Watershed Management Plan for Lake, Porter, and LaPorte Counties

Northwestern Indiana Regional Planning Commission

Final

October 2005

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1.1 Background

The purpose of the Northwest Indiana Regional Watershed Plan is to develop a framework for water quality improvements and planning within Northwestern Indiana Regional Planning Commission's (NIRPC) planning area. The water quality problems and issues facing this region are sometimes complicated and need to be addressed in a holistic manner. Water quality problems can be linked to how the region has developed over the last century.

The area once was home to great marshes, wetlands, meandering streams and rivers, and plant and animal diversity that we can only get a glimpse of in protected and undeveloped areas. Industrial development along Lake Michigan has left its legacy of issues behind in regional waterbodies, but it is not the only source of water quality impairments. Agricultural uses along the Kankakee River have changed the river bringing along a different set of issues. As northwest Indiana has seen population growth and development, occurrences of combined sewer overflows and sanitary sewer overflows, failing septic systems, and the loss of wetlands and open space have all increased as a result of this growth. Growth is not necessarily bad if the system is protected and the impacts of development are managed in a way to mitigate the potentially negative effects.

Located on approximately 45 miles of the southern shore of Lake Michigan, Lake, Porter, and LaPorte counties encompass approximately 1,513 square miles. Within this area there are two large watersheds partially lying within the three counties. The Little Calumet-Galien Basin lies in the northern portion of the counties along Lake Michigan, and the Kankakee River Basin lies to the south. Figure 1-1 shows the project location. NIRPC is planning for these two large water basins because they are the two which are of truly regional scale in northwest Indiana, crossing all three of the counties comprising NIRPC's planning jurisdiction.

NIRPC undertook this plan that focuses on the two watersheds rather than on the artificial political boundaries that have been the focus of water quality planning in the past. By focusing on watersheds, this water quality planning initiative recognizes that any pollution that is discharged within a watershed will eventually flow downhill with the potential to impair the waterway, unless properly managed or naturally attenuated. Communities throughout Lake, Porter, and LaPorte Counties have started to develop watershed plans and/or implementation projects that will improve water quality within that sub-watershed (Appendix 1). Smaller sub-watersheds within these larger basins can be better planned for and managed by the individual counties or their municipalities. For more details on the development of subwatershed plans see Chapter 6.

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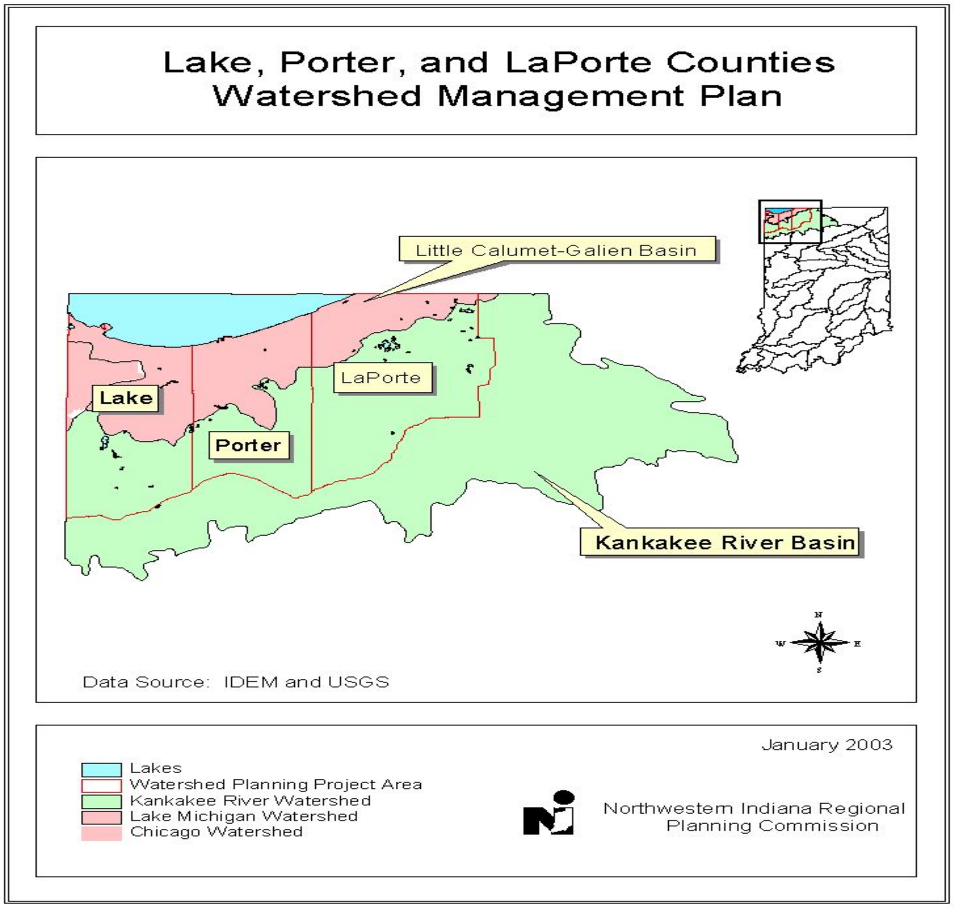


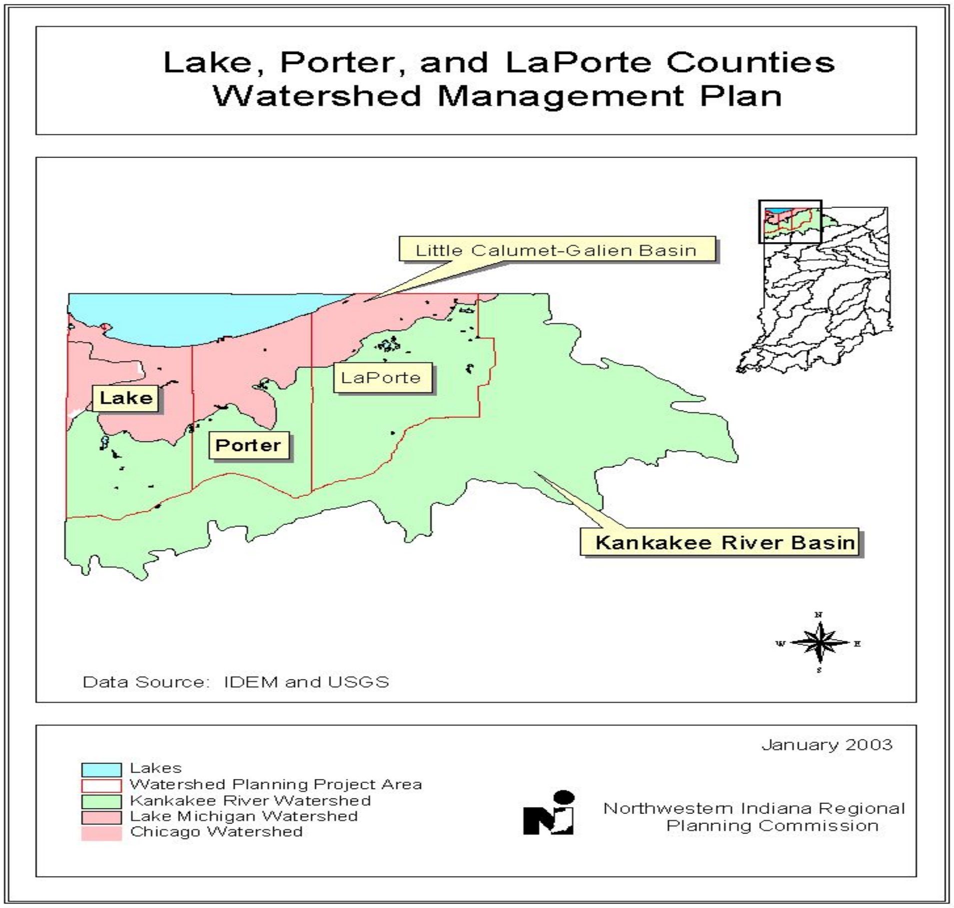
Figure 1-1 Project Location

1.2 History of Regional Watershed Planning in Northwest Indiana

NIRPC received a Clean Water Act Section 205(j) watershed planning grant from the Indiana Department of Environmental Management (IDEM) in July 2001 for a comprehensive watershed planning project for the counties of Lake, Porter and LaPorte in northwest Indiana which has funded the development of this plan.

In 1998, the three-county area was determined to have a high priority for water restoration funding by the Unified Watershed Assessment for Indiana. The most recent plan dealing with watershed and water quality issues in northwest Indiana was completed by NIRPC in 1978 under a grant from Section 208 Water Quality Management Planning from the United States Environmental Protection Agency (USEPA). However, that plan only addressed issues in Lake and Porter Counties.

Water quality and watershed management issues are slowly becoming increasingly important in northwest Indiana. As communities began implementing strategies from the section 208 Water Quality Management Planning project, a need for an updated plan was realized. Several sub-watersheds either are in the process or have all ready developed



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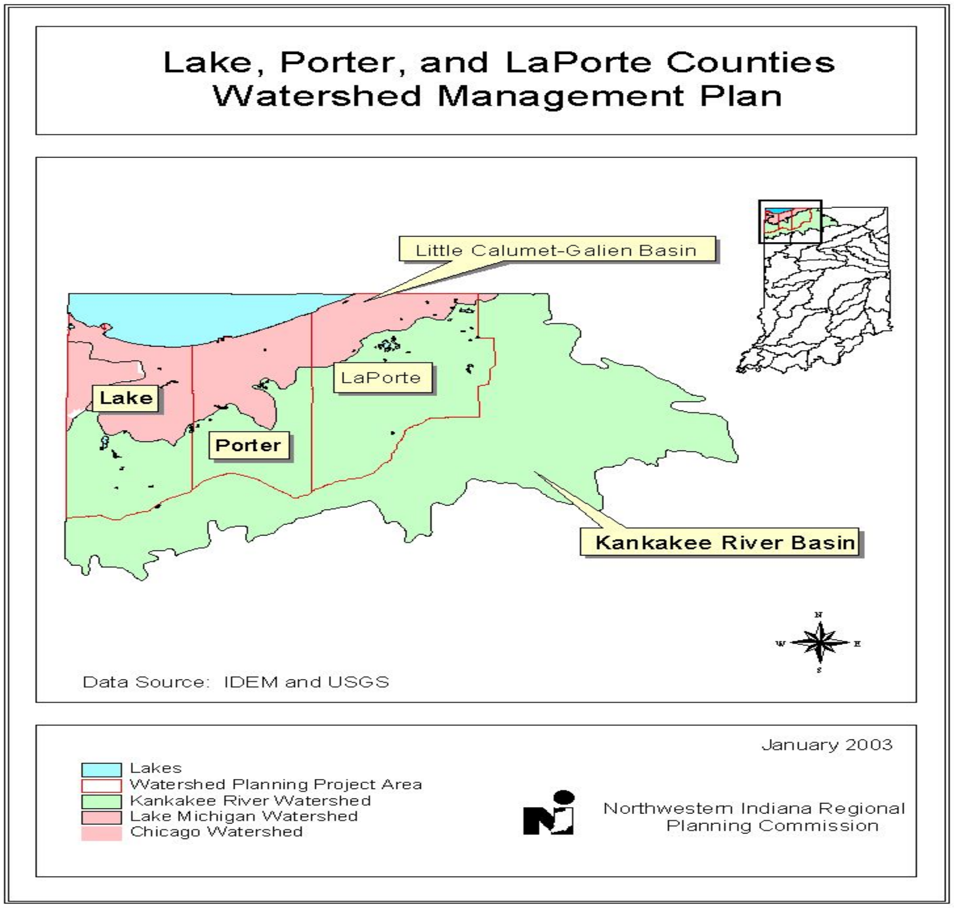

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their own watershed management plans. This study is unique in that it is addressing two rather large watersheds from a comprehensive vantage point.

The goals for this plan were to bring all of the stakeholders to the table and to commit to work together in establishing achievable management practices and protective goals. This plan will assist the State in water quality management planning, provide support for IDEM's Total Maximum Daily Load program (see next section), and provide guidance for the region's communities and the public.

