CMAP

Boone-Dutch Creek Watershed-based Plan

March 2016

Acknowledgments

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Unless otherwise specified, all photos are by CMAP staff.

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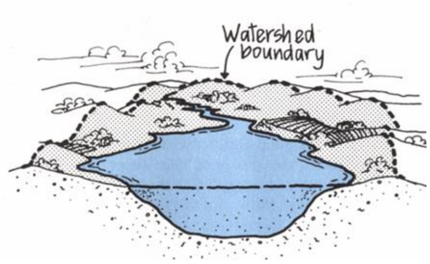
1. Introduction

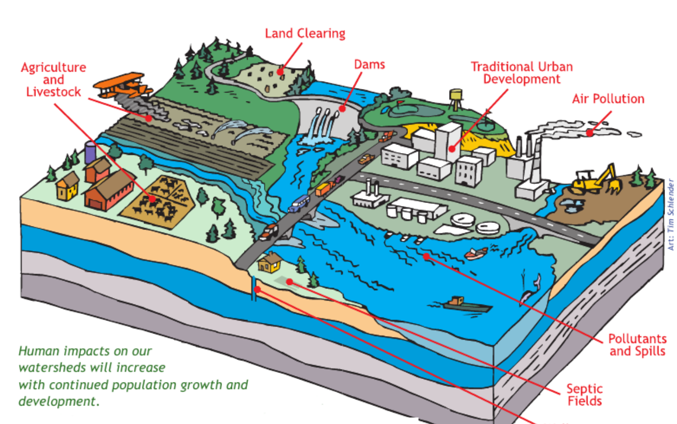
Watershed planning is a public process involving all parties with an interest or "stake" in the environmental health and quality of life of the area at issue. A watershed, the land area from which precipitation and resulting surface runoff drain to a lake or river, serves as the organizational framework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

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



Everyone lives in a watershed, and smaller watersheds are typically nested within increasingly larger ones since water runs downhill. Thus, watershed boundaries are defined by topography or the "lay of the land." Human activities within the watershed affect local water quality and the waters of their downstream neighbors. While watersheds grow in spatial extent when one stream joins with one another, watersheds typically end when a river drains into the ocean, large lake, or, more rarely, an inland point such as a relatively low lying wetland that serves to recharge groundwater.

Watershed planning is commonly driven by the need to correct water pollution problems in streams and/or lakes. Planning can also focus on protecting water resources that are not impaired by any number of potential sources and causes of pollution that typically stem from land-use change or land-management activities that do not fully account for off-site impacts. When remedy for water pollution is sought, it is usually made possible by funding that stems from the Clean Water Act.[1] Such is the case with this plan.



Source: Washington Dept. of Ecology

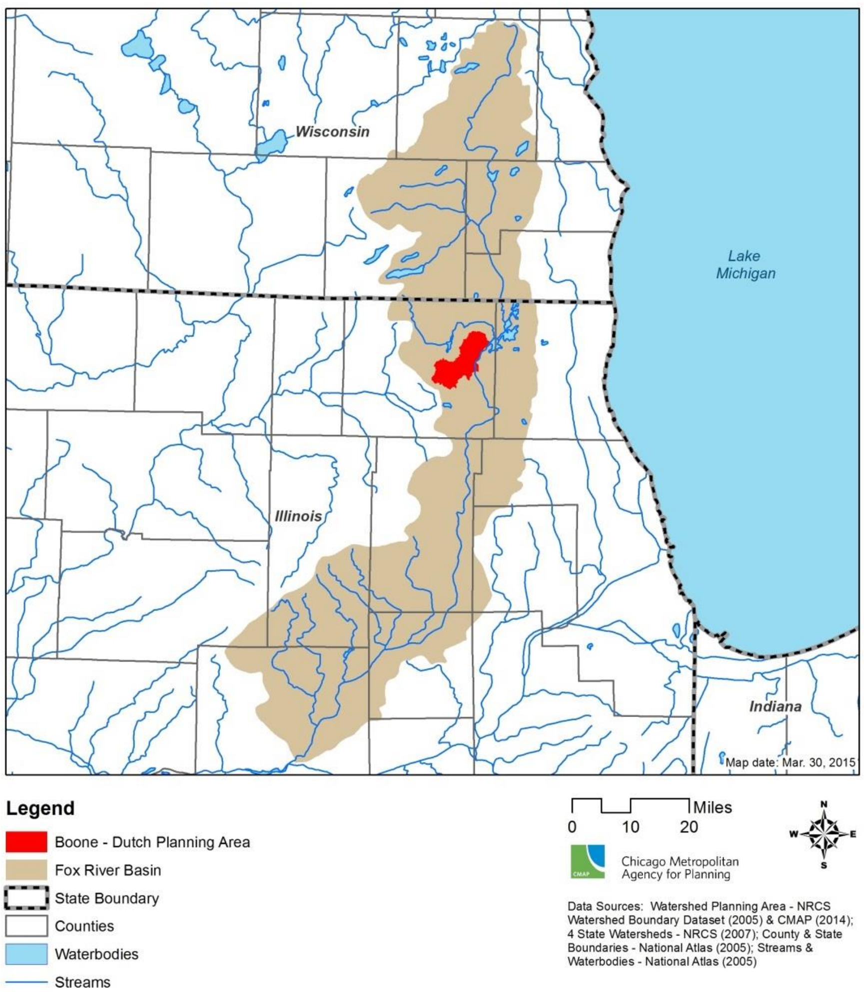
The Chicago Metropolitan Agency for Planning (CMAP) received a Clean Water Act grant from the Illinois Environmental Protection Agency to develop a watershed plan for two adjacent watersheds in eastern McHenry County that drain to the Upper Fox River. Thus, the purpose of this plan is to work with local stakeholders to develop recommendations that upon implementation will help restore and protect the water quality of Boone Creek, Dutch Creek, and other local streams that drain to the Upper Fox River, as well as the Fox River itself. This plan must also follow federal guidelines since it is made possible by Clean Water Act funding.

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

2. Boone Creek and Dutch Creek Watershed Planning Area

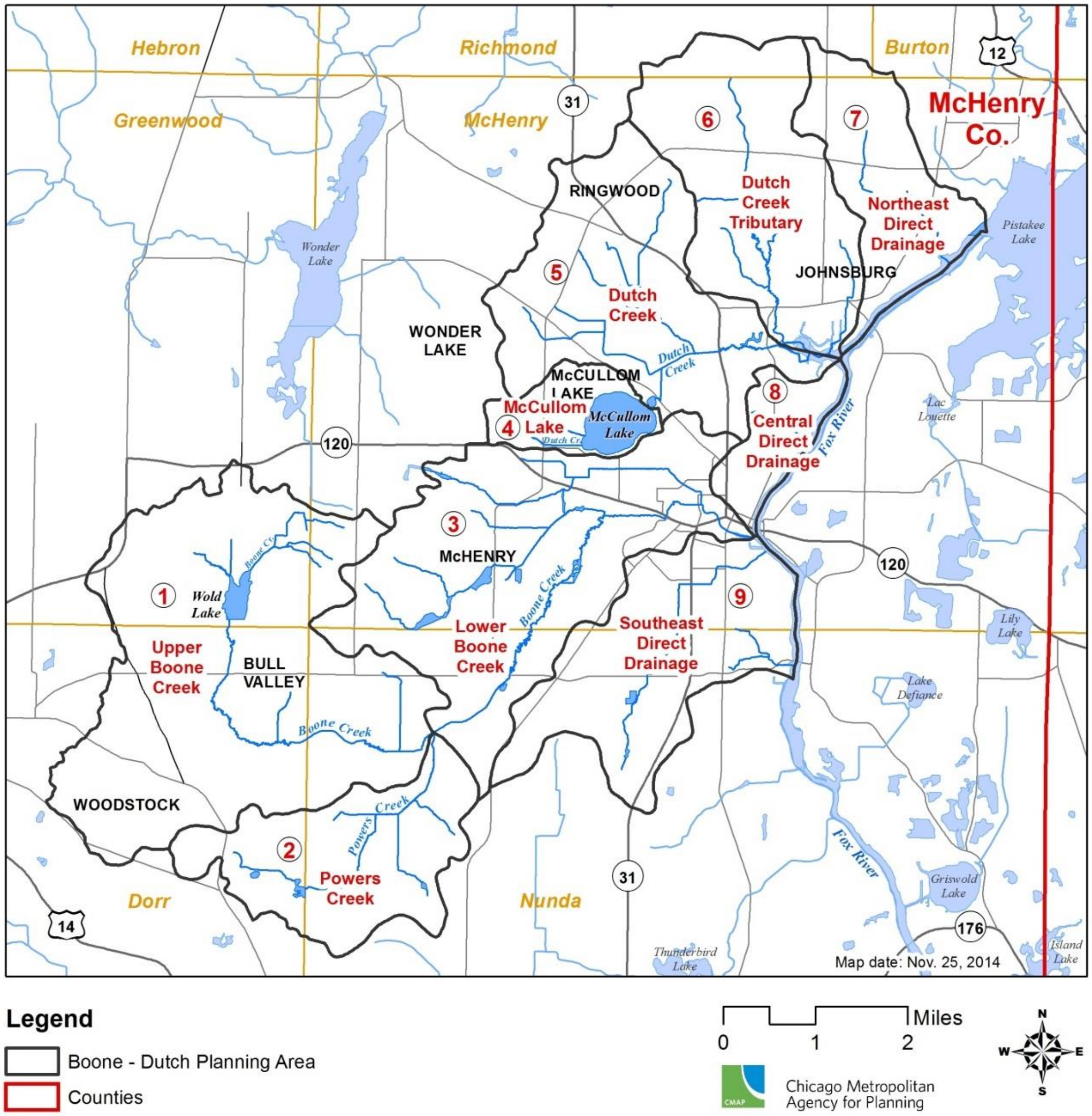
The Boone – Dutch Creek Watershed planning area lies within the Upper Fox River Subbasin[2] and is situated entirely in McHenry County, Illinois (Figure 1). The 45.3 square mile planning area is subdivided into nine study units, most of which are watersheds in their own right except for the main stem of Boone Creek which has been split between upper and lower sections (Figure 2, Table 1). Subdividing the planning area allows for a more nuanced understanding of local conditions and will improve consideration of best management practices in terms of where they will be helpful.

Figure 1. Boone-Dutch Creek Watershed planning area within the Fox River Basin.



[2] The Fox River Basin (HUC 0712006) is split between Upper and Lower subbasins with the divide running through Elgin and Streamwood. Tyler Creek from the west and Poplar Creek from the east are the southernmost watersheds in the Upper Fox River Subbasin.

Figure 2. Boone-Dutch Creek Watershed planning area and subwatershed study units.



Data Sources: Watershed Planning Area - NRCS Watershed Boundary Dataset (2005) & CMAP (2014); County & Township Boundaries (CMAP 2014); Major Roads - IDOT (2011); Streams - USGS National Hydrography Dataset Flowline (2007), McHenry Co. ADID (NIPC 1999), & CMAP (2014); Waterbodies - CMAP Land Use (2005)

Table 1. Subwatershed study units in the Boone-Dutch Creek planning area.

Study Unit / Subwatershed		*Area*	
#	*Name*	*sq. miles*	*acres*
1	Upper Boone Creek	11.17	7,147.52
2	Powers Creek	3.98	2,546.24
3	Lower Boone Creek	8.33	5,334.29
4	McCullom Lake	1.36	871.50
5	Dutch Creek	5.95	3,811.04
6	Dutch Creek Tributary	5.44	3,484.88
7	Northeast Direct Drainage	2.93	1,876.19
8	Central Direct Drainage	1.24	791.85
9	Southeast Direct Drainage	4.91	3,141.00
	Totals	**45.31**	**29,004.51**

2.1 Previous Work in Planning Area

The Boone Creek Watershed Alliance and Northeastern Illinois Planning Commission developed the *Watershed Protection and Restoration Strategy for Boone Creek* in 2003[3] for a 23.4 square mile watershed within the current 45.3 square mile planning area (study units 1, 2 and 3 in Figure 2). The Boone Creek report identified several threats to land and water resources, many of which are likely related to the present day aquatic life impairment that the current planning effort seeks to remedy. The goals and key recommendations made in the Boone Creek report were revisited and used to inform the goals and objectives of the current planning effort.

In cooperation with the City of McHenry, the Northeastern Illinois Planning Commission led a federal Clean Lakes Program Phase 1 Diagnostic and Feasibility Study of McCullom Lake and its watershed (study unit 4 in Figure 2). Following the completion of the lake restoration and protection plan in 1992, numerous recommendations were implemented over the next several years with the help of federal Clean Lakes Program Phase 2 implementation funds and local match. Additional information is provided in Appendix B.

2.2 Problem Statement and Goals

Early in the planning process, stakeholders developed the following problem statement and goals for this plan:

Problem Statement: Surface water bodies (i.e., lakes and streams) must meet water quality standards sufficient to achieve designated uses. Boone Creek and McCullom Lake within the watershed planning area fail to meet all of their designated uses due to known and unknown causes that are often related to land use. Best management practices, including new or improved policy initiatives, must be identified and implemented by landowners and managers

[3] Available on the Boone Creek Watershed Alliance webpage: http://www.boonecreekwatershed.org/the-watershed

as resources allow to improve water quality, restore designated use attainment, and protect high-quality water resources. A plan is to be completed that outlines protective actions to solve the problem and guide remedial activities during the following 5-10 years.

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

Goal: Build on local partnerships and expertise to enhance intergovernmental coordination for achieving sustainable development.

Goal: Protect the quality and quantity of groundwater.

Goal: Conserve open space – wetland, prairie, and woodland communities – through a coordinated plan and public-private partnerships.

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

Goal: Raise public awareness and increase understanding of the impacts of land use and land/water management decisions on water and habitat quality.

3. Watershed Resource Inventory

3.1 Population and Demographics

Population (2010) in the planning area is estimated to be 40,154 people, 18 percent greater than the 2000 population of 34,015.[4] The rate of population growth was considerably greater than the 3.3 percent increase for the state of Illinois during the same interval. CMAP's GO TO 2040 comprehensive regional plan (updated version, October 2014) forecasts a population of 81,021 or 101 percent growth. The difference in population over the intervening 30 years translates into a (linear) growth rate of approximately 26 percent per decade.[5] Either way, this is clearly a significant rate of estimated population growth and one that exceeds the 28.6 percent rate of growth forecast (Population in Households in 2040) for the entire seven-county region or 65.7 percent growth forecast for McHenry County.[6]

Employment forecasts are similarly relevant in that growth will impact land use change, water use, water quality, and other factors. The revised GO TO 2040 forecast totals for the region estimate employment growth to be 72.4 percent in McHenry County and 31.2 percent for the region.[7]

Table 2 features additional demographic data that characterize the planning area as compared to the entirety of McHenry County and the State of Illinois.

[4] U.S. Census Bureau census block data for 2000 and 2010. "Clipping" census blocks with the planning area boundary using ESRI ArcMap v10.1 geoprocessing tools will result in an overestimate of population.

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

[6] CMAP, 2014. GO TO 2040 Update Appendix: Socioeconomic Forecast Update Overview. Available at: http://www.cmap.illinois.gov/documents/10180/332742/Update+Socioeconomic+Forecast+FINAL.pdf/41d87400-d211-4763-b941-b487022d8032

[7] Ibid.

Table 2. Select demographic data for planning area, county, and state.

Characteristic	*Boone-Dutch Creek Planning Area*	*McHenry County*[8]	*Illinois*[9]
Median age	42	38	-----
Age 65 & over	12%	10.1%	13.5%
< 5 years of age	6.1%	6.4%	6.2%
< 18 years of age	25.4%	27.3%	23.5%
Female population	50.9%	50.1%	50.9%
Race/One Race/White	92%	90.1%	77.7%
Housing Tenure – Owner Occupied	75.3%	83.1%	-----

3.2 Local Governments and Districts

In northeastern Illinois, over 1,200 units of government collect revenues and provide services to the seven-county region's residents, businesses, and visitors. Portions of seven municipalities and six townships are included in the Boone-Dutch Creek planning area (Figure 3, Table 3). Municipal jurisdictions cover approximately 60.9 percent (27.6 square miles) of the planning area. Among the townships intersecting the planning area, McHenry Township covers the most land area at 24.9 square miles or 54.9 percent.

There are two library districts that will likely play an important role in the education component of the plan: Johnsburg Public Library District and the McHenry Public Library District. There are three regional wastewater treatment agencies: the Village of Wonder Lake; the City of McHenry, which owns and operates the City's two wastewater facilities; and the Village of Johnsburg. There are also 19 public or private elementary/secondary school/ community college schools and districts. The McHenry County Conservation District and the Illinois Department of Natural Resources are other special purpose units of government with land management jurisdiction within the planning area. Lastly, the planning area includes the Loyola University Retreat and Ecology Campus, through which the university is actively involved in restoration efforts within the watershed.

[8] U.S. Census Bureau, American Fact Finder. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF

[9] U.S. Census Bureau, State and County Quick Facts. http://quickfacts.census.gov/qfd/states/17000.html

Figure 3. Municipalities and townships within the Boone-Dutch Creek planning area.

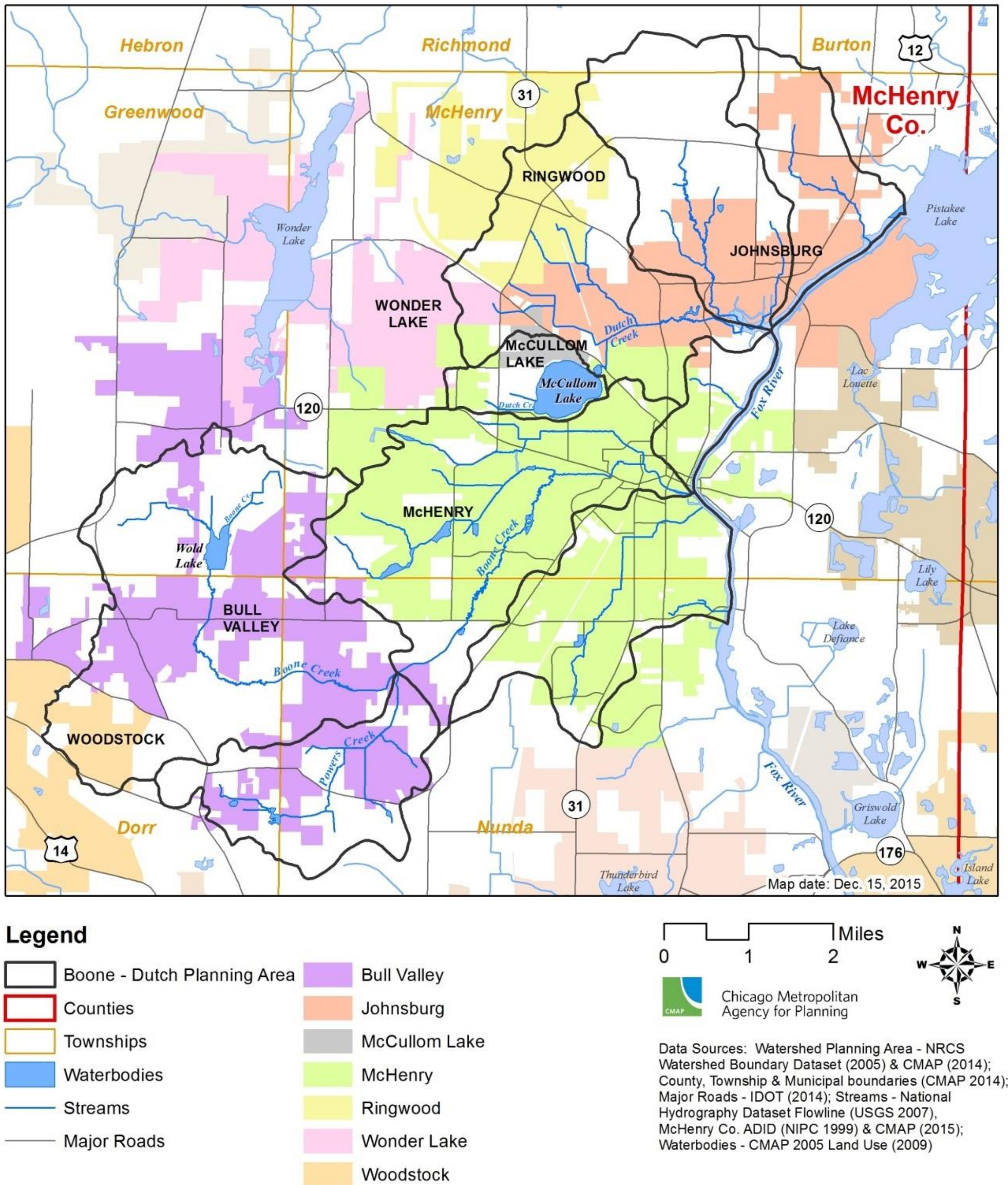


Table 3. Municipalities and townships within the Boone-Dutch Creek planning area.

Jurisdiction	*Area (sq. miles)*	*Percent of Planning Area*
Municipality		
Johnsburg	5.4	11.9
Ringwood	1.8	4.0
McCullom Lake	0.4	0.9
Wonder Lake	0.3	0.7
McHenry	12.1	26.7
Bull Valley	6.8	15.0
Woodstock	0.8	1.7
Totals	***27.6***	***60.9***
Township		
Burton Township	0.1	0.2
Richmond Township	0.8	1.8
McHenry Township	24.9	54.9
Greenwood Township	3.2	7.1
Nunda Township	9.4	20.8
Dorr Township	6.6	14.6
Totals	***45***	***99.4***

3.3 Physical and Natural Features

3.3.1 Climate

The planning area has a continental climate with warm summers and cold winters. The average annual temperature is 47.9˚F. January is the coldest month with an average temperature of 20.9˚F (28.8˚F average high/13.1˚F average low) while July is the warmest with an average of 72.3˚F (82.1˚F average high/62.6˚F average low). Annual precipitation averages 36.55 inches. Consistent with a continental climate, there is no pronounced wet or dry season.

Meteorological winter features the three driest months (December 1.97 in., January 1.53 in., and February 1.97 in.) while meteorological summer features the wettest months (June 4.05 in., July 3.82 in., and August 4.19 in.) Spring and fall are similar for their average seasonal precipitation totals, 9.97 and 9.05 in. respectively.[10]

[10] U.S. Dept. of Commerce, National Oceanic & Atmospheric Administration, National Climatic Data Center. 1981-2010 Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days. Station: Mundelein 4 WSW, IL US. Requested and received on 6/11/13.

The climate is notable for two reasons: 1) the threat of rain storms and resultant nonpoint source pollution is a year-round phenomenon, and 2) the lengthy winter season in combination with an extensive road network results in large amounts of applied road salts whose fate has a negative impact on both local surface waters[11] and shallow groundwater[12].

3.3.2 Topography

Elevation within the planning area ranges from a high of 1013 feet above mean sea level (MSL) to a low of 735 feet MSL, for total relief of 278 feet. The highest elevations are generally in the southwest and northwest with lowest elevations along the Fox River (Figure 4).

3.3.3 Ecoregion Geography and Surficial Geology

Ecoregions have been composed as a robust geographic framework based on the principle that they can be identified and mapped by analyzing the spatial patterns and composition of observable biotic and abiotic factors that either affect or reflect differences in ecosystem quality and integrity.[13] Put another way, ecoregions organize space around ecosystems that are similar and take into consideration such phenomena as geology, physiography, climate, soils, hydrology, wildlife, vegetation, soils, and land use. Ecoregion maps are useful in the development of ecosystem management strategies, especially since land use – human alteration and occupation of the land – informs ecoregion delineation at levels III and IV which are smaller (i.e., spatial extent) subdivisions of levels II and III, respectively.

The planning area lies entirely within the Southeastern Wisconsin Till Plains, Kettle Moraines Ecoregion.[14] While perhaps not as relevant here as within areas of greater spatial extent that also feature large federal or state land holdings, the information can be instructive nonetheless to more local land conservation efforts. Since the planning area lies entirely within one ecoregion, ecosystem management strategies can be somewhat more consistent across the planning area than might be appropriate for a more ecoregionally diverse area. At a minimum, a description is provided of the planning area relative to a rich geographic framework that classifies the entire continental United States.

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

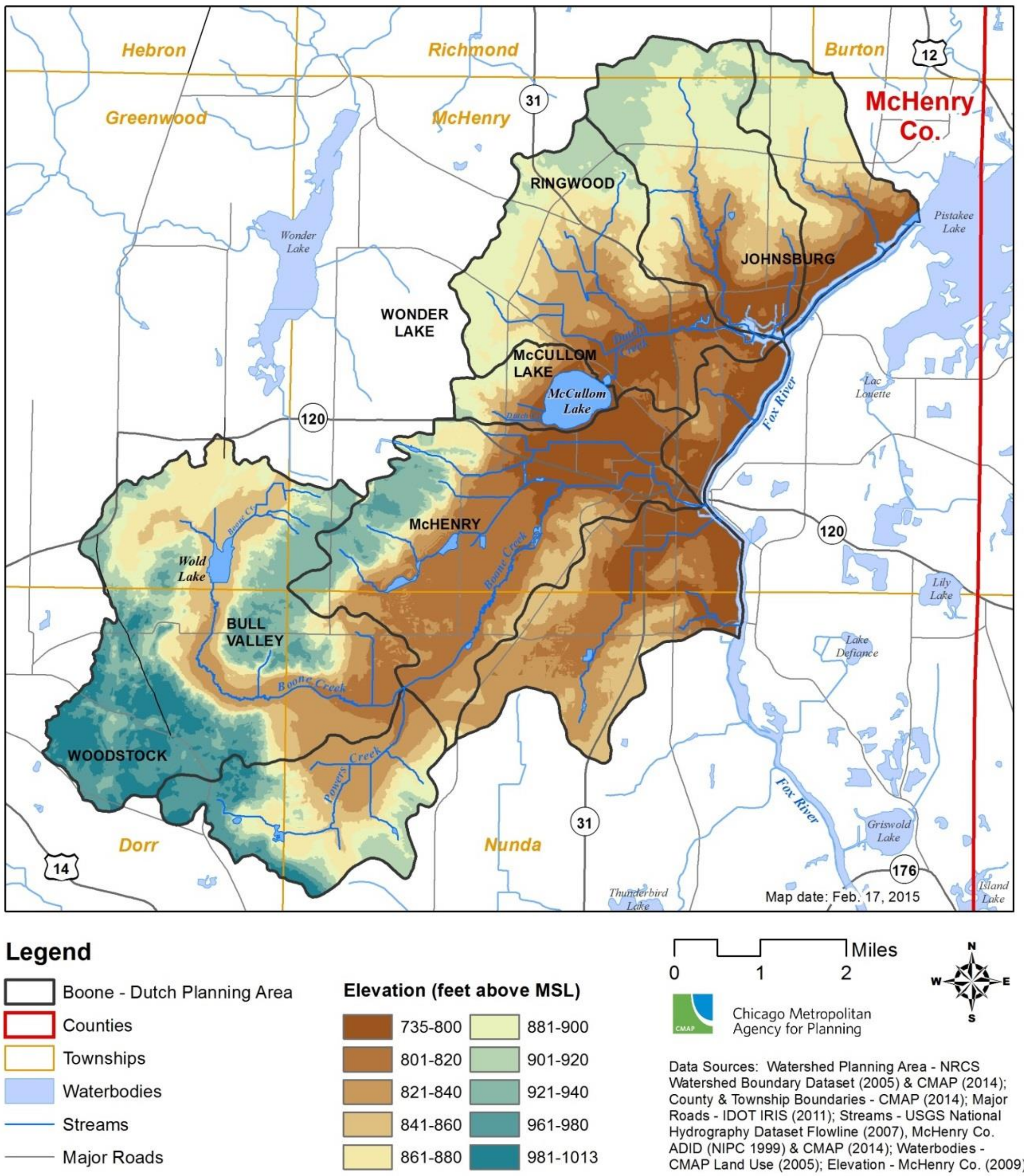
[12] Walton R. Kelly and Steven D. Wilson, 2008. An Evaluation of Temporal Changes in Shallow Groundwater Quality in Northeastern Illinois Using Historical Data. Illinois State Water Survey, Center for Groundwater Science. Scientific Report 2008-01. Champaign, Illinois.

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

[14] US EPA, Level III and IV Ecoregions of EPA Region 5, ftp://ftp.epa.gov/wed/ecoregions/reg5/epa_reg5.pdf (accessed February 2, 2015).

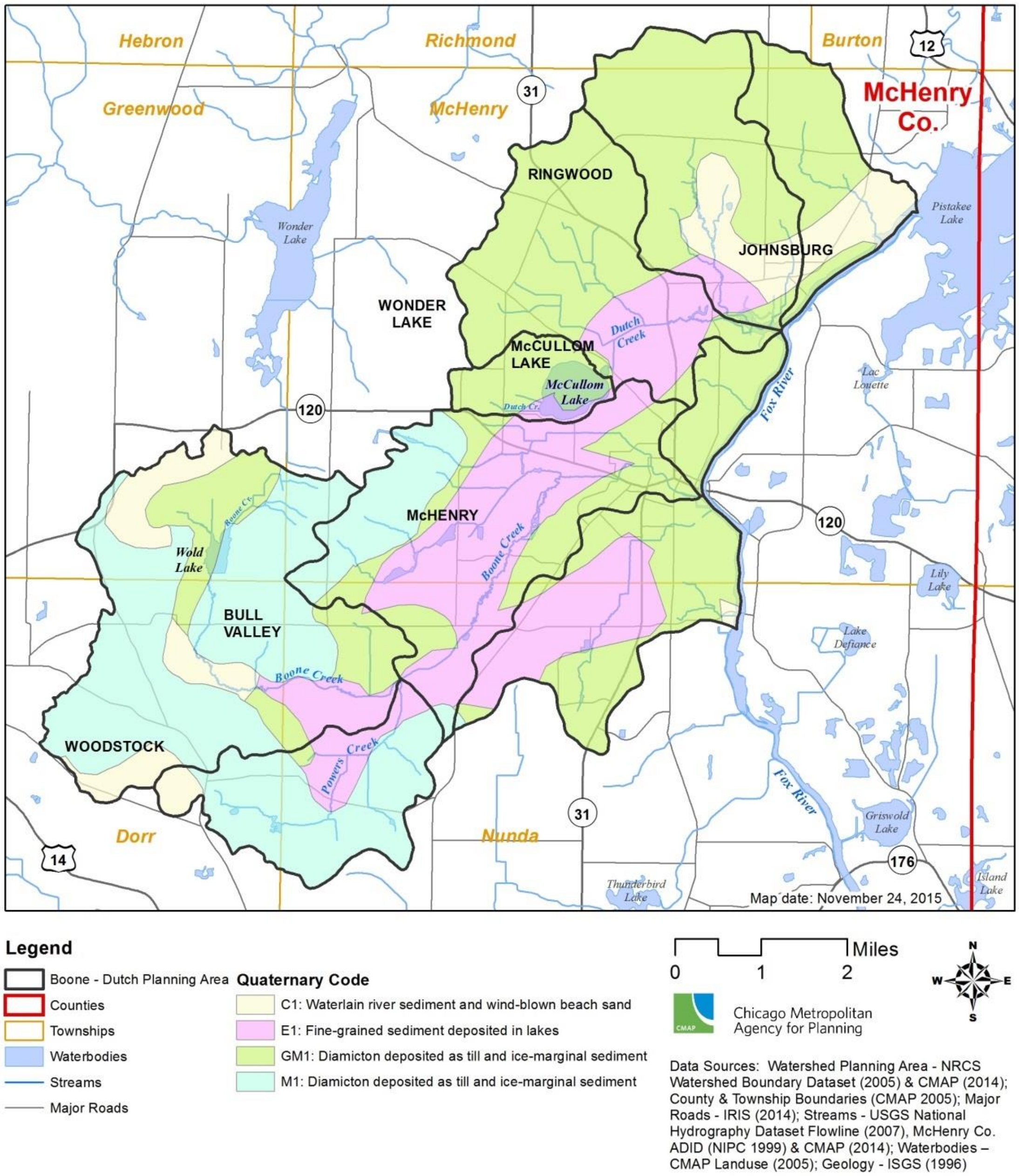
Geologically, the area is dominated by glacial end moraines that are composed of unsorted clay, silt, sand, and gravel: a product of surface deposits from the most recent glaciation – the Wisconsin Episode. Roughly coincident with the Fox River floodplain and terrace, surface deposits feature two divisions of recent stream sediments and glacial outwash (Figure 5).

Figure 4. Elevation in the Boone-Dutch Creek planning area.



Surficial geology is important because it is often exposed during mass grading for new development.

Figure 5. Surficial geology in the Boone-Dutch Creek planning area.



3.3.4 Soils

For purposes of this watershed plan, hydrologic soils groups, hydric soils, soil drainage class, and highly erodible soils will be discussed. It is important to consider these types of soil classifications as they relate to land use/change and water quality. The soils data are obtained from the Soil Survey Geographic (SSURGO) Database produced by the U.S. Department of Agriculture – Natural Resources Conservation Service (NRCS)[15].

3.3.4.1 Hydrologic Soil Groups

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

The four hydrologic soil groups are described as A – soils with low runoff potential when wet / water is transmitted freely through the soil, B – moderately low runoff potential when wet / water transmission through the soil is unimpeded, C – moderately high runoff potential when wet / water transmission is somewhat restricted, and D – high runoff potential when wet / water movement through the soil is restricted or very restricted. If certain wet soils are able to be drained, they are assigned to dual HSGs (e.g., A/D, B/D) based on their saturated hydraulic conductivity and the water table depth when drained. The first letter refers to the drained condition and the second to an undrained condition (Table 4).

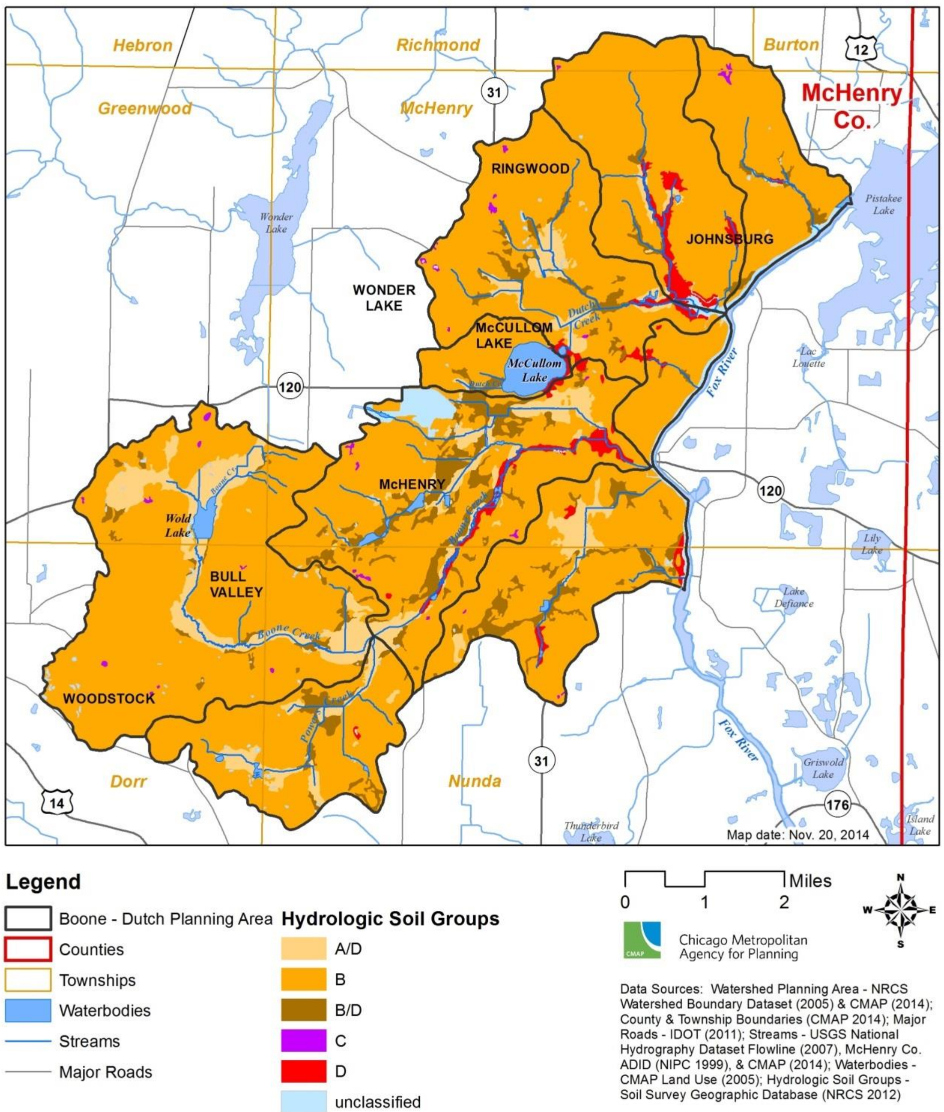
Table 4. Characteristics and extent of hydrologic soil groups in the Boone-Dutch Creek planning area.

Hydrologic Soil Group	*Definition/Characteristics*	*Area (acres)*	*Percent of Planning Area*
A	Soils have a low runoff potential when thoroughly wet. Water is transmitted freely through the soil.	0	0.0
A/D	The first letter applies to the drained condition and the second to the undrained condition.	2,394.1	8.3
B	Soils have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded.	23,165.6	79.9
B/D	The first letter applies to the drained condition and the second to the undrained condition.	1,840.4	6.3
C	Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted.	75.0	0.3
D	Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.	655.6	2.3
Unclassified	n/a	873.8	3.0
	Totals	***29,004.5***	***100.0***

[15] http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/geo/

The majority of the Boone-Dutch Creek planning area features Group B soils (nearly 80 percent) (Figure 6). The dual groups A/D and B/D are next most common at 8.3 and 6.3 percent, respectively. The unclassified soils are those underlying waterbodies and gravel pits. No exclusively group A soils are present in the planning area. Figure 6 illustrates a general pattern of HSG distribution, revealing that A/D, B/D, and D soils are found primarily along stream and river corridors where under saturated condition, infiltration is limited and runoff potential is high.

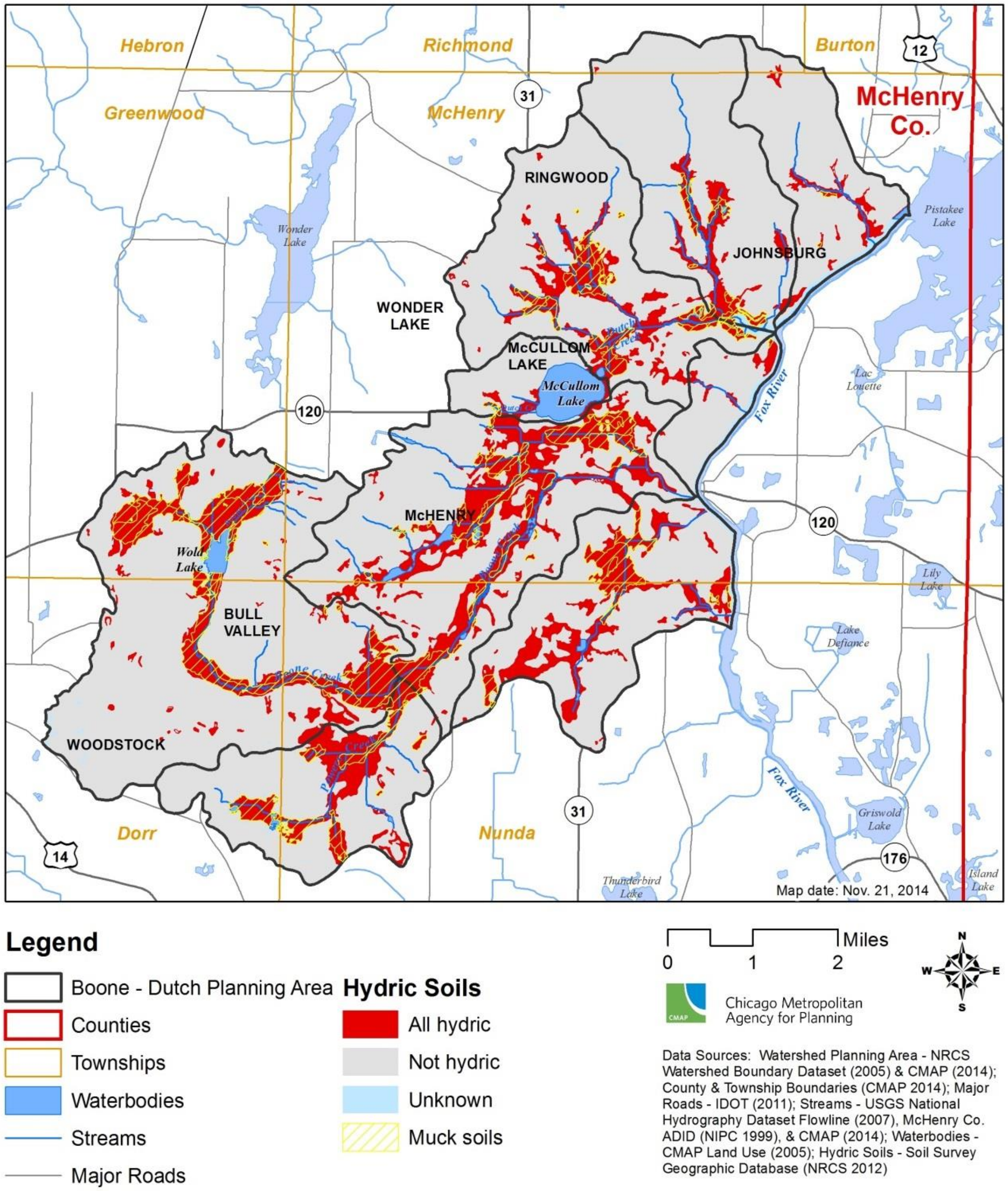
Figure 6. Hydrologic soil groups in the Boone-Dutch Creek planning area.



3.3.4.2 Hydric Soils

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

Figure 7. Hydric soils in the Boone-Dutch Creek planning area.



The extent of hydric soils within the Boone-Dutch Creek planning area is shown in Figure 7 and enumerated in Table 5. Approximately three-fourths of the Boone-Dutch Creek planning area features “not hydric” soils. “All hydric” soils are distributed throughout the planning area, most commonly along stream and river corridors, and represent about 20 percent of the planning area. Muck soils are a category of hydric soils. The “unknown” soils (2.3 percent) are those underlying waterbodies and gravel pits.

Table 5. Hydric soil extent in the Boone-Dutch Creek planning area.

Hydric Soil Class	*Area (acres)*	*Percent of Planning Area*
All hydric	5,831.3	20.1
Not hydric	21,214.9	77.6
Unknown	678.7	2.3
Totals	***29,004.5***	***100.0***

3.3.4.3 Soil Drainage Class

Soils are categorized in drainage classes based on their natural drainage condition in reference to the frequency and duration of wet periods[16]. The classes are Excessively Drained, Somewhat Excessively Drained, Well Drained, Moderately Well Drained, Somewhat Poorly Drained, Poorly Drained, and Very Poorly Drained[17]. The extent of soils in these drainage classes within the Boone-Dutch Creek planning area is shown in Figure 8 and enumerated in Table 6.

Knowledge of soil drainage class has both agricultural and nonagricultural applications. For example, the Well Drained drainage classes (which cover approximately 60 percent of the planning area) indicate areas where stormwater infiltration BMPs may best be utilized. On the other hand, the Excessively Drained soils (about eight percent of the planning area) may not be good locations for siting infiltration BMPs where shallow groundwater is used for drinking water supplies.

The Poorly Drained drainage classes indicate soils which limit or exclude crop growth unless artificially drained. Soils in the Somewhat Poorly Drained, Poorly Drained, or Very Poorly Drained drainage class occur on nearly 29 percent of the planning area. These areas that are farmed can be taken as an approximation of the likely extent of artificial drainage given that crop growth on these lands would be severely impacted or even impossible without artificial drainage.

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

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

Figure 8. Soil drainage classes in the Boone-Dutch Creek planning area.

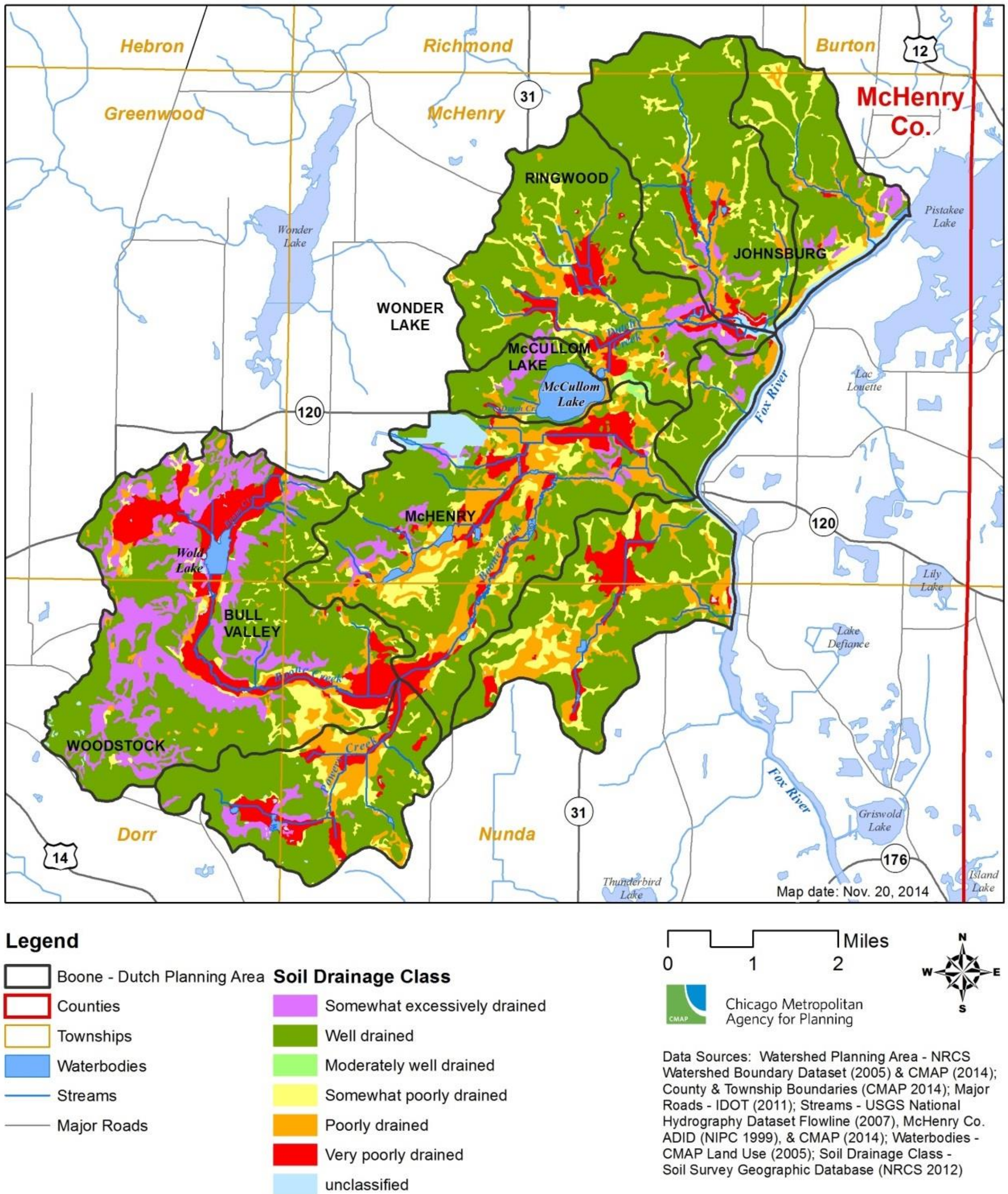


Table 6. Extent of soil drainage classes in the Boone-Dutch Creek planning area.

Soil Drainage Class	*Area (acres)*	*Percent of Planning Area*
Somewhat excessively drained	2,327.0	8.0
Well drained	17,462.1	60.2
Moderately well drained	43.9	0.2
Somewhat poorly drained	2,466.4	8.5
Poorly drained	3,322.3	11.5
Very poorly drained	2,508.9	8.7
Unclassified	873.8	3.0
Totals	***29,004.5***	***100.0***

3.3.4.4 Highly Erodible Soils

The USDA – NRCS defines a highly erodible soil or soil map unit as one that has a maximum potential for erosion that equals or exceeds eight times the tolerable soil erosion rate (T).[18] The maximum potential erosion rate is determined using the formula RKLS/R (where R = the rainfall factor, K = erodibility value of the soil, and LS = the slope factor). If RKLS/T > 8, then the soil meets the criteria for a highly erodible soil.[19] All soil map units with "C" slopes or greater are considered highly erodible in Illinois.[20] Highly erodible soils are of agricultural concern as cropland is either designated highly erodible land (HEL) or non-HEL. Note that the maximum erosion potential is calculated without consideration to crop management or conservation practices, which can markedly lower the actual erosion rate on a given field.

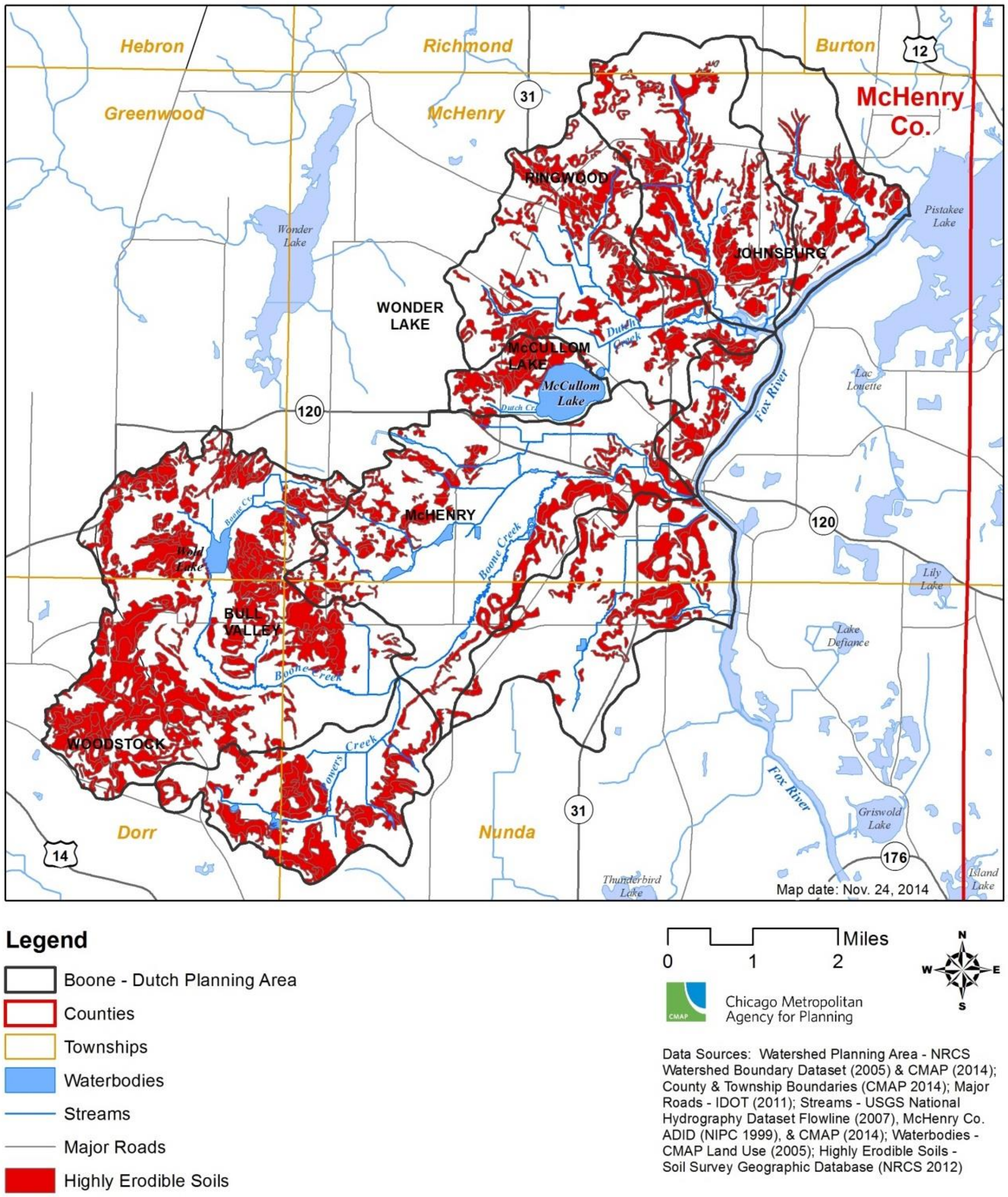
Figure 9 illustrates the pattern of highly erodible soils in the Boone-Dutch Creek planning area, covering 8,611 acres (29.7%). Keep in mind that all soils can severely erode when excavated and stockpiled; thus, erosion control practices should be planned for any human disturbance of an area.

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

[19] http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ri/soils/?cid=nrcs144p2_016637

[20] Bob Oja, McHenry-Lake County SWCD. Nov. 24, 2014. Personal communication.

Figure 9. Highly erodible soils in the Boone-Dutch Creek planning area.



3.3.5 Floodplains

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

When a natural floodplain is developed for other uses, such uses become susceptible to flooding which can result in property and crop damage as well as degraded water quality. Development in the floodplain can even affect areas that aren't directly adjacent to a waterbody, such that those areas can become flooded in heavy storms. Thus, it is important that floodplains and their relationship to land use be considered in watershed plans as well as any other type of land use planning.

According to floodplain data derived from the Federal Emergency Management Authority (FEMA) Flood Insurance Rate Maps (FIRMs) and floodplain data received by CMAP from FEMA in 2012, about 6.8 percent (1,969 acres or 3 square miles) of the planning area lies within the 100-year or base floodplain[23] and an additional one percent (284 acres or 0.4 square miles) is within the 500-year floodplain (Table 7, Figure 10). Much of the floodplain lies within and adjacent to Boone Creek, the North Branch of Dutch Creek, and the Fox River. Lakes in this planning area are included in the base floodplain.

Encroachments in the floodplain should be monitored by communities since they lead to increased upstream and downstream flood elevation. No new development should be allowed in the 100-year floodplain.

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[21] Federal Emergency Management Agency (FEMA), Floodplain Management Requirements, Appendix D: Glossary, August 11, 2010, accessed October 27, 2014, http://www.fema.gov/pdf/floodplain/nfip_sg_appendix_d.pdf

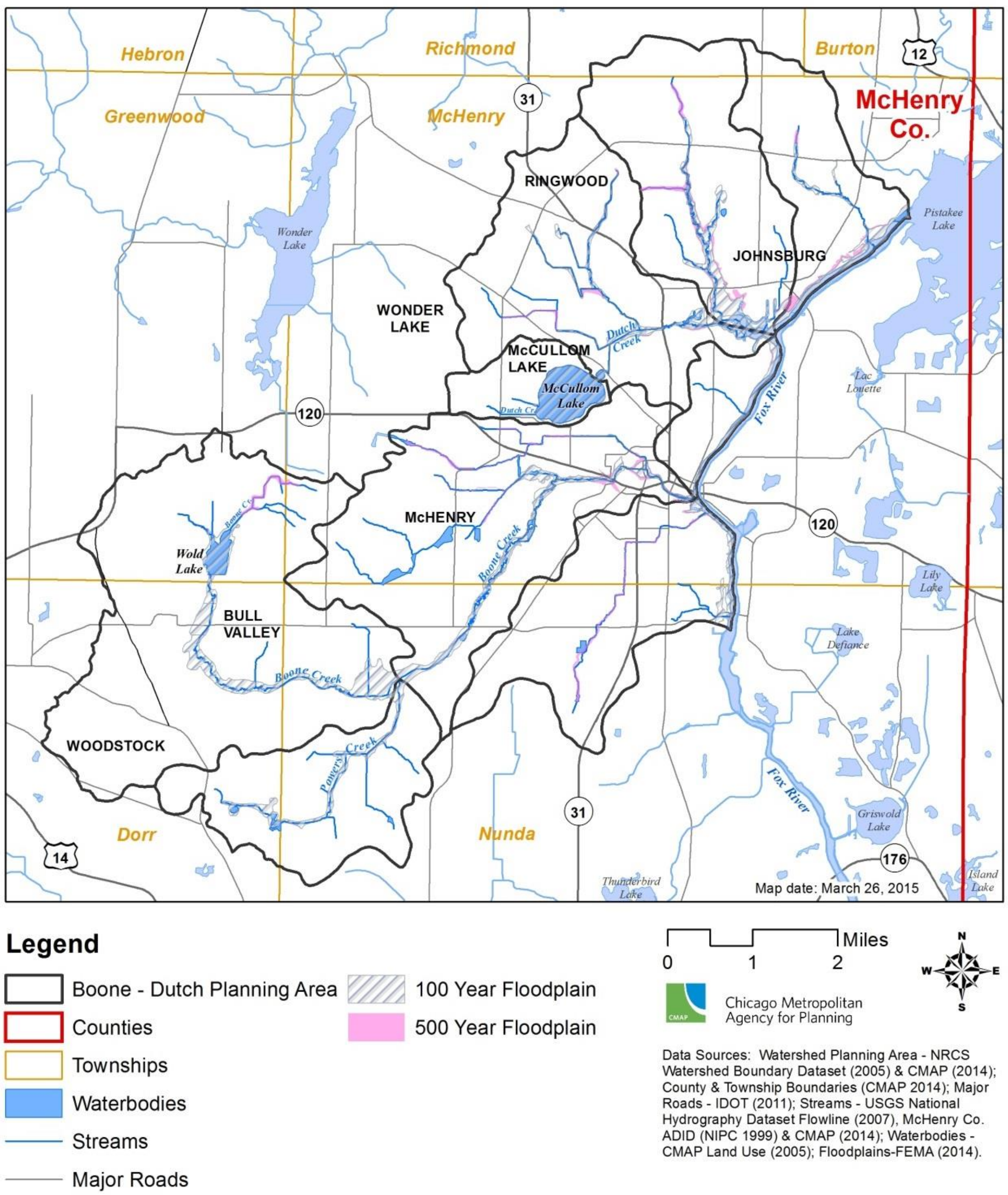
[22] Federal Emergency Management Agency (FEMA), Floodplain Management Requirements, Appendix D: Glossary, August 11, 2010, accessed December 22, 2014, https://www.fema.gov/floodplain-management/floodway

[23] "Base Flood," FEMA, last modified August 11, 2010, accessed October 28, 2014, http://www.fema.gov/floodplain-management/flood-zones. A 100-year floodplain is described as a "flood having one percent chance of being equaled or exceeded in in given year." A 500 year floodplain is a flood having 0.2% chance of flooding within any given year.

Table 7. Floodplains in the Boone-Dutch Creek planning area.

Floodplain	*Area (acres)*	*Percent of Planning Area*
100-year	1,969	6.8
500-year	284	1.0

Figure 10. Floodplains in the Boone-Dutch Creek planning area.



3.3.6 Wetlands

Wetlands provide social, economic, and ecological benefits to communities by cleaning polluted runoff before discharging to other surface waterbodies, recharging aquifers that are used as drinking water supplies , and providing temporary storage for rainfall to reduce flooding At the regional landscape scale, wetlands are an integral part of the movement to conserve green infrastructure and thereby employ nature to help manage hydrology in the built environment. There are many other wetland functions that generate ecosystem services that are valued by society. Despite this, the extent of America's wetlands continues to decline.[24]

Based on the National Wetlands Inventory, there are an estimated 3,262 acres of wetlands, about 11 percent of the land area, within the Boone-Dutch Creek Watershed planning area. The planning area also has a good concentration of high quality wetlands amongst the 3,456 acres as identified in the McHenry County Advanced Identification of wetlands (ADID) planning process,[25] originally published in 1999 and updated in 2005 (Figure 11).[26]

Each wetland is categorized by its size, quality, and the type of function it performs (e.g. water-quality, habitat, flood reduction).[27] In the 2005 ADID wetland inventory, 14 wetlands covering 352 acres were identified as "High Functional Value Wetland," meaning the wetland has high capacity for stormwater storage and water quality mitigation. Twelve wetlands encompassing 1,440 acres were classified as "High Quality Wetland" since they contain diverse and unmitigatable plant and animal communities. Additionally, 119 farmed wetlands were identified at the time, encompassing approximately 198 acres. Thirty-three wetlands covering 34 acres were interpreted to have undergone "urban conversion."

Modifications of ADID wetlands are subject to the U.S. Army Corps of Engineers via Section 404 the Clean Water Act which regulates the management of wetland areas.

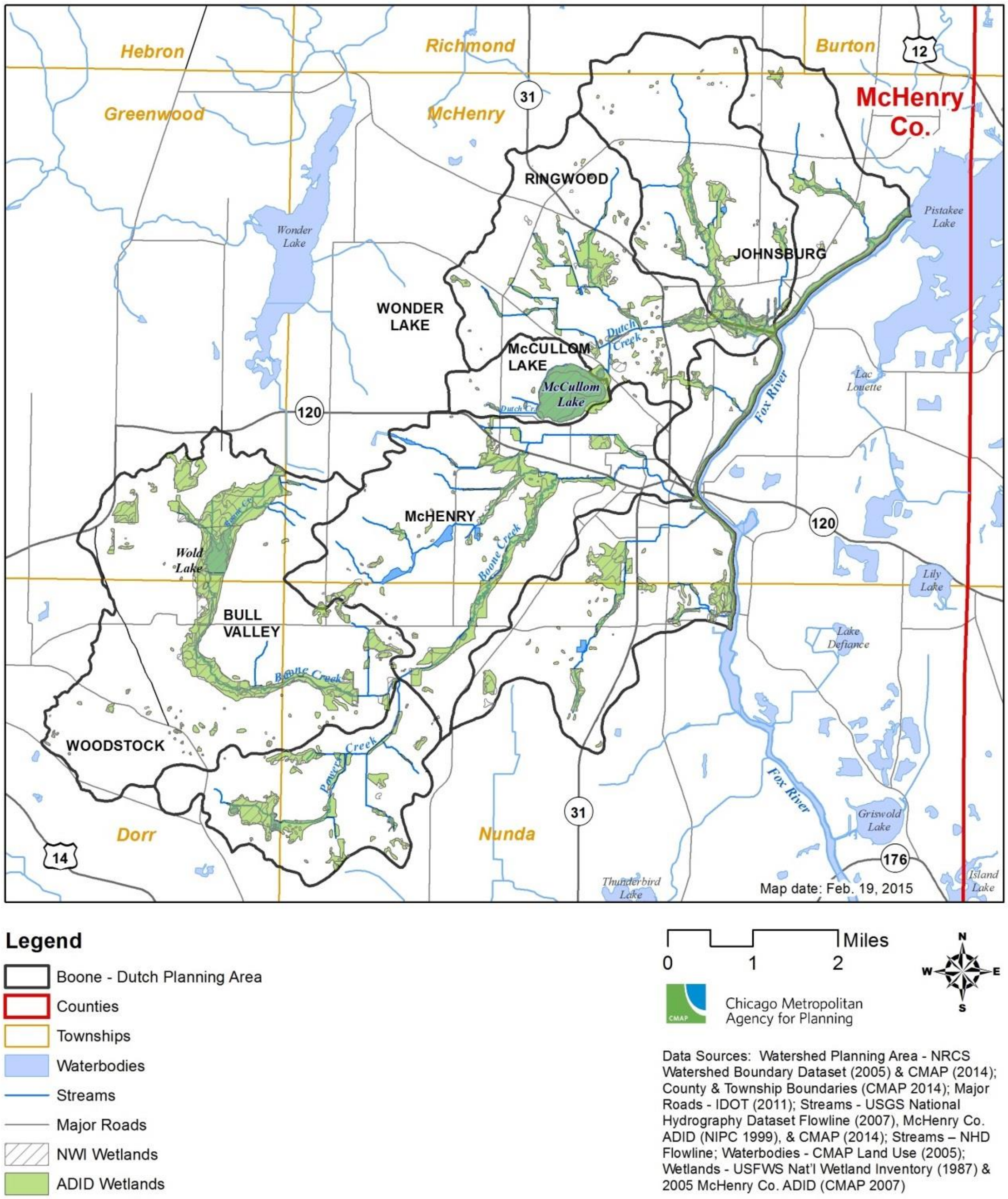
[24] U.S. Fish and Wildlife Service, 2011. National Wetlands Inventory. http://www.fws.gov/wetlands/Status-And-Trends-2009/index.html; the National Land Cover Database 2006 estimates that Woody and Emergent Herbaceous Wetlands account for 5.12 percent of land cover in the conterminous United States http://www.mrlc.gov/nlcd06_stat.php.

[25] The ADvance IDentification of disposal areas planning process (ADID) is used to identify wetlands and other waters that are either suitable or unsuitable for the discharge of dredged and fill material. Wetlands that meet certain criteria are deemed 'high-functional value' and thus, are unsuitable for accepting dredged and fill material. For more information, see http://water.epa.gov/type/wetlands/outreach/fact28.cfm

[26] Variations in ADID and NWI wetland classifications schemes account for the seemingly higher number of ADID wetlands in the watershed.

[27] USGS. *Restoration, Creation, and Recovery of Wetlands Wetland Functions, Values and Assessments*, by Richard Novitzki (ManTech Environmental Technology, Inc., R. Daniel Smith, (U.S. Army Corps of Engineers) and Judy D. Fretwell (U.S. Geological Survey) http://water.usgs.gov/nwsum/WSP2425/functions.html (accessed November 26, 2014).

Figure 11. Wetlands in the Boone-Dutch Creek planning area.



3.3.7 Oak Communities

Prior to European settlement, oak-dominated communities (oak barrens, savanna, woodland, or forest) covered much of McHenry County.[28] Within the Boone-Dutch Creek planning area in 1837, approximately 14,386 acres (22.5 sq. miles) were occupied by oak-dominated communities, representing 49.7 percent of the land area. By 1939 when the first comprehensive aerial photographic survey of the county was undertaken, the extent of oak communities in the Boone-Dutch planning area had declined nearly 78 percent to 3,233 acres (5.1 sq. miles), representing 11.3 percent of the land area. In 2005, the extent had decreased to 2,084 acres (3.3 sq. miles), just 7.3 percent of the planning area – indicating an overall decrease of 85.5 percent. A 2011 assessment revealed no significant changes in the planning area since 2005 (Table 8, Figure 12).

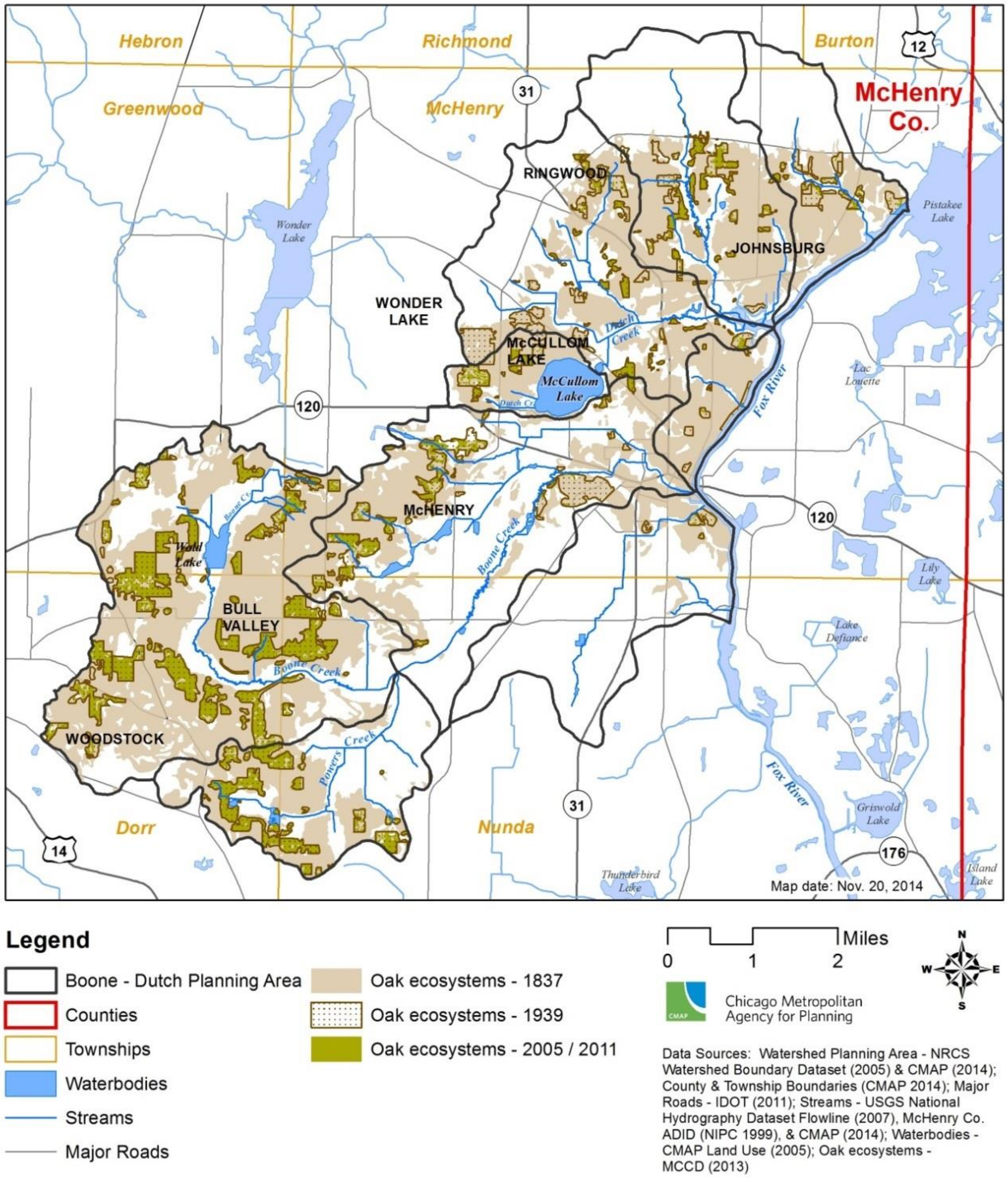
Identification of remaining natural areas, including oak dominated communities, supports conservation efforts and should be used as a tool to preserve important natural landscapes and establish greenways. New conservation opportunities and best management projects aimed at restoring natural vegetation and biodiversity may be identified and implemented in order to provide links between fragmented habitats as well as provide stormwater management benefits through retainment of pervious cover.

Table 8. Oak communities in the Boone-Dutch Creek planning area, 1837 to 2011.

Year	*Area*		*Percent of*
	(acres)	*(sq. miles)*	*Planning Area*
1837	14,386	22.5	49.7
1939	3,233	5.1	11.3
2005 / 2011	2,084	3.3	7.3

[28] McHenry Co. Conservation District. *The Oaks of McHenry County*. Woodstock, IL: MCCD, 2009. https://www.mccdistrict.org/web/assets/publications/brochures/OaksofMcHenryspreads_WC.pdf (accessed March 22, 2013).

Figure 12. Oak ecosystem change in the Boone-Dutch Creek planning area, 1837 to 2011.



3.4 Land Use and Land Cover

Land use is classified using CMAP's 2010 Land Use Inventory Classification Scheme. The land-use scheme employs a new methodology and results in 57 categories of land use that are aggregated under five general categories: Urbanized, Agriculture, Open Space, Vacant or Under Construction, and Water. CMAP's land-use data is parcel based. Road right-of-ways are not included in parcel data and therefore the total land area categorized is less than the actual land area contained within the planning area by approximately 10 percent.

For purposes of this plan, land use within the planning area is organized among nine categories (Figure 13 and Table 9). Each category will be a slight underestimate because of the parcel-based nature of the data, but the relative proportions identified are instructive nonetheless. Agricultural (39%) and Residential (35%) land uses are co-dominant within the planning area. Vacant or Under Construction land is the third most common type of land use (10%) while Open Space is featured at seven percent of the area.[29]

Land use within each of the nine study units is tabulated by the nine major categories (Table 10). Residential is the majority land use type (68%) in the Central Direct Drainage study unit and is the most common category (i.e., plurality) within five other study units: Upper Boone Creek (39%), Lower Boone Creek (42%), McCullom Lake (38%), NE Direct Drainage (48%), and SE Direct Drainage (29%). Agricultural land use dominates the other three study units: Powers Creek (50%), Dutch Creek (62%), and Dutch Creek Tributary (58%).

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

Figure 13. Land use in the Boone-Dutch Creek planning area.

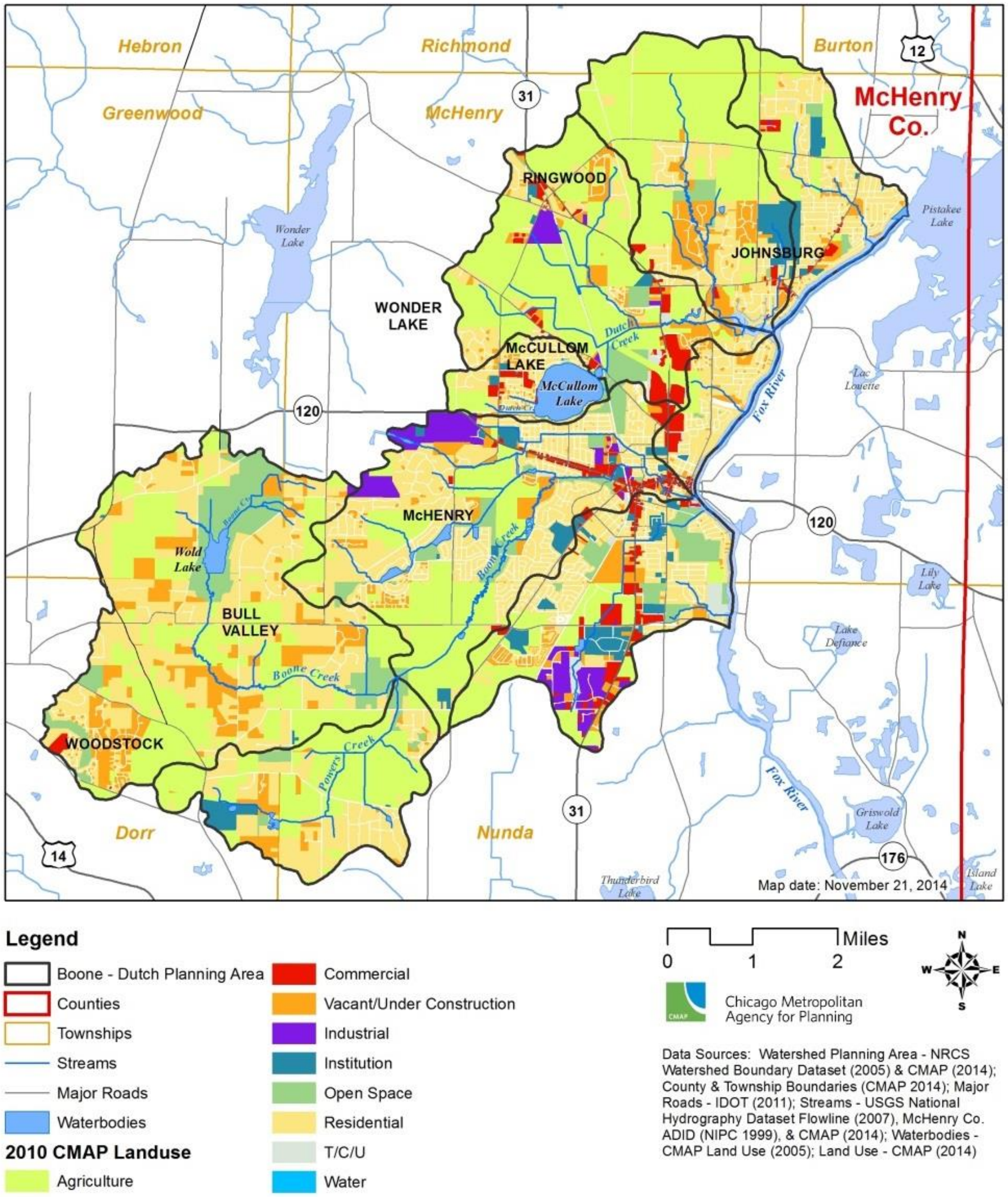


Table 9. Land-use categories and extent within planning area.

Land-Use Category	*Area (acres)*	*Area (sq. miles)*	*Percent of Planning Area*
Agriculture	10,310	16.1	39
Residential	9,184	14.4	35
Commercial	768	1.2	3
Institutional	768	1.2	3
Industrial	576	0.9	2
T/C/U	192	0.3	1
Open Space	1,920	3.0	7
Vacant/Under Construction	2,560	4.0	10
Water	230	0.4	1
Totals	***26,508***	***41.5***	***101****

T/C/U = transportation, communications, and utilities;
* Rounding negates summing to 100%

Table 10. Land use (acres) by study unit within Boone-Dutch Creek planning area.

Land-Use Category	*Upper Boone Creek*	*Powers Creek*	*Lower Boone Creek*	*McCullom Lake*	*Dutch Creek*	*Dutch Creek Tributary*	*NE Direct Drain.*	*Central Direct Drain.*	*SE Direct Drain.*
Study Unit #	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Agriculture	2197	1216	1492	112	2226	1885	541	48	609
Residential	2680	767	1999	303	544	689	756	410	781
Commercial	24	0	154	39	203	40	37	56	225
Institutional	6	97	148	15	29	148	100	14	242
Industrial	7	0	286	2	81	0	1	0	209
T/C/U	1	0	9	2	31	2	14	3	109
Open Space	896	93	352	12	168	69	51	10	300
Vacant/Under Construction	1055	278	302	47	300	427	76	60	256
Water	0	0	0	230	1	0	0	0	0
Totals	***6,866***	***2,451***	***4,742***	***762***	***3,583***	***3,260***	***1,576***	***601***	***2,731***

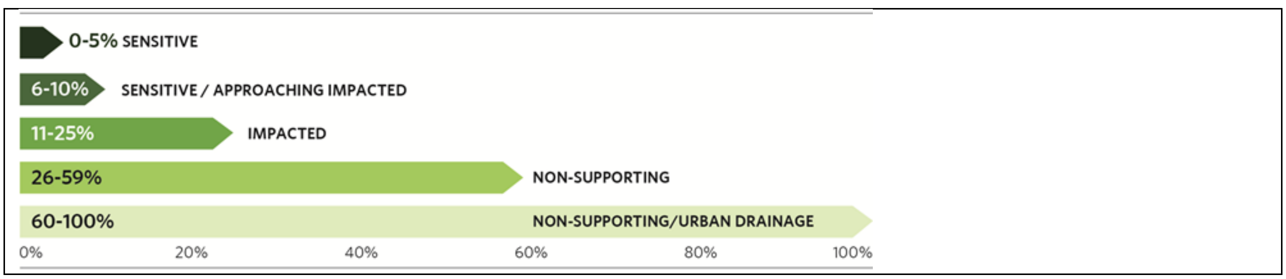
3.4.1 Impervious Surface

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

The National Land Cover Database 2011 (NLCD 2011) is applied for the analyses featured in this plan.[30] The NLCD 2011 is the most recent Landsat-based, 30-meter resolution land cover database for the Nation. One product derived from these data is the NLCD 2011 Percent Developed Imperviousness. Each data point or pixel represents a 30-meter square remotely-sensed image of the Earth's surface with a value of imperviousness assigned that ranges from 0 to 100 percent. Figure 15 displays the pattern and extent of impervious surface within the Boone-Dutch Creek planning area.[31] Data analysis reveals that 11.2 percent of the planning area is covered with impervious surface.

For purposes of this plan, the extent of impervious surface is best understood in the context of its impact on water quality (Figure 14).

Figure 14. Stream health categories relative to extent of impervious surface.



Source: Center for Watershed Protection (2003)[32]

There is considerable variability in impervious surface throughout the 45 square mile planning area. The relationship between impervious surface and water quality, therefore, is best examined at smaller units of geography. More localized land areas of less spatial extent have more direct impacts on the water quality of nearby lakes and streams. Table 11 shows the

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[30] Multi-Resolution Land Characteristics Consortium (MRLC), National Land Cover Database. Available at: http://www.mrlc.gov/

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

[32] Center for Watershed Protection. 2003. Impacts of Impervious Cover on Aquatic Systems: Watershed Protection Research Monograph. Center for Watershed Protection, Ellicott City, MD. Pages 1-158. Available at: http://www.cwp.org/online-watershed-library/cat_view/63-research/72-impacts

relationship between current impervious surface extent for each of the nine study units and the resultant stream health category, and Figure 16 illustrates the pattern.

Figure 15. Impervious surface (0-100%) in the Boone-Dutch Creek planning area.

