Creek Watershed Plan

Technical Report

Hickory Creek Watershed Planning Group Steering Committee

Village of Frankfort
Village of Homer Glen
City of Joliet
Village of Mokena
Village of New Lenox
Village of Orland Park
Village of Tinley Park
Forest Preserve District of Will County
Will County
Illinois Sierra Club
Chicago Metropolitan Agency for Planning

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The many contributors to this planning process include the staff of the Villages of Frankfort, Homer Glen, Mokena, New Lenox, Orland Park, and Tinley Park, as well as the City of Joliet, the Will County Stormwater Management Planning Committee, Will County Board, and the Forest Preserve District of Will County, which all provided in-kind match and resolutions of support for the project. The authors thank the many stakeholders who participated in the planning process, but especially the Joliet Park District, Frankfort Square Park District, Illinois Chapter of the Sierra Club, Prairie Rivers Network, the U.S. Army Corps of Engineers, the Natural Resources Conservation Service, a number of private consultants, and the Illinois Department of Natural Resources for their participation and expertise.

CMAP is the delegated authority for the region's areawide water quality management plan. Thus, CMAP is obligated to outline management strategies for eliminating point- and nonpoint-source pollution, protecting groundwater, and managing wastewater throughout the seven-county region. CMAP uses, as did the Northeastern Illinois Planning Commission before it, a collaborative watershed approach to planning that seeks to protect and remediate water quality. Water pollution prevention and groundwater protection is the shared responsibility of state and local governments and private concerns.

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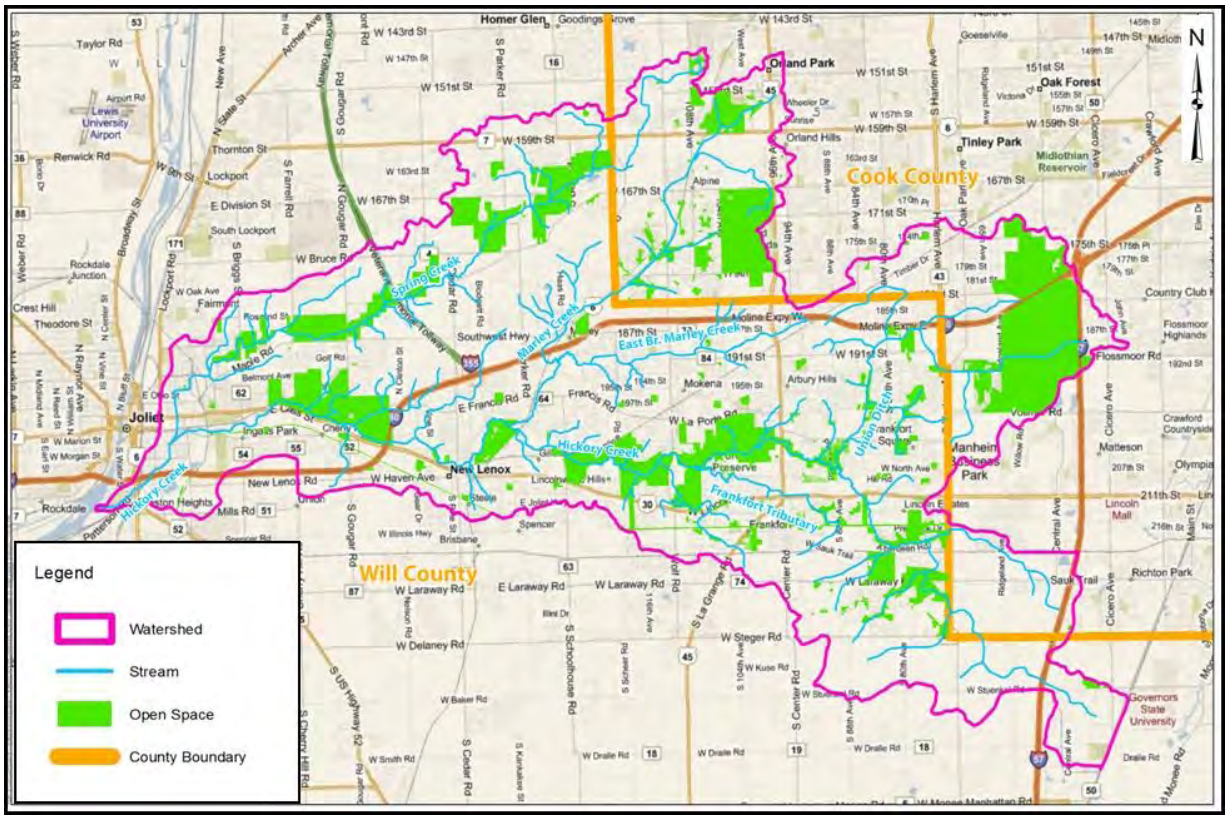
1. Introduction

Hickory Creek flows into the Des Plaines River just downstream from the Brandon Road Lock and Dam in Joliet, having coursed approximately 28 miles from its headwaters east of Frankfort through varied neighborhoods and forest preserves or parks, being joined along the way by Marley Creek, Spring Creek, and Union Ditch as major tributaries (Figure 1-1). The final segment consists of a three-mile channelized stretch with concrete walls in an older neighborhood of Joliet. Although canoes do ply the stream and anglers catch smallmouth below its riffles, Hickory Creek is not a stream with a large recreational user base. Nor is it always recognized by residents as being worthy of conservation attention. But among stream ecologists in the Chicago area, it has considerable fame. As Dr. David Bardack of the University of Illinois noted, "Hickory Creek has attained the status of a classic biological study area. It has shaped the understanding of ecologists of the basic principles of stream faunal succession."[1]

Figure 1-1. Hickory Creek Watershed



The watershed is home to streamside Illinois Nature Preserves with a host of rare plants and animals. The Forest Preserve District of Will County has made great strides in protecting the land immediately around the stream network, most recently with the greenway that it has established along Spring Creek. Park districts have also protected significant areas, as has the Forest Preserve District of Cook County. Approximately 15 percent of the watershed is located within some form of protected open space. Hickory

[1] Quoted in Joel Greenberg and Bill Eyring, *The Lessons of Hickory Creek* (unpublished manuscript). Faunal succession in this context means correlations between changes in animal communities and changes in physical or other conditions, e.g., from upstream to downstream.

Creek is also a substantially urbanized watershed, with nearly half of its 109 square miles developed. Nevertheless, approximately 44 square miles of undeveloped land remain outside of protected holdings, which are located in areas of significant projected growth, particularly New Lenox, Frankfort, Homer Glen, and Joliet. Furthermore, nine wastewater treatment plants serve the basin and discharge into Hickory Creek or one of its tributaries.

The Hickory Creek Watershed Planning Group (HCWPG), a stakeholder group consisting of local government representatives, resource agencies, advocates, and others, developed this plan for Hickory Creek and its tributaries. The collaborative effort undertaken by the HCWPG represents a departure from early litigation over the proposed expansion of a municipal wastewater treatment plant in the watershed, and disagreement over the adequacy of an environmental document (the anti-degradation analysis) used to support the expansion. While the legal question was resolved by the courts,[2] a later settlement between municipal representatives and environmental advocates pointed to a collaborative watershed planning process as a way to identify and address water quality problems in the Hickory Creek system without resorting to further legal action.

1.1 Why a Watershed Plan is Needed

Certain portions of Hickory Creek and its tributaries have impairments to their "beneficial uses" under the federal Clean Water Act. These uses are aquatic life support and primary contact recreation — in other words, some stream segments are biologically unhealthy, while others are not safe to swim in. The state has therefore placed Hickory Creek and several tributaries on the Illinois "303(d) list" of impaired waters,[3] a formal acknowledgment of water quality concerns. The impairments to the creek are caused by a number of factors described in more detail in Section 2, but the major impairments include chemical pollution, contamination by fecal bacteria, and physical damage to the stream environment. The fundamental purpose of the watershed plan is to evaluate and recommend the best measures to help restore the beneficial uses in Hickory Creek and its tributaries, with the long-term goal of improving conditions enough that Hickory Creek and its tributaries can be removed from the 303(d) list. This goal will be accomplished by the improvement of biological conditions in the streams and the reduction of fecal contamination.

1.2 Areas of Emphasis for the Hickory Creek Plan

Measures to help protect and restore the beneficial uses of Hickory Creek can be grouped broadly into projects and policies, the projects being meant mainly to address existing problems, while the policies help limit future problems. Both are recommended in this plan. The project types include (1) stream restoration projects, including improvements to habitat or restoration of hydrology, (2) stormwater management infrastructure retrofits, and (3) agricultural best management practices. These are discussed in more detail in the *short term project implementation plan* in Section 4, which describes priority projects recommended for implementation within about five years of plan completion. A five-year time period was chosen because it corresponds to the typical horizon of a Capital Improvement Plan, and furthermore a watershed plan cannot be expected to have a shelf-life much beyond five years. It is recommended that the Hickory Creek Watershed Plan be updated in 2016.

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[2] *Illinois Environmental Protection Agency v. Illinois Pollution Control Board*, 386 Ill. App. 3d 375 (3d Dist. 2008).

[3] The state is required to produce this list every two years under the Clean Water Act; the name of the report comes from the section of the Clean Water Act (303(d)) that requires it. The list can be found at available at http://www.epa.state.il.us/water/tmdl/303d-list.html.

Policy recommendations, the second type of measure proposed in Hickory Creek, primarily relate to local ordinances and comprehensive planning, but recommendations for wastewater treatment plants are also included in this category. While local stormwater management requirements and some aspects of zoning/subdivision codes have certainly been strengthened in recent years, some improvements are still needed. Current requirements and recommendations for improvement are contained in Section 3 *vision and policy*.

In particular, this plan recommends changing zoning codes and stormwater management ordinances to minimize impervious surface creation (streets, parking lots, roofs, etc.), to retain more runoff on-site, to use green infrastructure to manage stormwater, and to encourage reinvestment in already developed areas rather than seeking to build new on undeveloped sites.

While the watershed has become substantially urbanized, the amount of land that could still be developed in the watershed is not inconsequential, and future land use is perhaps the most important determinant of whether stream conditions will improve or decline. A great deal of information suggests that increasing amounts of impervious surface correlate strongly and negatively with the biological health of streams.[4] While the use of better stormwater management practices alleviates this somewhat, an important part of watershed planning is to find ways to moderate the increase in impervious surfaces without compromising development potential.

The overarching purposes of the plan are to improve biological conditions in the stream and to reduce fecal contamination. Projects and policies must therefore address one of these goals, but measures with benefits beyond just these are much preferred to single-purpose projects. Therefore, although standalone measures for flood control, recreation, upland habitat improvement, etc. were not sought, projects and policies with these additional benefits were considered much higher priorities. Furthermore, it is best to see the specific projects in the short term implementation plan in Section 4 not just as individual projects, but also as *examples* of improvements that need to be made in many other places. In other words, the projects in the short term plan need to be scaled up in the longer term. Section 3.4.3 proposes several means of doing so, one of the best being to seek opportunities to include water quality elements in local projects being undertaken for other reasons. For example, this plan recommends that local governments institute a policy to seek to build water quality benefits into projects in their Capital Improvement Programs wherever possible. In that way, the myriad infrastructure projects the county and municipalities undertake every year — sidewalk repairs, ditch reshaping, road resurfacing, tree replacement, utility work, etc. — could improve water quality or habitat conditions at a small additional cost.

1.3 Flooding on Hickory Creek

Residents and local officials may recognize flooding within the watershed as being the issue of most concern to them — especially at the downstream end of the watershed — and with good reason. A 1957 flood left $56 million in damage (in 2010 dollars) in the Hickory and Spring Creek watersheds, while in

[4] This information is perhaps most convincingly assembled in the Center for Watershed Protection's publication *The Impacts of Impervious Cover on Aquatic Systems.* March 2003. Watershed Protection Research Monograph No. 1.

1980 high water caused another $44 million in damages (again, in current dollars).[5] With the amount and source of funding used for the development of the plan, it was not possible to delve into flood risk reduction in any detail. However, this plan does support the completion of the channel modification projects proposed by the IDNR Office of Water Resources (OWR) and the City of Joliet on lower Hickory and Spring Creeks. These projects will provide additional conveyance for flood waters by lowering and widening the channel. Indeed, the construction of the first phases of the project on Hickory Creek appears to have kept damages down significantly during the 1996 flood event that inflicted extensive damage elsewhere in the Chicago area.

While this plan endorses the proposed flood control project, it does make two general recommendations: (1) the stream and wetland restoration projects identified in the *Hickory Creek Watershed Plan* should be considered the first choice for any required compensatory mitigation, rather than seeking compensatory mitigation in a bank outside the watershed; and (2) OWR is encouraged to do everything reasonable to minimize the temporary elevation changes that fish must negotiate during project construction. Several other minor recommendations for the project have also been made to OWR.[6] One of these is that, as part of its future work, the HCWPG should seek funding to analyze projects upstream that could provide additional storage or prevent sedimentation, both of which could help the proposed channel modification projects work better.

1.4 Use of the Hickory Creek Watershed Plan

This watershed plan is meant to be a technically-sound, results-oriented strategy for improving biological conditions in the streams and reducing fecal contamination, with specific actions recommended for specific stakeholders. It is intended as a road map to a cleaner stream that is broadly agreed upon, and which stakeholders intend to implement. Besides the environmental benefits of implementing the plan, it should reduce future conflict by laying out clear expectations for water quality management in the watershed.

A watershed plan is an advisory document. As a means of formalizing agreement about the plan's contents, each participating implementer in the watershed[7] is being asked to adopt the plan with a resolution supporting the collective implementation of the plan. This does not, of course, mean the recommendations of the plan automatically go into place. Ordinances may need to be revised, and local funding may need to be committed to projects through normal budgeting processes. Given the difficult fiscal situation that many implementers face, the plan is sensitive to the need to minimize local funding contributions. External funding is expected to cover most of the costs of projects in the short term implementation plan (see Section 4.5). However, the need for some local funding cannot be avoided, including "dues" to support the HCWPG (or a successor organization) as discussed in Section 3.4.6.1.

[5] Nominal damages provided by Illinois Department of Natural Resources, Office of Water Resources in presentation given to HCWPG, December 10, 2010. Inflation adjusted with Bureau of Labor Statistics calculator, based on Consumer Price Index.
[6] Letter from Hickory Creek Watershed Planning Group Steering Committee to Kathy Chernich, Army Corps of Engineers, January 26, 2011.
[7] The Villages of Frankfort, Homer Glen, Mokena, New Lenox, Orland Park, and Tinley Park, as well as the City of Joliet, Will County, and the Forest Preserve District of Will County.

The Illinois Environmental Protection Agency (IEPA) could use the Hickory Creek Watershed Plan in two main ways. First, the Hickory Creek plan was developed to meet the so-called "nine minimum elements"[8] required of plans funded under the Section 319 nonpoint source pollution grant program. This means that requests to fund projects found in the watershed plan should receive higher priority from IEPA under Section 319 than projects which are not in a watershed plan. IEPA has slowly been moving to make watershed plan implementation the primary use of project funding under the Section 319 program, and there is little reason to believe this will change. Second, the IEPA could make more of its financing (i.e. State Revolving Fund and other grant programs) and permitting decisions consistent with the watershed plan, such as ensuring that a proposed wastewater treatment plant expansion follows the recommendations in the plan.

1.5 Pollution Reduction Goals and Relationship to TMDL Development

The Hickory Creek plan is based on reducing pollutant loading to a certain target or "end point" judged to protect the beneficial uses of the creek. Considering the short timeframe for plan development and limited funding, as well as the orientation of the HCWPG toward action rather than analysis, this plan concentrates on developing recommendations for projects and policies rather than on data analysis. Thus, while annual load targets were developed for the Hickory Creek plan, they were not based on additional data collection or sophisticated analysis and are intended for the watershed as a whole, not for individual segments.

It is expected that the Illinois Environmental Protection Agency will at some point need to develop *total maximum daily loads* (TMDLs) for one or more stream segments and pollutants in Hickory Creek. The TMDL, a kind of pollution budget, is another requirement in the Clean Water Act which is triggered by beneficial use impairments as documented on state 303(d) lists of impaired waters. As such, the federal government has redoubled its efforts to compel states to develop TMDLs on impaired waters. TMDLs provide the target load and therefore indicate the amount of pollution reduction needed to alleviate beneficial use impairments. Unlike a watershed plan, compliance with a TMDL is not purely voluntary in the sense that the portion of the TMDL allocated to point sources (e.g., wastewater treatment plants) can be written into the NPDES permits. In a similar manner, allocations for urban runoff could potentially be written into permits for municipal storm sewer system permits (although this has not yet happened in Illinois), which could necessitate improved treatment of these stormwater discharges.

A TMDL must, by federal law, eventually be developed for each cause of impairment on each 303(d)-listed stream segment. Yet it seems reasonable that stakeholders in Hickory Creek should see a benefit in return for their early and voluntary commitment to watershed management. This plan therefore recommends that IEPA treat the Hickory Creek plan as the implementation plan for a TMDL or set of TMDLs that would be developed at a later time (at least five years following the completion of the present plan), after thorough monitoring and modeling, and with the close involvement of the stakeholders who created the Hickory Creek plan. TMDLs could be done in conjunction with the watershed plan update recommended above. Voluntary steps taken during this interim period to reduce pollutant loading should be counted toward any reductions required. Conducting additional monitoring and bioassessment, as recommended in this plan, would help verify the actual impairments in the stream so that only appropriate TMDLs are developed. In addition, the recommended studies could also help

[8] See *Guidance for Developing Watershed Action Plans in Illinois,* pp. iv – v, available at http://www.cmap.illinois.gov/water-quality. Also see *Nonpoint Source Program and Grants Guidelines for States and Territories* (Federal Register V. 68, No. 205, October 23, 2003).

determine the extent to which habitat improvements are needed to restore the aquatic life beneficial use.

2. Watershed Assessment

Collecting and analyzing existing information for the Hickory Creek watershed is an important element in reducing uncertainty in the scientific recommendations provided in this watershed plan. Hickory Creek has been the subject of numerous stream studies conducted by various entities, and a great deal of data exist for the watershed. Nevertheless, information gaps remain, and in Section 5 this plan recommends a program for additional monitoring and bioassessment. Much of the existing information is summarized in the following section to provide a detailed "existing conditions" watershed characterization. The information collected and summarized below includes existing and future land use, physical trait (e.g. soils, wetlands, etc.), water quality, biological, and habitat data. This information serves as the basis for the recommendations included in the remaining sections of the plan. For example, the recommended green infrastructure network presented in Section 3.1.1 is largely based on watershed characteristics such as wetlands, floodplains and topography.

2.1 Watershed Characterization

The Hickory Creek watershed is located in north-central Will County and southwestern Cook County in Northeastern Illinois. The Hydrologic Unit Code (HUC) 10 watershed (0712000406) drains approximately 109 square miles of land tributary to the Des Plaines River, with approximately 74 percent (81 square miles) of the watershed located within Will County.[1] In addition to the main stem of Hickory Creek, the Hickory Creek stream system is comprised of several significant tributaries including Spring Creek, Marley Creek, East Branch of Marley, Union Ditch and Frankfort Tributary. Collectively, there are approximately 63 miles of stream within the Hickory Creek watershed.[2] The main stem of Hickory Creek accounts for approximately 28 miles of the 63 stream miles within the watershed.

The Hickory Creek watershed can further be divided into three HUC 12 subwatersheds. The three subwatersheds are the Headwaters Hickory Creek ("Headwaters"), Middle Hickory Creek, and Spring Creek subwatersheds (Figure 2-1). The Headwaters subwatershed (40 square miles) includes the drainage areas of Union Ditch and the uppermost portion of the main stem of Hickory Creek downstream to its confluence with Frankfort tributary. The Middle Hickory Creek subwatershed (49 square miles) includes the drainage areas of Frankfort Tributary, Marley Creek, and East Branch of Marley Creek, and drainage area directly tributary to the main stem of Hickory Creek from its confluence with Frankfort Tributary to the Des Plaines River. The Spring Creek subwatershed (20 square miles) includes the drainage area of Spring Creek.

Approximately 61 percent (67 square miles) of the Hickory Creek watershed was incorporated as of 2009, with portions of 13 different municipalities located within the watershed (Figure 2-1; Table 2-1). Municipalities comprising significant portions (i.e. greater than five square miles) of the incorporated area within the watershed include Frankfort, Homer Glen, Orland Park, Mokena, New Lenox, Tinley Park, and Joliet. The incorporated area within these 7 municipalities represented approximately 57 percent of the watershed and 92 percent of the total incorporated area in 2009.

[1] The Hydrologic Unit system is a standardized watershed classification system developed by USGS in the mid 1970s. Hydrologic units are watershed boundaries organized in a nested hierarchy by size. http://nwis.waterdata.usgs.gov/tutorial/huc_def.html

[2] Stream length estimate includes the main stems of the streams identified in the text and does not include lower order tributaries within the watershed.

Figure 2-1.

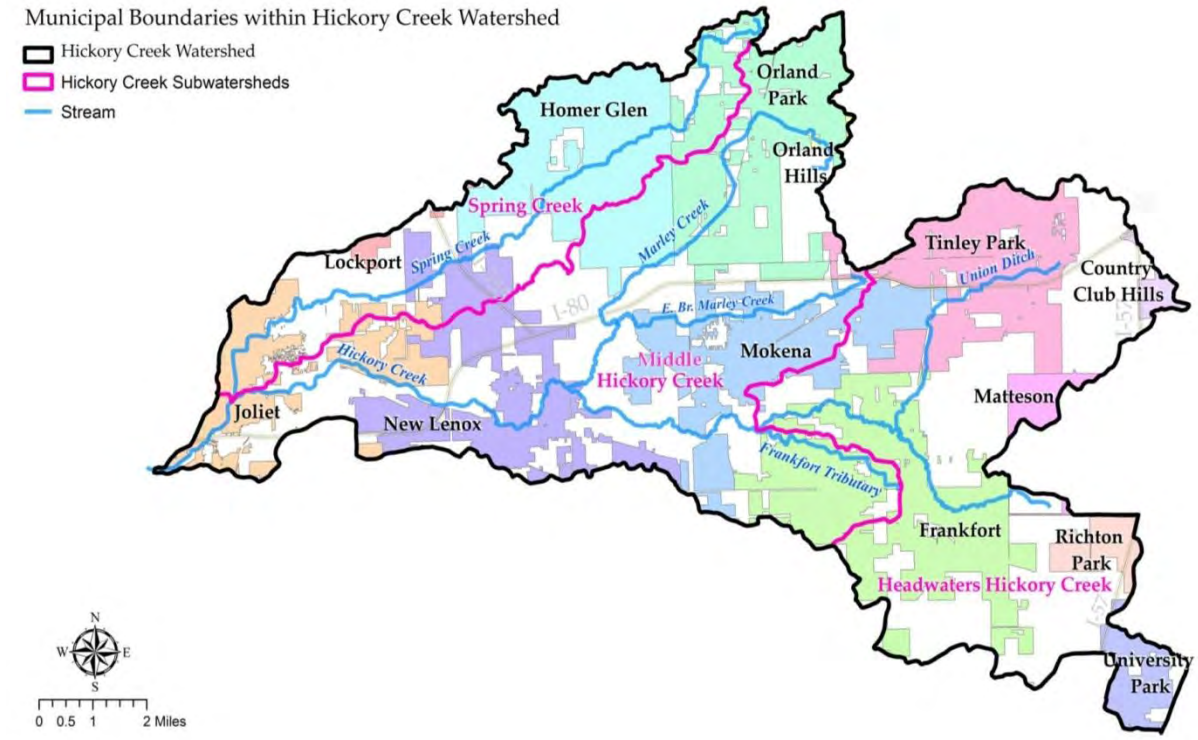


Table 2-1. Incorporated Area within Hickory Creek Watershed (2009)

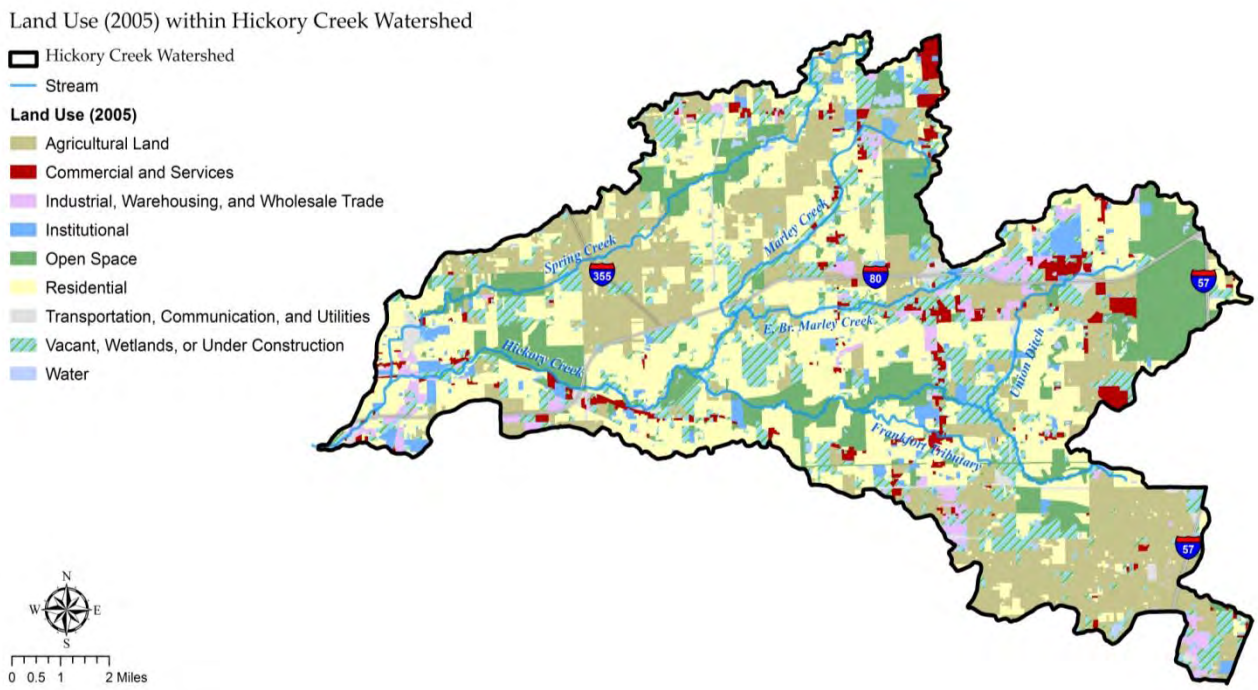
Municipality	Square Miles		
Frankfort	12.1	University Park	1.7
Homer Glen	9.6	Richton Park	1.3
Orland Park	9.6	Matteson	1.1
Mokena	8.5	Country Club Hills	0.5
New Lenox	8.4	Lockport	0.3
Tinley Park	8.1	Orland Hills	0.1
Joliet	5.6	**Total**	**67.0**

2.1.1 LAND USE

Land use within the Hickory Creek watershed in 2005 was generally a mix of agricultural land (25 percent), urban uses (45 percent) and open space (30 percent).[3] The lower Hickory Creek subwatershed is more urbanized (54 percent urban uses) than either the Headwaters (36 percent) or Spring Creek (42 percent) subwatersheds. In contrast, only 18 percent of the Middle Hickory Creek subwatershed is in an agricultural land use as compared to the 32 percent agricultural land in both of the other subwatersheds.

[3] Urban uses include the following land use types: Residential; Commercial and Services; Institutional; Industrial, Warehousing, and Wholesale Trade; and Transportation, Communication and Utilities.

Figure 2-2.



Source: CMAP 2005 Land Use Inventory

In the Hickory Creek watershed and in each of the three subwatersheds, residential use made up the majority of the urban uses in 2005. Residential use comprised 33 percent of the watershed, whereas the remaining urban uses accounted for only 12 percent of the watershed. While Figure 2-2 and Table 2-2 are intended to provided a "snapshot" of land use within the watershed at a given time, the collected information was incorporated into the watershed plan development process, such as developing pollutant load estimates (Section 2.5) and in identifying the recommended green infrastructure network for the watershed (Section 3.3.1).

Table 2-2. Land Use within Hickory Creek Watershed (2005)

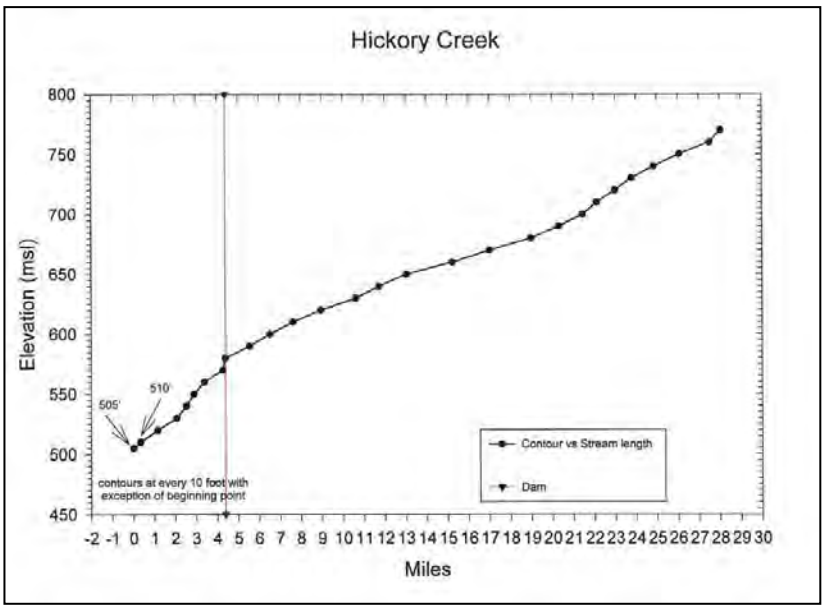
	HUC 12 Subwatershed							
	Headwaters		Middle Hickory Creek		Spring Creek		Watershed Total	
Land Use	Acres	Percent of Subwatershed	Acres	Percent of Subwatershed	Acres	Percent of Subwatershed	Acres	Percent of Watershed
Residential	5,837	23%	12,958	41%	4,434	35%	23,228	33%
Commercial	958	4%	1,217	4%	213	2%	2,388	3%
Institutional	710	3%	1,042	3%	265	2%	2,018	3%
Industrial	870	3%	815	3%	145	1%	1,830	3%
TCU	757	3%	786	3%	250	2%	1,794	3%
Agricultural	8,214	32%	5,515	18%	4,059	32%	17,788	25%
Open Space	4,376	17%	3,755	12%	1,647	13%	9,778	14%
Vacant or Wetlands	3,714	14%	4,999	16%	1,697	13%	10,410	15%
Water	234	1%	215	1%	122	1%	571	1%

Source: CMAP 2005 Land Use Inventory. TCU = Transportation, Communication, and Utilities. Vacant includes land under construction in 2005.

2.1.2 TOPOGRAPHY

The main stem of Hickory Creek has an overall longitudinal distance of approximately 28 miles from its headwaters downstream to the Des Plaines River. The change in elevation over distance of the main stem of Hickory Creek is approximately 252 feet, which equates to an overall stream gradient of approximately 8.9 feet/ mile, or .0017 feet/foot.[4] As seen in Figure 2-3, a notable stream gradient change is present at the dam located in Pilcher Park in Joliet. According to the Illinois State Water Survey (ISWS), the stream gradient of the lower reach of Hickory Creek from the dam downstream to the confluence with the Des Plaines River (approximately 4.4 stream miles) is approximately 14.8 feet/mile, or 0.0028 feet/feet.[5] The stream gradient between the headwaters of Hickory Creek and the dam is approximately 7.9 feet/mile, or.0015 feet/feet.[6] These estimates indicate that Hickory Creek generally is a low- gradient stream, but the stream below the dam is notably steeper than the upper portion of the stream.

Figure 2-3. Hickory Creek Stream Gradient

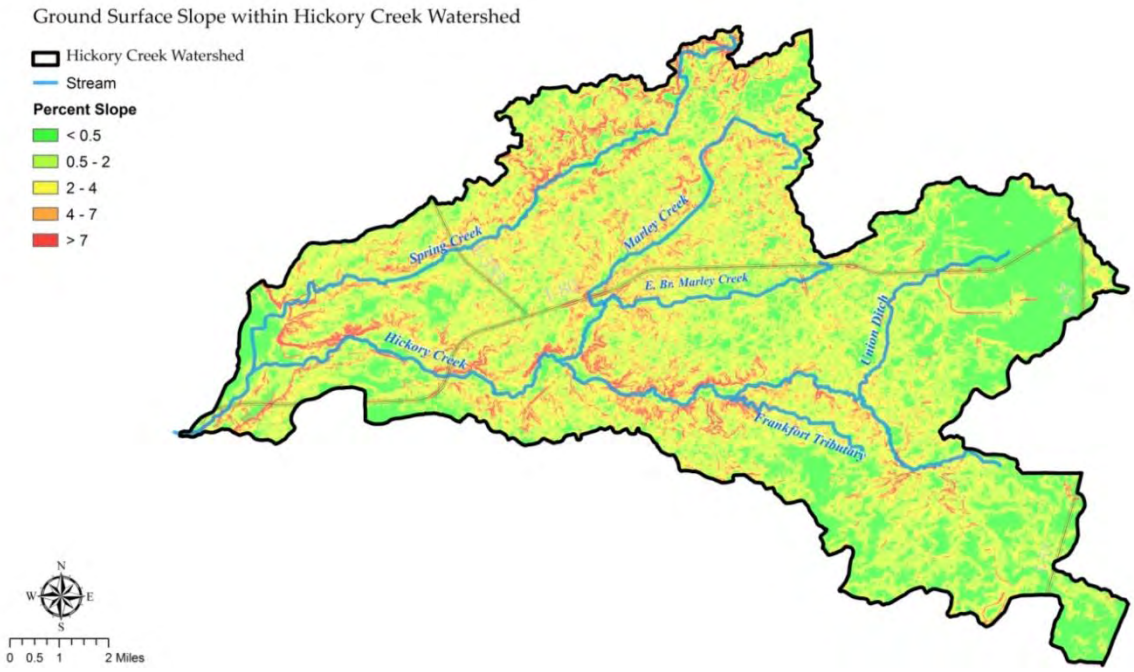


Source: Modified from ISWS. 2004.

The Hickory Creek watershed is relatively flat with the majority of the land surface within the watershed (84 percent) having less than four percent slope. Steeper (i.e. greater than four percent slope) slopes within the watershed are generally present along the main stem of Hickory Creek and its tributaries and in the central and western portions of the watershed (Figure 2-4). Qualitative comparison of Figures 2-2 and 2-4 indicates the concentration of agricultural land in the southeastern portion of the watershed is generally flat; however, in the northwestern portion of the watershed, steeper slopes appear to be more prevalent in the concentrated area of agricultural land.

[4] ISWS. 2004. *Preliminary Stream Geomorphological Assessment of a Segment of Hickory Creek Joliet, Will County, Illinois (Pilcher Park Dam to Washington Street)*. Provided through personal communication with William P. White, ISWS.
[5] *Ibid.*
[6] *Ibid.*

Figure 2-4.



Source: USGS 10-meter digital elevation model.

2.1.3 SOIL CHARACTERISTICS

Evaluating the soil characteristics within the watershed is an important part in developing an understanding of the watershed. Information related to hydrology, potential sources of pollutants and past watershed conditions can be garnered from soil characteristics.

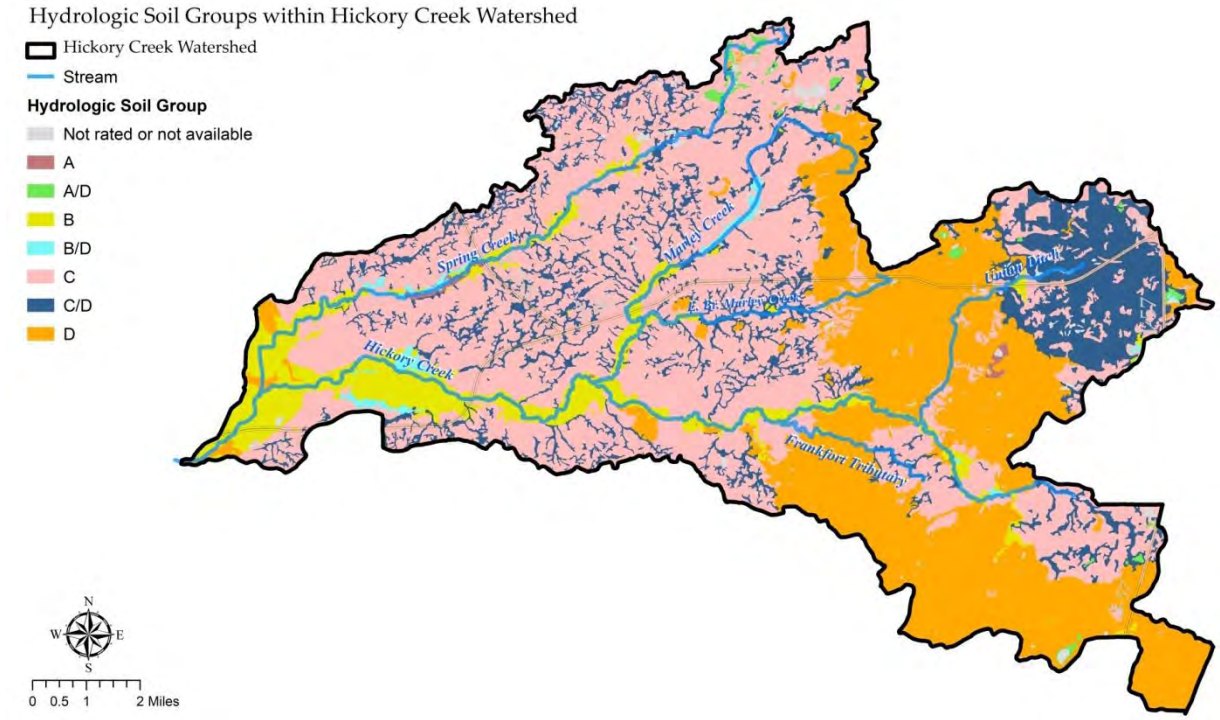
2.1.3.1 Hydrologic Soils Groups and Saturated Hydraulic Conductivity

The majority of soils within the Hickory Creek watershed are classified as either silt loam (59 percent) or silty clay loam (26 percent). Silt clay, muck and loam make up the remaining balance of the watershed soils. Soils within the watershed are predominately (89 percent) classified within Hydrologic Soil Groups (HSG) C and D (Figure 2-5). HSGs are based on estimates of the runoff potential of soils characterized as A, B, C, or D. The "A" soils have the lowest runoff potential and highest infiltration, while "D" soils are poorly drained and tend to have high runoff potential.

Related to the HSGs is the saturated hydraulic conductivity of the soils. Saturated hydraulic conductivity refers to the ease with which pores in a saturated soil transmit water.[7] Saturated hydraulic conductivity is an important consideration in designing stormwater Best Management Practices as well as in the design of soil drainage systems and septic tank absorption fields. Soils within the Hickory Creek watershed are predominately (89 percent) estimated to have moderately high saturated hydraulic conductivity values between 1 and 10 micrometers per second, or 0.142 to 1.42 inches per hour. Portions of the watershed with higher saturated hydraulic conductivity values are generally located within the areas with HSG B soils.

[7] NRCS Soil Data Viewer Version 5.1.000.0012.

Figure 2-5.



Source: USDA NRCS Will County Soil Survey.

From Figure 2-5, it can be seen that soils with low to moderately low runoff potential and unimpeded transmission of water through the soil (HSG B) are generally concentrated along the main stems of Hickory Creek and its tributaries, whereas soils with moderately high to high runoff potential and restricted water transmission through the soil (HSGs C and D) are generally found in the remaining portions of the watershed. These soil properties are consistent with the surficial geology of the watershed, which generally consists of alluvium and glacial outwash material in the stream valleys of Hickory Creek and its tributaries with predominately clayey till material in the remaining portions of the watershed.[8] The large, generally contiguous area of soils classified within HSG C/D in the headwaters of Union Ditch also appears to be consistent with the surficial geology of this portion of the watershed, which predominately consists of lake bed sediment comprised of silt and clay.

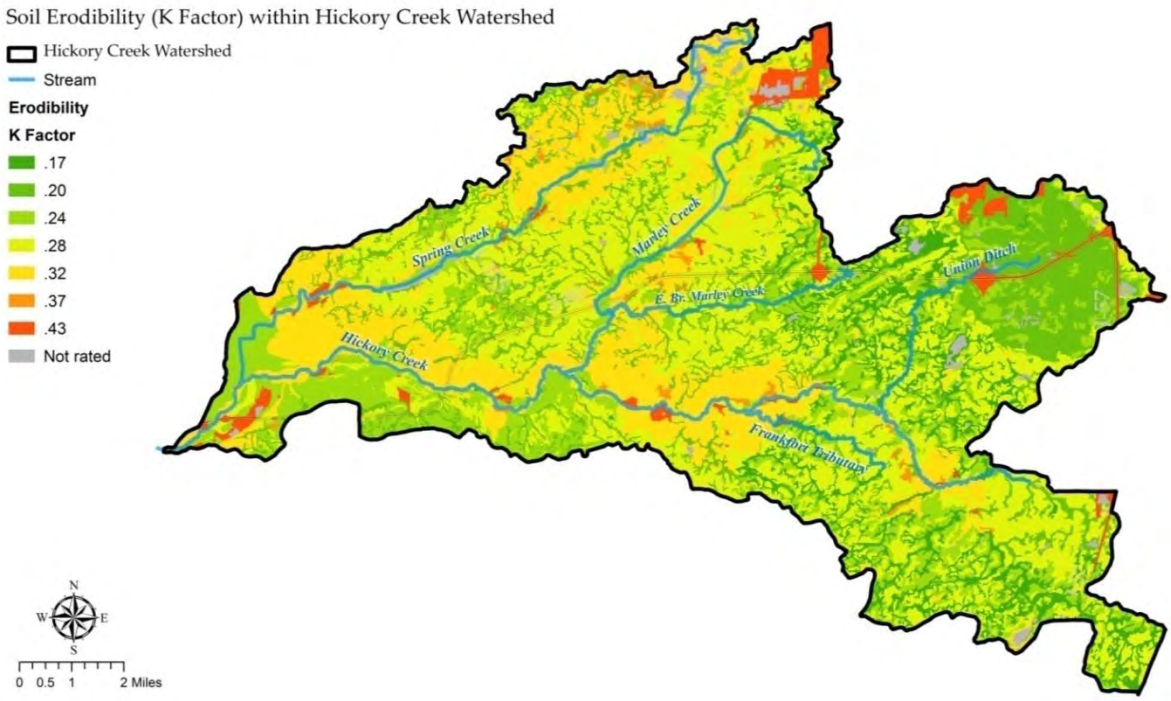
2.1.3.2 Erodibility

The susceptibility of soil to erosion by water is one factor used in predicting soil loss caused by sheet and rill erosion. The Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) are commonly used to predict the average annual rate of soil loss by sheet and rill erosion. The USLE and RUSLE are also commonly used in the identification of highly erodible lands and in the planning and design of soil conservation practices and stormwater Best Management Practices. The K Factor in these equations represents the susceptibility of a soil to sheet and rill erosion by water and is based on soil characteristics such as percentage of silt, sand, and organic matter and saturated hydraulic conductivity.[9] The K Factor values range from 0.02 to 0.69 with higher values representing increased susceptibility of the soil to sheet and rill erosion by water.

[8] Willman, H. B. 1971. Su*mmary of the Geology of the Chicago Area*. Illinois State Geological Survey; Circular 460; Urbana, IL.
[9] NRCS Soil Data Viewer Version 5.1.000.0012

Approximately 72 percent of the soils within the Hickory Creek watershed are estimated to have K Factor values within the range of 0.24 to 0.32, which is in the middle of the overall range of K Factor values. However, as can be seen in Figure 2-6, many of the soils within the watershed with relatively higher susceptibility to erosion (i.e. K Factor values equal to or greater than 0.32) are generally located in proximity to the Hickory Creek and Marley Creek main stems and within the Spring Creek subwatershed.

Figure 2-6.



Source: USDA NRCS Will County Soil Survey.

2.1.3.3 Hydric Soils

Hydric soils are defined as soils "that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part."[10] Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation. As such, the presence of hydric soils is used as one of the key indicators to existence of wetlands. Hydric soils within the Hickory Creek watershed are shown in Figure 2-7

Approximately 26 percent of the soils within the Hickory Creek watershed are rated as "All Hydric," while approximately 71 percent of the soils are rated as "Partially Hydric."[11] It should be noted map units that are made up dominantly of hydric soils may have areas of minor nonhydric components, and,

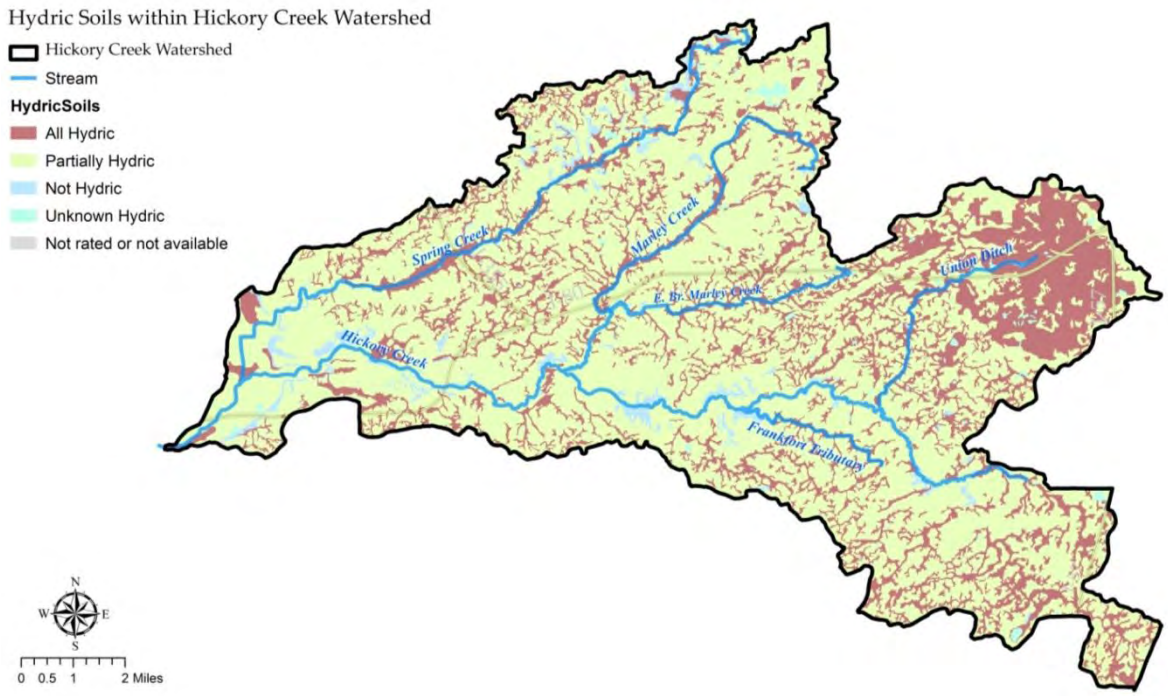
[10] http://soils.usda.gov/use/hydric/intro.html

[11] The hydric rating indicates the proportion of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. "All hydric" means that all components listed for a given map unit are rated as being hydric, while "not hydric" means that all components are rated as not hydric. "Partially hydric" means that at least one component of the map unit is rated as hydric, and at least one component is rated as not hydric. "Unknown hydric" indicates that at least one component is not rated so a definitive rating for the map unit cannot be made.

conversely, map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components.[12]

Again, the large, generally contiguous area of hydric soils in the headwaters of Union Ditch appears to be consistent with the surficial geology of this portion the watershed, which predominately consists of lake bed sediment comprised of silt and clay.

Figure 2-7.



Source: USDA NRCS Will County Soil Survey.

2.1.4 WETLANDS AND FLOODPLAINS

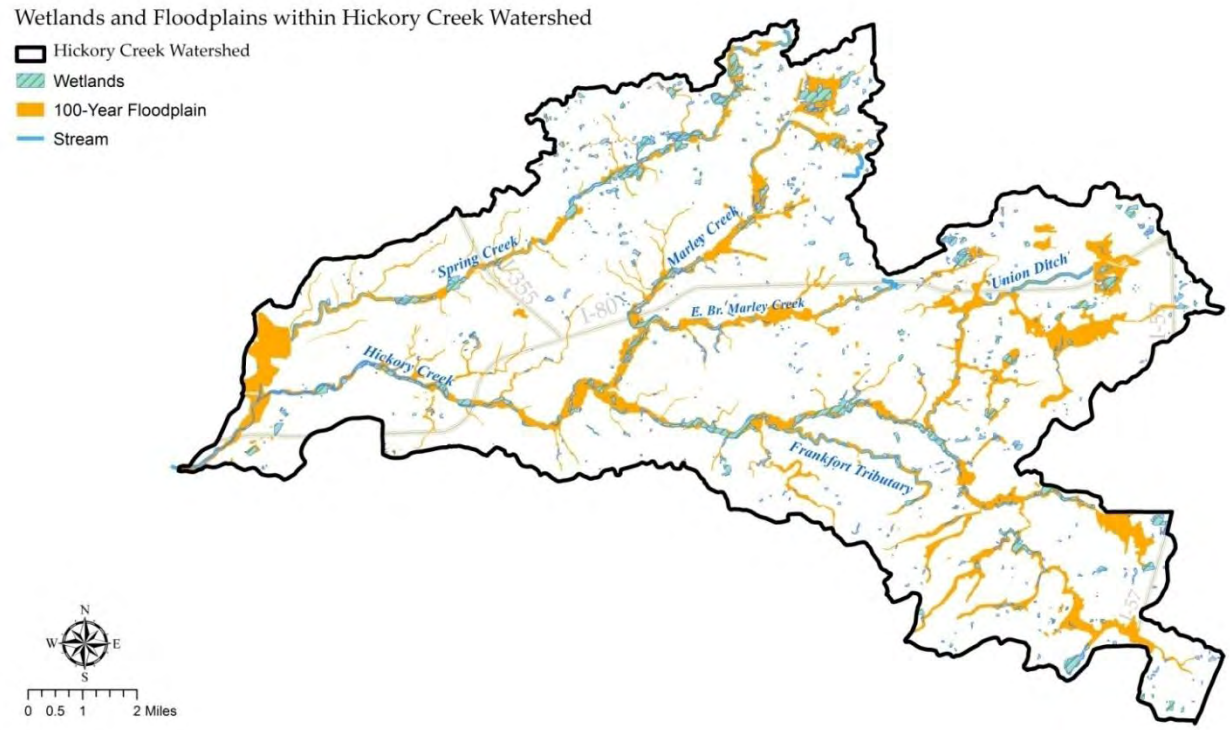
Approximately four percent of the Hickory Creek watershed was identified as wetland by the National Wetland Inventory (NWI). From Figure 2-8 it can be seen that much of the wetland area is concentrated along the main stem of Hickory Creek and along Spring Creek and Marley Creek. Comparison of Figures 2-2 and 2-8 also shows that the majority of wetlands along Hickory Creek and Spring Creek are located within existing open space areas, namely the FPDWC's Hickory Creek Preserve along Hickory Creek and Messenger Woods Nature Preserve and Hadley Valley Preserve along Spring Creek. Assuming the hydric soils mapped within the watershed developed under natural conditions, comparison of Figures 2-7 and 2-8 indicates that much of the historic wetland area within the watershed (approximately 16,700 acres or 93 percent) has been lost.

Digital representation ("Q3 Data") of the 100-year floodplain within the watershed from the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (FIRMs) is also presented in Figure 2-8. FEMA and the IDNR have entered into a Cooperative Technical Agreement to modernize FIRMs in Illinois. "The Map Modernization Program uses state-of-the-art technology, engineering and digital mapping standards to deliver more reliable digital flood hazard data and maps in a Geographic Information Systems (GIS) format" and will "…culminate in the finalization of revised FIRMs and Flood

[12] NRCS Soil Data Viewer Version 5.1.000.0012

Insurance Studies (FIS)."[13] According to the project web site, the effective date of the modernized maps for Cook County was in August 2008, whereas the modernized maps for Will County were not yet effective as of the writing of this plan.

Figure 2-8.



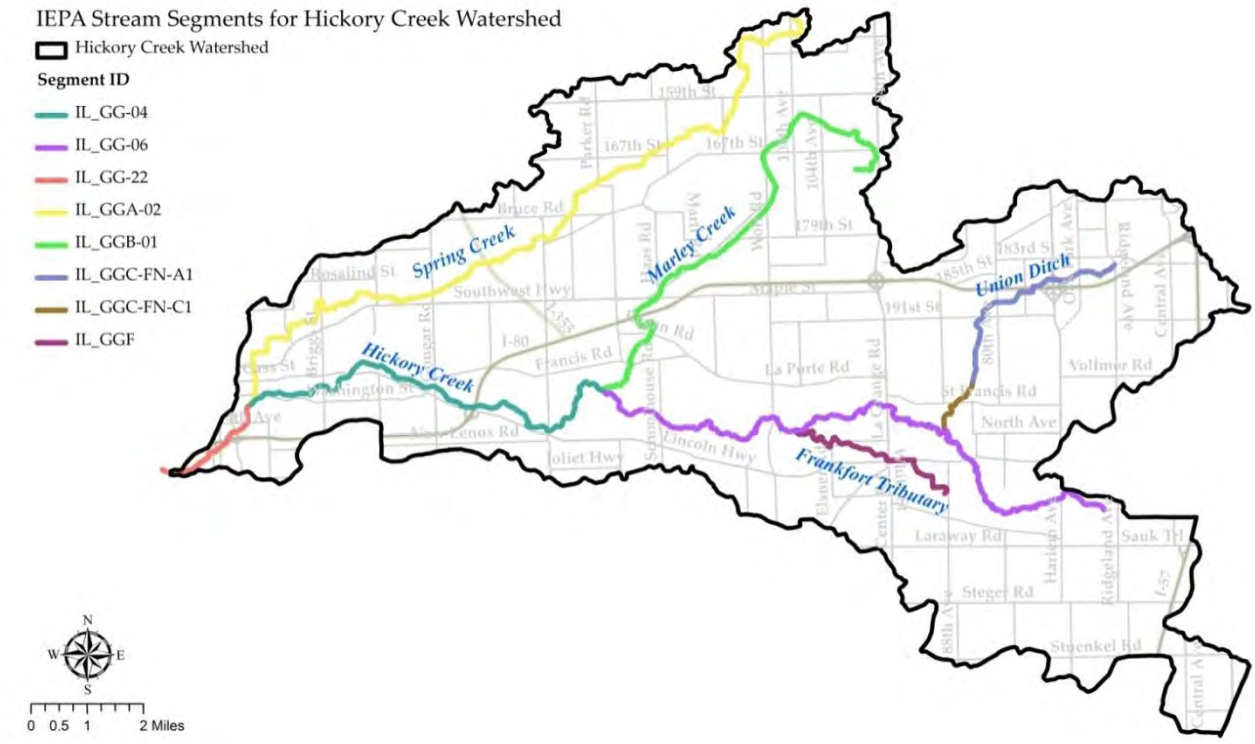
Source: USFWS National Wetland Inventory and FEMA Q3 Data.

[13] See http://dnr.state.il.us/flood/ for further details and project status for Will and Cook Counties.