1.3 Related Initiatives

1.3.1 Lake Michigan Coastal Program Nonpoint Pollution Control Plan

As a part of becoming a Coastal Zone state, the Indiana Lake Michigan Coastal Program (ILMCP) is required to complete a Coastal Nonpoint Source Pollution Management Plan (6217 plan). This plan is required by the National Oceanic and Atmospheric Administration (NOAA) and the USEPA. There is some overlap between this plan and the 6217 plan since they both address essentially the same geographic area. The plan will include a series of 5-year implementation plans. The plan's management measures address agricultural runoff; forestry runoff; marinas and recreational boating; channel modification; dams and erosion of stream banks and the shoreline; wetlands; riparian areas; and vegetated treatment systems. For more information go to www.in.gov/dnr/lakemich/issues/cprprogram.htm

1.3.2 Municipal Separated Storm Sewer Systems (MS4)

MS4 affects most communities within the three-county study area. The program requires communities to develop, implement, and enforce a stormwater management program that will reduce the discharge of pollutants. The program has six (6) control measures and should identify best management practices (BMPs) and measurable goals for each measure. The six (6) control measures are: 1) Public Education and Outreach, 2) Public Participation/Involvement, 3) Illicit Discharge Detection and Elimination, 4) Construction Site Runoff Control, 5) Post-construction Runoff Control, and 6) Pollution Prevention/Good Housekeeping. NIRPC is conducting the first two control measures for most MS4 communities within Lake and Porter Counties. For more information go to: http://cfpub.epa.gov/npdes/stormwater/phase2.cfm or http://www.in.gov/idem/water/npdes/permits/wetwthr/storm/rule13.html

1.3.3 Grand Calumet Remedial Action Plan

The Grand Calumet River has been listed as an Area of Concern with the International Joint Commission since 1987. The Grand Calumet Remedial Action Plan (RAP) provides strategies for restoration and delisting the Grand Calumet River, which is listed for all 14 Beneficial Use Impairments. The Citizens Advisory for the Remediation of the Environment committee and IDEM are leading this effort to restore the Grand Calumet River and delist it as an area of concern.

1.3.4 Kankakee River Basin Commission

The Kankakee River Basin Commission (KRBC) was created in 1977 by the Indiana General Assembly to address water resource development issues, primarily flood control and drainage problems, in the eight-county Kankakee River basin. Currently, the KRBC's priorities include sediment/erosion, development impacts on the basin, and flooding. The KRBC is working with the local drainage boards and the SWCDs to encourage and implement best management practices on farmland. With the local drainage boards, the KRBC has continued a program to remove trees and obstructions to the river channel which have led to scouring of the riverbanks and levees and also partnered with other local and state agencies to provide stabilization to the riverbanks through vegetation or rip rap. The KRBC and the Lake County Drainage Board built a six mile levee in southern Lake County which protects over 10,000 agricultural and residential acres from direct flooding of the Kankakee. The long range priorities of the KRBC lie with the ecosystem restoration/flood control study being completed by the Chicago District Army Corps of Engineers for the entire Illinois-Indiana Kankakee watershed. The KRBC also is sponsoring watershed management plan development for smaller watersheds within the larger basin.

1.3.5 National Pollutant Discharge Elimination System (NPDES)

The Clean Water Act of 1972 enabled the National Pollutant Discharge Elimination System (NPDES) that requires a permit to discharge pollutants to waterbodies within the United States. The permit includes a limit to the amount of pollutant that can be discharged. Municipal wastewater treatment plants and industrial users that discharge pollutants into streams and rivers are required to obtain NPDES permits. The purpose of the NPDES permit is to protect water bodies from point source pollution. Pollution in the waterbodies can limit recreational uses as well as impair drinking water sources. NPDES permits in Indiana are obtained through the IDEM with oversight from USEPA Region 5.

1.3.6 IDEM 305(b) and 303(d) Water Quality Reports and Total Maximum Daily Loads

IDEM's Office of Water Quality completed its most recent Integrated Water Quality Monitoring and Assessment Report for Indiana streams in 2004. Required biannually by Section 305(b) and Section 303(d) of the federal Water Pollution Control Act, the assessment provides an evaluation of whether or not waterbodies support the State's designated uses and water quality standards.

Once assessed, each waterbody is placed into one of five categories depending on the degree to which it supports designated uses for full body contact recreation and for protection of aquatic life, wildlife or human health. The fifth category is the 303(d) List of Impaired Waterbodies and is separated into two (2) categories. The waterbodies placed on the 5A list are required to undergo a planning process designed to reduce the amount of the pollutant(s) for which it is listed from both point and nonpoint sources of pollution. This process is called Total Maximum Daily Loads (TMDL). IDEM defines a TMDL as "a process that leads to quantification of the amount of a specific pollutant discharged into a waterbody that can be assimilated and still meet the water quality standards (designated uses)." The waterbodies placed on the 5B list are impaired for Fish Consumption Advisories (FCA) for PCBs and/or mercury and do not require a TMDL.

River miles in a 14-digit watershed (a smaller sub-watershed than the 8-digit watersheds used for this plan) are designated as one waterbody. These waterbodies can be broken into smaller segments to properly reflect the water quality assessment. Each lake in a watershed is reported as a separate waterbody. A total of 60 waterbody segments are listed on the 2004 303(d) List for Impaired Waterbodies (303(d) List) for the Little Calumet-Galien (43 segments) and Kankakee River Basins (17 segments). Appendix III contains the Impaired Waterbodies lists including parameters of concern, some for multiple parameters, and the TMDL development schedule. For the sake of this management plan, the portion of Lake County which now drains into Illinois (the Chicago Basin) is included because during certain times of the year this area flows into the Little Calumet-Galien basin. Four waterbody segments from this basin are located within Indiana. Figure 1-2 indicates the 2004 303(d) impaired waterbodies.

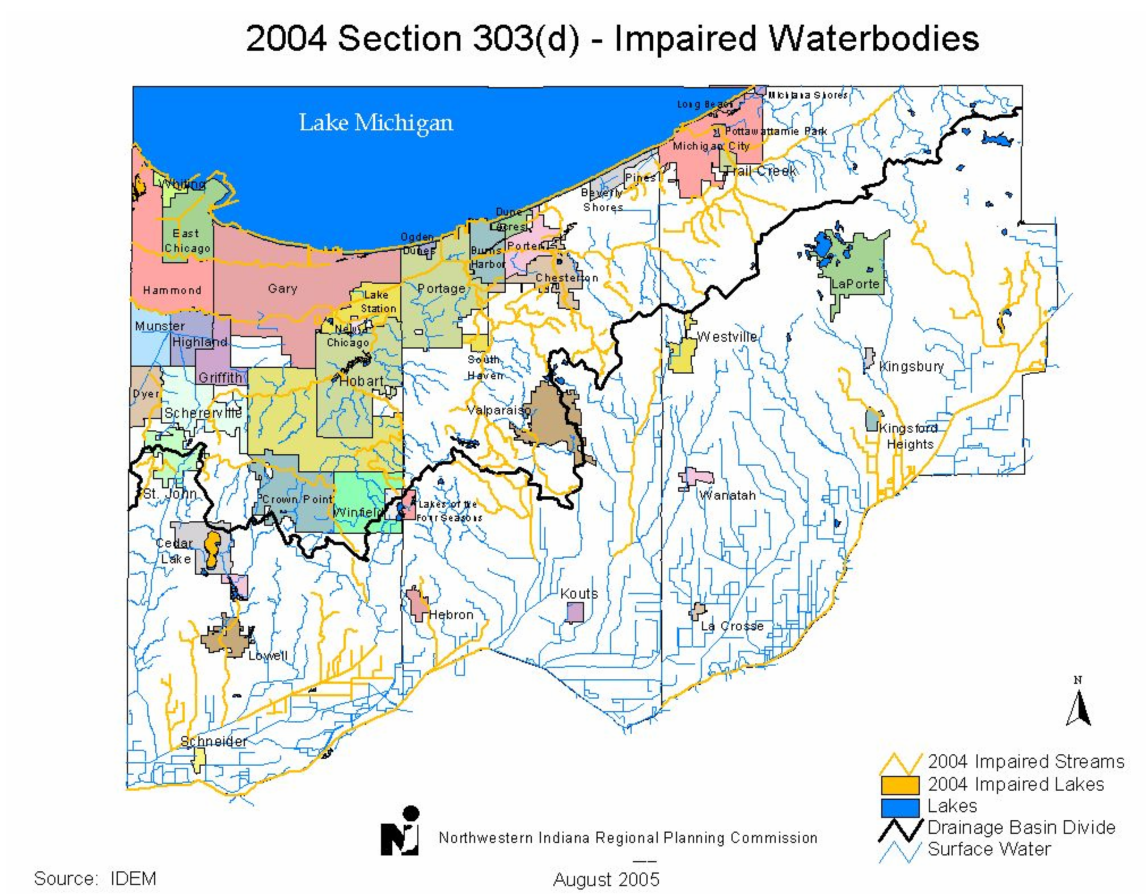


Figure 1-2 2004 Section 303(d) Impaired Waterbodies

The following is a summary of these impairments for the Little Calumet-Galien:

- **Main Beaver Dam Ditch:** Impaired Biotic Community
- **Burns Waterway:** Fish Consumption Advisories for Polychlorinated Biphenyl (PCB) and Mercury, Impaired Biotic Community and *E. Coli*;
- **Little Calumet River West Branch:** Fish Consumption Advisory for PCB and Mercury, *E. coli*, and Cyanide;
- **Little Calumet River East Branch:** Fish Consumption Advisory for PCB and Mercury, *E. coli*
- **Dunes Creek**: *E. coli*, Impaired Biotic Community;
- **Deep River:** Impaired Biotic Community, siltation, and *E. coli*;
- **Grand Calumet River:** Fish Consumption Advisory for PCB and/or Mercury, Cyanide, oil and grease, Impaired Biotic Community, and Ammonia;
- **Lake Michigan Shoreline:** *E. coli* and Fish Consumption Advisory for PCB and Mercury;
- **Salt Creek**: Impaired Biotic Community and *E. coli*;
- **Trail Creek:** *E. coli*, Impaired Biotic Community, and Fish Consumption Advisory for PCB;
- **Galena River:** *E. coli* and Impaired Biotic Community;
- **Coffee Creek:** *E. coli*

The following is a summary of these impairments for the Kankakee River:

- **Cedar Creek:** Impaired Biotic Communities, FCA
- **Cobb Creek/Breyfogel Ditch:** Impaired Biotic Communities
- **Crooked Creek:** Impaired Biotic Communities
- **Dyer Ditch:** Impaired Biotic Communities
- **Kankakee River – Mainstem:** Impaired Biotic Communities, FCA, *E. coli*,
- **Bull Run Basin:** Impaired Biotic Communities
- **Singleton Ditch – Bruce Ditch/Bailey Ditch:** Impaired Biotic Communities
- **Singleton Ditch – Bryant Ditch:** *E. coli*
- **Kankakee River – Travis Ditch/Long Ditch:** *E. coli*
- **Cobb Ditch – Sievers Cree**k: Impaired Biotic Communities
- **Salisbury Ditch:** Impaired Biotic Communities
- **Little Kankakee River – Byron:** *E. coli*
- **Little Kankakee River – Mill Creek-Fish Lakes:** Impaired Biotic Communities
- **Lower Fish Lake:** FCA
- **Pine Creek – Horace Miller Ditch:** *E. coli*
- **East Branch Stony Run:** Nutrients, Total Dissolved Solids

1.4 Watershed Advisory Group

This watershed planning effort would not have occurred without the participation of the advisory group and technical team members. Their dedication to the mission and vision for a three county two watershed planning effort has resulted in this planning document.

The watershed planning project began in 2001, with a group of stakeholders from Lake, Porter, and LaPorte counties representing federal, state, and local agencies, industry, agricultural and environmentalist groups and citizens. A complete list of stakeholders can be found in Table 1-1. These individuals came together to participate on the Regional Watershed Advisory Group (Advisory Group). This four year planning effort has seen many contributors and has persevered through two watershed coordinators and the shifting of federal and state planning criteria.