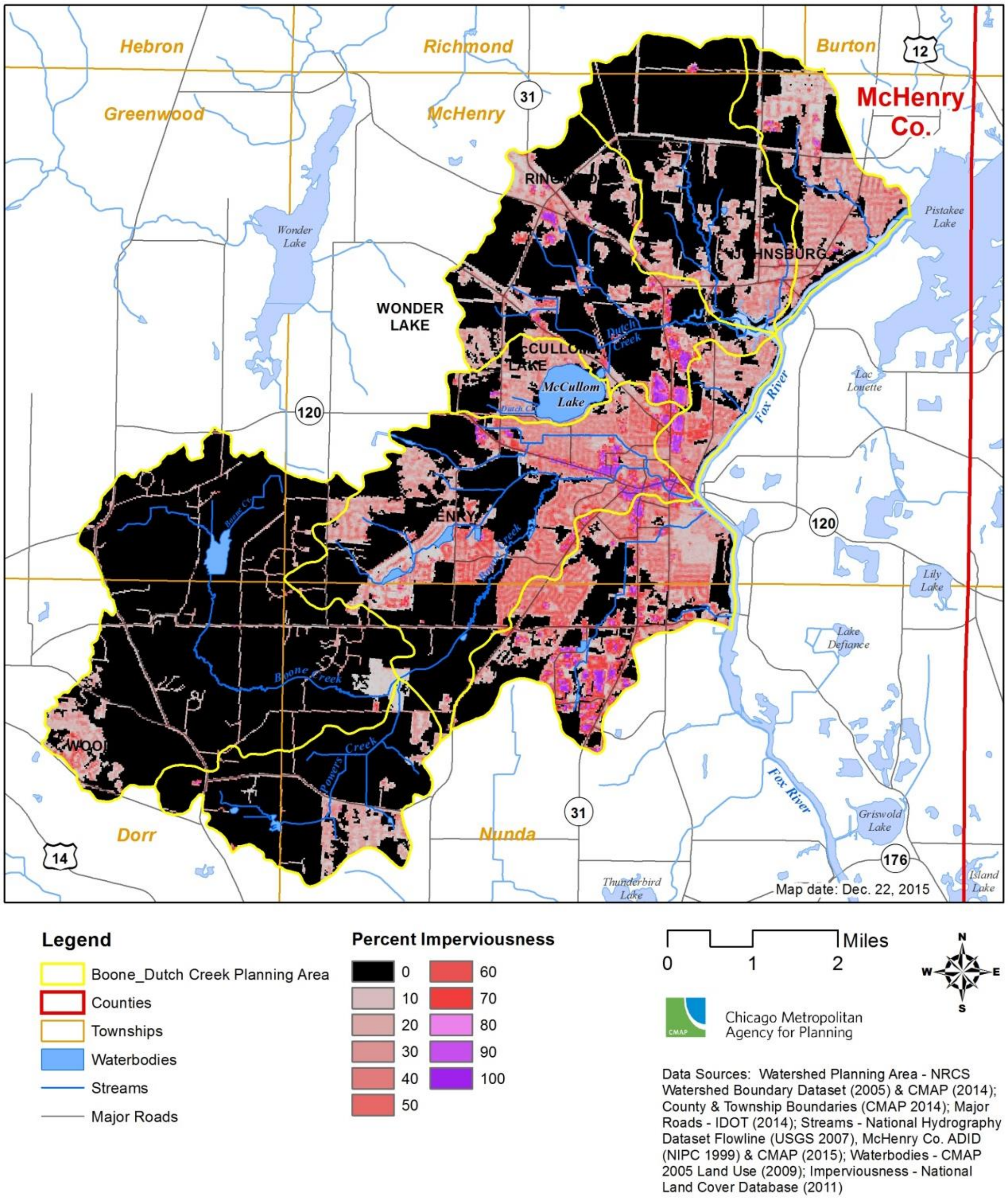
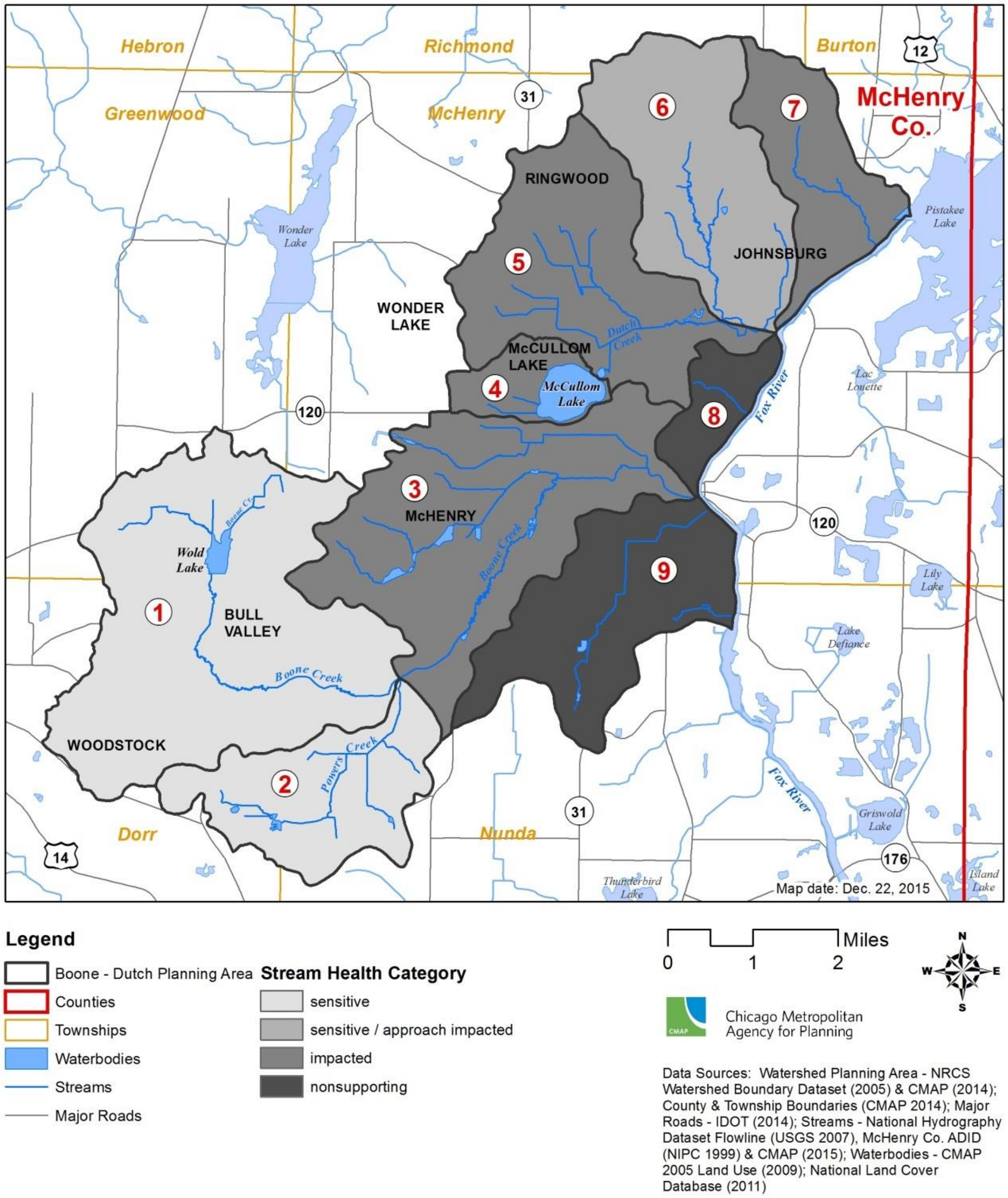


Table 11. Impervious surface and relationship with stream health by study unit.

Study Unit Name	*Study Unit #*	*Area (ac)*	*Impervious Surface Area (ac)*	*Percent Impervious Surface*	*Stream Health Category*
Upper Boone Crk	1	7,148	164	2.3	Sensitive
Powers Crk	2	2,546	89	3.5	Sensitive
Lower Boone Crk	3	5,333	982	18.4	Impacted
McCullom Lake	4	872	105	12.0	Impacted
Dutch Crk	5	3,811	432	11.3	Impacted
Dutch Crk Tributary	6	3,485	202	5.8	Sensitive / Approaching Impacted
Northeast Direct Drainage	7	1,877	271	14.4	Impacted
Central Direct Drainage	8	792	218	27.5	Nonsupporting
Southeast Direct Drainage	9	3,141	800	25.5	Nonsupporting
Totals		**29,005**	**3,263**	**11.2**	**Impacted**

Most of the headwaters area of Boone Creek (i.e., Upper Boone Creek and Powers Creek study units) warrants special consideration as development proceeds in order to maintain relatively good water quality and the currently small percentage of impervious surface. The Dutch Creek Tributary study unit should be given similar consideration given its relatively low percentage of impervious surface and high water quality. This means that low impact development, principles of conservation design, and site-level green infrastructure should be implemented at the highest levels possible as development proceeds in these parts of the planning area lest the water quality of the entire area become impacted or worse as is currently the case in a couple of study units. Population and employment growth forecasts for the planning area and county as discussed above suggest that without ordinances and subdivision codes that seek to protect water quality, the likelihood of water resource degradation is great.

Figure 16. Status of stream health as a function of impervious surface extent.



3.4.2 Open Space Reserve

Open space reserve is an area of land and/or water that is protected or conserved such that development will not occur on this land at any time in the future[33]. Land that is owned and managed by the McHenry County Conservation District (MCCD) is a core component of the open space reserve within the Boone-Dutch Creek planning area. To that, public parks are included along with private land on which a conservation easement is placed (Figure 17). Also shown on the figure are golf courses and other land that is privately held and could be sold and converted to a type of land use that is neither protected nor considered to be in a conservation status; thus, these lands are not technically part of the current open space reserve.

MCCD holdings within the planning area include the Boone Creek Conservation Area, Boger Bog (an Illinois Nature Preserve), and Pioneer Fen (not open to the public). Also managed by MCCD is Illinois DNR's Bull Valley State Fish and Wildlife Area within the Boone Creek Conservation Area. Six additional dedicated Illinois Nature Preserves include Boone Creek Fen (partial conservation easement), Amberin Ash Ridge (conservation easement), Gladstone Fen (privately owned, partial conservation easement), Julia M. & Royce L. Parker Fen (privately owned, conservation easement), Boloria Fen and Sedge Meadow Nature Preserve (Boone Creek Watershed Alliance, conservation easement), and Wheeler Fen Land and Water Reserve (City of McHenry and McHenry County, partial conservation easement).

3.4.3 Presettlement Land Cover

For a qualitative sense of historical land use change, Figure 18 shows the presettlement land cover – primarily vegetation – in and around the Boone-Dutch Creek planning area as surveyed in the early stages of Euro-American settlement in the early 1800s[34]. At that time, the land cover was comprised primarily of forest and prairie along with wetlands (categorized as bottomland, slough, swamp, or other wetland types)[35] and open water. The glacial lake that was later named McCullom Lake is evident (as are Pistakee, Lily, Defiance, and Griswold Lakes to the east of the Boone-Dutch planning area). This historic land cover can be informative for current land use planning and ecological restoration project purposes.

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[33] In lieu of a "textbook" definition, a defensible description of the phrase is offered here: http://en.wikipedia.org/wiki/Open_space_reserve

[34] Illinois Natural History Survey. INHS GIS database. *Land cover of Illinois in the early 1800s*. (August 2002) http://wwx.inhs.illinois.edu/resources/gis/glo/.

[35] Several terms are used to describe different types of wetlands. A swamp is a wetland dominated by trees or shrubs. In the northern and midwestern United States, slough is another term for a swamp or shallow lake system. Bottomland wetlands are lowlands along streams and rivers, usually on alluvial floodplains that are periodically flooded (from Mitsch, W.J. and J.G. Gosselink. 1986. *Wetlands*. Van Nostrand Reinhold Co. Ltd., New York, NY).

Figure 17. Open space in the Boone-Dutch Creek planning area.

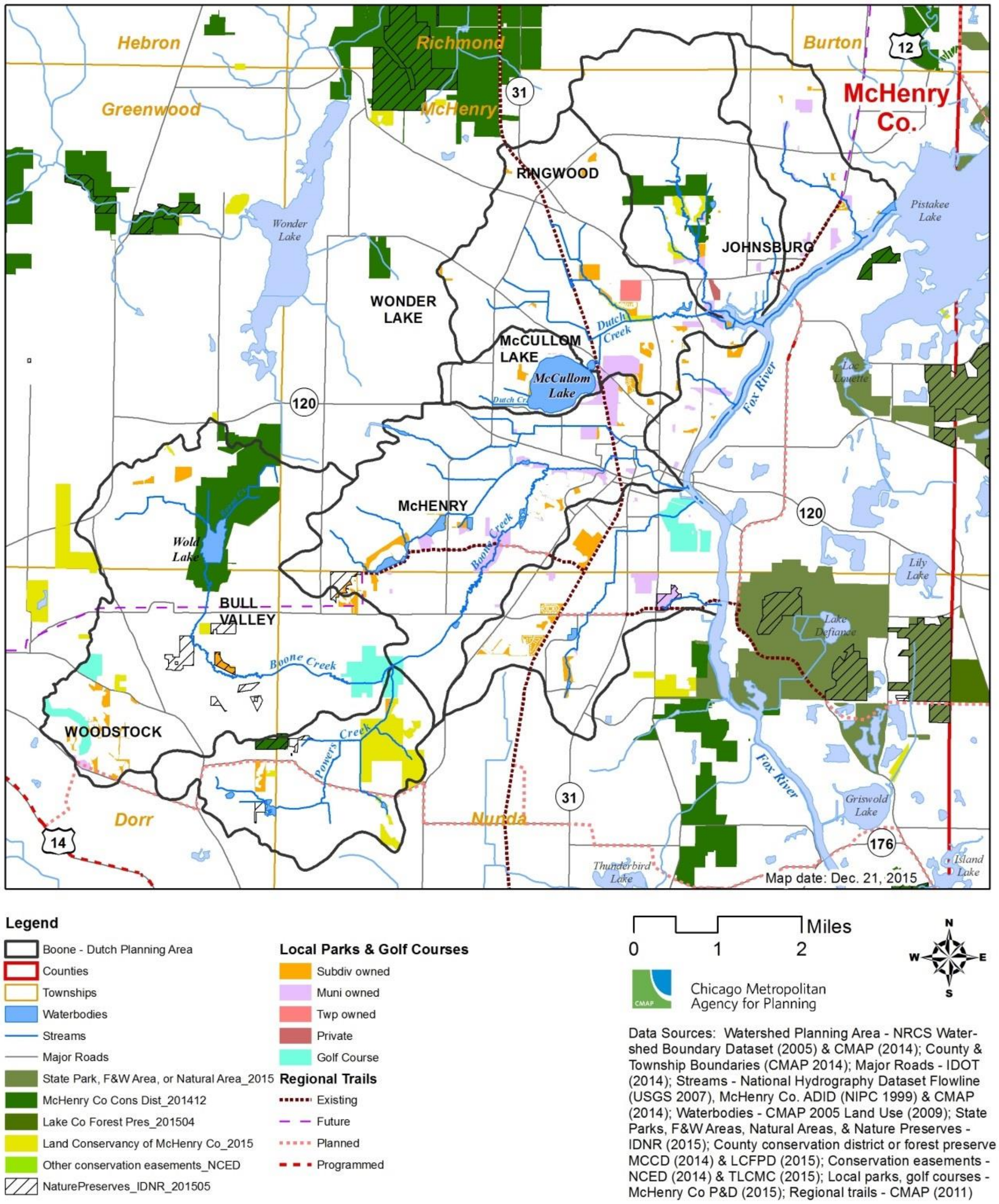
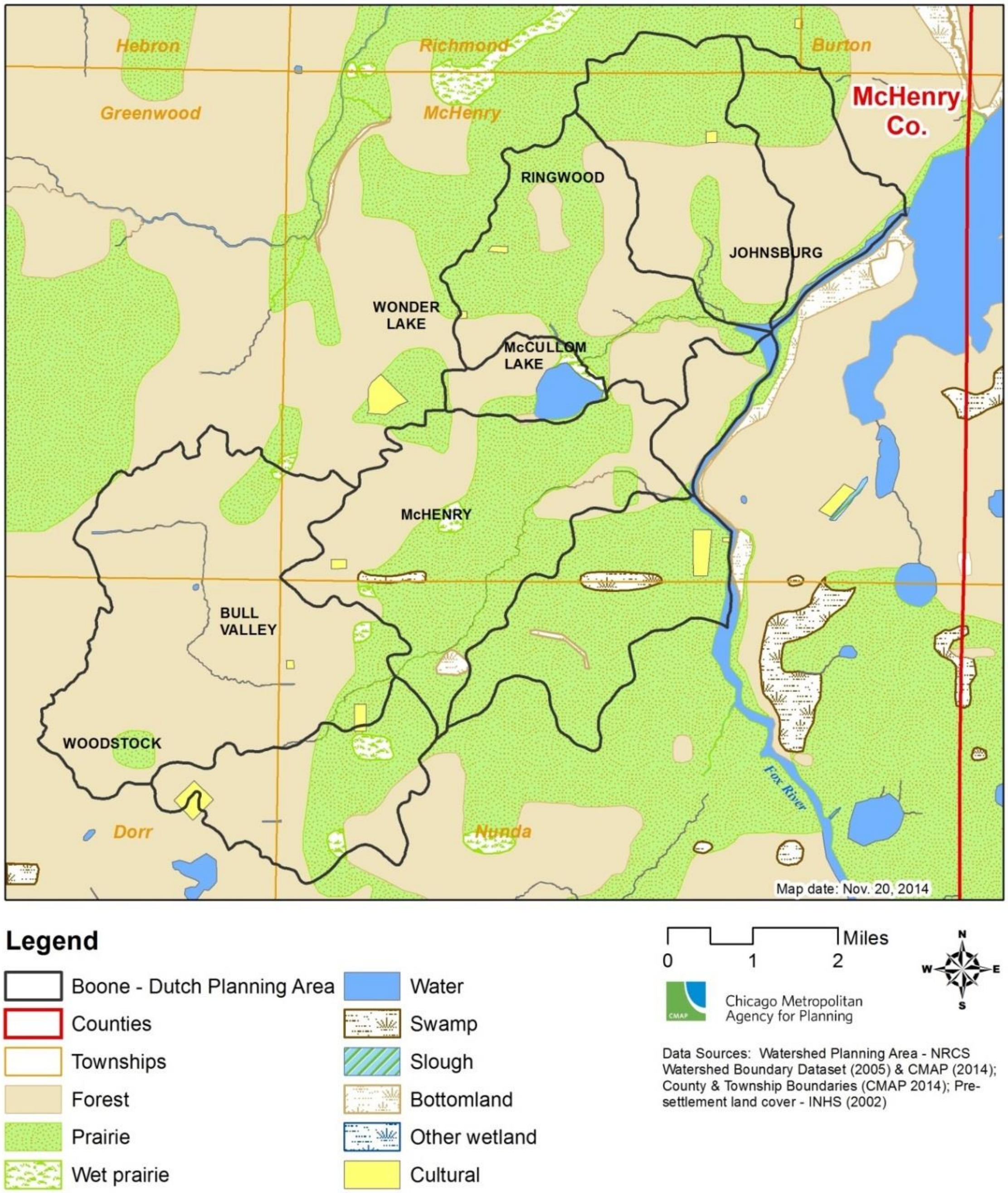


Figure 18. Presettlement land cover in the Boone-Dutch Creek planning area.



3.5 Water Resource Conditions

3.5.1 Watershed Drainage System

Water in the Boone-Dutch Creek Watershed planning area generally flows from west to east toward the Fox River. As noted previously, the 45.3 square mile planning area has been subdivided into nine subbasins or "study units" (Figure 2). The Boone Creek Watershed is comprised of three subbasins: Upper Boone Creek (study unit 1), Powers Creek (unit 2), and Lower Boone Creek (unit 3). The Dutch Creek Watershed also is comprised of three subbasins: McCullom Lake (unit 4), main stem and west branch Dutch Creek (unit 5), and north and east branches of Dutch Creek (unit 6). Finally, there are three direct drainage areas with tributaries to the Fox River: a Northeast Direct Drainage area with Sunnyside Creek (unit 7), a Central Direct Drainage area with an unnamed tributary (unit 8), and a Southeast Direct Drainage area with Edgebrook Creek and a small unnamed stream (unit 9). Numerous ponds, wetlands, and stormwater detention basins also serve as storage features and conduits for watershed drainage.

3.5.2 Physical Stream Conditions

3.5.2.1 Boone Creek 2002 Assessment

The Northeastern Illinois Planning Commission (NIPC), in cooperation with the Fox River Ecosystem Partnership (FREP), conducted a stream inventory project on several streams within the Fox River Basin in 2002, including the main stem of Boone Creek from its confluence with the Fox River to slightly upstream of Bull Valley Road. The goal of the inventory was to provide stream assessment information for use in watershed-based plan development.[36]

The inventory documented several elements including channel conditions (bank erosion, channel dimensions, bank vegetation), hydraulic structures (e.g., bridges, culverts), point discharges (e.g., pipes, ditches), substrate composition (e.g., gravel, sand, clay), water quality indicators (filamentous algae, oil and grease), types of fish habitat, observations of aquatic plants and animals, and land use/land cover and vegetation types within the stream corridor. The NIPC stream inventory work utilized a field data form (Stream Inventory Report Form, SIRF) modified from, and following the same stream assessment methodology utilized by, the Lake County Stormwater Management Commission.

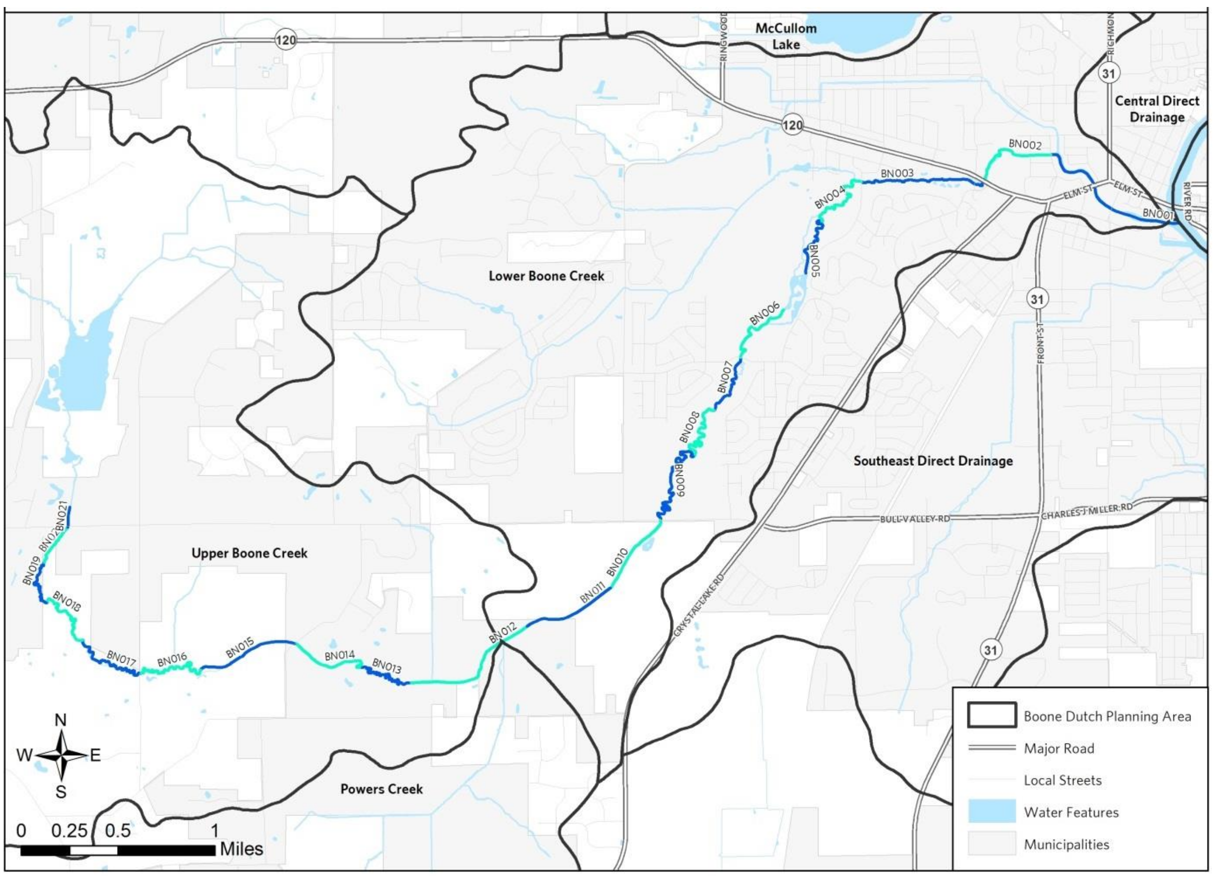
For the field work, the stream was divided into approximate 1,500 – 2,500 foot sections or "reaches" based on relative homogeneity within a reach (e.g., sinuosity, adjacent land use/cover) and identifiable beginning and end points (e.g., road crossings) as initially determined from aerial photos. Boone Creek was divided into 21 reaches from its confluence with the Fox River to slightly upstream of Bull Valley Road where a former private hunting

[36] NIPC. *Implementation of the Fox River Watershed Management Plan, Phase 1*. Chicago, IL: CMAP, 2004.

club property began (Figure 19). The stream was always waded in an upstream direction. One SIRF was filled out for each reach. At the beginning and end of each reach, a GPS waypoint and representative photo were taken. A photo and GPS waypoint were also taken at each hydraulic structure, point discharge, debris blockage, and areas exhibiting a high degree of erosion. At three representative locations in each reach, measurements of bank height, bank slope, water depth, and top and bottom channel width were recorded along with a GPS waypoint. All GPS waypoint and photo numbers were recorded on the SIRF. Formal macroinvertebrate and fish surveys were not conducted, though the interns did make note of any aquatic or terrestrial organisms they observed.

On a weekly basis, the interns would download the digital photos and GPS waypoints and enter the field data into a database. This data was used for mapping several key stream condition aspects, descriptions of which follow below.

Figure 19. Boone Creek reaches, 2002 stream assessment.



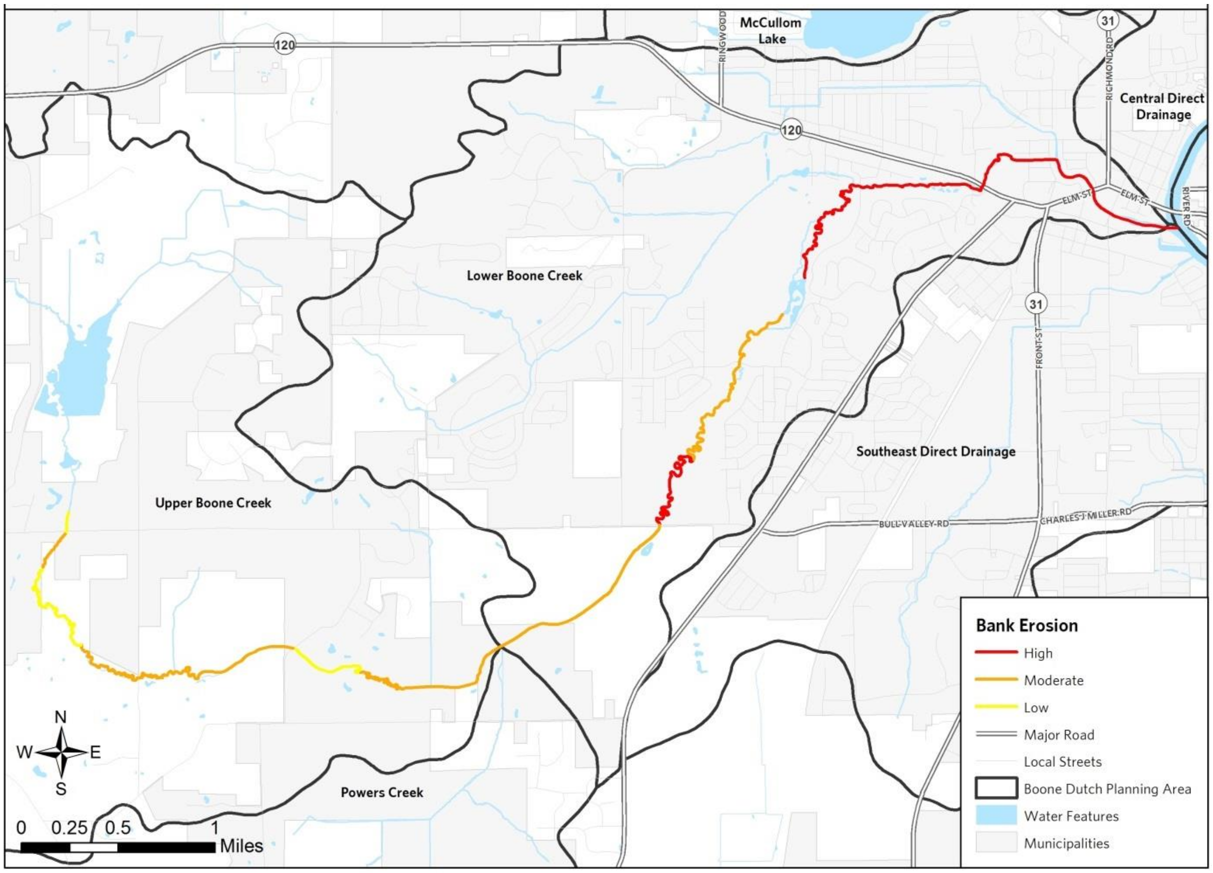
Streambank Erosion

While erosion is a natural process, it can be greatly accelerated by changes in hydrology associated with urbanization. Streambank erosion can contribute a large amount of sediment that then settles in slower moving reaches of the stream, negatively impacting aquatic habitat and overall stream health. Eroding banks also lead to losses of stream corridor habitat. The degrees of streambank erosion shown on Figure 21 reflect both the overall prevalence of erosion (proportion of the reach experiencing bank erosion) and the height of the banks. "Low" erosion was indicated by moderately stable banks with infrequent, small areas of erosion mostly healed over, with 5-33% of the reach having areas of erosion. "Moderate" erosion was indicated by moderately unstable banks with 33-66% of the reach having areas of erosion and with high erosion potential during floods. "High" erosion was evidenced by unstable banks with many eroded areas, frequent "raw" areas along straight sections as well as bends, obvious bank sloughing, and 66-100% of the reach exhibiting erosional scars.

Some degree of erosion was present in all the assessed reaches of Boone Creek (Figure 21). A high degree of erosion was seen in Boone Creek's five lower reaches as well as a centrally located reach (reach 9).

Figure 20. Examples of a high degree of bank erosion along Boone Creek in reach 3 (left) and reach 9 (right) observed during a 2002 stream assessment.

Figure 21. Assessed reaches of Boone Creek showing degree of bank erosion, based on a 2002 assessment of stream conditions.



Sediment Accumulation

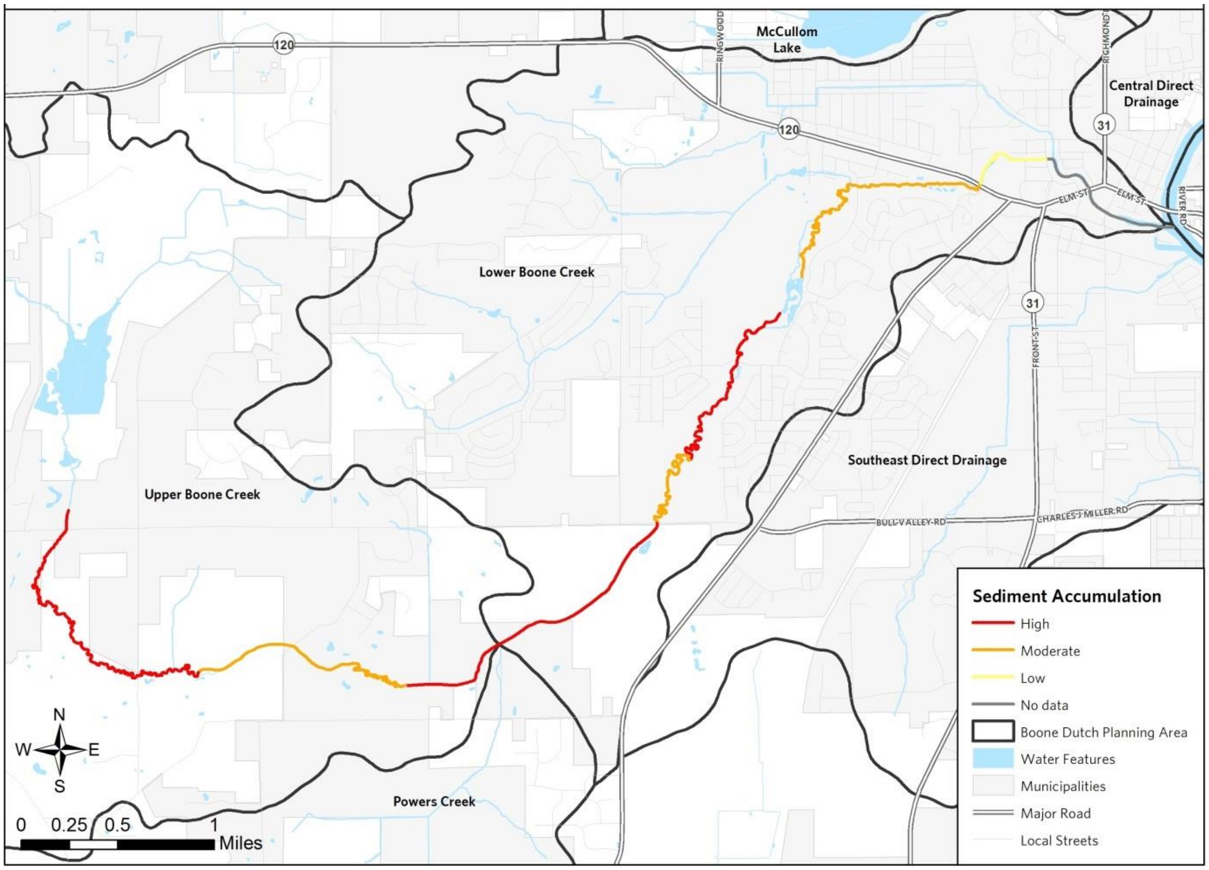
Stream channels that are stable have a balance between aggradation (deposition/accumulation on the streambed of additional materials transported from upstream) and degradation (removal of streambed materials caused by the erosional force of water flow). Aggradation is evidenced by silt deposits in pools, embedded riffles, mid-channel bars and islands, enlargement of point bars, and deposition in areas above the streambank.

Figure 23 shows the degree of sediment accumulation in the assessed reaches of Boone Creek. High sediment accumulation was exhibited in several of the upper and centrally located reaches, while low accumulation was

Figure 22. Example of a mid-channel island observed in Boone Creek (reach 3) during a 2002 stream assessment.

seen in lower sections downstream of Route 120 (reach 2). (Note: reach 1 was too deep to wade and thus unable to be assessed.)

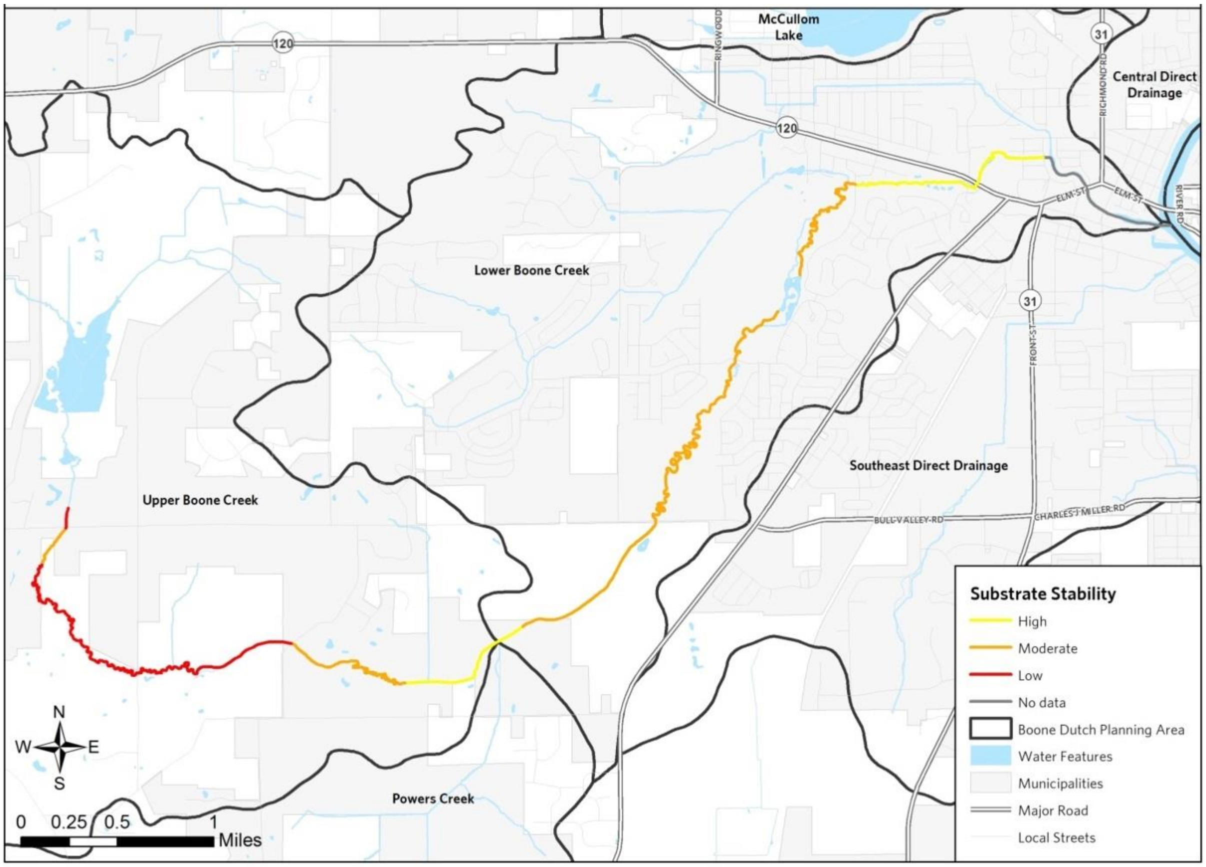
Figure 23. Assessed reaches of Boone Creek showing degree of sediment accumulation, based on a 2002 assessment of stream conditions.



Substrate Stability

Highly stable substrates are indicated by the ability to walk in the stream without sinking and typically indicate a gravelly stream bottom. Substrate stability is usually high in natural streams but varies from high stability in riffle areas to lower stability in areas of slower moving water (pools) between riffles. High stability substrate areas are necessary for supporting a variety of fish and aquatic insects. Low to no substrate stability is evidenced in areas with moderate to high silt deposits. These can be the result of soil erosion from upstream land surfaces, streambank erosion, and where the stream passes through naturally soft organic soils. Figure 24 shows the degree of substrate stability in the assessed reaches of Boone Creek.

Figure 24. Assessed reaches of Boone Creek showing degree of substrate stability, based on a 2002 assessment of stream conditions.



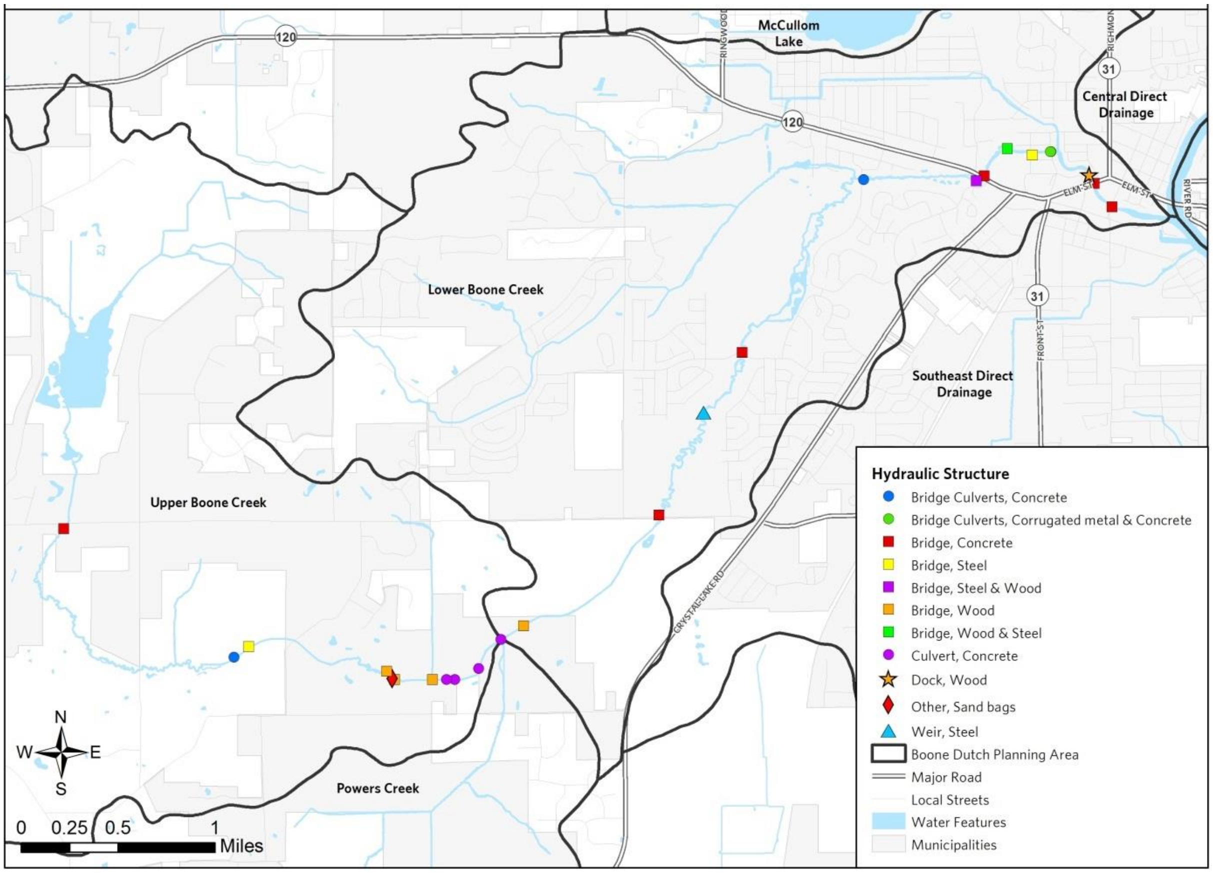
Hydraulic Structures

Numerous hydraulic structures (e.g., bridges, railways, culverts, weirs) were documented crossing Boone Creek (Figure 25, Figure 26). Hydraulic structures can alter stream hydrology (including exacerbating local flooding), impact the stability of the stream, and prevent fish migration. Thus, these locations indicate where projects could potentially be conducted to improve fish migration; repair, replace, or modify culverts or bridges; and/or stabilize the surrounding stream channel and streambanks. Along with transportation, drainage, and stormwater storage considerations, opportunities for incorporating best management practices for water quality protection should be considered and incorporated as much as possible.

Figure 25. A few of the hydraulic structures observed crossing Boone Creek during a 2002 stream assessment.

Reach # where each photo taken, from top to bottom, left to right: 1, 2, 2, 2, 8, 9, 12, 13, 14.

Figure 26. Hydraulic structure locations along assessed reaches of Boone Creek during a 2002 assessment of stream conditions.



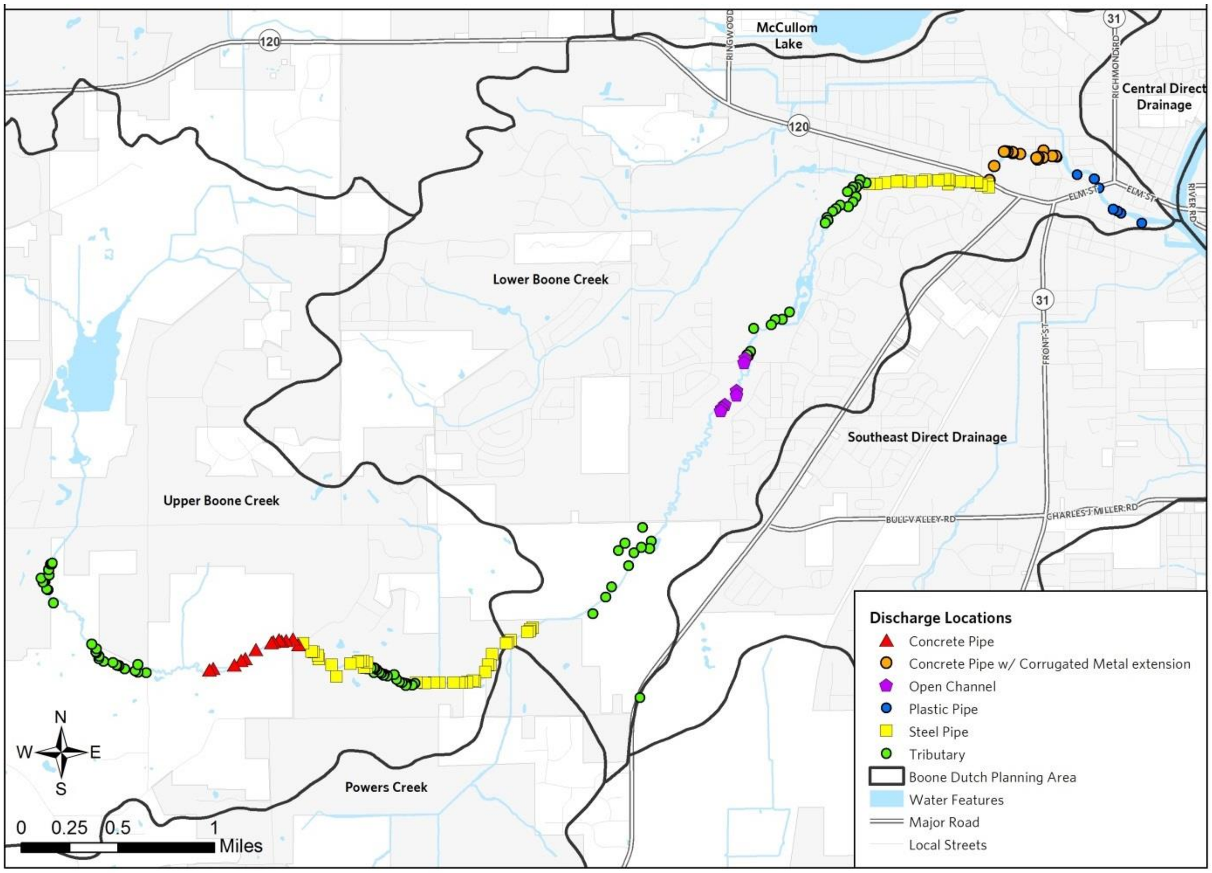
Discharge Locations

Numerous locations where water discharges into Boone Creek were documented. These included various pipes (e.g., storm sewer outfalls, agricultural drain tiles) as well as open channels, swale, and significant tributaries (Figure 27). Dimensions of the discharges were recorded as well as comments regarding flow, odors, sheens, and color or turbidity. Figure 28 displays the locations and general types of discharges observed along the assessed reaches of Boone Creek during the 2002 stream assessment.

Figure 27. A few of the discharge locations observed along assessed reaches of Boone Creek during a 2002 assessment of stream conditions.

Reach # where each photo taken, from top to bottom, left to right: 1, 3, 3, 3, 7, 10, 12, 12, 16.

Figure 28. Discharge locations along assessed reaches of Boone Creek during a 2002 assessment of stream conditions.



Channelization

Channelization indicates the straightening, deepening, and/or widening of a stream by humans. Channelization is done for a variety of reasons, including to improve the utility or economic use of riparian lands and floodplains, reduce upstream drainage or flooding problems, and to change the aesthetic character of the riparian zone.[37] However, channelization destroys in-stream and riparian habitat, disconnects the stream from its floodplain (contributing to increased downstream flooding), causes channel instability, and increases streambank erosion. In areas where the purpose of historical channelization no longer exits, these adverse consequences remain today. Opportunities for re-meandering and reconnecting the stream with its floodplain should be pursued wherever possible.

Figure 29 displays the degree of channelization for the assessed reaches of Boone Creek during the 2002 stream assessment.

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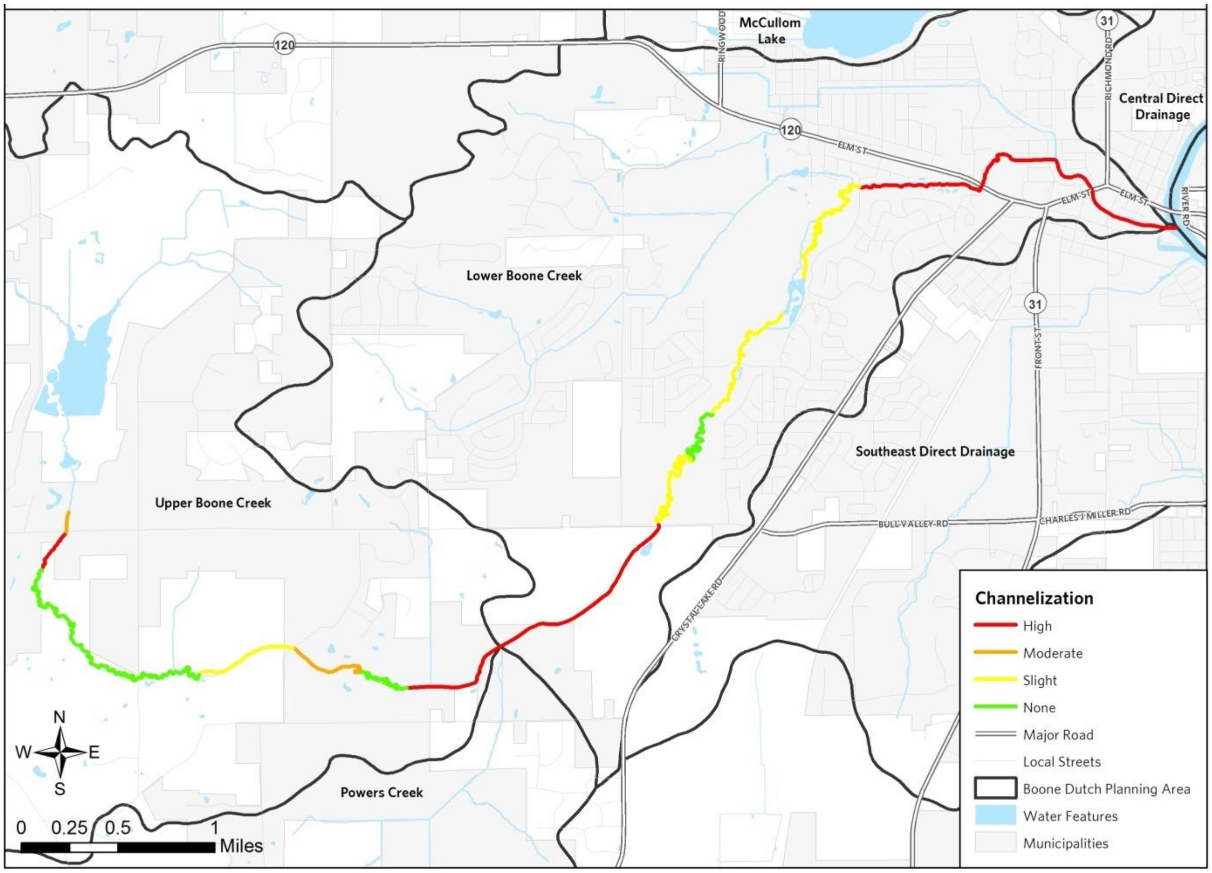
[37] Dreher, D. and L. Heringa. 1998. Restoring and Managing Stream Greenways: A Landowner's Handbook. Prepared by Northeastern Illinois Planning Commission for Chicago Region Biodiversity Council.

Figure 29. Assessed reaches of Boone Creek showing degree of channelization, based on a 2002 assessment of stream conditions.



3.5.2.2 Boone-Dutch Creek Planning Area 2015 Stream Conditions Assessment

Field checks were conducted in summer 2015 by visiting publicly accessible stream crossings to assess bank erosion, channelization, and riparian condition.[38] High resolution aerial imagery was also viewed to better assess average channelization for each reach, as well as to assess riparian buffer condition within 100 feet to each side of the stream. Several figures and summary tables follow presenting the assessment data, beginning with Figure 30 showing the steam network divided into reaches, each with a standardized systematic code, and Table 12which provides a summary of stream lengths by subwatershed. Approximately 52 miles of stream are depicted in Figure 30, of which approximately 35 miles were assessed. The remaining 17 miles represent first order stream reaches that were typically not accessible due to

[38] For a truer assessment of streambank erosion and riparian conditions, it is recommended that the stream beds/ corridors be walked in their entirety.

the lack of publicly accessible road crossings. The reach-specific assessment information is provided in Appendix C.

Figure 30. Stream reaches in the Boone-Dutch Creek planning area.

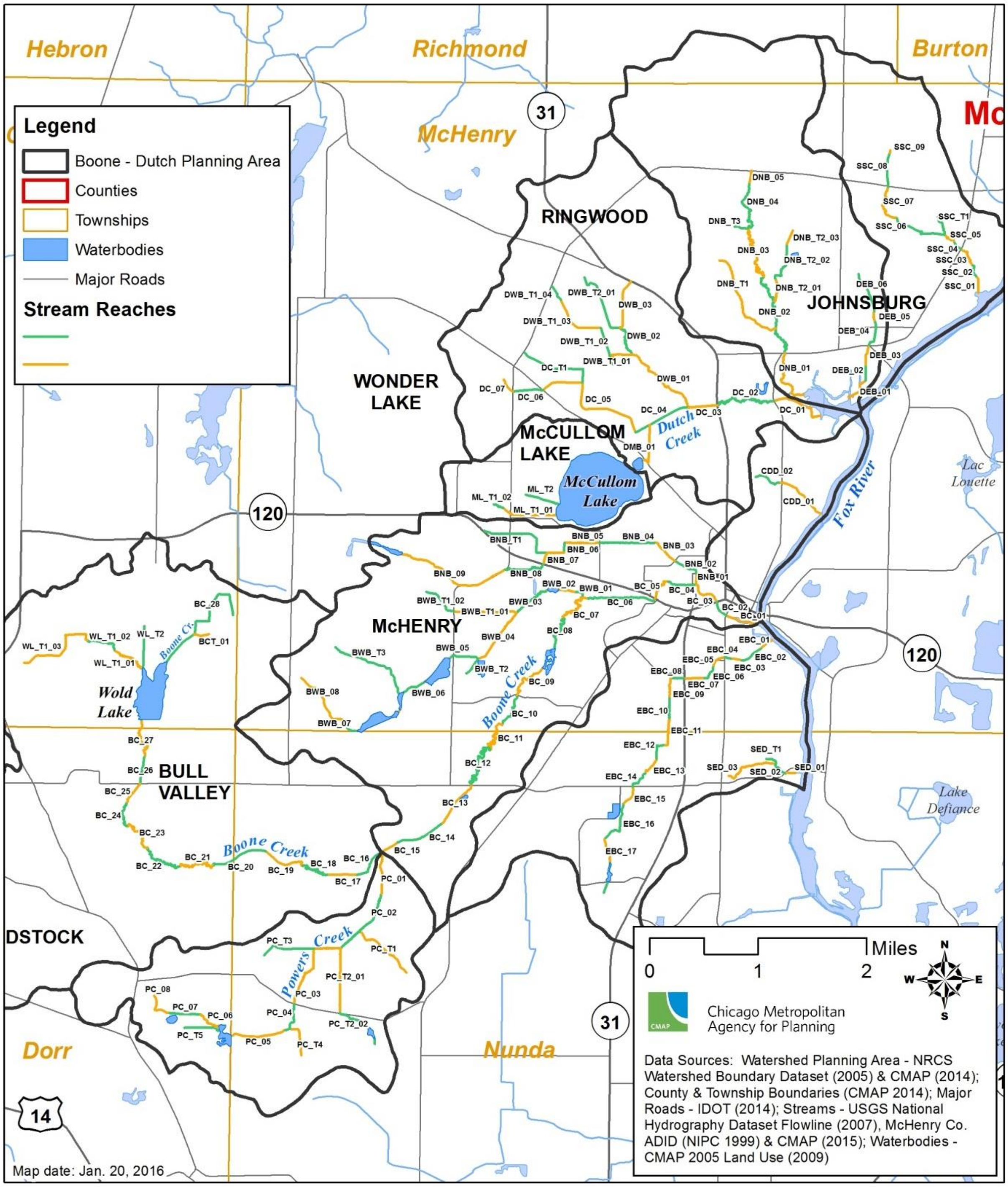


Table 12. Summary of assessed and unassessed stream system in the Boone-Dutch Creek planning area.

Name	*Study Unit #*	*Assessed Stream Length*		*Unassessed Stream Length*		*Totals*	
		ft	mi	ft	mi	ft	mi
Boone Creek Watershed	1, 2, & 3	105,836	20.0	50,265	9.5	156,101	29.5
Dutch Creek Watershed	4, 5, & 6	56,664	10.7	29,116	5.5	85,780	16.2
NE Direct Drainage Watershed	7	6,805	1.3	839	0.2	7,644	1.5
Central Direct Drainage Watershed	8	0	0.0	4,015	0.8	4,015	0.8
SE Direct Drainage Watershed	9	16,722	3.2	4,688	0.9	21,410	4.1
Totals		**186,027**	35.2	**88,923**	16.8	**274,950**	52.1
Percent of Total		67.7%		32.3%			

Streambank Erosion

Within the main stem of Boone Creek, stakeholders did not believe that bank erosion levels would be much different than those recorded in 2002. Field checks at stream crossings in 2015 confirmed that bank erosion levels appeared similar to those in the 2002 assessment, with the exception of the lowest reach between the Fox River and Elm Street in downtown McHenry. This approximately 1,830 linear foot reach (BC_01 in the 2015 assessment) exhibited high erosion in 2002 but had since been stabilized with seawall and riprap in association with residential, commercial, and park development. Figure 33 illustrates and Table 13 summarizes the 2015 streambank erosion assessment findings within the Boone-Dutch Creek planning area.

It should be noted that with the exception of the stream beds or stream corridors that were waded or walked (Boone Creek main stem from the Fox River upstream to Bull Valley Rd south of Wold Lake during the 2002 assessment; and during the 2015 assessment Edgebrook Creek from the Fox River up to Bull Valley Rd, the upper reaches of Powers Creek within LUREC, and the upper reaches of Sunnyside Creek), relative bank erosion levels may be underestimated for some reaches due to vegetation concealing bank conditions as viewed from publicly accessible road crossings during mid-summer. To obtain a truer assessment of bank erosion conditions throughout the Boone-Dutch Creek planning area, at a minimum stream crossings should be visited during late fall after dormancy or early spring before leaf out and when water levels are low. Ideally, all the streams would be walked in their entirety and measurements made following a similar methodology to that of the 2002 Boone Creek assessment.

Figure 31. View downstream of the north and south banks in Boone Creek reach 1 (BN_01) from the footbridge east of Green St. in downtown McHenry, 2015.

Figure 32. Mid-summer (left) versus late fall (right) views of Boone Creek reach 5 (BN_05) adjacent to the Jewel parking lot in McHenry, 2015.

Figure 33. Degree of streambank erosion estimated for assessed stream reaches in the Boone-Dutch Creek planning area, 2015.

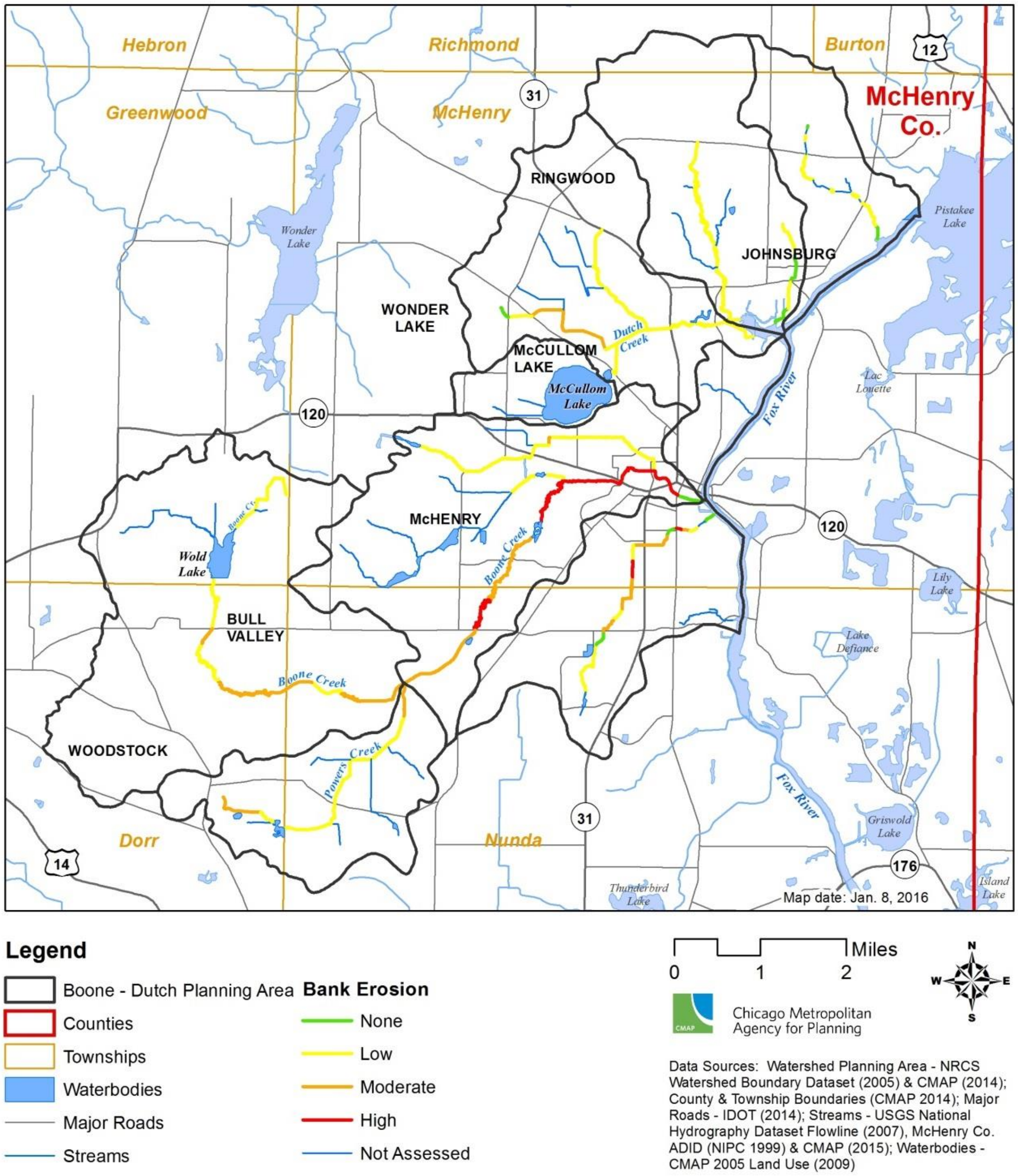


Table 13. Summary of streambank erosion degree estimated for assessed reaches within the Boone-Dutch Creek plannning area.

Stream Name	*Stream Code*	*Length Assessed (ft)*	*No Erosion*		*Low Erosion*		*Moderate Erosion*		*High Erosion*	
			ft	*%*	*ft*	*%*	*ft*	*%*	*ft*	*%*
Boone Creek	BC	65,011	1,831	2.8	16,499	24.5	28,445	43.8	18,236	28.1
Boone Creek North Branch	BNB	17,807	0	0	17,315	97.2	492	2.8	0	0
Boone Creek West Branch	BWB	3,584	0	0	3,584	100	0	0	0	0
Powers Creek	PC	19,434	0	0	14,289	73.5	5,145	26.5	0	0
Boone Creek Watershed Totals		**105,836**	**1,831**	**1.7**	**51,687**	**48.8**	**34,082**	**32.2**	**18,236**	**17.2**
Dutch Creek	DC	20,513	766	3.7	13,251	64.6	6,496	31.7	0	0
Dutch Creek East Branch	DEB	7,021	3,187	45.4	3,834	54.6	0	0	0	0
Dutch Creek North Branch	DNB	17,953	0	0	17,935	100	0	0	0	0
Dutch Creek West Branch	DWB	8,964	0	0	8,964	100	0	0	0	0
Dutch Creek McCullom Lake Branch	DMB	2,213	0	0	2,213	100	0	0	0	0
Dutch Creek Watershed Totals		**56,664**	**3,953**	**7.0**	**46,197**	**81.5**	**6,496**	**11.5**	**0**	**0**
Sunnyside Creek (w/in NE Direct Drainage unit)	SSC	6,805	985	14.5	5,820	85.5	0	0	0	0
Edgebrook Creek (w/in SE Direct Drainage unit)	EBC	16,722	2,548	15.2	6,233	37.3	6,623	39.6	1,318	7.9
Direct Drainage Totals		**23,527**	**3,533**	**15.0**	**12,053**	**51.2**	**6,623**	**28.2**	**1,318**	**5.6**
Boone-Dutch Planning Area Totals		**186,027**	**9,317**	**5.0**	**109,937**	**59.1**	**47,201**	**25.4**	**19,554**	**10.5**

Channelization

Figure 34 displays and Table 14 summarizes the degree of channelization for the assessed stream reaches in the Boone-Dutch Creek planning area, based on review of 2013 high resolution aerial imagery.

Figure 34. Degree of stream channelization for assessed stream reaches in the Boone-Dutch Creek planning area, 2013.

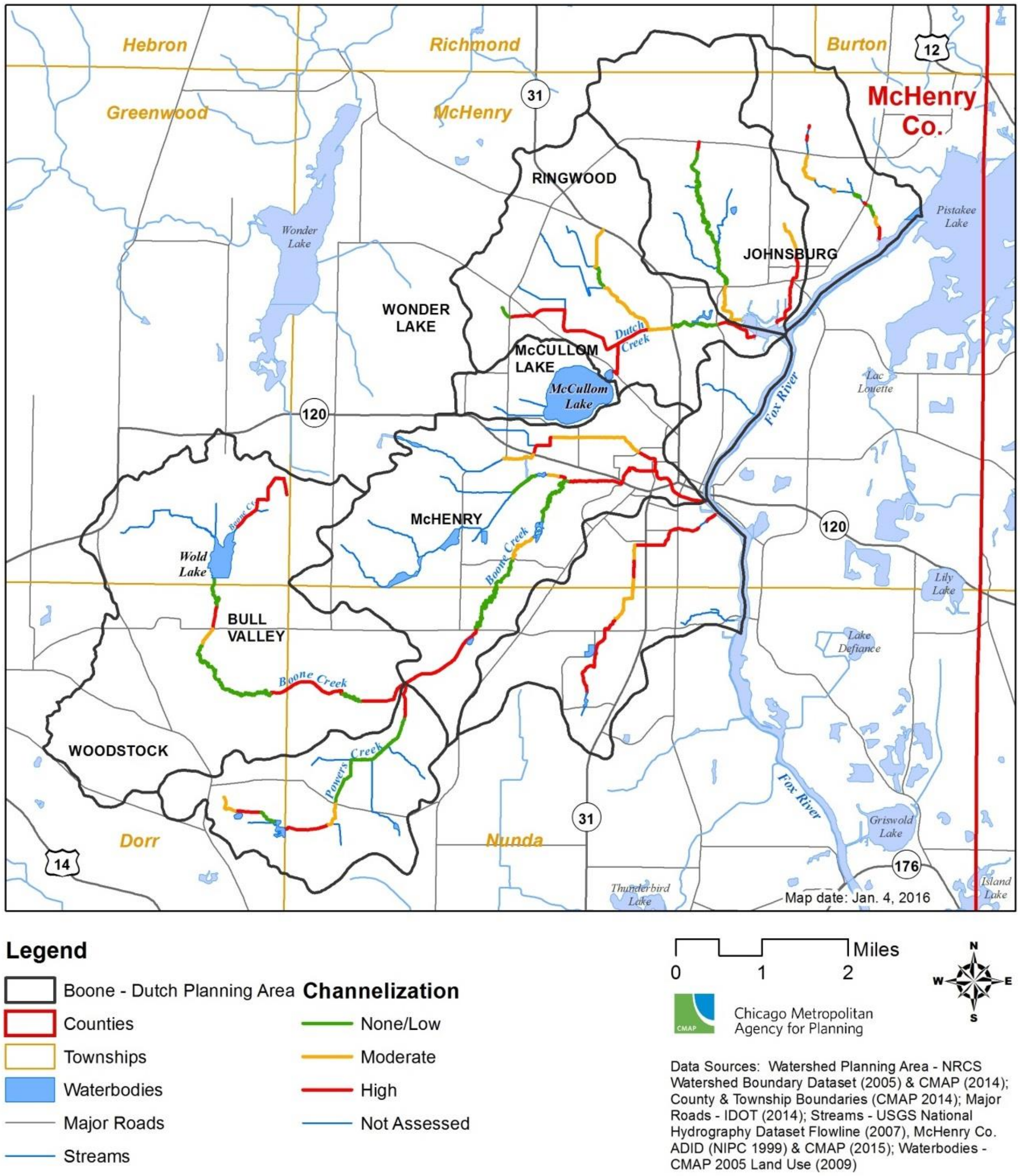


Table 14. Summary of stream channelization degree for assessed reaches in the Boone-Dutch Creek planning area.

Stream Name	*Stream Code*	*Length Assessed (ft)*	*No – Low Channelization*		*Moderate Channelization*		*High Channelization*	
			ft	*%*	*ft*	*%*	*ft*	*%*
Boone Creek	BC	65,011	29,610	45.5	3,534	5.4	31,867	49.0
Boone Creek North Branch	BNB	17,807	0	0	8,172	45.9	9,635	54.1
Boone Creek West Branch	BWB	3,584	2,213	61.7	715	19.9	656	18.3
Powers Creek	PC	19,434	9,854	50.7	3,108	16.0	6,475	33.3
Boone Creek Watershed Totals		**105,836**	**41,677**	**39.4**	**15,529**	**14.7**	**48,633**	**46.0**
Dutch Creek	DC	20,513	5,348	26.1	1,460	7.1	13,705	66.8
Dutch Creek East Branch	DEB	7,021	0	0	2,165	30.8	4,856	69.2
Dutch Creek North Branch	DNB	17,953	14,156	78.9	3,142	17.5	655	3.6
Dutch Creek West Branch	DWB	8,964	2,224	24.8	6,740	75.2	0	0
Dutch Creek McCullom Lake Branch	DMB	2,213	0	0	0	0	2,213	100.0
Dutch Creek Watershed Totals		**56,664**	**21,728**	**38.3**	**13,507**	**23.8**	**21,429**	**37.8**
Sunnyside Creek (w/in NE Direct Drainage unit)	SSC	6,805	1,956	28.7	3,431	50.4	1,418	20.8
Edgebrook Creek (w/in SE Direct Drainage unit)	EBC	16,722	0	0	4,724	28.3	11,998	71.7
Direct Drainage Totals		**23,527**	**1,956**	**8.3**	**8,155**	**34.7**	**13,416**	**57.0**
Boone-Dutch Planning Area Totals		**186,027**	**65,361**	**35.1**	**37,191**	**20.0**	**83,478**	**44.9**

Riparian Condition

Figure 35 displays and Table 15 summarizes the relative and qualitative riparian buffer condition for the assessed stream reaches in the Boone-Dutch Creek planning area, based on field observations at stream crossings and review of 2013 high resolution aerial imagery within 100 feet of both sides of the stream. "Good" riparian condition was typically characterized by woodland, prairie, and/or wetland vegetation dominant on both sides of the stream, "poor" condition typified by turf grass and/or developed areas dominant, with "fair" condition typically having at least some vegetative buffer along the stream to filter runoff from upland developed areas. It is important to note that reaches with "good" riparian condition were assessed based solely on aerial interpretation, but these areas may in fact be dominated by invasive species, such as buckthorn, honeysuckle, reed canary grass, and phragmites, among others, and thus compromised in their pollutant filtering and settling capacities.

Figure 35. Riparian buffer condition for assessed stream reaches in the Boone-Dutch Creek planning area, 2015.

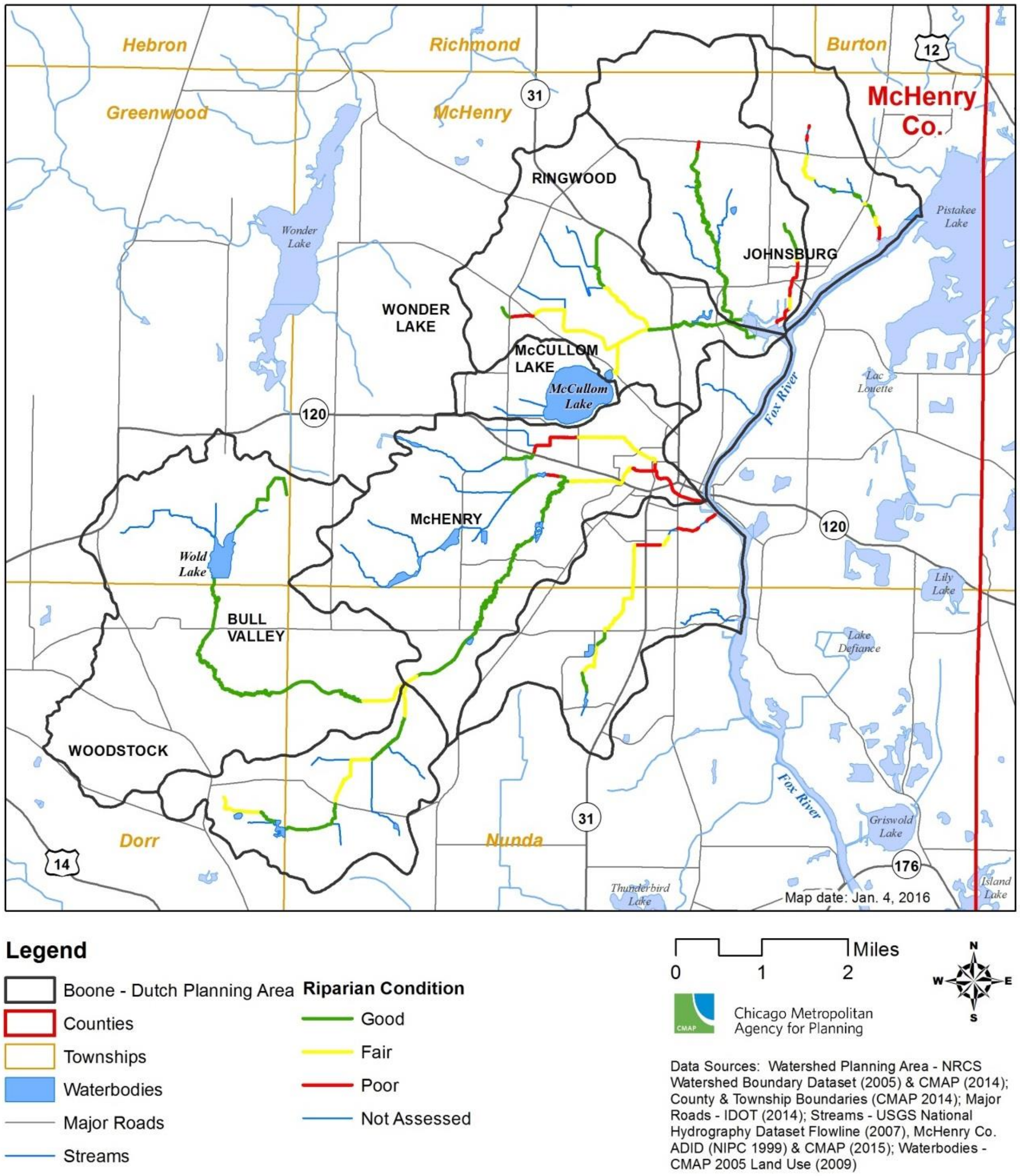


Table 15. Summary of riparian buffer condition for assessed stream reaches in the Boone-Dutch Creek planning area.

Stream Name	*Stream Code*	*Length Assessed (ft)*	*Good Riparian Condition*		*Fair Riparian Condition*		*Poor Riparian Condition*	
			ft	*%*	*ft*	*%*	*ft*	*%*
Boone Creek	BC	65,011	50,434	77.5	8,942	13.8	5,635	8.7
Boone Creek North Branch	BNB	17,807	8,092	45.4	5,465	30.7	4,250	23.9
Boone Creek West Branch	BWB	3,584	2,869	80.1	0	0	715	19.9
Powers Creek	PC	19,434	9,604	49.4	9,830	50.6	0	0
Boone Creek Watershed Totals		**105,836**	**70,999**	**67.1**	**24,237**	**22.9**	**10,600**	**10.0**
Dutch Creek	DC	20,513	9,624	46.9	9,398	45.8	1,491	7.3
Dutch Creek East Branch	DEB	7,021	2,165	30.8	1,163	16.6	3,693	52.6
Dutch Creek North Branch	DNB	17,953	17,298	96.4	655	3.6	0	0
Dutch Creek West Branch	DWB	8,964	4,739	52.9	4,225	47.1	0	0
Dutch Creek McCullom Lake Branch	DMB	2,213	0	0	2,213	100.0	0	0
Dutch Creek Watershed Totals		**56,664**	**33,826**	**59.7**	**17,654**	**31.2**	**5,184**	**9.1**
Sunnyside Creek (w/in NE Direct Drainage unit)	SSC	6,805	2,468	36.3	3,052	44.8	1,285	18.9
Edgebrook Creek (w/in SE Direct Drainage unit)	EBC	16,722	2,273	13.6	10,029	60.0	4,420	26.4
Direct Drainage Totals		**23,527**	**4,741**	**20.2**	**13,081**	**55.6**	**5,705**	**24.2**
Boone-Dutch Planning Area Totals		**186,027**	**109,566**	**58.9**	**54,972**	**29.6**	**21,489**	**11.6**

3.5.2.3 Stormwater Detention Basins

Stormwater detention is accomplished by way of a variety of means. Historic wetlands, ponds, and lakes (including McCullom Lake) are very often the recipients of stormwater that is expedited to such depressional areas via culverts and other traditional gray infrastructure. Of these, some have no natural outlet while others spill downhill or are evacuated via a lift station. Some wetlands may not have direct stormwater inputs but receive overland flow from other waterbodies that receive piped stormwater. Other detention basins are purposefully built in conjunction with newer developments. Of this last type, some basins are normally dry (i.e., dry bottom) and others retain water year round (i.e., wet bottom) unless designed as infiltration basins.

In an attempt to create a comprehensive inventory of detention basins in the Boone-Dutch Creek planning area, municipal and county governments were approached first to see if they had a comprehensive inventory or mapping of detention basins within their jurisdictions. No such data was available; thus, large base maps with recent aerial imagery were printed out and potential wet and dry basins marked. Meetings with local municipal officials or their engineering consultants provided additional basin locations. Field verification was accomplished by driving around the planning area, which also resulted in identification of additional basins (typically dry basins that were more difficult to see on the aerial imagery).

The number, location, type[39], and relative water quality benefit of detention basins were determined for this plan. All things considered, the planning area appears to have at least 187 engineered features of the landscape that serve a stormwater detention role at a minimum (Table 16, Figure 39). Of this total, nine are unassessed basins since they were located on private property and could not be readily accessed. Unless something unique or unusual was obvious, condition for providing overall water quality benefits – good, fair, poor – is largely a function of detention basin type. Retrofitting opportunities and management needs were also noted (Appendix D).

To assess the basins in the field, a "rapid assessment" was conducted based on protocols developed by the Lake County Stormwater Management Commission (LCSMC). A field assessment "short form" was prepared that condensed the "long form" used by LCSMC. The following aspects of each detention basin were assessed:

- Type of basin (wet, wet with extended dry detention, dry, constructed wetland)
- On-stream (yes/no, stream name)
- Connected to Other Basins (yes/no, upstream/downstream)
- Side Slope Cover types (turf grass, native plants, invasive plants, rip rap, seawall)
- Side Slope Angle (horizontal : vertical)

[39] Four types of detention basins are noted: 1) dry bottom, most typically turf grass but many native vegetation basins were present in the planning area, 2) wet bottom, 3) wet bottom with an extended dry area, and 4) constructed wetland.

- Buffer Width (native plants)
- Water's Edge Cover types (not applicable, turf grass, native/wetland plants, invasive plants, rip rap)
- Basin Bottom Cover types (unknown, turf grass, native/wetland plants, submersed aquatic vegetation, invasive plants, concrete-lined channel)
- Shoreline Erosion (not applicable, minimal, slight, moderate, high)
- Safety Shelf presence (yes/no/unknown) and Wetland Vegetation presence (yes/no)
- Sediment Forebay presence (yes/no/unknown)
- Stilling Basin presence at Inlets and Outlets (yes/no/unknown)
- Short Circuiting (yes/no)
- Overall Water Quality Benefits Assessment (good, fair, poor)
- Management needs
- Retrofit opportunities within the basin and immediate contributing area

Table 16. Summary of stormwater detention basins in Boone-Dutch Creek planning area.

