CHAPTER 4
THE CHICAGO SUB-BASIN

HUC 07120003

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Chicago Sub-Basin

4.1 Part I- Watershed Inventory

4.1.1 Overview

The Chicago sub-basin (HUC 07120003) covers nearly 656 mi² of Indiana and Illinois. The project area, outlined in Figure 1, drains approximately 90 mi² of predominately developed land in Lake County, Indiana. Of the 59 miles of stream and ditch that drain this landscape, nearly 32 miles (54%) are impaired (303d List of Impaired Waterbodies- IDEM, 2008). The most common impairments include Chloride (19 miles), Cyanide (21 miles), Dissolved Oxygen (11 miles), *E. coli* (18 miles), Impaired Biotic Communities (18 miles), and PCB's in Fish Tissue (21 miles). Each impaired stream reach, with the exception of Dyer Ditch, has multiple impairments (29 miles). Some of the major tributaries in

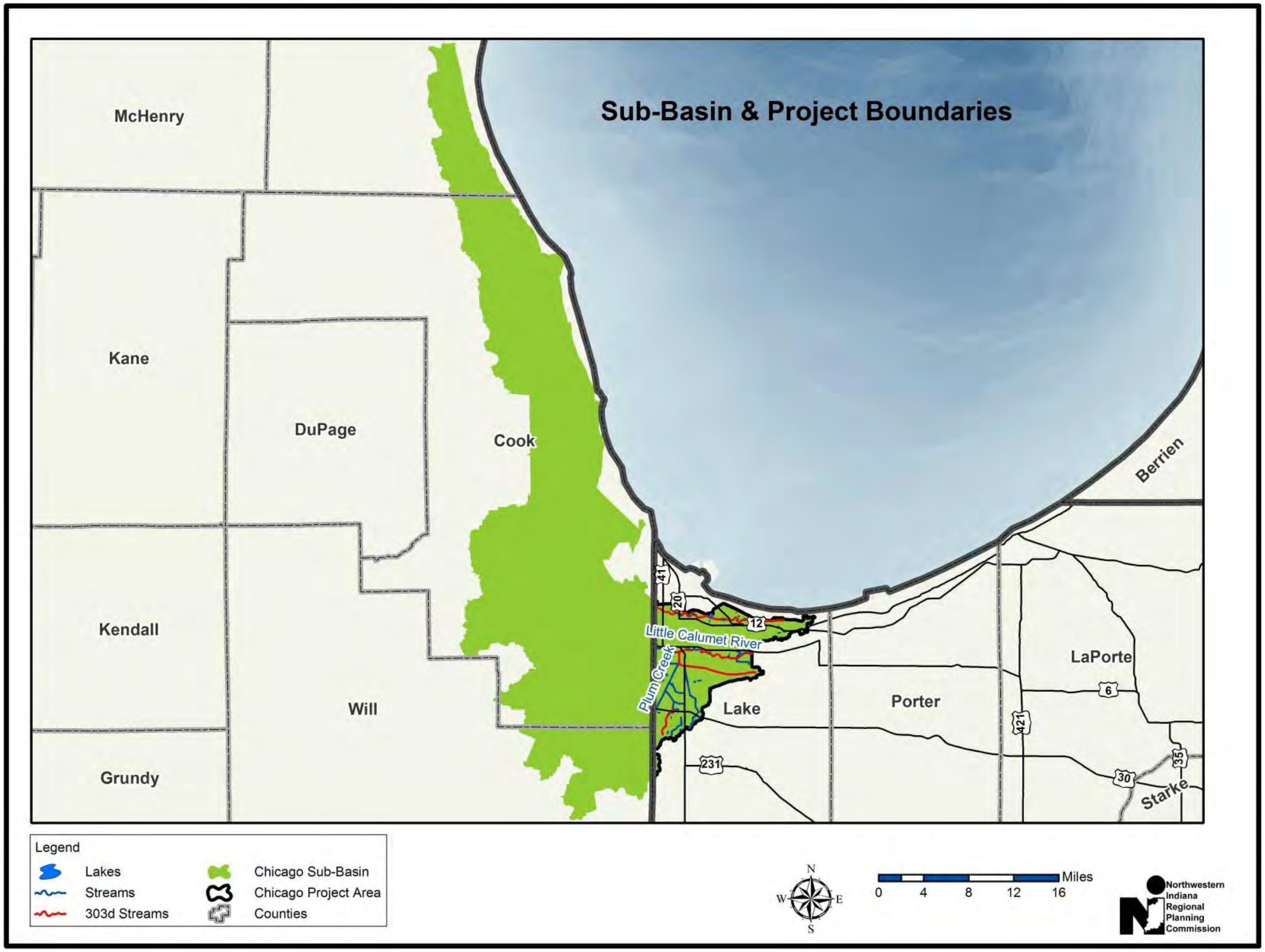

Figure 1 Chicago Sub-Basin & Project Boundaries

the sub-basin include the Little Calumet River, Hart Ditch, and Cady Marsh Ditch.

4.1.2 Geology/Topography

Elevation

The topography of the Chicago 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, which the Chicago sub-basin was once part of prior to significant drainage improvement projects, and Kankakee to the south (IDNR, 1994). The Chicago sub-basin grades away from a high of 740 feet near St. John along the Valparaiso Moraine to a low of 577 feet near East Chicago and Hammond along the Grand Calumet River (Figure 2).

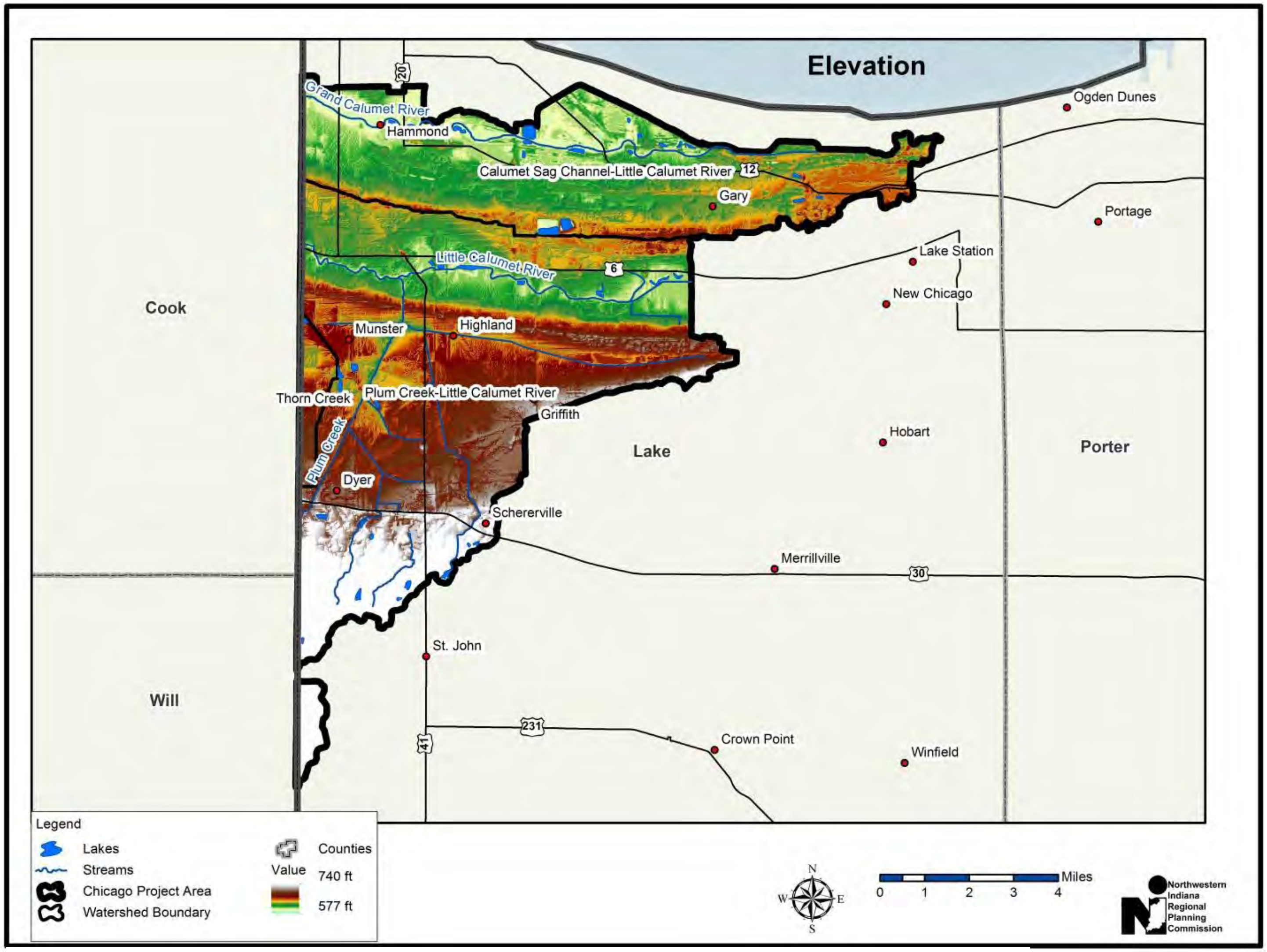

Figure 2 Elevation

Physiography

The sub-basin is positioned across two physiographic regions including the Lake Michigan Border and the Valparaiso Morainal Complex (Figure 3). Physiographic regions are based on topography and the effect of glaciers on the landscape.

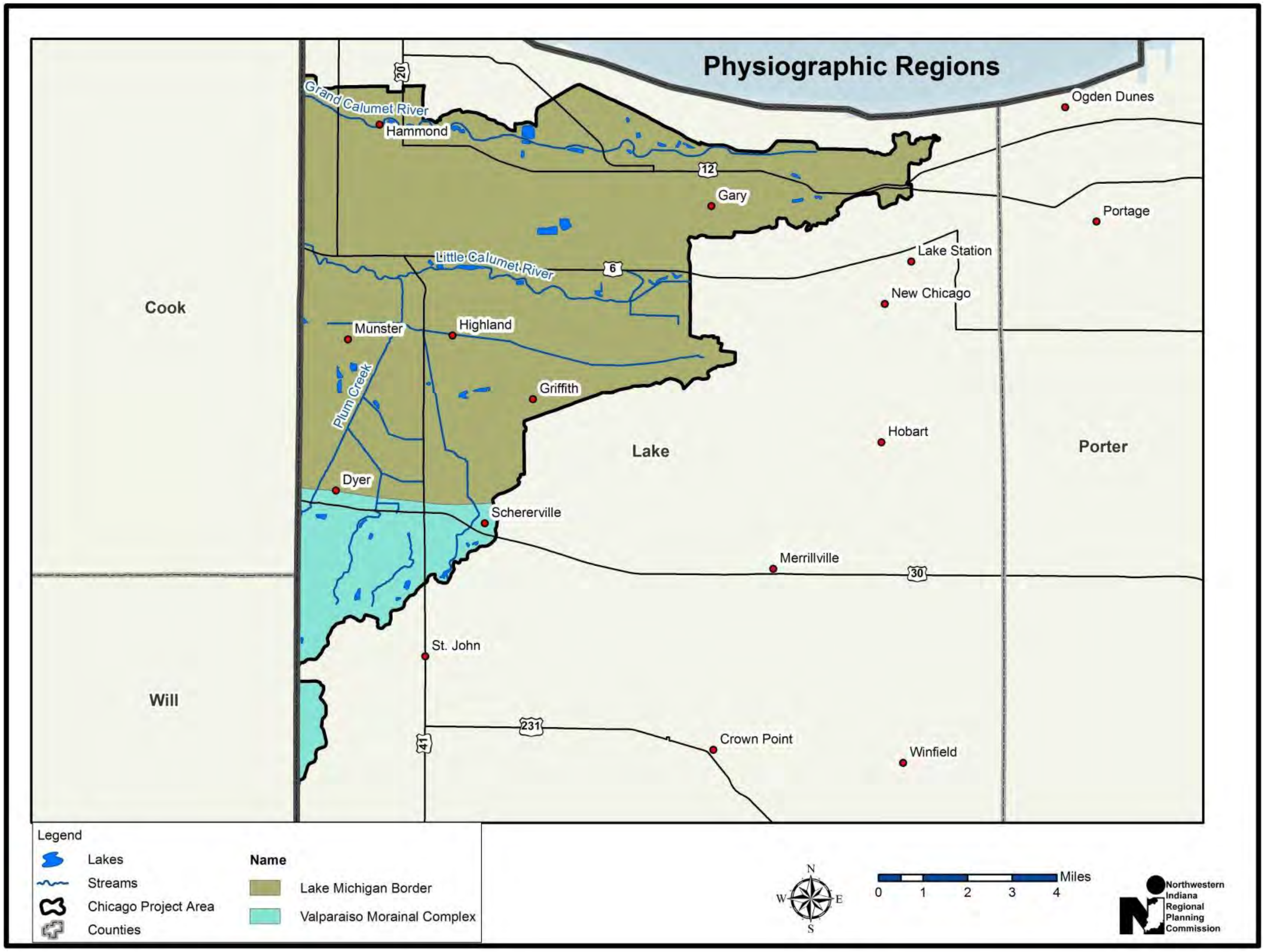

Figure 3 Physiographic Regions

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).

Slope

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 along the Valparaiso Moraine in the southern portion of the sub-basin and along a series of ridges that run parallel to the Lake Michigan shoreline starting just south of the Little Calumet River near Highland and Munster (**Error! Reference source not found.**). The greatest slope observed in the sub-basin basin is approximately 11%.

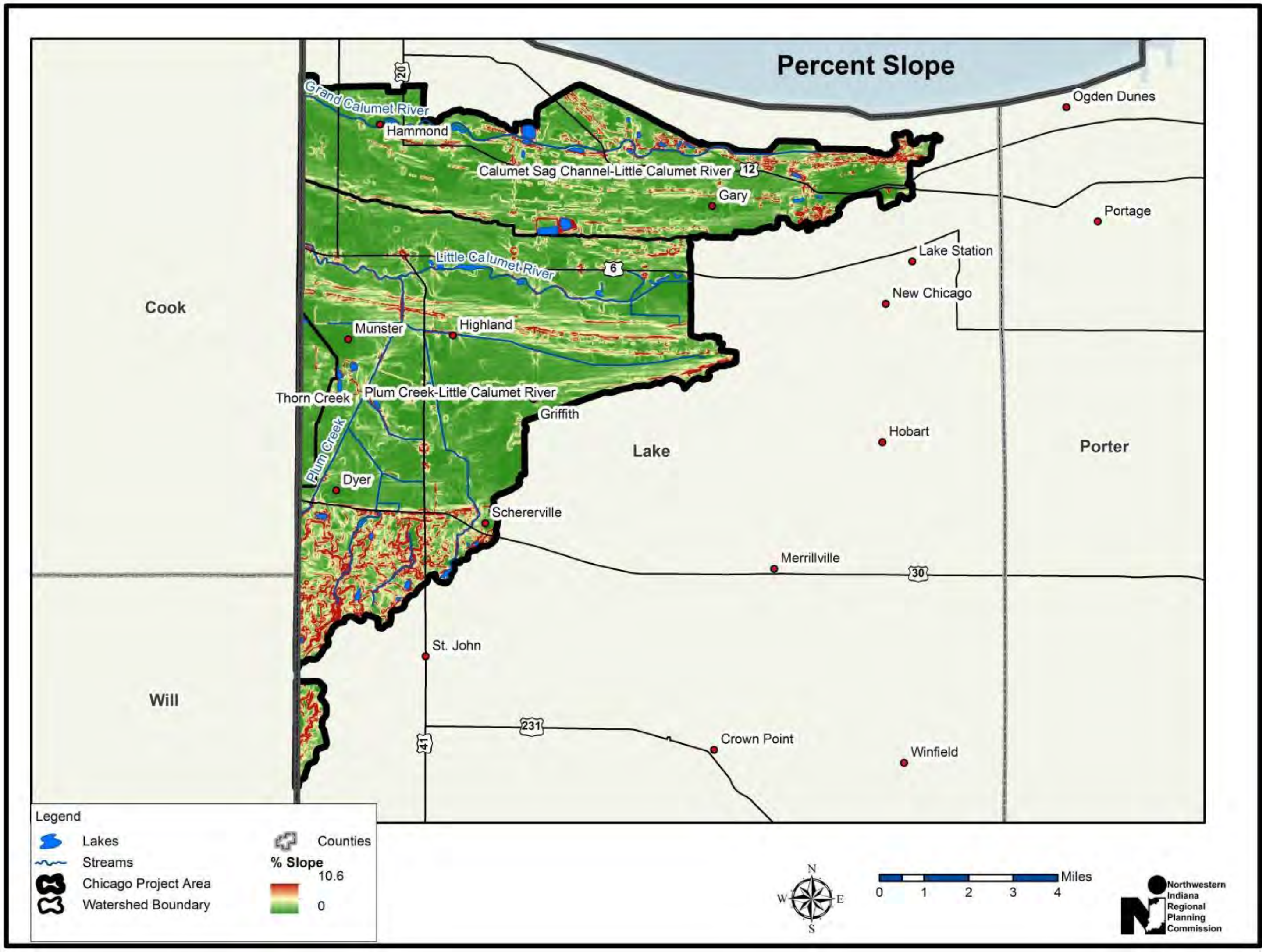

Figure 4 Percent Slope

4.1.3 Hydrology

Surface Waterbody Features

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. Drainage improvement projects have altered surface hydrology to such an extent that land areas that once drained to Lake Michigan now ultimately drain to the Gulf of Mexico. The Little Calumet and Grand Calumet Rivers were once part of a single river called the "Calumet River". This sluggish river system flowed from its headwaters in LaPorte County, westward into Illinois near Blue Island then turned eastward again into Indiana where it emptied into Lake Michigan at Marquette Park in Gary. 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

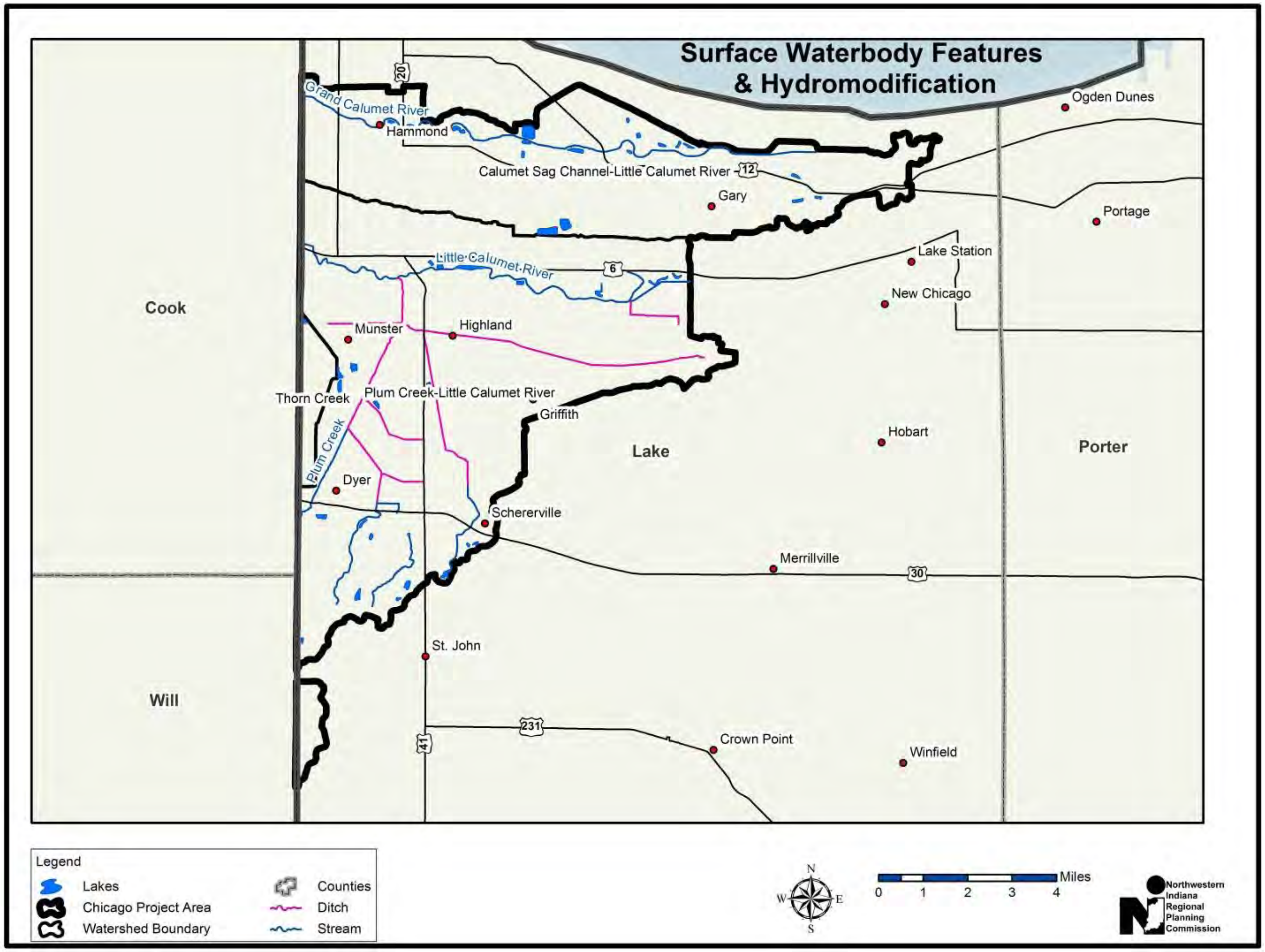

Figure 5 Surface Waterbody Features

tributaries in northern Lake County. During flood events a control structure on the Little Calumet River near Munster redirects water eastward towards Lake Michigan through the Little Calumet River.

Today nearly 59 miles of stream and ditch transect the landscape of the sub-basin based information from the National Hydrography Dataset (Figure 5). The primary drainage networks include the Little Calumet River, Grand Calumet River and Plum Creek which is known locally as Hart Ditch.

There are relatively few lakes in the sub-basin. Approximately 46 lakes/ponds covering a combined surface area of 532 acres are scattered across the area. Most are relatively small, unnamed lakes with a mean size of 11.6 acres (NIRPC analysis, 2011). Some of the lakes may have been formed as a result of past glacial activity or are oxbow remnants. Others are man-made consisting of old gravel and borrow pits. An unknown number of lakes have been destroyed or greatly reduced in size due to drainage or filling for development purposes (DNR, 1994)

Compared to the Little Calumet-Galien and Kankakee sub-basins, access to the rivers and lakes of the Chicago sub-basin is a bit more of a challenge. Yet recreational opportunities do exist. Parks such as Riverside Park, Wicker Memorial Park, and Lake Etta County Park provide public access to local waterbodies. Lake Etta County Park has a canoe launch that provides access to the Little Calumet River which is a State designated navigable waterway. The Greenways & Blueways Northwest Indiana Regional Plan[1] identifies several other opportunities for potential water trail access points. Additionally the Indiana Department of Natural Resources (IDNR) maintains a web-based mapping application that shows the locations and features of public access and fishing areas throughout the state[2].

[1] http://nirpc.org/transportation/greenwaysandbluewayshome.htm
[2] http://www.in.gov/dnr/fishwild/3591.htm

Wetlands

There are approximately 8.3 mi^2 of wetland located within the sub-basin based on National Wetland Inventory Data. Historically that figure was probably closer to 31 mi^2 prior to the area being settled and the land drained. Figure 6 shows a number of wetland areas adjacent to the Grand Calumet River, Little Calumet River and the areas surrounding Turkey Creek Ditch near Schererville. Further information on areas of wetland loss is presented in 4.1.8 Relevant Relationships.

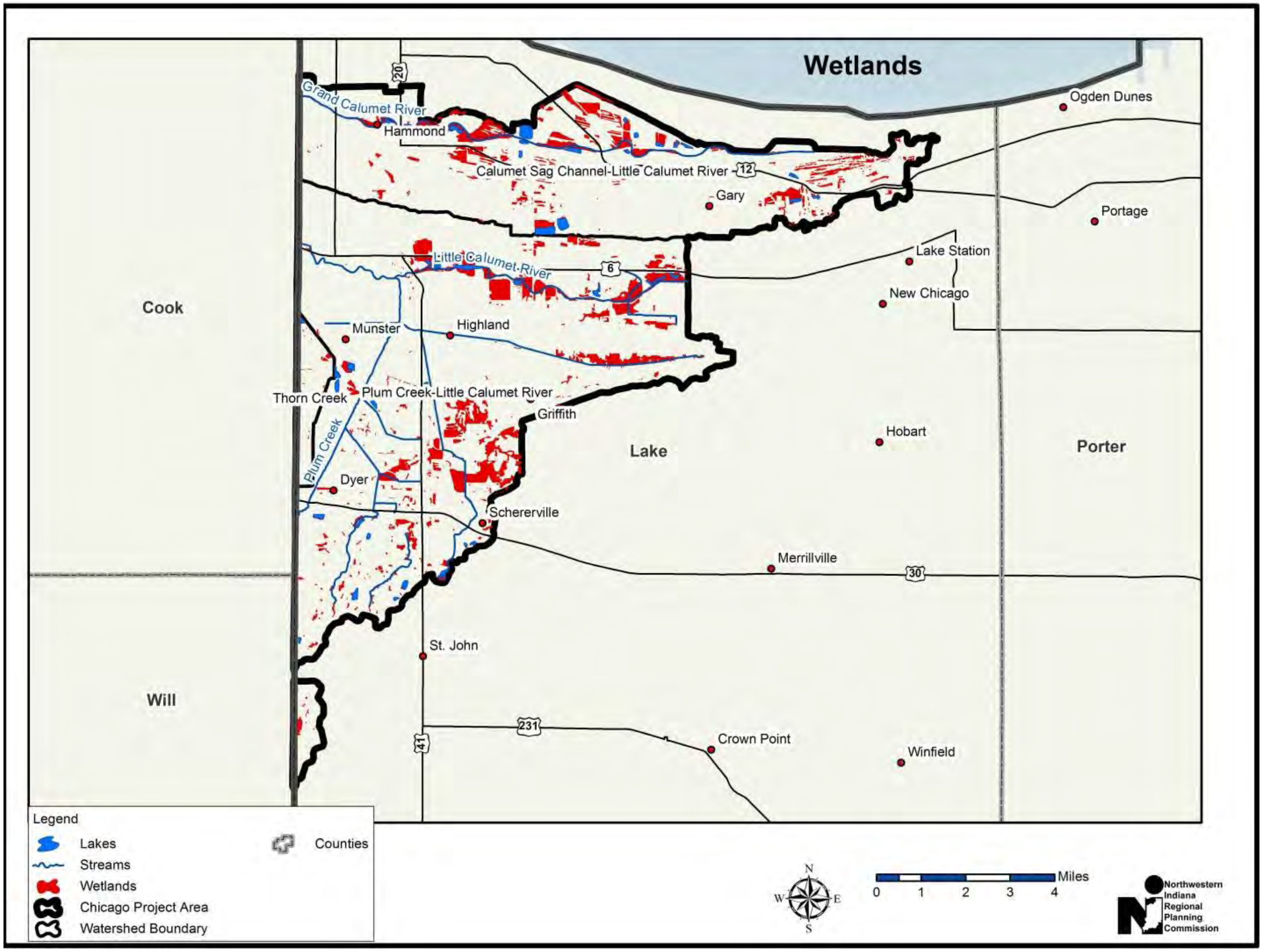

Figure 6 Wetlands

Hydromodification

According to the EPA, hydromodification is one of the leading sources of impairment in streams, lakes and other waterbodies in the United States. Hydromodification is defined as *alteration of the hydrologic characteristics of coastal and non-coastal waters, which in turn could cause degradation of water resources*[3]. Examples include dredging, straightening, stream relocation, construction along or in streams, dams, and land reclamation. The EPA has grouped hydromodification into three major categories including (1) channelization and channel modification, (2) dams, and (3) streambank and shoreline erosion. The following information in this section covers the channelization and channel modification category of hydromodification. There are

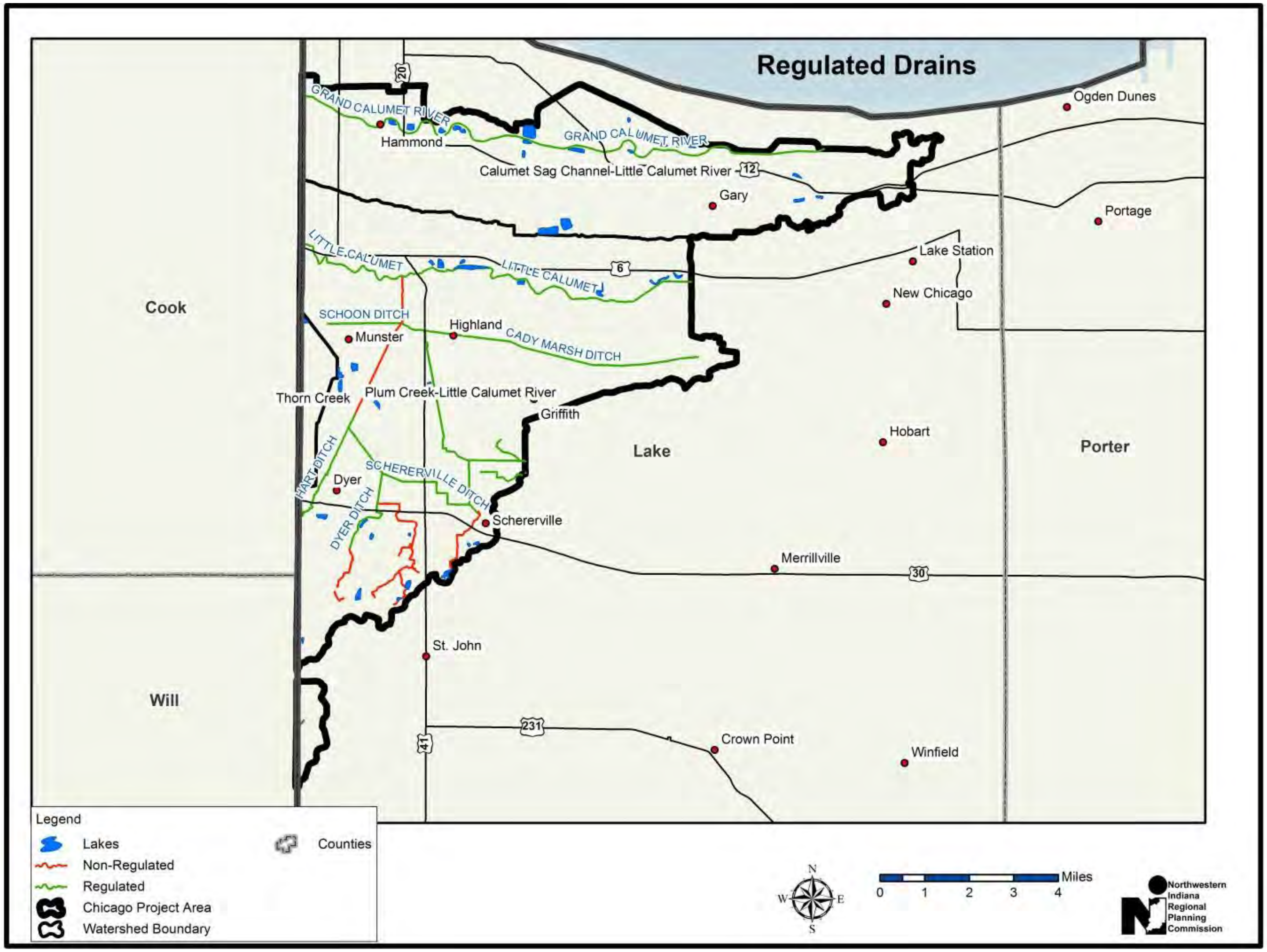

Figure 7 Regulated Drains

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[3] National Management Measures to Control Nonpoint Source Pollution from Hydromodification EPA 841-B-07-002 http://www.epa.gov/owow/nps/hydromod/index.htm

no dams located within the sub-basin project area. Streambank and shoreline erosion, while known to exist in the sub-basin has not been comprehensively mapped.

Regulated Drains

There are approximately 50 miles of regulated drain within the sub-basin based on GIS data provided by the Lake County Surveyor's Office to NIRPC (Figure 7). A regulated drain (a.k.a. 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.

Little Calumet River Flood Control Project

The Little Calumet River Basin Development Commission[4] was created in 1980 by the Indiana General Assembly to serve as the required local sponsor for the Little Calumet River, Indiana Flood Control and Recreation Project. The Federal project, which was authorized for construction in the 1986 Water Resources Development Act, is designed to provide structural flood protection up to the 200-year level along the main channel of the Little Calumet River from the Illinois State Line to Martin Luther King Drive in Gary, Indiana.

The flood control project features include:

- Construction of over 9.7 miles of set-back levees in Gary and Griffith.
- Construction of 12.2 miles of levees and floodwalls in Hammond, Highland, and Munster.
- Installation of a flow diversion structure at the Hart Ditch confluence in Hammond/Munster.
- Modification of four major highway bridges along the river corridor to permit better flow.
- Creation of 16.8 miles of hiking/biking trails connecting recreational developments.

Figure 8 shows the Little Calumet River flood control project area. The hatched lines represent levee and floodwall locations.

[4] http://www.littlecalumetriverbasin.org/home

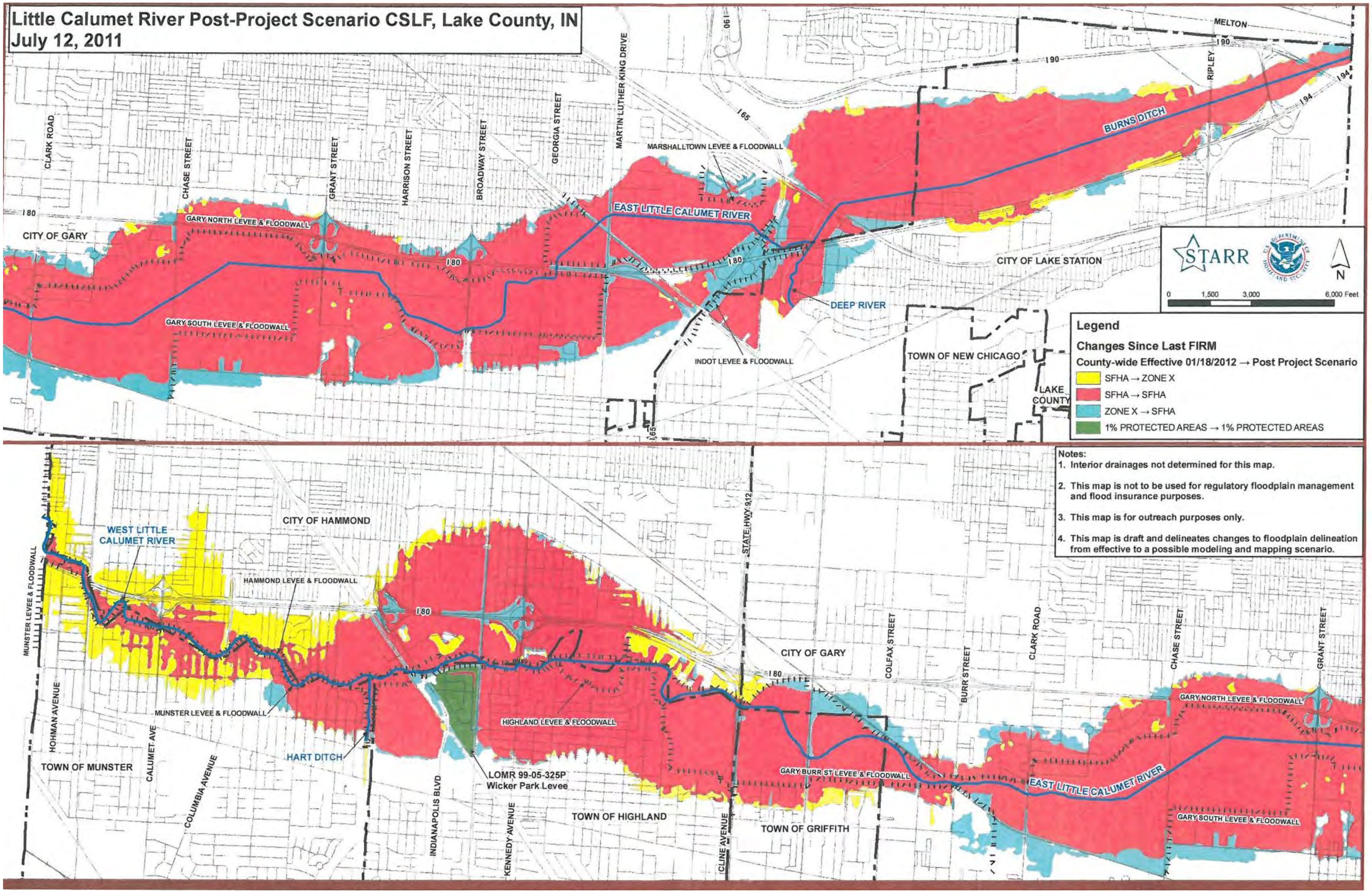

Figure 8 Little Calumet River Flood Control Project

4.1.4 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 9. Approximately 34% or 31 mi^2 of the sub-basin's soils are rated as hydric.