Table 1-1 Watershed Advisory Group

Name	Organization	County
Non Governmental or Industrial Groups		
Tom Anderson	Save The Dunes Council	LaPorte County
Lee Botts	Environmentalist	Lake County
Charlotte Read	Save The Dunes Council	LaPorte County
Dr. Mark Reshkin	Professor Emeritus, Indiana University	Porter County
Jeffery Edstrom	CADMUS Group	Chicago, IL
Municipalities		
Dorreen Carey	City of Gary	Lake County
Jim Meyer	City of Gary, Gary Sanitary District	Lake County
Glen Eberly	Town of Dyer	Lake County
Craig Grow	Town of Ogden Dunes	Porter County
Margorie Hefner	Town of Kouts	Porter County
Craig Hendrix	City of Portage	Porter County
Denarie Kane	City of Hobart	Lake County
Steve Truchan	City of Hobart	Lake County
Paul Panther	Town of Ogden Dunes	Porter County
Dave Pilz	City of Valparaiso	Porter County
Dan Thompkins	Town of Trail Creek	LaPorte County
Steve Yagelski	Town of Chesterton	Porter County
County and Regional Representatives		
George Van Til	Lake County Surveyor	Lake County
Dan Gossman	Lake County Surveyor’s Office	Lake County
Kevin Breitzke	Porter County Surveyor	Porter County
Robert Thompson	Porter County Planning Director	Porter County
Dan Gardner	Little Calumet River Basin Commission	
Jody Melton	Kankakee River Basin Commission	
Industry		
Kay Nelson	Northwest Indiana Forum	
Doug Bley	ISG Burns Harbor	Porter County
Bill Herbert	Lake Station	Lake County

Federal and State Agencies		
Larry Osterholz	Indiana Department of Agriculture	
Chuck Walker	USDA-NRCS	Porter County
Mike Molnar	IDNR – Lake Michigan Coastal Program	
Jenny Orsburn	IDNR – Lake Michigan Coastal Program	
Martin Jaffe	IL-IN Sea Grant Program	University of Illinois Chicago
Robert McCormick	IL-IN Sea Grant Program	Purdue University – West Lafayette
Molini Goel	IDEM – Northwest Office	
Alex DaSilva	IDEM – Northwest Office	
Joe Keithly	IDEM – Northwest Office	
Eric Oliver	IDEM	
Bonnie Elifritz	IDEM	
Matt Jarvis	IDEM-NRCS Watershed Advisor	
NIRPC Coordinators		
Jennifer Gadzala	NIRPC Watershed Coordinator	(2001-2004)
Christine Owens	NIRPC Watershed Coordinator	(2004-2005)

In addition, the Advisory Group serves as the advisory body to the Environmental Management Policy Committee (EMPC) and ultimately NIRPC commissioners. They act as advocates for the watershed management plan to local agencies, communities, and the general public. It is the intention of NIRPC that a standing Watershed Group be established with the vital role of plan implementation throughout the region. Specifically, the Advisory Group was established for the following purpose:

1. To advise NIRPC on the development of the regional watershed management plan and the execution of activities
2. To identify regional water quality issues
3. To develop and promote a regional focus for a tri-county watershed management plan
4. To guide technical teams while working with existing water quality initiatives at the local and state level

The Advisory Group met quarterly throughout the four year process. Their tasks included the development of the vision and mission statement, reviewing the information collected by the technical teams, reviewing draft plans and making comment, and conducting public comments and participation sessions. The Technical Team met monthly the first three years and then quarterly the last year with monthly conference calls and e-mail correspondence.

The Technical Teams functioned as the research and working groups for the planning process. Initially there were three Technical Teams created to focus on three areas of concern identified by the Advisory Group: (1) Governmental Regulation, Coordination, and Enhancement; (2) Water Quality and Environmental Impacts; (3) and Land Use. In 2003, the Technical Teams came together as one group to organize the identified concerns and begin developing goals and objectives. The Technical Team was divided by watershed in 2005 to allow for a more detailed focus on the Little Calumet-Galien and Kankakee River Basins.

1.5 Plan Development

This plan was developed using and building upon the resources provided through current regional initiatives and the Indiana Department of Environmental Management (IDEM) Watershed Management Section, Watershed Plan Checklist, effective August 2003. The IDEM 303(d) and 305(b) water quality reports provide a basis for the identification of water quality problems that are discussed in subsequent chapters. The Regional Watershed Plan, following the Watershed Plan Checklist, provides the framework for smaller watersheds in the three county region of northwest Indiana to develop and implement their own watershed plan.

Many of the participants in the development of the Regional Watershed Plan concurrently participated in the development of the Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan (6217 Plan). Because many of the same issues were identified during both processes, the 6217 Plan was used as a foundation for this plan as adopted by the Watershed Advisory Group. Though the 6217 Plan addresses only the Little Calumet- Galien basin excluding the Chicago Watershed, the plan management measures are consistent with the issues identified in the Kankakee River Basin.

The Watershed Advisory Group by working to address all concerns came up with this widely accepted solution to prevent duplication and overlap. Technical Teams through guidance from USEPA Region 5, IDEM, and the Lake Michigan Coastal Program developed a regional watershed plan that adopts the 6217 goals and builds upon the recommendations made in the 6217 plan.

For the purposes of this plan, the Watershed Advisory Group and Technical Teams chose to focus on the 303(d) listed water body impairments as the impairments addressed in this plan. It is the intent of this plan, that resources should be focused on 303(d) listed waterbodies for the critical areas identified in subsequent chapters. Other concerns raised by the group are discussed in the Concern Matrix found in Appendix IV. Many of these concerns are discussed throughout this document.

1.6 Quality of Life

NIPRC worked cooperatively with the Northwest Indiana Quality of Life Council to develop a Quality of Life Indicators Report (Report) for northwest Indiana. The data and analysis that was collected helped the Advisory Group with the task of identifying regional concerns and contributed to a broader understanding of the region's assets, challenges, concerns, and potential for all citizens. The Indicators Report served as a guidepost for watershed stakeholders as they moved through the planning process and integrated environmental concerns with economic development, regional opportunity, growth, and social equity.

The Quality of Life Council Indicators Report reviewed the concerns and challenges developed by the Advisory Group Technical Teams and agreed that water pollution may represent a long-term challenge to the northwest Indiana region. The Report also concluded with the Advisory Group that since all communities in northwest Indiana derive their drinking water from Lake Michigan, groundwater, or surface water and with water playing a vital role in our economic and environmental well-being maintaining, the quality of the region's water systems should be regarded as a very high priority.

The Advisory Group agreed to continue to partner with the Quality of Life Council as the watershed planning process moved forward.

1.7 Mission Statement

The Mission the Advisory Group developed is as follows:

To establish a watershed planning and management framework for the enhancement, restoration, and protection of water quality in Lake, Porter, and LaPorte counties through the facilitation of communication, education, and coordination among watershed stakeholders.

This mission statement reflects the concerns of the watershed stakeholders that coordination among stakeholders and awareness of watershed issues need to be addressed. The mission statement is used to guide the group in developing goals and recommendations to improve water quality within the Little Calumet/Galien and Kankakee River basins.

1.8 Public Involvement

The general public is an important component of any successful planning effort. Those individuals that live and work within the Little Calumet-Galien and Kankakee River basins bring a wealth of knowledge to this project. In order to encourage their participation, NIRPC developed press releases and sent out flyers to identified stakeholders announcing the kickoff meeting for the project. All meetings were open to the public. Throughout the duration of the project, a calendar on NIRPC's website listed dates and times for the Advisory Group and Technical Team meetings. Other efforts were made through announcements at other meetings, the creation of the *Regional Waters* newsletter, and participation at events such as environmental fairs and conferences. Public comment sessions were held to obtain additional participation and input in the plan. The Advisory Group reported back to the EMPC on the progress made toward the completion of the plan monthly, allowing attendees an opportunity to provide feedback and an opportunity to participate in the process through public comment periods or volunteering to serve on a committee. A series of information sessions were held throughout the three-county area prior to the adoption of this plan by the NIRPC Commission.

Many communities within the basins recognized the significance that this project had on them and committed to make appropriate staff and resources available to this effort. Sanitary Districts, health departments, and town council representatives participated at various levels. The IDEM Northwest Regional Office, USEPA Region 5, Natural Resource Conservation Services (NRCS), IL/IN Sea Grant and Indiana Department of Natural Resources (IDNR) provided input and information as well.

1.9 Document Format

The next chapter is dedicated to the delineation and description of the Little Calumet-Galien and Kankakee River watersheds. Subsequent chapters of this document are organized according to issue categories affecting northwest Indiana's water quality following the format of the Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan (6217). They fall into three areas:

Chapter 3 - Urban and Rural Areas
Chapter 4 - Agricultural Sources
Chapter 5 - Hydromodifications

Within each chapter there will be identification of the specific problems; causes, sources, and stressors of those problems; and goals, objectives, and action steps to achieve improved water quality with associated indicators and costs to implement.

In the 6217 plan one additional area was investigated that did not receive a high priority by the Watershed Advisory Group: Marinas and Recreational Boating. The goal developed in the plan stated "Ensure that marina construction and operation, and recreational boating in the northwest Indiana meet and maintain applicable water quality standards." Eight critical areas with associated objectives were developed. Details of this section may be found in the 6217 plan.

Finally, Chapter 6 presents a plan for adopting and evaluating the plan including steps for subwatershed group to take to plan further in their subwatersheds.

An inventory of references used to develop this plan including water-related, soils, and land information, guidance information, reports/studies in the region, comprehensive plans, and other projects is included in Appendix II.

Chapter 2
Watershed Descriptions

2.1 Little Calumet-Galien Watershed

2.1.1 Overview

The Little Calumet-Galien Basin encompasses the northern portions of Lake, Porter, and LaPorte counties with the Valparaiso moraine being the boundary between this and the Kankakee River basin. Approximately 115 square miles or 19 percent of the Little Calumet-Galien Basin is drained by streams that flow either into the state of Illinois or Michigan (IDNR, 1994). A portion of Lake County that historically drained to Lake Michigan was diverted into Illinois in 1850 when Hart Ditch was excavated to improve local drainage (IDNR, 2001). This area is included in this watershed management plan (Figures 2-1 and 2-2).

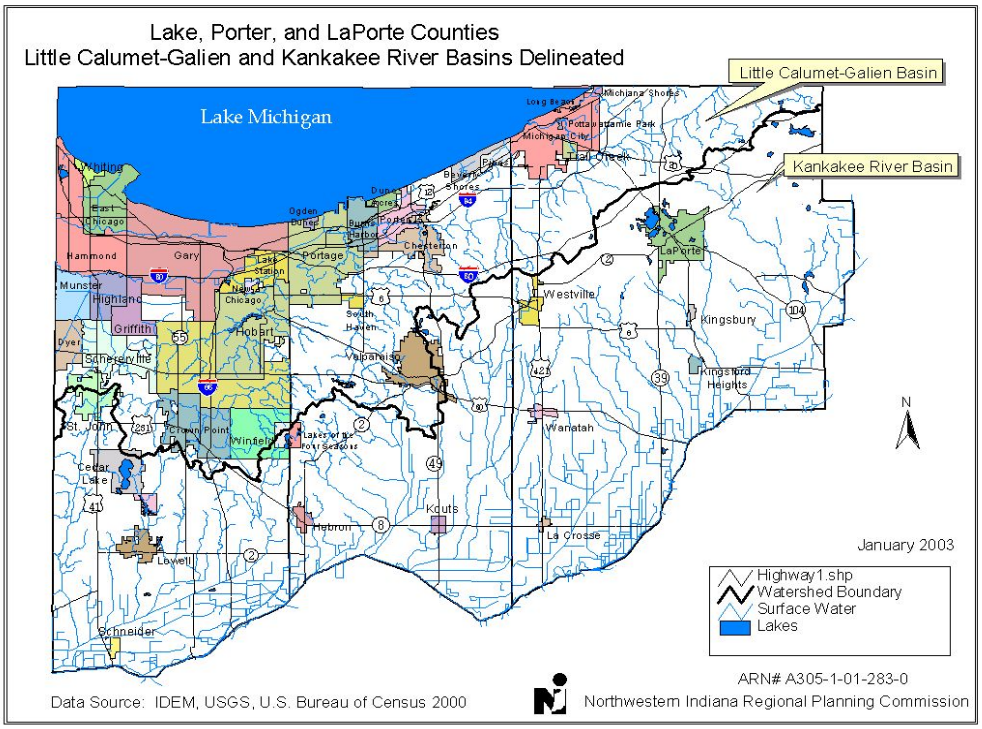
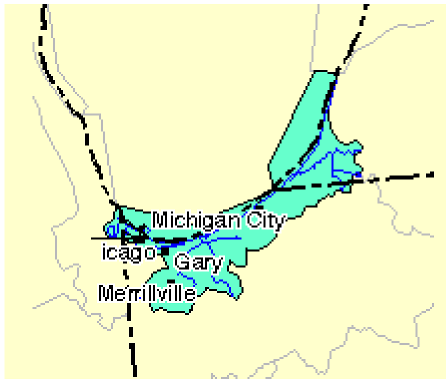
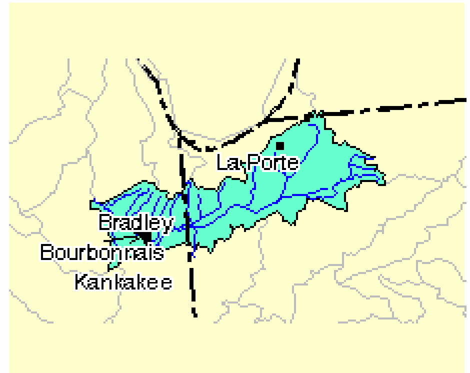