By Political Jurisdiction		*No. of Detent. Basins identified*	*Detention Basin Type*					*Water Quality Benefit*			
			Wet	*Dry*	*Wet-Ext. Dry*	*Constr. Wetland*	*Unas-sessed*	*Good*	*Fair*	*Poor*	*Unas-sessed*
Vlg of Bull Valley		11	1	4	--	3	3	5	1	2	3
Vlg of Johnsburg		43	15	14	--	12	2	19	15	7	2
Vlg of McCullom Lk		2	--	2	--	--	--	1	1	--	--
City of McHenry		108	41	40	2	21	4	38	27	39	4
Vlg of Ringwood		5	2	1	--	2	--	4	--	1	--
City of Woodstock		11	--	10	1	--	--	9	1	1	--
Door Twp		1	--	1	--	--	--	--	--	1	--
McHenry Twp		3	--	3	--	--	--	--	--	3	--
Nunda Twp		3	1	1	--	1	--	2	1	--	--
Totals		**187**	**60**	**76**	**3**	**39**	**9**	**78**	**46**	**54**	**9**
By Subwatershed											
1	Upper Boone	15	1	13	1	--	--	11	1	3	--
2	Powers Crk	9	1	3	--	2	3	3	1	2	3
3	Lower Boone	40	17	15	--	8	--	10	9	21	--
4	McCullom Lk	4	1	3	--	--	--	2	1	1	--
5	Dutch Crk	24	10	7	--	7	--	18	4	2	--
6	Dutch Crk Trib	16	4	4	--	8	--	9	3	4	--
7	NE Direct Drainage	17	8	7	--	--	2	1	10	4	2
8	Central Direct Drainage	8	1	4	--	3	--	3	2	3	--
9	SE Direct Drainage	54	17	20	2	11	4	21	15	14	4
Totals		**187**	**60**	**76**	**3**	**39**	**9**	**78**	**46**	**54**	**9**

Generally, basins providing "good" water quality benefits were either a) wet detention with a vegetated wetland shelf, native plant side slopes, and submersed aquatic vegetation, b) constructed wetlands, or c) dry detention with native vegetation throughout the basin bottom and side slopes (Figure 36). Basins providing "fair" water quality benefits were generally either a) wet detention with a vegetated wetland shelf, turf grass side slopes, and possibly submersed aquatic vegetation, or b) dry detention containing a native vegetation waterway or bioswale, or a native vegetation pre-outlet area (Figure 37). Basins providing "poor" water quality benefits were typically either a) wet detention with turfgrass side slopes, no or minimum vegetated wetland shelf, and possibly short-circuiting, or b) dry detention with turfgrass bottom, possibly a concrete-lined channel, and/or possibly short circuiting (Figure 38).

Figure 36. Examples of detention basins providing "good" water quality benefits.


DB5-01


DB9-27


DB1-07

Figure 37. Examples of detention basins providing "fair" water quality benefits.


DB9-33


DB3-04


DB7-01

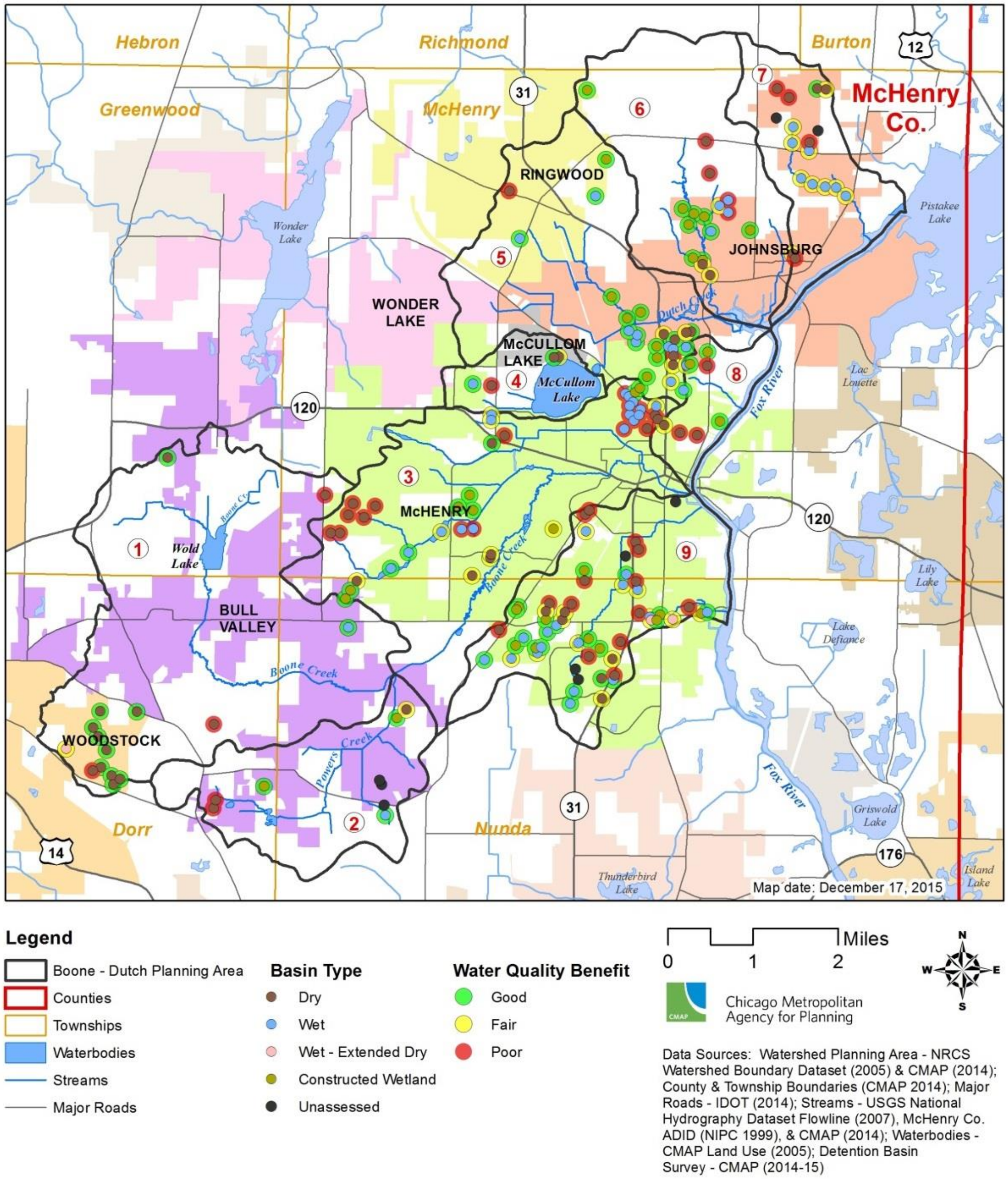
Figure 38. Examples of detention basins providing "poor" water quality benefits.


DB3-01


DB6-04


DB9-21

Figure 39. Stormwater detention basins in Boone-Dutch Creek planning area.



3.5.3 Groundwater Studies

Published results of groundwater quality studies have been lacking of late. An exception is an Illinois State Water Survey study (2009) that sought to characterize the variability of arsenic (As) concentrations in groundwater over relatively short distances (i.e., tens to hundreds of meters) to determine the feasibility of a process that a small water system could use to site a new well with low-As water.[40] The 2009 study sampled a number of private wells in Tazewell County and another ten private wells in and around Wonder Lake. While all samples from the Wonder Lake area exceeded the primary drinking water standard for As (i.e., MCL of 10 μg/L), the study's main conclusion was that As concentrations are highly variable over short distances, making prediction of concentrations from regional-scale models difficult to impossible. Thus, these results will impact decisions made regarding the siting of new wells.

The U.S. Geological Survey (USGS) sampled 25 residential wells in McHenry County for a number of analytes and water levels (131 data points) in 1979.[41] A current USGS study underway will compare those sample results to data collected in 2010 from the current well monitoring network to assess changes in groundwater quantity and quality. Preliminary results reveal no statistical difference in water levels is found, but there is a statistically significant difference in chloride concentrations as they are found to be five times greater in 2010 than in 1979.[42] A heavy reliance on winter-time road-salt applications is implicated along with timer-based water softeners used by private-well owners.

Other recent work has focused on water levels to support planning efforts in McHenry County. An Illinois State Water Survey (ISWS) study (2013) mapped heads (i.e., water levels) in shallow aquifers and developed a model to simulate groundwater flow in the aquifers supplying drinking water in the county.[43] Shallow aquifer levels are not found to be in decline compared to levels found in 1994 despite changes in land use, land cover, and withdrawal rates. Drawdown of the deep aquifers increases from west to east, exceeding 400 feet in the southeastern part of the county near Algonquin as of 2009. Drawdown will continue to increase according to demand scenarios modeled to 2050.[44] These findings and expectations should influence water use management (i.e., municipal-run conservation, efficiency, and loss/waste

[40] Thomas R. Holm and Steven D. Wilson, 2009. Spatial variability of arsenic in groundwater. Center for Groundwater Science, Illinois State Water Survey. Institute of Natural Resource Sustainability, University of Illinois at Urbana-Champaign. MTAC Publication TR09-01, ISWS CR 2009-06. Available at: http://mtac.isws.illinois.edu/mtacdocs/pubs/MTACTR09-01.pdf

[41] Water level data were mapped and the results were published in: J.R. Nicholas and J.T. Krohelski, 1984. Water in Sand and Gravel Deposits in McHenry County, Illinois. U.S. Geological Survey, Water-Resources Investigations Report 83-4048. Prepared in cooperation with the McHenry County Regional Planning Commission. Available at: http://pubs.usgs.gov/wri/1983/4048/report.pdf

[42] Amy Gahala, Hydrologist, USGS-IL WSC, 2014. *Personal communication*.

[43] S.C. Meyer, Y-F Lin, D.B. Abrams, G.S. Roadcap, 2013. Groundwater simulation modeling and potentiometric surface mapping, McHenry County, IL. Illinois State Water Survey, Champaign, Illinois. ISWS CR 2013-06. Available at: http://www.isws.illinois.edu/pubs/pubdetail.asp?CallNumber=ISWS+CR+2013%2D06

[44] Regional water-demand scenarios are synthesized in *Water 2050: Northeastern Illinois Water Supply/Demand Plan* (CMAP, 2010) available at: http://www.cmap.illinois.gov/livability/water/water-2050-implementation . More detailed information on water-demand scenarios can be found in a report published by Southern Illinois University Carbondale (2008) and found on the same webpage listed immediately above.

reduction programs) especially in light of population and employment growth forecasted by CMAP for the county.

The difference in drawdown dynamics between the shallow and deep aquifers has much to do with the rate at which they each receive replacement water. The greater rate of replacement water received by shallow aquifers has much to do with that water originating as captured surface water. Thus, while withdrawals from the shallow aquifers are not creating drawdown, they are reducing natural groundwater discharge to streams, wetlands, and lakes. Model simulations suggest that natural groundwater discharge in the McHenry County area has been reduced by 11.5 percent by pumping of shallow groundwater used largely to supply community water systems. Some, but not all, local streams receive treated wastewater (i.e., effluent) at rates that compensate in quantity lost to reductions in natural groundwater discharge. Effluent differs in water quality, however, including temperature and is discharged at discrete points rather than by diffuse seepage along the entire stream network.

For other groundwater studies that have been done more broadly for northeastern Illinois, the reader is referred to the Illinois State Water Survey, Publications Search webpage.[45]

3.5.4 Sensitive Aquifer Recharge Areas

McHenry County developed a Sensitive Aquifer Recharge Areas (SARA) map in response to municipal and private reliance on shallow aquifers as a source of drinking water in light of the stressors of population growth and land-use change. The SARA map incorporates data from the USDA-NRCS Soil Survey and the Illinois State Geological Survey. The map has two primary purposes: 1) to identify areas within the county that are susceptible to aquifer contamination, and 2) to identify areas that may aid in protecting groundwater recharge. The SARA map is designed to guide local land-use planning decisions, support watershed planning efforts, and support efforts to develop a countywide wellhead protection program and groundwater protection ordinance.

Figure 40 illustrates the two thematic SARA classifications: A - High Potential for Aquifer Contamination and, B - Moderately High Potential for Aquifer Contamination:[46]

Map Unit A – High Potential for Aquifer Recharge/Contamination: Sand and gravel deposits are more than 20 feet thick (commonly 50 feet thick) and lie within 20 feet of the surface. Nearly 52 percent (14,963 acres) of the Boone-Dutch Creek planning area falls in Unit A.

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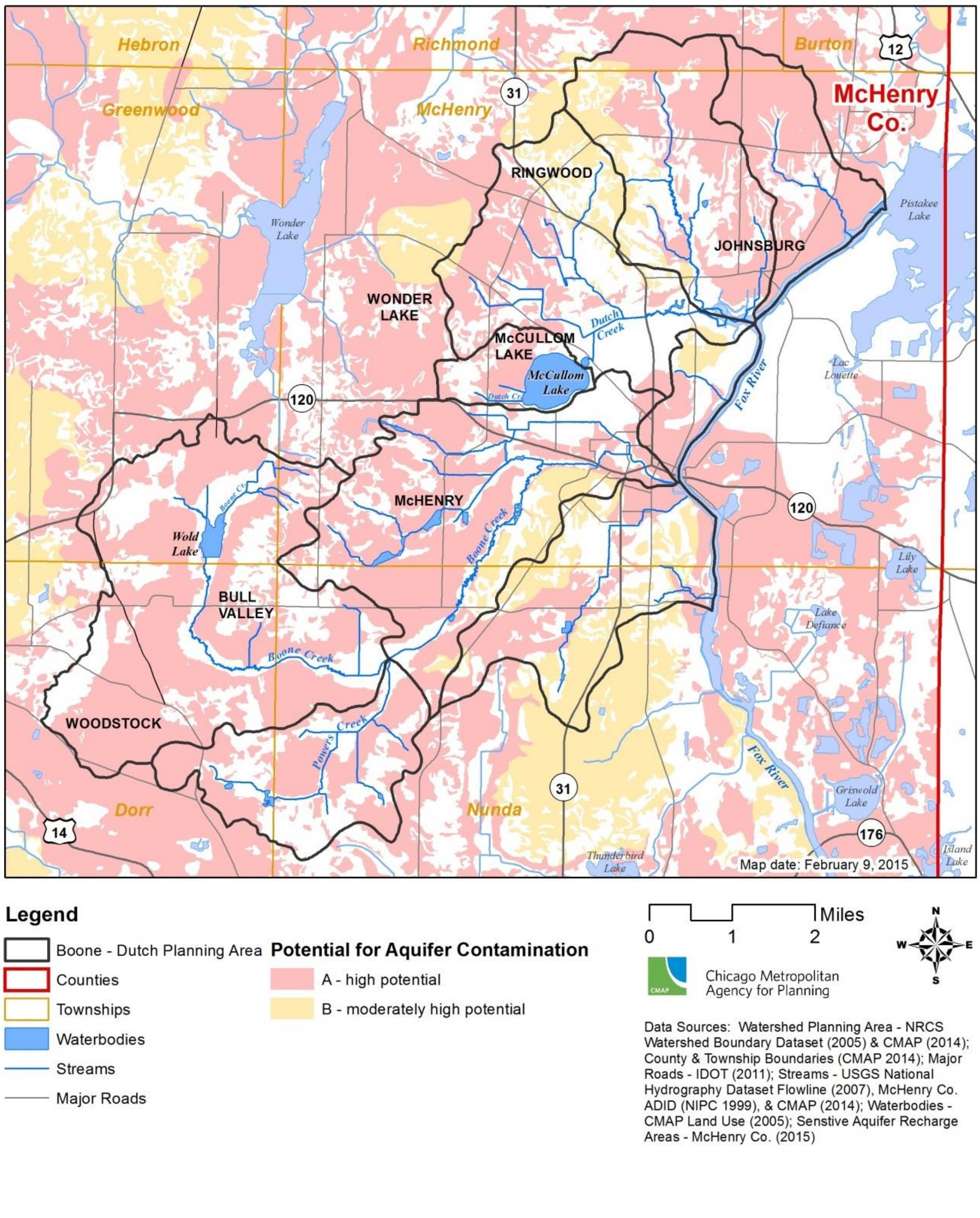
[45] Available at: http://www.isws.illinois.edu/pubs/isearch.asp

[46] "Sensitive Aquifer Recharge Areas Map Descriptor: McHenry County, Illinois," McHenry County, Illinois, GIS Department, last modified May 2009, accessed November 7, 2011, http://www.co.mchenry.il.us/departments/Countyboard/PDFDocs/Appendix%202.3.pdf.

Map Unit B – Moderately High Potential for Aquifer Recharge/Contamination: Sand and gravel deposits less than 20 feet thick and generally lie within 20 feet of surface and are either at land surface or overlain by the Haeger diamicton or fine-grain deposits. About nine percent (2,675 acres) of the planning area falls in Unit B.

Figure 40. Sensitive aquifer recharge areas in the Boone-Dutch Creek planning area.



3.5.5 Surface Water Quality

3.5.5.1 Designated Uses, Assessment and Impairment Status

The Illinois Integrated Water Quality Report (Integrated Report) and Section 303(d) List [303(d) List] comprise a major source of information available for assessing stream health and identifying sources of impairment on the part of watershed planning initiatives statewide. These documents are released every two years by the Illinois Environmental Protection Agency (Illinois EPA), with the most recent Integrated Report issued in 2014. The purpose of the Integrated Report is to provide water quality data for both surface and ground waters and to fulfill Section 303(d) of the federal Clean Water Act and the Water Quality Planning and Management regulation at 40 CFR Part 130 for the State of Illinois.[47]

This watershed plan focuses on the surface water data as it relates to waterbodies within the Boone-Dutch Creek planning area. The Integrated Report seeks to assess the extent to which waterbodies support a set of recognized designated uses. Each designated use has a related standard for which the designated use for that stream or lake is protected. Illinois EPA has seven possible designated uses; however, only five of those uses apply within the Boone-Dutch Creek planning area. These are Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, and Aesthetic Quality. A waterbody is considered not fully supporting of a designated use if it does not meet the related standard. These standards are derived from several types of information including biological data, water chemistry, in stream habitat, and toxicity data. Table 17 shows the three tier rating system associated with each standard.

Table 17. Levels of designated use attainment.

Level of Use Support	*General Resource Quality*	*Relationship to Water Quality Standard*	*Impaired? (on 303(d) List)*
Fully Supporting	Good	Meets Standard	No
Not Supporting	Fair	Does not meet standard	Yes
Not Supporting	Poor	Does not meet standard	Yes

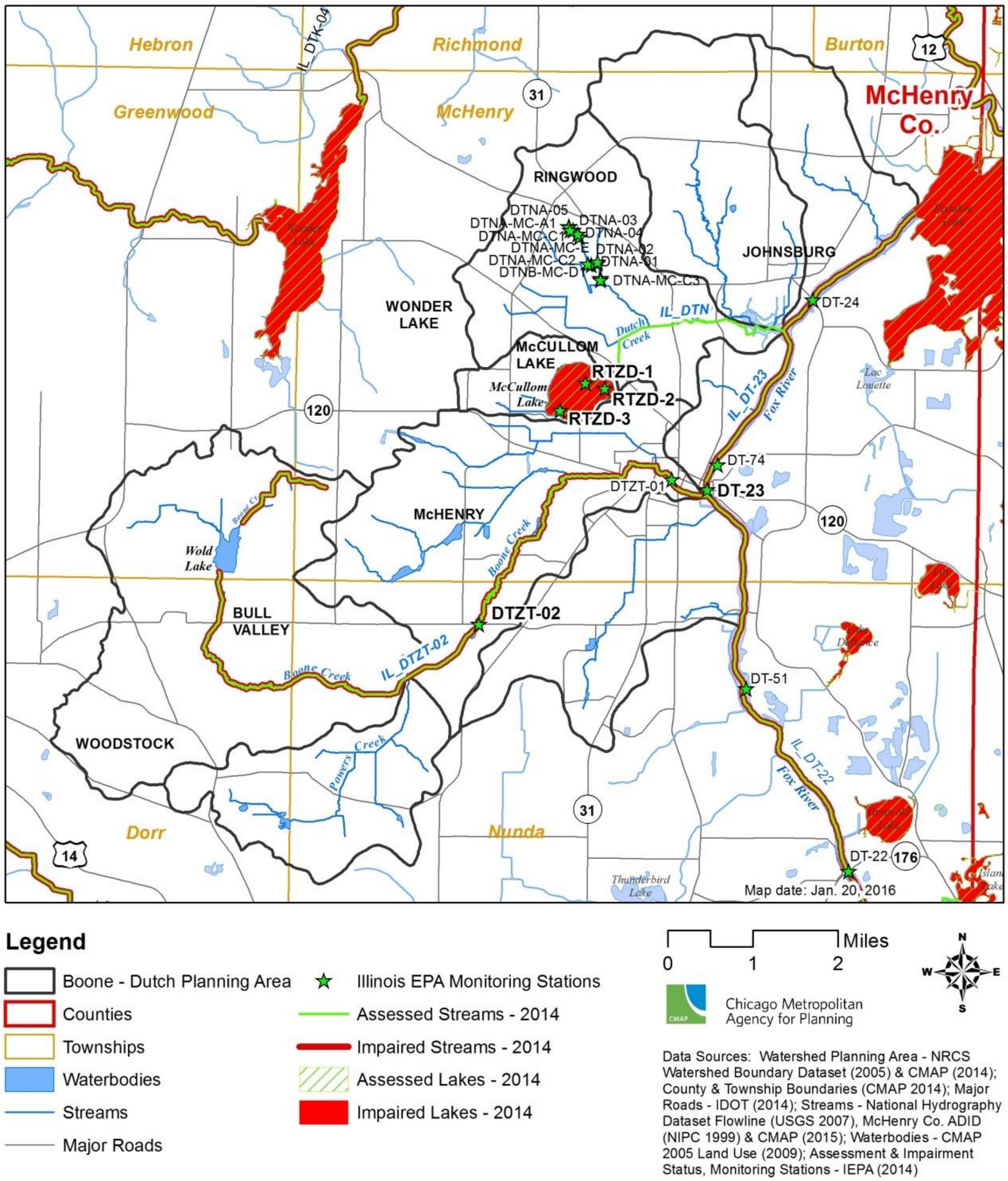
Waters found to be not fully supporting of any of the seven designated uses as an outcome of an assessment are said to be impaired and placed on the 303(d) List. Removing waterbodies from the 303(d) List is a main objective of watershed planning projects like the Boone-Dutch Creek Watershed-Based Plan. The following sections summarize the available information from the Integrated Report relevant to these efforts.

Boone Creek, McCullom Lake, and Fox River segment DT-23 have been assessed for water quality impairments. Monitoring station locations are shown in Figure 41. Dutch Creek, Powers Creek (a tributary to Boone Creek), and the direct drainage tributaries to the Fox River within

[47] IEPA. 2014. "Illinois Integrated Water Quality Report and Section 303(d) List DRAFT." Accessed December 1, 2014. Available at: http://www.epa.state.il.us/water/tmdl/303d-list.html.

the planning area have not been monitored by Illinois EPA and therefore have not been assessed.

Figure 41. Illinois EPA monitoring stations and waterbody impairment status in the Boone-Dutch Creek planning area.



The following three tables summarize the designated uses, assessment status, and impairment status of Boone Creek, McCullom Lake, and Fox River segment DT-23, respectively. Table 21 provides more details including the causes and sources of impairment as determined by Illinois EPA in their 2014 Integrated Report.[48]

Table 18. Assessment status of Boone Creek segment DTZT-02

Designated Use	*Use ID*	*Assessed in 2014 Integrated Report?*	*Impaired? (on 303(d) List)*
Aquatic Life	582	Yes	Yes
Fish Consumption	583	No	n/a
Primary Contact	585	No	n/a
Secondary Contact	586	No	n/a
Aesthetic Quality	590	No	n/a

Table 19. Assessment status of McCullom Lake, RTZD

Designated Use	*Use ID*	*Assessed in 2014 Integrated Report?*	*Impaired? (on 303(d) list)*
Aquatic Life	582	Yes	No
Fish Consumption	583	No	n/a
Primary Contact	585	No	n/a
Secondary Contact	586	No	n/a
Aesthetic Quality	590	Yes	Yes

Table 20. Assessment status of Fox River segment DT-23

Designated Use	*Use ID*	*Assessed in 2014 Integrated Report?*	*Impaired? (on 303(d) list)*
Aquatic Life	582	Yes	Yes
Fish Consumption	583	Yes	Yes
Primary Contact	585	Yes	No
Secondary Contact	586	Yes	No
Aesthetic Quality	590	No	n/a

[48] Illinois Integrated Water Quality Report and Section 303(d) List - Volume I: Surface Water – 2014. Available at: http://www.epa.state.il.us/water/tmdl/303d-list.html#2014

Table 21. Assessment status of waterbodies in the Boone-Dutch Creek planning area.*

Waterbody Name / ID	*Stream Length / Surface Area*	*Watershed Area*	*Impaired Designated Use*	*Causes of Impairment*	*Sources of Impairment*
Boone Creek / IL_DTZT-02	11.81 mi.	15,030 ac. (23.5 sq. mi.)	Aquatic life	pH; Alteration in streamside or littoral vegetative covers; Other flow regime alterations	Loss of riparian habitat; Impacts from hydrostructure flow regulation/ modification; Site clearance; Unknown
Dutch Creek / IL_DTN	2.76 mi.	8,168 ac.** (12.8 sq. mi)	Not assessed	n/a	n/a
McCullom Lake / IL_RTZD	245 ac.	873 ac. (1.4 sq. mi.)	Aesthetic quality	Unknown; Aquatic plants (Macrophytes)	Internal nutrient recycling; Waterfowl; Crop production; Urban runoff/storm sewers; Runoff from forest/ grassland/parkland
Fox River / DT-23	7.77 mi.	---	Aquatic life; Fish consump-tion	Alteration in streamside or littoral vegetative covers; Other flow regime alterations; PCBs; Aquatic algae; Unknown	Impacts from hydrostructure flow regulation/modification; Dam or impoundment; Habitat modification other than hydromodification; Unknown

*as indicated in the Illinois Integrated Water Quality Report and Section 303(d) List, 2014
**does not include the McCullom Lake watershed

Since Boone Creek, McCullom Lake, and Fox River Segment DT-23 were assessed for aquatic life, and also fish consumption in the case of the Fox River, the sections below examine these designed uses in more detail, including how Illinois EPA defines the designated use, the standard for each, and the assessment data by which the impairment determination was made.

Aquatic Life Designated Use Assessment – Streams

Illinois EPA relies on biological, water chemistry, and physical habitat data to determine the extent to which a stream supports aquatic life. Primarily, three biological indices are used in assessing stream quality: the fish Index of Biotic Integrity (fIBI), the macroinvertebrate Index of Biotic Integrity (mIBI), and the Macroinvertebrate Biotic Index (MBI). Fish IBI scores can range from 1 to 60, mIBI scores from 0 to 100, and MBI scores from 0 to 11. For each index, higher scores indicate better stream quality. Table 22 presents these standards and interpretation related to these indices.

Table 22. Biological indicators used for stream assessments.

Biological Indicator:[49]			
Fish Index of Biotic Integrity (fIBI)	≤ 20	> 20 and < 41	≥ 41
Macroinvertebrate Index of Biotic Integrity (mIBI)	≤ 20.9	> 20.9 and < 41.8	≥ 41.8
Macroinvertebrate Biotic Index (MBI) *(used if mIBI is not available)*	> 8.9	> 5.9 and ≤ 8.9	≤ 5.9
Interpretation:			
Impairment Status	Severe Impairment	Moderate Impairment	No Impairment
Designated Use Support	Not Supporting	Not Supporting	Fully Supporting
Resource Quality	Poor	Fair	Good

Illinois EPA uses a detailed decision matrix combining the biological indices scores with water chemistry data and habitat information to determine the level of aquatic life use support. One of the habitat information sources is another index, the Qualitative Habitat Evaluation Index, QHEI. The QHEI evaluates habitat corresponding to the physical features that affect fish and other biotic communities. The index ranks the conditions of six factors: substrate, instream cover, channel morphology, riparian and streambank conditions, pool and riffle quality, and steam gradient. QHEI scores range from 0 to 100 where higher scores indicate better quality habitat.

Table 23 shows the scores for the Aquatic Life biological indicators for Boone Creek and Fox River Segment DT-23.[50]

Table 23. Biological indices scores for assessed streams in the Boone-Dutch Creek planning area.

Biological Indicator	*Boone Creek IL_DTZT-02*		*Fox River DT-23*	
Year of data collection	2007	2012	2007	2012
Fish Index of Biotic Integrity (fIBI)	36	36	42	27
Macroinvertebrate Index of Biotic Integrity (mIBI)	43.6	61.4	---	19.5
Macroinvertebrate Biotic Index (MBI)	---	---	8.3	---
Qualitative Habitat Evaluation Index (QHEI)	48	64	---	40

[49] Illinois Integrated Water Quality Report and Section 303(d) List - Volume I: Surface Water – 2014. Available at: http://www.epa.state.il.us/water/tmdl/303d-list.html#2014

[50] Data provided by Howard Essig, Illinois EPA-Des Plaines, via email message to the author(s), April 29, 2015.

Fish Consumption Designated Use Assessment

Illinois EPA found the specific cause for Fish Consumption in Fox River Segment DT-23 to be polychlorinated biphenyl (PCB) contamination. PCBs can enter waterways from runoff flowing over poorly maintained hazardous waste sites that contain PCBs; illegal disposal of PCB waste; disposal of products containing PCBs that are dumped into landfills not authorized to handle PCB waste; and sites where electrical transformers containing PCBs have leaked.[51]

Table 24 contains the guidelines used in the Integrated Report for determining impairment status for Fish Consumption from PCBs. The degree of use support for Fox River segment DT-23 is Not Supporting, given that the Illinois Department of Public health has annually issued restricted fish consumption advisories. For 2014, these restrictions included carp, channel catfish, and fresh water drum.[52]

Table 24. Guidelines used for assessing fish consumption designated use.

Degree of Use Support	*Guidelines*
Fully Supporting (Good)	PCBS are less than 0.06 mg/Kg and chlordane is less than 0.16 mg/kg in fish tissue in the two most recent years of samples for each species collected since 1985; and mercury is less than 0.06 mg/kg in fish tissue in the two most recent years of samples for each species collected since 1985, and those samples include at least one predator species of a “large size class” in two different years.
Not Supporting (Fair)	A water body-specific, “restricted consumption” fish consumption advisory is in effect; or, mercury is greater than or equal to 0.06 mg/kg in fish tissue of any species, in at least one of the two most recent years of samples collected in 1985 or later.
Not Supporting (Poor)	A “no consumption” (i.e., “Do Not Eat”) fish-consumption advisory, for one or more fish species, is in effect for the general human population; or, a commercial fishing ban is in effect.

[51] “Polychlorinated Biphenyls (PCBs) Basic Information,” U.S. EPA, last modified April 8, 2013, accessed December 1, 2014, http://www.epa.gov/osw/hazard/tsd/pcbs/about.htm.

[52] “2014 Sports Fish Consumption Advisory,” IDPH, accessed December 1, 2014, http://www.idph.state.il.us/envhealth/fishadvisory/foxriver.htm.

3.5.5.2 Other Stream Studies

FISH INVENTORIES[53]

This report is primarily focused on the presence of species found in Boone and Dutch Creeks in 2004-15 which were listed in *The Illinois Comprehensive Wildlife Conservation Plan & Strategy,* commonly referred to as the Illinois Wildlife Action Plan (IWAP).[54] The surveys were accomplished during the development of this watershed-based plan in order to provide a better understanding of the scope of biodiversity throughout the Boone-Dutch Creek Watershed planning area; 25 sites were inventoried. Previous inventories in Boone Creek only focused on about five or six stretches. Dutch Creek had only two, single-sites inventories in the last ten years.

The large number of inventory sites for this assessment were selected because it was felt that basing the watershed study on a small number of downstream stretches would not provide a clear understanding of its overall health and biodiversity. Boone Creek's IBI ratings in past years were accomplished in stretches where it flowed as a third order stream. The Illinois EPA site (IL_DTZT-02) which has been used through the years for its stream assessment rating is located at Bull Valley Road where the creek is third order. Most of the other IBI's accomplished by the Illinois DNR in its Fox River Basinwide surveys were also in third order locations.

However, many of Boone Creek's first and second order headwater stretches provide cold, spring-fed and wetland-fed groundwater which provides excellent conditions for five of the six Boone Creek IWAP-listed species: mottled sculpin, southern redbelly dace, blacknose dace, brook stickleback, and central mudminnow. Additionally, the Iowa darter was found in low gradient creek stretches. An American lamprey was also found.

The Dutch Creek system is composed of a main stem and two major branches, the North Branch (within subwatershed #6) and the West Branch (within subwatershed #5); and two smaller branches, the East Branch (within subwatershed #6) and the McCullom Lake Branch (subwatershed #4). Within the Dutch Creek system, the 2014-15 inventories identified the presence of five IWAP species: southern redbelly dace, blacknose dace, brook stickleback, central mudminnow, and largemouth bass.

Past Surveys of the Aquatic Diversity of Boone and Dutch Creeks

The Boone Creek system has been partially inventoried in the recent past, primarily for fish species, though several mussel inventories were also accomplished (McHenry County Conservation District – 1995; Roger Klocek – 1996, 2010; Illinois DNR – 5-year Fox River Basin Study cycle). These studies, while small in the number of geographic locations assessed,

[53] This section was written by Ders Anderson, Openlands, provided via email correspondence to the author(s), November 20, 2015. The accompanying figures and photos also were provided by Ders Anderson.

[54] http://www.dnr.illinois.gov/conservation/IWAP/Pages/default.aspx

identified significant fish diversity, pollution-sensitive and temperature-sensitive species, as well as the presence of state-threatened mussel species.

The McHenry County Conservation District (MCCD) 1995 inventory found 3 mottled sculpins close to the headwaters of the main stem of Boone Creek, at Bull Valley Road near the discharge of a hunt club dam. Just two miles downstream in better habitat at Cherry Valley Road, 54 were found, and two miles farther downstream at Bull Valley Road 48 more were identified. The Cherry Valley Road location also had small numbers of central mudminnows, a wetland species probably associated with the low gradient waters flowing through the upstream Boone Creek Fen (Illinois Nature Preserve) or the downstream Boone Creek Golf Course. Three darter species also were an indication of the high quality habitat. At the third order lower reach of Boone Creek in downtown McHenry at Whispering Oaks Park, 24 species were present, resulting in an IBI of 54. Twelve blacknose dace were found along with five darter species.

The Whispering Oaks site was also noteworthy because of the presence of 1 ellipse mussel (MCCD – 1996 survey), which when re-surveyed by MCCD in 2007, identified 10 ellipse mussels and 1 slippershell. Ellipse mussels depend on orangethroat darters, johnny darters, and mottled sculpins to host their glochidia. Slippershell mussels depend on johnny darters and mottled sculpins. There is evidence that at some date in the recent past a total die-off of slippershell mussels may have occurred. Recent mussel surveys by Roger Klocek since 2010 turn up calcified shells of numerous slippershells in several locations throughout the Boone Creek system. The calcification is present because of the mineral-rich groundwater surcharge occurring in many locations along Boone Creek.

Illinois DNR fishery biologists have also periodically surveyed Boone Creek at several downstream locations in their 5 year cycle of the Fox River Basin Study. These reports have not been obtained as part of this watershed planning study but provide additional natural resource information. [Note: See Table 23 for Illinois EPA's biological indices scores from its 2007 and 2012 surveys. The Boone Creek fish IBI score at Bull Valley Road was 36 both years.]

The Dutch Creek Watershed, on the other hand, has been little inventoried in the past. MCCD inventoried a lower stretch of the main stem, east of Route 31, in 1996, which was in good structural shape with meanders, pools, and riffles. Only 11 relatively common species were identified, with the exception of one IWAP-listed brook stickleback. In 2004, MCCD inventoried a lower reach of the North Branch just north of Johnsburg Road and found four IWAP species: 1 southern redbelly dace, 14 blacknose dace, 1 brook stickleback, and 1 central mudminnow. Fifty-eight orangethroat darters were found as well, raising the possibility of the presence of important mussel species.

Influence of Soils and Surficial Geology on Aquatic Habitat

Both the Boone Creek and Dutch Creek Watersheds lie within heavy deposits of glacial-age sands and gravels. Rainfall is substantially infiltrated in 70-80 percent of the area of the upper watersheds of both creek systems. Because of this high rate of infiltration, groundwater surcharging of the creeks is evident in many locations (note the sensitive aquifer recharge areas in Figure 40). The rapidly and moderately permeable soils throughout the watershed provide positive aquatic habitat features (cool temperatures, constant baseflows), but because of the permeability they can also introduce a different scale and diversity of pollutant loadings within the groundwater baseflows.

There are also large organic soil-based wetlands throughout both systems which do provide a second source of groundwater surcharging. Seeps along the creek banks in locations of both permeable and peaty organic soils were regularly encountered during the 25 fish surveys. Many of these large bordering wetlands to the creek system have been preserved through public agency acquisitions or private landowner dedications as conservation easements. In at least one case in the City of McHenry, homes and neighborhoods were built on these soils, and subsurface drainage structures were installed to keep groundwater below building foundations or at least to minimize basement infiltrations. These drainage structures provide additional discharge of groundwater into the creeks.

A preliminary review of aerial photographs and site visits within the Boone Creek Watershed identified at least 45 individual sources of normal season perennial flow in the main stem portion of the Boone Creek watershed. Most of these were groundwater based sources but also included groundwater and surface water-fed ponds and detention facilities and storm sewer discharges. The Powers Creek subwatershed had at least 25 additional sources.

Pollutants Affecting Aquatic Life

Data on regulated or unregulated pollutants was not available for the 25 inventory sites. Only a small number of pollutants are regulated. However, 84,000 chemical compounds, which may have differing levels of toxicity to aquatic life, are registered with the U.S. EPA as required by the federal Toxic Substances Control Act of 1976. Only a fraction of these have been fully tested for health effects on humans. A fraction of this fraction has been tested for effects on aquatic life. Research over the last 10-15 years has shown substantial effects on aquatic life from antibiotics, estrogen, salts, driveway sealers, and other chemical agents and compounds which are not treated or removed by wastewater treatment facilities, including septic systems located in permeable soils which may directly affect creek recharge. Over the past ten years, the U.S. EPA and U. S. Geological Survey have substantially expanded their efforts to identify some of these “emerging contaminants” and their presence in the nation’s river and creek systems. Research is ongoing, and it is possible that especially deleterious chemicals may become regulated in the future.

Accomplishing the 2014-2015 Inventory

During the first stakeholder meeting for this watershed plan in June 2014, several attendees strongly recommended that updated biological information was needed because previous inventories were both too old and not comprehensive with regard to the planning area’s streams. While the old inventories showed that Boone Creek supported indicator fish species that signified the presence of relatively high quality habitats, there remained the question of whether these species were still present in 2014. In addition, there was recognition that the Boone Creek system was actually little studied in terms of its first and second order headwater stretches. Dutch Creek was minimally studied in any of its stretches. However, no funding was available to retain aquatic biologists, and under the timeframe of the planning process, the stakeholders were afforded only a short period to accomplish updated inventories, which were dependent on the availability of aquatic biologists. As a stakeholder in the planning process, Openlands volunteered to attempt to enlist aquatic biologists who might be willing to volunteer, pro-bono, their time to the project, if only for one to three days each year. Six biologists committed to the inventory: Phil Willink, Roger Klocek, Jim Bland, Randy Schietzelt, Cindi Jablonski, and Brad Woodson. Additionally in 2015, Logan Gilbertsen volunteered his time.

Figure 42. Fish inventory volunteers knee-deep in Boone Creek in 2014.

For the purpose of preparing an updated inventory of fish species, it was felt that accomplishing a rapid assessment of the presence of those species listed in the Illinois Wildlife Action Plan should be the focus. Other species would be identified as well if time allowed. If total numbers were not counted for each species of fish collected, at least presence or absence would be determined. It also was decided that a much broader number of inventory sites would be utilized. Openlands identified potential inventory sites at park sites or undeveloped lands owned by local governments, as well as land holdings of the local land trust, The Land Conservancy of McHenry County (TLCMC). A number of private property owners who appeared to have good riparian habitats were contacted, including those who had established conservation easements on their land. In 2014, eleven sites were inventoried in the Boone Creek Watershed and four in the Dutch Creek Watershed. Approximately 20 additional prospective sites were identified throughout the two watersheds, but there was not time to contact and obtain access permission from the property owners. A follow-up on these sites was planned for 2015, and ten additional sites were inventoried that year. Table 25, Figure 43, Figure 44, and Figure 45 present the inventory locations; Appendix E provides site-specific species data.

Summary of the August – October 2014 Inventories

Eleven stretches of the Boone Creek system were inventoried in 2014 (Figure 43, Table 25). Four IWAP species were present among seven different sites: 1) Iowa darters at Whispering Oaks Park and Dartmoor Drive, 2) central mudminnows at Dartmoor Drive and Ericksen, 3) brook stickleback at Gladstone, and 4) mottled sculpins at Ericksen, Powers Creek, and Burkes.

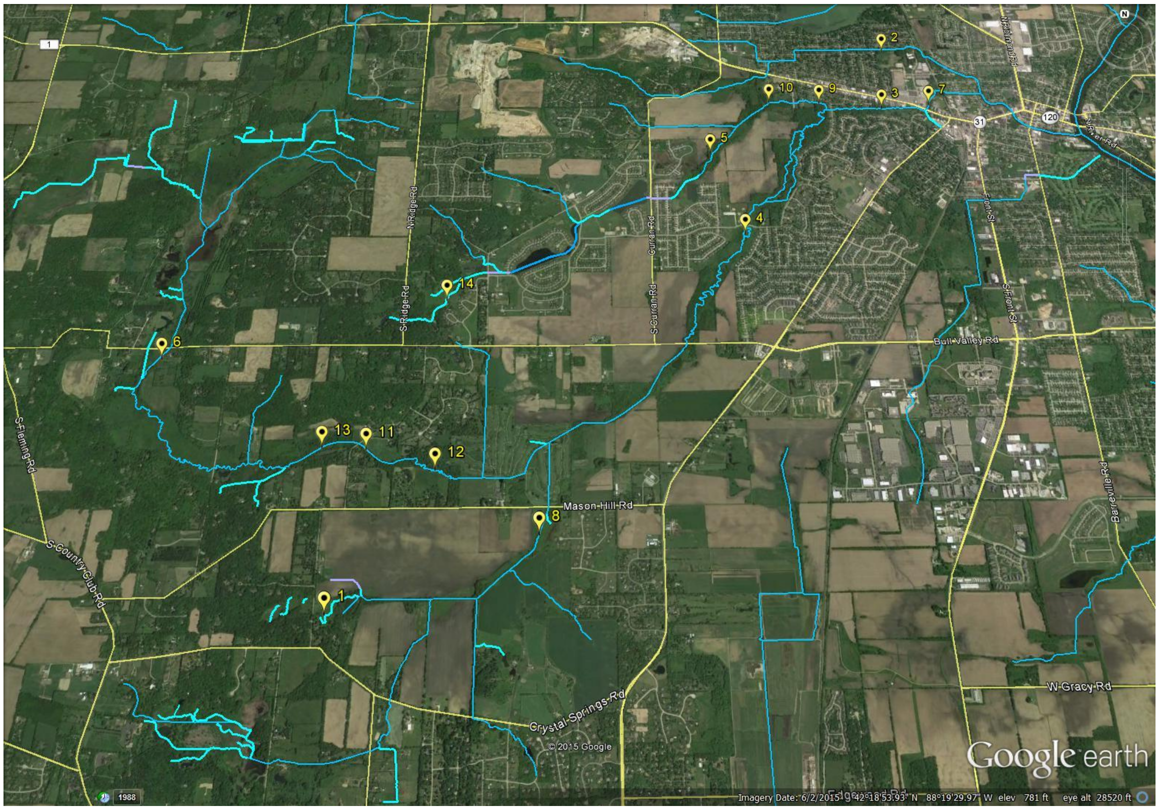
There are especially noteworthy landscape features that are responsible for sustaining these fish species in each location. Very large wetland buffers adjoin Boone Creek at Dartmoor Drive and immediately upstream of Whispering Oaks Park. The Ericksen property includes a short headwater stretch of Boone Creek with pools and riffles just below an old dam discharge of the upper headwaters owned almost entirely by MCCD and IDNR. Thus water quality is probably high, but the short run of the creek on the Ericksen property then flows through one mile of peaty soil with sluggish creek meanders and less habitat diversity, even though this stretch has excellent groundwater surcharge from INAI and INPC sedge meadows, fens, and marshlands. Thus the Ericksen stretch is isolated, which may be minimizing the number of species. In 1995, MCCD inventoried the Ericksen site and found 58 orangethroat darters, as well as three mottled sculpins.

Table 25. Fish inventory locations in the Boone-Dutch Creek planning area, 2014-15.

Boone Creek system			*Dutch Creek system*		
Site Number	**Description**	**Year**	**Site Letter**	**Description**	**Year**
1	Gladstone	2014	A	Sweetwater Lane	2014
2	Althoff Park	2014	B	Burhoe	2014
3	Whispering Oaks Park	2014	C	Remington Grove	2014
4	Dartmoor Drive	2014	D	Peterson Farm	2014
5	Miglin	2014	E	Johnsburg Park	2015
6	Ericksen	2014	F	Pioneer Fen	2015
7	Jewel	2014	G	Larkspur Lane	2015
8	Powers Crk TLCMC	2014	H	North Johnsburg Road	2015
9	Glen Drive	2014	I	South Johnsburg Road	2015
10	Scully Drive	2014	BB	Johnsburg Jr. High	2015
11	Burkes	2014			
12	Bradley/Crosby	2015			
13	Byrnes/Goerner	2015	***Sunnyside Creek***		
14	Boloria	2015	AA	n/a	2015

The Gladstone property is a Powers Creek headwater seep with generally an inch of water, a width of less than two feet, and good habitat for brook sticklebacks, which were present. The Powers Creek/TLCMC stretch had pools and riffles, some meandering, and cold water, but with substantial channelization upstream of the site as well as several subdivisions. Howver, almost 400 upstream acres are preserved as dedicated open space, plus even more acreage managed as agricultural or pasturelands. This site had high numbers of mottled sculpins in the past and still is the second richest site for this species found in the entire Boone Creek watershed in the 2014 inventories. The Burkes site had in the recent past been heavily impacted by silt and sandy sediment. It lies just a few hundred yards east of the glacial valley discharge of the main stem of Boone Creek where water volume quickly loses its velocity as it hits the flat glacial lake plain where the Burkes site is located. Nonetheless, water quality is probably very high because of the significant acreage of aforementioned protected INAI wetlands immediately upstream, as well as a significant number of valley wall seeps and springs. This was also a site with a historically large number of mottled sculpins previously inventoried, and it still represents the highest concentration of this species in sites inventoried in 2014.

Figure 43. Fish inventory locations in the Boone Creek Watershed, 2014-15.



Four stretches of the Dutch Creek system were inventoried in 2014 (Sweetwater Lane, Burhoe, Remington Grove, and Peterson Farm) (Figure 44, Table 25). Four IWAP species were present: 1) central mudminnows at all four sites, 2) brook sticklebacks at Sweetwater Lane and Burhoe,3) blacknose dace at Remington, and 4) southern redbelly dace at Sweetwater Lane and Burhoe. Landscape features responsible for sustaining these species include substantial protection of the upper watershed of the North Branch of Dutch Creek by MCCD and conservation easements held by the TLCMC. These environmentally managed landholdings buffer and sustain the North Branch of Dutch Creek at both the Burhoe and Sweetwater sites. The Peterson site is a channelized stretch which lies within a large peaty wetland expanse. It is sustained by groundwater discharge from its wetland. It is also fed by the drainage discharge from McCullom Lake which probably degrades a number of pollutants within the lake waters due to phyto-remediation and sunlight [and settling] before discharging to the Peterson farm site. The Remington site lies within a just-started subdivison of over 100 lots, of which only a few had homes built before the recent recession. Much of the upper watershed of this West Branch tributary is undeveloped with large wetlands, but there is substantial creek channelization and the presence of major industrial facilities with registered hazardous waste issues. Possibly the pollutants may be degraded before reaching the Remington site. This is the only site in the Dutch Creek Watershed where blacknose dace, an IWAP species, was identified in large numbers.

Figure 44. Fish inventory locations in the North, West, and McCullom Lake Branches of Dutch Creek, 2014-15.

An interesting habitat phenomenon was seen in the North Branch of Dutch Creek. Significant numbers of orangethroat darters were identified in the 2004 MCCD inventory, which while the sampling site was not clearly identified, seemed to be located close to Johnsburg Road within a quarter mile of the Fox River backwater part of Dutch Creek. (Four IWAP species were also found here in 2004: central mudminnow, brook stickleback, blacknose dace, and southern redbelly dace.) Approximately one mile upstream on the same tributary, at Sweetwater in the 2014 survey, over 100 rainbow darters were found as well as large numbers on the Burhoe site, but no orangethroat darters. Both the 2004 and the 2014 sites were considered for re-inventory during 2015.

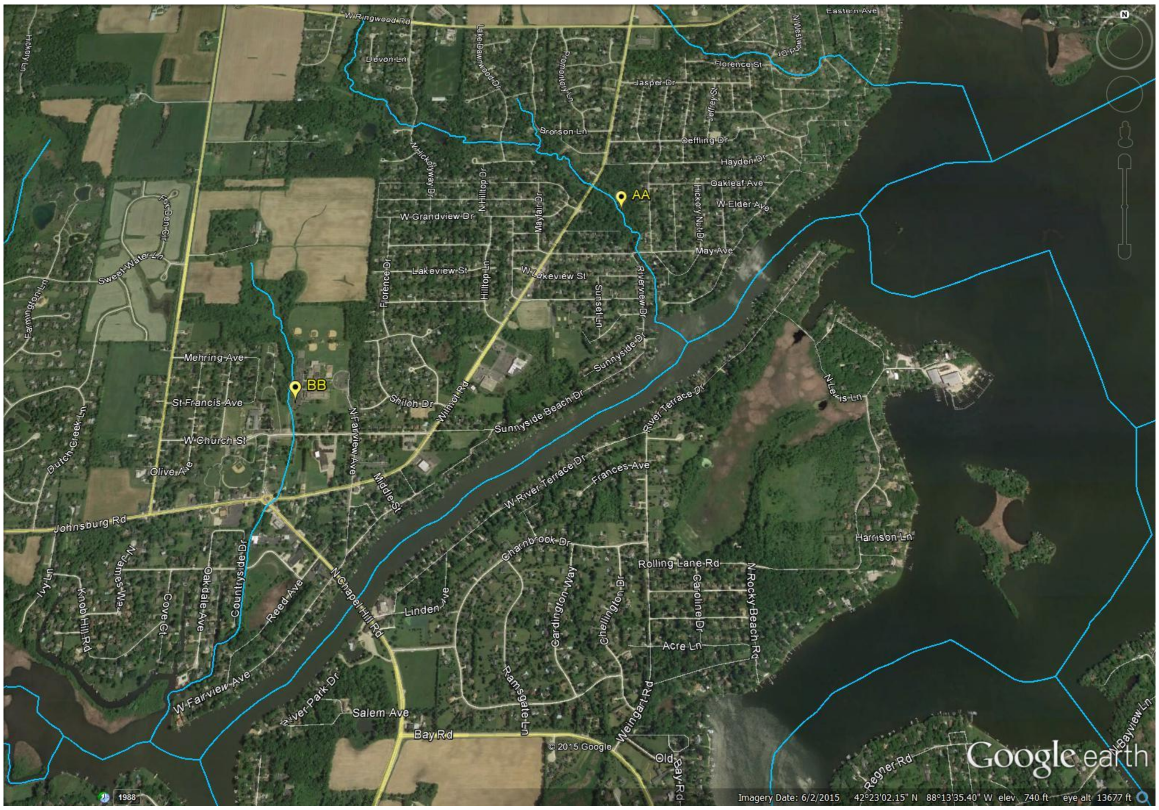
Summary of the September – October 2015 Inventories

Ten additional sites in the planning area were inventoried on September 23 and 30 and October 1, 2015. These included six sites in the Dutch Creek system (five on the North Branch and one on the East Branch), three sites in the Boone Creek system, and one site in a creek directly draining to the Fox River (Sunnyside Creek) in subwatershed #7 (Figure 43, 44, 46; Table 25).

Five IWAP species were found among the Dutch Creek sites: 1) blacknose dace at Pioneer Fen and the Larkspur Lane MCC conservation easement, 2) southern redbelly dace at Larkspur

Lane, 3) largemouth bass at Larkspur Lane and on the north and south side of Johnsburg Road, 4) central mudminnows at Larkspur Lane, the stretch north of Johnsburg Road, and the largest number at Johnsburg park at Sweetwater Lane, and 5) brook sticklebacks at Johnsburg Park and Larkspur Lane. In the East Branch of Dutch Creek, which is approximately 2/3 of a mile long with half of this length represented by a concrete channel with no habitat value, no fish were found in a short stretch of natural stream immediately upstream of the concrete channel at the Johnsburg Jr. High School site.

Figure 45. Fish inventory locations in the East Branch of Dutch Creek and Sunnyside Creek, 2015.



The five additional sites inventoried during 2015 on the North Branch of Dutch Creek, when combined with the two sites sampled in 2014, provide a unique intensive survey of seven sites within only 1.6 miles of creek corridor. While IWAP species were identified at each location, the two sites on the north and south side of Johnsburg Road proved to be the least biologically rich and sensitive locations with one and two IWAP species, respectively. Yet this site would probably have been a typical location for an Illinois DNR basin-wide inventory. (Note: Dutch Creek is not yet included in the Fox River Basin inventory). The richest site with five IWAP species was located in the back of privately owned lots where a conservation easement allowed for access to accomplish the inventory. Three other 1st and 2nd order headwater sites were habitat for three IWAP species, all proving to be richer in habitat diversity than the Johnsburg Road sites (Figure 47).

Three additional sites along the main stem of Boone Creek were inventoried in 2015. Three IWAP species were present: 1) brook sticklebacks and 2) mottled sculpins at Byrnes/Goerner and Bradley/Crosby, and 3) American brook lamprey at Bradley/Crosby. It is probable that the number of sculpins and sticklebacks at the Byrnes/Goerner site was greatly underestimated.

Water temperature was 52°F, and after almost 300 yards of inventorying, only 6 mottled sculpins were found and no other species. The survey team felt that possibly the cold water was causing the fish to move downstream. At the stopping point, with the back pack shocker turned off, Randy Schietzelt swept his net several times through a mass of eelgrass and captured 10 sculpins plus a brook stickleback and a creek chub. If this was typical of all of the aquatic vegetation masses which were passed by while electroshocking, the stunned fish would have been trapped within the aquatic vegetation and not seen, explaining the low number actually observed. This stretch of Boone Creek was bordered on both sides by wetlands with occasional fen plant species, but otherwise heavily shaded by invasive shrubs. In addition, the creek had been historically channelized, although there was good pool and riffle structure.

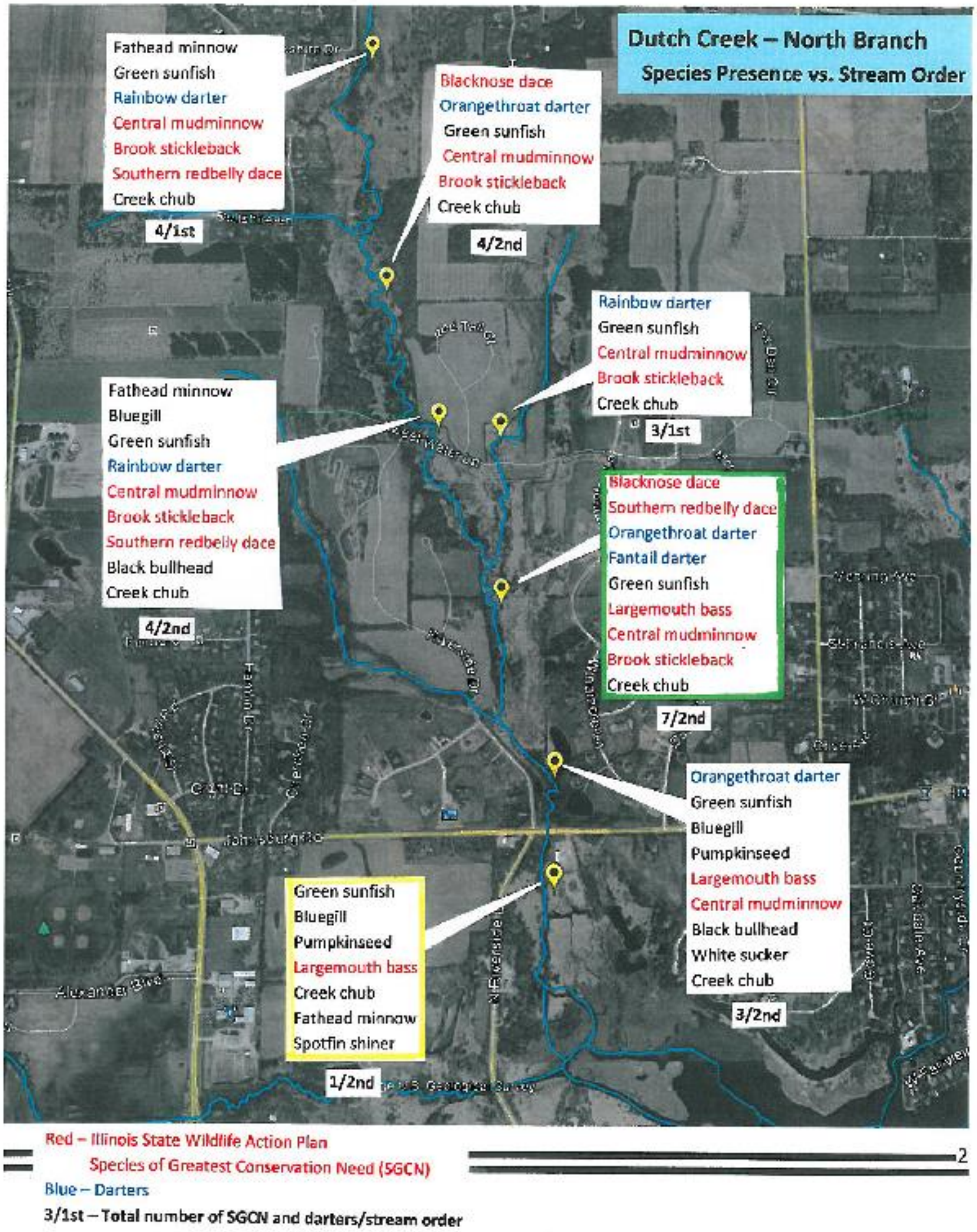
The following day, the Bradley/Crosby site was inventoried, 0.4 miles downstream from the Byrnes/Goerner stretch. This stretch was in excellent natural condition with little invasive shrub growth on the banks, large meanders, and excellent pools and shallows. Water temperature wasn't measured, but seemed somewhat warmer than the previous day upstream. Fifty-nine mottled sculpins, an American brook lamprey, and a brook stickleback were present.

Figure 46. Stream inventory volunteers talking with Johnsburg Jr. High School students during the 2015 fish inventory in the East Branch of Dutch Creek.

A headwaters to Boone Creek was inventoried at Boloria Nature Preserve where a small flow discharges from an ephemeral wetland. No fish species were found, although it was rich in snails, frogs, crayfish, and macroinvertebrates.

The direct drainage signified by subwatershed #7 may be known locally as Sunnyside Creek. It is only 1/3 mile long before being bisected by an upstream culvert discharge from an in-line pond. It was dominated by creek chubs and seemed to be heavily impacted by stormwater surges.

Figure 47. Fish species by site in Dutch Creek - North Branch, 2014-15.



Observations and Recommendations

- Overall fish diversity, as well as the presence of Illinois Wildlife Action Plan "Species of Greatest Conservation Need" is best understood through a comprehensive inventorying of the stream system. Fish diversity can shift substantially in relatively short distances depending on the quality of the habitat niches in the stream stretch that are sampled.

- Access to private property opens up the opportunity to inventory more comprehensively.

- Landowners who allowed inventories were genuinely interested in knowing what was living on their property. Several asked for best management practices that would preserve or enhance their riparian habitats.

- While several downstream IBIs present a perspective of a stream system's biodiversity and an indication of its overall integrity, they shouldn't be extrapolated to the entire stream system.

- First and second order headwater streams in both Boone and Dutch Creeks provided habitat for the largest number of IWAP species.

- Although 25 creek stretches were inventoried for this watershed plan, this number still doesn't represent a good understanding of the overall distribution of fish species. It's recommended that additional inventories be accomplished as follows:
  - 1 inventory in the headwaters of Boone Creek, above Wold Lake – Subwatershed #1
  - 2 inventories in Powers Creek - Subwatershed #2
  - 1 inventory in the headwaters of the West Branch of Boone Creek – Subwatershed #3
  - 2 inventories in the headwaters and east of Rt. 31 in the Main Stem of Dutch Creek – Subwatershed #5
  - 1 inventory in the West Branch of the Main Stem of Dutch Creek – Subwatershed #5
  - 1 inventory in the Central Direct Drainage unnamed creek – Subwatershed #8
  - 2 inventories in the Southeast Direct Drainage unnamed creek (locally known as Edgebrook Creek) – Subwatershed #9

- An educational outreach should be made to local residents to share the results of the inventories, especially with regard to the high habitat quality both Boone and Dutch Creek provide for the significant number of Illinois Wildlife Action Plan species, as well as other sensitive species that are dependent on clean creek waters. Clean creek waters, in turn, depend on minimal use of pesticides, fertilizer, driveway sealers, and other chemicals by property owners, since storms commonly wash them into storm sewers and then to creeks.

- The Illinois EPA should involve the Illinois DNR in a consultation process when reviewing new discharge permits.

- Inventories should be repeated, at least on a 5 year cycle, in order to maintain an awareness of positive or negative trends to the aquatic biota.

- Stream habitat enhancement should focus on channelized and shaded stretches where invasive shrubs can be removed, adjoining wetlands can be restored to provide groundwater recharge, pools and riffles can be introduced, and re-meandering can be accomplished or allowed to naturally happen. Creek corridors should retain partial shading to minimize algal blooms generated by fertilizer runoff. Algal blooms can drastically cause a decline in dissolved oxygen in the creek at night when the algae are respiring; low dissolved oxygen is one of the primary stressors for fish life and diversity.

Chloride Concentrations

Chloride (CL) concentrations in both groundwater and surface water are increasing and should be viewed as problematic. Primary sources of chlorides are road-salt applications during the winter-time driving season and home water softeners where private wells are in use. Among the 66 potential causes of all designated use impairments in Illinois streams (2014), CL ranks number 15 in number of stream miles (422) impaired.[55]

A numeric standard of 250 mg/L is used as a guideline for determining whether CL is a potential cause of impairment for the Public and Food Processing Water Supply designated use in streams, freshwater lakes, and Lake Michigan.[56] The U.S. EPA has also established a chronic water quality criterion for aquatic organisms as a concentration exceeding 230 mg/L as a four-day average and an acute criterion as a one-hour average concentration exceeding 860 mg/L.[57]

An Illinois State Water Survey dataset of over 100 years documents an unequivocal upward trend in CL concentrations across six counties of northeastern Illinois.[58] While the average CL concentration in the counties monitored remains below the secondary drinking water standard of 250 mg/L, trend lines across all counties suggest the potential for concentrations in shallow wells to reach this level in the future. Should that come to pass, the drinking water from shallow wells (i.e., most private wells) will taste salty. It should also be noted that CL is more persistent in groundwater due to longer flushing or replacement cycles.

Chloride concentrations in surface water feature a more seasonal signature, typically rising in winter/early spring in concert with snowmelt and road runoff and falling to more ambient levels during the summer and fall. Research by the USGS, however, shows that concentrations

[55] The total number of stream miles assessed varies by designated use. For example, all 1,056 steam miles designated for the Public and Food Processing Water Supply use were assessed. Of the 119,158 designated stream miles for Aquatic Life use, 17,432 were assessed. There are 119,244 stream miles in Illinois.

[56] Chloride concentrations (acute) of 500 mg/L would qualify as a potential cause of impairment of Aquatic Life use in Illinois streams and freshwater lakes.

[57] US EPA, Office of Water. 1988. Ambient Water Quality Criteria for Chloride – 1988. EPA 440/5-88-001

[58] Walton R. Kelly. 2008. Long-Term Trends in Chloride Concentrations in Shallow Aquifers near Chicago. *Ground Water* 46(5): 772-781.

are rising throughout the year in the northern U.S. and are positively correlated with percent urban land cover present in the watershed.[59] Furthermore, this same study indicates that the rate of CL concentration increase over time has outpaced the rate of urbanization during the same period, suggesting that other factors beyond urban land cover are contributing to rising concentrations over time. One such factor was found to be road salt sales that increased by 40% more than the rate of urban land cover increase during the study period.[60]

Chloride concentrations are found to be rising over a 10-year sample period in Boone Creek near Illinois Natural Area Inventory (INAI) groundwater seeps (Figure 48, 49, and 50; Table 26; data collected by E. Ellllinghausen, P.E.). The concern here, beyond those discussed, is how unnaturally high levels of CL near/within natural fens will impact this prized and unique wetland community. Fens are sustained by mineral-rich and alkaline groundwater and the plants present in a fen are there in response to the special groundwater chemistry. Chloride-rich water will likely kill many of the plant species present and create an opening for more salt-tolerant invasive species. Such a negative impact on local biodiversity is to be avoided if possible. To avoid all negative impacts will require reductions in the use and application of both road salts and rock salt in water softeners.

Table 26. Chloride sampling locations near Boone Creek INAI groundwater seeps.

Site Number	*Site Name*	*Site Number*	*Site Name*
S2	Stone	**S7**	Staley W.
S3	Kins./Bailey	**S8**	Staley E.
S4	Babcock	**S9**	Dammann
S5	Mikel W.	**S13**	Mikel E.
S6	Kieras/Mikel	---	

[59] Steven R. Corsi, Laura A. De Cicco, Michelle A. Lutz, and Robert M. Hirsch. 2015. River chloride trends in snow-affected urban watersheds: increasing concentrations outpace urban growth rate and are common among all seasons. *Science of the Total Environment* 508(2015): 488-497.

[60] *Ibid*.

Figure 48. Chloride sampling locations near Bonne Creek INAI groundwater seeps.

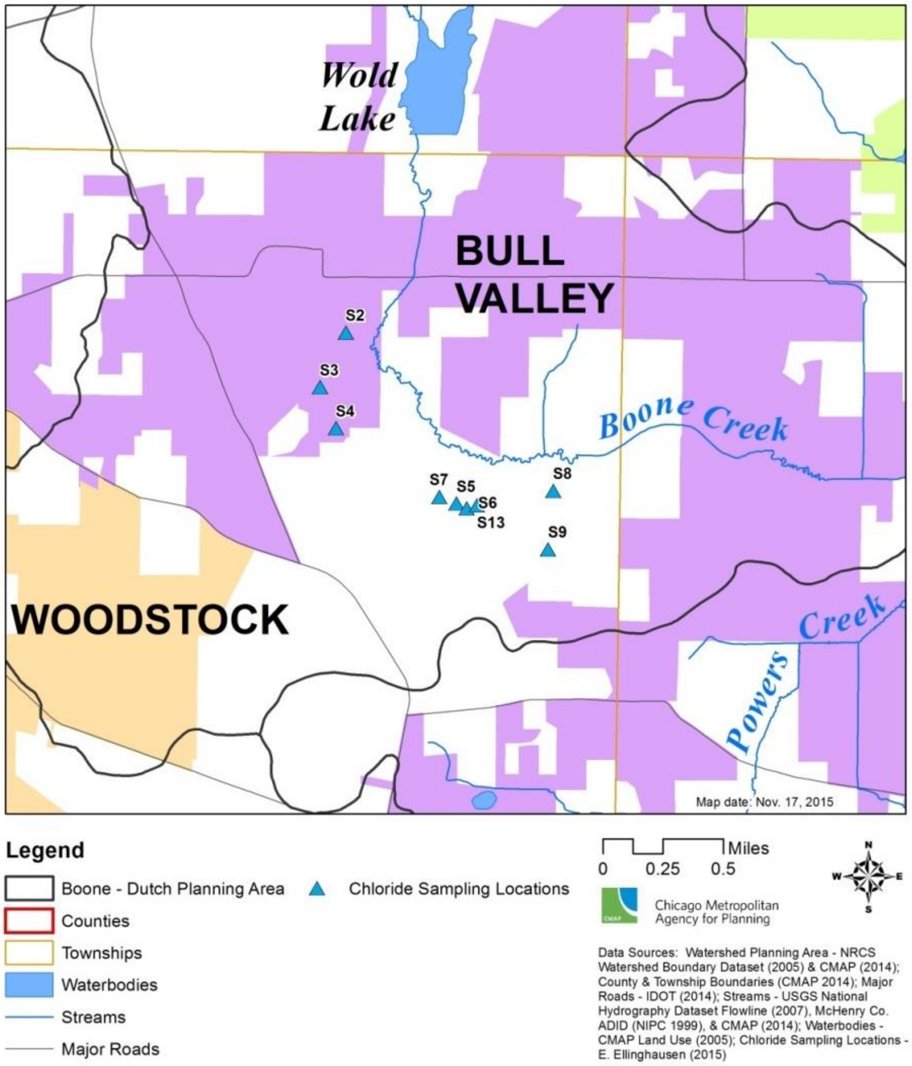


Figure 49. Chloride concentrations near Boone Creek INAI sites over time, 2003-2014.

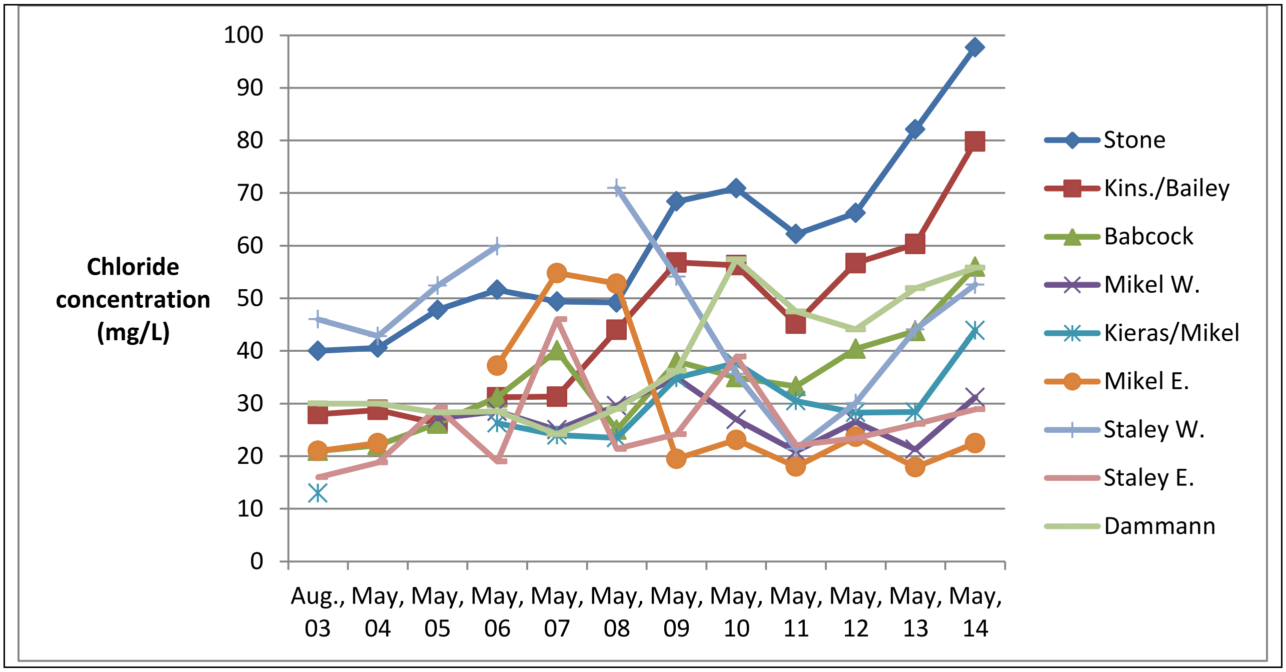
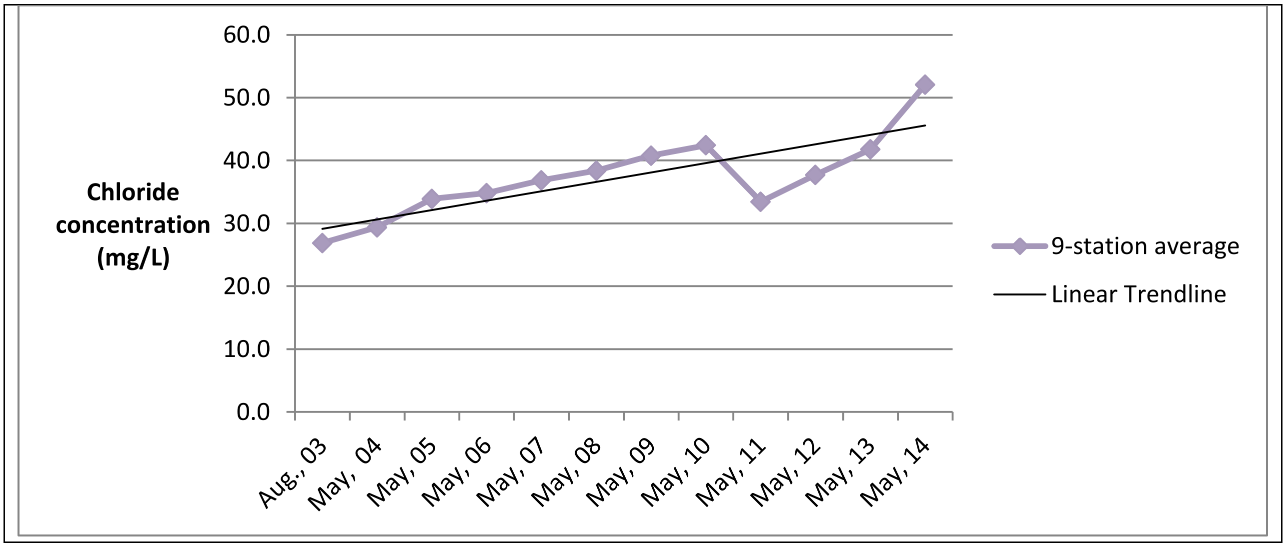


Figure 50. Average chloride concentration near Boone Creek INAI area groundwater seeps over time, 2003-2014.



3.5.5.3 McCullom Lake

Lake Location, Ownership, Use, and Morphometry

This glacial lake is located in the southwest portion of the Dutch Creek Watershed (in subwatershed/study unit #4 in Figure 2), somewhat centrally in the overall Boone-Dutch Creek planning area. Originally shallow and marshy and known as McCullom (McCollum's) Slough, a dam was built circa 1890 at the lake's outlet along the northeast shore, raising the water level approximately 1.5 feet. An approximately 40-foot long, 4-foot wide concrete box flume carries water from the lake to Mass' Pond. A Dutch Creek tributary (dubbed Dutch Creek McCullom lake Branch in this plan) then flows north until its confluence with Dutch Creek, which then continues eastward to the Fox River. The total distance from McCullom Lake's outlet to the Fox River is about three miles.

The majority of the 628-acre contributing drainage area to McCullom Lake lies to its west and north. Initially a summer cottage community surrounded by farmland, McCullom Lake is now surrounded primarily by residential lots. Current watershed land use is about 40 percent residential and 15 percent agricultural (Table 10). Most of the lake lies within the City of McHenry, with the remainder within unincorporated McHenry Township and the Village of McCullom Lake. A majority of the lake bottom is owned by the City of McHenry, with the remainder privately or organizationally owned.

McCullom Lake is used recreationally for swimming, fishing, non-motorized and low-power boating (10 hp limit on boats, 25 hp limit on pontoons), wind surfing, waterfowl observation, and aesthetics. The City of McHenry maintains three public parks along the lakeshore, two with a swimming beach, and a boat launch. The Village of McCullom Lake offers a park, beach, and boat launch for its residents.

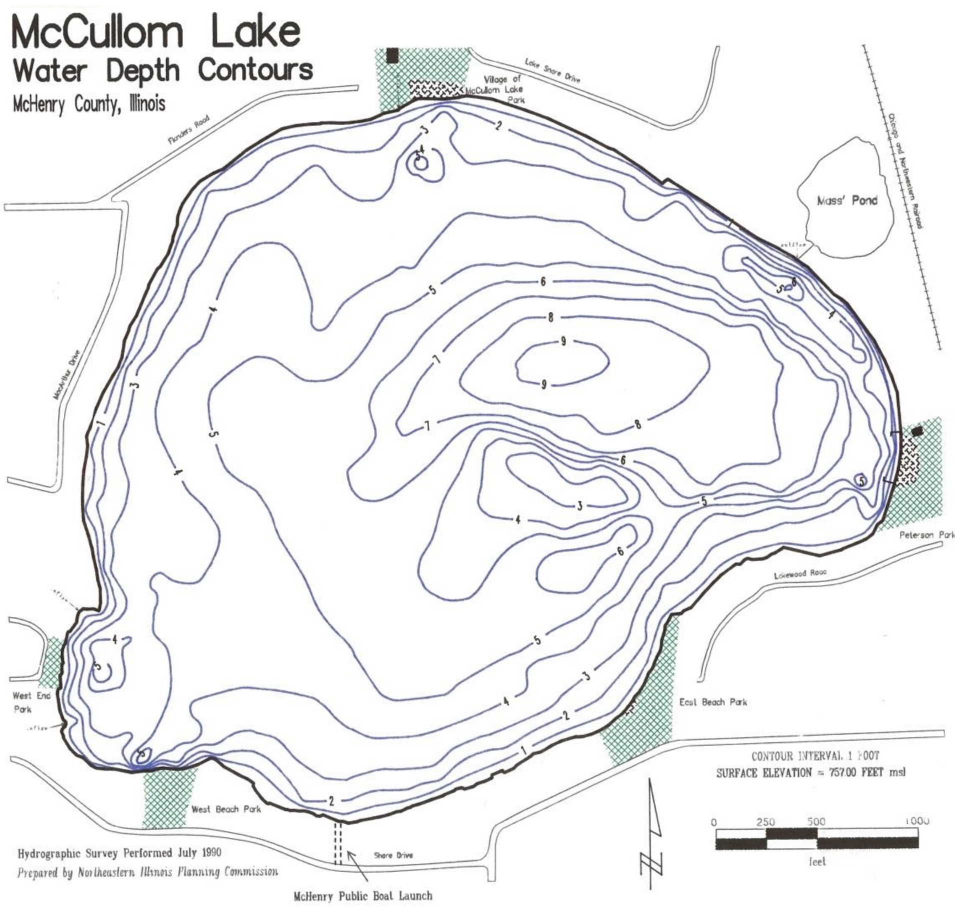
Lake morphometric information is provided in Table 27. A bathymetric map is provided in Figure 51.

Table 27. McCullom Lake morphometric information.

Illinois EPA lake code	IL_RTZD
Surface Area[a]	244.0 ac / 98.75 ha
Maximum Depth[a]	9.5 ft / 2.9 m
Average Depth[a]	4.4 ft / 1.3 m
Volume[a]	1,079 ac-ft / 1,330,098 m^3
Shoreline Length[a]	2.45 mi / 3.94 km
Lake Elevation[a]	757.02 ft above MSL
Watershed Area[b]	627.5 ac / 253.9 ha
Watershed to lake ratio	2.5:1
Average Water Residence Time / Flushing Time[a]	0.7 yr (255 days) / 1.4 times per yr
Lake Type	Glacial, dammed c. 1890

a) From Phase I Diagnostic/Feasibility Study of McCullom Lake (NIPC 1992); based on full pool elevation of 757.02 ft above MSL (top of spillway weir).
b) Determined using CMAP's GIS system based on watershed boundaries delineated for this plan; does not include lake's surface area.

Figure 51. McCullom Lake bathymetric map.



Current Water Quality Conditions

Illinois EPA's lake assessment for their 2014-cycle Integrated Report is based on monitoring conducted by Illinois EPA staff in 2010 under the agency's Ambient Lake Monitoring Program (ALMP). Water samples were collected and in-situ measurements made at three in-lake locations on five dates during the May-October monitoring season (May 24, June 21, July 28, August 23, and October 19, 2010). Site 1 is in the deepest area near mid-lake, Site 2 is in the eastern part of the lake, and Site 3 is in the southwestern part of the lake near the inflow of Dutch Creek (Figure 52). Samples were collected at 1 foot below the water surface, except for chlorophyll which is an integrated sample collected to twice the Secchi depth. Data provided by Illinois EPA-Des Plaines Lakes Unit staff61 were reviewed; the average values are provided in Table 28. In 2015, McCullom Lake was monitored by Volunteer Lake Monitoring Program (VLMP) participant Logan Gilbertsen. Secchi disk transparency readings were recorded at the three in-lake monitoring sites on five dates (May 21, June 16, July 2, August 4 and September 24, 2015) during the monitoring season, and the average values are included in Table 28.