2.2 Impairments and Potential Sources of Impairment

The IEPA's *Illinois Integrated Water Quality Report and Section 303(d) List-2008*[14] ("2008 Integrated Report") indicates that Hickory Creek and its major tributaries (Spring Creek, Union Ditch, and Frankfort Tributary) are impaired for aquatic life use, with the exception of Marley Creek, which was not assessed. The 2008 Integrated Report also indicates that a portion of Hickory Creek is also impaired for primary contact use. The assessments provided in the 2008 Integrated Report are based on stream segments defined by the IEPA, which are presented in Figure 2-9.

Figure 2-9.



Source: IEPA

The potential cause of impairment for primary contact use in Segment IL-GG-22 is identified as fecal coliform in the 2008 Integrated Report. Potential causes of aquatic life use impairment for the Hickory Creek watershed stream segments are present in Tables 2-3 and 2-4, with potential causes separated by "pollutant" and "non-pollutant" causes as defined by the IEPA in the 2008 Integrated Report. The potential causes of impairment for primary contact and aquatic life uses are the basis for this plan and are the focus of the sections that follow; however, analysis of other parameters, such as nitrogen, was performed as noted in the following sections.

[14] The information provided in this plan is based on the 2008 Integrated Report. The *draft* 2010 Integrated Report was available for review, but had not yet been approved and finalized during the development of this plan.

Table 2-3. Potential *Pollutant* Causes of Impairment for Aquatic Life Use for Hickory Creek Watershed

Stream	Segment ID	Cl	Silver[15]	Zinc[16]	TP	Ammonia	TSS	Sed/silt[17]	Mn	Causes/ Segment
Union Ditch	IL_GGC-FN-A1	---	---	---	---	---	---	√	---	**1**
Union Ditch	IL_GGC-FN-C1	√	---	---	√	√	---	√	---	**4**
Frankfort Trib.	IL_GGF	---	---	---	√	---	---	---	---	**1**
Hickory Creek	IL-GG-06[18]	√	---	---	√	---	---	---	---	**2**
Marley Creek	IL_GGB-01					not assessed				
Hickory Creek	IL-GG-04	√	---	---	√	---	---	---	---	**2**
Spring Creek	IL_GGA-02	---	---	---	√	---	---	√	√	**3**
Hickory Creek	IL-GG-22	√	√	√	√	---	√	√	---	**6**
Segments Listed with Potential Cause		**4**	**1**	**1**	**6**	**1**	**1**	**4**	**1**	

Source: IEPA 2008 Illinois Integrated Water Quality Report and Section 303(d) List
Cl = chloride, TP = total phosphorus, TSS = total suspended solids, Sed/silt = sedimentation and siltation, Mn = manganese

Table 2-4. Potential *Nonpollutant* Causes of Impairment for Aquatic Life Use for Hickory Creek Watershed

Stream	Segment ID	Alteration in stream-side or littoral vegetative covers	Other flow regime alterations	Aquatic Algae	DO	Causes/ Segment
Union Ditch	IL_GGC-FN-A1	√	√	---	√	**3**
Union Ditch	IL_GGC-FN-C1	√	√	---	√	**3**
Frankfort Trib.	IL_GGF	---	---	---	---	**2**
Hickory Creek	IL-GG-06	---	---	---	---	**---**
Marley Creek	IL_GGB-01		**not assessed**			
Hickory Creek	IL-GG-04	---	---	---	---	**---**
Spring Creek	IL_GGA-02	---	---	---	√	**1**
Hickory Creek	IL-GG-22	√	√	√	---	**3**
Segments Listed with Potential Cause		**3**	**3**	**1**	**3**	

Source: IEPA 2008 Illinois Integrated Water Quality Report and Section 303(d) List

[15] No stream segments within the Hickory Creek watershed are listed for silver in the draft 2010 Section 303(d) List.
[16] No stream segments within the Hickory Creek watershed are listed for zinc in the draft 2010 Section 303(d) List.
[17] Sedimentation/siltation is not identified as a potential cause of impairment for Segment IL_GG_22 in the draft 2010 Section 303(d) List.
[18] Arsenic is identified as a potential cause of impairment for Segment IL_GG_06 in the draft 2010 Section 303(d) List.

2.3 Data Compilation and Analysis Findings

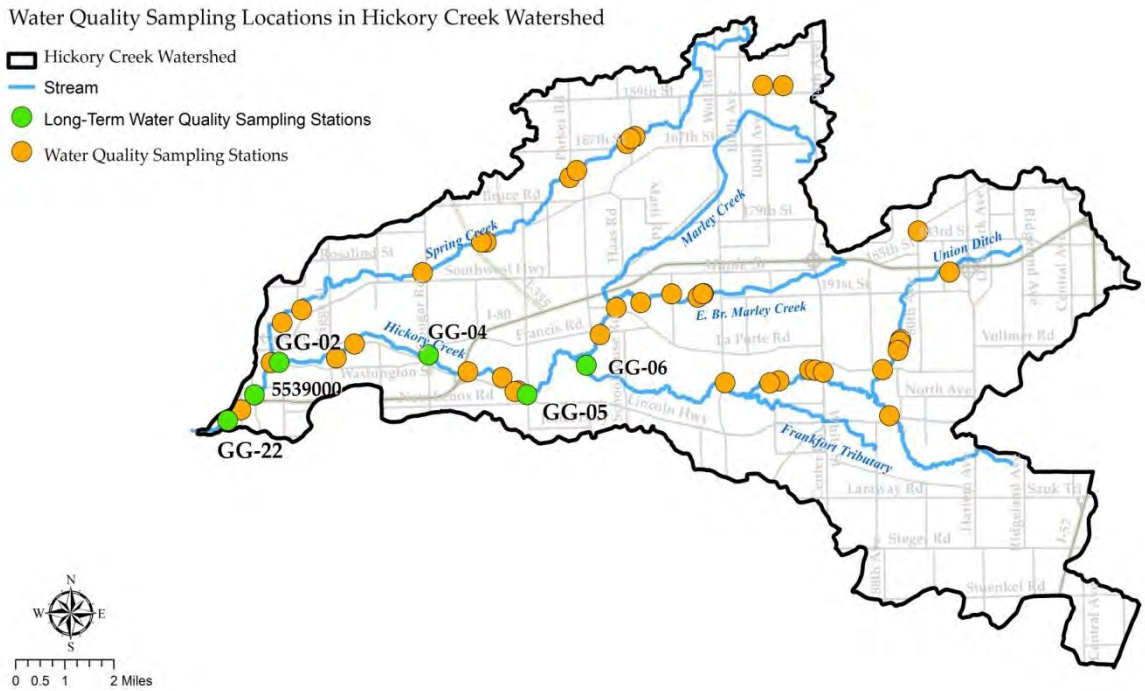
As part of the watershed assessment effort, in-stream chemical, biological and physical data were collected for the Hickory Creek watershed from numerous sources, such as the IEPA, Illinois Department of Natural Resources (IDNR), municipalities within the watershed, consultants, educational institutions, and volunteers. In total, forty-eight surface water quality and biological data stations were identified within the Hickory Creek watershed based on the various data sources. The data from each of these locations was compiled and analyzed as part of the watershed planning effort to develop a detailed understanding of the existing and past watershed conditions. Additional detailed information is presented in the appendices.

In general, the water quality data suggest that chloride may be problematic in Hickory Creek and in Union Ditch. Total phosphorus is clearly elevated, although chlorophyll *a* – which indicates algal growth, and therefore is one potential response variable – is only moderately high. Fecal coliform, the indicator of bacterial contamination, is generally elevated. On the other hand, suspended sediment concentrations spike only periodically in lower Hickory Creek. Although dissolved oxygen levels are low on Spring Creek, they appear to be within healthy ranges in Union Ditch, Hickory Creek, and Marley Creek based on the available data. Silver, zinc, and manganese were identified as being potential causes of impairment, but there is reason to believe that they may not have been listed properly in the IEPA 2008 Illinois Integrated Water Quality Report and Section 303(d) List as indicated in Sections 2.3.1.2 through 2.3.1.4. Findings of impairment by ammonia nitrogen appear to be based on very old data, and recently collected samples do not appear to exceed water quality criteria.

2.3.1 IN-STREAM CHEMICAL DATA ANALYSIS

In-stream chemical data were compiled in a Microsoft (MS) Access database to facilitate the data analysis and to provide the HCWPG with a tool that can be used for the compilation and analysis of data from future monitoring efforts. Water quality sampling locations for available data are shown in Figure 2-10. Brief summaries of the analysis findings for the in-stream chemical data are provided in the following sections. Supporting tables and discussions on data limitations and data handling are provided in Appendix A.

Figure 2-10.



2.3.1.1 Chloride

In 2008 IEPA identified chloride as a potential cause of impairment of aquatic life use in all Hickory Creek segments as well as Union Ditch (segment ID IL_GGC-FN-C1). The IEPA uses the General Use Water Quality Standard of 500 mg/L as the guideline for identifying chloride as a potential cause of aquatic life impairment.[19] Within the impaired segments, maximum chloride concentrations ranged from 720 mg/L in June 2003 to 933 mg/L in December 2005 (Appendix A: Table A-1). A maximum chloride concentration in excess of the 305(b) criterion (i.e., 684 mg/L) was also observed in Union Ditch at a location approximately 50 yards upstream from the Frankfort North Sewage Treatment Plant.[20]

2.3.1.2 Total Silver

In 2008 IEPA identified silver as a potential cause of impairment of aquatic life use in lower Hickory Creek (segment ID IL_GG-22). The IEPA uses the General Use Water Quality Standard of 5 µg/L as the 305(b) guideline for identifying silver as a potential cause of aquatic life impairment. The maximum observed total silver concentration in segment IL_GG-22 was 12 µg/L based on data collected in 1986 (Appendix A: Table A-2). The most recent total silver concentration in excess of the criterion was 6 µg/L in 1995. Although Hickory Creek segment IL_GG-04 is not currently identified as impaired by IEPA, total silver concentrations of 10 and 6 µg/L were observed based on data collected in 1976 and 2002, respectively. No other samples observed within the Hickory Creek watershed exceeded the total silver criterion.

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[19] The use of guidelines to determine whether a water quality constituent is a potential cause of impairment is discussed in the *Illinois Integrated Water Quality Report and Section 303(d) List-2008* starting at page 52.

[20] However, it should be noted that this site plots approximately only 100 yards upstream of segment IL_GGC_FN-C1. Due to uncertainties in GIS layer precision, further investigation may be necessary to determine whether this sample was indeed taken in Union Ditch (segment IL_GGC_FN-A1).

2.3.1.3 Dissolved Zinc

Acute and chronic dissolved zinc criteria for the protection of aquatic organisms are functions of hardness. According to Section 302.208 of Illinois Water Quality Standards, hardness-based metals criteria are assessed using the hardness of the water body at the time the metals sample was collected. The metal concentration is divided by the calculated water quality standard to determine a quotient value. Attainment is assessed by averaging the quotient values for the duration of the averaging period, which in the case of zinc chronic criteria is four days. Average quotient values less than or equal to one are considered in attainment. For purposes of this assessment, individual zinc values were compared to their respective chronic and acute criteria if hardness data were available. Quotient values were not calculated.

Available data suggest that Spring Creek, Union Ditch (segment ID IL_GGC_FN_C1), East Branch Marley Creek, and all three segments of Hickory Creek may have dissolved zinc concentrations above their respective chronic criteria (Appendix A: Tables A-3 and A-4). However, it is important to note that these results are potentially biased by reporting limits in excess of criteria.[21] Only lower Hickory Creek (segment ID IL_GG-22) was identified by IEPA as impaired for zinc in 2008. Seventeen dissolved zinc samples within segment IL_GG-22 had concentrations in excess of criteria (Appendix A: Table A-4). The majority of these exceedances appear to be based on data over 20 years old or on data below laboratory detection limits. The only sample from IL_GG-22 in excess of criteria, above detection limits, and collected more recently than 1990 had a dissolved zinc concentration of 22 μg/L, which only slightly exceeded its calculated chronic zinc criterion of 19 μg/L. However, the calculated criterion was based on a hardness value of only 87 mg/L, which is relatively low and may represent an outlier.

2.3.1.4 Total Manganese

In 2008 IEPA identified total manganese as a potential cause of impairment of aquatic life use in Spring Creek. The IEPA uses the General Use Water Quality Standard of 1,000 μg/L as the 305(b) guideline for identifying manganese as a potential cause of aquatic life impairment. The maximum observed total manganese concentration from available data was 830 μg/L in Spring Creek segment IL_GGA-02 (Appendix A: Table A-5). According to Strand and Associates, the 303(d) listing was based on data collected in 1986, which were not available for this study. Strand and Associates furthermore suggest that elevated levels of total manganese observed in 1986 may be due to groundwater, which was the primary potable water supply to the Oak Valley WRF service area prior to the late 1990s.[22]

2.3.1.5 Total Ammonia Nitrogen

According to Section 302.208 of Illinois Water Quality Standards, total ammonia nitrogen (ammonia) must in no case exceed 15 mg/L. However, additional acute, chronic, and sub-chronic ammonia criteria apply.[23] Union Ditch (segment ID IL_GGC-FN-C1) was identified as impaired for ammonia by IEPA in

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[21] Of 227 dissolved zinc samples from the Hickory Creek watershed, 102 samples had a reporting limit of 100 μg/L and 68 samples had a reporting limit above 50 μg/L. Although unclear due to insufficient metadata, an additional 12 samples potentially had reporting limits of 100 μg/L. Lack of metadata also made it difficult to distinguish between practical quantification limits and method detection limits, which is critical information when such limits approach criteria as is the case here.

[22] Strand and Associates. 2006. Letter Report to Illinois Environmental Protection Agency Quality Assurance Officer Mike Henerby regarding Spring Creek (GGA-2) stream sampling results. September 12, 2006.

[23] The acute criterion has a high of 15 mg/L at a pH equal or less than 7.6 and decreases as pH increases (e.g., 8.41 mg/L at pH of 8.0). The chronic criterion (i.e., 30-day average) is a function of pH, temperature, and the early life stages (ELS) period. ELS present chronic criteria were evaluated for purposes of this assessment. At a temperature of 26˚C the ELS present chronic criteria range from 1.16 mg/L at a pH of 8.0 to 2.82 mg/L at a pH of 7.0. Sub-chronic criteria (i.e., 4-day average) are equal to 2.5 times the chronic criteria. The less conservative ELS absent criterion would only apply outside the ELS present period from March through October if

2008. Based on an analysis of available ammonia data, it is unclear why IEPA made this determination. This segment of Union Ditch had a maximum ammonia concentration of 1.0 mg/L, which was less than its corresponding acute, chronic, or sub-chronic criteria (Appendix A: Table A-6 and A-7).

On the other hand, criteria exceedances were observed in all Hickory Creek segments as well as Spring Creek and Marley Creek. Maximum ammonia values in these segments ranged from 4.3 to 9.5 mg/L. However, it is important to note that all the observed exceedances date to the mid-1970s or earlier with the exception of Spring Creek. Chronic ammonia criteria were exceeded twice in segment IL_GGA-02 in 2006, but it is unclear whether these excursions constitute an impairment per Section 302.208 of the Illinois Water Quality Standards given that the analysis of the compiled data was based on single samples whereas the chronic criterion is based on a 30-day average.

2.3.1.6 Total Phosphorus

In 2008 IEPA determined all segments of Hickory Creek as well as Spring Creek, Union Ditch (IL_GGC-FN-C1), and Frankfort tributary to be impaired for aquatic life and identified total phosphorus (TP) as a potential cause. Illinois does not have water quality standards based criteria for TP; however, IEPA does have a non-standards-based TP criterion of 0.61 mg/L. As another point of measure, TP values may also be compared with its half-saturation constant. At nutrient levels approximately five times the half-saturation constant (i.e., the nutrient concentration at which the algal growth rate is one-half its maximum value) algal growth is no longer limited by nutrients and becomes constant.[24] Literature values of half-saturation constants for phosphorus vary widely; however, U.S. Environmental Protection Agency (USEPA) suggests typical constants for phosphorus range from 0.005 to 0.030 mg/L.[25] Therefore, algal communities are generally not considered phosphorus-limited at levels above 0.025 and 0.15 mg/L.

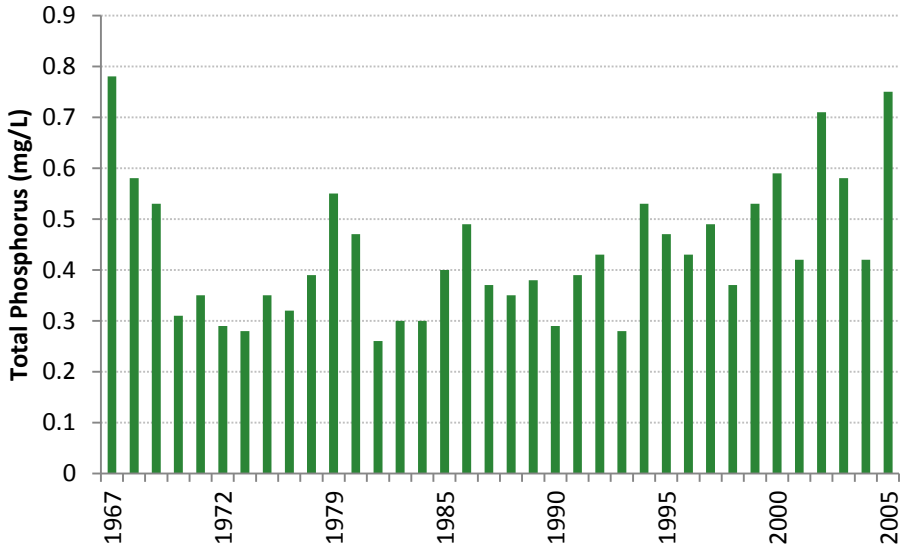
Relative to IEPA's non-standards-based TP criterion and USEPA's suggested half-saturation constants, TP concentrations in the Hickory Creek watershed are high. With the exception of Lake Sedgewick and Union Ditch, the maximum observed TP concentration exceeds Illinois' non-standards-based criterion anywhere from approximately two to four-fold (Appendix A: Table A-8). Data from Hickory Creek stations located at S. Joliet Street (GG-22), Gardner Street (GG-01), Richards Street (5539000), and Washington Street (GG-02) were compiled to obtain a more complete picture of TP trends. Annual geometric means from 1967 to 2005 ranged from 0.26 to 0.78 mg/L, but no clear trend could visually be observed based on the annual geometric mean bar chart (Figure 2-11). Results of a Mann-Kendall test suggest a significant upward trend in TP at the 95% confidence level; however, a more rigorous analysis would be required to make this conclusion. Statistical complexities such as seasonality, correlated data, and corrections for flow would need to be taken into account to properly assess for trends.

ELS are not actually present. Illinois makes no default assumptions regarding the presence or absence of ELS outside the ELS present period. Additionally, the ELS absent criterion only differs from the ELS present criterion at temperatures below 15°C.

[24] Chapra, S.C, 1997. Surface Water-Quality Modeling. The McGraw-Hill Companies, Inc., New York.

[25] USEPA. 1985. Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling (Second Edition). United States Environmental Protection Agency, Washington, D.C. EPA. EPA/600/3-85/040.

Figure 2-11. Total Phosphorus Annual Geometric Means for Hickory Creek



2.3.1.7 Sestonic Chlorophyll *a*

Chlorophyll *a* is a photosynthetic pigment found in algae, either attached to the bottom or suspended in the water column, and may be used as a measure of algal biomass. Limnologists consider chlorophyll *a* to be an early indicator response variable to excessive nutrient loading. Excessive levels of chlorophyll *a* may indicate negative effects from nutrient enrichment. Although no criterion currently exists for chlorophyll *a* in Illinois, suggested benchmarks for sestonic (i.e., in the water column) algae in rivers and streams are available. Some research has suggested that sestonic chlorophyll *a* concentrations of over 30 µg/L represent enriched conditions,[26] while USEPA has suggested that appropriate sestonic chlorophyll *a* reference conditions are either 2 or 7 µg/L, depending on the analysis method.[27]

The greatest sestonic chlorophyll *a* concentrations were observed in lower Hickory Creek (segment ID IL_GG-22) and in Lake Sedgewick. Hickory Creek segment ID IL_GG-22 had a geometric mean and maximum concentration of chlorophyll *a* of 19 and 1,510 µg/L, respectively (Appendix A: Table A-9). However, the validity of the 1,510 µg/L outlier value is questionable, as all other chlorophyll *a* samples were well below 100 µg/L. With the exception of GG-22, all other stream segment IDs had geometric mean values less than 10 µg/L. Thus, the data seem to suggest moderately increased algal biomass in response to nutrient concentrations.

[26] Dodds, W., J.R. Jones, and E.B. Welch. (1998). Suggested Classification of stream trophic State: Distributions of Temperate Stream Types by Chlorophyll, Total Nitrogen, and Phosphorus. Water Research. 32(5): 1455-1462.

[27] These values are for the level III ecoregion 54 for sestonic chlorophyll *a* concentrations measured by Flourometric and by Spectrophotometric methods, respectively. These values are based on the 25th percentile of USEPA's nutrient database for level III ecoregion 54 (which contains the Hickory Creek watershed). However, these values were based upon very limited datasets. USEPA. (2000). Ambient Water Quality Criteria Recommendations, Information Supporting the Development of State and Tribal Nutrient Criteria, Rivers and Streams in Nutrient Ecoregion VI United States Environmental Protection Agency, Washington, D.C. EPA. EPA-822-B-00-017.

2.3.1.8 Dissolved Oxygen

IEPA designated both segments of Union Ditch and Spring Creek as impaired for low dissolved oxygen (DO) in 2008.[28] Data compiled for this project validate the finding that DO levels are below the numeric criteria for Spring Creek. Discrete DO data collected in Spring Creek as part of the 2006 Oak Valley WRF water quality study include concentrations below criteria (Appendix A: Table A-10). Additionally, continuous dissolved oxygen data collected as part of this same study routinely dropped below 1.0 mg/L on a daily basis throughout much of July 2006 both upstream and downstream of the Oak Valley WRF. Moderate fluctuations from day to night (2 to 4 mg/L) and relatively low daily maximum DO levels suggest that excessive algae is not significantly contributing to low DO levels. Instead, low DO in Spring Creek is likely the result of high sediment oxygen demand (SOD), as evidenced by the "silt/mud" substrate noted in the 1986 IEPA study and lack of reaeration[29].

On the other hand, data compiled for Union Ditch do not clearly indicate DO impairment issues. Only five and six discrete DO data points were obtained for Union Ditch segments IL_GGC-FN-A1 and IL_GGC-FN-C1, respectively. The only discrete data point to drop below the instantaneous criterion of 3.5 mg/L had a concentration of 3.4 mg/L in August 2003 in segment IL_GGC-FN-C1. As an arithmetic mean, only segment IL_GGC-FN-C1 is below its respective spring and summer criterion of 6.0 mg/L with an average concentration of 5.4 mg/L; however, this is only based on two data points. More DO data would be necessary to properly assess Union Ditch for criteria attainment. There do not appear to be any significant DO issues on Hickory or Marley Creeks based on the compiled dataset. With the exception of a few notable DO readings at or below 3.0 mg/L collected over 30 years ago, DO concentrations appear to be in compliance in Hickory and Marley Creeks.

2.3.1.9 Total Suspended Solids

In 2008 IEPA identified lower Hickory Creek (segment ID IL_GG-22) as impaired for aquatic life and identified total suspended solids (TSS) as a potential cause. Illinois does not have a water quality standards based criterion for TSS, but IEPA uses a non-standards-based TSS criterion of 116 mg/L to determine impairment. Lower Hickory Creek had 14 out of 197 samples with TSS concentrations above 116 mg/L and had a maximum TSS concentration of 1,560 mg/L in 1994 (Appendix A: Table A-11). With one exception on Spring Creek in 2006, no other samples in the entire dataset exceeded the 116 mg/L non-standards-based criterion.

2.3.1.10 Fecal Coliform

In 2008 IEPA identified lower Hickory Creek (segment ID IL_GG-22) as impaired for primary contact recreation based on high fecal coliform values.[30] Available data suggest that fecal coliform levels are indeed elevated throughout the Hickory Creek watershed. Maximum fecal coliform concentrations

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[28] This determination was based on the following criteria from Section 302.206 of Illinois Water Quality Standards:

1. March through July
   a. 5.0 mg/L at any time; and
   b. 6.0 mg/L (6.25 mg/L for enhanced waters) as a daily mean averaged over 7 days.
2. August through February
   a. 3.5 mg/L (4.0 mg/L for enhanced waters) at any time;
   b. 4.0 mg/L (4.5 mg/L for enhanced waters) as a daily minimum averaged over 7 days; and
   c. 5.5 mg/L (6.0 mg/L for enhanced waters) as a daily mean averaged over 30 days.

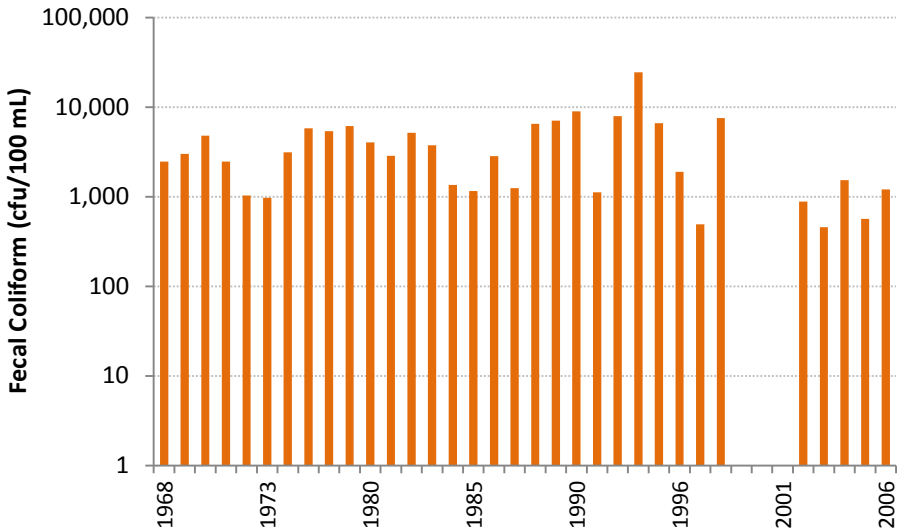
[29] Strand and Associates. 2006. Letter Report to Illinois Environmental Protection Agency Quality Assurance Officer Mike Henerby regarding Spring Creek (GGA-2) stream sampling results. September 12, 2006.

[30] The criterion for fecal coliform in Illinois during the recreational season from May through October is 200 colony forming units (cfu) per 100 mL, which is expressed as a geometric mean and is based on a minimum of five samples taken over not more than a 30 day period. Additionally, no more than 10 percent of the samples may exceed 400 cfu/100 mL during any 30 day period.

exceeded 10,000 cfu/100 mL in Hickory, Spring, and Marley Creeks (i.e., all segment IDs with fecal coliform data). Geometric means in Hickory Creek segment IDs IL_GG-04 and IL_GG-06 were 860 and 271 cfu/100 mL, respectively (Appendix A: Table A-12). Fecal coliform geometric means for Spring Creek segment ID IL_GGA-02 and Marley Creek also exceed criteria, but the underlying dataset is over 25 years old. Although the fecal coliform dataset is spatially and temporally limited, the existing data do suggest that fecal contamination is a pervasive and chronic issue throughout the watershed.

Review of annual geometric means from four Hickory Creek monitoring stations located near the bottom of the watershed suggests that there are no apparent long-term trends in fecal coliform. Data from Hickory Creek stations located at S. Joliet Street (GG-22), Gardner Street (GG-01), Richards Street (5539000), and Washington Street (GG-02) were compiled to obtain a more complete picture of fecal coliform levels. A visual inspection of the data based on the recreational season does not suggest any clear long-term trends (Figure 2-12).

Figure 2-12. Recreational Season Fecal Coliform Annual Geometric Means for Hickory Creek



Note: Fecal coliform data were not available at these stations for 1999 to 2001.

2.3.2 AQUATIC BIOLOGY

Biological data for the Hickory Creek watershed were collected from several sources, including the IDNR, IEPA, Illinois RiverWatch Network and municipalities and their consultants. The purpose of collecting biological data was to gain an understanding of the condition of the aquatic life within the watershed. Biological data are also used by the IEPA to assess streams for impairment for aquatic life use.

2.3.2.1 Biological Diversity and Integrity Ratings

A comprehensive view of the aquatic biological condition within the Hickory Creek watershed is provided through the IDNR's Biological Stream Rating System ("Rating System"), which rates streams for biological diversity, integrity and significance. This rating system utilizes "…fish, macroinvertebrates, crayfish, mussels, and threatened and endangered species information to generate an overall score of biological diversity and integrity in streams."[31] Data collected by the IDNR, IEPA and Illinois Natural History Survey from 1997 to 2006 were considered in developing the ratings statewide.[32] Separate

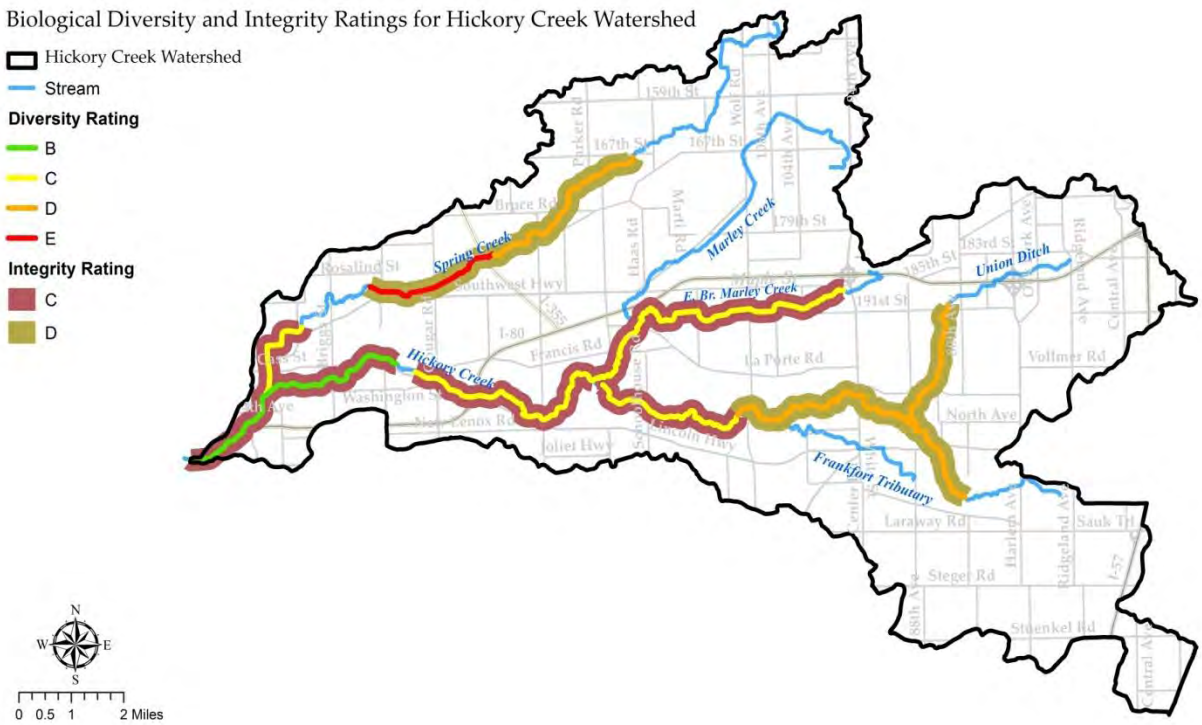
[31] See: http://dnr.state.il.us/pubaffairs/2008/October/stream.html

[32] IDNR. 2008. *Integrating Multiple Taxa in a Biological Stream Rating System.* For the purpose of IDNR's Rating System, biological diversity is "…broadly defined as the variety of taxa within several important aquatic groups (e.g., mussels, fish,

diversity and integrity ratings are developed for stream segments. Letter ratings of "A" (good) through "E" (poor) are used for both ratings.[33]

The biological diversity and integrity ratings for stream segments within the Hickory Creek watershed are presented in Figures 2-13. Biological diversity for segments within the watershed received ratings that ranged from "B" to "E", with diversity generally increasing from upstream to downstream. The "B" rating in the downstream segment of Hickory Creek is consistent with, and possibly in part is based on, 2006 IDNR fish data discussed later in this report, which demonstrated relatively increased diversity in this portion of the stream. Biological integrity is limited to ratings of "C" and "D," but again biological integrity appeared to increase from upstream to downstream. No Biologically Significant Stream segments, as defined by IDNR's Rating System, were identified within the Hickory Creek watershed.

Figure 2-13.



Source: IDNR Stream Rating Geodatabase

macroinvertebrates, and crayfish)," and biological integrity is defined as "a system's wholeness and the ability of a system to support organisms and processes comparable to natural habitat of the region.

[33] *Ibid.*

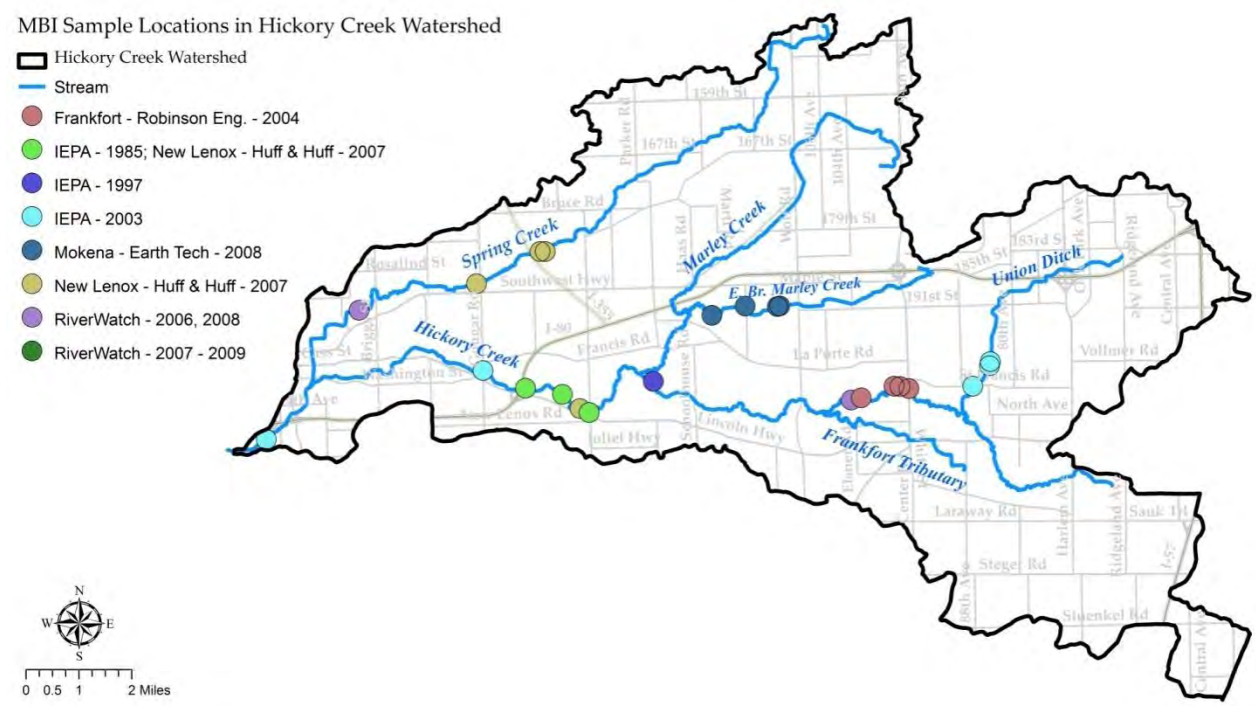
2.3.2.2 Macroinvertebrate Biotic Index

Macroinvertebrate (aquatic insects, worms, clams, snails, and crustaceans) data is utilized by the IEPA in its assessments of streams for impairment of aquatic life use. The IEPA uses macroinvertebrate indices, specifically the new macroinvertebrate Index of Biotic Integrity (mIBI) and the Macroinvertebrate Biotic Index (MBI). Macroinvertebrate data collected during the watershed assessment was generally accompanied by calculated MBI values rather than mIBI values. As a result, the following discussion is limited to MBI values within the Hickory Creek watershed. MBI values range from 0 to 11, with lower values representing higher quality. Although the IEPA uses a detailed decision table for assessing whether given stream segments are impaired for aquatic life, the IEPA uses MBI values of 5.9 or greater to make preliminary assessment conclusions that stream segments are impaired for aquatic life use.[34]

Biological sampling locations with calculated MBI values are presented in Figure 2-14. MBI values, organized by the IEPA stream segments and sampling location, are provided in Table 2-5. Visual inspection of Table 2-5 shows that each stream segment listed in the table had MBI values calculated that were above the IEPA cutoff criterion for impairment, except for the upper segment of Union Ditch (segment ID IL_GGC-FN-A1). Also from visual inspection of the table, the East Branch of Marley Creek is the only stream segment for which all of the MBI scores were above the IEPA cutoff criterion.

A notable observation about the compiled macroinvertebrate data and MBI values is that the collected data do not appear to include contemporaneous watershed-wide data, but rather is comprised of uncoordinated sample collection efforts from discrete periods and discrete locations. In contrast, the fish data below were collected with the intent to characterize the entire stream network at one point in time.

Figure 2-14.



[34] IEPA. 2008. Illinois Integrated Water Quality Report and Section 303(d) List-2008.

Table 2-5. MBI Values for the Hickory Creek Watershed

Stream	Project Station ID[35]	Data Source	Collection Year	MBI[36]
Hickory Creek	GG-22	IEPA	2003	7.2
	GG-05	IEPA	1985	5.2
	HC-HI-1	IEPA	1985	5.4
	HC-HI-2	IEPA	1985	6.1
	GG-04	IEPA	2003	5.7
	GG-04	IEPA	2003	5.9
	GG-04	New Lenox - Huff & Huff	2007	5.5, 7.8
	GG-05	New Lenox - Huff & Huff	2007	5.3, 8.3
	HC-HI-1	New Lenox - Huff & Huff	2007	5.5, 5.1
	HC-HI-2	New Lenox - Huff & Huff	2007	5.0, 4.9
	HC-HI-3	New Lenox - Huff & Huff	2007	5.7, 4.1
	HC-HI-4	Frankfort - Robinson Eng.	2004	6.2
	HC-HI-5	Frankfort - Robinson Eng.	2004	5.8
	HC-HI-6	Frankfort - Robinson Eng.	2004	6.5
	HC-HI-7	Frankfort - Robinson Eng.	2004	5.8
	GG-06	IEPA	1997	5.6
	GG-06	IEPA	2003	5.7
	R0209003	RiverWatch	2006	5.3
	R0209003	RiverWatch	2008	5.7
Spring Creek	GGA-SC-02	New Lenox - Huff & Huff	2007	8.4, 10.3
	HC-SP-1	New Lenox - Huff & Huff	2007	5.1, 9.5
	HC-SP-2	New Lenox - Huff & Huff	2007	5.9, 8.9
	R0209102	RiverWatch	2007	5.2
	R0209102	RiverWatch	2008	5.4
	R0204101	RiverWatch	2009	5.7
	R0209102	RiverWatch	2009	5.7
Union Ditch	GGC-FN-A1	IEPA	2003	5.7, 5.7
	GGC-03	IEPA	2003	5.8, 9.3
	GGC-FN-C1	IEPA	2003	9.3, 9.7
E. Br. Marley Creek	GGBA-M-A1	Mokena - Earth Tech	2008	6.1
	GGBA-M-C1	Mokena - Earth Tech	2008	7.9
	GGBA-M-C2B	Mokena - Earth Tech	2008	6.0
	GGB-MC-02	Mokena - Earth Tech	2008	6.0

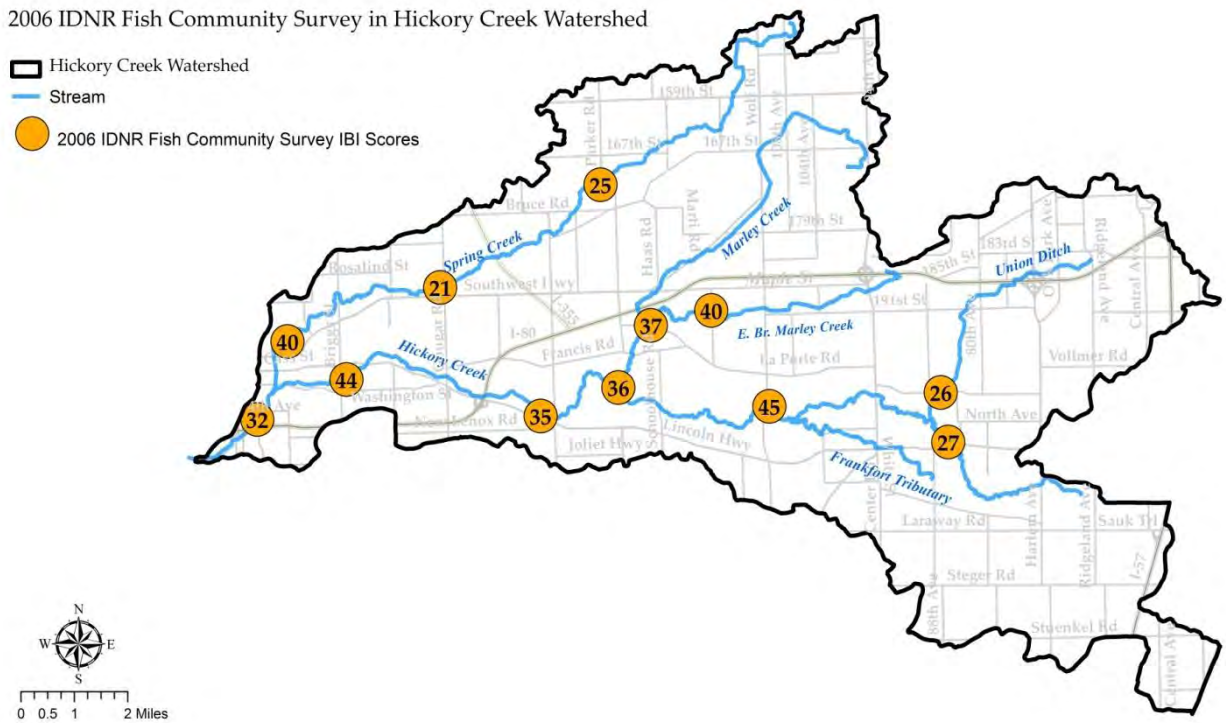
[35] Project-designated sample station IDs are shown. Correlation table between project-designated IDs and original source IDs is provided in Appendix A; Table A-13.

[36] Samples were collected using both the Kick-Sort and Hester-Dendy sampling methods. MBI values are presented for Kick-Sort and Hester-Dendy methods, respectively.

2.3.2.3 Fish Index of Biotic Integrity

The Fish Index of Biotic Integrity (IBI) is used to measure the health of the fish community as compared to reference streams of similar size and geographic region. IBI values are calculated based on ten metrics derived from fish community samples and the range of IBI value is 0 to 60, with higher values representing higher biotic integrity and stream quality. IBI values calculated from various sampling efforts were compiled as part of the watershed assessment. These data were reviewed with respect to dates of collection and distribution of sampling efforts and it was determined that the 2006 Fish Community Survey conducted by IDNR offers watershed-wide fish data and IBI values from a given time period (June 2006). The sampling locations for the IDNR survey and the IBI values are presented in Figures 2-15.

Figure 2-15.



The IEPA uses IBI values of 41 or less to make preliminary assessment conclusions that stream segments are impaired for aquatic life use.[37] Review of the IBI values in Figure 2-15 indicates that each of the stream segments had IBI values that were below the IEPA criterion. However, Hickory Creek segments IL_GG-04 and IL_GG-06 had IBI values within select sampling reaches that were higher than the IEPA criterion.

2.3.3 PHYSICAL STREAM CONDITION

Physical stream condition information for the Hickory Creek watershed was collected from several sources, including the IDNR, IEPA, Illinois RiverWatch Network and municipalities and their consultants. Much of the physical stream condition information collected appears to have been collected to characterize aquatic habitat. Data collected by the IDNR during its 2006 fish community assessment of Hickory Creek and its tributaries provides a contemporaneous and watershed-wide collection of physical

[37] IEPA. 2008. Illinois Integrated Water Quality Report and Section 303(d) List-2008.

stream condition information (Appendix A; Table A-14). Data from the IEPA's Stream Habitat Assessment Protocol (SHAP) for Hickory Creek and Union Ditch are provided in Table 2-6.

Table 2-6. 2003 IEPA Stream Habitat Assessment Protocol (SHAP) Findings for Select Reaches

Habitat Metric	Hickory Creek Watershed Stations[38]					
	Hickory Creek			Union Ditch		
	GG-06	GG-04	5539000	GGC-FN-A1	GGC-FN-C1	GGC-03
Bottom Substrate	Excellent	Excellent	Good	Poor	Poor	Fair
Deposition	Good	Excellent	Excellent	Poor	Fair	Fair
Substrate Stability	Excellent	Excellent	Excellent	Poor	Fair	Fair
Instream Cover	Good	Excellent	Poor	Good	Fair	Good
Pool Substrate Characterization	Excellent	Excellent	Poor	Fair	Fair	Fair
Pool Quality	Fair	Excellent	Poor	Poor	Fair	Poor
Pool Variability	Fair	Excellent	Poor	Poor	Fair	Fair
Canopy Cover	Excellent	Excellent	Poor	Excellent	Good	Excellent
Bank Vegetative Protection/Stability	Fair	Excellent	Excellent	Fair	Good	Good
Top of Bank Land use	Fair	Excellent	Poor	Poor	Poor	Poor
Flow-related Refugia	Good	Excellent	Poor	Fair	Fair	Good
Channel Alteration	Good	Excellent	Fair	Fair	Fair	Fair
Channel Sinuosity	Fair	Fair	Poor	Poor	Poor	Poor
Width/Depth Ratio	Poor	Fair	Poor	Fair	Poor	Poor
Hydrologic Diversity	Good	Excellent	Poor	Poor	Fair	Fair
Overall	**Good**	**Excellent**	**Fair**	**Fair**	**Fair**	**Fair**

Source: IEPA 2003 SHAP data provided through personal communication with Howard Essig of IEPA.

Evaluation of the IDNR data and other collected data indicates that the physical stream condition throughout the watershed is relatively variable; however, some generalizations can be made from the data:

- The downstream portions of Hickory Creek and Spring Creek have been heavily altered through the construction of concrete walls and widening for flood control purposes.
- The upper portions of the tributaries also appear to have been in part channelized and a portion of Spring Creek appears to have high percentage of silt and mud.
- The middle reaches of Hickory Creek appear to have had better stream conditions than other segments, including relatively higher percentages of in-stream cover, coarse substrate and pool/riffle sequences.

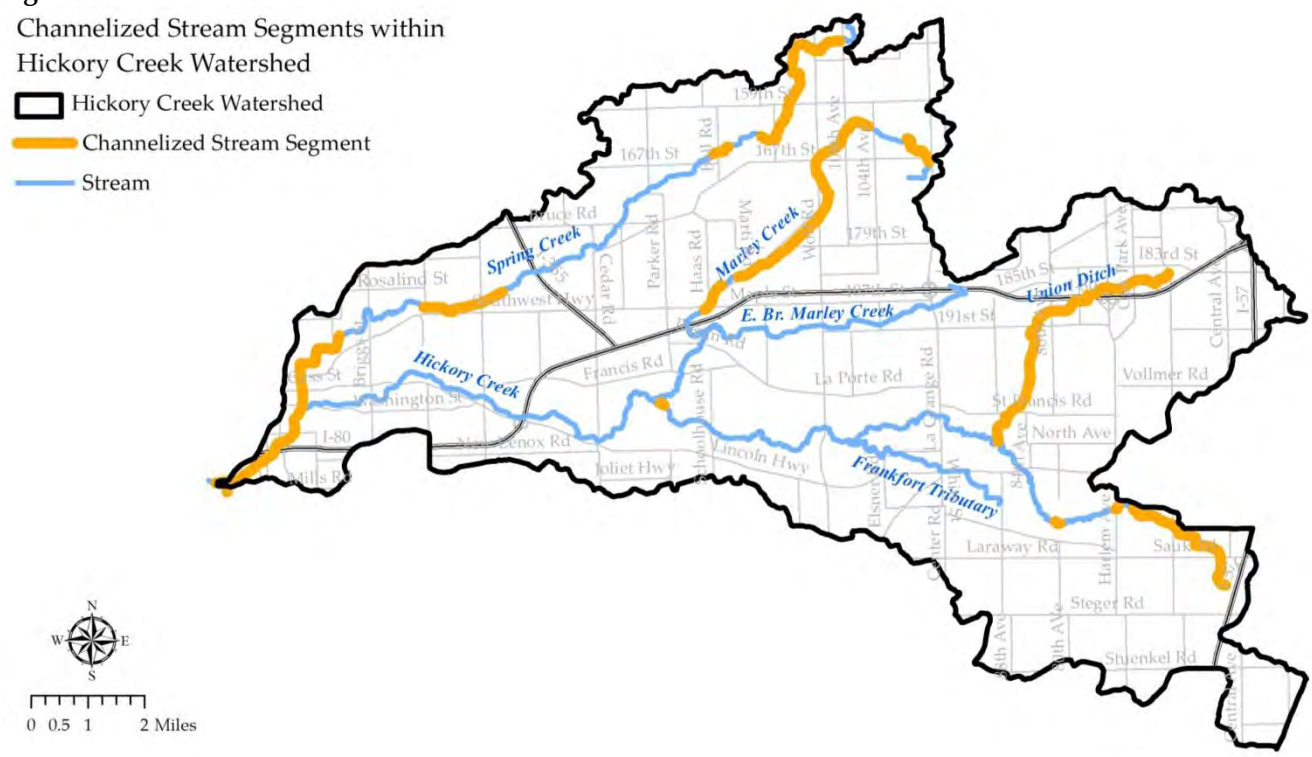
These findings are consistent with the channelized stream segment data presented in Figure 2-16.[39] This data set indicates that approximately 22 miles of stream have been channelized within the watershed.

Additional physical stream characteristic information collected during the watershed reconnaissance conducted as part of the plan development process is discussed in Section 2.4.

[38] Project-designated sample station IDs are shown. The correlation table between project-designated IDs and original source IDs provided in Appendix A; Table A-13.

[39] Data presented in Figure 2-16 was modified to include the channelized portion of Hickory Creek. Recently completed stream restoration projects such as the FPDWC's Hadley Valley project on Spring Creek are not reflected in the data.

Figure 2-16.



Source: Modified from Illinois Streams Information System statewide data.

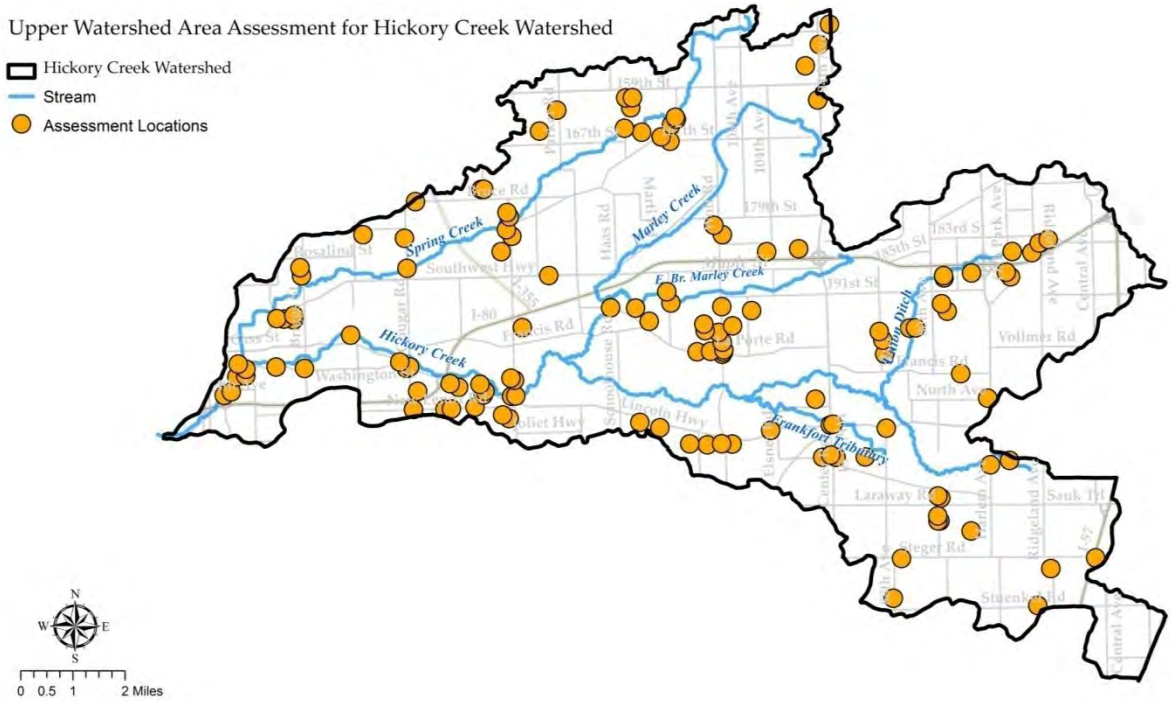
2.4 Watershed Reconnaissance

A strategic watershed reconnaissance was performed to complement the watershed assessment and to support recommendations included in this plan. The reconnaissance effort included the evaluation of areas that were potential sources of non-point source pollution and the identification and evaluation of potential retrofit and restoration opportunities. The field reconnaissance included evaluation of existing conditions within both the stream corridors and the upper watershed areas.

The purpose of the assessment of the upper watershed areas was to obtain a detailed understanding of current stormwater management practices within the watershed in each of the municipalities and to identify opportunities for stormwater retrofits to improve water quality. The upper watershed areas were assessed following a modified version of the Center for Watershed's (CWP) Unified Subwatershed and Site Reconnaissance methodology. Following a desktop review of aerial imagery for the watershed, field crews visited select sites throughout the watershed to identify, evaluate and photo-document site conditions with respect to water quality improvement opportunities. Several sites currently in agricultural production were also assessed as part of this effort. The site locations visited as part of the upper watershed assessment are shown in Figure 2-17. Specific project recommendations derived from the upper watershed assessment are included in Section 4.1 and in Appendix D. The upper watershed assessment revealed ample opportunity for improvements in water quality through the implementation of stormwater retrofits and improved development practices. Consistent with current stormwater regulations (e.g. the Will County Stormwater Ordinance), the stormwater management approach observed in much of the developed areas within the watershed appears to focus predominantly on stormwater discharge rate control (i.e. detention) with minimal attention given to water quality

treatment. Additionally, several areas exist in the watershed where neither rate control or water quality treatment measures were observed. These locations appear to have been developed prior to the establishment of the county-wide ordinance.

Figure 2-17.



Assessment of the stream corridors within the watershed was comprised of two assessment efforts. One assessment focused on the evaluation of physical stream characteristics and the other focused on potential problems areas within and adjacent to the stream corridor. Physical stream characteristics were evaluated using a standardized assessment approach.[40] This approach not only allowed for comparative analysis between assessed reaches, but provided the opportunity to evaluate specific parameters (e.g., sediment deposition, channel sinuosity, etc.) that may need to be addressed if a stream restoration project is undertaken in a given reach. A total of 13 stream reaches were assessed as part of this effort (Figure 2-18).[41] The results of the assessment are presented in Table 2-7 and 2-8, which are separated based on whether the field crew determined that the given reach was predominately riffle/pool habitat or glide/pool habitat. This distinction allows for more appropriate comparison between reaches. Based on the assessment results, a few reaches, such as Site 001 on Union Ditch, Site 008 on Marley Creek and Site 006 on the East Branch of Marley Creek, stand out as having relatively degraded physical stream characteristics. Recommendations for stream restoration projects within these reaches are provided in Section 4.2.

