CHAPTER 2
LITTLE CALUMET-GALIEN SUB-BASIN

HUC 04040001

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Little Calumet-Galien Sub-Basin

2.1 Part I- Watershed Inventory

2.1.1 Overview

The Little Calumet-Galien sub-basin (HUC 04040001) stretches across the southern shore of Lake Michigan from Berrien County, Michigan to Cook County, Illinois (Figure 1). Within Indiana, the sub-basin includes nearly 512 square miles of northern Lake, Porter, LaPorte, and St. Joseph Counties. Its land cover is a diverse mix of agriculture, forest, grassland, wetland, and urban/rural development. Of the 533 miles of stream and ditch that drain the landscape to Lake Michigan, nearly 277 miles (44%) are impaired (303d List of Impaired Waterbodies- IDEM, 2008). The most common impairments include *E. coli* (132 miles) and Impaired Biotic Communities (109 miles). In some cases streams have multiple impairments within the same reach (69 miles). Some of the major tributaries in the sub-basin include the Little Calumet River, Deep River, Salt Creek, Trail Creek, and Galien River.

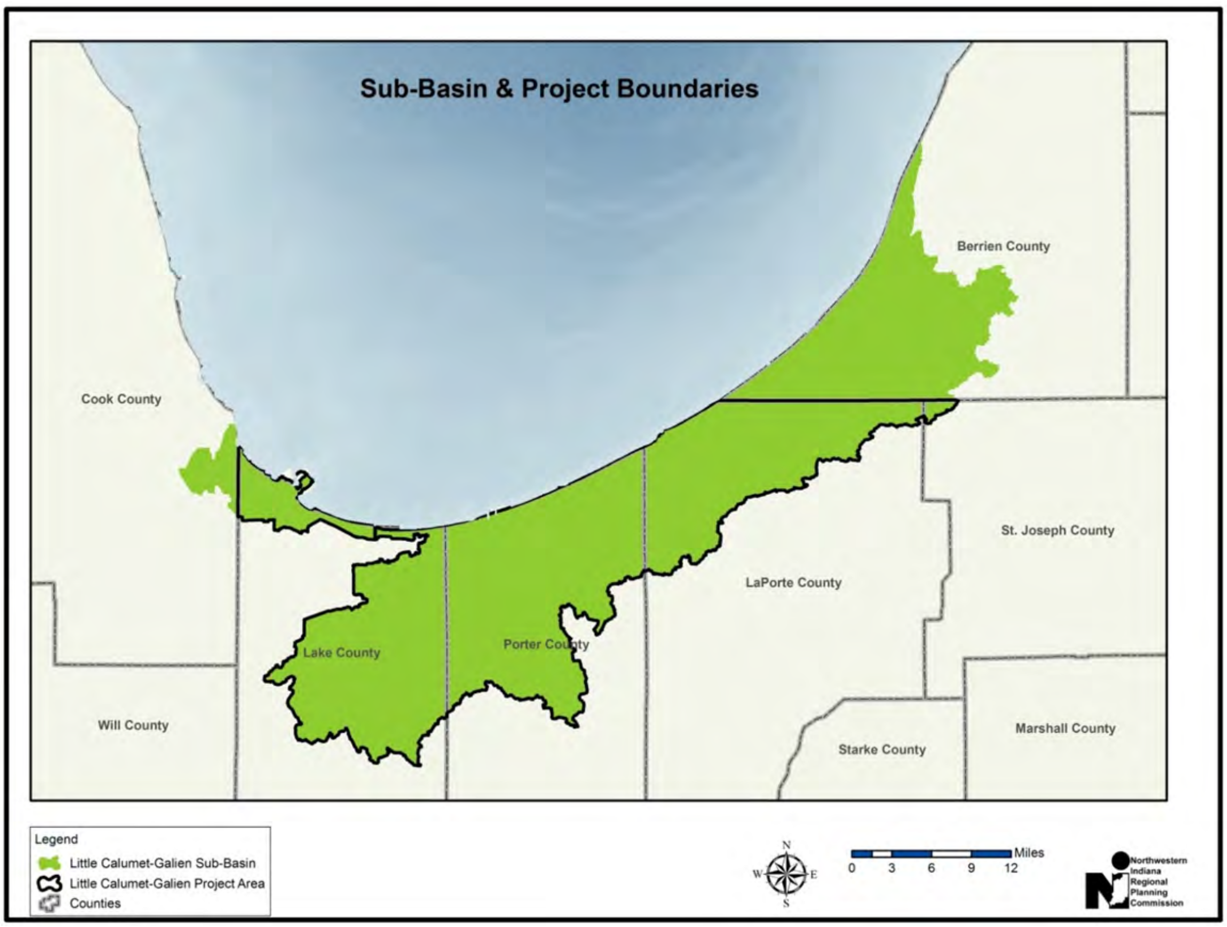

Figure 1. Little Calumet-Galien Sub-Basin & Project Boundaries

2.1.2 Geology/Topography

The topography of the sub-basin is almost entirely the result of erosional and depositional action from the last glaciation. The Valparaiso Moraine, a remnant from the Wisconsinan glacial period, forms much of the drainage divide between the Little Calumet-Galien to the north and Kankakee to the south (IDNR, 1994). The sub-basin grades away from an elevation of 950 feet along the Valparaiso Moraine to a low of 574 feet near Lake Michigan (Figure 2).

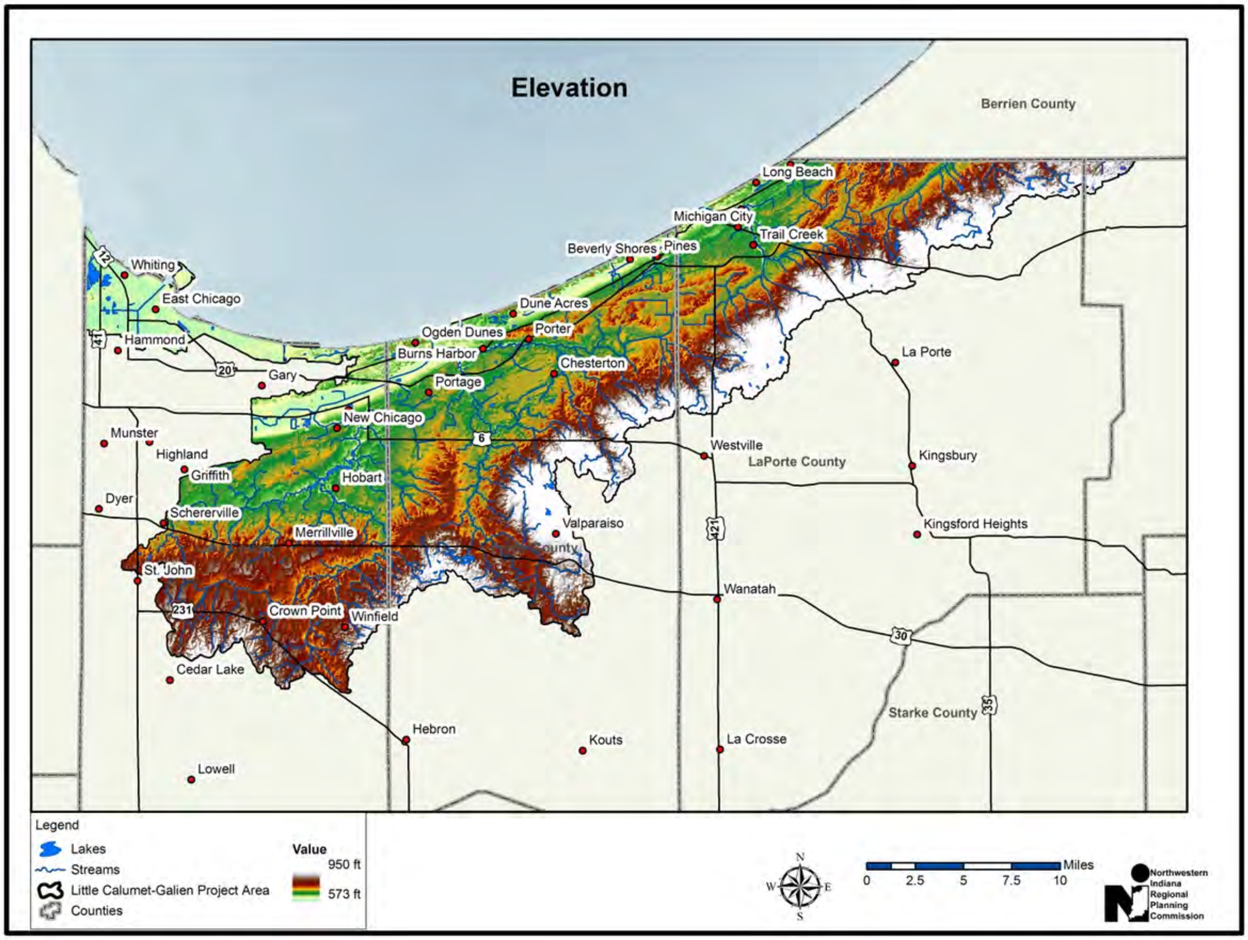

Figure 2. Elevation

The Little Calumet-Galien sub-basin is positioned across two physiographic regions including the Lake Michigan Border and Valparaiso Morainal Complex (Figure 3). Physiographic regions are based on topography and the effect of glaciers on the landscape. The Lake Michigan Border forms a 4-11 mile wide band along the southern shore of Lake Michigan which includes a complex of beach ridges, dunes, moraines and lake floor deposits and related washed surfaces. The Valparaiso Morainal Complex forms a 13-20 mile wide band that is roughly concentric with the Lake Michigan shoreline. Its most dominate land forms are moraines and alluvial fans that grade to the southeast. Lakes can be found in the depressions of till areas and tunnel valleys. Few natural lakes exist in the depressions of the alluvial fans because of their sandy nature and low water table (IGS, 2000).

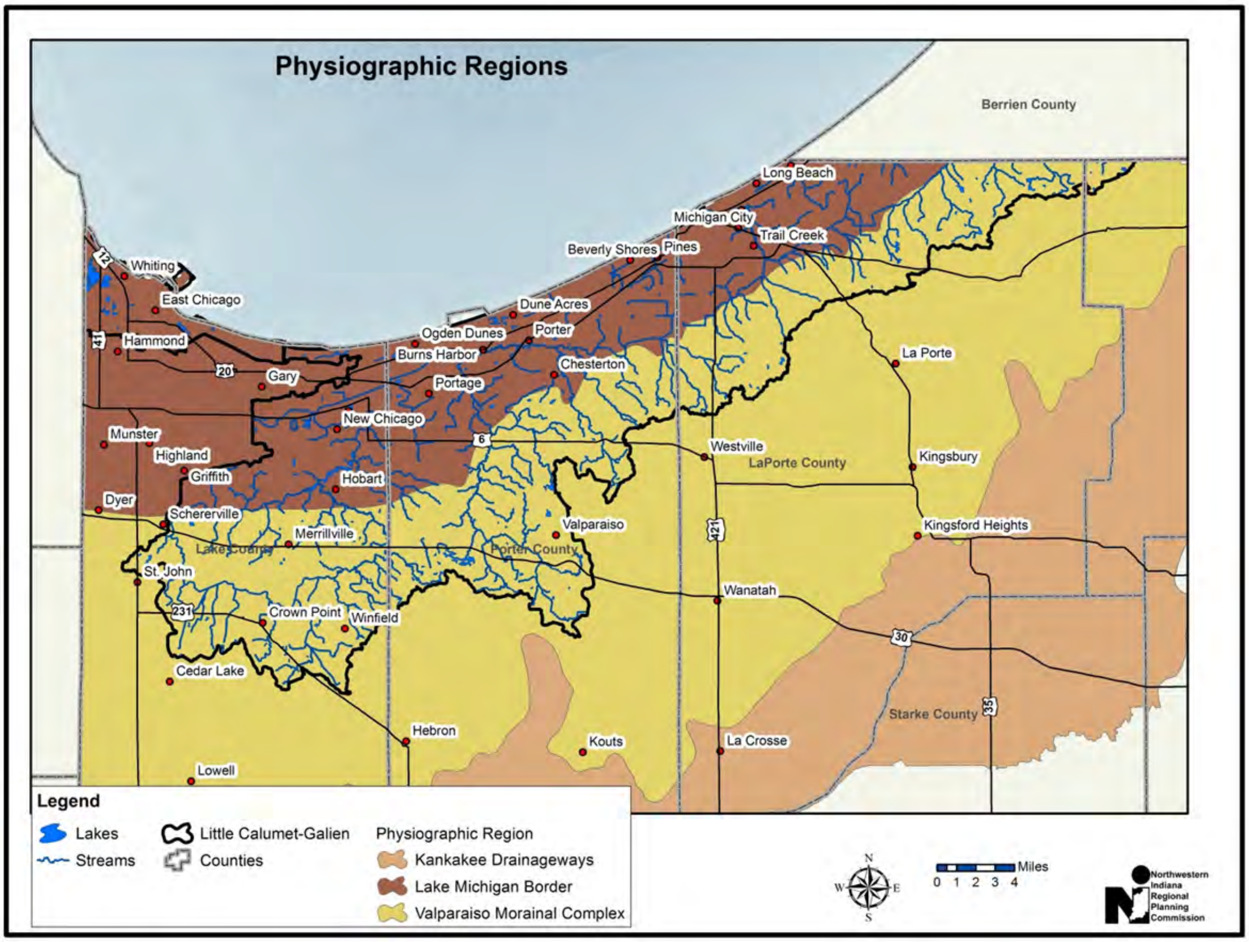

Figure 3. Physiographic Region

Rain fall or snow melt on steeply-sloped land runs off more quickly than on flat land. The increase in runoff velocity makes areas with steep slopes more prone to erosion depending on a number of factors including soil type and plant cover. Additionally slope affects the shape, form and stability of streams. To calculate percent slope, 30-meter resolution elevation data from the National Elevation Dataset was analyzed using ArcMap 10's Spatial Analyst. The steepest slopes in the sub-basin can be found at the headwaters along the Valparaiso Moraine and the dunes along the Lake Michigan shoreline (Figure 4). Some of the most extreme slopes approach nearly 23%. In 2007, IDEM published the Indiana Storm Water Quality Manual which defined "steep" slopes as those exceeding 15% (www.in.gov/idem/4899.htm). The manual recommended development be prohibited on these steep slopes because of the high potential for soil erosion, degradation of surface water, and excessive stormwater runoff.

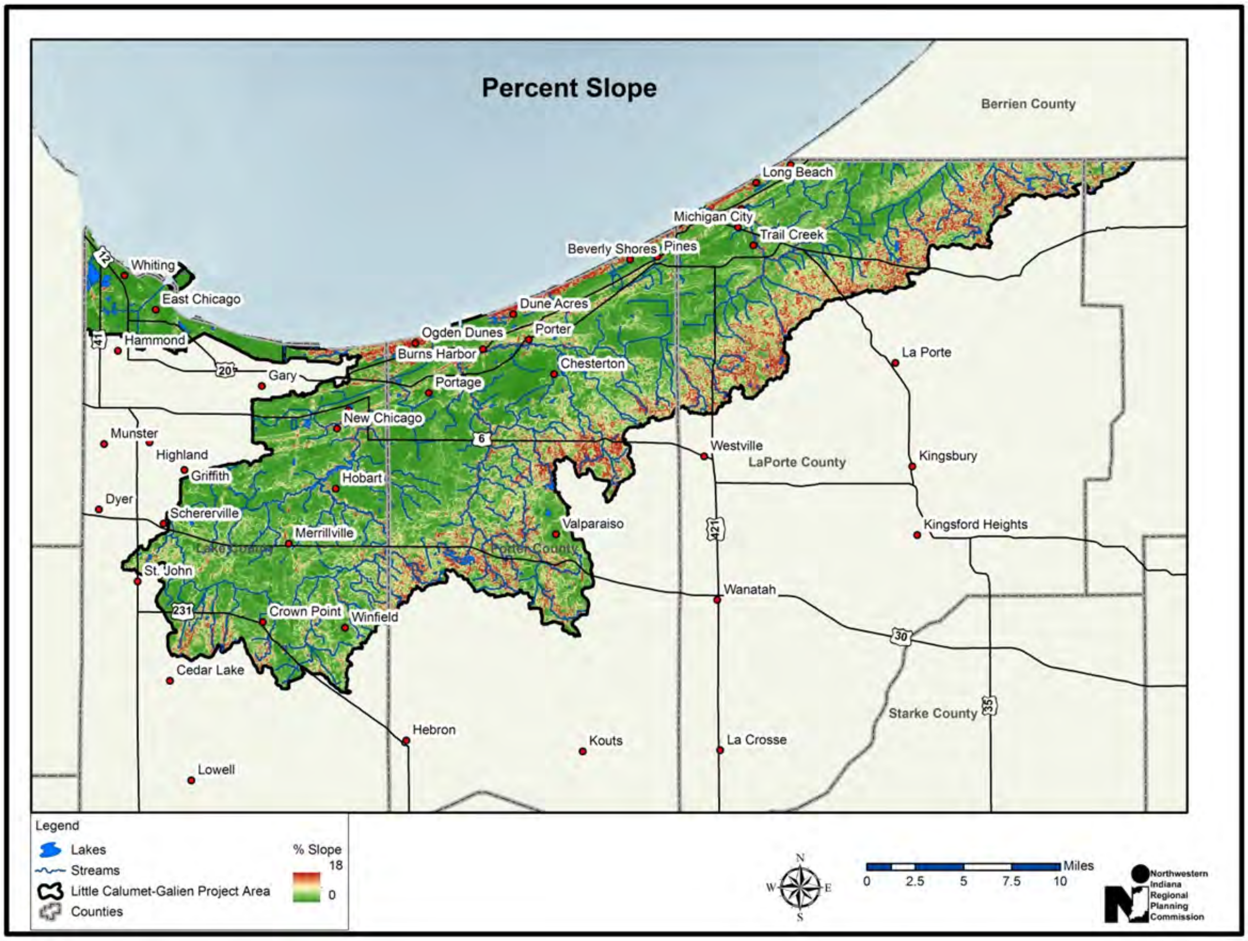

Figure 4. Percent Slope

2.1.3 Hydrology

Hydrology in the sub-basin is markedly different than what once existed due to urbanization and industrialization of the region during the 1800's and 1900's. The most extensive changes have occurred along the Lake Michigan shoreline and the Little Calumet River. Following the construction of harbors and canals, industries moved lakeward filling nearshore areas with slag and marshes and swamps with sand from nearby dunes and beaches. A series of levees and flood control projects were completed to protect low lying, flood prone urban areas along the mainstem of the Little Calumet River and its tributaries in northern Lake County. Additionally drainage improvement projects altered surface hydrology to such an extent that land areas that were once part of the Little Calumet-Galien now empty into the Gulf of Mexico through the Chicago sub-basin.

Today nearly 533 miles of stream and ditch transect the landscape of the sub-basin based on information from USGS National Hydrography Dataset (Figure 5). The Little Calumet River is the largest drainage network of the sub-basin including Deep River, Turkey Creek, Salt Creek, Coffee Creek and their respective tributaries. Further to the east several smaller drainage networks flow directly into Lake Michigan, including Dunes Creek, Derby Ditch, Trail Creek, White Ditch and the Galena River (DNR, 1994).

Many of the sub-basin's lakes are located in the urban and industrialized regions of Lake County and along the Valparaiso Moraine. In total there are approximately 234 lakes/ponds covering a combined surface area of 3,274 acres. Most are relatively small, unnamed lakes with a median size of 7.6 acres (NIRPC analysis, 2011). Some of these lakes were formed as a result of past glacial activity others are man-made. Most of the artificial lakes consist of old gravel and borrow pits or impoundments of rivers and streams. Lake George in Hobart and Lake Louise near Valparaiso are the two largest impoundments in the sub-basin. An unknown number of lakes have been destroyed or greatly reduced in size due to drainage or filling for development purposes (DNR, 1994)

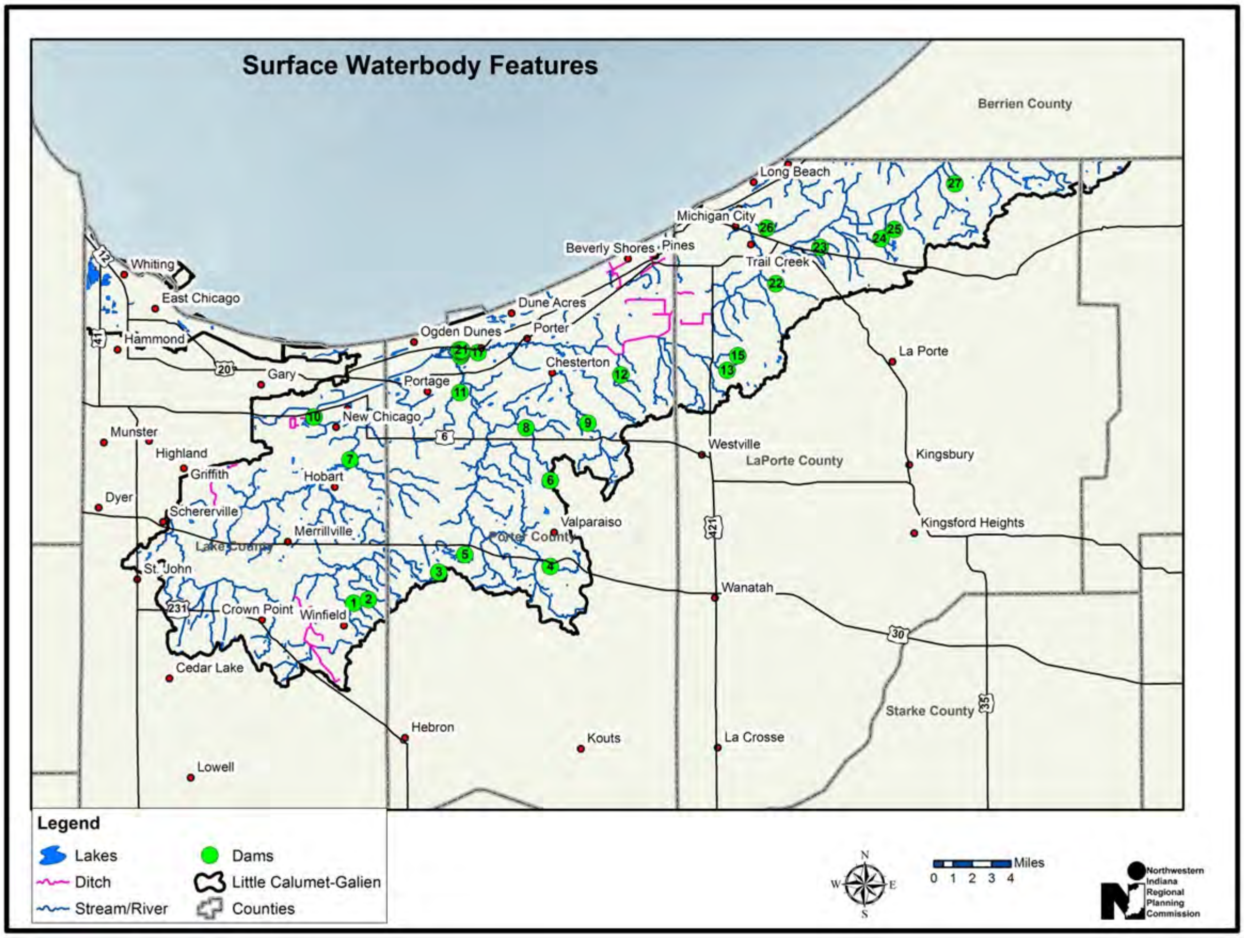

Figure 5. Surface Waterbody Features

The lakes and rivers of the sub-basin provide many recreational opportunities including boating, fishing, swimming and nature watching. There are approximately 21 marinas along or near the lakefront that provide the public with access to Lake Michigan and small inland waterways. In total 42 total miles of river and stream pass through local, state, and federal park boundaries within the sub-basin (NIRPC analysis, 2011). Nearly 194 miles of tributary are designated by the state as trout and salmon streams. The Department of Natural Resources (DNR) maintains a web-based mapping application that shows the locations and features of public access and fishing areas throughout the state. It is available at http://www.in.gov/dnr/fishwild/3591.htm.

In total there are X miles of regulated drain within the sub-basin (Figure 6). A regulated drain (aka legal drain) is an open channel or closed tile/sewer that is subject to the provisions of the Indiana drainage code, I.C.-36-9-27. Under this code, a drainage board has the authority to construct, maintain, reconstruct or vacate a regulated drain. The board can maintain the regulated drain by dredging, clearing, tile repair, obstruction removal or other work necessary to keep the drain in proper working order based on its original specifications.

Figure 6. Regulated Drains

Dams are another common source of hydromodification in the sub-basin. They were generally built to store and provide water for mechanical power generation (e.g., waterwheels to mill grain) and recreation (e.g., boating and fishing). However, dams can also be associated with a number of negative impacts including changes to hydrology, water quality, habitat, and river morphology. Human activities, such as agricultural and urban land uses, can contribute to contaminant and sediment loads to the impoundments by these dams (EPA, 2007).

There are 27 dams located within the sub-basin based upon information obtained from Indiana Map (http://www.indianamap.org/index.html) (Figure 5). General location information, drainage area, impoundment surface area and the drainage area to surface area ratio is presented below in Table 1. Dams. The largest dam by storage capacity is the Lake George dam in Hobart. It also has one of the largest drainage to surface area ratios for impoundments greater than ten acres. This makes Lake George particularly susceptible to nonpoint source pollution impacts including sedimentation and excess nutrient loading.

#	Name	County	Drainage Area (mi^2)	Surface Area (ac)	DA/SA Ratio*
1	Hooseline & Molchan Lake Dam	Lake	0.65	12	34.7
2	Doubletree Lake Estates Dam (West)	Lake	-	90	-
3	Norman Olson Lake Dam	Porter	0.23	14	10.5
4	Lake Of The Woods Dam	Porter	6.3	20.4	197.6
5	Lake Louise Dam	Porter	2.56	228	7.2
6	Loomis Lake Dam	Porter	0.6	49.7	7.7
7	Lake George Dam	Lake	124	242	328
8	Roy Nicholson Dam (In-Channel)	Porter	3	1	1920
9	Old Longs Mill Dam	Porter	7.59	9.9	490.7
10	Hobart Deep River Dam (In-Channel)	Lake	141	0	-
11	Lake Of The Woods Dam	Porter	2.73	9	194.1
12	Rice Lake Dam	Porter	2.71	17	102.0
13	Camp Red Mill Lake Dam	LaPorte	1.84	21.7	54.3
14	Bethlehem Steel Check Dam No. 1 (In-Channel)	Porter	2	0	-
15	Walton Lake Dam	LaPorte	0.36	19.4	11.9
16	Bethlehem Steel Check Dam No. 2 (In-Channel)	Porter	2	0	-
17	Linde Dam (In-Channel)	Porter	70	0	-
18	Bethlehem Steel Check Dam No. 3 (In-Channel)	Porter	2	0	-
19	Bethlehem Steel Check Dam No. 5 (In-Channel)	Porter	0	0	-
20	Bethlehem Steel Check Dam No. 6	Porter	0	0	-
21	Bethlehem Steel Check Dam No. 4 (In-Channel)	Porter	2	0	-
22	Lakeside Estates Dam	LaPorte	2.37	2.5	606.7
23	Seybert Lake Dam	LaPorte	2	1	1280
24	Jack Ragle Dam (In-Channel)	LaPorte	3	1	1920
25	La Lumiere	LaPorte	0.18	15	7.7
26	Michigan City Golf Course Dam	LaPorte	3.7	1	2368
27	Wallace Lake Dam	LaPorte	1.13	38	19.0

Table 1. Dams

2.1.4 Soils

Hydric Soils

Hydric soils are one of three characteristics used to identify wetlands. The National Technical Committee for Hydric Soils (NTCHS) defines hydric soils as *soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part*. These soils, under natural conditions, are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic (water-loving) vegetation. Areas where hydric soils are present but wetlands no longer exist can be useful in identifying potential wetland restoration opportunities. Hydric soils data from the Natural Resources Conservation Services (NRCS) are displayed for the sub-basin in Figure 7. Hydric Soils. In total there are approximately 123 mi^2 of hydric soils within the sub-basin.

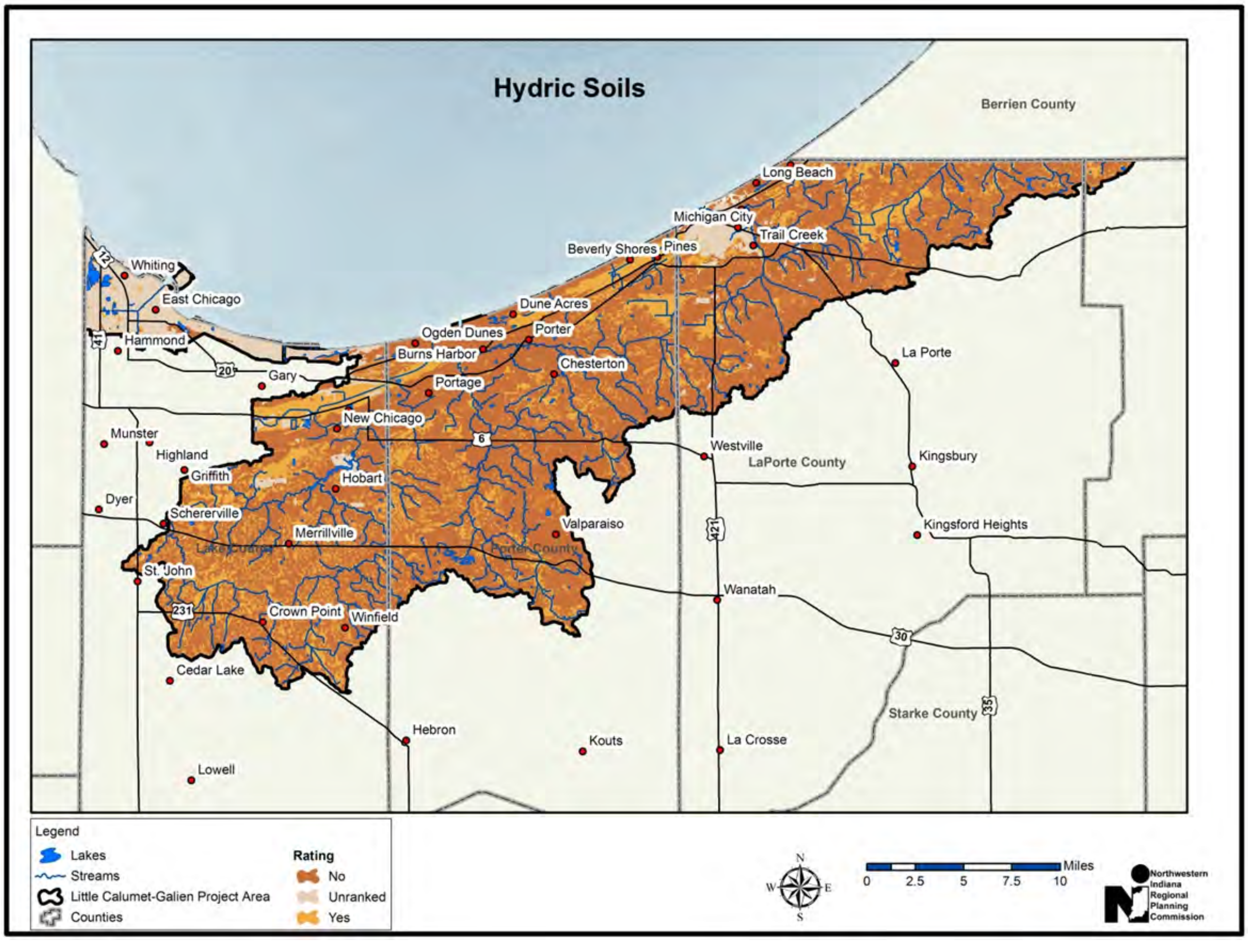

Figure 7. Hydric Soils

Hydrologic Groups

A hydrologic group, as defined by the NRCS, is a group of soils that have similar runoff potential under similar storm and cover conditions. The influence of ground cover is treated independently and the slope of the soil surface is also not considered in assigning hydrologic soil groups. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. This information is useful in identifying nonpoint source pollutant contributions areas coupled with land use and prioritizing implementation measures to reduce pollutant loading from runoff.

The hydrologic soil groups found in the sub-basin are displayed in Figure 8. Hydrologic Soil Groups and described as follows:

Group A- Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. They account for 23% of the sub-basin.

Group B- Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. They account for 23% of the sub-basin.

Group C- Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. They account for 38% of the sub-basin.

Group D- Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. They account for 3% of the sub-basin.

Unclassified- Soils are highly disturbed such as in urban areas. They account for 13% of the sub-basin.

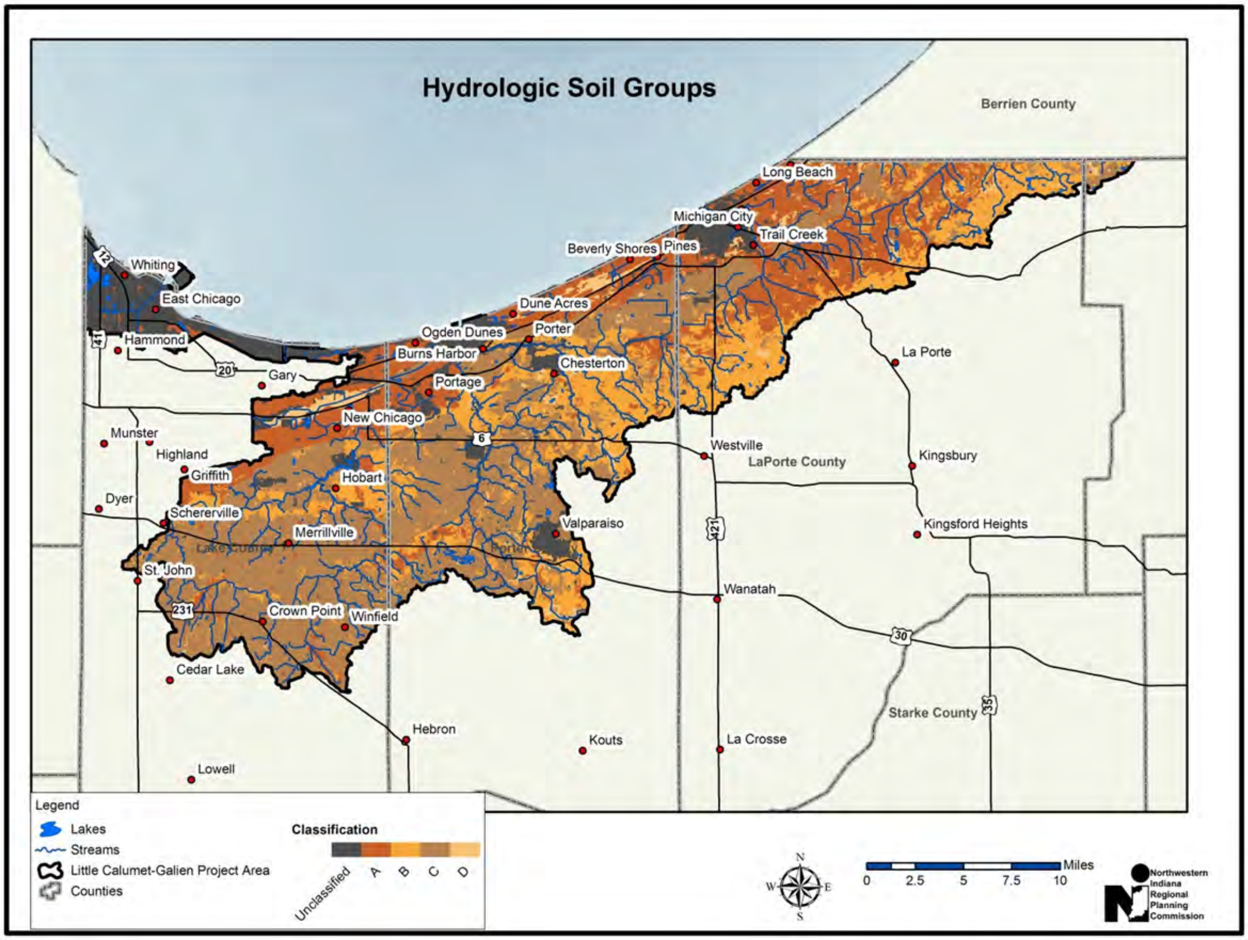

Figure 8. Hydrologic Soil Groups

Septic System Suitability

Conventional onsite sewage disposal systems (a.k.a. septic systems), while common, are not suitable for all areas. Among the limitations which might preclude installation of a conventional system are: high groundwater tables; shallow limiting layers of bedrock or fragipan; very slowly or rapidly permeable soils; topography; and lot size.

Figure 9 shows soil limitations within the sub-basin for conventional septic systems that use absorption fields for treatment. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. The data used to generate this figure was obtained from the NRCS SSURGO datasets for each county and processed in ArcMap with the NRCS Soil Viewer Tool http://soils.usda.gov/sdv/ with assistance from the DNR Lake Michigan Coastal Program. The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

The rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. These include:

> “Not rated”- Soils are highly disturbed such as in urban areas. They account for 13% of the sub-basin.
>
> “Not limited”- Soils have features that are very favorable for the specified use. Good performance and very low maintenance can be expected. They account for 0% of the sub-basin.
>
> "Somewhat limited" - Soils have features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. They account for approximately 6% of the sub-basin.
>
> "Very limited" - Soils have one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected. They account for approximately 81% of the sub-basin.

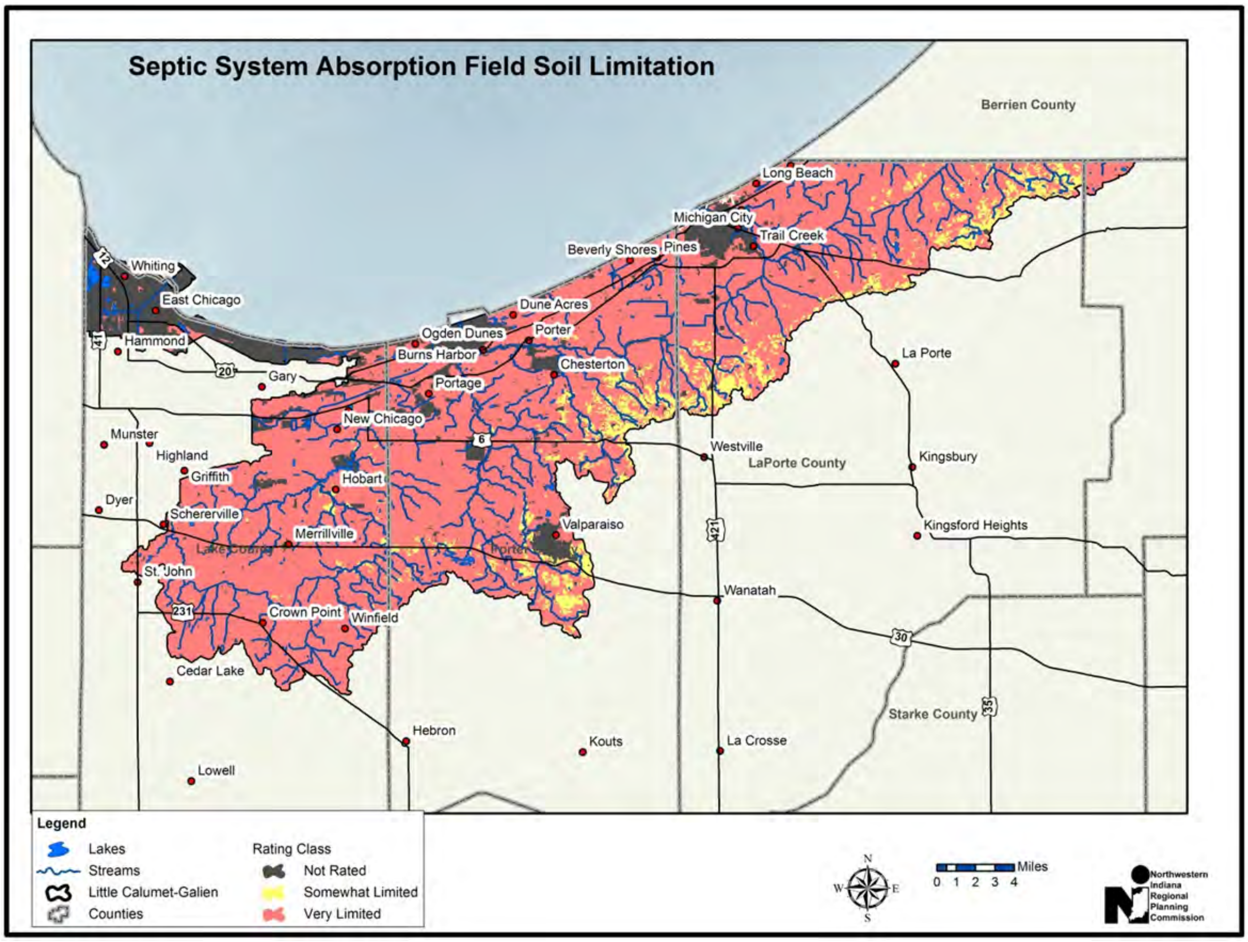

Figure 9. Septic System Absorption Field Suitability

Highly Erodible Land

Highly Erodible Land (HEL) soils for the sub-basin are displayed in Figure 10. Soils data used to generate the figure were downloaded for each county from the NRCS Geospatial Data Gateway (http://datagateway.nrcs.usda.gov) on May 17, 2011. A query provided by Rick Neilson with the NRCS was used in Microsoft Access to identify HEL soils. The basis that NRCS uses for identifying highly erodible land is the erodibility index of a soil map unit. The erodibility index of a soil is determined by dividing the potential erodibility for each soil by the soil loss tolerance (T) value established for the soil. The T-value represents the maximum annual rate of soil erosion that could take place without causing a decline in long-term productivity. Approximately 279 mi^2 or 54% of the soils in the sub-basin are classified as highly erodible.

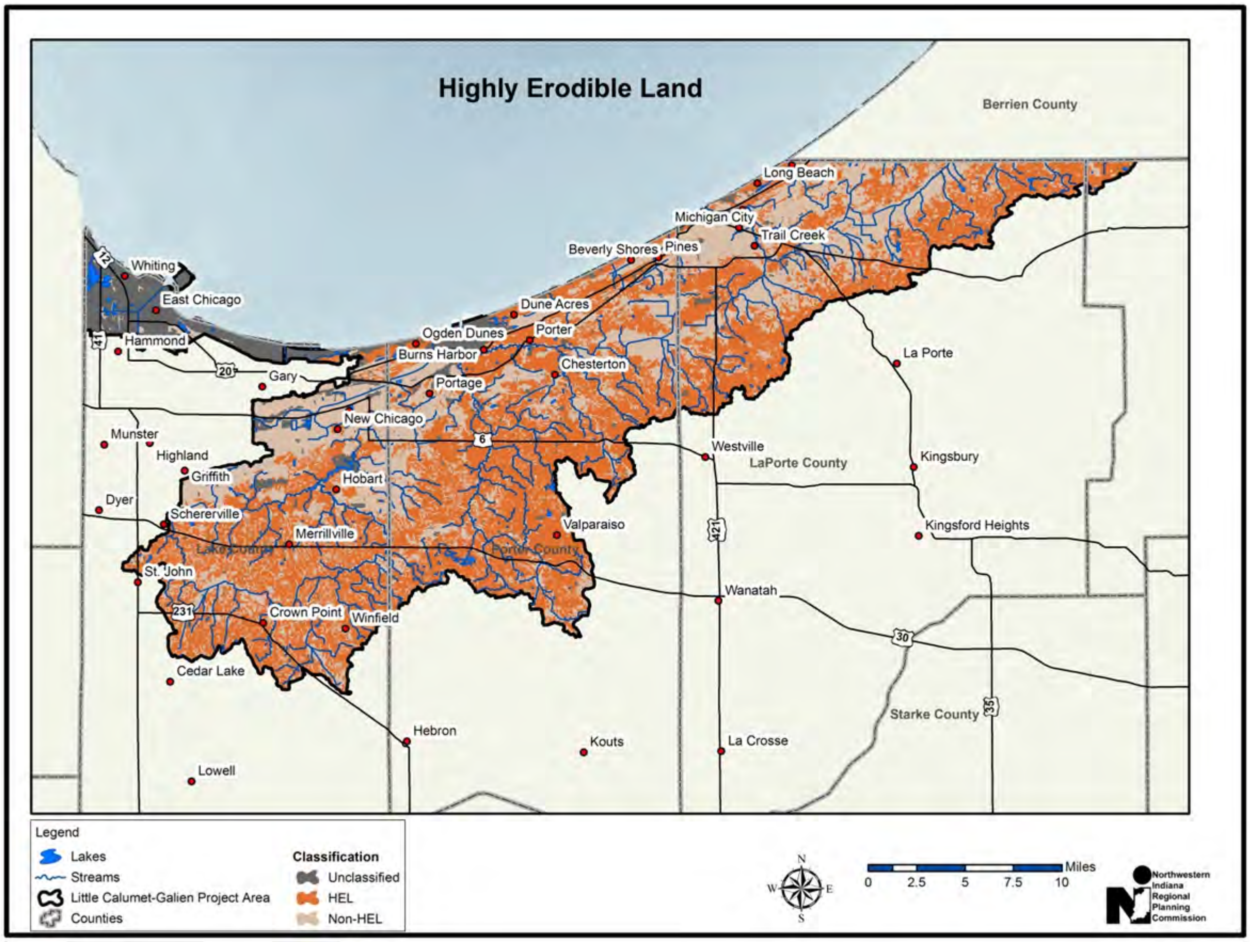

Figure 10. Highly Erodible Soils

Soil Drainage Class

The soil drainage classes identify the natural drainage condition of the soil and refer to the frequency and duration of periods when the soil is free of saturation. Figure 11 displays drainage classes within the sub-basin.