Figure 2-1 Features of the Region



Little Calumet-Galien Basin
HUC 04040001
Source: EPA Surf your Watershed Website



Kankakee River Basin
HUC 07120001
Source: EPA Surf your Watershed Website

Figure 2-2 Hydrologic Unit Code-Basin Map

This basin is densely populated and includes most of the urbanized communities within Lake, Porter and LaPorte counties. Waterbodies within this basin ultimately flow into Lake Michigan. The northwestern part of the basin is one of the major industrial centers of the United States. Economic development and the sustainability of northwest Indiana were primarily dependent upon steel, petrochemical, energy generation, and other ancillary industrial development. Historically, northwest Indiana's most densely populated areas were near the industrial cores along Lake Michigan. Figure 2-3 shows the current urbanized areas in northwest Indiana and Figure 2-4 shows the project population change from 2000 to 2030.

Northwest Indiana saw a 4.2% growth rate from 1990 to 2000 based on U.S. Census information. In 2000, the population for Lake, Porter, and LaPorte Counties was 741,468. Of that, Lake County represented 484,564; Porter County represented 146,798; and LaPorte County represented 110,106. The most significant increase during the period was Porter County with a 13.9% growth rate. Given the current growth and population shift trends and the projections seen in Figure 2-4, new development appears to be moving south and east in this region, which will potentially put additional stress on the undeveloped portions of the watershed. The extensive urban and industrial development has had detrimental effects on the environment and surface water resources within the basin, including Lake Michigan. There are 77 NPDES (21 municipal, 56 industrial) permitted facilities in the Little Calumet-Galien Basin that fall within Lake, Porter, and LaPorte Counties (IDEM web page accessed August 17, 2005).

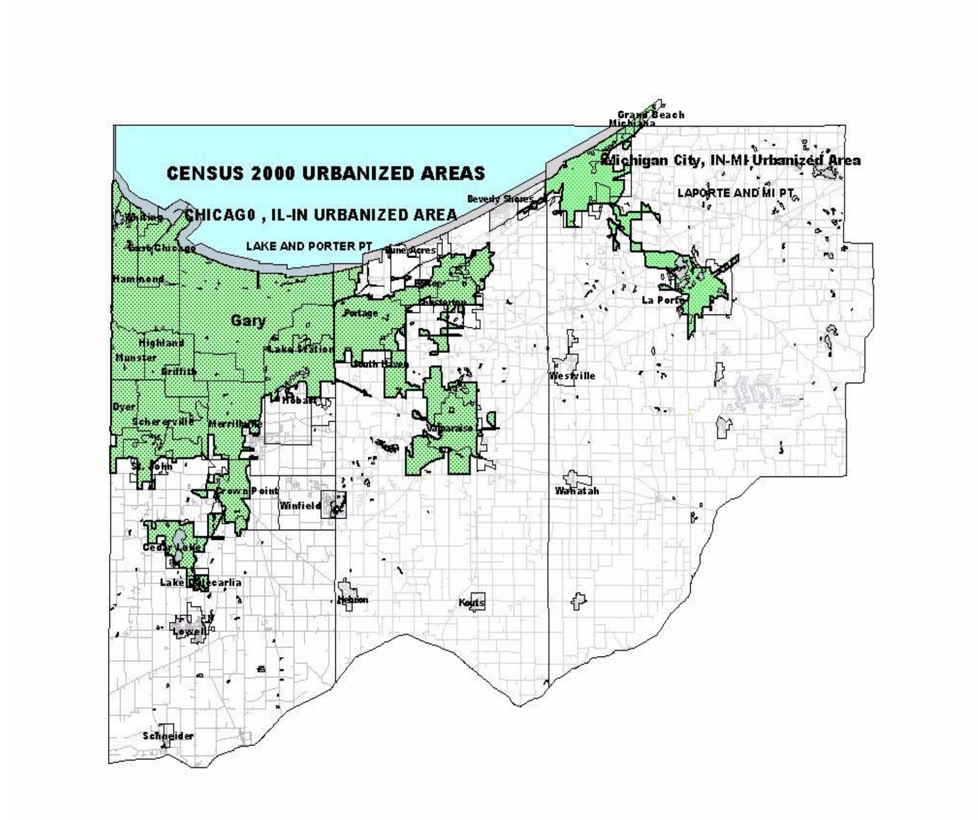


Figure 2-3 Census 2000 Urbanized Areas

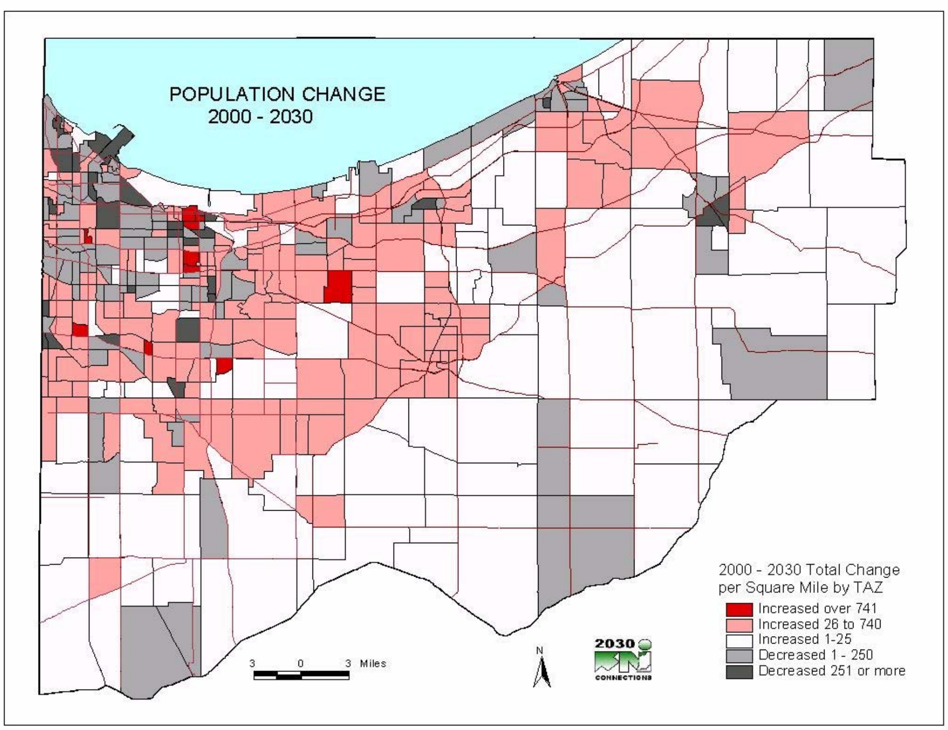


Figure 2-4 Population Change 2000 – 2030

The principal drainage network for the basin is formed by the Grand Calumet and Little Calumet Rivers, draining most of the western and central parts of the region (IDNR, 1994). Channelization and construction of canals have significantly altered the natural stream hydrology of the region (IDNR, 1994). Several smaller streams drain the eastern part of the Lake Michigan Region, including Trail Creek, Galena River, White Ditch, Spring Creek, Derby Ditch, and Dunes Creek (IDNR, 1994). The Galena River's headwaters are in LaPorte County and it has not been significantly impacted by human influence (IDNR, 1994). Trail Creek's drainage area is approximately 59.1 square miles within the region, making it a secondary drainage basin to the Grand Calumet and Little Calumet Rivers (NIRPC, 1993).

Aquatic ecosystems have suffered from the chronic effects of contaminated sediments and air deposition. In the early and mid-1960s, most streams in northwestern Lake County were affected by pollution. Water quality currently is characterized within the basin by low dissolved oxygen, high biochemical oxygen demand (BOD), pollutant tolerant aquatic biota that has replaced native species in the northern reaches of the basin, and fish consumption advisories. Oil, grease, floating debris and offensive odors have made most portions of the Grand Calumet and Little Calumet rivers unappealing to recreational boaters and fishermen. High bacteria counts also have made them unfit for full body contact. Causes of such pollution include a history of unregulated and poorly regulated discharges from industries and sewage treatment plants, combined sewer overflows, urban runoff carrying pesticides, nutrients and heavy metals, and sedimentation (IDNR 1994).

A total of 43 river segments, including near shore Lake Michigan, throughout the basin's three counties are listed as impaired under the 2004 Clean Water Act (CWA) Section 303(d) List of Impaired waterbodies. Appendix III contains a complete listing of impaired streams in the Little Calumet-Galien Watershed based on the 303(d) list.

That being said, it is necessary to look at the landscape of the basin including soils, hydrology, topography, natural history, and a look at land use from an historical perspective. These topics set the stage for some of the water quality problems in northwest Indiana. Past land uses have left behind some sites that require remediation, while others altered the flow of waterbodies or removed vegetation. Whatever the case may be, it is important to understand the landscape of the region prior to making recommendations for improvements, as will be done in subsequent chapters.

2.1.2 Physical Setting

The Little Calumet-Galien Basin (HUC 04040001) encompasses a land area of 604 square miles within the northern halves of Lake and Porter Counties and the northern third of LaPorte County. The basin is drained in Indiana primarily by the Little Calumet River, which flows approximately parallel to the Lake Michigan shoreline and discharges to Lake Michigan through Burns Ditch on the western side of Porter County. The major tributaries to the Little Calumet River are Turkey Creek, Deep River, and Salt Creek

(Figure 2-5). Each tributary originates on the Valparaiso Moraine and flows north to the Little Calumet River. The eastern part of the basin in LaPorte County is drained by smaller creeks that flow directly into Lake Michigan (Fenelon 1992).