[40] Missouri Department of Natural Resources. 2003. *Stream Habitat Assessment Project Procedure*. Rating descriptions presented in this plan—excellent, good, fair, and poor— were changed from those presented in the procedure document—optimal, suboptimal, marginal, and poor—respectively.

[41] A total of 17 sites were visited as part of this effort, but physical stream characteristic assessments were only conducted at 13 sites.

Figure 2-18.

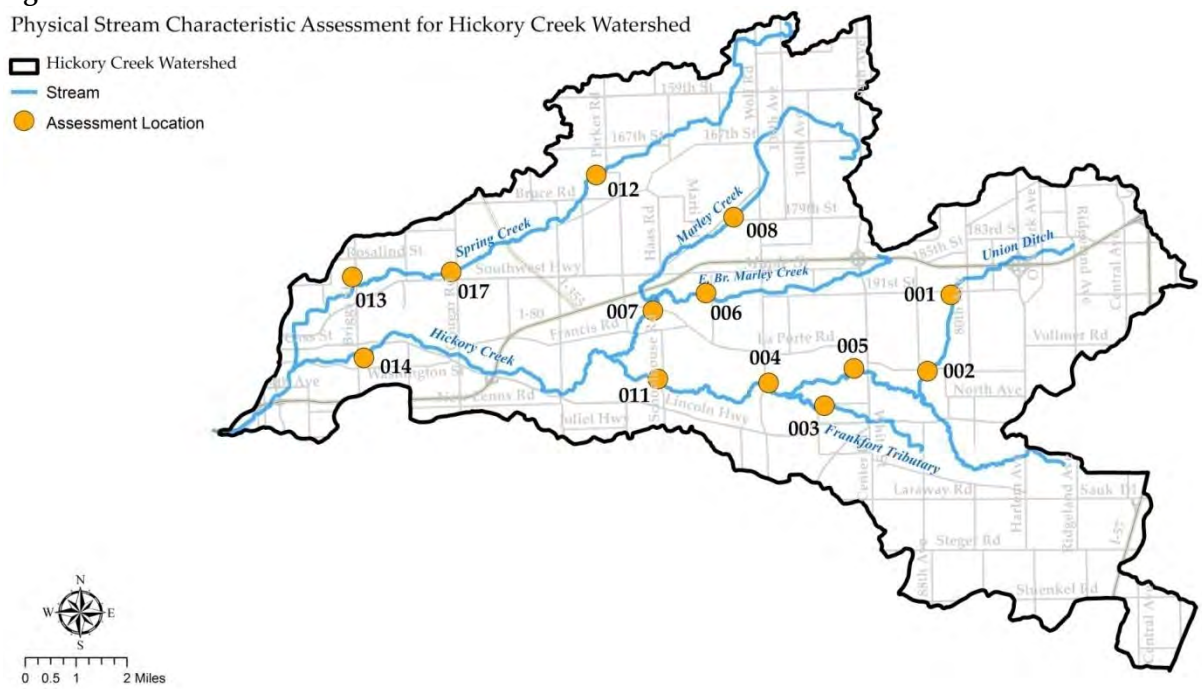


Table 2-7. Physical Stream Condition Assessment—Glide/Pool Habitat

Parameter	Site 001 Union Ditch	Site 002 Union Ditch	Site 007 Marley Creek	Site 008 Marley Creek	Site 011 Hickory Creek	Site 012 Spring Creek	Site 017 Spring Creek
Epifaunal Substrate / Available Cover	Poor	Good	Fair	Poor	Poor	Good	Poor
Pool Substrate Characterization	Fair	Good	Fair	Fair	Fair	Good	Fair
Pool Variability	Poor	Fair	Poor	Poor	Poor	Poor	Fair
Sediment Deposition	Poor	Fair	Fair	Poor	Poor	Poor	Good
Channel Flow Status	Good	Good	Fair	Fair	Excellent	Good	Good
Channel Alteration	Poor	Good	Good	Fair	Good	Excellent	Good
Channel Sinuosity	Poor	Fair	Good	Fair	Fair	Fair	Excellent
Bank Stability-Left	Good	Good	Fair	Poor	Good	Good	Excellent
Bank Stability-Right	Good	Good	Fair	Poor	Good	Good	Excellent
Vegetative Protection-Left	Good	Good	Fair	Fair	Fair	Good	Excellent
Vegetative Protection-Right	Good	Good	Fair	Fair	Fair	Good	Excellent
Riparian Vegetative Zone Width-Left	Fair	Fair	Good	Poor	Excellent	Excellent	Excellent
Riparian Vegetative Zone Width-Right	Fair	Fair	Good	Poor	Fair	Excellent	Excellent

Table 2-8. Physical Stream Condition Assessment—Riffle/Pool Habitat

Parameter	Site 003 Frankfort Tributary	Site 004 Hickory Creek	Site 005 Hickory Creek	Site 006 E. Br. Marley Creek	Site 013 Spring Creek	Site 014 Hickory Creek
Epifaunal Substrate / Available Cover	Good	Excellent	Good	Fair	Excellent	Excellent
Embeddedness	Good	Good	Fair	Fair	Good	Good
Velocity / Depth Regime	Fair	Good	Fair	Fair	Good	Good
Sediment Deposition	Good	Good	Fair	Poor	Good	Good
Channel Flow Status	Fair	Good	Fair	Fair	Fair	Good
Channel Alteration	Good	Excellent	Good	Fair	Excellent	Good
Riffle Quality	Good	Good	Good	Fair	Good	Good
Bank Stability-Left	Good	Good	Good	Fair	Good	Poor
Bank Stability-Right	Good	Good	Good	Fair	Fair	Good
Vegetative Protection-Left	Good	Good	Excellent	Fair	Good	Fair
Vegetative Protection-Right	Good	Good	Excellent	Fair	Good	Good
Riparian Vegetative Zone Width-Left	Poor	Poor	Excellent	Poor	Excellent	Fair
Riparian Vegetative Zone Width-Right	Poor	Excellent	Excellent	Fair	Good	Excellent

The other stream corridor assessment focused on identifying potential problem areas within the stream corridor of Hickory Creek and its tributaries. The approach used for the stream corridor assessment was a modified version of the CWP's Unified Stream Assessment methodology. Assessments were categorized into one of eight categories: channel modification, erosion, impacted buffer, outfall, stream crossing, trash and debris, utility impacts, and miscellaneous. As can be seen from review of Figure 2-19 several potential problem areas were identified through this assessment. At a few locations, more than one problem type was identified at that location. Common problems identified at these locations included streambank erosion, channel modification, trash and debris, and impacted buffers (Figures 2-20 through 2-27) Specific project recommendations developed to address some of these problem areas are included in Section 4 and in Appendix D.

Figure 2-19.

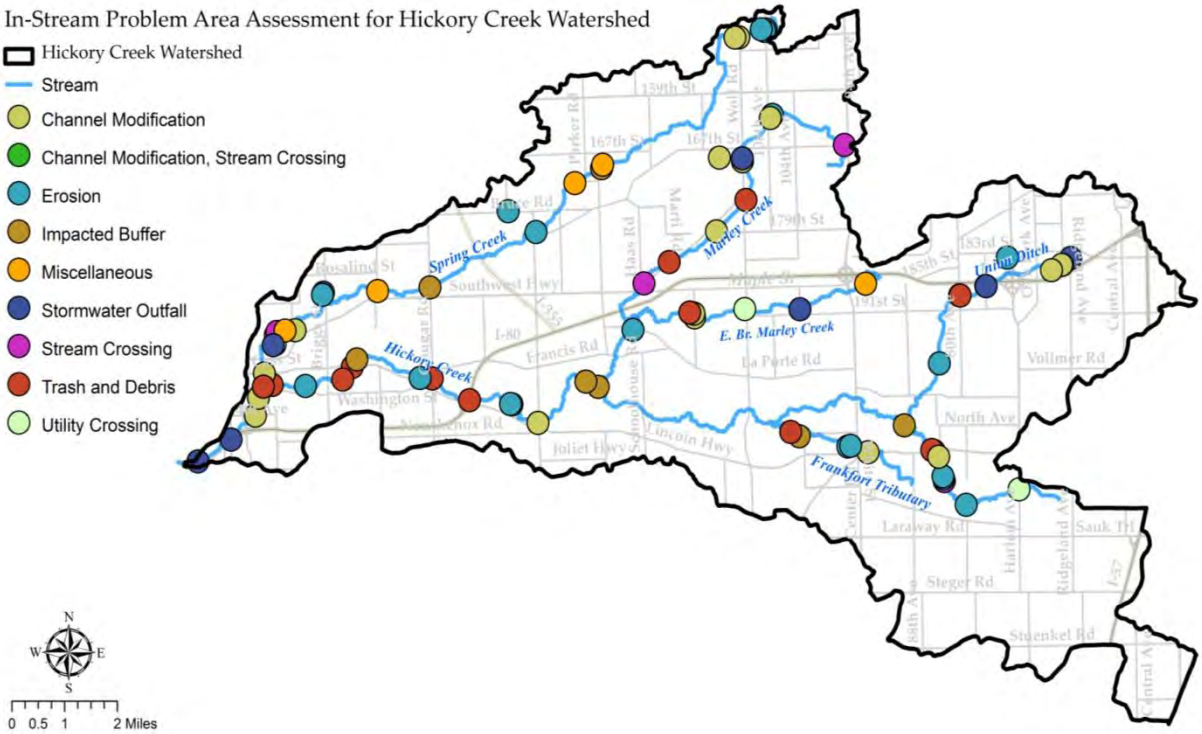


Figure 2-20. Trash and Debris Accumulation and Channel Modification, Frankfort Tributary, Frankfort

Figure 2-21. Impacted Buffer, Hickory Creek, Frankfort

Figure 2-22. Channel Modification, Marley Creek at Wolf Road

Figure 2-23. Streambank Erosion, Hickory Creek at Hillcrest Road

Figure 2-24. Channel Modification, Hickory Creek, Joliet

Figure 2-25. Accumulated Sediment and Woody Debris, Hickory Creek at I-80

Figure 2-26. Channel Modification (On-line Detention), Union Ditch, Tinley Park

Figure 2-27. Impacted Buffer and Streambank Erosion, Frankfort Tributary, Frankfort

2.5 Existing Watershed Conditions Pollutant Loads

A critical step in providing recommendations within this plan is the identification of the different pollutant sources within the watershed and the relative magnitude of pollutant loads from those sources.

2.5.1 NON-POINT SOURCE POLLUTANT LOADS AND CRITICAL AREAS

For non-point source pollution, an effective method to estimate pollutant loads at the watershed scale is to use variable watershed characteristics that can affect pollutant load contributions, such as land use, soils, etc. The USEPA's planning level tool, Spreadsheet Tool to Estimate Pollutant Loads (STEPL), was used to develop "existing conditions" non-point source pollutant load estimates for total nitrogen, total phosphorus, and sediment within the Hickory Creek watershed.

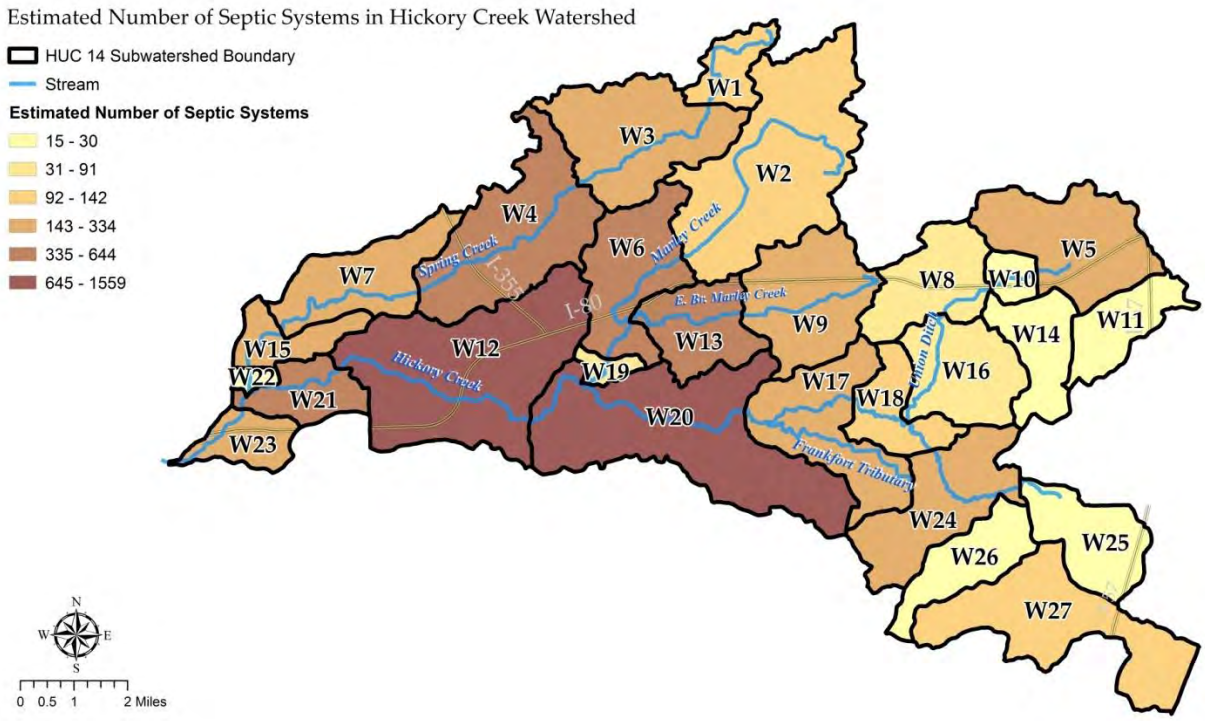
One of the primary inputs to STEPL is land use information. The land use data used the Hickory Creek watershed analysis was largely based on CMAP's land use inventory for 2005. This data was also updated using more recent land use information from the FPDWC and a database on recent developments maintained by CMAP. STEPL allows for a detailed breakdown of the broader urban land use category into categories such as commercial, single-family residential, etc. to developed more refined pollutant load estimates based on variable pollutant concentrations in stormwater runoff from these land uses.

In an effort to further refine the pollutant load estimates for the watershed, the pollutant load estimates were developed at the subwatershed level using the IEPA's HUC 14 watershed boundaries, which separates the Hickory Creek watershed into 27 subwatersheds (Figure 2-28, 2-29, 2-30, and 2-31). Estimating the pollutant loads at the subwatershed level, as well as at the watershed level, helps identiy critical areas, providing the opportunity to evaluate subwatersheds on a relative pollutant load contribution basis and to better target the recommendations included in this plan and in future planning efforts. Data tables presenting the results at the subwatershed-scale are provided in Appendix B.

The STEPL tool also affords the ability to analyze nutrient contributions to the watershed from failing septic systems. In the absence of readily-available septic system location information for the Hickory Creek watershed, an approach similar to the approach used in the Jackson Creek Watershed Plan was used to develop an estimate of the number of septic systems within the watershed on a subwatershed basis.[42] This approach entailed using Census 1990 data for on-site sewage disposal, NIPC's 1990 land use data, and CMAP's 2005 land use data to estimate the number of systems within the watershed in 2005. The approach is based on the assumption that all new septic systems were installed in unincorporated residential areas. It was also assumed that those septic systems in place in 1990 had not been removed. This assumption was based on the fact that significant portions of the watershed have incorporated since 1990, but existing residential dwellings may not have not necessarily been connected to a municipal sewage collection system.[43] The septic system estimates are presented in Figure 2-28 and Table B-1 in Appendix B. No records on septic failure rates are available for systems within the watershed; however, the Will County Health Department suggests that the failure rate may be on the order of 10 percent of systems within the watershed.[44]

[42] CMAP and Will County Stormwater Management Planning Committee. *Jackson Creek Watershed Plan; Technical Report*. April 2009.
[43] Personal communication with Brian Scanlon, Will County Health Department.
[44] *Ibid.*

Figure 2-28.



The "existing conditions" non-point source pollutant load estimates for nitrogen, phosphorus, and sediment are shown in Table 2-9 for the whole watershed. These results indicate that based on existing watershed conditions, agricultural land is the largest (over 50 percent for each parameter) non-point source of these pollutants within the Hickory Creek watershed, with urban land as the next largest source. The contributions from agricultural land are in part based on the characteristics of the land on which much of the remaining agricultural land is located; the southeastern and northwestern portions of the watershed. In the southeastern portion of the watershed, the soils are classified as having high runoff potential and restricted water transmission through the soil (HSG D; Figure 2-5), whereas the northwestern portion of the watershed has areas with relatively steep slopes (Figure 2-4). These characteristics both contribute to increased pollutant loads based on the calculation approaches employed by STEPL. The unit loads (mass of pollutant per unit area) are shown by subwatershed in Figures 2-29, 2-3-, and 2-31. These maps therefore show *critical areas* for nonpoint source pollutant management. Again, high contributions can be seen – but for different reasons -- from the agricultural land in the Spring Creek subwatershed and in the southeast part of the headwaters.

Table 2-9. Non-Point Source Pollutant Load Estimates

Sources	Nitrogen Load (lb/yr)	Phosphorus Load (lb/yr)	Sediment Load (t/yr)
Urban	229,358	28,528	8,586
Cropland	336,032	45,035	10,206
Pastureland	1,122	127	22
Forest	4,285	1,968	121
Septic	22,124	8,665	--
Total	**592,922**	**84,322**	**18,934**

Figure 2-29.

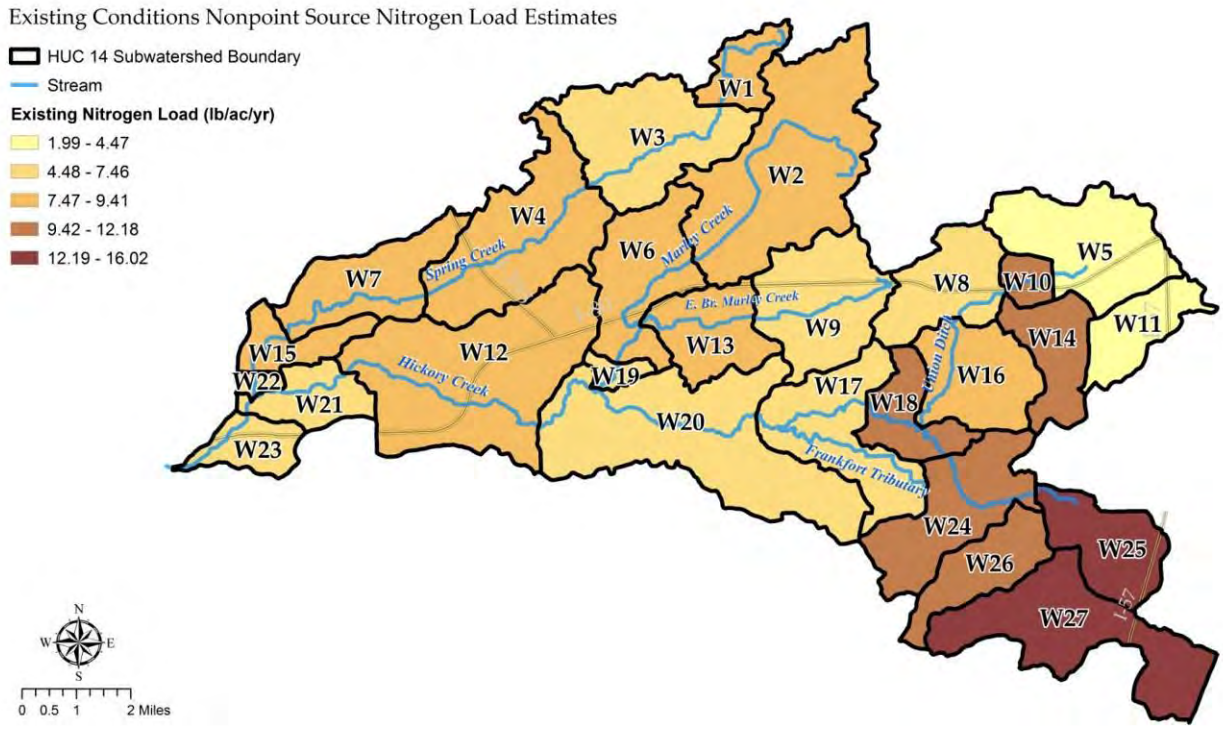


Figure 2-30.

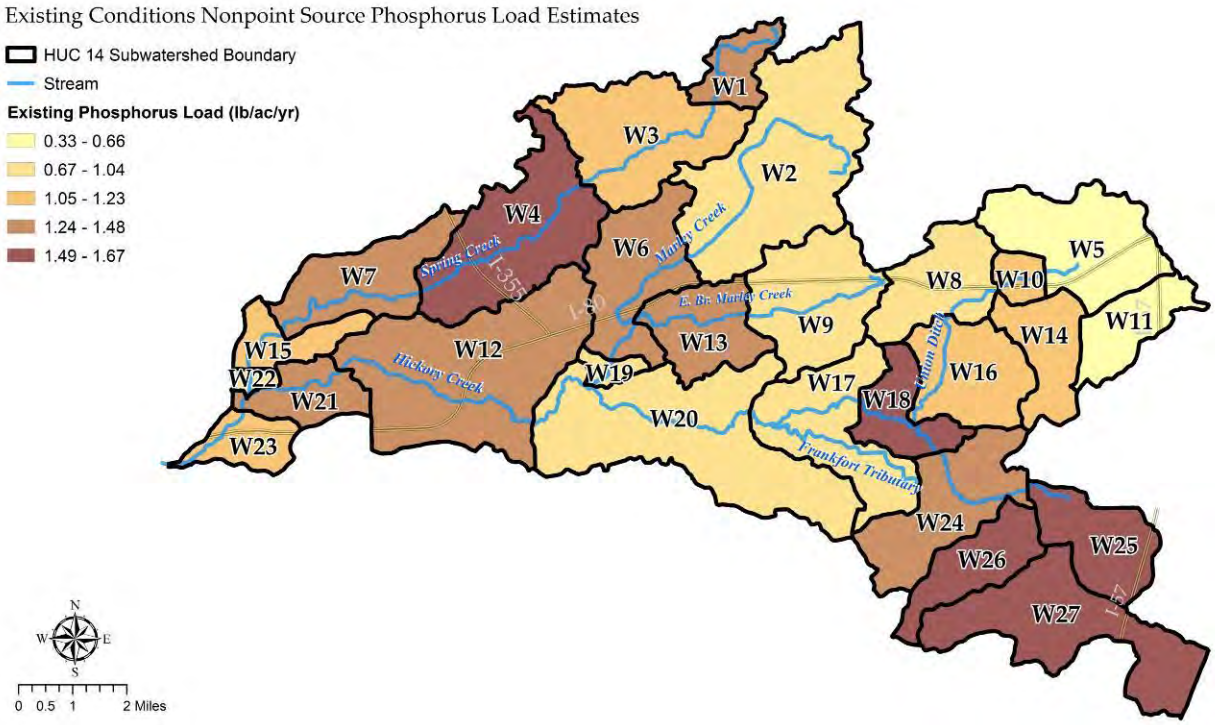
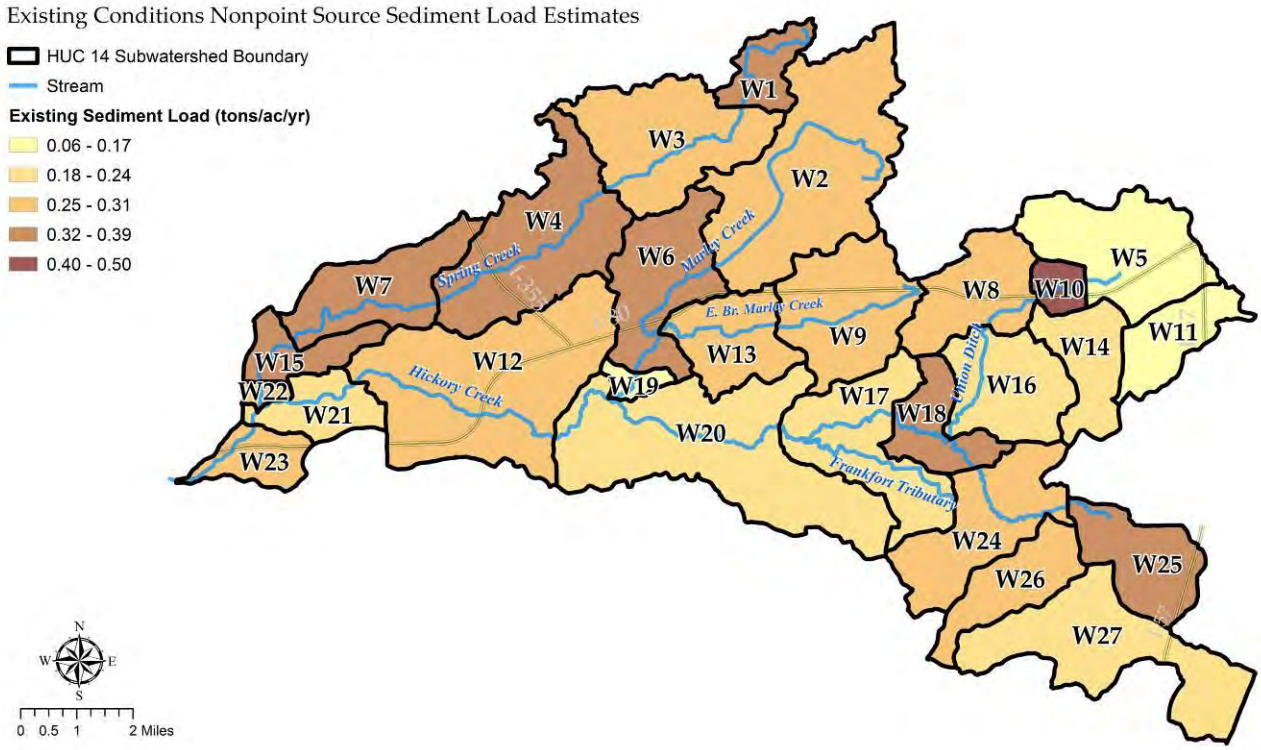


Figure 2-31.



The information provided in the previous paragraphs primarily focused on the results of the STEPL analysis, and further details regarding data sources and assumptions are provided in Appendix B. However, several issues regarding the project-specific use and capabilities of STEPL are worth noting.

- STEPL was not used to analyze pollutant loads from streambank erosion at the watershed scale; pollutant load reduction estimates for streambank erosion at specific locations are provided in Section 4.4
- STEPL does not account for drain tile contributions of pollutants.
- Pollutants from construction sites were not included in the analysis. Pollutant loads from construction sites can be highly variable and should be analyzed on a site-by-site basis and should be addressed through IEPA's NPDES program for construction activities.
- It is important to recognize that STEPL is not an in-stream response model and only estimates watershed pollutant loading based on coarse data, such as event mean concentrations.
- STEPL is not calibrated. Additional monitoring data and a more sophisticated watershed loading model would be required to develop a calibrated model for the Hickory Creek watershed as recommended in Section 5.2.

Nonetheless, STEPL serves as a useful planning-level tool for estimating relative contributions of different pollutant sources within the watershed. STEPL also allows for the estimation of pollutant load reductions from the implementation of many of the projects recommended in Section 4.

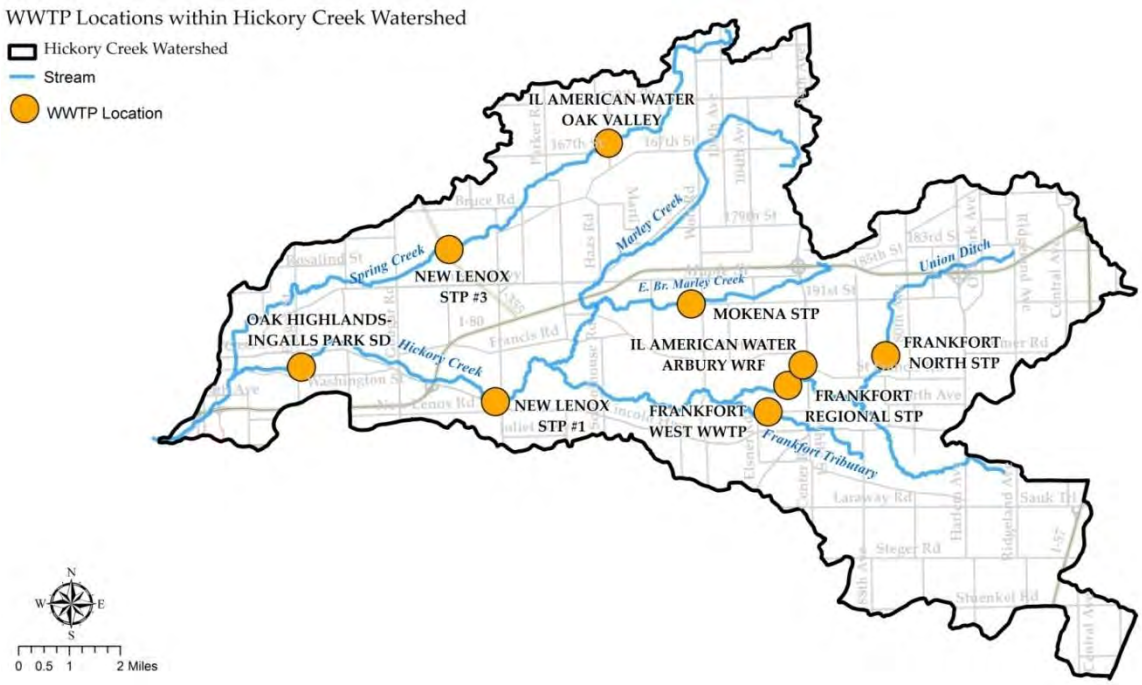
2.5.2 MUNICIPAL WASTEWATER TREATMENT PLANT POLLUTANT LOADS

As part of the effort to identify contributions from the various sources of pollutants to the Hickory Creek watershed, an analysis of the existing municipal wastewater treatment operations was performed. Eight wastewater treatment plants (WWTPs) currently discharge effluent to the Hickory Creek watershed.[45] Additionally, New Lenox WWTP #3 will discharge to Spring Creek when it comes online in 2012. The WWTPs currently, or soon to be, discharging effluent to the Hickory Creek watershed are identified in Table 2-10 and the locations of the facilities are shown in Figure 2-29.

Table 2-10. WWTPs within Hickory Creek Watershed

Facility Name	Owner/Operator	Location	Receiving Stream	Design Average Flow (mgd)[46]
Oak Highlands/Ingalls Park (OH/IP)	OH/IP Sanitary District	Unincorporated	Hickory Creek	0.25
New Lenox STP #1	Village of New Lenox	New Lenox	Hickory Creek	1.54[47]
New Lenox WWTP #3	Village of New Lenox	New Lenox	Spring Creek	0.36
Frankfort Regional STP	Village of Frankfort	Frankfort	Hickory Creek	3.00
Frankfort West WWTP	Village of Frankfort	Frankfort	Frankfort Trib.	1.30
Frankfort North STP	Village of Frankfort	Frankfort	Union Ditch	1.35
Mokena STP	Village of Mokena	Mokena	E. Br. Marley Creek	2.50
Illinois American—Arbury Hills WRF	Illinois American Water	Mokena	Hickory Creek	0.62
Illinois American—Oak Valley WRF	Illinois American Water	Homer Glen	Spring Creek	1.50

Figure 2-32.



[45] The project team validated that the following WWTPs, originally in the Hickory Creek watershed, are no longer in service: Camp Manitoqua (Frankfort) and Marilyn Estates STP (Mokena).

[46] Design Average Flow (DAF) values were determined through review of existing facility NPDES permits and personal communication with plant operators.

[47] The DAF in the proposed permit for New Lenox STP #1 is 2.5 million gallons per day.

WWTP effluent quality (e.g., TSS, $CBOD_5$, ammonia, etc.) and flow data were collected and analyzed from each of the WWTPs for the period of 2007 through 2009 as part of the watershed assessment effort. In general, the data from the eight wastewater treatment plants currently in service indicate that these plants are properly operated and produce an effluent significantly better than their respective NPDES permit requirements.

The pollutant load estimates for the WWTPs presented in the following paragraphs are focused on WWTP nutrient (i.e. total nitrogen and total phosphorus) loads. Additional watershed loading analysis results for nutrients and other parameters are provided in the section that immediately follows (Section 2.5.3). The majority of the plants within the Hickory Creek watershed are not required to monitor total nitrogen or total phosphorus given that the plants are not currently regulated for these parameters. Frankfort Regional STP is the only plant within the watershed currently required to meet the IEPA's interim phosphorus standard of 1.0 mg/L, and only limited data for total phosphorus for this plant was provided. New Lenox STP #1 also monitors, and provided data for, orthophosphate.

The nutrient pollutant load estimates for the WWTPs were estimated through use of the flow data provided by each of the plants for 2007 through 2009 and effluent concentration estimates for plants where usable data were not available (i.e. all plants except Frankfort Regional STP and New Lenox STP #1). The effluent concentration estimates, 4 mg/L for total phosphorus and 20 mg/L for total nitrogen, are based on the project team's experience with similar treatment systems and are within ranges of values supported by literature for these types of systems.[48] For New Lenox STP #1, the orthophosphate data was assumed to approximately represent the total phosphorus concentration present in the plant effluent. The existing conditions WWTP nutrient load estimates are provided in Table 2-11.

Table 2-11. Wastewater Treatment Plant Nutrient Load Estimates Based on Reported Flow

Facility	Reported Average Flow (mgd)	Estimated Concentrations (mg/L)		Estimated Annual Load (lb/yr)	
		Total N	Total P	Total N	Total P
Oak Highlands-Ingalls Park SD	0.170	20	4.0	10,360	2,070
New Lenox--STP #1	2.124	20	2.99[49]	129,400	19,340
New Lenox--WWTP #3	0	0	0	0	0
Frankfort Regional STP	1.569	20	0.86[50]	95,590	4,090
Frankfort West WWTP	1.269	20	4.0	77,310	15,460
Frankfort North STP	1.103	20	4.0	67,200	13,440
Mokena STP	1.973	20	4.0	120,200	24,040
Arbury (Illinois American)	0.369	20	4.0	22,460	4,490
Oak Valley WRF (Illinois American)	0.741	20	4.0	45,140	9,030
Totals				**567,660**	**91,960**

Although the nitrogen and phosphorus loads from point sources (i.e. WWTPs) and non-point sources were estimated using two different and rather simplistic estimation approaches, combining the estimates (Figure 2-33) provides an opportunity to compare the relative contributions of the various sources of nutrients to the Hickory Creek watershed. This comparison indicates that point sources and non-point sources both contribute approximately 50 percent of the average annual nutrient loads to the watershed. However, as will be seen in the following section, analysis using actual in-stream chemical data and flow

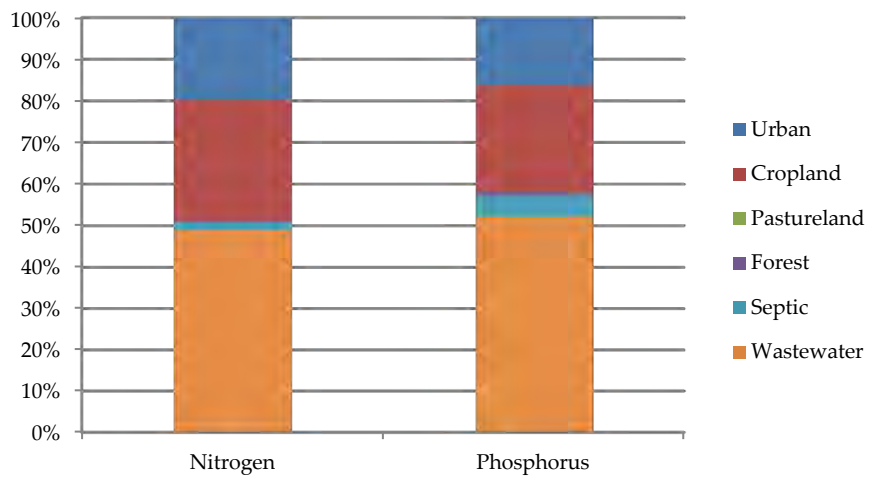
[48] Asano, Takashi, Franklin Burton, Harold Leverenz, Ryujiro Tsuchihashi, and George Tchobanoglous. 2007. *Wastewater Reuse: Issues, Technologies, and Applications*. Metcalf and Eddy. Table 3-14.

[49] Total P concentration estimated from 2007-2009 Orthophosphate data; range 0.13 to 5.37 mg/L, mean 2.99 mg/L.

[50] Total P concentration estimated from 12/2009-5/2010 Total P data; range 0.83 to 0.87 mg/L, mean 0.86 mg/L.

data indicates that substantial nutrient loads are observed under higher stream flow conditions, which would be dominated by non-point sources of nutrients.

Figure 2-33. Relative Contributions of Estimated Annual Nutrient Load by Source



2.5.3 IN-STREAM LOAD ESTIMATES AND LOAD REDUCTIONS

The Hickory Creek Watershed Plan is focused on reducing pollutant loads to remedy beneficial use impairments. An analysis of in-stream data was performed to develop pollutant reduction goals, supplementing the pollutant load estimates presented in the previous section. Existing pollutant loads and associated reductions needed to improve water quality in Hickory Creek were evaluated using the load duration curve (LDC) approach developed by USEPA.[51] The LDC approach is a method by which existing water quality conditions can be compared to water quality targets over a range of expected flow conditions. Specifically for the purpose of watershed planning, the LDC approach provides an understanding of pollutant load contributions during the range of hydrologic regimes. This understanding can help guide load reduction decisions for non-point and point sources by pollutant of concern.

The LDC method uses existing flow records and water quality criteria to visually depict the allowable loading capacity of a pollutant at any flow condition. Existing water quality data are then compared to the loading capacity to determine whether or not reductions are needed. Because the LDC method provides estimates of loading capacity over the range of hydrologic conditions, it is a useful method for linking water quality impacts at a location with large-scale watershed processes.[52]

LDC results must be carefully interpreted. Linkages between pollutant loading and beneficial use impacts are quite complex. Through this technique, loading capacities are derived using numeric water quality criteria and site flow data. Generally speaking, numeric water quality criteria may be expressed in terms of magnitude, duration (i.e., acute or chronic exposure periods), and frequency of allowable exceedance. However, since the LDC technique only utilizes the criterion magnitude, the user should carefully consider the importance of duration and frequency in the interpretation of results. For example, individual exceedances of an LDC based on an acute criterion, such as that for chloride, may assume critical importance because of their immediate effect on aquatic life, while individual exceedances of an LDC for a criterion with a long-term duration, e.g., nutrients, may be less consequential.

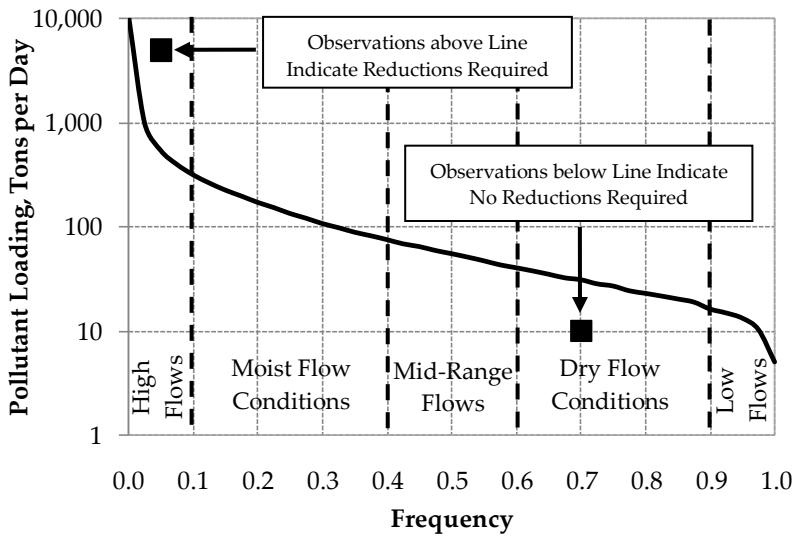
[51] USEPA. 2007. *An Approach for Using Load Duration Curves in the Development of TMDLs*. Office of Wetlands, Oceans and Watersheds. Washington, DC. EPA 841-B-07-006.
[52] *Ibid.*

2.5.3.1 Load Duration Curve Development

Load duration curves graphically present the cumulative frequency of allowable pollutant loadings over a range of flow conditions for a specified time period. They are calculated using historical daily average flow data measured at a sampling location and a water quality target of interest (generally, a water quality criterion). Final loading capacities are then presented as the frequency, or percent of time, that they occur and are generally divided into five flow condition categories (Figure 2-34). Observed water quality data are then compared to the loading capacity line; observations above the line indicate pollutant reductions are necessary, whereas those below the line indicate that water quality criteria are not exceeded (Figure 2-34). A basic interpretation of the load duration curve is that loads estimated within the "high" and "moist" flow conditions are likely dominated by non-point sources – pollutants carried in stormwater runoff – while loads within the "dry" and "low" flow conditions are expected to be primarily from point sources, such as wastewater treatment plants.

In Figure 2-34, for example, a pollutant loading of 5,000 tons per day occurs approximately 5% of the time. Because the loading occurs during the "high flow" hydrologic condition, the observation is likely the result of a non-point source runoff event. The observed loading is well above the allowable loading line and indicates that reduction measures are needed during high flow conditions. However, during dry flow conditions (70% of the time), pollutant loading observations (10 tons per day) are well below the allowable level (30 tons per day) and indicate that reduction measures are not needed. For more information about developing or interpreting LDCs, see USEPA's LDC guidance document.

Figure 2-34. Example Load Duration Curve, Flow Conditions, and Interpretation of Water Quality Sampling Results.



Nearly 11,000 daily average flow records collected from USGS gage 05539000 (Table 2-12) between 1980 and 2009 were used to develop LDCs for total phosphorus, total nitrogen, total suspended solids, fecal coliform, and chloride. Water quality data collected from three nearby sampling stations (GG-22, GG-01, and 05539000) during the same time period were aggregated to develop existing load estimates for each parameter (Table 2-12). It should be noted that the water quality and flow data used in the analysis were only collected near the mouth of the Hickory Creek watershed. As a result, the data only provide an estimate of impacts in the most downstream segment of the stream; impacts that have been previously reported or observed in upstream segments may not be reflected in the LDC results.

Table 2-12. Summary of Water Quality Records Used to Develop Hickory Creek Load Duration Curves.

Flow Condition (narrative)	Flow Records (#)	Rec. Season Flow Records (#)	Total Phosphorus (#)	Total Nitrogen (#)	TSS (#)	Fecal Coliform (#)	Chloride (#)
High	1,088	550	11	1	14	5	13
Moist	3,265	1,652	52	7	61	17	61
Mid	2,176	1,101	31	8	35	13	35
Dry	3,265	1,652	44	9	53	21	55
Low	1,087	549	21	2	23	14	23
Total	**10,881**	**5,504**	**159**	**27**	**186**	**70**	**187**

IEPA utilizes two types of numeric water quality criteria: those that are true standards, set in the Illinois Administrative Code, and those that are guidelines used in the process of determining potential causes of impairment. These guidelines are referred to as 305(b) non-standards based criteria, named after the section of the Clean Water Act that requires states to assess their waters and determine their impairments. Not all of the pollutants for which LDCs were developed have standards-based criteria, so some LDCs were developed for each pollutant using either the more appropriate of the standards-based water quality criteria or non-standards based criteria. In the case of total phosphorus and nitrogen, USEPA's ambient based ecoregional nutrient criteria were also used.[53] The ecoregional criteria were developed by compiling stream sample data on nutrients in the Corn Belt and Great Plains area, then assuming that the lower 25 percent of the data points would represent approximately undisturbed natural (or "reference") conditions. Existing loading conditions and associated reductions for each parameter were estimated using the most appropriate percentile of existing data within each hydrologic category. For example, the 305(b) non-standards based criteria were set at the 85th percentile of Illinois stream data, while USEPA's ecoregional criteria were based upon the 25th percentile of available ecoregion data. Therefore, the LDCs were calculated using the same statistical approach with the historic Hickory Creek data. The loading estimates using this approach do not reflect estimates of average annual loading since the median was not utilized for most parameters. The LDCs for each parameter are provided in Figures B-7 through B-12 in Appendix B. The estimated pollutant load and associated load reductions are provided in the following sections.

2.5.3.2 Total Phosphorus

Based on collaboration with the HCWPG Technical Committee, two total phosphorus LDCs were developed using: 1) the 305(b) non-standards based criterion of 0.61 mg/L[54] and 2) USEPA's suggested ecoregional criterion of 0.0725 mg/L.[55] Existing loading conditions for the non-standards based LDC and the ecoregional based LDC were estimated using the 85th and 25th percentile of existing data, respectively, within each hydrologic category.

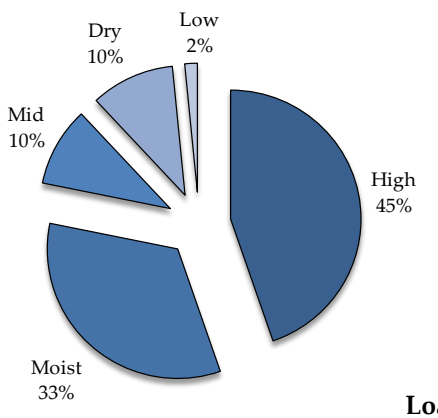
Results of the LDC analysis suggest that a majority of total phosphorus loading in Hickory Creek occurs during high (45 percent) and moist (33 percent) flow conditions (Figure 2-35). However, only loads estimated during dry and low flow conditions exceeded the allowable loading capacity using the non-

[53] USEPA. 2000. *Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI*. Office of Water. Washington, DC. EPA 822-B-00-017. Available at http://tinyurl.com/4npurbc.
[54] IEPA 2008 Illinois Integrated Water Quality Report.
[55] USEPA, op. cit.

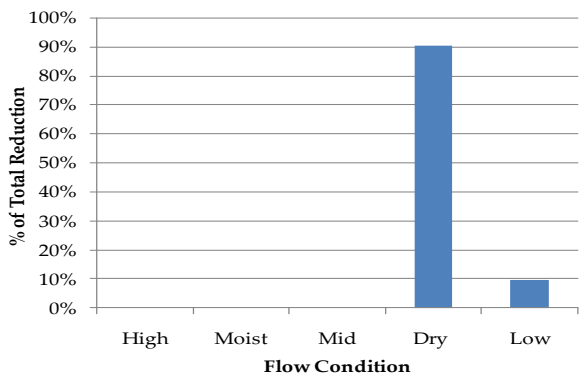
standards based criterion. Based on this analysis, overall total phosphorus loading during dry conditions should be reduced by nearly 23 percent while loadings during low flow conditions should be reduced by 16 percent to achieve allowable loading levels. Overall, the LDC analysis indicates that 2,380 pounds of total phosphorus per year must be reduced to achieve allowable loading levels as established by the non-standards based criterion of 0.61 mg/L. These results indicate that total phosphorus load reductions should be focused on point sources.

Figure 2-35. Total Phosphorus Loading Estimates Developed Using the Illinois 305(b) Non-Standards Based Water Quality Criterion of 0.61 mg/L and the 85th Percentile of Existing Data.

Existing Load by Flow Condition
(As Percent of Total Existing Load)



Load Reductions by Flow Condition
(As Percent of Total Needed Reduction)



Load Analysis Summary

Flow Condition (ID)	Existing Load* (lbs/year)	Allowable Load* (lbs/year)	Required Reduction (lbs/year)	Required Reduction (% Existing Load)
High	40,237	48,603	0	0%
Moist	30,130	36,003	0	0%
Mid	8,889	9,841	0	0%
Dry	9,349	7,201	2,148	23%
Low	1,407	1,176	231	16%
Total	**90,012**	**102,823**	**2,380**	**3%**

*Loadings given in lbs/year are weighted according to frequency of occurrence.

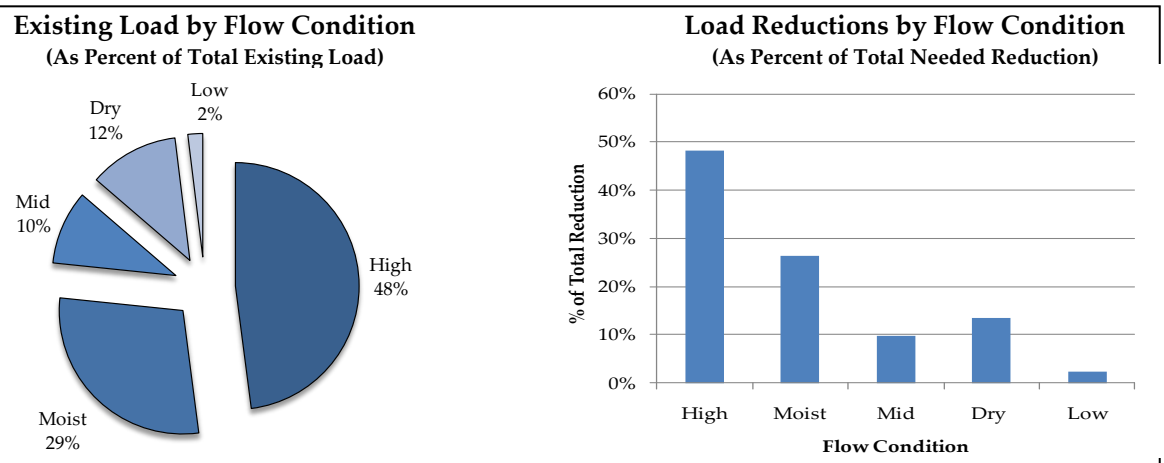
Existing load and reduction targets estimated with the ecoregional analysis are significantly different than non-standards based estimates. This substantial difference stems from the more stringent ecoregional total phosphorus criterion (0.0725 mg/L) and historic data percentile (25th) values used compared to the non-standards based analysis (0.61 mg/L, 85th percentile). Nationally, the use of USEPA's ecoregional criteria has been quite controversial due to the simplistic method used to derive the criteria (i.e., statistical analysis of historic data). The linkages between causal variables (e.g., nutrients) and response variables (e.g., algae, macroinvertebrates, fish) are extremely complex and vary between waterbodies. Often physical factors (e.g., light, habitat, substrate) limit biologic responses rather than nutrients; therefore, it is not certain whether the estimated nutrient load reductions are insufficiently or overly protective.

Ecoregional LDC results indicate that existing phosphorus loads are above the allowable loading levels across the entire range of flow conditions with considerable exceedances occurring under high flow conditions (Figure 2-36). Significant loading under high flow conditions (i.e., runoff events) suggests that non-point sources are a major source of total phosphorus loading in the Hickory Creek watershed.

Overall, the LDC analysis suggests that reductions of more than 33,500 pounds of total phosphorus per year are needed to achieve allowable loading levels.

Until numeric nutrient criteria are developed and included in Illinois' water quality standards, it may be necessary to perform a special study to quantify the relationship between nutrient loading and biological responses in Hickory Creek. In the interim, the two approaches presented above preliminarily suggest that between 2,400 and 33,500 pounds of total phosphorus per year should be reduced in the watershed.

Figure 2-36. Total Phosphorus Loading Estimates Developed Using the EPA Ecoregional Criterion of 0.0725 mg/L and the 25th Percentile of Existing Data.



Load Analysis Summary

Flow Condition (ID)	Existing Load* (lbs/year)	Allowable Load* (lbs/year)	Required Reduction (lbs/year)	Required Reduction (% Existing Load)
High	21,951	5,777	16,175	74%
Moist	13,132	4,279	8,853	67%
Mid	4,436	1,170	3,267	74%
Dry	5,371	856	4,515	84%
Low	887	140	747	84%
Total	**45,777**	**12,221**	**33,557**	**73%**

*Loadings given in lbs/year are weighted according to frequency of occurrence.

2.5.3.3 Total Nitrogen

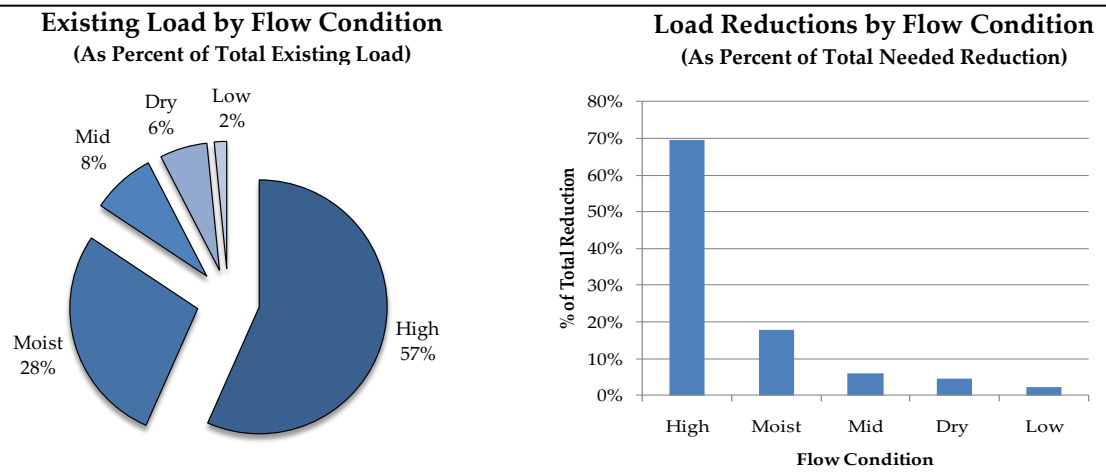
In the absence of a water quality standard and 305(b) criterion for total nitrogen, the total nitrogen LDC was developed using USEPA's suggested ecoregional criterion of 2.461 mg/L.[56] The previous discussion regarding the use of ecoregional nutrient criteria also applies to nitrogen. Existing loading conditions and associated reductions were based on the 25th percentile of existing data within each flow condition category.

Like the ecoregional-based total phosphorus LDC analysis, total nitrogen results show that existing loads are above the target loading level under all flow conditions. The most significant loadings occur under high flow conditions (57 percent of existing load) and need to be reduced by 52 percent to reach the target loading level. It should be noted here that the load estimate for the high flow condition is based on one

[56] *Ibid.*

water quality sample. However, the results indicate that non-point sources contribute significant quantities of total nitrogen during runoff or high flow events. Overall, this analysis estimates that reductions of more than 300,000 pounds of total nitrogen per year (Figure 2-37) are needed to achieve target levels.

Figure 2-37. Total Nitrogen Loading Estimates Developed Using the EPA Ecoregional Criterion of 2.461 mg/L and the 25th Percentile of Existing Data.



Load Analysis Summary

Flow Condition (ID)	Existing Load* (lbs/year)	Allowable Load* (lbs/year)	Required Reduction (lbs/year)	Required Reduction (% Existing Load)
High	406,356	196,087	210,269	52%
Moist	198,899	145,249	53,650	27%
Mid	57,915	39,702	18,213	31%
Dry	43,085	29,050	14,035	33%
Low	11,240	4,745	6,495	58%
Total	**717,495**	**414,832**	**302,663**	**42%**

*Loadings given in lbs/year are weighted according to frequency of occurrence.