The rating classes are described as follows:

"Excessively drained"- Water is removed very rapidly. The occurrence of internal free water commonly is very rare or very deep. The soils are commonly coarse-textured and have very high hydraulic conductivity or are very shallow.

"Somewhat excessively drained"- Water is removed from the soil rapidly. Internal free water occurrence commonly is very rare or very deep. The soils are commonly coarse-textured and have high saturated hydraulic conductivity or are very shallow.

"Well drained"- Water is removed from the soil readily but not rapidly. Internal free water occurrence commonly is deep or very deep; annual duration is not specified. Water is available to plants throughout most of the growing season in humid regions. Wetness does not inhibit growth of roots for significant periods during most growing seasons. The soils are mainly free of features that are related to wetness.

"Moderately well drained"- Water is removed from the soil somewhat slowly during some periods of the year. Internal free water occurrence commonly is moderately deep and transitory through permanent. The soils are wet for only a short time within the rooting depth during the growing season, but long enough that most mesophytic crops are affected. They commonly have a moderately low or lower saturated hydraulic conductivity in a layer within the upper 1 m, periodically receive high rainfall, or both.

"Somewhat poorly drained"- Water is removed slowly so that the soil is wet at a shallow depth for significant periods during the growing season. The occurrence of internal free water commonly is shallow to moderately deep and transitory to permanent. Wetness markedly restricts the growth of mesophytic crops, unless artificial drainage is provided. The soils commonly have one or more of the following characteristics: low or very low saturated hydraulic conductivity, a high water table, additional water from seepage, or nearly continuous rainfall.

"Poorly drained"- Water is removed so slowly that the soil is wet at shallow depths periodically during the growing season or remains wet for long periods. The occurrence of internal free water is shallow or very shallow and common or persistent. Free water is commonly at or near the surface long enough during the growing season so that most mesophytic crops cannot be grown, unless the soil is artificially drained. The soil, however, is not continuously wet directly below plow-depth. Free water at shallow depth is usually present. This water table is commonly the result of low or very low saturated hydraulic conductivity of nearly continuous rainfall, or of a combination of these.

"Very poorly drained"- Water is removed from the soil so slowly that free water remains at or very near the ground surface during much of the growing season. The occurrence of internal free water is very shallow and persistent or permanent. Unless the soil is artificially drained, most mesophytic crops cannot be grown. The soils are commonly level or depressed and frequently ponded. If rainfall is high or nearly continuous, slope gradients may be greater.

"Not rated"- Soils have characteristics that show extreme variability from one location to another. Often these areas are urban land complexes or miscellaneous areas. An on-site investigation is required to determine soil conditions present at the site.

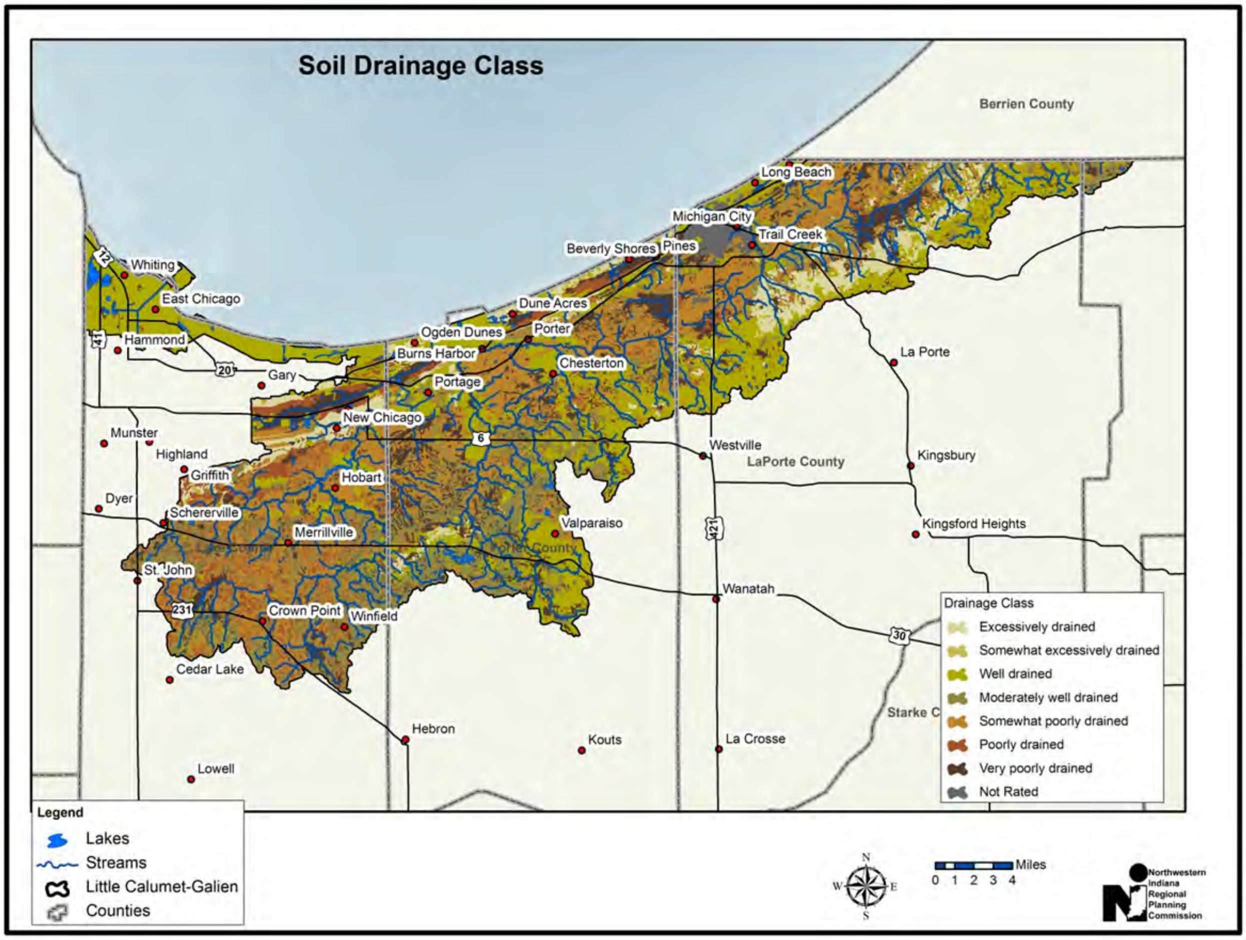

Figure 11. Soil Drainage Class

2.1.5 Land Use & Land Cover

Land use and cover within a watershed can have a profound impact on both water quality and habitat. Natural land cover such as forests, wetlands, and grasslands help protect or improve water quality and aquatic habitats. Alteration of natural land cover for human use almost inevitably leads to increased runoff which can carry pollutants to nearby waterbodies. The pollutants generated are dependent on the land uses within the given watershed. Some of the common pollutants generated in urbanized areas include excess nutrients, sediment, metals, pathogens, and toxins. In agricultural areas common pollutants can include excess nutrients, sediment, pathogens, herbicides and pesticides. For this reason having an understanding of what land uses are present in a watershed can help determine what factors may be contributing to water quality or habitat problems.

Several figures within this section have been generated using land cover data to help characterize the subwatersheds within the sub-basin study area. The intent of these figures is to assist stakeholders in identifying and prioritizing critical areas for restoration or preservation within the sub-basin.

Land cover data from 2006 is shown in Figure 12. Data used to generate this figure was obtained from NOAA's Coastal Change Analysis Program (CCAP) data. CCAP produces a nationally standardized database of land cover and land change information for the coastal regions of the United States. It provides inventories of wetlands and adjacent uplands with the goal of monitoring these habitats by updating the land cover maps every five years. Data is developed using multiple dates of remotely sensed imagery and consist of land cover maps, as well as a changes that have occurred between these dates and where the changes were located. CCAP data for Indiana was available for 1996, 2001, and 2006 during the writing of this version of the Framework. It is available for down or viewing via the CCAP Land Cover Atlas at www.csc.noaa.gov/digitalcoast/data/ccapregional/index.html.

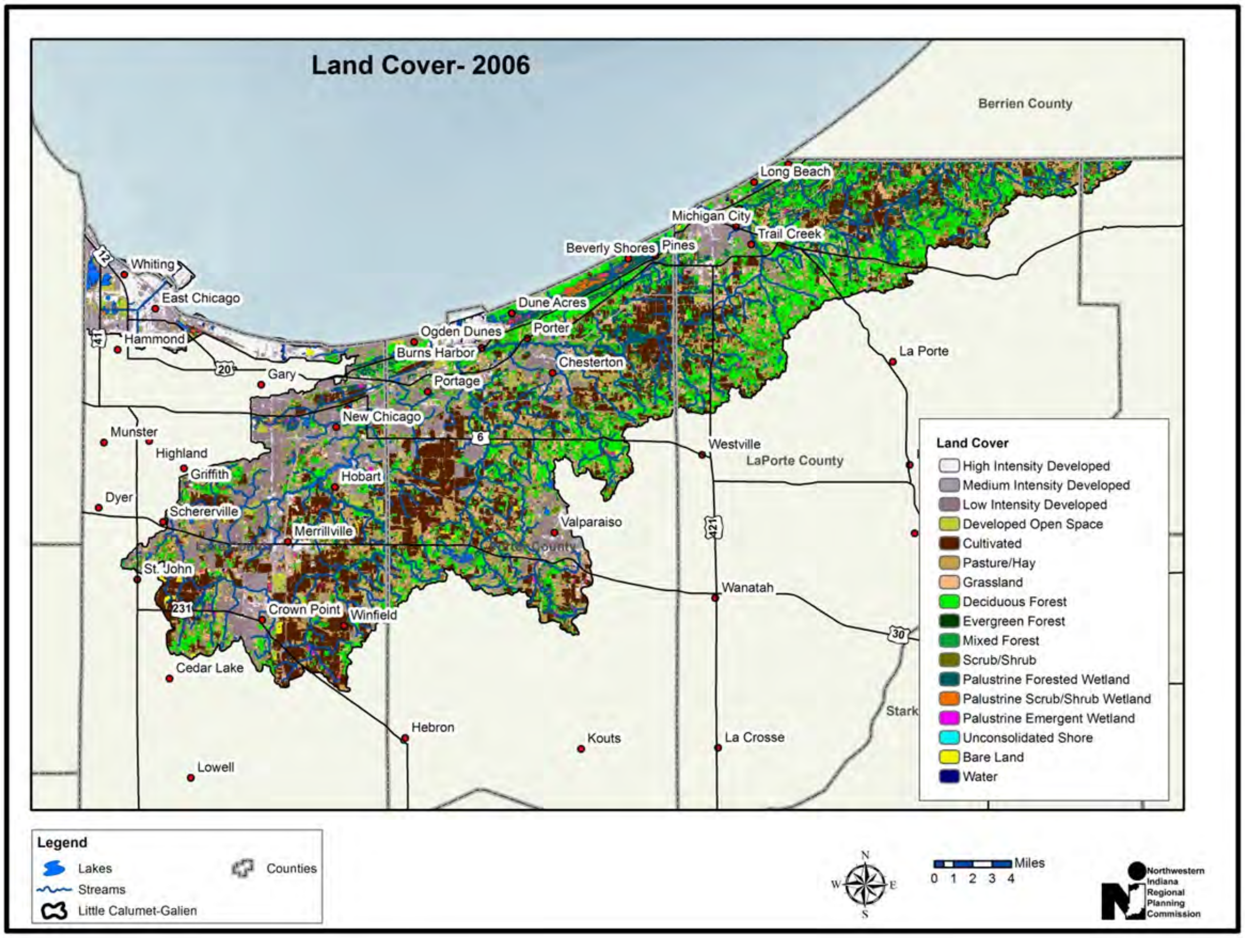

Figure 12. Land Cover (2006)

Figure 13 displays the 2006 land cover data as a percentage of the sub-basin area. Similar cover types have been grouped into generalized cover classes for display purposes. As can been seen in the figure, the developed cover class (high, medium, low, open space) is the dominant land cover type within the sub-basin followed by agriculture (cultivated and pasture/hay) and forest. The greatest concentration of developed land occurs in the western half of the sub-basin and along the Lake Michigan shoreline.

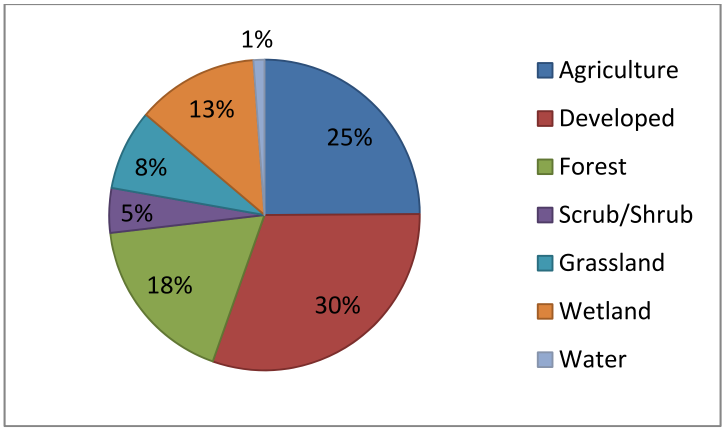

Figure 13. Sub-Basin Land Cover Percentage (2006)

Land cover change between 1996 and 2006 sub-basin wide showed increases in development with losses in forest, grassland, scrub/shrub and cultivated land (Figure 14).

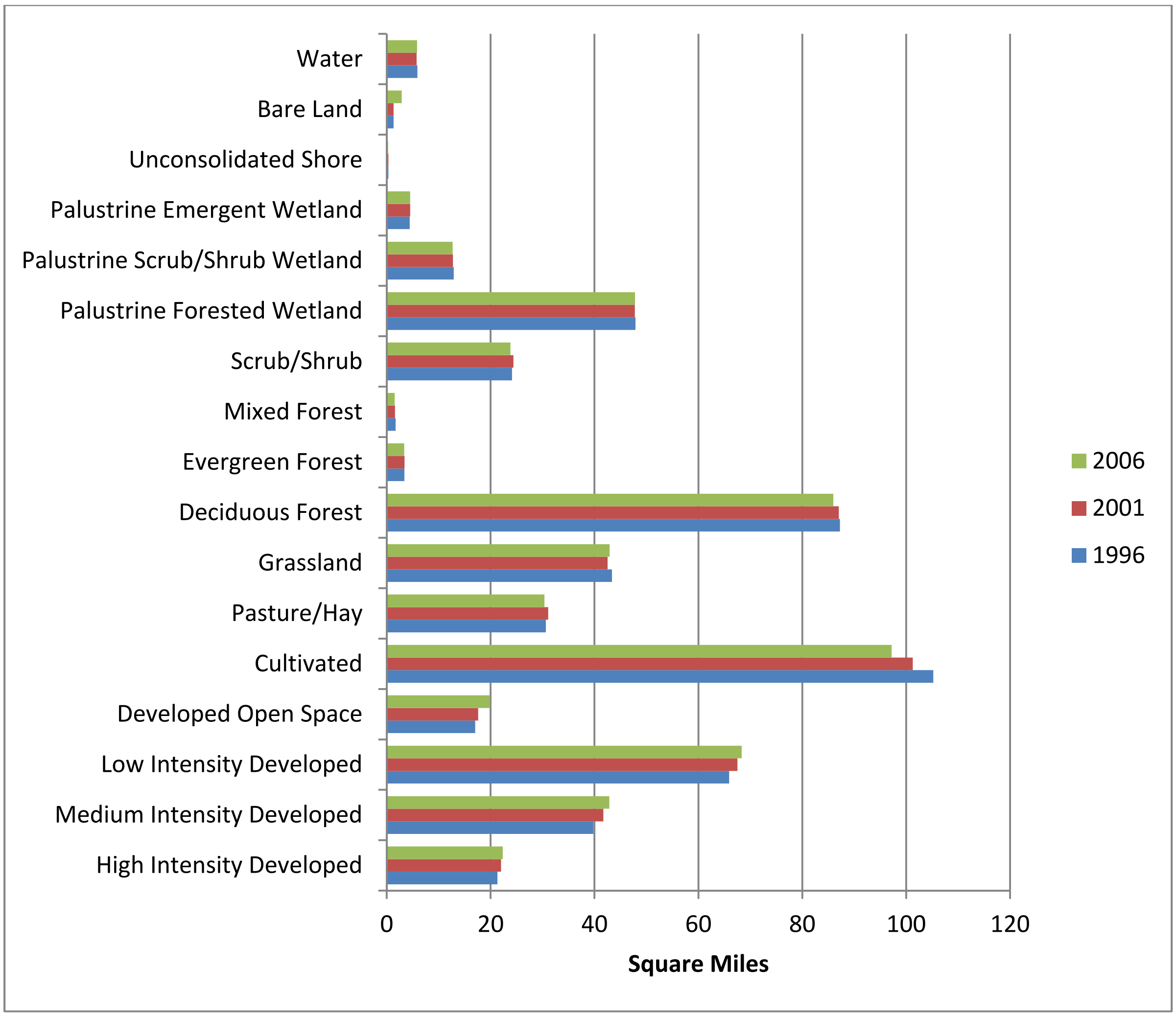

Figure 14. Distribution of Land Cover Classes (1996-2006)

Developed

Figure 15 displays land development changes between 1996 and 2006 in the sub-basin. The figure was generated by superimposing the 1996 CCAP developed land cover classes (high, medium, and low intensity development and developed open space) over 2006 data. In essence the figure shows areas of recent growth.

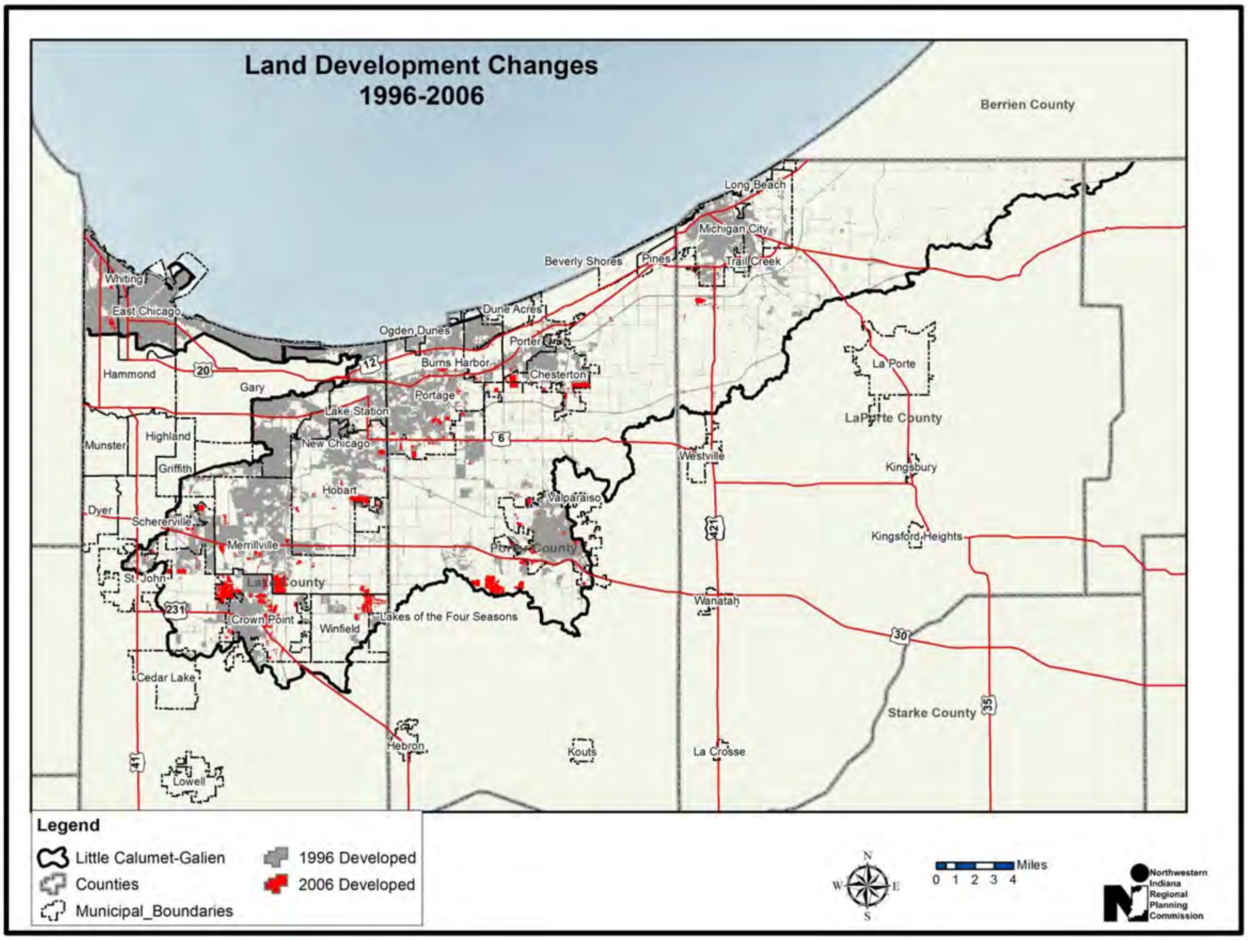

Figure 15. Land Development Changes (1996-2006)

Most of the new growth in the sub-basin took place on agricultural lands (Figure 16). Nearly 4,400 acres of agricultural land was converted for development purposes. In the 2040 Comprehensive Regional Plan, NIRPC showed that development trends, particularly for residential uses, shifted away from urban core communities towards the suburbs and unincorporated areas. In most cases new development densities decreased resulting in greater land consumption. More than 20% of the region's population now resides in unincorporated areas. Maintaining this growth pattern will place increasing demand and stress on the region's natural resources.

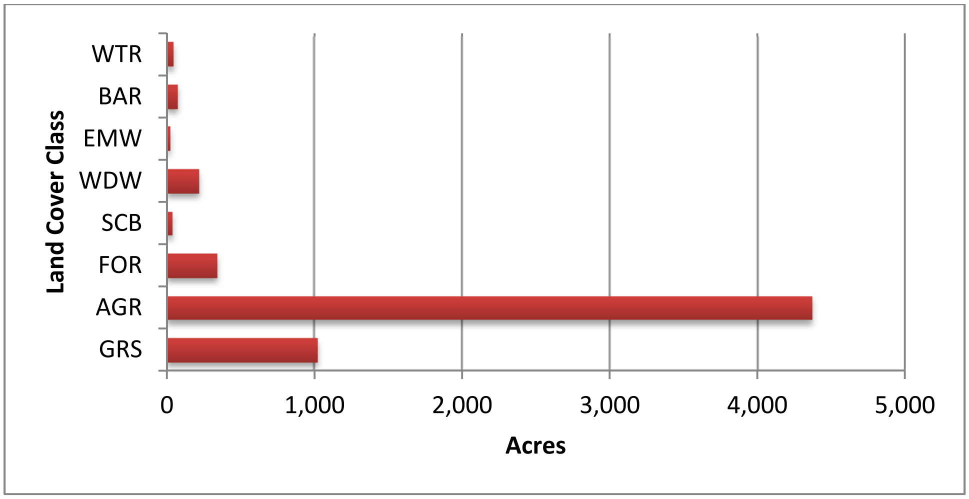

Figure 16. Distribution of Areas Lost to Development by Land Cover

Figure 17 displays the percentage of developed land in each subwatershed. Jenks Natural Breaks was used in ArcMap10 to classify the percentage for each subwatershed. The western half of the sub-basin has the highest percentage of developed land. The eastern half, with the exception of Michigan City area remains relatively rural in nature.

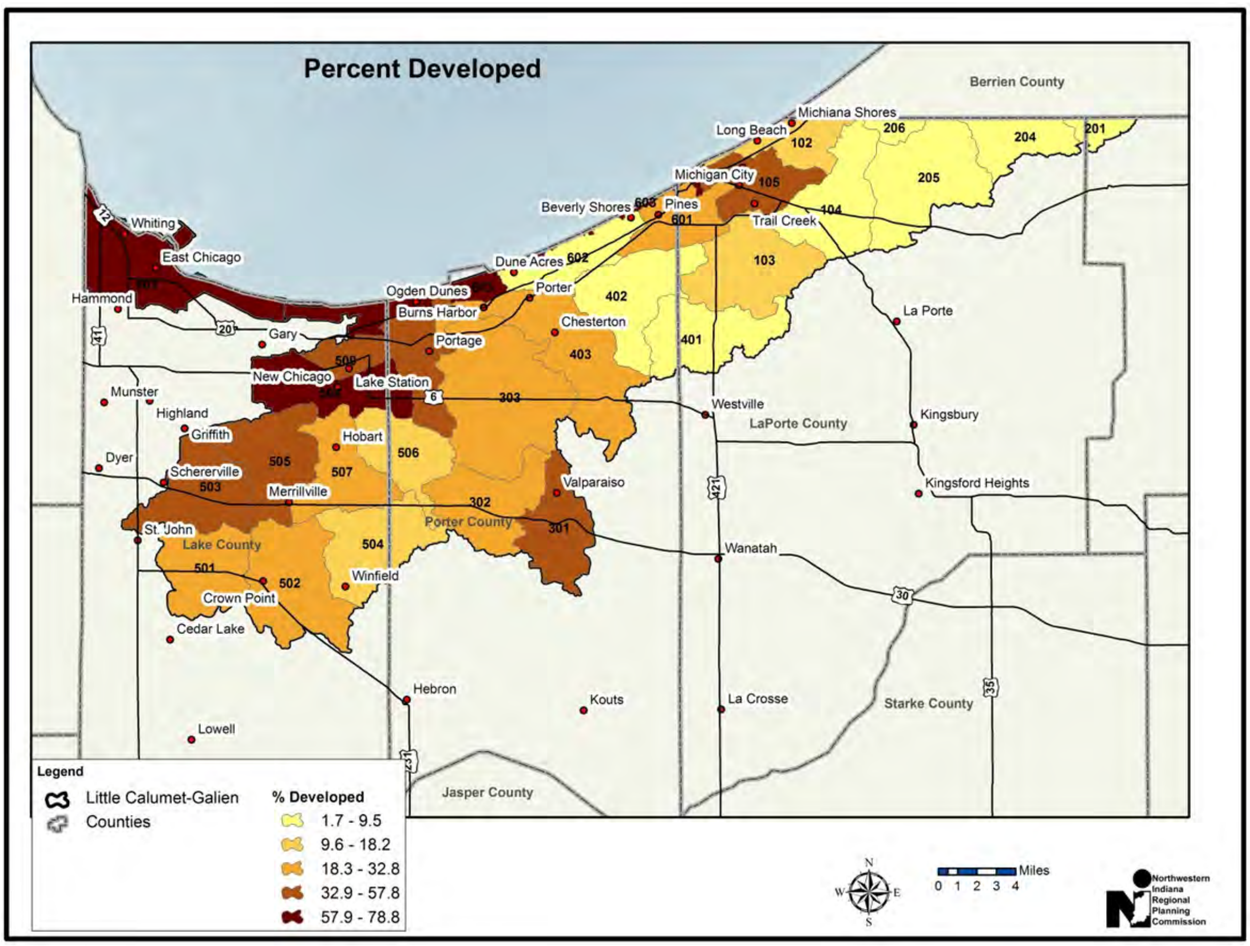

Figure 17. Percent Developed by Subwatershed

A considerable amount of research has been done to evaluate the direct impact of urbanization on streams. Much of this research has focused on hydrologic, physical and biological indicators. In recent years, impervious cover (IC) has emerged as a way to explain and sometimes predict how severely these indicators change in response to varying levels of watershed development. The Center for Watershed Protection (CWP) has integrated research findings into a general watershed planning model, known as the impervious cover model (ICM). The ICM predicts that most stream quality indicators decline when watershed IC exceeds 10%, with severe degradation expected beyond 25% IC (CWP, 2003).

CCAP 2006 land cover data was used to calculate percent impervious cover for each subwatershed in the sub-basin (Figure 18). Lacking impervious cover coefficients for the region, coefficients developed by the Nonpoint Education for Municipal Officials program in Connecticut were used http://nemo.uconn.edu/tools/impervious_surfaces/data/isat_coeff.htm. An IC coefficient was assigned to each CCAP land cover class. Using the Zonal Statistics tool in ArcMAP 10, percent impervious cover was calculated for each subwatershed.

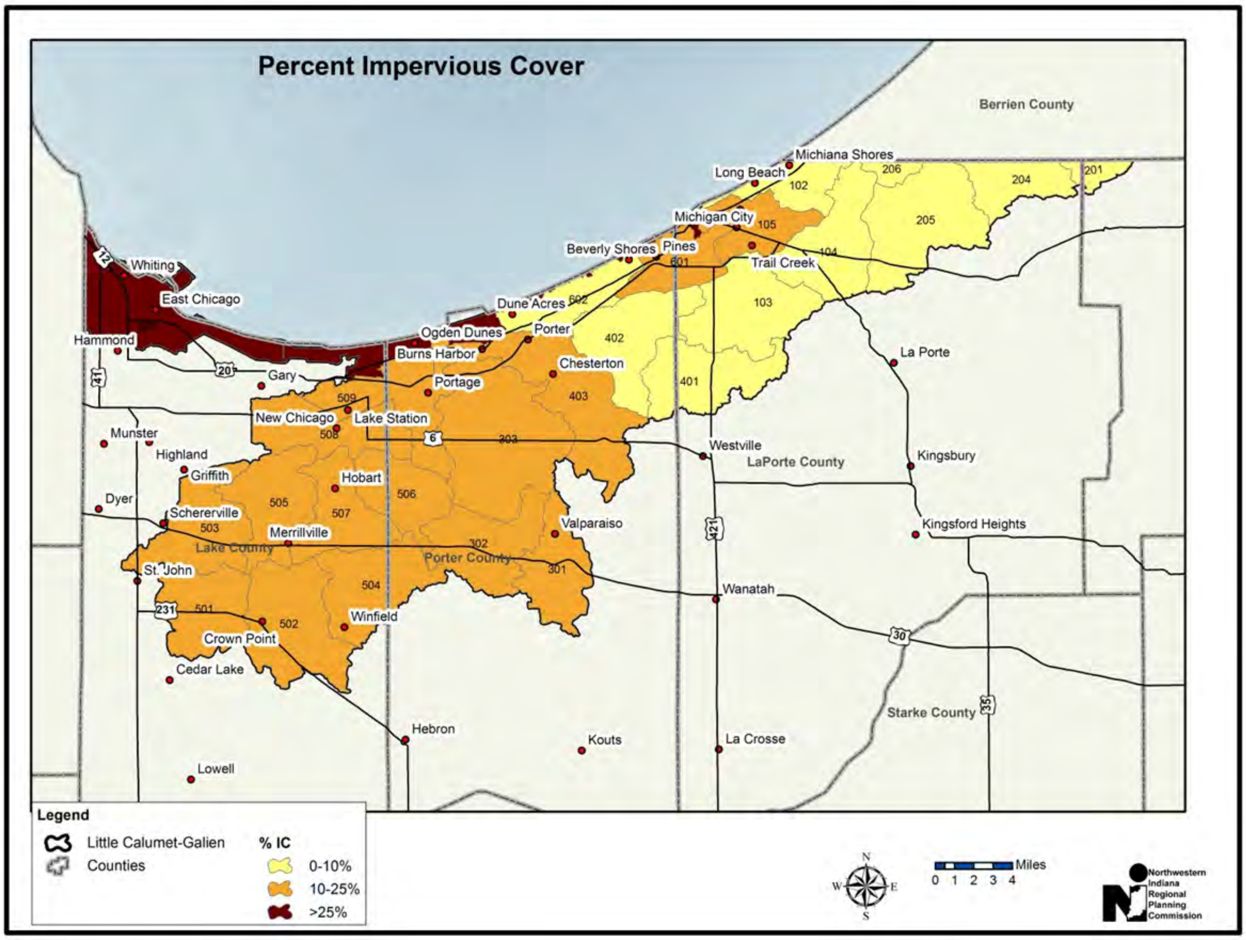

Figure 18. Percent Impervious Cover by Subwatershed

The impervious cover analysis showed that the western half of the sub-basin has the greatest amount of impervious cover. Based on the ICM, streams within these subwatersheds are susceptible to streambank erosion, down cutting and widening, and degraded water quality. The eastern portion, being much less developed, generally had the least amount of impervious cover with the exception of the Michigan City area.

Agriculture

Overall agriculture remains a major land use in the sub-basin. In 2006 approximately 127 mi² (25%) of the sub-basin was devoted to agriculture. Cultivated land accounted for 76% of agricultural use (CCAP, 2006) with corn and soybeans being the predominant crops in Lake, Porter, LaPorte, and St. Joseph Counties (USDA Agricultural Census, 2007). Pasture/hay accounted for the remaining 24% of agricultural land use. Figure 19 shows the percentage of agricultural land in each subwatershed of the sub-basin.

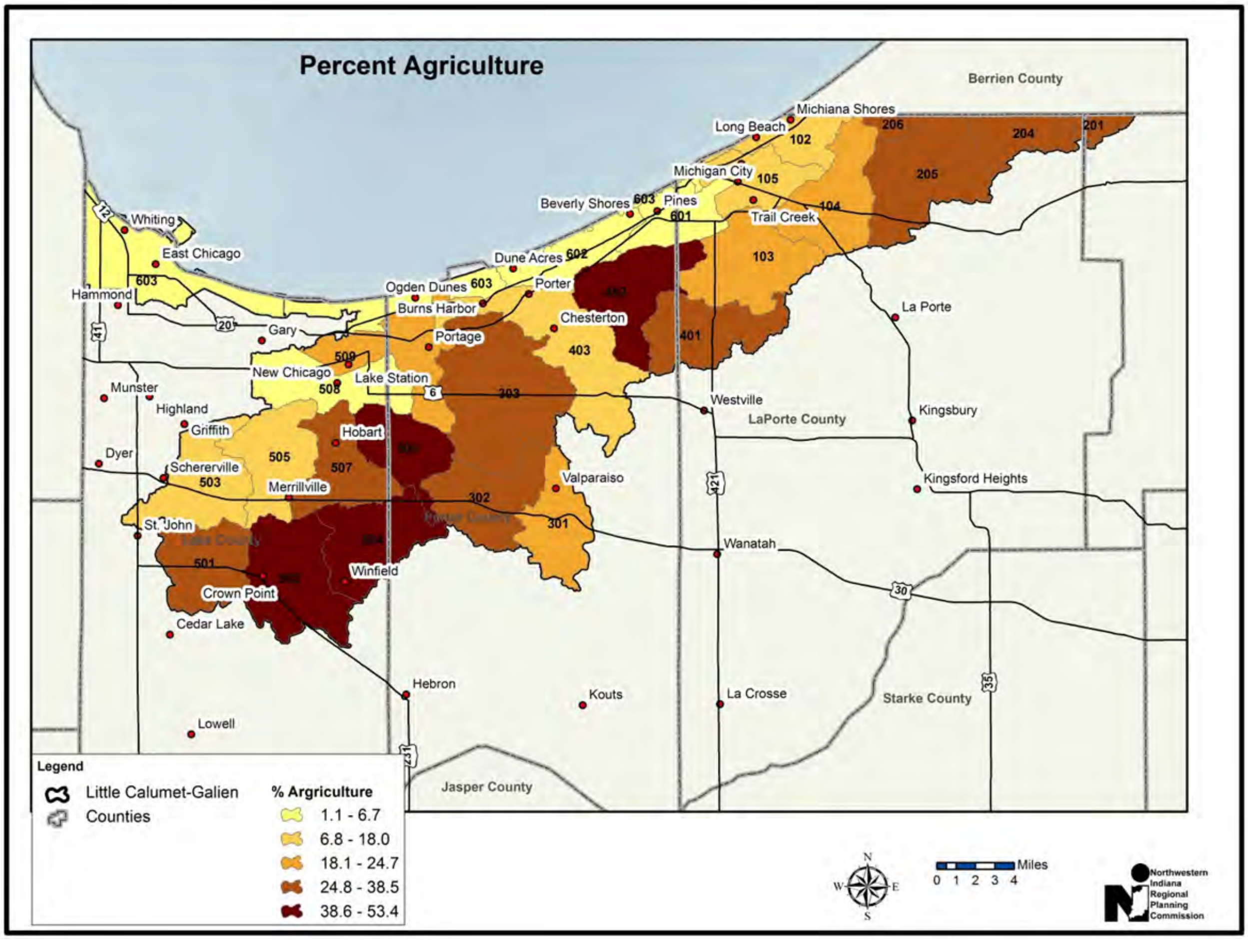

Figure 19. Percent Agriculture by Subwatershed

In cultivated areas, tillage practices can have a major effect on water quality. Conventional tillage leaves the soil surface bare and loosens soils particles making them susceptible to wind and water erosion. Conservation tillage reduces erosion by leaving at least 30 percent of the soil surface covered with crop residue after planting. Residues protect the soil surface from the impact of raindrops and act like a dam to slow water movement. Rainfall stays in the crop field allowing the soil to absorb it. With conservation tillage less soil and water leave a field.

While there is no data specifically available for conservation tillage practices by Hydrologic Unit Code, the Indiana State Department of Agriculture (ISDA) does provide data by county. Cropland tillage data for 2009 for both corn and soybean are presented in Figure 20 and Figure 21. In Lake and Porter Counties corn field tillage is dominated by conventional tillage while in LaPorte and St. Joseph Counties it is dominated by mulch tillage. For soybeans, conservation tillage practices are more often used in all four counties.

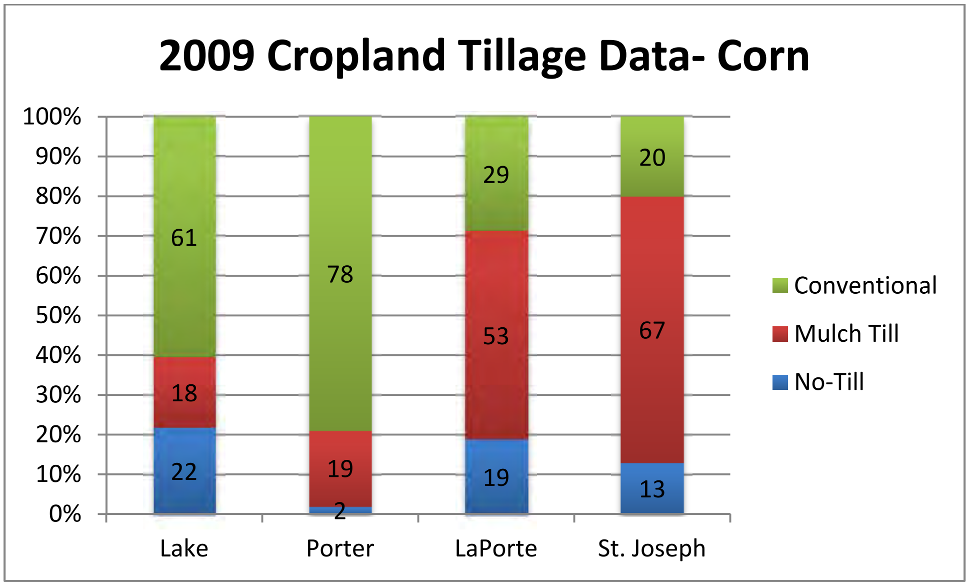

Figure 20. 2009 Cropland Tillage Data- Corn

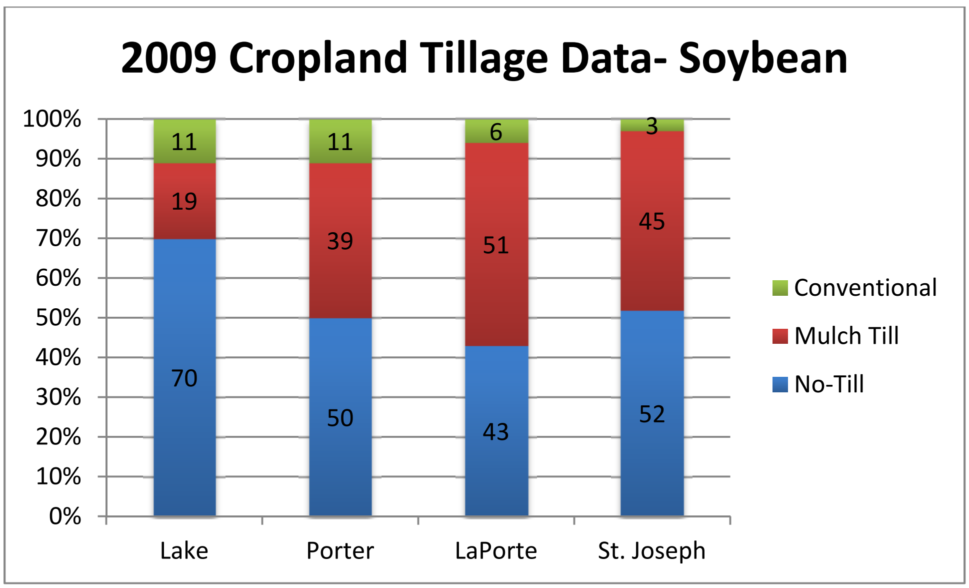

Figure 21. 2009 Cropland Tillage Data- Soybean

No-till: Any direct seeding system including strip preparation with minimal soil disturbance.

Mulch till: Any tillage system leaving greater than 30% of the crop residue after planting, excluding no-till.

Conventional: Any tillage system leaving less than30% crop residue cover after planting.

Only one Confined Feeding Operation (CFO) facility exists in the sub-basin based on IDEM data accessed from Indiana Map (www.indianamap.org/index.html) on May 27, 2011. It is located between Crown

Point and Winfield just north of US 231 in the Main Beaver Dam Ditch-Deep River subwatershed (HUC 040400010502). IDEM regulates these facilities, as well as smaller operations which have violated water pollution rules or laws, under IC 13-18-10, the Confined Feeding Control Law. Due to size or historical compliance issues some confined feeding operations are defined as concentrated animal feeding operations (CAFOs). The CAFO regulation contains more stringent operational requirements and slightly different application requirements.

Animals raised in confined feeding operations produce manure and wastewater which is collected and stored in pits, tanks, lagoons and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial reuse provides a natural source of nutrients for crop production. It also lessens the need for fuel and other resources that are used in the production of commercial fertilizer.

Confined feeding operations, however, can also pose environmental concerns, including the following:

- Manure can leak or spill from storage pits, lagoons or tanks
- Improper application of manure to the land can impair surface or ground water quality

Indiana law defines a CFO as any animal feeding operation engaged in the confined feeding of at least 300 cattle, or 500 horses, or 600 swine or sheep, or 30,000 fowl, such as chickens and turkeys. The IDEM CFO/CAFO approval/permit program is based on the Confined Feeding Control Law administered through regulations adopted under the Water Pollution Control Board. The focus of the regulations is to protect water quality. The program is intended to provide an oversight process to assure that waste storage structures are designed, constructed and maintained to be structurally sound and that manure is handled and land applied in an environmentally acceptable manner.

Forest

Forests play a critical role in the health of a watershed. Forest cover reduces stormwater runoff and flooding by intercepting rainfall and promoting infiltration into the ground. Trees growing along streams help prevent erosion by stabilizing the soil with their root systems. They help improve water quality by filtering sediment and associated pollutants from runoff and they provide cover for both terrestrial and aquatic life. Forests also reduce summer air and water temperatures and improve regional air quality (www.forestsforwatersheds.org/urban-watershed-forestry/).

Based on 2006 CCAP data, there is approximately 91 mi² of forest cover within the sub-basin. This accounts for about 18% of the entire land area of the sub-basin. A further breakdown of percent forest cover by subwatershed is presented in Figure 22. In general the highest percent forest cover by subwatershed can be found in the moraine forest area of LaPorte County and northern Porter County. The subwatershed in Porter County corresponds with land protected within the Indiana Dunes National Lakeshore and Indiana Dunes State Park. Some of the region's highest quality streams such as the Galena River and its tributaries exist in these areas.