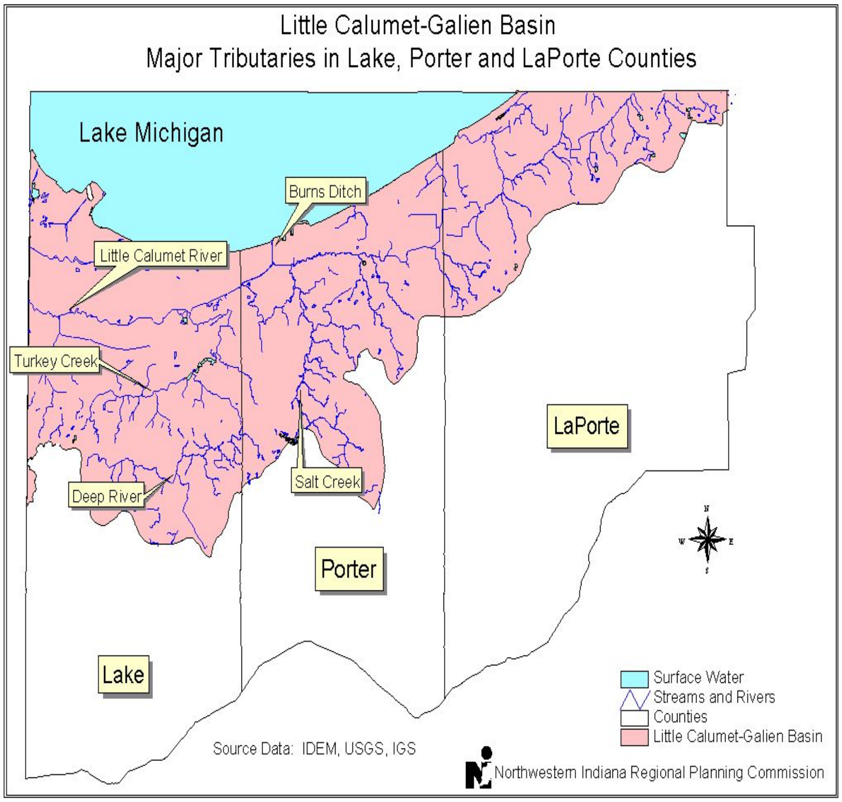


Figure 2-5 Little Calumet-Galien Basin

The area was glaciated between a period of 12,000 and 20,000 years ago. The advancing and retreating of glaciers formed the geology and soils of this region. Advancing and retreating of glaciers leads to the creation of complex geological arrangements known as "moraines." Thus the soils, geology and topography of the region will not likely be very uniform and are more likely to be quite diverse, even within the same basin. This is important because soils and other subsurface characteristics (like depth to groundwater) can impose quite significant engineering constraints on development projects proposed on the surface.

Normal annual precipitation at Gary, Hobart, Ogden Dunes and Valparaiso averages 36.2 inches for the period 1951 – 1980 (IDNR, 1994). The presence of Lake Michigan alters the local climate in northwest Indiana. Although modifications of climate are most pronounced within a mile or two of the shore, several lake-effect features extend about 25 miles inland (IDNR-ILMCP, 2001). Annual snowfall is quite variable in the region because of the lake effect, with annual averages ranging from 35 inches near the Indiana-Illinois state line to about 70 inches in the lake-related snowbelt (IDNR, 1994). The normal annual temperature averages 50 degrees Fahrenheit. Normal seasonal temperature averages 49 degrees Fahrenheit in spring, 72 degrees Fahrenheit in summer, 54 degrees Fahrenheit in autumn and 27 degrees Fahrenheit in winter (IDNR-ILMCP, 2001)

2.1.3 Natural History

The northern portion of the three-county section of the Little-Calumet Galien basin was once home to undisturbed sand dunes, with some of the tallest estimated to be 200 feet tall. The dune and swale ecosystems may be the most notable in northwest Indiana. This ecosystem was formed by the retreating of Lake Michigan and glaciers. Today it still is home to endangered and threatened species like the Karner Blue Butterfly. The dune area is extremely vulnerable to the blowing wind coming off Lake Michigan and very few plants live in the areas closest to the lake. Primarily, marram grass can be found growing in the foredune. As one moves further away from the lake, cottonwood trees, sumac and other sturdy grasses and plants can be found in the forested dunes. As one continues to move further away from the lake, more diverse flora and fauna can be found. Woodlands in the backdune area contain black and white oak trees, sassafras, blueberry, and bracken fern, among others. Wetlands, marsh, and shrub swamps can be found in many areas throughout the basin.

The Grand Calumet and Little Calumet Rivers once ran together as a single river, the Calumet River (IDNR, 1994). The Calumet River flowed westward into Illinois, made a hairpin turn at present-day Blue Island, and flowed back eastward into Indiana, where it eventually discharged into Lake Michigan at present-day Marquette Park Lagoon (IDNR, 1994). A second river formed when Native Americans constructed a new channel to Lake Michigan in Illinois in the early 1800s (IDNR-ILMCP, 2001). The Little Calumet River became the smaller river to the south discharging to Lake Michigan in Illinois, while the Grand Calumet River runs to the north and discharges to the east in Indiana (IDNR-ILMCP, 2001). The present outlet for the Grand Calumet River was constructed in the 1900s at the Indiana Harbor Ship Canal. A U.S. Topographic Bureau map from 1845 showed the Grand Calumet River no longer flowing into Lake Michigan (because it was clogged with aquatic vegetation and sand) (IDNR-ILMCP, 2001).

The Little Calumet and Galien Rivers originate in the Trail Creek sub-watershed. Trail Creek naturally empties into Lake Michigan in LaPorte County. A harbor was constructed near this location in the early 1800s. Standing at the harbor entrance was Hoosier Slide, the tallest sand dune in the area. Today, NIPSCO's Michigan City plant sits at the site, which was mined by a prior owner. In the early 1970s, the IDNR Division of Fish and Wildlife began stocking Trail Creek with Chinook salmon, Coho salmon, Skamania summer-run steelhead, and wither-run steelhead.

The dunes, wetlands, marshes and other terrain made early development difficult, especially in the northern part of the basin. In Porter County, dune ridges towered nearly 200 feet above Lake Michigan. There were interdunal ponds and blowouts up to a mile inland. In Lake County, a low ridge of dunes was along the lakeshore with abutting wetlands to the Grand and Little Calumet rivers. The Great Marsh, which extended from

Michigan City in LaPorte County to Lake Street in Lake County, lay behind these dunes (NPS, 1988).

2.1.4 Public and Managed Lands

Appendix VI contains a listing of public and managed lands in Lake, Porter, and LaPorte counties.

2.1.5 Endangered Species

Appendix VII contains a listing of state and federal threatened and endangered species found within Lake, Porter and LaPorte Counties.

2.1.6 Soils

The Little Calumet – Galien Basin can be broken into two primary soil regions or areas. The Calumet Lacustrine Plain covers the northern part of the basin and a portion of the Valparaiso Moraine makes up the southern portion of the basin.

Sands are very permeable and thus precipitation (and any pollution they carry) might pass through the soils quickly to the groundwater below without much attenuation by microorganisms or physical or chemical processes. Clays and fine silts, on the other hand, would swell up when wet to retard the passage of water. Although this might keep pollution out of the groundwater, it would more likely pond on the surface (reaching the waterway as runoff), plus the shrinking and swelling action of the fine particles as they get wet and dry out would create localized ground movement, stressing foundations for roads and buildings. Both very permeable and relatively impermeable soils can often both be found in the same complex morainal area.

Calumet Lacustrine Plain – Northern Section

The Calumet Lacustrine Plain lies adjacent to the coastline of Lake Michigan. The northern part of this plain is characterized by alternating high ridges and flats that have a topography of gradual swales and swells (swells are slight rises in topography at 2 to 3 feet at the most). The high ridges are old, coarse-textured, eolian (wind-blown) sand dunes that are narrow, elongated and typically oriented parallel to the Lake Michigan coastline. Most of these ridges have been stabilized by woody vegetation or beach grasses. Brems, Oakville, and Plainfield soils are the dominant soils found on these sandy ridges.

Areas separating the high sand ridges are characterized by slightly depressional to nearly level soils formed in sandy glacial outwash and organic deposits. Adrian, Houghton, Edwards, Maumee, Palms, Tawas, and Warners soils are the dominant soils in these areas. Interspersed throughout these flats are areas of Morocco and Watseka soils on slightly higher swells.

The soils in the northern part of the Calumet Lacustrine Plain generally have poor potential for cultivated agricultural crops because of slope and droughtiness. If vegetation is removed from these areas, the sands are subject to shifting and moving by the wind. Soils on the nearly level to depressional areas are wetter and require drainage to be suitable for cultivated agricultural crops.

Soils in the northern part of the Calumet Lacustrine Plain are poorly suited to on-site sewage disposal systems and building site developments. Slope and pollution of groundwater are the main concerns for on-site sewage disposal systems. Effluent from on-site waste disposal facilities can cause pollution of groundwater because the sand has poor filtering qualities. In regard to building sites, the instability of the sands can be a limitation on sloping areas. Wetness is a limitation for building sites on the nearly level to depressional areas. If structures are built with crawl spaces or basements, it is extremely important to provide subsurface drainage to lower the seasonal water table.

Calumet Lacustrine Plain – Southern Section

The southern part of the Calumet Lacustrine Plain is characterized by nearly level to gently sloping soils formed in glacial outwash sediments and glacial till. Alida, Blount, Bono, Bourbon, Del Rey, Hanna, Milford, Pinhook, Selfridge, Tracy, and Whitaker are the dominant soils in this area.

When adequately drained, soils in the southern part of the Calumet Lacustrine Plain are suited to cultivated agricultural crops. Some depressional areas are ponded in winter and early spring. Much of the area has been drained by open drainage ditches and subsurface drainage tile to allow for the planting and harvesting of cultivated crops. Diversions, terraces, waterways, and minimum tillage help control surface runoff and erosion on the gently sloping soils.

Soils in the southern part of the Calumet Lacustrine Plain are poorly suited to on-site sewage disposal facilities and building site developments. The main limitations for soils formed in glacial outwash are wetness and pollution of groundwater. Effluent from waste disposal facilities can pollute groundwater because of poor filtering qualities of the sandy part of the soil. The main limitations for soils formed in glacial till are the slow to moderately slow permeability, ponding, and wetness.

Valparaiso Moraine

South of the Calumet Lacustrine Plain is the Valparaiso Moraine. The northern portion of this morainal system drains through the Little Calumet – Galien Basin. Dominant soils in this region include the very poorly drained Markham and Pewamo soils; the somewhat poorly drained Blount and Elliott soils; the moderately well drained Morley soils; and the well drained Riddles and Tracy soils. With the exception of the Riddles and Tracy soils, the soils in this region have a seasonal water table that is at a depth of less than three feet at the wettest times of the year unless artificially drained.

When drained, the soils in this region are well suited to cultivated agricultural crops. Diversions, terraces, waterways, and minimum tillage help control surface runoff and erosion on these gently sloping to steeply sloping soils.

In general, only the well drained soils in the Valparaiso Morainal region are fairly well suited to on-site sewage disposal systems. Slope and permeability are the main limitations. Shrinking and swelling of the soil and seepage are additional limitations for building site development. Erosion needs to be controlled during and after construction. Special attention and design considerations should be addressed to eliminate or at least minimize soil limitations when using these areas for urban land uses.

2.1.7 Topography

Surficial geology greatly influences topography and soil development, which, in turn, control runoff and infiltration of precipitation. This influences groundwater resources and surface water quality. In the Lake Michigan region, geologic forces shaped the land and left behind deposits of clay-rich till, sand and gravel outwash, sand beaches, lake silt and clay, and peat that now provide us with a tremendous water resource (Figure 2-6).