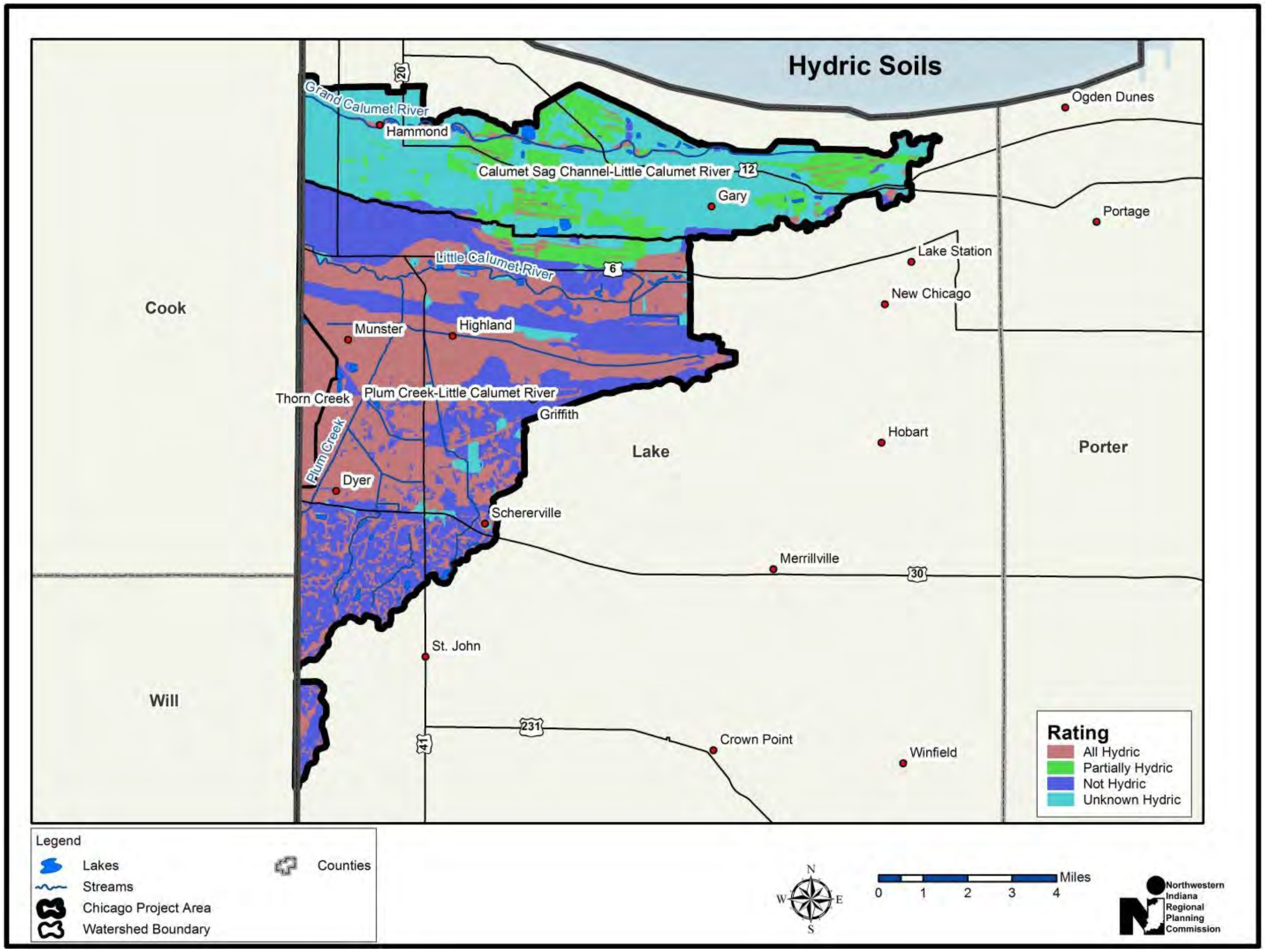

Figure 9 Hydric Soils

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 10 and are 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 44% of the sub-basin.
- Group B- Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the

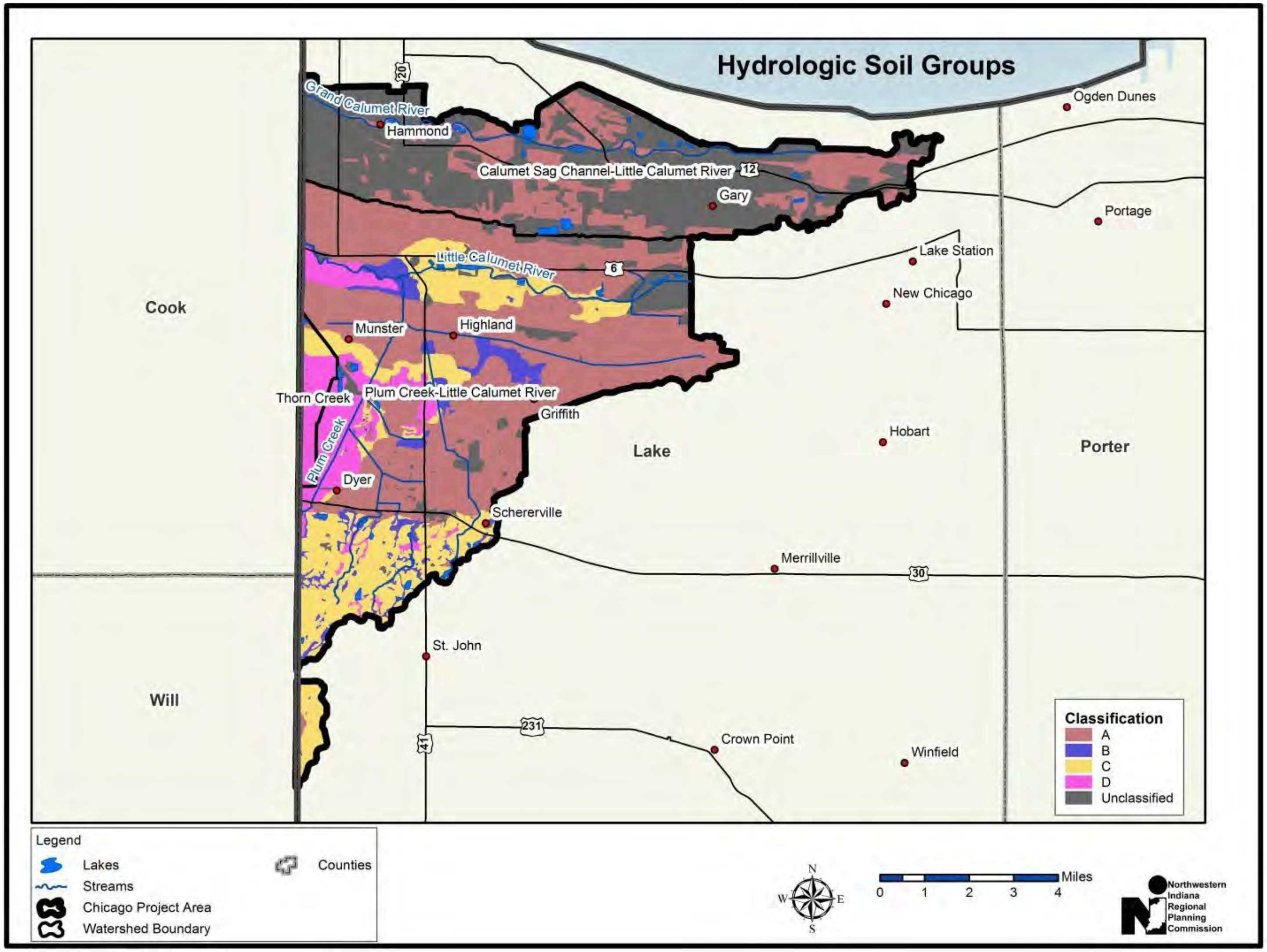

Figure 10 Hydrologic Soil Groups

soil is unimpeded. They account for 3% 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 16% 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 7% of the sub-basin.
- Unclassified- Soils are highly disturbed such as in urban areas. They account for 30% of the sub-basin.

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.

Soil limitations within the sub-basin for conventional septic systems that use absorption fields for treatment are displayed in Figure 11. 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

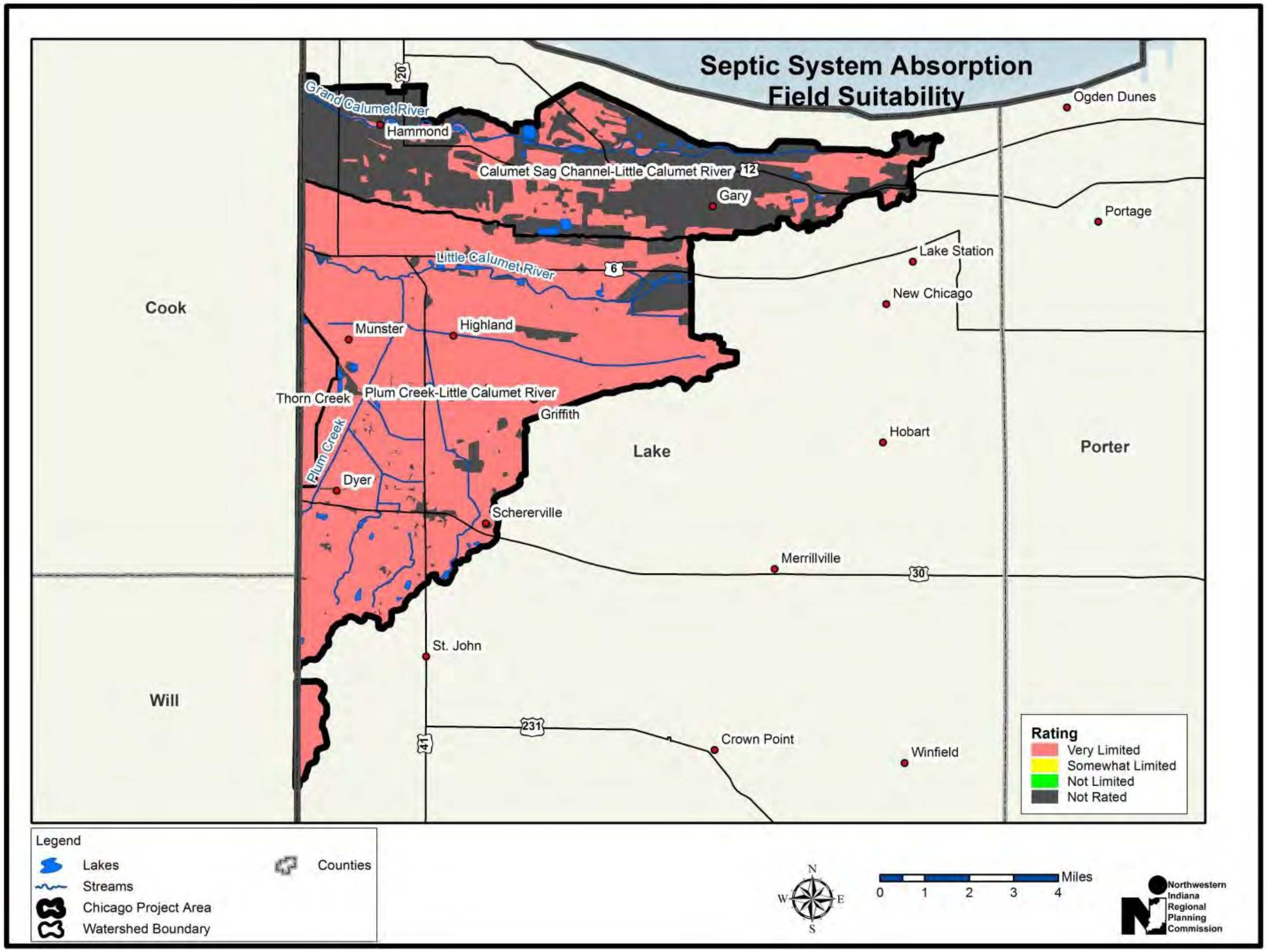

Figure 11 Septic System Absorption Field Suitability

Viewer Tool[5] 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 30% 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 0% 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 70% of the sub-basin.

[5] http://soils.usda.gov/sdv/

Highly Erodible Land

Highly Erodible Land (HEL) soils for the sub-basin are displayed in Figure 12. Soils data used to generate the figure were downloaded for each county from the NRCS Geospatial Data Gateway[6] 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 9% of the soils in the sub-basin are classified as HEL soils based on query results. The highest

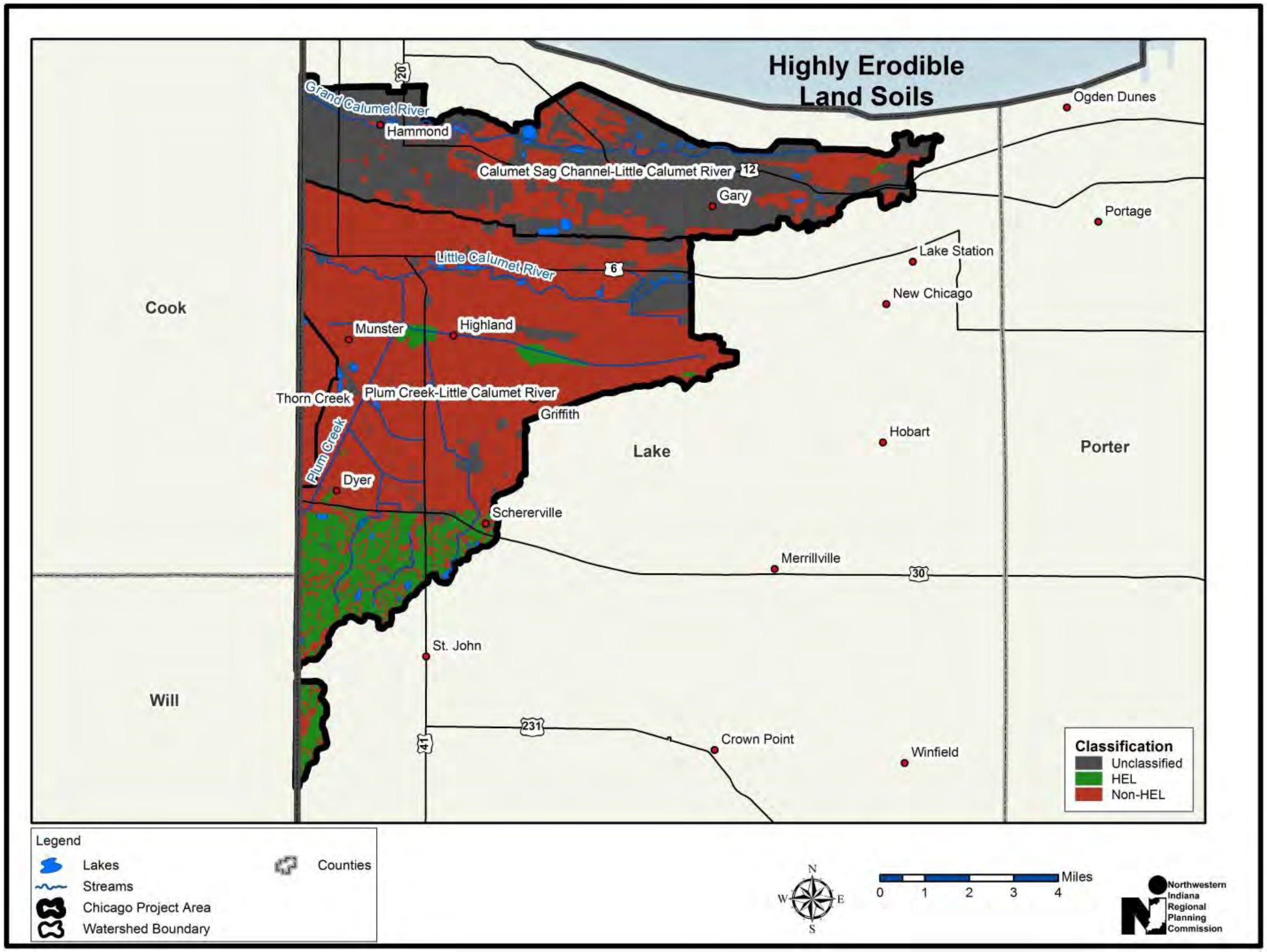

Figure 12 Highly Erodible Land Soils

[6] http://datagateway.nrcs.usda.gov

concentration exists south of U.S. Hwy 30 along the Valparaiso Morainal Complex and also along Cady Marsh Ditch.

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 13 displays drainage classes within the sub-basin. This information can be of value when trying to identify where field drain tiles may exist in agricultural lands.

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. They account for 9% of the sub-basin.
- "Somewhat excessively drained"- Water is removed from the soil

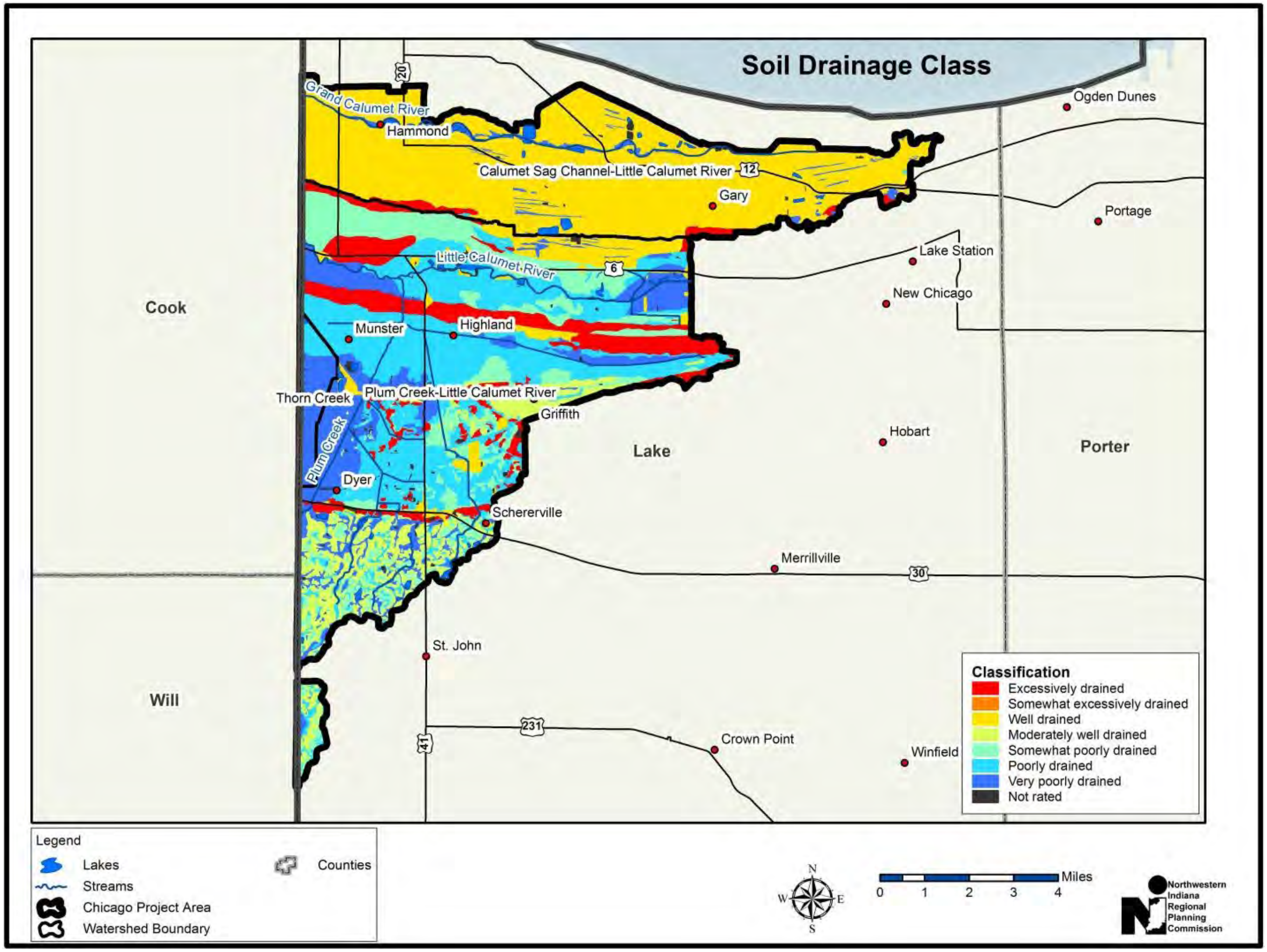

Figure 13 Soil Drainage Class

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. They account for 0% of the sub-basin.

- “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. They account for 36% of the sub-basin.
- “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. They account for 7% of the sub-basin.
- “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. They account for 11% of the sub-basin.
- “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. They account for 22% of the sub-basin.
- “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. They account for 12% of the sub-basin.
- “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. They account for 3% of the sub-basin.

4.1.5 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.

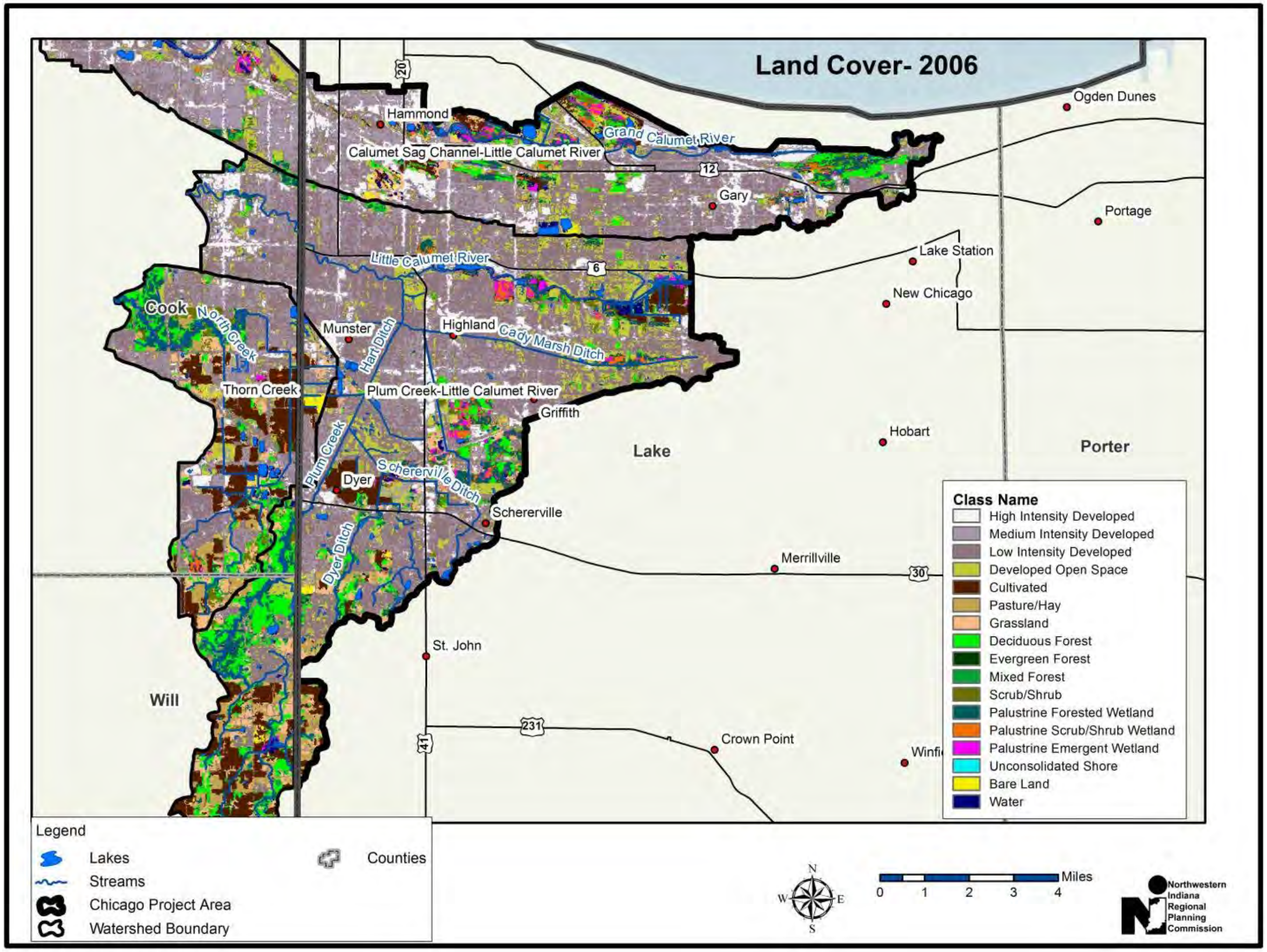

Figure 14 Land Cover (2006)

Several figures within this section have been generated using land cover data to help characterize the subwatersheds within the sub-basin study area. Additionally, land cover data is included for the portions of the subwatersheds which Indiana shares with Illinois as the headwaters of the Plum Creek-Little Calumet River watershed begin in Illinois. Data used to generate these figures were obtained from NOAA's Coastal Change Analysis Program (CCAP). 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 14. Data used to generate this figure was obtained from NOAA's Coastal Change Analysis Program (CCAP) data[7]. 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.

Figure 15 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. In both instances, the dominant land cover class is "developed". This includes high, medium, and low intensity development as well as developed open space. Within Indiana's portion of the sub-basin agriculture is a minor land use. However, when land cover from Illinois is included agriculture accounts for a higher percentage of the total area.

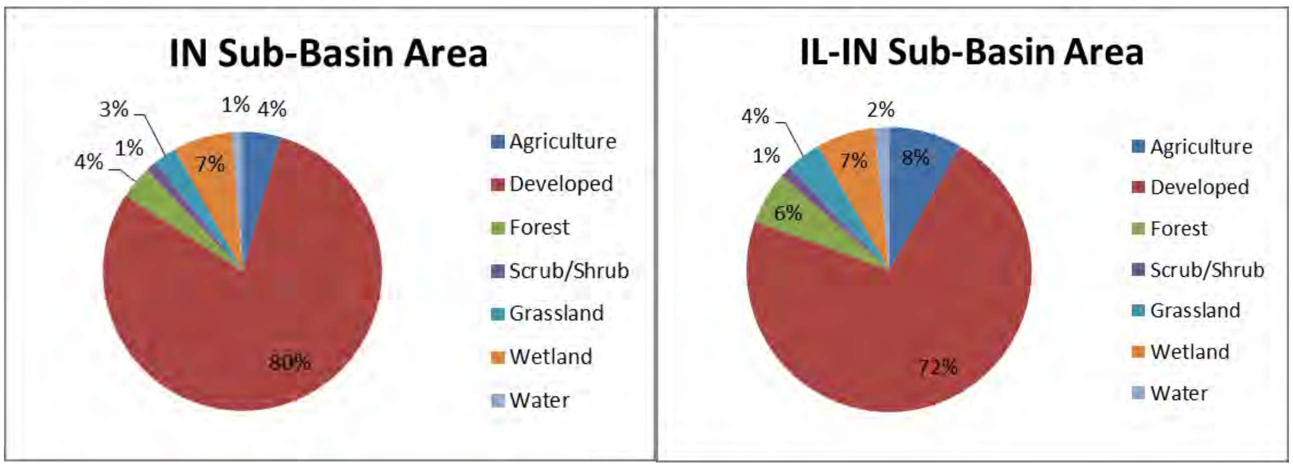

Figure 15. Sub-Basin Land Cover Percentage (2006)

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[7] www.csc.noaa.gov/digitalcoast/data/ccapregional/index.html

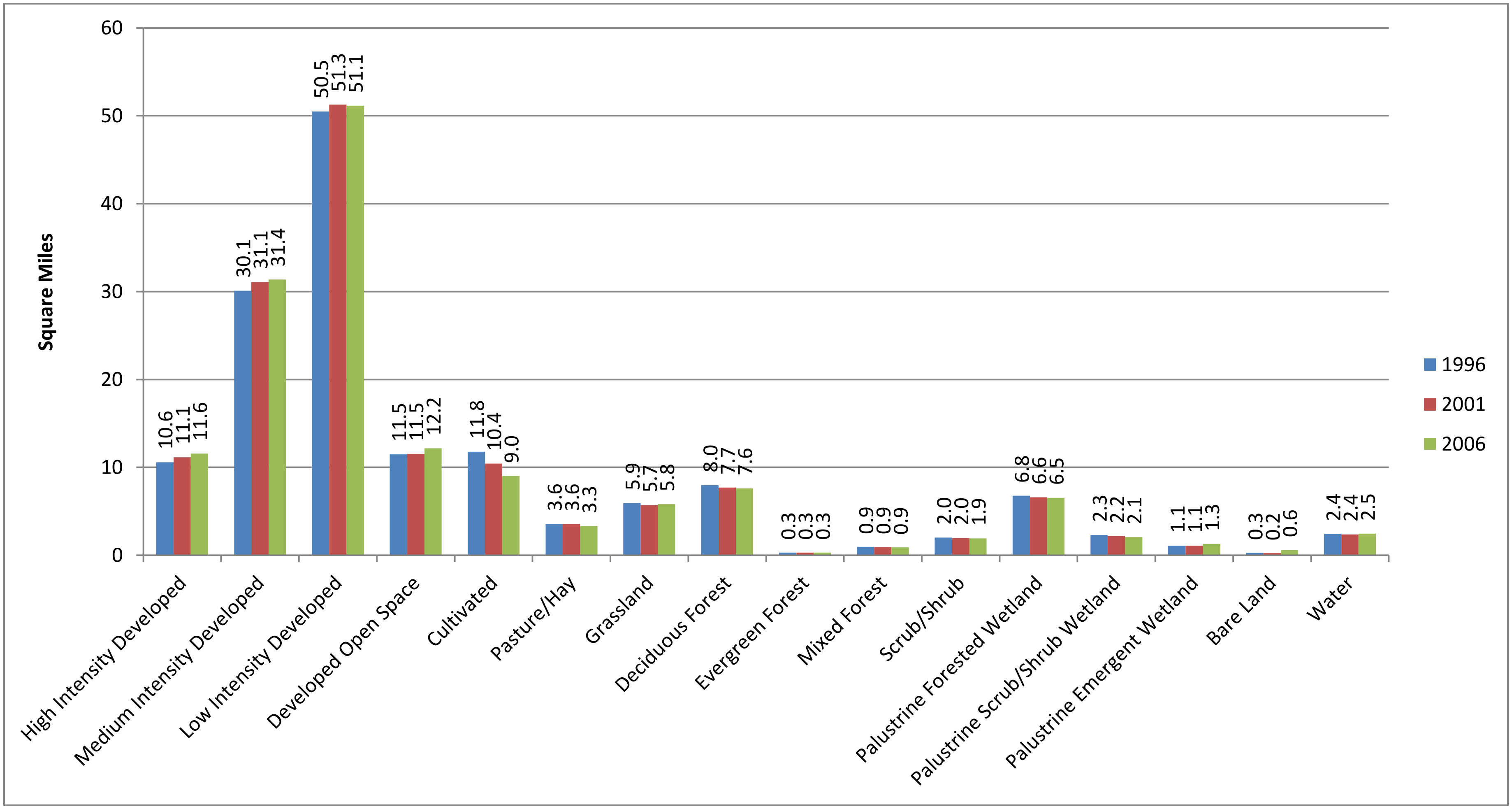


Figure 16 Distribution of Land Cover Classes (1996-2006)

Between 1996 and 2006 high density development increased slightly more than 9%. Medium density development increased approximately 4% while low density development increased approximately 1%. Most of the new development occurred on agricultural lands where there was a 23% decrease in cultivated land and 7% decrease in pasture/hay lands. Decreases in forested wetland, scrub/shrub wetland, and deciduous forest were also observed over this time period (Figure 16).

Developed

In 2006 approximately 103 mi² (70%) of land in the shared subwatersheds of the sub-basin were classified as developed. Between 1996 and 2006 the amount of developed land increased by approximately 4 mi². This equates to a 4% change over this time period. Areas of recent growth are displayed in Figure 17. Within Indiana, the areas of greatest change occurred within the municipal boundaries of Munster, Schererville and Highland. 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 CCAP data.