Secchi disk.

Secchi transparencies were moderately low in 2010, averaging between 3 and 3.5 feet. Total phosphorus (TP) averaged averaged 0.025, 0.023, and 0.027 mg/L at Sites 1, 2, and 3, respectively; and no individual sample exceeded Illinois' General Use Water Quality Standard of 0.050 mg/L. Inorganic forms of nitrogen -- nitrate+nitrite and ammonia nitrogen -- were all below the detection limit of 0.018 mg/L except for the August date at Site 2 when nitrate-nitrite was 0.058 mg/L. Total nitrogen (inorganic + organic nitrogen) was thus largely represented by total Kjeldahl nitrogen (TKN), which averaged between 0.633 and 0.739 mg/L. Total suspended solids (TSS) averaged from less than 7 to 9 mg/l, while volatile suspended (VSS) averaged from less than 6 to 7 mg/L. Nonvolatile suspended solids (NVSS) (calculated by subtracting VSS from TSS) were thereby low, ranging from 0 to 9 mg/L. Chlorophyll *a* concentrations were low, averaging between 7.66 and 10.02 µg/L among the three sites. Trophic state indices (TSIs) calculated by Illinois EPA based on the median Secchi, TP, and chlorophyll *a* values equaled 60, 49, and 52, respectively, place McCullom Lake into the mesotrophic/eutrophic category.

In 2015, Secchi transparencies exhibited a notable decrease compared to 2010, averaging 16 inches at Sites 1 and 3 and 14 inches at Site 2. Based on the median Secchi value, a Secchi TSI of 74 is calculated, which places McCullom Lake into the hypereutrophic category.

Dissolved oxygen measurements in 2010 revealed levels remained adequate for support of aquatic life throughout the water column (above 5 mg/L) on each monitoring date. Measurements of pH were all within normal ranges, averaging 8.9 – 9.0 pH units.

[61] Data provided by Diane Tancl, Illinois EPA-Des Plaines, via email messages to the author(s), November 2014.

Conductivity measurements in 2010 averaged 737 µS/cm at Sites 1 and 2 and 750 µS/cm at Site 3. Chloride concentrations averaged between 138 and 141 mg/L, with a maximum of 173 mg/L at Site 3 on the June sampling date.

Figure 52. Water quality monitoring sites in McCullom Lake.

	UTM coordinates		decimal degrees		
Site	**Easting**	**Northing**	**Latitude**	**Longitude**	**Depth (ft)**
1	16 393882 E	4690761 N	42.36188	-88.28867	9
2	16 394237 E	4690611 N	42.36058	-88.28432	6
3	16 393301 E	4690302 N	42.35767	-88.29563	4

Table 28. Average annual water quality characteristics for McCullom Lake, 2010 and 2015.

IEPA lake code		IL_RTZD					
Year		2010 ALMP			2015 VLMP		
Parameter	*Units*	*Site 1*	*Site 2*	*Site 3*	*Site 1*	*Site 2*	*Site 3*
Secchi transparency	inches	42	40	37	16	14	16
	feet	3.5	3.3	3.1	---	---	---
Total Phosphorus (TP)	mg/L	0.025	0.023	0.027	---	---	---
Dissolved Phosphorus (DP)	mg/L	0.005[K]	0.006[K]	0.004	---	---	---
Nitrite + Nitrate Nitrogen (NO_2+NO_3)	mg/L	0.018[K]	0.026[K]	0.018[K]	---	---	---
Ammonia Nitrogen (NH_3)	mg/L	0.023[K]	0.023[K]	0.023[K]	---	---	---
Total Kjeldahl Nitrogen (TKN)	mg/L	0.633	0.739	0.720	---	---	---
Total Suspended Solids (TSS)	mg/L	9	7[K]	8[K]	---	---	---
Volatile Suspended Solids (VSS)	mg/L	7	6[K]	6[K]	---	---	---
Dissolved Solids (DS)	mg/L	440	---	---	---	---	---
Chloride (Cl)	mg/L	138	138	141	---	---	---
Alkalinity	mg/L	135	135	146	---	---	---
Conductivity	µS/cm	737	737	750	---	---	---
pH	units	9.0	9.0	8.9	---	---	---
Chlorophyll *a* (corrected)	µg/L	8.42	7.66	10.02	---	---	---
TSI_{Secchi}	--	60			74		
$TSI_{phosphorus}$	--	49			---		
$TSI_{chlorophyll}$	--	52			---		

Aquatic Plants

Illinois EPA staff made note of overall aquatic plant coverage during each water sampling date in 2010 and also conducted a randomized, whole-lake survey on July 28, 2010 (rake toss sampling at 60 locations). Staff recorded that aquatic plants occupied 40 to more than 70 percent of the lake's area on each monitoring date and commented that the combination of shallow water depths with 3- to 4-foot Secchi transparencies allow McCullom Lake's entire area to be a littoral zone for most of the growing season. Aquatic plant diversity was very low with only four species collected during the July survey. The invasive exotic Eurasian water milfoil (*Myriophyllum spicatum*) was the most abundant species, followed by white water lily (*Nymphaea* spp.) and spatterdock (*Nuphar* spp.). The native northern water milfoil (*Myriophyllum sibericum*) was collected at two locations during the July survey.[62] To note, during the Phase I Study of McCullom Lake in 1990-91, aquatic plant diversity was higher, with 17 submersed and floating-leaved aquatic plant species documented, along with six emergent plant species.[63]

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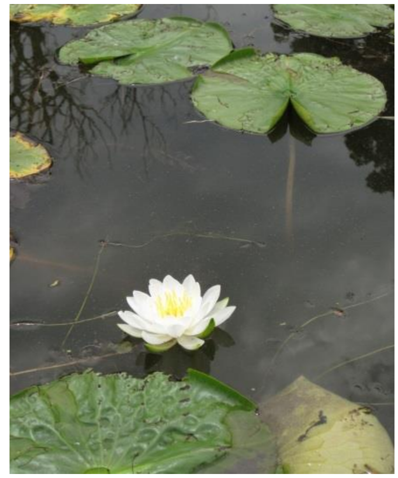
[62] Aquatic plant information provided by Diane Tancl, Illinois EPA-Des Plaines, via email messages to the author(s), November 2014.

[63] Hudson, H.L, R.J. Kirschner, and J.J. Clark. 1992. *Phase I Diagnostic/Feasibility Study of McCullom Lake, McHenry County, Illinois*. Prepared by Northeastern Illinois Planning Commission, Chicago.



Eurasian watermilfoil, spatterdock, and white water lily (L to R) are currently the most abundant aquatic plants (submersed and floating leaved) in McCullom Lake.

Fisheries

Fisheries management activities at McCullom Lake are conducted by the Illinois Department of Natural Resources – Division of Fisheries under a Cooperative Management Agreement with the City of McHenry. Activities include fish surveys every two to four years, annual stocking of largemouth bass, northern pike, and channel catfish, and fisheries and lake management recommendations. Illinois DNR's latest fisheries status reports following the 2011 and 2014 fish population surveys, along with recommendations, are provided in Appendix F.

Lakeshore Buffer Condition

McCullom Lake's riparian (lakeshore) buffer zone was assessed by CMAP staff using a qualitative methodology that considered an area up to 25 feet inland from the shoreline and for a width of a coded segment, typically bounded by a lot or parcel boundary. A 25 foot buffer was chosen based on research that indicates a 25-foot vegetated buffer is the minimum effective width for in-lake habitat maintenance (a 15 foot buffer is considered the minimum effective width for bank stability).[64] The following land cover categories were estimated for each parcel segment: turfgrass lawn, flower beds, unmowed grasses & forbs, tree trunks, shrubs, beach, impervious surface. Criteria used for category assignment are presented in Table 29.

The assessment was first conducted by viewing high resolution 2011, 2012, and 2013 aerial color and infrared photography using CMAP's GIS, along with the Internet mapping service Bing Maps Birds Eye View. Field verification was conducted by boat during July 2015 which revealed that there is no substitute for on-site assessment. The results of the assessment are presented in Table 30, Figure 53, and Appendix G.

[64] http://www.vtwaterquality.org/lakes/htm/lp_shorevegandbuffers.htm and http://www.watershedmanagement.vt.gov/lakes/docs/lp_shorelandbufferwidths.pdf (accessed September 2014)

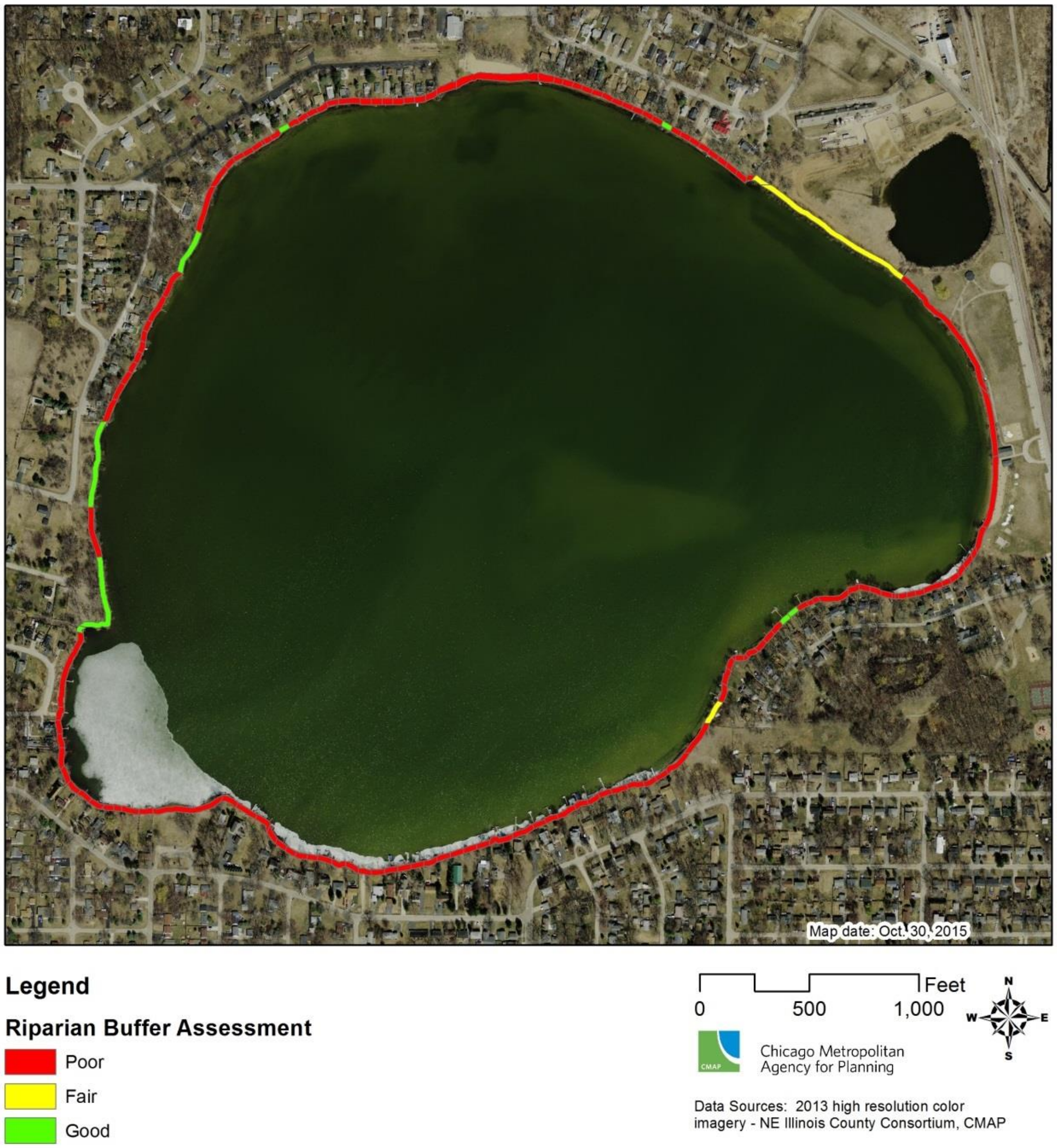
Table 29. Criteria used for categorizing riparian buffer condition.

Category	*Criteria*	
Good	Unmowed grasses & forbs + Tree trunks + Shrubs *and* Impervious surface	≥ 70% ≤ 5%
Fair	Unmowed grasses & forbs + Tree trunks + Shrubs *and* Impervious surface	≥ 50% and < 70% ≤ 10%
Poor	Unmowed grasses & forbs + Tree trunks + Shrubs *and* Turfgrass lawn + Flower beds + Beach + Impervious surface	< 50% ≥ 50%

Table 30. McCullom Lake riparian buffer assessment summary.

Category	*Shoreline length (ft)*	*Percent*
Good	1,285	9.9
Fair	947	7.3
Poor	10,704	82.7
Totals	**12,936**	**100**

Figure 53. McCullom Lake riparian buffer assessment, 2015.



Shoreline Erosion Assessment

McCullom Lake's shoreline erosion condition was assessed by CMAP staff during July 2015 via observation from a rowboat. Each segment was the same as used for the lakeshore buffer assessment, typically the width of a lot or parcel. The criteria used for assigning erosion categories were as follows:

- None: no erosion evident; these segments typically had a concrete or steel seawall
- Minimal: minor erosion; some bare soil areas evident; considered generally stable
- Slight: low erosion; approximately 3-6" bank heights
- Moderate: approximately 6-12" bank heights; sloughing, undercutting, or ice heave often evident
- High: approximately 12-24" bank heights; sloughing, undercutting, or ice heave often evident

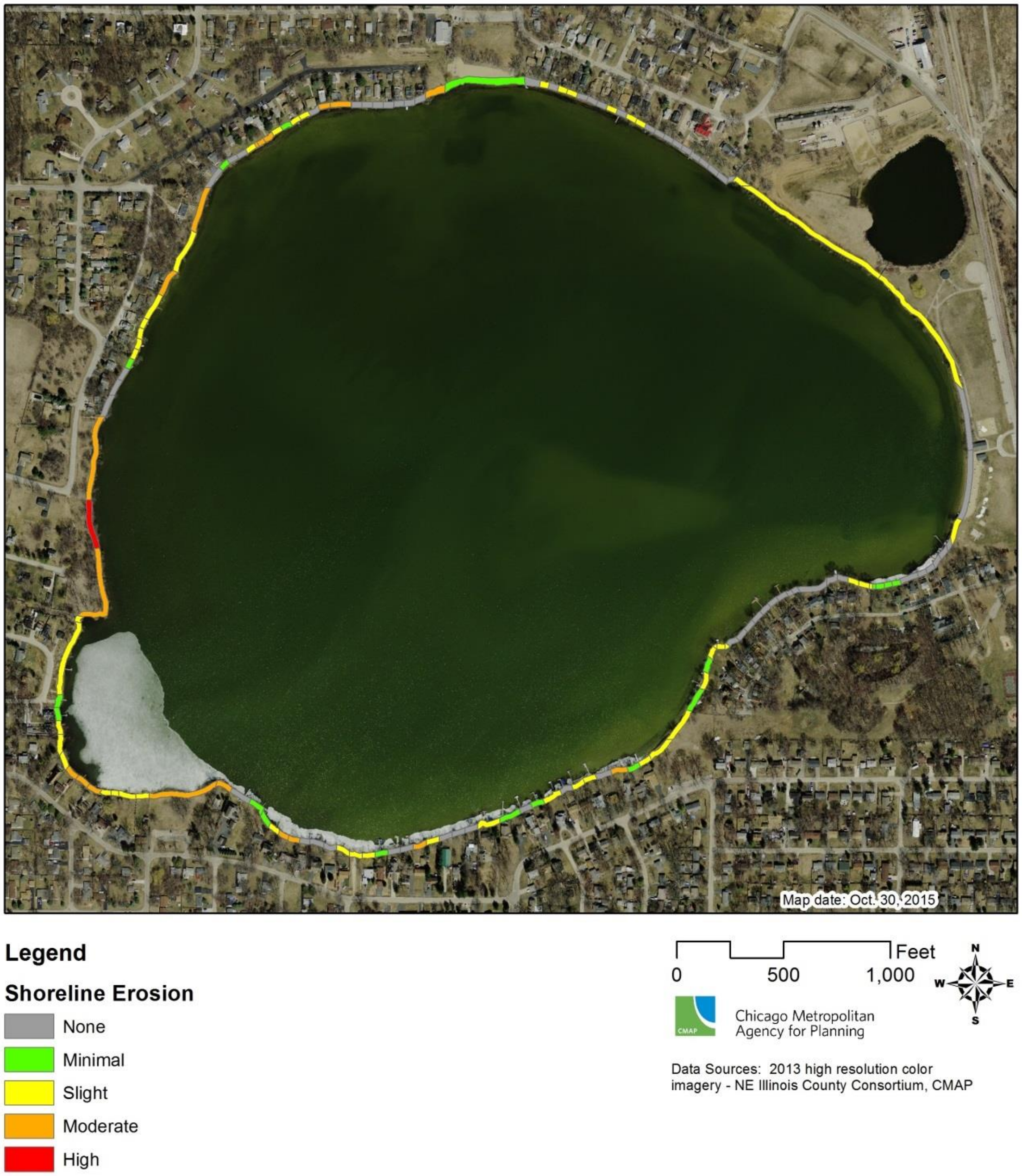
The results of the assessment are presented in Table 31, Figure 54, and Appendix G. An estimate of pollutant loads from shoreline erosion was made using the "Bank Stabilization" worksheet in a Microsoft Excel spreadsheet tool (EstPollutLoadReduct_2IEPA.xls) provided by Illinois EPA[65].

Table 31. McCullom Lake shoreline erosion assessment and pollutant load estimates summary.

Erosion Level	*Shoreline length (ft)*	*Percent*	*Nitrogen Load (lb/yr)*	*Phosphorus Load (lb/yr)*	*Sediment Load (ton/yr)*
None	4,153	32.1	---	---	---
Minimal	1,440	11.1	2	2	2
Slight	4,704	36.4	9	5	5
Moderate	2,409	18.6	25	12	13
High	231	1.8	11	6	6
Totals	**12,937**	**100**	**47**	**25**	**26**

[65] Scott Ristau, Illinois EPA. 2011. Personal communication.

Figure 54. McCullom Lake shoreline erosion assessment, 2015.



3.6 Pollutant Sources

3.6.1 Nonpoint Sources

Addressing designated-use impairments within the planning area is one of the primary reasons for developing this watershed plan. Another reason is to protect good water quality and designated-use attainment where present in the planning area. Table 21 provides the known details of water quality assessments according to Illinois EPA and as published in their 2014 Integrated Report. The reader will note that while Boone Creek and McCullom Lake have been deemed impaired for one of their designated uses, Dutch Creek has not been assessed. The status of the Fox River where Dutch Creek and the three direct drainage areas flow into the Fox also is listed in Table 21.

In addition to the causes and sources of impairments identified by Illinois EPA in the 2014 Integrated Report, there are numerous other potential causes of impairment and sources of pollution impacting water resources in the Boone-Dutch Creek Planning area, several of which are listed in italics in Table 32.

Recommendations made to mitigate and protect water quality from nonpoint source pollution will both yield local benefits and help improve Fox River water quality downstream. The Fox River serves as a drinking water supply for communities downstream in Kane County. Recommendations for "on the ground projects" will be guided by a tool that is described in the next section.

Table 32. Known and potential causes and sources of water pollution in the Boone-Dutch Creek planning area.

Streams	
Causes of Impairment	**Sources of Impairment**
• Alteration in stream-side or littoral vegetative covers (84) • Other flow regime alterations (319) • ~~pH (441)~~ *(will be removed as of 2016 IR)* • *Chloride (138)* • *Nutrients: Phosphorus (Total) (462) and Nitrogen (Nitrate) (452)* • *Oil and grease (317)* • *Sedimentation / Siltation (371)* • *Fish-Passage Barrier (228)* • *Loss of instream cover (501)* • *Low dissolved oxygen (322)* • *Temperature (388)*	• Loss of riparian habitat (72) • Site clearance (land development or redevelopment) (122) • Impacts from hydrostructure flow regulation / modification (58) • Source unknown (140) • *Channelization (20)* • *Habitat modification – other than hydromodification (157)* • *Streambank erosion (no #)* • *Drainage / Filling / Loss of wetlands (36)* • *Highway / Road / Bridge runoff (49)* • *Highway, roads, bridges, infrastructure (new construction (50)* • *Urban runoff / Storm sewers (177)*

	• *Golf courses (45)* • *Runoff from Forest / Grassland / Parkland (181)* • *Irrigated crop production (66)* • *Non-irrigated crop production (87)* • *Crop production (crop land or dry land) (144)* • *Animal feeding operations (NPS) (4)* • *Managed pasture grazing (73)* • *Livestock (Grazing or feeding operations) (143)* • *Industrial point source discharge (62)* • *Municipal point source discharges (85)* • *On-site treatment systems (Septic systems and similar decentralized systems) (92)* • *Leaking underground storage tanks (no #)*
Lakes	
Causes of Impairment	**Sources of Impairment**
• Cause unknown (463) • Aquatic Plants (Macrophytes) (478) • *Non-native aquatic plants (312)* • *Non-native fish [common carp], shellfish, or zooplankton (313)* • *Fecal coliform (400)* • *Turbidity (413)* • *Nutrients: Phosphorus (Total) (462) and Nitrogen (Nitrate) (452)* • *Chloride (138)*	• Internal nutrient cycling (65) • Waterfowl (134) • Crop production (crop land or dry land) (144) • Urban runoff/storm sewers (177) • Runoff from forest / grassland / parkland (181) • *On-site treatment systems (Septic systems and similar decentralized systems) (92)* • *Littoral / shore area modifications (71)* • *Shoreline erosion (no #)* • *Livestock (Grazing or feeding operations) (143)*
Fox River	
Causes of Impairment	**Sources of Impairment**
• Alteration in stream-side or littoral vegetative covers (84) • Other flow regime alterations (319) • Cause unknown (463) • Aquatic Algae (479) • PCBs (348) • *Chloride (138)* • *Nutrients: Phosphorus (Total) (462) and Nitrogen (Nitrate) (452)* • *Oil and grease (317)* • *Sedimentation / Siltation (371)* • *Fish-Passage Barrier (228)* • *Non-native fish, shellfish, or zooplankton (313)* • *Loss of instream cover (501)* • *Low dissolved oxygen (322)* • *Temperature (388)*	• Dam or impoundment (142) • Habitat modification – other than hydromodification (157) • Impacts from hydrostructure flow regulation / modification (58) • Source unknown (140) • *Streambank modifications / Destabilization [erosion] (125)* • *Sediment resuspension (contaminated sediment) 149)* • *Loss of riparian habitat (72)* • *Drainage / Filling / Loss of wetlands (36)* • *Highway / Road / Bridge runoff (49)* • *Highway, roads, bridges, infrastructure (new construction (50)* • *Urban runoff / Storm sewers (177)* • *Golf courses (45)*

	• *Runoff from Forest / Grassland / Parkland (181)* • *Site clearance (land development or redevelopment) (122)* • *Irrigated crop production (66)* • *Non-irrigated crop production (87)* • *Crop production (crop land or dry land) (144)* • *Agriculture (156)* • *Animal feeding operations (NPS) (4)* • *Managed pasture grazing (73)* • *Livestock (Grazing or feeding operations) (143)* • *Industrial point source discharge (62)* • *Municipal point source discharges (85)* • *On-site treatment systems (Septic systems and similar decentralized systems) (92)* • *Leaking underground storage tanks (no #)*
Groundwater	
Causes of Impairment	**Sources of Impairment**
• Chloride • *Volatile Organic Compounds* • *Bacteria*	• *Salt storage and road salting* • *Water softener discharge* • *Industrial facilities* • *Manufacturing/repair shops* • *Leaking underground storage tanks* • *Spills* • *Septic systems* • *Animal feedlots*

3.6.1.1 Nonpoint Source Pollutant Load Modeling[66]

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

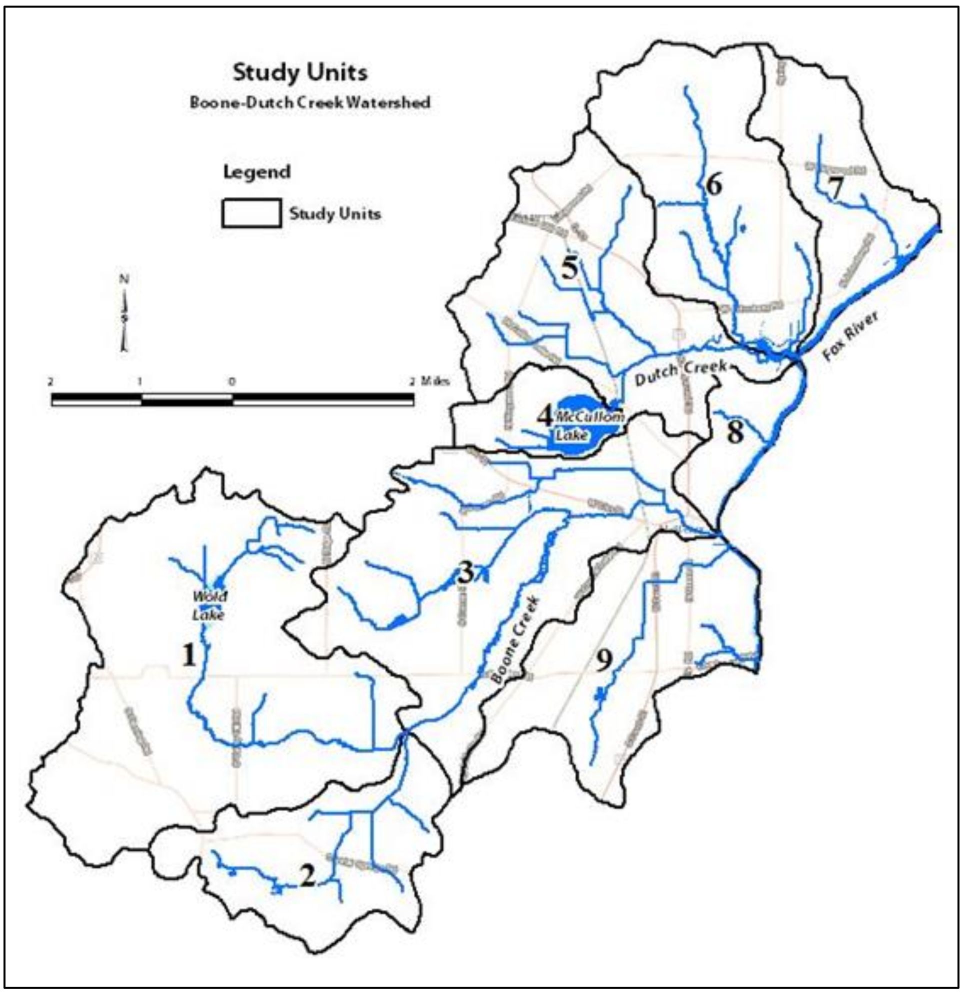
For nonpoint source pollution, an effective method to estimate pollutant loads at the watershed scale is to use variable watershed characteristics that can affect pollutant load contributions, such as land use, soils, etc. The U.S. Environmental Protection Agency's planning level tool, Spreadsheet Tool to Estimate Pollutant Loads (STEPL), was used to develop "existing conditions" nonpoint source pollutant load estimates for total nitrogen, total phosphorus, sediment, and biological oxygen demand (BOD) within the Boone-Dutch Creek planning area.

[66] STEPL modeling was conducted by and the sections describing land-use based nonpoint source pollutant loading were prepared by Geosyntec Consultants and provided via email correspondence to the author(s), November 2014.

One of the primary inputs to STEPL is land use information. The land use data used in the Boone-Dutch Creek watershed analysis was largely based on CMAP's preliminary 2010 land use data. STEPL allows for a detailed breakdown of the broader urban land use category into categories such as commercial, single-family residential, etc. to develop more refined pollutant load estimates based on variable pollutant concentrations in stormwater runoff from these land uses. With respect to single-family residential, it was identified that modification of the land use data was needed for the evaluation of pollutant loads from this land use category. Specifically, it was determined that because CMAP's 2010 land use data is parcel-based and because portions of the watershed are comprised of large residential estates, STEPL was likely over-predicting pollutant loads for portions of the watershed. As such, it was determined that large residential estates (i.e., two acres or larger with a single residence as defined for this project) would be evaluated, on a parcel-basis, as one acre of the single-family residential land use and the remaining portions of the parcel as the open space land use.

In an effort to further refine the pollutant load estimates for the watershed, the pollutant load estimates were developed at the study unit level using delineated subwatershed boundaries, which separates the Boone-Dutch Creek planning area into nine study units (Figure 55).

Figure 55. Nine study units within the Boone-Dutch Creek planning area.



Estimating the pollutant loads at the study unit level, as well as at the watershed level, provides the opportunity to evaluate study units on a relative pollutant load contribution basis and to better target the recommendations included in this plan and in future planning efforts. The "existing conditions" nonpoint source pollutant load estimates, by study unit, for nitrogen, phosphorus, biological oxygen demand (BOD), and sediment are shown in Table 33. Visual representations of the pollutant load estimates on a study unit basis are also illustrated in the figures in Appendix G. The pollutant load estimates are also presented by pollutant type and land use in Table 34 through Table 37 at the end of this section.

Table 33. Land use-based nonpoint source pollutant load estimates.

Study Unit	Nitrogen Load		Phosphorus Load		Sediment Load		BOD Load	
	lb/yr	lb/ac/yr	lb/yr	lb/ac/yr	T/yr	T/ac/yr	lb/yr	lb/ac/yr
1	39,596	5.5	5,668	0.8	1,215	0.2	70,828	9.9
2	19,703	7.7	2,574	1.0	567	0.2	28,118	11.0
3	39,031	7.3	4,968	0.9	1,526	0.3	86,017	16.1
4	4,378	5.0	551	0.6	195	0.2	11,783	13.5
5	36,882	9.7	4,461	1.2	1,090	0.3	53,100	13.9
6	31,262	9.0	3,896	1.1	954	0.3	45,800	13.1
7	14,756	7.9	1,873	1.0	620	0.3	33,546	17.9
8	5,213	6.6	665	0.8	283	0.4	17,048	21.5
9	23,417	7.5	2,929	0.9	1,084	0.3	60,506	19.3
Totals	**214,237**	**66.2**	**27,585**	**8.4**	**7,535**	**2.5**	**406,747**	**136.3**

The information provided in the previous paragraphs primarily focused on the set-up and results of the STEPL analysis. 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.
- STEPL does not account for drain tile contributions of pollutants.
- Pollutants from construction sites were not included in the analysis. Pollutant loads from construction sites can be highly variable and should be analyzed on a site-by-site basis and should be addressed through Illinois EPA's NPDES program for construction activities.
- 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 Boone-Dutch Creek watershed.

Nonetheless, STEPL serves as a useful planning-level tool for estimating relative contributions of different pollutant sources within the Boone-Dutch planning area.

Table 34. Land use-based nonpoint source nitrogen load estimates (pounds/year).

Study Unit	Commercial	Industrial	Institutional	Transpor-tation	Multi-Family	Single-Family	Open Space	Cropland
1	273	45	43	3,378	632	2,473	1,403	27,974
2	-	-	762	1,141	33	1,231	224	15,509
3	1,757	1,812	1,129	7,285	1,495	5,214	414	19,225
4	448	10	115	1,329	22	953	69	1,367
5	2,315	517	227	3,079	140	1,322	439	28,502
6	450	-	1,162	2,712	85	1,799	619	24,134
7	419	6	788	3,751	165	2,501	128	6,928
8	635	-	111	2,347	93	1,272	88	609
9	2,561	1,330	1,891	6,199	702	2,288	398	7,802
Totals	**8,856**	**3,720**	**6,229**	**31,221**	**3,367**	**19,052**	**3,783**	**132,050**

Table 35. Land use-based nonpoint source phosphorus load estimates (pounds/year).

Study Unit	Commercial	Industrial	Institutional	Transpor-tation	Multi-Family	Single-Family	Open Space	Cropland
1	17	5	6	470	83	319	261	3,342
2	-	-	100	159	4	159	42	1,853
3	112	188	148	1,014	196	673	77	2,296
4	29	1	15	185	3	123	13	163
5	148	54	30	428	18	171	82	3,405
6	29	-	153	377	11	232	115	2,883
7	27	1	103	522	22	323	24	828
8	41	-	15	327	12	164	16	73
9	164	138	248	862	92	295	74	932
Totals	**566**	**386**	**818**	**4,344**	**442**	**2,458**	**702**	**15,774**

Table 36. Land use-based nonpoint source BOD load estimates (pounds/year).

Study Unit	Commercial	Industrial	Institutional	Transpor-tation	Multi-Family	Single-Family	Open Space	Cropland
1	706	154	105	13,658	1,974	7,979	8,019	23,099
2	-	-	1,857	4,613	104	3,970	1,278	12,806
3	4,538	6,274	2,751	29,456	4,672	16,820	2,366	15,874
4	1,157	33	280	5,374	69	3,075	393	1,129
5	5,980	1,789	554	12,452	437	4,264	2,510	23,535
6	1,161	-	2,833	10,966	267	5,802	3,539	19,928
7	1,083	22	1,920	15,167	514	8,069	733	5,720
8	1,639	-	271	9,490	289	4,102	505	503
9	6,616	4,605	4,610	25,064	2,195	7,379	2,273	6,443
Total	**22,879**	**12,877**	**15,183**	**126,241**	**10,521**	**61,459**	**21,615**	**109,036**

Table 37. Land use-based nonpoint source sediment load estimates (tons/year).

Study Unit	Commercial	Industrial	Institutional	Transpor-tation	Multi-Family	Single-Family	Open Space	Cropland
1	8	2	3	290	39	61	60	639
2	-	-	47	98	2	30	10	354
3	50	80	69	626	91	129	18	439
4	13	0	7	114	1	24	3	31
5	66	23	14	264	9	33	19	651
6	13	-	71	233	5	44	27	551
7	12	0	48	322	10	62	5	158
8	18	-	7	202	6	31	4	14
9	73	59	116	532	43	56	17	178
Total	**253**	**165**	**381**	**2,681**	**206**	**470**	**162**	**3,014**

3.6.1.2 Streambank Erosion Pollutant Load Estimates

Pollutant loads from eroding streambanks were estimated using the "Bank Stabilization" worksheet in a Microsoft Excel spreadsheet tool (EstPollutLoadReduct_2IEPA.xls) provided by

Illinois EPA.[67] Bank heights for the Boone Creek main stem were based on the 2002 stream inventory measurements. For all other assessed stream reaches, bank heights were estimated based on the 2015 field observations. Lateral recession rates were assigned as follows: 0.03 for low, 0.13 for moderate, and 0.3 for high erosion reaches. Soil classes associated with each reach were determined using the NRCS SURRGO dataset. Results of the spreadsheet tool analyses are provided in Table 38.

Table 38. Streambank erosion pollutant load estimates.

Study Unit	*Stream Name*	*Length Assessed (ft)*	*Nitrogen Load (lb/yr)*	*Phosphorus Load (lb/yr)*	*Sediment Load (T/yr)*
1	Boone Creek (Upper)	15,545	524	262	174
3	Boone Creek (Lower)	49,466	3,922	1,962	1,921
3	Boone Creek North Branch	17,807	107	60	59
3	Boone Creek West Branch	3,584	17	8	10
2	Powers Creek	19,434	185	96	86
Boone Creek Watershed Totals		**105,836**	**4,755**	**2,388**	**2,250**
5	Dutch Creek	20,513	352	177	169
6	Dutch Creek East Branch	7,021	23	12	12
6	Dutch Creek North Branch	17,953	155	79	81
5	Dutch Creek West Branch	8,964	46	23	23
5	Dutch Creek McCullom Lk Br	2,213	6	4	4
Dutch Creek Watershed Totals		**56,664**	**582**	**295**	**289**
7	Sunnyside Creek (w/in NE Direct Drainage unit)	6,805	41	24	25
9	Edgebrook Creek (w/in SE Direct Drainage unit)	16,722	390	197	175
Direct Drainage Totals		**23,527**	**431**	**221**	**200**
Boone-Dutch Planning Area Totals		**186,027**	**5,768**	**2,904**	**2,739**

[67] Scott Ristau, Illinois EPA. 2011. Personal communication.

3.6.2 Point Sources

3.6.2.1 National Pollutant Discharge Elimination System (NPDES)

The National Pollutant Discharge Elimination System (NPDES) program supports the overall mission of the Clean Water Act. It requires all facilities that collect wastewater from industrial, municipal, concentrated animal feeding operations, and urban stormwater runoff to obtain a permit from the Illinois EPA[68]. The NPDES program plays a key role in protecting water from a level of degradation since it sets discharge limits, requires monitoring and reporting, and limits discharge of specific pollutants including BOD, total suspended solids, ammonia nitrogen, fecal coliform, dissolved oxygen, and phosphorus.

There are six permitted dischargers of wastewater in the planning area (Figure 56). Of these, three are municipal discharges and three are privately owned facilities. The municipal dischargers are the Village of Wonder Lake (ILL077836) with one outfall on Dutch Creek; the City of McHenry's Central WWTP (NPDES IL 0021067) and South WWTP (NPDES IL0066257) with both outfall locations on the Fox River; and the Village of Johnsburg with one outfall location on Dutch Creek (NPDES IL0074969). Privately owned facilities include Rohm and Haas Chemical LLC with three outfalls on a tributary to Dutch Creek (NPDES IL0001716), Modine Manufacturing Company with two outfalls on a tributary to Dutch Creek (IL0001279), and Huntsman International LLC (IL0079553) with five outfalls on a tributary to Dutch Creek.

NPDES Stormwater Program

Of the many units of government within the Boone-Dutch Creek planning area boundary, several have distinct roles and responsibilities related to water quality and nonpoint source pollution control. For example, eight units of government are operators of small municipal separate storm sewer systems (MS4s).[69] MS4s are intended to collect urban stormwater runoff, an important contributor to nonpoint source pollution, and, consequently, are regulated under the National Pollutant Discharge Elimination System (NPDES) program, discussed above.

In Illinois, discharges from small MS4s are regulated under Illinois EPA's General NPDES Permit No. ILR40. The central feature of this permit is a requirement that MS4 operators develop, implement, and enforce a stormwater management program to reduce the discharge of pollutants. A permittee's stormwater management program must include six minimum control measures:

1. Public education and outreach on storm water impacts
2. Public involvement and participation
3. Illicit discharge detection and elimination
4. Construction site storm water runoff control

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

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

5. Post construction storm water management in new development and redevelopment
6. Pollution prevention / good housekeeping for municipal operations

Table 39. MS4s within the Boone-Dutch Creek planning area.

Jurisdiction	*Certified Community*	*Non-Certified Community*	*MS4 Operator Permit*
Municipality			
Johnsburg	Yes		Yes
Ringwood	Yes		
McCullom Lake		Yes	Yes
Wonder Lake	Yes		Yes
McHenry	Yes		Yes
Bull Valley		Yes	Not Required[70]
Woodstock	Yes		Yes
Township			
Burton		Yes	Not Required
Richmond		Yes	Not Required
McHenry	Yes		Yes
Greenwood		Yes	Not Required
Nunda	Yes		Yes
Dorr	Yes		Yes
County			
McHenry	Yes		Yes

To define its storm water management program, a permittee must define best management practices (BMPs) and measureable goals for each of the six minimum control measures.

In order to obtain coverage under the permit, permittees must submit to Illinois EPA a completed Notice of Intent (NOI)[71] describing its BMPs and measurable goals, providing other program specifics, and identifying any arrangements made with others to share program responsibilities. Once coverage has been granted, a permittee must submit an annual report to Illinois EPA by June 1 which must include the following:

1. The status of compliance with the permit conditions, including an assessment of the BMPs and progress toward the measurable goals;

[70] No permit is required because the entity has 100% combined sewer overflow, is contained completely within another MS4 (townships), have a waiver, or do not have a governing body.

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

2. Results of any information collected and analyzed, including monitoring data;
3. A summary of the stormwater activities planned for the next reporting cycle;
4. A change in any identified best management practices or measurable goals; and
5. If applicable, notice of relying on another governmental entity to satisfy some of the permit obligations.[72]

In addition to the MS4 program, McHenry County has a stormwater management ordinance[73] that is enforced by the county in unincorporated areas and for noncertified communities, and it represents a minimum standard to be met by certified communities.[74] The county ordinance specifies many provisions including one pertaining to stormwater detention basins that are usually designed and installed by a developer. Once construction is complete, however, long-term responsibility (i.e., maintenance) is typically transferred to a homeowner's association (HOA) since the detention basin involves land in private ownership. While HOAs are not jurisdictions on par with various units of government, they play key roles in the scheme of local stormwater management nonetheless and, as it turns out, often unwittingly.

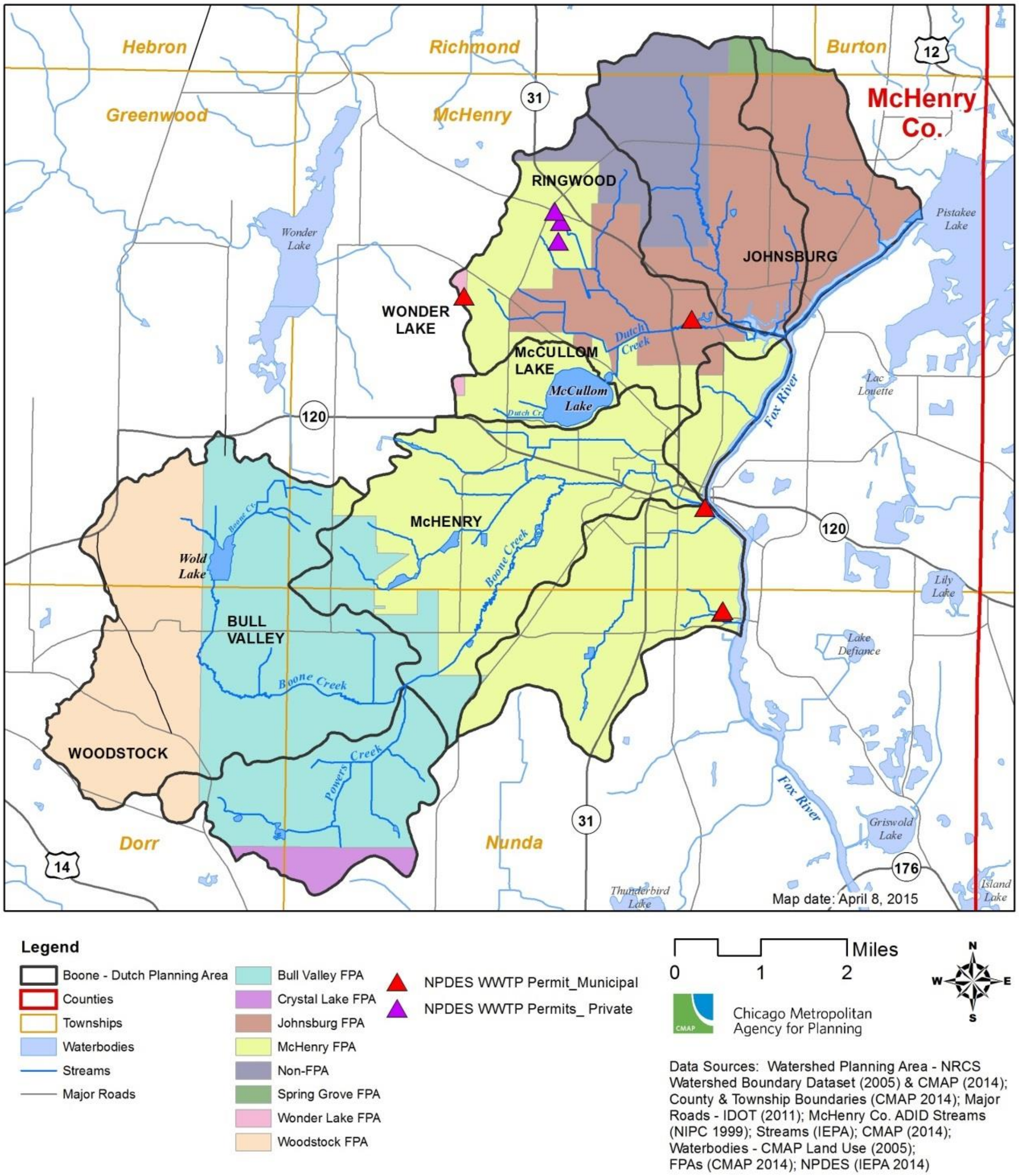
At the municipal level, there may be other codes and ordinances that either directly or indirectly protect water quality from nonpoint source pollution. Thus, county, township, and municipal governments all play key roles in nonpoint source pollution control.

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

[73] McHenry County, Illinois Stormwater Management Ordinance, available at: https://www.co.mchenry.il.us/home/showdocument?id=7922

[74]Certified Communities are those communities that have been delegated authority by a County to administer all, or portions of, the watershed development/stormwater management regulations within their community limits. Certified Communities apply for re-certification every three years. Communities may have regulations that are more stringent than the county ordinance. For more information, see, for example, http://www.lakecountyil.gov/Stormwater/FloodplainStormwaterRegulations/PermitsApprovals/Pages/CertifiedCommunities.aspx.

Figure 56. NPDES wastewater discharge permits in the Boone-Dutch Creek planning area.



3.6.2.2 Leaking Underground Storage Tanks

Leaking underground storage tanks (UST) are a source of environmental contamination and threaten the quality and safety of groundwater as a source of drinking water. The Office of the State Fire Marshall regulates the daily operation and maintenance of underground storage tank systems, and the Illinois EPA becomes involved once a release (i.e., leak) has been reported to the Illinois Emergency Management Agency (IEMA). Following a tank release report to IEMA, Illinois EPA's Leaking UST section begins oversight of remedial operations.[75]

While leaking UST sites are a concern wherever they exist, they are particularly relevant in an area of groundwater-dependent communities and private-well owners. The Boone-Dutch Creek planning area includes 43 leaking UST sites (Figure 57).

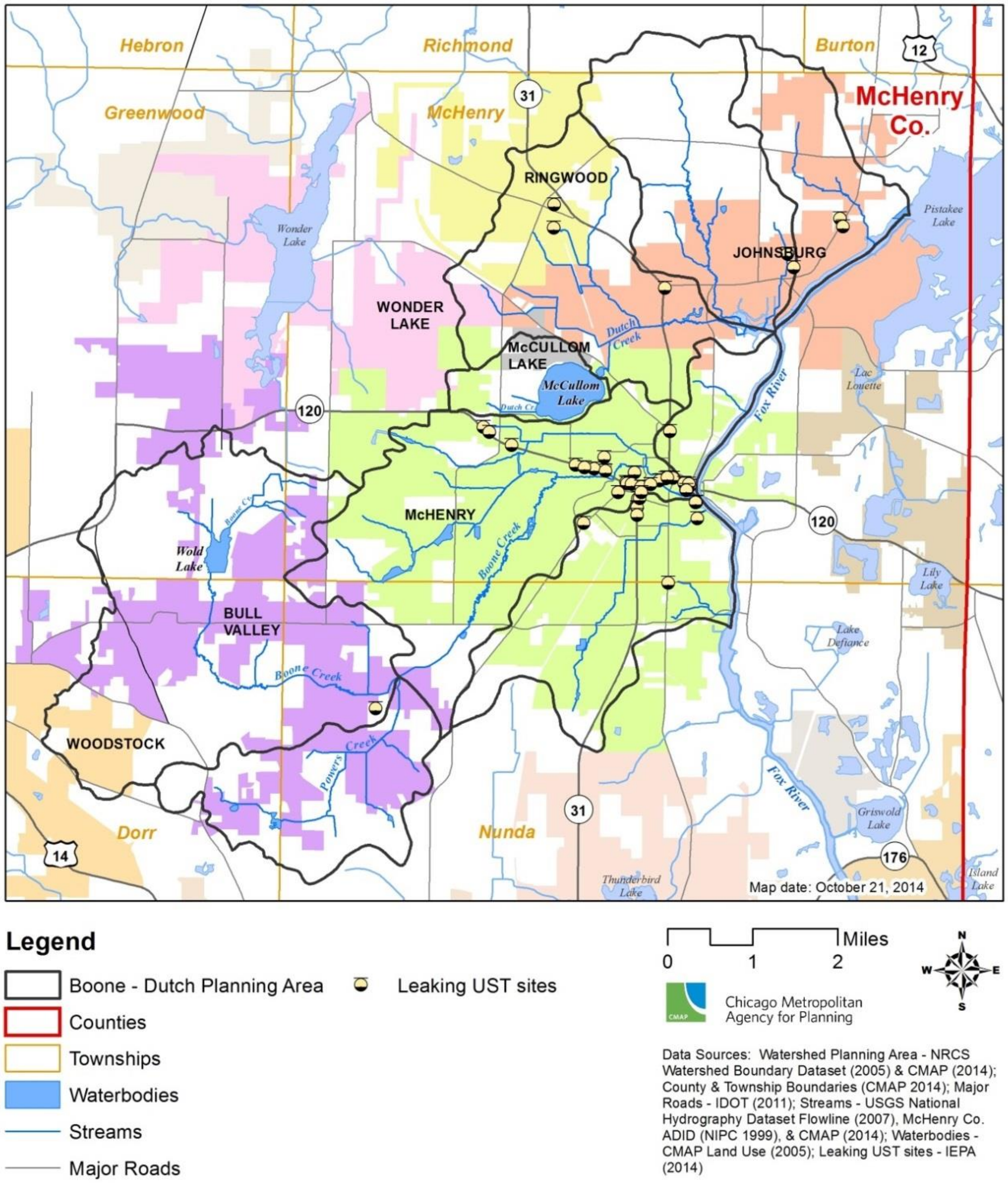
Knowledge of leaking UST sites and their clean-up status can work in favor of developing wellhead protection plans for existing community water supply wells. These plans can also reduce the vulnerability of wells to other potential sources of contamination. For more information regarding the status of leaking UST sites, readers are referred to the Leaking UST Incident Tracking database.[76]

An Underground Storage Tank Fund was established in 1989 to help owners and operators pay for cleaning up leaks from petroleum USTs. Illinois generates money for the leaking UST Fund through a $0.003 per gallon motor fuel tax and a $0.008 per gallon environmental impact fee, both of which are set to expire January 1, 2025.

[75] Illinois EPA. http://www.epa.state.il.us/land/lust/introduction.html

[76] Illinois EPA. http://epadata.epa.state.il.us/land/ust/

Figure 57. Leaking underground storage tank (UST) sites in the Boone-Dutch Creek planning area.



3.7 Land Management Practices

3.7.1 Agriculture

Agricultural land use is important in McHenry County and constitutes nearly 40 percent of the Boone-Dutch Creek planning area. Only residential land use (35 percent) comes close in spatial extent within the planning area. Agricultural land use is most prevalent in the Dutch Creek study unit (62 percent), Dutch Creek Tributary study unit (58 percent), and the Powers Creek study unit (50 percent; derived from Table 10). Crop production is identified as a potential source of impairment in McCullom Lake.

An inquiry was made with the USDA – NRCS office for McHenry County regarding nutrient management and the extent to which its implementation is common practice. It is not possible to quantify the prevalence or number of nutrient management plans that are in place based on data/information available from this office.[77] As for tillage practices, the Illinois Department of Agriculture shared data collected from the 2013 Illinois Soil Conservation Transect Survey (Table 40).[78]

Table 40. Percent (number) of fields with indicated tillage system for McHenry County, 2013.

Crop	*Conventional Tillage*	*Reduced Tillage*	*Mulch-till*	*No-till*	*Total*
Soybeans	30 (37)	20 (25)	5 (6)	45 (55)	(123)
Corn	71 (164)	17 (38)	6 (13)	7 (15)	(230)
Small grain	100 (17)	0 (0)	0 (0)	0 (0)	(17)

3.7.2 Forest Management Plans

The Illinois Department of Natural Resources, Division of Forestry, works with private landowners to reforest agricultural land and help with managing private woodlots. The Illinois Forestry Development Act (IFDA; 525 ILCS 15), funded in part by the U.S. Department of Agriculture – Forest Service, provides for this program. The IFDA created the Illinois Forestry Development Council, the Forestry Development Cost Share Program, and the Forestry Development Fund. Timber harvests in the State of Illinois are subject to a 4% harvest fee, and that money helps to fund the cost-share component of the program[79].

[77] Lewis Nichols, USDA NRCS, McHenry County District Conservationist, personal communication, March 4, 2015.

[78] The survey methodology involves driving a route that samples a minimum number of 456 sample sites. Frequency of stops (i.e., distance between data collection points) depends on number of acres of cropland. A complete description of the methodology is on file at CMAP.

[79] IDNR. *Information Sheet: Illinois Forestry Development Act*. Springfield, IL: IDNR, June 2006. http://dnr.state.il.us/conservation/forestry/IFDA/ (accessed March 20, 2013).

Ten acres of woods is the minimum land-area requirement; 11 acres if a home is present on the property. The program requires a landowner to develop an IFDA-approved management plan. With passage of the IFDA, the Illinois Property Tax Code was amended in order to provide a tax incentive to timber growers. In counties with less than 3,000,000 residents (i.e., all Illinois counties other than Cook), any land being managed in the IFDA is considered as "other farmland." Thus, the land is valued at one-sixth of its equalized assessed value based on cropland.

In northeastern Illinois, the program emphasizes exotic species removal and oak regeneration. Within the Boone-Dutch Creek planning area, there are 22 properties with management plans in the Illinois Forestry Development Act program. These plans total 367 acres and range in size from 5 to 45.5 acres.[80]

3.7.3 Comprehensive Plans

Each of the seven municipalities within the Boone-Dutch Creek planning area has adopted a comprehensive plan to guide development, transportation, and conservation. The municipalities developed these plans partly out of concern over the encroachment of residential development onto previously undeveloped "greenfield" land, threatening the rural character and natural landscapes of the communities. In order to influence the form of these developments, plan for their impacts on infrastructure, and mitigate their effects on natural areas and water resources, the municipalities adopted plans to inform ordinances and municipal decision making. Each plan includes a map of future land use that identifies key natural resource areas to preserve. In general, the plans all address natural resource and water resource concerns as a major priority. For the most part, the plans emphasize direct conservation of significant lands through development restrictions but have relatively few policies to limit the impact of development located in the rest of the community. These plans would benefit from fuller consideration of transportation and parking impacts, and many are old enough that they require updates to reflect more recent developments. The following section discusses the elements of each comprehensive plan that potentially impact water quality and watershed health. It also includes discussion of several relevant plans from other units of government and public agencies, including McHenry County's 2030 Comprehensive Plan and Green Infrastructure Plan, the McHenry County Conservation District's Long-Range Plan and Comprehensive Site Development and Public Access Plan, and Nunda Township's Open Space Plan.

Bull Valley

The Village of Bull Valley adopted its Comprehensive Land Use and Preservation Plan in 2011. It includes relevant chapters on community character and land use and natural resources. The plan states the principle that consideration of wetlands, woodlands, steep slopes, groundwater

[80] Dave Griffith, IDNR Division of Forest Resources, personal communication, November 10, 2014. Some of the plans are under 10 acres from a time when the program's minimum acreage was five.

recharge areas, and other areas identified on several regional natural resource maps "must be part of the approval process for all zoning requests in all areas." It also cites the preservation of the natural landscape as a key motivation for village efforts to maintain and preserve open space. The plan includes maps that identify critical natural and water resource areas for protection and preservation.

In addition to delineating areas of significance, the Bull Valley plan includes extensive discussion of stewardship and land use practices that can advance environmental goals. These recommendations include "Good Stewardship Practices" and additional practices for the "Protection of Our Groundwater Recharge Function and our Water Dependent Environmental Features." The plan emphasizes the importance of open space preservation, expresses the community's desire to maintain a rural character, and contemplates most future development as large lot, single family residential land use. While it states a goal of encouraging infill development, it contains no specific strategies to do so, nor does it recommend cluster or conservation design in residential developments. The plan contains little discussion of public transportation, and although it recommends accommodating walking and biking with off-street trails, it otherwise addresses mostly automobile circulation.

Johnsburg

The Village of Johnsburg updated and adopted its Comprehensive Plan in 2004. It includes specific land use recommendations for ten planning subareas within the village, a plan for a proposed mixed use village center, and design and development guidelines for the Route 31 corridor. It also addressees open space and natural resources. As a general principle, the plan stresses the importance of environmental conservation and states that natural resource areas identified on the plan's maps "should be protected in whole or in part." The map and planning elements related to environmental features identifies the Fox River and its tributaries, wooded sites, stream corridors, wildlife habitat, wetlands, floodplains, and areas of poor soils. The future land use plan identifies sizable areas for parks and open space, including private open space secured through conservation easements and land trusts. The open space elements of the plan emphasize preserving wetlands for a variety of reasons, including stormwater management.

In addition to identifying areas of significant natural resources for conservation or protection as open space, the Johnsburg plan includes several other recommendations that could improve environmental quality. The plan speaks generally about the need to protect groundwater resources, although it does not include specific recommend-dations. It also encourages the preservation and enhancement of existing trees within the Village. The Johnsburg plan also seeks to focus more intensive, mixed use development in a town center district, proposing infill development rather than the conversion of undeveloped land. For new residential developments that are not infill, it encourages cluster-based conservation design to maximize the amount of open space that can be preserved. The transportation elements of the plan include goals of pedestrian-oriented development in the village center, off-street paths for walking and biking, and a commuter rail station within the village.

McCullom Lake

The Village of McCullom Lake adopted its current Comprehensive Land-Use Plan in 2006. The plan establishes a general vision for future development in the community and includes specific recommendations related to land use, transportation, and community facilities, but lacks discussion of water resources and the natural environment. For the most part, the plan foresees limited new development, mostly single family residences similar to those already common in the village. While the plan includes an explanation of cluster development and the possibility of transit oriented development if the Metra commuter rail service is extended to Johnsburg, it does not recommend that the village adopt either model. If a new Metra station is constructed, the McCullom Lake plan recommends the creation of bike paths and routes throughout the village that would connect residents to transit as well as to regional trails.

McCullom Lake's plan does not include sections dedicated to natural resources, open space, or water resources. The plan cites the need for additional park space for a growing population and proposes the inclusion of pocket parks with new development, but it does not set quantitative goals or identify specific parcels to be preserved as parks or open space. Neither the text nor the associated maps identify key natural resource areas other than as scenic vistas. The plan's only discussion of water resources is to propose studying the creation of a potable water supply system to serve the original portion of the village.

McHenry[81]

In 2008, the City of McHenry adopted its Comprehensive Plan and Development Policies. This Plan lays out a 20-year vision for the city and guides the type, intensity, rate, and quality of growth. The plan's Community Profile section, which presents existing conditions, provides some discussion of natural resources, including Boone Creek, but lacks a map of the environmental features of the community, such as watersheds, wetlands, floodplains, groundwater recharge areas, hydric soils, oak groves, steep slopes, prairies, and savannas. The Community Profile also lacks extensive discussion of the City's groundwater concerns. The overall goals of the plan include objectives related to quality of life, growth management, and environmental concerns, and cite the importance of open space, waterways, and wooded areas. The overall goals do not explicitly address water quality, but exhibit a focus that is compatible with attention to water resource enhancement and groundwater protection.

For parks and open space, the plan includes a goal to preserve, expand, and connect environmental corridors to protect wetlands, floodplains, and mature forests for the purpose of maintaining wildlife habitat diversity and for environmental health, recreational, and aesthetic purposes. With this goal, the plan includes several desirable objectives focused on protecting steep slopes; minimizing massive grading of development sites; implementing erosion control measures; enhancing existing wetlands, floodplains, and groundwater recharge areas; and preserving mature trees. Additional protective measures are identified for the Boone Creek Corridor, including the use of stormwater best management practices to limit the impact of stormwater runoff.

The McHenry Comprehensive Plan's future land use recommendations stress dense, mixed use development that can help minimize resource consumption and environmental impacts. It does not specifically designate an area for mixed use development but does emphasize its overall importance, along with the benefits of infill and redevelopment in older parts of the city. For residential areas, the plan encourages conservation design and cluster development but also recommends low-density, large-lot residential development in outlying parts of the city. This latter type of development could threaten large, contiguous areas of open space.

McHenry's plan also addresses transportation and circulation including automobile, transit, pedestrian, and bicycle modes. The plan calls for increased transit service and transit-oriented

[81] This section is condensed from a previous CMAP analysis of McHenry's comprehensive plan: *City of McHenry Comprehensive Plan and Ordinance Assessment: an Implementation Step of the Silver Creek and Sleepy Hollow Creek Watershed Action Plan*. Available at: http://www.cmap.illinois.gov/programs-and-resources/lta/silver-creek-sleepy-hollow-watershed

development around the Metra commuter rail station. However, the plan also calls for additional parking at the train station without demonstrating a need for more spaces. Bikeways are recognized as an important asset of the community, with an emphasis on the regional and recreational bike network. The plan outlines off-street and on-street bikeways as a way to link residential neighborhoods with the community's amenities. The plan also calls for pedestrian access and circulation to be fully integrated into the design for streets and major land development.

In addition to its Comprehensive Plan, McHenry has adopted several plans for subareas within the city that touch on issues relevant to watershed planning. These plans build on the Comprehensive Plan's recommendations for dense, mixed-use development and multimodal transportation, providing more detailed recommendations for specific areas within the city that may be suitable for dense development. Enabling such development within designated areas of the city is a key step toward implementing the overall land use vision of the Comprehensive Plan, although they do not explicitly address water quality or natural resources.

- The *Core-Downtown Sub-Area Plan* (2009) covers an area of several blocks on both sides of Boone Creek near its confluence with the Fox River. The plan foresees a wide variety of business types and land uses within an integrated, pedestrian-oriented transportation network. Recognizing the benefits of a mix of uses that includes housing, retail, restaurants, and offices, the plan identifies specific parcels for redevelopment and infill development, including the current wastewater treatment plant. The plan describes streetscaping and traffic calming improvements that would make a more inviting environment for bicyclists and pedestrians, and it recommends additional bike routes and paths that build on the recommendations of McHenry's 2004 bike plan. It also stresses the importance of connections to public transit, including commuter buses and connections to the McHenry Metra station. Despite its emphasis on transit and non-motorized transportation, the plan does recommend increasing off-street parking, potentially through the construction of a multilevel parking deck.

- The *Main Street Sub-Area Plan* (2008) addresses a small area centered near the McHenry Metra Station, including parts of Main Street, Front Street (Rt. 31), and Elm Street. The plan seeks to create a thriving, transit-oriented downtown atmosphere with a mix of land uses and a pedestrian-friendly environment. Like the Core-Downtown plan, the Main Street Plan identifies infill locations for redevelopment, projecting that currently industrial land uses could become commercial, residential, and mixed-use in the future. The plan seeks to focus development around the existing Metra station and calls for increased service, improved access to the station via bicycle, and pedestrian links to regional trains and nearby destinations. It also recommends increased surface parking within the study area.

- The City of McHenry has created a *Riverwalk* along the downtown stretch of Boone Creek. The plan for the Riverwalk, which began construction in 2006, divides the potential length of the feature into three zones: Historic, Residential, and Commercial. As an element of downtown placemaking, the Riverwalk plan is consistent with the city's overall goals of attracting development and activity to its downtown, lessening the demand for land development in greenfield areas. However, the plan does not address improvements to water quality or stormwater management along Boone Creek.

- The *Crystal Lake Road Sub-Area Plan* (2006) addresses land use and circulation along a corridor that includes several expansive land uses, including a school, a medical facility, and large-format retail. The study area includes mostly unincorporated land, which prompted the city to be more proactive in planning. The plan focuses mostly on mitigating traffic circulation problems and says little about the impact on natural resource areas or water resources. The study area does include Cold Springs Park, a wetland area preserved as passive open space; the plan sets goals of improving access to the park for pedestrians and vehicles while preserving its integrity and high-quality natural assets.

Ringwood

The 2030 Comprehensive Land Use Plan for Ringwood was adopted by the village in 2006. The plan generally contemplates low-density, single-family residential development while citing the importance of open space and environmental protection. The plan discusses the importance of open space and natural areas, especially the McHenry County Conservation District's Glacial Park, in establishing the village's cherished rural setting. It also uses specific, quantitative standards for the amount of open space per resident and, based on projected population growth, sets targets for expanding parks and open space in the community. It also emphasizes the importance of preserving and planting trees as part of any new development in the village. Although the plan recognizes the benefits of open space and natural areas, it does not include specific or detailed guidance for how the village can protect and maintain its resources. It does not map or identify sensitive natural areas or discuss the role of open space in protecting water resources. The plan stresses the village's reliance on groundwater and the importance of protecting water sources, but only in general terms. The plan does consider the importance of efficient land use, encouraging infill development near the hamlet centered at the village's main crossroads. It also emphasizes alternative transportation, particularly bicycling.

An earlier plan, the 2010 Land Use Plan, contained more detailed information about the village's natural resources. The 2010 Plan, which was adopted in 1996, included a chapter on natural resources and several maps delineating land with environmentally significant qualities.

It discouraged development in areas containing water, areas with steep slopes, and areas associated with hydric soils. The Natural Resources chapter described multiple strategies for stewardships and environmental protection, including the role of open space in stormwater management. These elements are absent in the 2030 Comprehensive Land Use Plan.

Wonder Lake

In 2010, the Village of Wonder Lake adopted a revision to its Comprehensive Municipal Development Plan, originally created in 2004 and revised in 2005. The plan includes descriptions of the village's existing conditions as well as chapters specifically addressing the natural environment, transportation, demographics and housing, goals and objectives, and a land use plan. The plan emphasizes "protection, preservation, and enhancement" of natural resource areas, with special focus on waterbodies and water resource areas. It also discusses topography and soils, resource corridors, and woodlands. The plan includes maps of existing land use, future land use, and natural resources, all of which reflect the emphasis on the significance of natural resource areas. In terms of water resources, the main focus of the plan is on Wonder Lake itself, but it also identifies creeks, floodplains, and wetlands. The 2010 update is not a new plan, thus much of the analysis dates to the original 2004 planning process and 2005 revision.

The Comprehensive Municipal Development Plan includes a variety of recommendations to further natural resource and water resource goals. The plan sets a general goal of conserving high quality woodlands and habitats and protecting water resources. For Wonder Lake itself, the plan sets a goal of supporting an ongoing program of lake management to enhance water quality, ecology, and recreation. It states the need to identify sensitive areas, including groundwater recharge areas, and preserve them as open space. It recommends using the village's subdivision ordinance to encourage cluster development and recommends adopting surface water, groundwater, wetland, and floodplain protection ordinances as well. The plan recommends some amount of mixed use development along Wonder Lake Road and sets a goal of promoting alternative transportation. For residential areas, the plan states that cluster developments "should be highly encouraged" to preserve open space and drainage ways.

Woodstock

The City of Woodstock adopted its Comprehensive Plan in 2008. It includes chapters on Natural Resources, Open Landscapes, Parks, and Public Infrastructure that address issues of resource conservation, land use, and water quality. Mapping natural resource areas and water resource areas as "corridors for resource protection" was the city's first step in creating its land use map. Resource conservation areas include wildlife habitat, wetlands, floodplains, open water, groundwater recharge, farmland, woodlands, and areas of hydric soils. The future land use plan establishes "resource conservation buffers" around these conservation areas, further stating that development will "ideally" not be allowed in these areas and that only development using conservation design principles to reduce impacts will be considered. The plan uses parks and open space designations as one way to restrict development in sensitive areas.

The Woodstock plan contains a chapter on Natural Resources that lists protection goals in several categories, along with associated objectives and implementation strategies. The plan includes recommendations related to protecting the groundwater supply: the resource conservation areas that the plan's maps identify include groundwater recharge areas, and natural resource goals include ensuring an "adequate and clean supply of groundwater." The plan also recognizes the role of wetlands and how "open landscapes" can complement the function of natural areas. The Natural Resources chapter also includes an objective to preserve oak stands, hickory stands, and other woodland resources. It promotes the use of native landscaping and tree planting for shade, stormwater management, and aesthetics. The plan cites the existing Nippersink Creek and Kishwaukee River Watershed Plans as references that the city should use while reviewing the potential impact of development proposals on water resources.

The Woodstock plan recommends development patterns that promote efficient land use and alternative transportation options. It encourages density near existing community features, commercial development on infill sites, and revitalization of established areas such as downtown. To encourage infill development, the plan promotes reuse of empty and/or vacant commercial and industrial sites. The plan recommends that the Central Business District include a "dense mix" of multiple uses, including within single buildings, to discourage automobile dependency and provide multimodal, non-motorized transportation options. For transportation and circulation, the plan promotes bike and pedestrian trail connections between parks, residential neighborhoods, and regional trails. It emphasizes walkability and pedestrian-scale design and the importance of public transit in the town square, and encourages reducing the amount of land used for parking.

McHenry County

Adopted in 2010, the 2030 Comprehensive Plan is McHenry County's overall strategic vision for land use and development over a twenty-year period. As a county plan, it has greatest influence over unincorporated areas and limited applicability within municipalities, but it does provide guidance and recommendations for policies that municipalities could adopt. The plan strongly emphasizes compact development, transit oriented development, natural resource and open space preservation, and the protection of water resources. The plan establishes an overarching strategy of creating a more livable and sustainable county by first considering the value of natural features, ecology, and ecosystem functions prior to development. It sets ambitious goals for preserving open space and agricultural land and contains extensive information on ecology, water, and natural resource areas within McHenry County.

The 2030 Comprehensive Plan seeks to reduce the impact of growth by concentrating development at efficient densities around existing assets such as downtown areas and transit stations. The plan recommends compact development as a way to accommodate growth, particularly housing, while maintaining the ability to meet county priorities such as the preservation of currently undeveloped land and agricultural land and the protection of environmentally sensitive areas and groundwater resources. In its land use section, the plan details several key mechanisms for achieving this vision, including transit oriented development. Specific recommendations for increasing transit oriented development include the adoption of municipal ordinances that allow increased density near Metra stations, encouragement of shared parking to reduce land dedicated to surface parking, and improvements in transit and bike/pedestrian connections to Metra stations. While development near transit is one method the plan recommends, it emphasizes the importance of compact, contiguous development even in areas without transit service; the plan describes the community benefits of infill and redevelopment in areas already served by infrastructure. The county recommends using conservation design and "traditional neighborhood design" with new urbanist principles, which would allow new development to maximize preserved open space and limit the need for new infrastructure. The plan extends its emphasis on efficient development patterns to commercial and industrial uses as well, focusing development to key corridors, historic downtowns and transit areas, and areas within municipal boundaries already served by infrastructure. The plan's infrastructure section builds on its land use framework, stressing multi-modal transportation, improved transit service, and an expanded bicycle and pedestrian network as a way to reduce roadway construction and reliance on automobiles.

McHenry County's 2030 Plan includes extensive consideration of greenways, open space, and natural resources. It discusses the importance of green infrastructure for providing ecosystem services such as water quality protection as well as its role in habitat preservation and quality of life. The plan's open space recommendations focus on preserving environmentally sensitive areas (floodplains, wetlands, sensitive aquifer recharge areas, remnant natural areas, and others), promoting conservation in land use planning, developing viable alternative transportation, establishing a network of greenways and trails, and preserving habitat. It includes an open space inventory of public and private preserved land and seeks to reach a goal of 15 percent preserved open space within the county. The plan presents the benefits of greenways as riparian habitat, filtration buffers for water supplies, and opportunities to boost connectivity of conservation lands; the 2012 Green Infrastructure Plan, discussed below, develops these principles into a strategic plan. The 2030 Comprehensive Plan also includes an inventory of natural resources, considering topography, soils, sand and gravel deposits, vegetation, wildlife, and agricultural land. The associated maps include oak stands, relatively intact native plant communities, and other key resources. The plan also discusses the role of agricultural lands in natural resource systems, showing that farmland preservation can benefit water resources, especially with the use of best management practices the plan identifies. Key

open space and natural resource recommendations include minimizing impervious surfaces in sensitive aquifer recharge areas, discouraging construction on steep slopes, protecting land identified in the Illinois Natural Areas Inventory, increasing public and private land conservation, and encouraging green stormwater infrastructure and soil/stormwater management plans for new development. The 2030 Comprehensive Plan also includes a chapter addressing water resources. It includes a great deal of detailed information and maps on groundwater, surface water, various potential impacts to water resources, and stormwater management. The plan encourages a variety of best practices including watershed-based planning, limiting development in flood hazard areas, minimizing impervious surfaces, and steering building away from recharge areas. The plan includes extensive recommendations related to recharge area protection, wastewater, water conservation, coordinated water planning, protection of aquatic habitat, and stormwater runoff reduction.

McHenry County adopted a Green Infrastructure Plan in 2012 to advance the open space and natural resources strategies established in the 2030 Comprehensive Plan. The plan provides a detailed inventory and maps of green infrastructure in the county including lands for habitat, lands that provide ecological and recreational value, and areas where green stormwater infrastructure and similar technology has created ecosystem benefits. These benefits include stormwater management, protection of the water supply, wildlife habitat, biodiversity, enhanced groundwater recharge, reduced flooding, and recreational and trail connections. The plan identifies regional opportunities for protecting and preserving green infrastructure that local plans may miss. Rather than simply presenting a plan for land acquisition, the plan takes a multifaceted approach to protecting green infrastructure through public acquisition, private easements, planning and zoning, conservation design, greenways and trails, and landscape restoration and retrofitting. The broad suite of tools gives communities a range of options for green infrastructure, helping them choose the appropriate approach for their context. The plan includes a number of maps that display watershed boundaries, surface water features, floodplains, wetlands, Illinois Natural Areas Inventory sites, public open space, and woodland and grassland areas. To further inform local decision making, the plan also includes maps of hydric soils, organic soils, sensitive aquifer recharge areas, erodible soils, trails, and other features. The plan recommends a “cores and corridors” approach to protecting green infrastructure and calls for a greenways master plan to connect key natural resource areas.

McHenry County Conservation District

Two recent plans adopted by the McHenry County Conservation District (MCCD) include conservation and open space recommendations relevant to the Boone-Dutch Creek planning area. The Conceptual Framework for Long Range Planning for 2010-2030, adopted in 2010, is a set of goals and recommendations to guide long-range planning for preservation, education, recreation, and organizational effectiveness. It does not recommend specific parcels for preservation but instead establishes criteria MCCD should consider while evaluating parcels for acquisition or protection. The framework notes that the County's growing population will require additional open space to meet accepted standards for per capita acreage and sets a goal of preserving ten percent of the total land in McHenry County. The framework discusses several criteria for selecting conservation parcels including the value of open space in providing ecosystem services such as flood storage and groundwater protection. The plan's overall strategy is to focus on contiguous areas of open space, categorized as core preserves, nodes, corridors, and buffers. Riparian systems, floodplains, areas of hydric soil, and groundwater recharge areas are high value lands that can function as buffers and corridors. The framework recommends preserving high-quality natural areas including rivers, streams, and connected green infrastructure. It also recommends updating the regional trails plan and pursuing funding and partnerships for trails.

The 2008 Comprehensive Site Development and Public Access Plan reflects the other main mission of MCCD: providing public access and recreational opportunities that are consistent with the district's conservation mission. The main focus of the plan is on providing connections to currently preserved landholdings without unnecessarily fragmenting habitat or disrupting wildlife species. While the plan refers to the importance of ecological preservation, connectivity, and water resource management potential in MCCD's acquisition strategy, it focuses mainly on issues such as bike trails, hiking trails, and paddling access. The plan recommends updating the regional trails plan for biking and hiking. It emphasizes considering the impact of access improvements on environmental quality, including groundwater recharge, wetlands, and floodplains, in evaluating their appropriateness.

Nunda Township

Nunda Township, which includes parts of Bull Valley and the City of McHenry, completed an open space plan in 2004. It includes overall goals and principles that emphasize the importance of land conservation in protecting scenic vistas, habitat, and water resources. It also recommends preservation of 25 specific parcels, some of which fall within the Boone-Dutch Creek planning area, as open space. The township created the plan to help implement its 2003 land use plan, which recognized the importance of preserving the area's open spaces, streams, and lakes in the face of projected population growth and increased demand for water supply. The open space plan recognizes land preservation as a tool to preserve recreational opportunities and scenic vistas while also serving to protect the quantity and quality of the fresh water supply. The plan contains no guidance on development patterns or motorized transportation, but does note the importance and popularity of several regional trails for hiking and biking. It includes extensive, detailed consideration of natural resource areas, discussing the importance of wetlands, floodplains, groundwater recharge areas, hydric soils, farmland, and remnant natural areas. It includes maps of aquifer sensitivity, hydric soils, and highly permeable soils. It also stresses the importance of buffers, floodplains, remnant natural areas, and farmland in creating contiguous corridors to enhance resource protection. The plan places special emphasis on protecting groundwater recharge areas from pollution and overuse. The major recommendations of the plan focus on identifying specific parcels for conservation, whether through acquisition, purchase of development rights, or private easements, to advance resource protection and recreational goals.

3.7.4 Local Ordinances

Through ordinances and codes, communities implement the vision established in their comprehensive plans by establishing detailed, enforceable regulations. Zoning is the most common ordinance that municipalities and counties use to direct land use, transportation, and development practices, with many also using subdivision, stormwater, water use, and parking ordinances to regulate specific aspects of development. McHenry County and six of the seven municipalities within the Boone-Dutch Creek planning area each completed a questionnaire (Appendix I) assessing the extent to which their ordinances address issues related to water quality and natural resources. The questionnaire asked whether current codes fully, mostly, minimally, or do not address stormwater drainage and detention, soil erosion and sediment control, floodplain management, stream and wetland protection, natural areas and open space, conservation design, landscaping, transportation, parking, water efficiency and conservation, and pollution prevention.

The two communities whose ordinances addressed the greatest number of topics were McHenry County and the City of Woodstock. However, both derived a large amount of their high overall score from the extent their ordinances addressed parking and transportation, areas that many communities addressed minimally. While these ordinances directly apply to only a small percentage of the land within the watershed, each of the municipalities that completed the survey has adopted the McHenry County stormwater ordinance, expanding the scope of its positive impacts. Because the municipalities share a common stormwater ordinance, they are similarly successful in addressing stormwater, soil erosion, and elements of floodplain, stream, and wetland protection. The categories where municipal ordinances generally did not address key topics included natural areas and open space, parking, transportation, pollution prevention, water efficiency, and conservation design and infill. These areas present an opportunity for revised codes to make strides in encouraging compact development patterns, reducing impervious surfaces, and preserving open space.

McHenry County

McHenry County's ordinances address a broad range of topics that affect water quality including land use, transportation, and parking standards that many ordinances fail to include. To address stormwater drainage, the ordinances include tools for minimizing the quantity of stormwater runoff, encouraging natural drainage practices, limiting peak discharge from storm events, and requiring best practices in detention design and maintenance. The county also restricts detention within floodways, restricts discharge into wetlands, and addresses detention credits for temporary runoff storage. It is among the strongest stormwater ordinances within the watershed. The county's ordinances are also strong with respect to soil erosion and sediment control. The ordinances, which apply to all activity disturbing more than 5,000 square feet of land, set standards that minimize sediment transport, include explicit site design requirements and references to best practices, and require maintenance, inspection, and enforcement. The ordinances cover several requirements related to floodplain management including use restrictions within floodways, limits to stream channel modification, and requirements to adopt effective erosion and sediment control measure for all disturbances in a floodway. The county's ordinances have multiple measures for protecting wetlands and streams, discouraging modifications, and encouraging restoration. The county also partly addresses setbacks from wetlands and surface water and watercourse relocation. For water efficiency and pollution prevention, the county offers few requirements in its ordinances but does regulate activities within groundwater protection areas.

On land use topics, McHenry County's ordinances stand out as especially comprehensive. They include numerous elements related to natural areas and open space, setting aside land for preservation, and requiring secured funding, management plans, and binding easements to ensure that open space is preserved and well managed in perpetuity. The county's ordinances also encourage site design that preserves natural systems and open space through cluster development, although they lack designated areas and incentives for mixed-use and infill development. The county's landscaping requirements encourage native landscaping, require the protection and replacement of trees disturbed by construction, and require payment into a mitigation bank for trees that cannot be replaced. The ordinances also include a number of beneficial transportation and parking standards: the county encourages narrow streets, connected street grids rather than cul-de-sacs, the use of natural drainage, and connected sidewalks. It also uses relatively low parking requirements, encourages shared and flexible parking arrangements, and promotes pervious materials in parking areas.