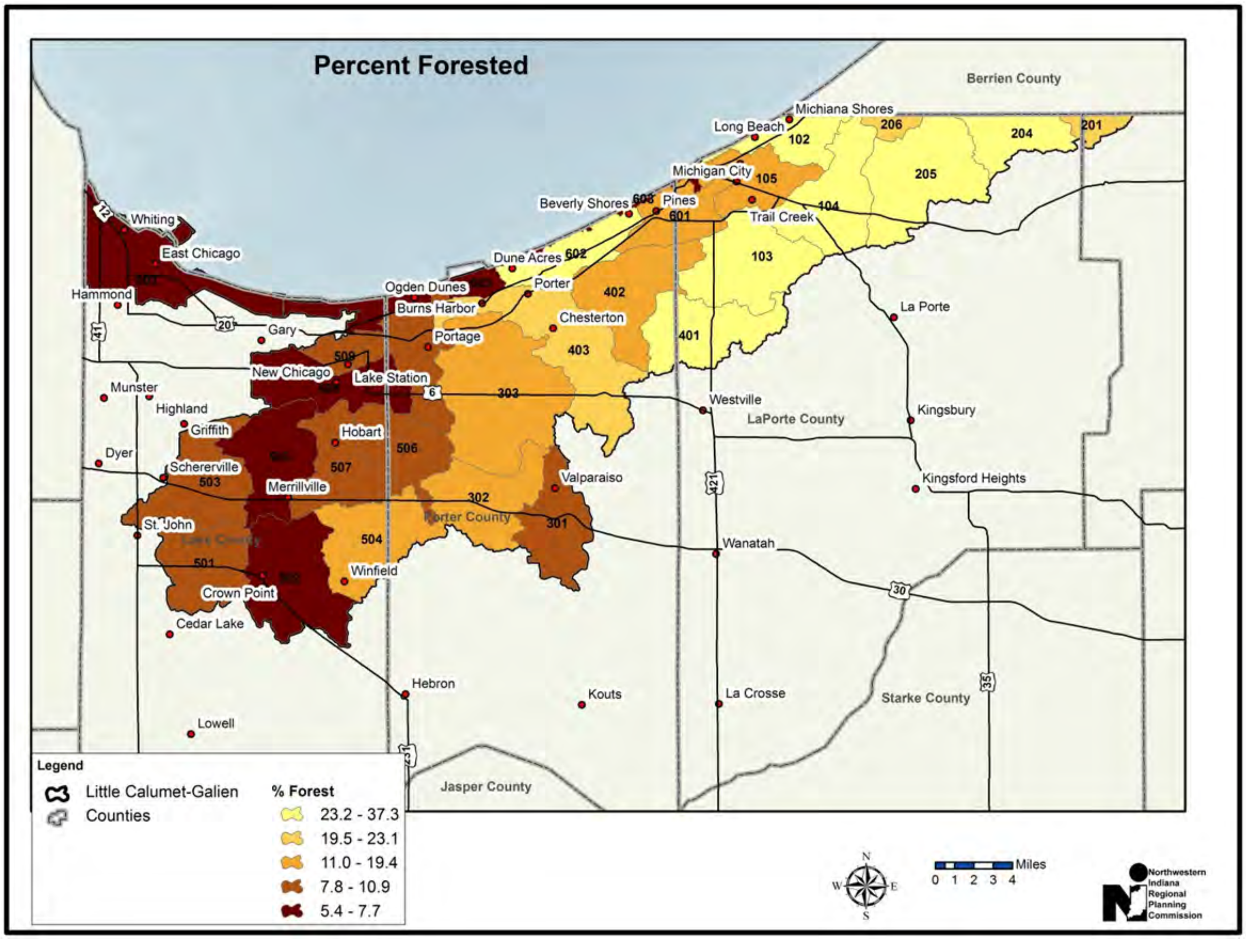

Figure 22. Percent Forested by Subwatershed

While it is important to have a general understanding of how much forest cover exists in a watershed, it is also at least equally as important to understand the quality and location of that forest cover. Forest fragmentation occurs when large, contiguous stands of mature forest are divided into smaller isolated patches known as "forest fragments." Forest fragmentation is caused by human activities, such as road construction, agricultural clearing, and urbanization, or by natural processes that include fire and climate change. Forest fragmentation is considered a useful indicator of forest ecosystem health. The degradation of core forest into fragments can cause biological diversity loss of native flora and fauna species, alterations to water cycles, and adverse impacts on air and water quality. Forests weakened by fragmentation become more susceptible to damage from insects and diseases, and this stress often degenerates into a condition of chronic ill health (www.csc.noaa.gov/digitalcoast/data/ccapregional/index.html).

CCAP forest fragmentation data for the sub-basin is displayed in Figure 23 and Figure 24. Core forest area decreased approximately 1.8% between 1996 and 2006 while patch forest area increased nearly 2.3% over the same time period. Much of this fragmentation can be attributed to new development.

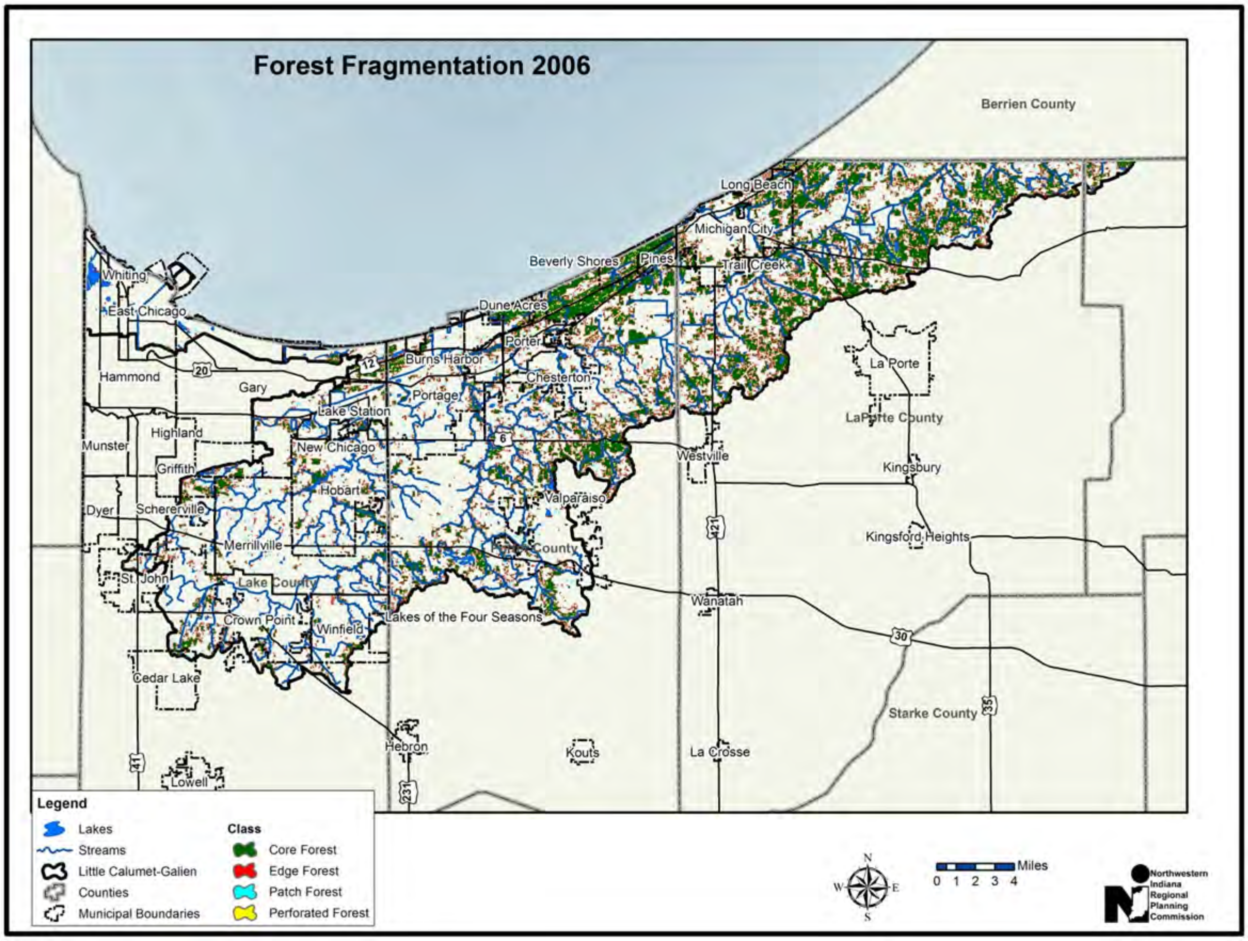

Figure 23. Forest Fragmentation

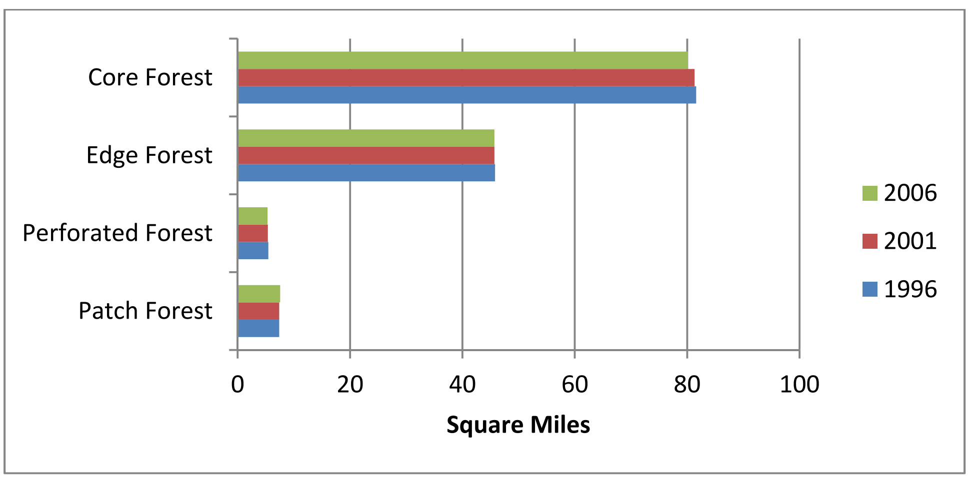

Figure 24. Distribution of Forest Fragmentation by Type (1996-2006)

Wetlands

Like forests, wetlands also play a critical role in watershed health. Wetlands function in flood control by storing and slowly releasing water. Wetlands capture and help filter out sediment and associated pollutants. They provide vital habitats for fish and wildlife, including threatened and endangered species. Wetlands also provide recreational opportunities and economic benefits (www.epa.gov/bioindicators/aquatic/importance.html).

Within the sub-basin there are approximately 65 mi² of Palustrine wetland based on 2006 CCAP data. This accounts for roughly 13% of the sub-basin land area. Due to data collection methodology this estimate of wetland area varies from the National Wetland Inventory estimate of 58.5 mi². Figure 25 displays percent wetland area by subwatershed. Overall those subwatersheds within the eastern portion of the sub-basin have the greatest percentage wetland area. The Dunes Creek subwatershed (HUC 040400010602), with significant tracts of protected land in the Indiana Dunes National Lakeshore and Indiana Dunes State Park, has the greatest percentage of wetland area at 41%.

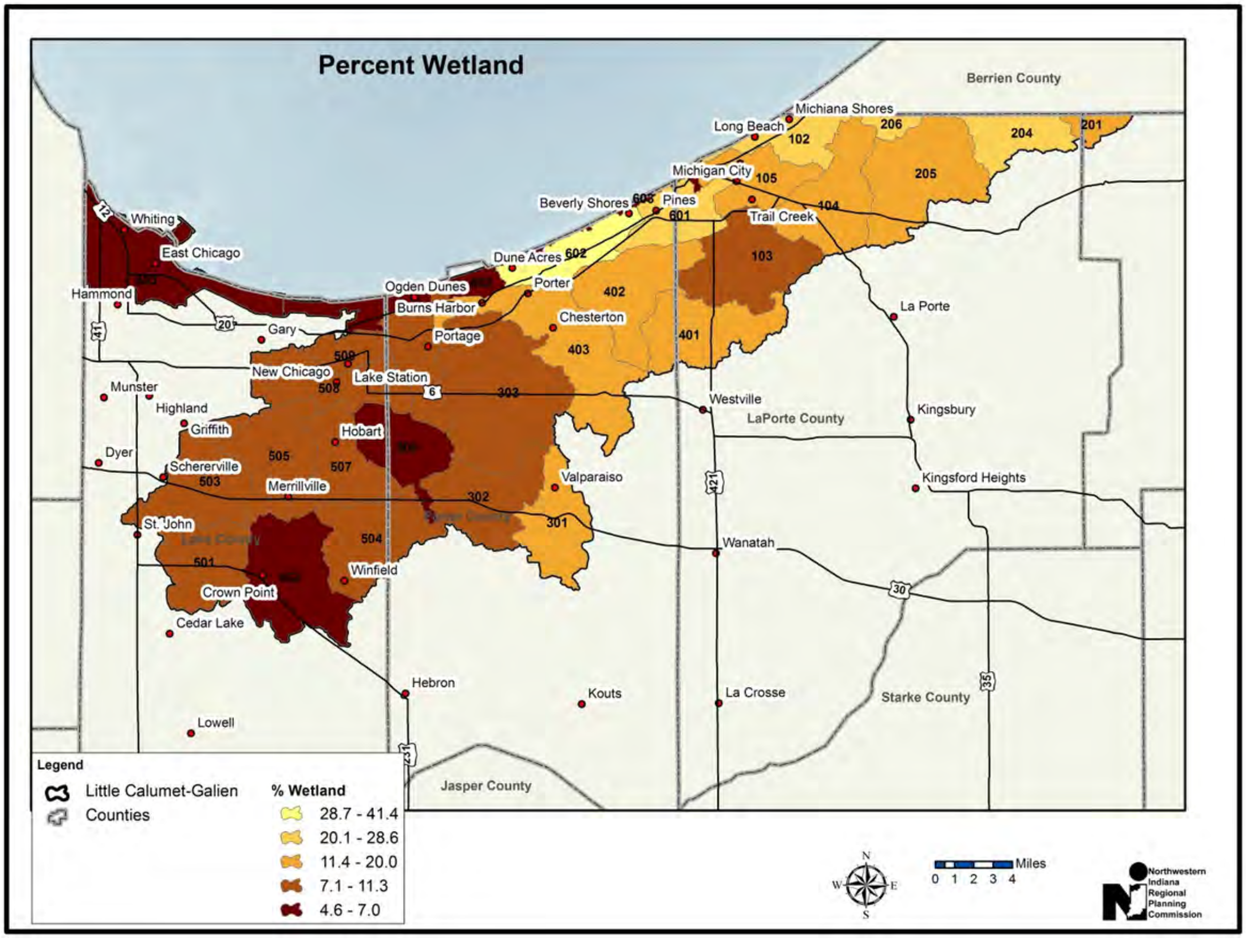

Figure 25. Percent Wetland by Subwatershed

Hydric soils data shows that nearly 64.5 mi² or 52% of the sub-basins historical wetland has been lost. Figure 26 displays percent wetland change by subwatershed. The data used to create the figure were extracted from hydric soils and 2006 CCAP wetland acreage data for each subwatershed using ArcMap10 Spatial Analyst. Twenty two of the subwatersheds showed wetland loss. Four subwatersheds showed increases including Calumet River-Frontal Lake Michigan (HUC 040400010603), White Ditch-Frontal Lake Michigan (HUC 040400010102), Dunes Creek (HUC 040400010602), and Spring Creek (HUC 040400010204). A closer review of the data reveals that a significant amount of wetlands (26.9 mi²) occur on non-hydric soils in the sub-basin. This in part helps explain the wetland gain observed in these four subwatersheds.

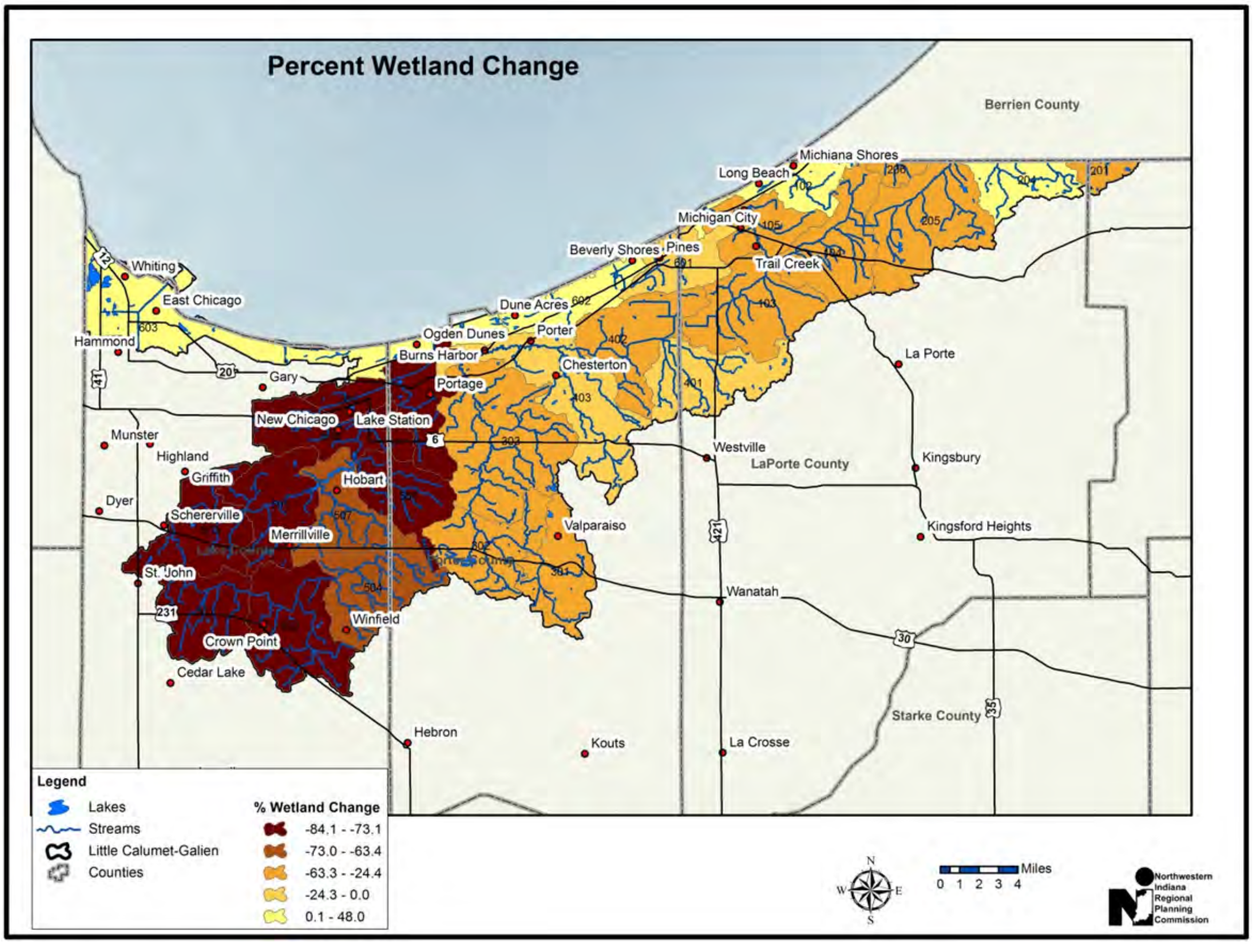

Figure 26. Percent Wetland Change by Subwatershed

2.1.6 Other Planning Efforts

Little Calumet-Galien/Chicago Watershed Restoration Action Strategy

The Little Calumet-Galien/Chicago Watershed Restoration Action Strategy (WRAS) (WHPA, 2002) is broken into two sections. The overall goal and purpose of Part I of the WRAS is to provide a reference point and roadmap to assist with improving water quality. It includes a compilation of information, facts, and local concerns in for the sub-basin within Indiana. It was intended to serve as a reference document, to be revised when updated information was available, for watershed groups and others involved in the assessment and planning of watershed restoration activities.

Part II of the WRAS discusses the water quality concerns identified by stakeholder groups and state and federal agencies. Additionally it recommended management strategies to address those concerns. While the WRAS identified a number of the stakeholder groups present in the region and their overarching program mission and goals, it did not actually list specific local stakeholder group concerns.

The Little Calumet-Galien/Chicago WRAS is available for viewing or download from IDEM at www.in.gov/idem/nps/2964.htm.

Combined Sewer Overflow (CSO) Long Term Control Plans

Combined sewer systems are sewers that are designed to collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. Most of the time, combined sewer systems transport all of their wastewater to a sewage treatment plant, where it is treated and then discharged to a water body. During periods of heavy rainfall or snowmelt, however, the wastewater volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. For this reason, combined sewer systems are designed to overflow occasionally and discharge excess wastewater directly to nearby streams, rivers, or other water bodies. These overflows, called combined sewer overflows (CSOs), contain not only stormwater but also untreated human and industrial waste, toxic materials, and debris.

CSO communities are required to submit Long Term Control Plans to IDEM as an NPDES permit requirement. IDEM's CSO program augments the NPDES Municipal permitting program by implementing a strategy for the maintenance and management of combined sewer collection systems. The primary objective of this group is to insure the minimization of impacts to waters of the state from CSOs. Based upon information from IDEM's Municipal NPDES Permits Section, LTCP's have been submitted by the Gary Waste Water Treatment Plant (WWTP), Michigan City Sanitary District, Valparaiso Municipal Sewage Treatment Plan (STP), Chesterton WWTP, and Crown Point WWTP. Further information about CSO permitting and LTCP status information is available from IDEM at www.in.gov/idem/4897.htm.

Municipal Separate Storm Sewer System (MS4)

MS4s are defined as a storm water conveyances owned by a state, city, town, or other public entity that discharges to waters of the United States. Regulated conveyance systems include roads with drains, municipal streets, catch basins, curbs, gutters, storm drains, piping, channels, ditches, tunnels and conduits. The Clean Water Act requires storm water discharges from certain types of urbanized areas to be permitted under the National Pollutant Discharge Elimination System (NPDES) program. Under Phase II, 327 IAC 15-13 (Rule 13) was written to regulate most MS4 entities (cities, towns, universities, colleges, correctional facilities, hospitals, conservancy districts, homeowner's associations and military bases) located within mapped urbanized areas, as delineated by the United States Census Bureau, or, for those MS4 areas outside of urbanized areas, serving an urban population greater than 7,000 people.

MS4 conveyances within urbanized areas have one of the greatest potentials for polluted storm water runoff. The Federal Register Final Rule explains the reason as: "urbanization alters the natural infiltration capacity of the land and generates...pollutants...causing an increase in storm water runoff volumes and pollutant loadings." Urbanization results "in a greater concentration of pollutants that can be mobilized by, or disposed into, storm water discharges."

A review of MS4 entities data from IDEM (www.in.gov/idem/5437.htm) shows there are nineteen municipalities within the sub-basin that are designated MS4s (Figure 27). Additionally portions of Lake, Porter, and LaPorte Counties are designated MS4s.

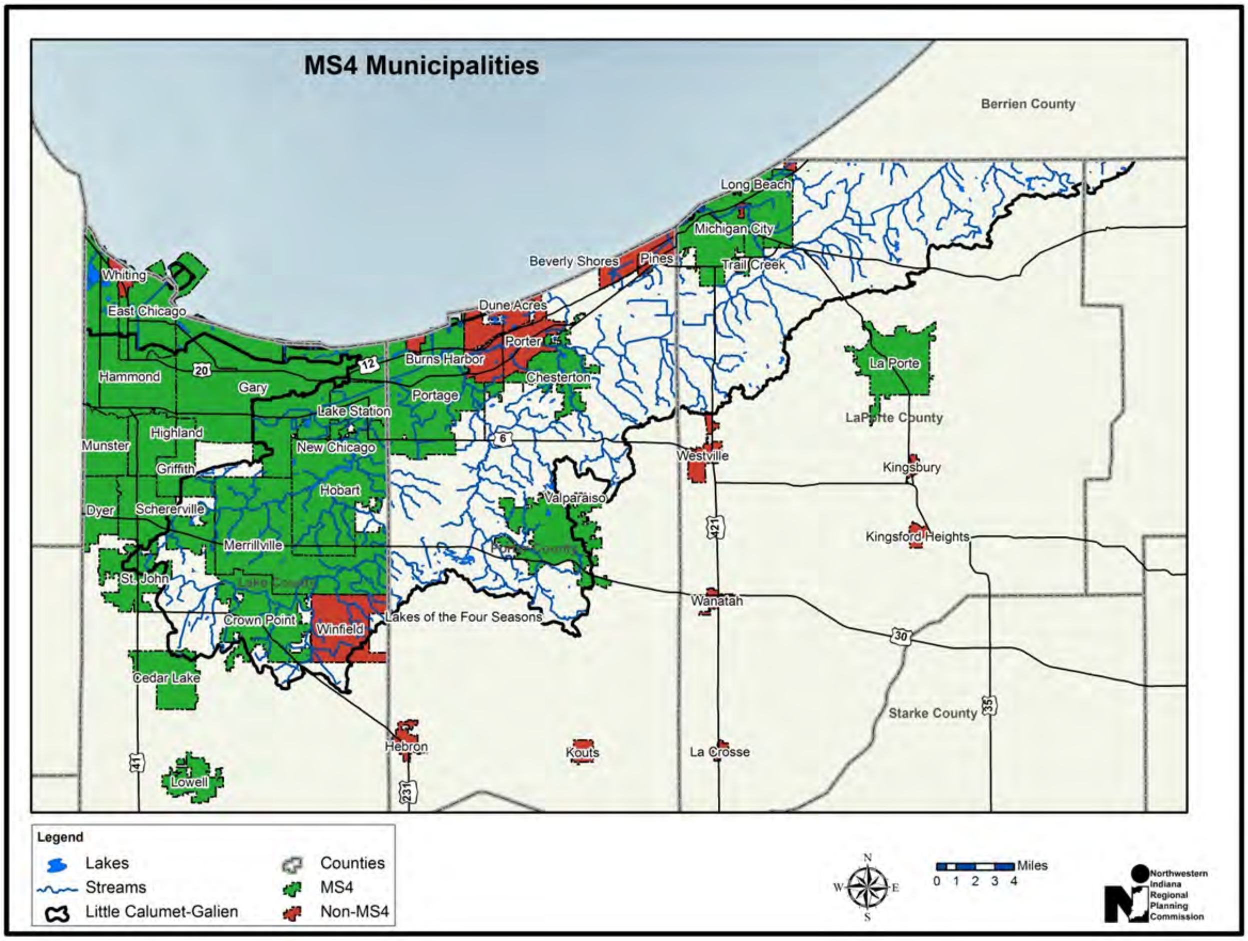

Figure 27. Designated MS4 Municipalities

MS4s are required to develop and implement a Storm Water Quality Management Plan (SWQMP). One of the most important aspects of MS4 to watershed management practitioners is Part C of the SWQMP. Part C outlines the priorities, goals, and implementation strategies that the MS4 will utilize to improve water quality. Each MS4 must address six minimum control measures in their Part C. These include:

- Public education and outreach
- Public participation and involvement
- Illicit discharge detection and elimination
- Construction site storm water runoff control
- Post-construction storm water runoff control
- Municipal operations pollution prevention and good housekeeping

Any request for watershed implementation funding through Section 319 must clearly go "above and beyond" these requirements. Further information about permitting under Rule 13 is available at www.in.gov/idem/4900.htm. Additional details about Rule 13 and Section 319 is available at www.in.gov/idem/nps/.

Wellhead Protection Program

IDEM's Ground Water Section administers the Wellhead Protection Program, which is a strategy to protect ground water drinking supplies from pollution. The Safe Drinking Water Act and the Indiana Wellhead Protection Rule (327 IAC 8.4-1) mandates a wellhead program for all Community Public Water Systems.

The Wellhead Protection Programs consists of two phases. Phase I involves the delineation of a Wellhead Protection Area (WHPA), identifying potential sources of contamination, and creating management and contingency plans for the WHPA. Phase II involves the implementation of the plan created in Phase I, and communities are required to report to IDEM how they have protected ground water resources.

Due to recent legislation wellhead protection areas are no longer available. However, IDEM does respond to site specific inquiries into whether a property is located within or outside of an IDEM approved Wellhead Protection Area by completing a Wellhead Protection Proximity Determination Request form. Additionally IDEM maintains a listing of the due dates for all Community Public Water Supply Systems with Wellhead Protection Plans. This listing is sorted by County and includes the Community's PWSID, population, Phase I approval date, Phase II due date, and a contact name and phone number. This database is available to anyone and can be accessed to determine the status of a community's plan at www.in.gov/idem/4289.htm#description.

Source Water Assessment Program

The Source Water Assessment Program (SWAP) fulfills an EPA requirement to identify the areas that are sources of public drinking water, assess the susceptibility of water-supply systems to contamination, and inform the public of the results. The SWAP includes both ground water and surface water systems. Source water assessments are provided to public water systems by IDEM and are intended to provide basic information to public water suppliers regarding where their drinking water comes from and the susceptibility to which the drinking water source may be impacted by potential sources of contamination. IDEM's susceptibility determination for public water systems can be viewed or downloaded at www.in.gov/idem/4288.htm.

Total Maximum Daily Load (TMDL) Reports

Total Maximum Daily Load (TMDL) reports are assessments of water quality in rivers, lakes, and streams in a given watershed where impairments exist. The report contains an overview of the waterbodies, the sources of pollutants, the methods used to analyze data, reductions in levels of pollutants needed to restore water quality, actions that need to be taken to reduce pollutant levels and actions that are being taken to improve water quality.

A TMDL calculates the maximum amount of a pollutant that can enter a waterbody and still have that waterbody meet water quality standards. The load for the particular pollutant (ex. *E. coli*) is allocated towards point sources and nonpoint sources. It also includes a margin of safety to account for uncertainty. The following formula is used to calculate the TMDL

$$\mathbf{TMDL = \Sigma WLA + \Sigma LA + MOS}$$

where WLA is the sum of wasteload allocations (point sources), LA is the sum of load allocations (nonpoint sources and background), and MOS is the margin of safety.

The following TMDLs have been completed within the sub-basin and are available at IDEM's Watersheds & Nonpoint Source Water Pollution website at www.in.gov/idem/nps/2652.htm:

- Galena River Watershed- *E. coli*, 2010
- Lake Michigan- *E. coli*, 2004
- Little Calumet River & Burns Ditch- *E. coli*, 2005
- Salt Creek- *E. coli*, 2004
- Trail Creek- *E. coli*, 2004

Grand Calumet River AOC Remedial Action Plan

The Grand Calumet River Area of Concern (AOC) begins 15 miles south of downtown Chicago and includes the east branch of the river, a small segment of the west branch and the Indiana Harbor and Ship Canal (Figure 28). Approximately 90% of the river's flow originates as municipal and industrial effluent, cooling and process water and storm water overflows. Although discharges have been reduced, a number of contaminants continue to impair the AOC. The largest extent of the impairment to the AOC comes from the legacy pollutants found in the sediments at the bottom of the river and Indiana Harbor and Ship Canal. Problems in the AOC include contamination from polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs) and heavy metals, such as mercury, cadmium, chromium and lead. Additional problems include high fecal coliform bacteria levels, biochemical oxygen demand (BOD) and suspended solids, oil and grease. These contaminants originated from both point and nonpoint sources.

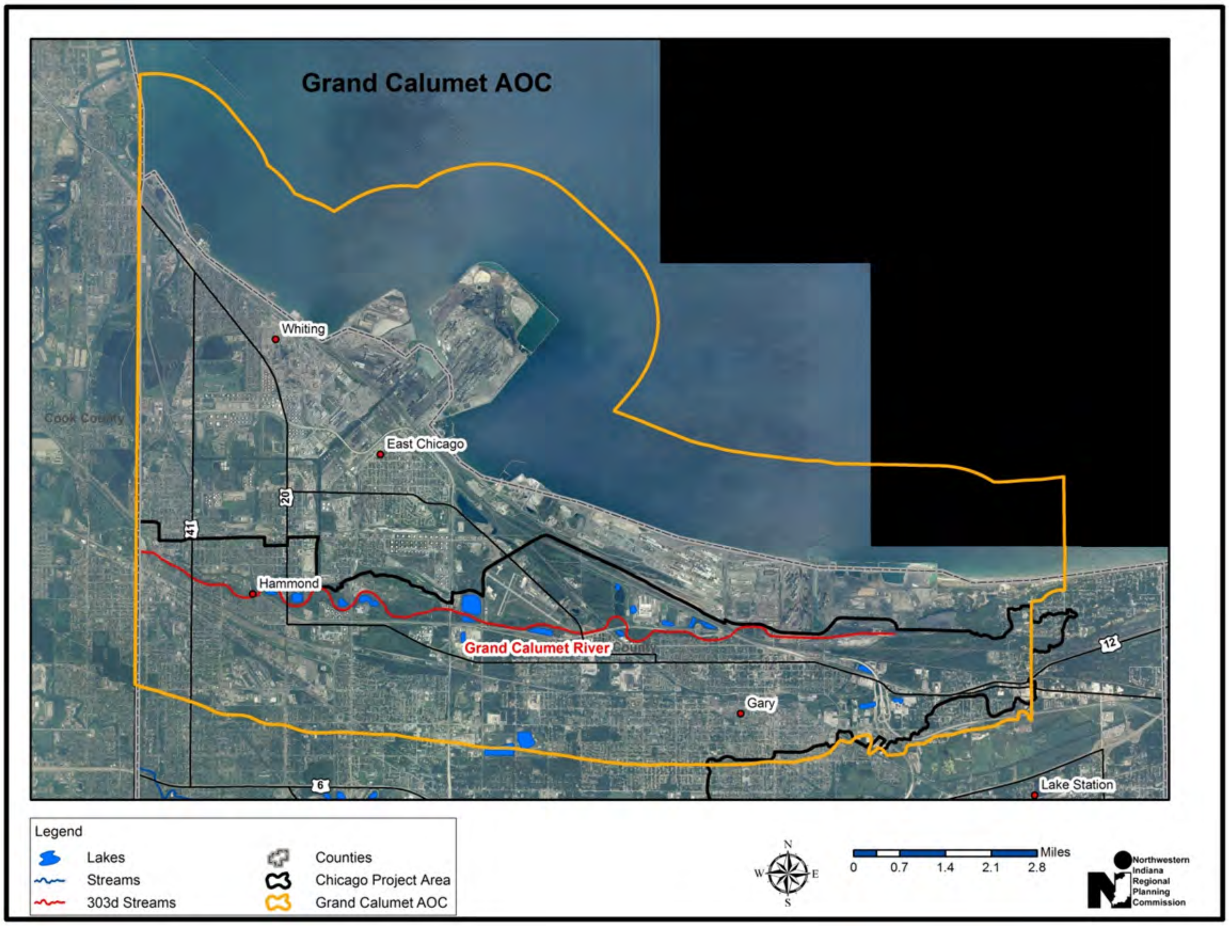

Figure 28. Grand Calumet River AOC

Nonpoint sources include:

- Contaminated Sediment. The Grand Calumet River and Indiana Harbor and Canal contain 5 to 10 million cubic yards (3.9 to 7.7 million cubic meters) of contaminated sediment up to 20 feet (6 m) deep. Contaminants include toxic compounds (e.g., PAHs, PCBs and heavy metals) and conventional pollutants (e.g., phosphorus, nitrogen, iron, magnesium, volatile solids, oil and grease).
- Industrial Waste Site Runoff. Stormwater runoff and leachate from 11 of 38 waste disposal and storage sites in the AOC, located within .2 mi (.3 km) of the river, are degrading AOC water quality. Contaminants include oil, heavy metals, arsenic, PCBs, PAHs and lead.
- CERCLA Sites. There are 52 sites in the AOC listed in the federal Comprehensive Environmental Response Compensation and Liability System (CERCLA). Five of these sites are Superfund sites on the National Priorities List (NPL).
- Hazardous Waste Sites under RCRA. There are 423 hazardous waste sites in the AOC regulated under the Resource Conservation and Recovery Act (RCRA), such as landfills or surface impoundments, where hazardous waste is disposed. Twenty-two of these sites are treatment, storage and disposal facilities.
- Underground Storage Tanks (USTs). There are more than 460 underground storage tanks in the AOC. More than 150 leaking tank reports have been filed for the Lake County section of the AOC since mid-1987.

- Atmospheric Deposition. Atmospheric deposition of toxic substances from fossil fuel burning, waste incineration and evaporation enter the AOC through direct contact with water, surface water runoff and leaching of accumulated materials deposited on land. Toxins from this source include dioxins, PCBs, insecticides and heavy metals.
- Urban Runoff. Rain water passing over paved urban areas washes grease, oil and toxic organics such as PCBs and PAHs into AOC surface waters.
- Contaminated Groundwater. Groundwater contaminated with organic compounds, heavy metals and petroleum products contaminates AOC surface waters. The United States Environmental Protection Agency (U.S. EPA) estimates that at least 16.8 million gallons (63.6 million liters) of oil float on top of groundwater beneath the AOC.

Point sources of contaminants include:

- Industrial and Municipal Wastewater Discharges. Three steel manufacturers contribute 90% of industrial point source discharges to the AOC. One chemical manufacturer discharges into the AOC. Permitted discharges include arsenic, cadmium, cyanide, copper, chromium, lead and mercury. Three municipal treatment works (Gary, Hammond and East Chicago Sanitary Districts) discharge treated domestic and industrial wastewater into the AOC.
- Combined Sewer Overflows (CSOs). Fifteen CSOs contribute untreated municipal waste, including conventional and toxic pollutants, to the AOC. Annually, CSO outfalls discharge an estimated 11 billion gallons (41.6 billion liters) of raw wastewater into the harbor and river. Approximately 57% of the annual CSO volume is discharged within eight miles (12.9 km) of Lake Michigan, resulting in nearshore fecal coliform contamination.

Historically, the Grand Calumet River supported highly diverse, globally unique fish and wildlife communities. Today, remnants of this diversity near the AOC are found in the Gary Works natural Area, Gary Enterprise Zone, Clarke junction West, Clarke and Pine General Refractories Addition, Clarke Junction East, Clarke and Pine Dune and Swale, Lake Shore Prairie, Brunswick Central Savanna, Penn Central, Ivanhoe South, Toleston Woods, Beemsterboer, Expolyer Pipeline Triangle, Toleston Ridges, Cline Avenue Dune and Swale, Roxanna Marsh, Grand Calumet River Tern Site, DuPont, George Lake Woods, Migrant Bird Trap. These areas contain tracks of dune and swale topography and associated rare plant and animal species, such as Franklin's ground squirrel, Blanding's turtle, the glass lizard and the black crowned night heron, among others. The problems mentioned above, however, have impaired many desired uses of the AOC, including all 14 beneficial uses.

The Stage 2.5 Remedial Action Plan is under revision for submittal to the International Joint Commission. Stage 2.5 extends the Stage 2 ecosystem approach and reviews how each regulatory, voluntary and enforcement activity in the AOC helps restore beneficial uses. The document begins to link these activities to environmental stressors. With the CARE committee's assistance, the State expects to finish the Stage 2.5. By tracking the myriad of activities that help restore beneficial uses, the CARE committee and State have begun to track Stage 3 progress, implementation.

The State submitted a Stage 2 document to the International Joint Commission in December 1997. Stage 2 links physical, biological and chemical stressors to each use impairment. Due to extensive use impairments and the complex nature of the ecosystem activities required to restore those uses, the RAP process divided Stage Two into smaller, more manageable components for planning purposes. It also makes integration of each new component an important concern as the planning process proceeds. Further details are available from EPA's Great Lakes National Program Office at www.epa.gov/glnpo/aoc/grandcal.html.

Watershed Management Planning & Implementation

To date six watershed management plans (WMPs) have been completed within the sub-basin that meet IDEM's Watershed Management Plan Checklist requirements (Figure 29). Each of these plans, being initiated prior to 2009, was developed using 11-digit (watershed) or 14-digit (subwatershed) HUC boundaries. In 2009, IDEM's 319 Program began requiring new plans be developed using 10- and 12-digit HUC boundaries. Additionally, HUC boundary changes reallocated areas of the Little Calumet-Galien to the Chicago sub-basin.

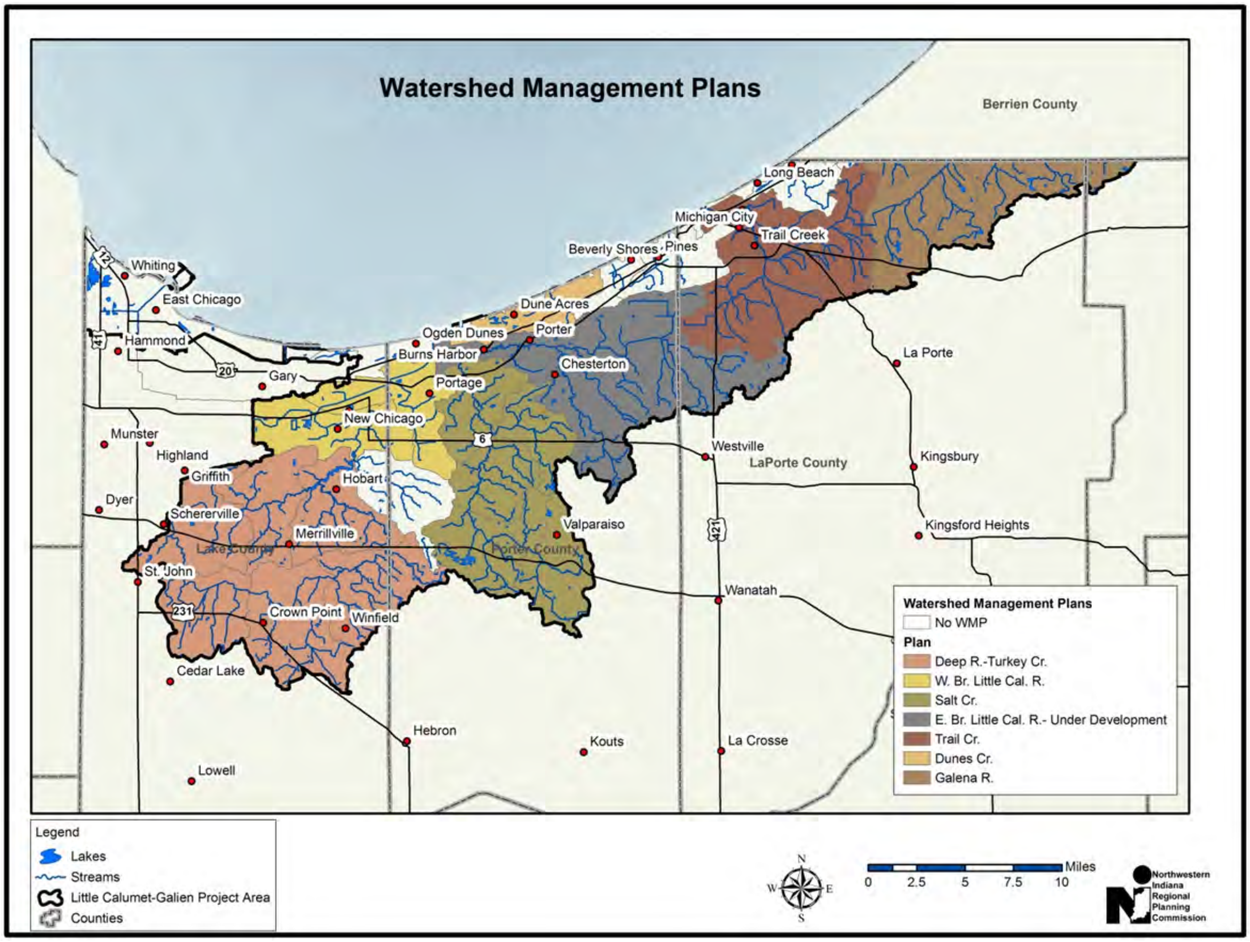

Figure 29. Watershed Management Plans in the Sub-Basin

Summary descriptions and complete reports are available for each of these plans on the IDEM website at www.in.gov/idem/nps/3254.htm with the exception of the Galena WMP which is available on the IDNR Lake & River Enhancement (LARE) Program website at www.in.gov/dnr/fishwild/3303.htm. General overviews for each plan are provided below.

Deep River/Turkey Creek- 2002

The Deep River/Turkey Creek watershed covers an area of approximately 124 mi^2 in Lake and Porter Counties. In the Deep River subwatersheds, there appeared to be a strong correlation between pollutant loading (total suspended solids, nutrients, and *E. coli*), potential soil erodibility (T-factor) ratings, and the presence of highly erodible lands (HEL). In the Turkey Creek subwatersheds, *E. coli* concentrations and poor in-stream habitat quality showed a correlation with urban land uses and channel modifications. Streambank erosion was also identified as an issue partly due to riparian zone and floodplain modifications.

For the most part this plan does not specifically identify critical areas for implementation. However the plan does encourage the following restoration strategies throughout the watershed where opportunities present themselves:

- Wetland and tree conservation
- Minimizing impervious surfaces
- Linear parks and open space preservation
- Constructed wetlands, bio-filters, catch basin inserts, buffer/ filter strips, etc.
- Shoreline and streambank bioengineering stabilization
- Native shoreline plantings
- Bridge storm water outlet retrofits
- Target BMP's towards highly erodible lands

Dunes Creek- 2006

The Dunes Creek watershed management plan covers an area of approximately 11 mi^2 in Porter County. The primary concerns identified in the plan were excess nutrient and sediment loading, high pathogen, total dissolved solid, and chloride concentrations, and impaired biotic communities.

The following goals and action items were identified for the Dunes Creek watershed:

- Manage stormwater runoff by conducting targeted wetland restoration
- Implement stormwater BMP's such as vegetated swales, pervious pavement and bioretention
- Restore natural hydrology by daylighting segments of Dunes Creek, plugging ditches, restoring wetlands and promoting two-stage channels
- Restore, manage, and protect streambank habitat and riparian areas

Trail Creek- 2007

The Trail Creek watershed management plan covers an area of approximately 59 mi^2 in LaPorte County. Four water quality problems were identified in the plan including *E. coli*, erosion and sedimentation, nutrient loading, and hydromodification.

The following implementation goals were identified for critical areas within the watershed:

- Preserve existing riparian corridors and buffers
- Protect, enhance and restore riparian corridors and wetlands
- Restore natural hydrology to Trail Creek
- Plan and design any channel modification activities to reduce/eliminate negative physical, chemical, and habitat impacts to Trail Creek
- Reduce discharges from stormwater runoff
- Increase recreational access
- Encourage utilization of Low Impact Development (LID) practices

Salt Creek- 2008

The Salt Creek watershed management plan covers an area of approximately 77 mi^2 in Porter County. The primary concerns identified in the plan were excess nutrient and sediment loading, high pathogen concentrations, and impaired biotic communities.

The following activities were identified for critical areas within the Salt Creek watershed:

- Implement LID and other BMPs to address stormwater runoff from development
- Restore and manage streambank and riparian habitat to reduce erosion
- Restore natural hydrology and improve flow dynamics and hydrologic function
- Increase turbulence and reduce water temperatures within stream to increase dissolved oxygen
- Work with DOTs to reduce road salt related impacts
- Implement restoration projects that reduce nutrient and sediment pollution

West Branch Little Calumet River- 2008

The West Branch Little Calumet River WMP includes three 14-digit subwatersheds in the western branch of the Little Calumet River. These subwatersheds cover approximately 54 mi^2 of Lake and Porter Counties. The primary pollutants of concern identified in the plan include *E. coli*, total suspended solids, nitrogen and phosphorous.

The following long-term implementation goals were identified for critical areas within the watershed:

- Land acquisition and funding to restore 4,780 acres of wetland
- Install 300 rain gardens in participating communities
- Install 20 green roofs or green parking lots
- Install infiltration BMP's at 10 sites
- Install 2,000 lineal feet of vegetated buffer
- Install 10 retention/detention ponds
- Implement stream and riparian restoration at 5 sites
- Install 5,000 lineal feet of vegetated channel in urban area
- Identify 20 existing priority wetland and riparian restoration areas and mitigate/restore at least 10
- Acquire at least 10 existing priority wetland and riparian areas through purchase or conservation easement
- Design and construct at least five projects that improve connectivity along river
- Install at least three projects that increase navigability along river
- Acquire land and construct at least 3 new public access sites

Galena River- 2010

The Galena River watershed management plan covers approximately 46 square miles of LaPorte County. The only pollutant of concern identified in the plan was *E. coli*. All other chemical and nutrient parameters met applicable water quality standards. Because the Galena River segments in Indiana have few measureable water quality problems, it was recognized that the watershed management plan should not focus strictly on improving water quality, but should also have a strong land preservation component, given the undeveloped and sensitive nature of the area.