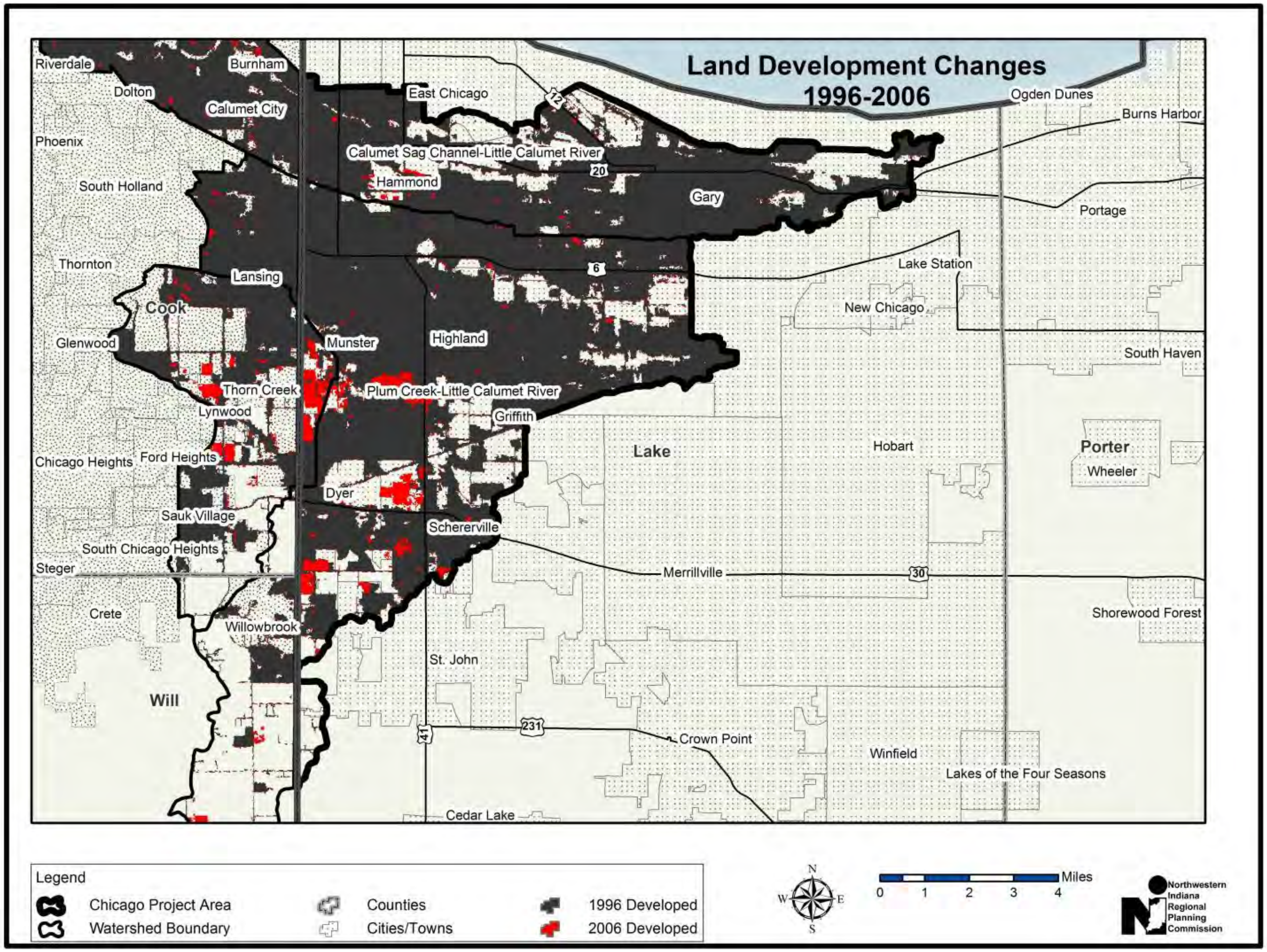
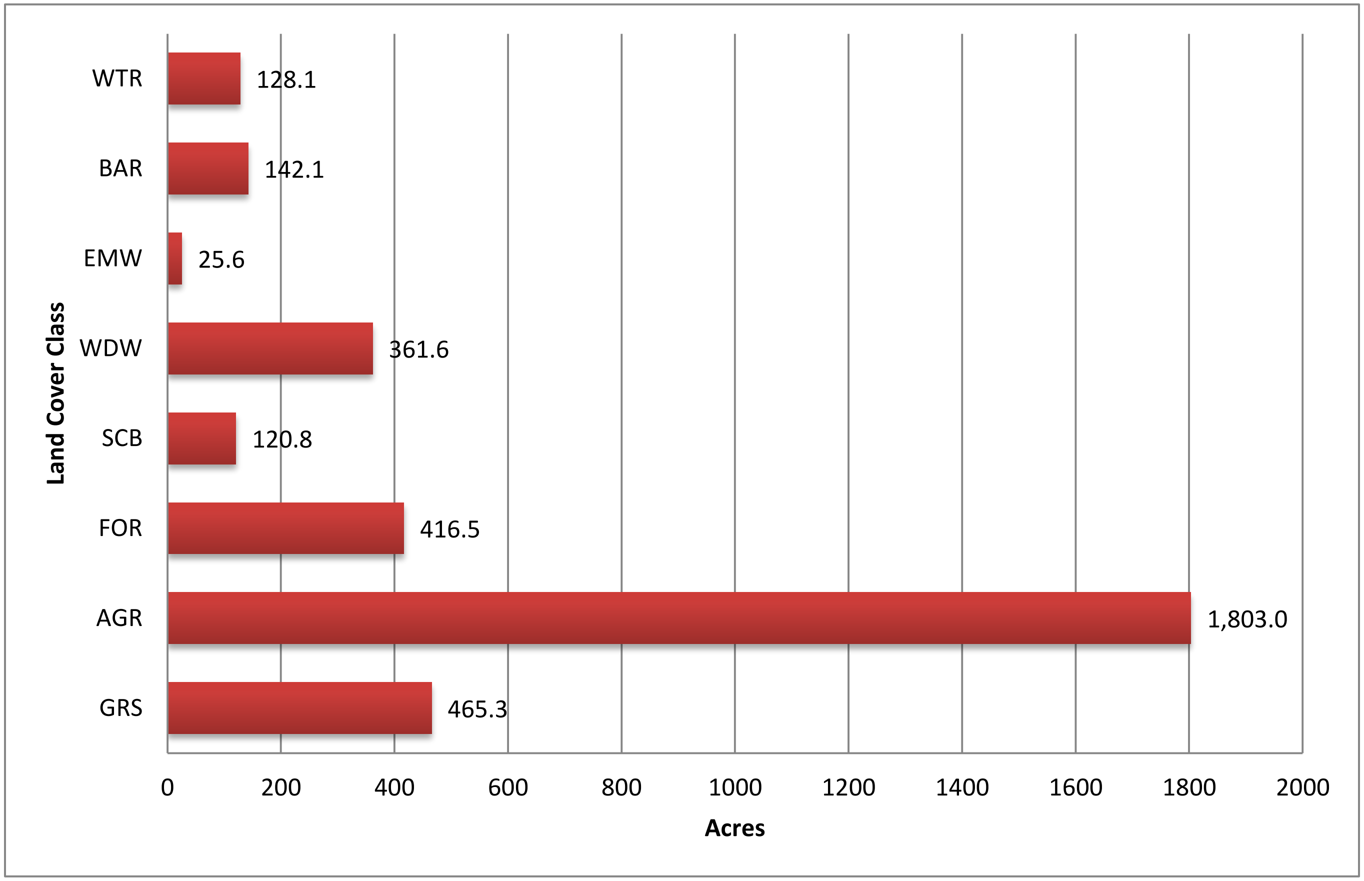


Figure 17 Land Development Changes (1996-2006)

An analysis of land cover conversion was performed by NIRPC using ArcMap10 Spatial Analyst. Developed land cover classes were extracted from the 2006 data and used as a mask of the 1996 data. The analysis showed that the majority of new growth observed took place on agricultural lands (Figure 18). Approximately 1,800 acres (2.8 mi^2) of agricultural land was converted to development. The analysis also showed that 465 acres (0.7 mi^2) of grassland, 361 acres (0.6 mi^2) of woody wetland, and 416 acres (0.7 mi^2) of forest were converted to development between 1996 and 2006. Most growth appears to have occurred within incorporated boundaries however, areas of annexation are not factored into this.



WTR- Water
BAR- Barren
EMW- Emergent wetland
WDW- Wooded wetland
SCB- Scrub/shrub
FOR- Forest
AGR- Agriculture
GRS- Grassland

Figure 18 Distribution of Areas Lost to Development by Land Cover

The percentage of developed land in each subwatershed is displayed in Figure 19. Jenks Natural Breaks was used in ArcMap10 to classify the percentage for each subwatershed. In general the entire sub-basin is highly urbanized. Most of the subwatersheds, with the exception of the Plum Creek Forest Preserve-Plum Creek subwatershed (HUC12 071200030302), are over 50% developed.

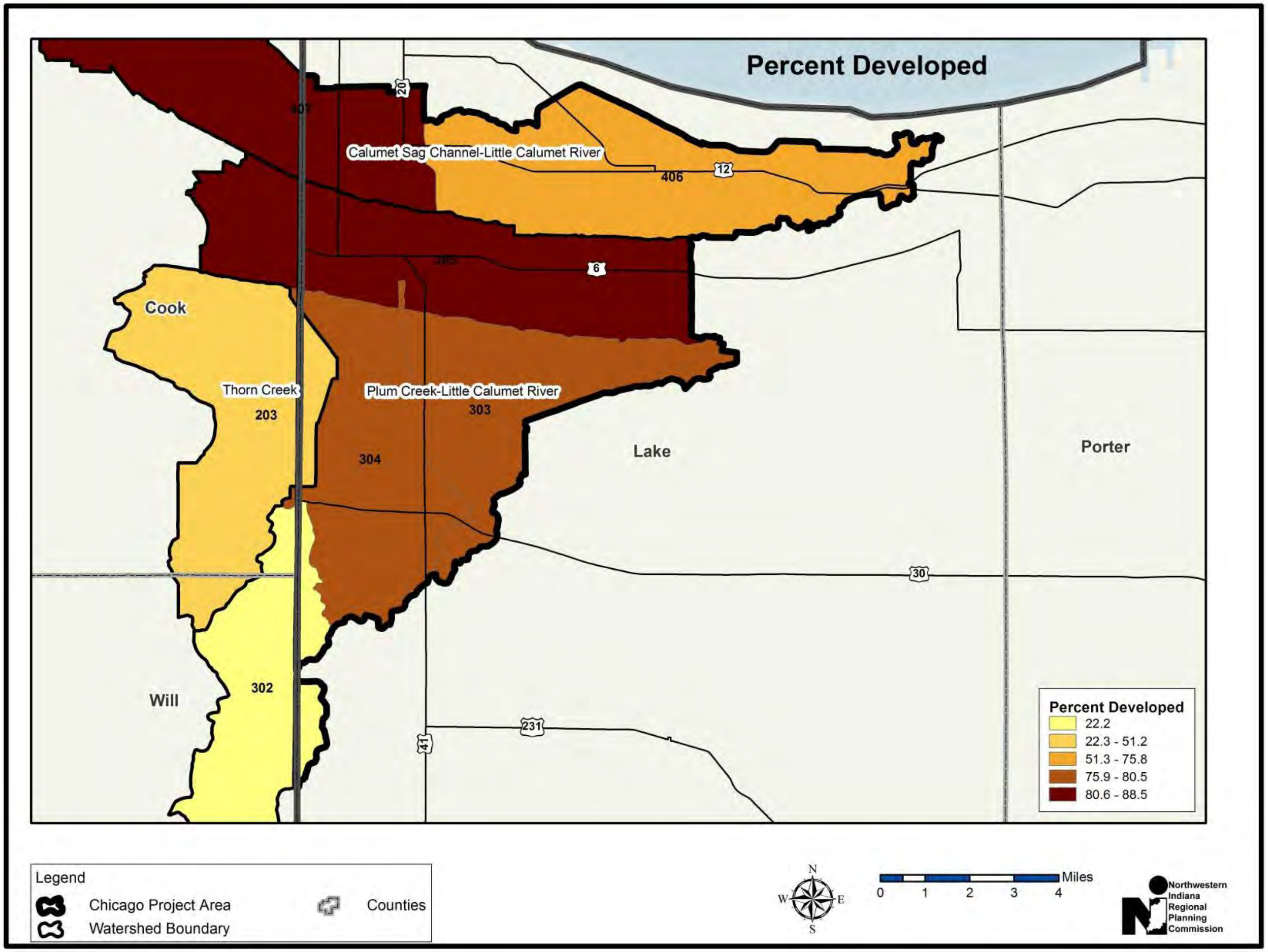


Figure 19 Percent Developed by Subwatershed

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).

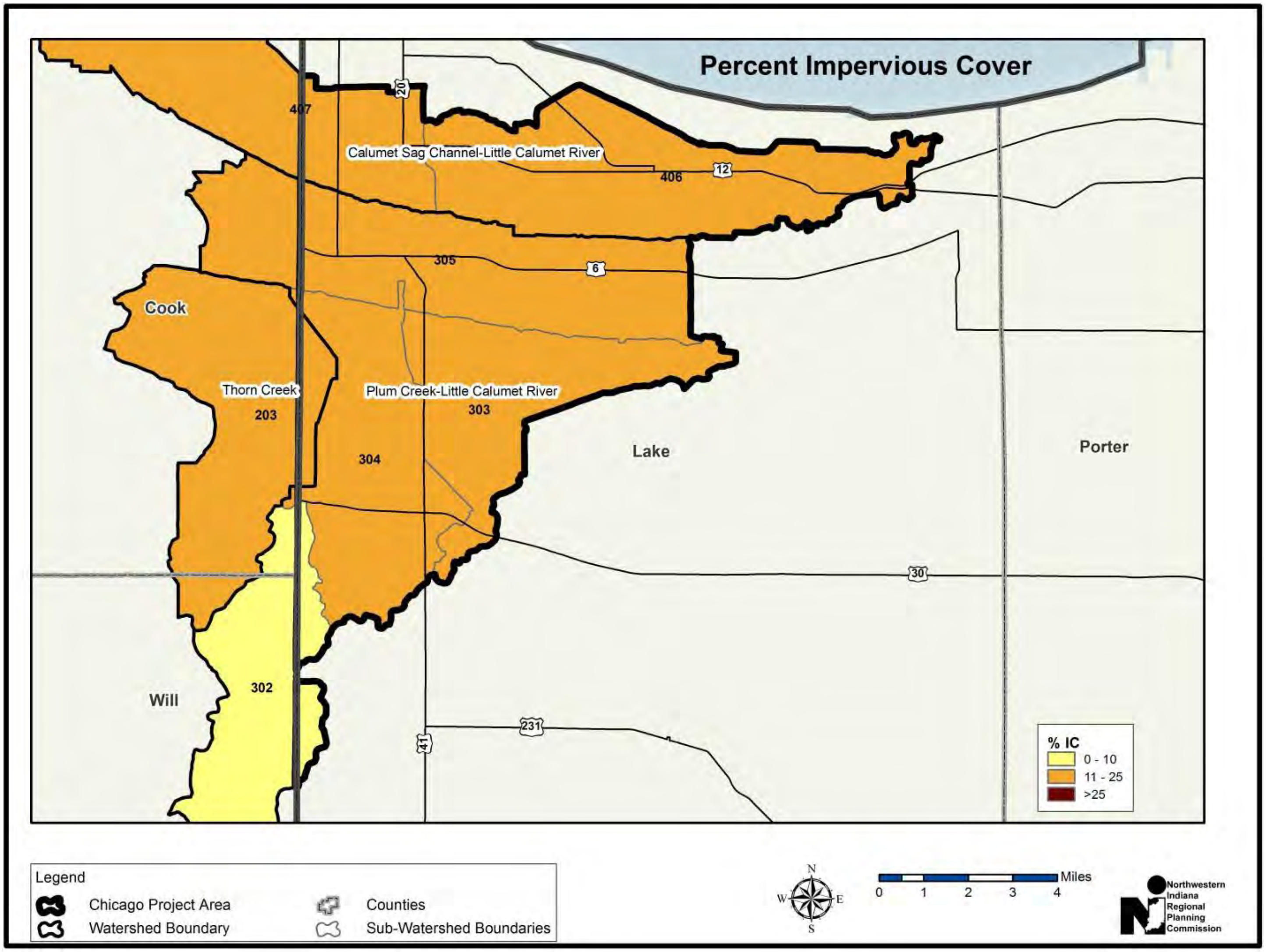


Figure 20 Percent Impervious Cover by Subwatershed

NOAA CCAP 2006 land cover data was used to calculate percent impervious cover for each subwatershed in the sub-basin (Figure 20). Lacking impervious cover coefficients for the region, coefficients developed by the Nonpoint Education for Municipal

Officials (NEMO) program in Connecticut were used[8]. An IC coefficient was assigned to each CCAP land cover class. Using the Zonal Statistics tool in ArcMap10, percent impervious cover was calculated for each subwatershed.

The impervious cover analysis showed that nearly all of the subwatersheds exceeded 10% impervious cover. The exception was the Plum Creek Forest Preserve-Plum Creek subwatershed (HUC12 071200030302) at 7.1%. The Grand Calumet River-Little Calumet River subwatershed (HUC12 071200030407) had the highest percentage of impervious cover at 24.4%. Based on the ICM, the streams within subwatersheds that exceeded 10% impervious cover are susceptible to streambank erosion, down cutting and widening, and degraded water quality.

[8] http://nemo.uconn.edu/tools/impervious_surfaces/data/isat_coeff.htm

Agriculture

Agriculture is a minor land use in Indiana's portion of the sub-basin and the subwatersheds it shares with Illinois. In 2006, approximately 12 mi² (8%) of this area was devoted to agriculture. Cultivated land accounted for 75% of agricultural use with corn and soybeans being the predominant crops in Lake County, Indiana (USDA Agricultural Census, 2007). Pasture/hay accounted for the remaining 25% of agricultural land use. The percentage of agricultural land in each subwatershed of the sub-basin is shown in Figure 21.

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

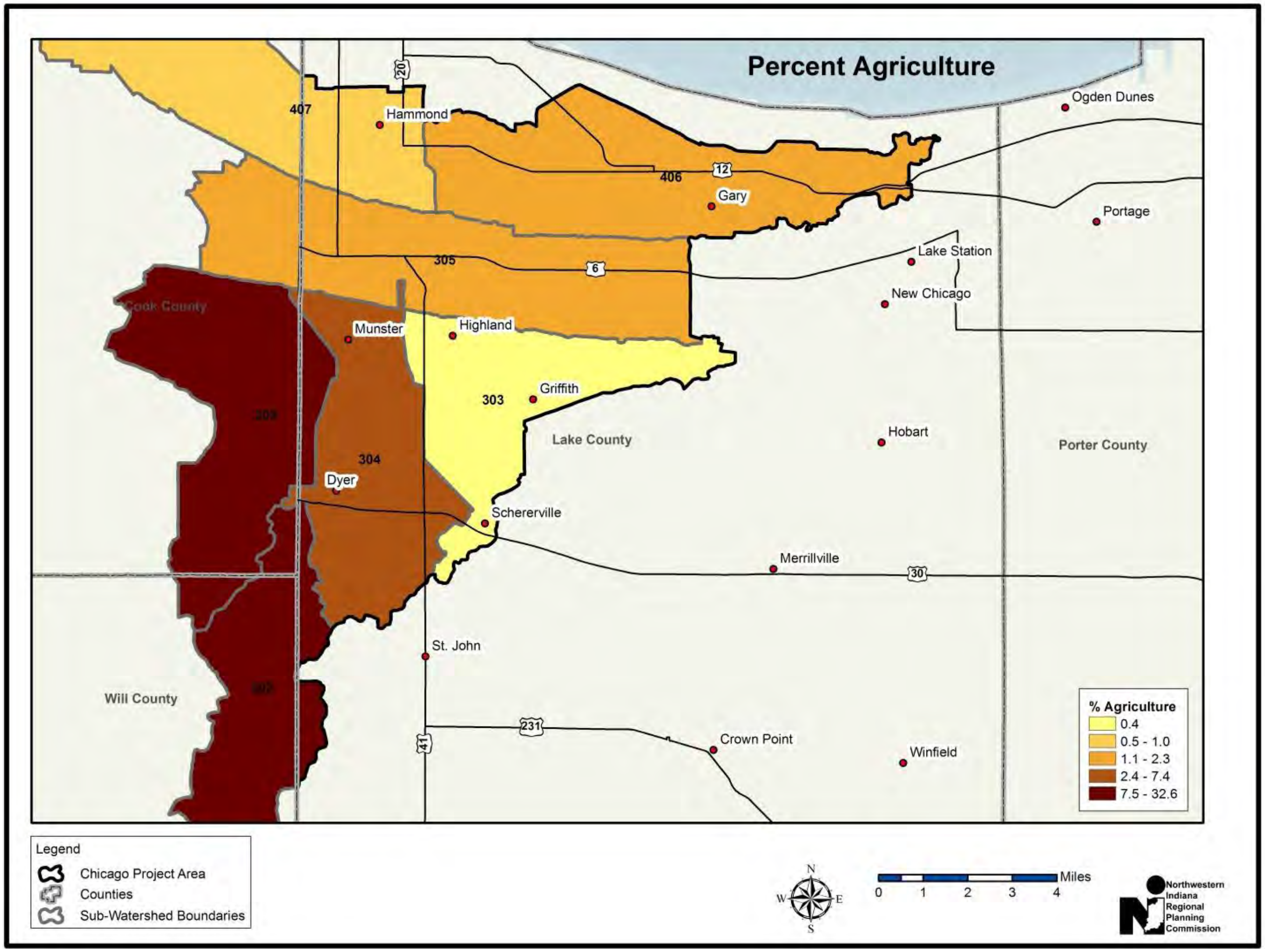


Figure 21 Percent Agriculture by Subwatershed

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 22. Approximately 40% of corn production acreage utilized conservation tillage practices in Lake County, Indiana. Utilization of conservation tillage was much more common for soybeans at 89%.

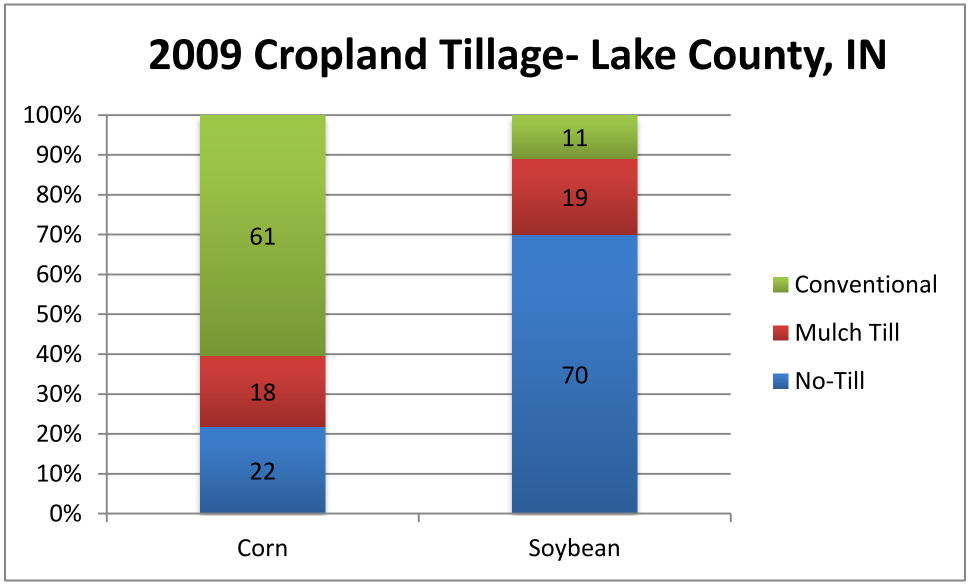


Figure 22 Cropland Tillage Data- Corn & Soybean (2009)

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 than 30% crop residue cover after planting.

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 streambanks help prevent erosion by stabilizing the soil with their root systems. They help improve water quality by filter sediment and associated pollutants from runoff. Forests provide cover for both terrestrial and aquatic life. Forests also reduce summer air and water temperatures and improve regional air quality[9].

Based on 2006 CCAP data there is approximately 9 mi² of forest cover within Indiana's portion of the sub-basin and the subwatersheds it shares with Illinois. This accounts for about 6% of the land area. A further breakdown of percent forest

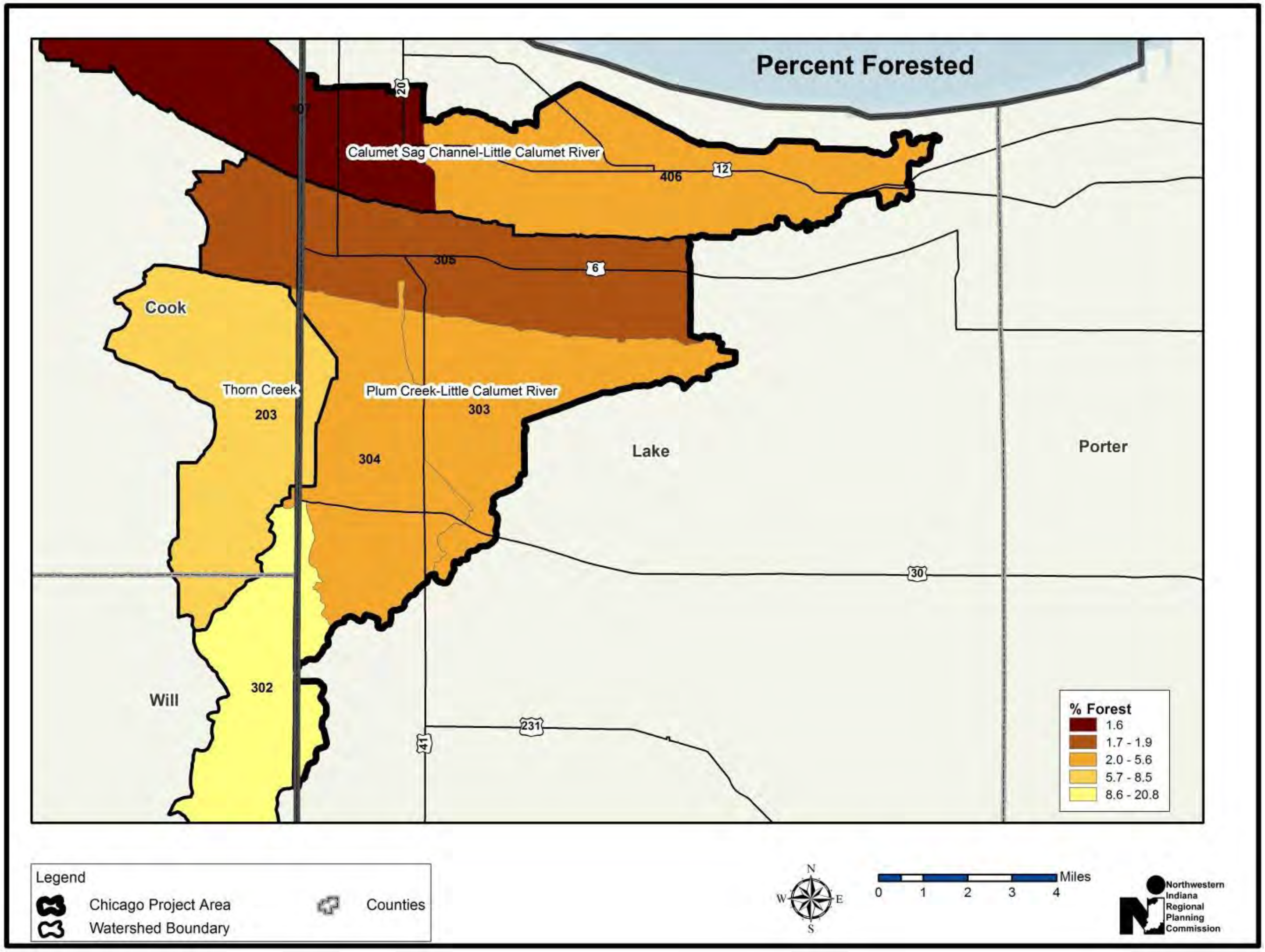


Figure 23 Percent Forested by Subwatershed

[9] www.forestsforwatersheds.org/urban-watershed-forestry/

cover by subwatershed is presented in Figure 23. Within Indiana's portion of the sub-basin, approximately 27% of the forestland exists within the protective boundaries of managed lands.

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 loss of native flora and fauna species, alterations to water cycles, and adverse impacts on

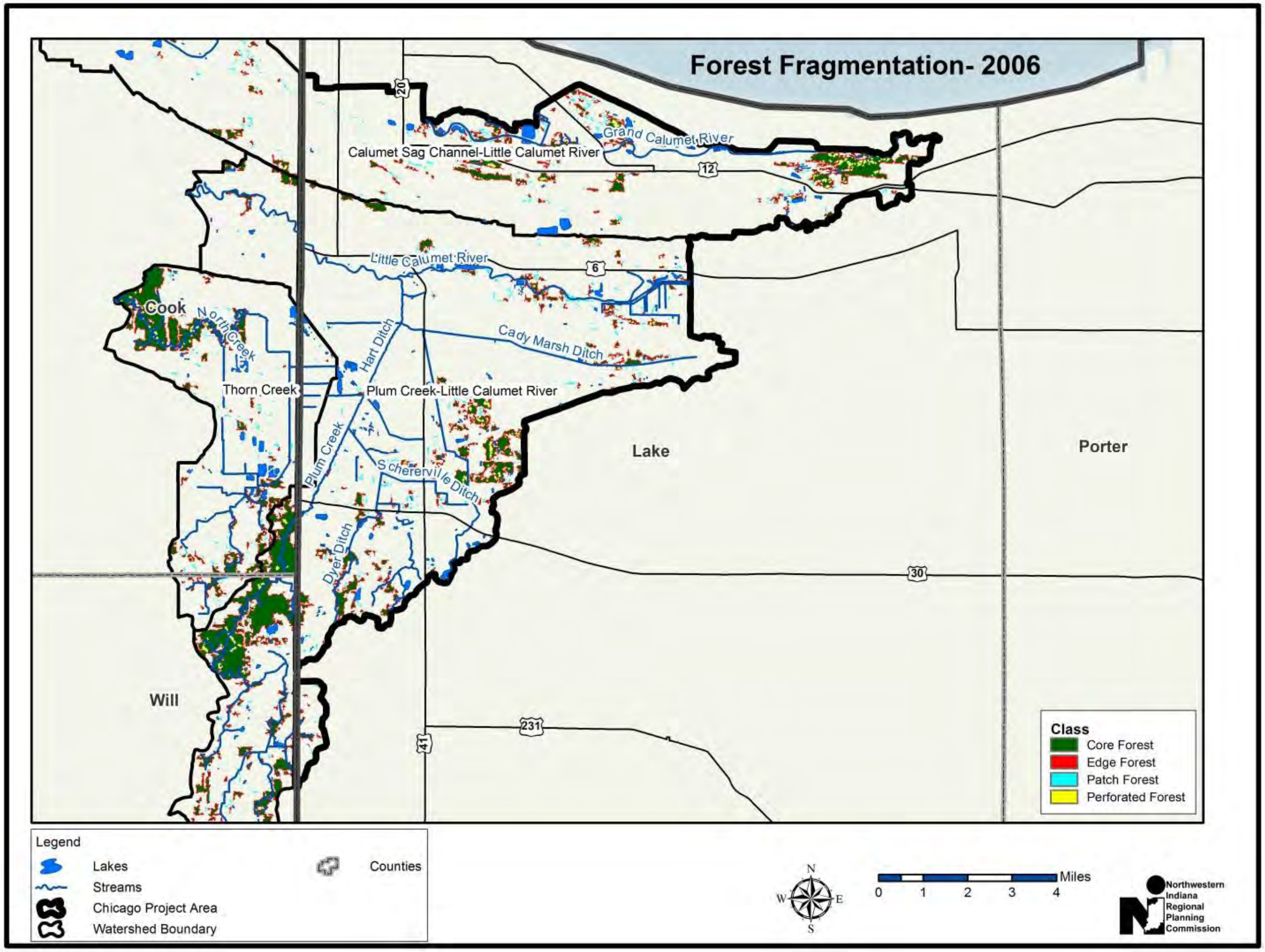


Figure 24 Forest Fragmentation

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[10].

Figure 24 and Figure 25 displays NOAA CCAP forest fragmentation data for Indiana's portion of the sub-basin and the subwatersheds it shares with Illinois. . The forest fragmentation data is classified into four categories: patch, edge, perforated, and core. These categories have been identified as indicators of forest ecosystem quality and can be used to assess the amount of fragmentation present in a landscape and potential habitat impacts[11] Overall there was a 4% decrease in forest area between 1996 and 2006. Core forest area decreased 3.6% during this time period.

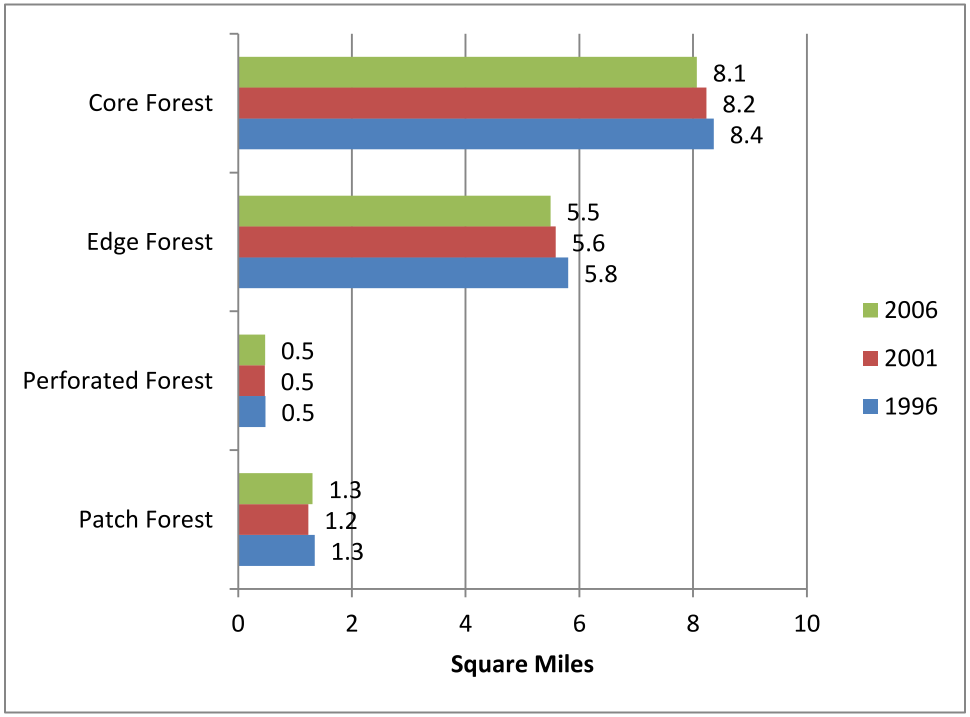


Figure 25 Distribution of Forest Fragmentation by Type (1996-2006)

Core forest is relatively far from the forest - non-forest boundary. Patch forest comprises coherent forest regions that are too small to contain core forest. Perforated forest defines the boundaries between core forest and relatively small perforations, and edge forest includes interior boundaries with relatively large perforations as well as the exterior boundaries of core forest regions.

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[10] www.csc.noaa.gov/digitalcoast/data/ccapregional/index.html

[11] http://clear.uconn.edu/tools/lft/lft2/vogt%20etal%202007%20mapping%20spatial%20patterns%20with%20morphological%20image%20processing.pdf

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[12].

Within Indiana's portion of the sub-basin and the subwatersheds it shares with Illinois there are approximately 10 mi² of palustrine wetland based on 2006 CCAP data. This accounts for roughly 3% of the sub-basin land area. Figure 26 displays percent wetland area by subwatershed.

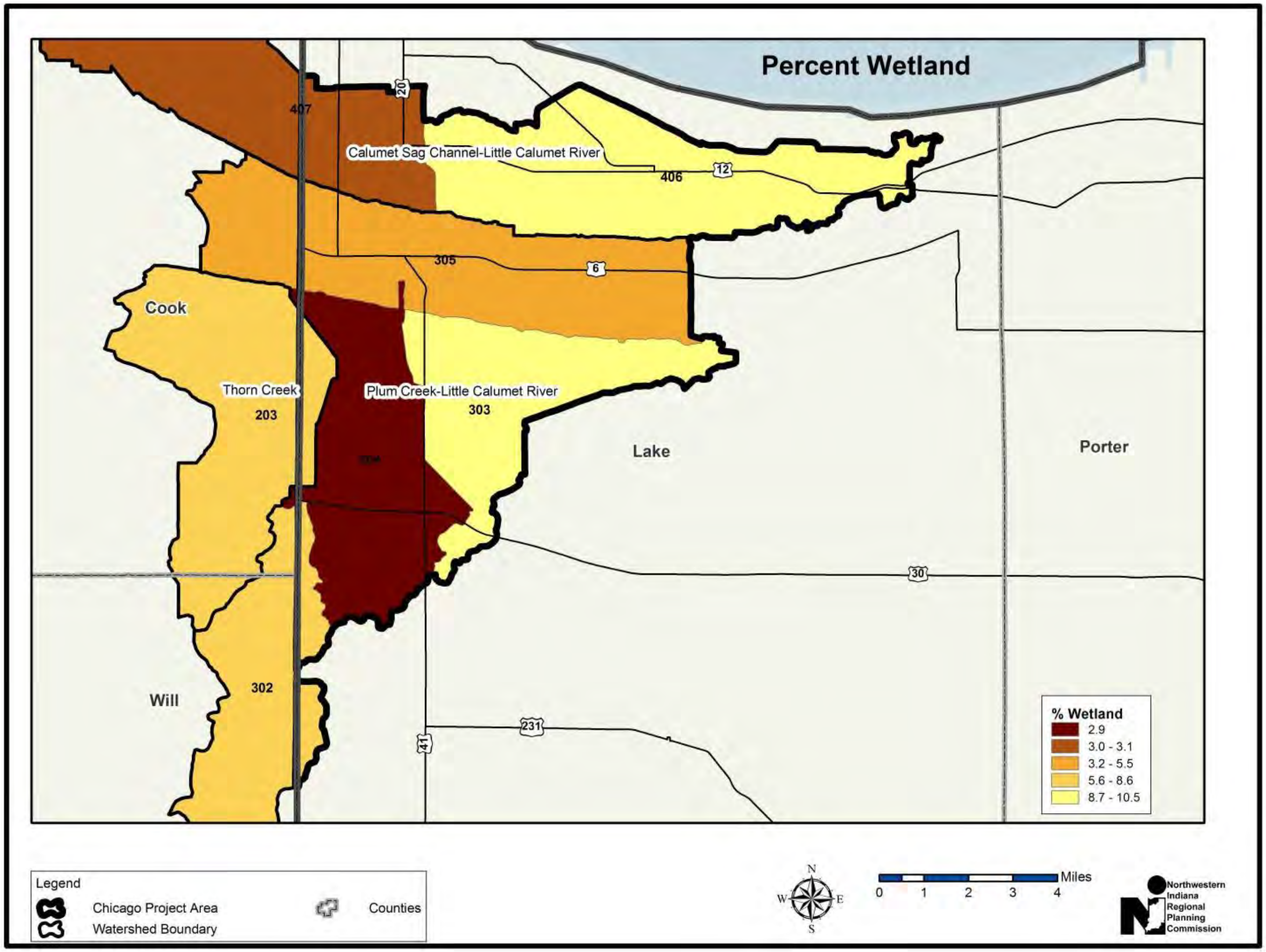

Figure 26 Percent Wetland by Subwatershed

Within Indiana, hydric soils data shows that nearly 25 mi² or 80%

[12] www.epa.gov/bioindicators/aquatic/importance.html

of the sub-basin study area's historical wetlands have been lost. Figure 27 displays percent wetland change by subwatershed. The data used to create the figure was extracted from hydric soils and 2006 CCAP wetlands for each subwatershed using ArcMap10 Spatial Analyst. Six of seven subwatersheds showed wetland loss. The only subwatershed showing a gain was the Headwaters Grand Calumet River subwatershed (HUC 071200030406). A closer review of the data reveals that wetlands do occur on soils classified as non-hydric soils in the sub-basin. This helps in part explain the wetland gain observed in the Headwaters Grand Calumet River subwatershed.