Bull Valley

The Village of Bull Valley has adopted the McHenry County Stormwater Management Ordinance which addresses a range of important stormwater and soil erosion issues (see above). In addition to those policy areas, the village has adopted several relevant requirements through its zoning ordinance. The zoning ordinance protects hydrologic functions and water quality in floodplains, requires effective erosion controls, and imposes some restrictions on stream channel modification and changes to the floodway based on use. The zoning ordinance also includes some flexible parking requirements, but as the village is almost entirely low-density residential, parking is generally not regulated. Bull Valley also promotes several best practices for landscaping through its codes including some encouragement of using native landscaping, street trees, and tree protection and replacement. Outside of these topics, the Village's ordinances could be strengthened to encourage additional best practices for the watershed. Bull Valley's current codes do not address water efficiency and have only minimal standards for pollution prevention, conservation design, natural areas, and stream and wetland protection.

Johnsburg

The Village of Johnsburg has adopted the McHenry County Stormwater Management Ordinance which addresses a range of important stormwater and soil erosion issues (see above). Johnsburg has also adopted a Model Floodplain Ordinance for Communities in Northeastern Illinois, which incorporates several standards that protect floodways from development impacts. Through its stormwater and subdivision ordinances, Johnsburg has adopted several policies that influence natural areas and wetlands and streams. The subdivision ordinance imposes requirements for easements and open space funding and management on new developments, while the stormwater ordinance provides some level of protection of wetlands and surface water areas from direct modification and development impacts. The village's current ordinances contain few measures related to conservation design, water efficiency, pollution prevention, transportation, or parking.

McCullom Lake

The Village of McCullom Lake has adopted the McHenry County Stormwater Management Ordinance which addresses a range of important stormwater and soil erosion issues (see above). These stormwater regulations also serve to provide some relevant protections for floodplains, wetlands, and streams. While the ordinances do not restrict modifications in floodways to a minimum of appropriate uses, they do include provisions for setbacks and buffers while prohibiting watercourse relocation and encouraging restoration. Outside of those policy areas, McCullom Lake's ordinances contain a few isolated standards related to landscaping, pollution prevention, and water conservation. They include some standards to encourage protection and replanting of trees, discourage the use of phosphorous fertilizers, and restrict downspout connections. The codes have no relevant language related to parking, conservation design, or natural areas and open space.

McHenry

The City of McHenry has adopted the McHenry County Stormwater Management Ordinance which addresses a range of important stormwater and soil erosion issues (see above). These stormwater regulations also serve to provide some relevant protections for floodplains, wetlands, and streams. The city's ordinances contain relatively little guidance on natural areas and conservation design but more extensively address landscaping, parking, and water efficiency and conservation. McHenry adopted a water conservation ordinance in 2014 that empowers the city to restrict water usage for lawn watering while encouraging the use of recycled water and harvested rainwater. McHenry requires the protection, restoration, and replacement of trees affected by construction and encourages the use of native plants and vegetation.

Ringwood

The Village of Ringwood has adopted the McHenry County Stormwater Management Ordinance which addresses a range of important stormwater and soil erosion issues (see above). These stormwater regulations also serve to provide some relevant protections for floodplains, wetlands, and streams. Ringwood's ordinances address a relatively large number of issues pertaining to streams and wetlands including restricting modifications, setting very high mitigation ratios for high quality wetlands, and requiring buffers along waterbodies. Ringwood also regulates and mitigates some impacts to natural areas through its codes; it encourages restoration of natural areas and requires maintenance and management plans for open space stormwater management facilities. The ordinances only minimally address landscaping, conservation design, transportation, and water efficiency, and the village did not report on pollution prevention or parking.

Wonder Lake

No ordinance review was received from the Village of Wonder Lake. As a McHenry County Certified Community, the village has adopted the McHenry County Stormwater Management Ordinance which addresses a range of important stormwater and soil erosion issues (see above). These stormwater regulations also serve to provide some relevant protections for floodplains, wetlands, and streams.

Woodstock

Of all the units of government within the watershed, the City of Woodstock features ordinances that address the largest number of topics affecting water quality. To address stormwater drainage, Woodstock has adopted the McHenry County Stormwater Management Ordinance which includes requirements minimizing the quantity of stormwater runoff, encouraging natural drainage practices, and limiting peak discharge from storm events. The city's ordinances are among the strongest in the area regarding soil erosion and sediment control. The ordinances, which apply based on the size and location of activity disturbing land, set standards that minimize sediment transport, include explicit site design requirements and references to best practices, and require maintenance, inspection, and enforcement. The ordinances cover several requirements related to floodplain management but could be stronger in restricting modifications to floodways to a minimum of appropriate uses. Woodstock's ordinances are moderately effective in addressing wetland and stream protection, discouraging modifications of high quality water resources but not fully addressing setbacks, buffers, restoration, and other best practices. For water efficiency and pollution prevention, the city offers few requirements in its ordinances but does restrict downspout connections to only porous surfaces or rain barrels, regulates activities within municipal well setback zones, and restricts pet waste disposal.

On land use topics, Woodstock's ordinances regulate a wide range of relevant activities. They cover a variety of natural areas and open space issues, setting aside land for preservation and requiring secured funding, management plans, and binding easements to ensure that open space is preserved and well managed in perpetuity. The city's ordinances also require developers to complete a site analysis map that includes a natural resource inventory, encourage mixed-use development through zoning, and allows and encourages cluster development and conservation design. Woodstock's landscaping requirements encourage the use of native vegetation and require planting, protecting, and replacing trees disturbed by development but do not require payment into a mitigation bank for trees that cannot be replaced.

Compared to other jurisdictions in the Boone-Dutch Creek planning area, Woodstock boasts the ordinances that most extensively consider transportation and parking practices that carry environmental benefits. The city requires siting streets to minimize encroachment on natural areas and encourages narrow, well-connected streets grids rather than cul-de-sacs, the use of natural drainage, and connected sidewalks. Woodstock also uses relatively low parking requirements, especially in the downtown area, and encourages shared and flexible parking arrangements and promotes pervious materials and landscaping in parking areas.

3.7.5 Conservation Easement Programs

A conservation easement is a land protection tool that allows private and public property owners to preserve their land from inadvertent or intentional destruction of desired natural, scenic, historic, or agricultural characteristics. Restrictions placed in a conservation easement are tailored to each property and situation. For example, the easement may require the land to remain in a natural, undisturbed condition or it may allow some limited use, such as farming or timber management. Easements can be placed on all or a portion of a landowner's property. For example, a stream and a prairie buffer along it could be specified in the easement, thereby allowing the remainder of the property to be developed. A conservation easement is permanent and is recorded like any other title interest and stays with the land when it is transferred by sale, gift, or bequeath. A conservation easement may provide income, estate, and/or property tax benefits as well.[82] Conservation easements are typically not open to the public. Entering an area that is not open to the public subjects an individual to possible sanctions for trespass.

Organizations with which Boone-Dutch Creek planning area landowners can work to establish conservation easements include The Land Conservancy of McHenry County (TLCMC), the Natural Land Institute, and the Illinois Nature Preserves Commission (INPC). Where there are high quality natural areas and habitats of endangered or threatened species, dedication or registration of such lands as an Illinois Nature Preserve, Land and Water Reserve, or Illinois natural heritage landmark can be made through the INPC.

Based on data from the National Conservation Easement Database and TLCMC, more than 888 acres of conservation easements are present within the Boone-Dutch Creek planning area (see Figure 17). Table 41 lists just those easements held by the Illinois DNR or INPC, encompassing

[82] http://www.conservemc.org/what-we-do/preserve-land/conservation-easements.html

about 454 acres. One conservation easement within the Boone-Dutch Creek planning area that is open to the public is Boloria Fen and Sedge Meadow Nature Preserve, owned and managed by the Boone Creek Watershed Alliance.

Table 41. INPC- and IDNR-held conservation easements in the Boone-Dutch Creek planning area.

Site Name	*Owner*	*Easement Holder*	*GIS Acres*
Amberin Ash Ridge Nature Preserve	Private	Illinois Nature Preserves Commission	9.2
Boloria Fen and Sedge Meadow Nature Preserve	Non-Governmental Organization	Illinois Nature Preserves Commission	42.2
Boone Creek Fen Nature Preserve	Private	Illinois Nature Preserves Commission	26.6
Gladstone Fen Nature Preserve	Private	Illinois Nature Preserves Commission	7.4
Julia M. & Royce L. Parker Fen Nature Preserve	Private	Illinois Nature Preserves Commission	13.4
Wheeler Fen Land and Water Reserve	Local Government	Illinois Nature Preserves Commission	27.9
Wold Addition	Local Government	Illinois Dept. of Natural Resources	327.4

3.7.6 Community Water Supply Well Setbacks and Phase 2 Wellhead Protection Areas

Municipalities or counties served by community water systems (CWS) are subject to the Illinois Groundwater Protection Act (IGPA; P.A. 85-0863).[83] Presently, two of the municipalities within the Boone-Dutch Creek Watershed planning area have CWS wells: the City of McHenry and the Village of Johnsburg (Table 42, Figure 58). The IGPA requires that a minimum setback zone be established around all CWS wells in order to minimize aquifer contamination potential by restricting certain land-use activities. The setback zone is set depending on the sensitivity of the aquifer to possible contamination, either a minimum of a 200 foot radius for wells finished within a confined aquifer or a 400 foot radius for wells finished within an unconfined aquifer (Figure 58).[84]

The IGPA also establishes a two-phase wellhead protection program for enhanced groundwater protection. Phase I establishes a 1,000 setback zone around community and non-community water supply wells. Phase II delineates a 5-year recharge area for the CWS well extending beyond 1000 feet of an existing wellhead protection area. Wellhead protection areas are not

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

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

regulated and are used for educational purposes.[85] Of the two communities with community water supply wells within the Boone-Dutch Creek planning area, the City of McHenry has three Phase II Wellhead Protection Areas.

Municipalities and counties also have the option of establishing by ordinance a maximum setback zone up to 2,500 feet around community water supply wells. A 2,500 foot maximum setback zone is restricted to CWS wells that are adjacent to navigable waterways. Such a decision will add an extra measure of protection from incompatible land-use activities yet offers flexibility to accommodate pre-existing activities. Within the Boone-Dutch Creek planning area, no maximum setback zones have been adopted to date. However, the City of McHenry has adopted two groundwater ordinances prohibiting the installation of new groundwater wells at two designated locations within the city.[86,87]

New CWS wells are required to initiate a local wellhead protection program[88] that provides some assurance that newly constructed wells will be designed for pollution prevention. There are three steps involved in this process: inventory potential sources of pollution within 1,000 feet of the well; perform tests on new wells during and after construction; and provide the Illinois EPA with well logs, groundwater flow direction, water levels, pump capacity, pumping rates, and water recovery rates.

Table 42. Number and type of community water supply wells in the Boone-Dutch Creek planning area.

Municipality	*# of unconfined aquifer wells (400 foot setback)*	*# of confined aquifer wells (200 foot setback)*
City of McHenry	4	6
Village of Johnsburg	1	5

3.7.7 Class 3 Special Resource Groundwater Classification

There are many resources that make the Boone-Dutch Creek planning area special including the presence of wetland fens. According to the Illinois Natural Areas Inventory, only 353.84 acres of high quality fens remain in Illinois. These fens are very rare and are best described as "wetlands whose unique assemblage of plants and animals are dependent upon an uninterrupted and unaltered flow of cold, highly mineralized water from the ground."[89]

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

[86] City of McHenry, Groundwater Protection Ordinance, http://epadata.epa.state.il.us/land/gwordinance/docs/R09092501.pdf (accessed March 26, 2015)

[87] City of McHenry, Groundwater Protection Ordinance, http://epadata.epa.state.il.us/land/gwordinance/docs/R05012002.pdf (accessed March 26, 2015)

[88] IEPA. "Wellhead Protection for New Community Water Supply Wells," http://www.epa.state.il.us/water/groundwater/wellhead-protection.html (accessed December 1, 2014)

[89] Byers, Steve. "Fens: More than 'Peat with Calcareous Seepage…'" *Illinois Audubon*. (Fall 2000): 8-13.

Fens support a diverse population of plants and animals because they are fed by alkaline-rich groundwater, providing unique hydrological conditions for a suite of unusual native plants and animals able to thrive in such an environment. Like all wetland systems, they help reduce flooding, are important in maintaining nearby water tables and influencing the recharge of local aquifers, and help improve water quality.

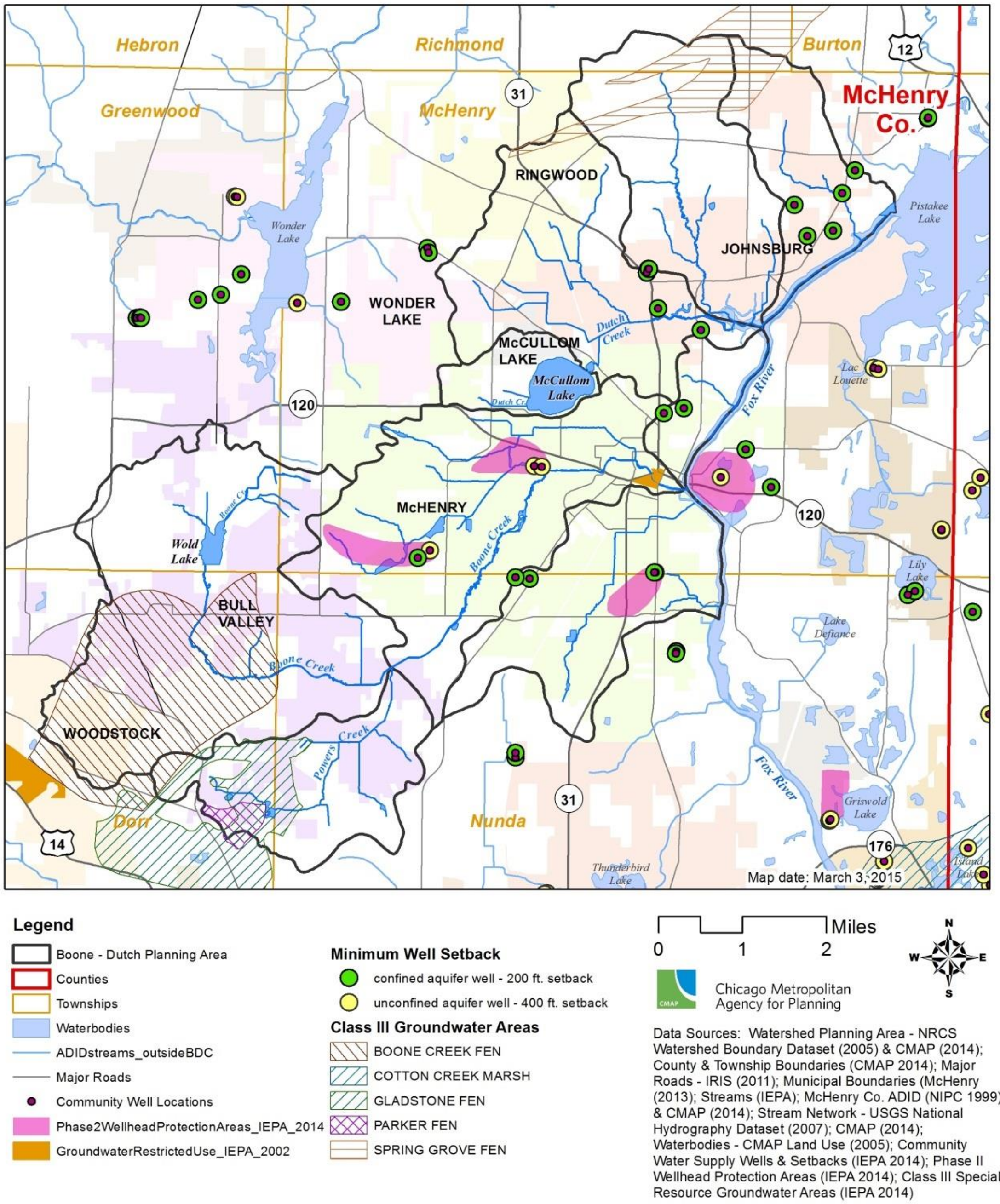
Given their uniqueness, Class III Special Resource Groundwater designations, stipulated by Illinois statue, are used as a tool to help protect groundwater recharge areas associated with groundwater-dependent wetlands (fens) and other aquatic ecosystems. The Illinois Pollution Control Board (IPCB) determines these areas that are "demonstrably unique..or..vital for a particularly sensitive ecological system ... or … groundwater that contributes to a dedicated nature preserve."[90] This designation can be used by local decision makers to implement practices that help protect groundwater recharge areas associated with groundwater-dependent wetlands (fens) and other aquatic ecosystems. Of the fens within and just outside the planning area, four have been given Class III Special Resource status, namely Boone Creek Fen, Gladstone Fen, Spring Grove Fen, and the Julie M. and Royce L. Parker Fen (Figure 58). Locally, communities are implementing groundwater protection measures to protect fen groundwater recharge areas. For example, McHenry County's Ground Water Action Plan,[91] Green Infrastructure Plan,[92] and proposed Unified Development Ordinance include provisions aimed at minimizing harmful impacts to natural recharge functions.

[90] *Class III: Special Resource Groundwater*. *Ill. Adm. Code* 35 (1997), Subtitle F, Chapter 1, Part 620, Section 230. http://www.ilga.gov/commission/jcar/admincode/035/035006200B02300R.html (accessed December 18, 2014).

[91] McHenry County, Illinois, Division of Water Resources. *Groundwater Protection Action Plan*, 2009. https://www.co.mchenry.il.us/home/showdocument?id=8022 (accessed 12/23/2014).

[92] McHenry County Planning and Development, *McHenry County Green Infrastructure Plan*, July 2012. https://www.co.mchenry.il.us/county-government/departments-j-z/planning-development/green-infrastructure-plan (accessed March 26, 2015).

Figure 58. Community water supply wells, Phase 2 wellhead protection areas, and Class III Special Resource Groundwater Areas in the Boone-Dutch Creek planning area.



4. Watershed Protection Measures

4.1 Planning, Policy, and Programming

4.1.1 General Planning and Ordinance Recommendations

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

Each of the seven municipalities within the Boone-Dutch Creek planning area, as well as McHenry County, has adopted a comprehensive plan. The plans generally stress the importance of preventing sprawl by pursuing future land use patterns that direct growth into an orderly pattern that preserves community character and open space. For the most part, the plans emphasize restricting development on identified areas of significant resources but have relatively few policies to limit the impact of development that does take place in the rest of the community. In other words, the plans seek to limit the overall impact of development on natural resources by setting aside land for conservation and pay less attention to mitigating the impacts of transportation and parking in developed and developing areas.

Each community will eventually need to update their comprehensive plans to reflect changing conditions over the coming years. As a general practice, municipalities should update their comprehensive plans every 10-12 years. Within the planning area, Johnsburg (2004), McCullom Lake (2006), and Ringwood (2006) should consider updating their plans in the near future. The following section describes some recommendations the communities should consider when they update their plans to advance the goals of this watershed-based protection plan.

4.1.1.1 Align local plans and ordinances with best practices

Existing municipal plans within the planning area reflect the importance of resource conservation goals to the communities. For example, the Bull Valley plan cites preservation of the natural landscape as a key motivation for village planning, and the Johnsburg plan stresses the importance of environmental conservation and protection of natural areas. The prominence of natural resource conservation as an overarching community goals shows that the will and commitment to advance environmental and water resource protection through planning and development ordinances exists within the planning area's communities. The following discussion provides some best practices that can be incorporated into future plans to achieve this goal.

- **McHenry County plans provide excellent framework for long-range planning and water resource protection in particular.**

  - The McHenry County 2030 Comprehensive Plan offers an excellent guide to municipalities for water resource planning and protection. It strongly emphasizes compact development patterns (which can minimize greenfield conversion and impervious surfaces), transit oriented development (TOD), open space preservation, and water resource protection. It also provides recommendations for coordinated planning as well as recommendations municipalities can adopt into their ordinances for groundwater, watersheds, surface water, and sensitive areas. The McHenry County Green Infrastructure Plan builds on the comprehensive plan's vision.

    The 2030 Plan recommends compact development as a way to accommodate growth while maintaining the ability to preserve undeveloped and agricultural land and protect environmentally sensitive areas, groundwater resources, and surface water. It also encourages cluster-based conservation design in new residential areas and stresses the importance of multi-modal transportation, improved transit service, and an expanded bicycle and pedestrian network; all these practices can reduce the need for new roads and impervious surfaces.

    The 2030 Plan also has a number of specific water resource policy recommendations to minimize the impacts of new development. These include policies for protection of sensitive aquifer recharge areas, hydric soil zones, wetlands, and riparian areas. There also are policies promoting aggressive implementation of stormwater BMPs for minimize runoff pollution and maximize infiltration.

  - McHenry County also adopted a comprehensive Water Resources Action Plan that was developed through a collaborative process involving municipalities, environmental organizations, and watershed groups. This plan strongly emphasizes the importance of protecting the quality and quantity of groundwater.

  - The McHenry County Green Infrastructure Plan builds on the open space strategies of the 2030 Plan by providing a detailed inventory of the location and ecosystem service benefits of green infrastructure in the county. They provide a basis for consistency that each municipality can utilize, and provide guidance on the respective roles of different levels of government.

- **McHenry County Stormwater Management Ordinance offers avenue for coordinated updates.**

  Each municipality within the planning area has adopted the McHenry County Stormwater Management Ordinance. Because the municipalities have adopted the same ordinance, they have the same core set of regulations on these topics and can update them through county action rather than piecemeal revisions at the local level. The countywide Ordinance has undergone several revisions since its initial adoption in 2004 (revised in 2008, 2010, 2011, and twice in 2014). The Ordinance has always included requirements for stream and wetland protection. The Ordinance also has strongly promoted (but not mandated) implementation of a runoff volume reduction hierarchy[93]. To address water quality and runoff volume reduction, the ordinance requires evaluation and implementation of the following design elements "to the maximum extent practicable":

- Wet detention facilities and stormwater wetlands
- Infiltration basins
- Infilitration strips
- Filter strips
- Vegetated swales

In practice, however, very few developments in the planning area have incorporated water quality or volume reduction designs, except for practices associated with naturalized detention basins. The most recent revisions to the countywide Ordinance (2014) have added specific requirements for runoff volume reduction.

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

  The review of local plans found that each municipality has a comprehensive plan, although several of them would benefit from an update. Because of the age of some existing plans, real estate markets have changed considerably since adoption. A new plan would better reflect current market conditions in most cases. The existing plans share a concern with orderly development patterns, and most emphasize the protection of natural resources and water resources. Open space acquisition is the dominant strategy these plans contemplate for protecting natural resources. However, they contain few policies designed to limit impacts in areas that see development, and pay little attention to the role of transportation and parking policies in protecting water resources.

  Select updates that communities could incorporate in future comprehensive plans include:
  - Be explicit about clean water as a goal and an aspect of community vision
  - Encourage native vegetation to stabilize streambanks and filter stormwater runoff

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

- Preserve and increase street trees
- Design streets and parking lots to support their regular functions without creating unnecessary impervious surface and stormwater runoff
- Encourage narrow, connected streets that can accommodate anticipated traffic volumes without requiring unnecessarily wide roadways
- Encourage the use of green stormwater infrastructure in street design
- Encourage green parking lots with integrated stormwater management and fewer, narrower spaces and shared parking to minimize impervious surfaces, and integrated stormwater management
- Emphasize conservation design, infill development, and alternative transportation to reduce overall greenfield development

- **Create and update supplemental subarea and topical plans.**

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

  - Natural resource plans
    - Communities should identify their natural resources and open space areas. Creating and refining a local green infrastructure map that supplements the County Green Infrastructure Map will allow communities to identify natural resource areas and protect them from development impacts using buffers and other controls. Identified natural areas could be protected via strict development prohibitions or through flexible zoning that allows for clustering around sensitive natural areas. These regulatory protections should be combined with the efforts of MCCD, townships, park districts, and other local governments to acquire key parcels of open space. Municipalities should also identify opportunities to work with The Land Conservancy of McHenry County to plan for creative ways to protect natural areas via conservation easements, purchases, and donations.
    - Management plans should be required for designated natural areas with performance criteria, identified responsible parties, and revenue sources.

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

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

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

- Model ordinance references include:
    - Model Water Use Conservation Ordinance (CMAP, 2010)
    - Conservation Design Resource Manual (NIPC, 2003)
    - Model Stormwater Drainage and Detention Ordinance (NIPC, 1994)
    - Model Soil Erosion and Sediment Control Ordinance (NIPC, 1991)
    - Model Floodplain Ordinance for Communities within Northeastern Illinois (NIPC, 1996)
    - Model Stream and Wetland Protection Ordinance (NIPC, 1988)

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

4.1.1.2 Jointly advocate for revisions to McHenry County Stormwater Management Ordinance

Because all the communities in the watershed have adopted it, McHenry County's stormwater management ordinance offers an avenue for coordinated updates of municipal codes. In addition to, or as an alternative to, calling for individual updates of each ordinance in each community, stakeholders can advocate for a single set of improvements to the county's stormwater ordinance that each community can then adopt.

Although they could all be strengthened to better encourage best practices for protecting water quality, stream and wetland protections as well as natural areas and open space ordinances could be strengthened. (An exception is the comprehensive natural areas and open space protections in McHenry County's Unified Development Ordinance.)

4.1.1.3 Locally adopt McHenry County Water Resource Action Plan

- Communities can use the county plan to inform local plans and ordinances.
- Communities should advocate for McHenry County to hire a dedicated water resources planner.

4.1.1.4 Coordinate efforts to advocate for bike trails, public transportation

- Transportation planning, including projects for both motorized and non-motorized modes, can be done much more effectively when it is coordinated over a larger area with bigger population.
- Communities should work with McHenry County, MCCD, and Openlands to leverage the resources of a larger population to advance goals that transcend municipal and township boundaries.

4.2 BMP Implementation Projects

4.2.1 Urban Stormwater Infrastructure Retrofits[94]

As shown in Table 9 in Section 3.4, 56 percent of land within the Boone-Dutch Creek Watershed planning area is undeveloped. The two most predominant land uses are Agriculture and Residential. Much of the residential land, particularly in upstream areas, is in low density estate and equestrian uses. As noted earlier, about 11 percent of the planning area is in

[94] Geosyntec Consultants conducted the watershed-wide BMP pollutant load reduction scenario and cost estimate analyses.

impervious cover, reflective of a relatively low density suburban or suburban edge watershed. However, as shown in Figure 14 in Section 3.4.1, even at this low level of imperviousness, watersheds, from a national perspective, are likely to show some signs of impaired ecological health.

In the developed portion of the planning area, stormwater conveyance methods vary widely. In the lower density residential areas, for example, most drainage occurs via roadside swales and ditches and by relatively unmodified headwater drainageways. Relatively few of these low-density areas are served by detention basins. In the more densely developed areas, runoff is generally routed directly from impervious surfaces to engineered stormwater collection and conveyance systems (primarily via storm sewers) with minimal volume reduction or water quality treatment. In more recently-developed portions of the watershed (i.e., since the 1980s), stormwater detention has been incorporated into most development sites.

Consistent with current countywide and municipal stormwater regulations, the primary goal of providing detention is to reduce the discharge rate of stormwater to decrease downstream flooding and channel erosion, and to provide water pollutant removal functions. While requirements vary by community, most ordinances prior to the adoption of the countywide Stormwater Management Ordinance (SMO) in 2004 did not require water quality measures to be incorporated into the design. As a consequence, many older basins are either dry-bottom or wet-bottom basins without water quality features such as wetland edges and naturalized side slopes. Further, because ordinance interpretation and enforcement varies somewhat by community and by project, some of the more modern basins also were built without water quality amenities.

Beyond runoff rate control, the outflow volume from detention basins remains higher than the pre-developed conditions. The increased volume of discharge during an extended drawdown period is a major cause of increased streambank erosion and ecological instability in urbanized stream watersheds. Additionally, even detention basins that incorporate water quality design features do not fully address the other environmental impacts (i.e., increased pollutant concentrations and elevated water temperatures) associated with increased imperviousness.

The countywide SMO (2004, and last revised December 2014) has strongly promoted (but not mandated) implementation of a runoff reduction hierarchy. To address water quality and runoff volume reduction, the ordinance requires evaluation and implementation of the following design elements "to the maximum extent practicable:"

- Wet detention facilities and stormwater wetlands,
- Infiltration basins,
- Infiltration strips,
- Filter strips, and
- Vegetated swales.

The most recent revisions to the countywide SMO have added specific requirements for runoff volume reduction. In practice, however, very few developments in the planning area have incorporated water quality or volume reduction designs, except for practices associated with naturalized detention basins. As a consequence, there are many opportunities to retrofit existing drainage and detention facilities to enhance their ability to provide pollutant removal and volume reduction benefits. The urban retrofit projects described below are intended to provide examples of projects that should be implemented in urban areas to allow for improved pollutant removal and/or stormwater volume reductions.

Many of the project recommendations focus 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, beyond naturalized detention basins, should be incorporated at the time of initial design and built during initial construction. This approach offers the most options, providing the engineer with more flexibility and cost-effective solutions. As noted above, the countywide SMO, and municipal, ordinances that follow its requirements provide a strong for the implementation of stormwater BMPs to specifically address the pollutants of concern in the Boone-Dutch Creek Watershed planning area.

A variety of urban BMPs could be used throughout the watershed, many of which could provide multiple benefits. This plan proposes the installation of bioretention (and biofiltration), vegetated swales, permeable pavement, detention basin retrofits, and building retrofits – such as planter boxes and green roofs – as the primary retrofit practices.[95] Three objectives guided the identification of urban retrofit projects included in this plan:

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

4.2.1.1 Bioretention / Biofiltration

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

[95] 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).

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 can also be used within roadway right-of-ways. Runoff from the site is typically conveyed in shallow engineered open swales, 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.

An alternative to bioretention retrofits for highly urbanized locations are the Filterra Bioretention Systems. These biofiltration systems are designed to treat stormwater pollution by incorporating trees and shrubs into curb inlet boxes to trap and treat the stormwater before entering the system. Expected pollutant removal can be up to as much as 70% for phosphorus, 45% for nitrogen, and up to 85% for TSS. A specialized Filterra unit, Bacterra, is expected to remove as much as 98% fecal coliform. While these systems are designed to treat smaller drainage areas they can be an effective urban retrofit to treat water quality.

Filterra system (source: Filterra.com)

4.2.1.2 Vegetated Swale (Conveyance) Retrofits

Vegetated swales are shallow, open conveyance channels that can be planted with turf grass or native vegetation that collect and slowly convey runoff to downstream discharge points. Swales remove stormwater pollutants by filtering flows through vegetation 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 ten minutes. The vegetation in the swale can vary depending on its location within a development project, is the choice of the designer, and is based upon the relevant functional criteria for the project. When appropriate, swales that are integrated within a project may use traditional landscaping, such as turf, while swales that are located on the project perimeter, within a park, or close to an open space area are more suited to deep rooted native vegetation which helps promote the infiltration and evapotranspiration processes.

Vegetated swale (source: werf.org)

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 from the stormsewer system. 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 densely developed areas, off-line swales may 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.

4.2.1.3 Detention Basin Retrofits

Both dry and wet stormwater detention basins are common throughout the Boone-Dutch Creek Watershed planning area. Dry basins were typically vegetated with turf grass and designed to drain completely after storm events. Dry basins also commonly had low flow channels that route flows from smaller storm events from basin inlets to the basin outlet with little or no water quality treatment.

Traditional wet detention basin.

Traditional dry detention basin.

A common dry detention basin retrofit to enhance water quality is to modify the design to incorporate sections of deep rooted native vegetation. Retrofitted dry detention basins typically include components such as an inlet with energy dissipation structures, a sediment forebay to settle out coarse solids and to facilitate maintenance, perimeter areas with shallow sections (0 to 2 feet deep) planted with wetland vegetation, deeper areas or micro pools to allow for open water features (3 to 5 feet deep), and a two stage outlet structure to improve water quality treatment. Meandering swales can also be incorporated into the basins to increase the residence time during low flow conditions.

Both wet and dry basins can also be retrofitted into extended wetland detention basins. 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. Wetland detention basins 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 discreet volumes of water that have been in the wetland a longer duration) are displaced by incoming slugs of water. This concept assumes there is little or no mixing of slugs in the direction of flow. Short circuiting occurs when quiescent areas or dead zones develop in the basin where pockets of water remain stagnant, causing other volumes to bypass using shorter flow paths through the basin (e.g., incoming stormwater slugs bypass these dead zones).

Example detention basin retrofit.

Designs 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 basin 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.

4.2.1.4 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 planter boxes, green roofs, and blue roofs. 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.

Example planter box.

Example green roof

Green roofs (also known as eco-roofs and vegetated roof covers) are roofing systems that layer a soil and vegetation over a waterproof membrane. There are two types of green roofing systems: extensive, which is a light-weight system, and intensive, which is a heavier system that allows for larger plants but requires additional structural support. Green roofs rely on highly porous media and moisture retention layers to store intercepted precipitation and to support vegetation that can reduce peak flows and the volume of stormwater runoff via evapotranspiration. Reduced flows may also limit contaminant mobilization and allow other downstream BMPs to perform more effectively by increasing the percent of runoff volume captured.

Example blue roof

Blue roofs are another form of green infrastructure, but unlike green roofs they are unvegetated systems that focus on collecting stormwater. A blue roof system detains rainwater directly on a rooftop and slowly releases that water, allowing for some depression storage and evaporation losses. The water collected can be used for irrigation, a site infiltration system, a rain garden, or slowly discharge into the sewer system. Blue roofs are less costly than green roofs due to the lack of soil and planting materials required, and are most effective and practical when installed on relatively flat surfaces, which are often associated with commercial or industrial buildings. Blue roofs do not provide benefits such as energy use reduction or habitat and aesthetic appeal, but they do slightly outperform green roofs for stormwater reduction. Due to the light colored roofing material they can also provide sustainability benefits through rooftop heat reduction. In some cases, special structural considerations are necessary to ensure that adequate support is provided for the detained water and blue roof materials themselves.

4.2.1.5 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 some sediments and metals are filtered out before allowing the stormwater to infiltrate into the ground or be conveyed through an underdrain system. Porous asphalt and porous concrete are poured in place while pavers are typically precast and installed in an interlocking array to create the surface. The use of permeable pavement in lieu of conventional pavement surfaces reduces the runoff volume and flow rates while maintaining functionality. Permeable pavement can be applied 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.

Example permeable pavement.

4.2.1.6 "Watershed-wide" Urban Stormwater Retrofit Scenarios Estimated Load Reductions and Implementation Costs

BMP scenarios were chosen to estimate the potential load reductions throughout the planning area. The scenarios modeled treat 25% of the watershed using a combination of high density development (i.e., greater than 50% urban landuse) and low density development (i.e., less than 50% urban landuse). High density sub-basins contain more retrofit and distributed BMPs while the low density sub-basins contain more detention basins and regional BMPs). The BMP distributions are displayed in Table 43.

Pollutant load reductions estimates for the implementation of a select few from the suite of BMPs recommended in this section were calculated with a spreadsheet watershed model by using literature estimates of pollutant removal efficiencies.[96] BMPs were selected based on a combination of the pollutant analysis, field assessment, and land use.
A summary of the pollutant load reduction and cost estimates by subwatershed are displayed in Table 46.

An expanded table is also presented in Appendix I. The reader should recognize the use of pollutant removal efficiencies, or percent removal, to estimate pollutant load reductions has several shortcomings.[97] As a result, the estimates derived from the analyses described above do not represent absolute expected results from the implementation of BMPs recommended in this plan, and are only planning-level estimates. BMP costs were developed from cost information derived through various Geosyntec projects and from other sources such as the USDA Forest Service and Milwaukee Metropolitan Sewer District. Pollutant removal rates used for the

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

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

Boone-Dutch Creek Watershed analysis are displayed in Table 44 and the BMP drainage area ratios and associated unit costs are displayed in Table 45.

Table 43. Urban stormwater retrofit BMP distributions.

Urban Stormwater Retrofit BMP Type	*High Density Development*	*Moderate to Low Density Development*
Vegetated Swale Retrofits	10%	10%
Bioretention/Rain garden	5%	5%
Detention Basin Retrofits	5%	10%
Biofiltration		
Filterra	1%	0%
Bacterra	1%	0%
Permeable Pavement	2.5%	0%
Green Roof	0.5%	0%
Total	**25%**	**25%**

Table 44. BMP pollutant removal rates.

Pollutant	*Vegetated Swale*	*Bioretention*	*Detention Retrofit*	*Filterra*	*Bacterra*	*Permeable Pavement*	*Green Roof*
N	8%	43%	55%	45%	0%	0%	25%
P	18%	81%	69%	70%	0%	40%	25%
TSS	48%	78%	86%	85%	0%	80%	72%
BOD	0%	60%	63%	0%	98%	0%	0%

Table 45. BMP design drainage area ratios and unit costs.

	Vegetated Swale	*Bioretention*	*Detention Retrofit*	*Filterra*	*Bacterra*	*Permeable Pavement*	*Green Roof*
Drainage Area Ratio	4:1	30:1	50:1	1000:1	1000:1	10:1	5:1
BMP Cost	$24/ft^2	$24/ft^2	$8/ft^2	$10,000/ unit	$10,000/ unit	$30/ft^2	$12/ft^2

Table 46. Pollutant load reduction and implementation cost estimates for the watershed-wide urban stormwater retrofit BMP scenarios, summary by subwatershed.

	Subwatershed	*Nitrogen Reduction (lb/yr)*	*Phosphorus Reduction (lb/yr)*	*Sediment Reduction (T/yr)*	*BOD Reduction (lb/yr)*	*Estimated Cost[1] ($)*
1	Upper Boone Creek	3,031	618	703	6,587	$ 17,791,922
2	Powers Creek	1,507	281	102	2,615	$ 6,236,541
3	Lower Boone Creek	2,150	458	1,627	5,712	$ 60,390,397
4	McCullom Lake	335	60	59	1,096	$ 2,151,252
5	Dutch Creek	2,824	487	1,122	4,938	$ 9,675,838
6	Dutch Creek Tributary	2,392	425	318	4,259	$ 8,580,736
7	Northeast Direct Drainage	812	172	343	2,227	$ 21,134,795
8	Central Direct Drainage	288	61	635	1,132	$ 9,067,337
9	Southeast Direct Drainage	1,290	270	1,057	4,018	$ 35,528,151
	Total	**14,628**	**2,833**	**5,966**	**32,584**	**$ 170,556,969**

1) BMP costs were derived from cost information derived through various Geosyntec projects and from other sources such as the Milwaukee Metropolitan Sewerage District Regional Green Infrastructure Plan.

n/a = not applicable or insufficient data.

4.2.1.7 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, 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.

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.[98]

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

4.2.2 Stream Channel and Riparian Buffer Restoration

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

Example streambank stabilization project.

Riparian buffers are vegetated areas next to streams that protect the water body from nonpoint source pollution, promote bank stabilization, and provide aquatic and wildlife habitat. Ideally riparian buffers should be composed of native vegetation including grasses or trees, or both. Riparian corridors have been impacted in many urban stream channels by human activities. Some of these activities include turf grass management up to the stream, agricultural

[98] 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

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.

Opportunities for streambank stabilization and stream channel restoration (remeandering, day lighting, concrete-lined channel removal) exist throughout the planning area. Several site-specific locations are identified in section 4.2.8 of this plan. To estimate potential pollutant load reductions for a watershed-wide scenario, an additional 20 percent of the assessed, eroding streambanks was assumed to be stabilized. Pollutant load reductions were estimated using the "Bank Stabilization" worksheet in a Microsoft Excel spreadsheet tool (EstPollutLoadReduct_2IEPA.xls) provided by Illinois EPA.[99] Stream stabilization/restoration cost varies by a number of factors including location, severity, and accessibility. Cost can range from $50/linear foot (rural, low severity, easy access) to $300/linear foot (urban private land, high severity, limited access) based on various sources such as the USDA Forest Service, The Virginia Department of Environmental Quality, the Water Quality Extension at the University of Illinois, and Geosyntec projects.[100] To derive an estimated implementation cost, an average cost of $150/linear foot was applied. Table 47 summarizes the results of these analyses.

4.2.3 Stream Maintenance

Reaches of Boone-Dutch Creek and its tributaries 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.

[99] Scott Ristau, Illinois EPA. 2011. Personal communication.

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

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

	Subwatershed	Stream Length Stabilized (ft / mi)	Nitrogen Reduction (lb/yr)	Phosphorus Reduction (lb/yr)	Sediment Reduction (T/yr)	Estimated Cost* ($)
1	Upper Boone Creek	3,109 / 0.6	105	52	35	$ 466,350
2	Powers Creek	3,887 / 0.7	37	19	17	$ 583,050
3	Lower Boone Creek	14,171 / 2.7	809	406	398	$ 2,125,650
4	McCullom Lake	n/a	n/a	n/a	n/a	n/a
5	Dutch Creek	6,338 / 1.2	81	41	39	$ 950,700
6	Dutch Creek Tributary	4,995 / 1.0	36	18	19	$ 749,250
7	Northeast Direct Drainage	1,361 / 0.3	8	5	5	$ 204,150
8	Central Direct Drainage	n/a	n/a	n/a	n/a	n/a
9	Southeast Direct Drainage	3,344 / 0.6	78	39	35	$ 501,600
	Total	**37,205 / 7.1**	**1,154**	**580**	**548**	**$ 5,580,750**

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

The recommendation for the Boone-Dutch Creek planning area is that communities should work cooperatively with park districts, forest preserve districts, 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 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 on-going input into the stream maintenance program activities.[101] 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.

4.2.4 Restored and Unrestored Natural Areas

Within the watershed are substantial areas where invasive brush species have overtaken former "natural" areas. The brush species – primarily non-native bush honeysuckle, buckthorn, and autumn olive, along with aggressive trees such as box elder and Siberian elm – tend to create dense understory canopies within woodlands. They also create stress for native oaks and hickories and greatly reduce the potential for native tree reproduction, thereby impacting the long-term health and viability of native woodlands. These same species can overtake grasslands, old pastures, remnant prairies, and wetland edges. Their aggressive growth

[101] 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/

behavior creates nearly impenetrable thickets and produces a very dense shade cover that, over time, virtually eliminates herbaceous ground cover.


Bare soil under invasive brush.

As a consequence, bare soil exists under the invasive brush thickets. This increases the erosion potential of underlying soils, both during heavy warm season thunderstorms and during the dormant season (typically mid-November through mid-April) when leaf cover is off.

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


Restored honeysuckle thicket.

Alternatively, the impact of these areas on pollutant loading is being represented on a per-acre basis by comparing and representing brush-infested areas with areas where brush does not exist or has been eliminated through ecological restoration efforts. The primary difference between these two situations is the presence of a relatively healthy ground cover of herbaceous vegetation and an associated soil-stabilizing root system in areas that are not infested with brush.

One limitation of this approach is the lack of runoff monitoring data in the literature for areas infested with invasive brush (i.e., reflecting the bare soil understory associated with this condition). So, the recommended approach for representing pollutant loads is based on field observations from the Boone-Dutch Creek Watershed planning area and professional judgment.

Several representative locations have been identified in the Boone Creek Watershed. These include portions of:

- Boloria Meadows Nature Preserve, a private open space (open to the public) in Bull Valley
- An adjacent woodland on a low density residential parcel in unincorporated McHenry County
- Various low density and “vacant” parcels along Bull Valley Road in Bull Valley

As noted above, the primary effect of invasive brush cover on water quality is higher levels of sediment runoff. A study in Toowoomba, Australia[102] found that for large storm events, bare soil areas produced sediment loads higher than roads, parking lots, roofs, or grass. Studies in Michigan[103] and Indiana[104] found similar results, with the study in Indiana producing an event mean concentration of 4000 mg/L for TSS. Along with sediment transport, loadings of other contaminants are expected to increase as particle-bound contaminants are washed away with sediment. The Indiana study found that bare soil areas had similar nutrient loadings as agricultural land.

4.2.5 Farmed Wetland Restoration

Farmed wetlands are wetlands that were partially drained or altered to improve crop production before Swampbuster, a provision of the Food Security Act, was enacted in 1985. Restoring farmed wetlands improves groundwater quality, helps trap and break down pollutants from runoff, prevents soil erosion, reduces downstream flood damage, and provides habitat for water bird and other wildlife. Restoring wetlands is typically accomplished by breaking drainage tiles, and occasionally building an embankment to pond runoff.

To identify currently farmed wetlands, the 2005 McHenry County ADID "farmed wetlands" polygons were compared to 2013 high-resolution aerial imagery. Polygons no longer farmed due to development were deleted, resulting in 87 farmed wetland polygons totaling approximately 164 acres across the Boone-Dutch Creek planning area (Figure 59). The U.S. EPA Spreadsheet Tool to Estimate Pollutant Loads (STEPL) was used to estimate the potential pollutant reductions if 30 percent of the farmed wetland acreage present in each study unit/ subwatershed was restored. Table 48 displays the estimated pollutant load reductions and implementation costs for these projects.

Farmed wetland site within the Boone-Dutch Creek Watershed planning area.

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

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

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

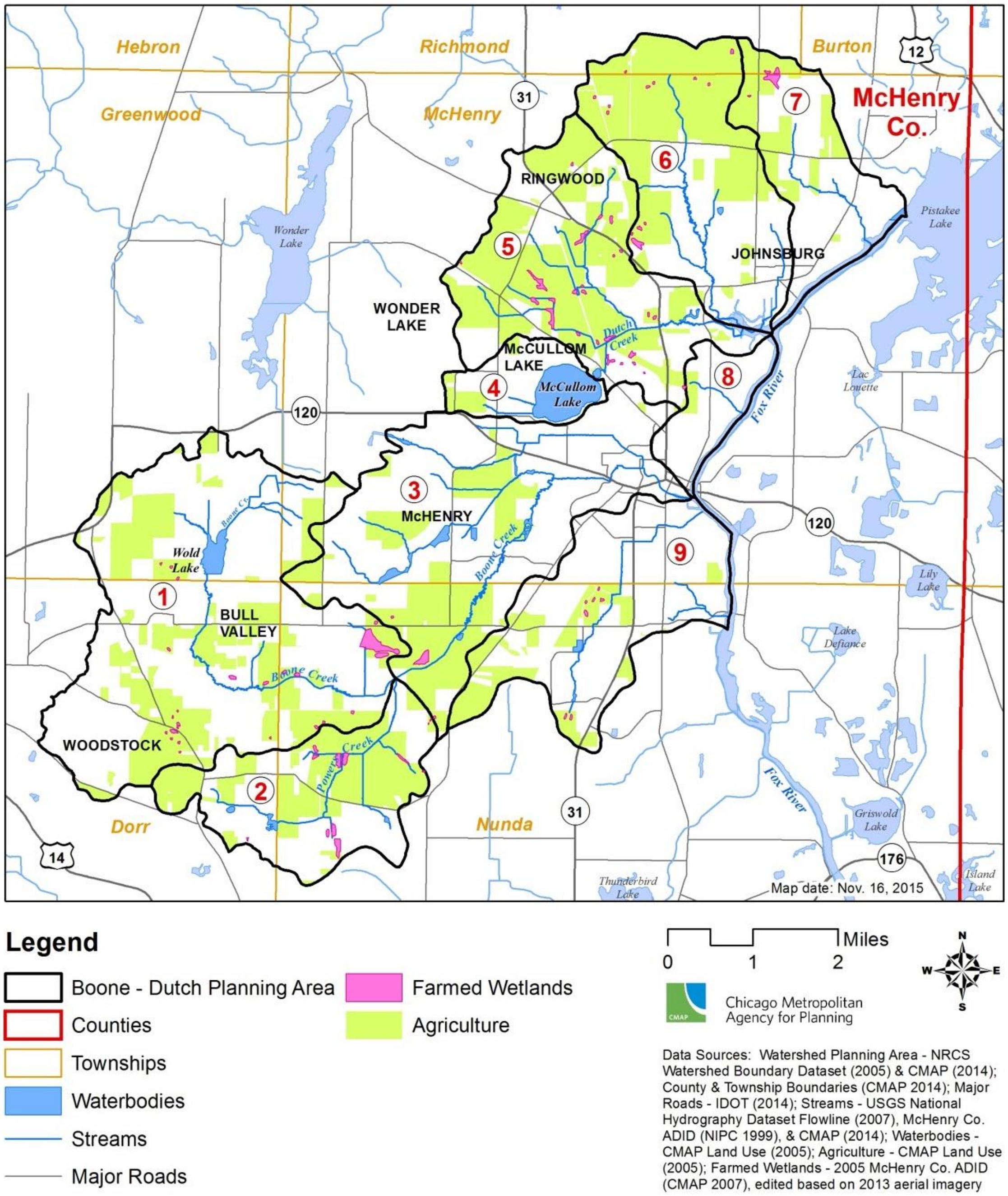
Table 48. Farmed wetland restoration pollutant load reduction and cost estimates.

	Subwatershed	*Farmed Wetland Restoration Area (acres)*	*Nitrogen Reduction (lb/yr)*	*Phosphorus Reduction (lb/yr)*	*Sediment Reduction (T/yr)*	*BOD Reduction (lb/yr)*	*Estimated Cost[1] ($)*
1	Upper Boone Creek	15.61	1,730	545	167	11,988	$ 224,862
2	Powers Creek	8.73	1,351	388	122	7,471	$ 125,756
3	Lower Boone Creek	3.16	462	129	57	3,949	$ 45,520
4	McCullom Lake	n/a	0	0	0	0	---
5	Dutch Creek	12.63	2,445	650	228	13,638	$ 181,935
6	Dutch Creek Tributary	3.78	678	186	65	3,850	$ 54,451
7	Northeast Direct Drainage	3.8	598	167	79	5,266	$ 54,739
8	Central Direct Drainage	n/a	0	0	0	0	---
9	Southeast Direct Drainage	1.56	233	64	34	2,329	$ 22,472
	Total	**49.27**	**7,496**	**2,130**	**752**	**48,491**	**$ 709,734**

[1] BMP costs were derived through various sources such as the USDA and the Ecosystem Marketplace.

n/a = no identified farmed wetlands

Figure 59. Farmed wetlands in the Boone-Dutch Creek planning area.



4.2.6 Denitrifying Bioreactors and Saturated Buffers

Drain tiles are likely prevalent throughout the agricultural portions of the Boone-Dutch Creek planning area, the discharges from which can be a significant source of nitrogen.[105] Research has shown that denitrifying bioreactors (a.k.a woodchip bioreactors) can significantly reduce nitrogen (N) levels from drain tile discharge.[106] A bioreactor consists of a constructed trench designed to receive drain tile discharge. It is filled with a carbon source, such as wood chips, that serve as a substrate for soil microorganisms (bacteria) that break down nitrates in the drain tile discharge via denitrification or other biochemical processes. A design goal is typically 50-80% removal of the inflowing N load.[107] In addition to the water quality improvement benefits of this BMP, bioreactors do not take agricultural land out of production, cause no decrease in drainage effectiveness, require little or no maintenance, and can last for up to 20 years.[108]

Saturated buffers are another potential conservation practice for improving drain tile discharge water quality. A saturated buffer is a modified vegetated buffer whereby drain tile discharge is distributed laterally through the buffer rather than routed directly to the receiving stream or ditch. It's here underground in the raised water table that much of the N is removed from the drain tile water via denitrification, microbial immobilization, and direct uptake by the vegetation. An additional benefit can be the reduction in the speed and volume of water entering the waterway, thus helping to attenuate flood flows. Several demonstration research projects are underway in the Midwest and results are positive,[109] with N removal potentially approaching 100 percent.[110]

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

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

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

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

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

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

The use of bioreactors in northeastern Illinois has been limited, and the current saturated buffer trials in Illinois are elsewhere in the state. In the Boone-Dutch Creek planning area, it is suggested that one or two demonstration projects be implemented. Local NRCS and McHenry-Lake SWCD staff would take the lead in identifying project sites and willing landowners, for a cumulative, target treatment drainage area of 60 – 200 areas. In Iowa, bioreactor installation costs have ranged from $7,000 - $10,000 to treat drainage from about 30 to more than 100 acres.[111] Limited information on saturated buffer costs indicates they are comparable to other N removal practices.[112] Thus, the estimated cost for two demonstration project(s) would be about $20,000.

4.2.7 Chloride Reduction Strategies

Typical BMPs are limited in their ability to remove chloride. As a result, the preferred approach for addressing chloride loading within the watershed is through source reduction. The recommendations to address chloride in the Boone-Dutch Creek Watershed planning area are separated into two components to target chloride loadings from roadway deicing activities and from other commercial and residential sources, such as water softeners.

The first component of the recommendation is for snow removal agencies within the watershed 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 to prevent ice from binding with pavement and pre-wetting solid deicing materials to minimize bounce and scatter. Mechanical snow removal is still the most effective manner of snow and ice management. Public safety is of the utmost importance in the evaluation of alternative snow and ice management methods. Therefore, the watershed snow removal agencies should carefully evaluate the effectiveness of alternative products and approaches.

McHenry County has developed a “Sensible Salting Workshop and Certification” program to promote alternatives to conventional roadway deicing practices and guide the implementation of alternatives. An element of their program was gathering information from the 80 deicing operators via survey questionnaires and evaluating alternative anti-icing programs that reduce chloride runoff. The mean salt application rate from the survey for 40 lane miles was 585 pounds/lane mile. Assuming similar application rates were applied within the Boone-Dutch Creek planning area, the estimated chloride loading would be approximately 5,749 tons/year. If

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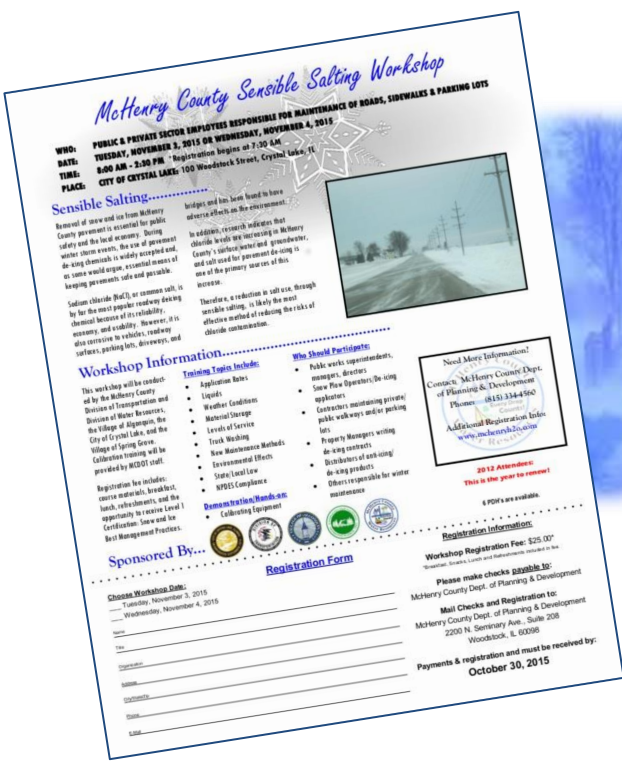
[111] Christianson, L. and M. Helmers. 2011. Woodchip Bioreactors for Nitrate in Agricultural Drainage. Iowa State University Extension Publication. PMR 1008. https://store.extension.iastate.edu/Product/Woodchip-Bioreactors-for-Nitrate-in-Agricultural-Drainage (accessed Dec. 2015).

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

alternative anti-icing programs were implemented throughout the planning area to reduce mean salt application rates to 252 pounds/lane mile, an estimated 3,272 tons/year, or 57 percent, of chloride loading could be reduced to the Fox River from the Boone-Dutch Creek planning area (Table 49).

Table 49. Chloride loading and reduction estimates.

	Subwatershed	*Lane Miles*	*Estimated CL Load with Avg. Reported Applic. Rate (T/yr)*	*Estimated CL Load with Recommended Applic. Rate (T/yr)*	*Estimated CL Load Reduction (T/yr)*
1	Upper Boone Creek	92	803	346	457
2	Powers Creek	26	232	100	132
3	Lower Boone Creek	177	1,554	669	884
4	McCullom Lake	29	253	109	144
5	Dutch Creek	65	571	246	325
6	Dutch Creek Tributary	53	466	201	265
7	Northeast Direct Drainage	76	667	287	380
8	Central Direct Drainage	38	330	142	188
9	Southeast Direct Drainage	100	873	376	497
	Total	**656**	**5,749**	**2,476**	**3,272**



McHenry County Sensible Salting Workshop

PUBLIC & PRIVATE SECTOR EMPLOYEES RESPONSIBLE FOR MAINTENANCE OF ROADS, SIDEWALKS & PARKING LOTS

WHO: PUBLIC & PRIVATE SECTOR EMPLOYEES RESPONSIBLE FOR MAINTENANCE OF ROADS, SIDEWALKS & PARKING LOTS
DATE: TUESDAY, NOVEMBER 3, 2015 OR WEDNESDAY, NOVEMBER 4, 2015
TIME: 8:00 AM - 2:30 PM *Registration begins at 7:30 AM
PLACE: CITY OF CRYSTAL LAKE: 100 Woodstock Street, Crystal Lake, IL

Sensible Salting

Removal of snow and ice from McHenry County pavement is essential for public safety and the local economy. During winter storm events, the use of pavement de-icing chemicals is widely accepted and, as some would argue, essential means of keeping pavements safe and passable.

Sodium chloride (NaCl), or common salt, is by far the most popular roadway deicing chemical because of its reliability, economy, and usability. However, it is also corrosive to vehicles, roadway surfaces, parking lots, driveways, and bridges and has been found to have adverse effects on the environment.

In addition, research indicates that chloride levels are increasing in McHenry County's surface water and groundwater, and salt used for pavement de-icing is one of the primary sources of this increase.

Therefore, a reduction in salt use, through sensible salting, is likely the most effective method of reducing the risks of chloride contamination.

Workshop Information

This workshop will be conducted by the McHenry County Division of Transportation and Division of Water Resources, the Village of Algonquin, the City of Crystal Lake, and the Village of Spring Grove. Calibration training will be provided by MCDOT staff.

Registration fee includes: course materials, breakfast, lunch, refreshments, and the opportunity to receive Level 1 Certification: Snow and Ice Best Management Practices.

Training Topics Include:
- Application Rates
- Liquids
- Weather Conditions
- Material Storage
- Levels of Service
- Truck Washing
- New Maintenance Methods
- Environmental Effects
- State/Local Law
- NPDES Compliance

Demonstration/Hands-on:
- Calibrating Equipment

Who Should Participate:
- Public works superintendents, managers, directors
- Snow Plow Operators/De-icing applicators
- Contractors maintaining private/public walkways and/or parking lots
- Property Managers writing de-icing contracts
- Distributors of anti-icing/de-icing products
- Others responsible for winter maintenance

Need More Information!
Contact: McHenry County Dept. of Planning & Development
Phone: (815) 334-4560
Additional Registration Info: www.mchenryh2o.com

2012 Attendees:
This is the year to renew!

6 PDH's are available.

Sponsored By...

Registration Form

Choose Workshop Date:
___ Tuesday, November 3, 2015
___ Wednesday, November 4, 2015

Name
Title
Organization
Address
City/State/Zip
Phone
E-Mail

Registration Information:
Workshop Registration Fee: $25.00*
*Breakfast, Snacks, Lunch and Refreshments included in fee.

Please make checks payable to:
McHenry County Dept. of Planning & Development

Mail Checks and Registration to:
McHenry County Dept. of Planning & Development
2200 N. Seminary Ave., Suite 208
Woodstock, IL 60098

Payments & registration and must be received by:
October 30, 2015

Source: https://www.co.mchenry.il.us/county-government/departments-j-z/planning-development/divisions/water-resources/snow-and-ice-removal

4.2.8 Site-Specific BMPs

More than than 100 potential site-specific best management practice (BMP) projects were identified throughout the Boone-Dutch Creek planning area by CMAP staff and planning participants (Figure 60, Appendix K). Agricultural BMPs identified included filter strips/riparian buffers, grassed waterways, water and sediment control basins, and livestock access control. Urban BMPs included filter strips, riparian buffers, vegetated swales/bioswales, bioinfiltration and bioretention facilities, oil and grit separators, permeable pavement, education and outreach, and water softener regeneration effluent capture and reuse. Hydrologic BMPs included streambank and shoreline protection, stream channel restoration (re-meandering, daylighting), and wetland restoration.

U.S. EPA's Spreadsheet Tool to Estimate Pollutant Loads (STEPL) was utilized by Geosyntec Consultants to estimate the potential pollutant reductions for the following BMP types: Ag Filter Strip, Bioretention, Grade-stabilization Structures, Grassed Swale (for Grassed Waterway), Oil & Grit Separator, Rain Garden, Infiltration Trench, Urban Filter Strip, Vegetated Swale (for Grassed-lined Channel with Permanent Vegetation/bioswale), and Wetland Restoration. CMAP estimated each BMP's surface area and estimated the drainage area to individual BMPs by using ArcGIS and two-foot contours or assigning appropriate drainage area ratios (for ag and urban filter strips, riparian wetland restoration). For estimating pollutant load reductions from streambank stabilization BMPs, CMAP used the "Bank Stabilization" worksheet in a Microsoft Excel spreadsheet tool (EstPollutLoadReduct_2IEPA.xls) provided by Illinois EPA[113]. Costs were derived by Geosyntec from various sources including USDA[114], the Virginia Department of Environmental Quality[115], and the University of Illinois[116] (Table 50). Table 51 summarizes and Appendix K provides more details regarding the estimated pollutant reductions and cost for these site-specific projects.

Additionally, numerous site-specific detention basin retrofit BMP opportunities were identified (Appendix D, Figure 39). Of the 189 detention basins inventoried, 126 were found to be candidates for water quality improvement retrofits, such as conversion of concrete lined channels to vegetated swales/ bioswales/ infiltration trenches, naturalization of turf bottom basins, modification of outlet control structures, establishment of wetland shelves in wet basins, addition of berms to create longer flow paths, and establishment of native vegetation buffers.

[113] Scott Ristau, Illinois EPA. 2011. Personal communication.

[114] USDA. 2013. "Building Capacity to Analyze the Economic Impacts of Nutrient Trading and Other Policy Approaches for Reducing Agriculture's Nutrient Discharge into the Chesapeake Bay Watershed." Office of the Chief Economist Cooperative Agreement No. 58-0111-11-006.

[115] Virginia Department of Environmental Quality. 2004. "The Virginia Stream Restoration & Stabilization Best Management Practices Guide." Department of Conservation and Recreation, Division of Soil and Water Conservation.

[116] University of Illinois. 2012. "Illinois Drainage Guide (online)" Department of Agriculture and Biological Engineering. 5 May 2015. http://wq.illinois.edu/DG/DrainageGuide.html.

Estimated pollutant load reduction and costs associated with any detention basin retrofit project are assumed incorporated into the watershed-wide scenarios presented in section 4.2.1.6.

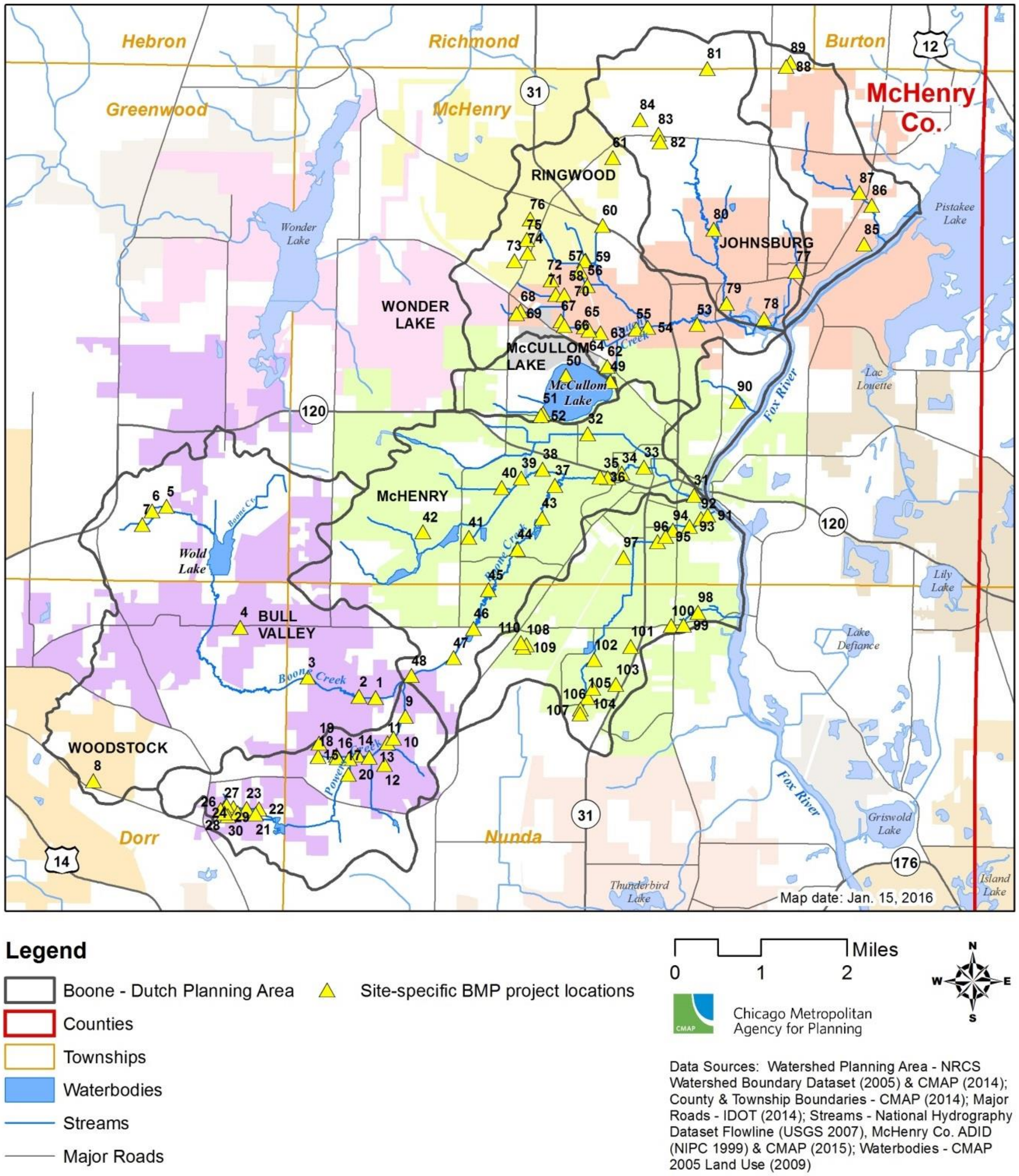
Table 50. Assumed unit costs for select BMPs.

BMP Type	*Unit Cost ($)*
Ag Filter Strip	$0.50/sq ft
Bioretention	$24 / sq ft
Fencing	$2 / lin ft
Grade Stabilization Structures	$70 / lin ft
Grassed Waterway	$8 / sq ft
Infiltration Trench	$24 / sq ft
Oil & Grit Separator	$8,000 each
Rain barrel	$75 each
Rain Garden	$24 / sq ft
Streambank & Shoreline Protection (stabilization)	$150 / lin ft
Urban Filter Strip	$0.75/ sq ft
Vegetated Swale / bioswale	$24 / sq ft
WASCOB	$2,500 each
Wetland Restoration	$14,405 / ac

Table 51. Pollutant load reduction and implementation cost estimates for the site-specific BMPs, summary by subwatershed.

	Subwatershed	*Nitrogen Reduction (lb/yr)*	*Phosphorus Reduction (lb/yr)*	*Sed. Reduction (lb/yr)*	*BOD Reduction (t/yr)*	*Estimated Cost[1] ($)*
1	Upper Boone Creek	3,387	820	343	1,803	$ 2,058,614
2	Powers Creek	7,108	1,596	785	8,062	$ 3,108,905
3	Lower Boone Creek	7,755	2,069	1,184	4,186	$ 6,579,904
4	McCullom Lake	227	67	55	183	$ 757,891
5	Dutch Creek	7,502	1,638	584	4,428	$ 5,155,945
6	Dutch Creek Tributary	3,308	709	262	2,010	$ 3,650,771
7	Northeast Direct Drainage	517	102	34	215	$ 1,348,793
8	Central Direct Drainage	1	0	0	11	$ 142,877
9	Southeast Direct Drainage	1,832	505	368	1,350	$ 3,630,115
	Total	**31,637**	**7,506**	**3,615**	**22,248**	**$ 26,433,815**

Figure 60. Site-specific BMP project opportunities in the Boone-Dutch Creek planning area.



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

Table 52 presents the compilation of the waterside-wide and site-specific BMP types identified in this plan, along with their associated pollutant load reduction and implementation cost estimates. As can be seen, there can be significant reductions in pollutant loads, although the costs to retrofit the built environment and restore natural areas to improve and protect water quality can be astounding. This puts into perspective the importance of putting into place effective plans, policies, codes, and practices to protect our land and water resources prior to land development even more compelling.

Table 52. Summary of watershed-wide and site specific BMP implementation projects' estimated pollutant load reductions and implementation costs.

BMP Type	Scenario	Est. Qty.	Unit	N Reduc. (lb/yr)	P Reduc. (lb/yr)	Sed. Reduc. (T/yr)	BOD Reduc. (lb/yr)	CL Reduc. (t/yr)	Estimated Cost ($)
Ag Filter Strip	SS	50.1	ac	9,490	2,147	5,091	790	n/a	$ 1,090,196
Biofiltration: Filterra	WW	2,427	#	186	36	15	n/a	n/a	$ 24,270,199
Biofiltration: Bacterra	WW	2,427	#	n/a	n/a	n/a	965	n/a	$ 24,270,199
Bioretention / Rain Gardens	WW	48.34	ac	4,605	1,118	294	12,202	n/a	$ 50,537,502
Bioretention / Rain Gardens	SS	0.78 / 34,150	ac / sq ft	5	2	24	1	n/a	$ 819,600
Chloride reduction strategies in road deicing	WW	3,266	t	n/a	n/a	n/a	n/a	3,266	$ ---
Dam Removal	SS	1	#	0	0	0	0	n/a	$ 300,000
Denitrifying Bioreactors[1] / Saturated Buffer	WW	2	#	?	?	0	0	n/a	$ 20,000
Detention Basin Retrofits	WW	46.87	ac	9,517	1,532	498	19,415	n/a	$ 16,331,769
Education	SS	1	#	0	0	0	0	n/a	$ 5,000
Education & Outreach	WW	12	#	0	0	0	0	n/a	$ 60,000
Fencing (livestock exclusion)	SS	7,000	ft	0	0	0	0	n/a	$ 14,000
Grade Stabilization Structures w/ Perm. Vegetation	SS	0.03	ac	7	1	3	0	n/a	$ 15,246
Grassed Waterway	SS	17.67	ac	3,410	608	2,881	176	n/a	$ 6,157,642
Green Roofs	WW	32.04	ac	309	39	39	n/a	n/a	$ 16,746,439
Infiltration Trench	SS	0.16	ac	18	5	0.0	6	n/a	$ 167,270
Oil & Grit Separator	SS	5	#	3	1	0	0	n/a	$ 40,000

BMP Type	Scenario	Est. Qty.	Unit	N Reduc. (lb/yr)	P Reduc. (lb/yr)	Sed. Reduc. (T/yr)	BOD Reduc. (lb/yr)	CL Reduc. (t/yr)	Estimated Cost ($)
Permeable & Porous Pavements	WW	27.86	ac	n/a	105	70	n/a	n/a	$ 36,405,300
Rain barrels	SS	5	#	n/a	n/a	n/a	n/a	n/a	$ 375
Shoreline Protection (stabilization)	SS	6,030	ft	46	25	n/a	26	n/a	$ 904,500
Social survey	WW	1	#	n/a	n/a	n/a	n/a	n/a	$ 20,000
Stream Channel Restoration (daylighting, CLC removal)	SS	1,800	ft	n/a	n/a	n/a	n/a	n/a	$ 270,000
Stream Channel Restoration (remeandering)	SS	tbd	#	n/a	n/a	n/a	n/a	n/a	$ n/a
Streambank Protection (stabilization)	WW	37,205	ft	1154	580	548	n/a	n/a	$ 5,580,750
Streambank Protection (stabilization)	SS	33,640	ft	1,440	721	n/a	678	n/a	$ 5,061,000
Urban Filter Strip	SS	22.3	ac	3,013	847	3,124	726	n/a	$ 730,841
Vegetated Swale / bioswale	WW	1.9	ac	11	3	5,053	n/a	n/a	$ 1,995,562
Vegetated Swale / bioswale	SS	2.66	ac	494	89	114	31	n/a	$ 2,780,870
WASCOB[2]	SS	11	#	---	---	---	---	n/a	$ 27,500
Water softener regeneration effluent capture and reuse	SS	1	#	n/a	n/a	n/a	?	n/a	$ 55,000
Wetland Restoration (farmed wetlands)	WW	49.27	ac	7,496	2,130	752	48,491	n/a	$ 709,734
Wetland Restoration	SS	555	ac	13,713	3,061	11,012	1,181	n/a	$ 7,994,775
TOTAL				**54,917**	**13,050**	**29,518**	**84,688**	**3,266**	**$ 203,381,269**

Notes:
SS = site specific
WW = watershed-wide
n/a = not applicable

ac = acre
ft = feet
# = number
lb = pounds
t = tons

N = nitrogen
P = phosphorus
Sed. = sediment
BOD = biological oxygen demand
CL = chloride
Reduc.=- reduction

1) Total N removal from denitrifying bioreactors is dependent on inflow load; research has shown 50-80% N removal; research is ongoing on removal of other pollutants such as phosphorus. Research is showing that total N removal from saturated buffers may approach 100%; removal of phosphorus and sediment is accomplished in the vegetated buffer from overland flow.
2) WASCOB (water and sediment control basin) pollutant removal was assumed to be included in associated, upgradient grassed waterway

4.2.10 Summary of Pollutant Loads and Potential BMP Pollutant Load Reductions

The following tables present, by subwatershed study unit, the compilation of the nitrogen (N), phosphorus (P), sediment (Sed.), and biological oxygen demand (BOD) pollutant loadings estimated in this plan by general source; along with the estimated pollutant load reductions from implementation of the watershed-wide (WW) and site-specific (SS) BMPs identified in this plan. Pollution load reduction targets are presented in section 5.2.

Table 53. Summary of estimated nitrogen loadings and potential BMP load reductions.

Subwatershed	*Pollutant Source*	*N Load (lb/yr)*	*BMPs*	*N Reduc. (lb/yr)*	*Percent Reduc. (%)*
#1 **Upper Boone Creek**	Land use-based	39,596	WW urban SW retrofits	3,031	
	Streambank erosion	524	WW strmbnk stabiliz	105	
	Shoreline erosion	n/a	WW farmed WL restor	1,730	
			SS BMPs	3,387	
Total		**40,120**		**8,253**	***20.6%***
#2 **Powers Creek**	Land use-based	39,596	WW urban SW retrofits	1,507	
	Streambank erosion	524	WW strmbnk stabiliz	37	
	Shoreline erosion	n/a	WW farmed WL restor	1,351	
			SS BMPs	7,108	
Total		**40,120**		**10,003**	***24.9%***
#3 **Lower Boone Creek**	Land use-based	39,596	WW urban SW retrofits	2,150	
	Streambank erosion	524	WW strmbnk stabiliz	809	
	Shoreline erosion	n/a	WW farmed WL restor	462	
			SS BMPs	7,755	
Total		**40,120**		**11,176**	***27.9%***
#4 **McCullom Lake**	Land use-based	39,596	WW urban SW retrofits	335	
	Streambank erosion	524	WW strmbnk stabiliz	n/a	
	Shoreline erosion	n/a	WW farmed WL restor	0	
			SS BMPs	227	
Total		**40,120**		**562**	***1.4%***
#5 **Dutch Creek**	Land use-based	39,596	WW urban SW retrofits	2,824	
	Streambank erosion	524	WW strmbnk stabiliz	81	
	Shoreline erosion	n/a	WW farmed WL restor	2,445	
			SS BMPs	7,502	
Total		**40,120**		**12,852**	***32.0%***

#6	Dutch Creek Tributary	Land use-based	39,596	WW urban SW retrofits	2,392	
		Streambank erosion	524	WW strmbnk stabiliz	36	
		Shoreline erosion	n/a	WW farmed WL restor	678	
				SS BMPs	3,308	
	Total		**40,120**		**6,414**	***16.0%***
#7	Northeast Direct Drainage	Land use-based	39,596	WW urban SW retrofits	812	
		Streambank erosion	524	WW strmbnk stabiliz	8	
		Shoreline erosion	n/a	WW farmed WL restor	598	
				SS BMPs	517	
	Total		**40,120**		**1,935**	***4.8%***
#8	Central Direct Drainage	Land use-based	39,596	WW urban SW retrofits	288	
		Streambank erosion	524	WW strmbnk stabiliz	n/a	
		Shoreline erosion	n/a	WW farmed WL restor	0	
				SS BMPs	1	
	Total		**40,120**		**289**	***0.7%***
#9	Southeast Direct Drainage	Land use-based	39,596	WW urban SW retrofits	1,290	
		Streambank erosion	524	WW strmbnk stabiliz	78	
		Shoreline erosion	n/a	WW farmed WL restor	233	
				SS BMPs	1,832	
	Total		**40,120**		**3,433**	***8.6%***
	Grand Total		**361,080**		**54,917**	***15.2%***

Table 54. Summary of phosphorus loads and potential BMP load reductions.

Subwatershed		*Pollutant Source*	*P Load (lb/yr)*	*BMPs*	*P Reduc. (lb/yr)*	*Percent Reduc. (%)*
#1	Upper Boone Creek	Land use-based	5,668	WW urban SW retrofits	618	
		Streambank erosion	262	WW strmbnk stabiliz	52	
		Shoreline erosion	n/a	WW farmed WL restor	545	
				SS BMPs	820	
	Total		**5,930**		**2,035**	***34.3%***
#2	Powers Creek	Land use-based	2,574	WW urban SW retrofits	281	
		Streambank erosion	96	WW strmbnk stabiliz	19	
		Shoreline erosion	n/a	WW farmed WL restor	388	
				SS BMPs	1,596	
	Total		**2,670**		**2,284**	***85.5%***
#3	Lower Boone Creek	Land use-based	4,968	WW urban SW retrofits	458	
		Streambank erosion	2,030	WW strmbnk stabiliz	406	
		Shoreline erosion	n/a	WW farmed WL restor	129	
				SS BMPs	2,069	
	Total		**6,998**		**3,062**	***43.8%***

#4 **McCullom Lake**	Land use-based	551	WW urban SW retrofits	60	
	Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
	Shoreline erosion	25	WW farmed WL restor	0	
			SS BMPs	67	
Total		**576**		**127**	*22.0%*
#5 **Dutch Creek**	Land use-based	4,461	WW urban SW retrofits	487	
	Streambank erosion	204	WW strmbnk stabiliz	41	
	Shoreline erosion	n/a	WW farmed WL restor	650	
			SS BMPs	1,638	
Total		**4,665**		**2,816**	*60.4%*
#6 **Dutch Creek Tributary**	Land use-based	3,896	WW urban SW retrofits	425	
	Streambank erosion	91	WW strmbnk stabiliz	18	
	Shoreline erosion	n/a	WW farmed WL restor	186	
			SS BMPs	709	
Total		**3,987**		**1,338**	*33.6%*
#7 **Northeast Direct Drainage**	Land use-based	1,873	WW urban SW retrofits	172	
	Streambank erosion	24	WW strmbnk stabiliz	5	
	Shoreline erosion	n/a	WW farmed WL restor	167	
			SS BMPs	102	
Total		**1,897**		**446**	*23.5%*
#8 **Central Direct Drainage**	Land use-based	665	WW urban SW retrofits	61	
	Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
	Shoreline erosion	n/a	WW farmed WL restor	0	
			SS BMPs	0	
Total		**665**		**61**	*9.2%*
#9 **Southeast Direct Drainage**	Land use-based	2,929	WW urban SW retrofits	270	
	Streambank erosion	197	WW strmbnk stabiliz	39	
	Shoreline erosion	n/a	WW farmed WL restor	64	
			SS BMPs	505	
Total		**3,126**		**878**	*28.1%*
Grand Total		**30,514**		**13,047**	*42.8%*

Table 55. Summary of sediment loading and potential BMP load reductions.