The following implementation goals were identified for critical areas within the watershed:

- Restore 10% of the potential wetland restoration areas
- Preserve natural areas through government coordination and/or land trusts
- Reduce sediment loads by restoring stream buffers identified in stream buffer analysis
- Complete streambank restoration at Site 6.

- Restore the natural hydrology and hydraulics to extent possible including ability of migratory fish to utilize habitats

East Branch Little Calumet River- Being Developed

The East Branch Little Calumet River watershed management plan will cover an area of approximately 74 square miles in LaPorte and Porter Counties. Save the Dunes has been recently (Fall 2011) awarded a contract by IDEM to coordinate the plans development.

Indiana Statewide Forest Assessment & Strategy

The Indiana Statewide Forest Strategy was developed by the IDNR in coordination with natural-resource professionals, landowners, conservationists, land stewards and forest stakeholders. It recognizes the most important issues that increasingly threaten the sustainability and ecological capacity of Indiana's forests to provide the benefits of clean air, carbon sequestration, soil protection, wildlife habitat, wood products and other values, goods and services. The plan addresses a limited forest base being fragmented or converted to other land uses, like subdivision housing, paved surfaces or row crop agriculture. The plan will enhance Indiana forests' ability to conserve soil and water resources by protecting existing targeted forest cover in watersheds and promoting reforestation along key streams and rivers. It will guide and improve efforts to control and combat the economically and ecologically disastrous effects of invasive plants in woodlands and make dramatic strides in the preservation of biological diversity by assuring that increasingly simplified and one-dimensional forests become more diverse and connected with one another.

The following long-term strategies were identified:

1. Conserve, manage, and protect existing forests. Especially large patches.
2. Restore and connect forests, especially in riparian areas.
3. Expand Best Management Practices, with special attention to invasive species.
4. Coordinate education, training, and technical assistance, especially to develop strategic partnerships.
5. Maintain and expand markets for Indiana hardwoods, especially those that are sustainably certified and are for local use.

The forest priority data displayed in Figure 30 was created by the IDNR as part of the Indiana Statewide Forest Assessment to prioritize and reflect the relative importance of Indiana forest issues. The figure was generated by compositing forest issues and assigning a relative weighting score based on stakeholder feedback.

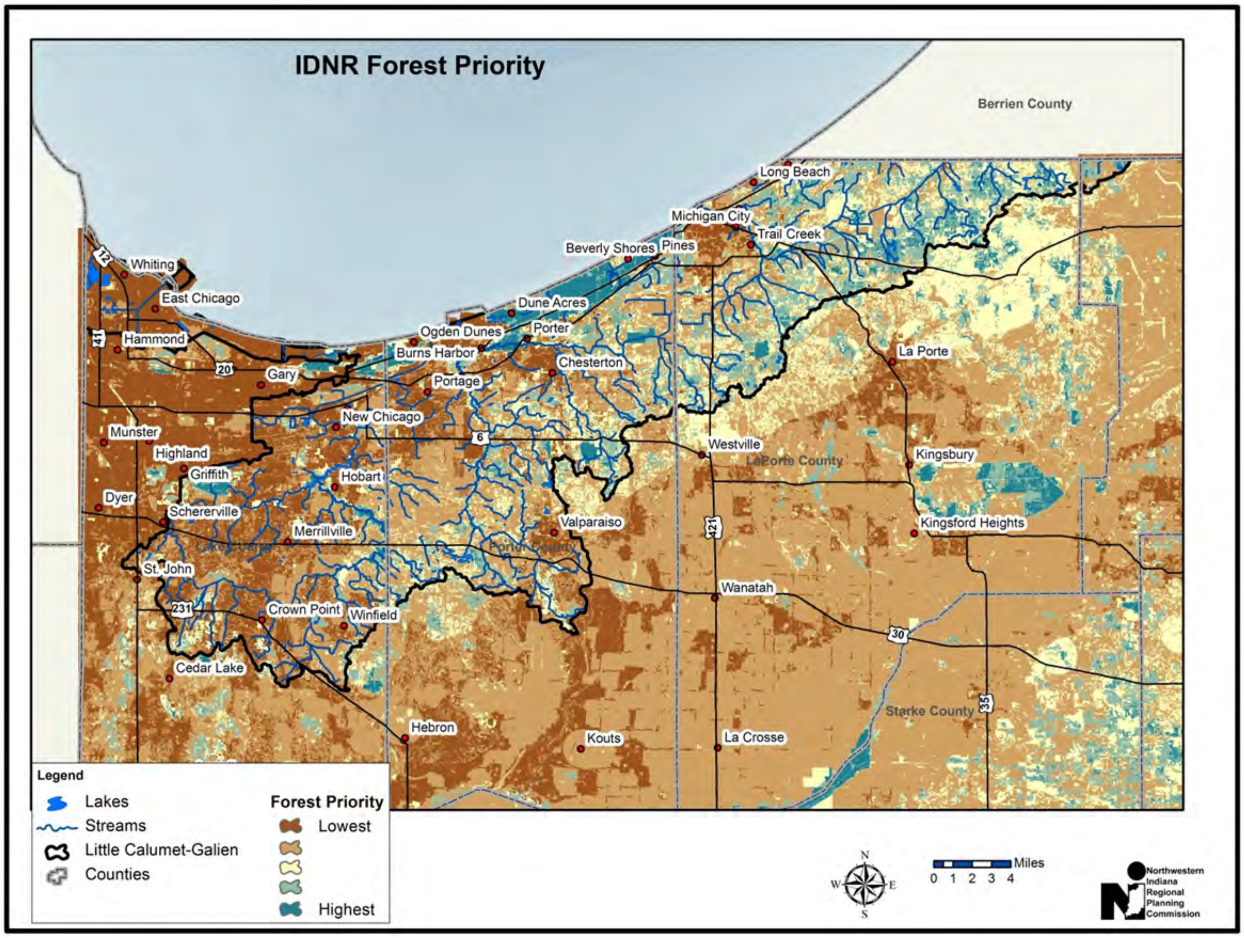

Figure 30. IDNR Forest Priority Areas

Community & Urban Forestry Program

The DNR Division of Forestry's Community & Urban Forestry Program provides statewide leadership to increase public awareness of the value of trees and associated natural resources in urban areas. The program assists municipalities and non-profits by offering a visiting urban forester for a day, technical assistance, tree board assistance, workshops, grant dollars for urban forestry management, and help in becoming a Tree City USA. Tree Cities located in the sub-basin as of 2010 include Chesterton, Crown Point, East Chicago, Merrillville, Michigan City, Valparaiso, and Whiting.

The program goals include:

- Protect, enhance and expand urban forests and related natural resources.
- Promote awareness of urban forestry issues which will result in increased broad-based support.
- Improve the expertise of urban forestry practitioners.
- Promote networking and partnership building among public and private entities.
- Increase funding opportunities for urban forestry programs.

Further details about the program area available at www.in.gov/dnr/forestry/2854.htm.

Indiana Wetlands Conservation Plan

The purpose of the Indiana Wetlands Conservation Plan (IWCP) is to achieve wetland conservation in a manner that is mutually beneficial. The IWCP serves as a framework for discussion and problem solving while establishing common ground on which progress of wetland conservation can be made. It also sets specific actions to achieve progress. While the IWCP does not specifically identify priority areas it does provide the following recommendations regarding prioritization.

1. Given that 85% of Indiana's wetlands have been lost, all remaining wetlands are important and should be considered important for conservation. However, a system for prioritizing wetlands for conservation must be developed.
2. Priorities for conserving wetlands based on water quality, flood control, and groundwater benefits should be made at the watershed or subwatershed level.
3. Special concerns for water quality, flood control, and groundwater should be identified for each watershed.
4. Statewide priorities for conserving wetlands based on biological and ecological functions should be developed based on the following criteria:

    a. Rarity of wetland type
    b. Presence of endangered, threatened, or rare species
    c. Presence of endangered, threatened, or rare species habitat, but species not yet identified at the site
    d. Diversity of native species
    e. Diversity of wetland community types
    f. Proximity of other valued ecosystem types
    g. Natural quality (amount of disturbance/degradation)
    h. Irreplaceability (can the wetland type be re-created)
    i. Recoverability (can the wetland type recover from disturbance it has experienced)
    j. Size
    k. Location

The priorities should be identified based on the natural regions currently used by the Indiana Department of Natural Resources, Division of Nature Preserves and many other agencies and organizations.

5. Historical and recreational benefits of wetlands should be considered in identifying priorities.
6. Based on the statewide biological and ecological priorities, a process should be developed to assist in identifying wetland priorities at the watershed or subwatershed level.
7. Better information on Indiana's wetland resources is needed to more effectively identify scientifically based priorities described in Appendix G.

For more information about the IWCP please visit www.in.gov/dnr/fishwild/3350.htm.

Indiana Comprehensive Wildlife Strategy

The Indiana Comprehensive Wildlife Strategy (CWS) was developed by the Indiana Department of Natural Resources (IDNR) in coordination with conservation partners across the state to protect and conserve habitats and associated wildlife at a landscape scale. It provides a comprehensive overview of conservation in Indiana and identifies needs and opportunities for helping prevent species from becoming threatened or endangered in the future. Species of greatest conservation need (SGCN) were identified utilizing the most current published list of federally endangered, threatened or candidate species and Indiana's list of endangered species and species of special concern. The Indiana CWS was developed using an information system designed to link SGCN to all wildlife species and the habitats on which they depend. This was done by using a set of representative species as surrogates for guilds including the SGCN and which were reflective of habitat needs for all wildlife species. Major habitat categories included agricultural lands, aquatic systems, barren lands, developed lands, forest lands, grasslands, subterranean systems, and wetlands.

The CWP provides implementation guidance organized by habitat focus areas. The possible threats as determined by technical experts to the SGCN and their habitat are listed. Indiana's priority conservation actions and implementation guidance are presented for both the SCGN and their habitats. While too numerous to list here for each habitat category, the following common elements are reoccurring.

- Habitat protection through regulation
- Habitat protection and restoration on public lands
- Habitat protection and restoration incentives
- Exotic/invasive species control
- Protection of adjacent buffer zone
- Pollution reduction
- Corridor development and protection
- Artificial habitat creation
- Cooperative land management agreements
- Adaptive management

For more information about the Indiana Comprehensive Wildlife Strategy please visit www.in.gov/dnr/fishwild/files/CWS_MANUSCRIPT.pdf

Coastal & Estuarine Land Conservation Program Plan

The Coastal & Estuarine Land Conservation Program (CELCP) Plan was developed by the IDNR Lake Michigan Coastal Program to prioritize land conservation needs and nominate potential projects for federal funding within Indiana's federally approved coastal program boundary. The purpose of the CELCP is to protect important coastal and estuarine areas that have significant conservation, recreation, ecological, historical, or aesthetic values, or that are threatened by conversion from their natural or recreational state to other uses. The CELCP gives priority to lands that can be effectively managed and protected, provide public access to coastal and estuarine resources, and have significant ecological value.

Indiana's CELCP Plan is based on the Indiana Biodiversity Initiative (IBI) model which identifies areas using Heritage plant occurrences and umbrella animal habitat information. The IBI project spatially identified ecologically sensitive areas critical for preservation. Figure 31 shows priority preservation areas within Indiana's coastal area based on the IBI methodology.

For additional information about the CELCP Plan please visit www.in.gov/dnr/lakemich/6133.htm.

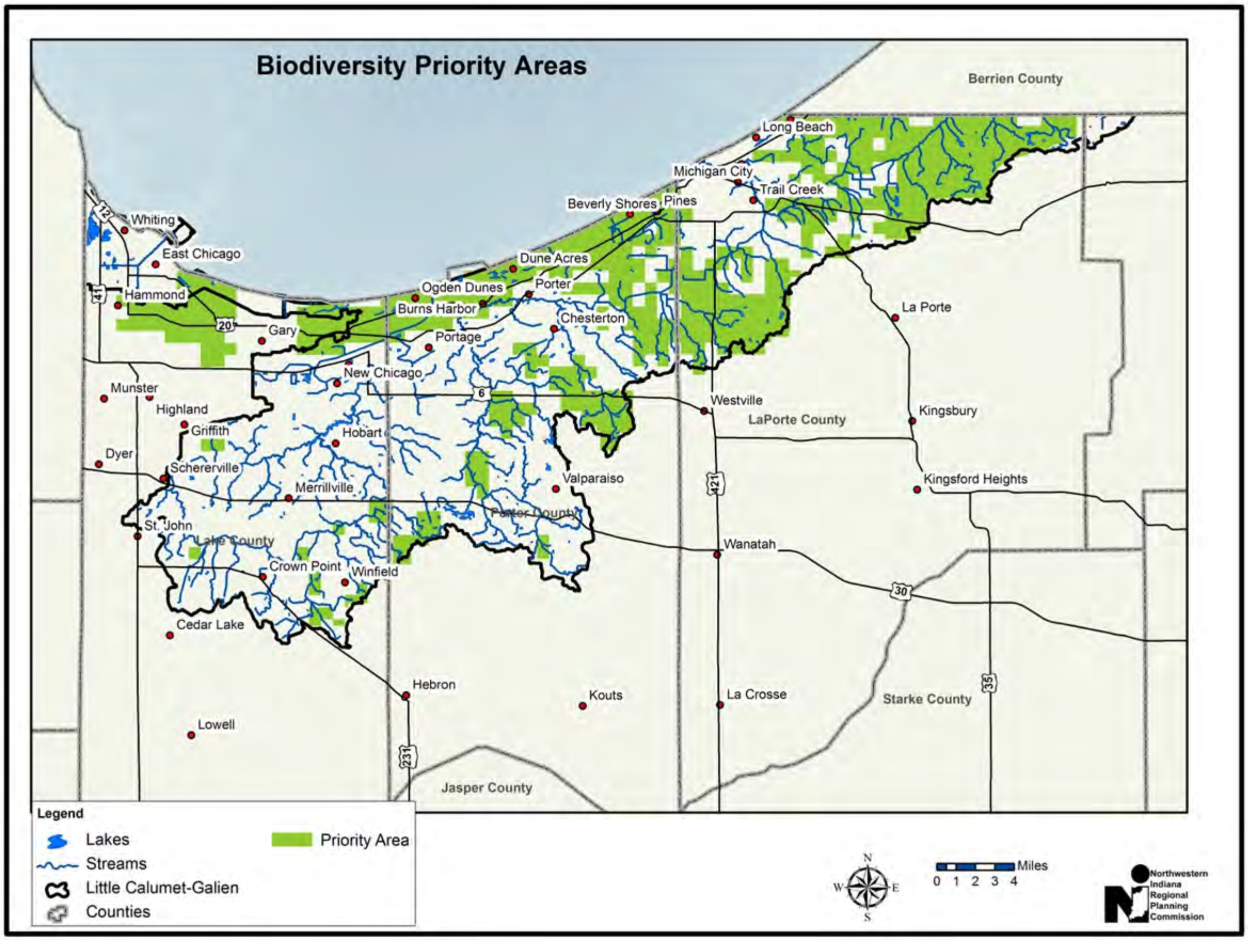

Figure 31. Biodiversity Priority Areas

Indiana Coastal Nonpoint Pollution Control Program

In its reauthorization of the Coastal Zone Management Act in 1990, Congress identified nonpoint source pollution as a major factor in the continuing degradation of coastal waters. Congress also recognized that effective solutions to nonpoint source pollution could be implemented at the state and local levels. Therefore, in the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA), Congress added Section 6217, which calls upon states with federally approved coastal zone management programs, such as the DNR's Lake Michigan Coastal Program, to develop and implement coastal nonpoint pollution control programs.

The program area includes the Little Calumet-Galien sub-basin within Lake, Porter, and LaPorte Counties, Indiana. The program address five broad categories of nonpoint source pollution, as defined by the EPA in a document titled "Guidance Specifying Management Measures for Sources of Nonpoint Source Pollution in Coastal Waters", including:

- Urban runoff
- Agriculture runoff
- Forestry runoff
- Marinas and recreational boating
- Hydromodification

The EPA has also included management measures for wetlands, riparian areas, and vegetated treatment systems that apply generally to various categories of sources of nonpoint pollution.
Under each of the five source categories are management measures that should be addressed by the state nonpoint source program. It is the job of the Coastal Nonpoint Program coordinator to ensure the achievement of each of the management measures, where applicable, within the coastal region. However, the program relies on existing state and local programs and actions for implementation. Watershed management is a key implementation strategy for the Indiana Coastal Nonpoint Program.

Further details about the program are available at www.in.gov/dnr/lakemich/6084.htm.

Indiana Nonpoint Source Management Plan

The Indiana Nonpoint Source Management Plan, prepared by the Indiana Department of Environmental Management (IDEM) Office of Water, reflects the current goals and direction of Indiana's Nonpoint Source Management Program. It documents the methods the state will use to meet the state's long-term goal of measurable improvements in water quality through education, planning, and implementation while also meeting United States Environmental Protection Agency's (U.S. EPA's) criteria. As required by Section 319(h), each state's Nonpoint Source Management Program Plan describes the state program for nonpoint source management and serves as the basis for how funds are spent. Three activity funding categories have been established by IDEM to provide a cost-effective approach to insuring pollutant load reductions at the local watershed scale. While the plan does not specifically identify critical areas it does identify where IDEM feels the greatest water quality improvements can be realized given limited Section 319 funding.

Category 1: Categories with this ranking are eligible for inclusion in Section 319 grant applications as the category historically has produced reliable load reductions, potentially has a high impact on water quality, and can reasonably be addressed at a local watershed level. Activities in the given category would be chosen first to address NPS pollution in critical areas.

Category 2: Categories with this ranking are potentially eligible for inclusion in Section 319 grant applications, provided applicants can demonstrate within a given watershed that all Category 1 priorities have been addressed by previous activities. The high cost of individual projects in these categories, when compared with Category 1 projects, makes these categories less desirable. IDEM will consider funding of these on a case-by-case basis.

Category 3: Categories with this ranking are likely not eligible for inclusion in a Section 319 application, even if applicants can demonstrate within a given watershed that all Category 1 and 2 projects have been addressed by previous activities. Many NPS sources in these categories are the responsibility of other state agencies or programs, or will require statewide solutions or expenditures of funds that far exceed the capacity of the 319 program. These categories could be counted as match towards grant activities, provided load reductions are ensured and a clear link is documented between the activity and the NPS problem that will be addressed.

Project activity categories:

- Agricultural Management (Category 1)
- Atmospheric Deposition (Category 3)
- Closed Landfills and Solid Waste Disposal Sites (Category 3)
- Ground Water (Category 2)
- Land Application of Non-Agricultural Wastes (Category 3)

- Urban Issues (Category 1)
- Natural Resource Extraction (Category 2)
- On-Site Sewage Disposal (Categories 1 & 3)
- Sediment Removal (Category 3)
- Stream Bank/Shoreline Erosion (Category 2)
- Timber Management (Category 2)
- Transportation (Category 2)

For more information about the Indiana Nonpoint Source Management Plan please visit www.in.gov/idem/5970.htm.

2040 Comprehensive Regional Plan for Northwest Indiana

The 2040 Comprehensive Regional Plan (CRP) was developed as a comprehensive, citizen-based regional vision that will guide the development of land use and transportation programming in Northwest Indiana. It is a policy program with strong coordination and implementation elements. The CRP deals largely with multijurisdictional needs and opportunities that no single agency can manage or effect on its own. The means of enhancing the region's prosperity and quality of life, improving mobility, supporting communities and realizing environmental justice were among the key considerations during the CRP's development.

While the CRP's vision, goals and objectives provide a critical policy framework for the CRP, the Growth and Revitalization Vision presents a physical expression of the vision and goals combined. The Growth and Revitalization Vision was developed through the CRP's scenario planning process. The rationale behind the development of the Growth and Revitalization Vision and, by extension, the growth of Northwest Indiana through 2040, is based on the following principles:

- Support urban reinvestment
- Ensure environmental justice/social equity
- Protect natural resources and minimize impact to environmental features and watersheds
- Integrate transportation and land use

For more information about the 2040 Comprehensive Regional Plan for Northwest Indiana please visit http://nirpc.org/.

2.1.7 Endangered, Threatened, and Rare (ETR) Species

Figure 32 shows high concentration areas or "hot spots" of ETR occurrences within the sub-basin. In general the highest concentrations of ETR species occur in habitats adjacent to Lake Michigan and coincide with managed lands such as the Indiana Dunes National Lakeshore and Indiana Dunes State Park. Data used to generate this figure was provided by the IDNR Indiana Natural Data Center. The Indiana Natural Data Center represents a comprehensive attempt to determine the state's most significant natural areas. Included in the figure are high quality natural areas and endangered, threatened and rare species occurrences for both state and federally listed species. Further information about the program and a list of ETR species by county is available at http://www.in.gov/dnr/naturepreserve/4746.htm.

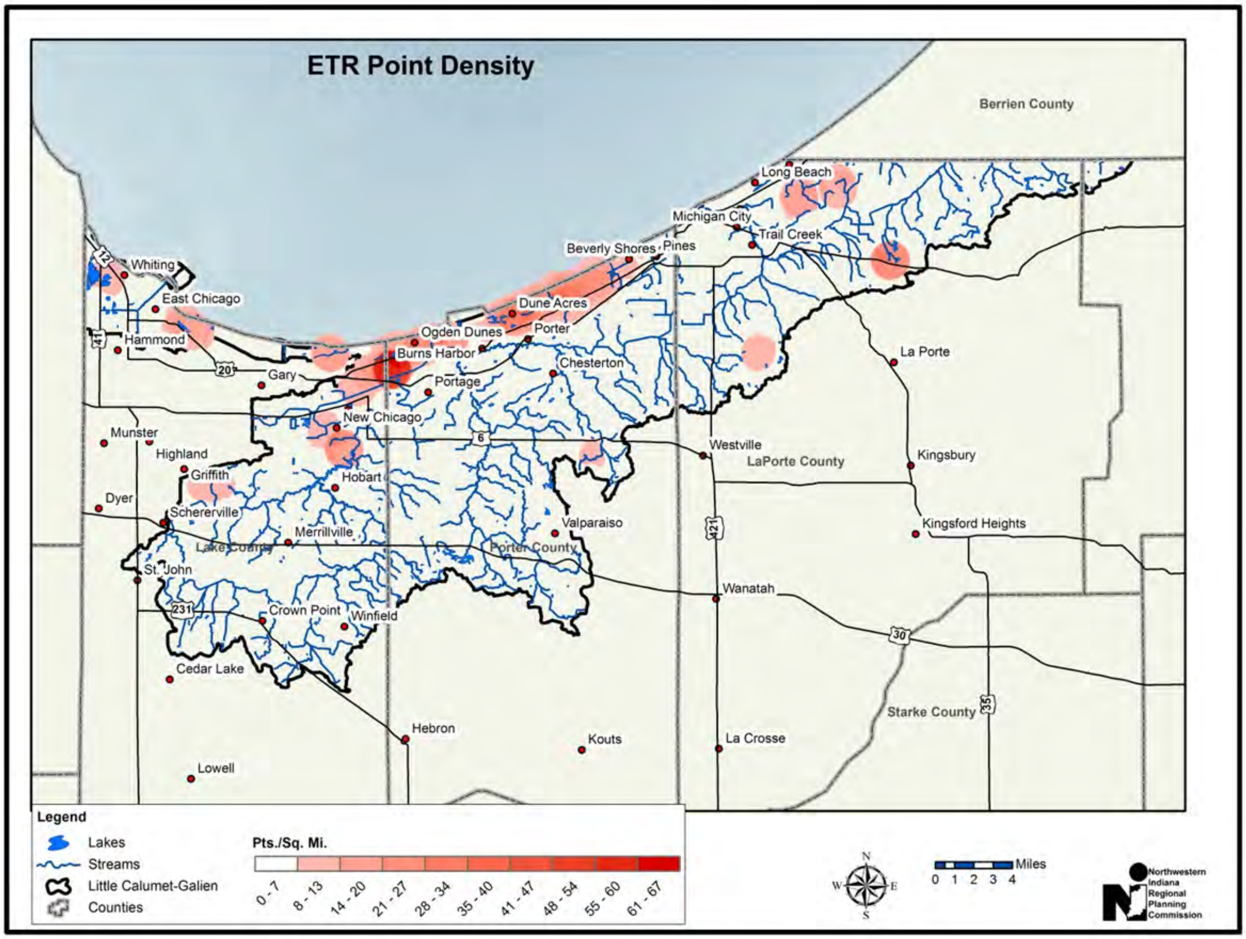

Figure 32. ETR Point Density

2.1.8 Relevant Relationships

Cultivated Land & Poorly Drained Soils

Many poorly drained soils in the state have been improved for row crop production by the installation of drain tiles. Drain tiles alter the natural flow of ground water by draining seasonally high ground water tables and excess soil moisture in the unsaturated zone to nearby streams or ditches. In so doing, nutrients and herbicides can more readily reach receiving waterbodies. The location of drain tiles is unknown in the sub-basin however the existence of cultivated lands on poorly drained soils can be a good indication of their existence. Figure 33 displays cultivated lands from the 2006 CCAP data set that exist on soils classes that include "poorly drained" as part of their classification. There are approximately 61.6 mi² (39,421 ac) of cultivated land on poorly drained soil classes in the sub-basin.

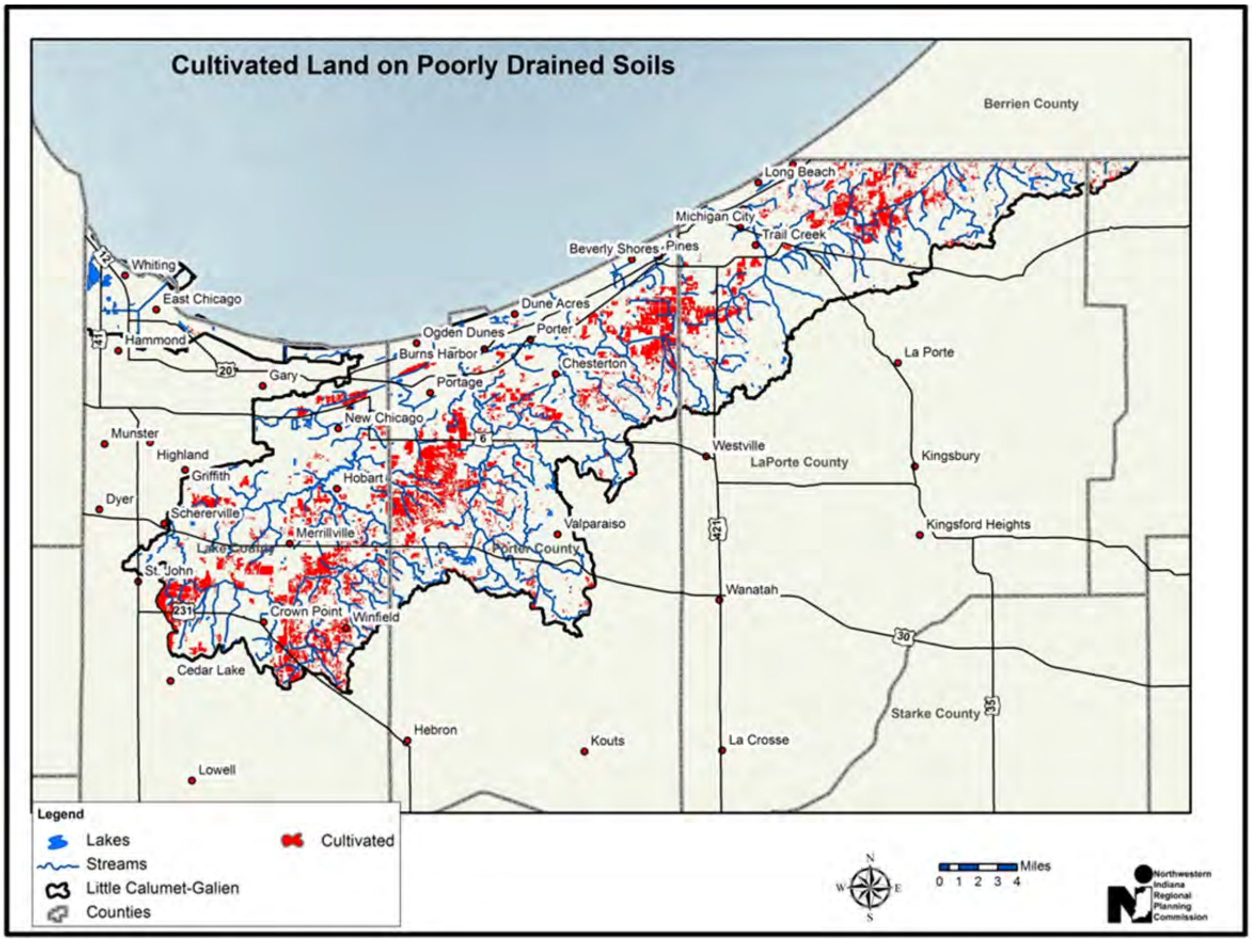

Figure 33. Cultivated Land on Poorly Drained Soils

Hydric Soils and Wetlands

Hydric soils are one of three characteristics used to identify wetlands. Areas where hydric soils are present but wetlands no longer exist can be useful in identifying potential wetland restoration opportunities. Figure 34 shows the locations of wetlands identified during the Ducks Unlimited NWI update overlain on soils identified as hydric by the NRCS. There are approximately 58.5 mi² of wetland (NWI) and 123 mi² of hydric soils within the sub-basin. This equates to a 52% loss in wetland area.

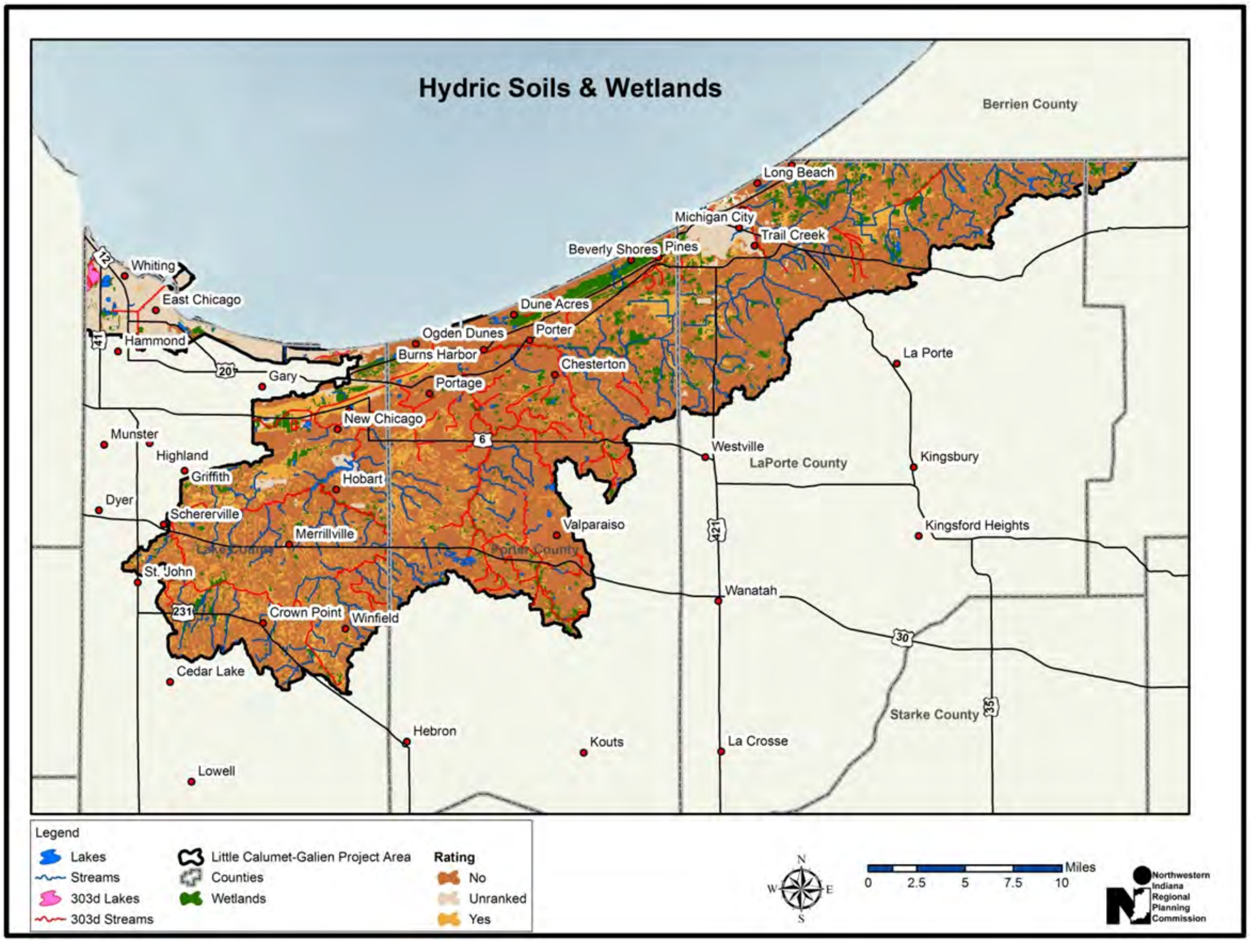

Figure 34. Hydric Soils & Wetlands

Land Cover & HEL Soils

Approximately 54% of the soils in the sub-basin are classified as HEL soils. Figure 35 displays 2006 CCAP land cover classes that exist on HEL soils. Row crop production occurring on these soils may need additional measures to reduce erosion and runoff. Preserving natural land cover occurring on these soils may be a way of preventing erosion and additional pollutant loading to nearby waterbodies. New development occurring on these soils may require additional erosion control measures.

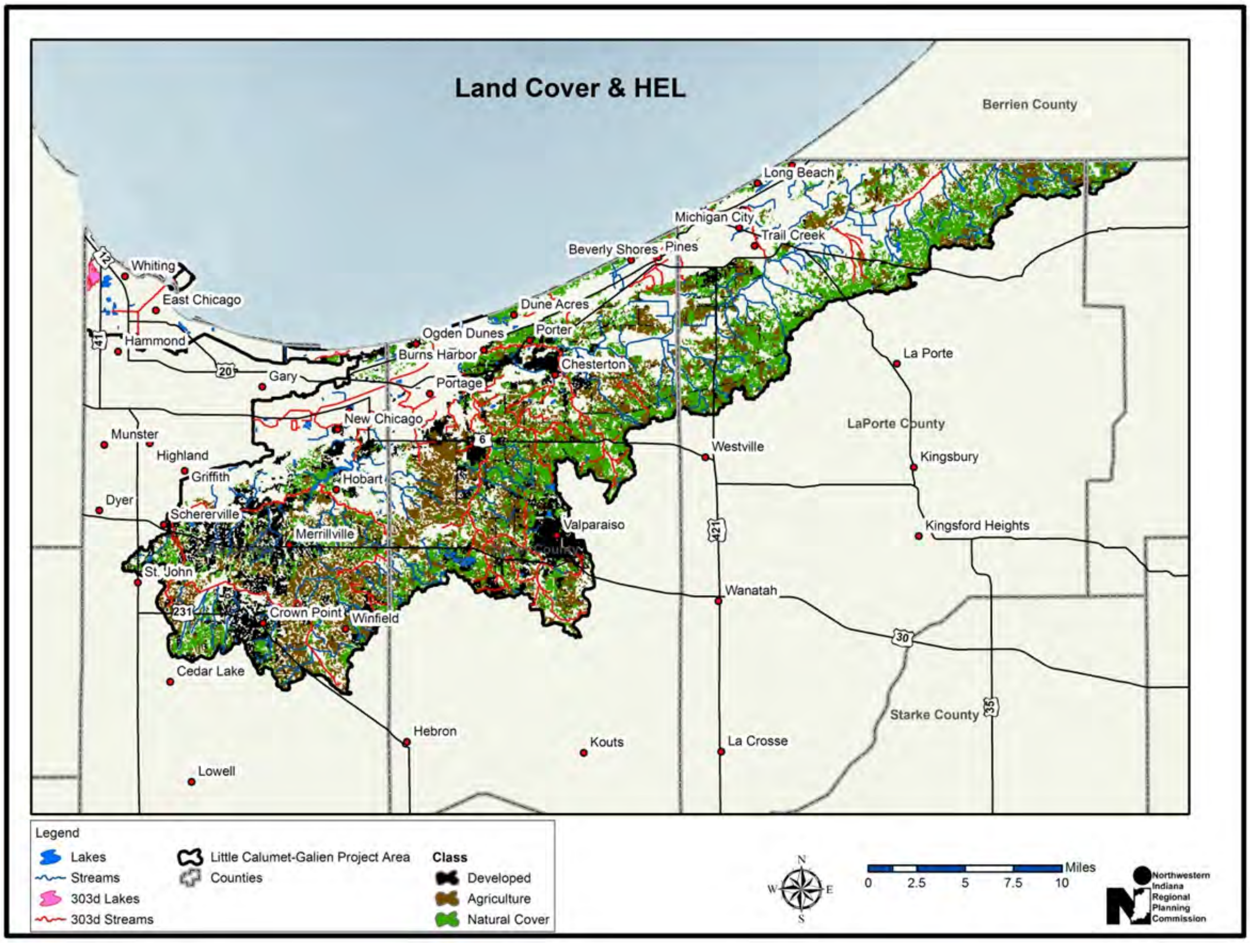

Figure 35. Land Cover & HEL Soils

2.2 Part II- Watershed Inventory

2.2.1 Data & Targets

NIRPC requested historical water quality data from IDEM for the time period of 1990 to 2010. IDEM provided spreadsheets with water chemistry, biological assessment, and habitat assessment data along with site coordinates. Data was filtered to only include information from 1999 to 2010. Watershed changes based on land cover were relatively stable over this time period. Site locations and sampling data were imported into ArcMap 10 for analysis. The data presented in Figure 36 is displayed to reflect sampling intensity (i.e. number of observations) for each station. Displaying the data in this way is useful to determine where additional sampling may be needed for future watershed management planning efforts. Water quality data from IDEM is included in the appendices.

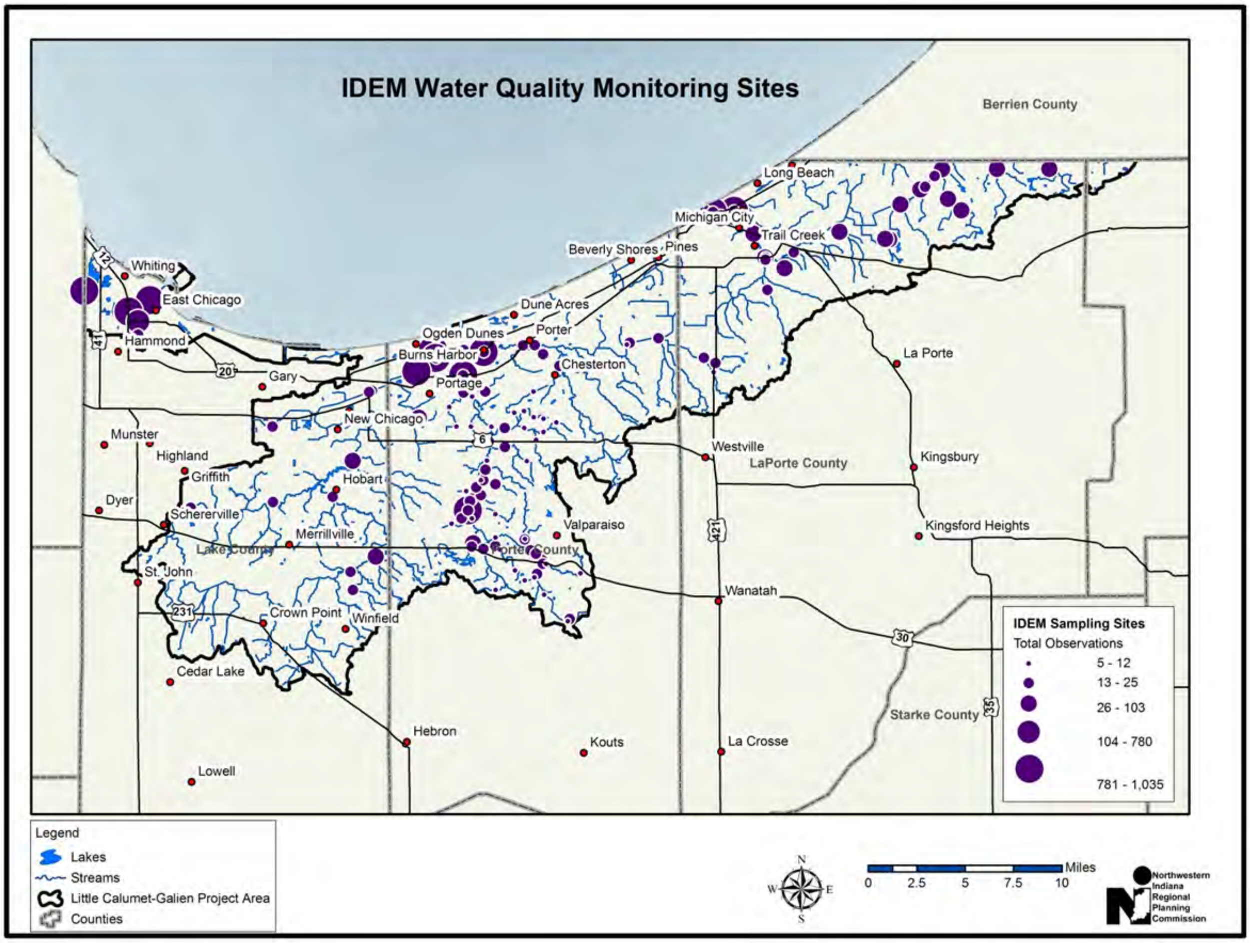

Figure 36. IDEM Water Quality Monitoring Sites

IDEM's Office of Water Quality, Assessment Branch Monitoring Program protocols are available at http://monitoringprotocols.pbworks.com/w/page/21630005/IDEM-Office-of-Water-Quality,-Assessment-Branch-Monitoring-Programs. In general water chemistry analysis included a combination of field and laboratory methods. Fish and benthic macroinvertebrate sampling data were used to calculate the Index of Biotic Integrity (IBI) and macroinvertebrate Index of Biotic Integrity (mIBI) respectively. Both of which are measures of the biological health of a stream. Qualitative habitat assessments were done using the Qualitative Habitat Evaluation Index (QHEI).

The following information on identifying water quality targets comes from IDEM www.in.gov/idem/6242.htm.

The IDEM Watershed Management Plan (WMP) Checklist (2009) requires groups to identify targets for water quality parameters of concern. A target is defined as the desired measured level of a water quality or habitat/biological parameter that a group has decided streams in the watershed should meet.

Where an Indiana Water Quality Standard or TMDL exists for a parameter of concern, the watershed group must, at a minimum, set the target to meet the respective standard or the loading limit set in the TMDL. Groups obviously are welcome to set more stringent targets if they wish. Table 2 *shows water quality parameters watershed groups are often concerned with and which have an Indiana Water*

Quality Standard. A complete list of Indiana's Water Quality Standards can be found in the Indiana Administrative Code.