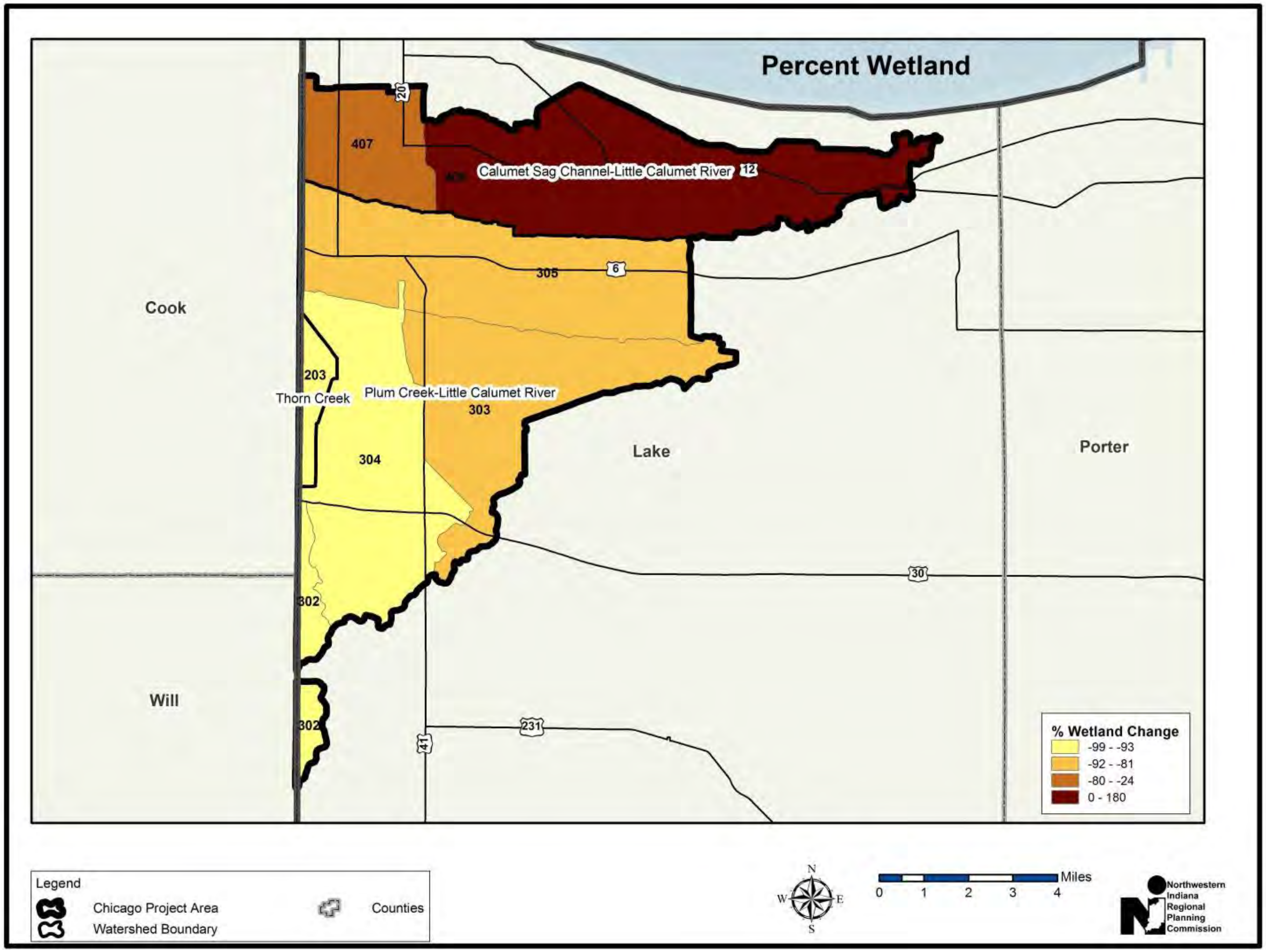

Figure 27 Percent Wetland Change by Subwatershed

4.1.6 Other Planning Efforts

Little Calumet-Galien/Chicago Watershed Restoration Action Strategy

The Little Calumet-Galien/Chicago Watershed Restoration Action Strategy[13] (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.

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[13] 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.

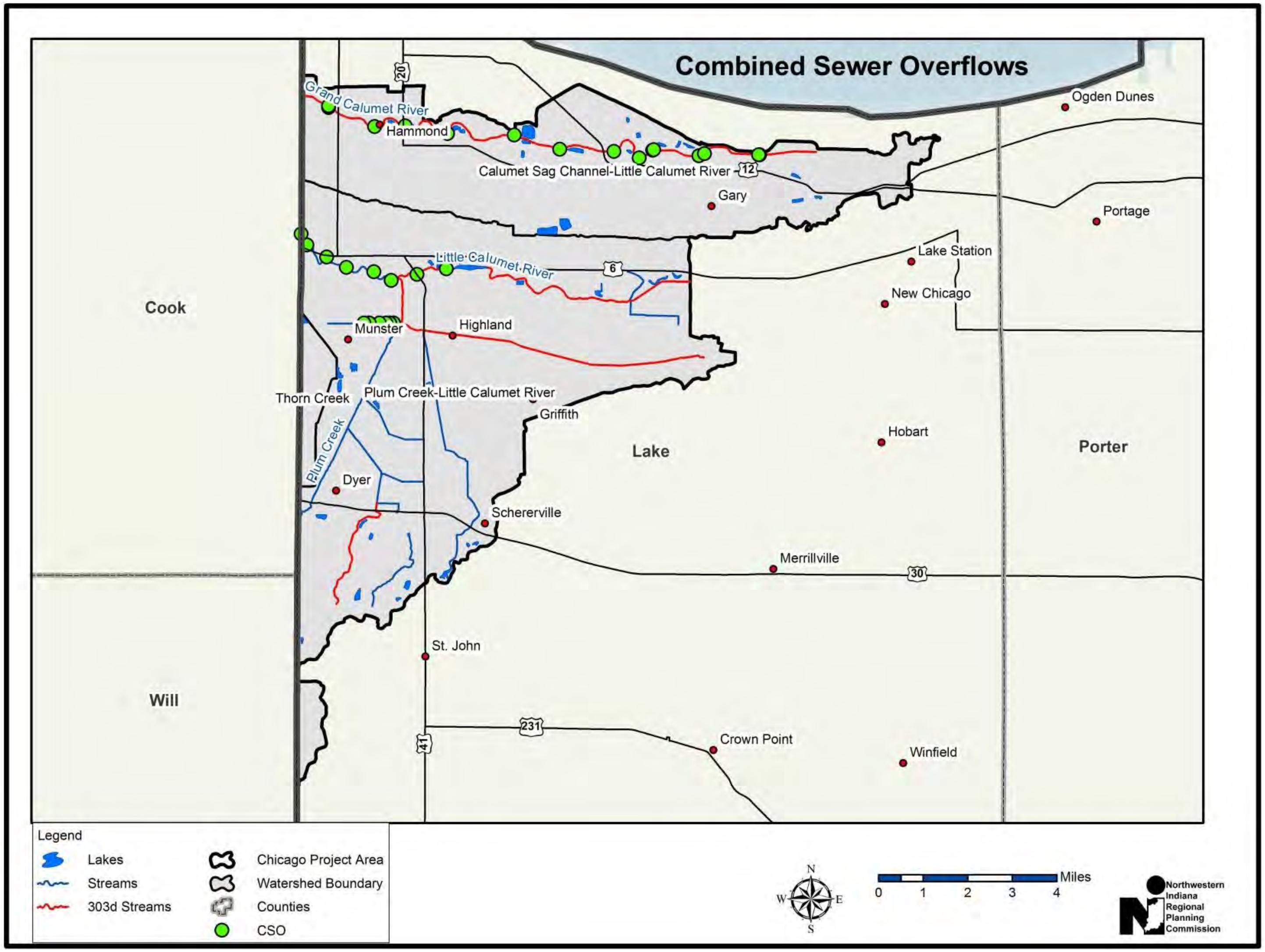

Figure 28 Combined Sewer Overflows

Combined Sewer Overflow locations are presented in Figure 28. In total, there are 34 CSOs within the sub-basin based on IDEM NPDES pipe location data. Twenty-one of these are located in Hammond; eleven are in Gary, and two in East Chicago. Seventeen CSOs are located along the Grand Calumet River within the Calumet Sag Channel-Little Calumet River watershed. Nine are located on the West Branch of the Little Calumet River and another eight are located on Schoon Ditch within the Plum Creek-Little Calumet River watershed.

CSO communities are required to submit Long Term Control Plans (LTCP) to IDEM as an NPDES permit requirement[14]. 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), East Chicago Municipal Sewage Treatment Plant (STP) and Hammond Municipal STP.

[14] www.in.gov/idem/4897.htm

Municipal Separate Storm Sewer System (MS4)

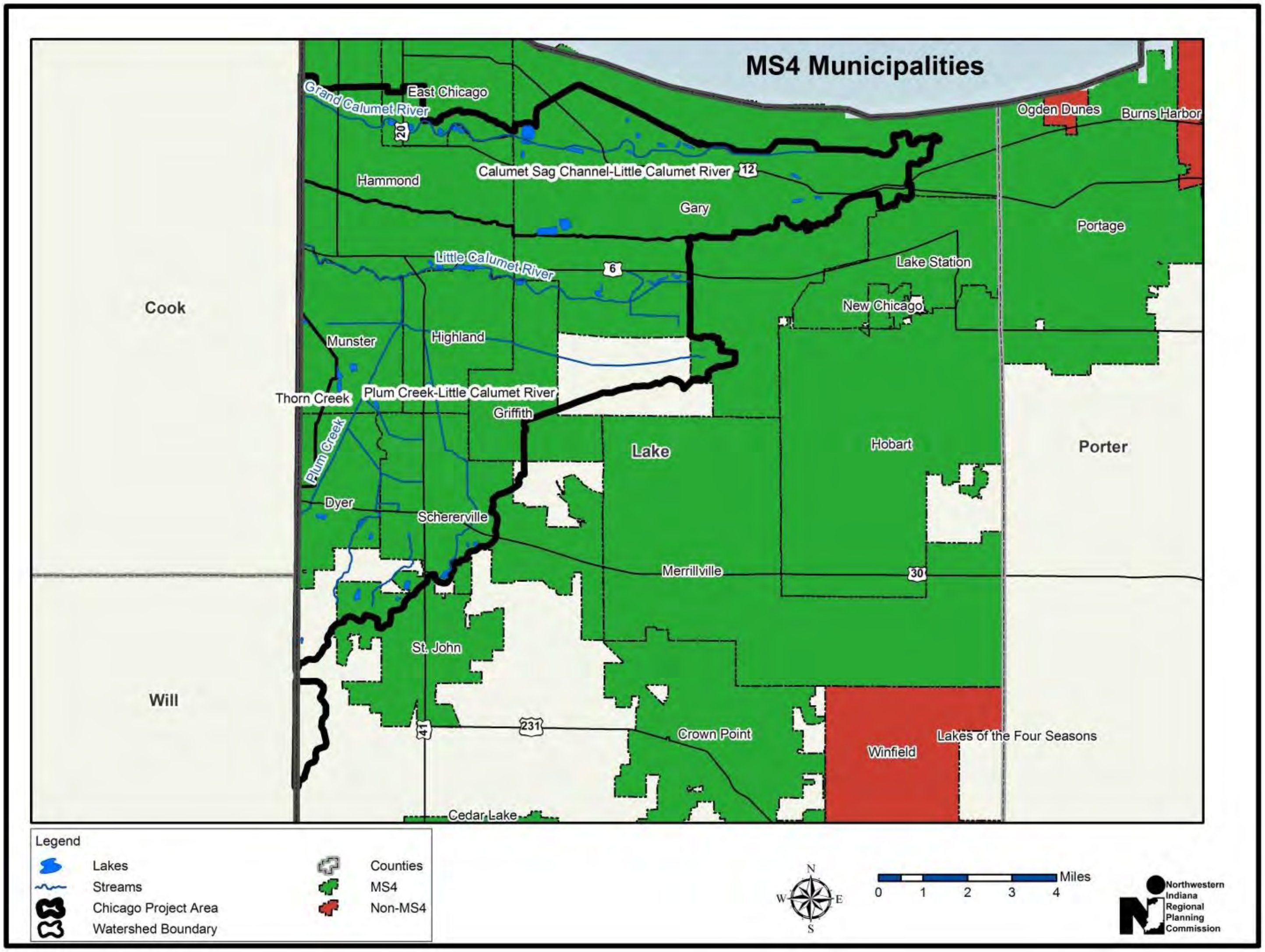

Figure 29 Designated MS4 Municipalities

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[15] shows there are eleven entities including nine municipalities within the sub-basin that are designated MS4s (Table 1 and Figure 29).

County	MS4 Entity	Permit Number
Lake	Munster, Town of	INR040017
Lake	St. John, Town of	INR040047
Lake	Dyer, Town of	INR040074
Lake	Gary, City of; Ivy Tech State College-Northwest	INR040101 Co-Permittees
Lake	Griffith, Town of	INR040108
Lake	Schererville, Town of	INR040112
Lake	Lake County	INR040124
Lake	Highland, Town of	INR040135
Lake	East Chicago, City of	INR040141
Lake	IU -Northwest (Gary)	INR040145
Lake	Hammond, City of	INR040018

Table 1. Designated MS4 Entities

[15] www.in.gov/idem/5437.htm

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[16].

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.

A data request to IDEM’s Ground Water-Drinking Water sections shows that within the Chicago sub-basin there are two wellhead protection areas totaling 1,298 acres. The wellhead protection areas are 3,000-foot fixed radius (systems that pump less than 100,000 GPD). 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.

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[16] http://www.in.gov/idem/nps/3430.htm

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[17].

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[18] :

- Lake Michigan- *E. coli*, 2004
- Little Calumet River & Burns Ditch- *E. coli*, 2005

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[17] www.in.gov/idem/4288.htm
[18] www.in.gov/idem/nps/2652.htm

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 30). 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.

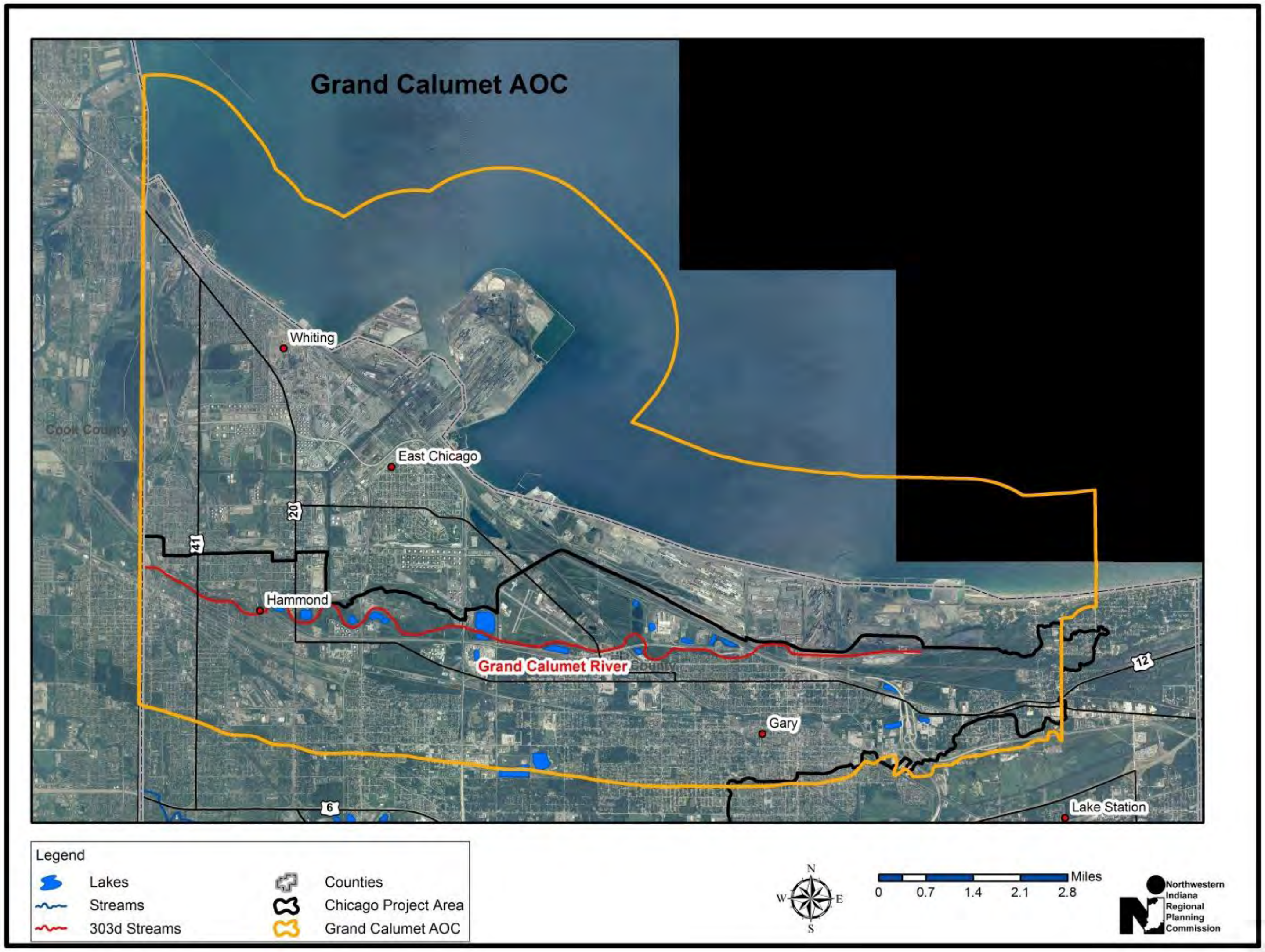

Figure 30 Grand Calumet River AOC

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.

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.

The 14 Beneficial Use Impairments

- Restrictions on fish and wildlife consumption
- Eutrophication or undesirable algae
- Tainting of fish and wildlife flavor
- Restrictions on drinking water consumption, or taste and odor
- Degradation of fish and wildlife populations
- Beach closings
- Fish tumors or other deformities
- Degradation of aesthetics
- Bird or animal deformities or reproduction problems
- Added costs to agriculture or industry
- Degradation of benthos
- Degradation of phytoplankton and zooplankton populations
- Restriction on dredging activities
- Loss of fish and wildlife habitat

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 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.

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. Further details are available from EPA's Great Lakes National Program Office[19].

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[19] EPA GLNPO www.epa.gov/glnpo/aoc/grandcal.html

In December 2011, IDEM and the CARE committee submitted documentation to EPA for the removal of the “Added cost to Agriculture and Industry” beneficial use impairment (BUI). This BUI has been removed from the AOC. The IDEM and the CARE committee also plan to submit information and paperwork for the removal of the “Restrictions on Drinking Water Consumption or Taste and Odor Problems” BUI in 2012 (Jim Smith, IDEM- Personal Communications).

Watershed Management Planning & Implementation

To date the only watershed management plan (WMP) completed within the sub-basin is the West Branch Little Calumet River WMP (Figure 31). This plan was developed using 14-digit (subwatershed) HUC boundaries. In 2009, IDEM's 319 Program began requiring new plans be developed using 10- and 12-digit HUC boundaries.

A Summary description and the complete reports is available for the plan on the IDEM Watersheds and Nonpoint Source Pollution website[20]. A general overview is provided below.

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

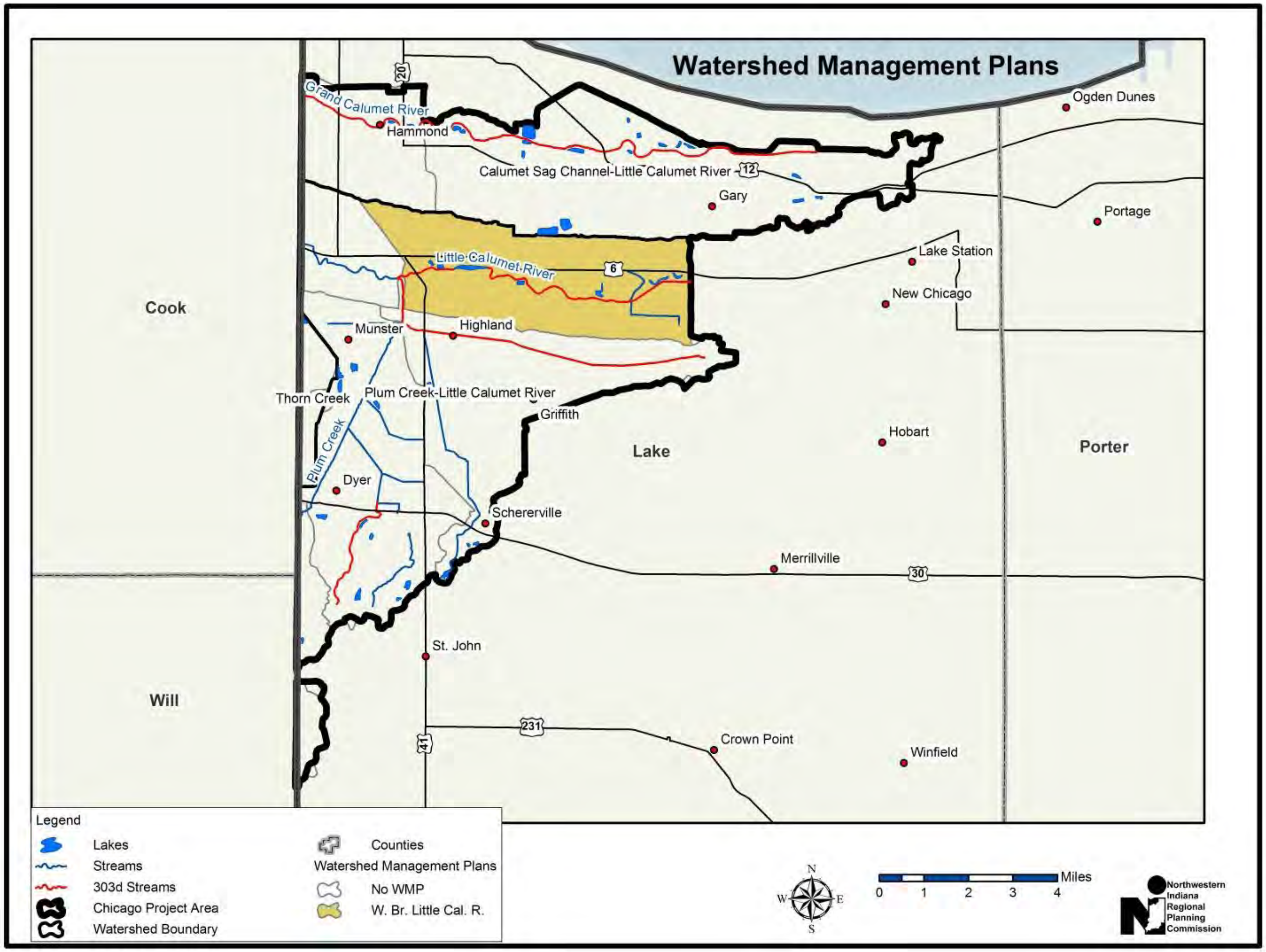

Figure 31 Watershed Management Plans

[20] www.in.gov/idem/nps/3254.htm

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

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

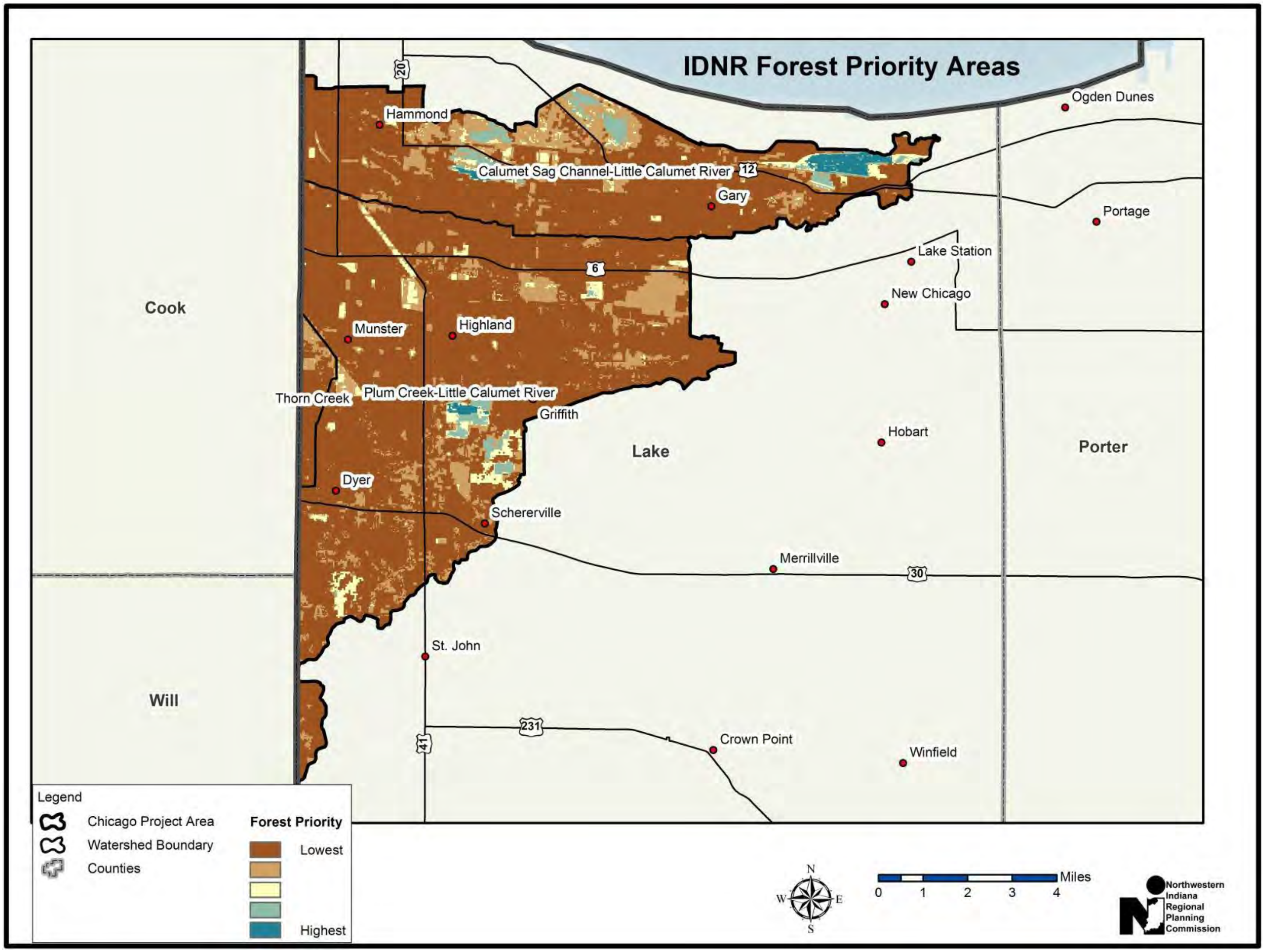

Figure 32 INDR Forest Priority Areas

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 Figure 32 was generated 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.

Community & Urban Forestry Program

The DNR Division of Forestry's Community & Urban Forestry Program[21] 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 Dyer, East Chicago, and Munster. 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.

[21] www.in.gov/dnr/forestry/2854.htm

Indiana Wetlands Conservation Plan

The purpose of the Indiana Wetlands Conservation Plan[22] (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.

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[22] www.in.gov/dnr/fishwild/3350.htm

Indiana Comprehensive Wildlife Strategy

The Indiana Comprehensive Wildlife Strategy[23] (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

[23] www.in.gov/dnr/fishwild/files/CWS_MANUSCRIPT.pdf

Indiana Nonpoint Source Management Plan

The Indiana Nonpoint Source Management Plan[24], 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)

[24] www.in.gov/idem/5970.htm

- 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)

2040 Comprehensive Regional Plan for Northwest Indiana

The 2040 Comprehensive Regional Plan[25] (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

[25] http://nirpc.org/

4.1.7 Endangered, Threatened, and Rare (ETR) Species

Figure 33 shows high concentration areas or "hot spots" of ETR occurrences within the sub-basin. Many of these areas coincide with managed lands such as the Indiana Dunes National Lakeshore, Indiana Department of Natural Resources, and local land trust properties. Data used to generate this figure was provided by the IDNR Indiana Natural Data Center. The Indiana Natural Data Center[26] 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.

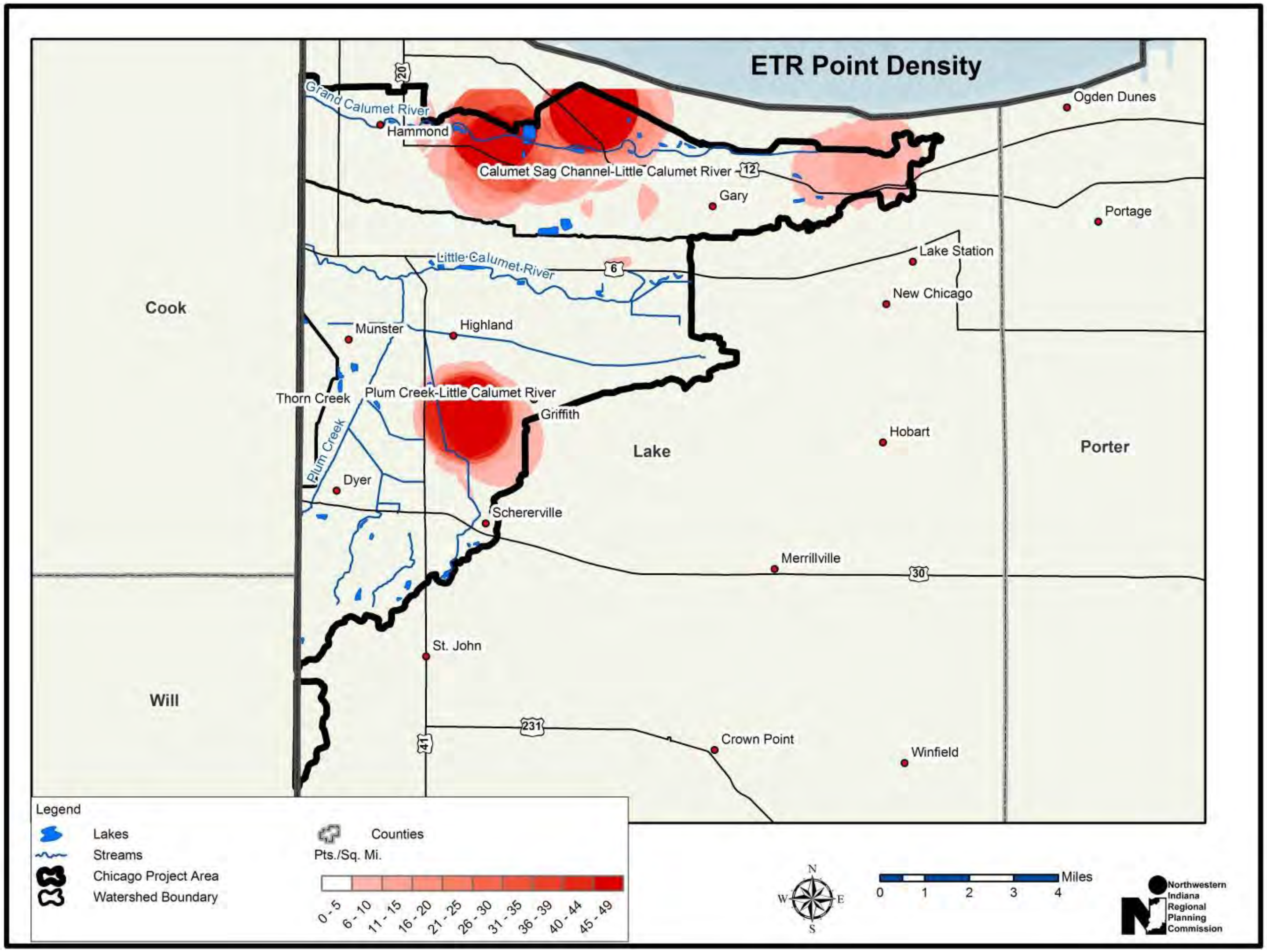

Figure 33 ETR Point Density

[26] http://www.in.gov/dnr/naturepreserve/4746.htm

4.1.8 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. Cultivated lands from the 2006 CCAP dataset existing on all "poorly drained" soil classes were extracted using ArcMap 10 Spatial Analyst. This data is displayed in Figure 34. There are approximately 2.1 mi² (1,355 ac) of cultivated land on all poorly drained soil classes in the sub-basin.