Subwatershed	*Pollutant Source*	*Sed. Load (T/yr)*	*BMPs*	*Sed. Reduc. (T/yr)*	*Percent Reduc. (%)*
#1 **Upper Boone Creek**	Land use-based	1,215	WW urban SW retrofits	703	
	Streambank erosion	174	WW strmbnk stabiliz	35	
	Shoreline erosion	n/a	WW farmed WL restor	167	
			SS BMPs	343	
Total		**1,389**		**1,248**	*89.8%*

#2 Powers Creek	Land use-based 567	WW urban SW retrofits 102		
	Streambank erosion 86	WW strmbnk stabiliz 17		
	Shoreline erosion n/a	WW farmed WL restor 122		
		SS BMPs 785		
Total	**653**	**1,026**		*157.1%*
#3 Lower Boone Creek	Land use-based 1,526	WW urban SW retrofits 1,627		
	Streambank erosion 1,990	WW strmbnk stabiliz 398		
	Shoreline erosion n/a	WW farmed WL restor 57		
		SS BMPs 1,184		
Total	**3,516**	**3,266**		*92.9%*
#4 McCullom Lake	Land use-based 195	WW urban SW retrofits 59		
	Streambank erosion n/a	WW strmbnk stabiliz n/a		
	Shoreline erosion 26	WW farmed WL restor 0		
		SS BMPs 55		
Total	**221**	**114**		*51.6%*
#5 Dutch Creek	Land use-based 1,090	WW urban SW retrofits 1,122		
	Streambank erosion 196	WW strmbnk stabiliz 39		
	Shoreline erosion n/a	WW farmed WL restor 228		
		SS BMPs 584		
Total	**1,286**	**1,973**		*153.4%*
#6 Dutch Creek Tributary	Land use-based 954	WW urban SW retrofits 318		
	Streambank erosion 93	WW strmbnk stabiliz 19		
	Shoreline erosion n/a	WW farmed WL restor 65		
		SS BMPs 262		
Total	**1,047**	**664**		*63.4%*
#7 Northeast Direct Drainage	Land use-based 620	WW urban SW retrofits 343		
	Streambank erosion 25	WW strmbnk stabiliz 5		
	Shoreline erosion n/a	WW farmed WL restor 79		
		SS BMPs 34		
Total	**645**	**461**		*71.5%*
#8 Central Direct Drainage	Land use-based 283	WW urban SW retrofits 635		
	Streambank erosion n/a	WW strmbnk stabiliz n/a		
	Shoreline erosion n/a	WW farmed WL restor 0		
		SS BMPs 0		
Total	**283**	**635**		*224.4%*
#9 Southeast Direct Drainage	Land use-based 1,084	WW urban SW retrofits 1,057		
	Streambank erosion 175	WW strmbnk stabiliz 35		
	Shoreline erosion n/a	WW farmed WL restor 34		
		SS BMPs 368		
Total	**1,259**	**1,494**		*118.7%*
Grand Total	**10,299**[a]	**10,881**[b]		*105.7%*

a) 10,299 tons = 20,598,000 pounds
b) 10,881 tons = 21,762,000 pounds

Table 56. Summary of biological oxygen demand loading and potential BMP load reductions.

Subwatershed		Pollutant Source	BOD Load (lb/yr)	BMPs	BOD Reduc. (lb/yr)	Percent Reduc. (%)
#1	Upper Boone Creek	Land use-based	70,828	WW urban SW retrofits	6,587	
		Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
		Shoreline erosion	n/a	WW farmed WL restor	11,998	
				SS BMPs	1,803	
	Total		**70,828**		**20,388**	***28.8%***
#2	Powers Creek	Land use-based	28,118	WW urban SW retrofits	2,615	
		Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
		Shoreline erosion	n/a	WW farmed WL restor	7,471	
				SS BMPs	8,062	
	Total		**28,118**		**18,148**	***64.5%***
#3	Lower Boone Creek	Land use-based	86,017	WW urban SW retrofits	5,712	
		Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
		Shoreline erosion	n/a	WW farmed WL restor	3,949	
				SS BMPs	4,186	
	Total		**86,017**		**13,847**	***16.1%***
#4	McCullom Lake	Land use-based	11,783	WW urban SW retrofits	1,096	
		Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
		Shoreline erosion	n/a	WW farmed WL restor	0	
				SS BMPs	183	
	Total		**11,783**		**1,279**	***10.9%***
#5	Dutch Creek	Land use-based	53,100	WW urban SW retrofits	4,938	
		Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
		Shoreline erosion	n/a	WW farmed WL restor	13,638	
				SS BMPs	4,428	
	Total		**53,100**		**23,004**	***43.3%***
#6	Dutch Creek Tributary	Land use-based	45,800	WW urban SW retrofits	4,259	
		Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
		Shoreline erosion	n/a	WW farmed WL restor	3,850	
				SS BMPs	2,010	
	Total		**45,800**		**10,119**	***22.1%***
#7	Northeast Direct Drainage	Land use-based	33,546	WW urban SW retrofits	2,227	
		Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
		Shoreline erosion	n/a	WW farmed WL restor	5,266	
				SS BMPs	215	
	Total		**33,546**		**7,708**	***23.0%***

#8	**Central Direct Drainage**	Land use-based	17,048	WW urban SW retrofits	1,132	
		Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
		Shoreline erosion	n/a	WW farmed WL restor	0	
				SS BMPs	11	
	Total		**17,048**		**1,143**	*6.7%*
#9	**Southeast Direct Drainage**	Land use-based	60,506	WW urban SW retrofits	4,018	
		Streambank erosion	n/a	WW strmbnk stabiliz	n/a	
		Shoreline erosion	n/a	WW farmed WL restor	2,329	
				SS BMPs	1,350	
	Total		**60,506**		**7,697**	*12.7%*
	Grand Total		**406,746**		**103,333**	*25.4%*

Estimated chloride loads and recommended chloride load reduction from road deicing practices were presented in section 4.2.7.

4.3 Public Information, Education, and Outreach

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

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

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

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

4.3.1 Resources for Watershed Information and Education Outreach Campaigns

There are many resources available to assist in developing an effective watershed information and education outreach campaign. U.S. EPA's *Getting in Step: a Guide for Conducting Watershed Outreach Campaigns* (2003) and CMAP and Illinois EPA's *Guidance for Watershed Action Plans in Illinois* (2007) are two recommended sources. Not-for-profit organizations provide information, outreach materials, volunteer opportunities, and other resources applicable to watershed protection. These organizations include the nationally renowned Center for Watershed Protection (CWP) and Center for Neighborhood Technology (CNT) along with a wide range of local organizations such as the Environmental Defenders of McHenry County (EDMC), McHenry County College (MCC), The Land Conservancy of McHenry County (TLCMC), McHenry County Conservation District (MCCD), McHenry County Farm Bureau's Ag in the Classroom Program, the McHenry County Schools Environmental Education Program (MCSEEP), The Wildflower Preservation & Propagation Committee, and many others.

4.3.2 Tools to Conduct a Successful Outreach Campaign

4.3.2.1 Establishing a Sense of Place

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

4.3.2.2 Identifying and Understanding the Audience

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

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

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

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

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

4.3.2.3 Setting Outreach Priorities for Targeted Audiences

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

- Improve and protect the ecological integrity of surface water resources, including wetlands, to attain or maintain designated uses of aquatic life support and aesthetic quality.
- Build on local partnerships and expertise to enhance intergovernmental coordination for achieving sustainable development.
- Protect the quality and quantity of groundwater.
- Conserve open space – wetland, prairie, and woodland communities – through a coordinated plan and public-private partnerships.
- Reduce flooding and attendant bank erosion risk through initiatives to improve and protect water quality.
- Raise public awareness and increase understanding of the impacts of land use and land/water management decisions on water and habitat quality.

4.3.2.4 Choosing Message Formats and Delivery Methods

There are a number of communication tools to help support successful outreach campaigns. Each may be customized to support the education effort and help foster relationships and a sense of community, build understanding, and motivate people to action. A number of formats may be used including those listed in Table 57.

4.3.2.5 Selecting Program Activities for Targeted Audiences

Once the targeted audience has been identified and outreach priorities, messages, and delivery formats determined, an outreach strategy should be developed. It should include priority topics, targeted audiences, vehicles to communicate the messages, and potential partners to lead information and education outreach efforts. Several information and education opportunities to support each of this plan's goals are summarized in Table 58.

Table 57. Communication tools for education and outreach campaigns.

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

Table 58. Existing and potential information and education opportunities by Boone-Dutch Creek Watershed-based Plan goal.

Targeted Audience	*Existing and Potential Opportunities*	*Potential Partners*
Goal: Improve and protect the ecological integrity of surface water resources, including wetlands, to attain or maintain designated uses of aquatic life support and aesthetic quality.		
Residents and landowners, Government officials and agencies, Land and resource managers	Natural Garden in Your Yard Program encourages homeowners to transform garden space to native plant gardens. The program also offers discounts on native plants. Native plants are also sold at various local garden centers in McHenry County and tree sales are hosted by the McHenry-Lake Soil and Water Conservation District (SWCD).	• Wildflower Preservation & Propagation Cmte • MCC • Garden centers • McHenry-Lake SWCD
	McHenry County College (MCC) features a rain garden demonstration project which integrates sustainable green practices. It should be used as an example among other landowners to promote similar projects.	• MCC • McHenry Co.
	Conservation@Home and Conservation@Work encourages use of ecofriendly landscapes among landowners. The program recognizes the importance of native plants and their effect on water resources.	• TLCMC • The Conservation Foundation
	McHenry Township provides an educational brochure to encourage recycling within the watershed. It also oversees its own brush and electronic scrap recycling program and provides brush converted into usable mulch to residents free of charge. Similarly, a number of communities within the watershed offer a recycling	• Dorr Twp. • McHenry Twp. • Nunda Twp. Hwy. Dept. • City of McHenry • Vlg of Bull Valley

	program and recycling services for residents or provide mulch free of charge.	• Vlg of Johnsburg • Vlg of Woodstock
Residents and landowners, Government officials and agencies, Land and resource managers	The Boone Creek Watershed Alliance (BCWA) is engaged in a number of outreach and education efforts to encourage landowners to protect the watershed: ecological restoration seminars; educational tours and workdays at Boloria Meadows; education and outreach at LUREC to address watershed issues; presentations; field trips to MCDOT.	• BCWA
Volunteers, Students	Increase citizen knowledge through the Illinois Volunteer Lake Monitoring Program (VLMP). Data used from the program is used to document water quality impacts to local lakes and aid in lake management decision-making.	• Illinois EPA • CMAP
	Friends of the Fox River (FOFR) volunteers can get their feet wet at water quality monitoring through the Fox River Monitoring Network Training & Benthic Macro Invertebrate Workshop which offers stream monitoring training for volunteers.	• FOFR
	Through the Illinois River Watch Program, volunteers can become "citizen scientists" and conduct habitat and biological surveys on streams. The macroinvertebrates collected are used as bioindicators of water quality.	• The National Great Rivers Research & Education Center • Johnsburg Jr. High School
Volunteers, Students	The Loyola University Retreat and Education Center (LUREC) offers workdays to increase public awareness of invasive species and provides guidance on how to eradicate them.	• LUREC
	LUREC provides summer-long internships for Loyola students in restoration and conservation and educates students in techniques of restoration and conservation and natural habitat management.	
Goal: Build on local partnerships and expertise to enhance intergovernmental coordination for achieving sustainable development.		
Volunteers, Residents and landowners, Government officials and agencies, Land resource managers and organizations	Environmental Defenders of McHenry County (EDMC) is a citizen organization dedicated to the perseveration and improvement of the environment. It offers a number of opportunities: stream cleanup, groundwater resource protection, education courses, and volunteer opportunities.	• EDMC
Government officials and agencies, Land and resource managers and organizations	CMAP's Local Technical Assistance (LTA) Program provides assistance to local governments, nonprofits, and intergovernmental organizations to address sustainable development.	• CMAP
	The Northwest Water Planning Alliance (NWPA) was formed in 2010 and seeks to collaboratively plan for a sustainable water resource supply. Other issues including water quality are reflected in NWPA's goals and objectives.	• NWPA • CMAP

Residents and landowners, Government officials and agencies	**The Fox River Ecosystem Partnership (FREP) is an umbrella organization and resource to communities interested in water resource conservation.**	• **FREP**
Government officials, Land and resource managers and organizations	Project Quercus is a coalition aimed at working collaboratively to create solutions to the decline in oak woodlands throughout McHenry County.	• TLCMC
Residents and landowners, Government officials, Land and resource managers and organizations	LUREC's Land Management Advisory Committee brings together neighboring land-owners, government agencies, private conservation groups, and the University to plan restoration in the Boone Creek headwaters.	• LUREC
Goal: Protect the quality and quantity of groundwater.		
Residents and landowners, Government officials and agencies, Land and resource managers and organizations, Developers	The WaterSense Program promotes the need for water efficiency by offering alternatives to use less water with water efficient products.	• U.S. EPA • NWPA
	McHenry County's website includes a number of educational resources that have been developed to protect the quality of groundwater and conserve water. Topics include: the use of water softeners, groundwater basics, indoor water conservation, parking lot and sidewalk de-icing, among others.	• McHenry Co.
	McHenry County provides deicing workshops, deicing operator certification, product application & calibration demonstrations.	• McHenry Co.
	McHenry-Lake County SWCD's website includes educational resources on conserving and protecting water and other resources and sells rain barrels at a discounted price.	• McHenry-Lake SWCD
Residents and landowners, Government officials and agencies, Land and resource managers	BCWA has given annual presentations to Loyola's Winter Ecology classes and group throughout the watershed on groundwater quality and quantity issues.	• BCWA
Goal: Conserve open space – wetland, prairie, and woodland communities – through a coordinated plan and public-private partnerships.		
Residents and landowners, Government officials and agencies, Developers	TLCMC works with landowners, communities, and other partners to protect McHenry County's prairies, wetlands, and woodlands. Conservation is accomplished through direct acquisition of a property or the establishment of a conservation easement.	• TLCMC
	The McHenry County Conservation District (MCCD) seeks to preserve, restore, and manage open spaces and natural areas within McHenry Co. MCCD offers a number of education and special events aimed at its mission, and owns or manages numerous open spaces.	• MCCD

Goal: Reduce flooding and attendant bank erosion risk through initiatives to improve and protect water quality.		
Residents and landowners, Government officials and agencies, Land resource managers and organizations, Developers	Meetings, local government websites, school websites, newsletters, email blasts, workshops, demonstration projects, public meetings, streambank and shoreline assessments.	• Elected officials • Park, forest preserve, & conservation districts • Non-profit groups • Landscape contractors • Homeowner's associations • Riparian landowners
Government officials and agencies	Develop a regional floodplain management plan. Potential benefits of the plan include: reduction of flood damage costs to communities; improvement of riparian vegetation, wildlife habitat and water quality; retention of natural beauty in the area.	• FEMA
Government officials and agencies	Village newsletters may be used by local governments to tie the educational component of their MS4 program to this watershed plan and its implementation such that collaborative efforts might benefit from a consistent message and efficiencies to be gained from cooperation.	• Elected officials • Illinois EPA
Volunteers, Residents and landowners, Government officials and agencies, Land resource managers, Developers	Targeted mailings, county/municipal websites, home owner's association workshops, handouts at permit facilities, local codes, ordinances	• Elected officials • McHenry Co. • CMAP
Goal: Raise public awareness and increase understanding of the impacts of land use and land/water management decisions on water and habitat quality.		
Government officials and agencies, Residents and landowners, Students	Websites, newsletters, stream and lake education days, library displays and programs, demonstration sites, MCC courses, McHenry-Lake SWCD programs, University of Illinois Extension programs	• Municipalities • Townships • McHenry Co. • MCCD • CMAP • EDMC • TLCMC • MCC • McHenry-Lake SWCD • Primary & secondary schools • Libraries • U of I Extension - McHenry Co. Master Gardeners

Students	The McHenry County Schools Environmental Education Program (MCSEEP) reaches out to schools in McHenry County to provide education to students on a variety of environmental conservation topics.	• McHenry Co.
Residents and landowners, Government officials, Land and resource managers	LUREC provides hands-on ecology courses: winter ecology; restoration ecology; field ornithology; ecology laboratory; field archaeology; and, summer flora.	• LUREC

4.3.3 Recommendations and Cost Estimate

Several recommendations for public information, education, and outreach activities within the Boone-Dutch Creek planning area are listed below.

1. The Boone Creek Watershed Alliance, a 501(c)(3) organization, should expand its boundaries to incorporate the Dutch Creek Watershed and direct drainage areas to the Fox River as included in this watershed-based plan.
2. Local conservation-oriented organizations and agencies as well as local governments should promote the Boone-Dutch Creek Watershed-based Plan and its recommendations in either special or regularly occurring communications with members and residents.
3. CMAP should issue a press release about the Boone-Dutch Creek Watershed-based Plan upon approval by Illinois EPA.
4. A social survey should be conducted to help determine barriers to and pathways for greater stakeholder participation.
5. County, township, and municipal governments should create a dialogue with neighborhood and/or homeowner's associations to raise awareness of stormwater management issues and responsibilities, in collaboration with local conservation-oriented organizations, educational providers, and stormwater professionals. Workshops on maintaining stormwater BMPs should be offered for HOAs and other property owners responsible for their maintenance.
6. County, township, and municipal governments should promote installation of rain gardens, rain barrels, and other property-level green infrastructure practices by neighborhood and/or homeowner's associations and local businesses, in collaboration with local conservation-oriented organizations, educational providers, and professionals in the field.
7. Municipal and other local government staff should incorporate NWPA recommendations and related requests for data sharing and information.
8. Local governments and nongovernmental organizations alike should promote
   a. use of phosphorus-free lawn fertilizer by homeowners and other private individuals who maintain their lawns (i.e., noncommercial or non-for-hire applicators),
   b. use of on-demand water softeners by homeowners and other private individuals and businesses,
   c. a pet waste disposal campaign.

9. The McHenry County Department of Health should conduct a septic system maintenance campaign, collaborating with local governments and nongovernmental organizations.
10. McHenry County should continue to offer their “sensible salting workshops” and conduct campaigns to encourage workshop participation and ongoing implementation.

The cost of developing, conducting, and analyzing a social survey to help determine barriers to and pathways for greater stakeholder participation, including municipal involvement and agricultural BMP implementation, is estimated at $15,000 to $20,000.[117]

Development of outreach and education programs, campaigns, workshops, displays, websites, materials, etc. is estimated at $5,000 per “event.” If each municipality and township within the Boone-Dutch Planning area, plus McHenry County, were to develop one new “event,” that would total 12 events, and thus $60,000 is estimated as a watershed-wide budget starting point. Partnerships with local organizations (e.g., BCWA, EDMC, TLCMC), schools, and libraries are encouraged. It is recommended that stakeholders develop a more detailed education work strategy during the first two years of plan implementation.

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

4.4 Funding and Technical Assistance

Plan implementation is largely based on the availability of funding and/or technical assistance for implementation projects and other plan recommendations. Table 59 describes several potential grant funding and technical assistance resources that may be used to assist with plan implementation.

Table 59. Funding and technical assistance resources.

Program	*Funding Agency*	*Funding Amount*	*Eligibility*	*Activities Funded*	*Website*
Clean Water and Drinking Water State Revolving Loan Funds	U.S. EPA	Loan Program	Local government, individuals, citizens (septic systems), not-for-profit groups	Green projects, wastewater treatment, NPS, watershed management, restoration and protection of groundwater.	http://www.epa.gov/aboutepa/about-office-water
Conservation Innovation Grants	USDA - NRCS	Up to $75,000 under state component	Landowners, organizations	Projects targeting innovative on-the-ground conservation, including pilot projects and field demonstrations.	http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/
Conservation Stewardship Program	USDA - NRCS	Not more than $200,000	Private and tribal agricultural lands, grassland, rangeland, pastureland, and nonindustrial private forest land	The program helps agricultural producers maintain and improve their existing conservation system.	
Environmental Quality and Incentives Program (EQIP)	USDA - NRCS	Advance payment of up to 50%	Agricultural producers, private owners	Resource limited farmers receive an increased payment rate to purchase equipment/materials to implement conservation practices.	
Healthy Forests Preserve Program	USDA - NRCS	50%, 75% or 100% of the enrolled land/ cost of the conservation practice. Funding based on 10-year or 30-year contract	Private landowners	The program offers 10-year restoration agreements and 30-year permanent easements for specific conservation actions.	

Program	*Funding Agency*	*Funding Amount*	*Eligibility*	*Activities Funded*	*Website*
FEMA Hazard Mitigation Buyout Program	FEMA	Market value of the real property (land and structures) at the time of sale or immediately prior to the flood event	Private landowners	The program provides assistance to property owners to purchase a flood-prone structure from the owner in order to restore and/or conserve the natural floodplain functions.	http://www.fema.gov/media-library/assets/documents/13664?id=3324
Illinois Clean Lakes Program	Illinois EPA	Phase 1: $75,000 Phase 2: $300,000 When funding is appropriated.	Owners/managers of lakes that have public access.	Two types of grants are awarded: Phase I identifies problems and sources of pollution. Phase II grants support implementation or procedures recommended in the Phase I report to improve water quality.	www.epa.state.il.us/water/conservation/iclp.html
Illinois Green Infrastructure Program	Illinois EPA	Small: $75,000 Retention: $750,000 CSO: $3M When funding is appropriated	Any entity eligible to receive funds from the state And the project is in a MS4 community.	Implementation of green infrastructure BMPs that are designed to improve water quality to lakes, rivers and streams through managing stormwater to reduce flows and remove pollutants.	http://www.epa.gov/green-infrastructure
Local Technical Assistance (LTA) Program	CMAP	--	Local governments, nonprofits, intergovernmental organizations.	Technical assistance is provided to address local issues including transportation, landuse, housing, natural environment, economic growth and community development.	http://www.cmap.illinois.gov/programs-and-resources/lta/
Nonpoint Source Management Program (319)	Illinois EPA	No set limit on awards	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, businesses.	Green Infrastructure best management practices for stormwater management to protect or improve water quality.	http://www.epa.illinois.gov/topics/water-quality/watershed-management/nonpoint-sources/grants/index

Program	*Funding Agency*	*Funding Amount*	*Eligibility*	*Activities Funded*	*Website*
Open Space Lands Acquisition & Development & Land & Water Conservation Programs	Illinois DNR	$750,000 acquisition $400,000 development	---	The program provides funding for water quality basins with native plantings, preservation/biological improvement of permanent wetlands, interpretive prairie gardens, etc.	www.dnr.state.il.us/
Project Quercus	The Land Conser-vancy of McHenry County	--	Homeowners, businesses, governmental units, education institutions, individuals	The program sells container-grown oaks from the Glacier Oaks Nursery in Harvard, IL.	http://www.conservemc.org/
Streambank Cleanup and Lake Shore Enhancement (SCALE) grants	Illinois EPA	$3,500	Any entity eligible to receive funds from the state.	Provides funds to assist groups that have established a recurring stream or lakeshore cleanup.	www.epa.state.il.us/water/watershed/scale.html
Sustainable Agricultural Grant Program	Illinois Dept. of Ag.	Up to $10,000 for individuals Up to $20,000 for units of government, non-profits, institutions.	Organizations, governmental units, educational institutions, non-profit groups, individuals	Practices are aimed at maintaining producers' profitability while conserving soil, protecting water resources and controlling pests through means that are not harmful to natural systems, farmers or consumers.	https://www.agr.state.il.us/conservation-2000/

4.5 The Value of Planning, Policies, Programs, and Projects for Resource Protection: Ecosystem Services Evaluation

The Boone-Dutch Creek planning area is rich with natural assets that perform a variety of valuable ecological functions. The priority areas for conservation and restoration are captured in the region's Green Infrastructure Vision (GIV).[118] Forests, wetlands, prairies, and waterbodies remove pollutants from the air and water, protect areas from flooding, supply marketable crops, and provide habitats for wildlife and recreation. While these functions are not always accounted for in traditional economic indicators, they significantly contribute to the economy and quality of life. Degradation of the watershed through land use changes, development, and other activities can compromise the ability of natural areas to provide these functions. In some cases, the loss of these natural ecosystem services would result in the need for public investment in infrastructure and technology to replace the services.

Based on a study to estimate the value of the region's green infrastructure,[119] the Boone-Dutch Creek planning area within the GIV contributes an estimated $91.5 million per year from flood control, groundwater recharge, water purification, and carbon storage (Table 60, Figure 61). This figure is based only on resources that are part of the regional GIV, not the full ecosystem services provided by all natural features within the planning area. The services this figure captures are from the landscape types seen in Figure 62, "Core Landscapes." Other valuable aspects of the planning area that are harder to quantify – such as biodiversity, outdoor recreation, and scenic quality – are not reflected in this valuation.

The planning area's water and wetland resources provide the highest economic and flood control value. The watershed's numerous lakes and wetlands within the GIV provide an estimated $66 million per year of protection against flooding damages to homes, roadways, and other infrastructure. The planning area's lakes, streams, wetlands, grasslands, and woodlands also provide significant groundwater recharge and water purification services.

Communities within the Boone-Dutch Creek Watershed planning area are important regional stewards of the Fox River and several of its tributaries. Conservation and restoration investments made in the planning area will not only have major economic and quality of life implications for local communities, but also for the dozens of communities that lie downstream.

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[118] http://www.cmap.illinois.gov/livability/sustainability/open-space/green-infrastructure-vision

[119] https://datahub.cmap.illinois.gov/dataset/green-infrastructure-vision-2-3-ecosystem-valuation

While some ecosystem services, particularly flood control, would not be affected by a decline in water quality, other functions depend on efforts to protect natural resources that these communities should undertake. Development of wetlands and the introduction of additional impervious surfaces would decrease the planning area's ability to provide groundwater recharge and water filtration services. While the estimated $91.5 million in ecosystem services that the planning area provides per year is not all at risk of being lost due to development, it does represent a valuable, functional resource that could be diminished at public cost without proper protection. Put another way, protection, maintenance, and expansion (wherever possible) of green infrastructure throughout the planning area is an investment worth making.

Table 60. Select ecosystem services aggregates values, Boone-Dutch Creek planning area.

Ecosystem Service	*Value*	*% of total aggregate value*
Flood Control[120]	$66,063,600	72.2
Groundwater Recharge[121]	$14,934,000	16.3
Water Purification[122]	$10,212,200	11.2
Carbon Storage[123]	$284,300	0.3
Aggregate Services	***$91,494,100***	*100.0*

[120] Flood control includes the reduction of flood damage, combined system sewer costs, erosion, and peak discharges. This value is derived from the avoided costs of constructing and operating stormwater infrastructure and replacement costs of damaged infrastructure and ecosystems.

[121] Groundwater recharge refers to the volume of surface runoff that is captured and restored into the groundwater supply. This value is derived from avoided costs of constructing and operating water supply infrastructure, replacement costs of building deeper wells, and the rate of the public water supply

[122] Water purification includes the reduction of nutrients, sediment, and other pollutants in water bodies. This value is derived from the avoided costs of wastewater treatment.

[123] Carbon storage is the reduction of atmospheric carbon dioxide, as well as the reduction of climate impacts, such as intense storms, droughts, and heat waves. This value is derived from the market price of carbon.

Figure 61. Selected ecosystem services aggregate value, Boone-Dutch Creek planning area.

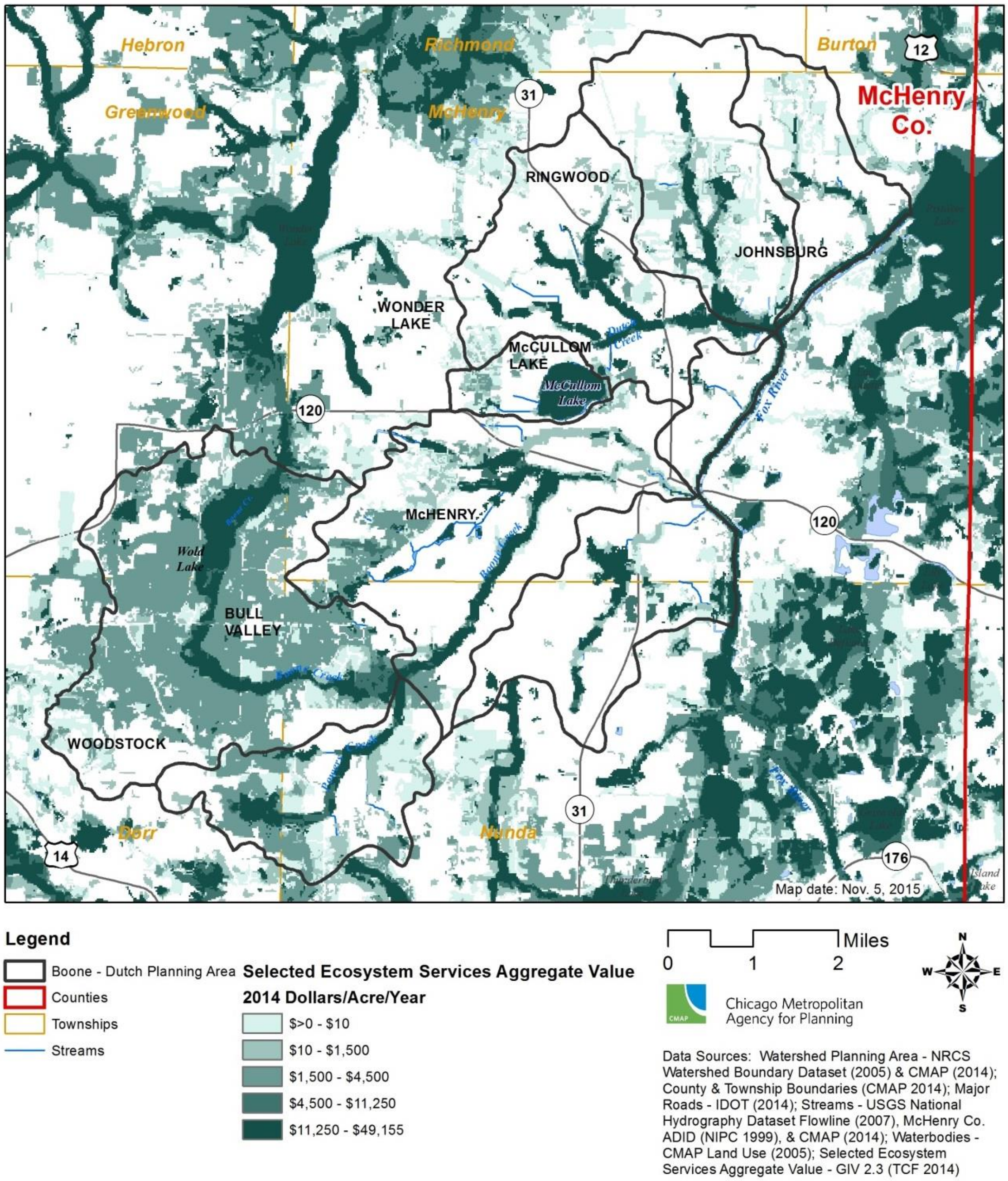
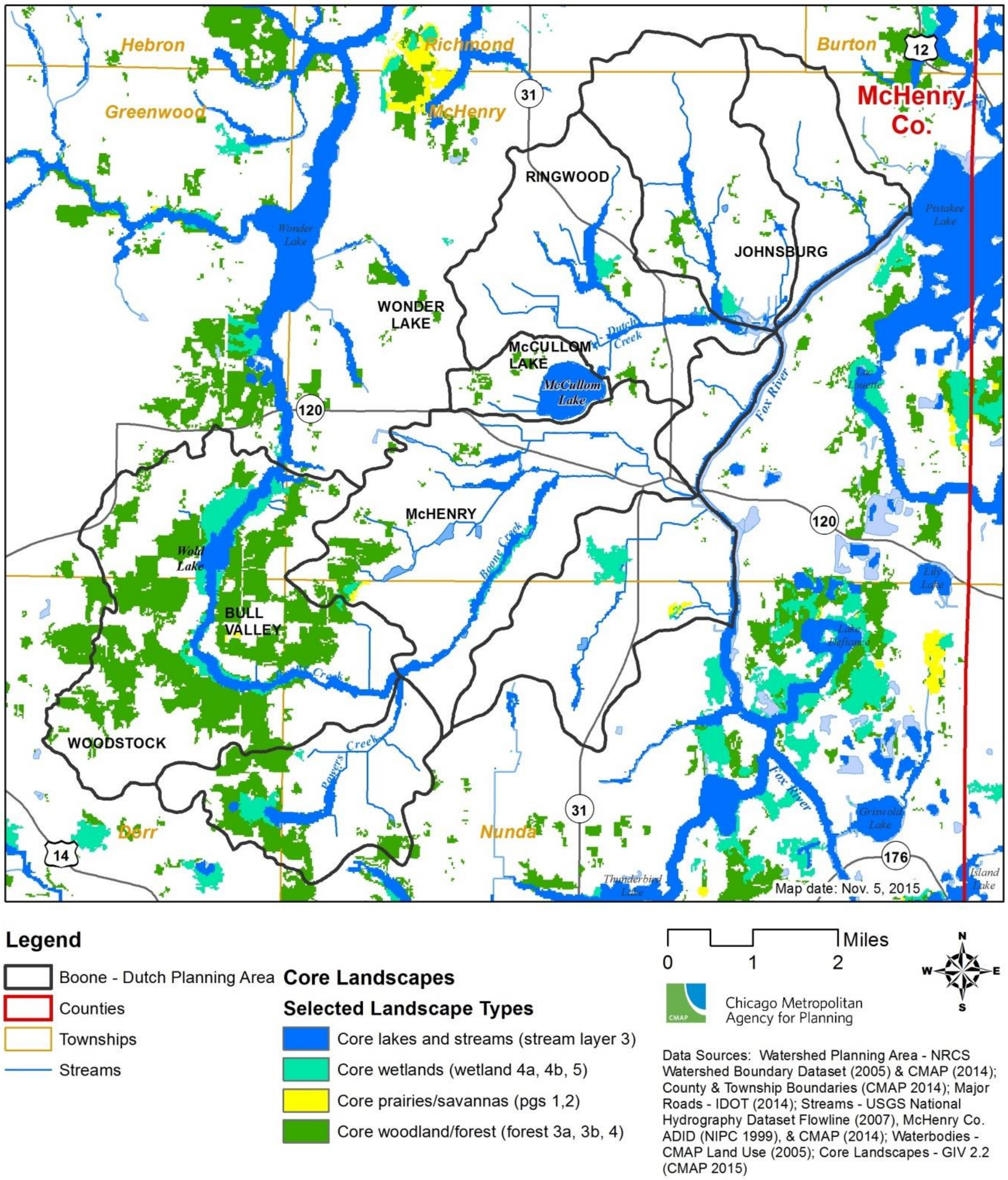


Figure 62. Core landscapes used in ecosystem services valuation.



5. Monitoring Success

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

5.1 Implementation Schedule

Table 61. General 10-year plan implementation schedule.

Task	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Year 10*	*(Year 11)*
Modify the boundaries and name of the Boone Creek Watershed Alliance to encompass the Dutch Creek Watershed and direct drainage areas to the Fox River as covered in this plan.	X										
Conduct outreach to elected officials & general public about Boone-Dutch Watershed-based Plan, including funding & tech assist opportunities	X			X			X				
Identify a series of plan recommendations to implement	X	X		X	X		X	X			
Identify available grant funding and tech assistance programs	X	X	X	X	X	X	X	X			
Develop and submit grant and tech assistance applications	X	X	X	X	X	X	X	X			
Implement on-the-ground, policy & planning, and education and outreach projects and programs		X	X	X	X	X	X	X	X	X	
Keep track and report progress to Boone-Dutch Creek watershed coalition	X	X	X	X	X	X	X	X	X	X	
Communicate success stories	X	X	X	X	X	X	X	X	X	X	
Evaluate accomplishments			X			X				X	X
Update the watershed-based plan										X	X

5.1.1 Interim Measureable Milestones

One requirement of a watershed-based plan is to establish interim measurable milestones for determining whether nonpoint source pollution management measures and other actions are being implemented. Table 62 identifies such milestones and ties them to goals that stakeholders established early in the planning process.

Stakeholders will evaluate progress towards measurable milestones on an annual basis and grade their efforts such that it will become clear where improvements and/or changes to an approach or the plan itself are needed. It is important, therefore, for a clear sense of progress to be documented.

Plan recommendations will require local commitments, resources, and collaboration for implementation success. While there are several sources of funding made available throughout the year, the Clean Water Act Section 319 grant program, administered by Illinois EPA, is a particularly important one for local stakeholders to pursue.

Table 62. Interim measureable milestones.

Goal	*Indicator*	*Two-year milestone*	*Five-year milestone*	*Ten-year milestone*
Improve and protect the ecological integrity of surface water resources	Lin. ft. vegetated swales	1,000	5,000	10,000
	No. of rain gardens	10	30	60
	No. of dry detention basin retrofits	---	5	10
	No. wet detention basin retrofits	---	5	10
	Acres permeable pavement	---	2	5
	Lin. ft. streambank stabilization	---	10,000	20,000
	Lin. ft. shoreline stabilization	---	2,000	5,000
	Acres new riparian buffer	5	20	50
	Acres restored riparian buffer	10	50	100
	Acres restored farmed wetlands	10	20	50
	Acres ecological habitat restoration	10	20	50
	No. of site-spec. ag. BMPs	1	3	7
	No. stream cleanup events	2	5	10
	No. of public sector trees planted	35	100	400
Build on local partnerships and expertise to achieve sustainable development	No. of presentations made to elected officials	12	24	36
	No. of communities whose comprehensive plan updates support low impact development/ environmental site design practices	1	4	7
	No. of communities whose ordinance updates improve water quality protections	---	4	8
	Hiring of dedicated water resource planner at county level	1	---	---

Goal	*Indicator*	*Two-year milestone*	*Five-year milestone*	*Ten-year milestone*
Protect groundwater quality & quantity	No. of communities becoming WaterSense (WS) partners as recommended by NWPA[124]	4: Bull Valley, Johnsburg, McCullom Lk, Ringwood	2 more: Woodstock, Wonder Lk	---
	No. of communities adopting NWPA or similar outdoor lawn watering ordinance[125]	4: Bull Valley, Johnsburg, Ringwood, McHenry Co.	2 more: Woodstock, Wonder Lk	---
	No. of communities adopting all policy recommendations of the McHenry Co. Water Resources Action Plan (WRAP)[126]	5: Bull Valley, Johnsburg, McCullom Lk, McHenry, Ringwood	2 more: Woodstock, Wonder Lk	---
	No. of new "on-demand" water softeners installed	10	50	100
	No. of "sensible salting" workshops offered by McHenry Co.	2	5	10
	No. of road maintenance departments participating in "sensible-salting" training / retraining	11	---	---
	No. of contractors participating in "sensible-salting" training / retraining	10	20	30
Conserve open space through a coordinated plan & public-private partnerships	No. of communities whose comprehensive plan updates support local-regional green infrastructure	---	2	7
	Acres placed in new, permanent conservation status	5	15	50

[124] McHenry County and City of McHenry are currently WaterSense Partners.

[125] The City of McHenry and Village of McCullom Lake are known to have adopted outdoor watering ordinances.

[126] Dennis Sandquist, Director of Planning and Development at McHenry County, contacted the seven municipalities and four townships in the Boone-Dutch Creek planning area in December 2015 to inquire if any had adopted or taken any additional steps to implement WRAP policies since a 2014 WRAP survey. The City of McHenry has adopted several policy recommendations contained in the WRAP, including water conservation, use of best practices to reduce road deicing salts, and participation in the county's winter deicing workshops. The Village of McCullom Lake has adopted water conservation policies and attends the winter deicing workshops. The Village of Bull Valley limits impervious surfaces in Class III Groundwater Areas, utilizes road salt reduction practices, and attends the winter deicing workshops. The City of Woodstock and Nunda and McHenry Townships have not adopted any WRAP policies. The other municipalities and townships did not respond to the survey.

Goal	*Indicator*	*Two-year milestone*	*Five-year milestone*	*Ten-year milestone*
Reduce flooding & attendant bank erosion risk through initiatives to improve & protect water quality	Acres green roof	---	1	3
	Acres blue roof	---	---	1
	Acres floodplain reconnection	10	50	100
Raise public awareness and increase understanding of the impacts of land use and land/water management decisions on water and habitat quality	No. of public presentations, displays, and/or field trips with Boone-Dutch Creek Plan implementation theme	10	30	50
	No. of newsletter articles with Boone-Dutch Creek Plan implementation theme	10	30	50
	No. of Conservation@Home and/or Conservation@Work installations	10	50	100
	No. of students enrolled in MCC "green curriculum" courses	20	50	100
	No. of active volunteer lake and stream monitors	2	5	8

5.2 Criteria for Determining Progress

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

Monitoring pollutant-load reductions and biological index scores will be the primary criterion by which progress can be judged. Table 63 identifies criteria of determining progress within five and ten-year timeframes to reflect the fact that it will take time to see improvements manifest in response to plan implementation.

Another important criterion for determining progress will be delisting of a waterbody due to use attainment as documented in the biennial integrated water quality reports. Thus, improvements in water quality should result in greater use attainment and/or delisting [Section 303(d)] in the 2024 Integrated Report.

Table 63. Criteria for determining progress in load reductions and attaining or maintaining water quality standards or criteria.

Criteria	*Current Load, Score, or Rating*	*Target within 5 years*	*Target within 10 years*
Watershed-wide			
Nitrogen load reduction	361,080 lb/yr	5% load reduction = 18,054 lb/yr (90,270 lb total)	15%* load reduction = 54,162 lb/yr (541,620 lb total)
Phosphorus load reduction	30,514 lb/yr	10% load reduction = 3,051 lb/yr (15,257 lb total)	25%* load reduction = 7,629 lb/yr (76,285 lb total)
Sediment load reduction	10,299 T/yr	10% load reduction = 1,030 T/yr (5,150 T total)	25% load reduction = 2,575 T/yr (25,748 T total)
BOD load reduction	406,746 lb/yr	5% load reduction = 20,337 lb/yr (101,687 lb total)	15% load reduction = 61,012 lb/yr (610,119 lb total)
Chloride load reduction (road deicing practices)	5,738 T/yr	25% load reduction = 1,437 T/yr (7,186 T total)	50% load reduction = 2,875 T/yr (28,745 T total)
No. of fish species in greatest need of conservation	8	≥ 8	≥ 8
Waterbody-specific			
Boone Crk (DTZT-02 at Bull Valley Rd.)			
fIBI score	36	≥ 36	≥ 41
mIBI score	61.4	≥ 61	≥ 61
QHEI score	64.25	≥ 64	≥ 64
Stream Rating for Integrity	C	≥ C	≥ B
Stream Rating for Diversity	C	≥ C	≥ B
Dutch Crk (new station to be established, probably upstream of Rt. 31)			
fIBI score	n/a	set baseline	≥ 41
mIBI score	n/a	set baseline	≥ 41.8
QHEI score	n/a	set baseline	≥ 50
Stream Rating for Integrity	n/a	set baseline	≥ C
Stream Rating for Diversity	n/a	set baseline	≥ C
Fox River (DT-23)			
fIBI score	27	≥ 27	≥ 41
mIBI score	19.5	≥ 20.9	≥ 41.8
QHEI score	40	≥ 40	≥ 50
Stream Rating for Integrity	B	≥ B	≥ B
Stream Rating for Diversity	C	≥ C	≥ B
McCullom Lake (RTZD) – annual average total phosphorus conc.	0.025 mg/L	≤0.025 mg/L	≤0.020 mg/L

*percent reduction matches Illinois Nutrient Reduction Strategy year 2025 goal

5.3 Monitoring to Evaluate Effectiveness

Boone and Dutch Creeks, McCullom Lake, and the direct drainage tributaries to the Fox River that were the focus of this watershed-based plan will require a robust water quality monitoring regime in order to evaluate the effectiveness of BMP implementation. Various models used to determine baseline or background pollution loads and load reduction estimates associated with BMP implementation were neither calibrated nor validated from water quality and land-use data collected from the planning area within the past couple of years. Of necessity, models were calibrated based on data from best available research conducted around the country over time (e.g., event-mean concentrations of pollutants, pollutant removal efficiencies, etc.). It will be important to keep track of BMPs implemented in the various study units as well as any in-lake management measures that may have been implemented to help explain any changes that occur or trends that may emerge.

Monitoring water quality to evaluate the effectiveness of the watershed plan will largely depend on the following water quality monitoring program components:

Fox River

- Illinois EPA and Illinois DNR Fox River Basin survey – water quality, habitat, macroinvertebrates, fish – every 5 years at monitoring station DT-23 (next scheduled in 2017)

Boone Creek

- Illinois EPA and Illinois DNR Fox River Basin survey – water quality, habitat, macroinvertebrates, fish – every 5 years at monitoring station DTZT-02 at Bull Valley Rd (next scheduled in 2017)
- ISWS – maintain gaging station at Bull Valley Rd, continue annual sonde deployment
- Volunteer chloride monitoring at INAI groundwater seeps – annual (last in 2014)

Dutch Creek

- Request Illinois EPA and Illinois DNR to establish monitoring station and include in Fox River Basin survey every 5 years (next scheduled in 2017)
- Investigate options for establishing a gaging station

Smaller Tributaries

- Volunteer monitoring of fish populations to document IWPA Species in Greatest Need of Conservation – every 5 years (potential partners: Openlands, MCCD, TLCMC, LUREC, MCC) (next in 2020)
- Volunteer monitoring of chloride concentrations – annual (potential partners: BCWA, Openlands, MCCD, LUREC, MCC, municipalities, townships, McHenry Co.)

- Volunteer monitoring of macroinvertebrates through the Illinois RiverWatch and/or Friends of the Fox River Monitoring Network programs – annual

McCullom Lake

- Volunteer Lake Monitoring Program (VLMP) – annual Secchi transparency, occasional water quality
- Illinois EPA Ambient Lake Monitoring Program (ALMP) – water quality, macrophytes – occasional (last in 2010)

List of Acronyms

ADID: Advanced Identification [of wetlands]
ALMP: Ambient Lake Monitoring Program
BMP: Best Management Practice
BOD: Biological Oxygen Demand
CL: Chloride
CMAP: Chicago Metropolitan Agency for Planning
CNT: Center for Neighborhood Technology
CWP: Center for Watershed Protection
CWS: Community Water System
DNR: Deparment of Natural Resources
EDMC: Environmental Defenders of McHenry County
EPA: Environmental Protection Agency
FEMA: Federal Emergency Management Agency
fIBI: fish Index of Biotic Integrity
FIRMs: Flood Insurance Rate Maps
FOFR: Friends of the Fox River
FREP: Fox River Ecosystem Partnership
GIV: Green Infrastructure Vision
HEL: Highly erodible land
HOA: Homeowner's Association
HSGs: Hydrologic Soil Groups
IEMA: Illinois Emergency Management Agency
IFDA: Illinois Forestry Development Act
IGPA: Illinois Groundwater Protection Act
INAI: Illinois Natural Area Inventory
INPC: Illinois Nature Preserves Commission
ISWS: Illinois State Water Survey
IWAP: Illinois Wildlife Action Plan
LTA: Local Technical Assistance
LUREC: Loyola University Retreat and Ecology Campus
MBI: Macroinvertebrate Biotic Index
MCC: McHenry County College
MCCD: McHenry County Conservation District
MCSEEP: McHenry County Schools Environmental Education Program
mIBI: macroinvertebrate Index of Biotic Integrity
MS4: Municipal Separate Storm Sewer System
N: Nitrogen
NIPC: Northeastern Illnois Planning Commission
NLCD: National Land Cover Database
NOI: Notice of Intent
NPDES: National Pollutant Discharge Elimination System
NRCS: Natural Resources Conservation Service
NVSS: Nonvolatile Suspended Solids
NWPA: Northwest Water Planning Alliance
P: Phosphorus
PCBs: Polychlorinated biphenyls
QHEI: Qualitative Habitat Evaluation Index
SARA: Sensitive Aquifer Recharge Area
SMO: Stormwater Management Ordinance
SS: Site-specific
SSURGO: Soil Survey Geographic
STEPL: Spreadsheet Tool to Estimate Pollutant Loads
SWCD: Soil & Water Conservation District
TKN: Total Kjeldahl Nitrogen
TLCMC: The Land Conservancy of McHenry County
TOD: Transit Oriented Development
TP: Total Phosphorus
TSI: Trophic State Index
TSS: Total Suspended Solids
UDO: Unified Development Ordinance
USDA: U.S. Department of Agriculture
USGS: U.S. Geological Survey
UST: Underground Storage Tank
VLMP: Volunteer Lake Monitoring Program
VSS: Volatile Suspended Solids
WW: Watershed-wide
WWTP: Waste Water Treatment Plant

Appendix A – Boone-Dutch Creek Watershed Planning Meeting Participants

Name		Organization
Craig	Adams	McHenry Township
Ders	Anderson	Openlands
Jean	Attermeier	Village of McCullom Lake
Joe	Araiza	Urban GIS, Inc.
Linda	Balek	The Land Conservancy of McHenry Co.
Patricia	Carty	Loyola University Retreat & Ecology Campus (LUREC)
Andrea	Cline	Geosyntec Consultants
Joanna	Colletti	McHenry Co. Planning & Development Dept.
Fran	Counley	Village of McCullom Lake
Terry	Counley	Village of McCullom Lake
Alex	Cuda	
Frank	Cuda	Scheflow Engineers
Chalen	Daigle	McHenry Co. Council of Governments
Sue	Draffkorn	McHenry Co. Board
Dennis	Dreher	Boone Creek Watershed Alliance
Carol	Ellinghausen	Boone Creek Watershed Alliance
Ed	Ellinghausen	Boone Creek Watershed Alliance; Vlg of Bull Valley Board
Logan	Gilbertsen	HR Green
Kim	Hankins	McHenry County College Sustainability Center
John	Huemann	Village of Johnsburg Board
Cory	Horton	McHenry Co. Water Resources Division
Kelley	Keppes	Village of Ringwood
Bobbi	Lammers-Campbell	Loyola University - LUREC
Doug	Martin	City of McHenry
Mary	McCann	McHenry Co. Board
Stephen	Mitten	Loyola University
Jeff	Murray	McHenry Co. Conservation District
Nicky	Obenauf	Environmental Defenders of McHenry Co.
Katrina	Phillips	Sierra Club
Adam	Rex	McHenry Co. Conservation District
Lisa	Rhoades	Boone Creek Watershed Alliance
Brittany	Rivera	Loyola University student
Nancy	Schietzelt	Environmental Defenders of McHenry Co.
Randy	Schietzelt	The Land Conservancy of McHenry Co.

Name		Organization
Paul	Siegfried	Baxter and Woodman
Cindy	Skrukrud	Sierra Club
Maggie	Soliz	Applied Ecological Services
Michael	Spiering	Loyola University student
Ralph	Stark	HR Green (rep. Village of Johnsburg)
Randy	Stowe	Biotechnical Erosion Control
Brian	Thomson	Biltmore Country Club (guest speaker)
Dan	Volkers	Farm Bureau
Ed	Weskerna	McHenry-Lake Soil & Water Conservation District
Mark	Willobee	Geosyntec Consultants
Brad	Woodson	McHenry Co. Conservation District
Steve	Zehner	Robinson Engineering (rep. Vlg of Wonder Lake)

Appendix B – McCullom Lake Restoration and Protection Program: Phase 1 Study Summary and Phase 2 Implementation Update

McCULLOM LAKE
RESTORATION AND PROTECTION PROGRAM

Project Update -- April 1996[1]

PROJECT OVERVIEW

The future looks bright for McCullom Lake in McHenry, Illinois! A Clean Lakes Program Phase II implementation grant from the U.S. Environmental Protection Agency was awarded to the City of McHenry in August 1993. The grant funds are being used to implement the *McCullom Lake Restoration and Protection Program* an ambitious project to restore the lake's recreational uses and provide for its long-term ecological protection. This plan was developed by the Northeastern Illinois Planning Commission and the City of McHenry under a Phase I study grant from the federal Clean Lakes Program during the period 1989 through 1992.

In the pages that follow, the results of the Phase I "diagnostic/feasibility" study are highlighted (pages 1 through 3), and the activities encompassed by the Phase II "implementation" program grant are described (pages 4 through 6). **On pages 7 and 8, the current status of the implementation project is reviewed.**

The partners in this ambitious lake restoration and protection effort cut across all levels of government and include the **City of McHenry** (local project sponsor), **Northeastern Illinois Planning Commission** (technical project coordinator), **Illinois Environmental Protection Agency** (overall grant administration and coordination), **Illinois Department of Natural Resources** (fishery eradication and restocking), as well as the **U.S. Environmental Protection Agency's Clean Lakes Program** grant program.

Voluntary cooperation and assistance from the local community are critical to the lake's long-term health. There are numerous opportunities for local individuals and organizations to become involved in this project. *Your questions and comments regarding this project are encouraged* and should be directed to Pete Merkel at the City of McHenry's Parks and Recreation Department (815/363-2160), or Bob Kirschner/Holly Hudson at the Northeastern Illinois Planning Commission (312/454-0400).

LAKE HISTORY AND PHASE I DIAGNOSTIC STUDY RESULTS

McCullom Lake is a 244-acre glacial lake located within the City of McHenry, Village of McCullom Lake, and unincorporated McHenry County, Illinois. A majority of the lake bottom (86.1 percent) is owned by the City of McHenry. The Village of McCullom Lake owns 4.5 percent of the lake bottom; private ownership accounts for the remaining 9.4 percent. The lake is managed by the City of McHenry with the cooperation of the other owners. Public access is available through four park sites owned and operated by the City which include three swim beaches and a boat launch. The Village of McCullom Lake owns and operates a park, beach, and boat launch for its residents.

The lake was dammed circa 1890, raising the lake level approximately 1.5 feet. The lake has an average depth of 4.4 feet, maximum depth of 9.5 feet, storage capacity of 1,079 acre-feet, and average retention time

[1] This section is copied from a project update report written by Robert Kirschner and Holly Hudson, Northeastern Illinois Planning Commission, April 1996.

of 254 days. Its watershed encompasses 616.4 acres, a majority of which lies to the west and northwest of the lake. Approximately 58 percent of watershed's land use is residential/developing residential, and about 21 percent is in agricultural use. Wastewater treatment for a majority of homes within the watershed is provided by septic systems. Only those homes in the Lakeland Park and Brittany Park subdivisions along the lake's southern shore and to its southwest are served by sanitary sewers.

Water inflows to McCullom Lake include two small tributaries entering along the south/southwest shore, numerous small ditches and swales, several small drainage pipes, diffuse overland flow, direct precipitation onto the lake surface, and groundwater. Runoff from the watershed accounts for approximately 25 percent of the lake's average annual inflow water volume, with groundwater and direct precipitation onto the lake surface contributing the remaining 30 and 45 percent (respectively). Approximately 35 percent of the average annual water outflow occurs over the lake's spillway, about 25 percent via groundwater exfiltration, and approximately 40 percent by evaporation from the lake's surface.

Nutrient loadings to the lake originate primarily from watershed runoff, groundwater, septic systems, atmospheric deposition, and internal regeneration. An estimated 565 pounds of phosphorus currently enter the lake each year. Watershed runoff and septic systems each contribute approximately 36 percent of the phosphorus load, while atmospheric deposition accounts for about 21 percent, internal regeneration about 6 percent, and groundwater about 1 percent.

Intensive in-lake water quality monitoring was conducted at two lake sites from May 1989 through August 1990. Secchi disc transparency (a measure of water clarity) at the mid-lake site (Site 2) ranged from a minimum of 15 inches to a maximum of 84 inches, averaging 53 inches. At the southwest area of the lake (Site 3), transparency ranged from 10 to 60 inches and averaged 37 inches, though many measurements were limited by the site's shallow water depths. When data from both sites are combined, total suspended solids averaged 7 mg/l (milligrams per liter) and volatile suspended solids averaged 6 mg/l. *Note:* During the period 1991 through 1993, water clarity declined such that mid-summer transparencies were often less than 12 inches.

During the 1989-90 sampling period, total phosphorus in the water varied from a minimum of 0.015 mg/l to a maximum of 0.069 mg/l, with an average of 0.026 mg/l. All concentrations were below Illinois' standard of 0.050 mg/l, except a 0.069 mg/l concentration detected in May 1989. However, total phosphorus concentrations were often adequate to stimulate nuisance phytoplankton (algae) growth (i.e, concentrations approached or exceeded the 0.030 mg/l threshold level reported in the scientific literature). Nitrate+nitrite nitrogen concentrations were low and averaged less than the detection limit of 0.1 mg/l. Ammonia+ammonium nitrogen concentrations were all well below state standards and averaged 0.13 mg/l; total Kjeldahl nitrogen averaged 1.3 mg/l. Total nitrogen to total phosphorus ratios indicated that on every sampling date, phosphorus was the nutrient limiting algal growth. Chlorophyll *a* (corrected), an indicator of algal concentrations in the lake water, averaged 10.19 Φg/l (micrograms per liter). Trophic state indices for transparency, total phosphorus, and chlorophyll *a* averaged 57, 51, and 51 respectively, and indicate that McCullom Lake is eutrophic, or "productive."

Phytoplankton (algae) taxa were typical of a eutrophic lake. A majority of the species were nuisance blue-green species (Cyanophyta), followed in abundance by green algae (Chlorophyta). McCullom Lake's aquatic macrophyte community (plants visible to the unaided eye) was diverse: 25 species were found including the state-endangered variable pondweed, *Potamogeton gramineus*. Other predominant species were *Chara*, white water lily, spatterdock, spiny naiad, narrow-leaved pondweeds, and Eurasian watermilfoil (*Myriophyllum spicatum*). Total macrophyte abundance declined dramatically from approximately 50 percent coverage of the lake bottom in 1990 to about 12 percent in 1991 (and even less in 1992 and 1993).

Fecal coliform concentrations occasionally exceeded public health standards at the lake's swimming beaches. Dissolved oxygen levels did not fall to concentrations which could endanger fish survival; however, the winters of 1989 and 1990 were relatively mild with less than normal snowpack duration. Thermal stratification did not occur. Water samples analyzed for heavy metals were within the state's water quality standards and many registered below detection limits. All persistent organics (pesticides) concentrations were below detection limits. Sediment samples analyzed for pesticides were also below detection limits; sediment samples analyzed for heavy metals were all in the "normal" or "below normal" categories developed by Illinois EPA.

McCullom Lake has a history of winter fishkills and unbalanced fisheries. The 1990 survey indicated that the fishery had been generally improving during the last several years. However, the 1991 survey revealed that the carp population had increased significantly, and coincided well with the greatly reduced water clarity observed during 1991 (average of 15 inches). Sport fish species present included northern pike, largemouth bass, bluegill, black crappie, yellow bass, and channel catfish. *Note:* Data collected in 1992 document a continuation of the fishery's dramatic degradation. By 1993, the fishery was completely dominated by carp.

PHASE I FEASIBILITY STUDY RESULTS and DEVELOPMENT OF THE PHASE II IMPLEMENTATION PROGRAM

A number of lake quality problems were identified during the Phase I Diagnostic Study: turbid water, shallow water depths, sedimentation, colonization by exotic aquatic vegetation, excessive aquatic vegetation growth, fishkills, a degraded fish community, and reduced lake aesthetics. To help resolve these problems and guide the development of a management plan for McCullom Lake, a series of use objectives were identified. These objectives were derived in consultation with City staff, lakeshore homeowners, and lake users:

#1 Improve water clarity for aesthetics, swimming, and other water-contact activities.

#2 Eradicate invasive exotic plant and animal species, notably *Myriophyllum spicatum* (Eurasian watermilfoil) and *Cyprinus carpio* (common carp).

#3 Promote species diversity and overall abundance of macrophytes consistent with a balanced ecosystem.

#4 Enhance the lake's plant and animal wildlife habitat opportunities.

#5 Promote public health by reducing bacterial contamination of lake water.

#6 Reduce the risk of fish winterkill.

#7 Enhance future lake management opportunities through public entity acquisition of additional lake bottom, shoreline, and near-shore/critical watershed areas.

#8 Enhance the quality of boating and fishing opportunities.

For each of these lake use objectives, a series of lake restoration/protection alternatives was developed. After evaluating the scientific, social, and financial feasibility of each alternative, a Phase II Lake Restoration and Protection Program emerged. Briefly, the Phase II program includes the following components:

Agricultural land management will be achieved through implementation of best management practices on agricultural lands within the watershed.

Urban construction erosion control will occur through enhancement of ordinances and diligent inspection and enforcement.

Drainage systems for newly-developing areas will be encouraged to adhere to guidelines that afford protection for both surface water and groundwater.

Drainage systems for already-developed areas will be improved to protect surface water and groundwater through the voluntary cooperation of watershed landowners.

A reduction in nutrient contributions from septic systems will be needed to afford the lake with long-term protection from excessive nutrient inflows. Because of the complexity and expense of the septic system control alternatives, it was not possible within the timeframe of the Phase I Study to identify a financially-, socially-, and politically- acceptable solution. However, municipal and county authorities are planning to work together to find an approach which protects the lake yet fairly addresses financial hardship issues.

Homeowner actions to reduce nutrient/sediment runoff will be encouraged through an ambitious public education program spearheaded by the City of McHenry.

A soil testing and low/no-phosphorus fertilizer initiative will utilize community service organizations, local vendors, and the watershed's municipalities to encourage application of minimal amounts of agricultural and residential fertilizers; low- and no-phosphorus formulations will be made available and encouraged.

Streambank stabilization will be undertaken along the tributary streams to encourage streambank soil stability through selective pruning of the overstory vegetation canopy.

Presedimentation basins along tributary inflows will be proposed for inclusion in any future development plans within areas west of the lake.

Manual removal of floating algae mats by lakeside homeowners and municipal staff will be encouraged, in deference to chemical treatment methods.

The promotion of balanced growth of lakebed-shielding plant species will be achieved through implementation of other lake management activities, including watershed nutrient and sediment controls, and removal of exotic plant and animal species.

Motorized watercraft restrictions which limit watercraft engines to 7 -horsepower (currently in place) will be continued.

Shoreline erosion control will be encouraged along private residential areas; non-structural and vegetative approaches will be used whenever possible.

Eurasian watermilfoil control will be accomplished through implementation of a long-term management plan; initially, existing dense stands will be eradicated followed by an on-going maintenance program utilizing manual removal methods and planting of native species. In addition, public education efforts to reduce the risk of reinfestation will be instituted, and the City of McHenry will consider use access policies that minimize the introduction of watercraft from other milfoil-infested lakes.

Control of the common carp will be accomplished through a fish eradication program followed by a balanced restocking program; this effort will be coordinated by the Illinois Department of Natural Resources.

Management of future overabundance of macrophytes will be on an as-needed basis, and will preserve and protect the lake's unique ecological characteristics.

Enhancement of the lake's plant and animal wildlife habitat opportunities will be accomplished through the establishment of a 5- to 6-acre wildlife conservation area in the western portion of the lake; replanting with native submergent and emergent aquatic vegetation, nesting structures for selected avian species, and motorized watercraft exclusion will be incorporated.

Control of contamination from agricultural operations will be implemented to eliminate the potential for manure contamination from the adjacent horse farm property.
Control of pet waste contributions of nutrients to the lake will be achieved through public education efforts.

Discouragement of excessive resident waterfowl populations will be accomplished through a public education program to discourage public feeding and other activities which disrupt the waterfowls' natural movement and migration patterns.

Wintertime aeration, on an as-needed basis during the winter months only, will be installed to maintain dissolved oxygen levels needed for aquatic life; a compressed air system in the lake's deepest area connected to a compressor on shore will open up a relatively small area of ice so that atmospheric reaeration can restore the lake's oxygen levels. It is likely that operation of the system would only be needed during the last few weeks before ice out, and that there would be many years when operation of the system would not be needed at all.

Snow removal from the ice surface to promote photosynthetic reaeration under the ice by rooted plants and algae will be encouraged.

Acquisition of additional lake bottom, shoreline, and near-shore/critical watershed areas by a public entity will be accomplished through the City of McHenry's acquisition of a 44.7-acre parcel of land immediately north of Peterson Park. Approximately 24 acres of lake bottom, 2000 feet of shoreline, as well as the lake's outlet structure and outflow channel are included in the parcel.

Enhancement of the quality of boating and fishing opportunities will be considered by the City of McHenry; possible actions include limited near-shore dredging at public access sites, establishment of boat rental and/or boat storage facilities, additional fish stocking, and additional fishing facilities and fish habitat enhancement.

BENEFITS EXPECTED FROM THE PHASE II LAKE RESTORATION AND PROTECTION PROGRAM

The Phase II Lake Restoration and Protection Program will impart a wide range of water quality, aquatic habitat, and recreational use benefits for McCullom Lake. These are described in the paragraphs that follow.

Following carp eradication, the resultant decrease in resuspended sediment turbidity should allow springtime germination and survival of lakebed-shielding plants including *Najas* and *Chara*. In turn, increased competition for water column nutrients between *Chara* and phytoplankton will lead to decreased phytoplankton abundance throughout the growing season. The presence of such lakebed-shielding plants will also help protect the bottom sediments against resuspension from wind and wave action. Lake aesthetics will be improved and swimming use will increase as a result of decreased algal and sediment turbidity.

This improvement in lake water clarity coupled with the control of Eurasian watermilfoil (*Myriophyllum spicatum*) will help preserve the diversity of McCullom Lake's aquatic plant community and enhance the continued presence of the state-endangered variable pondweed, *Potamogeton gramineus*. Lake aesthetics, recreational boating, and fishing enjoyment will be improved.

Sport fish habitat, survival, and abundance will improve upon completion of the lake restoration activities. Elimination of carp and consequent improvement in water clarity will allow sight-feeding gamefish to better catch their prey and keep panfish populations in check. Control of Eurasian watermilfoil and replacement with aquatic plants possessing a more open structure will also improve gamefish feeding success and thereby help guard against panfish overpopulation and stunting. Wintertime aeration will significantly minimize the potential for fish winterkill. Non-game fish, aquatic insects, and aquatic microorganisms also will benefit from the lake's enhanced ecological quality.

Waterfowl, shorebirds, and other wildlife will benefit from establishment of the wildlife conservation area within the lake. The suggested vegetation plantings have been specifically chosen for wildlife forage and habitat. By maintaining a diversity of aquatic forage and habitat types throughout the lake ecosystem, continued attraction of species such as the state-endangered pied-billed grebe and osprey as well as migrating waterfowl such as mergansers and buffleheads will be safeguarded.

Public education and awareness activities throughout the restoration and protection project will help foster lake and watershed stewardship. Activities undertaken by lake users and watershed residents will reduce nutrient and sediment influxes and protect the lake ecosystem, thus helping to protect long-term water quality and recreational uses. It is expected that swimming, boating, fishing, windsurfing, and picnicking will increase as the quality of the lake environment improves. The extension of a regional multi-use trail through McHenry County and Peterson Park will attract additional visitors to McCullom Lake. However, overuse to the point of environmental degradation or recreational use impairment is not expected to occur. The City of McHenry plans to safeguard its current access areas as well as McCullom Lake itself from overuse through acquisition and careful development of public access areas, limiting the amount of automobile parking available, and by updating lake use policies as appropriate in the future.

PHASE II PROJECT UPDATE -- April 1996

Fisheries The carp eradication program in September 1993 has successfully removed this nuisance exotic species from the lake's fish community. Fish restocking has been carried out with the assistance of the Illinois Department of Conservation (now the Illinois Department of Natural Resources). Tens of thousands of fingerling bluegill, largemouth bass, northern pike, and channel catfish were restocked in the lake during fall 1993 and spring 1994. Fish survival, growth, and reproduction have all been excellent. In summer 1995, largemouth bass were about 8 inches, and northern pike were averaging about 15 inches. Excellent bluegill fishing through the ice occurred in December 1995 and early January, 1996, with many fish in the 6-8 inch size class. Anglers are encouraged to respect the size and catch limitations established for McCullom Lake, and to practice catch-and-release fishing on a continuing basis.

Water Quality Water clarity has increased significantly within the lake. Immediately prior to the carp eradication in September 1993, water clarity averaged less than 12 inches. Now, water clarity consistently extends to the lake bottom (up to 9 feet). Other measures of lake water quality, including algae growth, suspended solids, and bacteria levels, remain good to excellent.

Aquatic Plants By 1993, Eurasian watermilfoil had spread to about 10 percent of the lake, and by summer 1994 it had spread to nearly 70 percent. As the 1994 growing season progressed, native aquatic plants began to rebound, while at the same time, Eurasian watermilfoil growth appeared to slow somewhat. Nevertheless, plans were made for a "one time" herbicide treatment program in spring 1995 to curtail the milfoil's infestation to an amount that could be managed by "manual" removal methods in the future (i.e., hand-pulling of newly-emerging stands). However, when the ice went out on McCullom Lake on March 15, 1995, only a few strands of milfoil could be found anywhere in the lake. The definitive cause(s) for the McCullom Lake decline was not known at first, though an early suspect was an aquatic weevil insect native to North America, *Euhrychiopsis lecontei*. Milfoil declines in other parts of the country have been correlated with this weevil, but the only confirmed weevil-induced milfoil declines in the Midwest were at two lakes in Wisconsin.

The factors contributing to McCullom Lake's milfoil decline became more clear when on June 3, 1995, Northeastern Illinois Planning Commission staff and a local lake resident discovered several small strands of milfoil with more than 15 hungry *Euhrychiopsis lecontei* "Eurasian watermilfoil weevils" attached. This is believed to be the first sighting in Illinois of the weevil in the presence of a significant Eurasian watermilfoil decline. It is especially important because there has been only a handful of similar declines in areas outside of Illinois (Vermont, Connecticut, Wisconsin, Washington State, Ontario, and British Columbia).

Because the weevil feeds exclusively on milfoil species, it has the potential to be an effective "biological control" (in research experiments, the weevils have not damaged any other non-milfoil plant species). This is important, because the goal of most lake management programs is to maintain a balanced community of native plants. It is hoped that a research effort can be initiated to more fully understand the role this remarkable insect might have in managing Eurasian milfoil growth in McCullom Lake as well other lakes across Illinois and the country.

Desirable native aquatic plant species are rapidly re-colonizing many areas of the lake. The low-growing *Chara* algae is especially prevalent. As of mid-September 1995, five small colonies of EWM growing in relatively low densities were known to exist within McCullom Lake. The current plan is a "wait and see" approach regarding EWM management. The lake will continue to be monitored during 1996 to track EWM growth as well as the presence of *E. lecontei*.

Aeration Installation of a wintertime aeration system in McCullom Lake was completed in July 1995. Two electrical air blower units installed on City property were attached to approximately 1,500 feet of 1 -inch diameter polyethylene airline (weighted with 5/8-inch reinforcing bar) extending out to the deepest portion of the lake. The last 400 feet of each airline have 1/8-inch drilled holes spaced 15 feet apart. The two airlines run in a "V" pattern extending from shore. When the blower motors are operating, the turbulence caused by the rising air bubbles from the airline initially breaks open, and then keeps open, an ice-free area on the lake surface. Re-introduction of oxygen from the atmosphere now can occur, and the lake's oxygen levels are stabilized. The McCullom Lake aeration system has been designed to provide approximately 10 acres of ice-free area on the lake. Wooden posts, roping, signage, and other special markings alert lake users to the open water area. Ice strength is not compromised beyond the immediate area of the open water.

Aeration system installations of this type in Wisconsin have provided good to excellent protection from low dissolved oxygen conditions and consequent winterkill. The McCullom Lake system will be run only on an as-needed basis to save energy costs, reduce adverse effects on waterfowl migration patterns, and potentially lessen the possibility of "swimmer's itch" outbreaks during the following spring and summer. Careful monitoring of McCullom Lake's dissolved oxygen levels throughout the winter will be conducted to determine when, or even if, aeration in a particular year is necessary. In most years, aeration is not expected to be needed. But, during a severe winter, the aeration system should protect the lake and the years of investment that have been made in its recreational fishery.

McCullom Lake's aeration system was put to the test during the winter of 1995/1996. The cold autumn resulted in an early ice cover for the lake, though the ice did form quite clear. A dense algae bloom in early January (growing in the water under the ice) "crashed" by late January. This decaying algae biomass is believed to have caused a rapid decline in the lake's dissolved oxygen concentrations to levels that affect the survival of fish and some other aquatic organisms. Consequently, the aeration system was activated in late January. Within 24 hours, an area of the lake had been "blown open" (despite the week of record cold and an ice cover of 11-12 inches). Over the next week, dissolved oxygen levels gradually increased as the open water area expanded. It is believe that the aeration system prevented, at minimum, what would have otherwise become a moderate fish kill in McCullom Lake during the 1995/1996 winter.

Other Project Activities Project staff continue to work with the City of McHenry and the local community in efforts to reduce pollutant delivery to McCullom Lake and to protect the lake's ecology. During 1996, the project will bring informational materials for watershed and lakefront homeowners, technical assistance for shoreline stabilization projects, and an opportunity for the community to reduce lawn care impacts to the lake through a soil testing and low/no-phosphorus lawn fertilizer program.

Phase II Project Components with 2010[2] and 2015 Update Notes

Agricultural land management will be achieved through implementation of best management practices on agricultural lands within the watershed.

2010 Update: Not completed; little landowner interest.

Urban construction erosion control will occur through enhancement of ordinances and diligent inspection and enforcement.

2010 Update: City of McHenry reviewed ordinances and updated inspection and enforcement procedures.

Drainage systems for newly-developing areas will be encouraged to adhere to guidelines that afford protection for both surface water and groundwater.

2010 Update: Not undertaken by City of McHenry.

Drainage systems for already-developed areas will be improved to protect surface water and groundwater through the voluntary cooperation of watershed landowners.

2010 Update: Partially accomplished via the restoration program's public education activities and media coverage.

[2] 2010 update notes provided by Robert Kirschner, Chicago Botanic Garden, personal communication to Illinois EPA, May 2010.

A reduction in nutrient contributions from septic systems will be needed to afford the lake with long-term protection from excessive nutrient inflows.

2010 Update: Two of three subdivisions on septic were converted to sanitary sewer service (Lakewood Road and Village of McCullom Lake).

Homeowner actions to reduce nutrient/sediment runoff will be encouraged through an ambitious public education program spearheaded by the City of McHenry.

2010 Update: Accomplished via the restoration program's public education activities and media coverage.

A soil testing and low/no-phosphorus fertilizer initiative will utilize community service organizations, local vendors, and the watershed's municipalities to encourage application of minimal amounts of agricultural and residential fertilizers; low- and no-phosphorus formulations will be made available and encouraged.

2010 Update: Local hardware stores were not willing to stock the no-phosphorus fertilizer.

Streambank stabilization will be undertaken along the tributary streams to encourage streambank soil stability through selective pruning of the overstory vegetation canopy.

2010 Update: Not undertaken.

Presedimentation basins along tributary inflows will be proposed for inclusion in any future development plans within areas west of the lake.

2010 Update: Not undertaken by City of McHenry.

Manual removal of floating algae mats by lakeside homeowners and municipal staff will be encouraged, in deference to chemical treatment methods.

2010 Update: Successfully implemented.

The promotion of balanced growth of lakebed-shielding plant species will be achieved through implementation of other lake management activities, including watershed nutrient and sediment controls, and removal of exotic plant and animal species.

2010 Update: Successful Eurasian watermilfoil control via weevils in 1995 (see 1996 update above).

Motorized watercraft restrictions which limit watercraft engines to 7.5-horsepower (currently in place) will be continued.

2010 Update: Horsepower limitations were kept in place but modified to 10 hp.

Shoreline erosion control will be encouraged along private residential areas; non-structural and vegetative approaches will be used whenever possible.

2010 Update: Technical assistance was offered. A west shore homeowner established emergent vegetation along their shoreline.

Eurasian watermilfoil control will be accomplished through implementation of a long-term management plan; initially, existing dense stands will be eradicated followed by an on-going maintenance program utilizing manual removal methods and planting of native species. In addition, public education efforts to reduce the risk of reinfestation will be instituted, and the City of McHenry will consider use access policies that minimize the introduction of watercraft from other milfoil-infested lakes.

2010 Update: Successful Eurasian watermilfoil control via weevils in 1995 (see 1996 Update above).

Control of the common carp will be accomplished through a fish eradication program followed by a balanced restocking program; this effort will be coordinated by the Illinois Department of Natural Resources.

2010 Update: Completed (see 1996 Update above).

Management of future overabundance of macrophytes will be on an as-needed basis, and will preserve and protect the lake's unique ecological characteristics.

2010 Update: Re-infestation with Eurasian watermilfoil led to a 2004 fluridone treatment, resulting in good control.

2015 update: A second fluridone application was done in 2012, and another is planned in 2016.

Enhancement of the lake's plant and animal wildlife habitat opportunities will be accomplished through the establishment of a 5- to 6-acre wildlife conservation area in the western portion of the lake; replanting with native submergent and emergent aquatic vegetation, nesting structures for selected avian species, and motorized watercraft exclusion will be incorporated.

2010 Update: Not implemented; lack of local support.

Control of contamination from agricultural operations will be implemented to eliminate the potential for manure contamination from the adjacent horse farm property.

2010 Update: Manure management protocols were implemented.

Control of pet waste contributions of nutrients to the lake will be achieved through public education efforts.

2010 Update: Ambitious public education program on septic impacts and pet waste management was conducted.

Discouragement of excessive resident waterfowl populations will be accomplished through a public education program to discourage public feeding and other activities which disrupt the waterfowls' natural movement and migration patterns.

2010 Update: A public education program was conducted.

Wintertime aeration, on an as-needed basis during the winter months only, will be installed to maintain dissolved oxygen levels needed for aquatic life.

2010 Update: Completed (see 1996 Update above).

2015 Update: This system has been operated a few times since 1996 but only when deemed necessary for fish survival.

Snow removal from the ice surface to promote photosynthetic reaeration under the ice by rooted plants and algae will be encouraged.

2010 Update: Deemed not necessary.

Acquisition of additional lake bottom, shoreline, and near-shore/critical watershed areas by a public entity will be accomplished through the City of McHenry's acquisition of a 44.7-acre parcel of land immediately north of Peterson Park. Approximately 24 acres of lake bottom, 2000 feet of shoreline, as well as the lake's outlet structure and outflow channel are included in the parcel.

2010 Update: Completed circa 1994.

Enhancement of the quality of boating and fishing opportunities will be considered by the City of McHenry; possible actions include limited near-shore dredging at public access sites, establishment of boat rental and/or boat storage facilities, additional fish stocking, and additional fishing facilities and fish habitat enhancement.

> 2010 Update: Significant enhancement of fishing and public access facilities was completed at Petersen Park. A handicap-accesible fishing pier, picnic shelter, paved paths, boat rental (row boats, paddleboats, kayaks, and canoes), launch for carry-in boats, and a bath house were added. Under a Cooperative Management Agreement with the City, fisheries management activities are conducted by the Illinois Dept. of Natural Resources. These include annual stocking of largemouth bass, northern pike, and channel catfish, fish surveys every two to four years, and recommendations.

Appendix C – 2015 Stream Reach Assessment Data

Table C-1. Boone-Dutch Creek planning area – 2015 stream assessment data.