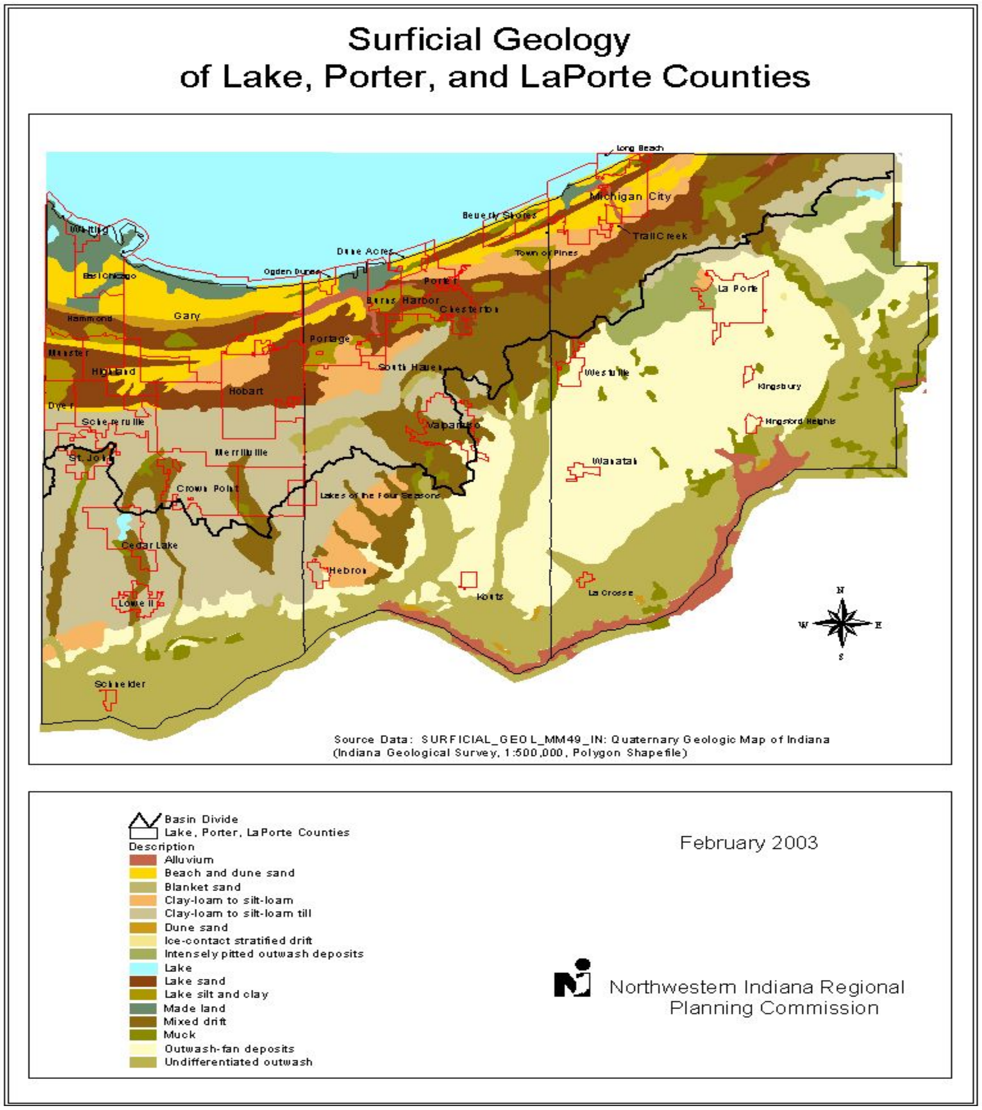


Figure 2-6 Surficial Geology Map

The Little Calumet-Galien Basin is comprised of two major physiographic units known as the Calumet Lacustrine Plain and the Valparaiso Morainal Area. A small portion of the Kankakee Outwash and Lacustrine Plain is located on the southern end of the City of Valparaiso in Porter County. The Calumet Lacustrine Plain in the northern part of the Little Calumet-Galien Basin occupies the lake bottom of the former glacial Lake Chicago-an extension of Lake Michigan in late Wisconsinian time. The lacustrine plain is not entirely flat, having a series of beach ridges, dunes and interridge marshes. There are three dominant relict shorelines: the Glenwood, Calumet, and Tolleston beach complexes. Relief in the plain ranges from elevations greater than 650 ft. above sea level in dunal areas associated with ancient beaches to approximately 580 ft. above sea level on the present day Lake Michigan shoreline (Fenelon 1992).

South of the Calumet Lacustrine Plain is the Valparaiso Moraine Area, composed of an arc-shaped end moraine complex that parallels the southern shore of Lake Michigan from Illinois, through northwestern Indiana, and into Michigan. The morainal complex is made up of several terminal moraines of Wisconsinian age including the Valparaiso and Tinley Moraines, which mark terminal positions of the Lake Michigan (glacial) Lobe. The Valparaiso Morainal complex is about 150 ft. higher than the Calumet Lacustrine Plain and forms a major divide that separates drainage to the Mississippi River from drainage to the Saint Lawrence River by way of Lake Michigan. Elevations in the complex generally range from 700 ft. to 800 ft. and are as high as 950 ft. above sea level. The western end of the complex is wide and gently undulating, whereas the part of the complex east of Valparaiso is more hilly and rugged (Fenelon 1992).

2.1.8 Water Use

The demand for water in the Little Calumet-Galien basin is influenced by a variety of factors, including socioeconomic characteristics, the physical environment, and hydrologic systems. However, urban and industrial uses are more influential in the northern portion of the basin. A total of 80 significant water-withdrawal facilities representing 108 surface water intakes and 112 wells in the Little Calumet-Galien basin were registered in 1990. These facilities accounted for 2,185 billion gallons of water removed from surface and groundwater in 1990. Ninety-nine percent of the total water withdrawals in the basin are from surface water. Sixty percent of the registered water users in the basin are industrial, followed by energy production at 36.5 percent. Public supply water-use was less than 3 percent of the total water use in 1990. Registered water withdrawals for agricultural and miscellaneous purposes constituted approximately 0.2 percent of the total water withdrawals. However, the number of facilities grouped into either category represents 40 percent of all registered facilities in the basin. The total daily average of registered water use in the basin for 1990 was 3,089 million gallons.

Instream uses include water-based recreation activities such as fishing, swimming, and boating. Instream uses in Lake Michigan and the surface drainage networks also include commercial transportation and waste discharge. The waterbodies also provide wetland flora and fauna habitat. Few high quality wetlands remain as remnants of former wetland complexes within the Little Calumet-Galien Basin.

2.1.9 Land Use

Looking at land use historically in the Little Calumet-Galien basin is helpful in seeing how the watershed developed and where some of the problems may have originated. The three counties in this study have similar development trends, but each county, and community, has a unique history.

Early Settlement

Prior to European settlement, Potawatomi Indians inhabited the area. Early Europeans operated trading posts. Settlement was slow in the northern sections of the counties due to the dunes, wetlands, marshes and other terrain that made it difficult to settle. In Porter County, dune ridges towered nearly 200 feet above Lake Michigan. There were interdunal ponds and blowouts up to a mile inland. In Lake County, a low ridge of dunes was along the lakeshore abutting wetlands of the Grand and Little Calumet rivers. The Great Marsh, which extended from Michigan City in LaPorte County to Lake Street in Lake County, lay behind these dunes (NPS, 1988). This left early settlement closer to the centers of these counties where there was fertile soil for farming. Many of these communities developed as rural, agricultural communities.

Early Industry and Development

With the founding of Michigan City, the Trail Creek Harbor began to see light boat traffic carrying both goods and passengers. By the 1840s, the Harbor was shipping cargo, making Trail Creek a major outlet for farm goods and for passengers who came up the Michigan Road. There were 13 grist mills on the banks of Trail Creek in the 1800s. In shipping volume, the Trail Creek harbor often exceeded that of Chicago and through the 1950s there were attempts to build major shipping facilities at Michigan City. On summer weekends, Chicagoans boarded steamers for day trips to Washington Park in Michigan City. The tourist trade began to decline in 1915 with the sinking of a Chicago steamer.

With the expansion of the railroad to northern Indiana in the mid-19th century many communities developed as commercial centers. Railroads allowed access to the growing Chicago market as well as others. This improved access to communities and spurred their growth. The construction of the Chicago-Detroit Road was used primarily by soldiers to deliver mail a couple of times a week and later became a stage coach route through the area. Stations developed along the Chicago-Detroit road as stage coach stops. The construction of the Michigan Road (US 421), which ran from Madison, Indiana to Michigan City brought settlement to LaPorte County (Historic Landmarks Foundation of Indiana, 1989). The opening of US Route 12 and the Lincoln highway (US 30) in the early twentieth century further connected northern Indiana with other parts of the nation. Industries began looking at the Lake Michigan corridor with its expanses of dunes, marshes, and undeveloped land in Lake County for steel and associated manufacturing uses. Gary, Hammond, East Chicago, and Whiting saw an influx in population during this period (1890-1920) with tens of thousands of workers for these new industries. As railroads and paved roads further developed in northwest Indiana, communities saw more industries sprouting up (Historic Landmarks Foundation of Indiana, 1996).

Early Recreation

Lake Michigan and other lake areas became more accessible for recreation with the increased transportation links. Resort areas sprouted up in Porter and LaPorte Counties. Chicagoans came to northern Indiana for the weekends via the South Shore Line. Northern parts of Michigan City and Long Beach experienced growth as resort areas, bringing in weekend visitors all summer from Chicago. Ogden Dunes and Dune Acres developed as lakeshore communities geared toward the urban market of Chicago (Historic Landmarks Foundation of Indiana, 1991).

Dune Development and Preservation

Early preservationists and environmentalists saw a need to protect the Indiana Dunes from development and their fight for a national park to provide that protection began in 1916. The impacts industry has had on the lakeshore and the northern part of the Little Calumet-Galien basin in Lake, Porter, and LaPorte counties are staggering. Sand mining of the dunes dates back to the early twentieth century, when Hoosier Slide, just west of Michigan City, was taken away in rail cars for use in making glass. Hoosier Slide was then the tallest dune at 200 feet. This site now is home to Northern Indiana Public Service Company's (NIPSCO) power generating station (NPS, 1988). More dunes were mined and the sand was taken to Chicago and other areas where it was used to fill in lower wet areas. These locations and those in which wetlands were drained gave way to industrial uses. Three ports were constructed in Lake (Indiana Harbor in East Chicago and Buffington Harbor in Gary) and Porter (Port of Indiana) Counties between 1916 and 1966 in addition to the already constructed and operational Trail Creek Harbor. The Indiana Harbor Shipping Canal was constructed to connect the Grand Calumet River to Lake Michigan. In the 1960s, Bethlehem Steel Corporation opened up a new steel mill in an area that was once a part of the Great Marsh. Two other steel mills and NIPSCO's Bailly Generating Station sprouted up around the Bethlehem Steel Burns Harbor plant with the construction of the Port of Indiana. This development occurred in the area referred to as the Central Dunes, which was thought to be the most spectacular stretch of the Indiana Dunes. For these reasons environmentalists pushed for the creation of a State Park in the dunes area, which was achieved in 1923. The fight for the creation of the National Lakeshore continued until it was finally created in 1966.

Historical Places

Just as the area has a rich natural history, there are many structures in the region listed on the National Register of Historic Places and the State Register of Historic Places including sites representative of the regions diverse history. A complete list can be found in Appendix V. Inventories of historic places for all three counties have been completed by the Historic Landmarks Foundation of Indiana.

Current Economic Trends

Economic trends also have affected northwest Indiana. The area was hit hard in 2003 when LTV, National, and Bethlehem Steel Companies filed for bankruptcy. Some of these companies were bought out; communities in the region began to consider diversifying their industrial bases. Northwest Indiana's industrial base also is affected by the lower costs of doing business overseas. Several companies have closed their doors and moved their operations outside of the country, leaving vacant buildings and an unemployed workforce. These trends continue as the industrial base continues to change and population growth continues to shift away from urban areas.

Current Land Use

Urban and industrial areas in northern Lake and Porter Counties and agricultural land in LaPorte County dominate the current landscape of the Little Calumet-Galien Basin. Remnants of natural prairies and wetland landscapes occur in isolated parcels in the basin. The Indiana Dunes National Lakeshore and the Indiana Dunes State Park in northern Lake and Porter counties contain the largest expanse of natural forest in the Little Calumet-Galien basin. In the Little Calumet-Galien basin, urban areas form an almost continuous complex across northern Lake county and northwestern Porter county. Other developed land areas in this basin include Crown Point in Lake County, Michigan City in LaPorte County, and Valparaiso, Chesterton, Portage, Porter, Dune Acres, Beverly Shores, Pines, Long Beach, Trail Creek, Burns Harbor, and Ogden Dunes in Porter County (IDNR, 1994).

Fifty-eight percent of the 972,800 acres of land that comprise Lake, Porter and LaPorte counties is farmland (IDNR, 1990). Of that, 90 percent is cropland (harvested crops, orchards, vineyards, nurseries and greenhouses), 4 percent is woodland (woodlots, timber production and Christmas tree production), and 6 percent is other (house lots, barn lots, ponds, roads and wasteland). The remaining 42 percent of land use is forest land, wetlands and urban development. In the Kankakee and the Little Calumet-Galien basins 8 percent and 29 percent respectively are developed urban land areas.

Figure 2-7 shows land use within Lake, Porter, and LaPorte Counties, as identified in the 1992-1993 GAP Analysis Program land use data.