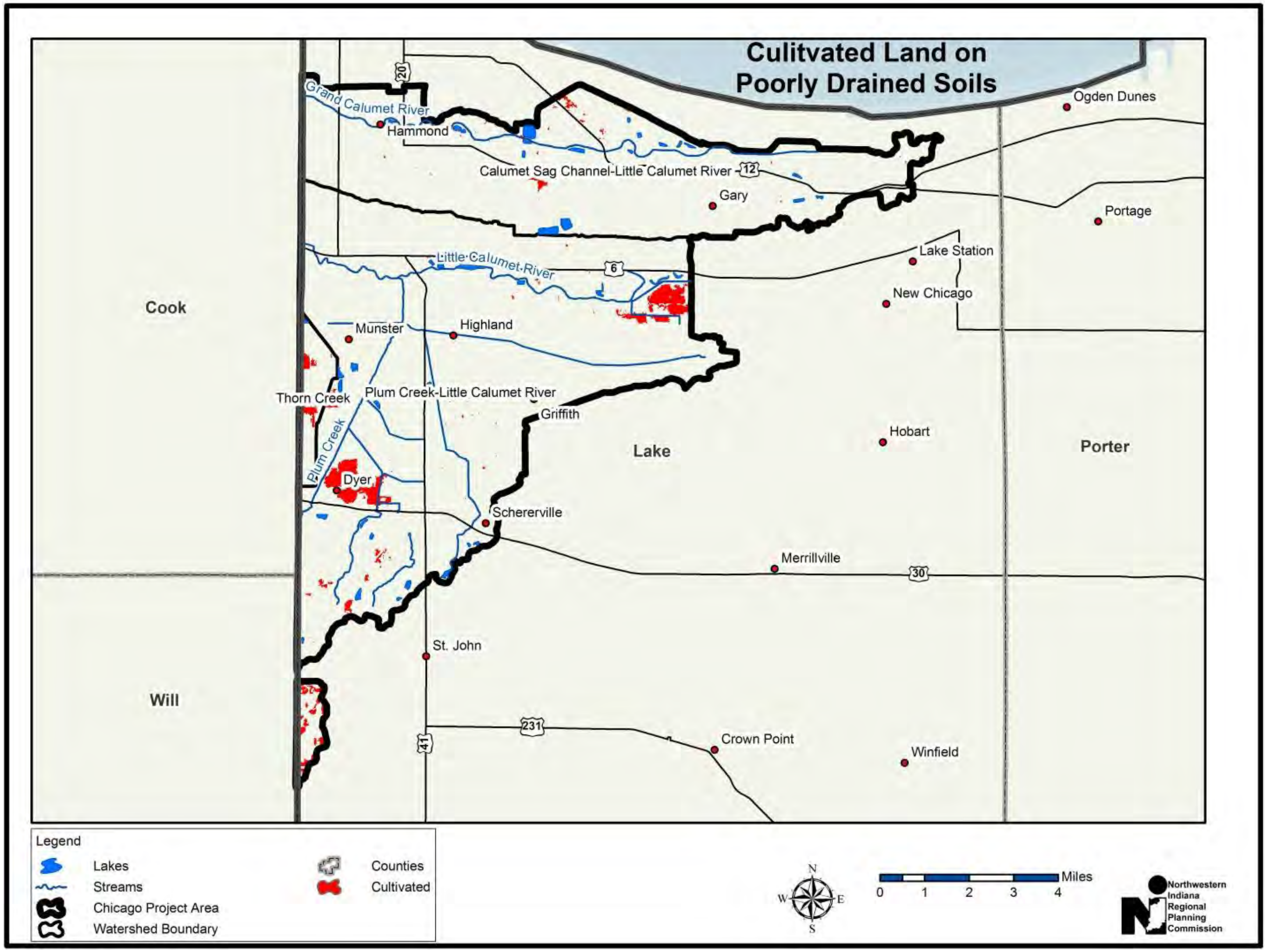

Figure 34 Cultivated Land on Poorly Drained Soils

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 due to conversion can be useful in identifying potential wetland restoration opportunities. Figure 35 shows the general locations of wetlands identified by the Ducks Unlimited NWI update overlain on soils identified as hydric by the NRCS. In total there are approximately 8.3 mi² of wetland (NWI) and 31 mi² of hydric soils within the sub-basin. This equates to a 73% loss in wetland area.

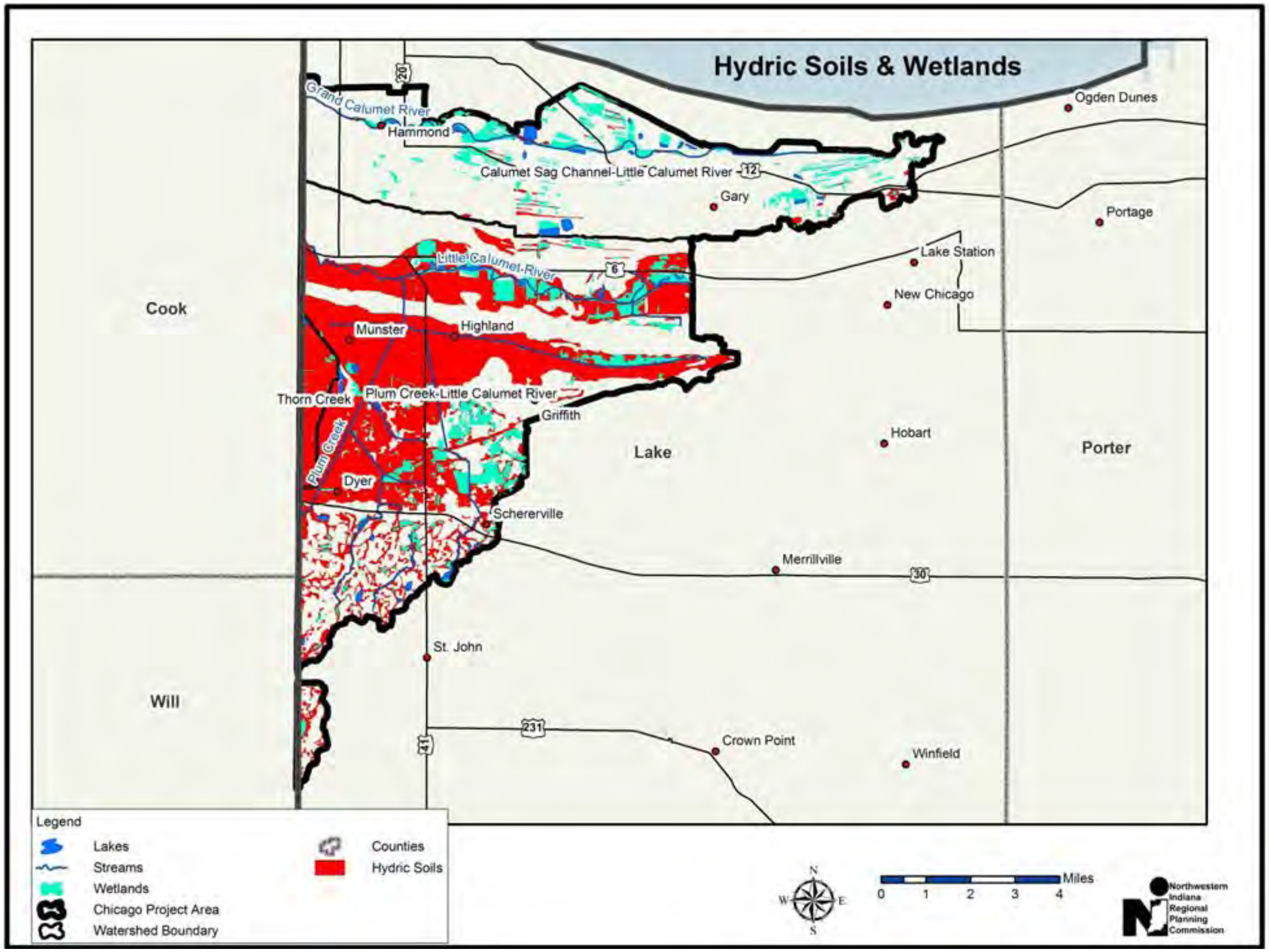

Figure 35 Hydric Soils & Wetlands

Land Cover & HEL Soils

Approximately 9% of the soils in the sub-basin are classified as HEL soils. The highest concentration exists in southern portion of the sub-basin and along portions of Cady Marsh Ditch. Figure 36 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.

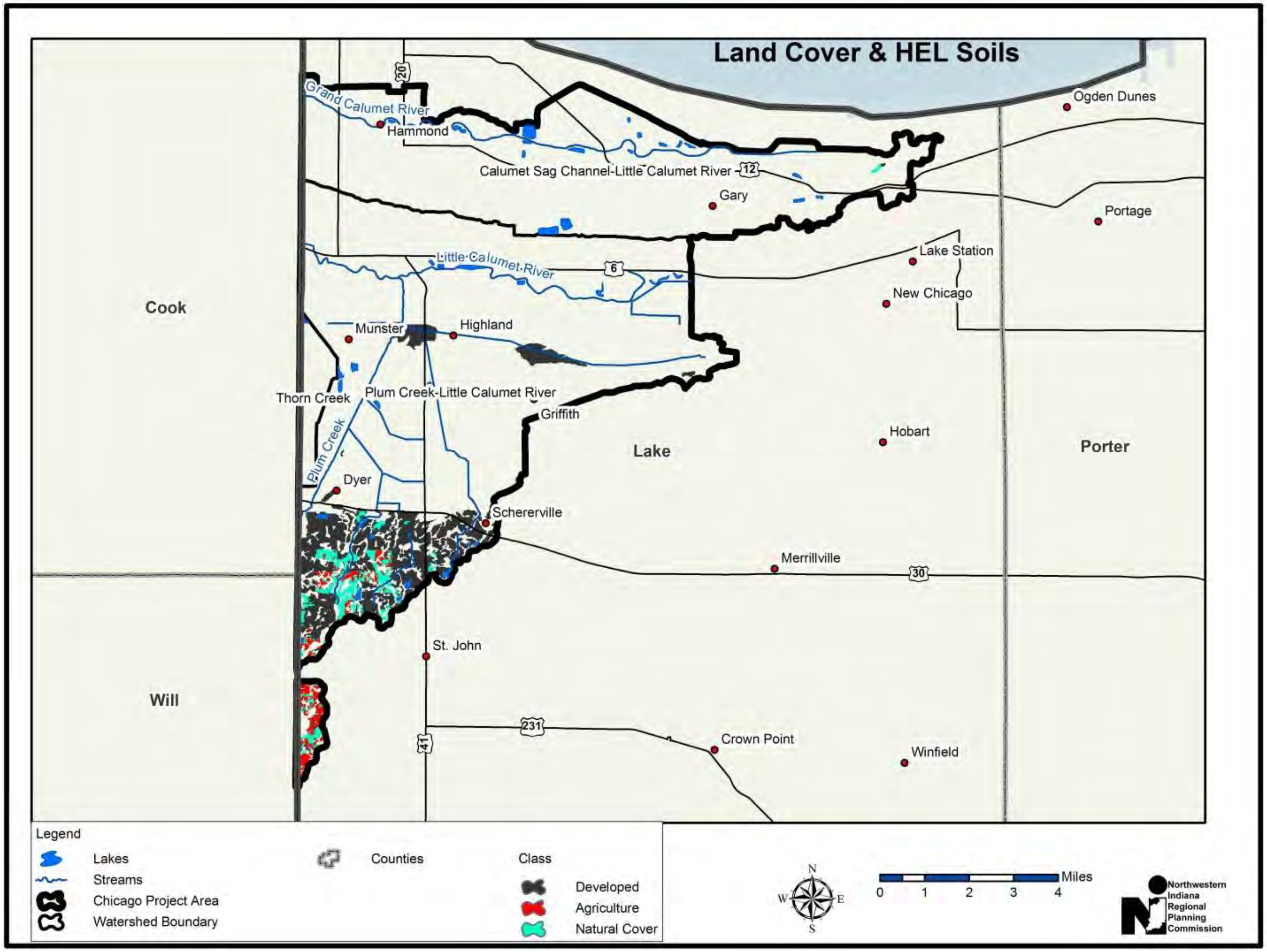

Figure 36 Land Cover & HEL Soils

4.2 Part II- Watershed Inventory

4.2.1 Data & Targets

Historical water quality data was requested from IDEM for the time period of 1990 to 2010 for the sub-basin. IDEM provided spreadsheets with water chemistry, biological assessment, and habitat assessment data along with site coordinates. Based on recommendations in the Watershed Management Checklist Instructions (2009) for data older than 10-years, 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 37 is displayed reflect sampling intensity (i.e. number of observations). 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.

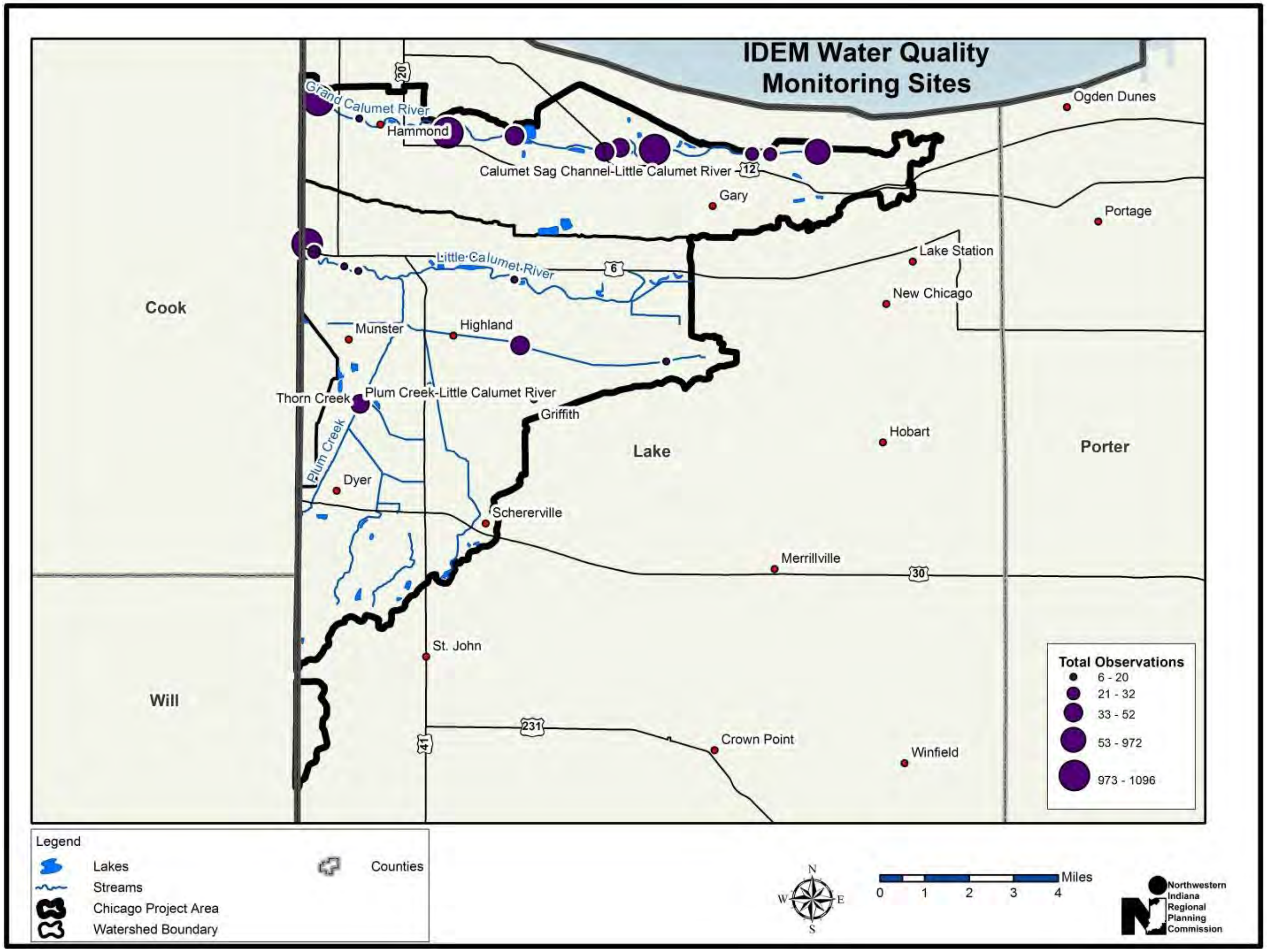

Figure 37 IDEM Water Quality Monitoring Stations

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 watershed. 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.

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

For the threshold/exceedance analysis preformed and presented below in Section 4.2.2 Water Quality Information, NIRPC used the target values presented below in Table 4. The values chosen by NIRPC were based upon the water quality standards and target values present above.

Parameter	Target Value
E. coli	Max: 235 CFU/ 100mL in a single sample
Nitrate-N + Nitrite-N	Max: 10 mg/L
Total Kjeldahl Nitrogen	Max: 0.591 mg/L
Total Phosphorus	Max: 0.3 mg/L
Total Suspended Solids	Max: 30.0 mg/L
Dissolved Oxygen	Min: 5 mg/L and Max 12 mg/L
pH	Min: 6 and Max: 9
Turbidity	Max 10.4 NTU
Qualitative Habitat Evaluation Index	QHEI score >51 (conducive of supporting warmwater fishery)
Index of Biotic Integrity	IBI score >36 (supporting)
Macroinvertebrate Index of Biotic Integrity	mIBI score >2.2 (supporting)- kick sample methodology

Table 4. NIRPC Threshold/Exceedance Analysis Target Values

4.2.2 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 38 and presented in Table 5. Of the 59 miles of stream and ditch that drain this landscape, nearly 32 miles (54%) are impaired. Table 4-6 shows the most common impairments are Impaired Biotic Communities (24 miles), Cyanide (21 miles), Chloride (19 miles), and E. coli (18 miles). Additionally, most of the listed waterbodies have multiple impairments within the same reach (29 miles).

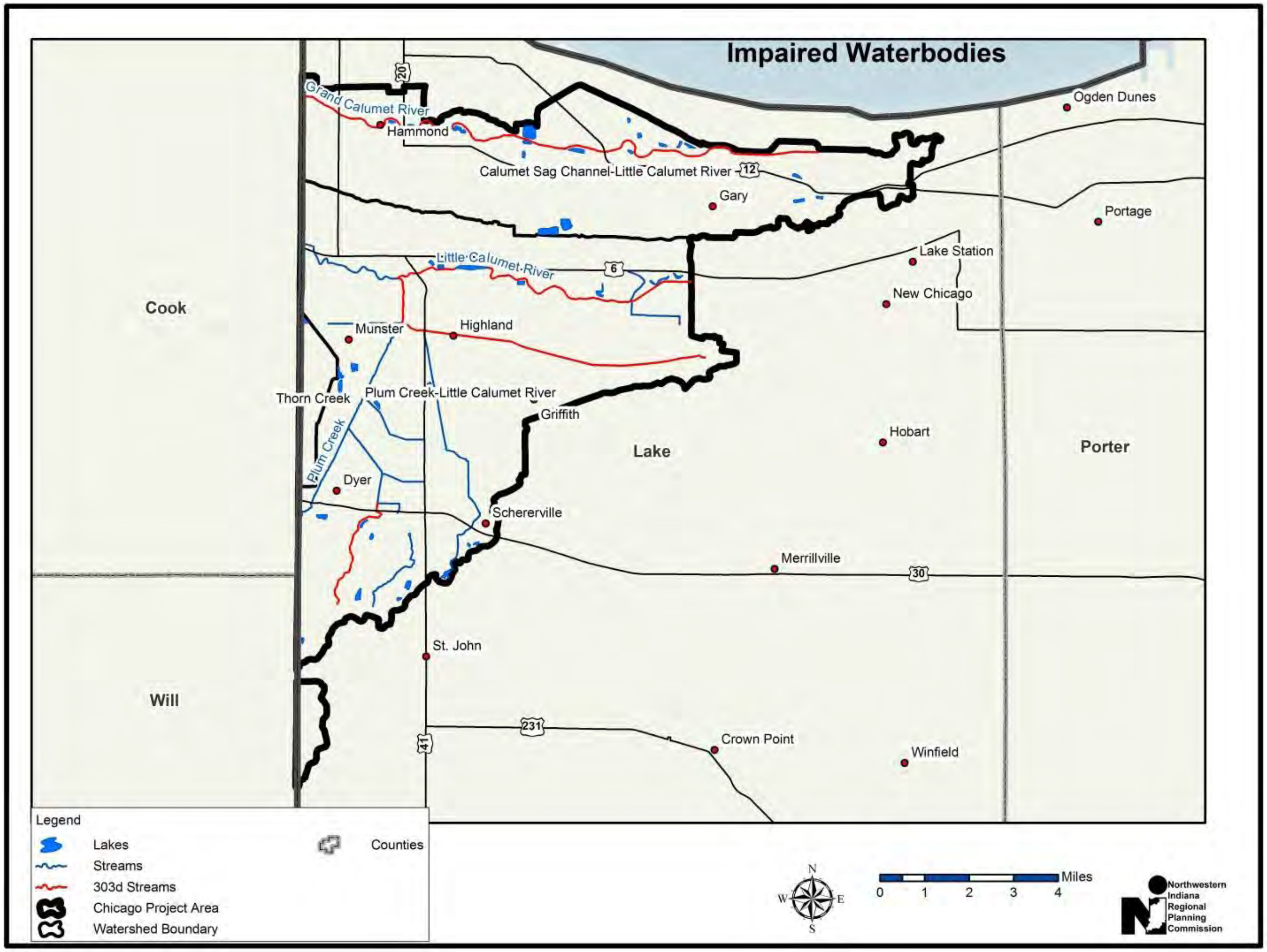

Figure 38 Impaired Waterbodies

Waterbody	County	Reason
Grand Calumet River - Illinois To Indiana Harbor Canal	Lake	Ammonia, Chloride, Cyanide, DO, E. coli, IBC, Nutrients, PCB-FT
Dyer Ditch	Lake	IBC
Cady Marsh Ditch	Lake	Chloride, E. coli, IBC, Nutrients
Little Calumet River	Lake	Chloride, Cyanide, DO, PCB-FT
Indiana Harbor Canal Main Channel	Lake	E. coli, PCB-FT
Grand Calumet River - Headwaters	Lake	Ammonia, Cyanide, IBC, Oil & Grease, PCB-FT
Grand Calumet River - Gary To Indiana Harbor Canal	Lake	Cyanide, E. coli, IBC, Oil & Grease, PCB-FT

Table 5 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.

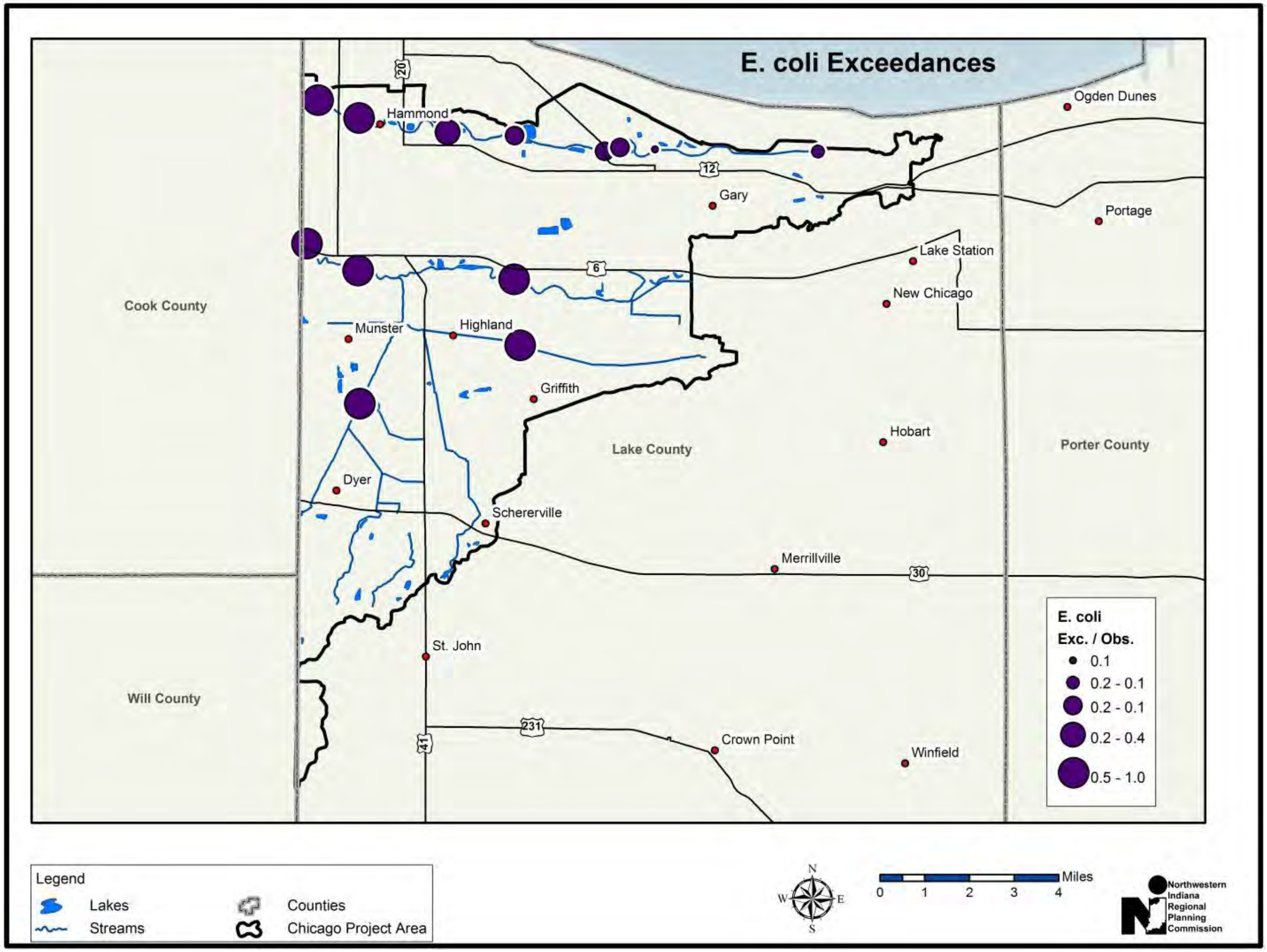

Figure 39 E. coli Exceedances

Between 1999 and 2010, IDEM collected 79 *E. coli* samples from 13 different stations in the sub-basin project area. Using 235 CFU/100 ml for a single sample as a target value (Table 2), all stations sampled exceeded the water quality standard at least once and 32 of the 79 total samples (41%) collected exceeded the water quality standard. Figure 39 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*.

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 6. 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 6. 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 7 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%

Table 7. Tributary Allocations for the Lake Michigan E. coli 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 (NO_3), nitrite (NO_2), and ammonia (NH_3). 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

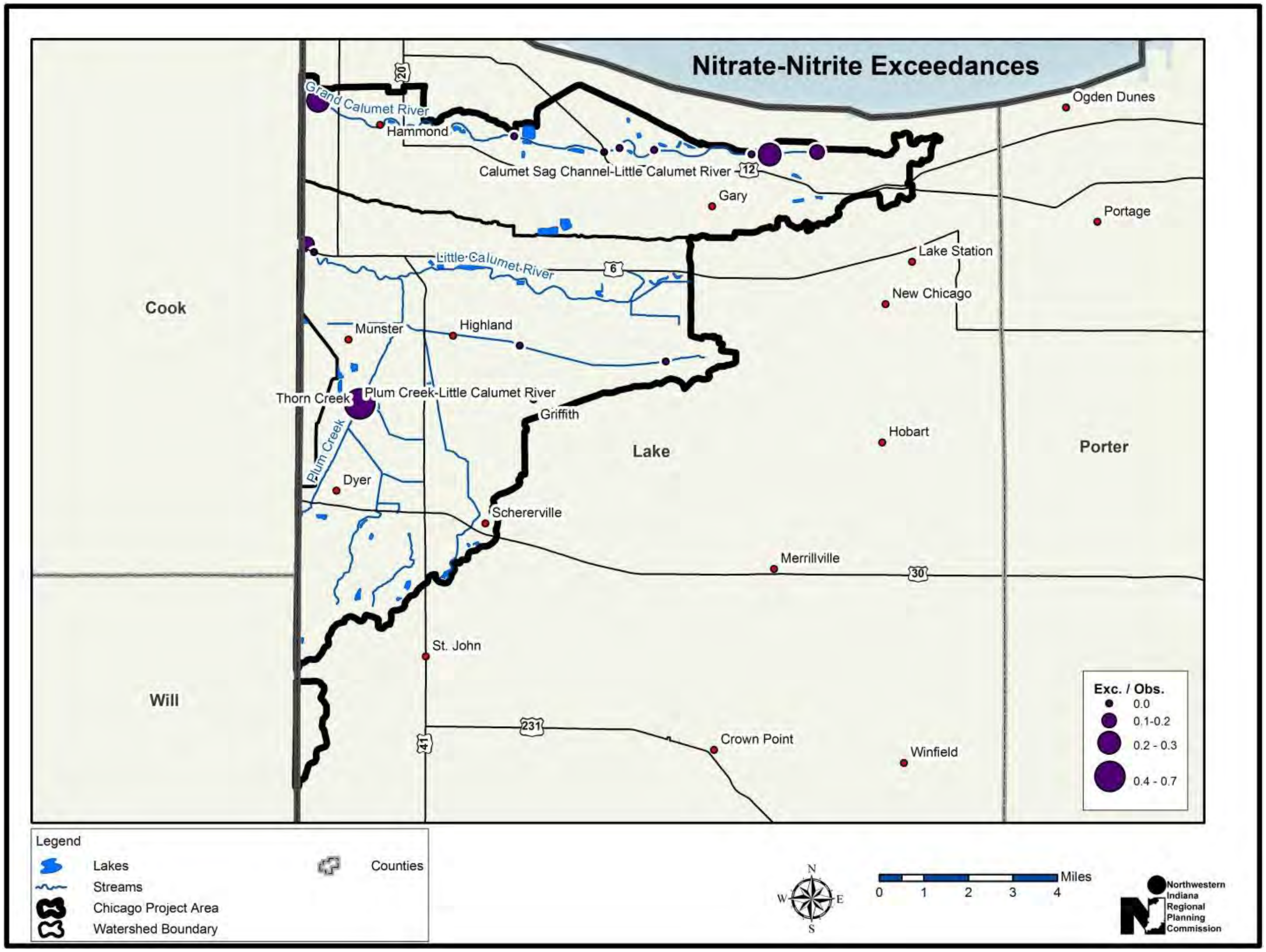

Figure 40 Nitrate-Nitrite Exceedances

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. Between 1999 and 2010, IDEM collected 679 Nitrate + Nitrite samples from 14 different stations in the sub-basin project area. Using 10 mg/l as a target value for Nitrate + Nitrite (Table 2), 5 of the 14 stations (36%) sampled had a target value exceedance at least once and 33 of 679 total samples (5%) collected exceeded the target value. Figure 40 shows the sample locations and the location in which the target value of 10 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 Nitrate + Nitrite.

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 634 TKN samples from 14 different stations in the sub-basin project area. Each of the 14 stations sampled had at least one target value exceedance and 607 of 634 total samples (96%) collected exceeded the target value. Figure 41 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.

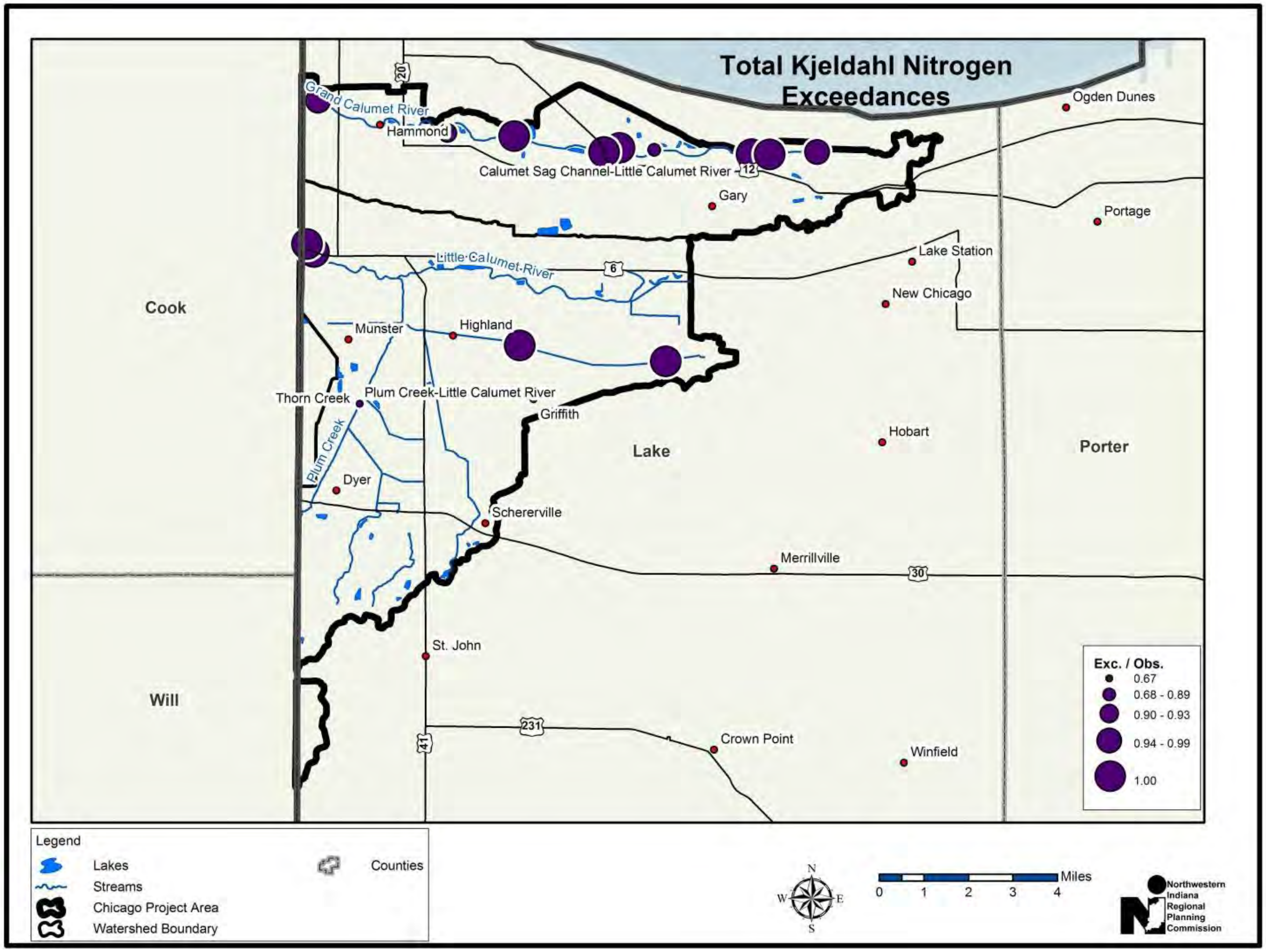

Figure 41 Total Kjeldahl Nitrogen Exceedances

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.

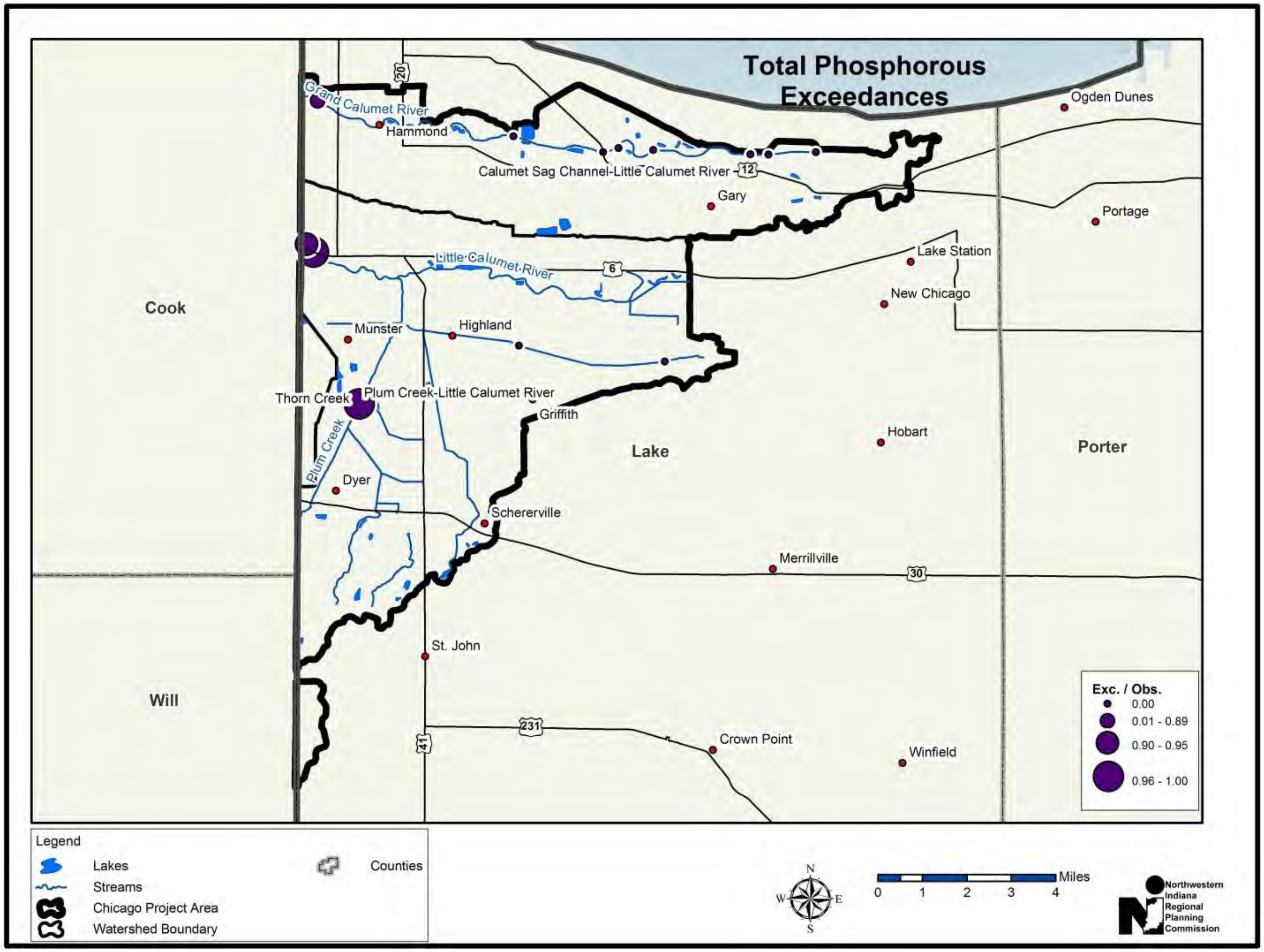

Figure 42 Total Phosphorous Exceedances

Between 1999 and 2010, IDEM collected 683 Total Phosphorous (TP) samples from 14 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). Four of the 14 stations (29%) sampled had a target value exceedance at least once and 244 of the 683 total samples (36%) collected exceeded the target value. Figure 42 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.