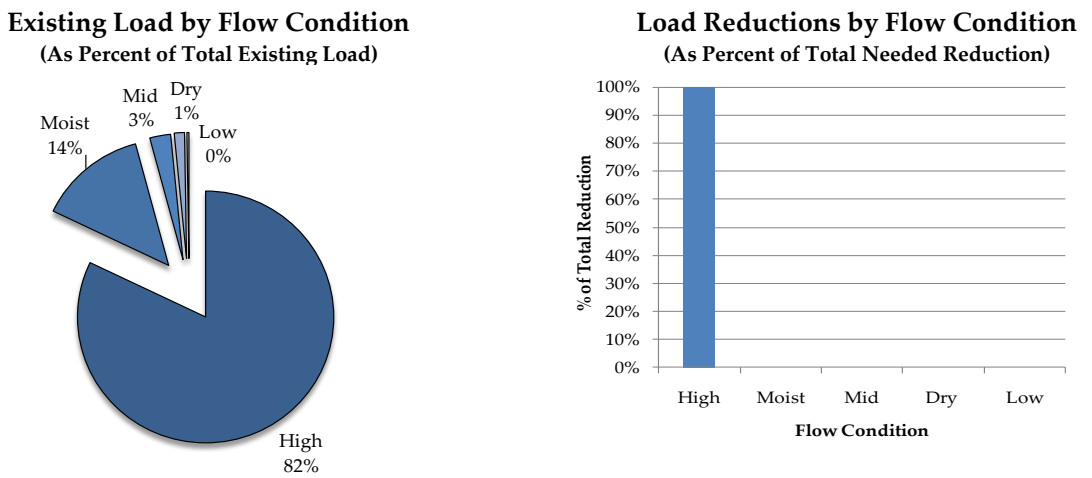
2.5.3.4 Total Suspended Solids

Total suspended solids LDCs were developed using the 305(b) non-standards based water quality criterion of 116 mg/L.[57] Existing loading conditions and associated reductions were based on the 85th percentile of existing data within each flow condition category.

With the exception of the high flow category, total suspended solids loadings were below target levels under all flow conditions (Figure 2-38). High flow condition loadings accounted for 82% of the existing total suspended solids loading in Hickory Creek and were more than twice as high as the target loading level (existing = 11,302 tons per year, target = 4,621 tons per year). As with total phosphorus and nitrogen, the considerable loading under high flow conditions suggests that non-point sources contribute most of the TSS load. In addition, non-point source controls directed at solids reductions should also be effective for reducing phosphorus loading.

[57] IEPA 2008 Illinois Integrated Water Quality Report.

Figure 2-38. Total Suspended Solids Loading Estimates Developed Using the Illinois 305(b) Water Quality Criterion of 116 mg/L and the 85th Percentile of Existing Data.



Load Analysis Summary

Flow Condition (ID)	Existing Load* (tons/year)	Allowable Load* (tons/year)	Required Reduction (tons/year)	Required Reduction (% Existing Load)
High	11,302	4,621	6,681	59%
Moist	1,889	3,423	0	0%
Mid	362	936	0	0%
Dry	177	685	0	0%
Low	35	112	0	0%
Total	**13,766**	**9,777**	**6,681**	**49%**

*Loadings given in tons/year are weighted according to frequency of occurrence.

2.5.3.5 Fecal Coliform

The fecal coliform LDC was developed using the water quality criterion of 400 colony forming units (cfu) per 100 milliliters (mL), which is expressed as a short-term criterion. Existing loading conditions and associated reductions were based on the 50th percentile of existing data within each flow condition category.[58]

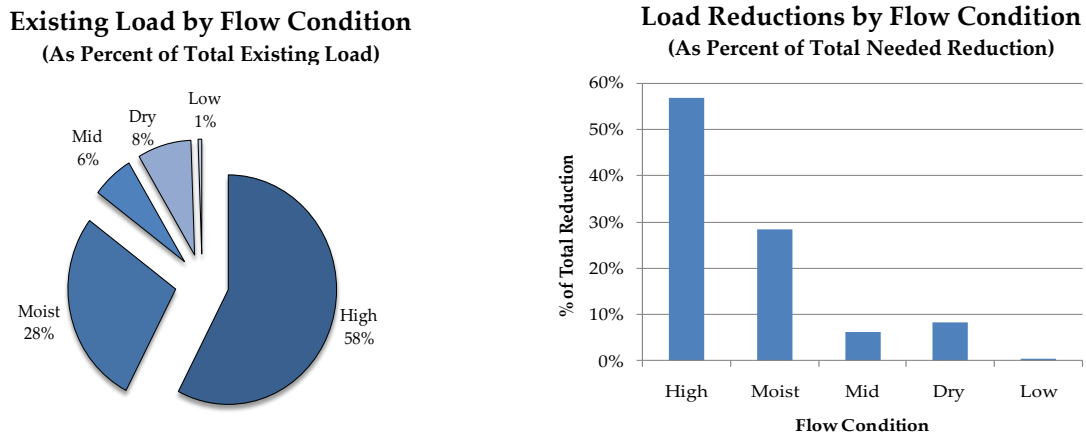
Existing fecal coliform loadings exceeded target loading levels across all flow conditions (Figure 2-39). The most significant loading occur under high (58 percent) and moist (28 percent) flow conditions, although considerable load reductions are needed for each flow category. The LDC analysis indicates that existing loads need to be reduced between 80 and 98 percent, with the greatest reductions needed under high flow conditions (Figure 2-39). These load reduction estimates are extremely high and warrant further additional water quality assessment and evaluation of potential sources (Section 5).

It is unclear whether fecal coliform loading patterns in Hickory Creek are due solely to point (e.g., wastewater treatment facilities) or non-point (e.g., septic systems, agricultural runoff, wildlife) sources.

[58] As sufficient data were not available to directly compare existing loads (calculated as the geometric mean of more than 4 samples in a 30 day period) to the long-term (200 cfu/100 mL) fecal coliform criterion, the 50th percentile of individual data points, as opposed to the geometric mean of multiple points, were compared against the short-term (400 cfu/100 mL) criterion. Therefore, LDC results do not necessarily reflect the actual attainment or exceedance of bacteria criteria in Hickory Creek.

The fact that fecal coliform loads consistently exceed water quality targets across all flow conditions suggests that constant, untreated sources contribute fecal coliform to Hickory Creek. Although it is possible that these are diffuse contributions from agricultural operations, they may also be from sources such as septic systems and wildlife.

Figure 2-39. Fecal Coliform Loading Estimates Developed Using the Illinois Water Quality Standard of 400cfu/100 mL and the 50th Percentile of Existing Data.



Load Analysis Summary

Flow Condition (ID)	Existing Load* (#/year)	Allowable Load* (#/year)	Required Reduction (#/year)	Required Reduction (% Existing Load)
High	2.E+15	1.E+14	1.E+15	93%
Moist	7.E+14	2.E+13	7.E+14	97%
Mid	2.E+14	9.E+12	2.E+14	94%
Dry	2.E+14	5.E+12	2.E+14	98%
Low	1.E+13	3.E+12	1.E+13	81%
Total	**3.E+15**	**1.E+14**	**3.E+15**	**95%**

*Loadings given in lbs/year are weighted according to frequency of occurrence.

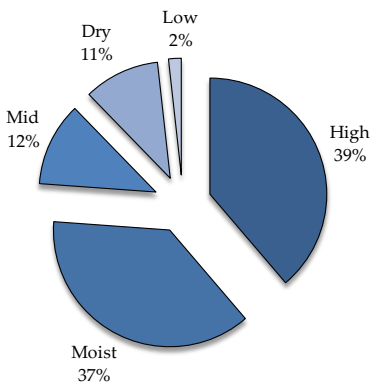
2.5.3.6 Chloride

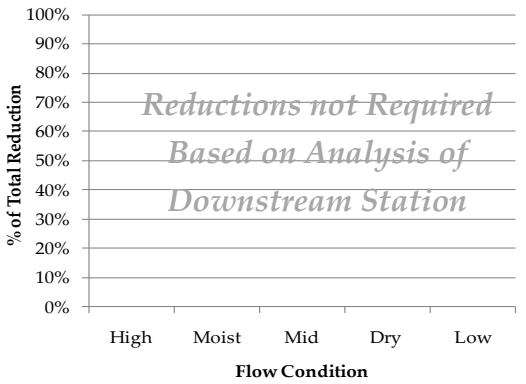
The chloride LDC was developed using the water quality criterion of 500 mg/L, expressed as an acute criterion. Existing loading conditions and associated reductions were based on the 90th percentile of existing data within each flow condition category.

The chloride LDC analysis indicates that a significant portion (76 percent) of the existing pollutant loading of chloride occurs under the high and moist flow conditions, indicating that the load is predominately from non-point sources during runoff events.

The chloride LDC analysis shows that chloride loadings are below target levels under all flow conditions (Figure 2-40). The existing chloride load in Hickory Creek (36.1 million pounds per year) is less than half of the total allowable load (84.3 million pounds per year) and existing loads for each flow condition are well below their respective allowable loads (Figure 2-40).

Figure 2-40. Chloride Loading Estimates Developed Using the Illinois Water Quality Criterion of 500 mg/L and the 90th Percentile of Existing Data.





Load Analysis Summary

Flow Condition (ID)	Existing Load* (lbs/year)	Allowable Load* (lbs/year)	Required Reduction (lbs/year)	Required Reduction (% Existing Load)
High	14,007,335	39,838,838	0	0%
Moist	13,515,695	29,510,250	0	0%
Mid	4,191,164	8,066,135	0	0%
Dry	3,796,199	5,902,050	0	0%
Low	634,313	964,002	0	0%
Total	**36,144,705**	**84,281,274**	**0**	**0%**

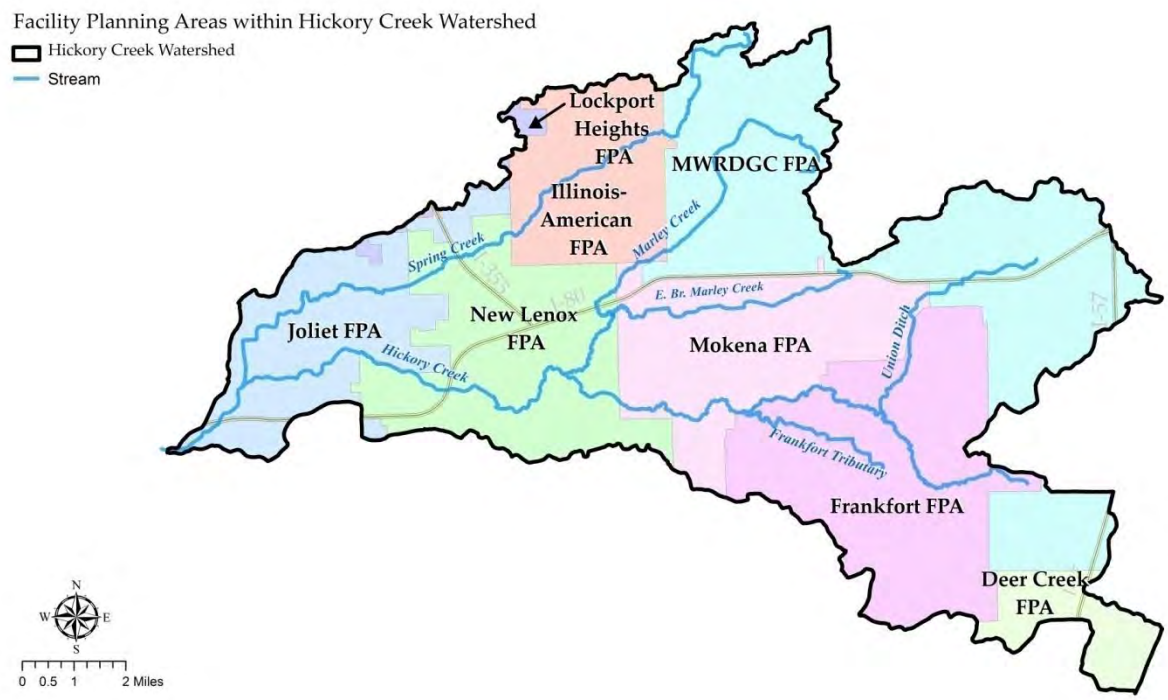
*Loadings given in lbs/year are weighted according to frequency of occurrence.

The LDC results appear to contradict the 2008 Illinois 303(d) Report which listed Hickory Creek as being impaired for chloride. However, as indicated in Section 2.2.1.1 and in Table A-1 in Appendix A, exceedances of the water quality criterion for chloride have been observed in each of the 303(d)-listed stream segments and in Union Ditch Segment IL-GGC-FN-A1. Additionally, the LDC data only reflect water quality impacts observed at the most downstream stations (GG-22, GG-01, and 05539000) and do not include sample data from other stream segments within the watershed. In an effort to evaluate the needed load reductions for chloride in the stream segments in which exceedances of the water quality criterion for chloride have been observed, an alternative, simplified approach was used. This approach entailed comparing the average of the exceedance observations to the water quality criterion for chloride. The estimated load reduction needed based on this approach, on a percentage basis, is approximately 28 percent.

2.6 Future Watershed Conditions Pollutant Loads

Evaluation of the potential future watershed conditions is an important part of the watershed planning process. This critical step provides an opportunity for stakeholders within the Hickory Creek watershed to identify and evaluate potential future sources of pollutants to Hickory Creek and its tributaries and to proactively, rather than reactively, address these concerns. Although much of the existing watershed is currently developed or is in protected open space, much of the remaining 25 percent of the watershed is expected to be developed. This is supported by the Facility Planning Area boundaries, which essentially cover the entire watershed area (Figure 2-41), and the future land use derived by stitching together municipal comprehensive plans and zoning and subdivision maps (Figures 2-42 and 2-43).

Figure 2-41.

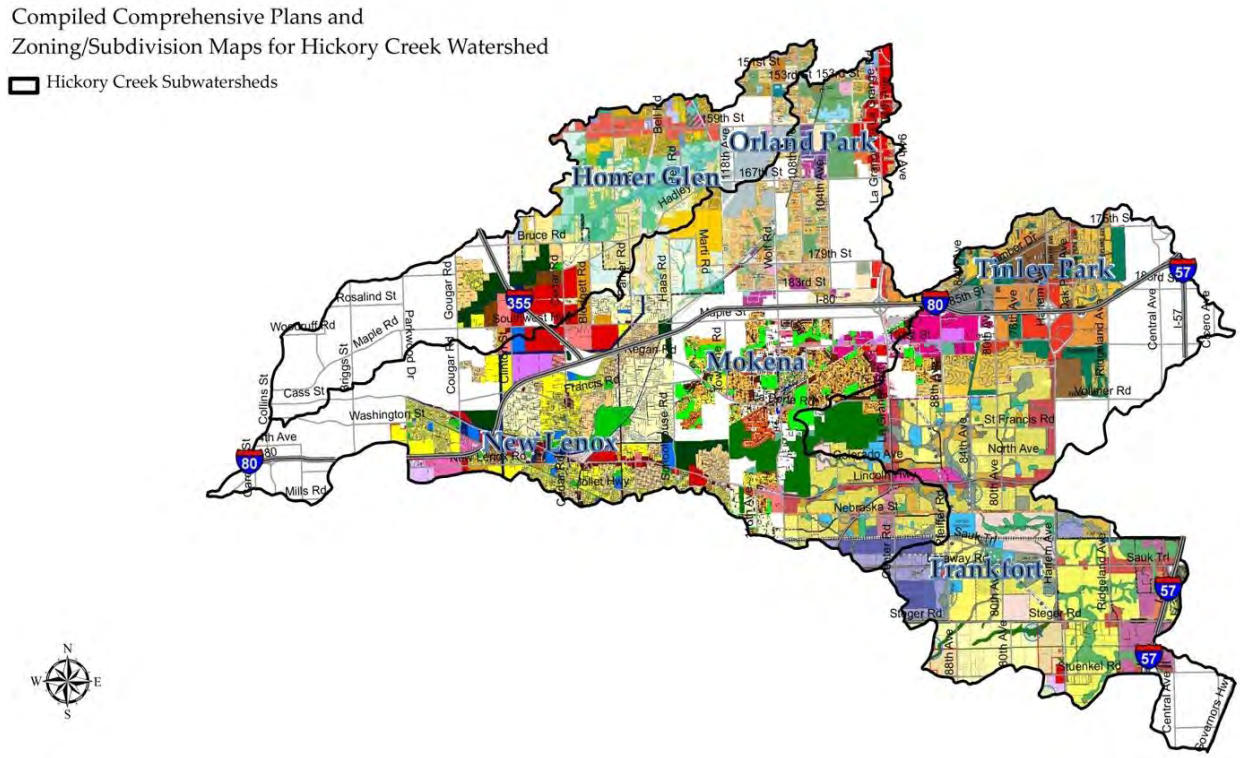


Source: IEPA

2.6.1 FUTURE CONDITIONS NON-POINT SOURCE POLLUTANT LOADS

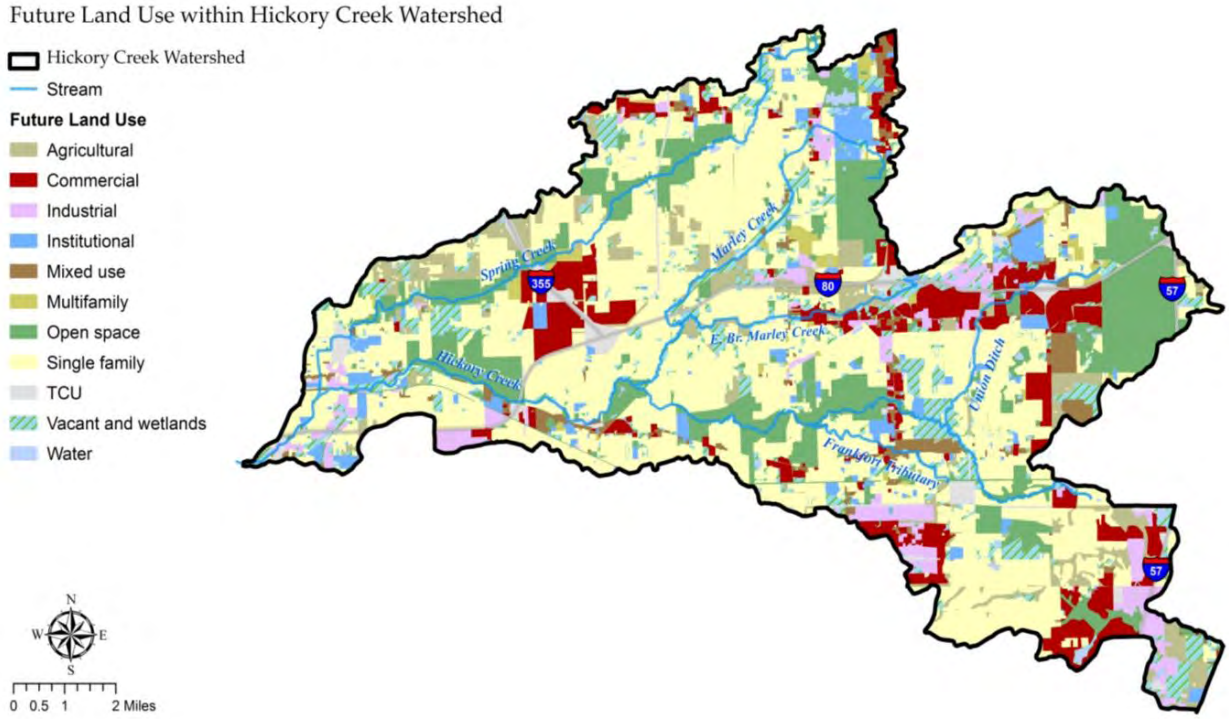
As with existing conditions, the future conditions non-point source pollutant load estimates for total nitrogen, total phosphorus, and sediment were estimated using STEPL. Much of the input data remained the same as that for the existing conditions analysis given that certain parameters (i.e. soils, slopes, etc.) would not be expected to change in the future conditions. The primary data that were changed for the future conditions analysis was the land use data. The land use data was incorporated as a layer derived by CMAP by combining comprehensive plans and zoning and subdivision maps (Figures 2-42 and 2-43). It should also be noted that for the future conditions analysis forest areas were captured in STEPL as open space areas under the urban category as opposed to the separate forest category used in the existing conditions analysis. The septic system input data was kept the same as the existing conditions analysis based on the assumption that the majority of future development will include connection of dwellings to municipal sewage collection systems.

Figure 2-42.



Source: CMAP

Figure 2-43.



Source: CMAP

The future conditions non-point source pollutant load estimates for nitrogen, phosphorus, and sediment are shown in the next section in Table 2-14. These results indicate that based on future watershed conditions, urban land is the largest non-point source of these pollutants (77 percent for nitrogen, 69 percent for phosphorus, and 81 percent for sediment) within the Hickory Creek watershed. Agricultural land accounts for approximately 18 percent of the total estimated load for each parameter for future conditions.

Comparison of the non-point sources pollutant load estimates for existing (Table 2-9) and future conditions may lead one to the conclusion that development of the watershed is a means to reduce pollutant loads within the watershed. However, several counterpoints to that conclusion should be noted.

- The non-point source pollutant loading analysis is not tied to the beneficial uses of Hickory Creek and its tributaries due to inherent complexities within the watershed.
- Lower non-point source load estimates under future conditions are not surprising based on the input parameters and calculations within STEPL (e.g., the use of event mean concentrations and the use of the Universal Soil Loss Equation for non-urban land uses).
- STEPL does not account for changes in the stream hydrology and other pollutant loads that may increase as result of development within the watershed. For example, the total annual runoff volume is estimated to increase by approximately 20 percent under future conditions. Unless mitigated, this increase in runoff volume could further impair the stream channels within the watershed.

2.6.2 FUTURE CONDITIONS MUNICIPAL WASTEWATER TREATMENT PLANT POLLUTANT LOADS

Understanding how future development will potentially affect wastewater discharges and associated pollutant loads to the Hickory Creek watershed is imperative in developing an effective watershed plan. Similar to existing conditions, a simplified approach based on average discharge flow and expected effluent concentrations was used to develop estimates for nutrient loads to the watershed from WWTPs under future conditions. To develop average discharge flows for each of the existing WWTPs discharging flows to the watershed, an estimation approach was employed using CMAP's *GO TO 2040* household projections for 2040. These household projections were compared against the household projections for 2010 to develop a growth factor within the FPA boundaries for each of the existing WWTPs (Table 2-13). The growth factor was used to then develop a projected average daily flow for the WWTPs (Table 2-15).

Table 2-13. Estimated Household Growth Factor

Facility Planning Area	Existing (2010) Households	Projected (2040) Households	Estimated Growth Factor
Mokena	9,048	15,266	1.69
Frankfort	11,534	21,553	1.87
New Lenox	6,575	10,233	1.56
Illinois American	8,633	16,306	1.89
Joliet	77,520	113,505	1.46

The projected flows were then used to develop estimates for nutrient loads from wastewater assuming no additional nutrient removal measures were implemented under future conditions. Comparison of these estimates with the future conditions non-point source pollutant load estimates (Table 2-14) indicates that under this scenario point sources would be the dominant sources of nutrients (approximately 67 percent for nitrogen and 70 percent for phosphorus).

Table 2-14. Future Conditions Non-Point Source and Point Source Pollutant Load Estimates

Sources	Nitrogen Load (lb/yr)	Phosphorus Load (lb/yr)	Sediment Load (t/yr)
Urban	362,092	46,855	12,948
Cropland	86,354	12,275	2,982
Septic	22,124	8,665	--
Wastewater	992,400	160,220	--
Total	**1,462,970**	**228,015**	**15,930**

Future nutrient load estimates were also estimated by using potential effluent concentrations for total nitrogen and phosphorus that would likely be realized within this analysis timeframe (2040). Based on collaboration with the HCWPG Technical Committee and foreshadowing of potential regulatory requirements to be implemented within this timeframe, a range of potential nutrient effluent concentrations was identified. The range for total nitrogen was estimated to be 5 to 10 mg/L and for phosphorus was 0.5 to 1.0 mg/L. The nutrient load estimates for future conditions are presented in Table 2-17.

Table 2-15. Future Conditions WWTP Nutrient Load Estimates Based on Reported Flow

Facility Planning Area	Existing Reported Average Flow (MGD)	Growth Factor	Projected (2040) Average Flow (MGD)	Estimated Annual Load (lb/yr)			
				Total N @ Effluent Concentration of:		Total P @ Effluent Concentration of:	
				5 mg/L	10 mg/L	0.5 mg/L	1.0 mg/L
Mokena[59]	2.342	1.69	3.95	60,170	120,340	6,020	12,030
Frankfort	3.941	1.87	7.36	112,170	224,330	11,220	22,430
New Lenox (STP #1 and #3)[60]	2.124	1.56	3.31	50,460	100,930	5,050	10,090
Oak Valley WRF (Illinois American)	0.741	1.89	1.40	21,330	42,660	2,130	4,270
Oak Highlands-Ingalls Park SD[61]	0.170	1.46	0.25	3,780	7,560	380	760
Totals	**9.318**		**16.28**	**247,910**	**495,820**	**24,800**	**49,580**

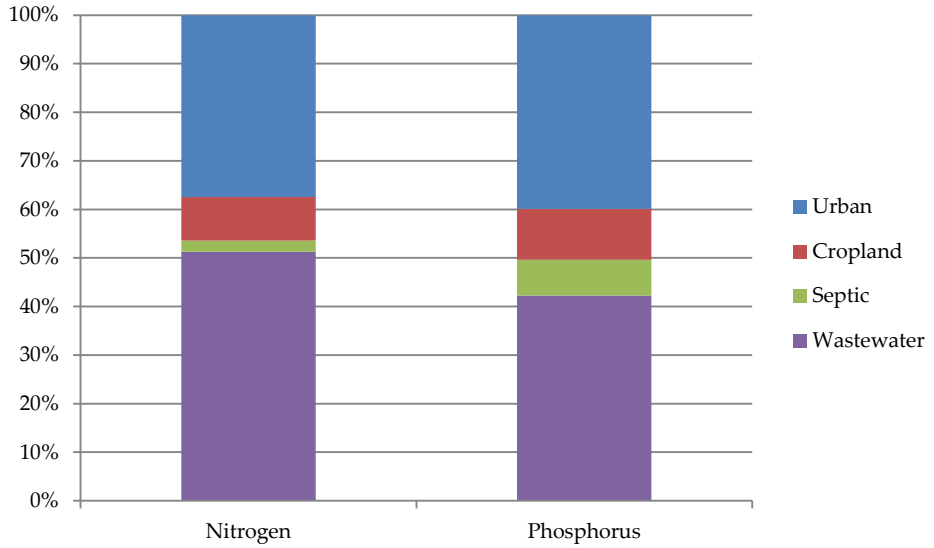
Again, combining the nutrient load estimates for non-point and point sources provides an opportunity to compare the relative potential contributions of the various sources of nutrients to the Hickory Creek watershed. For illustrative purposes, the load estimates shown in Figure 2-44 are based on the higher estimated effluent concentrations for the WWTP discharges (i.e., 10 mg/L for total nitrogen and 1.0 mg/L for phosphorus). This comparison indicates that point sources and non-point sources both are expected to contribute approximately 50 percent of the average annual nitrogen load to the watershed and that non-point sources are expected to contribute the majority of the phosphorus load.

[59] Existing reported average flow for Mokena includes flows from both Mokena STP and Arbury STP (Illinois American) based on FPA boundary and plant locations

[60] FPA boundary and growth factor adjusted based on personal communication with Ron Sly with respect to the portion of the FPA that is routed to New Lenox STP #2, which discharges flows outside of the Hickory Creek watershed.

[61] Oak Highlands-Ingalls Park SD is located within the Joliet FPA and the growth factor for this facility is based on data for the Joliet FPA.

Figure 2-44. Relative Contributions of Estimated Future Conditions Annual Nutrient Load by Source



To demonstrate the significance of the WWTP-related recommendation presented in Section 3.4.1, another valuable evaluation is the comparison of the future conditions nutrient loads based on the estimated existing effluent concentrations and the projected effluent concentrations. This comparison indicates that even with a nearly doubling of discharge flows, the nutrient loads from the WWTPs could be reduced by approximately 13 to 56 percent for total nitrogen and approximately 46 to 73 percent for total phosphorus by implementing nutrient removal processes. These estimates assume that each of the existing plants within the watershed will eventually implement nutrient removal processes.

2.7 Summary of Opportunities for Watershed Improvement and Restoration

The primary purpose of collecting and analyzing existing Hickory Creek watershed information is to identify and recommend opportunities for improving and restoring Hickory Creek and its tributaries. A summary of the opportunities identified during the watershed assessment and reconnaissance efforts is presented below. Recommended actions to improve and restore stream conditions are provided in the remaining sections of this plan.

- Ample opportunity for water quality improvements through implementation of stormwater management retrofits and improved development practices were identified. The predominant stormwater management approach observed within the watershed apparently focused on discharge rate control (i.e. detention) with minimal attention given to water quality treatment. In developed portions of the watershed, stormwater management retrofit projects should be undertaken. These retrofits could be undertaken as stand-alone projects, where funding allows, or implemented during infrastructure rehabilitation projects (e.g., roadway improvement projects). Municipal policies should also support implementation of stormwater management practices that provide water quality benefits.
- Numerous stream corridor impacts were identified during the watershed assessment and reconnaissance efforts. These impacts include dams, severely eroding streambanks, stream channelization, impacted buffers, and degraded in-stream habitat characteristics (e.g., areas with excessive sediment deposition). Stream corridor restoration projects that remedy these impacts and improve the physical, chemical and biological conditions of the streams should be implemented within the watershed.

- Comparison of the hydric soils and wetland data indicates that much of the wetland area within the watershed has been lost. Protection of the remaining wetlands within the watershed should be considered a watershed priority. Wetland restoration should also be incorporated into municipal planning and policies and as part of natural area and stream corridor restoration projects, as appropriate.
- Wastewater treatment plants within the watershed have high operating standards and few numeric effluent limit violations. However, these discharges are estimated to contribute approximately half of the nutrient load (total nitrogen and total phosphorus) in Hickory Creek. Additionally, WWTP discharge flows are expected to nearly double within the analysis timeframe (2040). As such, nutrient removal processes should be evaluated and implemented, as appropriate, at WWTP within the watershed.
- Exceedances of the chloride water quality criterion were observed in several of the assessed stream segments within the Hickory Creek watershed. Additionally, chloride data indicate that existing pollutant loading of chloride is predominately from non-point sources during runoff or snowmelt events. The reasonable expectation is that the majority of this chloride loading is from roadway, parking lot, and sidewalk deicing activities. Alternative snow and ice management practices and education should be implemented within the watershed.
- Approximately one quarter of the watershed area remains as agricultural land, and this land is estimated to significantly contribute nutrients and sediment to the Hickory Creek watershed. Based on USDA NCRS input and observations made during the watershed reconnaissance, much of the agricultural land within the Hickory Creek watershed is managed using practices (e.g., no-till, add another one or two) intended to reduce non-point sources of pollutants. However, opportunities to further reduce loads from agricultural land should be evaluated and implemented within the watershed.
- Based on HCWPG member input and observations made during the watershed reconnaissance, trash and debris removal is needed within stream channels. The noted areas ranged from large accumulations of woody debris at road crossings to select pieces of large trash. Stream maintenance should be implemented through the collective effort of watershed stakeholders. The stream maintenance should also balance improved conveyance with habitat considerations.
- Relatively large amounts of physical, chemical, and biological data exist for the Hickory Creek watershed. However, much of the available data were collected either at limited locations, over short time periods, or for very specific purposes such as evaluating conditions around wastewater treatment plant discharges. Additional in-stream data should be collected to assess in-stream conditions more accurately. These efforts will allow decision-makers to determine long-term trends and improve characterization of different sources of pollutants in the watershed.

3. Vision and Policy

Local governments have a "vision" of how they aspire to grow, shape community character, and protect natural resources within their current or eventual borders, as expressed through their comprehensive plans and ordinances. To ascertain how well local policies are protecting Hickory Creek and its tributaries, this section reviews existing comprehensive plans, local ordinances, and environmental programs. While in many cases these expressions of policy are effective in protecting natural resources and promoting quality of life in the watershed, in other cases improvements are needed.

To help focus the efforts of stakeholders on those improvements that would be the most important to make, this plan establishes recommendations for policy and planning priorities for the watershed. While the recommendations are meant to improve stream habitat and decrease pollutant loading, they also have multiple other benefits, including flood prevention, cost savings, promoting additional recreation opportunities, and improving quality of life. It is envisioned that most of the recommendations within this section of the plan would be implemented by revising local plans and ordinances or establishing new programs, supported by additional studies if needed. It is anticipated that the majority of this work could begin in 2011–2012, taking perhaps one to five years to complete and adopt. The recommended revisions can be undertaken by municipal staff with assistance from CMAP and from consultants.

The vision and policy discussion is framed in the following categories:

- *Plans*: Local plans establish the framework and policy basis for actions by local governments. In the review of municipal and county comprehensive land use plans undertaken for the Hickory Creek watershed plan, it was observed that a number of the plans established a strong policy basis for water and natural resource protection. Some municipalities also have adopted targeted plans that specifically address water resources and/or green infrastructure. Notably, most of the plan policies that were relevant to water quality or stream habitat also implicitly were linked to related objectives, such as flood prevention, water supply, open space, sustainable development, and urban form.
- *Ordinances*: Countywide stormwater ordinances -- the Will County Stormwater Management Ordinance (SMO) and the pending Cook County Watershed Management Ordinance (WMO) -- establish minimum standards for stormwater runoff, soil erosion and sediment control, floodplain management, and stream and wetland protection. However, municipalities in the watershed should be free to establish additional requirements beyond the countywide ordinance. In addition to stormwater ordinances, the subdivision, landscaping, and zoning codes also have, or could have, a significant bearing on watershed protection objectives.
- *Programs*: Broadly, programs are suites of non-regulatory actions of local government that can be implemented to improve water quality, hydrology, and stream use impairments. Local programs might involve public education, infrastructure investment, incentives for landowners (e.g., for rain barrels or natural landscaping), or a variety of other activities.

3.1 Review of Comprehensive Plans

The primary purpose of the comprehensive plan analysis effort undertaken during the watershed plan development process was to identify the relevant elements of land use and policy plans that support important water and natural resource objectives. Comprehensive plans can establish priorities for a number of important watershed protection objectives, including the following, which were the focus of this review:

- Protecting natural resources and open space;

- Promoting green infrastructure approaches to manage precipitation and runoff;
- Promoting efficient, compact development patterns; and
- Promoting efficient street and parking lot designs that minimize impervious surfaces.

Municipal and county comprehensive plans were compiled and analyzed for communities within the Hickory Creek watershed. These communities include Frankfort, Homer Glen, Joliet, Mokena, New Lenox, Orland Park, Tinley Park, and Will County (Table 3-1). While there are other communities with territory in the watershed, the named communities compromise the vast majority of the land. The reviewed plans were adopted over the period of 1997 to 2010 (Table 3-1). In addition to the comprehensive land use plans, other related plans -- addressing topics such as water resource management and establishing goals for a "greener" form of development -- also were reviewed.

Table 3-1. Plans Reviewed for Hickory Creek Watershed Plan

Reviewed Information	Date
Village of Frankfort Comprehensive Plan	2004
Village of Frankfort 2010 Future Land Use Plan Update	2010
Village of Frankfort Water Resources Management Plan	2008
Comprehensive Plan for the Village of Homer Glen	2005
Green Vision of the Homer Glen Community	2004
City of Joliet South Side Comprehensive Plan[1]	2007
Village of Mokena Comprehensive Plan	2002
Village of Mokena Downtown Station Area Plan	2008
Village of New Lenox 2004 Comprehensive Plan Update	2004
Village of Orland Park Comprehensive Plan	1997
Orland Park Open Lands Fund	---
Orland Park Vision	2010
Tinley Park Comprehensive Plan	2000
Will County Land Resource Management Plan	2002

3.1.1 PROTECTING NATURAL RESOURCES AND OPEN SPACE

A core tenet of responsible watershed management is the understanding that in order to protect water, one must also protect land. Streams, lakes, and wetlands depend on adjacent upland areas, buffers, and the recharge zones that maintain healthy baseflows. An integrated network of aquatic ecosystems, buffers, and certain upland areas – a "green infrastructure network" -- provides a number of critical functions including habitat and wildlife linkages, infiltration and filtration of runoff that contributes to a healthy stream baseflow, and recreational corridors and access for fishing, boating, and nature observation.

The multiple benefits of a green infrastructure network are essential to not just a healthy aquatic ecosystem but also to recognition and enjoyment of the system by watershed residents. A land use plan will not only embrace these objectives but also will identify open space and resource protection priorities in its future land use map. After the important green infrastructure has been identified, the plan can direct desired growth into areas that are more suitable to development. Another critical component to planning for natural resource and open space protection is to identify creative mechanisms for their preservation. In addition to conventional acquisition by park and forest preserve districts, natural resources also can be

[1] Joliet does not have a comprehensive plan for the portions of the city in the Hickory Creek watershed. However, it does have a plan for its south side that could be viewed as a model for progressive approaches for Hickory Creek.

protected through conservation easements on private land, preservation of farmland, and conservation development.

All of the plans reviewed had at least some reference to the importance of natural resource and open space protection. The most progressive plans identified natural resource and open space protection – i.e., "green infrastructure" -- as the underpinning of the entire planning process. Some plans also directly linked open space and natural resources to community image, vitality, and economic development. For example, the Homer Glen logo contains the phrase "Community and Nature…in Harmony." At a minimum, most of the plans placed a priority on the protection of streams, floodplains, and wetlands. Some plans include additional detail identifying features, such as tree groves, sensitive soils, wildlife habitats, and steep slopes as sensitive resources needing protection.

Most plans emphasized traditional regulatory and acquisition approaches for the protection of natural resources and open space. Some entities, such as New Lenox and Will County, identified innovative approaches including conservation easements, land trusts, acquisition of development rights, and special service areas. Some plans also identified mechanisms for the long-term maintenance, ownership, and financing of protected areas.

Conservation development (also called conservation design, open space community) was identified as an important mechanism to accomplish natural resource and open space protection in several plans (notably Frankfort, Homer Glen, Mokena, New Lenox, and Will County). Several of these plans included relatively specific recommendations for ordinance changes and minimum requirements for open space within conservation developments.

Several plans discussed the need for stronger ordinances for stream, wetland, and buffer protection. For example, the plans of Frankfort, Joliet (South Side Comprehensive Plan), Homer Glen, New Lenox, Orland Park, and Will County identified specific regulatory measures, such as wider stream buffers, stronger floodplain protections, and protection of headwater streams and isolated wetlands. Virtually all of the plans recognized the importance of linking open spaces with trails and bikeways. Some plans specifically recognized trails and greenways following Hickory Creek, its tributaries, and headwaters. Several plans also referred to adopted or recommended trails plans and the importance of coordinating with Will County, the Forest Preserve District, townships, and park districts to implement their plans.

3.1.2 PROMOTING GREEN INFRASTRUCTURE APPROACHES TO MANAGE STORMWATER RUNOFF

Should all of the aforementioned policy objectives be implemented, there would still be a critical need to manage stormwater runoff more sustainably than is currently required. At the core of a green infrastructure approach is the objective to treat runoff as a resource. Green infrastructure designs encourage managing stormwater at the source, maximizing infiltration, and reducing pollutant discharge.

While green infrastructure approaches are ultimately implemented via stormwater, subdivision, and landscaping ordinances, it is important to lay the policy basis for green infrastructure design in the land use plan. In particular, the comprehensive land use plan can identify synergies between the water resource objectives of green infrastructure and associated social and economic considerations, particularly aesthetic benefits, cost savings, and quality of life. A community that embraces green infrastructure is setting itself apart from its neighbors in making a conscious investment in alternative green technologies to meet its infrastructure needs. The community also is making a statement to prospective employers, developers, and new residents of its intentions to embrace sustainability. In addition, land use plans can encourage the use of green infrastructure for public infrastructure projects. Visible public projects set a good example for private developers and help to educate residents about the benefits of creative designs.

Most of the plans reviewed identified a need for more holistic management of stormwater. The most advanced plans on this topic – including Homer Glen, Joliet, and Will County – recognized the need for a holistic approach to stormwater management. In addition to minimizing increased flooding, there was also an emphasis on preserving natural hydrology, protecting water quality, and preserving groundwater recharge. Several of the plans made specific recommendations to update relevant ordinances to meet these objectives.

One recurring theme in several plans was recognizing the need for more "naturalized" stormwater management approaches to reduce runoff volumes and pollutant loads. Several of the plans identified best management practices (BMPs) such as bio-swales, rain gardens, permeable paving, level spreaders, recessed landscape islands, infiltration trenches, and filter strips. Naturalized detention also was emphasized in several plans. Naturalized basins incorporate native wetland and prairie plants to enhance pollutant removal as well as recreational and aesthetic benefits. Some plans, most notably Frankfort, identified needs to map, evaluate, and ensure long-term maintenance of detention basins and associated drainage ways.

Native landscaping was recommended in most of the plans to provide stormwater quality and infiltration benefits as well as habitat and reduced cost and maintenance needs. Some of the plans also identified the need for long-term requirements for maintenance, monitoring, and performance criteria for natural landscapes and associated BMPs. On a related note, two of the plans – Homer Glen and Will County -- addressed alternative wastewater treatment and disposal approaches. They encouraged options that reuse, reduce, and recharge treated wastewater, including spray irrigation, constructed wetlands, and shared septic systems.

3.1.3 PROMOTING EFFICIENT, COMPACT DEVELOPMENT PATTERNS

One way to reduce stream impacts from development would be to undertake development in ways that consume less land and create less impervious surfaces, as compared to conventional development. More specifically, accommodating a given amount of growth via higher density development can substantially lessen the adverse impacts of growth. While this may run contrary to conventional wisdom, it has been demonstrated by the U.S. Environmental Protection Agency and others that, for a given amount of growth, higher density results in less impervious area per capita.[2] It also results in a smaller growth footprint, thereby allowing for greater protection of critical recharge areas and natural resources. The land use plan can promote this objective by endorsing higher density residential development, clustered/conservation development, redevelopment, and mixed-use development approaches. Ultimately, these objectives can be translated into changes in the zoning code and zoning maps.

Nearly all of the plans recognize the importance of a mix of land uses, particularly the preservation of density and redevelopment in downtown areas. Several of the plans, including Mokena, New Lenox, Orland Park, and Will County, go a step further and embrace various forms of compact development as important themes of their plans. Some of the recurring concepts endorsed in these plans include:

- Requiring new development to be contiguous to existing development and infrastructure;
- Protecting agricultural lands from premature development;
- Using conservation easements and transfer of development rights to preserve agricultural land;
- Using boundary agreements and utilities to control "leapfrog" development;
- Promoting re-development of downtown and historic business districts;
- Encouraging pedestrian friendly, mixed-use development;

[2] USEPA. 2006. *Protecting Water Resources with Higher Density Development*. http://www.epa.gov/smartgrowth/pdf/protect_water_higher_density.pdf

- Encouraging transit-oriented development near commuter rail stations; and
- Residential clustering.

3.1.4 PROMOTING EFFICIENT STREET AND PARKING LOT DESIGNS TO MINIMIZE IMPERVIOUS SURFACES

A comprehensive land use plan can recognize the desirability of reduced imperviousness by establishing the policy basis for creative, more balanced design approaches. For example, it can lay the groundwork for narrower street widths that not only reduce runoff but also promote more livable residential neighborhoods and reduce pedestrian-automobile traffic accidents. It can also encourage creative commercial and mixed-use developments, and redevelopments, that reduce the need for parking or encourage shared parking.

In general, there was not a substantial emphasis on this topic in the plans that were reviewed. The plans that do specifically address reducing impervious surfaces -- Frankfort, Joliet, Homer Glen, Mokena, and Orland Park – identify a range of approaches, including:

- Reduced parking requirements, shared parking, and fees-in-lieu of additional parking;
- Use of permeable paving;
- Flexible grouping of structures to limit impervious surfaces; and
- Minimize paved surface area of streets, driveways, and sidewalks.

3.1.5 COMPREHENSIVE PLAN REVIEW CONCLUSIONS AND RECOMMENDATIONS

A number of plans by local governments in the watershed have established a strong policy basis for water and natural resource protection. Some municipalities also have adopted targeted plans that specifically address water resources and/or green infrastructure. Notably, most of the plan policies that were relevant to water quality or stream habitat also implicitly were linked to related objectives, such as flood prevention, water supply, open space, sustainable development, and urban form.

While there are several standout plans that cover parts of the watershed, protection and restoration of Hickory Creek ultimately requires the implementation of advanced approaches throughout the watershed. As a result, communities with plans lacking such approaches are encouraged to consider relevant elements of the plans of their neighboring communities to update or amend their current plans to better embrace holistic watershed protection opportunities. These communities also are encouraged to consider using readily-available regional and national water quality, water resource, and ecological protection planning references.[3] In addition, more specific policy recommendations are provided in Section 3.3.

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[3] For instance, see *Water Quality Scorecard: Incorporating Green Infrastructure Practices at the Municipal, Neighborhood, and Site Scales*, U.S. EPA, 2009. Available at http://www.epa.gov/smartgrowth/pdf/2009_1208_wq_scorecard.pdf. Also *Ecological Planning and Design Directory*, NIPC. Available at http://www.nipc.org/environment/sustainable/content.htm; *Protecting Water Resources with Higher Density Development*, U.S. EPA. Available at http://www.epa.gov/smartgrowth/pdf/protect_water_higher_density.pdf; and *Local Greenprinting for Growth: Using Land Conservation to Guide Growth and Preserve the Character of Our Communities*, Trust for Public Land and National Association of Counties. 2002. See http://www.tpl.org/content_documents/local_greenprinting_Vol_1.pdf. *Watershed Urbanization Impacts on Stream Quality Indicators in Northeastern Illinois*, Proceedings from the National Symposium: Assessing the Cumulative Impacts of Watershed Development on Aquatic Ecosystems and Water Quality, U.S. Environmental Protection Agency, p. 129-135, Dreher, D.W., 1997.

3.2 Review of Local Ordinances

Local ordinances provide local governments with the legal framework necessary for the achievement of water and natural resources goals for their respective communities, as land development that occurs under these ordinances can directly or indirectly affect the quality of Hickory Creek and its tributaries. With assistance from municipal staff, a review of relevant municipal and county stormwater, subdivision, zoning, and related development ordinances was performed as part of the watershed planning process. To facilitate this review, a 70-question checklist was developed using a combination of local, regional, and national ordinances and resources, including:

- NIPC *Facility Planning Area Nonpoint Source Management* checklist
- Provisions of local municipal ordinances, countywide stormwater ordinances, and other municipal or county conservation design ordinances that are good examples for others to follow
- NIPC/CMAP *Ecological Planning and Design Directory*[4]
- *Blackberry Creek Watershed: Zoning Code Analysis and Ordinance Language Recommendation* report[5]
- USEPA *Water Quality Scorecard*[6]
- Center for Watershed Protection, *Better Site Design (Code and Ordinance Worksheet and related publications)*[7]

The checklist emphasizes key stormwater provisions, including detention requirements, floodplain management, erosion control, and stream/wetland protection. The review also included relevant subdivision, zoning, landscaping, and any conservation design provisions that would be desirable in promoting sustainable development and redevelopment in the watershed. The ordinance review considered the following five major topical areas. A table summarizing the findings is presented in Appendix C.

- Comprehensive Stormwater Standards
  - Stormwater drainage and detention
  - Soil erosion and sediment control
  - Floodplain management
  - Stream and wetland protection
- Natural Area Standards
- Landscaping Standards
- Impervious Area Reduction: Street and Parking Requirement
- Conservation Design: Zoning/Subdivision Standards

The review was performed for the Villages of Frankfort, Homer Glen, Mokena, New Lenox, Orland Park, and Tinley Park, as well as for the City of Joliet and the countywide *Will County Stormwater Management Ordinance*.

3.2.1 COMPREHENSIVE STORMWATER MANAGEMENT STANDARDS

The watershed protection priorities for this component of the ordinance review were to adopt advanced, comprehensive standards for the protection of water resources and related aquatic resources. In particular, ordinances should go beyond a core emphasis on controlling peak stormwater runoff rate to also emphasize protection of water quality, natural hydrology, and aquatic habitat. These items can be addressed through an integrated approach to stormwater drainage and detention, soil erosion and sediment control, floodplain management, and stream and wetland protection.

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[4] http://www.chicagowilderness.org/sustainable/directory_documents.php
[5] Kane County, 2004, http://www.co.kane.il.us/kcstorm/blackberry/zoning/FinalReport.pdf
[6] http://www.epa.gov/smartgrowth/pdf/2009_1208_wq_scorecard.pdf
[7] http://www.northinlet.sc.edu/training/media/resources/Better%20Site%20Design%20SW%20Code%20Ordinance%20Worksheet.pdf

Will County has developed a well-written countywide stormwater ordinance that covers, in part, the direct stormwater impacts of development. However, this ordinance is not intended to address water quality, maintenance of natural hydrology, and aquatic resources of streams and wetlands. More recently, the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) has developed a draft comprehensive ordinance for the Cook County portion of the watershed that is similar, in some respects, to the Will County ordinance. However, it exceeds the water resource and habitat protections provided in the Will County ordinance. All Hickory Creek watershed communities in Will County have adopted stormwater standards that are at least equivalent to the countywide ordinance. Cook County communities will presumably be following suit in adopting the provisions of the new MWRDGC ordinance. The standards adopted by these communities should meet or exceed the MWRDGC requirements.

3.2.1.1 Comprehensive Stormwater Standards Analysis Results

Stormwater Drainage and Detention: A slight majority of ordinances currently in place within the Hickory Creek watershed embrace protection of water quality and hydrology in their purpose statements. However, the ordinances are split over the level of encouragement or requirement of stormwater BMPs. Several of the ordinances, including Joliet, Orland Park, Frankfort, Homer Glen and Will County, incorporate NIPC model ordinance requirements regarding detention design for water quality benefits and discouragement of onstream detention and direct discharge of untreated runoff into wetlands. Also, all of the ordinances require maintenance plans for detention facilities, although the requirements are relatively vague in most ordinances. The ordinances are relatively weak overall in encouraging or requiring stormwater BMPs, such as vegetated swales and bioretention, or providing any detention credit for BMPs like permeable paving. None of the ordinances include numerical water quality-related performance criteria, such as runoff volume control criteria.

Soil Erosion and Sediment Control: Most of the ordinances have strong purpose statements and/or comprehensive principles for minimizing erosion. Half of the communities – Tinley Park, Frankfort, Mokena, and New Lenox -- have adopted specific site design requirements for sediment and erosion control. Most of the ordinances require routine maintenance and inspection and include a range of penalties for non-compliance; however, details are lacking on some of these latter provisions. Another area where significant improvement could be achieved in several ordinances is the addition of a specific reference to the *Illinois Urban Manual*.[8]

Floodplain Management: Nearly all ordinances include strong purpose statements addressing water quality and aquatic habitat. Most ordinances also discourage stream channel modifications and require mitigation for unavoidable water quality or habitat impacts. However, most of the ordinances, with the exception of Joliet, Homer Glen, and New Lenox, do not limit appropriate uses of the floodway to the NIPC-recommended list (e.g., ordinances allow uses such as parking lots).

Stream and Wetland Protection: The ordinances vary widely in their approach to stream and wetland protection. About half of the communities do not address wetland protection, beyond requiring some pretreatment of stormwater prior to discharge into a wetland. In contrast, other communities, including Joliet, Frankfort, Homer Glen, and New Lenox, have fairly advanced wetland protection standards based on the NIPC Model *Stream and Wetland Protection Ordinance*. A majority of the ordinances also have some basic provisions for pretreatment of stormwater prior to discharge into a wetland and protection of a 25-foot buffer strip adjacent to wetlands and stream channels. However, none of the community ordinances, nor the Will County SMO, take a truly comprehensive approach to wetland protection and mitigation as has been done in countywide ordinances in places like DuPage and Lake Counties.

[8] http://aiswcd.org/IUM/index.html

3.2.1.2 Stormwater Ordinance Recommendations

All communities should strive to adopt comprehensive standards for the protection of water resources and aquatic habitat. In particular, ordinances should go beyond a core emphasis on stormwater rate and quantity, as required in the countywide *Will County Stormwater Management Ordinance*, to also emphasize protection of water quality, natural hydrology, and aquatic habitat. These items can be addressed through an integrated approach to stormwater drainage and detention, soil erosion and sediment control, floodplain management, and stream and wetland protection. This can largely be achieved by the adoption of the provisions of the following Northeastern Illinois Planning Commission (NIPC) model ordinances, as some watershed communities have already done. These ordinances can be found on the CMAP website.[9]

Communities can acquire copies of advanced ordinances from their neighboring municipalities. Alternatively, communities may wish to consider the provisions of the countywide stormwater ordinances of DuPage, Kane, Lake, and/or McHenry Counties. All of these countywide ordinances, to varying degrees, incorporate provisions addressing water quality, hydrology, and aquatic habitat. If this latter approach is taken, it may be appropriate for Hickory Creek watershed communities to coordinate with other Will County communities to discuss possible changes and improvement to the countywide *Will County Stormwater Management Ordinance*. In particular, the communities in the Lower DuPage River watershed also are engaging in an ongoing watershed planning process and may be supportive of this approach.

3.2.2 NATURAL AREA STANDARDS

Careful protection, restoration, and management of natural areas are key recommendations to improve Hickory Creek and its tributaries. These recommendations address *remnant* landscapes as well as *restored/created* natural areas. The Cook and Will countywide stormwater ordinances already address, to varying degrees, protection of streams, lakes, and wetlands and establishment of appropriate buffers. However, these ordinances do not specifically address associated upland natural areas – such as prairies, savannas, and woodlands – that buffer aquatic systems and provide critical landscape linkages for wildlife. Therefore, management plans should be developed for designated natural areas and buffers, including performance criteria, qualified management entities, and revenue sources for management activities.

3.2.2.1 Natural Areas Standards Analysis Results

The ordinances that were reviewed were somewhat divergent in their approach to protecting and managing natural areas. While most communities have some type of open space set-aside, only a few – including Orland Park, Homer Glen, and Will County -- include a specific focus on protecting natural areas such as woodlands, wetlands, and prairies. Most of the ordinances have requirements for identifying the ownership of open space parcels associated with new developments, with several specifically referencing conservation easements. Finally, only a few ordinances, including Frankfort, Homer Glen and Will County, include requirements for long-term stewardship plans and related performance criteria for the management of protected natural areas.

3.2.2.2 Natural Area Protection Recommendations

All communities are encouraged to identify and inventory their natural resources and open spaces, including the various features referenced above. This can lead to the mapping of a community-wide (or watershed-wide) "green infrastructure" network (as discussed later in this chapter) that identifies aquatic and upland resources to be protected, along with appropriate buffers. Protection could be accomplished, for example, via a series of "natural area overlay districts." Identified natural areas could be protected via

[9] http://www.cmap.illinois.gov/wastewater-committee/about-fpa-requests. The ordinances include the Model Stormwater Drainage and Detention Ordinance, Model Soil Erosion and Sediment Control Ordinance (1991), Model Floodplain Ordinance for Communities Within Northeastern Illinois (1996), Model Stream and Wetland Protection Ordinance (1988).

strict development prohibitions or through flexible zoning that allows for clustering around sensitive natural areas. Specific standards should address natural area identification, allowable uses and cover within the natural area, buffer transitions, and other design elements. These regulatory protections could be supplemented by the acquisition programs of park and forest preserve districts.