Stream Name	*Reach Code*	*Length (ft)*	*Bank Erosion*	*Channelization*	*Riparian Condition*
Boone Creek	BC_01	1831	None	High	Poor
Boone Creek	BC_02	839	High	High	Poor
Boone Creek	BC_03	1547	High	High	Poor
Boone Creek	BC_04	1418	High	High	Poor
Boone Creek	BC_05	1334	High	High	Fair
Boone Creek	BC_06	3601	High	High	Fair
Boone Creek	BC_07	2663	High	None _ Low	Good
Boone Creek	BC_08	2456	High	None _ Low	Good
Boone Creek	BC_09	2365	Moderate	Moderate	Good
Boone Creek	BC_10	1986	Moderate	None _ Low	Good
Boone Creek	BC_11	2790	Moderate	None _ Low	Good
Boone Creek	BC_12	4378	High	None _ Low	Good
Boone Creek	BC_13	2366	Moderate	High	Good
Boone Creek	BC_14	2558	Moderate	High	Good
Boone Creek	BC_15	835	Moderate	High	Fair
Boone Creek	BC_16	1872	Moderate	High	Fair
Boone Creek	BC_17	1300	Moderate	High	Fair
Boone Creek	BC_18	2598	Moderate	None _ Low	Good
Boone Creek	BC_19	2294	Low	High	Good
Boone Creek	BC_20	2872	Moderate	High	Good
Boone Creek	BC_21	2900	Moderate	None _ Low	Good
Boone Creek	BC_22	2834	Moderate	None _ Low	Good
Boone Creek	BC_23	2414	Low	None _ Low	Good
Boone Creek	BC_24	1941	Low	None _ Low	Good
Boone Creek	BC_25	1169	Moderate	Moderate	Good
Boone Creek	BC_26	1330	Low	High	Good
Boone Creek	BC_27	2650	Low	None _ Low	Good
Boone Creek	BC_28	5870	Low	High	Good
Boone Creek Trib	BCT_01	748	n/a	n/a	n/a
Boone Creek North Branch	BNB_01	550	Low	High	Poor
Boone Creek North Branch	BNB_02	1315	Low	High	Fair
Boone Creek North Branch	BNB_03	1405	Low	Moderate	Fair
Boone Creek North Branch	BNB_04	2745	Low	Moderate	Fair
Boone Creek North Branch	BNB_05	1747	Low	Moderate	Poor
Boone Creek North Branch	BNB_06	492	Moderate	High	Poor
Boone Creek North Branch	BNB_07	1461	Low	High	Poor
Boone Creek North Branch	BNB_08	2275	Low	Moderate	Good
Boone Creek North Branch	BNB_09	5817	Low	High	Good
Boone Creek North Br Trib 1	BNB_T1	3888	n/a	n/a	n/a

Stream Name	*Reach Code*	*Length (ft)*	*Bank Erosion*	*Channelization*	*Riparian Condition*
Boone Creek West Branch	BWB_01	656	Low	High	Good
Boone Creek West Branch	BWB_02	715	Low	Moderate	Poor
Boone Creek West Branch	BWB_03	2213	Low	None _ Low	Good
Boone Creek West Branch	BWB_04	3105	n/a	n/a	n/a
Boone Creek West Branch	BWB_05	1535	n/a	n/a	n/a
Boone Creek West Branch	BWB_06	1151	n/a	n/a	n/a
Boone Creek West Branch	BWB_07	1076	n/a	n/a	n/a
Boone Creek West Branch	BWB_08	3126	n/a	n/a	n/a
Boone Creek West Br Trib 1	BWB_T1_01	3111	n/a	n/a	n/a
Boone Creek West Br Trib 1	BWB_T1_02	1797	n/a	n/a	n/a
Boone Creek West Br Trib 2	BWB_T2	934	n/a	n/a	n/a
Boone Creek West Br Trib 3	BWB_T3	4330	n/a	n/a	n/a
Powers Creek	PC_01	2106	Moderate	High	Fair
Powers Creek	PC_02	3810	Low	None _ Low	Good
Powers Creek	PC_03	4685	Low	None _ Low	Fair
Powers Creek	PC_04	1695	Low	Mod	Good
Powers Creek	PC_05	2740	Low	High	Good
Powers Creek	PC_06	1359	Low	None _ Low	Good
Powers Creek	PC_07	1626	Moderate	High	Fair
Powers Creek	PC_08	1413	Moderate	Moderate	Fair
Powers Creek Trib 1	PC_T1	3348	n/a	n/a	n/a
Powers Creek Trib 2	PC_T2_01	3162	n/a	n/a	n/a
Powers Creek Trib 2	PC_T2_02	2494	n/a	n/a	n/a
Powers Creek Trib 3	PC_T3	2674	n/a	n/a	n/a
Powers Creek Trib 4	PC_T4	1700	n/a	n/a	n/a
Powers Creek Trib 5	PC_T5	1910	n/a	n/a	n/a
Wold Lake Trib 1	WL_T1_01	2115	n/a	n/a	n/a
Wold Lake Trib 1	WL_T1_02	1726	n/a	n/a	n/a
Wold Lake Trib 1	WL_T1_03	4314	n/a	n/a	n/a
Wold Lake Trib 2	WL_T2	2021	n/a	n/a	n/a
Dutch Creek	DC_01	2816	Low	High	Good
Dutch Creek	DC_02	4582	Low	None _ Low	Good
Dutch Creek	DC_03	1460	Low	Moderate	Good
Dutch Creek	DC_04	2902	Low	High	Fair
Dutch Creek	DC_05	6496	Moderate	High	Fair
Dutch Creek	DC_06	1491	Low	High	Poor
Dutch Creek	DC_07	766	None	None _ Low	Good
Dutch Creek Trib 1	DC_T1	3754	n/a	n/a	n/a
Dutch Creek East Branch	DEB_01	1325	None	High	Poor
Dutch Creek East Branch	DEB_02	796	Low	High	Fair

Stream Name	*Reach Code*	*Length (ft)*	*Bank Erosion*	*Channelization*	*Riparian Condition*
Dutch Creek East Branch	DEB_03	873	Low	High	Poor
Dutch Creek East Branch	DEB_04	1495	None	High	Poor
Dutch Creek East Branch	DEB_05	367	None	High	Fair
Dutch Creek East Branch	DEB_06	2165	Low	Moderate	Good
Dutch Creek North Branch	DNB_01	3142	Low	Moderate	Good
Dutch Creek North Branch	DNB_02	6156	Low	None _ Low	Good
Dutch Creek North Branch	DNB_03	4837	Low	None _ Low	Good
Dutch Creek North Branch	DNB_04	3163	Low	None _ Low	Good
Dutch Creek North Branch	DNB_05	655	Low	High	Poor
Dutch Creek North Br Trib 1	DNB_T1	5014	n/a	n/a	n/a
Dutch Creek North Br Trib 2	DNB_T2_01	1375	n/a	n/a	n/a
Dutch Creek North Br Trib 2	DNB_T2_02	2347	n/a	n/a	n/a
Dutch Creek North Br Trib 2	DNB_T2_03	724	n/a	n/a	n/a
Dutch Creek North Br Trib 3	DNB_T3	673	n/a	n/a	n/a
Dutch Creek West Branch	DWB_01	4225	Low	Moderate	Fair
Dutch Creek West Branch	DWB_02	2224	Low	None _ Low	Good
Dutch Creek West Branch	DWB_03	2515	Low	Moderate	Good
Dutch Creek West Br Trib 1	DWB_T1_01	1495	n/a	n/a	n/a
Dutch Creek West Br Trib 1	DWB_T1_02	1909	n/a	n/a	n/a
Dutch Creek West Br Trib 1	DWB_T1_03	2777	n/a	n/a	n/a
Dutch Creek West Br Trib 1	DWB_T1_04	811	n/a	n/a	n/a
Dutch Creek West Br Trib 2	DWB_T2_01	3559	n/a	n/a	n/a
Dutch Crk McCullom Lake Br	DMB_01	2213	Low	High	Fair
McCullom Lake Trib 1	ML_T1_01	2385	n/a	n/a	n/a
McCullom Lake Trib 1	ML_T1_02	545	n/a	n/a	n/a
McCullom Lake Trib 2	ML_T2	1748	n/a	n/a	n/a
Sunnyside Creek	SSC_01	858	None	High	Poor
Sunnyside Creek	SSC_02	632	Low	Moderate	Fair
Sunnyside Creek	SSC_03	1182	Low	None_Low	Good
Sunnyside Creek	SSC_04	133	Low	High	Fair
Sunnyside Creek	SSC_05	774	Low	None_Low	Good
Sunnyside Creek	SSC_06	512	Low	Moderate	Good
Sunnyside Creek	SSC_07	2287	Low	Moderate	Fair
Sunnyside Creek	SSC_08	300	Low	High	Poor
Sunnyside Creek	SSC_09	127	None	High	Poor
Sunnyside Creek Trib 1	SSC_T1	839	n/a	n/a	n/a
Central Direct Drain	CDD_01	2596	n/a	n/a	n/a
Central Direct Drain	CDD_02	1419	n/a	n/a	n/a
Edgebrook Creek	EBC_01	692	None	High	Poor
Edgebrook Creek	EBC_02	486	Low	High	Poor

Stream Name	*Reach Code*	*Length (ft)*	*Bank Erosion*	*Channelization*	*Riparian Condition*
Edgebrook Creek	EBC_03	549	Moderate	High	Poor
Edgebrook Creek	EBC_04	304	High	High	Poor
Edgebrook Creek	EBC_05	832	None	High	n_a
Edgebrook Creek	EBC_06	870	Moderate	High	Fair
Edgebrook Creek	EBC_07	893	Moderate	High	Poor
Edgebrook Creek	EBC_08	664	Moderate	High	Poor
Edgebrook Creek	EBC_09	1056	Low	Moderate	Fair
Edgebrook Creek	EBC_10	1014	High	High	Fair
Edgebrook Creek	EBC_11	1665	Moderate	Moderate	Fair
Edgebrook Creek	EBC_12	959	Moderate	Moderate	Fair
Edgebrook Creek	EBC_13	1044	Low	Moderate	Fair
Edgebrook Creek	EBC_14	1023	Moderate	High	Fair
Edgebrook Creek	EBC_15	1024	None	High	Good
Edgebrook Creek	EBC_16	2398	Low	High	Fair
Edgebrook Creek	EBC_17	1249	Low	High	Good
SE Direct Drain	SED_01	544	n/a	n/a	n/a
SE Direct Drain	SED_02	726	n/a	n/a	n/a
SE Direct Drain	SED_03	2784	n/a	n/a	n/a
SE Direct Drain Trib 1	SED_T1	634	n/a	n/a	n/a

Appendix D – Detention Basin Assessment Data and Retrofit Opportunities

Table D-1. Boone-Dutch Creek Watershed planning area detention basin inventory and assessment information including retrofit and nearby BMP opportunities, and observed maintenance needs.

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB1-01	Woodstock	Dry - naturalized				-88.395961	42.304359
DB1-02	Woodstock	Dry - naturalized				-88.397475	42.301592
DB1-03	Woodstock	Dry - naturalized				-88.396322	42.300059
DB1-04	Woodstock	Dry - naturalized			Mng inv veg	-88.394327	42.297825
DB1-05	Woodstock	Dry - naturalized				-88.395469	42.294831
DB1-06	Woodstock	Dry - naturalized			Address gully erosion below E inlet FES	-88.393094	42.293459
DB1-07	Woodstock	Dry - naturalized				-88.392623	42.291986
DB1-08	Woodstock	Dry - naturalized			Address gully erosion	-88.391117	42.292886
DB1-09	Woodstock	Dry - naturalized	Correct short circuiting	Address gully erosion below outfall on N side of Country Club Rd		-88.387506	42.304388
DB1-10	Woodstock	Dry - naturalized	Naturalize basin bottom & side slopes, incl possibly wet mesic prairie nr W inlet		Address erosion around S inlet FES	-88.397385	42.294238
DB1-11	Woodstock	Wet - Extended Dry	Naturalize turf area of basin bottom or expand buffer to wet section at minimum		Mng inv veg, diversify native veg	-88.403621	42.297949
DB1-12	Bull Valley	Dry - naturalized			Mng inv veg, address gully erosion off Florence Ct	-88.381423	42.347712
DB1-13	Dorr Twp	Dry - turf	Correct short circuiting, naturalize basin bottom	Naturalize turf swales along Whispering Pines Tr		-88.369777	42.302509
DB1-14	McHenry	Dry - turf	Naturalize bottom & side slopes, raise outlet elevation	Naturalize roadside swales in neighborhood	Repair erosion below inlet FES & in swale to E	-88.345151	42.341757
DB1-15	Bull Valley	Wet		Maintain roadside veg swales if/when construction restart	Mng inv veg	-88.339347	42.319362

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB2-01	Bull Valley	Dry - turf	Correct short circuiting & expand naturalized area around outlet	Filter strip along driveway, green roof		-88.369592	42.288241
DB2-02	Bull Valley	Dry - turf	Naturalize basin bottom, modify outlet to hold more water	Filter strip along parking lot, naturalize swale to SW	Repair gully off parking lot	-88.369154	42.289607
DB2-03	Bull Valley	Constructed Wetland		Ensure roadside veg swales if/when constr restart	Mng inv veg	-88.358044	42.292074
DB2-04	Nunda Twp	Constructed Wetland		Naturalize contibuting turf swales, education: landscape waste dumping	Mng inv veg, diversify native veg	-88.327948	42.304083
DB2-05	Nunda Twp	Dry - part turf / part nat'lzd	Naturalize turf portion	Naturalize contributing turf swales	Mng inv veg, diversify native veg	-88.325713	42.305515
DB2-06	Nunda Twp	Wet		Naturalize contributing roadside turf swales, filter strip along Fox Run on E	Mng inv veg	-88.33017	42.28746
DB2-07	Bull Valley	Unassessed				-88.330506	42.289192
DB2-08	Bull Valley	Unassessed				-88.33115	42.292718
DB2-09	Bull Valley	Unassessed				-88.331661	42.293368
DB3-01	McHenry	Wet	Construct wetland shelf, estab 5-10 ft native veg buffer, correct short circuiting		Stabilize eroding shorelines	-88.311072	42.336436
DB3-02	McHenry	Wet	Construct wetland shelf, estab 5-10 ft native veg buffer			-88.31371	42.336293
DB3-03	McHenry	Dry - turf	Naturalize turf sections, meander veg channels	Convert turf swale to NE to native veg	Mng inv veg	-88.311143	42.328494
DB3-04	McHenry	Dry - turf	Naturalize turf sections or estab buffer around wetland inflow basins		Mng inv veg	-88.307112	42.331553
DB3-05	McHenry	Dry - turf	Nat'lize turf sections or estab buffer around wetland inflow basin, correct short circuiting		Mng inv veg	-88.30688	42.332115

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB3-06	McHenry	Constructed Wetland			Mng inv veg	-88.312055	42.342161
DB3-07	McHenry	Constructed Wetland			Mng inv veg	-88.314541	42.340096
DB3-08	McHenry	Constructed Wetland			Mng inv veg	-88.311162	42.339614
DB3-09	McHenry	Wet	Construct wetland shelf, extend native veg buffer in certain areas		Stabilize eroding shorelines, mng inv veg	-88.318401	42.335854
DB3-10	McHenry	Wet	Estab wetland shelf veg	Add boardwalk around N end	Mng inv veg	-88.325802	42.332267
DB3-11	McHenry	Wet	Construct wetland shelf		Stabilize eroding shorelines, mng inv veg	-88.329792	42.329454
DB3-12	McHenry	Wet	Construct wetland shelf, estab 5 ft native veg buffer		Stabilize eroding shorelines	-88.276652	42.35984
DB3-13	McHenry	Wet	Estab wetland shelf veg, estab 5 ft native veg buffer		Stabilize eroding shorelines	-88.275841	42.359308
DB3-14	McHenry	Wet	Estab wetland shelf veg, estab 5 ft native veg buffer	Discourage overabundant Canada geese population	Stabilize eroding shorelines	-88.274849	42.358374
DB3-15	McHenry	Wet	Estab wetland shelf veg, estab 5-10 ft native veg buffer		Stabilize eroding shorelines	-88.273103	42.357168
DB3-16	McHenry	Wet	Construct partial wetland shelf, estab 5 ft native veg buffer		Stabilize eroding shorelines	-88.27556	42.356262
DB3-17	McHenry	Wet	Estab wetland shelf veg, estab 5 ft native veg buffer or stop mowing up to edge		Stabilize eroding shorelines	-88.275605	42.357764
DB3-18	McHenry	Wet	Construct partial wetland shelf, estab 5 ft native veg buffer		Stabilize eroding shorelines, mng inv veg	-88.274564	42.355284
DB3-19	McHenry	Wet	Estab wetland shelf veg, estab 5 ft native veg buffer		Stabilize eroding shorelines	-88.273444	42.35621

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB3-20	McHenry	Wet	Construct wetland shelf, estab 5 ft native veg buffer		Stabilize eroding shorelines	-88.276815	42.353824
DB3-21	McHenry	Constructed Wetland			Mng inv veg	-88.27444	42.360076
DB3-22	McHenry	Constructed Wetland			Mng inv veg	-88.273326	42.360801
DB3-23	McHenry	Wet	Extend buffer on N & W		Mng inv veg, stabilize eroding shorelines	-88.269541	42.357778
DB3-24	McHenry	Dry - turf	Naturalize basin bottom	Parking lot retrofits, green &/or blue roof		-88.269822	42.356173
DB3-25	McHenry	Dry - turf	Naturalize basin bottom, correct short circuiting	Parking lot retrofits, green &/or blue roof		-88.269066	42.355543
DB3-26	McHenry	Constructed Wetland	Correct short circuiting, extend native veg buffer up side slopes	Convert turf drainageway from N tennis cts to native veg swale, education: landscape waste dumping	Mng inv veg (in basin & veg swale)	-88.292651	42.336612
DB3-27	Bull Valley	Dry - naturalized	Correct short circuiting		Mng inv veg, diversify native veg	-88.337618	42.327208
DB3-28	Bull Valley	Constructed Wetland			Mng inv veg, diversify native veg	-88.340154	42.324223
DB3-29	Bull Valley	Constructed Wetland			Mng inv veg	-88.339054	42.325613
DB3-30	McHenry	Wet	Estab native buffer above RR	Downspout disconn		-88.307264	42.35587
DB3-31	McHenry	Wet	Estab native buffer above RR	Downspout disconn		-88.307406	42.354972
DB3-32	McHenry	Dry - turf	Naturalize bottom, correct short circuiting (remove CLC), route Parkland School parking lot runoff into basin	Filter strip along Parkland School parking lot to N		-88.304261	42.352342
DB3-33	McHenry	Dry - naturalized	Correct short circuiting		Mng inv veg, diversify native veg	-88.307084	42.350997

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB3-34	McHenry	Dry - turf	Naturalize bottom & side slopes, raise outlet elevation	Filter strip along Deerwood Tr to N, naturalize roadside swales in neighborhood		-88.343725	42.335332
DB3-35	McHenry	Dry - turf	Naturalize bottom & side slopes, raise outlet elevation	Filter strip along Deerwood Tr to N, naturalize roadside swales in neighborhood		-88.341672	42.335342
DB3-36	McHenry	Dry - turf	Naturalize bottom & side slopes, raise outlet elevation, correct short circuiting	Filter strip along Timber Tr to N, naturalize roadside swales in neighborhood	Repair erosion below FES off Ridgeway	-88.336158	42.338067
DB3-37	McHenry	Dry - turf	Nat'lize bottom & side slopes, raise outlet elevation, route roadside swale into basin			-88.338727	42.340386
DB3-38	McHenry	Dry - turf	Naturalize bottom & side slopes, raise outlet elevation	Filter strip along Timber Tr to N, naturalize roadside swales in neighborhood		-88.339811	42.338446
DB3-39	McHenry	Dry - turf	Naturalize bottom & side slopes, raise outlet elevation	Filter strip along Burning Tree Cir to N, naturalize roadside swales in neighborhood		-88.333611	42.340059
DB3-40	McHenry	Dry - turf	Convert CLCs to veg swales or infiltration trenches, correct short cicuting, naturalize basin bottom			-88.271547	42.353934
DB4-01	McCullom Lk	Dry - part turf/part nat'lzd	Naturalize turf section of basin bottom, correct short circuiting		Mng inv veg, diversify native veg	-88.291989	42.365874
DB4-02	McCullom Lk	Dry - naturalized			Mng inv veg, diversify native veg	-88.293144	42.365822
DB4-03	McHenry	Wet	Estab native buffer along N, expand on W	Filter strip along E side Radcliff Ct, naturalize roadside turf swales	Mng inv veg	-88.31166	42.361056

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB4-04	McHenry Twp	Dry - turf	Naturalize basin bottom & side slopes	Filter strip along parking lot to W	Repair gully erosion	-88.307398	42.360866
DB5-01	Ringwood	Wet		Maintain roadside swales as nat veg swales (subdiv under devel)	Mng inv veg in buffer & basin, diversify emergent veg	-88.284134	42.393364
DB5-02	Ringwood	Constructed Wetland		Convert NW turf swale to nat veg swale/bioswale, maintain roadside swales as nat veg swales	Mng inv veg in buffer & basin, diversify emergent veg	-88.28192	42.399605
DB5-03	Ringwood	Dry - turf	Naturalize basin bottom incl incorp native veg swale in flow path			-88.30405	42.393962
DB5-04	Ringwood	Wet		Estab nat veg swale to W, green roofs, pkng lot catch basins manuf device	Mng inv veg, Diversify emergent veg, address gully erosion below inlet on N shore	-88.301461	42.385915
DB5-05	McHenry	Constructed Wetland	Extend buffer on E side behind Home Depot & on W side behind homes	Parking lot retrofits, green roofs	Mng inv veg, enhance buffer diversity, add rock at inlets	-88.2718	42.362774
DB5-06	McHenry	Wet	Extend buffer on S side	Parking lot retrofits, green roof	Stabilize eroding shorelines, mng inv veg, enhance buffer diversity, fix broken FES	-88.266274	42.36198
DB5-07	McHenry	Wet		Green roof, curb cuts	Mng inv veg, address bank erosion near W side inlet	-88.263273	42.36057
DB5-08	Johnsburg	Wet			Mng inv veg	-88.274379	42.368572
DB5-09	Johnsburg	Wet			Mng inv veg	-88.274139	42.369813
DB5-10	Johnsburg	Wet			Mng inParking lot retrofits, green roofsv veg	-88.276096	42.370497
DB5-11	Johnsburg	Dry - naturalized	Extend native veg buffer, estab veg swale in SW corner	Parking lot retrofits, green roofs	Mng inv veg, diversify veg	-88.268027	42.370059
DB5-12	McHenry	Wet	Correct short circuiting		Mng inv veg, aerate surrounding turf	-88.266922	42.367883

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB5-13	McHenry	Wet			Mng inv veg, fix gully erosion & undercutting FES at S side inlet	-88.265872	42.367553
DB5-14	McHenry	Dry - turf	Convert to bioinfiltratiion trenches	Parking lot retrofits, green roofs		-88.265748	42.366339
DB5-15	McHenry	Dry - part turf/part nat'lzd	Naturalize remaining turf bottom, estab native veg buffer on side slopes	Parking lot retrofits, green roofs	Mng inv veg	-88.265785	42.364811
DB5-16	McHenry	Wet		Green roofs, blue roofs	Mng inv veg, stabilize eroding shrlines, enhance wetland shelf veg, fix gully eros nr outlet	-88.26283	42.367887
DB5-17	Johnsburg	Dry - naturalized	Extend native veg buffer, estab veg swale at S end + curb cut		Mng inv veg, enhance buffer diversity	-88.265477	42.369142
DB5-18	Johnsburg	Dry - naturalized	Correct short circuiting	Education: landscape waste dumping	Mng inv veg	-88.261778	42.370536
DB5-19	Johnsburg	Dry - turf	Naturalize basin bottom			-88.262932	42.370353
DB5-20	Johnsburg	Constructed Wetland			Mng inv veg	-88.273444	42.373709
DB5-21	Johnsburg	Constructed Wetland			Mng inv veg	-88.276469	42.372671
DB5-22	Johnsburg	Constructed Wetland			Mng inv veg, diversify native veg, gully erosion on undevel lots	-88.280154	42.376266
DB5-23	McHenry	Constructed Wetland			Mng inv veg, diversify native veg	-88.269461	42.365975
DB5-24	McHenry	Constructed Wetland	Extend buffer 5 ft	Downspout disconn & rain garden, parking lot catch basins manuf device	Mng inv veg, diversify native veg	-88.26962	42.367897
DB6-01	McHenry Twp	Dry - turf	Correct short circuiting, naturalize basin bottom	Filter strip along S end Hickory Ln, naturalize road side swales		-88.258077	42.397525
DB6-02	McHenry Twp	Dry - turf	Naturalize basin bottom	Filter strip along Hickory Ln, naturalize road side swales		-88.258994	42.402925

Basin Code	Political Jurisdiction	Basin Type	Retrofit Opportunities	Other BMP Opportunities	Maintenance Needs	Longitude	Latitude
DB6-03	Johnsburg	Constructed Wetland		Maintain roadside and inlet swales in native veg post-development	Mng inv veg, diversify native veg	-88.248606	42.387937
DB6-04	Johnsburg	Wet	Estab native veg along park shoreline (~160 LF), estab native buffer above riprap			-88.253639	42.3909
DB6-05	Johnsburg	Wet	Estab native buffer above riprap,	Retrofit SE swale to veg swale, mng inv & diversify native veg in adjoining ADID wetland to W		-88.255733	42.392042
DB6-06	Johnsburg	Wet	Estab native buffer above riprap		Mng inv & diversify native shoreline veg	-88.253747	42.392956
DB6-07	Johnsburg	Wet			Mng inv veg, repair gully erosion below NE FES	-88.257532	42.38764
DB6-08	Johnsburg	Constructed Wetland		Maintain roadside & other drainage swales as nat veg swales (subdiv under devel)	Mng inv veg, diversify emergent veg	-88.259115	42.39013
DB6-09	Johnsburg	Constructed Wetland		Maintain roadside & other drainage swales as nat veg swales (subdiv under devel)	Mng inv veg, diversify native veg	-88.261629	42.390595
DB6-10	Johnsburg	Constructed Wetland		Maintain roadside & other drainage swales as nat veg swales (subdiv under devel)	Mng inv veg, address erosion by outlet	-88.264119	42.391417
DB6-11	Johnsburg	Constructed Wetland		Maintain roadside & other drainage swales as nat veg swales (subdiv under devel)	Mng inv veg, diversify native veg, stabilize sloughing along S slope	-88.262677	42.388742
DB6-12	Johnsburg	Constructed Wetland		Maintain roadside & other drainage swales as nat veg swales (subdiv under devel)	Mng inv veg, diversify native veg	-88.25942	42.382721
DB6-13	Johnsburg	Constructed Wetland		Maintain roadside & other drainage swales as nat veg swales (subdiv under devel)	Mng inv veg, diversify native veg	-88.261612	42.38309
DB6-14	Johnsburg	Dry - part turf / part nat'lzd	Naturalize turf area	Filter strip along E side Riverside Dr, naturalize turf swales along Prairie Dr	Mng inv veg	-88.259406	42.381989

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB6-15	Johnsburg	Dry - part turf / part nat'lzd	Naturalize turf area		Mng inv veg, diversify native veg, repair erosion below both curb cuts & FESs	-88.257605	42.380193
DB6-16	Ringwood	Constructed Wetland		Estab nat veg swales along subdiv roads (subdiv under devel)	Mng inv veg, address gully erosion in swales off Glacial Trail	-88.286525	42.411347
DB7-01	Johnsburg	Dry - turf	Extend wetland veg at outlet end, naturalize turf bottom or install rain garden & veg swale from NE corner	Filter strip along entrance & ciircle drives, green roof, route roof runoff to basin	Mng inv veg	-88.238694	42.384059
DB7-02	Johnsburg	Dry - turf	Install veg swale off road at NE end to basin center, rain garden by outlet	Filter strip along entrance drive		-88.238161	42.383259
DB7-03	Johnsburg	Wet	Outlet control, estab native buffer on turf side slopes		Mng inv veg, dredging	-88.228962	42.395388
DB7-04	Johnsburg	Wet	Outlet control, estab native buffer		Dredging	-88.231536	42.395492
DB7-05	Johnsburg	Wet	Outlet control, extend buffer 5-10 ft	Education (entire subdiv): lawn care incl fertilizers & pesticides	Mng inv veg, stabilize eroding shorelines, dredging	-88.234407	42.395882
DB7-06	Johnsburg	Wet	Outlet control, correct short circuiting, extend native buffer to min 10 ft		Mng inv veg, stabilize eroding shorelines, dredging	-88.237053	42.396867
DB7-07	Johnsburg	Wet	Outlet control, estab native buffer		Dredging	-88.226779	42.393978
DB7-08	Johnsburg	Wet	Estab native buffer, construct partial wetland shelf	Permeable pavement pkng lot, filter strip around pkng lot, naturalize turf swales		-88.235346	42.401535
DB7-09	Johnsburg	Dry - turf	Correct short circuiting, naturalize basin	Install rain gardens at outfall of 12 roof drains, veg swale for sidewalk runoff, green roof	Sedimentation at inlet	-88.235287	42.403019
DB7-10	Johnsburg	Unassessed				-88.233386	42.404992

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB7-11	Johnsburg	Wet	Extend buffer min 10 ft, construct wetland shelf		Mng inv veg (willows predomiant)	-88.239053	42.405585
DB7-12	Johnsburg	Wet	Construct wetland shelf	Naturalize turf swale entering nr NE end	Mng inv veg (willows predominant)	-88.239205	42.402846
DB7-13	Johnsburg	Dry - turf	Correct short circuitng, naturalize basin bottom	Filter strip along S side Dakota Rdg, naturalize road side swales		-88.240094	42.410618
DB7-14	Johnsburg	Dry - turf	Correct short circuitng, naturalize basin bottom	Filter strip along S side Bison Ln, naturalize road side swales, wetland restoration N of Bison Ln		-88.242905	42.412065
DB7-15	Johnsburg	Dry - naturalized	Extend native buffer on E & N sides		Mng inv veg	-88.23365	42.412195
DB7-16	Johnsburg	Dry - naturalized	Correct short circuitng on W end		Mng inv veg	-88.231651	42.412071
DB7-17	Johnsburg	Unassessed				-88.242958	42.407049
DB8-01	McHenry	Wet	Extend native veg buffer, correct short circuiting. estab veg swale at N end	Education: landscape waste dumping	Mng inv veg, stabilize eroding shorelines, enhance wetland shelf veg, fix gully eros at NW corner	-88.262672	42.364801
DB8-02	Johnsburg	Constructed Wetland			Mng inv veg	-88.26192	42.365039
DB8-03	Johnsburg	Constructed Wetland	Naturalize turf area of basin bottom		Mng inv veg	-88.257905	42.367145
DB8-04	Johnsburg	Dry - turf	Correct short circuitng, naturalize basin bottom			-88.257976	42.364796
DB8-05	McHenry	Dry - naturalized	Correct short circuitng, estab native veg buffer		Mng inv veg, diversify veg, remove siltation	-88.26765	42.354521
DB8-06	McHenry	Dry - turf	Convert CLCs to veg swales or infiltration trenches, correct short cicuting, naturalize basin bottom			-88.263996	42.353333

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB8-07	McHenry	Dry - turf	Convert CLC to veg swale or infiltration trench, correct short circuiting, naturalize basin bottom		Mng inv veg (Phragmites), address erosion around & gullies from NE inlets	-88.260061	42.352909
DB8-08	McHenry	Constructed Wetland	Establish native veg buffer		Mng inv veg, diversify native veg	-88.254853	42.355359
DB9-01	McHenry	Wet	Estab 5-10 ft native buffer, construct wetland shelf, correct short circuiting betwn SE inlet & N shore outlet		Stabilize erodiing shorelines	-88.273109	42.326458
DB9-02	McHenry	Wet	Estab 5-10 ft native buffer, correct short circuiting	Downspout disconn & rain gardens, pkng lot catch basins manuf device	Stabilize erodiing shorelines	-88.270229	42.321888
DB9-03	McHenry	Constructed Wetland	Estab native veg swale in extended dry basin area	Pkng lot permeable pavement or catch basins manuf device		-88.267997	42.322301
DB9-04	McHenry	Wet - Extended Dry	Estab native veg swale in extended dry basin area, estab 5-10 ft native buffer, correct short circuiting	Education: grass clippings dumping	Stabilize eroding shorelines, address gully erosion frm S inlet, mng inv veg, diversify emergent veg	-88.269932	42.321342
DB9-05	McHenry	Constructed Wetland		Estab native veg swale to NE of basin along Miller Rd	Address gully erosion below 2 inlets, mng inv veg, diversify emergent veg	-88.26872	42.321322
DB9-06	McHenry	Wet - Extended Dry	Estab native veg swale in extended dry basin area, extend native buffer 5-10 ft, correct short circuiting			-88.26505	42.321521
DB9-07	McHenry	Constructed Wetland	Estab 20 ft native veg buffer, correct short circuiting			-88.258578	42.322629
DB9-08	McHenry	Wet	Extend native veg buffer 5 ft from wet edge along Miller Rd & N side			-88.257099	42.32283

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB9-09	McHenry	Dry - turf	Naturalize basin bottom incl incorp native veg swales in flow paths	Convert turf swales to N & NW of main bldg to native veg	Mng inv veg (Phragmites)	-88.261311	42.323655
DB9-10	McHenry	Dry - part turf/part nat'lzd	Naturalize turf section of basin bottom, correct short circuiting	Manuf device in pkng lot catch basin		-88.280977	42.307859
DB9-11	McHenry	Wet	Extend native veg buffer 5-10 ft on W side	Estab native veg swale on W side of basin from pkng lot	Mng inv veg	-88.288213	42.306965
DB9-12	McHenry	Wet		Estab native veg swale on E side of basin W of path	Mng inv veg	-88.287395	42.309012
DB9-13	McHenry	Wet	Extend native veg buffer 5-10 ft		Diversify emergent veg	-88.278467	42.311081
DB9-14	McHenry	Dry - naturalized		Convert eroding turf swale to native veg or infilltration trench along SW side of Kia bldg	Mng inv veg, add rock below NE & NW inlet aprons	-88.281163	42.311291
DB9-15	McHenry	Dry - part turf/part nat'lzd	Naturalize turf section of basin bottom, incorp native veg swales/infil trenches frm downspouts & roof drain, correct short circuiting		Mng inv veg, diversify native veg	-88.278727	42.314625
DB9-16	McHenry	Wet	Add wetland veg & native veg buffer on E & S, diversify wetland veg & expand buffer on W & N	Discourage overabundant Canada geese population	Mng inv veg	-88.276541	42.32725
DB9-17	McHenry	Wet	Add wetland veg	Maintain native veg buffer after development occurs	Mng inv veg	-88.27582	42.32907
DB9-18	McHenry	Dry - turf	Naturalize basin bottom	Convert turf ditch to native veg swale or infiltration trench to NE betwn Centegra Dr & pkng lot		-88.276894	42.317609
DB9-19	McHenry	Constructed Wetland			Mng inv veg	-88.281673	42.316393

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB9-20	McHenry	Dry - turf	Convert concrete-lined channels to veg swales or infiltration trenches, estab wetland around outlet, correct short circuiting	Convert outlet ditch to veg swale, downspout disconnections		-88.284161	42.314992
DB9-21	McHenry	Wet	Add wetland shelf, estab native veg buffer, correct short circuiting on N end		Stabilize eroding shorelines	-88.286557	42.317248
DB9-22	McHenry	Dry - turf	Convert concrete-lined channel to veg swale or infiltration trench, correct short circuiting			-88.293407	42.323964
DB9-23	McHenry	Constructed Wetland	Estab 5 ft native veg buffer (at min, stop mowing to damp edge)		Mng inv veg, add rock at inlets	-88.300445	42.323316
DB9-24	McHenry	Constructed Wetland	Estab 5-10 ft native veg buffer (at min, stop mowing to damp edge)		Mng inv veg	-88.300902	42.322754
DB9-25	McHenry	Wet	Estab wetland shelf veg		Mng inv veg	-88.30808	42.314143
DB9-26	McHenry	Wet	Estab wetland shelf veg, extend native veg buffer		Mng inv veg, dtop mowing buffer on NE, N & W	-88.301893	42.314424
DB9-27	McHenry	Constructed Wetland	Extend native veg buffer 5 ft	Several opps for estab native veg swales, filter strips around pkng lot, entrance roads	Mng inv veg, diversify emergent veg	-88.300954	42.316674
DB9-28	McHenry	Wet		Opps for estab upland native veg swales	Mng inv veg, add rock at inlets	-88.299125	42.318014
DB9-29	McHenry	Wet	Estab wetland shelf veg, correct short circuiting		Mng inv veg, stop mowing buffer veg, add rock at inlets	-88.29591	42.315444
DB9-30	McHenry	Constructed Wetland	Extend buffer, naturalize SW inlet swale		Mng inv veg	-88.296361	42.316275

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB9-31	McHenry	Wet	Extend native veg buffer	Naturalize adjacent turf swales along Bull Valley Rd	Mng inv veg	-88.295048	42.316502
DB9-32	McHenry	Wet	Estab wetland shelf veg, extend native veg buffer		Mng inv veg	-88.293632	42.319072
DB9-33	McHenry	Wet				-88.29165	42.320208
DB9-34	McHenry	Dry - naturalized		Filter strip along parking lot, parking lot retrofits, green roof	Mng inv veg, diversify native veg	-88.272668	42.322545
DB9-35	McHenry	Dry - turf	Naturalize bottom & side slopes, correct short circuiting			-88.273557	42.327912
DB9-36	McHenry	Constructed Wetland	Extend native veg buffer 5 ft	Downspout rain gardens & rain barrels	Mng inv veg, diversify native veg; address bare soil/erosion & estab native veg in E swale	-88.294088	42.321132
DB9-37	McHenry	Dry - turf	Naturalize bottom & side slopes		Address bare soil undre willows	-88.290295	42.321175
DB9-38	McHenry	Dry - turf	Naturalize bottom & side slopes			-88.289742	42.322464
DB9-39	McHenry	Dry - turf				-88.294168	42.322554
DB9-40	McHenry	Dry - turf	Naturalize bottom & side slopes		Address gully erosion & bare soil below S & center FESs	-88.288273	42.323864
DB9-41	McHenry	Dry - turf	Naturalize bottom & side slopes, inlet rain garden			-88.28535	42.327892
DB9-42	McHenry	Constructed Wetland			Mng inv veg, diversify native veg	-88.284272	42.317996
DB9-43	McHenry	Wet		Downspout disconn, naturalize turf swale to NW	Mng inv veg, diversify native veg	-88.285254	42.336263
DB9-44	McHenry	Dry - turf	Raise outlet elevation, naturalize bottom & side slopes, correct short circuiting	Parking lot retrofits, manuf device in drop box inlet on NW edge of basin		-88.285445	42.339119

Basin Code	*Political Jurisdiction*	*Basin Type*	*Retrofit Opportunities*	*Other BMP Opportunities*	*Maintenance Needs*	*Longitude*	*Latitude*
DB9-45	McHenry	Dry - turf	Raise outlet elevation, naturalize bottom		Repair erosion below rock at FES off pkng lot curb cut	-88.284511	42.339875
DB9-46	McHenry	Dry - turf	Naturalize bottom & side slopes, correct short circuiting	Filter strip along parking lot to N, green roof	Repair/convert undercut concrete flume off parking lot, address erosion below FESs	-88.304782	42.319283
DB9-47	McHenry	Constructed Wetland			Mng inv veg	-88.285444	42.329638
DB9-48	McHenry	Dry - turf	Naturalize bottom & side slopes (shade tolerant)			-88.273813	42.334642
DB9-49	McHenry	Dry - turf	Naturalize bottom & side slopes	Parking lot retrofit - permeable pavement	Address erosion below rock aprons	-88.273052	42.333359
DB9-50	McHenry	Unassessed				-88.276092	42.332198
DB9-51	McHenry	Dry - turf	Naturalize bottom & side slopes	Filter strip along parking lot to E & driveway to S	Address possible outlet pipe failure	-88.278139	42.311877
DB9-52	McHenry	Unassessed				-88.26472	42.341569
DB9-53	McHenry	Unassessed				-88.287136	42.312861
DB9-54	McHenry	Unassessed				-88.28643	42.311015

Appendix E – Stream Fish Inventory Data, 2014-15

2014-2015 Fish Inventory Data, Boone-Dutch Creek Watershed Planning Area

	Blacknose Dace*	Southern Redbelly Dace*	Orangethroat Darter	Johnny Darter	Rainbow Darter	Iowa Darter*	Banded Darter	Fantail Darter	Green Sunfish	Bluegill	Pumpkinseed Sunfish	Largemouth Bass*	Central Mudminnow*	Brook Stickleback*
Dutch Creek system														
Johnsburg Park @ Sweetwater Ln (A)					1				16				76	37
Pioneer Fen/MCCD (C)	1		36						1					
Larkspur Lane @MCCD C.E.	5	4	7					3	9			1	3	2
North Johnsburg Road (A)			4						6	20	1	5	1	
South Johnsburg Road (A)									2	89	2	3		
Sweetwater Lane		1			100+				1	6			30	4
Burhoe		x			x				x				x	x
Remington Grove	100+												5	5
Peterson Farm									2	4		3		
Johnsburg Jr. High School (Note 2) (B)														
Boone Creek system														
Bradley/Crosby (C)				2						1				1
Byrnes/Goerner (B)														1 (Note 1)
Boloria Nature Preserve (Note 3) (B)														
Gladstone												1		5
Althoff Park			x	x					x	x		x		
Whispering Oaks Park			2	1		1		8	1	3		1		
Dartmoor Drive			1	1		1			2	6		4	2	
Miglin									8			10		
Ericksen				x						x		x	x	
Jewel			x				x	x		x		x		
Powers Creek LCMC			8	3				32				1		
Glen Drive										17		15		
Scully Drive									3		1	11		
Burkes				1									3	
Sunnyside Creek														
Johnsburg Park @ Oak Creek Dev. (A)												1		

	Mottled Sculpin*	Yellow Bullhead	Black Bullhead	White Sucker	Common Carp	Creek Chub	Fathead Minnow	Spotfin Shiner	American Brook Lamprey*	Hornyhead Chub	Bigmouth Shiner	Common Shiner	Bluntnose Minnow	Suckermouth Minnow	White Crappie	Northern Hognose Sucker	Stonecat
Dutch Creek system																	
Johnsburg Park @ Sweetwater Ln (A)						32											
Pioneer Fen/MCCD (C)						40											
Larkspur Lane @MCCD C.E.						74											
North Johnsburg Road (A)			1	12		3											
South Johnsburg Road (A)						3	2	1									
Sweetwater Lane			2			40+	2										
Burhoe						x	x										
Remington Grove			1	4													
Peterson Farm					1	1	30					3					
Johnsburg Jr. High School (Note 2) (B)																	
Boone Creek system																	
Bradley/Crosby (C)	59	1	2	73	2	30			1								
Byrnes/Goerner (B)	16 (Note 1)					1 (Note 1)											
Boloria Nature Preserve (Note 3) (B)																	
Gladstone																	
Althoff Park				x		x	x				x		x				
Whispering Oaks Park				x		x					x			x		1	3
Dartmoor Drive			1	4	1	2					2		2		1		
Miglin		7		1			1										
Ericksen	x	x		x		x											
Jewel		x		x		x											1
Powers Creek LCMC	8			18		46											
Glen Drive						24				1			8				
Scully Drive		8		12			19						21				
Burkes	21			3		5											
Sunnyside Creek																	
Johnsburg Park @ Oak Creek Dev. (A)						99	7										

* Species of Greatest Conservation Need as listed in the Illinois Wildlife Action Plan (IWAP species)

"x" indicates species was present but no counts were done

Survey leaders:

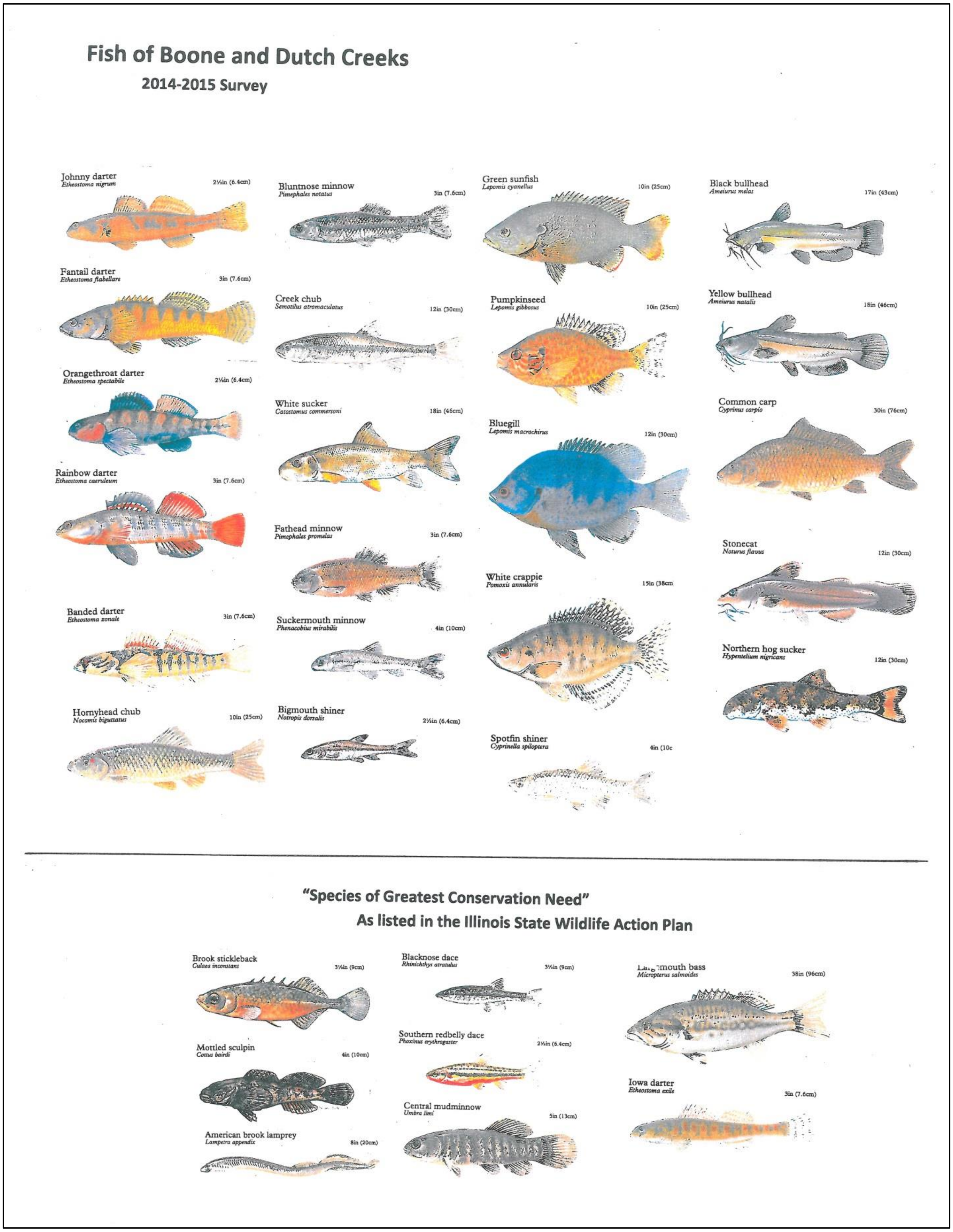
A) Phil Willink & Randy Schietzelt
B) Roger Klocek & Randy Schietzelt
C) Cindi Jablonski MCCD
Other sites same leaders + Jim Bland

Note 1: Total is undercounted -Shocking ineffective, last of 10+ mats yielded 10 sculpins, 1 stickleback, 1 crk chub w/only net

Note 2: Headwater creek separated from Fox R. by concrete channel

Note 3: Intermittent headwater creek from ephemeral wetland. Stagnicola elodes (marsh snail) and Lemna triscula (forked duckweed) observed

Data tabulated by Ders Anderson, Openlands, provided via email correspondence to the author(s), January 14, 2016.



-- compilation of fish species sketches courtesy of Ders Anderson, Openlands

Appendix F – McCullom Lake Fisheries Data and Recommendations

FM 43 – Lake Management Status Report

Date of Report: 3/14/12	Fisheries Manager: Andrew Plauck	District: 6
Lake Name: McCullom Lake	County: McHenry	Water Number: 0068
Ownership (State, PUBC, PUBO): PUBC		Acreage: 60.1

LM STATUS REPORTS WILL INCLUDE THE FOLLOWING SECTIONS:

1. Listing of the Sport Fish Regulations in Effect
2. Listing of Fisheries Management Activities Completed with Evaluation of Success
3. Lake Management Plan Progress Table
4. Recommendations for Observed Problem Trends

1. Listing of the Sport Fish Regulations in Effect.

Two pole and line fishing only.
Largemouth Bass – 15-inch minimum length limit; 1 fish daily creel limit.
Channel Catfish - 6 fish daily creel limit.
Bluegill or Pumpkinseed - 25 fish daily creel limit.

2a. Listing of Fisheries Management Activities Completed.

3/21-23/07 – Completed a northern pike spawning survey.
5/18/07– completed a shoreline estimate of black crappie spawning die-off.
7/19/07 – Stocked 956 northern pike fingerlings (average length = 8.6 in.).
8/8/07 – Stocked 4,874 largemouth bass fingerlings (average length = 4.0 in.).
8/21/07 – Stocked 1,576 channel catfish fingerlings (average length = 8.0 in.).
10/22/07 – Electrofishing survey to capture and remove common carp.
4/2/08 – Completed a northern pike spawning survey.
7/1/08 – Stocked 20,000 largemouth bass fingerlings (average length = 1.5 in.).
7/10/08 – Stocked 735 northern pike fingerlings (average length = 8.5 in.).
8/22/08 – Stocked 5,000 largemouth bass fingerlings (average length = 4.3 in.).
9/4/08 – Stocked 3,450 channel catfish fingerlings (average length = 8 in.).
9/23-24/08 – Completed a fall fish population survey.
10/21-22/08 – Electrofishing survey to capture and remove common carp.
07/13/09 – Stocked 764 northern pike fingerlings (average length = 8in.)
08/06/09 – Stocked 2,149 channel catfish fingerlings (average length = 8 in.).
08/28/09 – Stocked 4,800 largemouth bass fingerlings (average length = 4.0 in.).
09/03/09 – Stocked 2,253 largemouth bass fingerlings (average length = 5.0 in.).
06/01/10 – Stocked 12,250 walleye fingerlings (average length = 2 in.).
07/20/10 – Stocked 886 northern pike fingerlings (average length 8.9 in.).
10/14/10 – Stocked 24,000 channel catfish fingerlings (average length = 8 in.).
06/28/11 – Conducted a fish population survey
07/20/11 – Stocked 735 northern pike fingerlings (average length 10.25 in.).
07/21/11 – Stocked 1,948 channel catfish fingerlings (average length = 8 in.).
08/15/11 – Stocked 4,800 largemouth bass fingerlings (average length = 4.2 in.).

2b. Evaluation of Activities Listed in Part 2a.

The fish population survey included sampling with a boat electro-fishing unit (5,000 W DC) for 60 minutes around most of the perimeter of the lake. The survey took place from approximately 10:00 – 11:00 AM on June 28, 2011. Water quality measurements were made at a mid lake location at 11:45 AM on a sunny, warm, and calm day. Air temperature was 80°F, water temperature was 81.5°F, pH was 7.4 units, Secchi transparency was 3 ft., and conductivity was 614 µS/cm. All measurements were similar to ranges found in previous surveys of McCullom Lake and within ranges that we consider typical for lakes in northeastern Illinois. Fish data was collected and compared to previous years' data (see Table 1).

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We visually estimated that 50% of the lake's surface area contained submersed or floating vegetation. This represents a moderate increase in vegetation coverage compared to fall 2008 that was largely due to reestablishment of Eurasian milfoil (*Myriophyllum spicatum*). Observations made during fish sampling indicated a plant community consisting of roughly equal amounts of water lily (*Nymphaea tuberosa*) and Eurasian milfoil.

The 2011 fish survey found a similar species composition as previous surveys, with the exception of white suckers being absent. We captured 158 individuals from 10 different species (See Table 2). Yellow bass (N = 44) and yellow perch (N = 43) were the most abundant species, making up 55% of the sample. Bluegill (N = 33) and largemouth bass (N = 22) were the next most abundant species. Six more species were caught with sample sizes less than ten; common carp (N = 7), pumpkinseed (N = 4), northern pike (N = 2), black crappie (N = 1), golden shiner (N = 1) and channel catfish (N = 1).

Largemouth bass abundance was low with only 22 fish captured per hour of electrofishing (Table 1). Catch rates may have been affected by some thick stands or Eurasian milfoil, which can inhibit electrofishing success. Catch rate for largemouth bass has decreased since 2004, but size structure seems to be improving with the proportional stock density (PSD) increasing from 34 in 2004 to 73 in 2011. The PSD rating system is the proportion of quality size (≥ 12 inches) compared to the number of the stock size bass (≥8 inches). The relative stock density (RSD – 15 and the RSD – 18) have also improved from 24 and 5, respectively in 2004 to 36 and 9 in 2011. The RSD -15 and RSD – 18 are proportion of bass ≥ 15 inches and ≥ 18 inches, respectively, compared to rest of the stock (bass ≥ 8 inches). While abundance of bass may be low, these size indices indicate there are fish for the angler looking to catch something bigger than 15 inches! The largest bass in the sample was 19 inch fish that weighed 3.6 pounds. Average relative weight (Wr, a measure of condition) for the largemouth bass was also good at 90. A Wr of 90 – 105 indicates a fat and healthy fish. Relative weight at McCullom Lake has not been less than 89, most likely due to a strong forage bass of bluegill, young of year yellow perch and yellow bass, and other small bodied fish. A healthy young to adult ratio (YAR = 1.4) is most likely due to the recent stocking of largemouth bass in McCullom Lake. This healthy ratio of small fish should keep the McCullom Lake bass population well stocked for years to come!

Bluegill abundance was lowest in 2011 that it has been in any survey since 2004 (33 fish per hour). Well balanced lakes in the area have a catch rate of about 120 bluegills per hour. The size structure has remained relatively similar over the years with PSD's ranging 20 – 36 in recent years. The PSD of 27 in 2011 means that 27% of the stock (bluegills ≥ 3 inches), are longer than 6 inches. While 3% of the stock was over 7 inches in 2004, bluegill over 7 inches have not been captured in any survey since. The average Wr of the bluegill population has increased slightly since 2004, with Wr of 84 in 2004, 88 in 2006, 92 in 2008 and 94 in 2011. This suggests that fewer bluegills are competing for resources, resulting in heavier fish for their size.

Black crappies do not seem to have "bounced back" from their 2007 die-off. Only one 4.7 inch black crappie was collected. Spring and fall trap-nets are better a better tool for crappie population estimates. We will continue to monitor this species to determine their role in the McCullom Lake fishery.

Only one channel catfish was captured during this survey, it was 15 inches long. Typically, we see more channel catfish in a regularly stocked lake during one hour of electrofishing. The dense milfoil, mentioned earlier, may have contributed to the low catch as well as the timing of our sample. McCullom Lake is on the state's list of regularly stocked channel catfish lakes.

Only two northern pike, 15.5 and 27.7 inches, were captured during this electrofishing survey. We typically target northern pike in the spring with trap-nets. A spring 2012 netting survey is planned for this species.

Yellow bass were the most abundant fish in the sample (N = 44) and ranged in size from 4.3 to 5.6 inches. Unfortunately, none of these fish were of harvestable size (≥ 7 inches). This species has become more abundant in recent years and can compete with other predators at certain size ranges. Since this fish can reach nuisance levels in just a matter of a few years, anglers should be encouraged to harvest all yellow bass caught in McCullom Lake. Unlike the last two samples, we didn't capture high numbers of young-of-year (less than 4 inches) indicating they did not spawn as successfully as they had in previous years.

Yellow perch were also abundant (N = 43) and small, ranging in size from 4.3 to 6.0 inches. These fish, like yellow bass can also stunt and reach nuisance levels and compete with more desirable game fish. A healthy population of predators, such as northern pike, walleye and largemouth bass, should keep this population from reaching nuisance levels.

Common carp numbers are down from previous years (N = 7; CPUE = 7 carp per hour). Cool water electrofishing was initiated in 2007 to reduce the numbers of common carp. To date, nearly 150 carp weighing a combined 719 lbs. have been captured and removed. The previous report (2008) indicated electrofishing catch rates of 21 carp per hour in 2007 and 9.9 carp per hour in 2008. In 2011, common carp ranged in size from 15.5 to 21.6 inches. A lack of small carp in the most recent sample suggests the removal effort to driving this population in the desired direction!

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3. Lake Management Plan Progress Table (Table 1)

SPECIES	CRITERIA	LMP GOAL	2004	2006	2008	2011	RATING*
LMB	Catch Rate	60/hr.	47	35	33	22	Poor
	PSD	40-60%	34%	56%	53%	73%	Good
	RSD-15	15-30%	24%	33%	32%	36%	Good
	RSD-18	1-5%	5%	11%	5%	9%	Good
	Relative Weight	90-105	89	95	90	90	Good
	Young:adult ratio	1 - 3	1.3	1.7	2.2	1.4	Good
BLG	Catch Rate	120/hr.	103	56	92	33	Poor
	PSD	15-30%	20%	36%	25%	27%	Good
	RSD-7	6-10%	3%	0%	0%	0%	Poor
	RSD-8	1-5%	0%	0%	0%	0%	Poor
	Relative Weight	90-105	84	88	92	94	Good
BLC	Total Catch	>20	18	149	11	1	Poor
	PSD	40-60%	44%	2%	2%	NA	NA
	RSD-9	15-30%	6%	1%	1%	NA	NA
	RSD-10	1-10%	0%	0%	0%	NA	NA
	Relative Weight	90-105	87	92	92	151	Good
CCF	Total Catch	>20	3	49	18	1	Poor
	PSD	50-70%	NA	33%	31%	NA	NA
	RSD-20	15-30%	NA	15%	6%	NA	NA
	RSD-24	5-10%	NA	0%	0%	NA	NA
	Relative Weight	90-105	88	91	78	81	Fair
NOP	Spring Catch Rate	>5/net-day	16.2	9.7	2	NA	NA
	PSD	50-70%	78%	69%	NA	NA	NA
	RSD-24	15-30%	17%	31%	NA	NA	NA
	RSD-28	5-10%	2%	7%	NA	NA	NA
	RSD-32	1-4%	1%	0%	NA	NA	NA
	Relative Weight	90-105	94	93	79	NA	NA

* Index ratings are based on spring 2011 data. NA indicates index could not be calculated due to insufficient catch. For abundance, size structure, and young:adult ratio (YAR) estimates “Good” indicates goal was met, “Fair” indicates goal was almost met, and “Poor” indicates goal was not met.

For relative weight estimates “Good” indicates Wr values between 90-105, “Fair” indicates values between 80-89, and “Poor” indicates values < 80.

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4. Recommendations For Observed Problem Trends:

Fish community
Continue stocking about 2,500 channel catfish fingerling (> 8 in. long) annually to maintain the catfish fishery (IDNR).

Continue stocking about 735 northern pike fingerlings (>8 in. long) annually to maintain the pike fishery (IDNR).

Enhance predator abundance by continuing to stock about 5,000 advanced largemouth bass fingerlings (4-6 in. long) annually for five years, after which the success of the introductions will be evaluated. McCullom Lake has now received advanced bass fingerlings since 2006, with the exception of 2010.

Conduct cool water electrofishing for common carp removal. The effort will be considered successful if carp catch per unit of effort continues to decline (less than 9.9 fish per hour).

Vegetation
Monitor aquatic vegetation coverage annually during summer to track changes in abundance that may warrant additional herbicide application. Spot treat Eurasian milfoil during spring or early summer with Navigate (2,4-D) granular herbicide at rates of 100 lbs./surface when milfoil is the predominant plant present.

Introduce desirable submersed plants to compete with invasive exotic species, such as Eurasian milfoil. Suitable plant species for McCullom Lake include eelgrass (*Vallisneria americana*), water stargrass (*Heteranthera dubia*), and Illinois pondweed (*Potamogeton illinoensis*).

Fish attractors
The City of McHenry should consider building and deploying half-log and brush fish attractors in 2-5 ft. of water near public fishing access locations (e.g., Petersen Park). Physical structure is needed to provide cover for fish and structure for invertebrate production now that stands of aquatic vegetation have been successfully reduced with herbicide. Structures should be located near shore and marked adequately to discourage motorboat/structure accidents.

Evaluation
Conduct a spring trap net survey for northern pike annually and a fall population survey every other year (next survey scheduled for spring 2012) to assess the status of the sport fish community and monitor changes in abundance of common carp and yellow bass. Conduct spring electrofishing survey in 2014 to evaluate largemouth bass stockings.

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Table 2. Summary of Catch Data for McCullom Lake in 2011.

		Length (In.)			Weight (Lbs.)		
Species	Count	Average	Minimum	Maximum	Average	Minimum	Maximum
Yellow Bass	44	5.0	4.3	6.6	0.1	0.0	0.1
Yellow Perch	43	5.0	4.3	6.0	0.1	0.0	0.1
Bluegill	33	5.4	4.4	6.9	0.1	0.1	0.2
Laregmouth Bass	22	9.0	3.7	19.0	1.1	0.0	3.6
Common Carp	7	19.9	15.5	21.6	3.2	1.6	4.3
Pumpkinseed	4	4.6	3.6	6.2	0.1	0.1	0.2
Northern Pike	2	23.1	18.4	27.7	1.6	1.1	2.0
Black Crappie	1	4.7	4.7	4.7	0.1	0.1	0.1
Golden Shiner	1	6.3	6.3	6.3	0.2	0.2	0.2
Channel Catfish	1	15.4	15.4	15.4	1.0	1.0	1.0
Grand Total	158						

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McCullom Lake

FISHERIES STATUS SUMMARY

LOCATION – McCullom Lake is located at the northwest edge of McHenry off of McCullom Lake Road. The main entrance is at 4300 Peterson Park Road.

DESCRIPTION – This 244-acre, northeastern Illinois lake is relatively shallow, averaging around four feet with a maximum depth of nine feet (see map on reverse side). Shoreline access is available at several small parks, including the City of McHenry's Peterson Park located on the northeast shoreline. Petersen Park has a handicap-accessible fishing pier that is available spring through fall. There is a launch for carry in boats. A small, undeveloped boat launch on the lake's south shore provides boat access for small trailerable boats with motors of 10 horsepower or less (located off West Shore Drive in McHenry). Private residences surround approximately 80% of the shoreline. An aerator is ran periodically through the winter so watch for open water if ice fishing. The lake is managed under a cooperative management agreement with the Illinois Department of Natural Resources.

MANAGEMENT ACTIVITIES: McCullom Lake is stocked with largemouth bass, northern pike and channel catfish. The IDNR conducts fish surveys every two to four years. A sixty minutes electrofishing survey was conducted on October 10, 2014. A table summarizing the catch is on the reverse side of this summary.

STATUS OF THE SPORT FISHERY – Unfortunately this shallow lake is prone to fish kills and carp infestation.

LARGEMOUTH BASS – Two harsh winters (2010-11 and 2013-14) in the last four years have taken their toll on the bass population in this lake. Largemouth bass were captured at a rate of 11 fish per hour. Bass catch rates have declined since 2004 when the catch rate was 47 fish per hour. A couple of nice bass weighing close to three pounds were captured in the 2014 survey. Adult bass have an abundant food supply as yellow perch and yellow bass have exploded.

BLUEGILL – Bluegill abundance was quite low at 16 fish per hour. This number is usually variable as it has ranged from 33 to 103 fish per hour in the last four surveys. The bluegill average length was 4.6 inches.

CHANNEL CATFISH – No channel catfish were captured during this survey. Channel catfish over 20 inches have been caught in previous surveys. About 1,600 channel catfish are stocked into McCullom Lake annually.

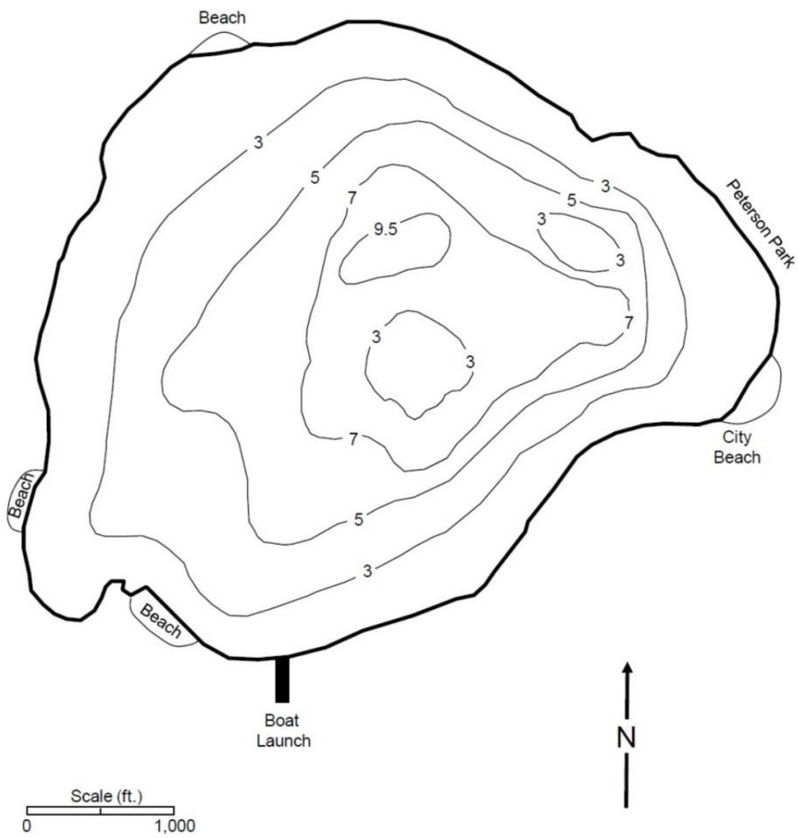
BLACK CRAPPIE – Black crappie were not captured in this sample. Species specific die-offs have occurred twice in the last 8 years (2014 and 2007). This most recent die-off occurred in late September of 2014 when about 50 dead black crappie were documented at three locations around the lake.

ADDITIONAL FISH SPECIES: Yellow bass and yellow perch were extremely abundant during the 2014 survey. They were collected at an estimated 240 and 204 fish per hour. These two species can become so overabundant they develop into a stunted population as well as compete with young of year largemouth bass. Future stockings of largemouth bass and northern pike should help to correct this problem. Other species present in this sample include common carp, golden shiner, bluntnose minnow and emerald shiner. Northern pike, white sucker and pumpkinseed were not found in this sample but have been previously surveyed in McCullom Lake.

McCullom Lake Survey on October 10, 2014 **60 minutes D.C. electrofishing**

Species	Number Collected	Length (Inches) Min	Max	Avg.	Weight (pounds) Min	Max
Yellow bass *	20	3.54	8.39	5.35	0.06	0.29
Yellow perch *	17	3.15	4.92	4.59	0.02	0.06
Bluegill	16	1.69	6.61	4.70	0.04	0.17
Largemouth bass	11	2.87	17.52	10.13	0.26	2.93
Common carp	7	20.87	24.33	23.32	4.09	6.15
Golden shiner	4	3.43	4.06	3.66	0.02	0.02
Bluntnose minnow	1	2.83	2.83	2.83		
Emerald shiner	1	2.83	2.83	2.83		
Total # of fish collected	77					

* indicates five minute subsample



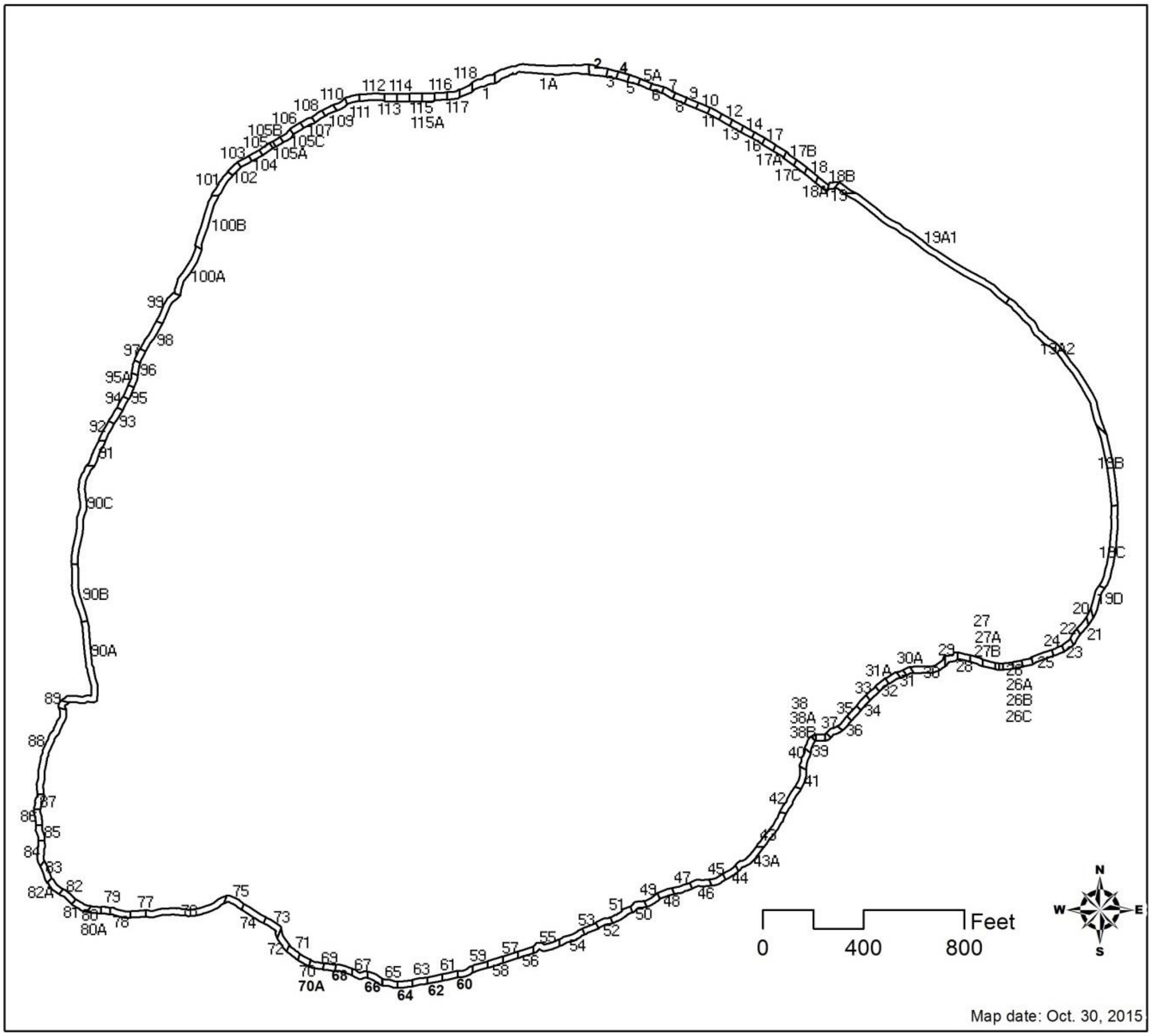
Soundings (ft.) – 1958
Illinois Natural History Survey

Illinois Department of Natural Resources
Division of Fisheries
2006 - V.S.

For more information about McCullom Lake call the Village of McHenry at (815) 363-2100 or IDNR Fisheries at (815) 675-2386 ext. 214

Appendix G – McCullom Lake Shoreline Erosion and Riparian Buffer Assessment Data

McCullom Lake Shoreline Segments



Chicago Metropolitan Agency for Planning

Table G-1. McCullom Lake shoreline erosion and riparian buffer assessment data.