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.

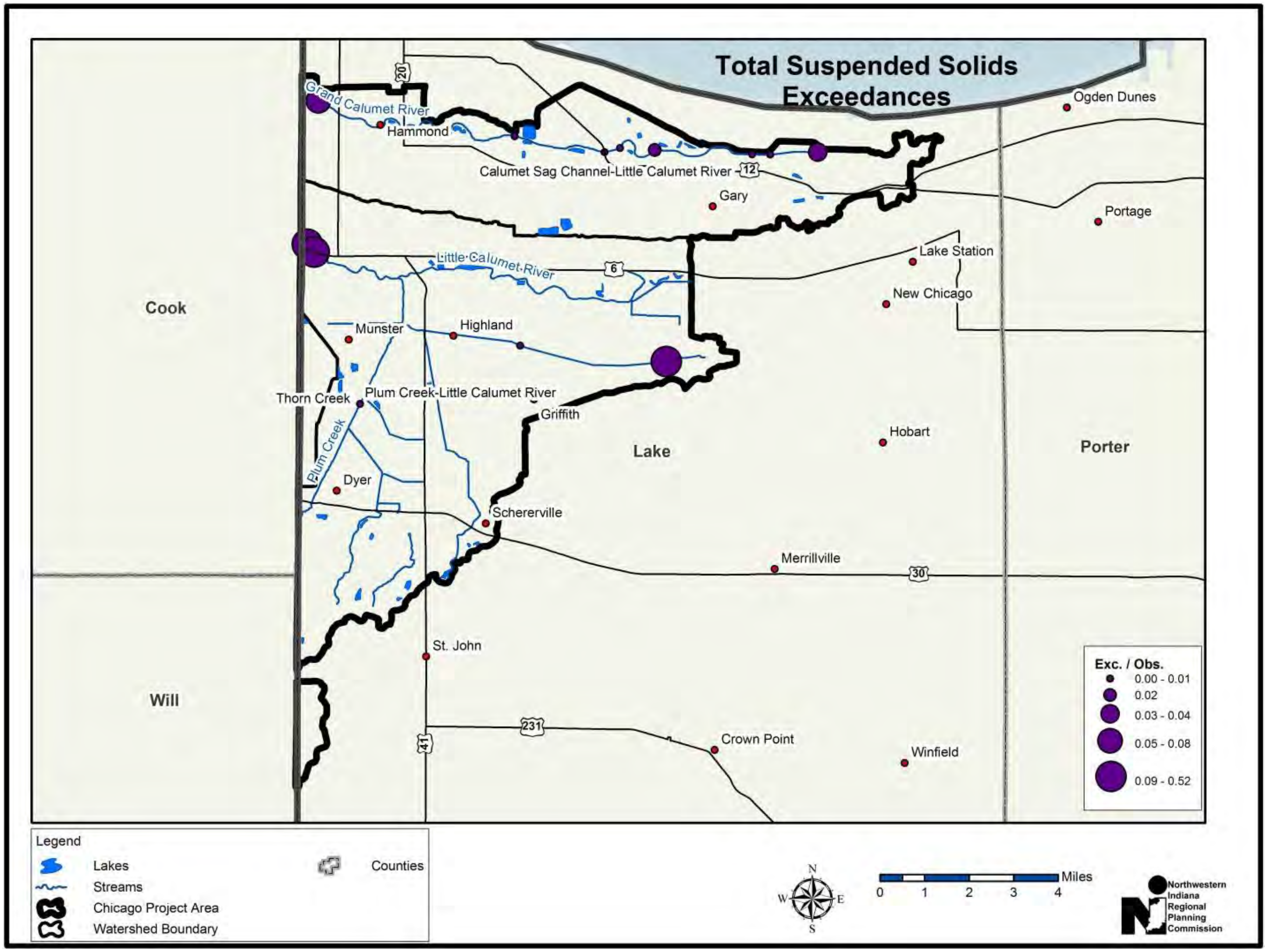

Figure 43 Total Suspended Solids Exceedances

Between 1999 and 2010, IDEM collected 685 TSS samples from 14 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). Seven of the 14 stations (50%) sampled had a target value exceedance at least once and 89 of the 685 total samples (13%) collected exceeded the target value. Figure 43 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.

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 770 DO samples from 18 different stations in the sub-basin project area. Using 4 mg/l as a minimum and 12 mg/l as a maximum target value (Table 2), 7 of the 18 stations (39%) sampled exceeded the water quality standard at least once and 79of the 770 total samples (10%) collected exceeded the water quality standard. Figure 44 shows the 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) for DO.

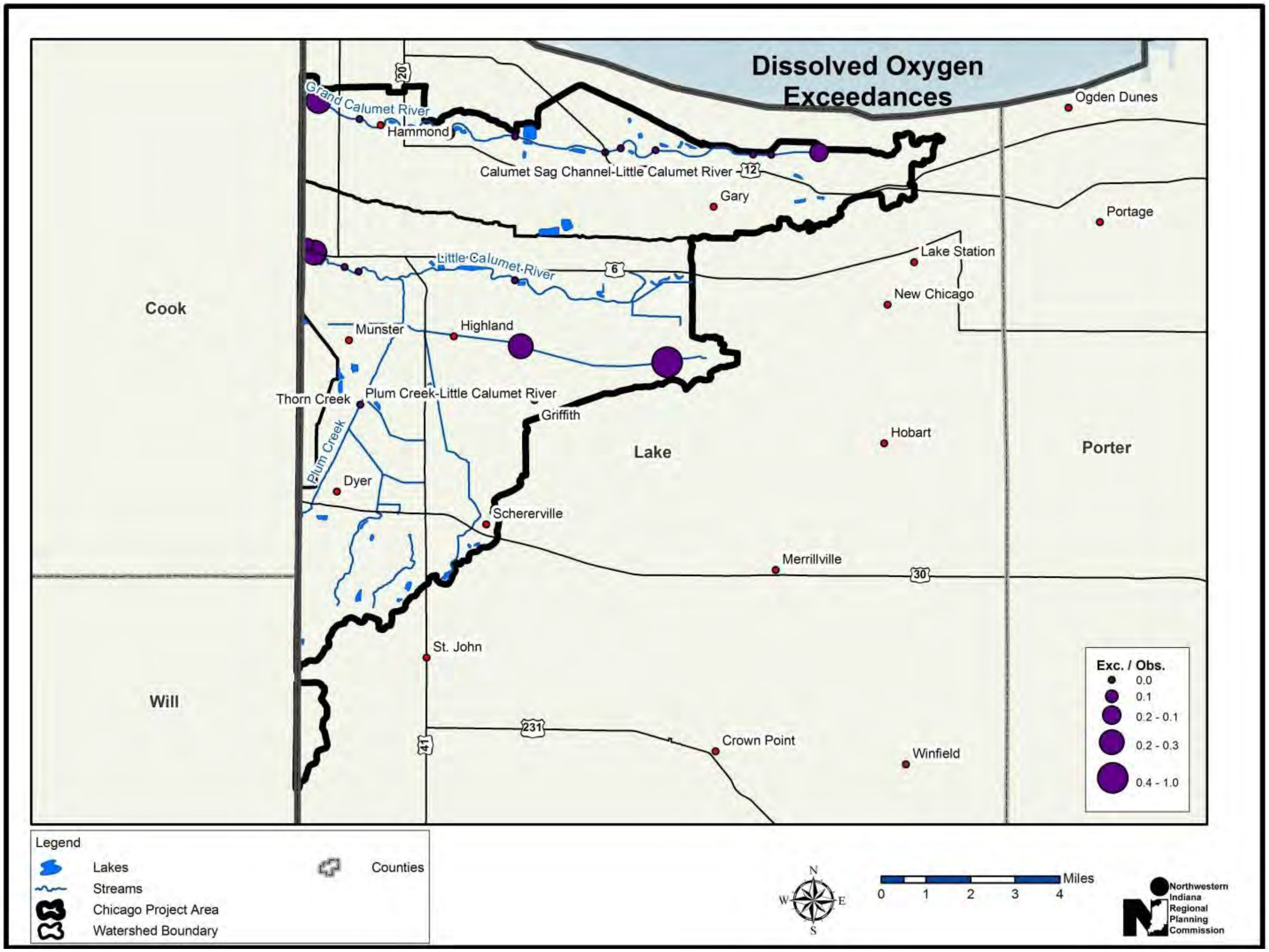

Figure 44 Dissolved Oxygen Exceedances

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 at 18 different stations in the sub-basin project area. The water quality standard for pH is falls within the range of 6-9 (Table 2). None of the 1,414 pH measurements taken exceeded the water quality standard. Figure 45 shows the sample locations in which water temperature was taken.

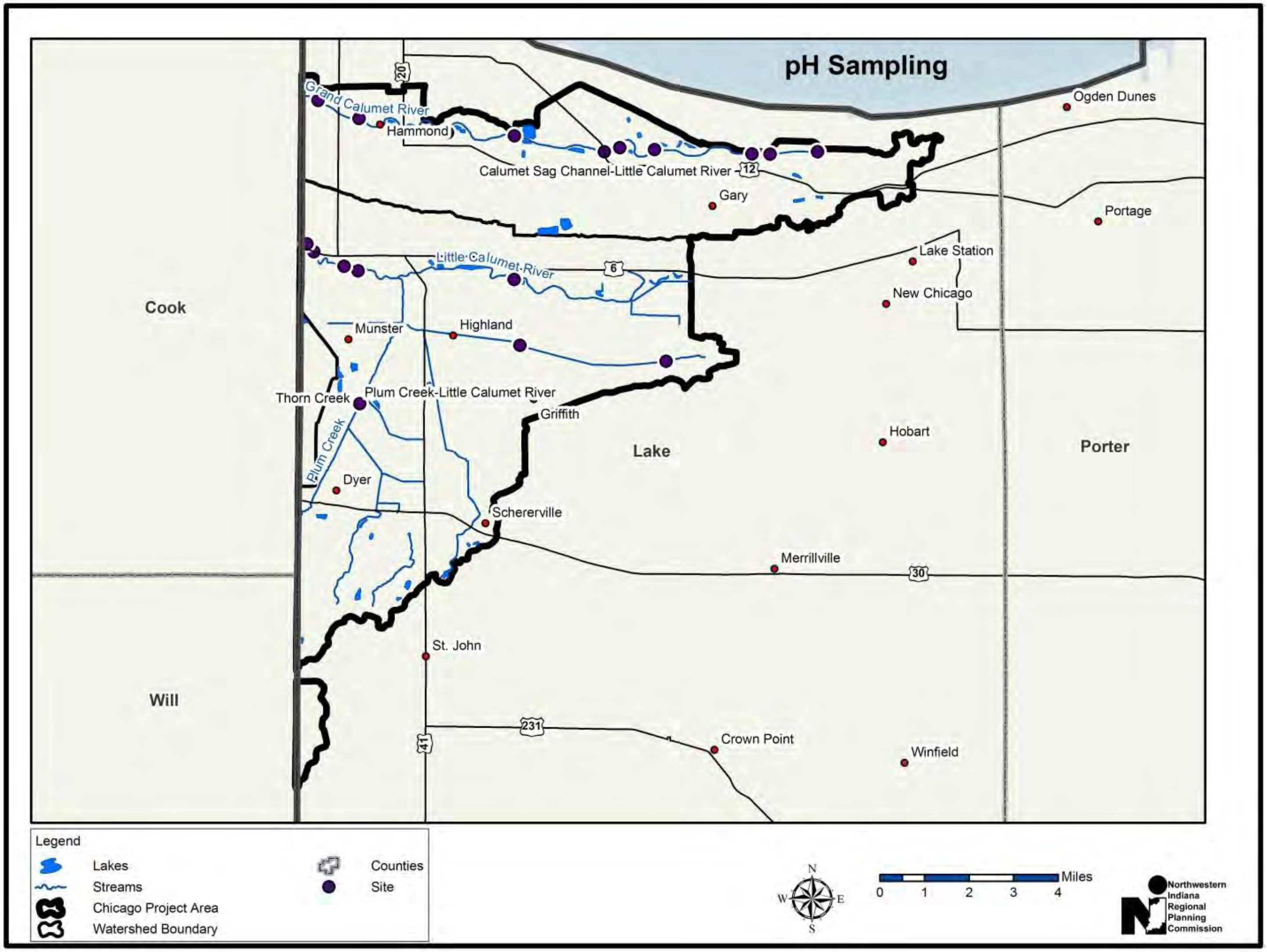

Figure 45 pH Sampling Locations

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.

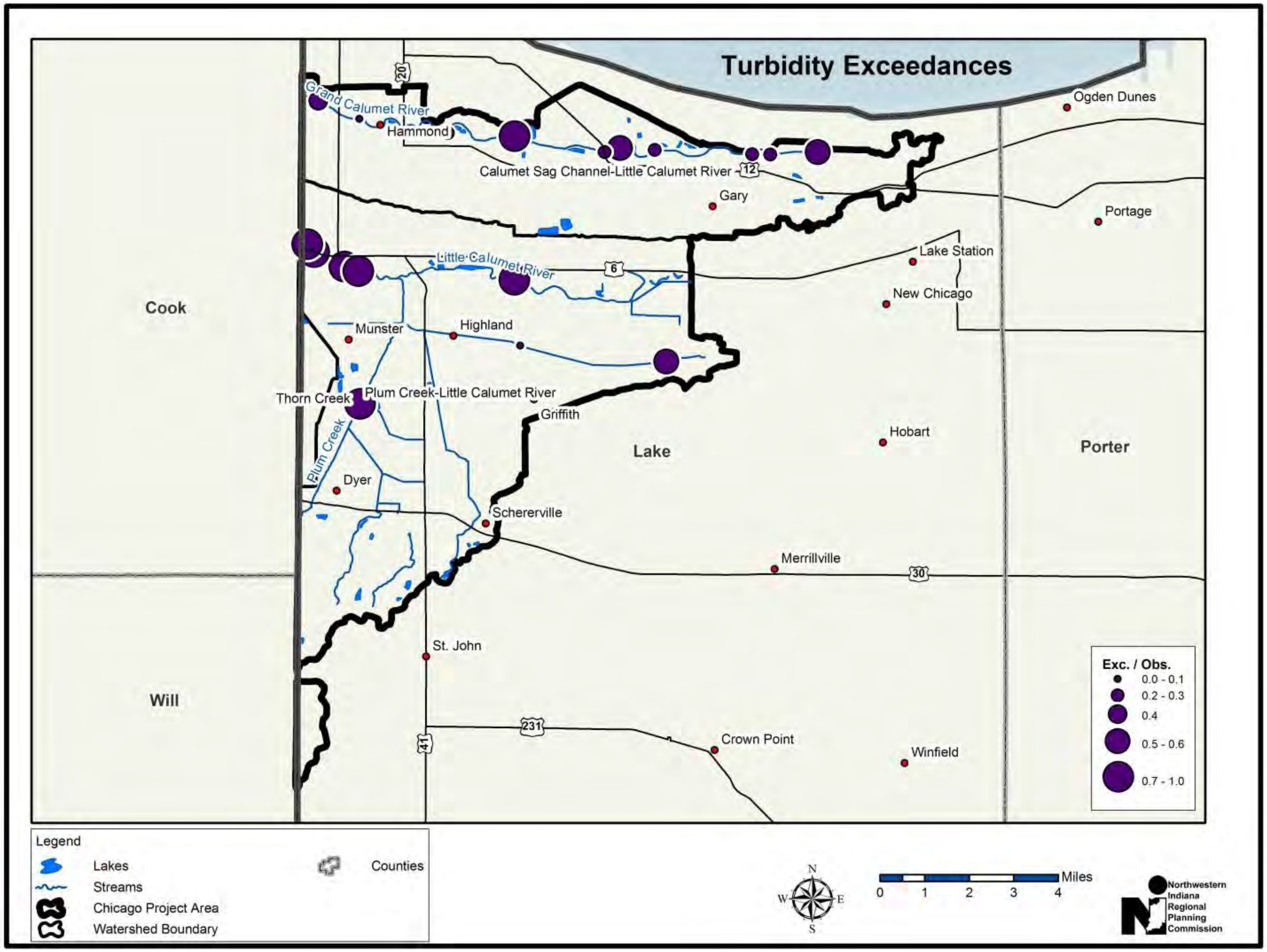

Figure 46 Turbidity Exceedances

Between 1999 and 2010, IDEM collected 762 Turbidity samples from 18 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). Seventeen of the 18 stations (94%) sampled had a target value exceedance and 358 of the 672 total samples (53%) collected exceeded the target value. Figure 46 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.

NPDES Facilities

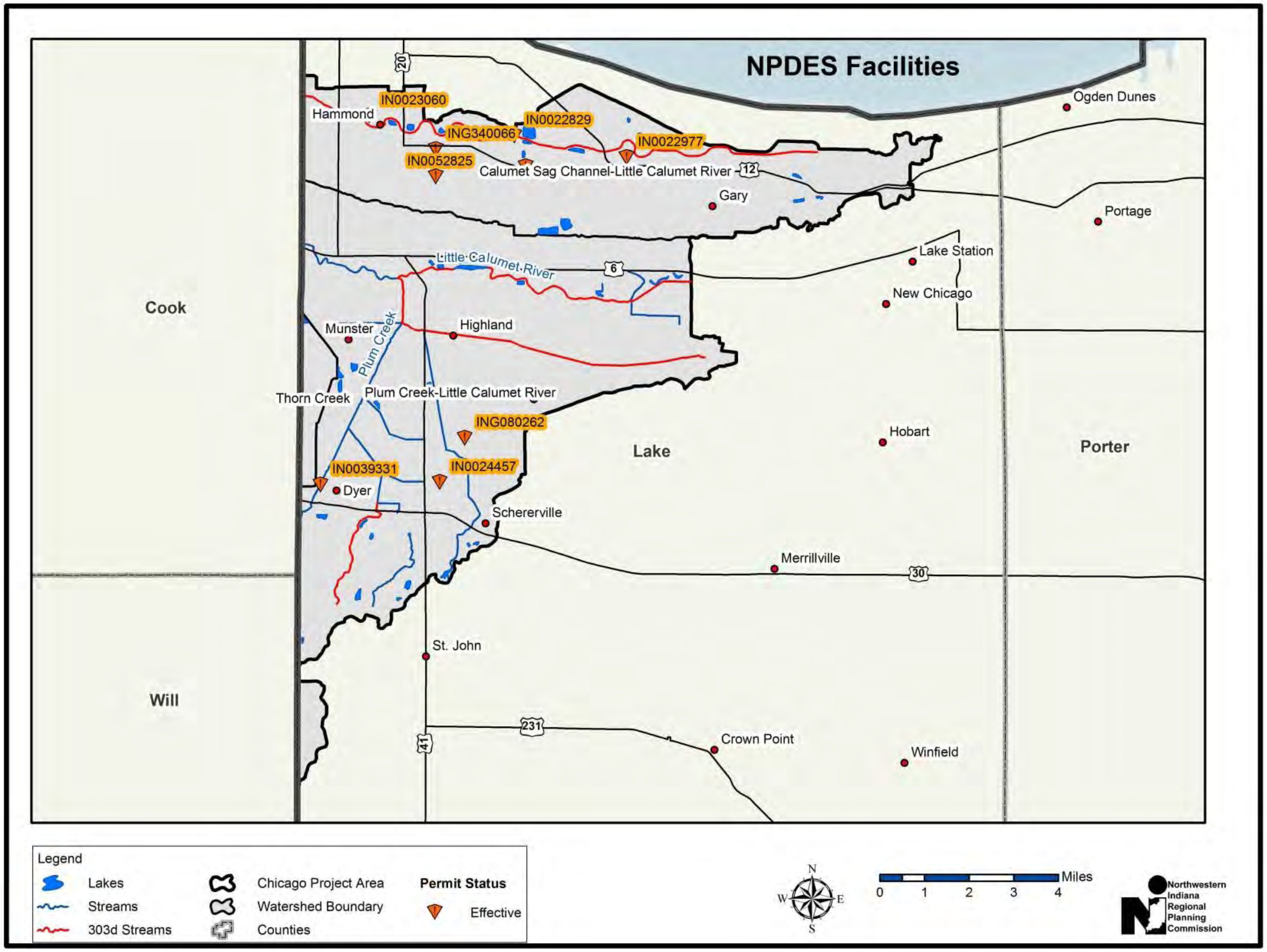

Figure 47 NPDES Facilities

The NPDES facility locations shown in Figure 47 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. In total there are nine NPDES facilities located in the sub-basin project area based upon this data. The IDEM states within the GIS metadata for the NPDES shapefile "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."

Data presented below in Table 8 provides 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[27] (ECHO) system by NIRPC on September 21, 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. 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. Facilities with an asterisk were not included in the IDEM NPDES shapefile.

NPDES ID	Facility Name	# Effluent Exceedances (3yrs)	Informal Enforcement Actions (5yrs)	Formal Enforcement Actions (5yrs)
IN0045985	Avery Dennison DFD*	2		
ING080050	Buckeye Pipe Line Co. - Griffith Station*	2		
ING340066	Buckeye Terminals Hammond Terminal	Incomp dmr entry		
ING340052	Buckeye Terminals Hartsdale Station*	0		
IN0052825	Calumet Flexicore Corp.	0		
IN0039331	Dyer Wastewater Treatment Plant	14		
IN0022829	East Chicago Sanitary District	22	4	
ING080169	Explorer Pipeline Co. - Hammond Station*	0		
ING340012	Explorer Pipeline Co. Hammond*	0		
IN0023060	Hammond Wastewater Facility	23	5	
ING080089	Marathon Pipe Line LLC*	0		
ING340044	Premcor Pipeline Hammond Terminal*	0		
IN0024457	Schererville WWTP	9	1	
ING340058	Wolf Lake Terminals Inc.*	9	2	

Table 8. NPDES Facility Compliance

[27] http://www.epa-echo.gov/echo/index.html

4.2.3 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)

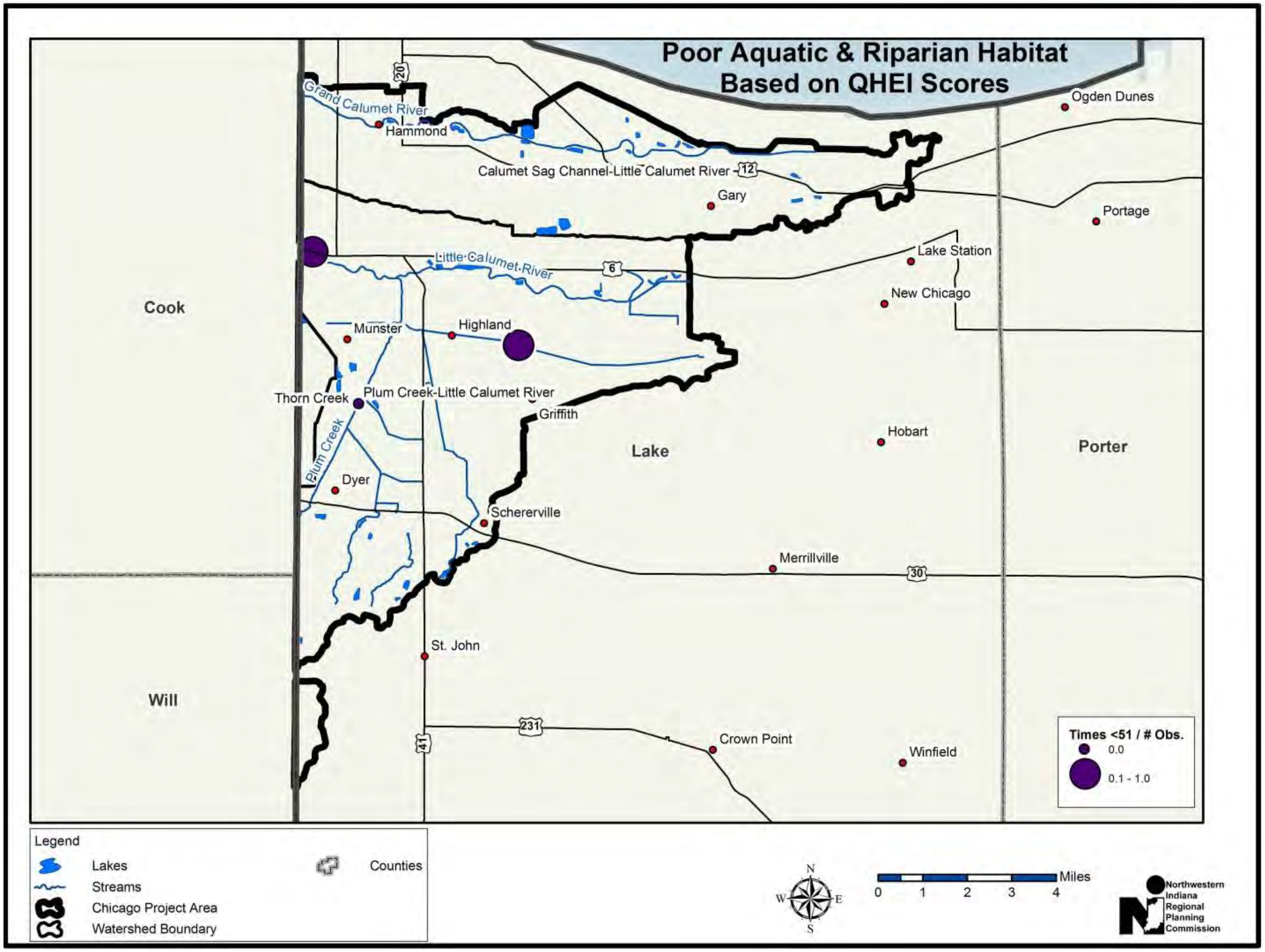

Figure 48 Qualitative Habitat Evaluation Index Exceedances

scores indicate 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 three 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. Two of the 3 stations (66%) evaluated had a QHEI score of less than 51. Figure 48 shows the sample locations and the location which QHEI scores fell below the target value of 51 (represented by large dot). The number of times in which a station fell below the target value was normalized by the total number of habitat evaluations at that station.

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.

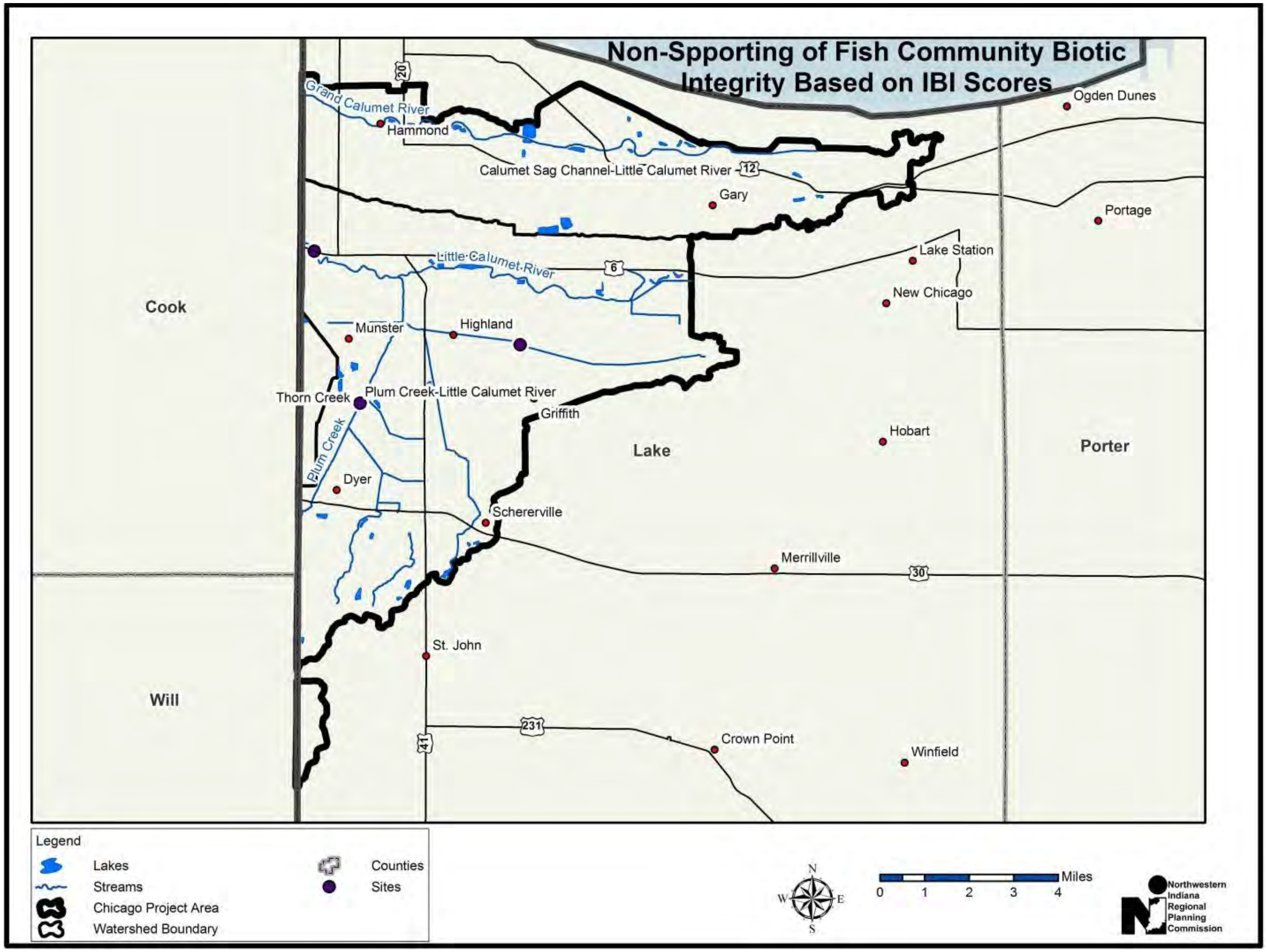

Figure 49 Index of Biotic Integrity Exceedances

Between 1999 and 2010, IDEM evaluated fish communities at 3 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. All 3 stations evaluated had IBI scores of less than 36 (IBI <36). Figure 49 shows the sample locations and the location in which the target value of 36 was not met.

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 single station evaluated met the target value (mIBI <2.2). Figure 50 shows the sample locations within the sub-basin project area.

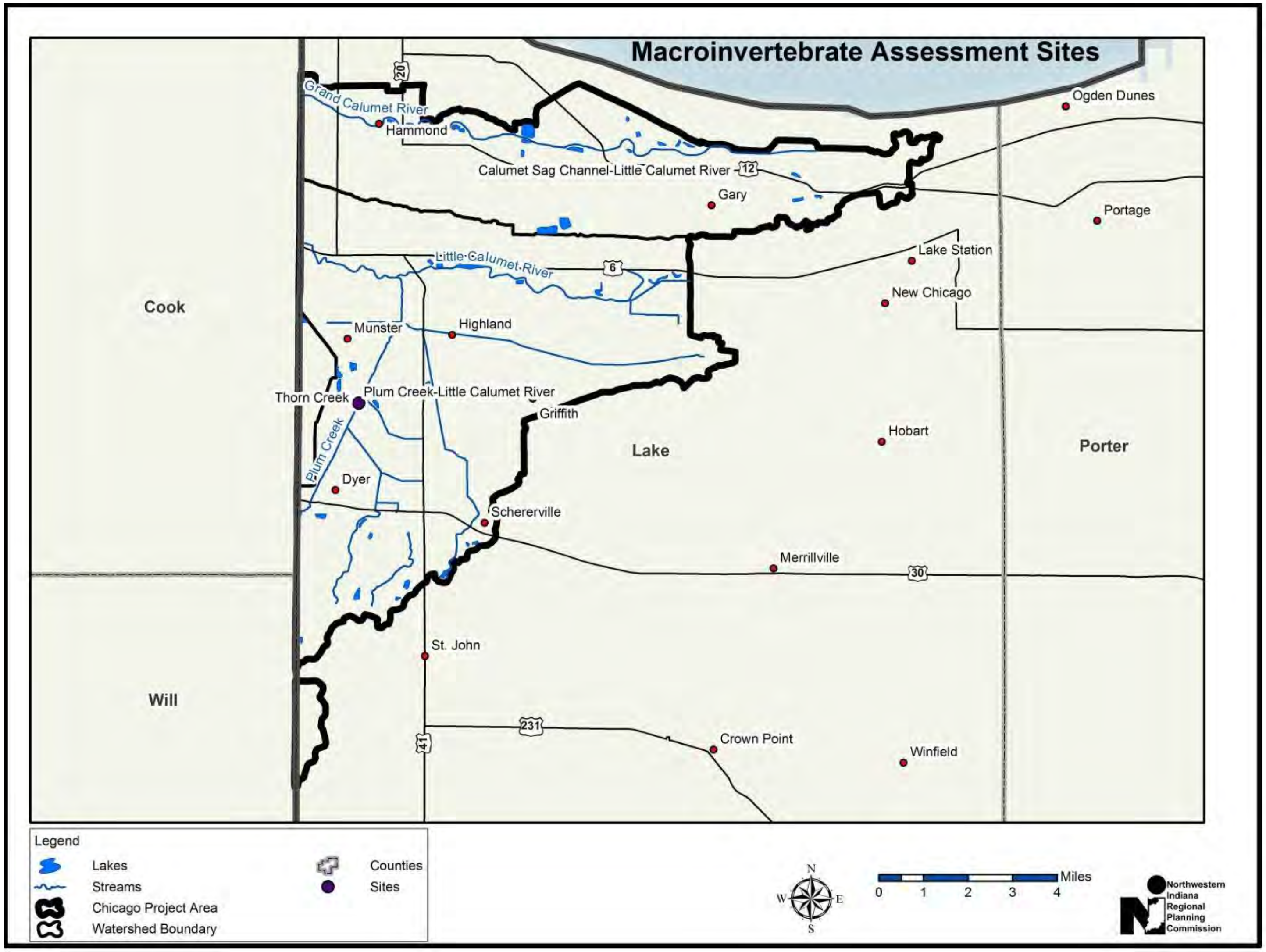

Figure 50 Macroinvertebrate Index of Biotic Integrity Sites

Figure 51 is a composite of all the water quality/habitat/biological parameters presented above and used by NIRPC for exceedance analysis. In total, 5,715 observations were made by IDEM at 18 stations in the sub-basin project area. Each of the stations sampled had at least one target value not met and 1,449 of the 5,715 observations (25%) failed to meet target values. Figure 51 shows sample locations and the location in which the target values were not met. The number of times a target value was not met by station was normalized by the total number of observations at that station (i.e. samples taken). For the parameters analyzed the greatest frequency of targets not met occurred along the West Branch Little Calumet River downstream of Plum Creek (aka Hart Ditch).