In addition, preparation of short- and long-term management plans should be required for designated natural areas. Further, vegetative performance criteria, qualified ownership and management entities, conservation easement provisions, and revenue sources for management activities should be clearly spelled out. Watershed communities should consider the progressive ordinance provisions of neighboring communities, such as Orland Park, Homer Glen, and Will County. Alternatively, a recently adopted conservation design ordinance in McHenry County is an excellent model for natural area protection standards.[10] This subject is further addressed below under Section 3.2.5, Conservation Design Standards.

3.2.3 LANDSCAPING STANDARDS

Natural landscaping can greatly benefit the preservation of water quality and natural hydrology. Natural landscaping can be encouraged, where appropriate, in common areas in lieu of conventional turf grass landscapes. Use of native vegetation can also be specifically targeted to BMP applications, such as bio-infiltration swales, rain gardens, filter strips, and naturalized detention basins.

Unfortunately, some landscaping ordinances may unintentionally discourage the use of natural landscaping via "weed" prohibition language. Some ordinances also require the physical separation of pervious and impervious surfaces on site, thereby effectively preventing runoff from impervious surfaces flowing onto pervious areas. A common example is the requirement to install raised landscape islands in parking lots rather than allowing recessed islands with stormwater management components.

3.2.3.1 Landscaping Standards Analysis Results

The ordinances within the Hickory Creek watershed are divided in their approach to natural landscaping. While most ordinances encourage the use of native vegetation for common areas and stormwater facilities, only one community actually requires it. Only about half of these communities have provisions for long-term maintenance, funding, and performance criteria for natural landscapes and common areas. About half of the communities – Joliet, Tinley Park, Frankfort, and Homer Glen -- have tree protection and replacement requirements, while all communities require planting of street trees. While the majority of communities have requirements for pervious landscaped areas associated with parking lots, only two communities – Joliet and New Lenox -- encourage the use of recessed landscape islands for stormwater filtering and infiltration.

3.2.3.2 Landscaping Recommendations

Landscaping ordinances should encourage the integration of pervious, landscaped areas with the impervious areas of the site. Runoff, where feasible, should be routed across and through landscaped areas. Language to specifically allow integration of bio-infiltration into parking lot islands and street side landscape strips is recommended. Unfortunately, there are relatively few local ordinances that address this topic effectively. A suggested reference for ordinance approaches is the *Conservation Design Resource Manual*.[11]

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[10] http://www.co.mchenry.il.us/departments/planninganddevelopment/Documents/Ordinances/Conservation%20Design%20Addendum.pdf

[11] NIPC. 2003. *Conservation Design Resource Manual.* http://www.chicagowilderness.org/sustainable/conservationdesign/Manual/Conservation_Design_Resource_Manual.pdf .

Wherever appropriate, deep-rooted natural landscaping should be used in lieu of conventional, shallow-rooted turf grass landscaping. Further, ordinances should include specific provisions for the maintenance of natural landscapes, including performance criteria. As a starting point, communities interested in upgrading their natural landscaping requirements should consider the Will County landscape maintenance provisions. A more detailed reference for natural landscape design and maintenance criteria is *Natural Landscaping for Local Officials: Design and Management Guidelines*.[12]

Tree protection language is recommended to provide protection of desirable (e.g., native) trees and shrubs. Flexibility should also be provided to allow removal of trees where appropriate for proper forest/natural area management, along with the inclusion of replacement criteria for the unavoidable removal of desirable species. There are a number of good local tree protection ordinances to model, including those referenced above.

3.2.4 IMPERVIOUS AREA REDUCTION: STREET AND PARKING REQUIREMENTS

A significant proportion of the impervious surfaces and source of stormwater impacts is related to streets and highways. Limiting the amount of impervious cover to that which is necessary and to the most appropriate areas is a key to ecologically sensitive design. Similarly, parking facilities often create large impervious surfaces that result in an increase in stormwater runoff and related water quality issues. Reduced parking area and alternative porous paving materials can help to reduce impervious surfaces and facilitate infiltration and groundwater recharge.

3.2.4.1 Impervious Area Reduction Analysis Results

Most of the watershed communities have taken a conventional approach to the planning and sizing of streets and parking lots. Correspondingly, there are relatively few examples of approaches that attempt to reduce impervious surface area associated with streets and parking lots. Several communities have provisions for narrow streets (e.g., Will County specifies 24 feet for local streets). Most other community requirements generally range from 28 to 36 feet (measured at back of curb) for residential neighborhoods. Parking standards – stall size and number of spaces -- vary significantly among communities. Permeable paving is encouraged in just two communities: New Lenox and Tinley Park. Most community ordinances allow flexible parking arrangements, such as shared parking, to reduce new parking requirements. Orland Park also has flexible parking provisions to encourage downtown re-development.

3.2.4.2 Impervious Area Reduction Recommendations

Revised design standards for narrower street widths, along with allowances for street designs that utilize naturalized stormwater infiltration and conveyance systems, should be incorporated into current codes. In addition to reducing stormwater runoff, narrower streets are beneficial in providing traffic calming and promoting more livable communities (discussed later in this chapter). Also, since stream crossings can cause significant stream impacts, recommended standards related to the number of crossings and the design of crossings should be considered.

The topic of reducing street widths will likely generate substantial interest from various constituents, including fire departments and public works officials. This conversation should be informed by the successful efforts of communities (regionally and nationally) to make practical reductions in street widths. Two insightful references for narrower streets are:

[12] NIPC. 2004. *Natural Landscaping for Local Officials: Design and Management Guidelines* http://www.chicagowilderness.org/sustainable/naturallandscaping/installation_maintenance_guide.pdf

- *Skinny Streets and Green Neighborhoods: Design for Environment and Community,*[13] *and*
- *Skinny Streets and Fire Trucks.*[14]

Parking standards should also be reconsidered to determine if ordinances are requiring more parking than is really needed, as well as updated to allow for shared parking, parking credit programs (i.e., purchasing credits for public parking in lieu of creating private spaces), and preferred parking for compact cars and non-motorized vehicles. Specific language to allow permeable parking surfaces such as interlocking concrete pavers, porous asphalt, and porous concrete is recommended in all communities. With the exceptions noted above, there are relatively few local ordinances that address this topic effectively. However, the previously referenced *Conservation Design Resource Manual* (NIPC, 2003) is a good source of information for making ordinance updates.

3.2.5 CONSERVATION DESIGN: ZONING/SUBDIVISION STANDARDS

Some of the approaches and standards discussed above may be inconsistent with existing zoning and subdivision codes. Therefore, greater flexibility is needed in existing codes to allow, encourage, and/or require creative, conservation-based site designs. One obvious way to enable creative designs is to incorporate standards for "clustering" of residential developments. This can provide a number of benefits, including allowing additional room for the incorporation BMPs; reducing mass grading; allowing shorter street networks; and protecting natural areas and open space without reducing the number of lots.

3.2.5.1 Conservation Design Analysis Results

Community ordinances are quite variable in their approach to conservation design. While only one zoning ordinance (Homer Glen) actually requires conservation development, both Will County and Joliet allow conservation design "by right." Several other ordinances provide flexibility regarding lot clustering, and provide density bonuses for conservation developments that exceed minimum standards.

3.2.5.2 Conservation Design Recommendations

Conservation design should be encouraged or required in zoning and/or subdivision codes. Conservation design would ideally incorporate a four-step site design process to protect sensitive natural resources and enhance runoff infiltration and filtering:

- Identify and preserve natural resources and conservation areas.
- Locate buildable areas to minimize impacts on natural areas and to take advantage of open space and scenic views.
- Design the street network to minimize encroachment in sensitive natural areas.
- Establish lot lines and lot sizes following a cluster development approach.

It also may be desirable to offer density bonuses to incentivize conservation design elements that exceed the minimum ordinance requirements.

When considering conservation design ordinances, communities should examine existing ordinances as models. For example, the Will County ordinance is an example that allows conservation design by right and the Homer Glen ordinances mandates conservation design for most residential development. The McHenry County conservation design ordinance, previously mentioned, is another good model. It was written as an addendum to the subdivision ordinance and stipulates conservation design on sensitive sites. It also contains very thorough provisions for the long-term management of common areas and natural landscapes.

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[13] Girling, C. and Kellet, R. 2005. *Skinny Streets and Green Neighborhoods: Design for Environment and Community.* Washington, DC: Island Press.

[14] http://www.smartgrowth.umd.edu/pdf/ULI_SkinnyStreets.pdf

3.2.6 LOCAL ORDINANCE REVIEW: CONCLUSIONS AND RECOMMENDATIONS

Overall, there is a high degree of variability in the requirements of the various ordinances. A number of the individual municipal and county (unincorporated) ordinances exceed the minimum requirements of the countywide Will County Stormwater Management Ordinance in their protection of water quality, hydrology, and aquatic resources. Several communities have embraced relatively advanced standards with respect to watershed protection priorities and sustainability, while several communities have relatively traditional requirements. As a consequence, significant gaps exist in the protection of water quality and wetland resources.

With regard to subdivision, zoning, and landscaping ordinances, there also is a high degree of variability in provisions that are relevant to watershed protection. In nearly every ordinance category that was reviewed, there were generally at least two or three communities with advanced standards that could be used as models for other communities that desire to upgrade their own standards. Overall, though, the subdivision and zoning codes do not recognize flexible and innovative design practices such as natural landscaping, bio-infiltration, and permeable paving (generally referred to as "green infrastructure" or "low impact development"). It may be possible to utilize such approaches, but developers will generally need to proceed with variances or go through planned development procedures.

Communities that desire to change their ordinances to reflect the concerns noted above should consider several options. First, they are encouraged to consider relevant elements of the ordinances of their neighboring watershed communities and amend their ordinances to better support the protection of Hickory Creek and its tributaries. The ordinance checklist itself, as well as the supporting documents listed earlier in the chapter (such as the NIPC model ordinances), also should be utilized in identifying important ordinance provisions in a comprehensive fashion.

While numerous specific recommendations for ordinance improvements have been made above, it is understood that such changes may be a challenge in many communities because of limited staffing and resources. There also may be concerns that ordinance improvements may be a deterrent to development in challenging economic times. However, there are significant arguments in support of ordinance updates, beyond the obvious watershed protection benefits. Some of these are highlighted below.

- Most existing municipal codes are relatively prescriptive, encouraging or requiring traditional "gray infrastructure" design approaches. By providing greater ordinance flexibility and removing existing *barriers* to preferred "green infrastructure" designs, developers are more likely to willingly implement innovative designs. These creative designs, that also promote more livable/sustainable communities, may have significant marketing advantages over conventional development.
- Municipalities can readily provide *incentives* for innovation and sustainability to encourage developer acceptance of new approaches. For example, stormwater detention credits can be applied to stormwater storage under permeable paving and density bonuses can be offered for creative conservation designs.
- Communities can educate landowners and developers regarding the *cost-effectiveness* of watershed-friendly development and redevelopment. For example, recent experience suggests that green infrastructure designs like permeable paving often have longer lives than traditional designs and, hence, lower life-cycle costs. Similarly, clustered conservation design subdivisions have been shown to have significantly lower infrastructure costs than conventional subdivisions.
- A strong case can be made that preservation of natural resources through green infrastructure designs, conservation development, and open space and greenway preservation, can enhance com-

munity character and quality of life. This, in turn, can attract desirable businesses and sustainable residential development.

- Municipalities can be role models for developers. Currently, there are funding programs, like the IEPA Green Infrastructure Grants Program and Section 319 Nonpoint Source grants, that can enable municipalities to implement green infrastructure designs for new or retrofitted infrastructure and facilities.
- Help in updating ordinances is available from multiple sources. In addition to the specific references cited above, municipalities can seek assistance from CMAP and other local and regional resource organizations.
- If ordinance changes are done cooperatively with other communities on a watershed or countywide scale, a "level playing field" is preserved from the perspective of developers. Specifically, it may be appropriate for Hickory Creek watershed communities to coordinate with other Will County communities to discuss possible water quality, hydrology, and aquatic habitat protection improvements to the countywide *Will County Stormwater Management Ordinance*. This could bring it up to a par with neighboring countywide ordinances. Similarly, communities on the Will-Cook County border should evaluate the protective provisions of the draft Cook County ordinance and consider updating their current municipal ordinance as the MWRDGC goes through final deliberations on the ordinance's economic implications.

Similarly, ordinance-related recommendations provided in this plan are consistent with the emerging nonpoint source pollutant control policies expected to be forthcoming from the U.S. EPA, as well as IEPA.[15] Implementation of these recommendations by the Hickory Creek watershed communities will allow the communities to be proactive in their implementation of these policies by taking action now.

[15] A compendium of resources from the USEPA for the implementation of green infrastructure at the municipal level is provided at: http://cfpub.epa.gov/npdes/greeninfrastructure/munichandbook.cfm

3.3 Priority Planning and Policy Recommendations

The review above noted many examples of effective local comprehensive plans and ordinances, as well as some areas where improvements are warranted. In the following sections, special priorities for local planning, ordinances, and programs are identified.

3.3.1 GREEN INFRASTRUCTURE NETWORK

A network of "green infrastructure" within the Hickory Creek watershed was identified as part of the watershed plan development process. This green infrastructure process was informed regionally by the *Green Infrastructure Vision* adopted by the 250 member Chicago Wilderness consortium.[16] One of the primary purposes of identifying a green infrastructure network for Hickory Creek was to refine the regional vision to a more realistic mapping of watershed-scale opportunities. It also was important to provide local stakeholders with a vision for green infrastructure within the watershed that is not limited by artificial political boundaries and to integrate the individual planning efforts of each municipality.

The green infrastructure network for the Hickory Creek watershed was identified through a collaborative effort with numerous watershed stakeholders. The stakeholders initially agreed on a comprehensive set of green infrastructure purposes. These included water quality, aquatic habitat, and biodiversity preservation at the core, but also included flood prevention, recreation, trails, and groundwater protection. The core of the green infrastructure network was identified by combining several mapped natural resources characteristics for the watershed, including:

- Protected open space
- Floodplains;
- Wetlands;
- Steep slopes (i.e., greater than 10 percent);
- Stream centerlines with 100-foot buffers;
- Wooded areas; and
- Existing protected open space areas.

The green infrastructure network was expanded through input from watershed stakeholders at a green infrastructure workshop.[17] Through discussion with the workshop participants, it was clarified that the green infrastructure network for the Hickory Creek watershed should not only be established through acquisition of natural areas, but should include green infrastructure in existing developed areas and in those areas slated for development. Based on this discussion, the workshop participants identified green infrastructure opportunity areas within the watershed. The identified green infrastructure network for the Hickory Creek watershed is present in Figures 3-1a through 3-1e.

[16] http://www.chicagowilderness.org/GIV.php
[17] September 8, 2010. Pilcher Park Nature Center, Joliet, IL.

Figure 3-1a.

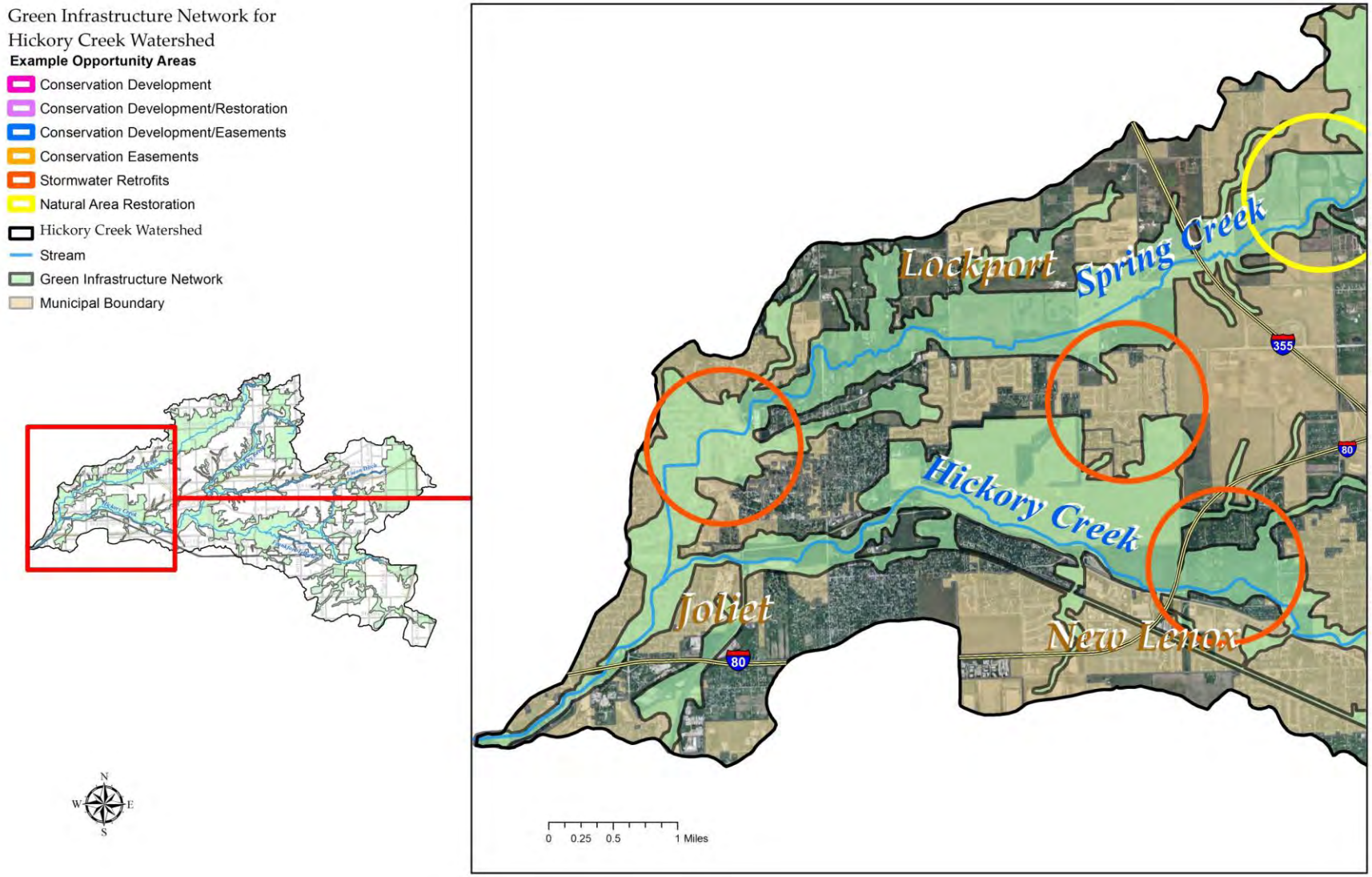

Green Infrastructure Network for
Hickory Creek Watershed
Example Opportunity Areas
Conservation Development
Conservation Development/Restoration
Conservation Development/Easements
Conservation Easements
Stormwater Retrofits
Natural Area Restoration
Hickory Creek Watershed
Stream
Green Infrastructure Network
Municipal Boundary
Lockport
Spring Creek
Hickory Creek
Joliet
New Lenox
355
80
80
0 0.25 0.5 1 Miles
N
W
E
S

Figure 3-1b.

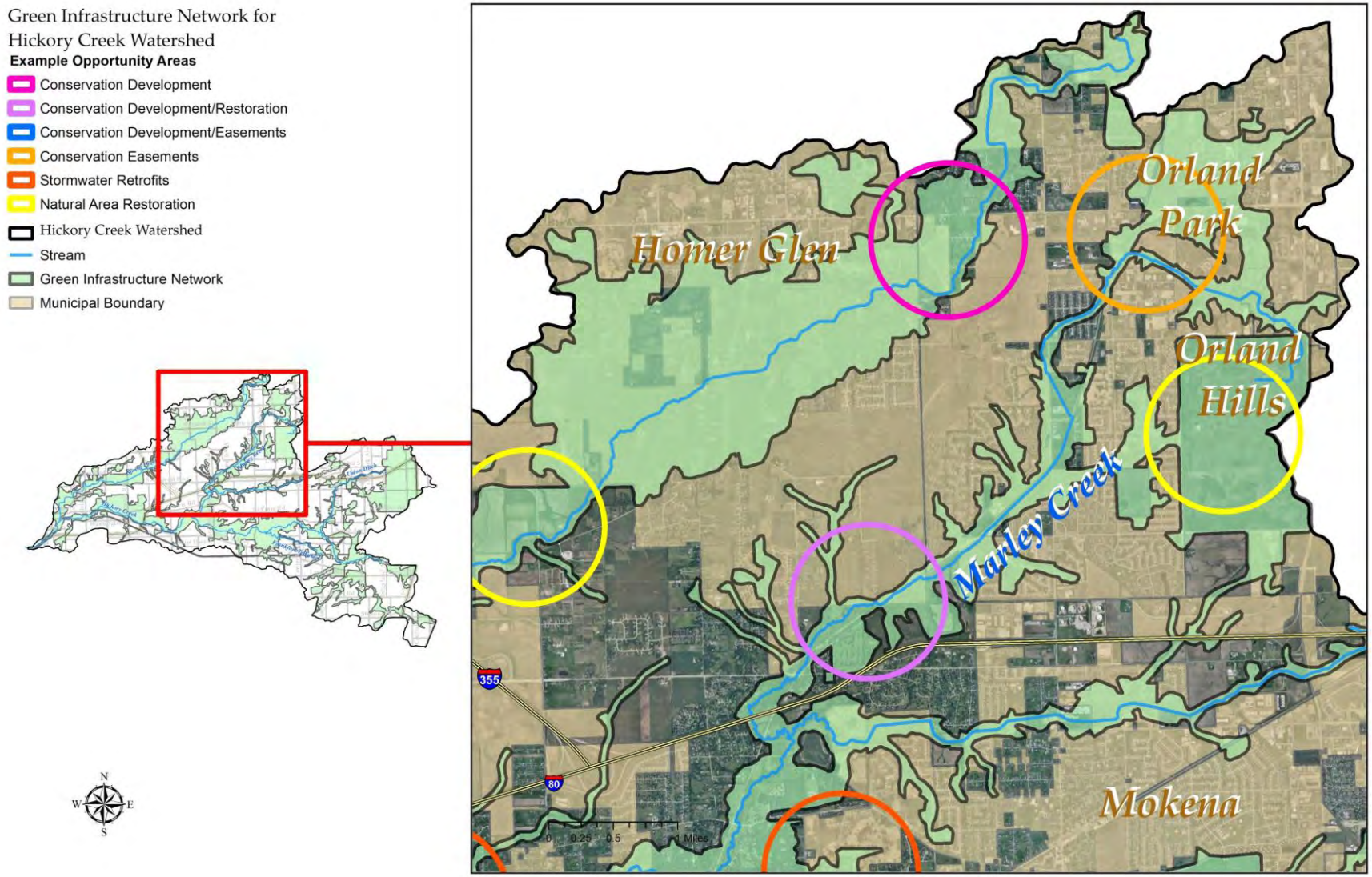

Green Infrastructure Network for
Hickory Creek Watershed
Example Opportunity Areas
Conservation Development
Conservation Development/Restoration
Conservation Development/Easements
Conservation Easements
Stormwater Retrofits
Natural Area Restoration
Hickory Creek Watershed
Stream
Green Infrastructure Network
Municipal Boundary
Homer Glen
Orland Park
Orland Hills
Marley Creek
Mokena
355
80
0 0.25 0.5 1 Miles
N
W
E
S

Figure 3-1c.

Green Infrastructure Network for Hickory Creek Watershed

Example Opportunity Areas

- Conservation Development
- Conservation Development/Restoration
- Conservation Development/Easements
- Conservation Easements
- Stormwater Retrofits
- Natural Area Restoration
- Hickory Creek Watershed
- Stream
- Green Infrastructure Network
- Municipal Boundary

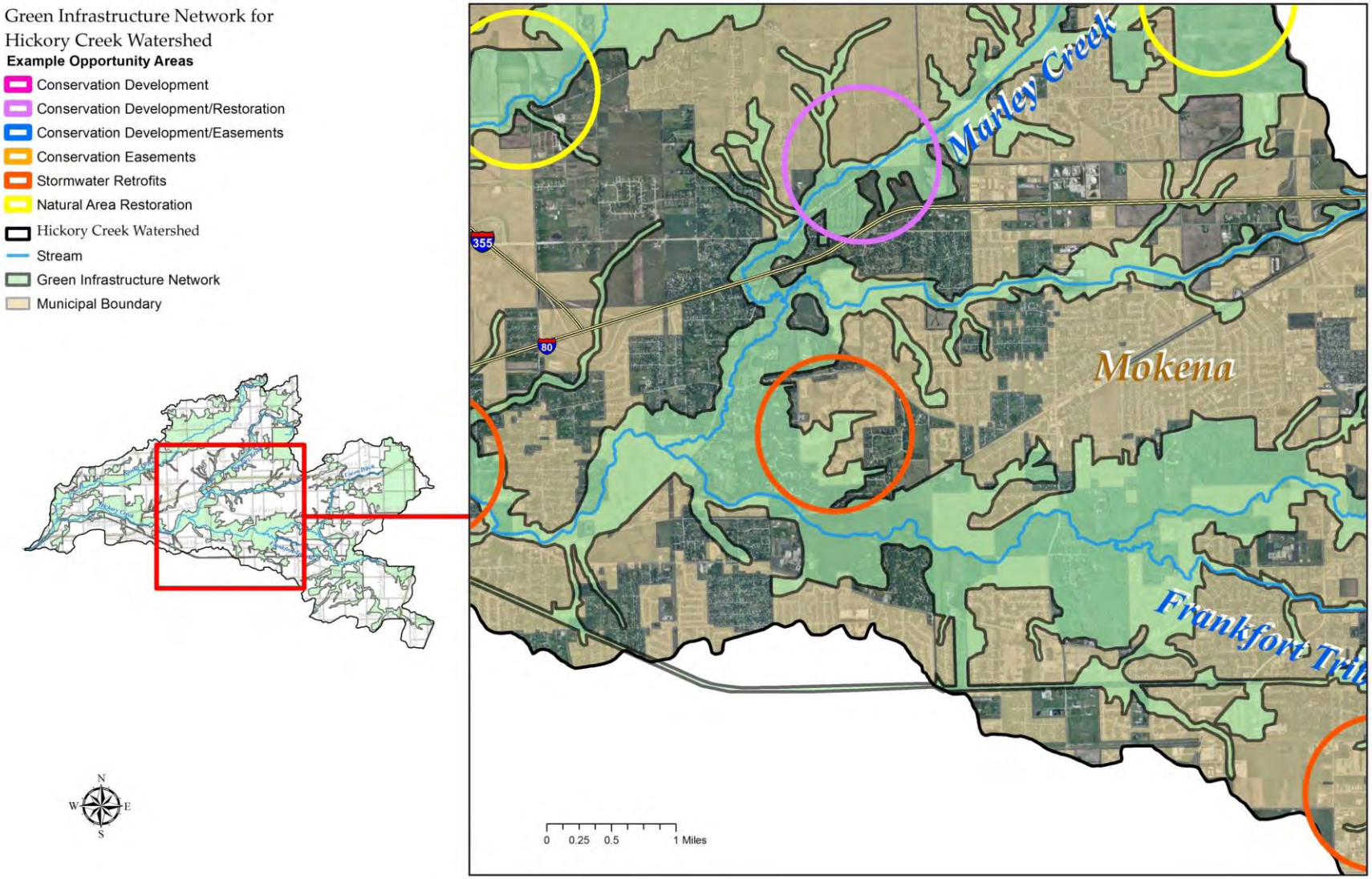


Figure 3-1d.

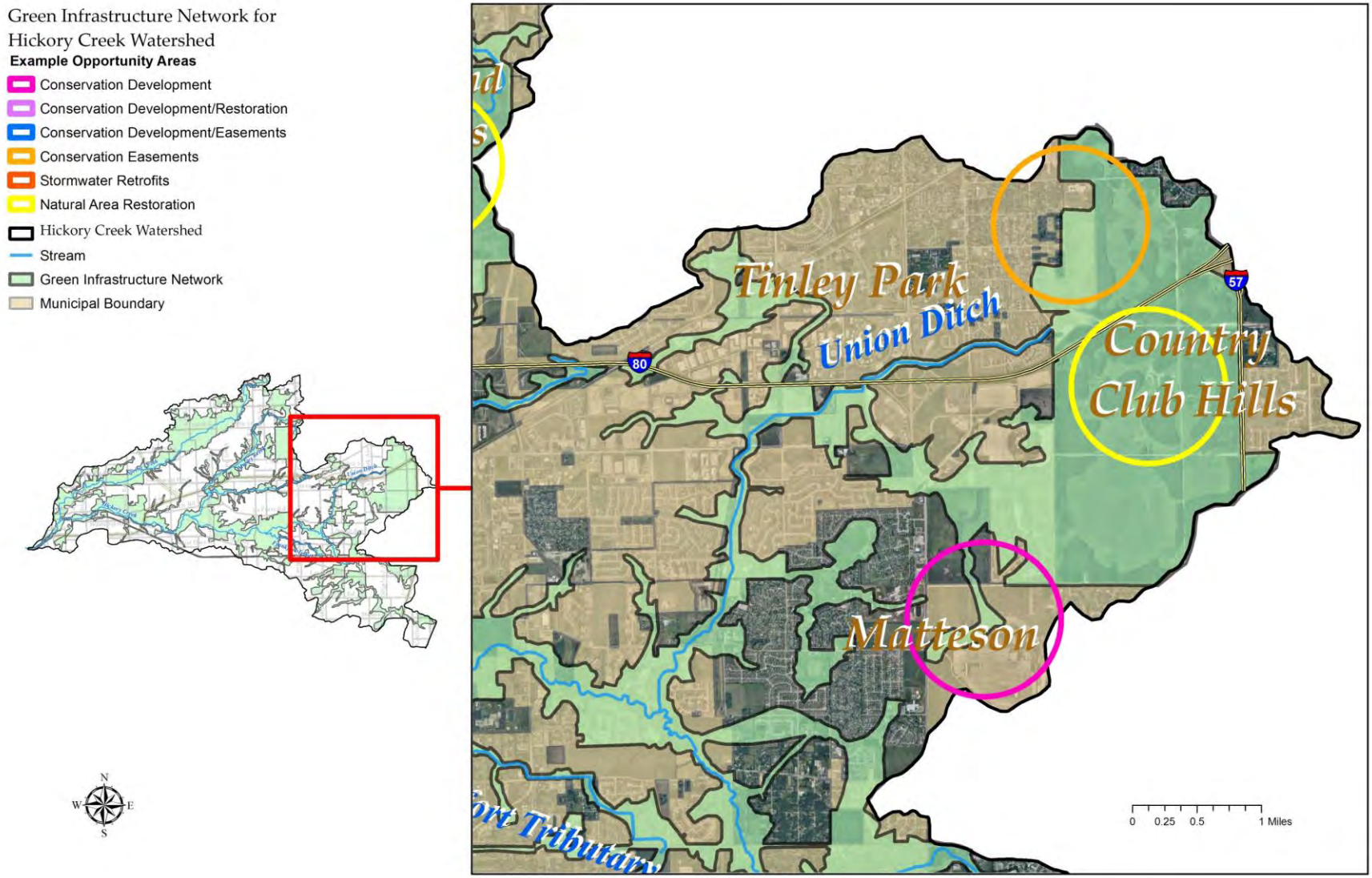
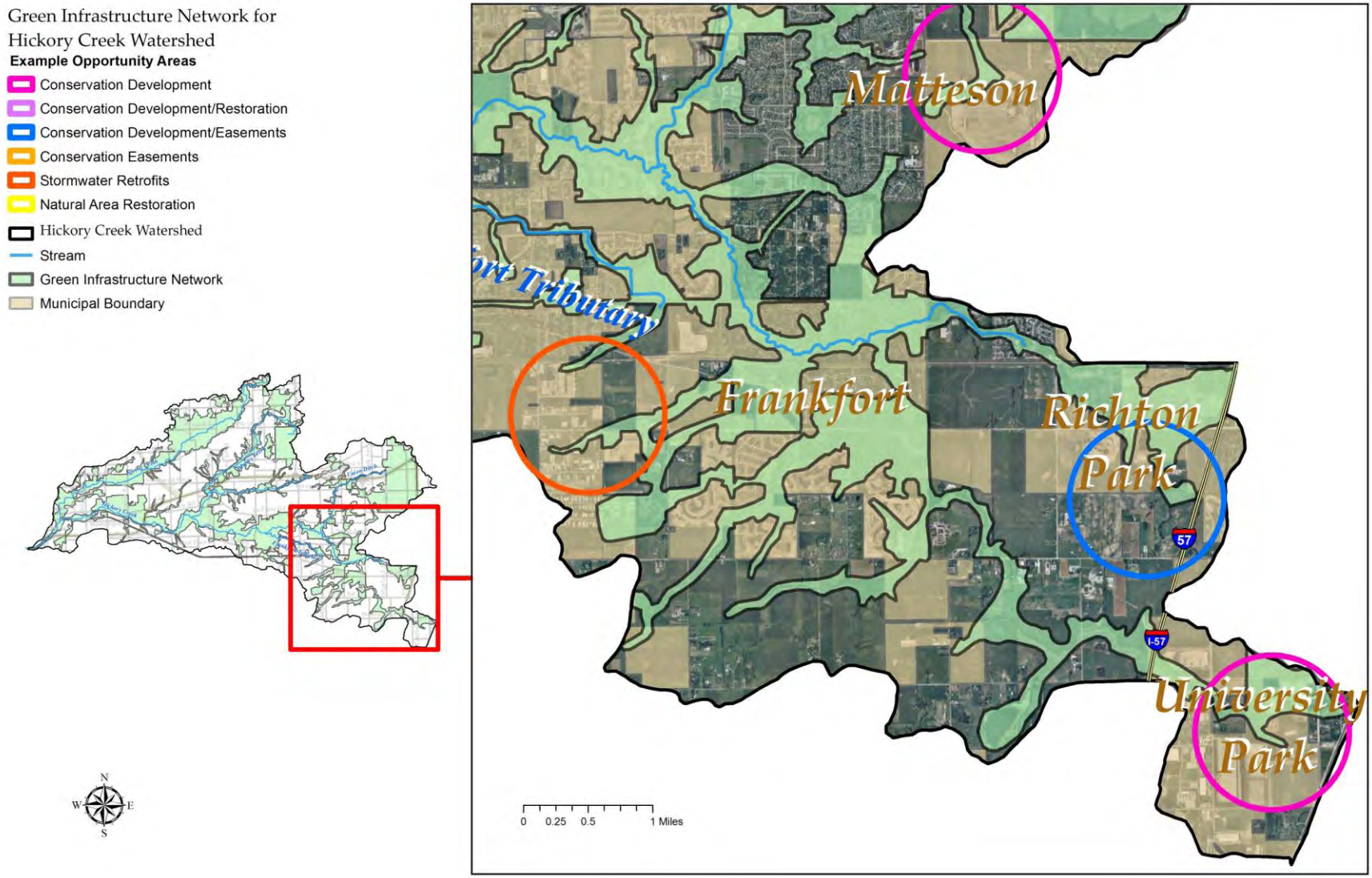

Green Infrastructure Network for
Hickory Creek Watershed
Example Opportunity Areas
Conservation Development
Conservation Development/Restoration
Conservation Development/Easements
Conservation Easements
Stormwater Retrofits
Natural Area Restoration
Hickory Creek Watershed
Stream
Green Infrastructure Network
Municipal Boundary
Tinley Park
Union Ditch
Country Club Hills
Matteson
80
57
0 0.25 0.5 1 Miles
N
W
E
S

Figure 3-1e.


Green Infrastructure Network for
Hickory Creek Watershed
Example Opportunity Areas
Conservation Development
Conservation Development/Restoration
Conservation Development/Easements
Conservation Easements
Stormwater Retrofits
Natural Area Restoration
Hickory Creek Watershed
Stream
Green Infrastructure Network
Municipal Boundary
Matteson
Frankfort
Richton Park
University Park
57
I-57
0 0.25 0.5 1 Miles
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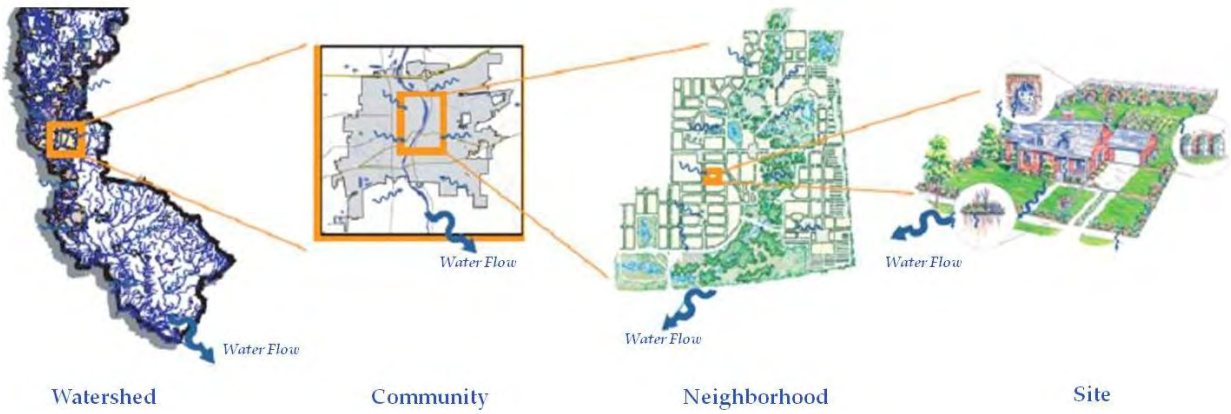
S

With regard to green infrastructure implementation, the watershed stakeholders were presented with a holistic strategy of implementing opportunities at multiple spatial scales, ranging from watershed to community, to neighborhood, to individual sites and lots (Figure 3-2).

Figure 3-2. Green Infrastructure Spatial Scales



At the *watershed scale*, green infrastructure protection could be achieved primarily through the efforts of large land management agencies, particularly the Forest Preserve District of Will County, to acquire large land holdings and establish interconnected greenways and trails. This could be supplemented by the efforts of The Land Conservancy of Will County to protect conservation easements on small private land holdings.

At the *community scale*, municipalities are encouraged to incorporate green infrastructure principles into their plans, land use maps, ordinances, and acquisition programs. This could provide protection for local sensitive natural areas by directing development to less sensitive areas. Communities, particularly park districts, also could establish important greenway connections and trails to the larger protected sites. While the watershed-level green infrastructure map is a good starting point, individual municipalities are encouraged to tailor the plan to their own circumstances and opportunities. In particular, communities are encouraged to engage local stakeholders, including municipal department representatives, park districts or departments, local residents and conservation organizations, to develop refinements through a workshop process.

At the *neighborhood scale*, conservation design should be used to preserve and restore isolated wetlands, headwater streams, and woodlands. Trails and greenways can also be established to provide important local connections to regional and community-level facilities. Long-term protection and stewardship of neighborhood open spaces could be ensured through conservation easements with The Land Conservancy or other natural resource organizations.

At the *site scale*, best management practices can be implemented in parks, school grounds, and residential lots to provide important water quality and habitat functions. These could be implemented on newly developed sites, or retrofitted into existing sites. Practices such as rain gardens, bio-swales, permeable paving, and green roofs, when considered cumulatively, can have remarkable benefits to downstream water bodies.

In summary, it was agreed that green infrastructure implementation in the Hickory Creek watershed should include an array of integrated protection strategies. These would include land acquisition, ecological restoration, greenway and trail connections, private conservation easements, protective land use planning and zoning, conservation development, BMP retrofits, and farmland preservation. Several ex-

ample "opportunity areas" for creative types of green infrastructure protection are highlighted in Figures 3-1a through 3.1e and descriptions of the different types of opportunities are provided below.

- *Stormwater Retrofits*—Given the built-out condition of portions of the watershed, green infrastructure implementation in these areas is expected to be largely accomplished through the implementation of interconnected stormwater management retrofit projects. These types of projects would be implemented at the neighborhood and site-level scale and would include practices that provide water quality benefits and stormwater runoff volume reductions. Example retrofit projects include rain gardens, vegetated swales, and wetland detention basins. Several specific examples of these types of projects are provided Section 4.1.
- *Conservation Development*— Conservation design principles are recommended in those areas slated for future development. These site developments would protect natural areas, create greenway and trail connections, and utilize stormwater management practices that provide water quality and runoff volume reduction benefits. It is expected that many platted, unbuilt (or partially built) developments exist within the watershed communities that incorporate conventional designs. These developments may provide opportunities to re-plat these projects with more compact and/or conservation designs. Interested developers could take advantage of this flexibility to achieve potential cost-savings and marketing advantages while also enhancing sustainability in the community.
- *Conservation Easements*—Portions of the green infrastructure network could be protected through the establishment of conservation easements. These easements may include existing natural areas or areas on which natural area restoration is expected. Groups, such as The Land Conservancy of Will County, could be the recipients of these easements. Conservation easements are included as a potential component for two of the recommended stream and wetland restoration projects presented in Section 4.2.3.
- *Natural Area Restoration*—Portions of the mapped green infrastructure network are already, or are expected to be, protected open space areas, such as the Orland Grasslands. It is expected that these portions of the green infrastructure network would be enhanced through on-going and future natural area restoration and management efforts. Several recommended stream and wetland restoration projects are presented in Section 4.2.

The challenge with establishing the green infrastructure network will be translating the mapped network into an actual network of protected and ultimately restored land while still preserving development potential in the watershed. While the Forest Preserve District and state land resource agencies may be the most visible implementers of the green infrastructure network, protecting the bulk of the identified network will require the collaborative and creative efforts of municipalities, park districts, land trusts, and private residents.

Local governments and open space protection organizations are encouraged to adopt the Hickory Creek green infrastructure network map as part of their comprehensive plan updates, as well as implement the various green infrastructure policies and programs recommended in this chapter. In addition, local policies should address protection of isolated wetlands and other important natural areas resources that may lie outside the mapped watershed-scale network. Further, it would be helpful for watershed communities and open space entities to identify and implement regional green infrastructure connections into adjacent watersheds following the recommendations of the Chicago Wilderness Green Infrastructure Vision.

3.3.2 LIVABLE COMMUNITIES

One important aspect to protecting Hickory Creek, in addition to drainage engineering, deals with land-use planning. Under a "livable communities" approach to local planning, municipalities specifically encourage development to be designed so that it is walkable and planned in such a way that residents can readily use public transit for many trips if they choose to do so. This means that more development would be located near transit and somewhat more compact than in the past. Furthermore, municipalities can also encourage redevelopment on underutilized sites, although this must be balanced with the need to protect community character. Although specific density requirements (i.e. dwelling units per acre) are not being presented here, the benefit to Hickory Creek is that the amount of land developed per new household would be reduced, meaning that stormwater runoff would also be reduced. Under this assumption, it is assumed that the land that is not developed will be used for parks or otherwise conserved. Besides its broad benefits, the livable communities approach may also bring cost savings for municipalities. In the long run, developing in new areas is more costly than compact development. Promoting livable communities also is the central theme of the recently adopted CMAP *GO TO 2040* Plan.

Many of the comprehensive plans in the watersheds have been updated relatively recently. Nearly all of the plans recognize the importance of a mix of land uses, particularly the preservation of density and redevelopment in downtown areas and several of the plans go a step further and embrace various forms of compact, contiguous development, as important themes of their plans. Additionally, several of the reviewed land use plans specifically address reducing impervious surfaces through better urban design.

In many cases, though, ordinances have not been updated to reflect these plans' visions of future growth and design. A number of areas have been identified where zoning, subdivision, and landscape ordinances could be improved to better reflect the comprehensive plan, helping implement the livable communities approach and likely reduce the infrastructure costs of future land development. Municipalities should be encouraged to make these recommended improvements to their comprehensive plans and implementing ordinance improvements, specifically to encourage and require compact/contiguous development and impervious area reduction strategies.

3.3.3 GREEN INFRASTRUCTURE FOR SITE DESIGN AND STORMWATER MANAGEMENT

Green infrastructure at the site or neighborhood scale is any site design or stormwater management technique that has the primary goal of preserving, restoring, or mimicking natural hydrology and water quality. These techniques target infiltrating and retaining more runoff on-site and improving the quality of the runoff that does leave the site. Green infrastructure practices typically provide infiltration and water quality improvement unit processes, in addition to the detention facilities already required.[18] According to case studies in the Midwest, the use of green infrastructure can reduce site development and long-term maintenance costs by reducing or eliminating the need for gray infra-

Figure 3-3. Bioretention, Panduit Building, Tinley Park

[18] Examples are the infiltration trench, infiltration basin, porous pavement, bioretention (bio-swales, rain gardens, etc.), green roof system (soil substrate), wet or dry swales, and a number of other practices.

structure.[19] This is not always the case however, as savings depend on site conditions and the specific green infrastructure techniques used. In general, the use of green infrastructure offers the possibility of saving developers and municipalities money.[20]

The general recommendation is for local governments within the watershed to require the wider use of green infrastructure practices in new development and redevelopment in their jurisdictions. In particular, is it recommended that at a basic level, local governments should embrace green infrastructure alternatives to conventional designs. At a more advanced level, they should also specify performance standards for green infrastructure practices.

Municipal ordinances can embrace green infrastructure alternatives to conventional gray infrastructure designs. Specifically zoning, subdivision, and landscaping ordinances should explicitly allow, encourage and/or require green infrastructure designs. For example, permeable paving standards should be explicitly specified as a preferred option in the subdivision ordinance. Recessed landscape islands that accommodate bio-retention should be specified as a preferred alternative to raised landscape islands. And conservation design, with provisions for lot clustering, natural landscaping, and density bonuses should be allowed by-right for residential development. These provisions can provide developers the assurances, incentives, and predictability to attempt creative designs that can provide cost savings and lead to potential marketing advantages over conventional projects.

At a more advanced level, performance standards to facilitate the use of green infrastructure can be added to stormwater drainage and detention ordinances. Most current ordinances encourage the use of BMPs to improve water quality or reduce runoff volume, but do not require BMPs or establish performance standards.[21] Three options have been identified and their implications are discussed below:

- Pollutant removal standard -- require a combination or "treatment train" of BMPs that would be expected to result in the removal of a certain amount of the pollutants in the runoff from a site, with the expected performance to be determined through modeling and documented for permit review.
- Volume control and treated release rate standards -- require that a portion of stormwater from a development site be retained on-site rather than being discharged to a storm sewer or receiving water body. The volume control standard could be a fixed amount, such as 0.5 to 1.0 inch, or it could be the volume based on maintaining a given percentage of the pre-development infiltration and evapotranspiration, which is the standard used by the State of Wisconsin. In addition, treated runoff discharges should be released at rates that do not impact downstream stability and also mimic natural hydrologic processes.
- Point system requirement – develop a rating scale of points for various BMPs or alternative site designs and require proposed developments to achieve a certain score.

BMP types have different removal rates/performance for various pollutants since the underlying treatment unit processes differ.[22,23] For example, wet detention ponds are common in new development within

[19] Conservation Research Institute. 2005. *Changing Cost Perceptions: An Analysis of Conservation Development.* http://www.nipc.org/environment/sustainable/conservationdesign/cost_analysis/

[20] The Center for Neighborhood Technology has developed a useful online calculator that estimates the costs associated with using conventional and green infrastructure techniques for a chosen soil type, lot size and slope, etc. Costs and cost savings are divided helpfully into private (developers and building owners) and public (mainly municipalities).

[21] The WCSMO does require the retention of 0.75 inches of runoff below the outlet invert of the detention facility if an agricultural use is immediately downstream.

[22] International Stormwater BMP Database, www.bmpdatabase.org

[23] National Pollutant Removal Performance Database, v3. September 2007. Center for Watershed Protection.

the watershed. While they can be quite effective at removing total suspended solids (TSS) – if designed correctly -- they are less effective at nutrient removal than are other practices, such as certain filtration practices. Therefore, one option could be to require a set of BMPs working together that reduce annual or seasonal pollutant load to a specified amount, based on the rainfall distribution and the assumed water quality characteristics of site runoff. Guidelines on how to design such treatment trains and estimate their removal efficiency would be needed in a special publication for Hickory Creek or in the County's Technical Guidance Manual.

Volume control standards should also be coupled with pollutant removal standards. The increase in runoff rates and volumes to Hickory Creek could continue to adversely alter its hydrology and aquatic habitat. A volume control standard to retain and infiltrate the runoff from small storms on-site could help address this problem. After reasonable infiltration measures are met, release rate standards from treated discharges should be established to minimize stream stability impacts and mimic natural hydrologic processes (e.g., interflows).

The third recommended option addresses the fact that most local ordinances encourage the use of BMPs, but do not require them or provide guidance on the extent and type. A BMP point system would not require developers to model or demonstrate how BMPs would perform, but could simply require selection of options from a BMP checklist with assigned point values, much like the LEED system. However, BMP design still needs to address water quality and quantity concerns on a site-specific basis. A point system may represent the most modest change to current practice. Again, guidelines on how to design such treatment trains and development of the point system would be needed in a special publication for Hickory Creek or in the County's Technical Guidance Manual.

3.3.4 INCENTIVES FOR EFFECTIVE STORMWATER MANAGEMENT

Figure 3-4. Wetland Detention Basin, Chelsea Elementary School, Frankfort

Incentives for using green infrastructure practices should be included in local stormwater management programs. Under current stormwater ordinances, many kinds of gray infrastructure are still required even if alternative green infrastructure is used on-site. For example, storm sewers may be required even if a parallel bio-swale system is installed, eliminating the potential green infrastructure cost savings for developers. Similarly, many green infrastructure practices are able to retain runoff on-site, at least temporarily. These practices, such as the storage provided in the gravel base layer under a permeable parking lot, should reduce the detention required under current ordinances. Therefore, elimination of redundant stormwater controls incentivizes green infrastructure practices by allowing reduction of the size and length of storm sewers and the size of detention. It would be incumbent upon the design and municipal engineers to verify through design and analysis that the proposed green infrastructure practices provide a true site runoff rate and volume reduction. Further, the parties should agree to a long-term maintenance regimen to ensure that green infrastructure practices continue to function as designed over time.

Conservation design approaches that emphasize the use of a range of green infrastructure practices are sometimes incentivized with density bonuses, allowing the developer more lots or square footage of commercial development as a trade-off for advanced designs that exceed minimum standards. A similar incentive is to offer expedited permit review and approval for projects that incorporate green infrastructure approaches. Another form of incentive is to provide a reduction in municipal stormwater maintenance fees if a project incorporates BMPs that demonstrably reduce stormwater runoff volume. This

could apply in communities that employ stormwater utilities or other fee systems for maintenance and management.

Municipalities and the County are encouraged to revise their ordinances or develop programs to permit appropriate cost savings for projects that incorporate green infrastructure. In particular, the following incentives are recommended:

a. Detention volume reduction credits;
b. Reduced storm sewer requirements;
c. Density bonuses; and
d. Reduced stormwater maintenance and/or utility fees.

3.3.5 STORMWATER INFRASTRUCTURE AND NATURAL LANDSCAPE MAINTENANCE AND OWNERSHIP

Effective operation and performance of stormwater BMPs and other green infrastructure investments requires appropriate long-term inspection, maintenance, and management. Some examples of maintenance needs include controlling debris, erosion, and sediment buildup in detention basins or sweeping/vacuuming permeable paving. Natural landscaping requires its own set of inspection and maintenance provisions, as well as objective performance criteria to ensure their long-term functionality and avoid nuisance complaints.

Ordinance provisions generally require the identification of a management entity and the preparation of a maintenance plan, although the details generally are not specified. In some communities, stormwater infrastructure (e.g., regional detention basins and storm sewers) is owned and maintained by local governments, most commonly by municipalities but sometimes by park districts. General revenue is typically used for maintenance. In most newer communities, stormwater management practices, such as detention basins and buffer areas, remain on private property and are subject to private maintenance. For instance, detention basins are typically maintained by homeowners or property owners associations. Some jurisdictions require a Special Service Area (SSA) as a backup to fund maintenance if it is not performed by the owners association. Without clear maintenance performance criteria, as well as regular inspections by municipal staff, privately maintained stormwater infrastructure may be in worse condition overall than publicly maintained infrastructure. Further, owners associations and residents may be unaware that the detention pond and other stormwater and green infrastructure elements are even their responsibility.

Similar provisions apply to installed natural landscaping, whether it is part of a detention basin or other BMP or used more broadly in the common areas of a conservation development. In addition to the basic maintenance, ownership, and funding considerations discussed above, it is important to establish clear performance criteria for the design, installation, and long-term maintenance of natural landscapes. Further, it may be desirable to require developers and homeowners associations to contract with reputable natural landscape contractors to install and maintain natural landscapes.[24]

Watershed municipalities are encouraged to revise their ordinances to require more explicit requirements for maintenance of stormwater facilities, natural landscaping, and related green infrastructure. In particular, more specific standards should be developed for maintenance frequency, performance criteria, and ownership. Municipalities should also consider dedication of stormwater management infrastructure to the municipality, as with roads and sidewalks. Alternatively, municipalities may wish to investigate crea-

[24] A recommended source of guidance on this topic is Natural Landscaping for Local Officials: Design and Management Guidelines, (Northeastern Illinois Planning Commission, 2004, http://www.chicagowilderness.org/sustainable/naturallandscaping/installation_maintenance_guide.pdf)

tion of a stormwater utility fee[25] to defray the costs of ongoing maintenance and inspections. Several communities in the watershed, notably the Village of Frankfort, have developed stormwater inventory and maintenance programs that could serve as models for their neighbors.

3.4 Program Recommendations

The program recommendations are suites of non-regulatory actions of local government that can be implemented to reduce water quality, hydrology, and stream use impairments. Local programs might involve public education, infrastructure investment, incentives for landowners (e.g., for rain barrels or natural landscaping), and other programs.

3.4.1 MUNICIPAL WASTEWATER TREATMENT

Wastewater treatment plants within the watershed have high operating standards and few numeric effluent violations for regulated pollutants. However, these discharges are estimated to contribute approximately half of the nutrient load (total nitrogen and total phosphorus) in Hickory Creek, as nutrient removal processes are not included in most plants. Upon expansion, some of these plants will have to comply with the interim state discharge standard of 1 mg/L total phosphorus. While nutrient removal unit processes can be generally added at a relatively low incremental cost during plant expansion or major renovation, plant retrofits solely for addition of these processes can be very expensive. Therefore, retrofitting existing plants should not be considered a watershed priority. However, it is recommended that phosphorus removal processes be implemented at expansion, during major renovation projects, or at NPDES permit renewal and that nitrogen removal processes should be strongly considered. In an effort to determine the WWTPs that will require expansion within the timeframe of the analysis (2040) performed for this plan, existing permitted design average flows were compared against the projected discharge flows on an FPA-basis (Table 3-2).