Many of the water quality parameters watershed groups are concerned with do not have a standard. In these instances groups are free to set whatever target they deem appropriate, but that freedom can be overwhelming given the myriad of targets being used across the county. This guidance does not attempt to tell watershed groups what targets to choose, but rather, lists in Table 3 *several targets used by other watershed groups in Indiana and the source of those targets. IDEM hopes this information helps watershed groups wisely choose water quality targets for their specific watershed. Exceedance*

Parameter	Target	Reference/Other Information
Total Ammonia (NH3)	Range between 0.0 and 0.21 mg/L depending upon temperature and pH	Indiana Administrative Code (327 IAC 2-1-6)
Atrazine	Max: 3.0 ppb	U.S. EPA Drinking Water Standard
Dissolved Oxygen (DO)	Min: 4.0 mg/L Max: 12.0 mg/L	Indiana Administrative Code (327 IAC 2-1-6)
	Min: 6.0 mg/L in coldwater fishery streams	Indiana Administrative Code (327 IAC 2-1.5-8)
	Min: 7.0 mg/L in spawning areas of coldwater fishery streams	Indiana Administrative Code (327 IAC 2-1.5-8)
E. coli	Max: 235 CFU/ 100mL in a single sample	Indiana Administrative Code (327 IAC 2-1.5-8)
	Max: Geometric Mean of 125 CFU/ 100mL from 5 equally spaced samples over a 30-day period	Indiana Administrative Code (327 IAC 2-1.5-8)
Nitrate	Max: 10 mg/L in waters designated as a drinking water source	Indiana Administrative Code (327 IAC 2-1-6)
Nitrite	Max: 1 mg/L in waters designated as a drinking water source	Indiana Administrative Code (327 IAC 2-1-6)
Nitrate-N + Nitrate-N	Max: 10 mg/L in waters designated as a drinking water source	Indiana Administrative Code (327 IAC 2-1-6)
Temperature	Dependent on time of year and whether stream is designated as a cold water fisheries	Indiana Administrative Code (327 IAC 2-1-6)

Table 2. Water Quality Standards

Parameter	Target	Reference/Other Information
Nitrate-nitrogen (NO3)	Max: 0.633 mg/L	U.S. EPA recommendation *
	Max: 1.0 mg/L	Ohio EPA recommended criteria for Warm Water Habitat (WWH) headwater streams in Ohio EPA Technical Bulletin MAS//1999-1-1 [PDF]
	1.5 mg/L	Dividing line between mesotrophic and eutrophic streams (Dodds, W.K. et al., 1998, Table 1, pg. 1459, and in EPA-822-B-00-002 [PDF], p 27.)
	10.0 mg/L	IDEM draft TMDL target based on drinking water targets
Ortho-Phosphate also known as Soluble reactive phosphorus (SRP)	Max: 0.005 mg/L	Wawasee Area Conservancy Foundation recommendation for lake systems, NESWP344
Suspended Sediment Concentration (SSC)	Max: 25.0 mg/L	U.S. EPA recommendation for excellent fisheries
	Range: 25.0-80.0 mg/L	U.S. EPA recommendation for good to moderate fisheries
Total Kjeldahl Nitrogen (TKN)	Max: 0.591 mg/L	U.S. EPA recommendation *
Total Phosphorus (TP)	Max: 0.076 mg/L	U.S. EPA recommendation
	0.07 mg/L	Dividing line between mesotrophic and eutrophic streams (Dodds, W.K. et al., 1998, Table 1, pg. 1459, and in EPA-822-B-00-002 [PDF], p 27.)
	Max: 0.08 mg/L	Ohio EPA recommended criteria for Warm Water Habitat (WWH) headwater streams in Ohio EPA Technical Bulletin MAS//1999-1-1 [PDF]
	Max: 0.3 mg/L	IDEM draft TMDL target
Total Suspended Solids (TSS)	Max: 80.0 mg/L	Wawasee Area Conservancy Foundation recommendation to protect aquatic life in lake systems
	Max: 30.0 mg/L	IDEM draft TMDL target from NPDES rule for lake dischargers in 327 IAC 5-10-4 re: monthly average for winter limits for small sanitary treatment plants
	Range: 25.0-80.0 mg/L	Concentrations within this range reduce fish concentrations (Waters, T.F.,, 1995). Sediment in streams: sources, biological effects and control. American Fisheries Society, Bethesda, MD. 251 p.
	Max: 40.0 mg/L	New Jersey criteria for warm water streams
	Max: 46.0 mg/L	Minnesota TMDL criteria for protection of fish/macroinvertebrate health
Turbidity	Max: 25.0 NTU	Minnesota TMDL criteria for protection of fish/macroinvertebrate health
	Max: 10.4 NTU	U.S. EPA recommendation

Table 3. Water Quality Targets

2.2.2 Water Quality Information

The Indiana Department of Environmental Management regularly assesses and compiles surface water quality data under the provisions of the Clean Water Act. The results of this work are used by IDEM to create the 303d List of Impaired Waterbodies based upon the waterbodies' designated uses. The "designated" uses of a waterbody are an expression of goals for the water, such as supporting aquatic life and human activities, including recreation and use as a public water supply. The 303d List shows which waterbodies do not or are not expected to meet those uses. The concept of a water body having designated uses is central to establishing appropriate water quality standards.

The following uses are designated by the Indiana Water Pollution Control Board (327 IAC 2-1-3 [327 IAC 2-1.5-5 for the Great Lakes system]):

- Surface waters of the state are designated for full-body contact recreation.
- All waters, except limited use waters, will be capable of supporting a well-balanced, warm water aquatic community and, where natural temperatures will permit, will be capable of supporting put-and-take trout fishing. All waters capable of supporting the natural reproduction of trout as of February 17, 1977, shall be so maintained.
- All waters, which are used for public or industrial water supply, must meet the standards for those uses at the point where water is withdrawn.
- All waters, which are used for agricultural purposes, must meet minimum surface water quality standards.
- All waters in which naturally poor physical characteristics (including lack of sufficient flow), naturally poor or reversible man-induced conditions, which came into existence prior to January 1, 1983, and having been established by use attainability analysis, public comment period, and hearing may qualify to be classified for limited use and must be evaluated for restoration and upgrading at each triennial review of this rule.
- All waters, which provide unusual aquatic habitat, which are an integral feature of an area of exceptional natural beauty or character, or which support unique assemblages of aquatic organisms may be classified for exceptional use (or designated as outstanding state resource waters in the Great Lakes system).

All waters of the state, at all times and at all places, including the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges (327 IAC 2-1-6 [327 IAC 2-1.5-8 for the Great Lakes system]):

- that will settle to form putrescent or otherwise objectionable deposits,
- that are in amounts sufficient to be unsightly or deleterious,
- that produce color, visible oil sheen, odor, or other conditions in such degree as to create a nuisance,
- which are in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill aquatic life, other animals, plants, or humans, or
- which are in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly, or otherwise impair designated uses.

Impaired waterbodies included on the 2008 303d list for the sub-basin are displayed in Figure 37. Impaired Waterbodies (2008)and presented in Table 4. Of the 572 miles of stream and ditch that drain this landscape, nearly 228 miles (40%) are impaired. The most common impairments are *E. coli* (132 miles) and Impaired Biotic Communities (109 miles). Additionally, a number of waterbodies have multiple impairments within the same reach (69 miles).

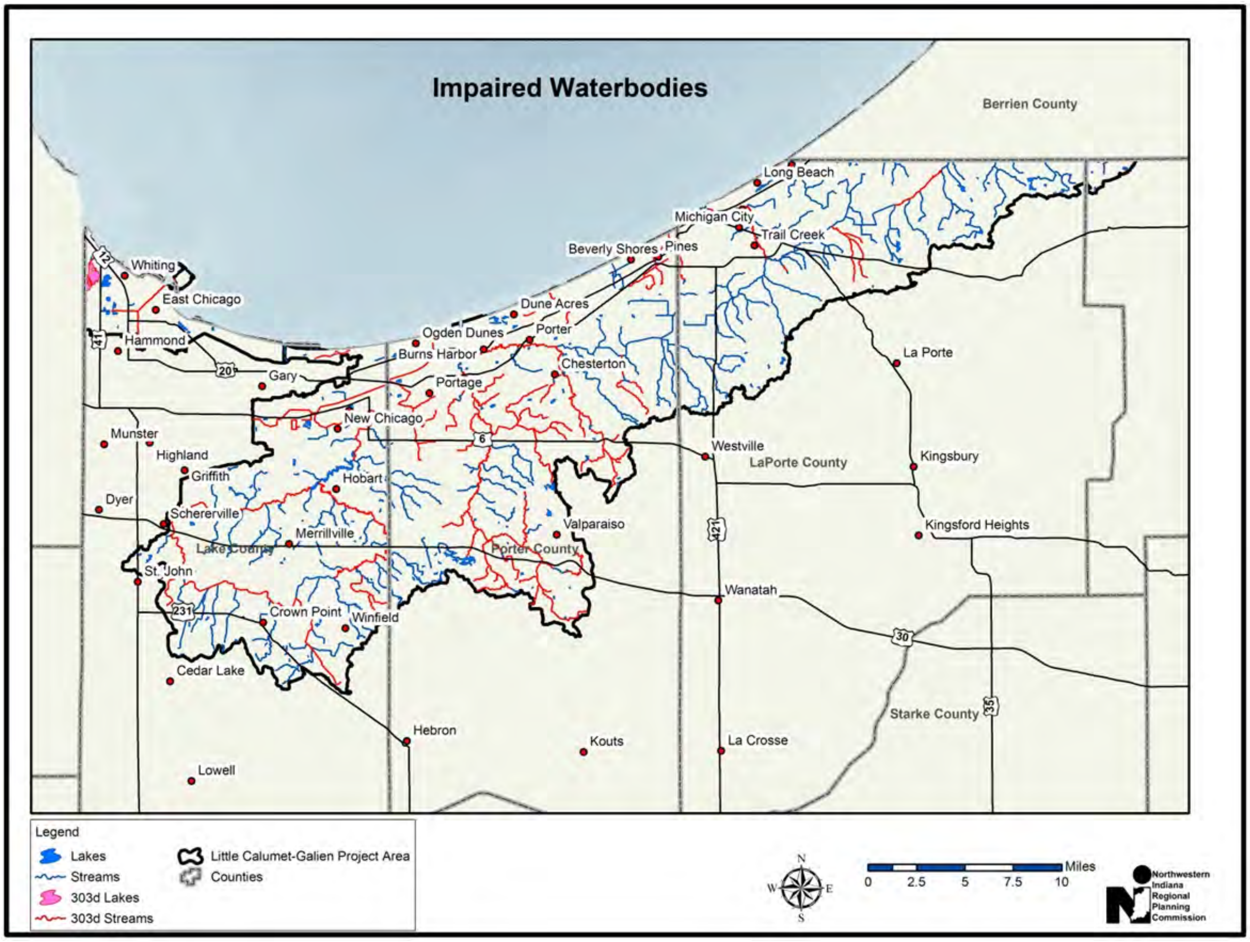

Figure 37. Impaired Waterbodies (2008)

Waterbody	County	Reason
Beauty Creek	Porter	IBC
Burns Ditch	Porter	PCB-FT
Chrisman Ditch	Porter	E. coli
Clark Ditch	Porter	E. coli, IBC
Clark Ditch	Porter	E. coli, IBC
Clark Ditch- Unnamed Headwater	Porter	E. coli
Clark Ditch- Unnamed Tributary	Porter	E. coli
Coffee Creek Basin	Porter	E. coli
Damon Run- Swanson Lamporte Ditch	Porter	E. coli
Damon Run & Tributary	Porter	E. coli
Deep River	Lake	E. coli
Deep River- Burns Ditch	Lake	IBC
Deep River- Tributary Merrillville	Lake	IBC, Siltation
Deep River Upstream US 30	Lake	E. coli, IBC

Waterbody	County	Reason
Dingler Lake Inlet	LaPorte	E. coli
Dunes Creek	Porter	E. coli, IBC
Galena River	LaPorte	E. coli
Gustafson Ditch- Other Tributaries	Porter	E. coli, IBC
Indiana Harbor	Lake	HG-FT, PCB-FT
Indiana Harbor Canal- Lake George Bridge	Lake	IBC, Oil & Grease, PCB-FT
Indiana Harbor- Main Channel	Lake	E. coli, PCB-FT
Kintzele Ditch & Tributaries	Porter	E. coli
Little Calumet River	Lake	Chloride, Cyanide, DO, IBC, PCB-FT
Little Calumet River- East Arm	Porter	IBC, PCB-FT
Main Beaver Dam Ditch Above Niles Ditch	Lake	IBC
Main Beaver Dam Ditch Above Crown Point	Lake	IBC
Munson Ditch	Porter	E. coli, IBC
Niles Ditch	Lake	IBC
Portage Burns Waterway	Porter	PCB-FT
Rice Lake Tributary & Outlet Streams	Porter	E. coli
Salt Creek	Porter	IBC
Salt Creek- Unnamed Tributary	Porter	E. coli, IBC
Salt Creek- Unnamed Tributary (Lake Louise)	Porter	E. coli, IBC
Salt Creek - Unnamed Tributary (Sedley, IN)	Porter	E. coli, IBC
Salt Creek Downstream of Clark Ditch	Porter	E. coli, IBC
Salt Creek Upstream of Clark Ditch	Porter	IBC
Salt Creek (Valparaiso, IN)	Porter	IBC
Salt Creek Tributaries	Porter	IBC
Squirrel Creek	Porter	IBC
Trail Creek	LaPorte	HG-FT, PCB-FT
Trail Creek, East Branch - Unnamed Tributary	LaPorte	E. coli
Turkey Creek- Merrillville	Lake	E. coli
Turkey Creek Mainstem	Lake	E. coli, IBC
Willow Creek- Unnamed Tributary	Porter	E. coli
Willow Creek Upstream of Chrisman Ditch	Porter	DO, E. coli, IBC

Table 4. 303d Listing (2008)

E. coli

Escherichia coli (*E. coli*) is a bacteria commonly found in the intestines of warm blooded animals and humans. Its presence in water is a strong indicator of recent sewage or animal waste contamination. While not necessarily pathogenic in itself, *E. coli* is relatively easy to test for and is used as an indicator other more severe waterborne disease causing organisms. The single sample water quality standard of 235 CFU/100 ml is used to protect human health during the recreational period (full body contact) of April through October.

Between 1999 and 2010, IDEM collected 603 *E. coli* samples from 85 different stations in the sub-basin project area. Using 235 CFU/100 ml for a single sample as a target value (Table 3), 76 of the 85 stations (89%) sampled exceeded the water quality standard at least once and 352 of the 603 total samples (58%) collected exceeded the water quality standard. Figure 38 shows the sample locations and the location in which the single sample target value of 235 CFU/100ml was exceeded. The number of exceedances by station was normalized by the total number of observations at that station (i.e. samples taken) for *E. coli*.

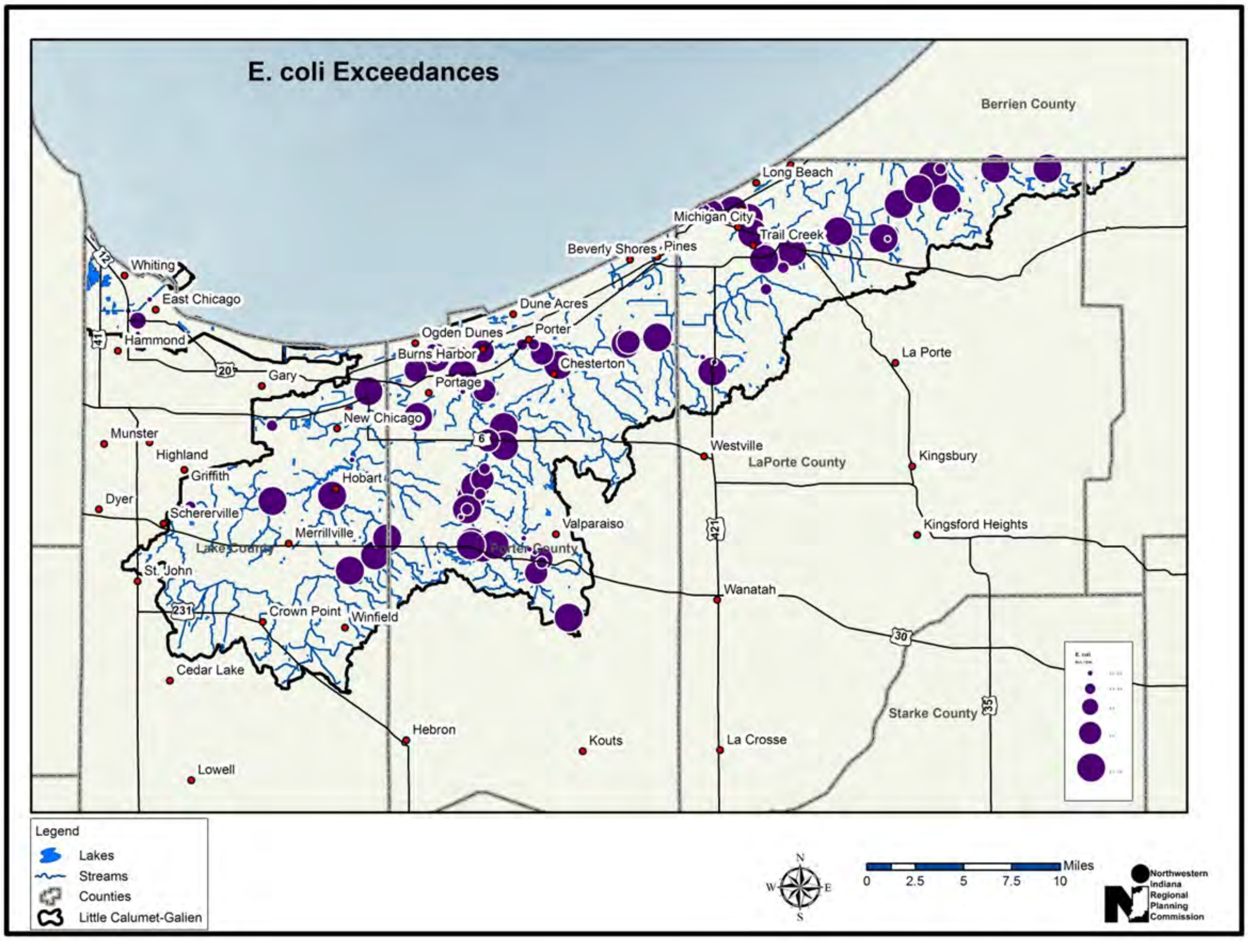

Figure 38. E. coli Exceedances

As noted in 2.1.6 Other Planning Efforts, a number of TMDL reports have been completed for *E. coli* within the sub-basin. These include the Trail Creek *E. coli* TMDL (Triad Engineering Inc., 2003), the Little Calumet & Portage Burns Waterway TMDL for *E. coli* Bacteria (Earth Tech, 2004), the Lake Michigan Shoreline TMDL for *E. coli* Bacteria (Tetra Tech, 2004), the Salt Creek *E. coli* TMDL (WHPA, 2004), and the TMDL for *E. coli* for the Galena River Watershed- LaPorte & St. Joseph Counties (IDEM, 2010).

Trail Creek TMDL

Based on source assessment and watershed modeling, *E. coli* levels in Trail Creek are present during both dry and wet weather conditions. In order to meet the TMDL target concentrations (125 and 235 cfu/100mL), continued operation of the four point sources in the watershed in accordance with their IDEM NPDES permits at their permitted effluent flow will meet the waste load allocation component of the *E. coli* TMDL for Trail Creek. For nonpoint sources of *E. coli*, the report concludes that: “non-point sources will need to be monitored locally for implementation of BMPs (best management practices) or in providing access to watershed grants to assist in reducing non-point sources to meet the load allocations (LA) developed under this TMDL.”

Little Calumet & Portage Burns Waterway TMDL

Based on modeling and data analyzed, the Little Calumet-Portage Burns Waterway will require a reduction of over 90% in nonpoint source loads for *E. coli*. Target load reductions from the TMDL are displayed in Table 5. A map of the study area and junctions (segments) can be found on Page 3-2 of the TMDL report. The major source of the *E. coli* bacteria impairment appears to be nonpoint sources. Nonpoint sources most likely contributing to the impairment of water quality include: failing septic systems, unknown illicit discharges of sewage, wildlife, small agriculture operations, bacteria laden sediments, and urban runoff. However, the TMDL states that there is still uncertainty of the magnitude that various nonpoint sources of *E. coli* play in the impairment of the Little Calumet and Portage Burns Waterway and that some improvements and modifications to the monitoring network should be considered to quantify these loads.

Point sources were found to be well below water quality standards. Therefore, point sources of *E. coli* make up such a small percent of the total load that further reductions would not significantly improve water quality. Combined sewer overflows (CSOs) are a known source of *E. coli* and play a major role in the water quality impairment when they occur. However, CSOs did not coincide with the dates of the simulated events, indicating that the waterbody was impaired by other sources in addition to CSOs.

There were no apparent patterns to the water quality violations relating to *E. coli* that would suggest that violations were more common during a certain time of year or under some critical flow or weather conditions. From the available data, one could not identify the magnitude of any single source of *E. coli*. However, there are five general pollutant sources that need to be considered.

- NPDES Discharges (point sources) – assumed to be in steady-state condition based on known data.
- Combined Sewer Overflow (CSO) discharges – intermittent discharges based on estimates using known data about the discharge event.
- Urban Nonpoint Sources Stormwater – no known sampling data, however, could estimate loads knowing runoff volume and land use.
- Other Nonpoint Sources (such as livestock, wildlife, and failing septic systems) – there is no known data to quantify loads form these sources.
- Loads from Tributary Watersheds (Coffee Creek, Salt Creek, Deep River, and Hart Ditch).

Junction	Total Average Loads (cfu/day)	Target Load Reduction from Tributaries			Remaining Target Loads from System		
		Average Daily Load (cfu/day)	% Reduction from Average Loads		Average Daily Load (cfu/day)	% Reduction from Average Loads	
			Wet Discharge	Dry Discharge		Wet Discharge	Dry Discharge
1	5.83×10^{10}				2.27×10^{10}	71%	0%
2	9.97×10^{12}				2.44×10^{10}	97%	0%
3	2.20×10^{12}	1.39×10^{12}	50%	11%	9.52×10^{10}	95%	46%
4	2.08×10^{10}				5.03 x 109	83%	85%
5	3.15×10^{10}				3.05×10^{9}	88%	95%
6	2.75×10^{10}				2.66×10^{9}	91%	93%
7	3.83×10^{10}				3.94×10^{9}	91%	92%
8	4.30×10^{10}				4.71×10^{9}	89%	91%
9	5.90×10^{11}				2.11×10^{10}	96%	92%
10	5.90×10^{11}				3.70×10^{10}	93%	85%
11	5.90×10^{11}	5.79×10^{11}	97%	99%	1.89×10^{10}	96%	96%
12	1.45×10^{12}	4.41×10^{11}	27%	12%	6.23×10^{10}	79%	23%
13	9.14×10^{10}				5.24×10^{9}	97%	38%
14	5.79×10^{10}				5.28×10^{9}	82%	44%
15	1.99×10^{10}				2.02×10^{10}	0%	41%

Table 5. Target Load Reductions for the Little Calumet-Portage Burns Waterway TMDL

Lake Michigan Shoreline TMDL

The analysis conducted for this TMDL indicated the need for significant reductions in *E. coli* loading to meet water quality standards. The most significant sources of *E. coli* were tributary loadings. Other sources of *E. coli* loading to the shoreline included residential septic systems, boaters, swimmers, beach sands and algae, and wildlife. Reduction of loads from controllable sources would require a voluntary approach and the implementation of a variety of best management practices (BMPs). Table 6 shows the allocations and percent reductions needed for tributary loading (Tetra Tech, 2004).

Source	Baseline Load (counts/rec season)	LA (counts/rec season)	MOS (counts/rec season)	TMDL = WLA + LA + MOS (counts/rec season)	Percent Reduction
Tributary Loads					
Indiana Harbor Ship Canal	7.66E+13	5.96E+13	3.13E+12	6.27E+13	18.1%
Burns Ditch	7.59E+14	1.65E+14	8.71E+12	1.74E+14	77.1%
Dunes Creek	1.15E+14	1.16E+13	6.08E+11	1.22E+13	89.4%
Derby Ditch	6.19E+13	5.59E+12	2.94E+11	5.88E+12	90.5%
Kintzele Ditch	6.33E+13	1.34E+13	7.05E+11	1.41E+13	77.7%
Trail Creek	2.38E+14	4.23E+13	2.23E+12	4.45E+13	81.3%
White Creek	1.45E+13	1.37E+13	7.23E+11	1.45E+13	0.0%

Table 6. Tributary Allocations for the Lake Michigan E. coli TMDL

Salt Creek TMDL

Analysis of existing water-quality data showed there was no single critical condition associated with violations of the *E. coli* standard in Salt Creek. Load-duration curve analysis (Figure 39) showed that exceedances of the single-sample standard (235 CFU/100ml) occur throughout the flow regime. A higher percentage of exceedances were observed in the high-to-middle range of flows (2-60 percent flow duration), indicating that concentrations above the standard are likely associated with nonpoint sources or other event-driven inputs such as storm sewer discharges and CSOs. Additional analyses confirmed that exceedances in Salt Creek and its tributaries were associated with precipitation events. Based on the modeling and data analyzed, Salt Creek will require an 88% reduction in *E. coli* loading. To accomplish this, a 29% reduction in point source loading, expressed as waste load allocation (WLA) in the TMDL formula, would be needed. The 29% reduction was calculated as the percent reduction achievable by eliminating all bypass flows and reducing the CSO input concentrations to the geometric mean standard of 125 CFU/100ml. A 55% reduction in nonpoint source loading, expressed as load allocation (LA) in the TMDL formula, would also be needed. The remaining 4% is an integrated margin of safety.

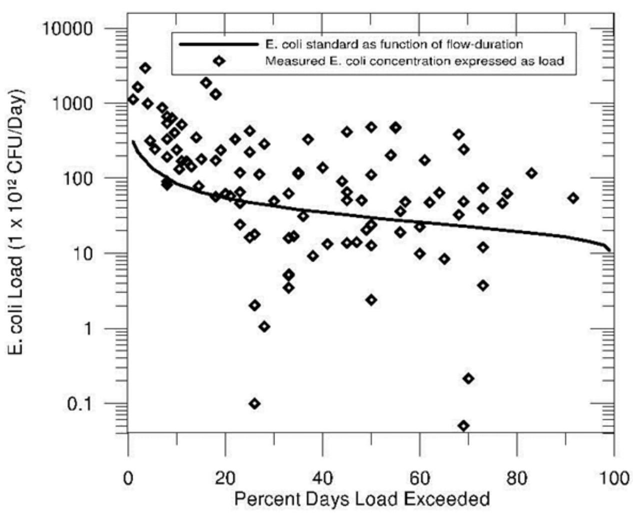

Figure 39. Load Duration Curve Salt Creek TMDL

Galena River Watershed TMDL

IDEM collected *E. coli* samples from nine locations within the watershed (Figure 40) in support of the Galena River Watershed TMDL. To help identify potential sources of *E. coli*, IDEM prepared load duration curves for all nine sites. Load duration curves for Sites 7-9 are presented below in Figure 41, Figure 42, and Figure 43. IDEM determined that these three sites provided the best description of *E. coli* sources in the watershed.

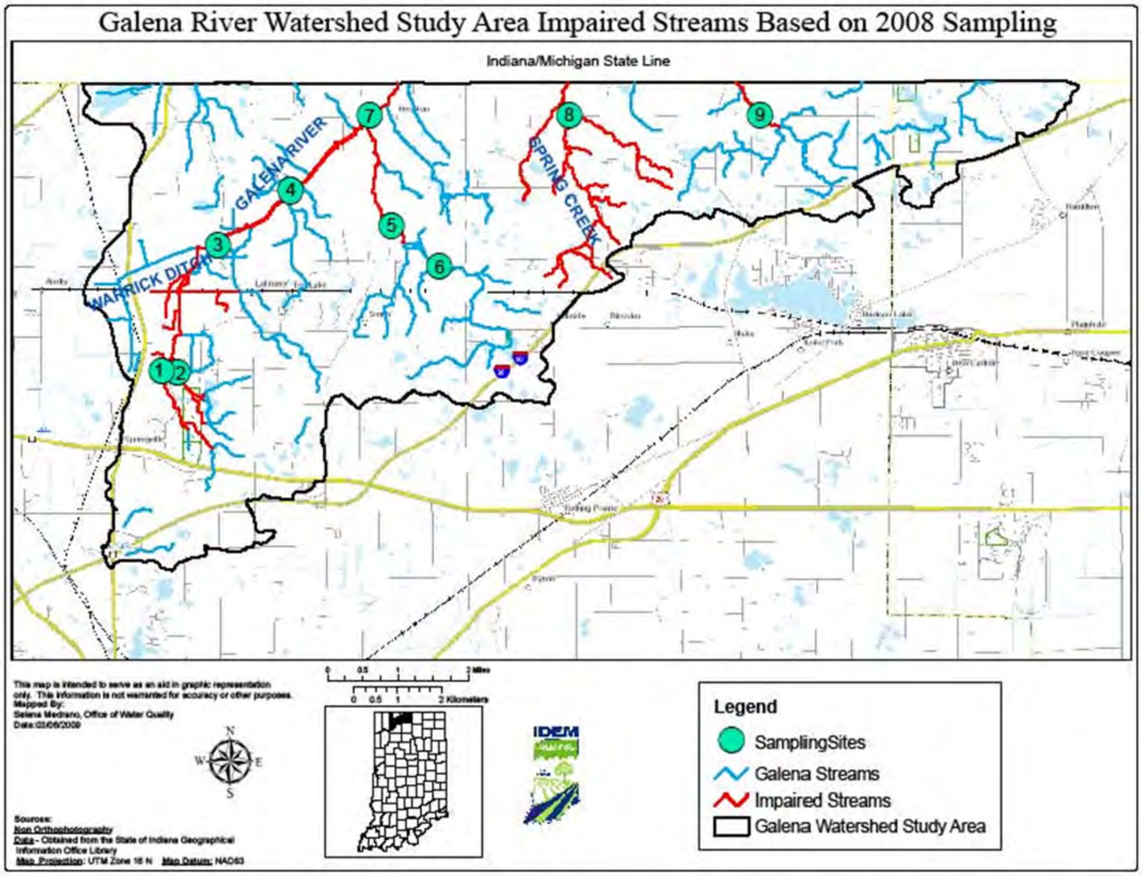

Figure 40. Galena River Watershed TMDL Sample Sites

Site 7 (Figure 41) was located on the Galena River on County Road 1000 North, just east of County Road 125 East. This site receives forested, wetland, and agricultural inputs and is in northern LaPorte County. The geometric mean at this site was 297 MPN/100 ml. Two of the five samples collected during the 2008 intensive water quality sampling were above the single standard maximum of 235 MPN/100 ml. The highest sample collected was 686.7 MPN/100 ml.

The highest sample was collected on a day when the precipitation was recorded as 0.09 inches. This high reading during a relatively dry period is unusual for this watershed. This high result could be the result of livestock having unrestricted access to the streams as noted in the watershed tour. Nonpoint sources also contribute to the *E. coli* impairment at this site as violations were noted during wet periods.

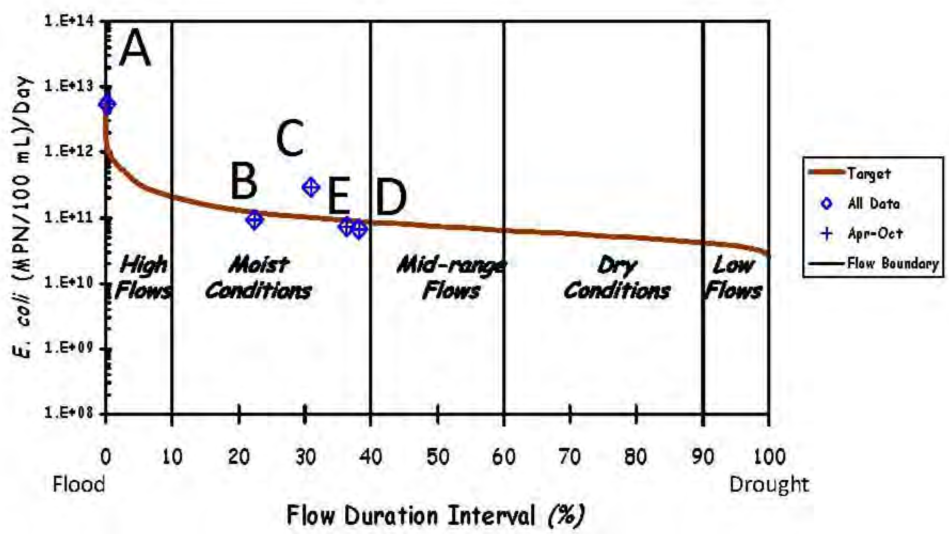

Figure 41. Load Duration Curve Site 7 Galena River Watershed TMDL

Site 8 (Figure 42) was located on Spring Creek on County Road 1000 North, West of County Road 500 East. This area is primarily forested with wetland areas with a few agricultural inputs and is located in northern LaPorte County. The stream in this area has a thin riparian buffer.

The geometric mean at this site is 383 MPN/100 ml. Of the samples collected during the 2008 intensive water quality sampling, one sample at this site was below the single sample maximum of 235 MPN/100 ml. The highest exceedance at this site is 686.7 MPN/100 ml, which occurred just after a rain event recorded as 4.06 inches, indicating that *E. coli* contributions are from nearby runoff.

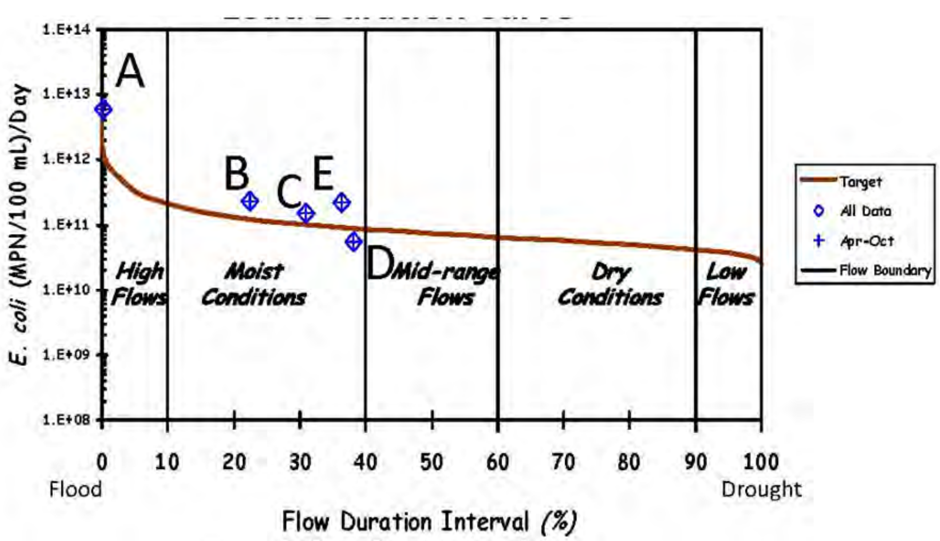

Figure 42. Load Duration Curve Site 8 Galena River Watershed TMDL

Site 9 (Figure 43) was located on an unnamed tributary to Spring Creek on County Road 1000 North, just East of County Road 700 East. This area receives inputs from forests, wetlands, and agriculture and is located in northeastern LaPorte County. There is a thin riparian buffer on either side of the stream. The geometric mean at this site is 424 MPN/100 ml. Four of the five samples collected during the 2008 intensive water quality sampling at this site were above the single sample maximum of 235 MPN/100 ml. The highest exceedance of the single sample maximum is 866.4 MPN/100 ml, which was collected on a day when the precipitation was recorded as 0.07 inch. This high reading during a relatively dry period is unusual for this watershed. This high result could be the result of livestock having unrestricted access to the streams as noted in the watershed tour. Nonpoint sources also contribute to the *E. coli* impairment at this site as violations were noted during wet periods.

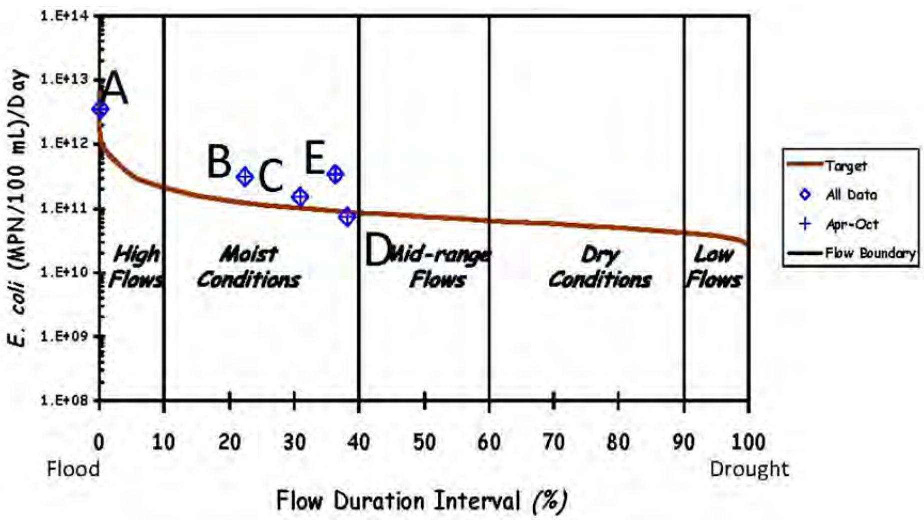

Figure 43. Load Duration Curve Site 9 Galena River Watershed TMDL

The following reductions in Table 7 are needed to meet water quality standards.

Site #	Stream Name	Geometric Mean	% Reduction Needed
1	Galena River	613	79.6%
2	Galena River East	144	13.2%
3	Galena River	379	67.0%
4	Galena River	288	56.6%
5	Unnamed Tributary East to Galena River	287	56.5%
6	Main Tributary East to Galena River	116	N/A
7	Galena River	297	57.9%
8	Spring Creek	383	67.4%
9	Unnamed Tributary to Spring Creek	424	70.5%

Table 7. Load Reductions for the Galena River Watershed TMDL

Nitrate-N + Nitrite-N

Nitrogen makes up about 80% of the air we breathe and is found in all living things. In water it occurs as nitrate (NO3), nitrite (NO2), and ammonia (NH3). Nitrate, an essential plant nutrient, is the most water-soluble and least attracted to soil particles form of nitrogen. Common sources include human and animal waste, decomposing organic matter, and fertilizer. Given it solubility in water, nitrate can move quite readily in runoff and through subsurface drainage (e.g. field tiles) to surface waters. In surface waters high nitrate levels can lead to excessive aquatic plant growth through a process known as eutrophication. Excessive algae growth can increase biochemical oxygen demand and turbidity which negatively affects water temperature and dissolved oxygen levels. In severe cases dissolved oxygen concentrations can drop below the levels needed to support aquatic life (<4 mg/l).

Indiana does not currently have nutrient water quality standards. However, Indiana Administrative Code (327 IAC 2-1-6) establishes a not to exceed value of 10 mg/l for Nitrate + Nitrite in waters designated as a drinking water source (Table 2). Between 1999 and 2010, IDEM collected 1,749 Nitrate + Nitrite samples from 86 different stations in the sub-basin project area. None of the sample exceeded the water quality standard. Figure 44 shows the sample locations.

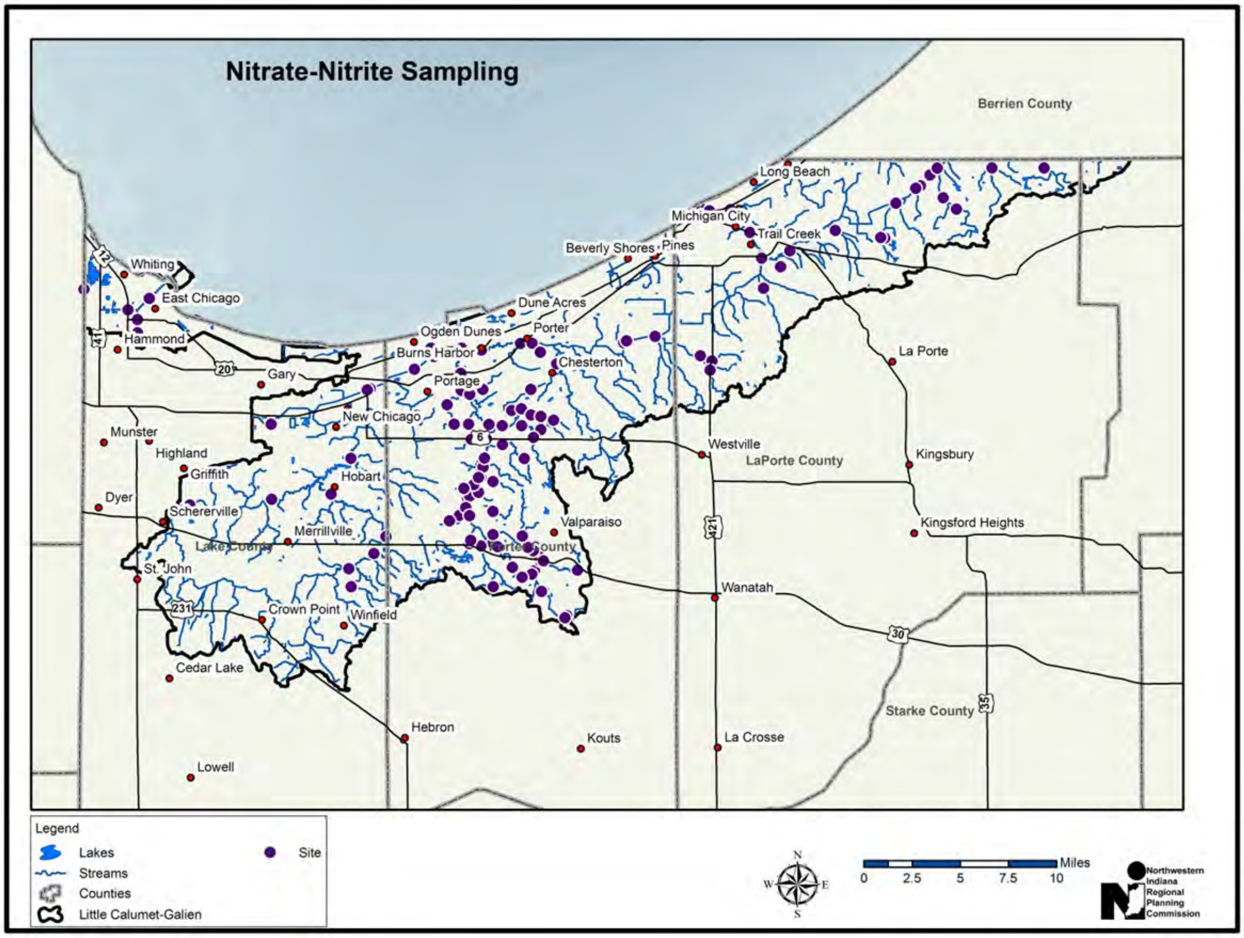

Figure 44. Nitrate-Nitrite Sampling Sites

Total Kjeldahl Nitrogen

Total Kjeldahl Nitrogen (TKN) is the sum of all organic nitrogen and ammonia. Since Indiana does not currently have a water quality standard for TKN, the U.S. EPA recommendation of 0.591 mg/l was used as a target value (Table 3). Between 1999 and 2010, IDEM collected 1,814 TKN samples from 87 different stations in the sub-basin project area. Sixty six of the 87 stations (76%) sampled had a target value exceedance and 1,417 of 1,814 total samples (78%) collected exceeded the target value. Figure 45 shows the sample locations and the location in which the target value of 0.591 mg/l was exceeded. The number of exceedances by station was normalized by the total number of observations at that station (i.e. samples taken) for TKN.

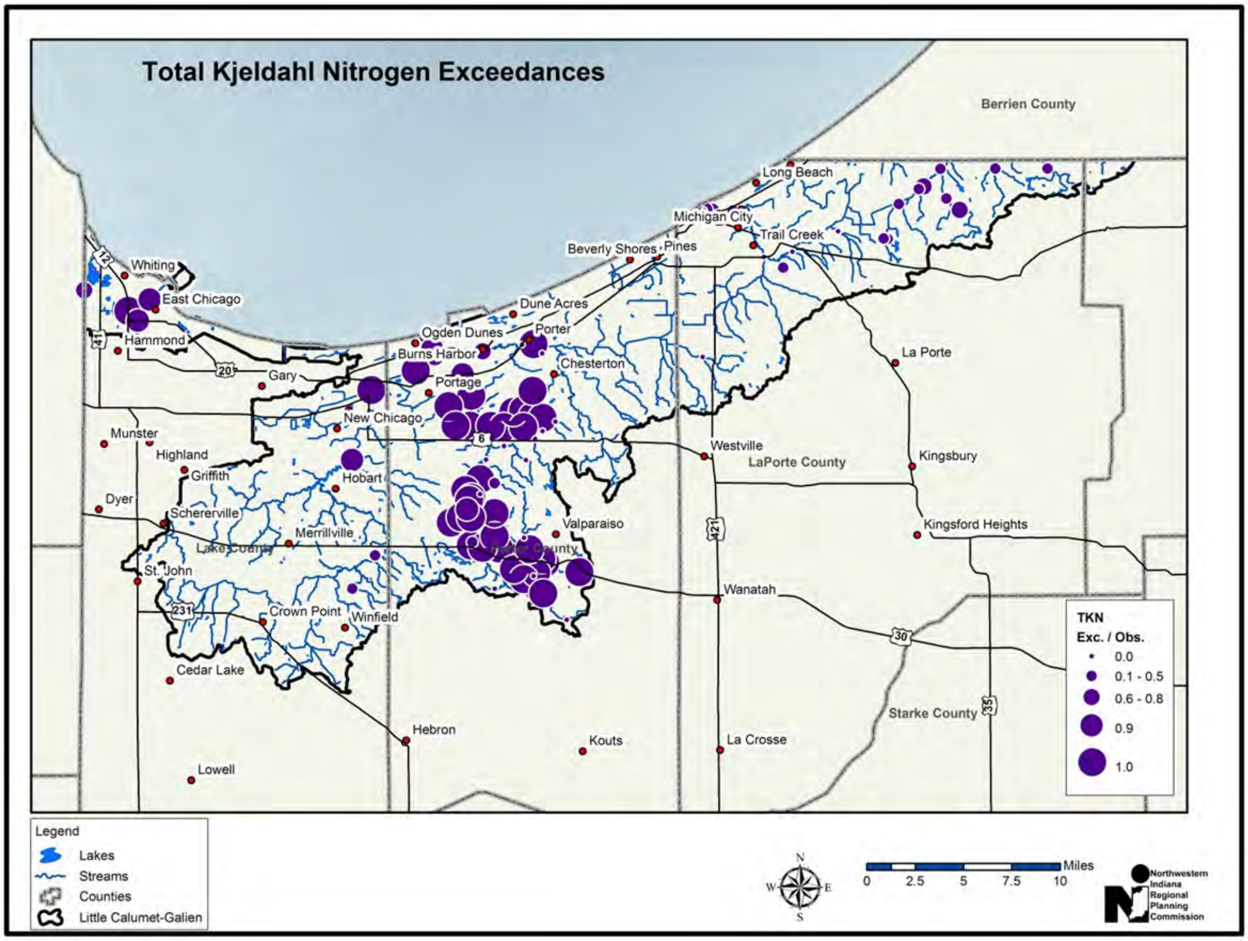

Figure 45. Total Kjeldahl Nitrogen Exceedances

Total Phosphorous

Like nitrogen, phosphorous is essential for plant and animal life. In aquatic systems phosphorous occurs as organic or inorganic phosphate. Organic phosphate is associated with organic material such as in plant or animal tissue. Phosphate that is not associated with organic material is inorganic and is the form required by plants. Unlike nitrogen, phosphorous does not have a gaseous phase. Once it is in an aquatic system it remains there and cycles through different form unless physically removed (e.g. plant harvesting or dredging).

Phosphorus is usually in short supply in freshwater lakes and streams. So even a small increase can lead to a series of water quality problems including accelerated plant and algae growth, low dissolved oxygen levels, and fish kills. Sources of phosphorus, both natural and human, include soils and rocks, wastewater treatment plants, fertilizer runoff, failing septic systems, and runoff from pastures or animal manure storage areas.