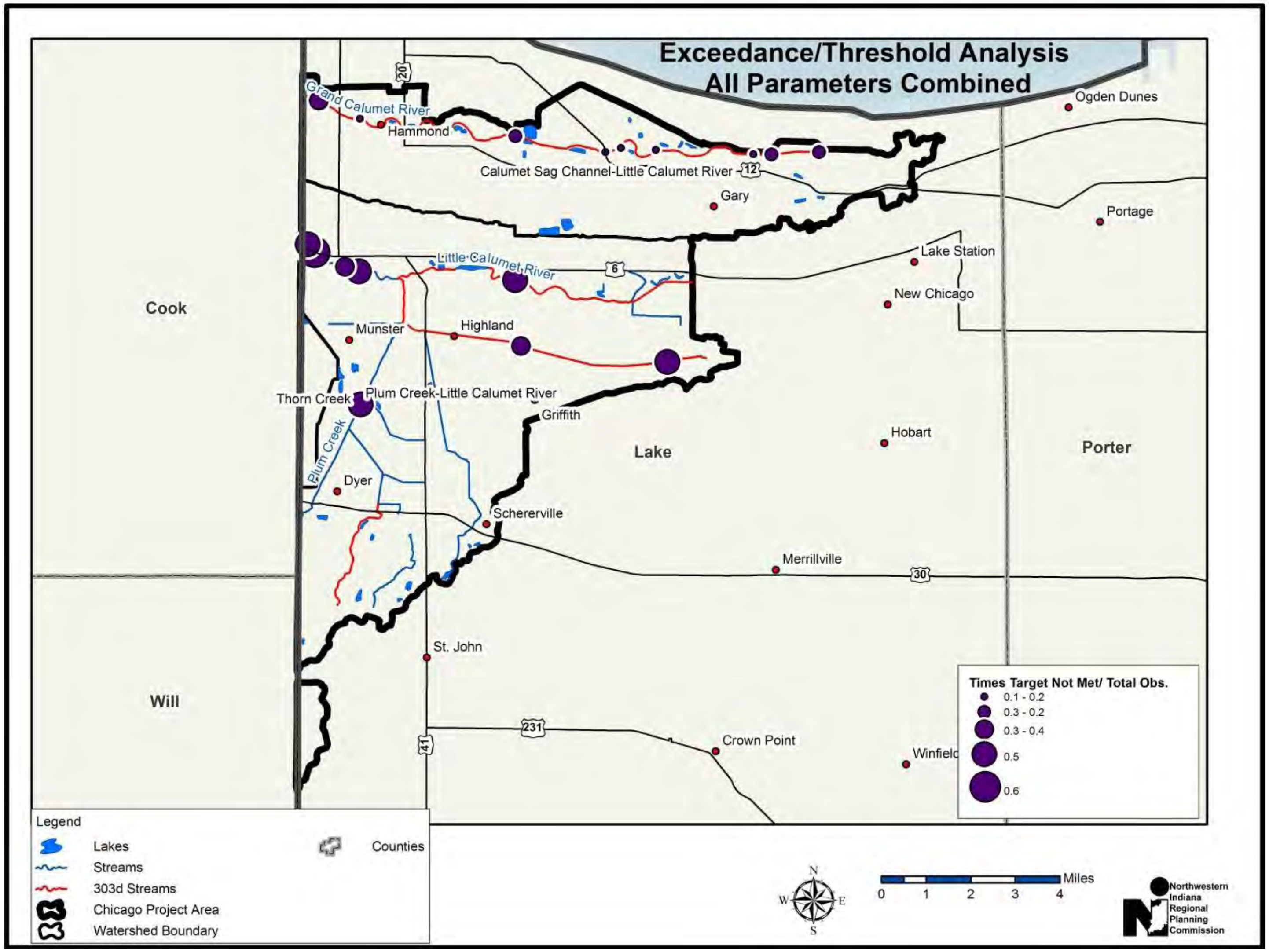

Figure 51 Total Water Quality Target Exceedances

To further assist watershed groups in identifying critical subwatersheds and areas where additional data may be needed; an analysis of percent exceedance by subwatershed was done using ArcMap10 (Figure 52). 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. Overall the subwatersheds in the Plum Creek-Little Calumet River watershed had the greatest percentage of exceedances based upon the parameter used for analysis. The most impacted subwatersheds were Plum Creek-Hart Ditch (HUC 071200030304) and Town of Black Oak- Little Calumet River (HUC 071200030305).

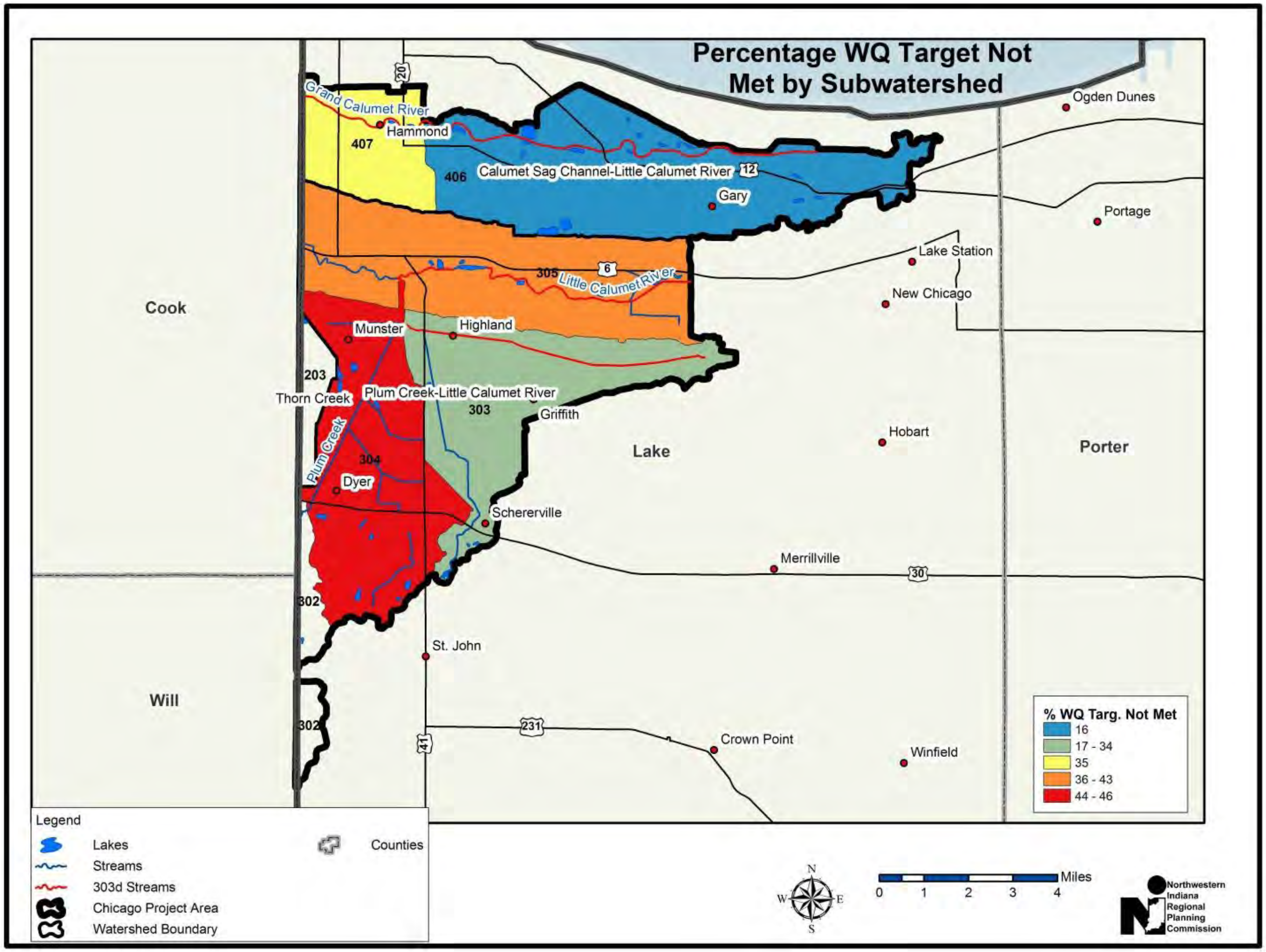

Figure 52 Percent Water Quality Target Exceedance by Subwatershed

4.3 Problems & Causes

4.3.1 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. Many of the plans share common stakeholder concerns despite geographical location and the year in which they were developed (2002-2010). Regardless, stakeholders should be solicited for additional concerns when new watershed management plans are being developed. As part of education and outreach and coordination efforts listed later on in the 4.5 Next Steps & Prioritization section, NIRPC will collect additional stakeholder concern information.

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.
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

Concern(s)	Problem
	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.
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.

Concern(s)	Problem
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 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

4.3.2 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
Development pattern trending outside of core communities.	
An operation and maintenance program does not currently exist for septic	• Lack of rules/regulations requiring maintenance

Problem	Potential Cause(s)
systems. Severe soil limitations for traditional systems.	• 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 forested stream buffers	• Urban and rural growth • Insufficient use of infiltration BMPs

Problem	Potential Cause(s)
contribute to increases in stream water temperatures.	• 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

Problem	Potential Cause(s)
	• 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
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

4.4 Potential Sources & Pollutant Loads

4.4.1 Potential Sources for Each Pollution Problem

Table 11 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 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	N/A
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

Problem	Potential Cause(s)	Potential Source(s)
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 (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	• Encroachment of development into floodplains	• Floodplain encroachment in developed areas

Problem	Potential Cause(s)	Potential Source(s)
wetlands and natural land cover that promote infiltration and reduce runoff volume (ex. forest and grasslands). Increasing impervious surface area with development.	• Destruction of wetlands and loss of open space from development and agriculture • Increased impervious surface area with development	• Conversion of wetlands, forest, and grasslands in developed and agricultural areas • High ISC in developed areas • Conveyance constriction
Development pattern trending outside of core communities.		N/A
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

Problem	Potential Cause(s)	Potential Source(s)
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	• CSO communities
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	• Insufficient coordination amongst groups and	N/A

Problem	Potential Cause(s)	Potential Source(s)
aquatic habitat issues in their watersheds.	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 • 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	• Developed and agricultural areas

Problem	Potential Cause(s)	Potential Source(s)
	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	N/A
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 occurring and potential sources in the sub-basin, NIRPC used Purdue University's web-based Load Duration Curve Analysis System[28]. The duration curve approach allows for characterizing water quality concentrations at different flow regimes. Using

[28] Purdue University Web-Based Load Duration Curve Analysis System https://engineering.purdue.edu/~ldc/JG/duration/main.cgi

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[29] . Loads that plot above the curve indicate 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.

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[30]

[29] 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

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

For this analysis NIRPC selected the option to retrieve USGS flow data and enter water quality data. A single USGS gaging station (#05536195) was found in the sub-basin corresponding to an IDEM sampling location UMC050-0002 with sufficient water quality parameter data to plot. This station is located on the Little Calumet River in Munster (Figure 53). Almost the entirety of the Plum Creek-Little Calumet River watershed empties through this point. Ideally, additional observations would also be available in upstream subwatersheds to help refine the identification of potential sources.

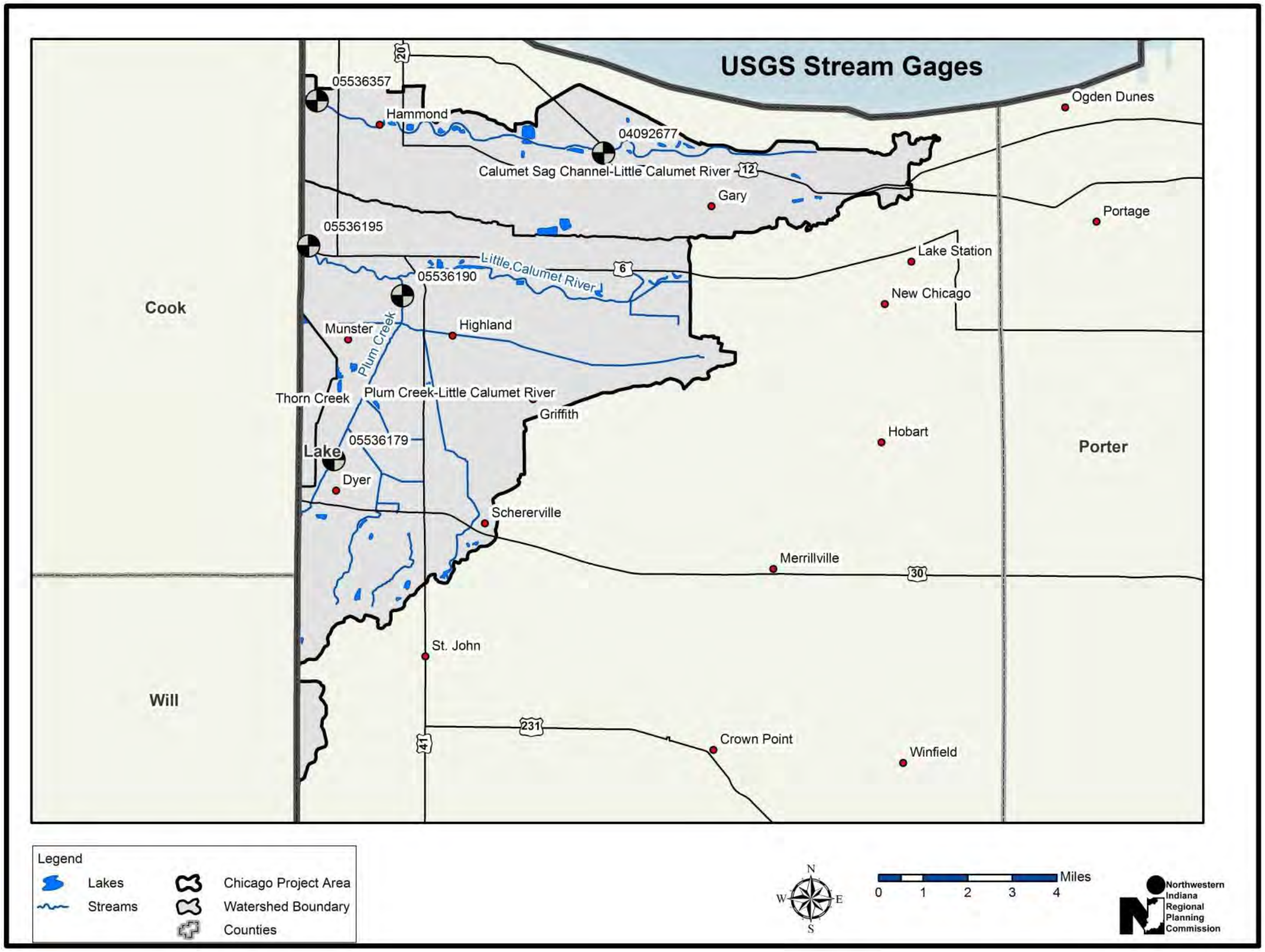

Figure 53 USGS Stream Gages

For the Load Duration Curve (LDC) analysis, NIRPC included the following water quality parameters when sufficient data was available:

- *E. coli*
- Total Suspended Solids (TSS)
- Total Kjeldahl Nitrogen (TKN)
- Total Phosphorous (TP)

Little Calumet River, UMC050-0002

Exceedances of the Nitrate-Nitrite water quality standard (10 mg/l) primarily occur during mid-range flows (Figure 54). Potential contributing sources areas with high relative importance for the mid-range flow regime include on-site wastewater systems (septic systems), riparian areas, storm water runoff from impervious areas (Figure 20), and combined sewer overflows (Figure 28).

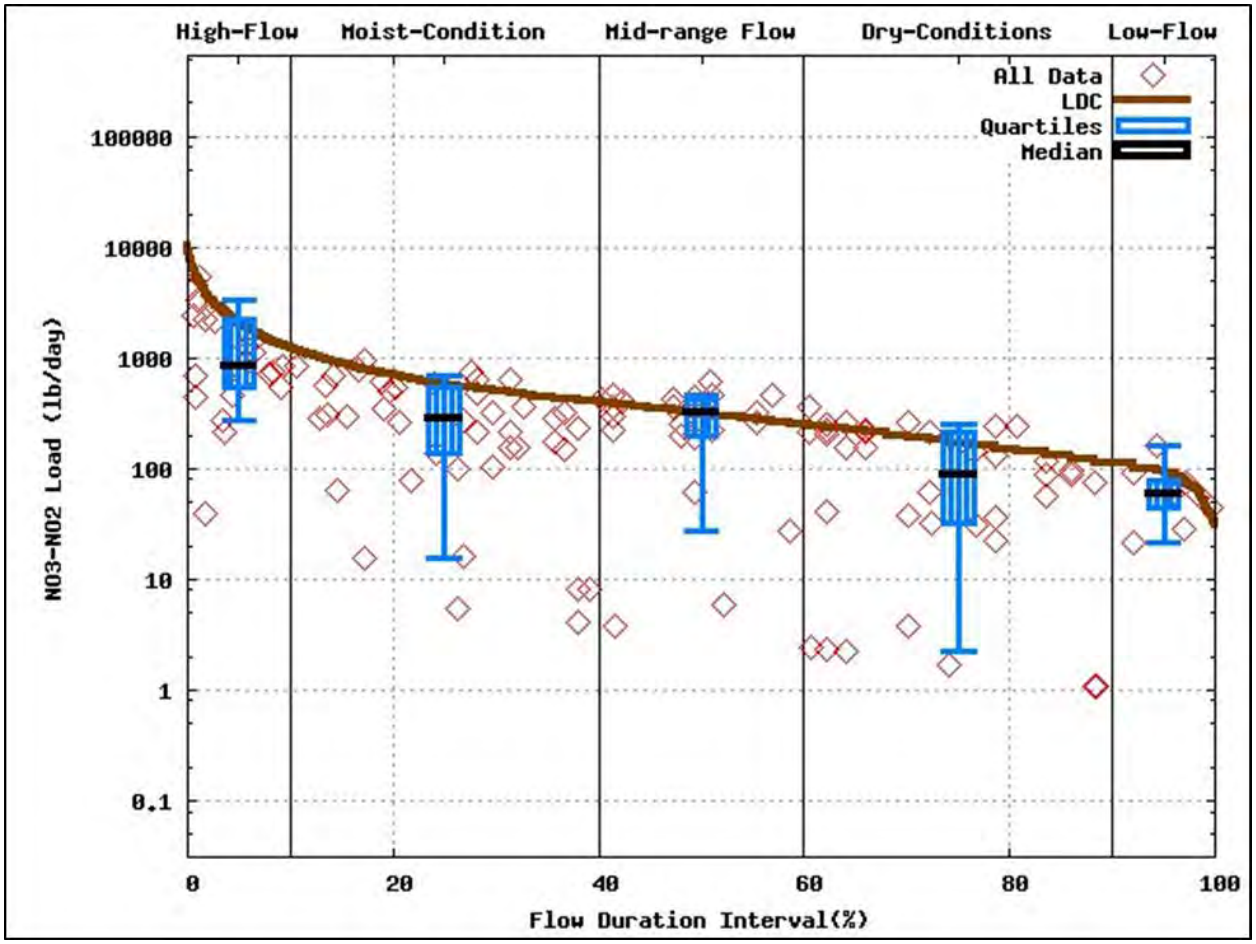

Figure 54 NO3-NO2 Load Duration Curve (IDEM Site UMC050-0002)

The load duration curve analysis for TKN (Figure 55) indicates that exceedances are occurring under all flow regimes at IDEM sampling location UMC050-0002. This indicates that exceedances can be attributed both point source discharges and storm water runoff. Several NPDES facilities are located upstream in the drainage area as can seen in Figure 47. Facilities such as wastewater treatment plants may contribute 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 19 shows that most of the subwatersheds that drain to the station have a high percentage development.

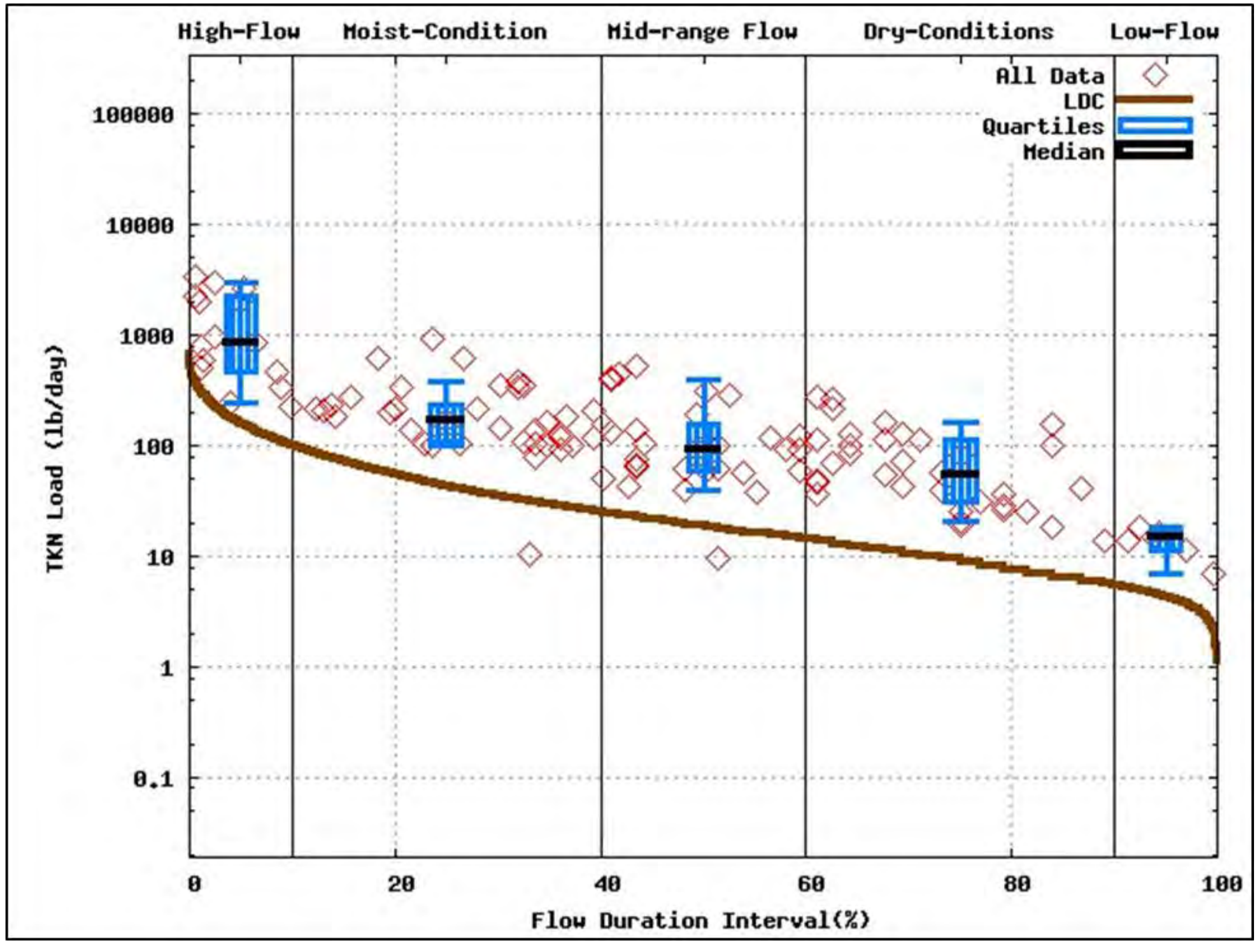

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Figure 55 TKN Load Duration Curve (IDEM Site UMC050-0002)

As with TKN, load duration curve analysis of total phosphorous (Figure 56) shows that exceedances are occurring under all flow regimes indicating both point and point source contributions from the watershed. Potential sources within the sub-basin include runoff from urban areas (Figure 14) and CSOs (Figure 28)

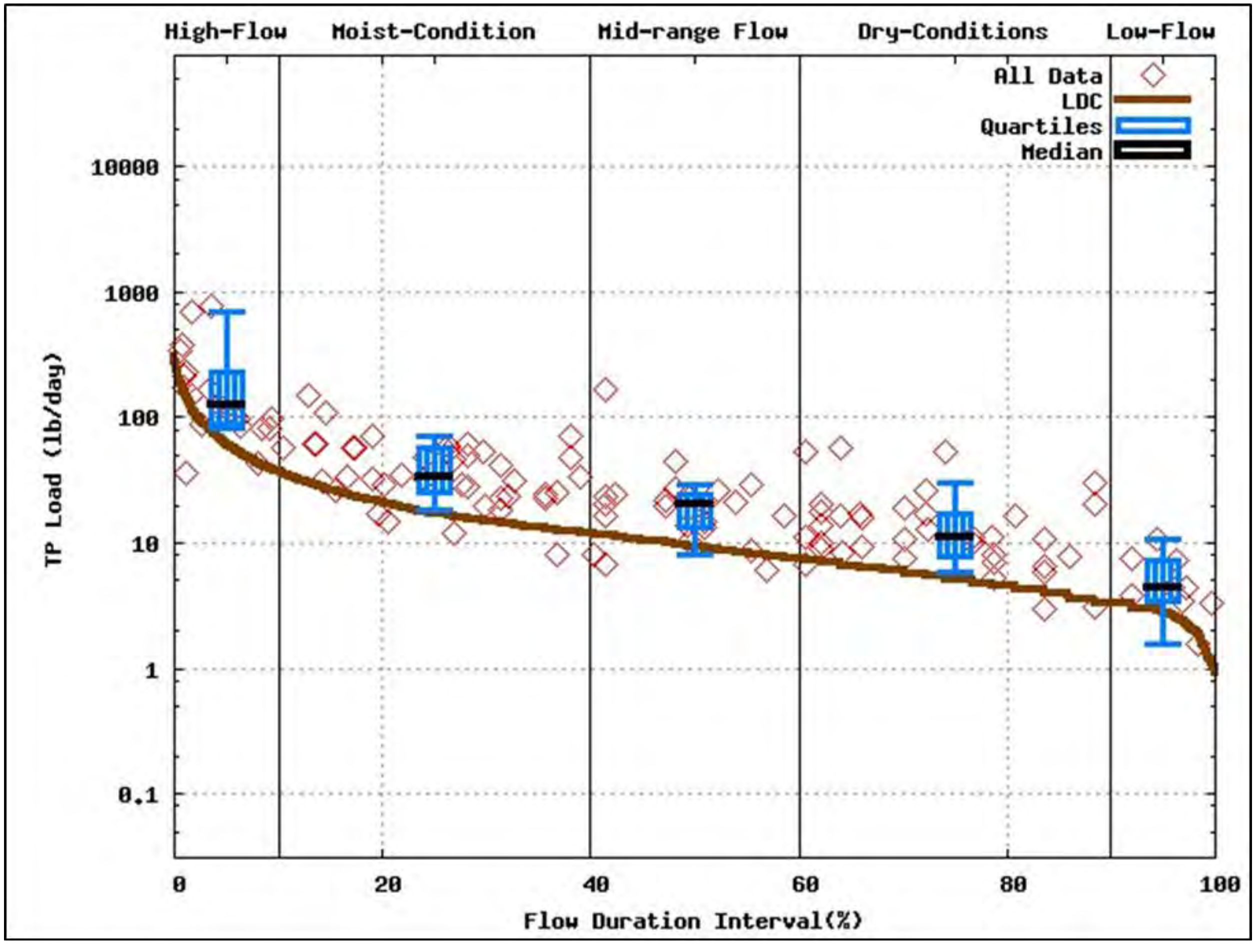

Figure 56 TP Load Duration Curve (IDEM Site UMC050-0002)

Load duration curve analysis for TSS (Figure 57) shows that exceedances while limited primarily occur during high flow (flood) conditions. High relative importance of contributing source areas includes upland storm water runoff (Figure 14) and streambank erosion.

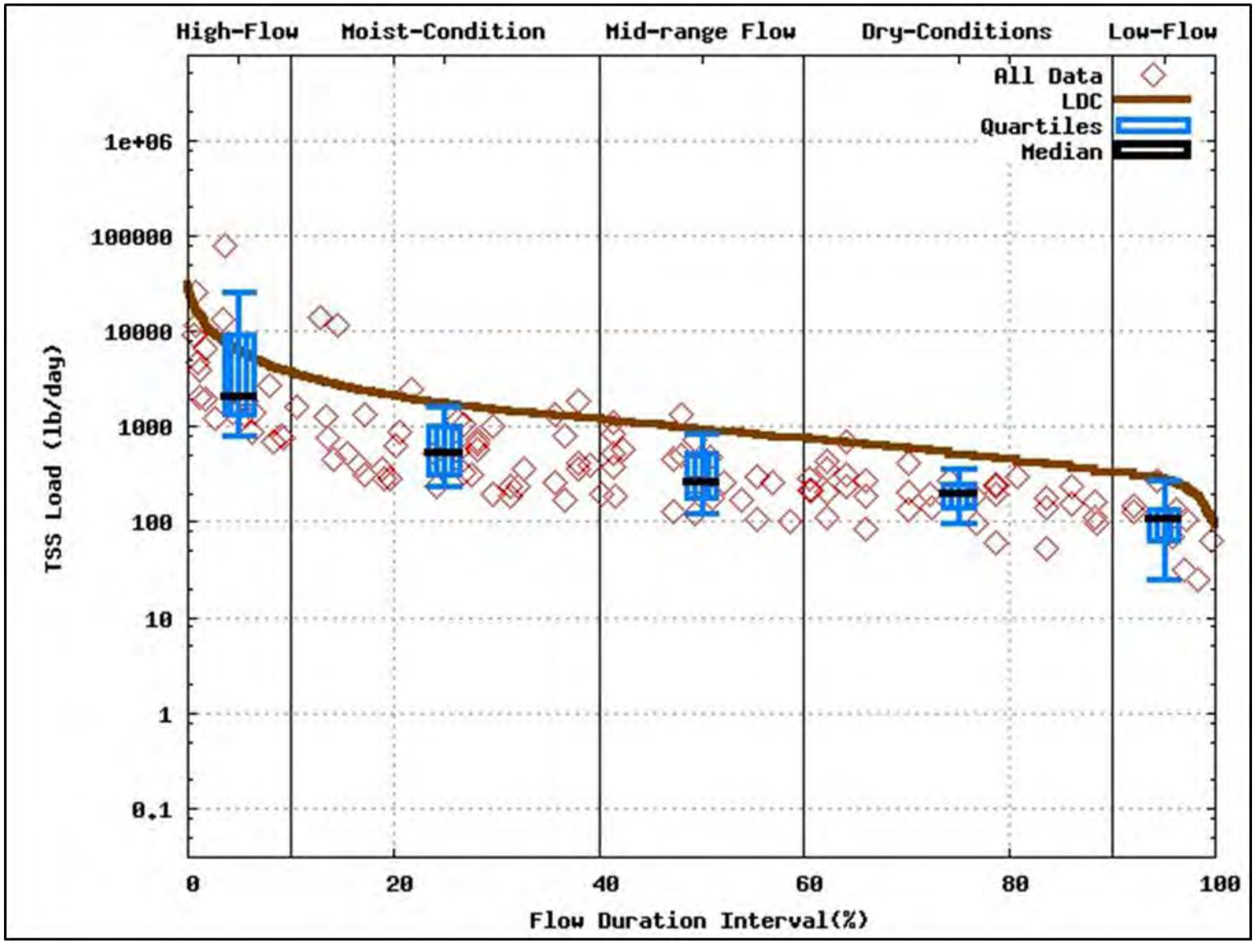

Figure 57 TSS Load Duration Curve (IDEM Site UMC050-0002)

4.4.2 Current Loads

Subwatershed loading of pollutants was done by NIRPC using the EPA's Spreadsheet Tool for Estimating Pollutant Load[31] (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 10), reference runoff curve number, nutrient concentration, urban land use distribution, and irrigation data.

NIRPC used the 2006 NOAA CCAP data presented in 4.1.5 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 4.1.4 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 in the following table and figures of this section. Table 13 presents the annual loading data for each subwatershed and also ranks them from highest to lowest.

[31] STEPL & STEPL Data Server http://it.tetratech-ffx.com/steplweb/default.htm

Subwatershed		N Load		P Load		BOD Load		Sediment Load	
HUC-12	STEPL #	lb/year	Rank	lb/year	Rank	lb/year	Rank	t/year	Rank
0203	W3	6,049.1	7	1,598.9	7	21,472.7	7	208.6	7
0302	W4	8,271.9	6	2,220.5	6	26,807.3	6	253.3	6
0303	W6	29,574.9	4	6,989.6	4	106,726.3	4	949.0	4
0304	W7	44,434.7	2	9,680.1	3	162,444.6	2	1,283.2	3
0305	W5	49,758.3	1	11,734.0	1	182,036.0	1	1,573.6	1
0406	W2	43,158.0	3	9,761.6	2	155,994.4	3	1,315.7	2
0407	W1	23,181.8	5	4,327.8	5	88,458.3	5	591.3	5
Total		204,428.7		46,312.4		743,939.7		6,174.7	

Table 13. Total Annual Load by Subwatershed

Figure 58 presents total nitrogen loading for each subwatershed. Total nitrogen load by land use for the sub-basin is displayed in Figure 59. The Town of Black Oak-Little Calumet River (HUC 071200030305), Plum Creek-Hart Ditch subwatershed (HUC 071200030304), and Grand Calumet River-Little Calumet River (HUC 071200030406) subwatersheds had the highest nitrogen loading rates as shown above in Table 13. From a watershed perspective, Figure 58 shows that subwatersheds located within the Plum Creek-Little Calumet River watershed generally had the highest nitrogen loading rates in the sub-basin. Nitrogen loading in the sub-basin is primarily from urban land uses.