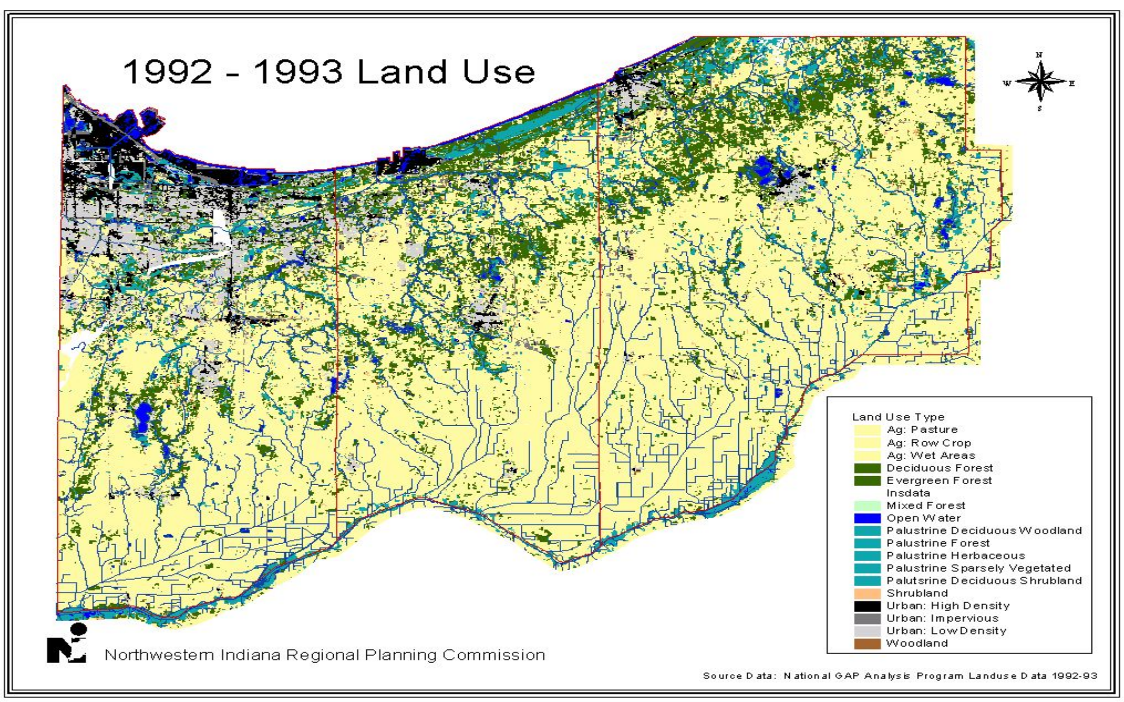


Figure 2-7 1992-1993 Land Use

2.1.10 Additional Little Calumet – Galien Information

More in depth information on the Little Calumet – Galien Basin can be found in the following publications:

- Lakewide Area Management Plan (LaMP) 2000 and its annual updates
- Indiana Lake Michigan Coastal Zone Scoping document and Nonpoint source (6217) program.
- Watershed Restoration Action Strategy for the Little Calumet-Galien Watershed, 2002
- Watershed Diagnostic Study of the Little Calumet – Galien River Watershed, 2001
- Grand Calumet Remedial Action Plan

2.2 Kankakee River Watershed

2.2.1 Overview

The Kankakee River basin, as opposed to the Little Calumet-Galien, is less densely populated, has more open land, and more agricultural uses. As development and population continue to shift to the south and east, the detrimental effects that are being realized in the Little Calumet-Galien basin will be felt in this basin. For the purposes of this study, the Kankakee River Watershed refers to the Kankakee River and its northern tributaries within the counties of Lake, Porter, and LaPorte in Indiana.

Rivers, streams and ditches in the Kankakee basin are used to receive wastewater discharged from public and industrial facilities. These discharges are regulated by the National Pollutant Discharge Elimination System (NPDES). There are 17 NPDES (14 municipal, 3 Industrial) permitted facilities within the Kankakee basin located within Lake, Porter and LaPorte counties.

A total of 17 waterbody segments are listed as impaired in the 2004 CWA Section 303(d) List of Impaired Waterbodies. Included in the list is Impaired Biotic Communities. Most streams and lakes in the Kankakee basin are designated for support of warm water fisheries; however, if biotic communities are affected by pH levels, temperature, dissolved oxygen concentrations, ammonia, and toxic substances, a substantial loss to these fisheries will occur. Studies conducted in 1986-87 and 1988-89 by IDEM found that approximately 20 percent of stream miles in the basin only partially supported aquatic use, and the main stem of the Kankakee River did not support full-body contact due to fecal coliform levels.

Other threats to the Kankakee basin include agricultural runoff that carries pesticides and huge amounts of sediment from farmland. Also, heavy metals, ammonia, and nutrients threaten water quality. There are some eutrophication and invasive species problems in a number of lakes throughout the basin, but the water quality of the lakes is generally good (IDNR 1990). Figure 2-1 shows the three county area and important features of the region.

2.2.2 Physical Setting

The Kankakee River Basin (HUC 07120001) is the sixth largest, 2,989 square miles, of the 12 water management basins in the State. The total basin includes most of Newton, Jasper and Starke Counties and one-half to two-thirds of Lake, Porter, LaPorte, St. Joseph, Marshall and Benton Counties. Overall, the Kankakee River drains 5,165 square miles in northeastern Illinois and northwestern Indiana. Within Indiana, the basin has an area of 2,989 square miles of which approximately 909 square miles are in Lake, Porter, and LaPorte Counties. Most of the northern part of the basin is bounded by the Valparaiso Moraine, which forms a major divide separating drainage to the Mississippi River from drainage to the St. Lawrence River. The major northern tributaries of the Kankakee River, which flow from the Valparaiso Moraine, are the Little Kankakee River, Crooked Creek, and Singleton Ditch (Figure 2-8). The current landscape of the Kankakee River Basin is dominated by agricultural crops and artificial drainage networks. Remnants of natural prairies, savannas and wetlands remain in isolated parcels. The City of LaPorte is the major urban center lying totally within the Kankakee basin. Large tracts of developed land also are found near smaller towns and around a few of the large lakes such as Cedar Lake in Lake County.

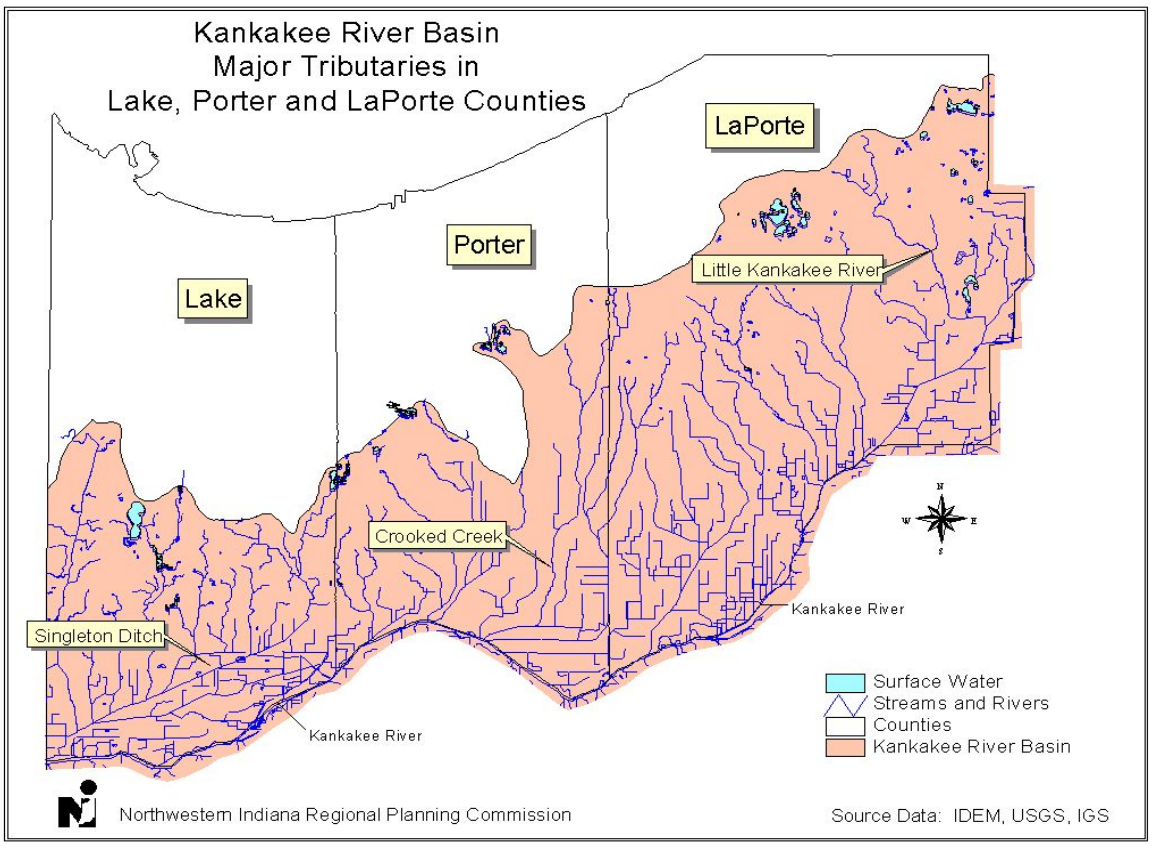


Figure 2-8 Kankakee River Basin

Normal annual precipitation at Kentland, Plymouth, Wheatfield, Valparaiso and South Bend averages 37.6 inches for the period 1951 – 1980 (IDNR, 1990). The presence of Lake Michigan alters the local climate in northwest Indiana. Although modifications of climate are most pronounced within a mile or two of the shore, several lake-effect features extend about 25 miles inland (IDNR, 1990). Annual snowfall in the northern part of the basin averages about 70 inches, which is twice the annual amount normally received in southern and western areas of the basin (IDNR, 1990). The normal annual temperature averages 50 degrees Fahrenheit. Normal seasonal temperature averages 49 degrees Fahrenheit in spring, 72 degrees Fahrenheit in summer, 53 degrees Fahrenheit in autumn, and 26 degrees Fahrenheit in winter (IDNR, 1990).

2.2.3 Natural History

The Kankakee valley was originally a Grand Marsh of more than 500,000 acres of river channel, lakes, marsh and marginal wetlands (KRBC, 1989). The Grand Marsh was extraordinary and known for its fertile hunting grounds. General Lou Wallace visited the area several times to hunt. John L. Campbell, in his 1883 report to the Indiana Governor stated "The Kankakee river is noted for its extreme crookedness…The water in the stream is remarkably clear and is of excellent quality for domestic purposes" (Campbell, 1883). Campbell's report recommended the straightening of the Kankakee River and draining of the Grand Marsh to improve drainage. Only a portion of the Grand Marsh would have been within this study area. The original river channel supported numerous varieties of wildlife. In the late 1800s, efforts were organized to drain the wetlands for agricultural production and channelization of the river was completed in 1917 (KRBC, 1989). This effort straightened the river and dredged the river making it deeper.

Much of the land in Lake, Porter, and LaPorte Counties adjacent to the river is used for agriculture. There remain some forested wetlands. Oak-Hickory forests and some prairie grasses can be found in the small sand hills that once were surrounded by wet prairies prior to the draining of the Grand Marsh (KRBC, 1989). Fish are prevalent in the Kankakee River and its tributaries (KRBC, 1989). Waterfowl, deer, pheasant, and quail also thrive in these habitats.

Once ditching began to drain the marsh, timber harvesting within and transport out of the marsh became popular. However, by the 1870s the freight transport of timber became an unsuccessful economic venture. In 1871, a massive forest and range fire burned out thousands of acres of marsh timber and grasses. Vegetation was burned down to the subsoil or to water level (IDNR et al, 1976). But as more and more acres of marsh land were ditched and drained, vast amounts of wildlife habitat were destroyed. Yet, as this process occurred, more and more acres of farmland were developed.

2.2.4 Public and Managed Lands

Appendix VI contains a listing of public and managed lands in Lake, Porter, and LaPorte counties.

2.2.5 Endangered Species

A complete list of Endangered and Threatened species found in Lake, Porter, and LaPorte Counties can be found in Appendix VII.