Between 1999 and 2010, IDEM collected 1,908 Total Phosphorous (TP) samples from 87 different stations in the sub-basin project area. Since Indiana does not currently have a water quality standard for Total Phosphorous, IDEM's draft 0.3 mg/l for TMDL's was used as a target value (Table 3). Twenty of the 87 stations (23%) sampled had a target value exceedance and 37 of the 1,908 total samples (2%) collected exceeded the target value. Figure 46 shows the sample locations and the location in which the target value of 0.3 mg/l was exceeded. The number of exceedances by station was normalized by the total number of observations at that station (i.e. samples taken) for TP.

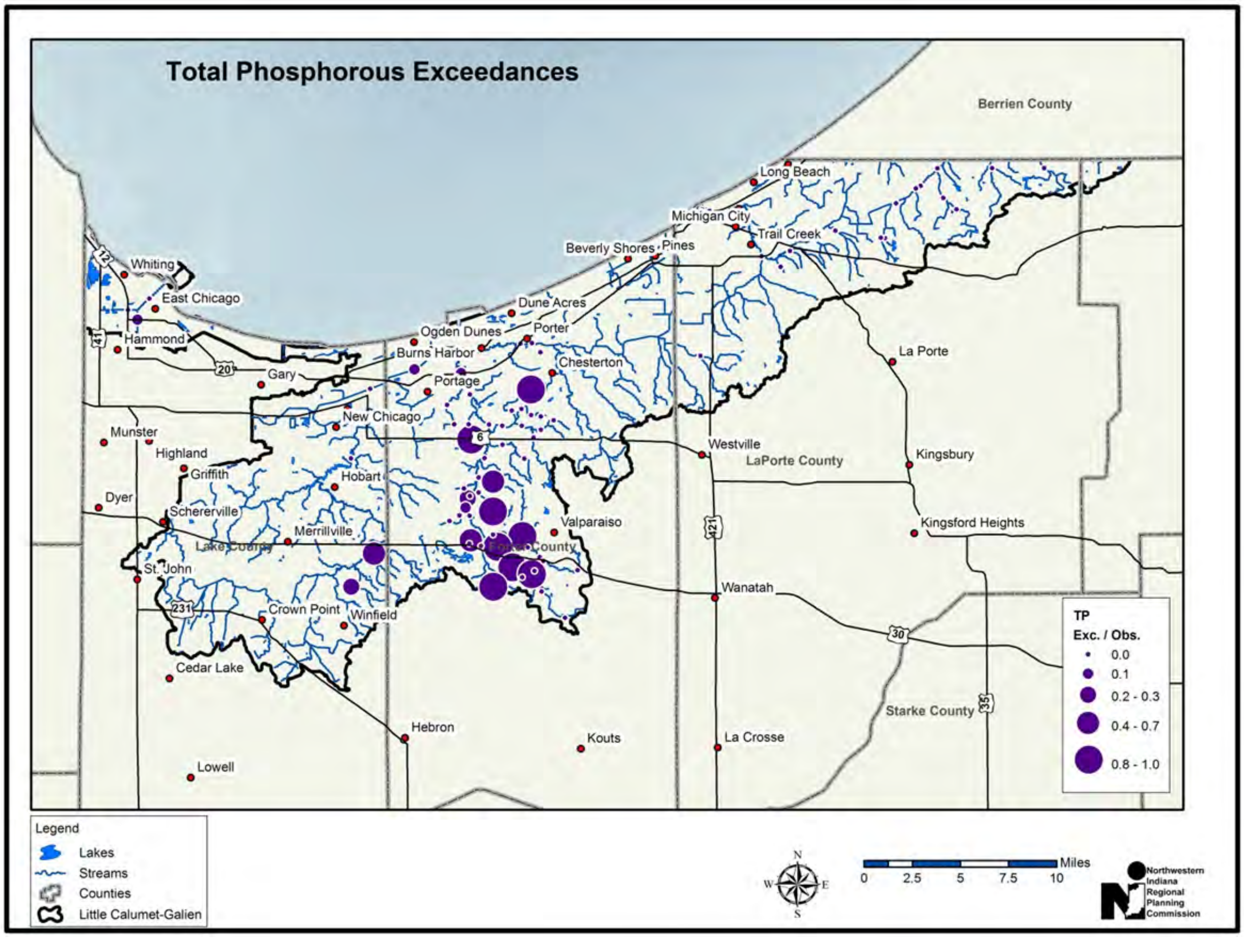

Figure 46. Total Phosphorous Exceedances

Total Suspended Solids

Total Suspended Solids (TSS) is a measure of solids in water that can be retained by a filter. TSS can include a variety of materials including silt, clay, and decaying plant and animal mater. Suspended solids absorb the suns energy causing increases in water temperature while also reducing the amount of sunlight reaching submerged vegetation. Both of which can lead to declines in dissolved oxygen levels. As stream velocity decreases suspended solids can settle to the bottom where they can smother critical benthic habitat.

Between 1999 and 2010, IDEM collected 1,893 TSS samples from 87 different stations in the sub-basin project area. Since Indiana does not currently have a water quality standard for TSS, IDEM’s draft 30 mg/l for TMDL’s was used as a target value (Table 3). Twenty nine of the 87 stations (33%) sampled had a target value exceedance and 226 of the 1,893 total samples (12%) collected exceeded the target value. Figure 47 shows the sample locations and the location in which the target value of 30 mg/l was exceeded. The number of exceedances by station was normalized by the total number of observations at that station (i.e. samples taken) for TSS.

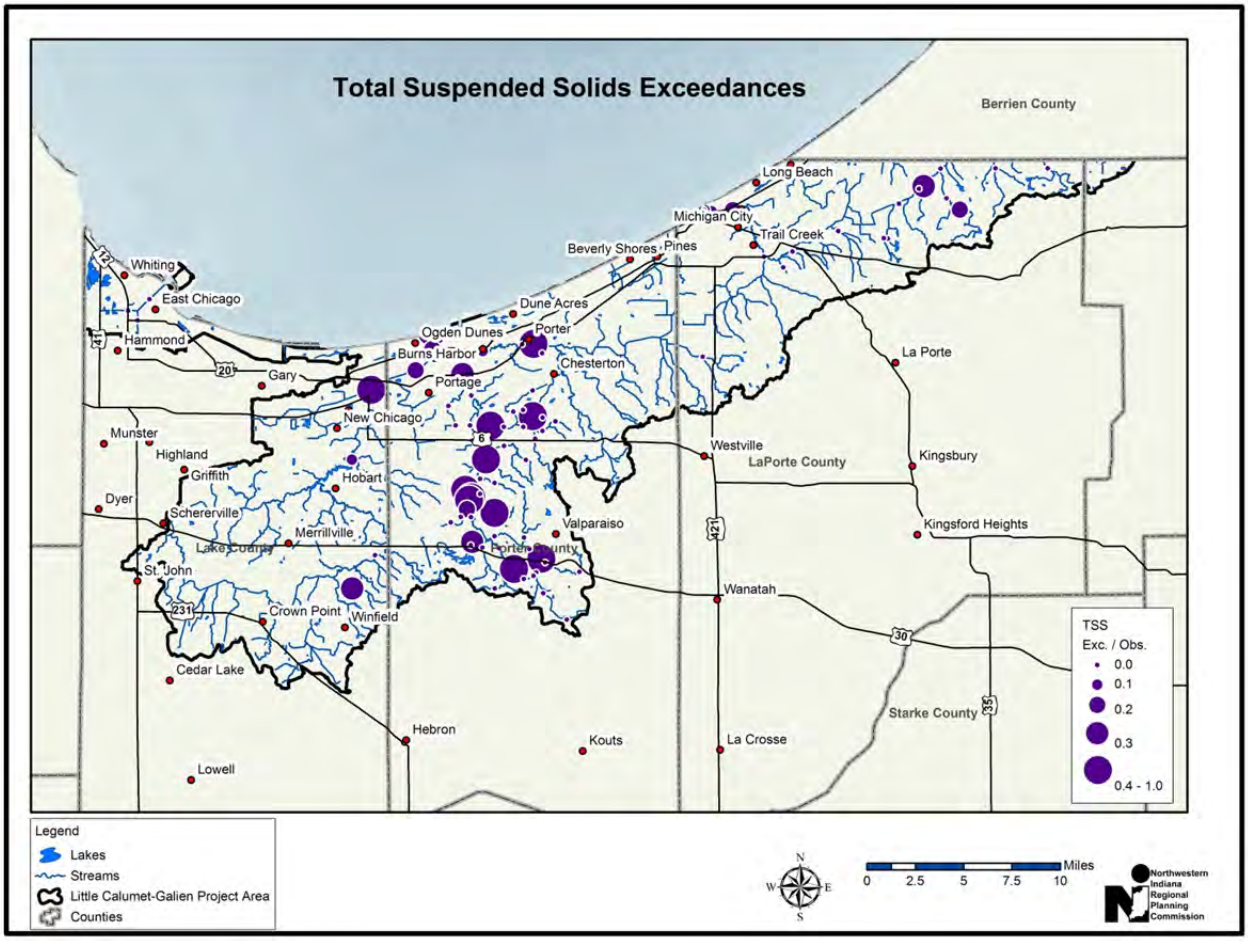

Figure 47. Total Suspended Solids Exceedances

Dissolved Oxygen

Dissolved Oxygen (DO) is a critical measure of stream health as most aquatic life requires it for survival. DO is influenced by several factors including stream temperature and velocity, as well as total suspended solids, nutrient, and organic waste concentrations.

Between 1999 and 2010, IDEM collected 2,395 DO samples from 127 different stations in the sub-basin project area. Using 5 mg/l as a minimum and 12 mg/l as a maximum target value (Table 3. Water Quality Targets), 15 of the 127 stations (12%) sampled did not meet the water quality standard at least once and 28 of the 2,395 total samples (1%) collected did not meet the water quality standard. Figure 48 shows sample locations and the locations in which the target values were not met. The number of exceedances (above or below standard) by station was normalized by the total number of observations at that station (i.e. samples taken) for DO.

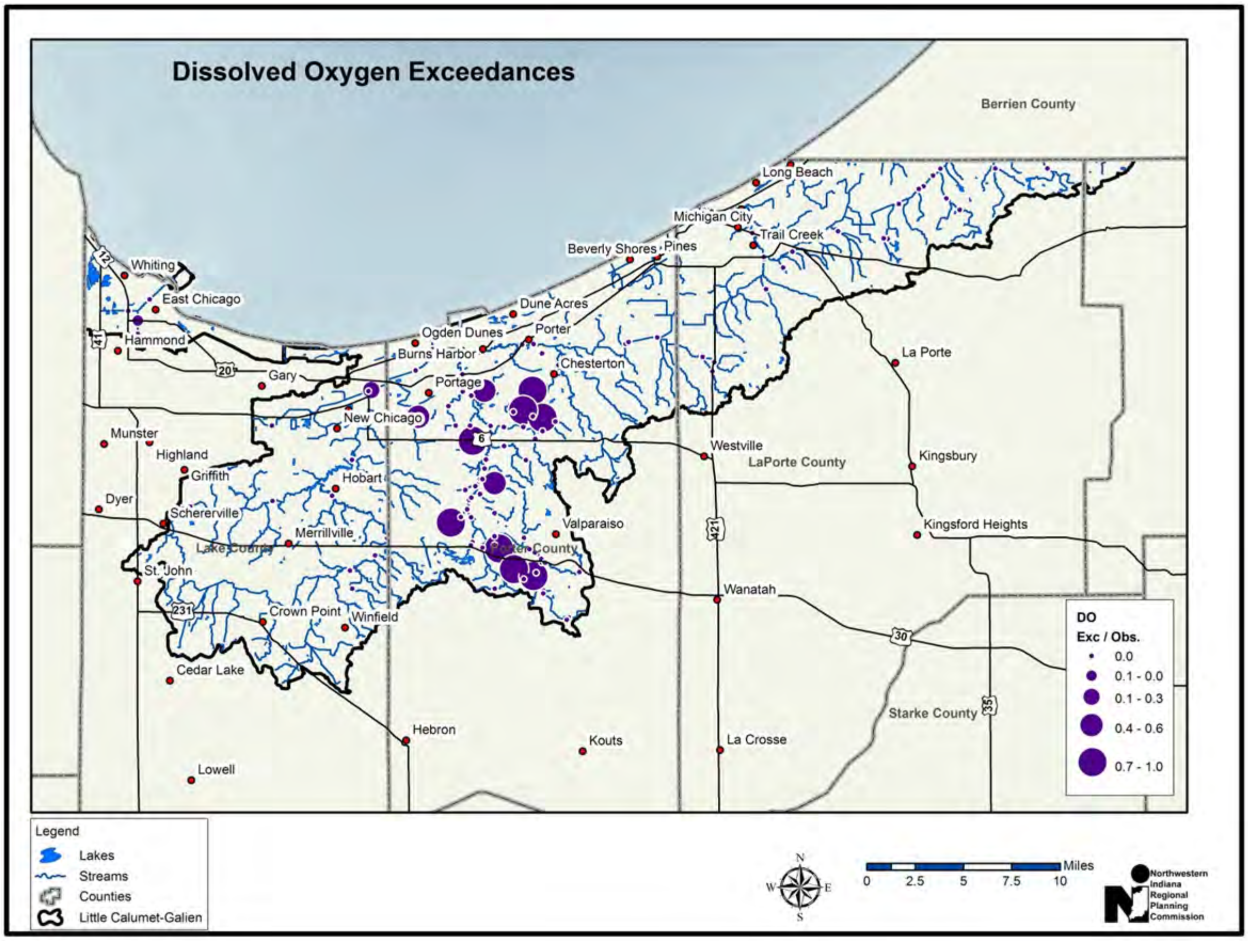

Figure 48. Dissolved Oxygen Exceedances

pH

pH is an important measure of water quality because many organisms are sensitive to low or high levels. Low pH levels can also increase the solubility of some heavy metals such as copper and aluminum allowing them to dissolve into the water column where they become toxic to aquatic life. A number of natural and human activities can affect pH levels. For example, algal blooms can raise pH by removing carbon dioxide (CO_2).

Between 1999 and 2010, IDEM measured pH 2,396 times at 127 different stations in the sub-basin project area. The water quality standard for pH falls within the range of 6-9 (Table 2). Eight of the 127 stations (6%) sampled did not meet the water quality standard at least once and 8 of the 2,396 total samples (<1%) collected did not meet the water quality standard. Figure 49 shows the sample locations and the locations in which the target values were not met. The number of exceedances (above or below standard) by station was normalized by the total number of observations at that station (i.e. samples taken) for pH.

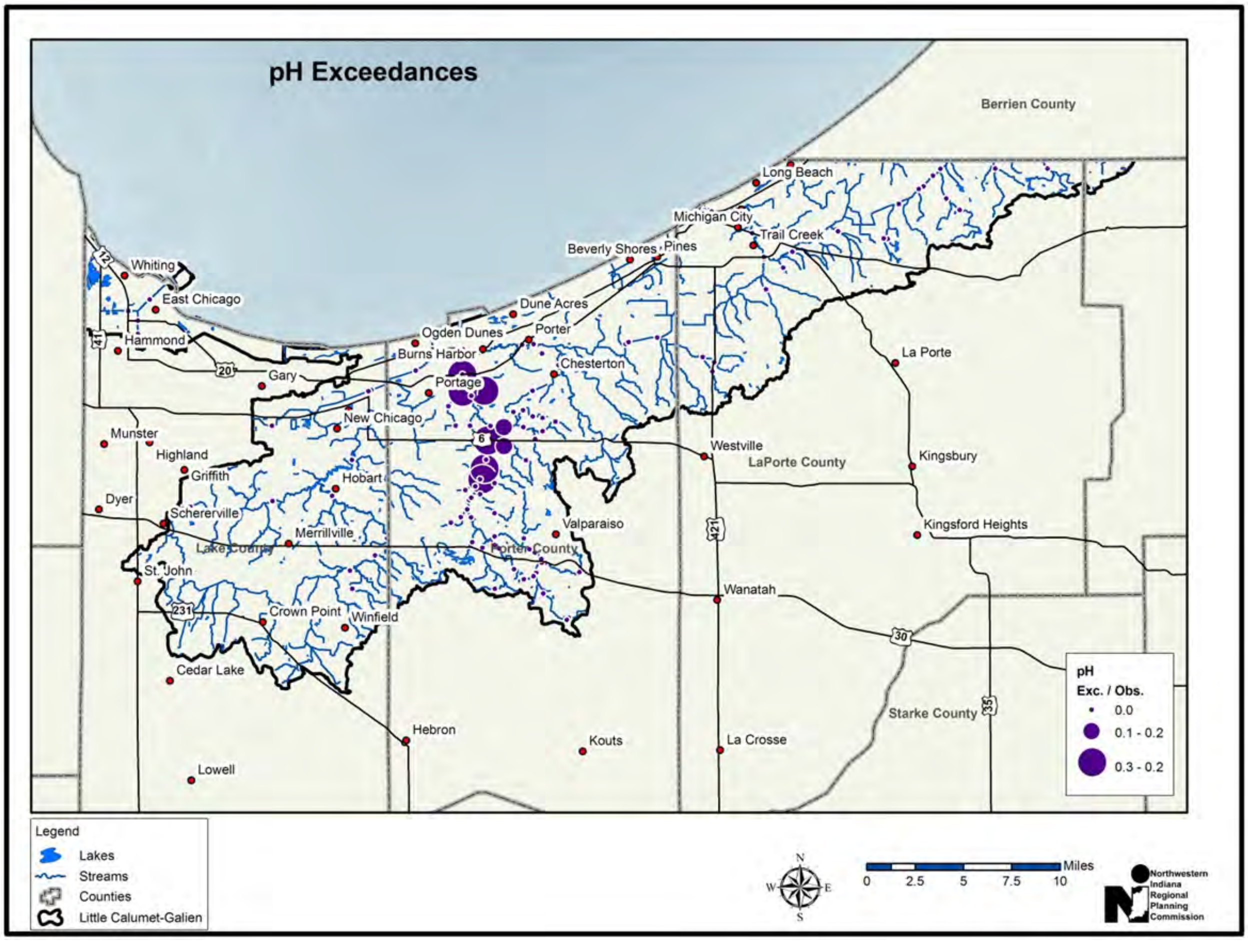

Figure 49. pH Exceedances

Turbidity

Turbidity is a measure of the relative clarity of water and is measured by shining a light through the water column. Suspended materials such as soil particles, algae, plankton, and other substances scatter and absorb light. This can cause increases in water temperature while also reducing the amount of sunlight reaching submerged vegetation. Both of which can lead to declines in dissolved oxygen levels. As stream velocity decreases suspended particles can settle to the bottom where they can smother critical benthic habitat. Sources of turbidity include soil and stream erosion, urban runoff, wastewater discharges, excessive algae growth and large numbers of bottom feeding fish which can stir up sediment.

Between 1999 and 2010, IDEM collected 1,667 Turbidity samples from 13 different stations in the sub-basin project area. Since Indiana does not currently have a water quality standard for Turbidity, the U.S. EPA's recommendation of 10.4 NTU was used as a target value (Table 3). Thirteen of the 13 stations (100%) sampled had a target value exceedance and 778 of the 1,667 total samples (47%) collected exceeded the target value. Figure 50 shows the sample locations and the location in which the target value of 10.4 NTU was exceeded. The number of exceedances by station was normalized by the total number of observations at that station (i.e. samples taken) for turbidity.

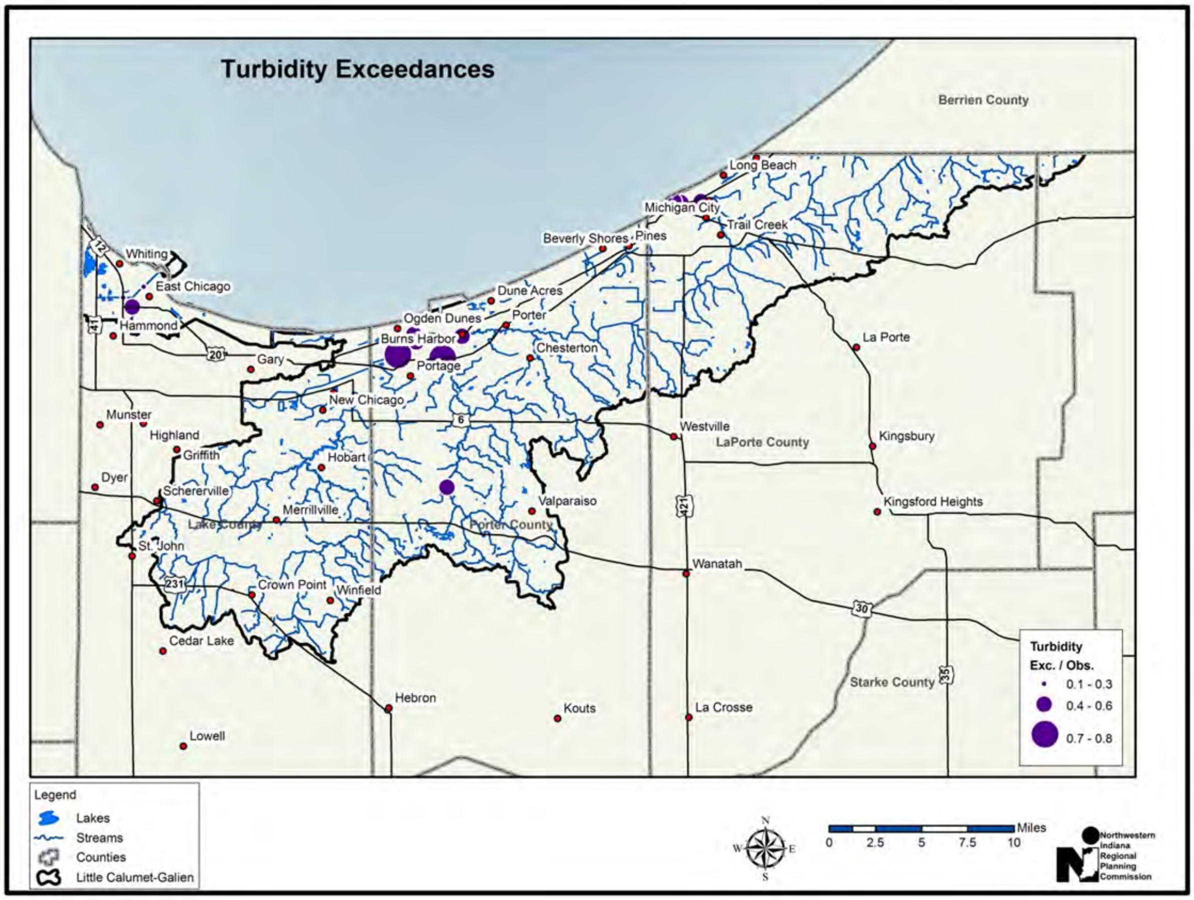

Figure 50. Turbidity Exceedances

NPDES Facilities

The NPDES facility locations shown in Figure 51 were provided by the IDEM Office of Water Quality as a GIS shapefile on July 20, 2011. The information used to create the shapefile was extracted from the U.S. EPA Integrated Compliance Information System (ICIS) database which includes all available records listed in Indiana associated with "Active" surface water discharges. It consists primarily of state permitted and regulated wastewater facility related information. The figure shows both “effective” and “terminated” permits. In total there are 52 NPDES facilities located in the sub-basin project area based upon this data. Although the database record set depicts all available information on regulated wastewater discharge sites as of the date of extraction, the locational and coordinate information is not complete; therefore queries and other searches are best handled through the attribute tables rather than from visually on maps where not all sites are represented.

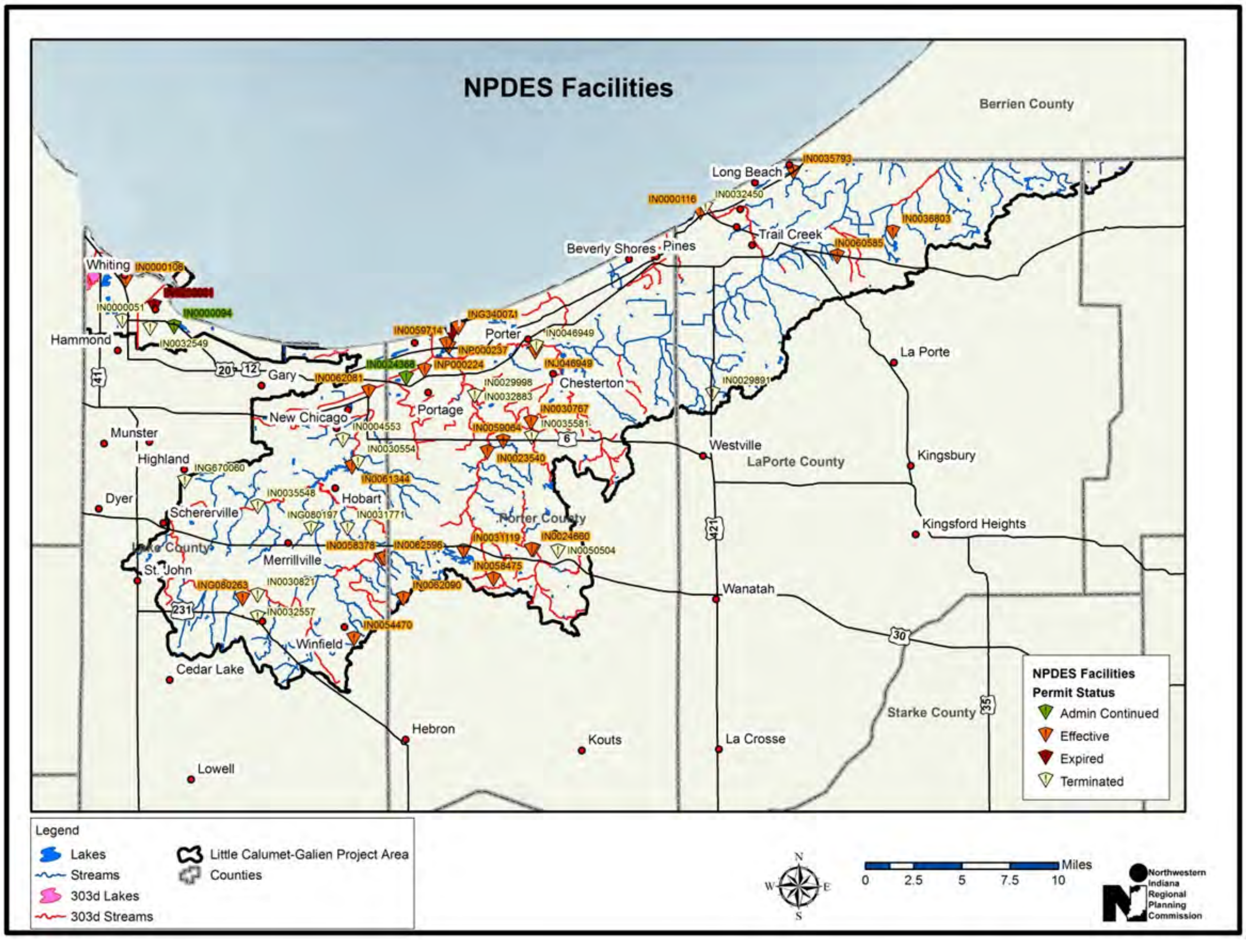

Figure 51. NPDES Facilities

Data presented below in Table 8provides a summary of NPDES facility effluent exceedances and enforcement actions in the sub-basin project area. The data was generated through a query of the U.S. EPA's Enforcement & Compliance History Online (ECHO) system by NIRPC on September 8, 2011. ECHO provides a fast integrated search of U.S. EPA and state data for regulated facilities. It integrates inspection, violation, and enforcement for the Clean Water Act. Data is generated as tables and can be viewed via the mapping tool. ECHO is available at http://www.epa-echo.gov/echo/index.html. Additional water quality information available but not presented here includes watershed condition, possible facility discharges related to 303(d) water impairment, and along with other relevant factors. Facility names with an asterisk were not included on IDEM's list of facilities.

NPDES ID	Facility Name	# Effluent Exceedances (3yrs)	Informal Enforcement Actions (5yrs)	Formal Enforcement Actions (5yrs)
IN0000027	Cargil Inc. Food And Pharma. Specialties*	1	1	
IN0000035	Praxair Inc.*	6		
IN0000094	Arcelor Mittal Steel USA Inc.	13		
IN0000108	BP Products Whiting Refinery	5	1	
IN0000116	NIPSCO Michigan City Gen Station	1		
IN0000124	Dean H Mitchell Gen Station*	0		

NPDES ID	Facility Name	# Effluent Exceedances (3yrs)	Informal Enforcement Actions (5yrs)	Formal Enforcement Actions (5yrs)
IN0000132	NIPSCO Bailly Gen Station*	5	1	
IN0000175	Arcelormittal Burns Harbor LLC*	11	1	
IN0000205	Arcelormittal USA Indiana Harbor West*	10	2	1
IN0000221	State Line Energy Generating Station*	0		
IN0000248	Resco Products*	0		
IN0000264	Unilever Home & Personal Care*	3		
IN0000281	United States Steel Corp - Gary Works Facility*	12		
IN0000329	WR Grace & Co	0		
IN0000337	US Steel Corp Midwest Plant*	3		
IN0020931	Ifa & Itrcc LLC Travel Plaza 3 WWTP*	0		
IN0022578	Chesterton WWTP*	6		
IN0022977	Gary Sanitary District*	4	6	1
IN0023752	Michigan City - J. B. Gifford WWTP *	9	4	
IN0024368	Portage Utility Service Facility WWTP	2	1	
IN0024660	Elden Kuehl Pollution Con Facility	11	1	
IN0025283	Hermits Lake WWTP	52	2	
IN0025763	Crown Point WWTP*	4	1	
IN0025887	Valparaiso Airport Water Treatment Plant	1		
IN0030651	Aqua Indiana, Inc., South Haven Sewer Works WWTP*	11		
IN0031119	Shorewood Forest Utilities	14	1	1
IN0035793	Shady Oak Mobile Home Park WWTP	17	3	
IN0036803	La Lumiere School	7	1	
IN0038709	Liberty Farm MHP*	25	1	
IN0039535	Woodberry Park WWTP*	8	2	
IN0039659	Forest Oaks WWTP*	22	2	
IN0042021	Elmwood MHP*	12	2	
IN0042498	Valparaiso Flint Lake Water Treatment Plant*	0		
IN0043435	Praxair Inc. Burns Harbor*	6		
IN0050041	Autumn Creek MHP*	7	1	
IN0050954	Marathon Pipe Line LLC*	2		
IN0054178	Linde Gas LLC Hammond Facility*	8	1	1
IN0054470	Chicagoland Christian Village	32	2	
IN0056910	East Chicago Terminal*	2		
IN0058343	Winfield WWTP*	11	2	
IN0058378	Deep River Water Park WWTP	12	3	
IN0058475	Nature Works Conservancy Dist.	1		
IN0059064	Mallards Pointe Condo Assoc.	9	1	
IN0059226	Federal Mogul Corp*	0		
IN0059714	MLMK - Indiana	0		
IN0060585	Friendly Acres MHP	57	2	1
IN0061077	US Grand Calumet Dredging*	1		
IN0061344	Hobart WWTP	0	2	1

NPDES ID	Facility Name	# Effluent Exceedances (3yrs)	Informal Enforcement Actions (5yrs)	Formal Enforcement Actions (5yrs)
IN0062081	Flying J Travel Plaza 650 Lake Station	8	2	
IN0062090	Falling Waters Conservancy District	4	2	
ING080230	Bulk Marathon 2108*	0		
ING250069	Monosol LLC*	0		
ING340009	Citgo East Chicago Terminal*	0	1	
ING340032	Exxonmobile Hammond Terminal*	0		
ING340034	Enbridge Energy Hartsdale Terminal*	0		
ING340036	Marathon Petroleum Hammond Terminal*	0		
ING340038	Enbridge Energy Griffith Term*	0		
ING340053	East Chicago Station Norco*	0		
ING340057	Marathon Pipe Line LLC Griffith Station*	0		
ING340068	Buckeye Pipe Line - East Chicago Station*	0		
INS100006	Facility Demolition Project*	No limit data		
INS200001	Indiana Pickling & Processing	No limit data		
INS210001	Carmeuse Lime Inc. Buffington*	No limit data		
INS230001	Praxair Inc.	No limit data		

Table 8. NPDES Facility Compliance

2.2.3 Habitat & Biological Information

Qualitative Habitat Evaluation Index

The Qualitative Habitat Evaluation Index (QHEI) provides information on a stream's ability to support healthy fish and macroinvertebrates communities by evaluating instream habitat and the land that surrounds it. The QHEI is composed of six separate metrics each designed to evaluate a different portion of a stream site. The metrics include substrate, instream cover, channel morphology, bank erosion and riparian zone, pool/glide and riffle/run quality, and gradient. When the 6 metrics are added together you get a total QHEI score. The higher the total score, the better the habitat. For streams where the macroinvertebrate and/or fish community (mIBI and/or IBI) scores indicate impaired biotic communities (IBC), QHEI scores are evaluated to determine if habitat is the primary stressor on the aquatic communities or if there may be other stressors/pollutants causing the IBC.

Between 1999 and 2010, IDEM evaluated stream and riparian habitat using the QHEI at 53 different stations in the sub-basin project area. IDEM has determined that a QHEI total score of <51 indicates poor habitat so this was used as the target value. Thirty of the 35 stations (86%) evaluated had a target value exceedance (QHEI <51). Figure 52 shows the sample locations and the locations in which the target value of 51 was not met. The number of exceedances by station was normalized by the total number of observations at that station (i.e. samples taken) for the QHEI.

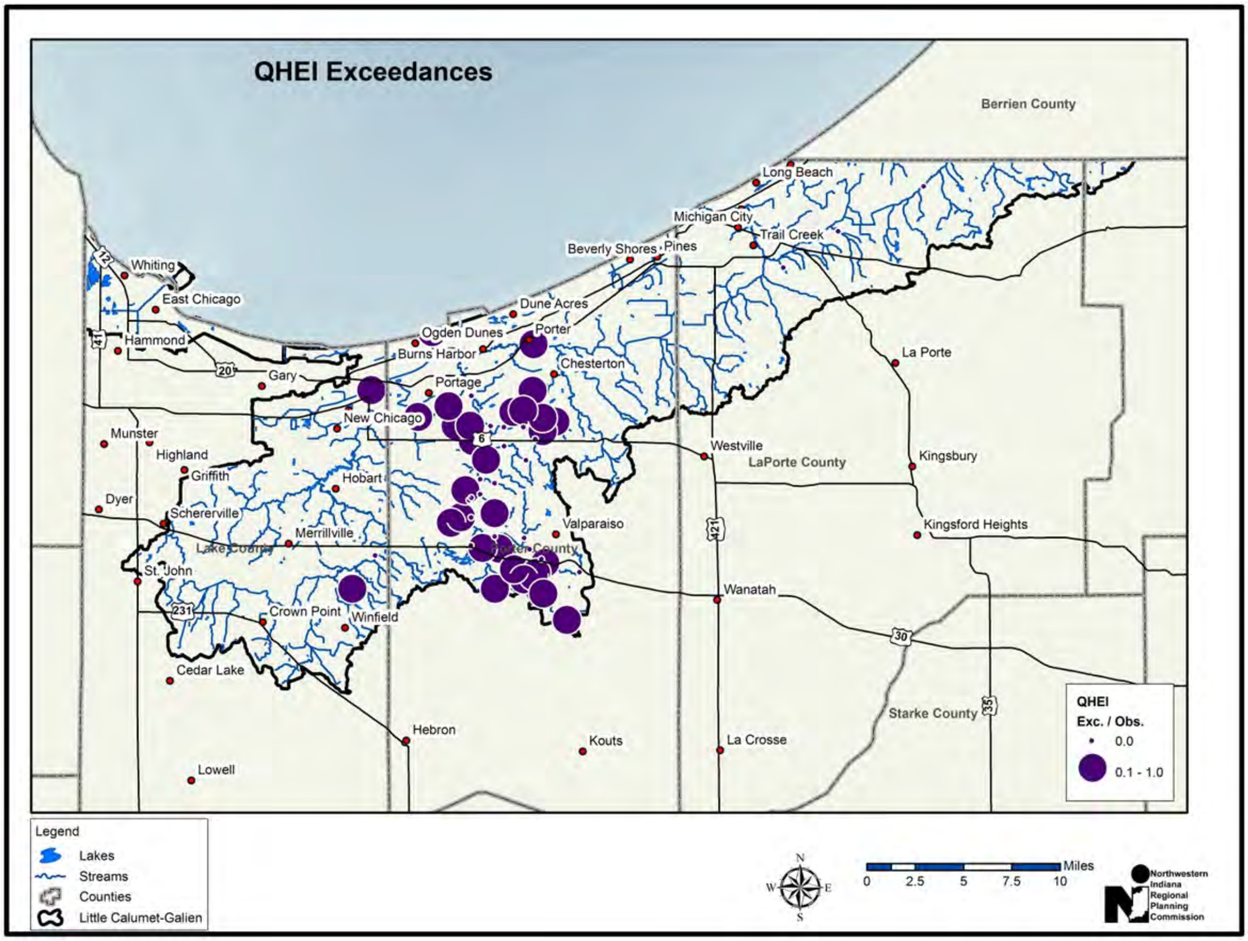

Figure 52. Qualitative Habitat Evaluation Index Exceedances

Index of Biotic Integrity

The Index of Biotic Integrity (IBI) provides a measure of a stream's health based upon the fish species collected from that stream. The IBI is comprised of a series of metrics to evaluate the health of the fish community. The metrics included in the IBI change by ecoregion however they all generally consider species richness and composition, indicator species, trophic function, and reproduction function. When the metrics are added together you get a total IBI score. The higher the total score, the better the stream's health based upon the fishery.

Between 1999 and 2010, IDEM evaluated fish communities at 53 different stations in the sub-basin project area. IDEM has determined that an IBI total score of <36 is considered non-supporting so this was used as the target value. Fifty of the 53 stations (94%) evaluated had a target value exceedance (IBI <36). Figure 53 shows the sample locations and the location in which the target value of 36 was exceeded. The number of exceedances by station was normalized by the total number of observations at that station (i.e. samples taken) for the IBI.

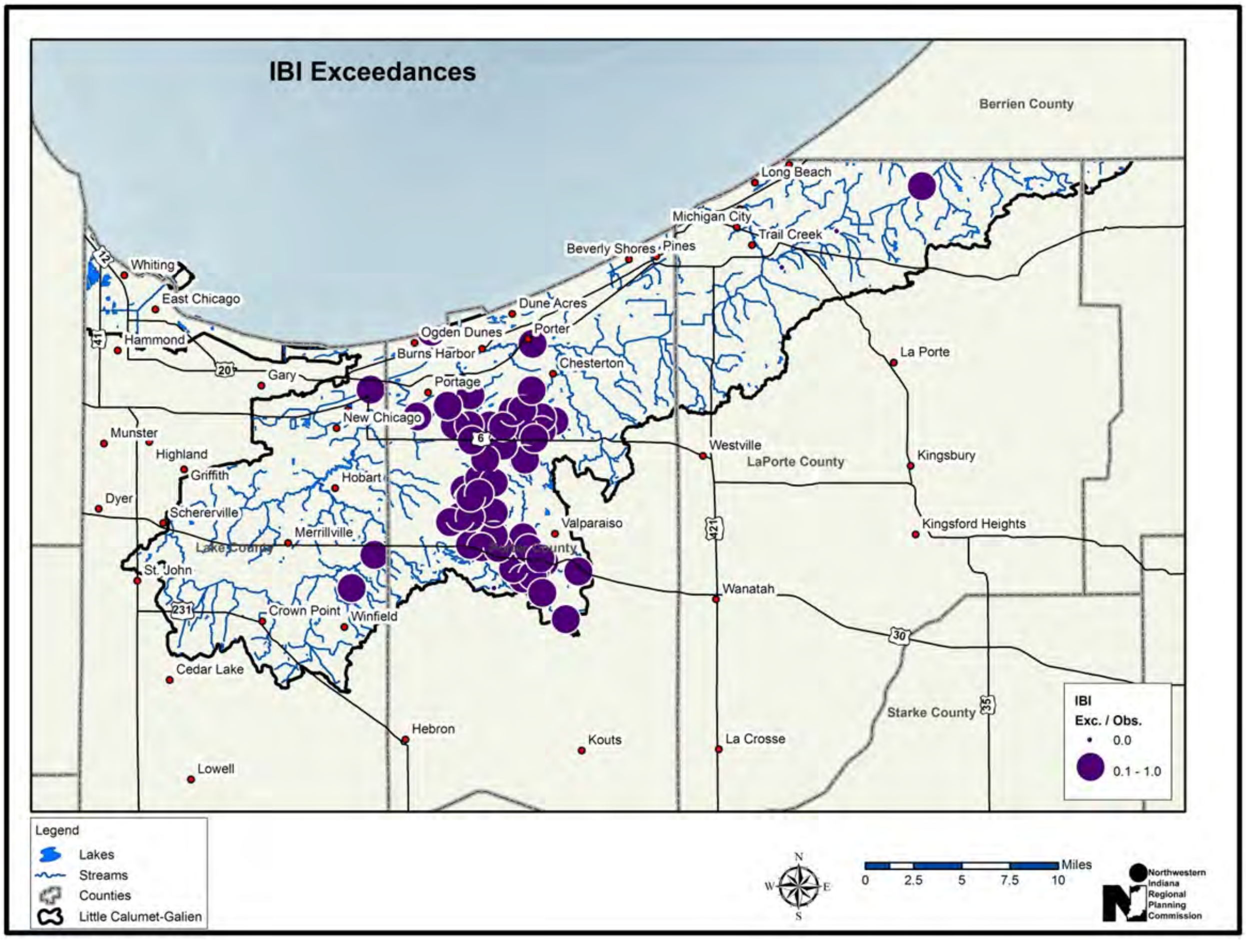

Figure 53. Index of Biotic Integrity Exceedances

Macroinvertebrate Index of Biotic Integrity

The macroinvertebrate Index of Biotic Integrity (mIBI) provides a measure of a stream's health based upon the macroinvertebrate species collected from that stream. Like the IBI, the mIBI is comprised of a series of metrics to evaluate the health of the macroinvertebrate community. When the metrics are added together you get a total IBI score. The higher the total score, the better the stream's health based upon the macroinvertebrate community.

Between 1999 and 2010, IDEM evaluated macroinvertebrate communities at one station in the sub-basin project area. IDEM has determined that a mIBI total score of <2.2 is considered non-supporting so this was used as the target value. The mIBI score at this station was above the target value. Figure 54 shows the sample location within the sub-basin project area.

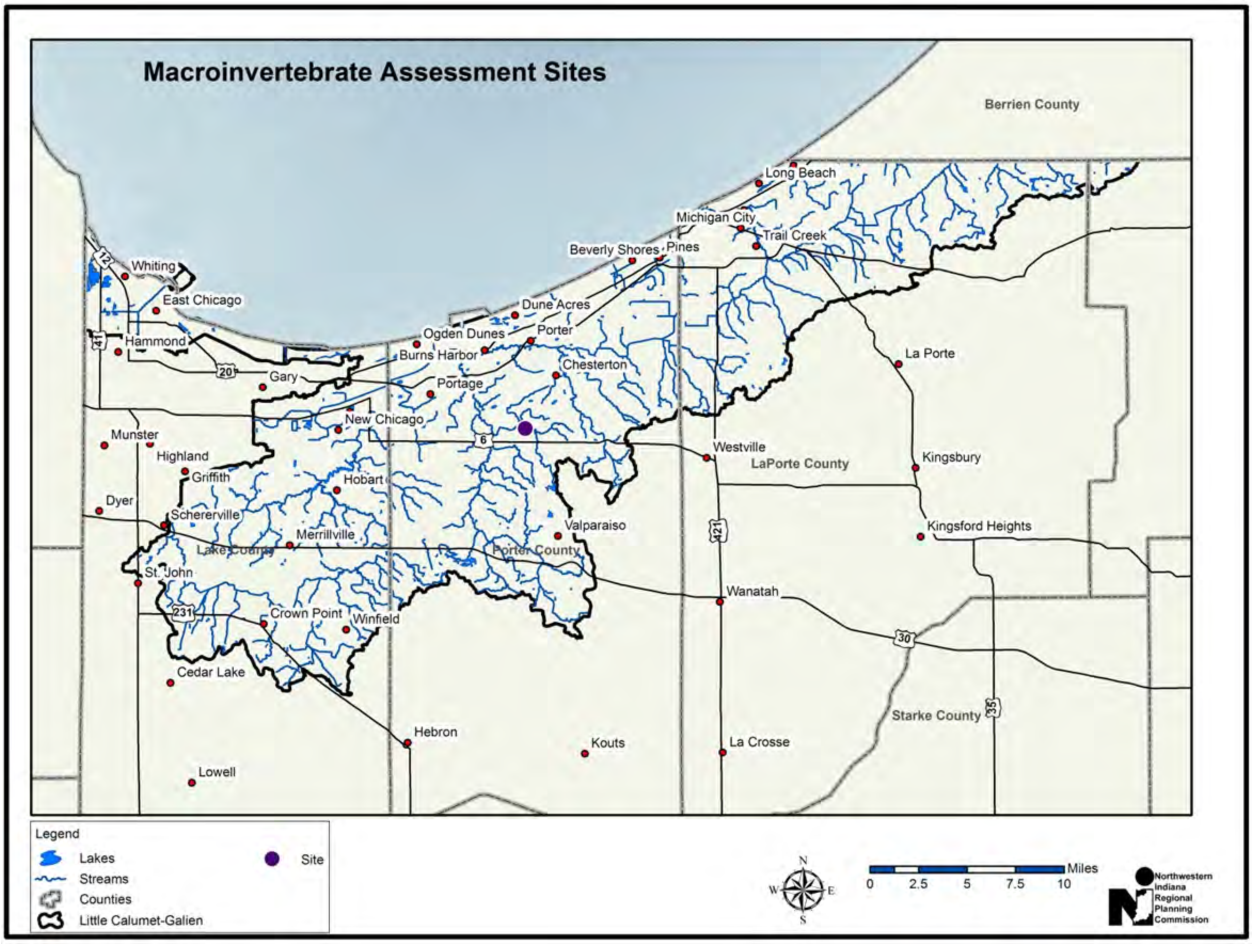

Figure 54. Macroinvertebrate Index of Biotic Integrity Assessment Sites

Figure 55 is a composite of all the water quality/habitat/biological parameters presented above and used by NIRPC for exceedance analysis. In total, 14,532 observations were made by IDEM from 127 stations in the sub-basin project area. One hundred twenty three (123) of the 127 stations (97%) sampled had at least one target value exceeded and 2,926 of the 14,532 observations (20%) exceeded a target value. Figure 55 shows sample locations and the location in which the target values were exceeded. The number of exceedances by station was normalized by the total number of observations at that station (i.e. samples taken).