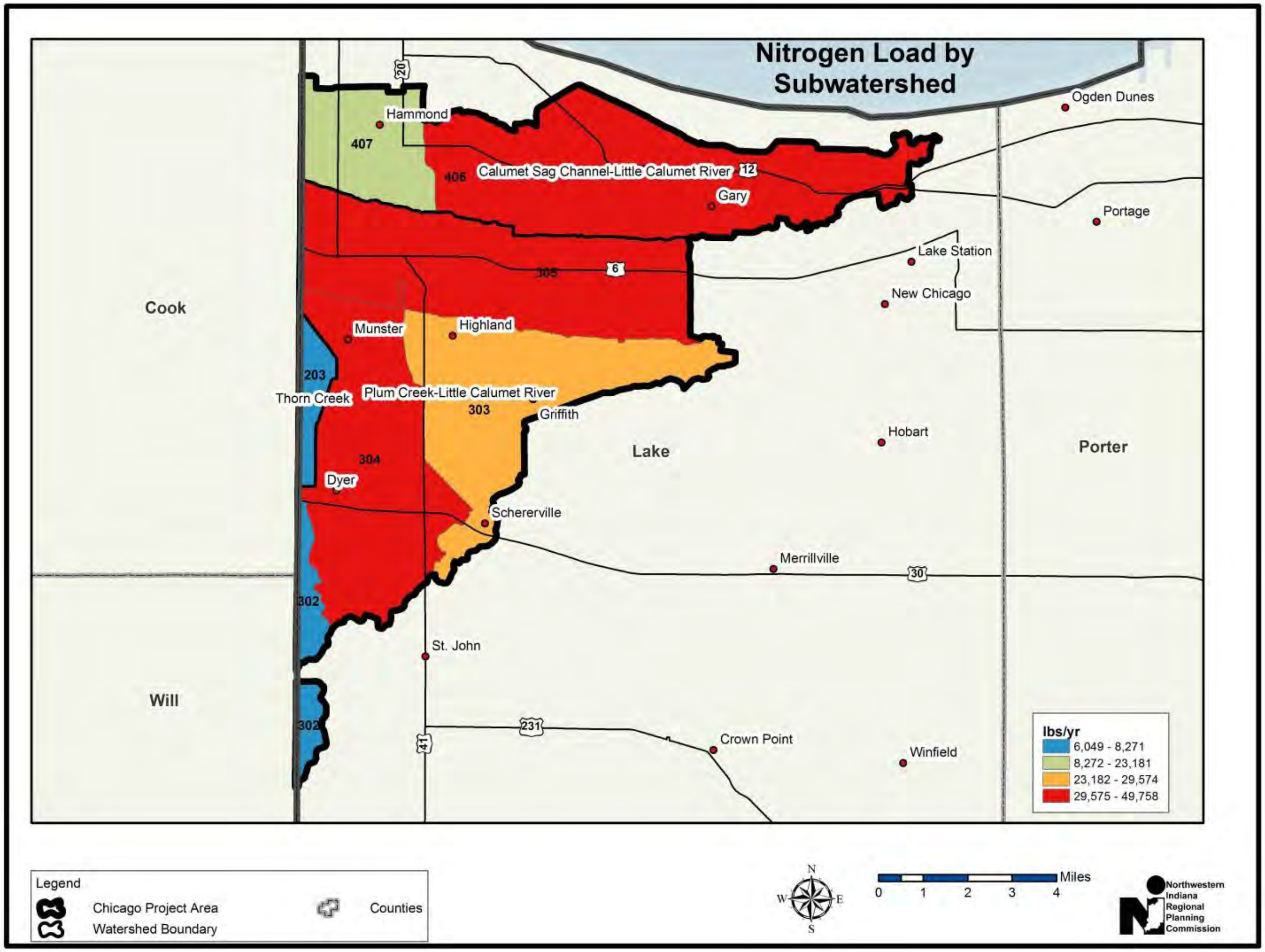

Figure 58 Nitrogen Load by Subwatershed

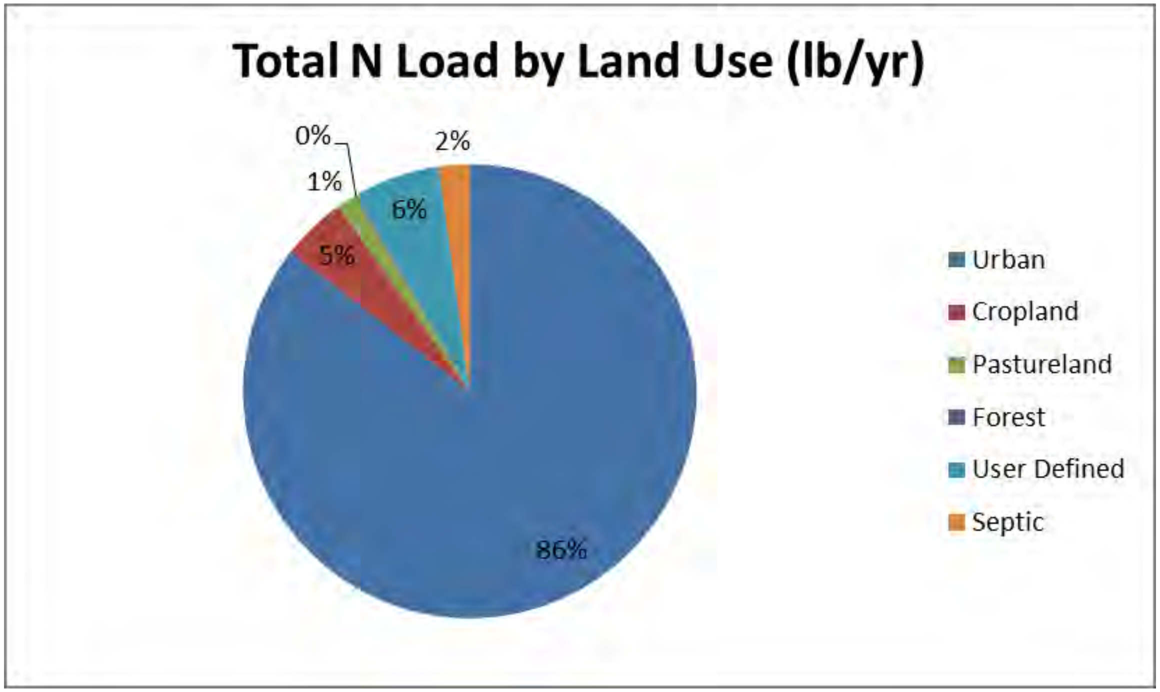

Figure 59. Total Nitrogen Load by Land Use

Figure 60 displays total phosphorous loading for each subwatershed. Total phosphorous load by land use for the sub-basin is displayed in Figure 61. The Town of Black Oak-Little Calumet River (HUC 071200030305), Plum Creek-Hart Ditch subwatershed (HUC 071200030304), and Grand Calumet River-Little Calumet River (HUC 071200030406) subwatersheds had the highest phosphorous loading rates as shown in Table 13. From a watershed perspective, Figure 60 shows that subwatersheds located within the Plum Creek-Little Calumet River watershed generally have the highest phosphorous loading rates in the sub-basin. Phosphorous loading in the sub-basin is primarily from urban land uses.

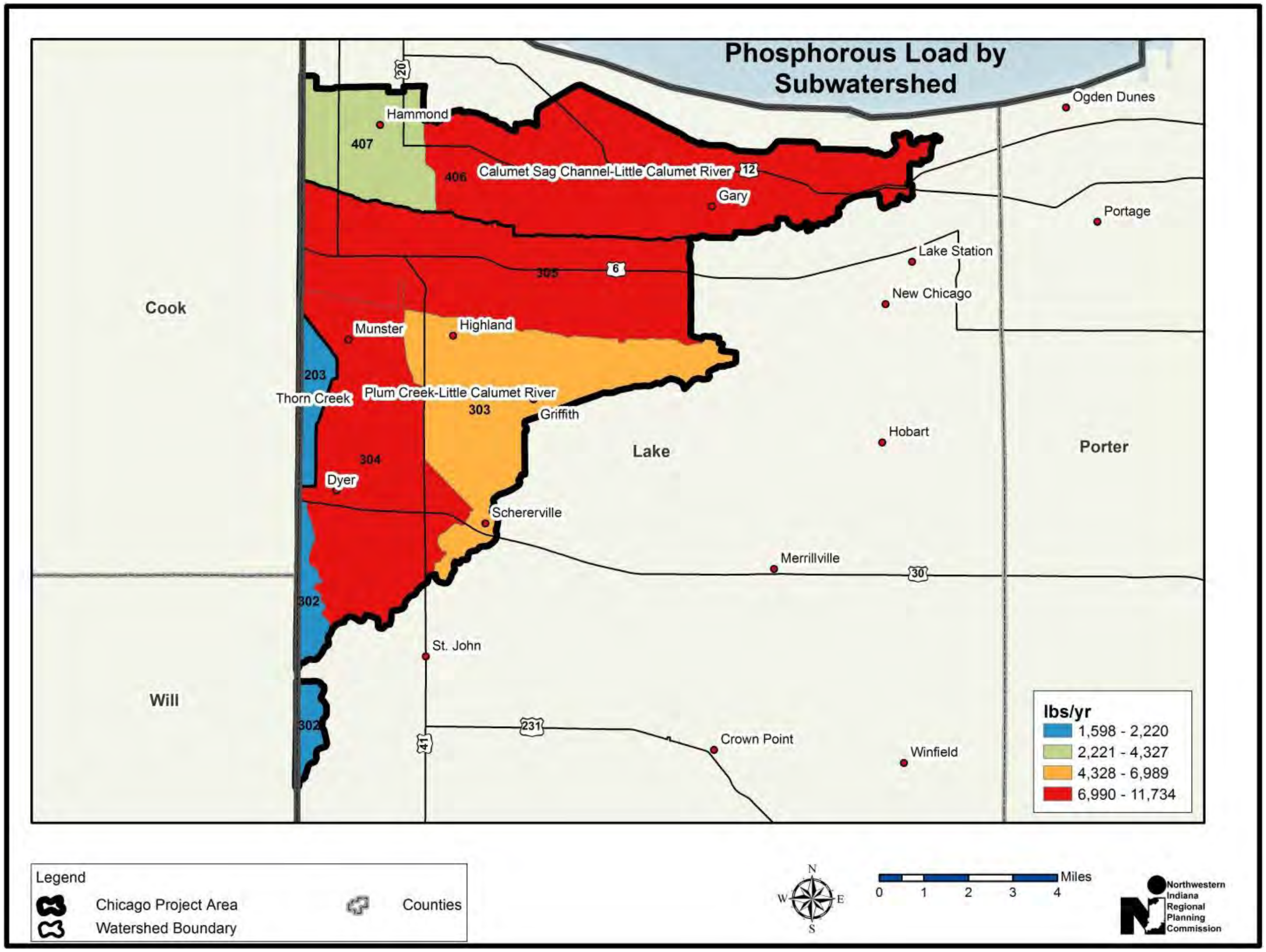

Figure 60 Total Phosphorous Load by Subwatershed

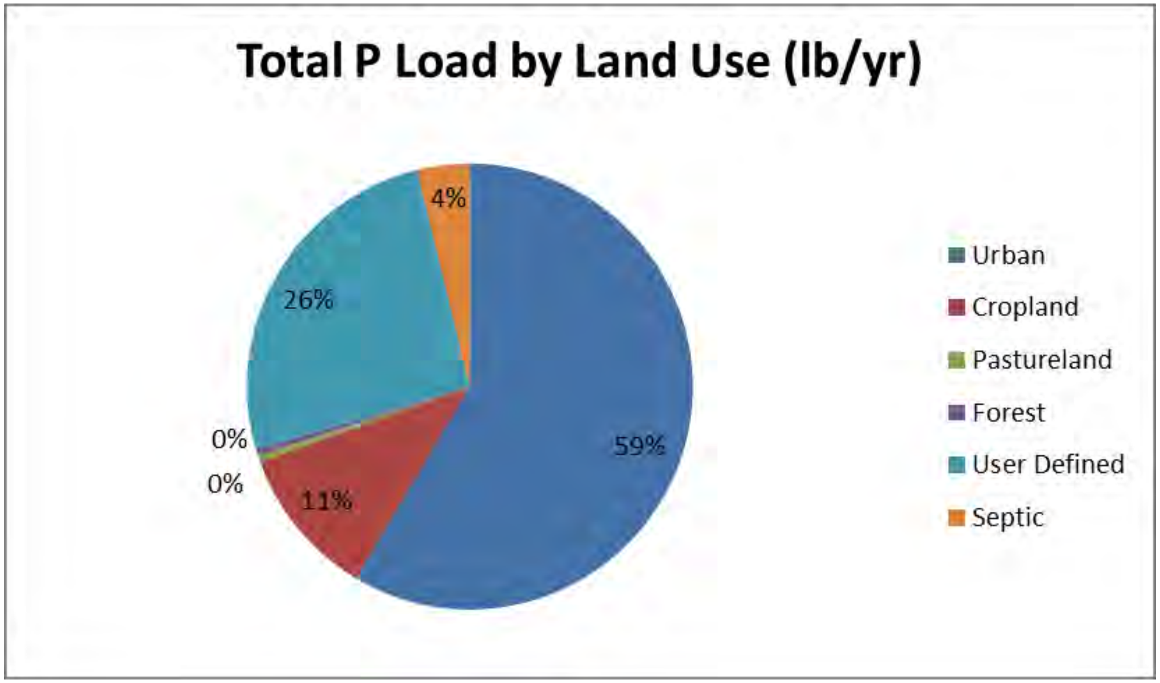

Figure 61 Phosphorous Load by Land Use

Figure 62 displays BOD loading for each subwatershed. Total BOD loading by land use for the sub-basin is shown in Figure 63. The Town of Black Oak-Little Calumet River (HUC 071200030305), Plum Creek-Hart Ditch subwatershed (HUC 071200030304), and Grand Calumet River-Little Calumet River (HUC 071200030406) subwatersheds had the highest BOD loading rates as shown in Table 13. From a watershed perspective, Figure 62 shows that subwatersheds located within the Plum Creek-Little Calumet River watershed generally have the highest BOD loading rates in the sub-basin. BOD loading is primarily attributed to urban sources in the sub-basin.

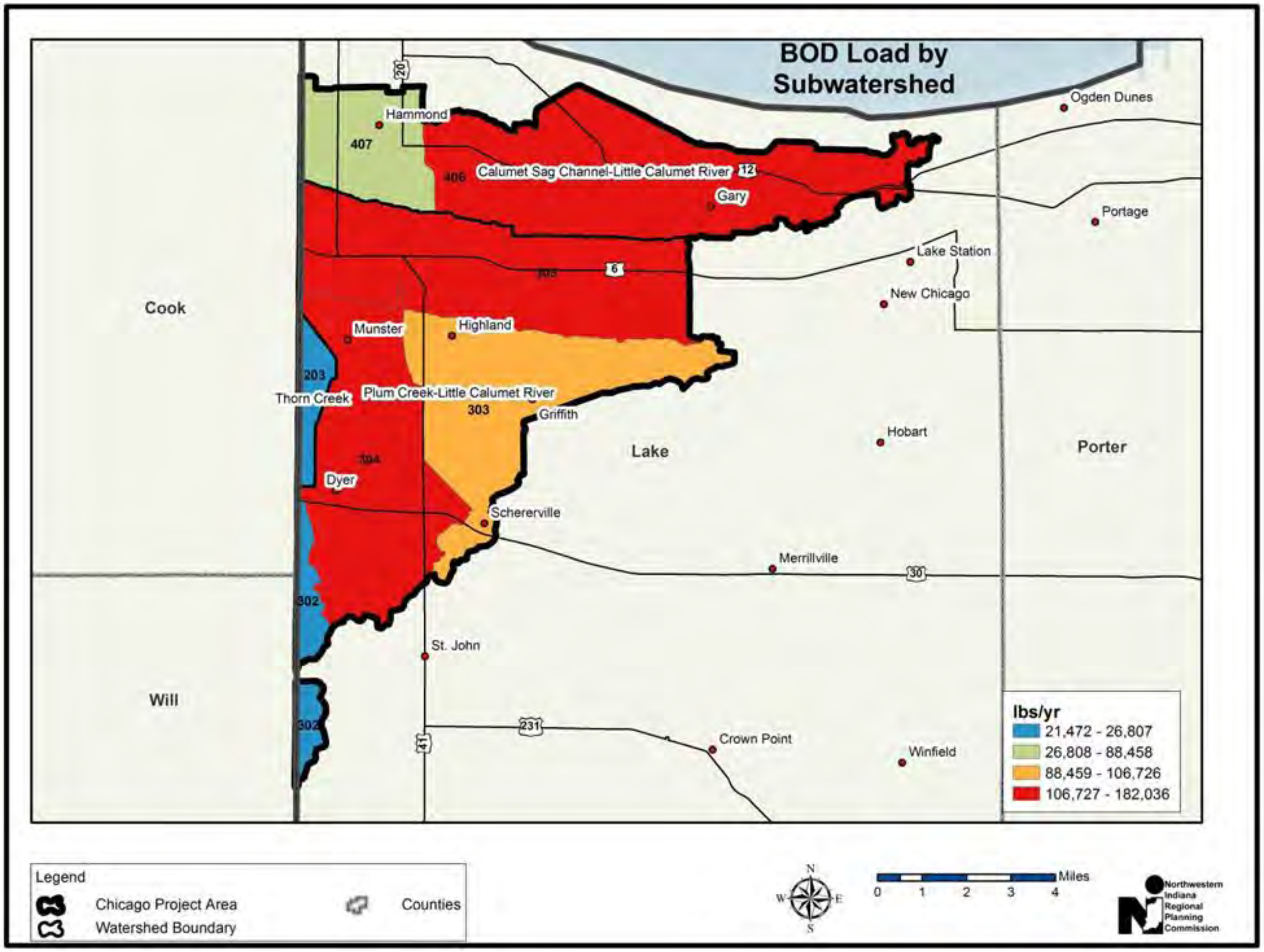

Figure 62 BOD Load by Subwatershed

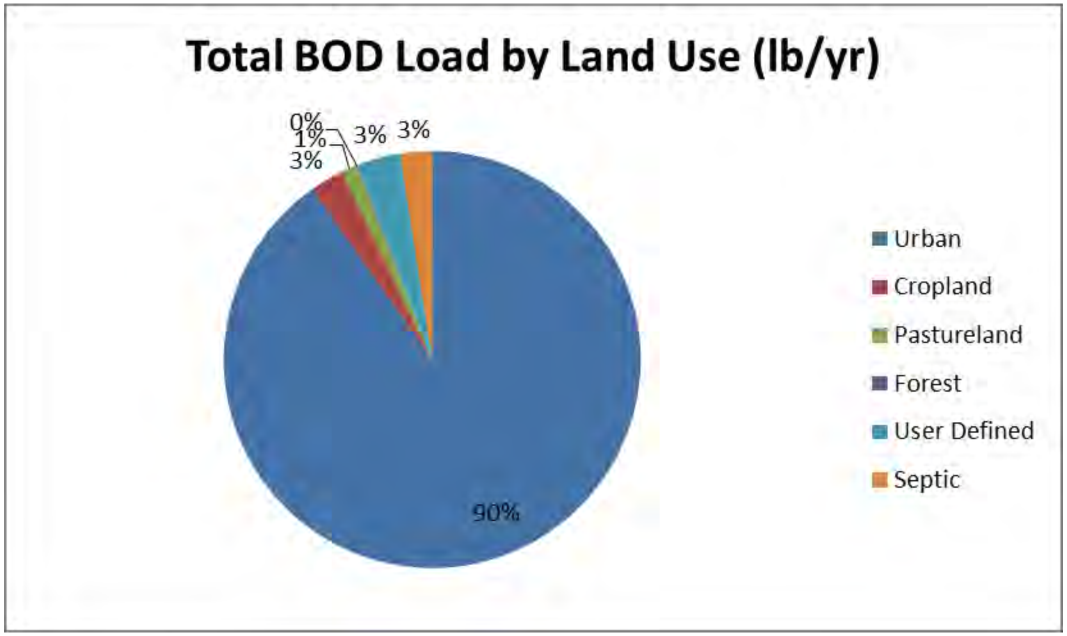

Figure 63. Total BOD Load by Land Use

Figure 64 displays sediment loading for each subwatershed. Total sediment loading by land use for the sub-basin is shown in Figure 65. The Town of Black Oak-Little Calumet River (HUC 071200030305), Plum Creek-Hart Ditch subwatershed (HUC 071200030304), and Grand Calumet River-Little Calumet River (HUC 071200030406) subwatersheds had the highest loading rates as shown in Table 13. From a watershed perspective, Figure 64 shows that subwatersheds located within the Plum Creek-Little Calumet River watershed generally have the highest sediment loading rates in the sub-basin. Urban land uses are the greatest contributor of sediment in the sub-basin.

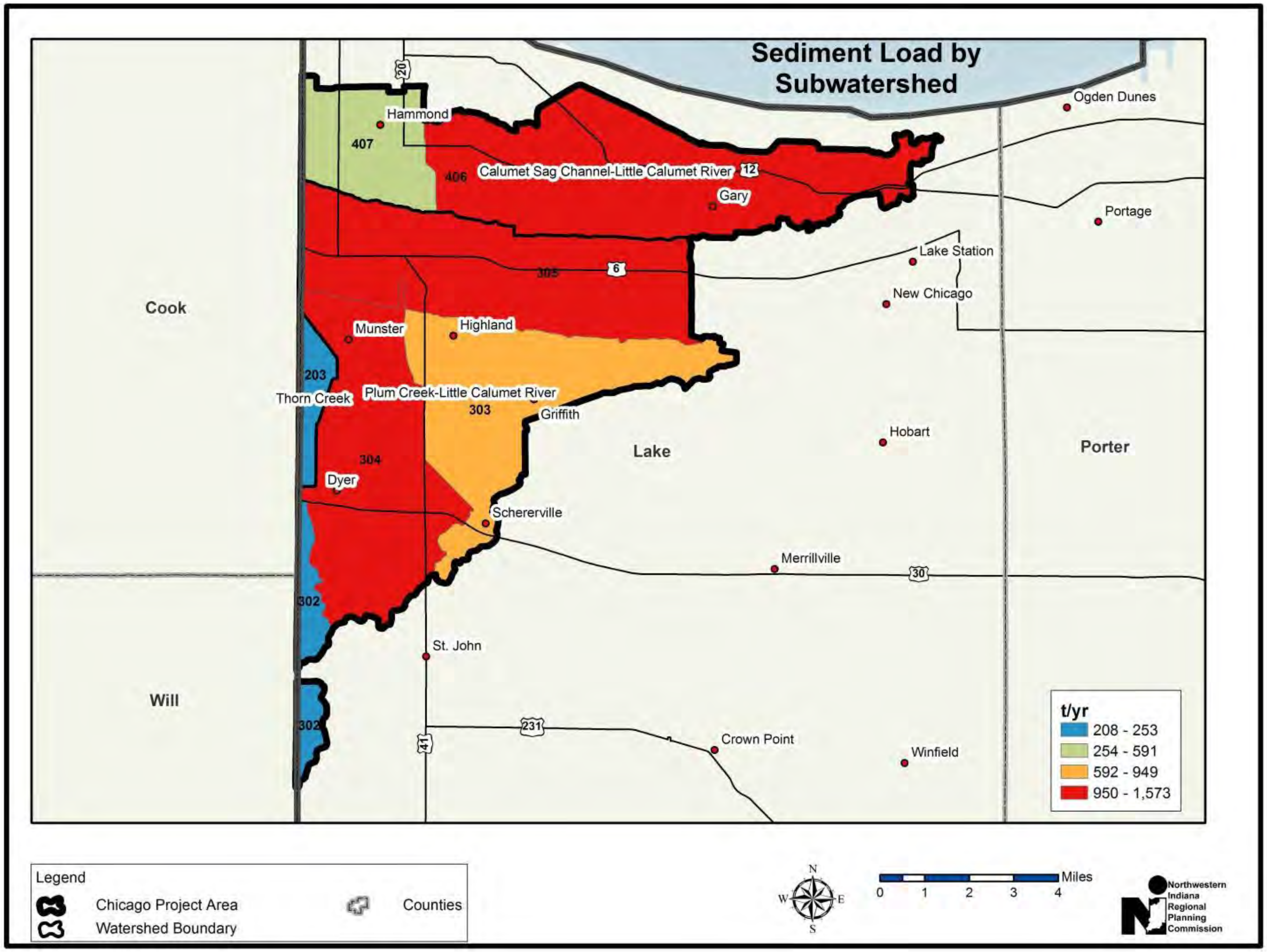

Figure 64 Sediment Load by Subwatershed

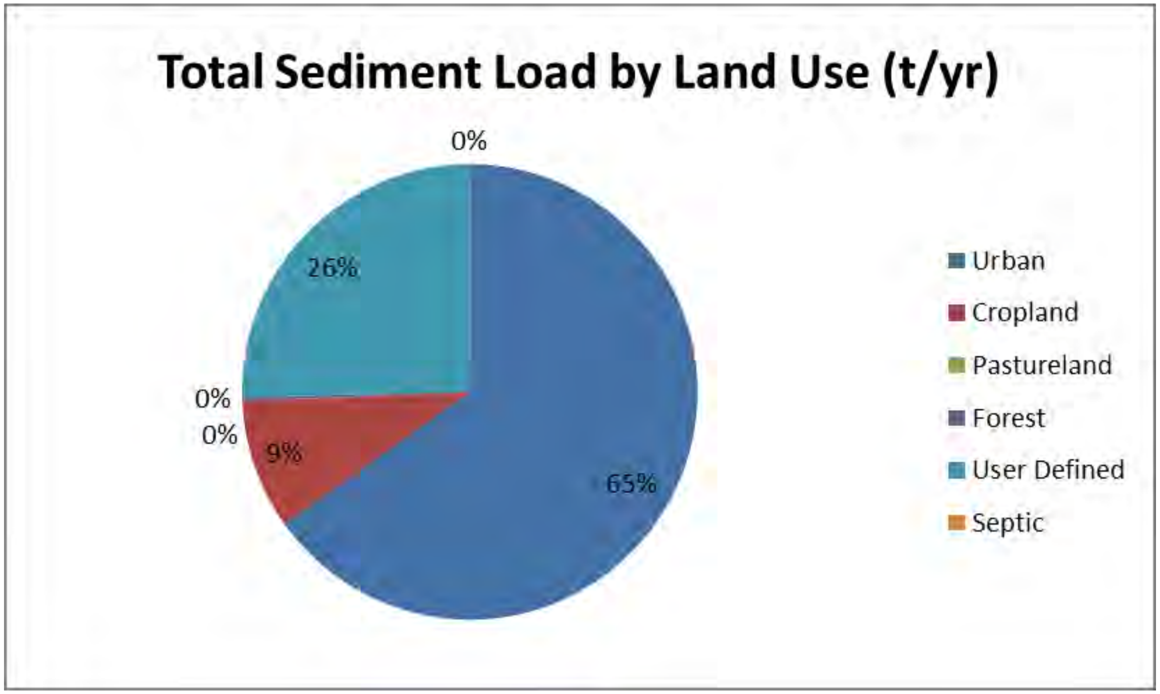

Figure 65. Total Sediment Load by Land Use

4.4.3 Load Reductions Needed

The following table presents the load reduction required based upon STEPL data and water quality targets used by NIRPC (Table 4). No reduction was need in nitrogen. Load reductions needed for *E. coli* are presented within the respective TMDL for that watershed presented in 4.2.2 Water Quality Information.

HUC-12	Nitrogen (lb/yr)			Phosphorous (lb/yr)			Sediment (t/yr)		
	Current	Target	Reduction Needed	Current	Target	Reduction Needed	Load	Target	Reduction Needed
203	6,049	27,580	N/A	1,599	827	772	209	41	167
302	8,272	32,346	N/A	2,221	970	1,250	253	49	205
303	29,575	121,683	N/A	6,990	3,650	3,339	949	183	766
304	44,435	208,079	N/A	9,680	6,242	3,438	1,283	312	971
305	49,758	234,867	N/A	11,734	7,046	4,688	1,574	352	1,221
406	43,158	179,476	N/A	9,762	5,384	4,377	1,316	269	1,046
407	23,182	113,839	N/A	4,328	3,415	913	591	171	421

Table 14. Load Reductions Needed to Achieve Target Pollutant Load

4.5 Next Steps & Prioritization

4.5.1 Next Steps

Four critical tasks are identified as needing immediate attention to move forward with watershed plan development:

1. Continuous Outreach: Constant communication and outreach is needed to raise awareness of water quality and aquatic habitat problems identified in the Watershed Framework and to build collaborative partnerships that lead towards the development of watershed management plans.
2. Scale: Information in the Watershed Framework will need to be focused to the watershed (HUC-10) scale through the creation of "watershed templates" to assist stakeholders in the development of individual watershed management plans.
3. Revitalization of Existing Watershed Management Plans: Existing plans that have not moved into implementation need to be revitalized and coordinated with the latest information.
4. Coordination: Successful development and implementation of watershed management plans depend primarily on the coordination of a variety of stakeholder groups.

Continuous Education and Outreach

In order for the Watershed Framework to be an effective watershed planning resource, the information it contains and its purpose will need to be promoted and conveyed in such a manner that a variety of stakeholder groups ranging from county and municipal officials to citizen groups can easily understand it. Key stakeholders will include those that can support and contribute resources towards the future development of watershed management plans. The benefits of the watershed approach will need to be conveyed so that the various stakeholder groups can see a clear benefit for them to participate. Establishing the stakeholder groups' primary motivators will need to be determined to best craft and convey the message.

NIRPC will work with a variety of partners such as the 2040 Comprehensive Regional Plan (CRP) Implementation Committee, SWCD's, and nonprofit environmental organization in developing an outreach strategy.

Scale

Watersheds have a hierarchy consisting of nested hydrologic units. The largest unit addressed in the Watershed Framework is the sub-basin which can be several hundred square miles in size. While the sub-basin (HUC-8) level information was effective in organizing and presenting regional scale information, practical and effective watershed management occurs at the watershed (HUC-10) and subwatershed (HUC-12) level. While organized to follow IDEM's 2009 WMP Checklist as closely as possible, information in the Watershed Framework will still need to be zoomed into to the watershed scale to develop individual watershed management plans that can be implemented. NIRPC can provide this information and at that scale in the form of "watershed templates" to assist stakeholders in developing plans for their particular watershed of interest.

Revitalization of Existing Watershed Management Plans

Within the Chicago sub-basin the West Branch Little Calumet River WMP's need to be revitalized and stakeholders reengaged so that implementation can move towards delisting waterbodies included on the 303d list. No coordinated effort currently existed to move this plan forward in implementation. No coordinator or implementation committee has been identified or formed to move it forward. An opportunity exists to realign this plan with current watershed boundaries to eliminate WMP gaps, eliminate management area overlap, and reengage stakeholders.

Coordination

Successful development and implementation of watershed management plans depend primarily on the coordination of a variety of stakeholder groups. Some will have knowledge of existing programs or plans that may be integrated into the watershed plan. Others may be able to provide information on the issues and concerns, provide technical or financial assistance, or help implement the plan.

Ultimately the decision to move forward with any watershed management planning process, and its future success in implementation, relies heavily on stakeholder buy-in and coordination. NIRPC will continue to raise awareness of the nonpoint source issues identified in the Watershed Framework and seek potential partners to help build and foster collaborative working relationships that lead towards plan development and implementation.

4.5.2 Prioritization

The West Branch Little Calumet River WMP is currently the only watershed management plan existing in Chicago sub-basin study area (Figure 31). This plan covers one 14-digit subwatershed within the Chicago sub-basin and two other subwatersheds located in the Deep River-Portage Burns Waterway watershed within the Little Calumet-Galien sub-basin. Gaps in the watershed planning within the Chicago sub-basin are listed in Table 15 and presented in Figure 66.

Subwatershed- No Existing Plan	Watershed Located IN
Headwaters Grand Calumet River	Calumet Sag Channel-Little Calumet River
Grand Calumet River-Little Calumet River	Calumet Sag Channel-Little Calumet River
Town of Black Oak-Little Calumet River (western portion)	Plum Creek-Little Calumet River
Plum Creek-Hart Ditch	Plum Creek-Little Calumet River
Plum Creek-Little Calumet River	Plum Creek-Little Calumet River
Plum Creek Forest Preserve-Plum Creek	Plum Creek-Little Calumet River
Cady Marsh Ditch	Plum Creek-Little Calumet River
North Creek	Thorn Creek

Table 15. Watershed Planning Gaps

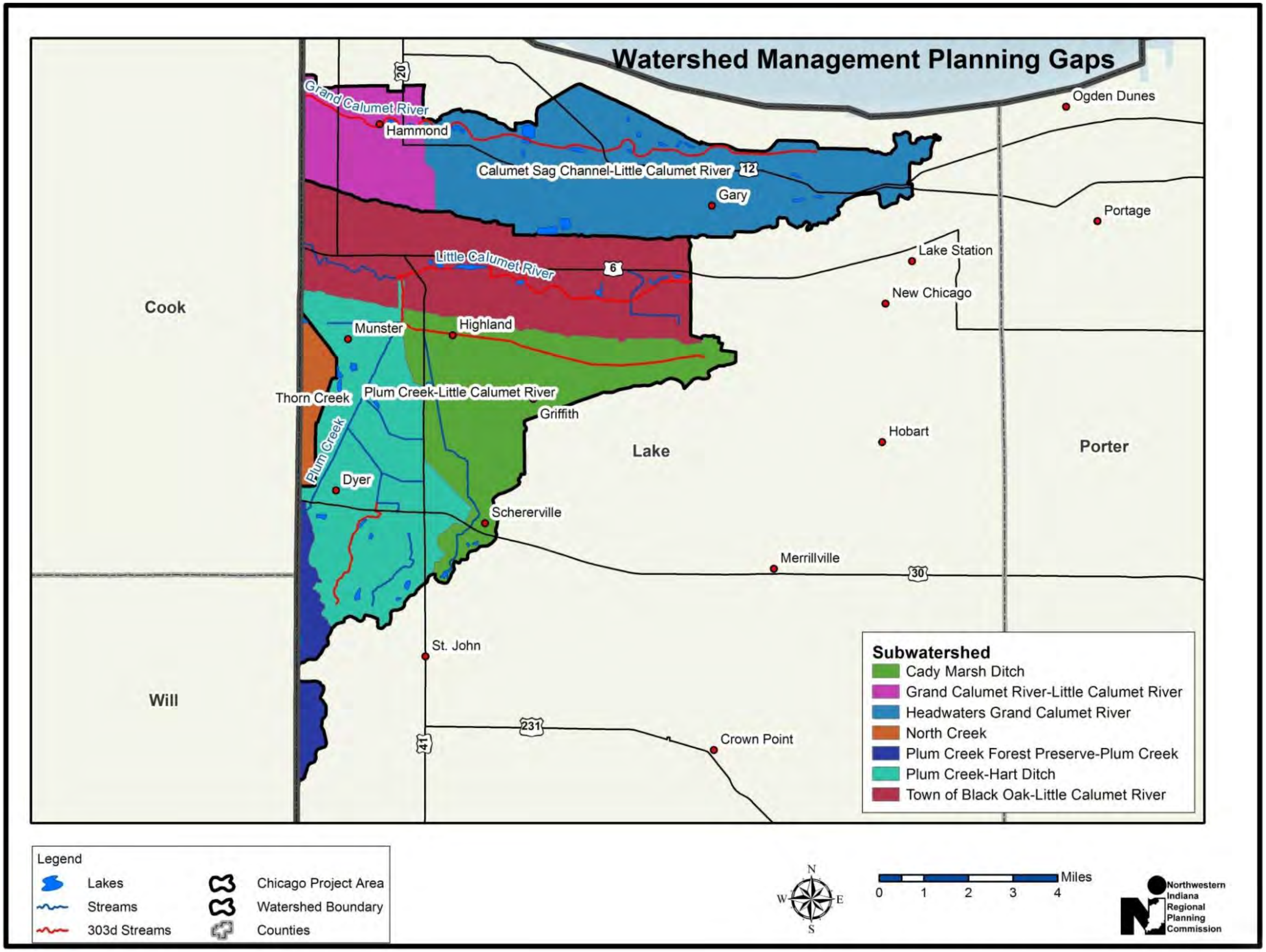

Figure 66 Watershed Management Planning Gaps

For consistency in following the revised watershed (HUC-10) and subwatershed (HUC-12) boundaries while filling these gaps, NIRPC's recommendations are as follows:

1. Based upon the exceedance/threshold analysis performed by NIRPC using water quality data from IDEM between 1999 and 2010, NIRPC places the highest priority on the Plum Creek-Little Calumet River watershed within the sub-basin. Phosphorous, BOD, and sediment annual loading rates for its subwatershed rank amongst the highest within the sub-basin. The watershed also had the highest development rates observed in the study area around Dyer, Highland and Munster. NIRPC did submit a 319 grant application for the 2011 funding cycle on behalf of a number of coordinating stakeholders to develop a watershed management plan.
2. Coordinate with stakeholders in Illinois should a plan ever startup on the Illinois side of the Thorn Creek Watershed. Less than 10% the watersheds drainage area is located within Indiana.
3. Participate with stakeholders working on delisting the BUIs for the Grand Calumet AOC as opportunities present themselves.

4.6 Potential Partners

The following table lists potential partners moving forward. It is meant to provide a starting point for consideration. The make-up of the partners will depend on the watershed and the key issues or concerns. Key partners include those that can contribute resources and technical assistance or that work on similar programs. The development of the stakeholder group is an iterative process. There likely won't be complete representation from the outset. Once stakeholders convene, the question of do any gaps in exist in representation can be asked.

Municipal Representatives
Dyer
East Chicago
Gary
Griffith
Hammond
Highland
Lake Station
Munster
Schererville
St. John
Land Owners
Citizen Groups

County or Regional Representative
Soil & Water Conservation Districts
County Surveyors Office
County Extension Service- Lake, Porter and LaPorte Counties
Little Calumet River Basin Commission
County Planning Departments
County Parks Departments
County Solid Waste Districts
County Health Department
State & Federal Agencies
NRCS
Indiana Department of Natural Resources- Coastal Program, Division of Fish & Wildlife
Indiana State Department of Agriculture
Indiana Dunes National Lakeshore
Indiana Department of Environmental Management- Watershed Specialist, Office of Pollution Prevention, Wellhead Protection Program
Northwest Territory RC&D
Indiana State Department of Health
U.S. Geological Survey
Indiana Department of Transportation
U.S. Fish & Wildlife Service
Universities
Indiana University Northwest
Indiana University
Purdue University Calumet
Purdue University North Central
Purdue University
Valparaiso University
Environmental & Conservation Groups
Save the Dunes
Shirley Heinze Land Trust
The Nature Conservancy

Izaak Walton League
Business & Industry Representatives
The Wildlife Habitat Council
Northwest Indiana Forum

Table 16 Potential Future Partners