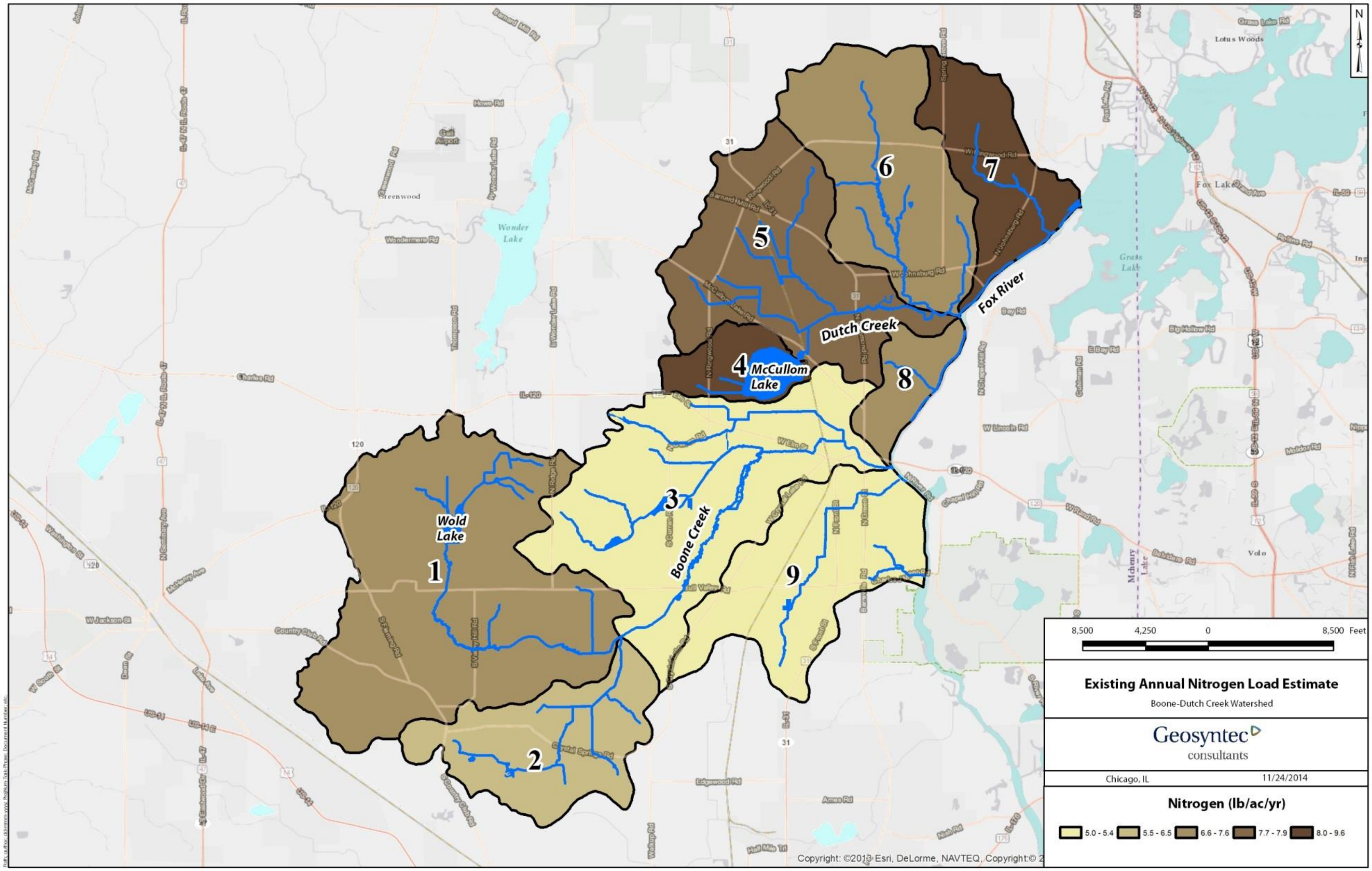
Segment Code	*Land Use*	*Ownership*	*Riparian Buffer Condition*	*Shoreline Erosion Level*	*Shoreline Length (ft)*
1	Open space	Public	Poor	Moderate	97.05
1A	Open space	Public	Poor	Minimal	398.63
2	Residential	Private	Poor	None	68.05
3	Residential	Private	Poor	Slight	40.95
4	Residential	Private	Poor	None	45.62
5	Residential	Private	Poor	Slight	43.44
5A	Residential	Private	Poor	Slight	49.96
6	Residential	Private	Poor	None	50.05
7	Residential	Private	Poor	None	50.67
8	Residential	Private	Poor	None	50.49
9	Residential	Private	Poor	Slight	49.92
10	Residential	Private	Poor	None	49.97
11	Residential	Private	Poor	Slight	51.31
12	Residential	Private	Poor	Slight	49.41
13	Residential	Private	Good	None	50.27
14	Residential	Private	Poor	None	48.56
16	Residential	Private	Poor	None	48.51
17	Residential	Private	Poor	None	50.51
17A	Residential	Private	Poor	None	53.96
17B	Residential	Private	Poor	None	50.94
17C	Residential	Private	Poor	None	51.57
18	Residential	Private	Poor	None	57.36
18A	Residential	Private	Poor	None	60.93
18B	Residential	Private	Poor	None	29.43
19	Agricultural	Public	Fair	Slight	46.56
19A1	Agricultural	Public	Fair	Slight	781.80
19A2	Open space	Public	Poor	Slight	615.28
19B	Open space	Public	Poor	None	331.25
19C	Open space	Public	Poor	None	323.23
19D	Open space	Public	Poor	Slight	95.02
20	Residential	Private	Poor	None	38.77
21	Residential	Private	Poor	None	60.02
22	Residential	Private	Poor	None	47.80
23	Residential	Private	Poor	None	44.63
24	Residential	Private	Poor	None	43.21
25	Residential	Private	Poor	None	85.83
26	Residential	Private	Poor	Minimal	44.03
26A	Residential	Private	Poor	Minimal	37.01
26B	Residential	Private	Poor	Minimal	38.02

Segment Code	*Land Use*	*Ownership*	*Riparian Buffer Condition*	*Shoreline Erosion Level*	*Shoreline Length (ft)*
26C	Residential	Private	Poor	Minimal	15.01
27	Residential	Private	Poor	Slight	15.31
27A	Residential	Private	Poor	Slight	51.45
27B	Residential	Private	Poor	Slight	55.12
28	Residential	Private	Poor	None	51.30
29	Residential	Private	Poor	None	55.96
30	Residential	Private	Poor	None	157.76
30A	Residential	Private	Poor	None	30.88
31	Residential	Private	Poor	None	28.80
31A	Residential	Private	Poor	None	50.86
32	Residential	Private	Good	None	50.21
33	Residential	Private	Good	None	50.81
34	Residential	Private	Poor	None	56.40
35	Residential	Private	Poor	None	55.85
36	Residential	Private	Poor	None	56.04
37	Residential	Private	Poor	None	54.81
38	Residential	Private	Poor	Slight	6.16
38A	Residential	Private	Poor	Slight	37.07
38B	Residential	Private	Poor	Slight	22.70
39	Residential	Private	Poor	Slight	52.63
40	Residential	Private	Poor	Minimal	75.19
41	Residential	Private	Poor	Slight	85.89
42	Residential	Private	Fair	Minimal	118.86
43	Open space	Public	Poor	Slight	166.55
43A	Open space	Public	Poor	Slight	111.76
44	Residential	Private	Poor	Slight	61.98
45	Residential	Private	Poor	Minimal	61.43
46	Residential	Private	Poor	Moderate	78.42
47	Residential	Private	Poor	None	76.03
48	Residential	Private	Poor	Slight	60.36
49	Residential	Private	Poor	Slight	61.74
50	Residential	Private	Poor	None	65.26
51	Residential	Private	Poor	Slight	95.42
52	Residential	Private	Poor	Minimal	60.60
53	Residential	Private	Poor	None	60.84
54	Residential	Private	Poor	Minimal	99.42
55	Residential	Private	Poor	Slight	118.02
56	Residential	Private	Poor	None	63.10
57	Residential	Private	Poor	None	63.15
58	Residential	Private	Poor	None	63.23

Segment Code	Land Use	Ownership	Riparian Buffer Condition	Shoreline Erosion Level	Shoreline Length (ft)
59	Residential	Private	Poor	Slight	62.58
60	Residential	Private	Poor	Moderate	65.00
61	Residential	Private	Poor	None	61.61
62	Residential	Private	Poor	None	61.08
63	Residential	Private	Poor	Minimal	60.95
64	Residential	Private	Poor	Slight	60.10
65	Open space	Public	Poor	Slight	61.06
66	Residential	Private	Poor	Slight	67.37
67	Residential	Private	Poor	None	66.24
68	Residential	Private	Poor	None	68.28
69	Residential	Private	Poor	None	47.26
70	Residential	Private	Poor	Moderate	54.97
70A	Residential	Private	Poor	Moderate	50.30
71	Residential	Private	Poor	Slight	57.58
72	Residential	Private	Poor	Minimal	71.12
73	Residential	Private	Poor	Minimal	80.33
74	Residential	Private	Poor	None	102.34
75	Residential	Private	Poor	Moderate	77.51
76	Open space	Public	Poor	Moderate	336.07
77	Residential	Private	Poor	Slight	63.53
78	Residential	Private	Poor	Slight	82.74
79	Residential	Private	Poor	Slight	36.76
80	Residential	Private	Poor	Slight	41.82
81	Residential	Private	Poor	Moderate	67.25
82	Residential	Private	Poor	Moderate	65.16
82A	Residential	Private	Poor	Moderate	66.60
83	Residential	Private	Poor	Slight	73.86
84	Residential	Private	Poor	Slight	81.24
85	Residential	Private	Poor	Slight	64.63
86	Residential	Private	Poor	Minimal	63.85
87	Open space; Road ROW	unknown	Poor	Minimal	68.08
88	Open space	Organizational	Poor	Slight	355.34
89	Open space; Stream ROW	unknown	Good	Slight	38.13
90A	Open space	Organizational	Good	Moderate	436.55
90B	Open space	Organizational	Poor	High	230.93
90C	Open space	Organizational	Good	Moderate	403.92
91	Residential	Private	Poor	None	110.06
92	Residential	Private	Poor	None	76.21
93	Residential	Private	Poor	None	63.78

Segment Code	*Land Use*	*Ownership*	*Riparian Buffer Condition*	*Shoreline Erosion Level*	*Shoreline Length (ft)*
94	Residential	Private	Poor	Minimal	50.17
95	Residential	Private	Poor	Slight	49.91
95A	Residential	Private	Poor	Slight	50.67
96	Residential	Private	Poor	Slight	51.29
97	Residential	Private	Poor	Slight	49.97
98	Residential	Private	Poor	Slight	129.26
99	Residential	Private	Poor	Moderate	134.29
100A	Residential	Private	Good	Slight	206.18
100B	Residential	Private	Poor	Moderate	226.25
101	Residential	Private	Poor	None	96.08
102	Residential	Private	Poor	Minimal	46.71
103	Residential	Private	Poor	None	49.18
104	Residential	Private	Poor	None	49.09
105	Residential	Private	Poor	Slight	49.16
105A	Residential	Private	Poor	Moderate	13.77
105B	Residential	Private	Poor	Moderate	35.41
105C	Residential	Private	Poor	Moderate	50.50
106	Residential	Private	Good	Slight	49.27
107	Residential	Private	Poor	Minimal	50.16
108	Residential	Private	Poor	Slight	49.22
109	Residential	Private	Poor	Slight	45.99
110	Residential	Private	Poor	None	54.17
111	Residential	Private	Poor	Moderate	50.77
112	Residential	Private	Poor	Moderate	99.64
113	Residential	Private	Poor	None	53.91
114	Residential	Private	Poor	None	50.00
115	Residential	Private	Poor	None	49.70
115A	Residential	Private	Poor	None	52.46
116	Residential	Private	Poor	None	49.41
117	Residential	Private	Poor	None	51.00
118	Residential	Private	Poor	None	58.45
				Total:	12936.65

Appendix H – Pollutant Loads by Study Unit Figures



Existing Annual Nitrogen Load Estimate
Boone-Dutch Creek Watershed
Geosyntec consultants
Chicago, IL
11/24/2014
Nitrogen (lb/ac/yr)
5.0 - 5.4
5.5 - 6.5
6.6 - 7.6
7.7 - 7.9
8.0 - 9.6
8,500
4,250
0
8,500 Feet
N
Wold Lake
McCullom Lake
Dutch Creek
Boone Creek
Fox River
Wonder Lake
1
2
3
4
5
6
7
8
9
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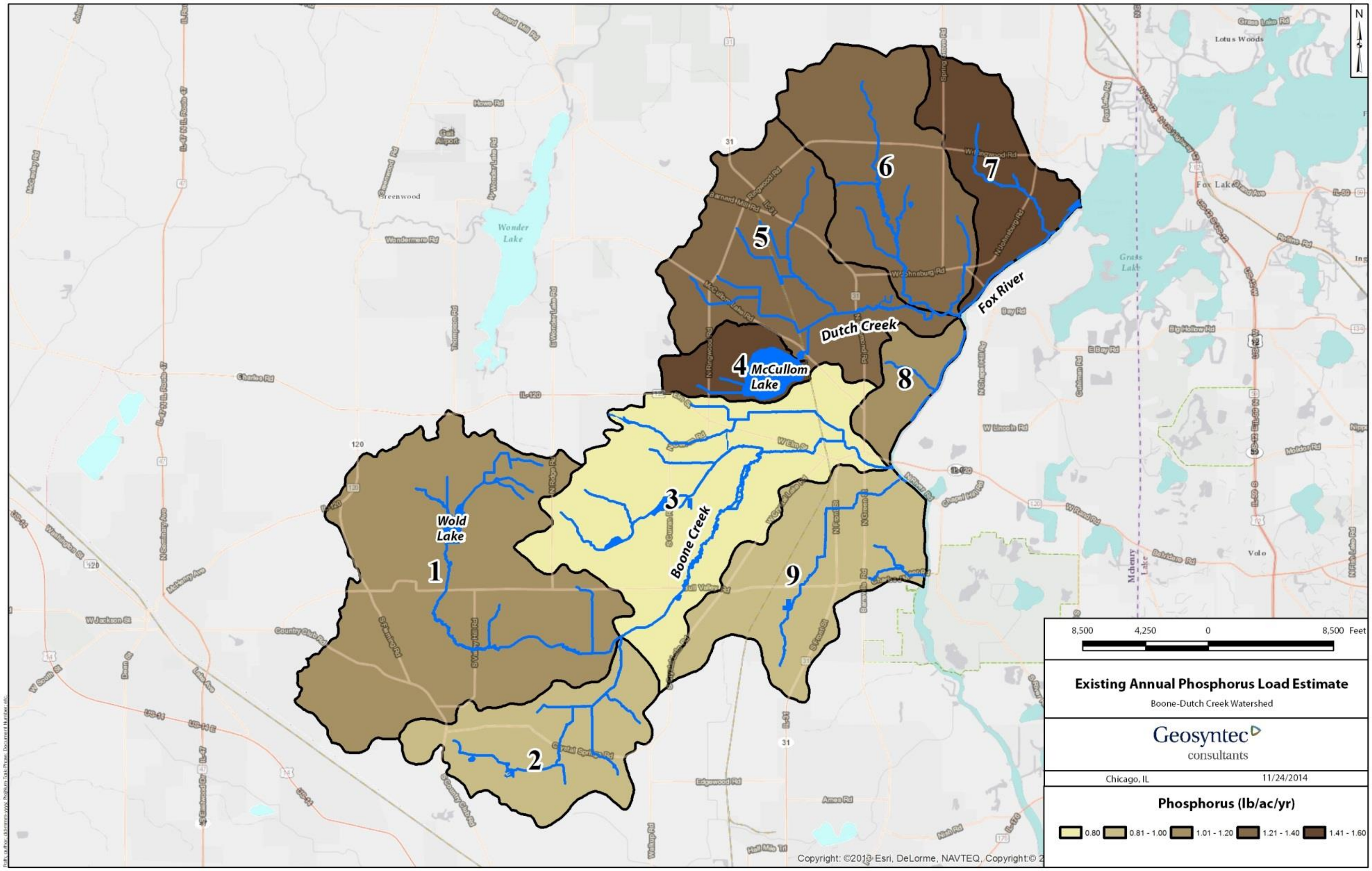

Existing Annual Phosphorus Load Estimate
Boone-Dutch Creek Watershed
Geosyntec consultants
Chicago, IL
11/24/2014
Phosphorus (lb/ac/yr)
0.80
0.81 - 1.00
1.01 - 1.20
1.21 - 1.40
1.41 - 1.60
8,500
4,250
0
8,500 Feet
N
1
2
3
4
5
6
7
8
9
Wold Lake
McCullom Lake
Dutch Creek
Boone Creek
Fox River
Wonder Lake
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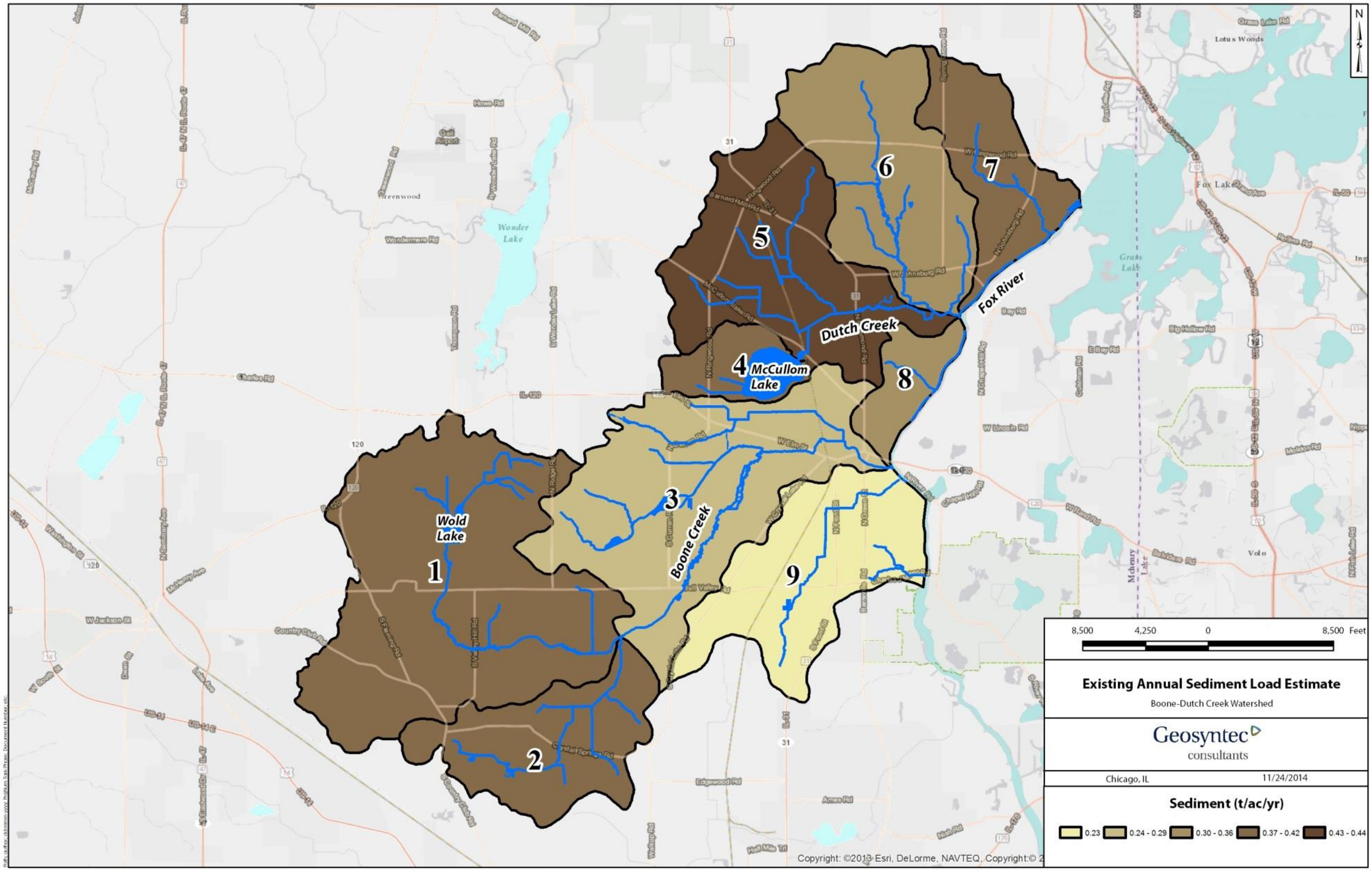
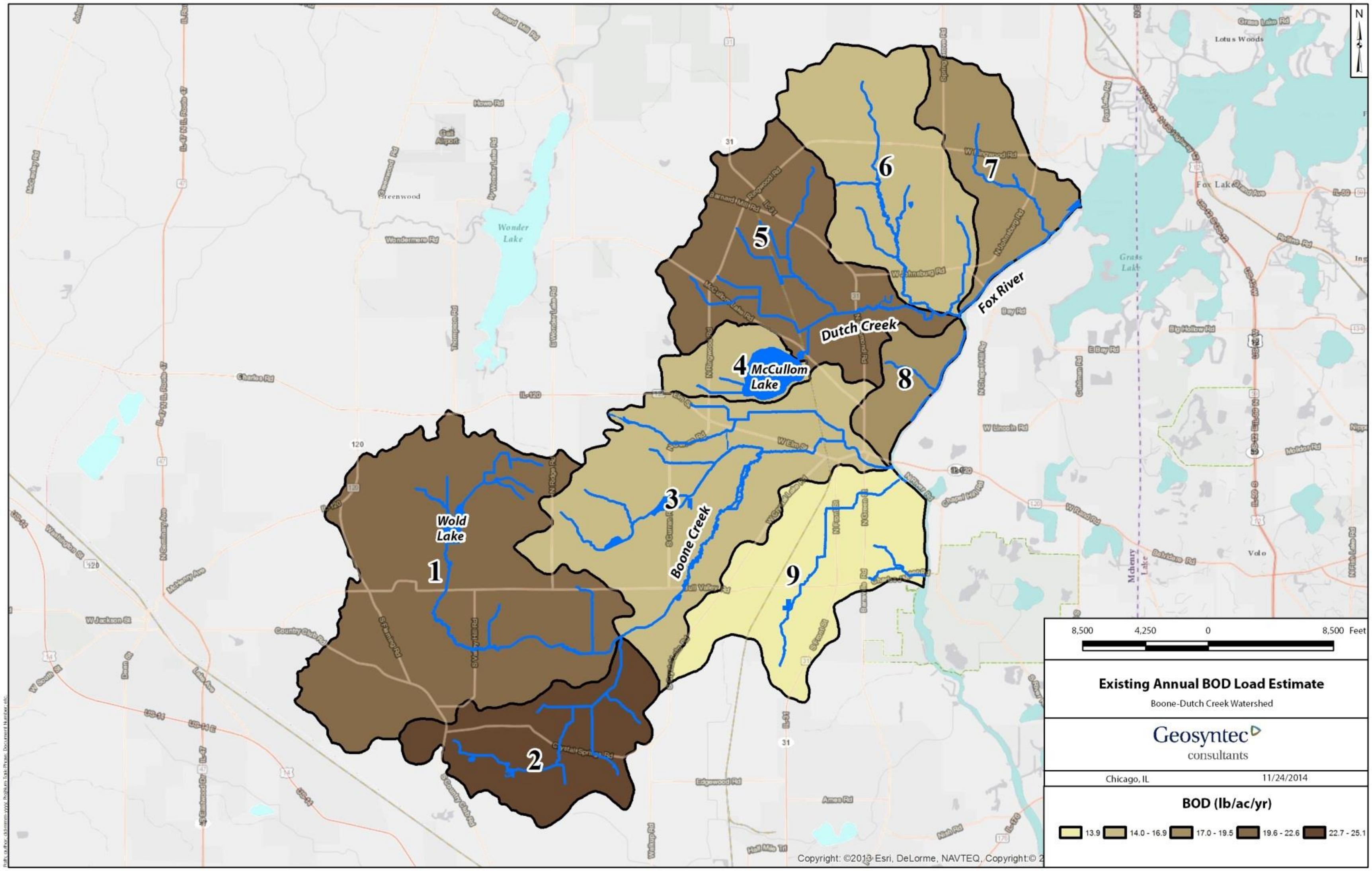

Existing Annual Sediment Load Estimate
Boone-Dutch Creek Watershed
Geosyntec consultants
Chicago, IL
11/24/2014
Sediment (t/ac/yr)
0.23
0.24 - 0.29
0.30 - 0.36
0.37 - 0.42
0.43 - 0.44
8,500
4,250
0
8,500 Feet
N
Wold Lake
McCullom Lake
Dutch Creek
Boone Creek
Fox River
Wonder Lake
1
2
3
4
5
6
7
8
9
Copyright: ©2013 Esri, DeLorme, NAVTEQ, Copyright:© 2


Existing Annual BOD Load Estimate
Boone-Dutch Creek Watershed
Geosyntec consultants
Chicago, IL
11/24/2014
BOD (lb/ac/yr)
13.9
14.0 - 16.9
17.0 - 19.5
19.6 - 22.6
22.7 - 25.1
8,500
4,250
0
8,500 Feet
N
Wold Lake
McCullom Lake
Dutch Creek
Boone Creek
Fox River
Wonder Lake
1
2
3
4
5
6
7
8
9
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Appendix I – Ordinance Questionnaire

Boone-Dutch Creek Watershed Planning - Ordinance Questionnaire

CODE AND STANDARD CATEGORY		CHECKLIST QUESTION: DOES THE ORDINANCE...	YES/NO OR MOSTLY/ MINIMALLY ADDRESSED	CODE SECTION	CURRENT STANDARD TEXT (OPTIONAL)	NOTES
STORMWATER DRAINAGE AND DETENTION						
1	Purpose	Include control of runoff rate, volumes, and quality in the purpose statement?				
2	Minimize stormwater quantity	Encourage the use of permeable paving, greenroofs, and similar practices that reduce the quantity of runoff that must be handled with innovative or conventional drainage practices?				
3	Natural drainage practices	Encourage/require the use of natural drainage practices (e.g., swales, filter strips, bio-infiltration devices, and natural depressions over storm sewers) to minimize runoff volumes and enhance pollutant filtering?				
4	Detention credits	Provide detention credit for practices, such as permeable paving or bio-infiltration, that provide temporary storage of runoff in the sub-surface void spaces of stone or gravel?				
5	Peak discharge	Require that peak post-development discharge from events less than or equal to the two-year, 24-hour event be limited to 0.04 cfs per acre of watershed?				
6	Detention design	Require detention design standards that maximize water quality mitigation benefits, with a requirement for "naturalized" wet bottom and/or wetland basins over dry basins?				
7	Water quality performance standards	Require conformance to numerical water quality performance standards (such as percent removal of sediment or phosphorus)?				
8	Floodway and stream detention restrictions	Prohibit detention in the floodway and on-stream detention, unless it provides a regional stormwater storage benefit (e.g., for upstream properties and/or multiple sites) and is accompanied by other upstream water quality BMPs, such as bio-infiltration?				
9	Stormwater discharge	Prohibit the direct discharge of undetained stormwater into wetlands?				
10	Maintenance	Require formal maintenance plans and contracts for the long-term maintenance and vegetative management of all new detention facilities?				
SOIL EROSION AND SEDIMENT CONTROL						
1	Limiting sediment delivery	Include a comprehensive purpose statement which limits sediment delivery, as close as practicable, to pre-disturbance levels and minimizes effects on water quality, flooding, and nuisances?				
2	Minimize sediment transport	Include a comprehensive set of principles that minimize sediment transport from the site for all storms up to the ten-year frequency event? (These principles should include provisions to minimize the area disturbed and the time of disturbance; follow natural contours; avoid sensitive areas; require that sediment control measures be in place as part of land development process before significant grading or disturbance is allowed; and require the early implementation of soil stabilization measures on disturbed areas.)				
3	Ordinance applicability - size	Require ordinance applicability for any land disturbing activity in excess of 5,000 square feet?				

Boone-Dutch Creek Watershed Planning - Ordinance Questionnaire (continued)

CODE AND STANDARD CATEGORY		CHECKLIST QUESTION: DOES THE ORDINANCE...	YES/NO OR MOSTLY/ MINIMALLY ADDRESSED	CODE SECTION	CURRENT STANDARD TEXT (OPTIONAL)	NOTES
SOIL EROSION AND SEDIMENT CONTROL						
4	Ordinance applicability - location	Require ordinance applicability for any land disturbing activity in excess of 500 square feet if adjacent to stream, lake, or wetland?				
5	Site design requirements	Include explicit site design requirements for sediment control measures, conveyance channels, soil stabilization, construction adjacent to water bodies, construction entrances, etc.?				
6	Site design references	Adopt by reference the "Illinois Urban Manual" published by the Natural Resources Conservation Service and the Illinois Environmental Protection Agency (1995, updated 2010) and the "Illinois Procedures and Standards for Urban Soil Erosion and Sedimentation Control" published in 1988 (the Greenbook)? (These references provide additional design standards and guidelines beyond the specific standards spelled out in the ordinance.)				
7	Maintenance	Require routine maintenance of all erosion and sediment control practices?				
8	Inspection	Require inspection by appropriately trained personnel of construction sites at critical points in the development process to ensure that measures are being correctly installed and maintained?				
9	Enforcement	Provide effective enforcement mechanisms including performance bonds, stop-work orders, and penalties, as appropriate?				
FLOODPLAIN MANAGEMENT						
1	Purpose	Include protection of hydrologic functions, water quality, aquatic habitat, recreation, and aesthetics in the purposes for the ordinance?				
2	Floodway restrictions - use	Restrict modifications in the floodway to the following appropriate uses: public flood control projects, public recreation and open space uses, water dependent activities, and crossing roadways and bridges? (The ordinance would thereby prohibit new treatment plants and pumping facilities; detached garages, sheds, and other non-habitable structures; parking lots and aircraft parking aprons; and roadways which run longitudinally along a watercourse.)				
3	Limit stream channel modification	Discourage stream channel modification and require mitigation of unavoidable adverse water quality and aquatic habitat impacts? (This would be done in cooperation with the Army Corps of Engineers for federally jurisdictional waterways.)				
4	Floodway restrictions - erosion	Require effective soil erosion and sediment control measures for ALL disturbances in the floodway?				

Boone-Dutch Creek Watershed Planning - Ordinance Questionnaire (continued)

CODE AND STANDARD CATEGORY		CHECKLIST QUESTION: DOES THE ORDINANCE...	YES/NO OR MOSTLY/ MINIMALLY ADDRESSED	CODE SECTION	CURRENT STANDARD TEXT (OPTIONAL)	NOTES
STREAM AND WETLAND PROTECTION						
1	Purpose	Include a comprehensive purpose statement which addresses the protection of hydrologic and hydraulic, water quality, habitat, aesthetic, and social and economic values and functions of wetlands?				
2	Protection	Protect the beneficial functions of streams, lakes, and wetlands from damaging modifications, including filling, draining, excavating, damming, impoundment, and vegetation removal? (This could be done through some combination of avoidance and mitigation requirements, similar to Army Corps of Engineer requirements for federally jurisdictional waters.)				
3	Modification - high quality resources	Prohibit the modification of high quality, irreplaceable wetlands, lakes, and stream corridors?				
4	Modification - wetlands	Discourage the modification of wetlands for stormwater management purposes unless the wetland is severely degraded and nonpoint source BMPs are implemented on the adjacent development?				
5	Waterbody setback	Designate a minimum 100 foot setback zone from the edge of identified wetlands and water bodies in which development is limited to the following types of activities: minor improvements like walkways and signs, maintenance of highways and utilities, and park and recreational area development?				
6	Waterbody buffer	Establish a minimum 25-foot wide protected native vegetation buffer strip along the edge of identified wetlands and water bodies?				
7	Relocation	Prohibit watercourse relocation or modification except to remedy existing erosion problems, restore natural habitat conditions, or to accommodate necessary utility crossings; and require mitigation of unavoidable adverse water quality and aquatic habitat impacts?				
8	Restoration	Encourage the restoration of stream and wetland habitat, hydrology, and morphology on development sites that contain degraded aquatic systems? (This could be accomplished through a streamlined permitting process and/or other development incentives.)				
NATURAL AREAS AND OPEN SPACE						
1	Natural areas protection	Protect remnant natural areas, including steep slopes, prairies, woodlands, and savannas (in addition to regulated wetlands and floodplains)?				
2	Open space - amount	Set aside onsite open space for residential development, generally conforming to the following guidelines: estate residential: 60%; moderate residential: 45%; urban residential: 30%? (Common open space is preferable, but deed-restricted open space also is acceptable.)				
3	Restoration	Encourage the restoration of protected natural areas to reduce invasive species and enhance biodiversity?				
4	Open space - ownership	Require the identification of an open space ownership entity, with a preference for a qualified public or private land conservation organization?				

Boone-Dutch Creek Watershed Planning - Ordinance Questionnaire (continued)

CODE AND STANDARD CATEGORY		CHECKLIST QUESTION: DOES THE ORDINANCE...	YES/NO OR MOSTLY/ MINIMALLY ADDRESSED	CODE SECTION	CURRENT STANDARD TEXT (OPTIONAL)	NOTES
NATURAL AREAS AND OPEN SPACE						
5	Open space - easement	Require the dedication of natural open space via a binding conservation easement or similar binding legal instrument that ensures protection in perpetuity?				
6	Open space - management	Require secure and permanent funding arrangements for the long-term management and maintenance of open space, natural areas, and stormwater facilities once responsibilities are turned over to a conservation entity or the homeowners/property owners association? (Said funding arrangements shall be noted and made part of the Covenants and Restrictions.)				
7	Open space - funding	Encourage the establishment of a back-up special service area (SSA) in order to provide funds necessary to support the maintenance of open space and stormwater management areas (in the event that the responsible land owner/manager does not meet the required maintenance standards)?				
8	Open space - management plans	Require or encourage long-term management/stewardship plans for all common open space areas, natural areas, and stormwater facilities?				
9	Open space - performance criteria	Establish measurable performance criteria for managed natural areas, including ground coverage, species diversity, and control of invasive species?				
CONSERVATION DESIGN AND INFILL						
1	Natural resource inventory	Require a site analysis map that includes a natural resources inventory at the Concept Plan stage or prior to the Preliminary Plan stage?				
2	Site design	Require that the proposed development be designed to preserve natural drainage patterns, use and preserve native vegetation, stabilize soils during construction, and protect, enhance, and maintain natural resources (such as remnant woodlands, prairies, and steep slopes)?				
3	Clearing and grading	Restrict on-site clearing and grading locations and extent?				
4	Clustering	Encourage/require clustering of residential lots around sensitive natural areas, thereby creating a protected common open space area?				
5	Density bonus	Provide density bonuses for conservation developments that exceed minimum standards (such as additional open space, providing for regional trails and greenways, or incorporating environmentally sensitive design features beyond what is required by the Ordinance)?				
6	Conservation design - by right	Allow conservation design as a "by-right" form of development?				
7	Conservation design - zoning map	Does the zoning map indicate areas where conservation development is required?				
8	Mixed use	Is there a downtown overlay district or another mechanism to encourage mixed-use development in neighborhood centers?				

Boone-Dutch Creek Watershed Planning - Ordinance Questionnaire (continued)

CODE AND STANDARD CATEGORY		CHECKLIST QUESTION: DOES THE ORDINANCE...	YES/NO OR MOSTLY/ MINIMALLY ADDRESSED	CODE SECTION	CURRENT STANDARD TEXT (OPTIONAL)	NOTES
CONSERVATION DESIGN AND INFILL						
9	Impact fees	Are there reduced impact fees or other incentives to encourage infill development?				
LANDSCAPING						
1	Native landscaping - restrictive provisions	Include "noxious weed" provisions that might intentionally, or unintentionally, preclude natural landscaping because of vegetation height standards or similar restrictive provisions?				
2	Native landscaping - common and natural areas	Encourage/require the use of native plant materials for the default landscaping of common areas, stormwater facilities, common open space areas, and the buffers of streams, lakes, wetlands and other natural areas?				
3	Native landscaping - management	Require provisions for long-term oversight, management, funding, and performance criteria for common areas and natural landscapes (as referenced above in greater detail)?				
4	Street trees	"Require planting street trees? If yes, how many trees?"				
5	Tree protection	Require protection of native/desirable trees (i.e., a tree protection ordinance)?				
6	Tree replacement	Require replacement of any trees that are unavoidably impacted by construction activities?				
7	Tree replacement - funding	Require payment into a tree replacement fund or "mitigation bank" when removed trees cannot be replaced/mitigated on site?				
TRANSPORTATION						
1	Street network - location	Require the street network to minimize encroachment in sensitive natural resources and take advantage of open space vistas, while providing an interconnection of internal streets and street connections to adjoining land parcels to create opportunities for future connectivity?				
2	Street network - stream crossings	Limit stream crossings by the street network?				
3	Street connectivity - external	Require connections to surrounding areas?				
4	Street connectivity - internal	Require subdivisions to achieve a certain score on an index for internal street connectivity?				
5	Street - widths	Encourage narrower street widths to reduce the amount of impervious surface?				

Boone-Dutch Creek Watershed Planning - Ordinance Questionnaire (continued)

CODE AND STANDARD CATEGORY		CHECKLIST QUESTION: DOES THE ORDINANCE...	YES/NO OR MOSTLY/ MINIMALLY ADDRESSED	CODE SECTION	CURRENT STANDARD TEXT (OPTIONAL)	NOTES
TRANSPORTATION						
6	Street - frontage roads	Discourage frontage roads?				
7	Street - length	Encourage reduced or flexible lot widths to reduce imperviousness and street length?				
8	Cul-de-sacs	Discourage cul-de-sacs and promote smaller scale design?				
9	Curb and gutter requirements	Encourage/require the use of natural drainage practices?				
10	Paving materials - streets	Promote use of previous materials?				
11	Sidewalks	Promote connected sidewalks in new developments and use of previous materials?				
PARKING						
1	Purpose	Does the purpose include a statement about tailoring parking requirements to meet average day-to-day demand as opposed to peak demand?				
2	Applicability	Apply off-street parking requirements only to parcels of a certain size or greater?				
3	Requirements	Establish parking requirements as a maximum?				
4	Parking ratio - office	Require a parking ratio for a professional office building that is 3 spaces, or less, per 1,000 square feet?				
5	Parking ratio - retail	Require a parking ratio for retail that is 4.5 spaces, or less, per 1,000 square feet?				
6	Parking ratio - residential	Require a parking ratio for a single family home that is 2 spaces, or less?				
7	Requirements - flexibility	Provide flexibility regarding alternative, reduced parking requirements (e.g., shared parking, off-site parking) and discourage over-parking of developments?				
8	Requirements - flexibility	Allow a reduction in the number of current parking spaces?				
9	Off-site parking	Provide flexibility regarding alternative, reduced parking requirements (e.g., shared parking, off-site parking) and discourage over-parking of developments?				
10	Shared parking	Provide flexibility regarding alternative, reduced parking requirements (e.g., shared parking, off-site parking) and discourage over-parking of developments?				
11	Requirements - location	Provide for uses in downtown areas by reducing or not requiring parking given the walkable, transit-served location?				
12	Credits - on - street parking	Allow a reduction in off street parking requirements when nearby on street parking is available?				

Boone-Dutch Creek Watershed Planning - Ordinance Questionnaire (continued)

	CODE AND STANDARD CATEGORY	CHECKLIST QUESTION: DOES THE ORDINANCE...	YES/NO OR MOSTLY/ MINIMALLY ADDRESSED	CODE SECTION	CURRENT STANDARD TEXT (OPTIONAL)	NOTES
PARKING						
13	Credits - bicycle parking	Allow a reduction in off street parking requirements when bicycle parking is provided?				
14	Size - parking stall	Require parking stalls to be less than or equal to 9 feet x 18 feet?				
15	Size - parking stall	Allow for reduction in parking stall size to account for vehicle overhang onto landscaped islands or perimeter landscaping? (eg., such flexibility might allow for an 18-foot deep stall to be reduced to 16 or 16.5 feet deep.)				
16	Size - compact stalls	Specify that a percentage of all parking stalls can be dedicated for compact cars, with correspondingly smaller stall dimensions?				
17	Size - parking aisles	Establish narrower aisle widths to minimize impervious surfaces?				
18	Driveways - width - nonresidential	Encourage/require reduced driveway widths?				
19	Driveways - width - residential	Encourage/require reduced driveway widths for single-family developments?				
20	Driveways - length	reduced front setbacks to limit the length (and thus impervious surface) associated with a driveway?				
21	Driveways - shared	Encourage/require shared driveways?				
22	Paving materials	Promote use of previous materials for paved areas, including parking lots and driveways?				
23	Landscaping - amount	Specify a minimum percentage of previous landscaping in parking lots?				
24	Landscaping - design	Encourage/require the use of recessed landscape islands (vs. raised islands) to facilitate infiltration and filtering of parking lot runoff?				
WATER EFFICIENCY AND CONSERVATION						
1	Water conservation - indoor	Encourage plumbing fixtures and fittings and appliances in all new and remodeled construction to not exceed specific flow rates and must be a labeled Water Sense product if available?				
2	Water conservation - outdoor	Set guidelines for vegetation (such as limiting turf area and location), minimum topsoil depth, and irrigation equipment, irrigation days and schedules, and irrigation permits?				
3	Rainwater harvesting and water reuse	Establish a water reuse model ordinance to encourage preservation of groundwater supplies?				

Boone-Dutch Creek Watershed Planning - Ordinance Questionnaire (continued)

CODE AND STANDARD CATEGORY		CHECKLIST QUESTION: DOES THE ORDINANCE...	YES/NO OR MOSTLY/ MINIMALLY ADDRESSED	CODE SECTION	CURRENT STANDARD TEXT (OPTIONAL)	NOTES
WATER EFFICIENCY AND CONSERVATION						
1	Water conservation - indoor	Encourage plumbing fixtures and fittings and appliances in all new and remodeled construction to not exceed specific flow rates and must be a labeled Water Sense product if available?				
2	Water conservation - outdoor	Set guidelines for vegetation (such as limiting turf area and location), minimum topsoil depth, and irrigation equipment, irrigation days and schedules, and irrigation permits?				
3	Rainwater harvesting and water reuse	Establish a water reuse model ordinance to encourage preservation of groundwater supplies?				
4	Downspouts	Set restrictions on downspouts being directly connected to storm sewers or sanitary sewers?				
5	Water waste prevention	Prohibit water waste or inefficient use of water?				
6	Water pricing	Establish a conservation pricing structure or other economic incentive to promote water conservation?				
POLLUTION PREVENTION						
1	Groundwater protection	Regulate activities within groundwater protection areas?				
2	Phosphorus reduction	Discourage the use of phosphorus in manufactured fertilizers in order to reduce the amount of phosphorus that enters water resources?				
3	Coal tar sealants	Discourage use of coal tar sealants to prevent loss of aquatic life?				
4	Chloride management	Adopt storage and handling ordinances that ensure proper salt, storage, handling and transport.				
5	Pet waste disposal	Have a pet waste disposal requirement?				
6	Private sewage treatment and disposal ordinance	Adopt the McHenry County Private Sewage Treatment and Disposal Ordinance?				

Appendix J – Subwatershed BMP Scenarios: "Watershed-wide" Urban Stormwater Infrastructure Retrofit BMPs and Associated Pollutant Load Reduction and Implementation Cost Estimates

Table J-1. Watershed-wide urban stormwater infrastructure retrofit BMPs with pollutant load reduction and implementation cost estimates by subwatershed.

Subwatershed	*Subwatershed Treated*	*BMP*	*Nitrogen Reduction (lb/yr)*	*Phosphorus Reduction (lb/yr)*	*Sediment Reduction (t/yr)*	*BOD Reduction (lb/yr)*	*Estimated Cost[1] ($)*
1 / Upper Boone Creek	10.0%	Vegetated Swales	1.42	0.47	551	n/a	356,544
	5.0%	Bioretention	851	230	47	2,125	12,453,841
	10.0%	Detention Basin Retrofits	2,178	388	104	4,462	4,981,537
	0.0%	Filterra	n/a	n/a	n/a	n/a	n/a
	0.0%	Bacterra	n/a	n/a	n/a	n/a	n/a
	0.0%	Permeable Pavement	n/a	n/a	n/a	n/a	n/a
	0.0%	Green Roofs	n/a	n/a	n/a	n/a	n/a
Total			**3,031**	**618**	**703**	**6,587**	**17,791,922**
2 / Powers Creek	10.0%	Vegetated Swales	0.09	0.03	31	n/a	25,344
	5.0%	Bioretention	424	104	22	844	4,436,569
	10.0%	Detention Basin Retrofits	1,084	176	49	1,771	1,774,628
	0.0%	Filterra	n/a	n/a	n/a	n/a	n/a
	0.0%	Bacterra	n/a	n/a	n/a	n/a	n/a
	0.0%	Permeable Pavement	n/a	n/a	n/a	n/a	n/a
	0.0%	Green Roofs	n/a	n/a	n/a	n/a	n/a
Total			**1,507**	**281**	**102**	**2,615**	**6,236,541**
3 / Lower Boone Creek	10.0%	Vegetated Swales	2.92	0.87	1,448	n/a	557,146
	5.0%	Bioretention	839	201	60	2,581	9,294,486
	5.0%	Detention Basin Retrofits	1,073	170	66	2,710	1,858,897
	0.5%	Filterra	88	17	6	n/a	11,618,107
	0.5%	Bacterra	n/a	n/a	n/a	421	11,618,107
	2.5%	Permeable Pavement	n/a	50	30	n/a	17,427,161
	1.5%	Green Roofs	146	19	17	n/a	8,016,494
Total			**2,150**	**458**	**1,627**	**5,712**	**60,390,397**
4 / McCullom Lake	10.0%	Vegetated Swales	0.06	0.02	35	n/a	25,344
	5.0%	Bioretention	94	22	8	353	1,518,506
	10.0%	Detention Basin Retrofits	241	38	17	742	607,402
	0.0%	Filterra	n/a	n/a	n/a	n/a	n/a
	0.0%	Bacterra	n/a	n/a	n/a	n/a	n/a
	0.0%	Permeable Pavement	n/a	n/a	n/a	n/a	n/a
	0.0%	Green Roofs	n/a	n/a	n/a	n/a	n/a
Total			**335**	**60**	**59**	**1,096**	**2,151,252**
5 / Dutch Creek	10.0%	Vegetated Swales	2.63	0.74	986	n/a	379,315
	5.0%	Bioretention	793	181	43	1,593	6,640,373
	10.0%	Detention Basin Retrofits	2,029	306	94	3,345	2,656,149
	0.0%	Filterra	n/a	n/a	n/a	n/a	n/a
	0.0%	Bacterra	n/a	n/a	n/a	n/a	n/a
	0.0%	Permeable Pavement	n/a	n/a	n/a	n/a	n/a
	0.0%	Green Roofs	n/a	n/a	n/a	n/a	n/a
Total			**2,824**	**487**	**1,122**	**4,938**	**9,675,838**

Table J-1. Watershed-wide urban stormwater infrastructure retrofit BMPs with pollutant load reduction and implementation cost estimates by subwatershed *(cont.)*.

Subwatershed	*Subwatershed Treated*	*BMP*	*Nitrogen Reduction (lb/yr)*	*Phosphorus Reduction (lb/yr)*	*Sediment Reduction (t/yr)*	*BOD Reduction (lb/yr)*	*Estimated Cost[1] ($)*
6 / Dutch Creek Tributary	10.0%	Vegetated Swales	0.51	0.15	199	n/a	79,862
	5.0%	Bioretention	672	158	37	1,374	6,072,053
	10.0%	Detention Basin Retrofits	1,719	267	82	2,885	2,428,821
	0.0%	Filterra	n/a	n/a	n/a	n/a	n/a
	0.0%	Bacterra	n/a	n/a	n/a	n/a	n/a
	0.0%	Permeable Pavement	n/a	n/a	n/a	n/a	n/a
	0.0%	Green Roofs	n/a	n/a	n/a	n/a	n/a
Total			**2,392**	**425**	**318**	**4,259**	**8,580,736**
7 / Northeast Direct Drainage	10.0%	Vegetated Swales	0.51	0.15	271	n/a	90,144
	5.0%	Bioretention	317	76	24	1,006	3,269,072
	5.0%	Detention Basin Retrofits	406	64	27	1,057	653,814
	0.5%	Filterra	33	7	3	n/a	4,086,340
	0.5%	Bacterra	n/a	n/a	n/a	164	4,086,340
	2.5%	Permeable Pavement	n/a	19	12	n/a	6,129,510
	1.5%	Green Roofs	55	7	7	n/a	2,819,575
Total			**812**	**172**	**343**	**2,227**	**21,134,795**
8 / Central Direct Drainage	10.0%	Vegetated Swales	0.88	0.26	602	n/a	185,434
	5.0%	Bioretention	112	27	11	511	1,379,713
	5.0%	Detention Basin Retrofits	143	23	12	537	275,943
	0.5%	Filterra	12	2	1	n/a	1,724,641
	0.5%	Bacterra	n/a	n/a	n/a	84	1,724,641
	2.5%	Permeable Pavement	n/a	7	6	n/a	2,586,962
	1.5%	Green Roofs	20	2	3	n/a	1,190,003
Total			**288**	**61**	**635**	**1,132**	**9,067,337**
9 / Southeast Direct Drainage	10.0%	Vegetated Swales	1.59	0.46	930	n/a	296,429
	5.0%	Bioretention	503	119	42	1,815	5,472,889
	5.0%	Detention Basin Retrofits	644	100	47	1,906	1,094,578
	0.5%	Filterra	53	10	5	n/a	6,841,111
	0.5%	Bacterra	n/a	n/a	n/a	296	6,841,111
	2.5%	Permeable Pavement	n/a	29	22	n/a	10,261,667
	1.5%	Green Roofs	88	11	12	n/a	4,720,367
Total			**1,290**	**270**	**1,057**	**4,018**	**35,528,151**
Grand Total			**14,628**	**2,833**	**5,966**	**32,584**	**170,556,969**

Appendix K – Site-specific BMPs and Associated Landowners, Location Coordinates, and Pollutant Load Reduction and Implementation Cost Estimates

Table K-1. Site-specific BMPs, landowners, potential partners, and location coordinates.

Map #	SU #	Study Unit	BMP Type	Category	BMP Code	Units	Landowner	Potential Partners	Longitude	Latitude
1	1	Upper Boone Crk	Stream Channel Restoration (remeandering), Streambank Protection, Urban Filter Strip (riparian buffer)	Hydrologic; Urban	9, 580; 835	number, feet; acres	private		-88.335	42.30858
2	1	Upper Boone Crk	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	999; 314	acres; acres	private (multiple)		-88.3387	42.3087
3	1	Upper Boone Crk	Wetland Restoration (riparian); Brush Management	Hydrologic	999; 314	acres; acres	private (multiple)		-88.3504	42.3118
4	1	Upper Boone Crk	Grassed Waterway, WASCB; Access Control / Fence (for livestock exclusion)	Agriculture; Livestock	412, 638; 472 / 382	acres, number; acres / feet	private		-88.366	42.32001
5	1	Upper Boone Crk	Stream Channel Restoration (remeandering)	Hydrologic	9	number	private		-88.3831	42.34014
6	1	Upper Boone Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3864	42.33937
7	1	Upper Boone Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3885	42.33705
8	1	Upper Boone Crk	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	840, 880 / ?	acres	City of Woodstock		-88.3986	42.29382
9	2	Powers Crk	Wetland Restoration (riparian); Brush Management	Hydrologic; Agriculture	999; 314	acres; acres	TLCMC, private (mult.)		-88.3281	42.30551
10	2	Powers Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3308	42.30182
11	2	Powers Crk	Grassed Waterway	Agriculture	412	acres	private		-88.3321	42.30099
12	2	Powers Crk	Grassed Waterway	Agriculture	412	acres	private		-88.3327	42.2973
13	2	Powers Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3362	42.29855
14	2	Powers Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3388	42.29882
15	2	Powers Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3407	42.29827
16	2	Powers Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3434	42.29832
17	2	Powers Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3436	42.29878
18	2	Powers Crk	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	999; 314	acres; acres	private (mult.), MCCD		-88.3477	42.29852
19	2	Powers Crk	Stream Channel Restoration (daylighting)	Hydrologic	9	feet	private	Vlg of Bull Valley, MCCD	-88.3476	42.30074

Table K-1. Site-specific BMPs, landowners, potential partners, and location coordinates *(cont.)*.

Map #	SU #	Study Unit	BMP Type	Category	BMP Code	Units	Landowner	Potential Partners	Longitude	Latitude
20	2	Powers Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3408	42.29559
21	2	Powers Crk	Wetland Restoration	Hydrologic	999	acres	Loyola Univ Chicago	BCWA, MCCD	-88.3617	42.28866
22	2	Powers Crk	Stream Channel Stabilizatiion; Streambank Protection (stabilization); Urban Filter Strip (riparian buffer)	Hydrologic; Urban	584; 580; 835	feet; acres	private, Loyola Univ. Chicago	BCWA, MCCD	-88.361	42.28956
23	2	Powers Crk	Stream Channel Stabilizatiion; Streambank Protection (stabilization); Urban Filter Strip (riparian buffer)	Hydrologic; Urban	584; 580; 835	feet; acres	private	Loyola Univ. Chicago, BCWA, MCCD	-88.3638	42.28958
24	2	Powers Crk	Wetland Restoration	Hydrologic	999	acres	Loyola Univ. Chicago	BCWA, MCCD	-88.3658	42.28884
25	2	Powers Crk	Stream Channel Stabilizatiion; Streambank Protection (stabilization); Urban Filter Strip (riparian buffer)	Hydrologic; Urban	584; 580; 835	feet; acres	private	Loyola Univ. Chicago, BCWA, MCCD	-88.3667	42.28972
26	2	Powers Crk	Grade Stabilization Structures, Permanent Vegetation	Urban	410; 880	nu,ber; acres	Loyola Univ. Chicago		-88.3683	42.29002
27	2	Powers Crk	Grade Stabilization Structures, Level Spreader, Permanent Vegetation	Urban	410; 870; 880	number; number; acres	Loyola Univ. Chicago		-88.3689	42.28962
28	2	Powers Crk	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale; Urban Filter Strip	Urban	840, 880 / ?; 835	acres	Loyola Univ. Chicago		-88.3697	42.2893
29	2	Powers Crk	water softener regeneration effluent capture & reuse	Other	n/a	pounds	Loyola Univ. Chicago	McHenry Co. DOT, Dorr Twp. Road Dist.	-88.3688	42.28872
30	2	Powers Crk	Grade Stabilization Structures, Rain Gardens	Urban	410; 897	number	Loyola Univ. Chicago		-88.368	42.28833
31	3	Lower Boone Crk	Oil & Grit Separator; Permeable Pavement	Urban	10; 890	number; sq feet	City of McHenry		-88.2634	42.3434
32	3	Lower Boone Crk	Streambank Protection (stabilization); Urban Filter Strip	Hydrologic; Urban	580; 835	feet; acres	unknown (ROW), City of McHenry, private (mult.)		-88.2877	42.35348
33	3	Lower Boone Crk	Streambank Protection (stabilization); Urban Filter Strip	Hydrologic; Urban	580; 835	feet; acres	unknown (ROW)	City of McHenry, neighboring subdiv residents	-88.2749	42.34798
34	3	Lower Boone Crk	Oil & Grit & Trash Separator	Urban	10	number	private	City of McHenry	-88.2799	42.34698

Table K-1. Site-specific BMPs, landowners, potential partners, and location coordinates *(cont.)*.

Map #	SU #	Study Unit	BMP Type	Category	BMP Code	Units	Landowner	Potential Partners	Longitude	Latitude
35	3	Lower Boone Crk	Streambank Protection (stabilization); Urban Filter Strip	Hydrologic; Urban	580; 835	feet; acres	City of McHenry		-88.2831	42.34612
36	3	Lower Boone Crk	Urban Filter Strip (riparian buffer)	Urban	835	acres	City McHenry, private (mult.)		-88.2849	42.34626
37	3	Lower Boone Crk	Wetland Restoration (riparian); Brush Management	Hydrologic	999; 314	acres; acres	private (mult.), City McHenry		-88.295	42.34474
38	3	Lower Boone Crk	Shoreline Protection (stabilization); Urban Filter Strip (shoreliine buffer)	Hydrologic; Urban	580; 835	feet; acres	City of McHenry	neighboring subdiv residents	-88.2979	42.3474
39	3	Lower Boone Crk	Wetland Restoration (riparian); Brush Management	Hydrologic	999; 314	acres; acres	private (mult.), City McHenry, HOA		-88.3027	42.34586
40	3	Lower Boone Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3071	42.34418
41	3	Lower Boone Crk	Bioretention Facility	Urban	800	sq feet	private (HOA?)		-88.3144	42.33576
42	3	Lower Boone Crk	Grassed Waterway, WASCB; Access Control / Fence (for livestock exclusion)	Agriculture; Livestock	412, 638; 472 / 382	acres, number; acres / feet	private		-88.3249	42.33654
43	3	Lower Boone Crk	Wetland Restoration (online/riparian), Dam removal	Hydrologic	16, 999	number, acres	private		-88.2978	42.33919
44	3	Lower Boone Crk	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	999; 314	acres; acres	City McHenry, private		-88.3034	42.33386
45	3	Lower Boone Crk	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	999; 314	acres; acres	private, City of McHenry		-88.3098	42.32697
46	3	Lower Boone Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.313	42.32046
47	3	Lower Boone Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3175	42.31549
48	3	Lower Boone Crk	Streambank Protection (stabilization), Stream Channel Stabilization; Urban Filter Strip (riparian buffer)	Hydrologic; Urban	580, 584; 835	feet; acres	private		-88.3269	42.31236
49	4	McCullom Lk	Bioretention Facility	Urban	800	sq feet	City of McHenry		-88.2828	42.36233
50	4	McCullom Lk	Shoreline Protection (stabilization); Urban Filter Strip (shoreline buffer)	Hydrologic; Urban	580; 835	feet; acres	private (mult.), City McHenry, Vlg McCullom Lk, POA		-88.2929	42.3632
51	4	McCullom Lk	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	840, 880 / ?	acres	private	City of McHenry	-88.298	42.35682

Table K-1. Site-specific BMPs, landowners, potential partners, and location coordinates *(cont.)*.

Map #	SU #	Study Unit	BMP Type	Category	BMP Code	Units	Landowner	Potential Partners	Longitude	Latitude
52	4	McCullom Lk	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale; Oil & Grit Separator	Urban	840, 880 / ?; 10	acres; number	unknown (ROW)	City of McHenry	-88.2985	42.3564
53	5	Dutch Crk	Wetland Restoration (riparian); Brush Management	Hydrologic	999; 314	acres; acres	private (multiple)		-88.2634	42.37214
54	5	Dutch Crk	Stream Channel Restoration (remeandering); Streambank Protection	Hydrologic; Urban	9; 580	acres; feet	private (mult.), IDOT, TLCMC		-88.2745	42.37155
55	5	Dutch Crk	Ag Filter Strip	Agriculture	393	acres	private, IDOT		-88.2772	42.37123
56	5	Dutch Crk	Streambank Protection (stabilization)	Hydrologic	580	feet	MCCD, private		-88.2883	42.37842
57	5	Dutch Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.2901	42.38084
58	5	Dutch Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.2891	42.38255
59	5	Dutch Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.2889	42.38262
60	5	Dutch Crk	Grassed Waterway, WASCB	Agriculture	412, 638	acres, number	private		-88.2851	42.38855
61	5	Dutch Crk	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	840, 880 / ?	acres	private (developer)		-88.2831	42.39999
62	5	Dutch Crk	Ag Filter Strip; Access Control / Fence (for livestock exclusion)	Agriculture; Livestock	393; 472 / 382	acres, acres / feet	City of McHenry		-88.2835	42.36483
63	5	Dutch Crk	Ag Filter Strip	Agriculture	393	acres	private, IDOT		-88.2852	42.37048
64	5	Dutch Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.2878	42.37087
65	5	Dutch Crk	Grassed Waterway	Agriculture	412	acres	IDOT, private		-88.2889	42.37143
66	5	Dutch Crk	Ag Filter Strip	Agriculture	393	acres	private, IDOT		-88.2935	42.37164
67	5	Dutch Crk	Grassed Waterway	Agriculture	412	acres	private		-88.2942	42.3724
68	5	Dutch Crk	Grassed Waterway	Agriculture	412	acres	private		-88.3034	42.37391
69	5	Dutch Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.3044	42.37353
70	5	Dutch Crk	Ag Filter Strip	Agriculture	393	acres	private		-88.2936	42.37674
71	5	Dutch Crk	Grassed Waterway	Agriculture	412	acres	private		-88.2955	42.3768
72	5	Dutch Crk	Grassed Waterway	Agriculture	412	acres	private		-88.2966	42.37925
73	5	Dutch Crk	Grassed Waterway	Agriculture	412	acres	private		-88.305	42.38237

Table K-1. Site-specific BMPs, landowners, potential partners, and location coordinates *(cont.)*.

Map #	SU #	Study Unit	BMP Type	Category	BMP Code	Units	Landowner	Potential Partners	Longitude	Latitude
74	5	Dutch Crk	Grassed Waterway	Agriculture	412	acres	private		-88.302	42.38368
75	5	Dutch Crk	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	840, 880 / ?	acres	private		-88.3023	42.38596
76	5	Dutch Crk	Grassed Waterway	Agriculture	412	acres	private		-88.3016	42.38942
77	6	Dutch Crk Tributary	Stream Channel Restoration; Urban Filter Strip (riparian buffer)	Hydrologic; Urban	9; 835	number; acres	private (mult.), Johnsburg Comm. School Dist 12	Vlg of Johnsburg, EDMC	-88.2411	42.3813
78	6	Dutch Crk Tributary	Urban Filter Strip (riparian buffer)	Urban	835	acres	private (multiple)		-88.2482	42.37327
79	6	Dutch Crk Tributary	Wetland Restoration (riparian); Brush Management, Urban Filter Strip	Hydrologic; Urban	999; 314, 835	acres; acres	Vlg Johnsburg, private		-88.2567	42.37576
80	6	Dutch Crk Tributary	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	999; 314	acres; acres	private (mult.), MCCD, TLCMC, Vlg of Johnsburg		-88.2599	42.38818
81	6	Dutch Crk Tributary	Grassed Waterway, WASCB; Access Control / Fence (for livestock exclusion)	Agriculture; Livestock	412, 638; 472 / 382	acres, number; acres / feet	private		-88.2619	42.41518
82	6	Dutch Crk Tributary	Grassed Waterway, WASCB; Access Control / Fence (for livestock exclusion)	Agriculture; Livestock	412, 638; 472 / 382	acres, number; acres / feet	private		-88.2723	42.40272
83	6	Dutch Crk Tributary	Grassed Waterway	Agriculture	412	acres	private		-88.2728	42.40405
84	6	Dutch Crk Tributary	Grassed Waterway, WASCB	Agriculture	412, 638	acres, number	private		-88.277	42.40643
85	7	NE Direct Drainage	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	840, 880 / ?	acres	Vlg of Johnsburg		-88.2257	42.38603
86	7	NE Direct Drainage	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	999; 314	acres; acres	Vlg Johnsburg, private		-88.2241	42.39257
87	7	NE Direct Drainage	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale); Access Control / Fence (for livestock exclusion)	Urban; Livestock	840, 880; 472 / 382	acres; acres / feet	private		-88.2269	42.39467
88	7	NE Direct Drainage	Grassed Waterway	Agriculture	412	acres	private		-88.244	42.41576
89	7	NE Direct Drainage	Grassed Waterway	Agriculture	412	acres	private		-88.243	42.41643

Table K-1. Site-specific BMPs, landowners, potential partners, and location coordinates *(cont.).*

Map #	SU #	Study Unit	BMP Type	Category	BMP Code	Units	Landowner	Potential Partners	Longitude	Latitude
90	8	Central Direct Drainage	Grassed Waterway	Agriculture	412	acres	IDOT, City of McHenry		-88.2539	42.35932
91	9	SE Direct Drainage	Oil & Grit Separator; Permeable Pavement	Urban	10; 890	number; sq feet	McHenry Country Club		-88.2603	42.34009
92	9	SE Direct Drainage	Shoreline Protection (stabilization); Urban Filter Strip (shoreline buffer)	Hydrologic; Urban	580; 835	feet; acres	McHenry Country Club, unknown (ROW?)		-88.2618	42.33949
93	9	SE Direct Drainage	Streambank Protection (stabilization); Urban Filter Strip (riparian buffer)	Hydrologic; Urban	580; 835	feet; acres	McHenry Country Club		-88.2644	42.33816
94	9	SE Direct Drainage	Rain Gardens (5?); rain barrels, Education	Urban	897, ?, 1	sq ft; number	McHenry Comm. School Dist 15	EDMC	-88.2681	42.33746
95	9	SE Direct Drainage	Urban Filter Strip (riparian buffer)	Urban	835	acres	McHenry Comm. School Dist 15	EDMC	-88.2697	42.33641
96	9	SE Direct Drainage	Streambank Protection (stabilization)	Hydrologic	580	feet	McHenry Comm. School Dist 15, private (multiple)	City of McHenry	-88.2716	42.33554
97	9	SE Direct Drainage	Wetland Restoration (riparian), Streambank Stabilization; Brush Management	Hydrologic; Urban	999, 580; 314	acres, feet; acres	private, City of McHenry, MCCD		-88.2792	42.33281
98	9	SE Direct Drainage	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	840, 880 / ?	acres	private		-88.2621	42.32373
99	9	SE Direct Drainage	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	840, 880 / ?	acres	unknown (ROW)		-88.2654	42.32151
100	9	SE Direct Drainage	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	840, 880 / ?	acres	unknown (ROW)		-88.2682	42.3214
101	9	SE Direct Drainage	Infiltration Trench or Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	847; 840, 880 / ?	feet; acres	unknown (ROW)	Centegra	-88.2773	42.31781
102	9	SE Direct Drainage	Infiltration Trench	Urban	847	feet	private (HOA?)		-88.2856	42.31549
103	9	SE Direct Drainage	Infiltration Trenches	Urban	847; 840, 880 / ?	feet; acres	private		-88.2806	42.31139

Table K-1. Site-specific BMPs, landowners, potential partners, and location coordinates *(cont.).*

Map #	SU #	Study Unit	BMP Type	Category	BMP Code	Units	Landowner	Potential Partners	Longitude	Latitude
104	9	SE Direct Drainage	Grass-Lined Channel w/ Permanent Veg. (vegetated swale) / bioswale; Permeable Pavement; Urb. Filter Strips	Urban	840, 880 / ?; 890; 835	acres; sq feet; acres	private	McHenry Corp. Cntr Assoc.	-88.2858	42.3107
105	9	SE Direct Drainage	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	840, 880 / ?	acres	private		-88.2869	42.30908
106	9	SE Direct Drainage	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	840, 880 / ?	acres	private	McHenry Corp. Cntr Assoc.	-88.2885	42.30718
107	9	SE Direct Drainage	Grassed Waterway	Agriculture	412	acres	private		-88.2886	42.30639
108	9	SE Direct Drainage	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale; Urban Filter Strip	Urban	840, 880 / ?; 835	acres	private		-88.301	42.31785
109	9	SE Direct Drainage	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale; Urban Filter Strip	Urban	840, 880 / ?; 835	acres	private		-88.3018	42.31737
110	9	SE Direct Drainage	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale; Urban Filter Strip	Urban	840, 880 / ?; 835	acres	private		-88.3022	42.31819

Table K-2. Site-specific BMPs with estimated quantities, pollutant load reductions, and costs.

Subwatershed #1 -- Upper Boone Creek										
Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
1	Urban Filter Strip (riparian buffer)	Urban	2.8	ac	STEPL	596.3	142.9	71.9	389.6	$ 93,000
	Stream Channel Restoration (remeandering)	Hydrologic	tbd	#	n/a	n/a	n/a	n/a	n/a	n/a
	Streambank Protection	Hydrologic	3,170	ft	IEPA sprdsht	136.0	68.0	46.0	n/a	$ 475,500
2	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	20	ac	STEPL	963.6	218.8	80.7	516.6	$ 288,100
3	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	20	ac	STEPL	963.6	218.8	80.7	516.6	$ 288,100
4	Grassed Waterway	Agriculture	0.1	ac	STEPL	0.3	0.1	0.1	0.0	$ 34,848
	WASCOB	Agriculture	1	#	*w/ gww*	---	---	---	---	$ 2,500
	Access Control / Fence (for livestock exclusion)	Livestock	500	ft	n/a	n/a	n/a	n/a	n/a	$ 1,000
5	Stream Channel Restoration (remeandering)	Hydrologic	unk	#	n/a	n/a	n/a	n/a	n/a	n/a
	Streambank Protection	Hydrologic	4,300	ft	IEPA sprdsht	17.0	9.0	6.0	n/a	$ 645,000
6	Ag Filter Strip	Agriculture	1.8	ac	STEPL	353.9	80.4	29.6	189.8	$ 40,000
7	Ag Filter Strip	Agriculture	1.5	ac	STEPL	298.6	67.8	25.0	160.1	$ 33,750
8	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.15	ac	STEPL	58.1	14.0	3.1	30.3	$ 156,816
Subwatershed #1 Totals						**3,387.4**	**819.7**	**343.2**	**1,802.9**	**$ 2,058,614**

Table K-2. Site-specific BMPs with estimated quantities, pollutant load reductions, and costs *(cont.)*.

Subwatershed #2 -- Powers Creek										
Map #	**BMP Type**	**BMP Category**	**Est. Qty**	**Units**	**Pollut. red. calc.**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (lb/yr)**	**BOD Reduction (lb/yr)**	**Estimated Cost ($)**
9	Wetland Restoration (riparian); Brush Management	Hydrologic; Agriculture	13	ac	STEPL	835.1	189.6	70.0	447.7	$ 187,265
10	Ag Filter Strip	Agriculture	5.2	ac	STEPL	995.4	226.0	83.4	533.7	$ 112,500
11	Grassed Waterway	Agriculture	0.49	ac	STEPL	577.0	95.1	25.7	446.3	$ 170,755
12	Grassed Waterway	Agriculture	0.37	ac	STEPL	113.7	20.2	6.0	95.7	$ 128,938
13	Ag Filter Strip	Agriculture	2.4	ac	STEPL	471.2	107.0	39.5	252.6	$ 53,250
14	Ag Filter Strip	Agriculture	1.3	ac	STEPL	250.0	56.7	20.9	134.0	$ 28,250
15	Ag Filter Strip	Agriculture	1.9	ac	STEPL	373.8	84.9	31.3	200.4	$ 42,250
16	Ag Filter Strip	Agriculture	0.8	ac	STEPL	146.0	33.1	12.2	78.3	$ 16,500
17	Ag Filter Strip	Agriculture	0.9	ac	STEPL	175.2	39.8	14.7	93.9	$ 19,800
18	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	35	ac	STEPL	562.1	127.6	47.1	301.4	$ 504,175
19	Stream Channel Restoration (daylighting)	Hydrologic	300	ft	n/a	n/a	n/a	n/a	n/a	$ 45,000
20	Ag Filter Strip	Agriculture	1.1	ac	STEPL	219.0	49.7	18.3	117.4	$ 24,750
21	Wetland Restoration	Hydrologic	17	ac	STEPL	442.3	92.4	37.3	1,712.3	$ 244,885
22	Urban Filter Strip (riparian buffer)	Urban	0.6	ac	STEPL	102.6	28.3	23.2	101.6	$ 18,000
	Streambank Protection (stabilization), Stream Channel Stabilization	Hydrologic	1200	ft	IEPA sprdsht	31.0	15.0	10.0	n/a	$ 180,000

Subwatershed #2 -- Powers Creek *(cont.)*

Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
23	Urban Filter Strip (riparian buffer)	Urban	0.4	ac	STEPL	114.5	32.9	29.7	125.4	$ 12,000
	Streambank Protection (stabilization), Stream Channel Stabilization	Hydrologic	800	ft	IEPA sprdsht	21.0	10.0	7.0	n/a	$ 120,000
24	Wetland Restoration	Hydrologic	5	ac	STEPL	1,151.2	197.7	72.0	2,621.0	$ 72,025
25	Urban Filter Strip (riparian buffer)	Urban	0.5	ac	STEPL	467.2	164.5	209.1	791.8	$ 16,500
	Streambank Protection (stabilization), Stream Channel Stabilization	Hydrologic	1100	ft	IEPA sprdsht	44.0	22.0	26.0	n/a	$ 165,000
26	Grade Stabilization Structures, Permanent Vegetation	Urban	0.02	#, ac	STEPL	0.7	0.2	0.1	2.7	$ 10,164
27	Grade Stabilization Structures, Level Spreader, Permanent Vegetation	Urban	0.01	#, ac	STEPL	6.3	1.0	0.0	0.0	$ 5,082
28	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale; Urban Filter Strip	Urban	0.15	ac	STEPL	8.3	1.4	0.9	0.0	$ 156,816
29	Water softener regeneration effluent capture & reuse	Other	1	#	n/a	n/a	n/a	n/a	n/a	$ 55,000
30	Rain Gardens; Grade Stabilization Structures	Urban	30000	sq ft	STEPL	0.7	0.2	0.3	5.3	$ 720,000
Subwatershed #2 Totals						**7,108.2**	**1,595.5**	**784.8**	**8,061.5**	**$ 3,108,905**

Table K-2. Site-specific BMPs with estimated quantities, pollutant load reductions, and costs *(cont.)*.

Subwatershed #3 -- Lower Boone Creek										
Map #	**BMP Type**	**BMP Category**	**Est. Qty**	**Units**	**Pollut. red. calc.**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (lb/yr)**	**BOD Reduction (lb/yr)**	**Estimated Cost ($)**
31	Oil & Grit Separator	Urban	1	#	STEPL	1.1	0.3	0.3	0.0	$ 8,000
	Permeable Pavement	Urban	18000	sq ft	*WW*	---	---	---	---	$ ---
32	Urban Filter Strip	Urban	4.3	acres	STEPL	274.3	62.3	23.0	147.1	$ 139,500
	Streambank Protection (stabilization)	Hydrologic;	9200	ft	IEPA sprdsht	42.0	22.0	19.0	n/a	$ 1,380,000
33	Urban Filter Strip	Urban	0.6	acres	STEPL	133.3	45.0	54.1	208.3	$ 20,250
	Streambank Protection (stabilization)	Hydrologic;	1400	ft	IEPA sprdsht	362.0	181.0	181.0	n/a	$ 210,000
34	Oil & Grit & Trash Separator	Urban	0	#	STEPL	1.8	0.1	0.2	0.0	$ 8,000
35	Urban Filter Strip	Urban	2.3	ac	STEPL	1,77.3	45.0	28.6	138.7	$ 75,000
	Streambank Protection (stabilization)	Hydrologic;	3600	ft	IEPA sprdsht	551.0	275.0	275.0	n/a	$ 540,000
36	Urban Filter Strip (riparian buffer)	Urban	1.7	ac	STEPL	127.7	31.7	18.6	93.5	$ 56,250
37	Wetland Restoration (riparian); Brush Management	Hydrologic	60	ac	STEPL	963.6	218.8	80.7	516.6	$ 864,300
38	Urban Filter Strip (shoreline buffer)	Urban	0.2	ac	STEPL	58.0	18.3	19.8	78.8	$ 6,450
	Shoreline Protection (stabilization)	Hydrologic	860	ft	IEPA sprdsht	18.0	10.0	11.0	n/a	$ 129,000
39	Wetland Restoration (riparian); Brush Management	Hydrologic	30	ac	STEPL	481.8	109.4	40.4	258.3	$ 432,150
40	Ag Filter Strip	Agriculture	3.3	ac	STEPL	631.8	143.4	52.9	338.7	$ 71,400
41	Bioretention Facility	Urban	900	sq ft	STEPL	2.0	0.6	0.3	19.0	$ 21,600

Subwatershed #3 -- Lower Boone Creek *(cont.)*

Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
42	Grassed Waterway	Agriculture	1.29	ac	STEPL	246.8	43.1	12.6	276.4	$ 449,539
	WASCOB	Agriculture	3	#	*w/ gww*	---	---	---	---	$ 7,500
	Access Control / Fence (for livestock exclusion)	Livestock	4000	ft		n/a	n/a	n/a	n/a	$ 8,000
43	Wetland Restoration (online/riparian)	Hydrologic	18	ac	STEPL	578.1	131.3	48.4	310.0	$ 259,290
	Dam removal	Hydrologic	1	#	n/a	n/a	n/a	n/a	n/a	$ 300,000
44	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	40	ac	STEPL	1,284.7	291.7	107.6	688.8	$ 576,200
45	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	55	ac	STEPL	883.3	200.5	74.0	473.6	$ 792,275
46	Ag Filter Strip	Agriculture	2.0	ac	STEPL	376.0	85.4	31.5	201.6	$ 42,500
47	Ag Filter Strip	Agriculture	1.5	ac	STEPL	297.3	67.5	24.9	159.4	$ 33,600
48	Urban Filter Strip (riparian buffer)	Urban	0.8	ac	STEPL	227.3	68.4	68.0	277.7	$ 24,600
	Streambank Protection (stabilization), Stream Channel Stabilization	Hydrologic	830	ft	IEPA sprdsht	36.0	18.0	12.0	n/a	$ 124,500
Subwatershed #3 Totals						**7,755.1**	**2,068.7**	**1,183.8**	**4,186.3**	**$ 6,579,904**

Table K-2. Site-specific BMPs with estimated quantities, pollutant load reductions, and costs *(cont.)*.

Subwatershed #4 -- McCullom Lake										
Map #	**BMP Type**	**BMP Category**	**Est. Qty**	**Units**	**Pollut. red. calc.**	**N Reduction (lb/yr)**	**P Reduction (lb/yr)**	**Sed. Reduction (lb/yr)**	**BOD Reduction (lb/yr)**	**Estimated Cost ($)**
49	Bioretention Facility	Urban	2750	sq ft	STEPL	1.8	1.2	0.0	0.0	$ 66,000
50	Urban Filter Strip (shoreline buffer)	Urban	1.8	acres	STEPL	178.0	49.8	42.3	182.8	$ 60,210
	Shoreline Protection (stabilization)	Hydrologic	3670	ft	IEPA sprdsht	22.5	11.5	12.0	n/a	$ 550,500
51	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.05	acres	STEPL	0.5	0.1	0.0	0.0	$ 52,272
52	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.02	acres	STEPL	24.4	4.1	1.1	0.0	$ 20,909
	Oil & Grit Separator	Urban	1	#	*w/ veg swl*	---	---	---	---	$ 8,000
Subwatershed #4 Totals						**227.2**	**66.8**	**55.4**	**182.8**	**$ 757,891**

Table K-2. Site-specific BMPs with estimated quantities, pollutant load reductions, and costs *(cont.)*.

Subwatershed #5 -- Dutch Creek										
Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
53	Wetland Restoration (riparian); Brush Management	Hydrologic	30	ac	STEPL	963.6	218.8	80.7	516.6	$ 432,150
54	Stream Channel Restoration (remeandering)	Hydrologic	tbd	#	n/a	n/a	n/a	n/a	n/a	n/a
	Streambank Protection	Hydrologic	2900	ft	IEPA sprdsht	11.0	6.0	4.0	n/a	$ 435,000
55	Ag Filter Strip	Agriculture	4.1	ac	STEPL	796.3	180.8	66.7	426.9	$ 90,000
56	Streambank Protection (stabilization)	Hydrologic	100	ft	IEPA sprdsht	15.0	7.0	5.0	n/a	$ 30,000
57	Ag Filter Strip	Agriculture	0.9	ac	STEPL	164.1	37.3	13.7	88.0	$ 18,550
58	Ag Filter Strip	Agriculture	2.4	ac	STEPL	471.2	107.0	39.5	252.6	$ 53,250
59	Ag Filter Strip	Agriculture	4.6	ac	STEPL	895.9	203.4	75.0	480.3	$ 101,250
60	Grassed Waterway	Agriculture	0.83	ac	STEPL	143.2	41.3	13.0	178.7	$ 289,238
	WASCOB	Agriculture	2	#	*w/ gww*	---	---	---	---	$ 5,000
61	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.11	ac	STEPL	88.8	16.4	4.7	53.9	$ 114,998
62	Ag Filter Strip	Agriculture	0.7	ac	STEPL	46.5	5.7	0.6	8.5	$ 15,246
	Access Control / Fence (for livestock exclusion)	Livestock	1100	ac / ft	n/a	n/a	n/a	n/a	n/a	$ 2,200
63	Ag Filter Strip	Agriculture	4.8	ac	STEPL	915.8	207.9	76.7	491.0	$ 103,500
64	Ag Filter Strip	Agriculture	2.2	ac	STEPL	415.0	94.2	34.8	222.5	$ 46,900
65	Grassed Waterway	Agriculture	0.55	ac	STEPL	185.8	32.0	8.9	142.9	$ 191,664
66	Ag Filter Strip	Agriculture	3.7	ac	STEPL	716.7	162.7	60.0	384.3	$ 81,000

Subwatershed #5 -- Dutch Creek *(cont.)*

Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
67	Grassed Waterway	Agriculture	0.58	ac	STEPL	35.1	6.4	2.4	61.8	$ 202,118
68	Grassed Waterway	Agriculture	0.75	ac	STEPL	133.2	30.2	11.2	71.4	$ 261,360
69	Ag Filter Strip	Agriculture	0.7	ac	STEPL	64.9	11.7	3.4	54.2	$ 15,050
70	Ag Filter Strip	Agriculture	2.2	ac	STEPL	415.0	94.2	34.8	222.5	$ 46,900
71	Grassed Waterway	Agriculture	0.87	ac	STEPL	52.7	9.6	2.8	44.8	$ 303,178
72	Grassed Waterway	Agriculture	1.84	ac	STEPL	164.4	28.5	8.0	127.6	$ 641,203
73	Grassed Waterway	Agriculture	1.45	ac	STEPL	239.3	40.8	11.3	180.2	$ 505,296
74	Grassed Waterway	Agriculture	0.98	ac	STEPL	307.9	51.9	14.2	226.5	$ 341,510
75	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.06	ac	STEPL	4.2	0.9	0.7	1.0	$ 62,726
76	Grassed Waterway	Agriculture	2.2	ac	STEPL	256.4	43.6	12.0	192.0	$ 766,656
Subwatershed #5 Totals						**7,501.8**	**1,638.1**	**584.2**	**4,428.3**	**$ 5,155,945**

Table K-2. Site-specific BMPs with estimated quantities, pollutant load reductions, and costs *(cont.).*

Subwatershed #6 -- Dutch Creek Tributary										
Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
77	Urban Filter Strip (riparian buffer)	Urban	0.7	ac	STEPL	77.4	22.8	21.8	90.1	$ 22,500
	Stream Channel Restoration (CLC removal)	Hydrologic	1500	#	n/a	n/a	n/a	n/a	n/a	$ 225,000
78	Urban Filter Strip (riparian buffer)	Urban	1.9	ac	STEPL	61.6	14.0	5.2	33.0	$ 62,625
79	Wetland Restoration (riparian); Brush Management	Hydrologic	15	ac	STEPL	240.9	54.7	20.2	129.2	$ 216,075
	Urban Filter Strip	Urban	1.2	ac	*w/ wtld restor*	---	---	---	---	$ 38,250
80	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	130	ac	STEPL	2,087.7	474.0	174.9	1,119.3	$ 1,872,650
81	Grassed Waterway	Agriculture	0.18	ac	STEPL	144.5	25.2	7.1	113.4	$ 62,726
	WASCOB	Agriculture	1	#	*w/ gww*	---	---	---	---	$ 2,500
	Access Control / Fence (for livestock exclusion)	Livestock	500	ft	n/a	n/a	n/a	n/a	n/a	$ 1,000
82	Grassed Waterway	Agriculture	0.41	ac	STEPL	255.4	43.4	11.9	191.2	$ 142,877
	WASCOB	Agriculture	1	#	*w/ gww*	---	---	---	---	$ 2,500
	Access Control / Fence (for livestock exclusion)	Livestock	700	ft	n/a	n/a	n/a	n/a	n/a	$ 1,400
83	Grassed Waterway	Agriculture	1.93	ac	STEPL	202.2	34.7	9.7	154.4	$ 672,566
	WASCOB	Agriculture	2	#	*w/ gww*	---	---	---	---	$ 5,000
84	Grassed Waterway	Agriculture	0.92	ac	STEPL	237.8	40.5	11.2	179.2	$ 320,602
	WASCOB	Agriculture	1	#	*w/ gww*	---	---	---	---	$ 2,500
Subwatershed #6 Totals						**3,307.6**	**709.2**	**261.9**	**2,009.8**	**$ 3,650,771**

Table K-2. Site-specific BMPs with estimated quantities, pollutant load reductions, and costs *(cont.)*.

Subwatershed #7 -- NE Direct Drainage										
Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
85	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.79	ac	STEPL	156.2	27.1	7.3	22.6	$ 825,898
86	Wetland Restoration (riparian); Brush Management	Hydrologic; Urban	7	ac	STEPL	224.8	51.0	18.8	120.5	$ 100,835
87	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale)	Urban	0.05	ac	STEPL	52.9	8.9	3.0	0.0	$ 52,272
	Access Control / Fence (for livestock exclusion)	Livestock	200	ft	n/a	n/a	n/a	n/a	n/a	$ 400
88	Grassed Waterway	Agriculture	0.51	ac	STEPL	50.0	9.1	2.7	42.6	$ 177,725
89	Grassed Waterway	Agriculture	0.55	ac	STEPL	33.4	6.2	1.8	29.4	$ 191,664
Subwatershed #7 Totals						**517.4**	**102.4**	**33.7**	**215.1**	**$ 1,348,793**

Subwatershed #8 -- Central Direct Drainage										
Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
90	Grassed Waterway	Agriculture	0.41	ac	STEPL	0.7	0.3	0.2	11.3	$ 142,877
Subwatershed #8 Totals						**0.7**	**0.3**	**0.2**	**11.3**	**$ 142,877**

Table K-2. Site-specific BMPs with estimated quantities, pollutant load reductions, and costs *(cont.)*.

Subwatershed #9 -- SE Direct Drainage										
Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
91	Oil & Grit Separator	Urban	2	#	STEPL	0.1	0.1	0.0	0.0	$ 16,000
	Permeable Pavement	Urban	24000	sq ft	WW	---	---	---	---	$ ---
92	Urban Filter Strip (shoreline buffer)	Urban	0.2	ac	STEPL	67.2	20.3	20.3	82.6	$ 6,000
	Shoreline Protection (stabilization)	Hydrologic	1500	ft	IEPA sprdsht	5.0	3.0	3.0	n/a	$ 225,000
93	Urban Filter Strip (riparian buffer)	Urban	0.6	ac	STEPL	171.9	47.4	38.9	170.1	$ 20,100
	Streambank Protection (stabilization);	Hydrologic	1340	ft	IEPA sprdsht	86.0	44.0	51.0	n/a	$ 201,000
94	Rain Gardens	Urban	500	sq ft	STEPL	0.2	0.1	0.0	0.0	$ 12,000
	Rain barrels	Urban	5	#	n/a	n/a	n/a	n/a	n/a	$ 375
	Education	Urban	1	#	n/a	n/a	n/a	n/a	n/a	$ 5,000
95	Urban Filter Strip (riparian buffer)	Urban	1.0	ac	STEPL	98.7	27.9	24.2	103.6	$ 32,625
96	Urban Filter Strip (riparian buffer)	Urban	0.5	ac	STEPL	79.6	25.3	27.7	109.6	$ 17,250
	Streambank Protection (stabilization)	Hydrologic	2400	ft	IEPA sprdsht	54.0	27.0	24.0	n/a	$ 360,000
97	Wetland Restoration (riparian); Brush Management	Urban	60	ac	STEPL	1,086.8	266.2	147.7	763.2	$ 864,300
	Streambank Protection (stabilization)	Hydrologic	1300	ft	IEPA sprdsht	34.0	17.0	12.0	n/a	$ 195,000

Subwatershed #9 -- SE Direct Drainage *(cont.)*

Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
98	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.21	ac	STEPL	16.4	2.8	1.8	0.0	$ 219,542
99	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.11	ac	STEPL	7.8	1.5	0.4	5.5	$ 114,998
100	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.03	ac	STEPL	3.8	0.6	0.2	0.0	$ 31,363
101	Infiltration Trench (or Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale)	Urban	0.02	ac	STEPL	0.9	0.3	0.3	0.0	$ 20,909
102	Infiltration Trench	Urban	0.05	ac	STEPL	13.4	4.1	4.9	0.0	$ 52,272
103	Infiltration Trenches	Urban	0.09	ac	STEPL	3.8	0.2	0.3	0.0	$ 94,090
104	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.01	ac	STEPL	5.6	0.8	0.4	0.0	$ 10,454
	Permeable Pavement	Urban	15400	sq ft	WW	---	---	---	---	$ ---
	Urban Filter Strips	Urban	0.16	ac	*w/ veg swl*	---	---	---	---	$ 5,250
105	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.03	ac	STEPL	2.8	0.4	0.3	0.0	$ 31,363
106	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.04	ac	STEPL	5.8	0.5	0.3	0.0	$ 41,818
107	Grassed Waterway	Agriculture	0.46	ac	STEPL	30.1	5.9	3.6	114.8	$ 160,301

Subwatershed #9 -- SE Direct Drainage *(cont.)*

Map #	BMP Type	BMP Category	Est. Qty	Units	Pollut. red. calc.	N Reduction (lb/yr)	P Reduction (lb/yr)	Sed. Reduction (lb/yr)	BOD Reduction (lb/yr)	Estimated Cost ($)
108	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.19	ac	STEPL	13.0	2.2	1.4	0.0	$ 198,634
	Urban Filter Strip	Urban	0.05	ac	*w/ veg swl*	---	---	---	---	$ 1,725
109	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.33	ac	STEPL	6.4	1.1	0.7	0.3	$ 344,995
	Urban Filter Strip	Urban	0.04	ac	*w/ veg swl*	---	---	---	---	$ 1,350
100	Grass-Lined Channel w/ Permanent Vegetation (vegetated swale) / bioswale	Urban	0.33	ac	STEPL	38.4	6.6	4.2	0.0	$ 344,995
	Urban Filter Strip	Urban	0.04	ac	*w/ veg swl*	---	---	---	---	$ 1,406
Subwatershed #9 Totals						**1,831.9**	**505.2**	**367.7**	**1,349.7**	**$ 3,630,115**

Boone-Dutch Planning Area Grand Totals	**31,637.2**	**7,505.8**	**3,614.8**	**22,247.8**	**$ 26,433,815**

The Chicago Metropolitan Agency for Planning (CMAP) is our region's official comprehensive planning organization. The agency and its partners are developing ON TO 2050, a new comprehensive regional plan to help the seven counties and 284 communities of northeastern Illinois implement strategies that address transportation, housing, economic development, open space, the environment, and other quality-of-life issues. See www.cmap.illinois.gov for more information.

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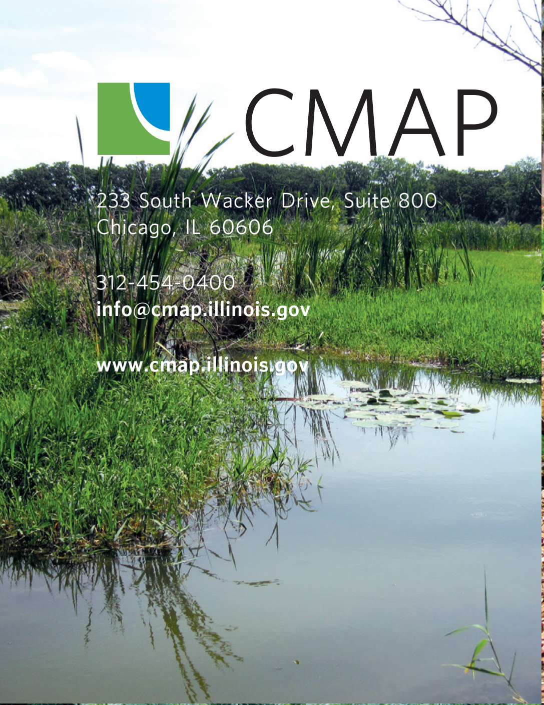







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