The most readily visible cluster of exceedances occurs in the area between Valparaiso and Portage. This corresponds with intensive sampling conducted by IDEM in the Salt Creek watershed. Forty nine percent (49%) of IDEM's sampling stations and 19% of the total observations within the Little Calumet-Galien sub-basin project area were located in this watershed. Smaller clusters can be observed in LaPorte County around Michigan City in the Trail Creek watershed and slightly further to the east in the Galena River watershed.

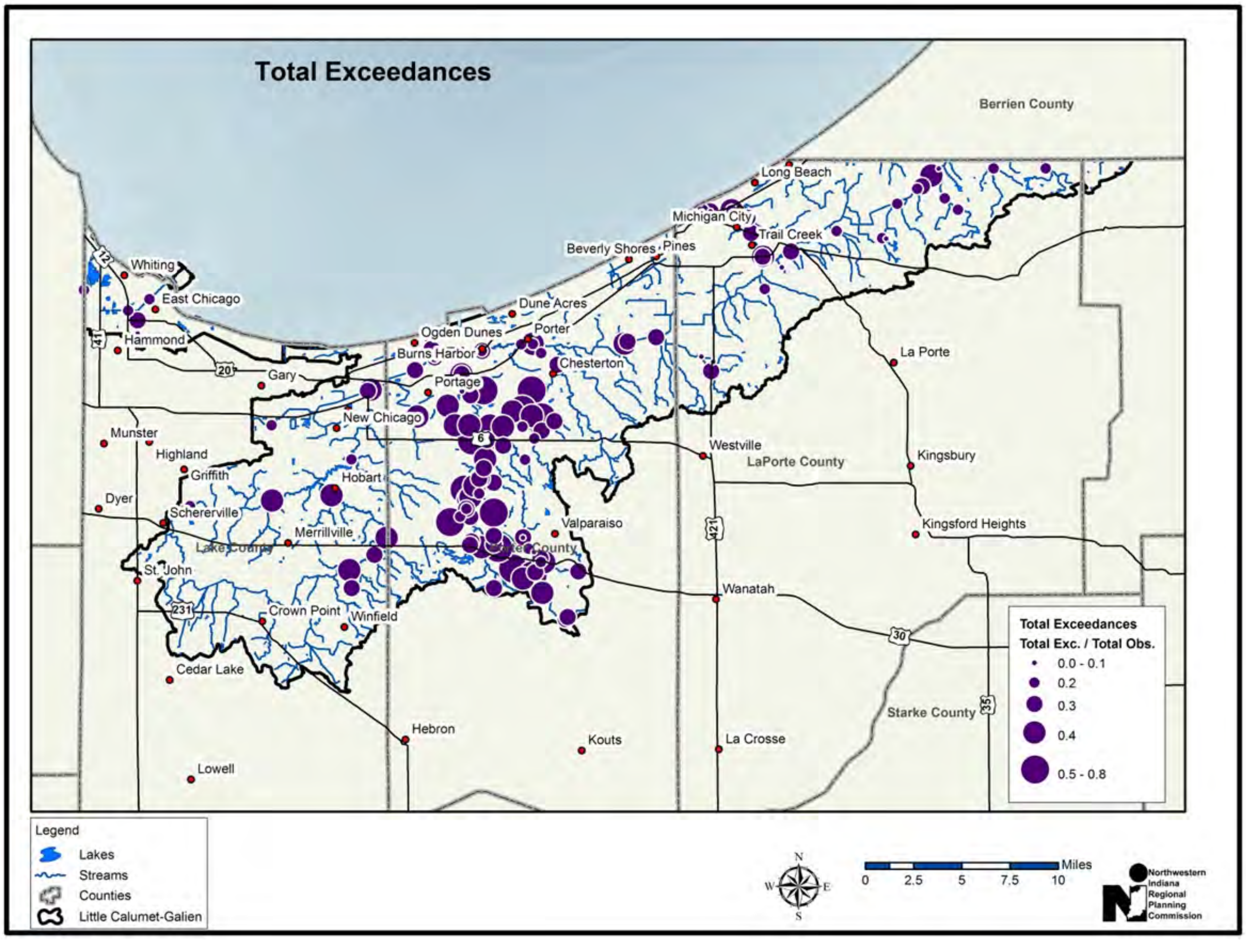

Figure 55. Total Exceedances

To further assist in the identification of critical subwatersheds, and also areas where additional data may be needed, an analysis of percent exceedance by subwatershed was done using ArcMap10 (Figure 56). The percent exceedance for all IDEM stations used in the analysis above was calculated for each subwatershed in the sub-basin project area. Subwatersheds without a fill color did not have data available for the analysis. The highest total percent exceedances for a subwatershed occurred in the City of Merrillville-Turkey Creek subwatershed (HUC 040400010505) with 33.3%, followed by Squirrel Creek-Salt Creek (HUC 040400010505) with 27.2%, and Kemper Ditch-East Arm Little Calumet River (HUC 040400010402). Overall, subwatersheds within the Deep River-Portage Burns Waterway watershed had some of the highest percent exceedance values of all the watersheds within the Little Calumet-Galien sub-basin.

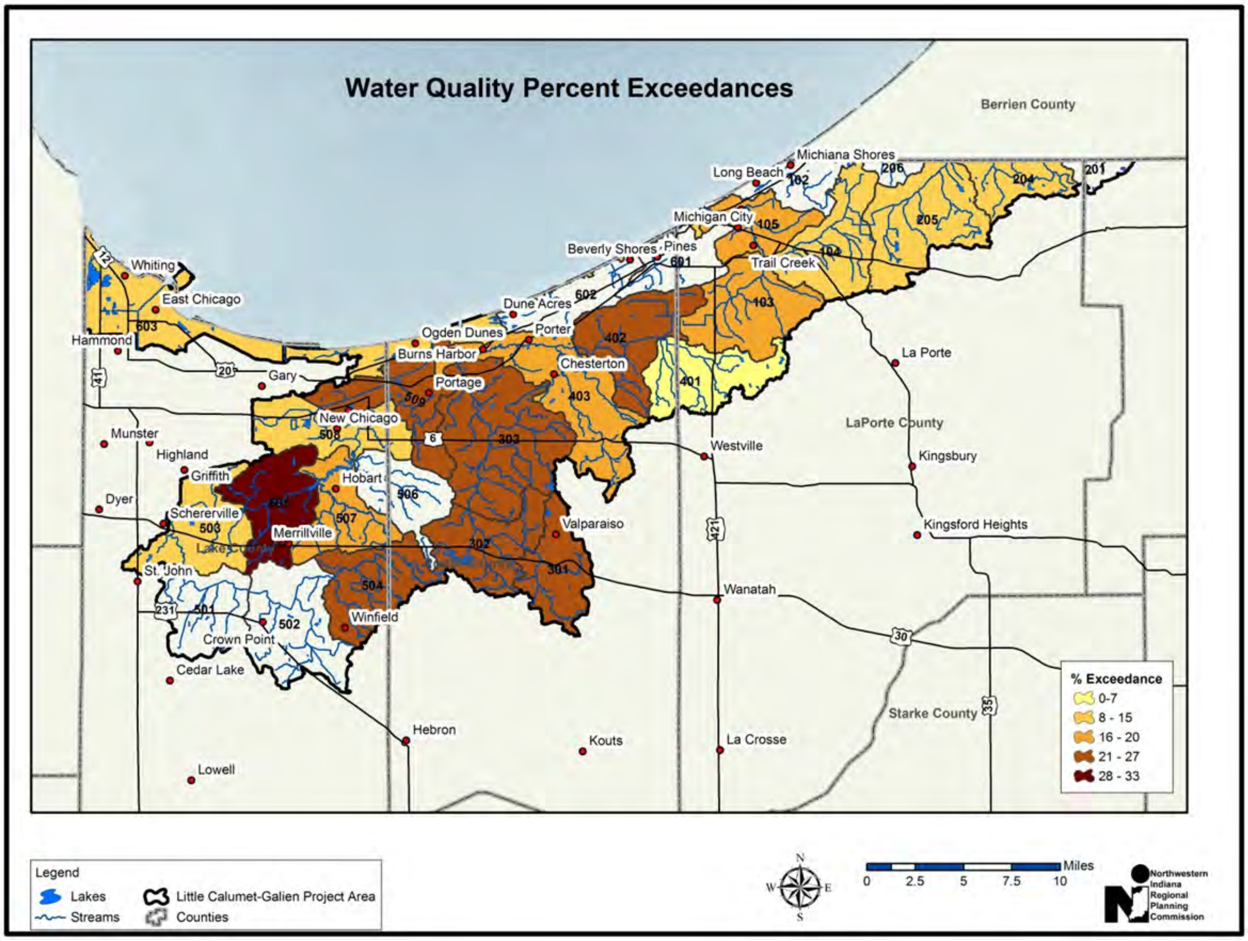

Figure 56. Percent Water Quality Exceedance by Subwatershed

2.3 Problems & Causes

2.3.1 Stakeholder Concerns

The following table (Table 9) is a synopsis of the concerns identified by stakeholder during the development of the 2005 Regional Watershed Management Plan for Lake, Porter and LaPorte Counties. It also incorporates the concerns identified in the existing watershed management plans outlined in the Other Planning Efforts section of Chapters 2-4.

Concern(s)	Problem
Inconsistent requirements and goals for water quality data collected by agencies (ex. IDEM, USACE, USGS).	Locations have been tested to the point that there is a wealth of information available for some locations and none at all for other areas (subwatersheds).
Fishery condition	A number of area streams are included on IDEM's 303d list for impaired biotic communities.

Concern(s)	Problem
Contaminated fish	A number of area streams and lakes have fish consumption advisories in place.
E. coli	A number of area streams and Lake Michigan shoreline are impaired for recreational contact on IDEM's 303d list.
Excessive nutrient levels	A number of area streams have nutrient levels that exceed IDEM target values for draft nutrient TMDLs.
Streambank/shoreline erosion and sedimentation	Streambank/shoreline erosion and sedimentation.
Flooding	Development and/or alteration of floodplains. Lack of upland storage in urbanized areas. Loss of wetlands and natural land cover that promote infiltration and reduce runoff volume (ex. forest and grasslands). Increasing impervious surface area with development.
Loss of open space	Development pattern trending outside of core communities.
Surface and groundwater contamination from failed septic systems	An operation and maintenance program does not currently exist for septic systems. Severe soil limitations for traditional systems.
Disposal of household and commercial wastes	Illegal dumping of household and commercial wastes. Litter in streams and lakes.
Contaminated sites	Remediation efforts lagging to reduce risk to human and wildlife health from contaminated sites and sediments.
Transportation impacts to water quality and habitat	Increased runoff volume and pollutant loads and loss of habitat and/or connectivity from transportation projects.
Combined sewer overflows	CSOs contribute to high E. coli levels and beach closures. Threat to public health, water quality and drinking water supplies.

Concern(s)	Problem
Water supply/drinking water protection	Development outside the Lake Michigan basin puts stress on ground water supplies for human consumption and support of aquatic life.
Pesticides	USGS shows increasing trends in pesticide concentrations in urban streams for the US.
Thermal pollution	Increased impervious surface area and lack of forested stream buffers contribute to increases in stream water temperatures.
Loss of species diversity/invasive species	Habitat loss and fragmentation from development coupled with invasive species introduction are threatening biodiversity in the region.
Lack of or reduced funding for WMP development and implementation	Watershed planning and implementation is underfunded.
Public awareness and buy-in	Public is not fully aware of water quality and aquatic habitat issues in their watersheds.
Local government involvement (participation)	Lack of local government involvement in watershed planning and implementation efforts.
Availability of information	Information can be difficult to obtain at times or difficult to understand for the average citizen.
Zoning and development	Existing development patterns have led to growth far outside existing core development areas.
Insufficient stream buffers	A number of area stream lack sufficient riparian buffers. Poor QHEI scores
Insufficient staff to implement watershed program/no watershed coordinator	Insufficient staff to implement watershed program/no watershed coordinator
Hydromodification	A number of area streams that have been modified are included on the 303d List by IDEM
Local coordination	A unified group/program does not exist for some areas.
Public access	Access to streams, lakes, Lake Michigan shoreline and other natural areas is limited in some

Concern(s)	Problem
	communities or areas.
Agricultural impacts to water quality	Use of conservation tillage practices are low compared to some other counties in the state.
Stormwater runoff from industrial/commercial sites	Streams in highly industrial areas listed by IDEM on 303d list.

Table 9. Concerns & Problems

2.3.2 Potential Causes

Table 10 below relates problems identified in Table 9 to potential causes.

Problem	Potential Cause(s)
Locations have been tested to the point that there is a wealth of information available for some locations and none at all for other areas (subwatersheds).	• State and federal agencies not coordinating to extent possible • Different sampling program design and priorities
A number of area streams are included on IDEM's 303d list for impaired biotic communities.	• Cumulative effects of activities that affect water quality and habit conditions over time
A number of area streams and lakes have fish consumption advisories in place.	• Mercury and PCBs in fish tissue exceed levels safe for human consumption
A number of area streams and Lake Michigan shoreline are impaired for recreational contact on IDEM's 303d list.	• *E. coli* levels exceed the water quality standard
A number of area streams have nutrient levels that exceed IDEM target values for draft nutrient TMDLs.	• Nutrient levels exceed IDEM's draft nutrient TMDL target values set by this project
Streambank/shoreline erosion and sedimentation.	• Stream alterations • Increased peak flow and volumes • Destruction or encroachment on riparian areas
Development and/or alteration of floodplains. Lack of upland storage in urbanized areas. Loss of wetlands and natural land cover that promote infiltration and reduce runoff volume (ex. forest and grasslands). Increasing impervious surface area with development.	• Encroachment of development into floodplains • Destruction of wetlands and loss of open space from development and agriculture • Increased impervious surface area with development

Problem	Potential Cause(s)
Development pattern trending outside of core communities.	
An operation and maintenance program does not currently exist for septic systems. Severe soil limitations for traditional systems.	• Lack of rules/regulations requiring maintenance • Public and elected official awareness of issue • Lack of buy-in from public and elected officials
Illegal dumping of household and commercial wastes. Litter in streams and lakes.	• Lack of awareness of existing Hazardous Household Waste Disposal programs • Ease of public and commercial businesses to dispose of waste in an appropriate manner • Lack of funding for HHWD program expansion and outreach
Remediation efforts lagging to reduce risk to human and wildlife health from contaminated sites and sediments.	• Population loss and growth shifting outside of urban core communities • Lack of funding for remediation • Unknown risk for developers
Increased runoff volume and pollutant loads and loss of habitat and/or connectivity from transportation projects.	• Inadequate use or selection of BMPs to mitigate NPS impacts from transportation • Lack of funding to mitigate impacts • Transportation agencies, communities and "environmental" organizations not coordinating to the extent possible
CSOs contribute to high E. coli levels and beach closures. Threat to public health, water quality and drinking water supplies.	• Stormwater and sewer infrastructure in CSO communities • Aging infrastructure • Lack of funding for separation • Increased impervious surface area
Development outside the Lake Michigan basin puts stress on ground water supplies for human consumption and support of aquatic life.	• Population shift outside of core communities with water supply infrastructure
USGS shows increasing trends in pesticide concentrations in urban streams for the US.	• Pesticide application by homeowners and businesses • Insufficient outreach on proper pesticide use and disposal • Proliferation of weed-and-feed products available to general public
Increased impervious surface area and lack of	• Urban and rural growth

Problem	Potential Cause(s)
forested stream buffers contribute to increases in stream water temperatures.	• Insufficient use of infiltration BMPs • Destruction of forested riparian habitat
Habitat loss and fragmentation from development coupled with invasive species introduction are threatening biodiversity in the region.	• Conversion of natural areas for development • Insufficient planning and effort to maintain or restore wildlife corridors
Watershed planning and implementation is underfunded.	• Federal and state funding mechanisms being cut back • Local match for grant funds • Not a priority for some communities or areas with shrinking budgets
Public is not fully aware of water quality and aquatic habitat issues in their watersheds.	• Insufficient coordination amongst groups and communities • No active group/organization or local champion to convey information • Existing outreach programs need bolstering • Sources of information are hard to find or understand for the average citizen • Water quality in not a concern or priority in the day-to-day lives for some members of the public
Lack of local government involvement in watershed planning and implementation efforts.	• Not a priority issue for community • Determining appropriate/key staff to participate • Lack of leadership support to participate
Existing development patterns have led to growth far outside existing core development areas.	• Zoning and ordinance • Declining quality of life
A number of area stream lack sufficient riparian buffers. Poor QHEI scores	• Destruction or encroachment of development or agricultural production into riparian zone • Drainage improvement • Lack of restoration funding • Insufficiently protective ordinances • Lack of incentives to maintain or restore riparian habitat • Removal of land in agricultural production (financial loss) • Insufficient education and outreach on

Problem	Potential Cause(s)
	riparian habitat benefits and programs • No interest in participating in federal or state funding programs • Lack of technical staff to support program • General lack of interest
Insufficient staff to implement watershed program/no watershed coordinator	• Insufficient funding for dedicated watershed coordinator • Workload and responsibilities of existing staff
A number of area streams that have been modified are included on the 303d List by IDEM	• Design and maintenance practices
A unified group/program does not exist for some areas.	• Lack of awareness on watershed issues • Insufficient collaboration between local communities, organizations, and groups
Access to streams, lakes, Lake Michigan shoreline and other natural areas is limited in some communities or areas.	• Lack of funding to acquire or improve access • Availability of land for purchase
Use of conservation tillage practices are low compared to some other counties in the state.	• Lack of interest in conservation programs • Insufficient understanding of practice benefits • Insufficient technical staff available locally • Insufficient funding for outreach
Streams in highly industrial areas listed by IDEM on 303d list.	• Legacy contaminants • Point source discharges • Storm water runoff

Table 10. Problems & Potential Causes

2.4 Potential Sources & Pollutant Loads

2.4.1 Potential Sources for Each Pollution Problem

Table 10 below relates potential causes identified in Table 10 to potential sources. Potential sources in the table are presented at a somewhat course scale. Further refinement of potential sources is possible through specific watershed management plan development with more detailed input from stakeholders.

Problem	Potential Cause(s)	Potential Source(s)
Locations have been tested to the point that there is a wealth of information available for	• State and federal agencies not coordinating to extent possible	N/A

Problem	Potential Cause(s)	Potential Source(s)
some locations and none at all for other areas (subwatersheds).	• Different sampling program design and priorities	
A number of area streams are included on IDEM's 303d list for impaired biotic communities.	• Cumulative effects of activities that affect water quality and habit conditions over time	• Poor habitat quality (QHEI <51) • High ISC (>11%) in urban areas • Conversion of critical wetland habitat adjacent to streams • Row crop production on HEL not utilizing conservation practices (ex. conservation tillage) • Lack of stream buffers in developed or agricultural areas • Urban and agricultural runoff, industrial discharges
A number of area streams and lakes have fish consumption advisories in place.	• Mercury and PCBs in fish tissue exceed levels safe for human consumption	• Air deposition • NPDES point source discharges • Contaminated sediments
A number of area streams and Lake Michigan shoreline are impaired for recreational contact on IDEM's 303d list.	• *E. coli* levels exceed the water quality standard	• Failed septic systems • Non-systems • CSOs • Livestock access to streams • Runoff from livestock operations • Wildlife

Problem	Potential Cause(s)	Potential Source(s)
		(including ducks and geese) • Pet waste
A number of area streams have nutrient levels that exceed IDEM target values for draft nutrient TMDLs.	• Nutrient levels exceed IDEM's draft nutrient TMDL target values set by this project	• Urban and agricultural fertilizer runoff • CSOs • Livestock access to streams
Streambank/shoreline erosion and sedimentation.	• Stream alterations • Increased peak flow and volumes • Destruction or encroachment on riparian areas	• High ISC (>11%) in developed areas • Conversion of critical wetland habitat adjacent to streams and headwater areas in developed or agricultural areas • Lack of stream buffers in developed or agricultural areas • Poorly designed drainage improvement projects • Loss of forest and grasslands in developed areas
Development and/or alteration of floodplains. Lack of upland storage in urbanized areas. Loss of wetlands and natural land cover that promote infiltration and reduce runoff volume (ex. forest and grasslands). Increasing impervious surface area with development.	• Encroachment of development into floodplains • Destruction of wetlands and loss of open space from development and agriculture • Increased impervious surface area with development	• Floodplain encroachment in developed areas • Conversion of wetlands, forest, and grasslands in developed and agricultural areas • High ISC in developed areas • Conveyance constriction
Development pattern trending		N/A

Problem	Potential Cause(s)	Potential Source(s)
outside of core communities.		
An operation and maintenance program does not currently exist for septic systems. Severe soil limitations for traditional systems.	• Lack of rules/regulations requiring maintenance • Public and elected official awareness of issue • Lack of buy-in from public and elected officials	N/A
Illegal dumping of household and commercial wastes. Litter in streams and lakes.	• Lack of awareness of existing Hazardous Household Waste Disposal programs • Ease of public and commercial businesses to dispose of waste in an appropriate manner • Lack of funding for HHWD program expansion and outreach	• Developed areas
Remediation efforts lagging to reduce risk to human and wildlife health from contaminated sites and sediments.	• Population loss and growth shifting outside of urban core communities • Lack of funding for remediation • Unknown risk for developers	• Primarily urban areas
Increased runoff volume and pollutant loads and loss of habitat and/or connectivity from transportation projects.	• Inadequate use or selection of BMPs to mitigate NPS impacts from transportation • Lack of funding to mitigate impacts • Transportation agencies, communities and "environmental" organizations not coordinating to the extent possible	• Roads, highways and bridges in developed areas
CSOs contribute to high E. coli levels and beach closures. Threat to public health, water quality and drinking water supplies.	• Stormwater and sewer infrastructure in CSO communities • Aging infrastructure • Lack of funding for separation • Increased impervious	• CSO communities

Problem	Potential Cause(s)	Potential Source(s)
	surface area	
Development outside the Lake Michigan basin puts stress on ground water supplies for human consumption and support of aquatic life.	• Population shift outside of core communities with water supply infrastructure	N/A
USGS shows increasing trends in pesticide concentrations in urban streams for the US.	• Pesticide application by homeowners and businesses • Insufficient outreach on proper pesticide use and disposal • Proliferation of weed-and-feed products available to general public	• Developed and agricultural areas
Increased impervious surface area and lack of forested stream buffers contribute to increases in stream water temperatures.	• Urban and rural growth • Insufficient use of infiltration BMPs • Destruction of forested riparian habitat	• Developed areas
Habitat loss and fragmentation from development coupled with invasive species introduction are threatening biodiversity in the region.	• Conversion of natural areas for development or agricultural production • Insufficient planning and effort to maintain or restore wildlife corridors	• Developed and developing areas • Agricultural areas
Watershed planning and implementation is underfunded.	• Federal and state funding mechanisms being cut back • Local match for grant funds • Not a priority for some communities or areas with shrinking budgets	N/A
Public is not fully aware of water quality and aquatic habitat issues in their watersheds.	• Insufficient coordination amongst groups and communities • No active group/organization or local champion to convey information • Existing outreach programs need bolstering • Sources of information are hard to find or understand for the average citizen	N/A

Problem	Potential Cause(s)	Potential Source(s)
	• Water quality in not a concern or priority in the day-to-day lives for some members of the public	
Lack of local government involvement in watershed planning and implementation efforts.	• Not a priority issue for community • Determining appropriate/key staff to participate • Lack of leadership support to participate • Multijurisdictional	N/A
Existing development patterns have led to growth far outside existing core development areas.	• Zoning and ordinance • Declining quality of life	N/A
A number of area streams lack sufficient riparian buffers. Poor QHEI scores.	• Destruction or encroachment of development or agricultural production into riparian zone • Drainage improvement • Lack of restoration funding • Insufficiently protective ordinances • Lack of incentives to maintain or restore riparian habitat • Removal of land in agricultural production (financial loss) • Insufficient education and outreach on riparian habitat benefits and programs • No interest in participating in federal or state funding programs • Lack of technical staff to support program • General lack of interest	• Developed and agricultural areas
Insufficient staff to implement watershed program/no	• Insufficient funding for dedicated watershed coordinator	N/A

Problem	Potential Cause(s)	Potential Source(s)
watershed coordinator	• Workload and responsibilities of existing staff	
A number of area streams that have been modified are included on the 303d List by IDEM	• Design and maintenance practices	• Urban drains • Regulated drains
A unified group/program does not exist for some areas.	• Lack of awareness on watershed issues • Insufficient collaboration between local communities, organizations, and groups	N/A
Access to streams, lakes, Lake Michigan shoreline and other natural areas is limited in some communities or areas.	• Lack of funding to acquire or improve access • Availability of land for purchase	• Developed areas
Use of conservation tillage practices are low compared to some other counties in the state.	• Lack of interest in conservation programs • Insufficient understanding of practice benefits • Insufficient technical staff available locally • Insufficient funding for outreach	• Agricultural areas adjacent to streams • Row crop production on HEL
Streams in highly industrial areas listed by IDEM on 303d list.	• Legacy contaminants • Point source discharges • Storm water runoff	• Developed areas

Table 11. Potential Sources for Each Problem

In an effort to help identify conditions in which exceedances occur and potential sources in the sub-basin, NIRPC used Purdue University's web-based Load Duration Curve Analysis System[1]. The duration curve approach allows for characterizing water quality concentrations at different flow regimes. Using the duration curve framework, the frequency and magnitude of water quality standard exceedances, allowable loadings, and size of load reductions are easily presented and can be better understood[2] . Loads that plot above the curve indicate and exceedance of the water quality standard or target, while those below the curve show compliance. Table 12 shows the general relationship between duration curve zone and potential contributing sources.

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[1] Purdue University Web-Based Load Duration Curve Analysis System https://engineering.purdue.edu/~ldc/JG/duration/main.cgi
[2] An Approach for Using Load Duration Curves in the Development of TMDLs (EPA 841-B-07-006) https://engineering.purdue.edu/~ldc/JG/duration/PDF/duration_curve_guide_aug2007.pdf

Contributing Source Area	Duration Curve Zone				
	High	Moist	Mid-Range	Dry	Low
Wastewater treatment plants				M	H
Livestock direct access to streams				M	H
Wildlife direct access to streams				M	H
On-site wastewater systems/Unsewered areas	M	M-H	H	H	H
Urban stormwater/CSOs	H	H	H		
Agricultural runoff	H	H	M		
Bacterial re-suspension from stream sediments	H	M			
Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low)					

Table 12. General Relationship between Duration Curve Zone and Contributing Sources[3]

Within the sub-basin there are five IDEM sampling sites that are located in near proximity to a USGS stream gage. IDEM site number LMG030-0008 corresponds with USGS gage number 04093000 which is located on Deep River at the Lake George outlet in Hobart. IDEM site number LMG060-0007 corresponds with USGS gage number 04095090 which is located on Burns Ditch in Portage. IDEM site number LMG060-0016 corresponds with USGS gage number 04094000 which is located on the East Branch of the Little Calumet River in Porter. However, water quality data is limited to five *E. coli* observations between 1999 and 2010. IDEM site number LMG070-0007 corresponds with USGS gage number 04095380 which is located on the Trail Creek harbor in Michigan City. IDEM site number LMG070-0016 corresponds with USGS gage number 04095300 located on Trail Creek in Michigan City. However, gaging data is not available for the period of time in which IDEM collected water quality samples in 2000.

Deep River, LMG030-0008

The load duration curve for Total Kjeldahl Nitrogen (TKN) (Figure 57), which is the sum of all organic nitrogen and ammonia, shows that the water quality target of 0.591 mg/l is exceeded across all flow conditions at this station. This indicates that contributing source areas include both point and nonpoint sources within the drainage area. Several NPDES facilities are located upstream in the drainage area as can be seen in Figure 51. Facilities such as wastewater treatment plants may contribute to the exceedances observed during dry conditions. Another potential contributing factor in dry-conditions is onsite wastewater (septic) systems. Across the mid-, moist, and high flow conditions nonpoint source sources are the primary contributor. Figure 17 and Figure 19 show that the contributing subwatersheds to the station have a fairly high percentage of development and agriculture respectively.

[3] Kankakee/Iroquois Watershed TMDL Report http://www.in.gov/idem/nps/files/tmdl_kankakee_iroquois_part3.pdf

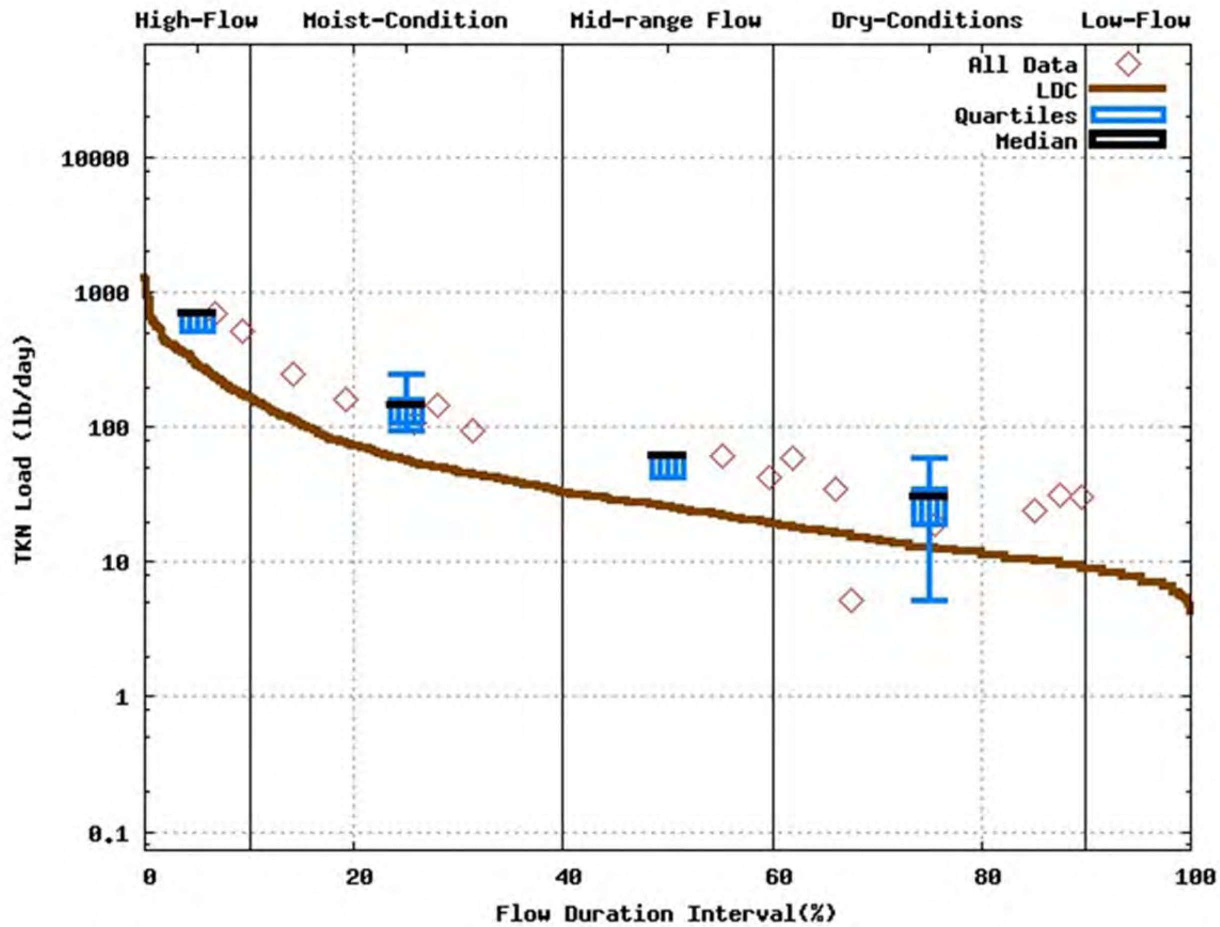

Figure 57. TKN Load Duration Curve (IDEM Site LMG030-0008)

The load duration curve for total suspended solids (TSS) (Figure 58) shows that the water quality target of 30 mg/l is primarily exceeded during high flow conditions. Under these conditions surface runoff from upland sources such as urban and agricultural areas, as well as stream channel erosion, are the primary contributing factors. Figure 17 and Figure 19 show that the contributing subwatersheds to the station have a fairly high percentage of development and agriculture respectively. Impervious cover data displayed in Figure 18 shows that the contributing subwatersheds range between 10-25% which can increase runoff volume resulting in channel erosion. Figure 35 displays developed and agricultural land existing on HEL soils. Row crop production and new development occurring on these soils may contribute to TSS loading.

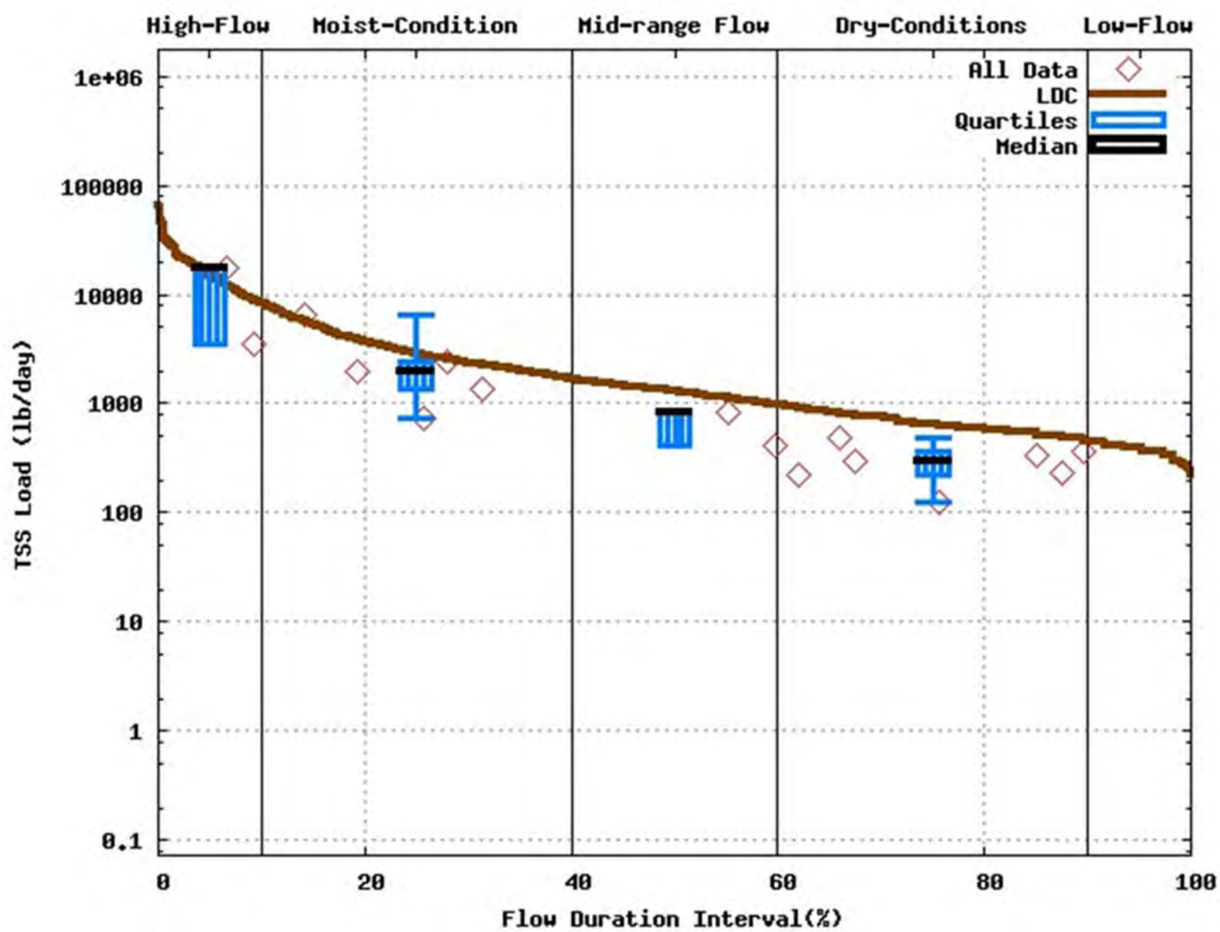

Figure 58. TSS Load Duration Curve (IDEM Site LMG030-0008)

Burns Ditch, LMG060-0007

The load duration curve for *E. coli* (Figure 59Figure 58) shows that the water quality standard of 235 CFU/l is primarily exceeded during high flow and moist conditions. Under these conditions contributing sources include failing septic systems, urban runoff/CSOs, runoff from agricultural land, and re-suspension of bacteria laden sediment. A confined feeding operation (CFO) is located between Crown Point and Winfield just north of US 231 in the Main Beaver Dam Ditch-Deep River subwatershed (HUC 040400010502). The impact of the CFO if any is likely diminished due to its distance from the IDEM sampling site on Burns Ditch. Figure 17 shows that several of the contributing subwatersheds to the station have a fairly high percentage of development. Several CSO communities exist within the large drainage area. Additionally impervious cover ranges from 10-25% for the contributing subwatersheds (Figure 18). Impervious surface areas can exacerbate CSO occurrences with increased runoff volume being captured by the system.

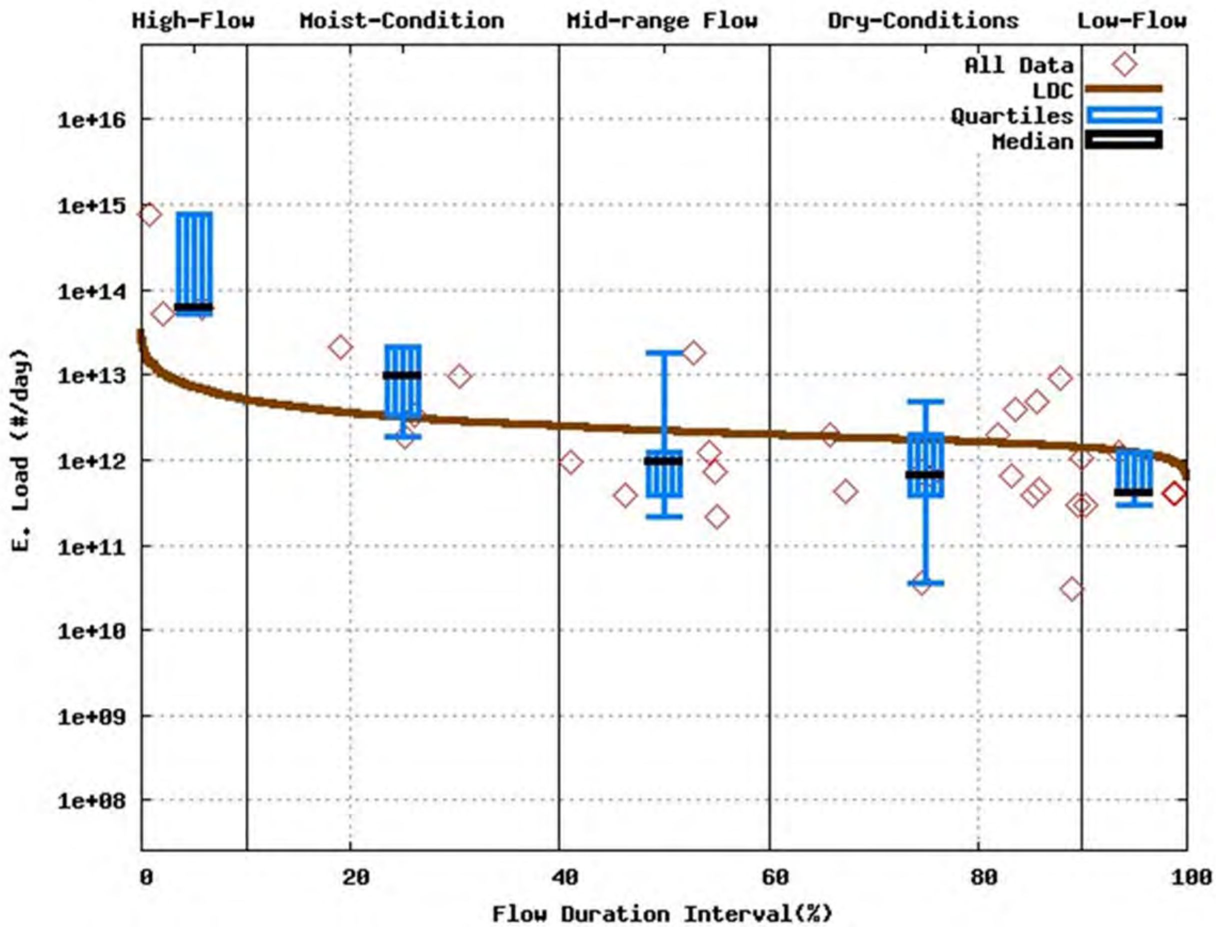

Figure 59. ***E. coli*** **Load Duration Curve (IDEM Site LMG060-0007)**

The load duration curve for total phosphorous (TP) (Figure 60Figure 58) shows that the water quality target of 0.30 mg/l is occasionally exceeded during high flow conditions. Under high flow conditions contributing sources primarily include urban and agricultural runoff and CSOs. To a somewhat lesser extent failing septic systems are also a potential contributing source. Figure 17 and Figure 19 show that the contributing subwatersheds to the station have a fairly high percentage of development and agriculture respectively. Figure 35 displays developed and agricultural land existing on HEL soils. Row crop production occurring on these soils may need additional measures to reduce erosion and runoff. Preserving natural land cover occurring on these soils may be a way of preventing erosion and additional pollutant loading to nearby waterbodies. New development occurring on these soils may require additional erosion control measures.

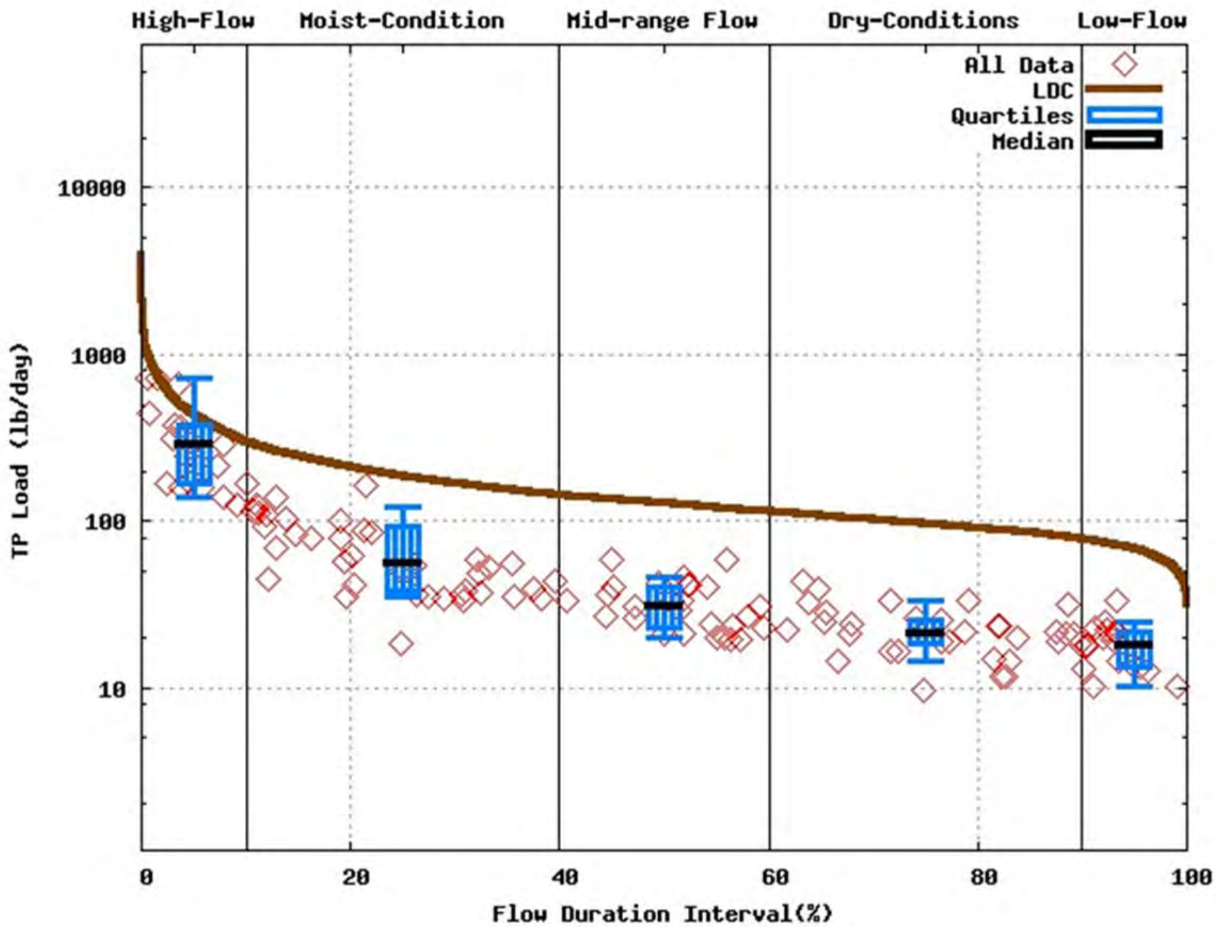

Figure 60. TP Load Duration Curve (IDEM Site LMG060-0007)

The load duration curve for TKN (Figure 61) shows that the water quality target of 0.591 mg/l is exceeded across all flow conditions at this station. This indicates that contributing source areas include both point and nonpoint sources within the drainage area. A number of NPDES facilities are located upstream in the large drainage area as can be seen in Figure 51. Facilities such as wastewater treatment plants may contribute to the exceedances observed during dry conditions. Another potential contributing factor in dry-conditions is onsite wastewater (septic) systems. Across the mid-, moist, and high flow conditions nonpoint source sources are the primary contributor. Figure 17 and Figure 19 show that the contributing subwatersheds to the station have a fairly high percentage of development and agriculture respectively.