Table 3-2. Comparison of Permitted Design Average Flows and Projected Flows on FPA-Basis

Facility Planning Area	Existing Permitted DAF for FPA (mgd)	Projected (2040) Average Flow (mgd)	Projected Capacity (mgd)
Oak Highlands/Ingalls Park	0.25	0.25	0
New Lenox	1.9[26]	3.31	**1.41**
Frankfort	5.65	7.36	**1.71**
Mokena	3.12	3.95	**0.83**
Illinois American Oak Valley	1.5	1.4	0

[25] The stormwater utility fee is typically charged to property owners in proportion to the amount of runoff from their property (typically proxied by the amount of impervious surface on site). It replaces the general revenues that currently support local government stormwater programs with an enterprise fund, and can be designed to be revenue neutral – in other words, the general fund revenues budgeted for stormwater management could be reduced by the amount in the enterprise fund. The amount of the fee must bear a reasonable relationship to the cost of service, so the charge for a stormwater fee depends on the need for stormwater infrastructure maintenance. It is arguably more equitable than funding stormwater programs out of general revenue since those who "use" the service more (i.e., place more demands on the stormwater management system) will pay more. While a cost of service study would need to be undertaken, the probable amount of the fee would be on the order of approximately $5.00 per month per single family residence equivalent, based on the fees charged in parts of Indiana and downstate Illinois. The stormwater utility can also fund other activities recommended in the Hickory Creek plan. First, it can be used to incentivize the use of green infrastructure. Under a "feebate" provision, property owners who install green infrastructure practices would have their stormwater fee reduced by a certain amount. Second, the fee can be used to help cover the match for certain grant programs to undertake projects, such as detention basin retrofits or stream bank restoration, to improve the creek.

[26] Existing permitted DAF for New Lenox STP #1 is 1.54 MGD, this value does not include the currently proposed DAF of 2.5 MGD

This comparison indicates that plants within the Mokena, New Lenox, and Frankfort FPAs are expected to require expansions within the planning timeframe. Other plants within the watershed that are not projected to require expansions should implement the recommendation presented here during major renovation projects, such as replacement or addition of treatment processes (e.g., extended aeration, upgrades to address wet weather flows, etc.) or at the time of NPDES permit renewal.

The nutrient loading benefits from the implementation of this recommendation were presented in Section 2.6.2. The future loading analysis demonstrated that even with a nearly doubling of discharge flows, the nutrient loads from the WWTPs could be reduced by approximately 13 to 56 percent for total nitrogen and approximately 46 to 73 percent for total phosphorus by implementing conventional nutrient removal processes, such as activated sludge with anoxic, aerobic, and anaerobic zones.[27] These estimates assume that each of the existing plants within the watershed will eventually implement nutrient removal processes.

The Village of Mokena is an example of this recommendation having already begun implementation during the watershed plan development process. As result of an upcoming proposed plant expansion at the Mokena WWTP, the Village will be required to implement phosphorus removal to meet the interim discharge standard of 1.0 mg/L. During the planning process, the Village also evaluated the implementation of biological nitrogen removal processes as part of the plant expansion, and has elected to do so.

Wastewater treatment plants are also encouraged to consider the feasibility of incorporating constructed wetlands as a polishing process so that the final effluent can receive the added benefits of total phosphorus and total nitrogen reductions. Admittedly, land availability in proximity to WWTPs may be a formidable obstacle for this consideration for some of the WWTPs within watershed. An example of this recommendation is the Frankfort Regional WWTP. This facility provides total phosphorus reduction via a biological treatment system (oxidation ditch) which allows it to meet its 1.0 mg/L effluent phosphorus requirement. The final effluent from the regional facility is then discharged to adjacent wetlands, which provide an unmeasured degree of additional nutrient reduction. Admittedly, land availability in proximity to WWTPs may be a formidable obstacle to this consideration for some of the WWTPs within watershed.

In addition to the implementation of improved nutrient removal as part of plant expansions and major renovations, wastewater dischargers (mostly municipalities) should implement non-point source pollutant control projects and make the policy changes recommended elsewhere in this plan. Example non-point source pollutant control projects within the jurisdictions of each of the dischargers, namely Mokena, New Lenox, and Frankfort, are provided in Section 4.

Municipalities should strongly consider instituting, or continued promotion of, indoor water conservation programs to reduce wastewater volumes. Similarly, they should continue to aggressively pursue inflow and infiltration reduction. For example, the Village of New Lenox is currently expending upwards of $200,000 per year for sanitary sewer improvements, including inflow and infiltration reductions.[28] Lastly, municipalities should explore opportunities for reuse of treated wastewater effluent in their jurisdictions. Again, New Lenox provides a small-scale example of this recommendation by providing treated wastewater to contractors for sewer jetting and dust control.[29]

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[27] Information on biological nutrient removal processes and related costs can be found at: http://water.epa.gov/scitech/swguidance/waterquality/standards/upload/2009_01_21_criteria_nutrient_bio-removal.pdf

[28] Electronic mail communication with Mike Turley, New Lenox Wastewater Treatment Plant Supervisor.

[29] *Ibid*.

3.4.2 SEPTIC SYSTEM INSPECTIONS

Septic systems located within the Hickory Creek watershed have the potential to produce nutrient loads and pathogens that may enter surface waters that flow to Hickory Creek and its tributaries. Poorly designed septic systems, or those that are not maintained well, will eventually fail, resulting in insufficiently treated wastewater leaving the sites. The watershed municipalities and the County do not currently have a systematic means of identifying failing systems within the watershed.

For areas where connections to a municipal collection system are not practical, it is recommended that the municipalities and/or the county consider adopting ordinance language to require the inspection of existing septic systems. A practical timing mechanism for these inspections would be when a property is sold. The key elements of the ordinance revisions should be: 1) inspections are initiated by a tangible timing mechanism, such as a property sale; 2) existing septic systems are inspected to ensure that the system is functioning properly and is sized appropriately based on number of occupants, as represented by the number of bedrooms and/or use; 3) site soils are suitable for the installed system; and 4) the relationship of existing systems to other systems will not have a negative cumulative effect on public health or water resources.

With respect to the implementation of the ordinance language, the municipalities and/or the county could use an approach consisting of: 1) providing an initial notification of real estate brokers and agents of the new requirements; 2) requiring the inspections to be performed by a "Designated Representative," which could be a commercial entity qualified by municipalities and/or the county and hired by the seller of the property; and 3) requiring inspection documentation to be submitted to the municipalities and/or the county or its authorized agent. In the event the results of the inspection indicate a system failure or site suitability limitations, further documentation could be required to indicate that the identified issues have been properly remedied. To facilitate the implementation of such an approach, the municipalities and the county should explore the possibility of collaborating on the development of a unified program to address systems in both incorporated and unincorporated areas.

Successful implementation of the approach described above could result in substantial water quality benefits. If the watershed-wide failure rate can be decreased from the current estimated 10 percent failure rate to 5 percent, estimated annual nutrient load reductions of approximately 11,000 pounds of nitrogen and 4,300 pounds of phosphorus could be achieved, or 50 percent for both parameters. Similarly, bacteria (e.g., fecal coliform) load reductions are expected to be realized through the reduction in the septic system failure rate.

The in-stream monitoring recommendations presented in Section 5.2 are intended to make it possible to more accurately identify portions of the stream with elevated pollutant loading or other impaired conditions. The results of this effort may allow the municipalities and the county to identify a more spatially-specific and timely inspection and maintenance program based on the recommended framework.

3.4.3 STREAM AND NATURAL AREA MAINTENANCE AND RESTORATION

The condition of most natural areas in the Hickory Creek watershed, including the creek corridor, wetlands, and upland woods and prairies, reflects many years of degradation caused by altered hydrology, draining, channelization, and invasive species. In addition, reaches of Hickory Creek are in need of debris and trash removal that contributes to overbank flooding and streambank erosion. While debris removal is often necessary, some amount of large woody debris is important, since it provides fish habitat and substrate for the aquatic insects that break down organic debris in the stream.

The recommendation for the Hickory Creek watershed is that communities should work cooperatively with park districts, the Forest Preserve District, school districts and private land owners in the long-term ecological management of stream corridors, wetlands, and upland natural areas. In particular, watershed communities should work cooperatively with the Will County Stormwater Committee to implement a regular stream maintenance program that balances improved conveyance with habitat considerations. This effort should entail the enlistment of ecologists, biologists and engineers from organizations operating within the watershed in providing ongoing input into the stream maintenance program activities.[30] This input should include evaluations of maintenance needs and the methods employed for the maintenance activities. An example of the latter is that the implementation of appropriate soil erosion and sediment control measures should be a critical consideration for stream maintenance activities.

Figure 3-5. Woody Debris Accumulation, Hickory Creek at Cedar Road, New Lenox

3.4.4 INTEGRATION OF GREEN INFRASTRUCTURE INTO INFRASTRUCTURE REHABILITATION

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

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

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

Public facilities, particularly police and fire stations, libraries, and public works facilities, are opportunities to incorporate green infrastructure alternatives that are highly visible to the public. The new police and fire stations in Orland Park are good examples of this approach. Communities that embrace green infrastructure for retrofit and replacement projects, as well as public facilities like police and fire stations, will serve as role models for the type of development they want to see in their communities. At the same time these projects may create a unique sense of place that could provide the community with a marketing advantage in attracting desirable development as the current recession eases. Lastly, the communities will realize cost-savings due to longer life cycles of green technology.[31]

Figure 3-6. Arterial Roadway with Vegetated Swale and Porous Pavement Sidewalk

Source: San Mateo County Sustainable Green Streets and Parking Lots Design Guidebook

It is recommended that communities institute a policy as part of the formal capital improvement program to incorporate green infrastructure designs. Examples of several of these types of projects are provided Section 4.1. The project described in Section 4.1.4.1, Degroate Road, New Lenox, provides an excellent example of this recommendation. This project entails the replacement of a failing concrete-lined roadside channel with a vegetated swale and rock check dams. While the Village of New Lenox could simply replace the concrete-lining, the alternative project recommendation provides increased water quality treatment and runoff volume reduction benefits.

The detailed project recommendations included in this plan are only *examples* of projects that should be implemented within the watershed. Ample opportunity for improvements in water quality through the implementation of stormwater retrofits was observed throughout the watershed during the reconnaissance effort. Therefore, watershed communities should implement the example and other similar projects over a reasonable schedule and fully integrate green infrastructure concepts into their existing infrastructure rehabilitation and replacement programs. To facilitate the implementation of this recommendation, watershed communities are encouraged to collaborate on the development of a consistent and structured mechanism to guide this process. The mechanism could be at least partially based on the Illinois Department of Transportation's *Illinois – Livable and Sustainable Transportation (I-LAST) Rating System and Guide*.[32] Sections of this document particularly pertinent to the recommendation presented here are the categories for "Reduce Impervious Area" (W-1), "Stormwater Treatment" (W-2), and "Construction Practices to Protect Water Quality" (W-3).[33]

[31] A useful resource for the incorporation of green infrastructure into rehabilitation and expansion project is provided at the Low Impact Development Center's web site at http://www.lowimpactdevelopment.org/greenstreets/index.htm
[32] http://www.dot.state.il.us/green/documents/I-LASTGuidebook.pdf
[33] *Ibid.*

3.4.5 CHLORIDE REDUCTION PROGRAM

Four stream segments within the Hickory Creek watershed are identified as potentially being impaired by chloride. Based on analysis of the existing data, chloride concentrations above the water quality criterion have also been observed in an additional segment of Union Ditch. The load duration curve analysis presented in Section 2.5.3.5 indicates that a significant portion (76 percent) of the existing chloride loading occurs under the high and moist flow conditions, suggesting that the chloride load is predominately from non-point sources. The reasonable expectation is that the majority of this chloride loading is from roadway, parking lot, and sidewalk deicing activities.

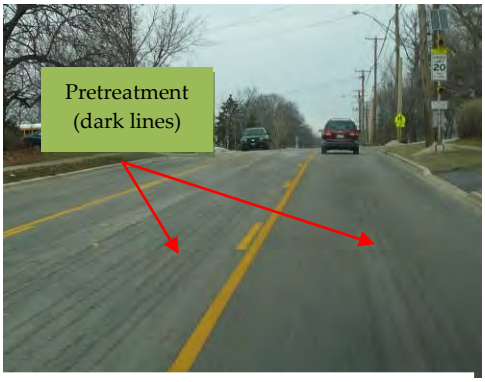


Figure 3-7. Pretreatment on Cedar Road, New Lenox

The removal of chloride from stormwater runoff through implementation of typical stormwater BMPs presents a challenge in that the effectiveness of most BMPs for chloride removal is limited. As a result, the preferred approach for addressing chloride loading within the watershed is through source reduction. The recommendation to address chloride in the Hickory Creek watershed is separated into two components to target chloride loadings from roadway deicing activities and from commercial and residential sources. The first component of the recommendation is for watershed communities to evaluate and implement alternative roadway snow and ice management methods. This may include the use of alternative products that have lower, or no, chloride content to supplement road salt usage, such as beet juice. Alternative approaches of snow and ice management should also be included, such as pretreatment of road surfaces with liquid anti-icing products in advance of winter storm events. Admittedly, public safety is of the utmost importance in the evaluation of alternative snow and ice management methods. Therefore, the watershed municipalities should carefully evaluate the effectiveness of alternative products and approaches.

The Village of New Lenox provides an example of the implementation of this recommendation. In the winter of 2008-2009, the village began to employ alternative deicing products and approaches, including the use of salt brine and beet juice solution for pre-treatment prior to winter storm events. Data on the village's road salt usage prior to (winter of 2007-2008) and after (winter of 2009-2010) conversion to alternative snow and ice management methods are presented in Table 3-2.[34] Using this information, the chloride fractions of the various products were determined and are also presented in Table 3-3. This information was then used to estimate the chloride reduction from the use of alternative deicing products and approaches. The analysis results indicate that the village reduced chloride application by approximately 655,000 pounds, or 19 percent. Additionally, the village's conversion to the alternative program resulted in a cost savings of approximately $50,000 for winter 2009-2010.[35]

[34] Data provided through email communication with Ron Sly, New Lenox Public Works Director. Data is for the entire Village of New Lenox.
[35] Minutes from March 26, 2010 HCWPG meeting.

Table 3-3. New Lenox Winter Maintenance Data and Chloride Reduction Estimates

Winter Season	2007-2008	2009-2010
Application Events	48	40
Snowfall (Inches)	58	56
Rock Salt Used (tons)	3,326	2,158
Pre-Treatment Solution[36] (gallons)	--	100,000
Chloride from Rock Salt (lbs)	4,035,119	2,617,686
Chloride from Pre-Treatment Solution (lbs)	--	121,477
Total Chloride (lbs)	4,035,119	2,739,164
Chloride Applied Per Event (lbs)	84,065	68,479
Average Chloride Annual Load[37] (lbs/year)	3,530,729	2,876,122
Chloride Load Reduction		**654,607**
Percent Reduction		**19%**

The Village of New Lenox is partially situated outside of the Hickory Creek watershed and consequently a portion of the estimated load reduction will occur outside of the watershed; however, these results demonstrate the water quality benefits that can be gained through the use of alternative deicing products and approaches on roadways throughout the watershed.

The second component of the recommended chloride reduction program is targeted at snow and ice removal activities performed in commercial and multi-family residential areas. No data are available on the amount of chloride-based deicing compounds currently being used on these properties throughout the watershed. However, is expected that the primary product being used for deicing activities on these properties is rock salt. The specific recommendation is that the watershed communities collaboratively develop an education and outreach program targeted at commercial applicators of deicing products within the watershed. Elements of the program should be to: 1) determine the products and typical application rates and approaches currently being used and 2) identify and disseminate information on alternative products and approaches that reduce chloride loading within the watershed, but are effective for snow and ice removal. Other entities that perform a large amount of snow and ice removal activities, such as park districts, should also be included in this effort.

Figure 3-8. Signage near Salt Creek, DuPage County

This recommendation could be facilitated by the establishment of an informal partnership with the DuPage River Salt Creek Workgroup, which has been developing and implementing a chloride reduction program for several years in those watersheds.[38]

[36] Pre-treatment solution consisted of 80% salt brine (30% concentration) and 20% Beet Juice
[37] Assumed average of 42 application events based on three years of New Lenox data.
[38] http://www.drscw.org/winter.html

3.4.6 EDUCATION

3.4.6.1 Cultivate an Adult Volunteer Group and Hire a Watershed Coordinator

Perhaps the single most important way to assure sustained work to protect and improve Hickory Creek would be to form a "Friends of Hickory Creek" (or similarly named) group with stable sources of funding. Citizens can actively improve conditions through volunteer stream cleanups, habitat restoration, etc. Doing so together helps cultivate a volunteer spirit. It will also be important to build a constituency for strong ordinances to protect Hickory Creek and achieve a wide range of sound land use policies and practices. Such an entity could also be the main group that would advocate for plan implementation. Several examples are available in the region, such as the Friends of the Fox River[39] and the Friends of the Chicago River.[40]

The Forest Preserve District of Will County and other groups have organized stream cleanup events to remove trash and debris. Volunteer efforts should be coordinated wherever possible with any stream maintenance programs being undertaken by Will County, Cook County Forest Preserve District and the Metropolitan Water Reclamation District. It is also possible to undertake ongoing debris clean-up using an Adopt-a-Stream model, something like the Adopt-a-Highway model. Individual organizations such as businesses or churches can commit to having their members keep a certain reach clean, generally by participating in a volunteer cleanup day every so often. Small streams, even ditches, within neighborhoods are usually ignored by regional organizations but are good locations for local neighborhood activity.

The Forest Preserve Districts of Will and Cook County conduct habitat restoration activities in several of their holdings within the watershed. In many cases, volunteers are used to conduct physical labor, such as woody vegetation removal with hand tools in prairie restoration. Typically the Districts will own tools, while volunteers are managed by a volunteer site steward or by District staff. Given the existing volunteer programs, the Friends of Hickory Creek could help most by generating more interest in volunteering, and especially encouraging new site stewards (advanced volunteers with some working knowledge of restoration who can lead teams of other volunteers) to come forward. This can be done by helping to market the volunteer program. The park districts in the watershed also have volunteer programs with which connections may be made.

Another important way that volunteers can protect and improve Hickory Creek is simply by helping monitor biological conditions and perhaps water chemistry over time. This is especially important in an era of reduced state spending on regular monitoring programs. The Hickory Creek Watershed Plan includes recommendations on additional regular monitoring (Section 5.2), some of which could and should be undertaken by volunteers. To some extent, volunteer data collection is already occurring, such as through the Pilcher Park Nature Center. The plan recommendation is to expand volunteer monitoring and make sure it produces maximum impact per unit of effort. Such monitoring does require training, as well as some oversight to make sure that sampling is being conducted on schedule, that results are being reported, and to QA/QC the data collected. The RiverWatch[41] program provides such training for a nominal fee, as does the StreamLeaders program through Openlands.[42] In its Water Sentinels program, the Sierra Club also provides a means to train and manage volunteers for water quality monitoring.[43]

Finally, while a spirit of volunteerism needs to animate a Friends of Hickory Creek group, a paid staff person or an organization – the watershed coordinator – will still be needed to get work done. Most other

[39] http://www.friendsofthefoxriver.org/
[40] http://www.chicagoriver.org/home/index.php
[41] http://www.ngrrec.org/index.php/riverwatch
[42] http://openlands.org/Greenways/Get-Involved/streamleaders.html
[43] http://www.sierraclub.org/watersentinels/map/illinois.aspx

successful watershed groups have hired at least a part-time coordinator, generally funded through a combination of grants and membership dues.

3.4.6.2 Forge Connections with Institutions Working at The K-12 Level

Another significant way to promote true long-term improvement of Hickory Creek (and any other environmental asset) is to teach youth to care about it and protect it. There are five major high schools in the watershed (Joliet Central, Lincoln-Way East, North, and Central in Lincoln-Way High School District 210 and Tinley Park High School in Bremen High School District 228), and most require community service for graduation. Given the connections that have been made between the Lincoln Way East Environmental Action Club (Scott McCreary), it may be possible to develop specific projects or workdays to improve Hickory Creek or upland areas that students could "plug into" (Figure 3-9).

Figure 3-9. Workshop with Lincoln Way East Environmental Action Club

The Boy Scouts of America have at least two relevant merit badges – Soil and Water Conservation and Environmental Science[44] – the requirements of which could be partially fulfilled through projects already available within the FPDWC. The Soil and Water Conservation badge in particular can involve practical environmental improvement projects. Similarly, the Girl Scouts have interest projects such as "Eco-Action" which could call for local volunteer work by girls in the program. Girl Scouts can also earn a "Get With the Land" patch through collaborative projects with state or federal resource agencies.[45]

3.4.6.3 Forge Connections with Research Institutions and Post-Secondary Education

Hickory Creek has been the setting for ecological research for almost a century. As noted earlier in this plan, Hickory Creek is a "classic biological study area." In line with that status, the Hickory Creek group should seek to build connections with research institutions so that the knowledge of scientists can enrich volunteer stewards, while scientific understanding can be given practical application through engaged research. While neither are located in the watershed, the University of St. Francis and Joliet Junior College are both nearby in Joliet. The Environmental Science program at the University of St. Francis has collaborative programs with a number of institutions, including FPDWC, and students from that program were involved in sampling Hickory Creek during 2008. While it is not clear that Joliet Junior College has engaged in field research or assisted with environmental projects, the Biology Department has been involved in restoring a severely eutrophic lake on campus, partly by installing infiltration practices and stormwater separators in the lake's watershed.[46] This experience could lead to additional efforts off-campus.

[44] http://www.scouting.org/scoutsource/BoyScouts/AdvancementandAwards/MeritBadges/mb-SOIL.aspx, http://www.scouting.org/scoutsource/BoyScouts/AdvancementandAwards/MeritBadges/mb-ENVS.aspx
[45] http://www.girlscouts.org/program/gs_central/insignia/online/participation_patches/getwithland/
[46] http://www.jjc.edu/academics/divisions/arts-sciences/natural-sciences/jjc-lake/Pages/default.aspx

One particular event that has succeeded in galvanizing large numbers of people around nature is a BioBlitz. Designed as part contest, part festival, part educational event, and part scientific endeavor, a BioBlitz brings together scientists in a race against time to see how many species they can count in a 24-hour biological survey of a natural area. The public is invited to observe the scientists' activities, to interact with them, and to participate in other activities provided by nature-oriented organizations. It could also serve as a gathering for the many scientists who have been using Hickory Creek as a living laboratory.

Figure 3-10. Scientists in Powderhorn Prairie during the Calumet Bioblitz (*Photo:* John Weinstein)

There have been several BioBlitzes in the Chicago region in recent years. In 2007, the Calumet BioBlitz covered a diversity of terrestrial and aquatic habitats in three adjacent sites within an area containing outstanding natural environments intermingled with industrial parks and steadfast neighborhoods stretching from Chicago to Northwest Indiana. In September 2008, 1,105 species of plants and animals were documented in the Middle Fork (of the Chicago River) BioBlitz sponsored by the Lake County Forest Preserve District. And in May 2009, more than 1,200 species were identified in the Indiana Dunes National Lakeshore. Each of these showed how a BioBlitz can energize a constituency for conservation as well as provide interesting scientific information. The Hickory Creek BioBlitz could be made even more important by targeting areas that are valuable to scientists as well as to provide much-needed information about the benefits of sustainable development.

3.4.6.4 Collaborate with Recreational User Groups to Protect and Restore Hickory Creek

Hickory Creek is relatively small and does not support many recreational boaters, but canoeists and kayakers do use it. The lower reaches of Hickory Creek have Class II and III rapids in high water, making it a fairly rare treat for whitewater enthusiasts in the Chicago area.[47] (The flood control improvements planned for Hickory Creek could include strategic access points for this use.) The Prairie State Canoeists or Illinois Paddling Council may have members who are willing to become volunteers in the Friends of Hickory Creek group proposed above. Either group may be willing to help sponsor events. The Illinois Paddling Council has a TrailKeeper program[48] for maintaining water trails, but Hickory Creek is not one of them – the water trails are generally larger rivers in northeastern Illinois. Nevertheless, it may be possible for the Paddling Council to lend expertise or volunteer personnel in the form of "In-Stream Maintenance" crews.

Figure 3-11. Smallmouth Fishing in Hickory Creek (*Photo:* Mark Willobee)

[47] Bob Tyler, *Canoeing Adventures in Northern Illinois* (iUniverse, 2004)
[48] http://www.illinoispaddling.org/trailkeepers

Anglers are another group that may have an interest in protecting and restoring the stream. While again Hickory Creek is not as well known a stream fishing destination as some others, it is fished locally. Fishing does have some organized interests, such as the Illinois Smallmouth Alliance, which besides advocacy also provides small grants for conservation projects that support smallmouth.[49]

3.4.6.5 Establish a Sense of Place along Hickory Creek

People will feel a protective affection for a place, in this case a watershed, if they know when they are in that place, what that place is, and why it is special. Place-making has become an area of planning into itself, and generally involves using unique design or other cues to establish a recognizable character for a neighborhood, district, or other place. Giving the Hickory Creek watershed and the stream itself a higher profile will be a long-term effort, involving the sustained work of the adult volunteer group recommended above as well as by major landowners in the watershed.

In characterizing what makes a place unique, a good starting point is its history. To that end, The Center for Neighborhood Technology and Joel Greenberg have drafted a text called *The Lessons of Hickory Creek*, an exciting and informative history of the Hickory Creek area. It includes a history of flooding, interviews with long-time residents, and stories of nature, with dozens of photographs. The work awaits final editing and conclusions. Its publication could be accomplished with participation by the Will County Historical Museum. Similarly, several of the extensive forest preserve holdings along Hickory Creek were obtained as part of early flood control projects. This history, along with information about the landforms thereby protected, could be the core of interpretive signage within the forest preserves that do not have it. Finally, the extensive trail network within the forest preserves and the Old Plank Road Trail still need to be linked throughout the urban areas of the watershed. This ambitious task will require many years of citizen participation and advocacy.

3.4.6.6 Facilitate Peer-to-Peer Exchanges for Local Elected Officials

The HCWPG has had success in engaging senior staff from local governments, including municipalities, county departments, the FPDWC, and park districts. It has not focused as much on engaging elected officials directly, but this will be crucial in implementing the plan. An appropriate way to start would be presentations to a meeting of the relevant Council of Governments (COGs), either by one of the mayors or village presidents, or by staff involved in developing the plan. The relevant COGs include the Southwest Conference of Mayors, the Will County Governmental League, and the South Suburban Mayors and Managers Association.

3.4.6.7 Education for MS4 Requirements and to Support Ordinance Changes

The 1987 amendments to the Clean Water Act brought urban drainage under the NPDES program, thereby regulating "municipal separate stormsewer systems" (or MS4s) as point sources. Larger systems were regulated in Phase I, beginning in 1990, while Phase II began in 2003. Phase II requires smaller operators of MS4s in urbanized areas and operators of small construction sites, through the NPDES permit system, to implement programs and practices to control water pollution stemming from stormwater runoff.[50] The small MS4 stormwater management program requires six minimum control measures, among which is engaging public education and outreach regarding stormwater quality.

It seems logical that this required public outreach should be done on a watershed-wide basis, for example by the "Friends of Hickory Creek" group and its paid watershed coordinator. Each municipality could then sponsor education efforts without having to carry out its own outreach program, while the water-

[49] http://illinoissmallmouthalliance.net/html/heritage.html

[50] USEPA Office of Water. 2005. *Stormwater Phase II Final Rule: An Overview.* Fact Sheet 1.0. EPA 833-F-00-001.

shed-wide education program could be expected to be more effective than one done for individual communities. One issue to consider is that several communities are partially located outside of the Hickory Creek watershed, so the watershed coordinator would need to carry out education efforts in the entirety of each community, not just the Hickory Creek portion. An example of an outreach technique would be to hold an effective series of events and training opportunities for residents within the watershed, as well as developers, to learn about, try and maintain sound landscape practices, including lawn care, green infrastructure, and water conservation.

A previously-discussed recommendation was that municipalities embrace a green infrastructure approach to stormwater management and an emphasis on development/redevelopment to support livable communities, which among other things generally means more compactly designed neighborhoods with narrower streets, better sidewalk connectivity, and a mixture of certain commercial uses with residential uses. Ordinance revisions would be needed to support these changes, but outreach to numerous different stakeholders will be needed to support the ordinance changes. A watershed coordinator and the "Friends of…" group may be able to help establish workshops in the area that would help explain new standards and indicate their benefits, such as improving the marketability of real estate and perhaps reducing development costs.

4. Short-Term Implementation Plan

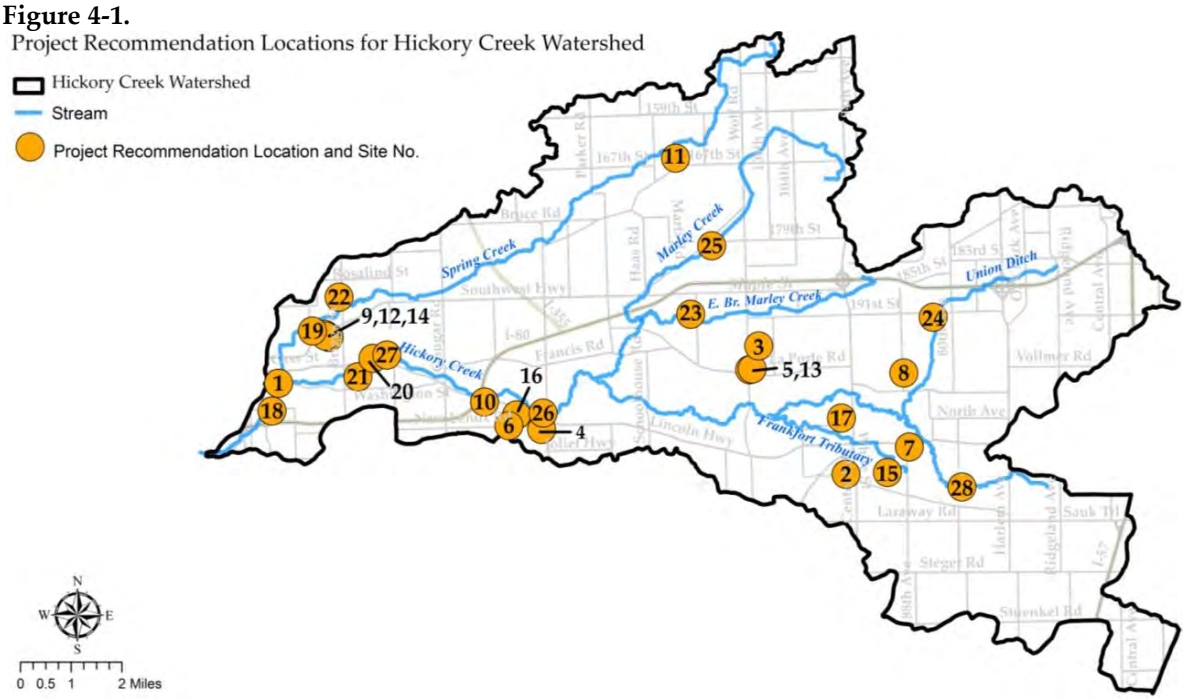
Based on the findings of the watershed assessment and reconnaissance efforts conducted during the development of this plan, numerous opportunities were identified to implement projects throughout the watershed with the goal of protecting and restoring Hickory Creek and its tributaries. Three kinds of projects are proposed:

- Retrofits to existing stormwater management infrastructure to address pollutant loading and increased runoff volume in developed areas;
- Stream channel and stream corridor restoration projects to improve habitat for aquatic life; and
- Improved management practices on farmland to reduce nutrient and sediment runoff.

This short-term implementation plan is not intended to exhaustively list every potential project, but rather propose representative projects that could reasonably be implemented within the next five years. These proposed projects can also be seen as *examples* that stakeholders could utilize to conceptualize other similar projects within the watershed. The projects included in this section are only a subset of the potential projects that were considered during the watershed assessment and reconnaissance efforts. A list of other potential projects are included Appendix D. The expectation is that projects other than those presented here that provide similar benefits toward protecting and restoring Hickory Creek and its tributaries would be eligible for funding from the appropriate funding sources presented in Section 4.5.

The recommended projects discussed in this section were developed in consultation with the HCWPG and potential project implementers. They were selected based on the ability of the project to correct impairments to Hickory Creek (pollutants, poor habitat quality, etc.) and their cost-effectiveness. As can be seen in the following sections, many of the recommended projects are located on public properties, and a public entity, such as a village or park district, is identified as the project lead or champion. Projects on public properties generally have a higher likelihood of being implemented within the timeframe of the short-term implementation plan. Additionally, many of the projects are located in areas where, with proper signage, the general public can learn about the benefits of the projects. The locations of the recommended projects included in the short-term implementation plan are presented in Figure 4-1.

Figure 4-1.



Based on the project selection criteria described in the previous paragraph, the number of project recommendations identified within each of the watershed communities varied. These results should not be interpreted to mean that additional project opportunities do not exist within the other watershed communities.

Please note that estimated project costs provided in this section are planning-level cost estimates only and do not account for potential cost variables such as utility conflicts, soil disposal, etc. Project implementers will need to develop more detailed cost estimates prior to undertaking any of the projects.

4.1 Urban Stormwater Infrastructure Retrofits

Many of the recommended projects include urban stormwater controls, because approximately half of the watershed has already been developed. In the developed portion of the watershed, stormwater is generally routed directly from impervious surfaces to stormwater collection and conveyance systems with minimal opportunity for water quality treatment or stormwater volume reductions. In more recently-developed portions of the watershed, stormwater detention has been incorporated into the sites. Consistent with current stormwater regulations, the primary goal of providing detention is to reduce the discharge rate of stormwater to decrease downstream flooding. However, the outflow volume from most detention basins remains higher than the pre-developed condition. The elevated flows from the basin during drawdown can lead to increased stream bank erosion. Additionally, the use of detention basins does not address the environmental impacts (i.e. increased pollutant concentrations and runoff volume) of increased imperviousness. The recommended urban retrofit projects are intended to provide examples of projects that should be implemented in urban areas to allow for pollutant removal or stormwater volume reductions.

The short-term implementation plan centers on retrofit opportunities within the watershed. It is important to reiterate that incorporating BMPs into new construction is much more cost-effective and efficient than retrofitting existing systems. Site stormwater BMPs should be incorporated at the time of initial design and built during initial construction. This approach offers the most options from the palette of BMPs, providing the engineer more flexibility and more cost-effective solutions. However, current ordinances do not mandate the use of stormwater BMPs to specifically address the pollutants of concern in Hickory Creek. For this reason, the short-term implementation plan focuses on retrofit opportunities within the watershed. The Vision and Policy section of this plan outlines opportunities to address policies that influence new development and redevelopment.

A variety of urban BMPs could be used throughout the watershed, many of which could provide multiple benefits. This plan proposes the installation of filtration practices, permeable pavement, bioretention, vegetated swales, detention basin retrofits, and building retrofits.[1] Three project objectives guide the identification of recommended urban retrofit projects included in the plan:

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

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

4.1.1 FILTRATION RETROFITS

Filtration BMPs target the removal of suspended impurities primarily through a physical removal process. One example of this type of BMP is a sand filter. The formation of microbial films aides in the removal of additional impurities through biological processes in addition to the physical treatment process.[2] Filtration devices that include organic material within the filter media, such as a sand and peat mixture, achieve a higher removal of pollutants by enhancing the growth of microbial communities. These filters greatly improve the removal of urban pollutants such as metals, hydrocarbons, and nutrients. Also, with the introduction of organic material in the filtration media, plants can be grown within the media. The continual regeneration of the root system provides the added benefit of breaking up the filtration media, reducing the rate of clogging and caking. These filtration practices are sometimes referred to as bio-filtration devices.

Several design approaches incorporate filtration or bio-filtration BMPs into the urban landscape. BMP design can be highly site-specific and designed to be constructed on site, or a proprietary device could be purchased from a vendor. Developing custom designs of filtration BMPs to conform to the site provides the most flexibility. The benefit of using a proprietary system is that the manufacturer can assist in selecting the proper size unit to satisfy site conditions, such as drainage area and anticipated pollutant load. Also, manufacturers routinely provide pollutant removal performance charts for their devices. Tree planter boxes are becoming a commonly used bio-filtration device. Their compact footprint and their effectiveness in removing urban pollutants makes this practice very effective. Design literature is readily accessible due to the popularity of these devices and the University of New Hampshire is a good resource for such information.[3] Numerous proprietary systems, such as the Filterra unit by Americast, are available.[4] The following project recommendations show how both site-specific designs and proprietary systems can be utilized.

4.1.1.1 Washington Street, Joliet—Project Site No. 1

Downtown areas typically have limited space for stormwater management, but this limitation does not preclude retrofitting BMPs into the existing infrastructure. Wide sidewalks provide opportunities to incorporate BMPs and improve the aesthetics of the area as shown in the picture below. Notice that sufficient area is provided for access to on-street parking in Figure 4-2. The planter boxes are also spaced to provide access to the sidewalk. An example of how this type of BMP could be incorporated into the Joliet area is shown for Washington Street, Figure 4-3. The planter boxes could be custom designed and constructed on site or prefabricated structures could be selected to meet site constraints.

Figure 4-2. Planter Boxes

Source: Center for Watershed Protection

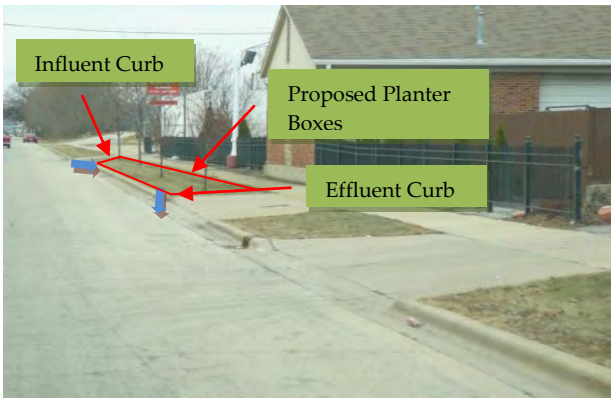


Figure 4-3. Washington Street, Joliet

The approach proposed for Washington Street consists of constructing planter boxes on site. One

[2] CWP. 2007. *Urban Stormwater Retrofit Practices: Version 1.0*.
[3] http://www.unh.edu/erg/cstev/fact_sheets/tree_filter_fact_sheet_08.pdf
[4] Filterra by Americast www.filterra.com

curb cut would be installed upstream to accept inflows and one curb cut on the downstream end to provide overflow routing. When the capacity of the planter box is exceeded, flows will continue along the curb gutter to the downstream curb inlet. The proposed planted box would have a drainage area of approximately 0.25 acres. The BMP would target treatment of 1″ of runoff. The estimated budget for the proposed project ranges between $17,500 and $27,000, including 10% for design services. This BMP practice could be easily replicated at additional locations throughout the city. The lead agency for this retrofit project would be the City of Joliet.

4.1.1.2 Historic Downtown Frankfort—Project Site No. 2

Two retrofit projects are proposed for historic downtown Frankfort. The first project consists of constructing planter boxes on site near the intersection of Oak Street and Nebraska Street (Figure 4-4). One curb cut would be installed at the upstream end of the planter boxes to accept inflows and one curb cut on the downstream end to provide overflow routing. When the capacity of the planter box is exceeded, flows will continue along the curb gutter to the downstream curb inlet. The proposed planted box would have a drainage area of approximately 0.25 acres. The BMP would target treatment of 1″ of runoff. The estimated budget for the proposed project ranges between $17,500 and $27,000, including 10% for design services. This BMP practice could be easily replicated at additional locations within the village.

Figure 4-4. Oak Street, Frankfort

Figure 4-5. Kansas Street, Frankfort

Another location in historic downtown Frankfort, at the intersection of Kansas Street and White Street (Figure 4-5), offers an opportunity to implement a different style of filtration BMP. There are many proprietary tree planter or bio-filtration devices that are available on the market. These pre-packaged units offer an alternative to custom designs. Proprietary units are often more expensive; however, the design process is minimized since units can be selected based on site conditions such as tributary area and anticipated pollutant loads. Also, the installation of pre-built units expedites installation and minimizes public inconveniences associated with construction. The tight location shown in Figure 4-5 is an ideal location for the installation of a tree planter or bio-filtration device such as the Filterra[5] unit shown in Figure 4-6.

Figure 4-6. Filterra Unit

Source: Filterra by Americast

The project recommendation at this location is to use a single proprietary Filterra unit, or equivalent. The drainage area is approximately 0.25 acres. With a target treatment runoff of 1″ a 6-foot by 6-foot Filterra Unit is proposed. The estimated

[5] *Ibid.*

installed costs of the units, including engineering consulting services, is between $16,000 and $19,000. The lead agency for these two retrofit practices would be the City of Frankfort.

4.1.2 PERMEABLE PAVEMENT

Permeable pavement in its many variations contains small voids that allow water to pass through to a stone base where runoff is retained and sediments and metals are treated to some degree. Porous asphalt and porous concrete are poured in place while pavers are typically precast and installed in an interlocking array to create a surface. The use of permeable pavement in lieu of conventional pavement surfaces reduces the runoff volume and flow rates while maintaining functionality. Permeable pavement can be applied to residential, commercial, and industrial areas as an alternative to traditional impermeable surfaces like sidewalks and parking lots. Permeable pavements typically are applied to infiltrate stormwater. In soils that prohibit infiltration, an underdrain system will likely be required. These pavements also remove stormwater pollutants through limited sorption and filtration. The paving surface, subgrade, and installation requirements of permeable pavements are more complex than those for conventional asphalt or concrete surfaces.

4.1.2.1 Village Hall, Mokena—Project Site No. 3

Porous pavement can be selectively installed at strategic locations to promote both infiltration and filtration of stormwater runoff prior to entering conventional storm sewer conveyance systems. The Village Hall in Mokena provides a good opportunity to incorporate porous pavement into a current parking lot layout. A project at this location could serve as an example of how parking lots could be retrofitted with porous pavement as a BMP. In the existing condition, the storm inlets are positioned near the drive isles. There is not sufficient space between the heads of each parking space to accommodate vegetated swales. To preserve the number of parking spaces, parking stalls that flank the catch basin inlets could be converted to porous pavement. This would allow an opportunity for runoff from minor storm events to be filtered and portions of the peak flow attenuated prior to entering the conventional storm sewer conveyance system. Stormwater would enter the conventional system through an underdrain placed below the base course, if not infiltrated to the underlying soils. Higher flows would still be able to enter the existing storm inlets. In addition to porous pavement, perimeter sand filters could also be incorporated into a retrofit design to enhance solids removal.

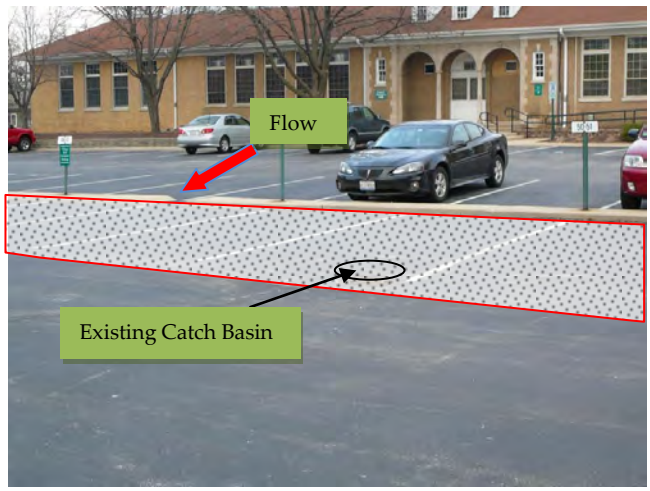


Figure 4-7. Mokena Village Hall Parking Lot

The proposed project for the Mokena Village hall consists of installing nearly 3,400 square feet of porous brick pavers. The tributary drainage area is approximately 0.85 acres, with a target treatment runoff of 1”. The estimated installed cost ranges between $38,500 and $58,000, including 15% for design and permitting. The lead agency for this retrofit project would be the Village of Mokena.

4.1.2.2 Pine Street, New Lenox—Project Site No. 4

There are a variety of porous pavement systems from which to select the best approach to meet the intended application. Pine Street in New Lenox is a typical street design found in many established residential neighborhoods. Residential driveways are present for parking; however, parallel parking in the right-of-way has been established along select portions of the street. The right-of-way parking is a mixture of asphalt and gravel. The use of a porous pavement system, such as concrete grids, for the parking surface offers an economical and visually attractive option for an effective stormwater BMP. The pavement voids could either be filled with coarse gravel (Figure 4-9) or grass, depending on resident or village desires.

Figure 4-8. Pine Street, New Lenox

Figure 4-9. Concrete Grid Paver with Gravel Fill

The proposed Pine Street retrofit project consists of constructing a ten foot wide shoulder for parking along approximately 800 feet of Pine Street. This porous pavement surface would replace the existing impervious parking surface consisting of a mixture of asphalt and compacted gravel. The anticipated tributary area served would be comprised of half the roadway and the parking surface itself, which is approximately 0.4 acres in total. The preliminary demolition and construction cost, including 15% for engineering design services, ranges from $80,000 to $92,000. The project lead would be the Village of New Lenox.

4.1.3 BIORETENTION

Bioretention areas, or rain gardens, are landscaped shallow depressions that store and filter stormwater runoff. These facilities normally consist of a ponding area, mulch layer, planting soils, and plantings. For areas with low permeability soils or steep slopes, bioretention areas can be designed with amended soils and an underdrain system that routes the treated runoff to the storm drain system rather than depending entirely on infiltration.

Bioretention areas function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. Bioretention areas have a wide range of applications and can be easily incorporated into existing residential, commercial, and industrial areas. These facilities are very versatile and can be easily integrated into landscaped areas and within roadway right-of-ways. Runoff from the site is typically conveyed in shallow engineered open conveyances, shallow pipes, curb cuts, or other innovative drainage structures. Where underlying soils have limited infiltration capacity, an underdrain should be included. Additional volume losses may be realized if the perforated pipe is placed above the bottom of the gravel drainage layer.

4.1.3.1 Mokena Fire Department—Project Site No. 5

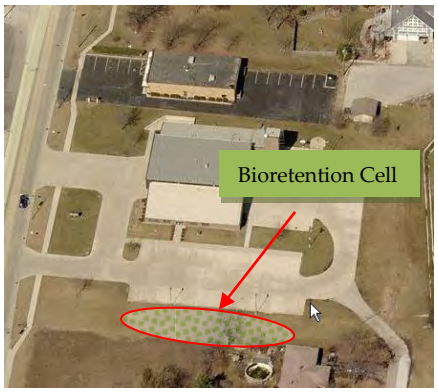


Figure 4-10. Mokena Fire Dept.

The parking lot and pavement surfaces at the Mokena Fire Department along Wolf Road are designed as a conventional system. Currently stormwater runoff is collected by perimeter curbs and gutters and is directed into curb inlets, where it is conveyed into the storm drain system. As can be seen in the site aerial photograph (Figure 4-10), the presence of ample open space affords several retrofit opportunities. Additionally, the existing storm structures are located in ideal areas to be modified to accommodate the installation of stormwater BMPs. Runoff from the south parking lot could be directed into a bioretention facility through curb cuts. Several catch basins are located within the open space that would be converted into the bioretention cell. The rims of these catch basins could easily be raised to allow ponding and infiltration, while providing an overflow flow for larger storm events.

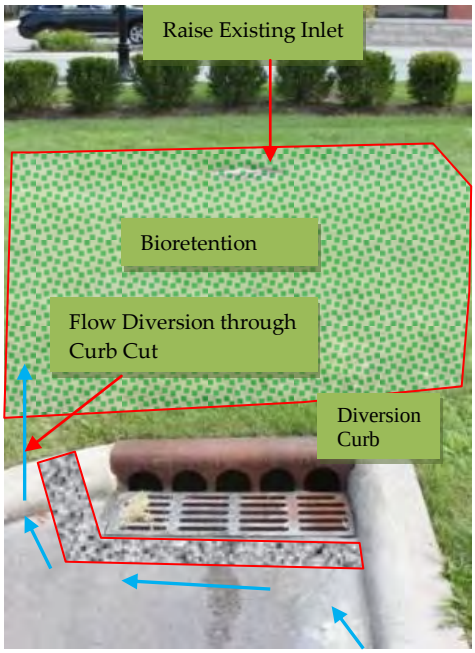


Figure 4-11. Proposed Retrofit

The proposed project would consist of constructing an approximately 1,600 square foot bioretention cell, installing three curb cuts and diversion curbs, and raising two existing inlet rims. The bioretention cell would service approximately 0.35 acres of tributary area, which primarily consists of the fire department parking lot. The estimated construction costs with engineering design and permitting fees range from $12,000 to $24,000. The Village of Mokena is the recommended lead agency for this project.

4.1.3.2 Village of New Lenox Police Department—Project Site No. 6

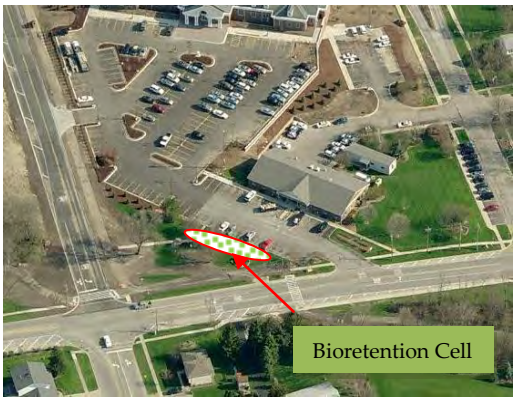


Figure 4-12. New Lenox Police Dept.

The configuration of the New Lenox Police Department parking lot offers an opportunity to retrofit the drainage system with bioretention to the southwest of building. The parking lot drains toward two inlets that are located in the adjacent grass area. Bioretention cells could be installed in the grass area. Water would enter the cell through the existing curb cuts. The concrete swale to the inlet would be removed and the inlets would be raised above the surface of the bioretention cell to allow ponding prior to infiltration. An under drain system could be installed and connected to the existing catch basin.

The proposed project consists of constructing an approximately 4,000 square foot bioretention cell, modifying two curb cuts and raising two existing inlet rims. The bioretention cell would service approximately 1.1 acres of tributary area, which primarily consists of the police department's parking lot and adjacent park area. The estimated construction costs with engineering design and permitting fees range from $30,000 to $46,000. The project lead would be the Village of New Lenox.

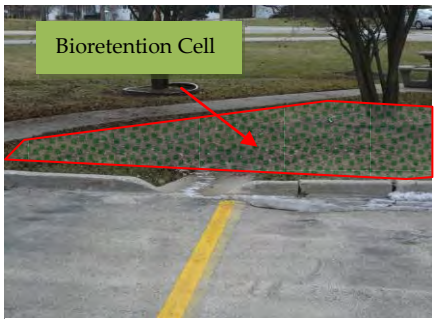


Figure 4-13. Proposed Retrofit

4.1.3.3 Village of Frankfort Public Library—Project Site No. 7

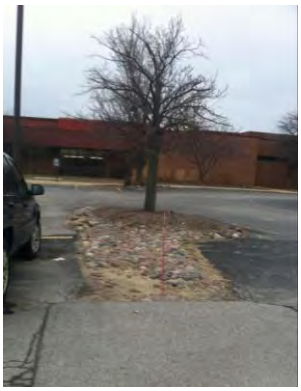


Figure 4-14. Frankfort Public Library Parking Lot

The parking lot configuration and degraded condition of the medians and pavement surface at the Frankfort Public Library offer an opportunity to retrofit with bioretention facilities when the parking lot is rehabilitated. In addition to bioretention facilities within parking lot medians, bioretention cells could be placed along the southern edge of pavement.

The proposed project consists of constructing two bioretention cells with a total area of approximately 1,300 square feet. The cells would be located within the existing parking lot by modifying the existing parking lot islands in eastern portion of the parking lot or immediately adjacent to the edge of the parking lot. The bioretention cells combined would service approximately 0.3 acres of tributary area from the parking lot. The estimated construction costs with engineering design and permitting fees range from $12,000 to $24,000. The Village of Frankfort would serve as the lead agency.

4.1.3.4 Dr. Julius Rogus School, Frankfort—Project Site No. 8

Schools offer a unique opportunity to educate their youth about stormwater BMPs through tangible examples that they see every day. Grass swales are present to the south of the parking lot; however, stormwater runoff from the parking lot is collected in conventional storm sewers within the pavement envelope and is then conveyed into a dry detention facility. Initial retrofit recommendations include the conversion of the turf depressional area into a bioretention facility with native vegetation. This design will enhance infiltration and reduce the intensive maintenance required for turf grass. Future retrofits

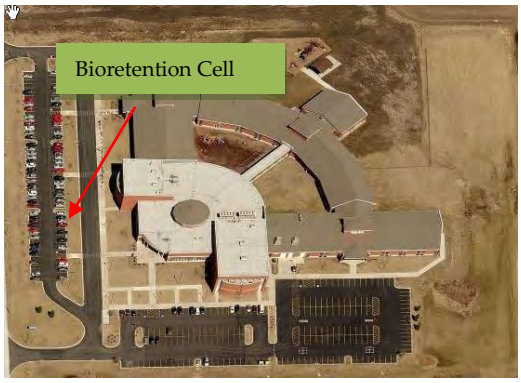


Figure 4-15. Dr. Julius Rogus School, Frankfort

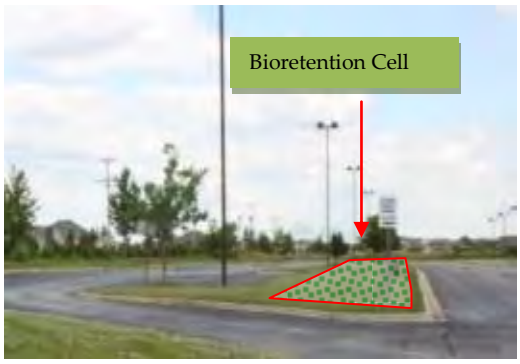


Figure 4-16. Proposed Retrofit

could include modifying the storm sewer outfalls to direct additional runoff through the bioretention facilities and modifying the dry turf grass detention facility into a wetland basin with native vegetation. Other potential retrofits include the use of roof runoff collection systems, such as cisterns, downspout gardens, or "blue roofs" (roof designs that allow storage of rainwater).

The proposed project consists of constructing a bioretention cell within the parking lot island in the west parking lot area. The size of the facility would be approximately 3,500 square feet. The bioretention facility would service approximately 0.8 acres of tributary area from the parking lot. The estimated construction costs with engineering design and permitting fees range from $21,000 to $29,000. The School District and Village would partner as lead agencies.

4.1.3.5 Silver Cross Hospital, Joliet—Project Site No. 9

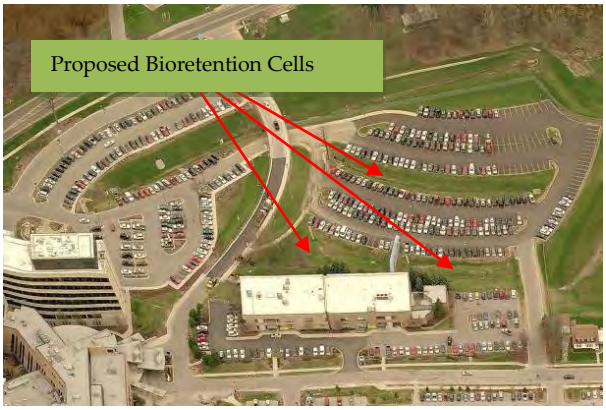


Figure 4-17. Silver Cross Hospital, Joliet

The Silver Cross Hospital parking lot has several depressed green islands that receive the stormwater runoff from the surrounding pavement. These depressions convey stormwater into the adjacent detention facility to the east. The use of depressed turf grass islands to collect the stormwater in lieu of concrete storm sewers provides water quality benefits. The configuration, depth, and large ratio of surface area to drainage area make these ideal locations for bioretention cells with native vegetation. Retrofitting would enhance the benefits of stormwater volume reduction and pollutant removal.