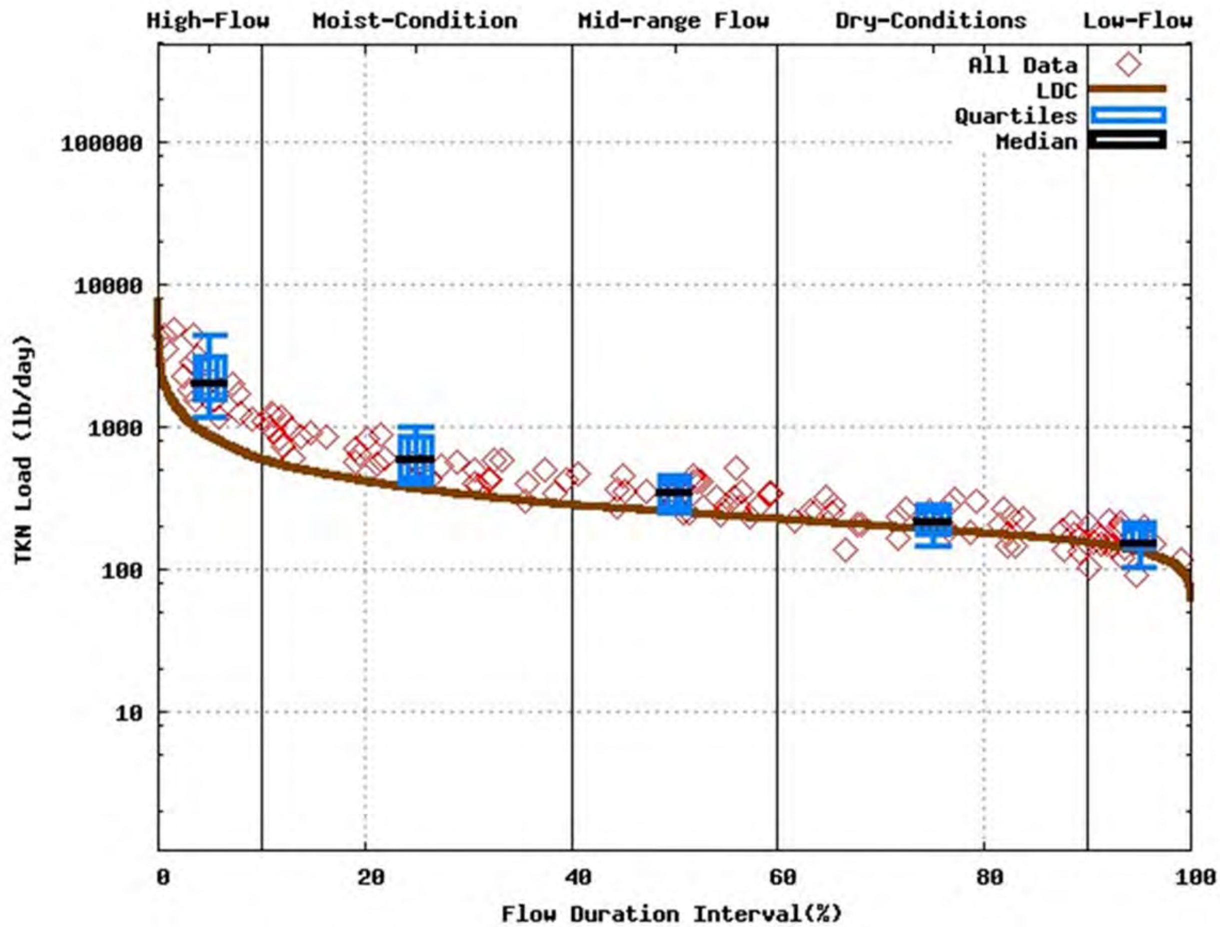

Figure 61. TKN Load Duration Curve (IDEM Site LMG060-0007)

The load duration curve for TSS (Figure 62) shows that the water quality target of 30 mg/l is primarily exceeded during high flow conditions. Under these conditions surface runoff from upland sources such as urban and agricultural areas, as well as stream channel erosion, are the primary contributing factors. Figure 17 and Figure 19 show that the contributing subwatersheds to the station have a fairly high percentage of development and agriculture respectively. Impervious cover data displayed in Figure 18 shows that the contributing subwatersheds range between 10-25% which can increase runoff volume resulting in channel erosion. Figure 35 displays developed and agricultural land existing on HEL soils. Row crop production and new development occurring on these soils may contribute to TSS loading.

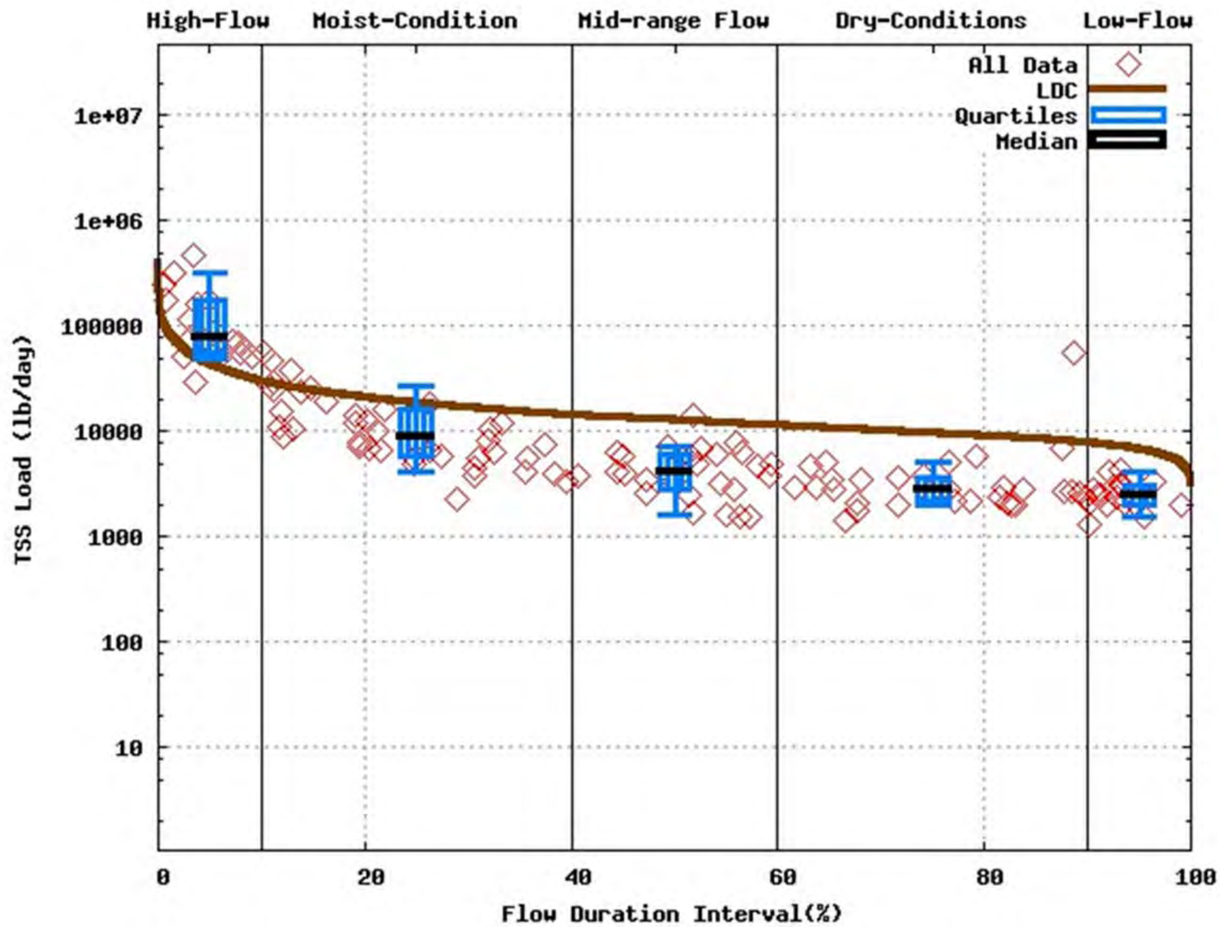

Figure 62. TSS Load Duration Curve (IDEM Site LMG060-0007)

East Branch Little Calumet River, LMG060-0016

The load duration curve for *E. coli* (Figure 63Figure 58), while limited to five sampling events, shows that the water quality standard of 235 CFU/l is primarily exceeded during high flow and moist conditions. Under these conditions contributing sources include failing septic systems, urban runoff/CSOs, and runoff from agricultural land. No CFOs existing within the drainage area. Figure 17 shows that the Coffee Creek-East Arm Little Calumet River subwatershed (HUC 040400010403) has the highest percentage of developed land (28.3%) for the station's drainage area. The other two remaining subwatersheds, Reynolds Creek-East Arm Little Calumet River (HUC 040400010401) and Kemper Ditch-East Arm Little Calumet River (HUC 040400010402), are primarily agricultural in nature (30.7% and 43.9% respectively) as can be seen in Figure 19. Chesterton is the only CSO communities within drainage area. Additionally the Coffee Creek-East Arm Little Calumet River subwatershed is the only subwatershed in the drainage area that exceeds 10% impervious cover (Figure 18). Impervious surface areas can exacerbate CSO occurrences with increased runoff volume being captured by the system.

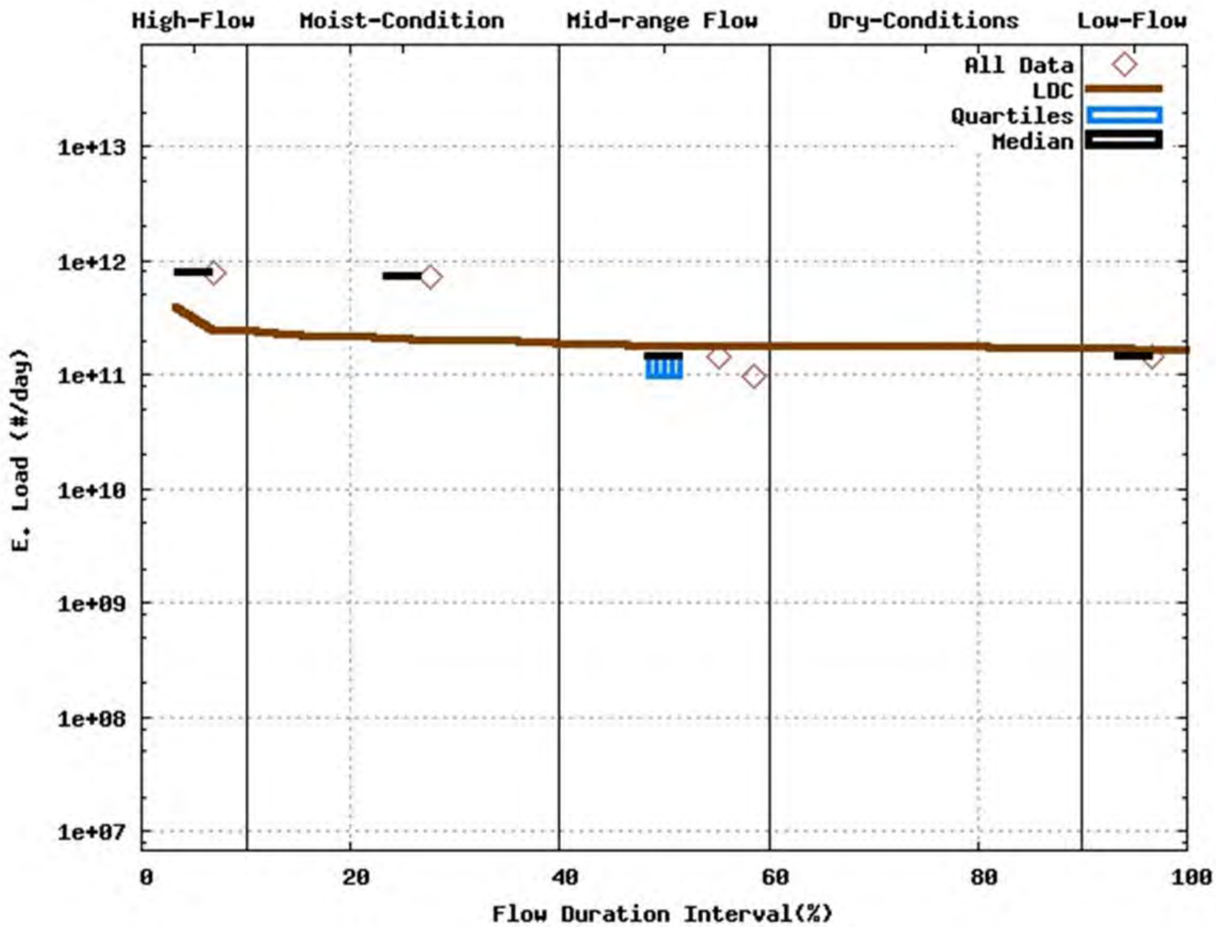

Figure 63. ***E. coli*** **Load Duration Curve (IDEM Site LMG060-0016)**

Trail Creek Harbor, LMG070-0007

The load duration curve for *E. coli* (Figure 64Figure 58) shows that the water quality standard of 235 CFU/l is primarily exceeded during high flow, moist, and midrange conditions. Under these conditions contributing sources include failing septic systems, urban runoff/CSOs, runoff from agricultural land, and re-suspension of bacteria laden sediment. No CFOs are located in the Trail Creek watershed however the Trail Creek Watershed Management Plan did indicate there were locations in which livestock had access to the stream. Figure 17 shows that the Trail Creek subwatershed (HUC12 040400010105) is the most developed in the station's drainage area (48.3%). The remaining two subwatersheds are primarily agricultural in nature (Figure 19). The Trail Creek subwatershed is the only subwatershed that exceeds 10% impervious cover in the station's drainage area (Figure 18).

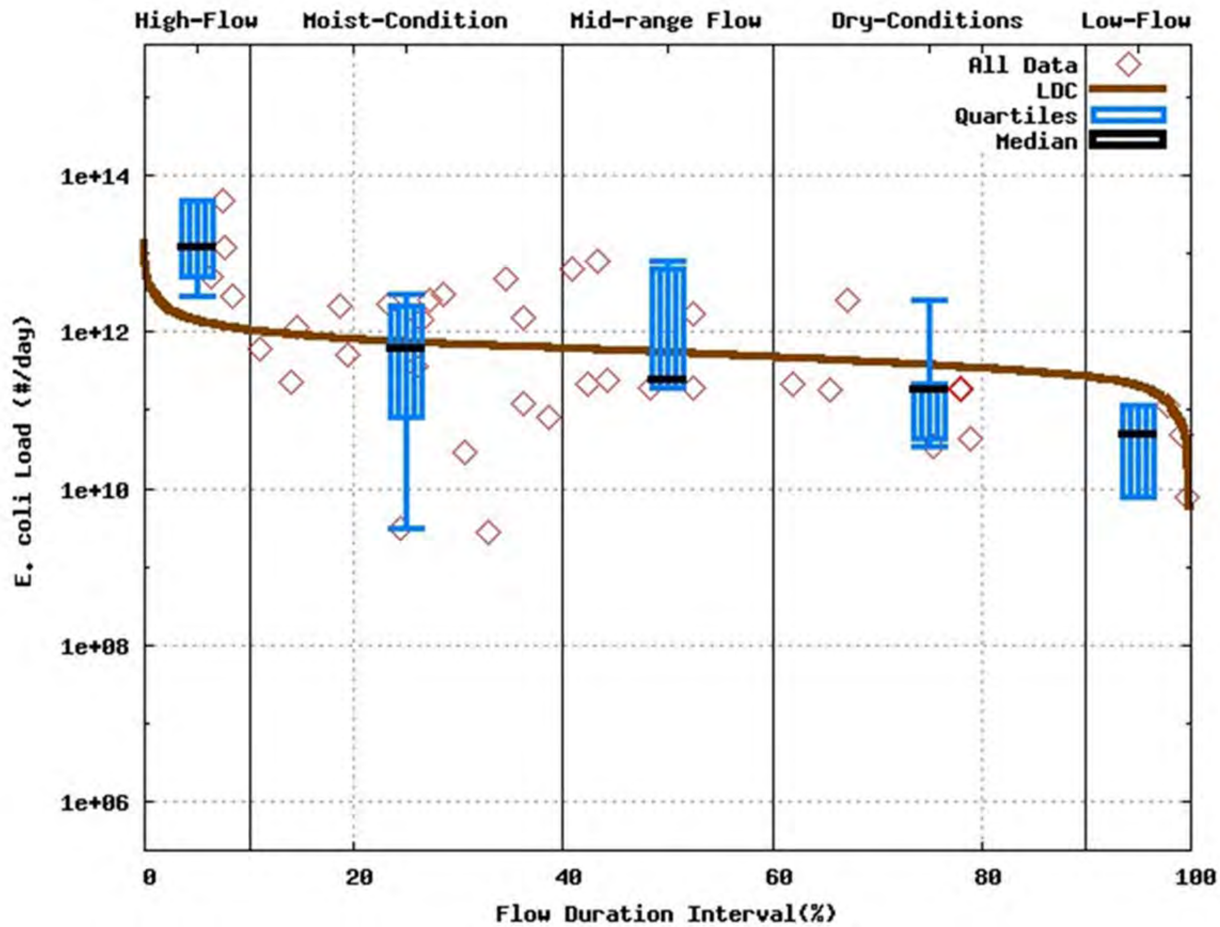

Figure 64. ***E. coli*** **Load Duration Curve (IDEM Site LMG070-0007)**

The load duration curve for TKN (Figure 65) shows that the water quality target of 0.591 mg/l is primarily exceeded during high flow and moist conditions at this station. Across moist and high flow conditions nonpoint sources are the primary contributor. Figure 17 and Figure 19 show that the contributing subwatersheds to the station have a fairly high percentage of development and agriculture respectively.

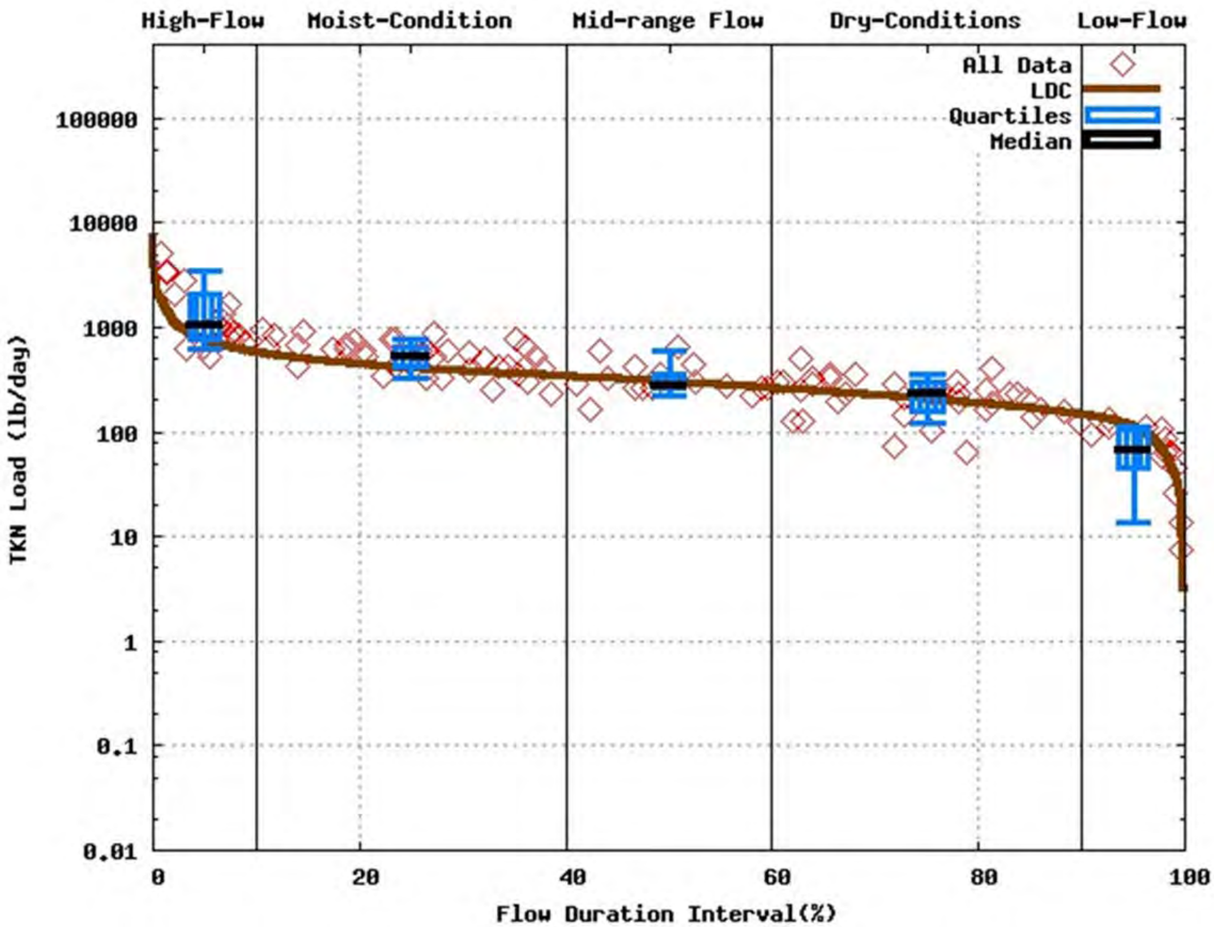

Figure 65. TKN Load Duration Curve (IDEM Site LMG070-0007)

The load duration curve for TSS (Figure 62) shows that the water quality target of 30 mg/l is primarily exceeded during high flow conditions. Under these conditions surface runoff from upland sources such as urban and agricultural areas, as well as stream channel erosion, are the primary contributing factors. Figure 17 shows that the Trail Creek subwatershed is the most developed in the station's drainage area (48.3%). The remaining two subwatersheds are primarily agricultural in nature (Figure 19). Impervious cover data displayed in Figure 18 shows that the Trail Creek subwatershed exceeds 10% which can increase runoff volume resulting in channel erosion. Figure 35 displays developed and agricultural land existing on HEL soils. Row crop production and new development occurring on these soils may contribute to TSS loading.

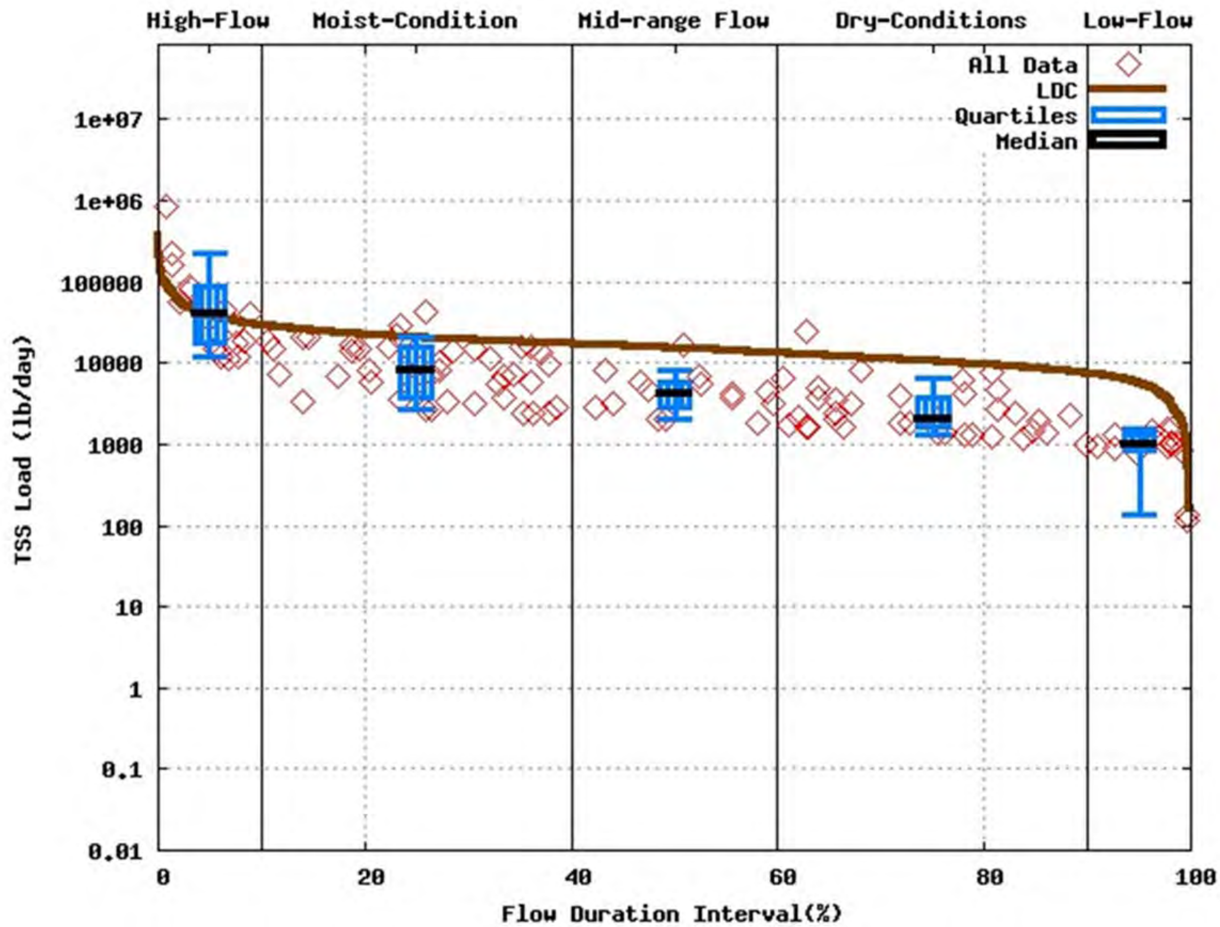

Figure 66. TSS Load Duration Curve (IDEM Site LMG070-0007)

2.4.2 Current Loads

Subwatershed loading of pollutants was done by NIRPC using the EPA's Spreadsheet Tool for Estimating Pollutant Load (STEPL). STEPL uses simple algorithms to calculate nutrient and sediment loads from different land uses. The results are presented as total load (nitrogen, phosphorous, biochemical oxygen demand (BOD), and sediment) by subwatershed and land use. The user inputs land use area (acres), agricultural animals (number), septic system data, and has the option to modify the Universal Soil Loss Equation (USLE) parameters for each land use. Data to help fill in these fields is available from the STEPL Data Server. Additionally the user can provide optional/modify input data including average soil hydrologic group (Figure 8), reference runoff curve number, nutrient concentration, urban land use distribution, and irrigation data. STEPL is available for download at http://it.tetratech-ffx.com/steplweb/default.htm as is access to the STEPL data server.

NIRPC used the 2006 NOAA CCAP data presented in 2.1.5 Land Use & Land Cover as input to STEPL for each subwatershed in the sub-basin. The CCAP developed land cover classes (high, medium and low density) were grouped for the urban input. The CCAP cultivated and pasture/hay land cover classes were used for cropland and pastureland inputs respectively. The CCAP deciduous, mixed and evergreen land cover classes were grouped for the forest input. The CCAP developed open space land cover class was used for the user defined land use input. Input values for agricultural animals and septic systems were obtained from the STEPL data server. The USLE parameters were modified for each land cover type with data provided with the STEPL download for the region. Average soil hydrologic group for each subwatershed was determined from the soils data presented in 2.1.4 Soils. Soil nitrogen and phosphorous concentration percentage was modified with data provided with the STEPL download for the region. The open space runoff curve number was used as the reference curve number for the user defined land cover input. The urban land use distribution was modified to zero to account for the inclusion of open space as a user defined input. The 5% that was used for percent open space was added to percent single family. All other parameter for the analysis was left as the default value provided.

The results of the analysis are presented below in Table 13, Figure 67, and Figure 68. Total loads for each pollutant are included for each subwatershed in the Little Calumet-Galien sub-basin. The Calumet River-Frontal Lake Michigan subwatershed (STEPL # W4), which forms a narrow strip along the southern tip of Lake Michigan from Lake County to Michigan City in LaPorte County, has the highest nitrogen (N), biochemical oxygen demand (BOD), and sediment annual loads of each of the subwatersheds analyzed in the sub-basin. It also has the 2nd highest phosphorous (P) load. The Calumet River-Frontal Lake Michigan subwatershed is the most developed subwatershed (79%) within the sub-basin. Figure 69 and Figure 71 show that urban (developed) land uses are the largest contributors of nitrogen and BOD respectively in the sub-basin.

The Squirrel Creek-Salt Creek subwatershed (STEPL # W14) had the second highest nitrogen and BOD annual loading and third highest phosphorous and sediment loading based on STEPL results. This subwatershed ranked second in percentage of water quality exceedances (27%) observed during NIRPC exceedance/threshold analysis of IDEM water quality data. The Main Beaver Dam Ditch-Deep River subwatershed (STEPL # W23) had the highest phosphorous load and second highest sediment load observed in the sub-basin. It also had the third highest nitrogen and BOD loads. No IDEM water quality data was available for the subwatershed during the 1999-2010 time period used by NIRPC for the exceedance/threshold analysis.

Subwatershed		N Load		P Load		BOD Load		Sediment Load	
HUC-12	STEPL #	lb/year	Rank	lb/year	Rank	lb/year	Rank	t/year	Rank
0102	W12	8279.1	23	3,907.8	22	23,179.0	23	462.3	22
0103	W7	19,810.4	18	7,977.5	18	56,500.6	18	903.5	18
0104	W13	16,012.3	20	7,573.1	19	42,061.2	21	850.5	19
0105	W5	18,052.8	19	5,758.2	21	59,997.6	16	737.0	20
0201	W26	6,475.1	24	2,495.2	24	16,641.0	24	248.4	25
0204	W2	13,011.3	21	5,945.6	20	31,403.1	22	625.4	21
0205	W3	21,061.5	17	10,908.8	12	51,162.1	19	1,216.1	12
0206	W1	3,667.7	26	2,418.0	25	8,071.8	26	289.6	24
0301	W21	31,397.4	15	8,562.0	17	103,945.2	15	1,020.2	16
0302	W22	37,111.0	12	10,231.5	14	114,446.2	10	1,065.9	15
0303	W14	77,102.2	2	21,700.2	3	233,025.3	2	2,238.3	3

Subwatershed		N Load		P Load		BOD Load		Sediment Load	
HUC-12	STEPL #	lb/year	Rank	lb/year	Rank	lb/year	Rank	t/year	Rank
0401	W9	22,265.3	16	8,859.4	15	58,195.8	17	917.2	17
0402	W8	43,260.5	7	16,273.1	4	108,868.7	14	1,642.6	4
0403	W11	41,503.3	9	11,783.9	11	135,366.7	6	1,341.4	11
0501	W25	42,030.1	8	13,024.0	7	127,186.4	7	1,441.9	10
0502	W23	70,482.2	3	22,923.4	1	198,052.6	3	2,417.3	2
0503	W17	49,842.8	4	12,570.4	8	169,784.6	5	1,497.2	7
0504	W24	46,865.9	6	15,600.9	5	126,827.2	8	1,570.9	5
0505	W20	49,839.5	5	12,012.7	9	174,865.8	4	1,485.7	8
0506	W18	41,337.9	10	14,437.7	6	110,546.9	13	1,498.1	6
0507	W19	38,116.5	11	10,906.3	13	117,552.1	9	1,184.2	13
0508	W15	32,656.3	14	8,615.3	16	114,381.3	11	1,139.3	14
0509	W10	35,618.9	13	11,866.1	10	113,915.0	12	1,483.4	9
0601	W16	12,480.8	22	3,481.9	23	42,728.8	20	435.7	23
0602	W6	4,547.2	25	1,663.7	26	15,008.9	25	178.9	26
0603	W4	124,756.1	1	22,731.9	2	484,386.0	1	3,128.3	1
	Total	907,584.0		274,228.7		2,838,100.0		31,019.3	

Table 13. Total Annual Load by Subwatershed

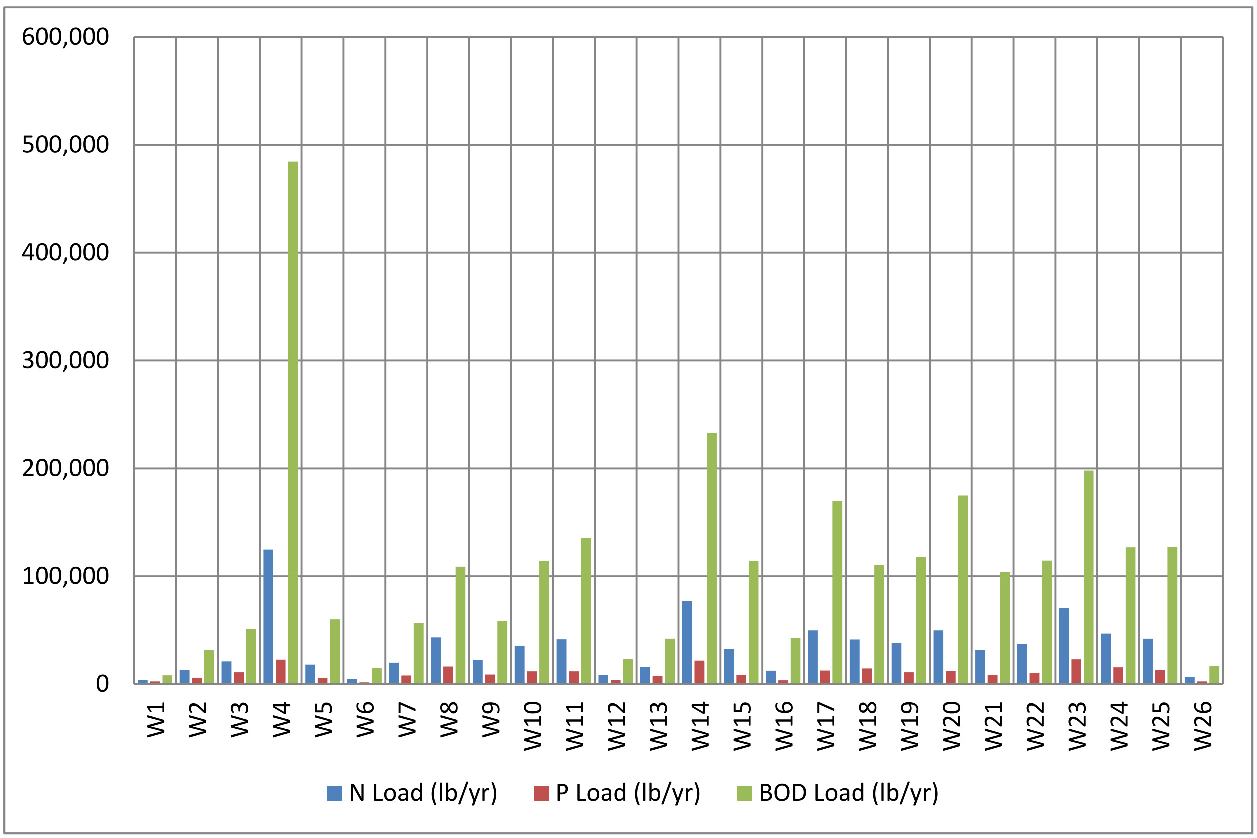

Figure 67. Nitrogen, Phosphorous, and BOD Load by Subwatershed

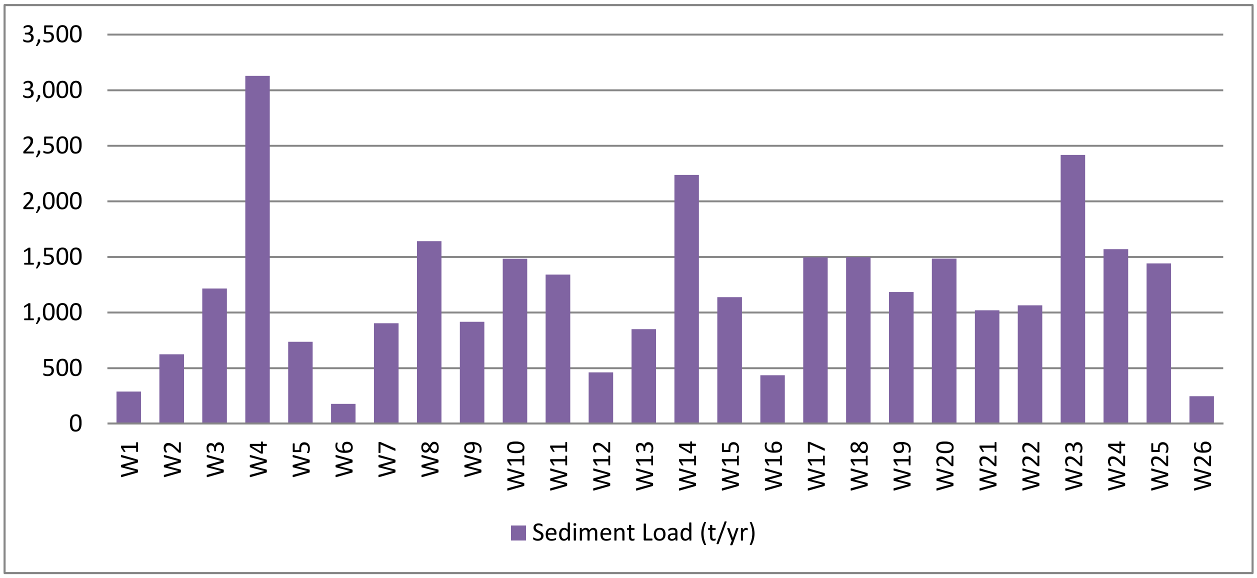

Figure 68. Sediment Load by Subwatershed

The following figures display loading data by land use for the Little Calumet-Galien sub-basin within Indiana. Urban land use accounts for the highest pollutant loading for total nitrogen (50%) and BOD (61%). Cropland was the largest contributor of phosphorous (57%) and sediment (54%) loading. sediment load.

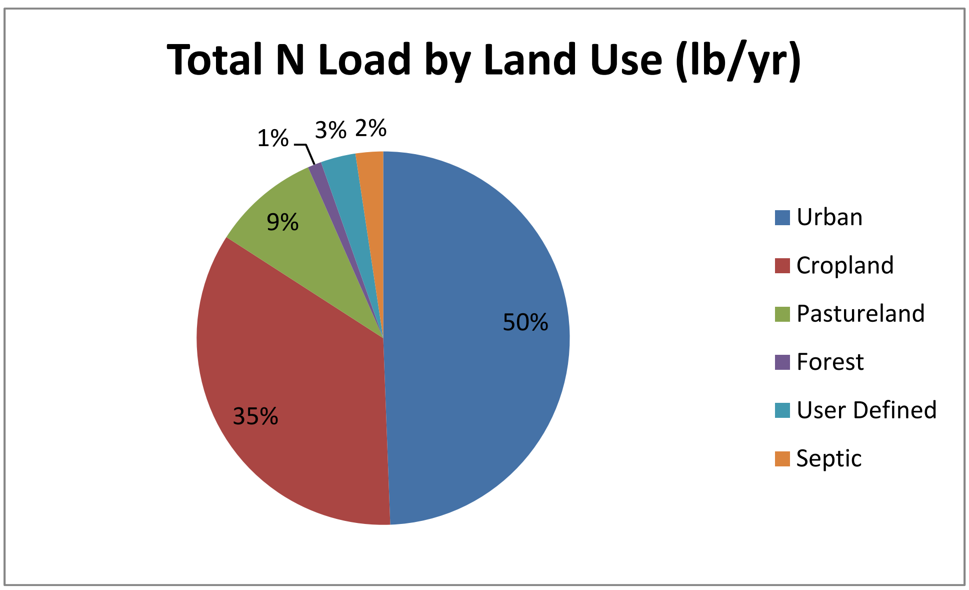

Figure 69. Total N Load by Land Use

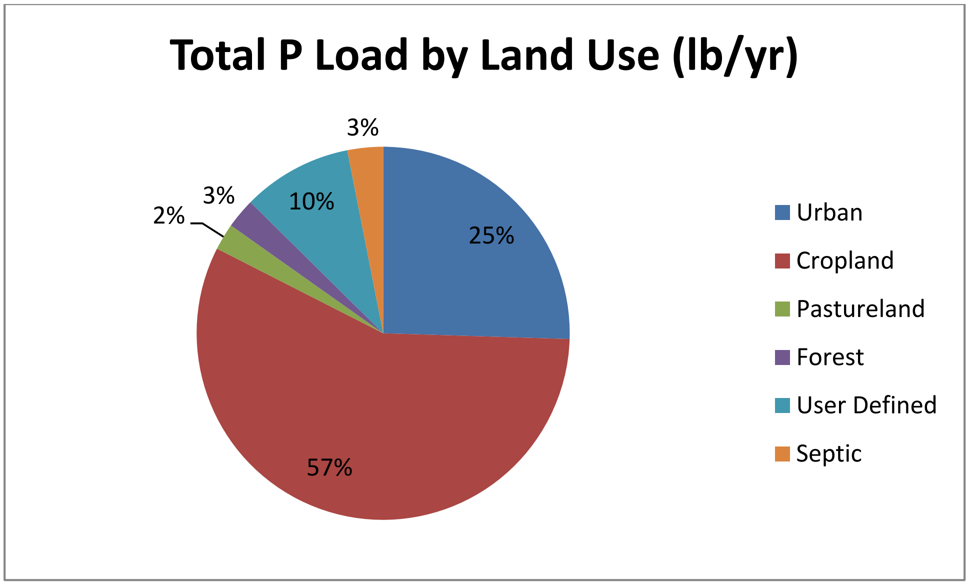

Figure 70. Total P Load by Land Use

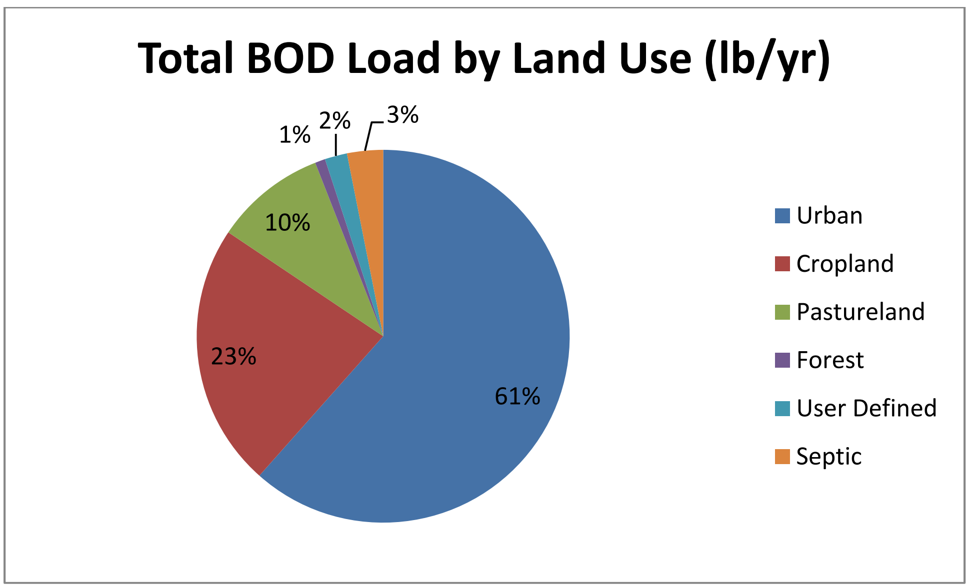

Figure 71. Total BOD Load by Land Use

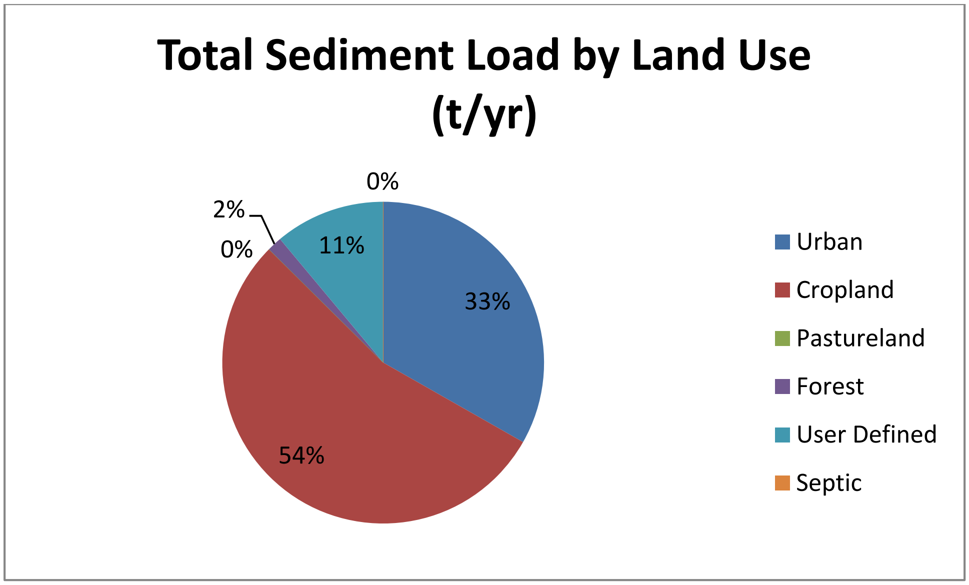

Figure 72. Total Sediment Load by Land Use