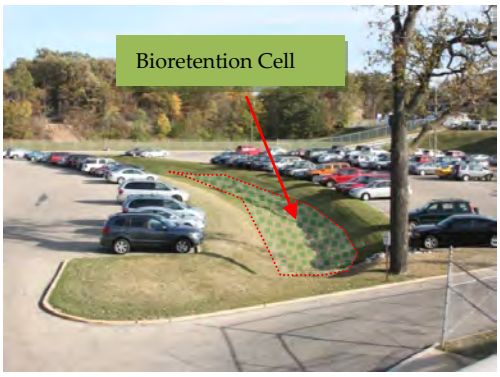


Figure 4-18. Proposed Retrofit

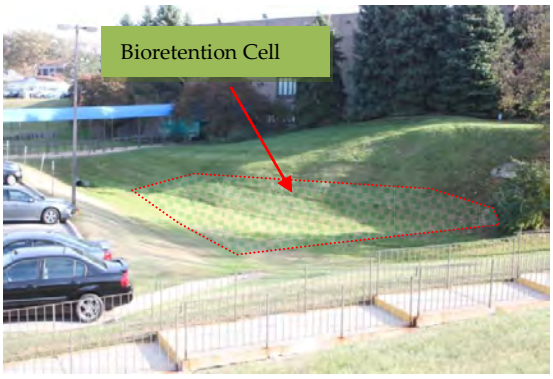


Figure 4-19. Proposed Retrofit

The proposed project would consist of constructing three bioretention cells, each within an existing depressional area within the main parking lot. The facilities would consist of modifying the lower portion of the depressional area by amending the soils and installing an underdrain. Regrading of the depressed area would be minimized to reduce construction costs. The bioretention facilities would serve a combined tributary area of approximately 6 acres from the parking lot. The estimated construction costs with engineering design and permitting fees range from $60,000 to $90,000. The wide range reflects the variability of the design options that could be implemented given the large footprint. The City of Joliet and the Hospital would partner as lead agencies.

4.1.4 VEGETATED SWALES (CONVEYANCE) RETROFITS

Vegetated swales are shallow, open conveyance channels with low-lying vegetation covering the side slopes and bottom that collect and slowly convey runoff through the vegetated bottom to downstream discharge points. Swales remove stormwater pollutants by filtering flows through vegetation (usually grasses) and by allowing suspended pollutants to settle due to the shallow flow depths and slow velocities in the swale. Biochemical processes also provide treatment of dissolved constituents. Vegetated swales can also provide effective volume reduction through infiltration and evapotranspiration processes. An effective vegetated swale achieves uniform sheet flow through a densely vegetated area for a period of at least 10 minutes. The vegetation in the swale can vary depending on its location within a development project and is the choice of the designer and the relevant functional criteria for the project. When appropriate, swales that are integrated within a project may use turf or other more intensive landscaping, while swales that are located on the project perimeter, within a park, or close to an open space area are encouraged to be planted with a more naturalistic plant palette.

Swales have a wide range of applications and can be used in residential, commercial, and industrial areas as well as treatment for linear projects such as roadways. A vegetated swale can be designed either on-line or off-line. On-line vegetated swales are used for conveying high flows as well as providing treatment of the water quality design flow rate, and can replace curbs, gutters, and storm drain systems. Off-line swales are the preferred practice, but in denser environments off-line swales many not always be feasible. In this case, limiting drainage areas and periodically providing outlets along the length of the swale to prevent the accumulation of excessive flows from inputs along the swale can improve the performance of on-line swales. Check dams are also recommended where longitudinal slopes exceed six percent. Check dams enhance sediment removal by causing stormwater to pond, allowing coarse sediment to settle out.

4.1.4.1 Degroate Road, New Lenox—Project Site No. 10

Excessive erosion is currently occurring in the roadside ditch along Degroate Road in New Lenox. Evidence of erosion was observed along the interface between the concrete and turf grass. The erosion is undercutting the concrete and transporting sediment to the downstream receiving waters. The retrofit project is to replace the failing concrete-lined swale with a native vegetated swale and with check dams to control velocity. The concrete could be removed and recycled. The initial concept is to crush the concrete on site and use the concrete rubble for the construction of the rock check dams along the reconstructed swale. This approach will result in local reuse of material and reduced construction costs.

Figure 4-20. Concrete-Lined Ditch, Degroate Road, New Lenox

The proposed project is to retrofit 600 feet of the existing concrete swale along Degroate Road. The swale has a tributary area of approximately 21 acres. The estimated construction costs with engineering design and permitting fees range from $18,000 to $27,000. The Village of New Lenox would serve as the lead agency for this project.

4.1.4.2 Deboer Woods Subdivision, Homer Glen—Project Site No. 11

The Deboer Woods Subdivision in Homer Glen is a neighborhood with wooded lots, rolling topography, and a private lake. The majority of the subdivision roadways are flanked by concrete swales that convey stormwater and pollutants directly into the lake within the subdivision. The lake is routinely enjoyed by the residents, with numerous small boats and docks flanking the shoreline. The retrofit project proposes to replace the concrete-lined and grouted-stone swales with vegetated swales with check dams to control velocity where appropriate. A facet of the project should include an outreach effort to educate the residents about the link between stormwater runoff and the lake's water quality. The character of the subdivision appears to draw its identity from the lake. Including the residents in the design phase will build consensus and long term success.

Figure 4-21. Deboer Woods Subdivision

The proposed project is to retrofit the concrete swale along both sides of South Catawba Road. The combined length is 2,500 feet with a combined tributary area of approximately 10 acres. A water quality flow rate for each of the proposed swale retrofits is based on 1 inch of runoff. The estimated construction costs with engineering design and permitting fees range from $40,000 to $62,000. The Village of Homer Glen would serve as the lead agency with close coordination with the subdivision residents.

4.1.4.3 Silver Cross Hospital, Joliet—Project Site No. 12

Figure 4-22. Eroding Channel, Silver Cross Hospital, Joliet

The channel that traverses the north side of the Silver Cross Hospital campus appears to be downstream of a regional detention facility that has a significant tributary area. Based on initial observations, the flow in the channel appears to be resulting in erosion of the turf grass swale. The flows occur for an extended time during the drawdown of the basin. The shallow root system of the turf grass does not adequately protect against high flows. The retrofit project would replace the eroding channel with a vegetated swale with deep rooted native plants. A rip rap-lined apron should be installed at the outfall to the swale and proper rock inlet protection should be placed at the inlet of the drop structure, shown in Figure 4-22. After entering the drop structure, the flows appear to be conveyed through concrete culverts below the existing hospital.

The proposed project is to stabilize the approximately 680 foot swale that runs through the Silver Cross Hospital Campus. The estimated construction costs with engineering design and permitting range from $39,000 to $47,000. The City of Joliet and the hospital would partner as lead agencies for the project.

4.1.5 DETENTION BASIN RETROFITS

Many early detention basins were constructed as dry detention facilities. These were typically vegetated with turf grass and designed to drain completely after storm events. A common detention basin retrofit to enhance water quality is to modify the design of dry detention basin to incorporate sections of wetland vegetation. Detention basin wetlands typically include components such as an inlet with energy dissipation structures, a sediment forebay to settle out coarse solids and to facilitate maintenance, a base with shallow sections (0 to 2 feet deep) planted with wetland vegetation, deeper areas or micro pools (3 to

5 feet deep), and a water quality outlet structure. Meandering swales can also be incorporated into the basins to increase the residence time during low flow conditions.

The interactions between the incoming stormwater runoff, aquatic vegetation, wetland soils, and the associated physical, chemical, and biological unit processes are a fundamental part of wetland basin designs. Detention basin wetlands are generally designed as plug flow systems in which the water already present in the permanent pool is displaced by incoming flows with minimal mixing and no short circuiting. Plug flow describes the hypothetical condition of stormwater moving through the wetland in such a way that older "slugs" of water (meaning water that has been in the wetland for longer) are displaced by incoming slugs of water with little or no mixing in the direction of flow. Short circuiting occurs when quiescent areas or "dead zones" develop in the wetland where pockets of water remain stagnant, causing other volumes to bypass using shorter paths through the basin (e.g., incoming stormwater slugs bypass these zones).

Enhancements that maximize residence time, aid in trapping and uptake of pollutants or assist with volume reduction are the main categories of enhancements available for wetland basins. Water quality benefits can be improved with a larger permanent pool, shallower depths, and denser vegetation. Wetland vegetation with known pollutant uptake potential may also enhance wetland performance. Outlet controls may be used to seasonally change wet pool depths and flow rates through the system to increase residence time. Extended detention flow control may also be integrated into the design to improve peak flow reductions.

4.1.5.1 Regional Basin, Mokena—Project Site No. 13

The regional detention facility in downtown Mokena serves the surrounding residential neighborhood. The facility is maintained as a dry, turf grass basin; however, the basin appears to be frequently inundated with a persistent base flow. Three concrete swales traverse the basin and converge at the basin's outfall. Presumably, the swales were installed because turf grass cannot withstand persistent base flow. The surrounding turf grass was discolored by a significant amount of silt and sediment. The gray hue can be seen in Figure 4-23. Pronounced ruts are visible in the basin from power equipment used to mow the turf grass. At the time of observation, precipitation had not occurred for several days, yet flowing water was observed in the concrete lined swales. Surrounding sump pump discharges from the surrounding residential neighborhood into the storm sewers may also be contributing to the flow.

Figure 4-23. Mokena Regional Basin

Figure 4-24. Aerial of Mokena Basin

The proposed retrofit is to establish wetland pockets at the three inlets into the basin and at the primary outfall. Wetland swales would connect the four wetland pockets. Rock check dams would be used to dissipate the erosive forces from the entering water. The rock check dams could be constructed with the remains of the pulverized concrete swales. Select areas in other portions of the basin could also be altered through shallow excavation to create additional wetland pockets. A blend of native wetland and prairie communities would be established within the basin. A small, native habitat garden is located a short distance to the north along Wolf Road. The

community has embraced this open space enhancement with native vegetation. The proposed basin retrofit project has the potential of making this community feature into a valuable resource for both aesthetics and water quality. The estimated construction costs with engineering design and permitting ranges from $29,000 to $40,000. The Village of Mokena would serve as the lead agency for the project.

4.1.5.2 Silver Cross Hospital Regional Basin, Joliet—Project Site No. 14

Figure 4-25. Silver Cross Hospital Regional Basin

The detention facility located adjacent to the Silver Cross Hospital is a conventional turf basin. The basin was constructed by excavating into the topography of the landscape. The high embankments have a reasonable side slope gradient to sustain healthy vegetation. Small gullies are visible from flows that enter from the southeast corner of the basin.

The proposed retrofit includes constructing a wetland pocket where a swale discharges flows into the facility at the southeast corner of the basin. A meandering wetland swale would be constructed through the facility to carry low flows. Select areas in other portions of the basin could also be altered through shallow excavation to create additional wetland pockets. A blend of native wetland and prairie communities would be established within the basin. This would provide an improvement to the water quality performance of the basin as well as providing habitat within the watershed. The estimated project costs with engineering design and permitting ranges from $40,500 to $52,000. The City of Joliet and the Hospital would partner as the lead agencies for the project.

Figure 4-26. Silver Cross Hospital Regional Basin

4.1.5.3 Nebraska Street Regional Basin, Frankfort—Project Site No. 15

The detention facility located along Nebraska Street in Frankfort is a conventional turf basin with concrete swales designed to directly convey low flows to the outfall. The remainder of the basin appears to be frequently inundated. The saturated areas of the basin are easily seen as dark areas in the aerial photograph in Figure 4-27. The figure also shows several tire tracks within the basin, which are presumably from mowing or other maintenance equipment.

Figure 4-27. Nebraska Street Regional Basin, Frankfort

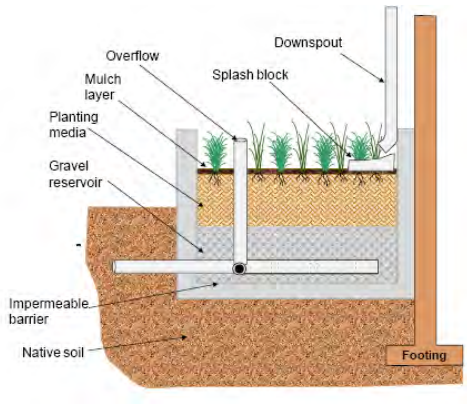
The proposed retrofit includes constructing wetland pockets at the two storm sewer inlets and at the outfall. Meandering, low flow wetland swales would be constructed through the facility. Larger wetland pools would be created along the swales to provide additional settling opportunity and habitat diversification to improve vegetation resilience to varying weather conditions. The remainder of the basin would be replanted with appropriate native wet-mesic or upland prairie vegetation. This would provide a significant improvement to water quality, specifically during low flow runoff events which currently appear to pass directly through the basin via the concrete swales. The estimated project costs including engineering

design and permitting ranges from $39,000 to $64,500. The City of Joliet and the hospital would partner as the lead agencies for the project.

4.1.6 BUILDING RETROFITS

Building retrofits are effective BMP techniques that can be viable options in many settings, including in urban areas that are dominated by impervious surfaces and roof tops. Three common techniques include the use of cisterns, planter boxes, and green roofs. The short-term implementation plan focuses on the strategic placement of planter boxes at the outfall of key downspouts (Figure 4-28). Green roofs and cisterns are potentially equally viable alternatives for each of the sites described in this section and throughout the watershed; however, site specific considerations such as structural constraints and harvested water use options should be considered.

Figure 4-28. Example Downspout Planter Box



Source: Modified from Center for Watershed Protection

Planter boxes are bioretention treatment control measures that are completely contained within an impermeable structure with an underdrain. The boxes can be comprised of a variety of materials, such as brick or concrete, and are filled with gravel on the bottom, planting soil media, and vegetation. Planter boxes require splash blocks for flow energy dissipation and geotextile filter fabric or choking stone to reduce clogging of the underdrain system.

4.1.6.1 New Lenox Park District Building—Project Site No. 16

The four entrances to the New Lenox Park District facility are positioned beneath the valleys of the roof line. The valleys direct runoff toward major downspouts located at each entrance to the facility. Currently the runoff is conveyed by large PVC pipes that outfall on the adjacent asphalt parking lot, in one case to a stripped walkway and handicapped parking space (Figure 4-29). The runoff is a nuisance to guests entering the facility during rain events and poses a safety concern during freezing conditions. Deicing agents are used at this outfall to mitigate the hazard of icing. The excessive deicing salt used at the down spout is easily seen in Figure 4-30 as the blue, granular material.

Figure 4-29. Entrance to New Lenox Park District Building

Figure 4-30. Deicing Agent

The proposed retrofit is to direct the down spouts into new planter boxes near the entrances of the facility. Planter beds constructed with modular block walls are currently located at each entrance and down spout. Four planter beds would be reconstructed to accept runoff from the down spouts. The under drain and overflow pipe from the planter box would connect to existing storm sewers within the parking lot. An alternative plan would be to direct the drain line into a constructed rain garden within the green space flanking the sidewalks. The estimated construction costs including engineering design and permitting ranges from $4,500 to $7,000. The Village of New Lenox and the New Lenox Park District serve as the lead agencies for the project.

4.1.6.2 Lincoln-Way East High School, Frankfort—Project Site No. 17

The Lincoln-Way East High School is a large facility with an expansive flat roof which comprises a significant portion of the impervious surface on the school campus. Manicured turf grass is maintained around the facility. Stormwater runoff from the site is directed into conventional dry turf basins with concrete low flow channels.

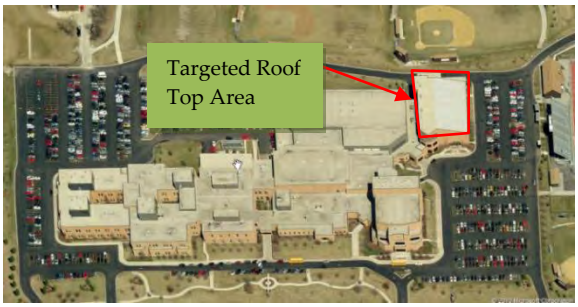


Figure 4-31. Lincoln-Way East High School, Frankfort

The proposed retrofit project is to construct several downspout planter boxes at the facility in appropriate locations to accept downspout discharges. The specific area identified for this project is the northeastern portion of the building (Figure 4-32), but can be replicated throughout the campus as appropriate. This portion of the roof top, which comprises nearly 0.6 acres of roof top, drains via downspouts and stone-lined channels to the eastern parking lot area and into the storm drain system.

Figure 4-32. Roof Drains on Northeastern Side of School

Planter boxes would be installed along the eastern edge of northeastern portion of the facility. Five downspout planter boxes would be constructed to accept runoff from the down spouts. With engineering design and permitting, the total project cost is estimated between $8,600 and $10,400. The Village of Frankfort is recommended to serve as the lead agency, in collaboration with the school, for the project. Another phase of the retrofit project could be to retrofit the onsite detention basins using techniques similar to those described in Section 4.1.5.

4.1.6.3 Edna Keith Elementary School, Joliet—Project Site No. 18

The back of the school is separated from Hickory Creek only by an asphalt driveway. Currently roof downspouts discharge onto the strip of asphalt, where it cascades over the vertical embankment into the stream. Currently, there is no opportunity for filtration of the runoff or volume reduction. A potential retrofit opportunity is to place planter boxes at downspouts around the school, specifically the rear of the facility. This will provide an opportunity for both filtration through the soil media and volume reduction through evapotranspiration. An additional benefit would be the beatification of the school façade. The drain from the planter boxes for excess water could outfall on the pavement, similar to the existing arrangement, or it could be directed through a minor drain to a rain garden proposed to be constructed adjacent to the existing playground.

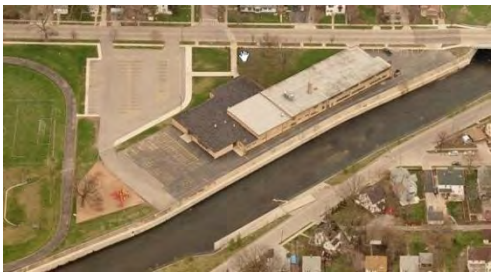


Figure 4-33. Aerial of School

Figure 4-34. Roof Drains in Rear of School

The proposed project includes the construction of five planter boxes in the rear of the building to accept runoff from the downspouts. Until additional site information is collected, the assumption is that the underdrain systems would outlet onto the existing asphalt surface.

The estimated project cost with engineering design and permitting is between $5,800 and $8,600. The City of Joliet is recommended to serve as the lead agency for the project.

4.2 Stream Channel and Riparian Corridor Restoration

Based on the findings of the watershed assessment and reconnaissance efforts conducted during the development of this plan, numerous opportunities were identified for stream channel and riparian corridor restoration projects. The primary objective of the projects included in the following sections is to provide improvements to the biological conditions of the streams within the watershed.

4.2.1 DAM MODIFICATION

Dams can significantly alter the physical, chemical and biological characteristics of a stream. The effects of dams on the stream corridor often include barriers to fish passage, disruption of in-stream sediment transport processes, accumulation of sediment and associated pollutants (e.g., various metals, phosphorus, etc.) in the dam impoundments, changes in water temperature, and highly variable dissolved oxygen levels creating adverse conditions for aquatic organisms. Additionally, the original use of the dam is often no longer justified but the current owners are responsible for maintenance of the structures and the associated liability. Dams can also present a safety hazard to recreational users of the stream, including paddlers.

Dam modification projects are often complicated, long-term projects that require extensive collaboration between the landowner, permitting agencies, the general public, and other stakeholders. This collaboration is necessary to balance project goals and project costs. As such, it is not the intent of this plan to suggest specific project details for dam modification projects, but rather is to provide an overarching recommendation for the modification of dams to improve and restore Spring Creek and Hickory Creek.

Several dam modification options exist and should be considered during the project planning process. These options include ramping, or bridging, the dam; complete dam removal; partial removal or breaching; or a combination of these options. Considerations for dam modification projects include management of the accumulated sediment behind the dam, fish passage and other habitat improvement opportunities, effects on downstream flooding, riparian corridor restoration, and improvements for recreational use.

Although funding assistance may not be readily available for the dam owners to perform regular dam maintenance activities, several of the potential funding sources identified in Section 5.2. above, such as IEPA Section 319 funds, can be used for projects that provide water quality and habitat benefits.

4.2.1.1 Spring Creek Dam at Draper Avenue—Project Site No. 19

A small concrete dam is located on Spring Creek, just downstream from Draper Avenue in Joliet. It is recommended that this dam be modified, specifically removed, to restore this section of the stream to a more natural stream system. In meetings held between the IDNR, Office of Water Resources (IDNR-OWR) and the HCWPG as part of the plan development process, the IDNR-OWR indicated that the removal of this dam was to be included in a larger flood control project to be undertaken by the agency and the City of Joliet in the near future. As a result, it is recommended that the removal of this dam remain as part of the flood control project plan.

Figure 4-35. Spring Creek Dam at Draper Avenue, Joliet

In the event the IDNR-OWR flood control project does not continue on its current course, the City of Joliet would be the expected lead in pursuing the removal of the dam as a stand-alone project. An estimate for the costs associated with this project will require a detailed evaluation of site conditions and constraints. As a reference, a planning level cost estimate recently developed for the removal of a similar size dam in DuPage County was approximately $250,000, including design and permitting.[6]

4.2.1.2 Pilcher Park Dam—Project Site No. 20

A large concrete dam is located near the downstream portion of the Joliet Park District's Pilcher Park. The dam spans the entire width of Hickory Creek, approximately 250 feet. The impoundment of the dam continues upstream within the boundaries of Pilcher Park. The recommendation for this site is that a dam modification project be evaluated and undertaken to restore the natural functions of this section of Hickory Creek, including fish passage, sediment transport, and water quality improvements. The planning for the project will require detailed evaluation of the methods (i.e. ramping, partial removal, or complete removal), or combination of methods, necessary to meet the goals and objectives of project stakeholders, most importantly those of the Joliet Park District and the City of Joliet. An important consideration for the project should be the management of the sediment within the dam impoundment; the Illinois State Water Survey has reported that the impoundment "…is at or very near its capacity for holding sediment."[7]

Figure 4-36. Pilcher Park Dam, Joliet

The determination of costs associated with this project will require a detailed understanding of project conditions and constraints and an evaluation of the options for dam modification. For reference, planning level cost estimates for modifications to a similar size dam in DuPage County are $800,000 to $1,000,000 for ramping the dam and $300,000 to $600,000 for partial dam removal, including design and permitting costs for both project options.[8] As reference for a project that combined dam modification approaches, the 2005-2006 South Batavia Dam Removal Project in Kane County included the complete removal of one concrete spillway and the lowering of another spillway for sediment management purposes. The cost for this project was approximately $1,200,000 for construction and $250,000 for design and permitting.[9]

Given the inherent complexities associated with a project of the nature and scale, the realistic expectation is that the preliminary planning and evaluation for this project would occur within the timeframe of this short-term implementation plan (i.e. five years) and that the implementation of the project would occur within approximately five to 10 years. The planning stage for this project would likely be initiated through the development and facilitation of a project-specific stakeholder group comprised of residents and technical resource agencies.

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[6] DuPage River Salt Creek Workgroup. 2009. *Stream Dissolved Oxygen Improvement Feasibility Study for Salt Creek*. Prepared by HDR Engineering, Inc., Huff and Huff, Inc. and Inter-Fluve, Inc. Cost estimate from Oak Meadows Golf Course Dam.
[7] ISWS. 2004. *Preliminary Stream Geomorphological Assessment of a Segment of Hickory Creek Joliet, Will County, Illinois (Pilcher Park Dam to Washington Street)*. Provided through personal communication with William P. White, ISWS.
[8] DuPage River Salt Creek Workgroup. 2009. *Stream Dissolved Oxygen Improvement Feasibility Study for Salt Creek*. Prepared by HDR Engineering, Inc., Huff and Huff, Inc. and Inter-Fluve, Inc. Cost estimates from Graue Mill Dam.
[9] Personal communication with Drew Ullberg, Kane County Forest Preserve District.

4.2.2 STREAM CHANNEL PROTECTION

Instability of stream channels was observed in numerous locations during the watershed reconnaissance effort (Section 2.4). This evidence included portions of the stream channels with variable degrees of stream bank erosion, ranging from moderate to severe. These eroding stream banks and degrading (i.e. downcutting) stream channels can be a significant source of sediment and sediment-bound nutrients. Eroding stream banks and degrading channels can also detrimentally affect property and infrastructure. Remedial actions to address channel stability concerns require a detailed understanding of the processes causing the channel instability. For example, an exposed stream bank may be the result of bank erosion by stream flows or may be caused by degradation of the stream channel and subsequent slumping of the stream bank. Additionally, remedial actions need to account for the severity of the channel instability. Moderate cases of stream bank instability may be addressed through relatively simple methods, including minor grading and establishment of deep-rooted vegetation as opposed to mowed turf grass. Areas with severe erosion will typically require more involved evaluation and remedies.

4.2.2.1 Hickory Creek at Hillcrest Road—Project Site No. 21

Figure 4-37. Hickory Creek at Hillcrest

Evidence of severe stream bank erosion was observed along a section of the Hickory Creek near Hillcrest Road, in unincorporated Will County. The eroding bank is approximately 30 to 35 feet high and extends for approximately 150 feet along the stream. As a result of the erosion, a portion of Hillcrest Road has fallen into the creek and an adjacent residential property has the potential to be damaged. In addition to being assessed as part of the watershed planning process, this stream bank has been the subject of evaluations conducted by the ISWS and the IDNR-OWR in association with the aforementioned IDNR-OWR flood control project.[10] To address the problem, one of the remedial actions being considered by the IDNR-OWR is to flatten the slope, provide rip rap at the toe of the slope, install articulated-block mat from the rip rap up to the 100-year flood level, and install an erosion control blanket from the articulated-block mat to the top of the slope.[11] The project would include building the new slope on top of the existing slope and excavation on the opposing bank to maintain flood conveyance. The 2006 cost estimate for this project was $400,000 for the bank stabilization activities and an additional $700,000 for the work on the opposing bank.[12]

Alternative methods of stabilizing the eroding slope were also evaluated as part of the watershed planning process. It should be noted that the flood conveyance capacity of the stream channel in this location was not evaluated as part of this effort. Therefore, for planning level purposes it was assumed that the excavation of the opposing bank would still be required.

[10] ISWS. 2004. *Preliminary Stream Geomorphological Assessment of a Segment of Hickory Creek Joliet, Will County, Illinois (Pilcher Park Dam to Washington Street)*. Provided through personal communication with William P. White, ISWS.
[11] Illinois Department of Transportation. 2006. *Hydraulic Report; Hillcrest Road, Will County, IL*. Prepared by Camp Dresser and McKee, Inc.
[12] *Ibid.*

One alternative approach would be to use rock toe stabilization with geocells[13] and fabric. In this alternative, the toe would be stabilized with rock along the entire eroding bank at about five to 8 feet in height. Above this, geocells would be stacked (potentially using soil from excavation on the opposite bank) for 10 to 15 vertical feet, or higher if deemed necessary during design. The cells could be stacked at an angle to match adjacent slopes or could be stacked more steeply to allow reconstruction of the failed road and minimal disturbance of nearby structures. The estimated cost for this alternative is approximately $300,000 to $330,000 including design, permitting and construction oversight.[14] This estimate does not include costs associated with excavation of the opposing bank. An additional $700,000 may be required for the work on the opposing bank.

Figure 4-38. Rock Toe Protection with Geocells, Milwaukee, WI (*Source*: Inter-Fluve, Inc.)

Another alternative provides stability similar to the previous alternative, but has a more naturalized appearance, improves aquatic habitat, and is less costly. This alternative involves using log cribs[15] to stabilize the toe of the slope and fabric encapsulated soil (FES) lifts.[16] The logs would be placed and stacked along the entire eroding bank at a height of 5 to 8 feet. The logs would be anchored in the slope and would extend partially into the channel, providing cover and in-stream habitat complexity. Above these logs, FES lifts could be built at a 2H:1V angle for 10 to 15 vertical feet. The lifts could be constructed using the soil excavated from the opposite bank. Above the lifts, fabric would be placed on the remaining slope and vegetation would be planted throughout. Seed can be mixed with top soil and incorporated into the FES lifts and can also be spread under the fabric laid at the top of the slope. Vegetation in these seed mixes grows through the fabric easily. Plant stakes or plugs can be placed along the lifts and on the slope above. This alternative provides a very natural appearance to the channel bank and slope, improves channel habitat, and provides both short and long-term bank stability with the logs, FES lifts, and growth of shrubs and trees with soil-stabilizing roots. Although the geocells can be stacked steeper if necessary, this

Figure 4-39. Log Cribbing, Salmon Creek, WA (*Source*: Inter-Fluve, Inc.)

[13] Geocells or geogrids are engineered plastic cells that are laid on a flat surface, filled with soil, and stacked on top of each other. A seed mix can be incorporated into the soil in the exposed cells to initiate vegetation growth and plant plugs or live stakes can be installed to encourage shrub and tree growth whose roots will help stabilize the hillslope. Over time, these cells will become obscured by the vegetation.

[14] Personal communication with Nick Nelson, Inter-Fluve Inc.

[15] Log cribbing provides similar stability as the rock, but also provides a more natural look and increased aquatic habitat. In addition, vegetation will grow more easily on the log cribbing than on the rock toe. The log cribbing involves excavating the toe of the bank and stacking logs in a grid so they are interwoven and locked into place. Most of the length of the logs is buried in the bank and the channel bed for long-term stability.

[16] FES lifts are soil wrapped in fabric that degrades naturally over time once the slope has stabilized and vegetation has taken hold. These FES lifts are typically 1-2 ft in height and can be stacked steeply, though not to the nearly vertical angles achievable with the geocells. The fabric holds the soil in place and allows vegetation to grow easily throughout the fabric, giving a naturalized look within a couple of years. By the time the fabric decomposes, the slope will be stabilized by the grass, shrub, and tree roots that have been growing.

alternative will also minimize the amount of property loss and damage to infrastructure at the top of the slope. The estimated cost for this alternative is approximately $285,000 to $315,000 including design, permitting and construction oversight.[17] This estimate does not include costs associated with excavation of the opposing bank. An additional $700,000 may be required for the work on the opposing bank.

Regardless of the alternative determined to be the appropriate remedy for this site based on a site-specific design and evaluation, it is expected that IDNR-OWR, City of Joliet and Will County would collectively work with the landowner of this site to further evaluate and implement this project.

4.2.2.2 Spring Creek at Briggs Street—Project Site No. 22

Evidence of severe stream bank erosion was observed along a section of the Spring Creek stream bank just west of Briggs Street, in unincorporated Will County. The eroding bank is approximately 30 to 35 feet high with a wooded area at the top and extends for approximately 150 feet along the stream. The proposed project for this location is stream bank stabilization. Evidence of channel degradation was not observed during the preliminary site assessment, but should be further investigated during project planning.

Figure 4-40. Spring Creek near Briggs Street

Given the absence of infrastructure requiring protection in the vicinity of the eroding bank, a minimalist approach to addressing stream bank erosion in this section of the stream could be employed. This approach would involve only the stabilization of the toe of the slope (i.e. the lower five to 8 feet of the bank). By stabilizing the toe, either with rock or log cribbing, future channel migration and increased slope failure will be minimized. This approach allows the slope above the toe to erode naturally until a more stable angle is attained. With a lower angle, vegetation will grow and the roots from trees, shrubs, and herbaceous plants will stabilize the soil and prevent future slope failures. This alternative is best if some slope failure is permissible. In the event slope failure above the toe protection is not permissible, the alternatives presented in Section 5.2.2.1. should be considered.

The estimate costs for implementation of the minimalist approach would be approximately $200,000 to $220,000, including design, permitting, and construction oversight.[18] This cost estimate assumes the use of log cribbing as opposed to rock. This estimate does not include any excavation of the opposing bank that may be required for flood conveyance. The FPDWC would be the expected lead for the implementation of this project as the site is located on District property. The City of Joliet may also assist with the project given the proximity of the site to the city and the site is located upstream of the proposed IDNR-OWR flood control project.

Worth noting here is that another site with evidence of stream bank erosion was observed downstream of this location near Draper Avenue during a review of aerial photography. This site appears to be similar in size and nature to the site above, but does not afford a discernable access route. This site should be investigated to determine if a similar project opportunity exists.

[17] Personal communication with Nick Nelson, Inter-Fluve Inc.
[18] *Ibid.*

4.2.3 STREAM AND WETLAND RESTORATION

One of the objectives of the watershed reconnaissance effort was to identify opportunities within the watershed for stream restoration. The primary method for identifying these opportunities was through the physical stream characteristic assessment. From this assessment, a few stream segments stood out as having relatively degraded physical stream characteristics in several of the assessment categories. The recommendations presented in the following sections are generally based on the findings of this assessment. Opportunities for associated wetland restoration activities were also identified and are reflected in the project recommendations. In addition to grant funding opportunities, wetland mitigation funds from regulated wetland impacts in other portions of the watershed may be a viable funding source for these projects.

4.2.3.1 East Branch of Marley Creek, Mokena—Project Site No. 23

An approximately 2,700-foot reach of the East Branch of Marley transects a parcel of primarily agricultural land west of Townline Road in Mokena. The upstream end of the reach is approximately 4,000 feet (stream length) downstream of Mokena's wastewater treatment plant. This reach of the creek appears to have been channelized and exhibits relatively degraded physical stream characteristics. In addition to the channelization of this reach, some of the noted characteristics include heavy sediment deposition, stream bank instability, and limited stream buffers.

Figure 4-41. East Branch of Marley Creek at Townline Road, Mokena

The proposed project recommendation is the restoration of this reach of the stream channel. The project would include remeandering the stream channel; improving the riparian zone through planting native vegetation, including trees; and installing in-stream structures such as rock riffles with the goals of improving habitat for aquatic organisms and sediment transport. Another component of the project would involve restoration of areas adjacent to stream channel as wetlands. Approximately 35 acres in this area are identified as being in the floodplain, making for ideal locations for the wetland areas.

Figure 4-42. East Branch of Marley Creek at Townline Road, Mokena

The estimated costs for this project are $825,000 to $1,100,000, including monitoring, reporting, five years of vegetation maintenance, and 10 percent for design and permitting.[19] This cost estimate assumes 2,700 feet of stream restoration and 10 acres of wetland restoration. Alternatively, the project could be completed in three phases, if deemed necessary, with approximately 1,000 feet of stream restoration and approximately 3 acres of wetland restoration occurring in each phase. The estimated cost per

[19] Cost basis provided through personal communication with Greg Wolterstorff of V3 Companies for the FPDWC's 2006 and 2008 restoration of Spring Creek in the Hadley Valley Preserve.

phase would be $310,000 to $410,000. These cost estimates does not include costs associated with land acquisition or conservation easements, which are expected to be necessary for this project to be implemented. Given the complexities associated with this project, specifically with respect to land ownership, the expectation is that the preliminary planning and evaluation for this project would occur within the timeframe of this short-term implementation plan. The Village of Mokena, in collaboration with the Mokena Community Park District, would be expected to take the lead on this project.

An additional larger-scale planning consideration is that the reach of the stream immediately upstream of Townline Road parallels the roadway and the presence of rip rap on the stream bank indicates that erosion of the roadway embankment has been a problem. The specific consideration is whether this section of Townline Road could be realigned to the west to create greater separation of roadway and the stream as part of the stream restoration.

4.2.3.2 Union Ditch, Tinley Park—Project Site No. 24

An approximately 1,700-foot reach of Union Ditch flows through an area of mixed land uses south of 191st Street in Tinley Park. The land uses immediately adjacent to the stream in this location include agricultural land, developing land, and a Commonwealth Edison transmission line.[20] Based on the assessment conducted as part of the watershed reconnaissance, this reach exhibits relatively degraded physical stream characteristics, such as heavy sediment deposition, channel alteration, absence of pools, and limited stream buffers.

Figure 4-43. Union Ditch at 191st Street, Tinley Park

The proposed project recommendation is to restore this reach of the stream channel. The project would include remeandering the stream channel; improving the riparian zone through planting native vegetation, including trees; and installing in-stream structures, such as pool and riffle complexes. During project planning and design phase, the remeandering aspect of the project will require detailed consideration of the Commonwealth Edison transmission towers located in this area. The restoration of wetland areas is also recommended to be included as part of this project. The wetland restoration could occur on the eastern side of the stream channel where a relatively wide floodplain exists.

Figure 4-44. Union Ditch at 191st Street, Tinley Park

The estimated costs for this project are $495,000 to $650,000, including monitoring, reporting, five years of vegetation maintenance, and 10 percent for design and permitting.[21] This cost estimate assumes 1,700 feet of stream restoration and 3 acres of wetland restoration. Alternatively, the project could be completed in two phases, if deemed necessary, with approximately 1,000 feet of stream restoration and approximately 1.5 acres of wetland restoration occurring in each phase. The estimated cost per phase would be $285,000

[20] Based on tax information found at: http://www.willcogis.org/gisweb.html

[21] Cost basis provided through personal communication with Greg Wolterstorff of V3 Companies for the FPDWC's 2006 and 2008 restoration of Spring Creek in the Hadley Valley Preserve.

to $385,000. These cost estimates does not include costs associated with land acquisition or conservation easements, which are expected to be necessary for this project to be implemented. Given the complexities associated with this project, specifically with respect to land ownership, the expectation is that the preliminary planning and evaluation for this project would occur within the timeframe of this short-term implementation plan. The Village of Tinley Park would be expected to take the lead on this project. Collaboration with the Village of Mokena may also be necessary as this site is located at the boundary of the two villages.

Another consideration for this project is that the Franklin Square Park District owns land with a paved path south of this location. An opportunity may exist to create riparian corridor and recreational connectivity between this site and the park district property.

4.2.3.3 Marley Creek, Orland Park—Project Site No. 25

An approximately 1,300-foot reach of Marley Creek flows through a relatively narrow corridor between an existing railroad line and a detention basin south of 179th Street. The stream assessment conducted as part of the watershed reconnaissance, which actually assessed the reach immediately upstream of 179th Street, indicated that this reach of Marley Creek exhibits relatively degraded physical stream characteristics, such as heavy sediment deposition, channel alteration, and absence of pools.

Figure 4-45. Marley Creek at 179st Street, Orland Park

The proposed project recommendation involves the restoration of this reach of the stream channel. The project would include improving the riparian zone through invasive species removal and planting of native vegetation, including trees, and installing in-stream structures, such as pool/riffle complexes. Sediment transport through this reach may also be improved by creating a narrower channel within the larger channel for lower flow conditions. Remeandering of this stream reach was not considered to be an option for this project given the close proximity of the site to the railroad line and the detention basin, but could be further explored during the project planning process. Wetland vegetation was also observed in select areas adjacent to the stream in this location. As a result, the recommendation for this site also includes enhancement of the wetlands through invasive species removal and planting of native species, as necessary. The inclusion of flood control improvements, such as the excavation of flood water storage areas adjacent to the stream where feasible, may be an added benefit of this project.

Figure 4-46. Marley Creek at 179st Street, Orland Park

The estimated cost for this project ranges from $165,000 to $185,000. This cost estimate assumes 1,300 feet of stream restoration and two acres of wetland enhancement, but does not include costs associated for flood control improvements. The Village of Orland Park would be expected to take the lead on this project. However, similar stream conditions exist both upstream and downstream of this reach in unincorporated Will County. As a result, it may logical for the village to collaborate with Will County to expand this project into those reaches.

4.2.4 BUFFER ESTABLISHMENT

Riparian buffers are vegetated areas next to streams that protect the water body from nonpoint source pollution, provide bank stabilization, and provide aquatic and wildlife habitat. Ideally riparian buffers should be composed of native vegetation including grasses or trees, or both. Along many reaches of the stream channels within in the Hickory Creek watershed, the riparian corridor has been impacted by human activities. Some of these activities include turf grass management up to the stream, agricultural uses, and commercial and industrial facilities immediately adjacent to the stream. The establishment of new riparian buffers in the watershed will likely present challenges given that the buffer areas are generally impacted in order to meet the needs of the property owners. However, opportunities exist within the watershed where buffers can be established. The following sections present three project recommendations for the establishment of riparian buffers along Hickory Creek.

4.2.4.1 New Lenox STP #1, New Lenox—Project Site No. 26

New Lenox STP #1 is located immediately adjacent to Hickory Creek west of Cedar Road. Currently, mowed turf grass exists along the majority of the facilities boundary with the stream. Therefore, an opportunity exists to establish a more naturalized riparian buffer along this section of the stream.

Figure 4-47. New Lenox STP #1

The proposed project for this location is to establish a riparian buffer consisting of native vegetation, including trees. The proposed buffer should be approximately 50 to 75 feet wide. A small buffer segment already exists directly north of the facility. As a result, this project should include enhancement of this existing buffer area and continuation of the buffer along the remainder of the facility boundary, approximately 800 feet.

The estimated costs for the proposed project are $7,500 to $8,500. The Village of New Lenox would be the lead agency for this project, with public works staff potentially performing some of the work.

4.2.4.2 Pilcher Park, Joliet—Project Site No. 27

The preservation and management of Pilcher Park as a natural area within the Hickory Creek watershed provides the watershed and park users with countless benefits. However, an opportunity for water quality improvement was noted during the watershed reconnaissance effort. In the western portion of the park, an area of mowed turf grass was observed along Hickory Creek. This area appears to be heavily used by anglers and other park visitors. Consequently, the establishment of a riparian buffer in this area needs to provide consideration for these users. Heavy use of this by Canada geese has also been observed. It is expected that the establishment of taller vegetation in this area would minimize the use of this area by the geese.

Figure 4-48. Western Portion of Pilcher Park

The proposed project for this location is to establish a riparian buffer consisting of native vegetation, including trees, along approximately 1,350 feet of the bank of Hickory Creek. The proposed buffer

should be approximately 50 to 75 feet wide. Flagstone-lined access points and landing areas approximately every 100 feet should incorporated into the design to account for recreational user access.[22]

The estimated costs for the proposed project are $29,500 to $32,500, including design and permitting. The Joliet Park District and Pilcher Park staff would be the lead agency for this project, with staff and park volunteers potentially performing some of the work.

4.2.4.3 Prestwick Country Club Golf Course, Frankfort—Project Site No. 28

The Prestwick Country Club Golf Course is a large golf course located in Frankfort. Hickory Creek bisects approximately the western two-thirds of the golf course. Observations made during the watershed reconnaissance and from review of aerial photography indicated that the majority of the portion of Hickory Creek that flows through the golf course (approximately 7,100 feet) is lined with either turf grass or rip rap, or both. Evidence of stream bank erosion was also observed in select locations during the watershed reconnaissance.

Figure 4-49. Prestwick Country Club Golf Course, Frankfort

Based on review of aerial photography, riparian buffers could be established along nearly 9,000 feet of the stream banks on the golf course property (this excludes stream banks that appear to be part of residential properties). Given the extent of this undertaking, the proposed project is for the establishment of riparian buffers in phases based on 1,000 foot increments. The buffers established on the golf course would need to consider course of play, but buffers consisting of deep-rooted native vegetation, including trees, and widths of approximately 50 to 75 feet are recommended. Minor grading of eroding sections of stream banks may also be required prior to the planting of the native vegetation.

The estimated project costs for establishing 1,000 feet riparian buffer on the golf course property are $9,500 to $11,000. The estimate costs for the entire project are $85,500 to $99,000. The Village of Frankfort would take the lead in assisting the Prestwick Country Club staff with the development of the buffer establishment program.

4.2.5 GENERAL STREAM MAINTENANCE

Early in the watershed planning process, Hickory Creek municipalities and major public landowners were asked to identify known problem areas within their respective portions of the watershed. One of the most prevalent responses was the need for trash and debris removal. The noted areas ranged from large accumulations of woody debris at road crossings to select pieces of large trash. The watershed reconnaissance also included a component for noting trash and debris concerns. Based on these findings, it is recommended that the watershed communities initiate a concerted program for removing trash and debris from the stream corridors. As noted in Section 3.4.2. , these stream maintenance activities need to balance habitat considerations with the need to remove trash and debris.

Figure 4-50. Debris Accumulation in Frankfort Tributary

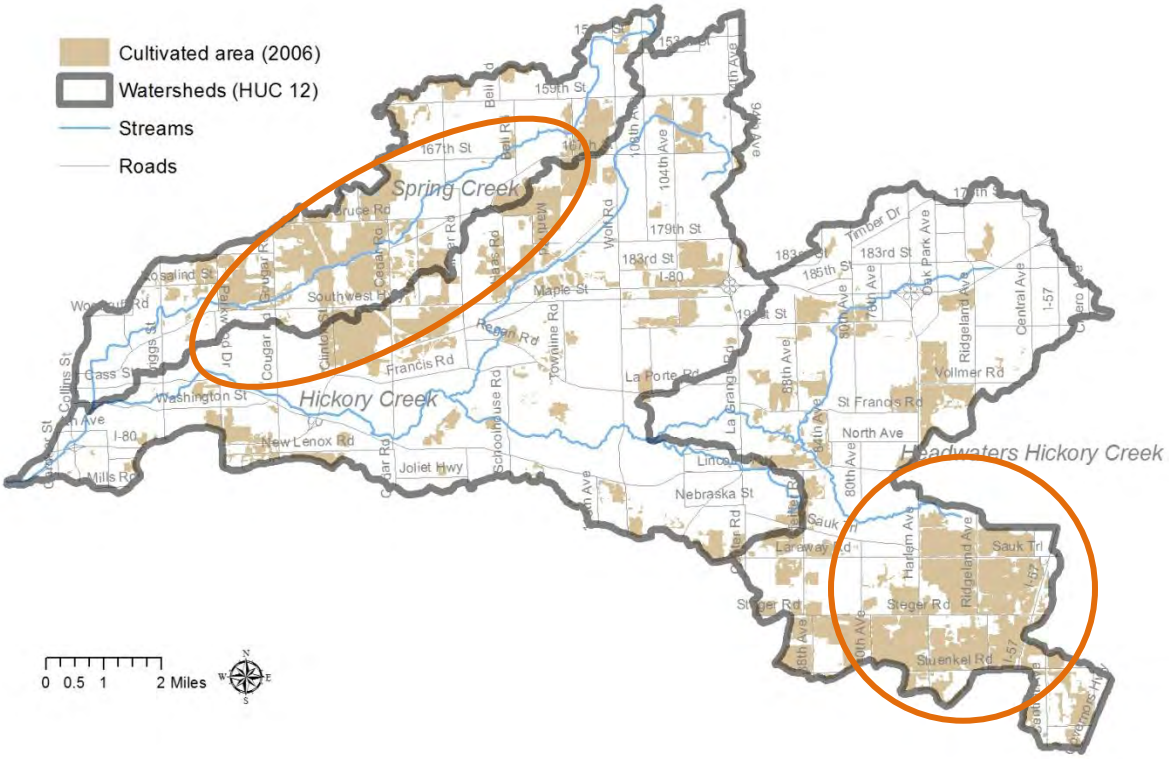
[22] A similar project was recently installed by the St. Charles Park District in Mt. Saint Mary Park in St. Charles.

For the removal of the large accumulations of debris, it is envisioned that municipal staff would undertake these activities. However, more wide-spread efforts to remove smaller pieces of trash and debris could be accomplished by organized volunteers with assistance from the municipal staff.

4.3 Agricultural Best Management Practices

Approximately one quarter of the watershed area remains as agricultural land, and this land is estimated to be a significant contributor of nutrients and sediment to the Hickory Creek watershed. Therefore, practices that reduce pollutant contributions from agricultural areas are an important element in the restoration and protection of Hickory Creek and its tributaries. The two main contributing areas are (1) in the far southeastern part of the watershed in the headwaters and (2) in the Spring Creek subwatershed and northern part of the middle Hickory Creek subwatershed. As discussed in Chapter 2, the Spring Creek subwatershed is fairly hilly, explaining why sediment loads and therefore sediment-bound nutrient loads are high from farmland in this area -- slope and slope length are generally the dominant factors in soil loss estimates using the RUSLE approach. The southeastern portion of the watershed, on the other hand, has predominantly very poorly drained, group D soils. These soils have high runoff potential, and when drained (as most are), they export nitrogen and phosphorus even more readily. Natural characteristics of the land explain the high proportion of the total nutrient and sediment load generated by farmland. Agriculture is taking place in areas with high runoff, soil loss, and nutrient export potential.

Figure 4-51. Cultivated areas in the Hickory Creek watershed.



A helpful heuristic device for understanding agricultural BMPs is to sort them by whether they work by avoiding, controlling, and trapping ("ACT") pollutants.[23] The avoidance component is accomplished through activities such as crop rotation and nutrient management practices, while the control component consists of practices such as conservation tillage. Much of the agricultural land within the Hickory Creek watershed is anecdotally known to be managed using practices that involve avoiding or controlling pollutants (e.g., no-till or other conservation tillage practices).[24] The use of these practices should of course be continued in the watershed because of their water quality benefits, but it is thought – again, anecdotally – that the penetration rate of these practices is already high and unlikely to increase extensively. (However, note that drainage water management, which has not been tried in the Hickory Creek watershed, is a "controlling" practice and could also be a very valuable approach to reducing nutrient export.)

The biggest opportunity for new nutrient and sediment reductions in the Hickory Creek watershed lies with practices in the third "ACT" category, which work by "trapping" or removing pollutants from runoff and that have not been used widely in northeastern Illinois. Two such practices are provided in the project recommendations provided below: constructed wetlands and denitrifying bioreactors. It is worth pointing out that these practices are meant to work directly with the tile drainage system, which has not been mapped but almost certainly underlies the farmland in the southeast agricultural area in the watershed and likely elsewhere.

4.3.1 CONSTRUCTED WETLANDS—PROJECT SITE NO. 29

Constructed wetlands are manmade systems that mimic the water quality improvement processes of naturally occurring wetlands. Surface flow wetlands are effective in removing phosphorus, nitrogen, and total suspended solids.[25,26] As water flows through the wetland, the velocity of the water decreases, allowing suspended solids to settle out. The microbial community that thrives in the soil of many wetlands transforms or removes pollutants, such as phosphorous and nitrogen[27]. Phosphorous retention occurs through sorption, precipitation, and sedimentation. Nitrogen (in nitrate form) is removed primarily through anaerobic denitrification.

Constructed wetlands that are properly sited and designed are effective in improving the water quality discharged from agricultural land uses. The wetland system can be designed to receive tile drainage, surface drainage, or a combination of the two. The use of constructed wetlands is common in several Midwestern states such as Iowa, Missouri, and Minnesota. The knowledge gained through the research conducted in these states can be referenced to guide the implementation of an effective program in the Hickory Creek watershed. Despite the convergence of high nutrient loads from agricultural land uses and favorable landscape conditions in Illinois, the use of constructed wetlands as a BMP in Illinois is not yet common.

Constructed wetlands should be located along primary drainage ways, downstream of a significant tributary area. Several factors need to be considered in designing a constructed wetland, such as tributary area, topography, soils, and anticipated pollutant loads. Proper placement is a critical step in BMP performance. Literature on nitrogen removal in constructed wetlands for agricultural drainage is

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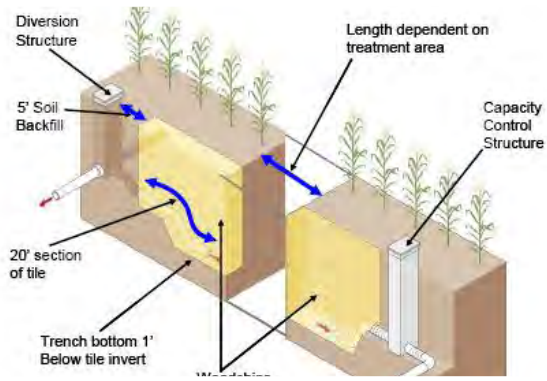
[23] http://www.epa.gov/owow_keep/msbasin/pdf/meetings/meeting18/01_ann_mills.pdf
[24] Personal communication with Bob Jankowski, USDA NRCS District Conservationist for Will County and other stakeholders.
[25] Reddy, K. R., R. H. Kadlec, E. Flag, and P. M. Gale. 1999. Phosphorous retention in streams and wetlands: A review. *Crit. Rev. Environ. Sci. Tech*. 29: 83-146.
[26] Reddy, K. R., R. G. Wetzel, and R. H. Kadlec. 2005. Biogeochemistry of phosphorous in wetlands. *Phosphorous: Agriculture and the Environment*, 263-316. Agronomy Monograph No. 46. Madison, Wisc.: ASA-CSSA-SSSA.
[27].USEPA, 2004. Constructed Treatment Wetlands, EPA: 843-F-03-013

readily available and is continually growing. The same level of analysis is not currently available on the effectiveness of phosphorous removal in constructed wetlands. Based on the Iowa guidance, the area of a constructed wetland should range from 0.5 percent to 2 percent of the tributary area, with a recommended target of 1 percent.[28,29] A study conducted in Illinois that evaluated both nitrogen and phosphorous removal provided wetland areas that ranged from 3 to 7 percent of the watershed area[30]. The proposed project for the Hickory Creek is to treat 500 acres of agricultural land with constructed wetlands. With a target ratio of 2 percent, approximately 10 acres of constructed wetlands would be created at locations throughout the watershed. Local NRCS staff is expected to take the lead in identifying project sites and willing landowners to implement this project. The estimated cost for this project is $45,000 to $49,500.

4.3.2 DENITRIFYING BIOREACTORS—PROJECT SITE NO. 30

Local NRCS staff has indicated that drain tile location information for the watershed is not readily available, but that the presence of drain tile is expected to be prevalent throughout the agricultural portions of the Hickory Creek watershed.[31] Discharges from drain tiles can be a significant source of nitrogen.[32] Denitrifying bioreactors have been shown to reduce nitrogen levels in discharges from drain tiles.[33] The bioreactors consist of constructing a trench to receive flows from a drain tile. The trench is filled with a carbon source, such as wood chips, which microorganisms (i.e., bacteria) then use to chemically reduce nitrates in the drain tile flows to nitrogen gas through denitrification. Typically, approximately 10 feet of trench, two to three wide, is constructed per acre of drainage area, at a cost of approximately $400 per acre drained.[34] The benefit of this practice is that it provides water quality improvement, but does not take agricultural land out of production.

Figure 4-51. Denitrifying Bioreactor Diagram



Source: Richard Cooke, University of Illinois Urbana-Champaign

The use of bioreactors in northeastern Illinois has been limited. As a result, the proposed project is for the implementation of bioreactors at select demonstration sites within the watershed. Under this recommendation, local NRCS staff would take the lead in identifying project sites and willing landowners to implement the project for a cumulative drainage area of 50 acres. The estimated cost for this project is $20,000 to $22,000.

4.4 Estimated Load Reductions

Pollutant load reductions estimates for the implementation of the projects recommended in this plan were calculated with watershed model STEPL by using literature estimates of pollutant removal efficiencies,

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[28] http://www.iowaagriculture.gov/waterResources/CREP.asp
[29] http://www.iowaagriculture.gov/waterResources/pdf/LandownerGuide.pdf
[30] Kovacic, D. A., Twait, R. M., Wallance, M. P., Bowling, J. M. 2006. Use of created wetlands to improve water quality in the Midwest – Lake Bloomington case study, Ecological Engineering 28(2006) 258-270.
[31] *Ibid.*
[32] P. Kalita, A. Algoazany, J. Mitchell, R. Cooke, and M. Hirschi. 2006. *Subsurface Water Quality from a Flat Tile-Drained Watershed in Illinois, USA.* Agriculture, Ecosystems and Environment 115:183–193.
[33] D. Jaynes, T. Kaspar, T. Moorman, and T. Parkins. 2008. *In Situ Bioreactors and Deep Drain-Pipe Installation to Reduce Nitrate Losses in Artificially Drained Fields*. J. Environ. Qual. 37: 429-436.
[34] http://www.admcoalition.com/Woodbio.pdf

unless otherwise noted in Table 4-1. The reader should recognize the use of pollutant removal efficiencies, or percent removal, to estimate pollutant load reductions has several shortcomings.[35] As a result, the estimates derived from the analyses described above do not represent absolute expected results from the implementation of projects recommended in this plan, and are only planning-level estimates.

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

Table 4-1. Watershed-wide Summary of BMPs Recommended for Implementation within 5 Years of Plan Adoption.

Project No.	Project Name	Total estimated cost	BMP	Unit	Amount	Area treated (ac)	Pollutant reduction			Priority	Lead parties
							N (lb/yr)	P (lb/yr)	Sediment (t/yr)		
1	Washington Street Filtration Retrofit[36]	$17,500 - $27,000	Sidewalk planter box	EA	1	0.25	1.3	0.3	0.2	L	City of Joliet
2	Historic Downtown Frankfort Retrofits	$33,500 - $46,000	Sidewalk planter box	EA	1	0.25	2.6	0.5	0.5	L	Village of Frankfort
			Bio-infiltration (Filterra)	EA	1	0.25					
3	Mokena Village Hall Pavement	$38,500 - $58,000	Permeable pavement	SF	3,400	0.85	7.1	0.7	0.5	L	Village of Mokena
4	Pine Street Porous Pavement Retrofit	$80,000 - $92,000	Permeable pavement	SF	8,000	0.40	4.2	0.4	0.4	L	Village of New Lenox
5	Mokena Fire Dept. Bioretention[37]	$12,000 - $24,000	Bioretention	SF	1,600	0.35	2.2	0.4	0.1	L	Village of Mokena
6	New Lenox Police Station Bioretention	$47,000 - $69,000	Bioretention	SF	4,000	1.10	3.3	0.8	0.2	L	Village of New Lenox
7	Frankfort Library Bioretention	$21,000 - $32,000	Bioretention	SF	1,300	0.30	2.5	0.4	0.1	L	Village of Frankfort
8	Dr. Julius Rogus School Bioretention	$21,000 - $29,000	Bioretention	SF	3,500	0.80	5.7	0.9	0.3	L	Village of Frankfort
9	Silver Cross Hospital Bioretention	$60,000 - $90,000	Bioretention cells	EA	3	6.00	31	5.1	1.8	M	Joliet, Silver Cross Hosp.
10	Degroate Road Swale Retrofit	$18,000 - $27,000	Vegetated swale	LF	600	21	21	4.8	7.3	M	Village of New Lenox
11	Deboer Subdivision Swale Retrofit	$40,000 - $62,000	Vegetated swale	LF	2,500	10	4.1	1.2	0.6	L	V. of Homer Glen, HOA
12	Silver Cross Hospital Swale Stabiliz.	$39,000 - $47,000	Vegetated swale	LF	680	---	28	9	7	M	Joliet, Silver Cross Hosp.
13	Mokena Regional Basin Retrofit[38]	$29,000 - $40,000	Urban strmwtr wetland	EA	3	---	47	13	5.6	H	Village of Mokena
14	Silver Cross Hospital Basin Retrofit	$40,500 - $52,000	Urban strmwtr wetland	EA	1	---	103	29	13	H	Joliet, Silver Cross Hosp.
15	Frankfort Regional Basin Retrofit	$39,000 - $64,500	Urban strmwtr wetland	EA	3	---	77	22	7.6	H	Village of Frankfort
16	New Lenox Pk Dist Bldg Retrofits[39]	$4,500 - $7,000	Downspout planter box	EA	4	---	n/a	n/a	n/a	M	V. New Lenox, NL Pk Dist
17	Lincoln-Way E. H. S. Bldg Retrofits	$8,600 - $10,400	Downspout planter box	EA	5	---	n/a	n/a	n/a	M	V.of Frankfort, school

[36] Load reduction estimates for the proposed filtration retrofit projects are based on pollutant removal efficiencies reported at: http://www.filterra.com/index.php/product/

[37] Sediment reduction estimates for the proposed bioretention retrofit projects were developed using the median removal efficiency reported in the CWP's National Pollutant Removal Performance Database, v3. 2007.

[38] Load reduction estimates for the proposed detention basin retrofit projects were developed assuming that the existing dry basins do not provide treatment of the water quality volume due to the presence of existing flow paths within the basins.

[39] Building roof tops do not typically generate high pollutant loads. Project benefits include runoff volume attenuation and volume reductions through evapotranspiration.

Project No.	Project Name	Total estimated cost	BMP	Unit	Amount	Area treated (ac)	Pollutant reduction N (lb/yr)	Pollutant reduction P (lb/yr)	Pollutant reduction Sediment (t/yr)	Priority	Lead parties
18	Edna Keith School Building Retrofit	$5,800 - $8,600	Downspout planter box	EA	5	---	n/a	n/a	n/a	M	City of Joliet
19	Spring Creek Dam Modification	Varies[40]	Dam modification	LS	1	---	ND	ND	ND	M	City of Joliet
20	Pilcher Park Dam Modification	Varies[40]	Dam modification	LS	1	---	ND	ND	ND	M	Joliet Pk Dist, C. of Joliet
21	Hickory Creek at Hillcrest Road	$985,000 – $1.3M[41]	Streambank stabiliz.	LF	150	---	342	110	101	H	OWR, Joliet, Will Cty
22	Spring Creek at Draper Avenue	$200,000 - $220,000	Streambank stabiliz.	LF	150	---	316	101	93	H	FPDWC, OWR, Joliet
23	E. Br. Marley Cr. Stream Restoration	$825,000 - $1.1M	Stream de-channeliz.	LF	2,700	---	ND	ND	ND	M	Mokena, Comm Pk Dist
			Wetland restoration	AC	10	---					
24	Union Ditch Stream Restoration	$495,000 - $650,000	Stream de-channeliz.	LF	1,700	---	ND	ND	ND	M	V. of Tinley Park, Mokena
			Wetland restoration	AC	3	---					
25	Marley Creek Stream Restoration	$165,000 - $185,000	Stream de-channeliz.	LF	1,300	---	ND	ND	ND	M	V. of Orland Park
			Wetland enhancement	AC	2	---					
26	New Lenox STP #1 Buffer Establ.	$7,500 - $8,500	Stream de-channeliz.	LF	800	5.50	15	1.6	1.1	H	Village of New Lenox
27	Pilcher Park Buffer Establishment	$29,500 - $32,500	Buffer establishment	LF	1,350	9.30	2.3	0.8	0.1	H	Joliet Park District
28	Prestwick Country Club Buffer Establ.	$85,500 - $99,000	Buffer establishment	LF	1,000	6.90	18	11	1.4	H	Frankfort, Prestwick CC
29	Agricultural Constructed Wetlands[42]	$45,000 - $49,500	Treatment wetlands	AC	10	500	6117	1134	325	H	NRCS
30	Agricultural Bioreactors[43, 44]	$20,000 - $22,000	Bioreactors	LF	500	50	633	n/a	n/a	H	NRCS

EA = each, SF = square foot, LF = linear foot, AC = acre, LS = lump sum
H, M, L = higher, medium, and lower priority, based on ranked cost-effectiveness of pollutant removal
n/a = not primary intended project benefit[45,46]

[40] The cost of dam modification will depend on the alternative chosen after further study.
[41] Estimate includes estimated $700,000 for excavation of opposing bank as presented in information provided by IDNR-OWR.
[42] Pollutant load reductions for nutrients estimated based on information reported in the references identified in Section 4.3.1. Sediment reduction estimates are based on CWP's National Pollutant Removal Performance Database, v3. 2007.
[43] Pollutant load reductions estimate based on information eported in references identified in Section 4.3.2.
[44] The primary water quality benefit of the bioreactors recommended in this plan is the removal of nitrate.
[45] Building roof tops do not typically generate high pollutant loads. Project benefits include runoff volume attenuation and volume reductions through evapotranspiration.
[46] The primary water quality benefit of the bioreactors recommended in this plan is the removal of nitrate.

4.5 Potential Funding Sources

The following table (Table 4-2) provides an extensive list of potential funding sources for the projects recommended in the short-term implementation plan or similar projects to be undertaken in the watershed. Select organizations and agencies that can be of technical assistance during the implementation of these projects are provided in Table 4.3.

Table 4-2. Selected Funding Sources for Potential Projects Identified in this Plan.

Program	Funding Agency	Type	Funding Amount	Eligibility	Activities Funded	Website
Water Quality						
Capitalization Grants for Clean Water State Revolving Funds	US EPA/Office of Wastewater Management	Loan revolving fund	No limit on wastewater funds Drinking water up to 25% of available funds	Local government, Individuals Citizen groups Not-for-profit groups	Wastewater treatment Nonpoint source pollution control; Watershed management; Restoration & protection of groundwater, wetlands/riparian zones, and habitat	http://www.epa.gov/owm/cwfinance/index.htm
Non-point Source Management Program (319 grants)	Illinois EPA	Matching Grant (60% funded)	No set limit on awards	Local government Businesses Individuals Citizen & environment groups	Controlling or eliminating non-point pollution sources Stream bank restoration Pesticide and fertilizer control	http://www.epa.state.il.us/water/financial-assistance/non-point.html
Illinois Green Infrastructure Grant Program for Stormwater Management	Illinois EPA	Matching Grant Minimum Local Match CSO: 15% Retention and Infiltration: 25% Green Infrastructure Small Projects: 25%	Up to: CSO: $3M or 85% of project costs Retention and Infiltration: $750,000 or 75% of project costs Green Infrastructure Small Projects: $75,000 or 75% of project costs	Any entity that has legal status to accept funds from the state of Illinois, including state and local governmental units, nonprofit organizations, citizen and environmental groups, individuals and businesses	Green infrastructure best management practices (BMPs) for stormwater management to protect or improve water quality	http://www.epa.state.il.us/water/financial-assistance/igig.html
Sustainable Agriculture Grant Program	Illinois Department of Agriculture	Matching Grant (60% funded)		Organizations, governmental units, educational institutions, non-profit groups, individuals	Practices are aimed at maintaining producers' profitability while conserving soil, protecting water resources and controlling pests through means that are not harmful to natural systems, farmers or consumers	http://www.agr.state.il.us/Environment/conserv/index.html

Program	Funding Agency	Type	Funding Amount	Eligibility	Activities Funded	Website
Streambank Stabilization and Restoration Program	Illinois Department of Agriculture	Matching grant (amount funded not specified)		Landowners, Citizen groups, Not-for-profit groups	Naturalized streambank stabilization in rural and urban communities, work with SWCD	http://www.agr.state.il.us/Environment/conserv/index.html
Conservation Innovation Grants	Natural Resources Conservation Service	Matching grant (50 % funded)	Up to $75,000 under State Component	Landowners, Organizations	Projects targeting innovative on-the-ground conservation, including pilot projects and field demonstrations	http://www.il.nrcs.usda.gov/programs/cig/
Habitat						
Partners for Fish and Wildlife Habitat Restoration Program	Department of Interior, US Fish and Wildlife Service	Cost-share (50% funded)	up to $25,000	Private landowners	Voluntary restoration or improvements of native habitats for fish and wildlife Restoration of former wetlands, native prairie stream and riparian areas and other habitats.	http://www.fws.gov/policy/640fw1.html
Bring back the Natives Grant Program	National Fish and Wildlife Foundation	Matching Grant (33% funded)	Varies with project ($50,000-$75,000)	Not-for-profit groups, Universities Local governments	Restoration of damaged or degraded riverine habitats and native aquatic species through watershed restoration and improved land management.	http://www.nfwf.org/AM/Template.cfm?Section=charter_programs_list&CONTENTID=18473&TEMPLATE=/CM/ContentDisplay.cfm
Wildlife Habitat Incentives Program	US Department of Agriculture	Grant, Matching Grant (at least 75% funded)		Private landowners, Not-for-profit groups	Establishment and improvement of fish and wildlife habitat on private land	http://www.nrcs.usda.gov/programs/whip/
Native Plant Conservation Initiative	National Fish and Wildlife Foundation	Matching Grant (50% funded)	$10,000-$50,000	Community and watershed groups Nonprofit groups Educ. institutions Conservation districts Local governments	"On-the-Ground" projects that involve local communities and citizen volunteers in the restoration of native plant communities.	http://www.nfwf.org/programs/npci.htm
Wetlands						
Wetlands Reserve Program	USDA NRCS	Direct contracts with landowners Easement (100%)	No set limit on awards	Individual Citizen groups, Not-for-profit groups	Wetlands restoration or protection through easement and restoration agreement	http://www.nrcs.usda.gov/programs/wrp/states/il.html

Program	Funding Agency	Type	Funding Amount	Eligibility	Activities Funded	Website
		Cost Share and 30 year easements (75%)				
Wetlands Program Development Grants	US EPA	Matching Grant (75% funded)	No set limit on awards	Not-for-profit groups Local government	Developing a comprehensive monitoring and assessment program; Improving the effectiveness of compensatory mitigation; Refining the protection of vulnerable wetlands and aquatic resources	http://www.epa.gov/owow/wetlands/grantguidelines
Northeastern Illinois Wetlands Conservation Account	US Fish and Wildlife Service/The Conservation Fund	Grant/Matching Grant (50% match strongly suggested)	Average of ~$38,000	A partnership of: Governmental agencies Not-for-profit conservation groups Private landowners	Restoration of former wetlands; Enhancement and preservation of existing wetlands; Creation of new wetlands Wetlands education and stewardship	http://www.conservationfund.org/node/133
Small Grants Program	North American Wetlands Conservation Council	Matching Grant	Up to $75,000	A partnership of: Governmental agencies Not-for-profit conservation groups Private landowners	Long-term acquisition, restoration, enhancement of natural wetlands	http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm
Wetland Restoration Fund	Openlands	Grant	$5,000-$100,000	Local government Not-for-profit groups Citizen groups Other organizations	Wetlands and other aquatic ecosystem restorations within the six-county Chicago region on land under conservation easement or owned by a government agency	
Five Star Restoration Program	National Fish and Wildlife Foundation	Matching Grant (50% funded)	One-year projects: $10,000-$25,000 Two-year projects: $10,000 -$40,000	Any public or private entity that can receive grants	Seeks to develop community capacity to sustain local natural resources for future generations by providing modest financial assistance to diverse local partnerships for wetland and riparian habitat restoration	http://www.nfwf.org/AM/Template.cfm?Section=Charter_Programs_List&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=60&ContentID=17901
Private						
Tellabs	Tellabs Foundation	Grant	At least $10,000	Not-for-profit groups	Environmental protection and improvement programs; Organizations which protect the	http://www.ivp.tellabs.com/about/foundation.shtml

Program	Funding Agency	Type	Funding Amount	Eligibility	Activities Funded	Website
					environment	
GVF Core Program	Grand Victoria Foundation	Grant/Matching Grant	Varies with scope of project, size of organization, other funding	Not-for-profit groups	Preservation and restoration of natural lands and waterways	www.grandvictoriafdn.org

Table 4-3. Selected Public and Nonprofit Technical Assistance Resources by Project Category

Water Quality	Habitat	Wetlands
Illinois Environmental Protection Agency	Openlands	Ducks Unlimited
Natural Resources Conservation Service	US Fish and Wildlife	Wetlands Initiative
Will – South Cook Soil and Water Conservation District	Natural Land Institute	The Conservation Fund
Center for Neighborhood Technology	The Nature Conservancy	US Army Corps of Engineers
The Conservation Foundation	Isaak Walton League	

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5. PLAN IMPLEMENTATION AND MONITORING

5.1 Implementation Schedule and Milestones

While developing a watershed plan is a critical step in the watershed management process, the plan is of little use for the protection and restoration of Hickory Creek and its tributaries unless the recommendations in the plan are implemented in a meaningful way. This section is intended to provide an implementation schedule and measureable milestones for the plan recommendations. The overall implementation timeframe for many of the recommendations in this plan is five years, with the expectation that the watershed plan would be revisited in 2016.

The vision and policy recommendations included in this plan are multi-faceted, and each of the communities and organizations within the watershed will need to contribute to implementation. For the recommendations related to comprehensive plans and ordinances, the expectation is that staff and elected officials from each community, with assistance from CMAP or consultants, would establish an appropriate course of action for their community to integrate the policy recommendations by 2016. Implementing one of the policy recommendations per year should be a minimum goal for each community. Completion of these efforts within the suggested timeframe would be aided by continued collaboration between the watershed communities through the Hickory Creek Watershed Planning Group (or successor organization).

Collaboration between watershed communities and organizations will also facilitate implementation of the program recommendations presented in Section 3.4. Additionally, the implementation of the education-related programs recommended in Section 3.4.6 will be greatly assisted by hiring at least a part-time watershed coordinator. The expectation, again, is that many of the recommended programs should be implemented by 2016. Program recommendations such as those related to the wastewater treatment plants (Section 3.4.1) and the implementation of green infrastructure during infrastructure rehabilitation projects (Section 3.4.4) are expected to be on-going programs. It is recommended that the watershed communities develop the recommended structured mechanism to guide "greener" infrastructure rehabilitation by 2012.

The short-term implementation plan provides a set of tangible, on-the-ground projects that should be implemented with the recommended five-year timeframe, with a few exceptions as noted below.

- Urban Stormwater Infrastructure Retrofits—implement three to four projects (Projects No. 1 through 18) per year until 2016.
- Stream Channel and Riparian Corridor Restoration
    - Dam Modifications—begin planning and evaluation process for both recommended projects (Projects No. 19 and 20) by 2013.
    - Stream Channel Protection—implement Spring Creek at Briggs Street stabilization project (Project No. 21) by 2013 and Hickory Creek at Hillcrest Road project (Project No. 22) by 2015.
    - Stream and Wetland Restoration— begin planning and evaluation for East Brach of Marley Creek (Project No. 23) and Union Ditch (Project No. 24) restoration projects by 2013; implement Marley Creek restoration project (Project No. 25) by 2014.
    - Buffer Establishment—implement one project (Projects No. 26 through 28) per year until 2016 (assumes Project No. 28—Prestwick Country Club—would be completed in phases).

- Agricultural Best Management Practices
  - Constructed Wetlands—implement constructed wetland pilot project by 2012 and projects for remaining recommended treatment area by 2016.
  - Bioreactors—implement bioreactor pilot projects for treatment of approximately 25 acres by 2013 and projects for the remaining 25 acres by 2015.

5.2 Monitoring Plan

Unlike many other watersheds of a size similar to the Hickory Creek watershed, a relatively large amount of physical, chemical, and biological data exist for the watershed. However, as shown in Section 2, many of the data were collected either at limited locations, over short time periods, or for very specific purposes such as evaluating conditions upstream and downstream of wastewater treatment plant discharges. Less attention has been paid to following a sample design that would maximize information about conditions in the stream network as a whole. For example, fecal coliform data were collected over a long time period (i.e. 30 years or more), but were primarily (approximately 73 percent) collected at stations in the lower portion of the watershed. On the other hand, macroinvertebrate data exist for a well-distributed set of locations throughout the watershed, but many of the data were collected at different times, so that they are not completely comparable. These data limitations ultimately affect the ability to make informed watershed management decisions. As such, the load estimates and load reduction target estimates included in this plan should be considered provisional. Data collected during the monitoring plan period described below would be expected to be used in the development of a more robust and accurate water quality model.

Additional monitoring within Hickory Creek and its tributaries is recommended to assess in-stream conditions more accurately, improving both the temporal and spatial representativeness of the data. This will allow decision-makers within the watershed to determine long-term trends and to improve characterization of different sources of pollutants in the watershed. To accomplish this, a two-part monitoring plan is recommended.

The first part of the recommended monitoring plan is a short-term, relatively intensive monitoring and assessment effort that would be conducted over approximately a one-year period. The proposed monitoring network would consist of spatially distributed sampling locations which essentially mirror the stations established by the IDNR for its 2006 fish community study (Figure 5-1).[1] The recommended parameters and collection frequency to be collected under this effort are provided in Table 5-1. Collection of additional fecal indicator bacteria (i.e., *E. coli* and enterococci) data is recommended as evidence suggests they reflect human health risks better than just fecal coliform data and will likely be future water quality criteria for protection of primary contact recreation.[2]

[1] Station HC-MC-01 on Marley Creek is recommended to be moved from downstream of the confluence with East Branch of Marley Creek to upstream of the confluence.

[2] http://water.epa.gov/type/rsl/monitoring/vms511.cfm

Figure 5.1.

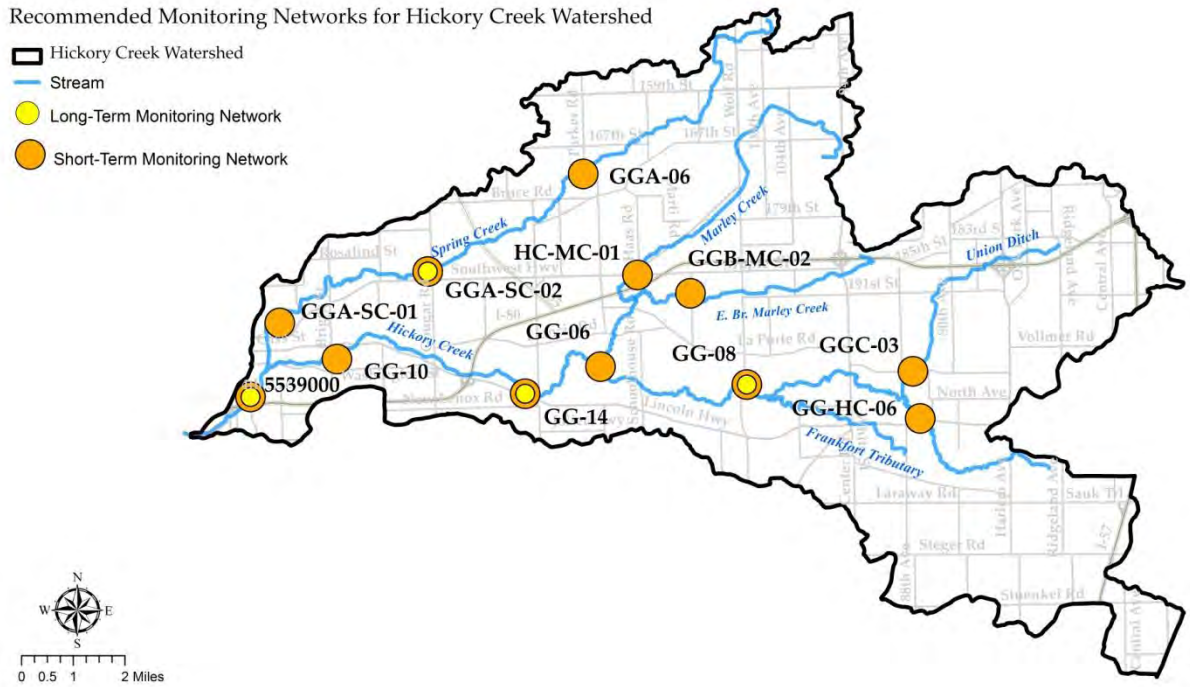

Table 5-1. Parameters and Frequencies for Short-Term Monitoring Plan

Parameter	Frequency	Duration
Fecal coliform	Weekly	16-20 weeks (Apr-Sept)
Escherichia coli	Weekly	16-20 weeks (Apr-Sept)
Enterococci	Weekly	16-20 weeks (Apr-Sept)
Total phosphorus	Weekly	16-20 weeks (Apr-Sept)
Total nitrogen	Weekly	16-20 weeks (Apr-Sept)
Total suspended solids	Weekly	16-20 weeks (Apr-Sept)
Benthic algae	Monthly	16-20 weeks (Apr-Sept)
Macroinvertebrate Assessment	2x per year	1 year (Apr and Sept)
Fish Assessment	Once	1 year
Chloride	Weekly + following snow/ice events	16-20 weeks (Apr-Sept), up to 3 snow/ice events in 1 year
pH	Weekly	16-20 weeks (Apr-Sept)
Temperature	Weekly	16-20 weeks (Apr-Sept)
Specific conductance	Weekly	16-20 weeks (Apr-Sept)
Dissolved oxygen (early morning)	Weekly	16-20 weeks (Apr-Sept)
Habitat Assessment	Once	1 year
Flow	With each sample event	With each sample event

The benefits of this short-term monitoring effort are two-fold. First, the data collected can be used to establish a watershed-wide baseline condition near the onset of plan implementation. This baseline could be used for comparison to later similar monitoring efforts to assess changes in the watershed conditions. Second, the intensive monitoring effort will allow for the evaluation of stream conditions for smaller portions of the watershed, making it possible to more accurately identify portions of the stream with elevated pollutant loading or other impaired conditions. Again, bacteria monitoring is provided as an example. Evaluating bacteria (e.g., fecal coliform) based on data primarily from two downstream stations

presents challenges in developing strategies to address the problem because the potential sources could vary by type and severity across the watershed (e.g., failing septic systems in lower density areas, pet waste or illicit cross-connections in other areas, etc.). The benefit of the recommended short-term monitoring plan would be that portions of the watershed with elevated bacteria levels could, at least potentially, be isolated and investigated further for potential source areas and remedial actions. The short-term monitoring plan should be repeated approximately every five years, or commensurate with the pace of changes within the watershed (e.g., plan implementation activities, land use changes).

The second component of the recommended monitoring plan is the establishment of a smaller number of long-term sampling stations. The recommended station locations are shown in Figure 5-1.[3] The recommended parameters and collection frequencies under this effort are provided in Table 5-2. The intended benefit of the long term monitoring plan would be to collect data that would allow assessment of stream conditions as they change over time. These data could be used to identify changes in watershed conditions and allow for an adaptive management approach to restoring and protecting Hickory Creek and its tributaries.

Table 5-2. Parameters and Frequencies for Long-Term Monitoring Plan

Parameter	Frequency
Fecal coliform	Monthly
Escherichia coli	Monthly
Enterococci	Monthly
Total phosphorus	Monthly
Total nitrogen	Monthly
Total suspended solids	Monthly
Benthic algae	Monthly
Macroinvertebrate Assessment	2x per year (spring and fall)/every 3 years
Chloride	Monthly
pH	Monthly
Temperature	Monthly
Specific conductance	Monthly
Dissolved oxygen	Monthly
Fish Assessment	Every 3 years
Flow (instantaneous)	With each sample event

Only one stream flow gage station is currently located in the Hickory Creek watershed, which is sited near the mouth of Hickory Creek (i.e., USGS station 5539000). At least one additional gage station is recommended to collect continuous flow data for the duration of the water quality monitoring program. The additional gage station should be located at station GG-06, which is located on Hickory Creek just upstream of Marley Creek.

The combined data from the long-term and short-term monitoring plans will allow the watershed stakeholders to evaluate indicators within the watershed to gauge watershed improvements over the longer term. For the beneficial use of aquatic life, these indicators should primarily be based on the collected macroinvertebrate and fish data, specifically mIBI and fIBI values, respectively. For the primary contact beneficial use, bacteria (e.g., fecal coliform) data would serve as the indicator. Initially the expected benchmarks for each of these indicators would be the IEPA's 305(b) criteria for aquatic life

[3] An additional long-term sampling station on Marley Creek would be advantageous if resources (i.e. funding, personnel, etc.) are available.

impairments[4] and the standard-based criterion for fecal coliform[5]. However, as additional data are collected and evaluated, and further watershed studies are conducted, more refined or additional indicators of watershed improvement may be defined.

It is recommended that the IEPA and other parties commit funds and personnel to facilitate the implementation of this monitoring plan. It is also recommended that fish assessments be performed in large part by the IDNR, potentially with assistance from watershed stakeholders. IDNR staff indicated during the watershed planning process that they would support additional fish assessments within the watershed. An early recommendation of the HCWPG was that macroinvertebrate sampling be conducted by a volunteer network within the watershed. It is recommended that trained volunteers assist with the collection of macroinvertebrates, but that macroinvertebrate identification be conducted by a professional aquatic biologist. The expectation is that more accurate and detailed information will aid in evaluation of the samples and related decision making. Included in this monitoring plan recommendation is the overarching recommendation that the data be collected in accordance with an IEPA-approved Quality Assurance Project Plan (QAPP). In general, the HCWPG or a successor organization will need to play a strong role in overseeing the execution of the sampling program.

The recommended monitoring plan is primarily focused on collecting in-stream data that is intended to allow for more informed decision making by the watershed stakeholders. The monitoring plan does not include site- or project-specific monitoring recommendations. However, additional monitoring efforts at this scale would allow for the evaluation of the effectiveness of implemented projects toward meeting project and watershed goals. The appropriate monitoring approach for a given project, or project category (e.g. bioretention retrofits), should be determined on a case-by-case basis and should be implemented when feasible based on funding and other available resources (e.g., field personnel or volunteers).

5.3 Achievement of Needed Load Reductions

The estimates of needed pollutant load reductions provided in Section 2.5.3 were developed to help identify recommendations for protecting and restoring Hickory Creek and its tributaries. Although the method used to develop these estimates (i.e., load duration curves) mask inherent complexities, the estimates prove useful for watershed planning purposes. The resulting estimates presented in Section 2.5.3 indicate that relatively high load reductions are needed for nutrients (based on the USEPA's ecoregional criteria), sediment, and fecal coliform to facilitate improvement within the watershed.

In an effort to evaluate the effectiveness of the plan, the estimated actual load reductions from the recommended projects and policies were compared to the load reductions estimated to be needed. For nutrients and sediment, the comparisons were performed based on whether in-stream flows were expected to be dominated by point sources or non-points sources.[6] These comparisons are provided in Table 5-3. The comparisons indicate that through implementation of the recommended measures to address point source contributions of nutrients (WWTP improvements and reducing septic system failure rates), significant progress can made be toward achieving the needed load reductions under the point source dominated flow regimes.

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[4] Although the IEPA uses a detailed decision table for assessing whether given stream segments are impaired for aquatic life, the IEPA uses IBI values of 41 or less, mIBI values of 41.8 or less, and MBI values of 5.9 or greater to make preliminary assessment conclusions that stream segments are impaired for aquatic life.

[5] The criterion for fecal coliform in Illinois during the recreational season from May through October is 200 colony forming units (cfu) per 100 mL, which is expressed as a geometric mean and is based on a minimum of five samples taken over not more than a 30 day period. Additionally, no more than 10 percent of the samples may exceed 400 cfu/100 mL during any 30 day period.

[6] For the purposes of this analysis, nonpoint source dominated flows were assumed to include the "high" and "moist" flow regimes presented in Section 2.5.3. Point source dominated flows were assumed to include the "mid-range," "low" and "dry" flow regimes.

Under the nonpoint source dominated flow regimes, the comparisons indicate that measures in addition to those presented in Section 4 are required to make significant progress toward achieving the needed load reductions. The relatively high load reductions needed for nutrients and sediment present a challenge to achieving the targets through the implementation of a limited number of projects in the short term. These findings further support recommendations presented in Section 3 intended to address pollutant contributions in the longer term. Specifically, local governments in the watershed should: 1) institute policy changes to reduce pollutant contributions from new development and redevelopment projects and 2) incorporate water quality improvement retrofit projects into municipal Capital Improvement Programs wherever possible.

Table 5-3. Comparison of Load Reduction Estimates for Nutrients and Sediment

	Phosphorus		Nitrogen	Sediment
	305(b) Criterion	Ecoregional Criterion		
Point Source Dominated Flow Regimes				
Load Reductions Needed	7%	80%	44%	0%
Estimated Load Reduction[7]	73% - 85%	73% - 85%	48% - 72%	0%
Nonpoint Source Dominated Flow Regimes				
Load Reductions Needed	0%	71%	35%	39%
Estimated Load Reduction[8]	23% - 31%	23% - 31%	5% - 17%	3%

The load reduction needed for chloride was roughly estimated to be 28 percent. As noted in Section 3.4.4, the recommended chloride reduction program and the nearly 20 percent reduction in chloride usage by the Village of New Lenox indicate that significant progress can be made through the watershed-wide implementation of the chloride reduction program. The needed load reduction for fecal coliform was estimated to be approximately 95 percent, and elevated levels were observed across all flow regimes. Urban watersheds frequently have elevated fecal coliform levels from diffuse sources; however, the levels based on the historic Hickory Creek data are above typical urban streams. Although recommendations included in this plan (i.e. septic system failure rate reduction) should aid in bacteria load reductions within the watershed, additional data are needed to more accurately identify bacteria sources and develop appropriate remedial actions. It is recommended that *E. coli* and enterococci be used as indicator organisms in addition to fecal coliform, as evidence suggests they reflect human health risks better.[9] Monitoring recommendations for the collection of additional bacteria data are presented in the previous section.

As noted in Section 2.2, potential non-pollutant causes of impairment of the aquatic life use (i.e., alteration of in stream-side vegetative cover, flow regime alterations, etc.) were identified for several of the stream

[7] Estimated load reductions under the point source dominated flow regimes include estimated reductions from improvements to septic systems and WWTPs. Estimated load reductions for the WWTP discharges presented here assume that each plant has implemented nutrient removal with discharge concentrations ranging from 5 to 10 mg/L for total nitrogen and 0.5 to 1.0 mg/L for total phosphorus. Although discharge flow rates are expected to nearly double within the timeframe (2040) over which future WWTP were analyzed (Section 2.6.2), the estimated load reductions presented here are based on existing discharge flow rates. This allows for a more accurate comparison of the estimates to the estimated needed load reductions, which are based on existing stream flows.

[8] Estimated load reductions under the nonpoint source dominated flow regimes include estimated reductions from the projects presented in Section 4 and the fraction of the estimated reductions from improvements to the WWTPs expected under these flow regimes.

[9] http://water.epa.gov/type/rsl/monitoring/vms511.cfm

segments within the Hickory Creek watershed. Several of the project recommendations presented in Section 4.2 represent project opportunities that are intended to assist in addressing these potential causes of impairment. Although it may seem obvious, local studies conducted by the DuPage River Salt Creek Workgroup indicate that physical stream characteristics (stream conditions) explain a considerable portion of the variability in mIBI scores.[10] Therefore, in addition to addressing pollutant loads, implementation of in-stream restoration projects will be a critical element in protecting and restoring Hickory Creek and its tributaries.

5.4 Longer Range Project Needs and Measures of Success

The projects recommended in the Short Term Implementation Plan (Chapter 4) are only a subset of the possible projects that would be beneficial in Hickory Creek. In general, the following kinds of projects are needed, any or all of which should be pursued in the longer range by organizations in the watershed:

1. Retrofits to existing stormwater management infrastructure to reduce pollutant loading and increased runoff volume in developed areas, which could include the installation of filtration practices; permeable pavement, bioretention, rain gardens, and other infiltration practices; vegetated swales, detention basin retrofits, and others.
2. Stream channel and stream corridor restoration projects to improve habitat for aquatic life, such as installation of instream habitat, grade controls in areas where stream incision is occurring, stream bank stabilization, and various measures up to and including full restoration of channelized streams.
3. Improved management practices on farmland to reduce nutrient and sediment runoff.

While it is important to have an overall "menu" of actions that would have a positive effect in the watershed and a system to track progress in implementing those measures, it is somewhat difficult to develop meaningful long range targets for them. This is due to two factors. First, although it can be said that all of the actions on the "menu" would be positive, it is not currently possible to describe a mechanistic connection between those actions and the beneficial use impairments. For example, although restoring wetlands will certainly improve the overall quality of terrestrial and aquatic environment in the watershed, most wetland restoration would not present a traceable line of causation to the improvement of fish and macroinvertebrate community index scores or fecal coliform levels. Second, establishing long range indicators is challenging simply as a practical matter because of uncertainties over funding, organizational commitment, and many other circumstances. This is why the Hickory Creek Watershed Plan was based on a five-year implementation timeframe, with the intention of revisiting the plan at the end of that period.

Nevertheless, in what follows, longer term targets (ten year timeline, or 2021) have been developed for a number of implementation categories with reference to baseline conditions and the short term recommendations in the plan (five year timeline).

Stream restoration

- Baseline: Approximately 22 miles of stream or 38 percent of the perennial stream network have been channelized. A 6,700 linear foot stretch of Spring Creek in the Hadley Valley Preserve was de-channelized by the Forest Preserve District of Will County starting in the mid-2000s.[11]

[10] Personal communication with Stephen McCracken, DuPage River Salt Creek Workgroup
[11] http://www.reconnectwithnature.org/SaveFile.asp?file=HadleyValley2011.pdf&location=10

- Short term: Full restoration (de-channelization) of a segment of the East Branch of Marley Creek (2,700 feet), a segment of Union Ditch (1,700 feet), and a reach of Marley Creek (1,300 feet) – projects #23, 24, and 25.
- Long term: Review progress at five years and determine extent to which promising opportunities for stream restoration exist beyond those identified.

Wetland construction and restoration

- Baseline: 3,095 acres of mapped wetlands exist in the watershed (National Wetland Inventory, supplemented by 2005 CMAP Land Use Inventory). Fairly extensive wetland restoration has taken place in the Spring Creek subwatershed, but this restores only a small portion of presettlement wetland area, as estimated by the prevalence of hydric soils.
- Short term: Constructing 10 acres of wetlands is recommended on a pilot basis to treat runoff from agricultural areas. 15 acres of wetland restoration are associated with the recommendations for stream de-channelization on the East Branch of Marley Creek, Union Ditch, and Marley Creek.
- Long term: Comparison of mapped wetlands to hydric soils (maps in Chapter 2) suggests that wetland drainage and filling has been extensive. Restoration will have to take place over many years, but a target for 2021 should be 100 cumulative acres of wetland construction or restoration.

Stream bank stabilization

- Baseline: 31% of the stream bank length evaluated during the watershed reconnaissance had fair to poor stability (on a scale of poor < fair < good < excellent), or approximately 18 miles of the perennial stream network.
- Short term: Stabilize 300 feet of severely eroding stream bank (projects #21 and 22).
- Long term: The remaining areas of erosion are not nearly as severe as those addressed in projects #21 and #22 and can likely be approached with bioengineering supplemented with hard measures like a-jacks. A cumulative total of 5,300 linear feet should be stabilized by 2021 (slightly more than 1,000 feet per year).

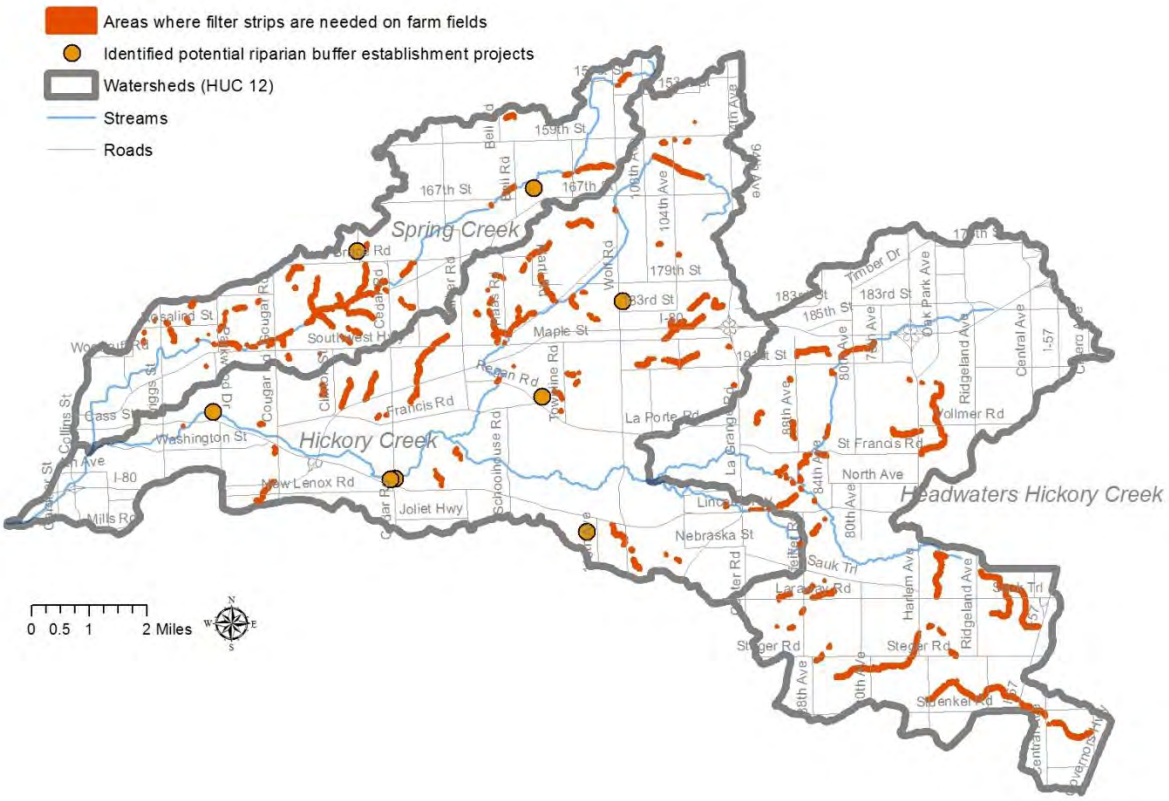
General riparian buffer expansion

- Baseline: The reconnaissance performed for the watershed plan indicated that 42% of the bank length evaluated had poor to fair buffer quality (on a scale of poor < fair < good < excellent).
- Short term: Install 3,150 linear feet of stream buffer – projects #26, 27, and 28.
- Long term: Cumulative total of 10,000 feet of new buffer installation by 2021. Five other potential buffer expansion projects were identified in the watershed reconnaissance (Figure 5.1). Reduce length of stream ranking poor or fair for buffer quality to 35%.

Agricultural filter strip installation

- Baseline: According to 2006 land cover data, approximately 16% of the land within 100 feet of the stream (perennial and intermittent) was being cultivated. Figure 5.1 indicates areas being cultivated within 100 feet of the stream as needing agricultural filter strips.
- Short term: Rather than on traditional agricultural BMPs, the focus of the Hickory Creek plan was on new or innovative practices that have not been tried extensively or at all in northeastern Illinois.
- Long term: Cumulative total of 10,000 feet of new filter strip installation by 2021. Here the distinction is made between filter strips for installation on cropland and general buffer establishment because of the ability to access Farm Bill programs in the case of the former.

Figure 5.2. Potential locations for filter strips and general riparian buffer establishment.



Conservation tillage

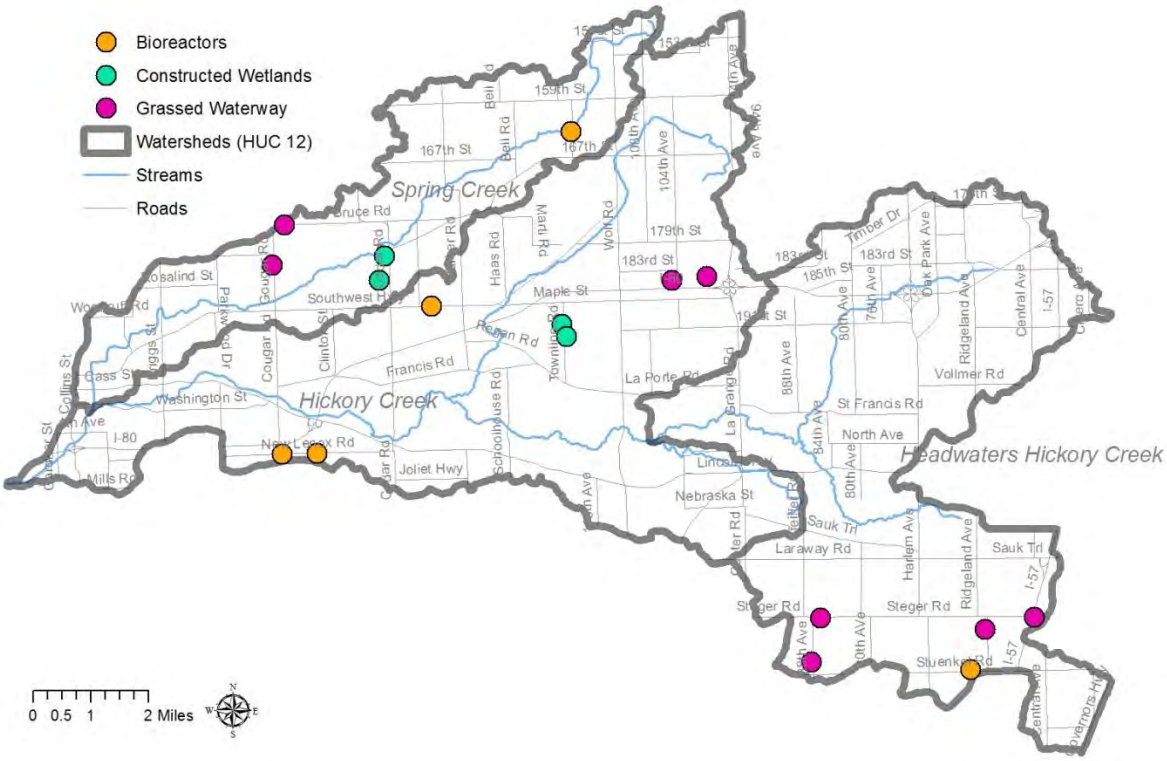
- Baseline: Data on the prevalence of conservation tillage are only available at the county level. In 2009, 41% of corn fields surveyed in Will County were in some form of conservation tillage, while 92% of soybean fields surveyed were in some form of conservation tillage.[12] That same year, the total area in the watershed planted in corn and soybeans was 3,629 and 6,935 acres, respectively, according to the 2009 NASS imagery (the only other crop planted in a significant amount was winter wheat at 219 acres). If the Will County penetration rates also apply to Hickory Creek, then 7,868 acres are in conservation tillage.
- Short term: Consultation with SWCD and NRCS staff suggests that few producers in the watershed will switch to conservation tillage if they have not done so already – the practice is at nearly full penetration. The better opportunities are innovative conservation practices, such as treatment wetlands and bioreactors (projects #29 and 30), that are not currently being used in Will County.
- Long term: All corn, soybean, and small grain fields would ideally be in some form of conservation tillage, but the long term focus should be on installing innovative practices.

Grassed waterways

[12] 2009 Illinois Soil Erosion and Crop Tillage Transect Survey

- Baseline: The number of grassed waterways in the watershed has not been completely catalogued.
- Short term: The focus of the Hickory Creek plan was on new or innovative practices that have not been tried extensively or at all in northeastern Illinois, but several opportunities for grassed waterways are known to exist in the watershed.
- Long term: Implement grassed waterways in any location where needed. A number of opportunities were identified in the watershed reconnaissance.

Figure 5.3. Potential management actions in agricultural areas identified in watershed reconnaissance.

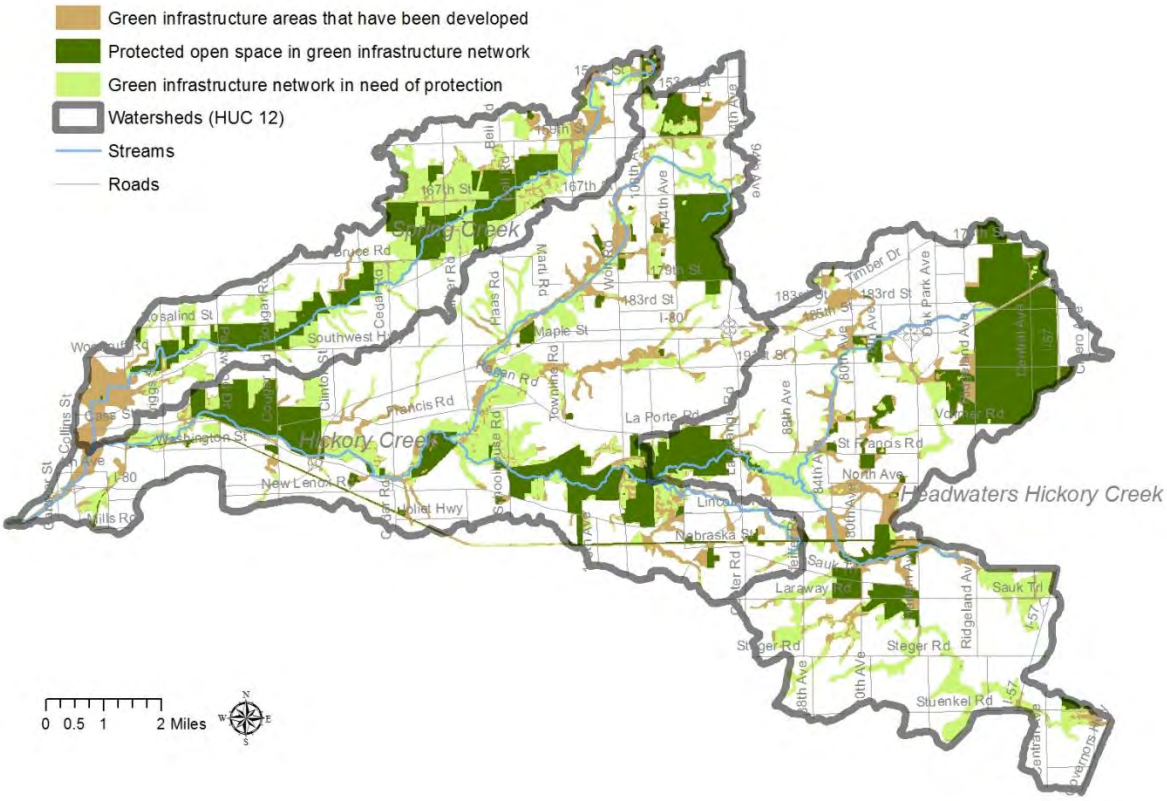


Green infrastructure network protection

- Baseline: The entire delineated green infrastructure network is 25,813 acres, of which approximately 33% or 8,540 acres have already been developed and 9,778 are already protected. The remainder of the network (7,495 acres) needs legal protection (Figure 5.1).
- Short term: Since the green infrastructure network will be protected in many ways (acquisition by forest preserve districts, developer donations to park districts, conservation easements associated with conservation design subdivisions, etc.) subject to a number of driving factors (referendum passage, housing market rebound, etc.), it is not readily possible to describe a short term target for land protection. However, several actions can be emphasized. Municipalities should ensure their comprehensive plans protect the delineated green infrastructure network. They should also begin revising local ordinances, in line with the review in Chapter 3, to protect the green infrastructure network.
- Long term: Half of the 7,495 acres of unprotected green infrastructure network should either be legally protected or be governed by protective mechanisms such as by-right conservation design

requirements or adequate stream setbacks. Any financial assistance is warranted for the protection of the green infrastructure network.

Figure 5.4. Green infrastructure network protection.



Detention basin retrofits

- Baseline: The complete number and condition of existing stormwater basins in the watershed is unknown, as is the total number in need of retrofit.
- Short term: 3 detention basins are recommended for retrofit in the watershed plan – projects #13, 14, and 15.
- Long term: A cumulative total of 7 detention basins should be retrofit by 2021. In the watershed reconnaissance, 17 potential detention basin retrofits were identified; any of these or others may be considered candidates, but should be examined further in the next plan update cycle.

Other urban stormwater infrastructure retrofits (including bioretention/filtration, conveyances, permeable pavement, and vegetated swales -- explained in more detail in Chapter 4)

- Baseline: The amount and condition of stormwater infrastructure in the watershed has not been exhaustively catalogued.
- Short term: Numerous kinds of stormwater retrofits are recommended in the watershed plan – projects #1 - 12.
- Long term: A cumulative total of 25 stormwater infrastructure retrofit projects should be undertaken by 2021. In the watershed reconnaissance, 61 potential stormwater retrofits were identified; any of these or others may be considered candidates, but should be examined further in the next plan update cycle.

Building retrofits

- Baseline: The overall level of opportunity for building retrofits (rain gardens, green roofs, etc.) in the watershed has not been inventoried.
- Short term: 3 building retrofits are recommended for retrofit in the watershed plan – projects #16, 17, and 18.
- Long term: A cumulative total of 6 building retrofits should be conducted by 2021. These were identified in the reconnaissance, but should be examined further in the next plan update cycle.

Figure 5.5. Potential detention basin, building, and other urban stormwater retrofits identified in watershed reconnaissance.

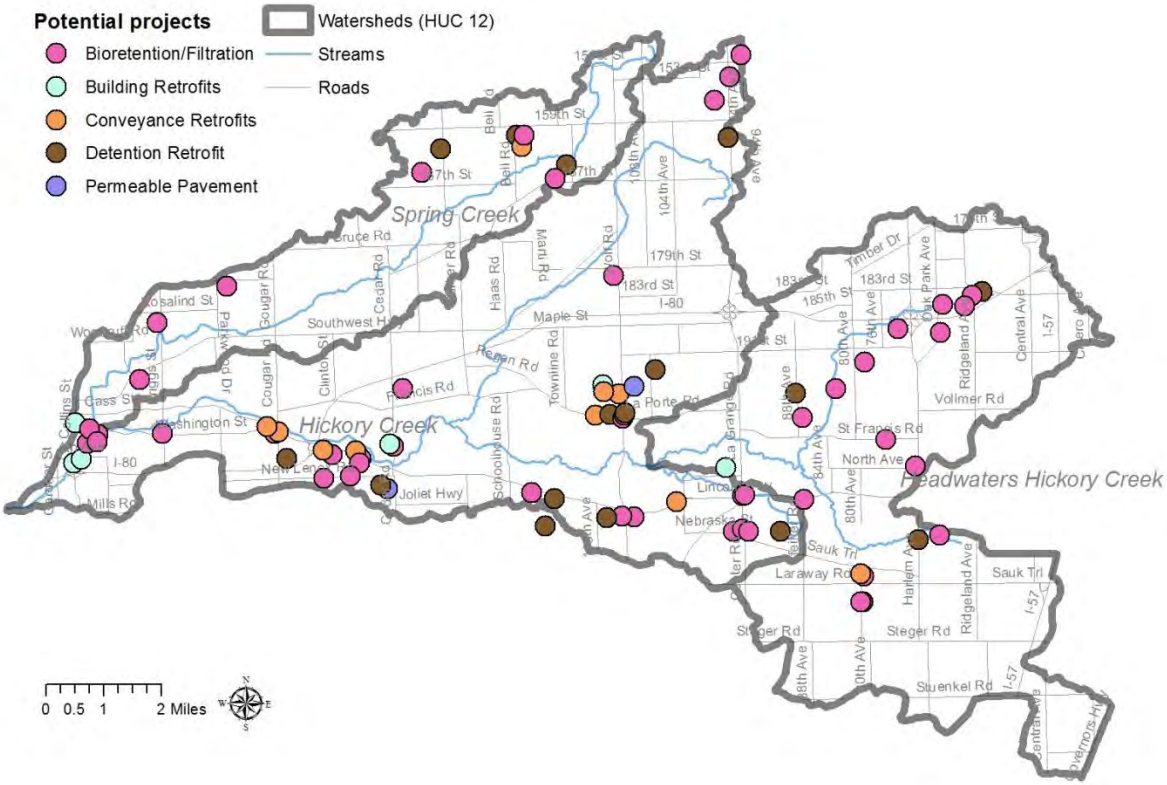


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Photo shows the dam on Hickory Creek at Pilcher Park. The plan proposes to study this dam and modify it to restore the natural functions of the creek, including fish passage, sediment transport, and water quality. See discussion of Project #20.

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