2.2.6 Soils

The Kankakee Basin can be broken into four major soil regions or areas. These regions are the Kankakee Floodplain, Kankakee Outwash Plain, Kankakee Lacustrine Plain, and Valparaiso Moraine.

Kankakee Floodplain

The Kankakee Floodplain region is an area that lies adjacent to the Kankakee River and some of its major tributaries. This region is dominated by poorly drained and very poorly drained Cohoctah, Suman, and Fluvaquent soils formed in loamy or silty alluvium on nearly level or depressional areas. Soils in this region typically have moderate to moderately slow permeability and have a seasonal water table that is near or above the soil surface at the wettest times of the year unless artificially drained.

If adequately drained, the soils in this region are suited to cultivated agricultural crops. Flooding, ponding, and wetness are the main limitations for agricultural uses. Flood control levees have been constructed along the major drainage ways to minimize the flooding potential. The wetness and ponding limitations have been minimized by constructing a network of open drainage channels and installing subsurface drainage tile.

Soils in this region are generally not suitable for most urban land uses. Flooding, ponding and wetness are the main limitations. Pollution of groundwater by effluent from on-site sewage disposal facilities is also a concern. Effluent from on-site waste disposal facilities can cause pollution of groundwater because the sandy part of the soils has poor filtering qualities.

Kankakee Outwash Plain and Kankakee Lacustrine Plain

Immediately north of the Kankakee Floodplain region is the Kankakee Outwash Plain and Kankakee Lacustrine Plain. These areas are characterized by nearly level or depressional to gently sloping topography. Soil textures range from loamy to sandy and permeability typically ranges from moderate to very rapid. Interspersed throughout the area are windblown sand dunes or ridges that are typically oriented in a southwesterly to northeasterly direction and are crescent shaped. Many of these ridges have been stabilized with trees and vegetation. The dominant soils in these areas are the poorly and very poorly drained Adrian, Edwards, Houghton, Gilford, Maumee, Pinhook and Sebewa soils; the somewhat poorly drained Alida, Bourbon, and Morocco soils; the moderately well drained Hanna soils; and the well drained to excessively drained Chelsea, Coupee, Door, Elston, Lydick, and Tracy soils.

When adequately drained, these soils are suited to cultivated agricultural crops. Wetness is the main limitation. Some of the minor soils are ponded in winter and early spring. Much of the Kankakee Outwash Plain and Kankakee Lacustrine Plain have been drained by open drainage ditches and subsurface drainage tile to allow for the planting and harvesting of cultivated crops. Often, control structures are incorporated into the drainage systems to hold water in the open ditches and subsurface drain tiles for the purpose of sub-irrigating crops during dryer periods of the growing season.

Soils in this region are poorly suited to on-site sewage disposal facilities and building site developments. Wetness and pollution of groundwater are the main limitations. Effluent from waste disposal facilities can pollute groundwater because the sandy part of the soils has poor filtering qualities.

Valparaiso Moraine

The Valparaiso Moraine lies immediately north of the Kankakee Outwash and Lacustrine Plains. The leading edge of the morainal system drains into the Kankakee Basin. Soils in this area typically consist of gently sloping to steeply sloping, loamy to silty and clayey soils with moderately slow to very slow permeability. These soils are generally poorly drained to moderately well drain. Additional information on these soils may be found in the Little-Calumet-Galien watershed soils section.

2.2.7 Topography

The Kankakee River basin, within Lake, Porter, and LaPorte Counties, lies primarily within the Northern Moraine and Lake Region, which includes the Valparaiso Morainal Area and the Kankakee Outwash and Lacustrine Plain (IDNR, 1990). The Valparaiso Morainal Area, in the northwestern part of the basin, is composed of an arc-shaped end moraine complex that parallels the southern shore of Lake Michigan from Illinois through northwestern Indiana into Michigan. The morainal complex marks a terminal position of the Lake Michigan (glacial) Lobe and separates the Kankakee River basin from the Little Calumet-Galien basin to the north. Elevations in the Valparaiso Morainal complex generally range from 700 to 800 ft and are as high as 950 ft above sea level. The western end contains till ridges on the top of the complex and outwash sands on the southern flank that extend northward beneath the moraine. East of Valparaiso, only a thin part of the Valparaiso Morainal Area near the crest of the morainal complex lies within the basin.

The Kankakee Outwash and Lacustrine Plain lies south and southeast of the Valparaiso Morainal Area and covers about two-thirds of the entire basin. It is a broad, flat, and poorly drained area that is primarily covered by glacial outwash, dune sand, alluvial deposits, and lake sand (Figure 2-6).

2.2.8 Water Use

The demand for water in the Kankakee basin is influenced by a variety of factors, including socioeconomic characteristics, the physical environment, and hydrologic systems. Agricultural irrigation is the major withdrawal use in the Kankakee basin, constituting about one-third of all water withdrawals. In 1987, there were a total of 533 significant water withdrawal facilities representing about 570 wells and 230 surface water intakes registered in the basin. These facilities had a combined withdrawal capability of 25.2 billion gallons for 1987. Nearly equal amounts of water are withdrawn from surface water and groundwater sources within the basin. Energy production, the second highest water use in the basin at 25 percent, is primarily from surface water. Public supply, at 19 percent total withdrawal, is from wells. About 63 percent of the basin residents obtain their water from non-registered, privately owned domestic wells (13 percent of all withdrawals) rather than from public supply systems. Industrial use and livestock use needs total 6 percent and 4 percent respectively.

Instream uses in the basin include water-based recreation activities such as fishing, swimming, and boating. The Kankakee basin supports water-dependent wildlife with wetlands associated with natural lakes and streams (IDNR, 1994).

2.2.9 Land Use

Early Settlement

In 1800, the Kankakee River ran a naturally meandering course of approximately 240 miles in Indiana. The Grand Marsh, 500,000 acres, began near the northern border of Starke County in the now drained English Lake region and extended downstream to Momence, Illinois (IDNR et al, 1976). There was an abundance of fish, game, furbearing animals and a notable lack of human settlement. The Potawatomi Indians had hunted in the area and were followed by French trappers around 1825. In 1829, the first white settlers within the Kankakee basin settled in LaPorte County. Trapping and fur trading between the early French settlers and the Indians was an important activity. Many professional hunters were attracted to the Grand Marsh area from which they harvested a large amount of wildlife for Chicago and New York markets.

Early Industry and Development

In 1836, the first sawmills and grain mills were established within small village settlements and trading posts that developed around the edges of the Grand Marsh. With the westward movement of white settlers, the final removal of the Potawatomi by the U.S. Government occurred in the summer of 1838, though the lands of the Potawatomi had been ceded to the U.S. six years earlier. In 1852, Indiana’s Governor Joseph Wright recommended legislation for draining the marsh lands along the Kankakee River to create new agricultural land (KRBC, 1989). It was the passage of this bill that subsequently led to the development of farms throughout much of this basin (IDNR, 1976).

Timber harvesting in the marsh area became popular in the mid-1860s and in 1866, the Indian Island Sawmill Company was formed to log the valuable timbers (IDNR, 1976). Timbers were transported by a river steamer and some flat boats to Momence, Illinois. However, this was not a lucrative business for the area (IDNR, 1976). In the 1870s and 1880s, the marsh became a great recreation area for hunters and hunt clubs were built throughout the marsh (IDNR, 1976).

In 1889, the state program was in place to straighten and clean the Kankakee River from South Bend to the Indiana-Illinois state line, and by 1917, the channelization of the river was complete. The 240 mile naturally meandering river had become a drainage ditch of only 90 miles in length. This new river averaged approximately 1 foot of fall per mile from the LaPorte-St. Joseph County line westward to the Illinois state line (KRBC, 1989).

Current Land Use

As railroads and roads expanded into the Kankakee River basin access to outside markets increased. With the exception of a couple communities, the basin continues to be agriculturally based. As population growth continues to move south and east out of the Little Calumet-Galien Basin, this watershed will be affected. See current land use discussion in the Little Calumet-Galien watershed section.

2.2.10 Additional Kankakee River Basin Information

More in depth information on the Kankakee River Basin can be found in the following publications:

- "Report upon the Improvement of the Kankakee River and the Drainage of the Marsh Lands in Indiana" by John L. Campbell, 1883.
- "Kankakee River Basin Indiana" by Indiana Department of Natural Resources, 1976.
- "Kankakee River Master Plan" by the Kankakee River Basin Commission, 1989.
- "Water Resource Availability in the Kankakee River Basin, Indiana" by Indiana Department of Natural Resources, 1990.

Chapter 3
Urban & Rural Areas

3.1 Introduction

Development and land use in urban and rural areas in northwest Indiana are tied to many of the water quality problems facing the region. Many studies have been conducted on the water quality within the Little Calumet-Galien and Kankakee River watersheds. There are differing opinions on the results of these studies and, therefore, the water quality issues addressed in this plan focuses on the IDEM and USEPA approved 2004 Water Quality Impairments (303(d)) List and other issues identified through public meetings, the Watershed Advisory Group, and the Technical Teams.

Northwest Indiana's diversity is not just related to its ecosystems, but also to the land use within Lake, Porter, and LaPorte Counties. The urban land use issues are primarily tied to the Little Calumet-Galien watershed, whereas the area encompassing the Kankakee River and its northern tributaries is primarily rural. The growth types may vary from one watershed to the next, but the effects of both urban and rural development can be seen in the region's waterbodies. Development can be linked to many of the impairments identified by the Watershed Advisory Group and on the IDEM 303(d) list of impaired waterbodies (Appendix III). Many of the impairments and sources for those water quality impairments are consistent for both the Little Calumet-Galien and Kankakee River watersheds; however, where they differ they will be addressed separately.

The total land area for the three-county region is 968,532 acre (Table 3-1). 272,512 acres (28%) are considered urban developed land. Urbanized land contains a mixture of residential, commercial, and industrial development and transportation networks.

Table 3-1 Land Use Patterns in Northwest Indiana (acres)

County	Urban Developed	Land in Farms	Remainder (e.g., vacant undeveloped, woodland, open space)	Land Area Total
Lake	154,176 (48.5%)	127,782 (40.2%)	36,112	318,070
Porter	77,312 (28.9%)	145,779 (54.5%)	44,499	267,590
LaPorte	41,024 (10.7%)	243,447 (63.6%)	98,401	382,872
Totals	**272,512 (28.1%)**	**517,008 (53.4%)**	**179,012**	**968,532**

Sources: Bureau of the Census, Census 2000, Urbanized Areas and Urban Clusters.
NIRPC, Connections 2030 Regional Transportation Plan.
U.S. Department of Agriculture, 2002 Census of Agriculture

The highest percentage of urbanized land lies in Lake County followed by Porter County and LaPorte County. As discussed in Chapter 2, heavy industrial development primarily occurred along the coast of Lake Michigan. Steel mills, oil refineries, and specialized industry have historically located on or near the Indiana Coast. Lake County has the highest density of industrial development. New development is occurring away from urban areas and it is projected to continue. Figure 2-4, Population Change 2000-2030, shows the highest growth rates occurring in northern portions of Lake, Porter, and LaPorte Counties and along the basin divide.

Based on information provided by the United States Department of Commerce, Bureau of the Census, a Purdue University study has documented population trends for Lake, LaPorte, and Porter Counties and local communities. The study, as shown in Table 3-2 entitled "Population Trends for Indiana Counties, Cities, and Towns, 1970 – 2000" reveals the following population trends:

Table 3-2 Population Trends for Indiana Counties, Cities, and Towns

County	Population 2000	Population 1990	Population Difference	Percent Change	Percent Rural
Lake	484,564	475,594	8,970	1.89	8.37
LaPorte	110,105	107,066	3,039	2.84	41.46
Porter	146,798	128,932	17,866	13.86	41.77

Source: United States Department of Commerce, Bureau of the Census

3.2 Water Quality Impairments

3.2.1 Overview

Water quality impairments for the purpose of this study are defined as those listed on the IDEM and USEPA approved 2004 Water Quality Impairments (303(d) list). These include:

Little Calumet-Galien Watershed

- impaired biotic communities
- fish consumption advisories for PCBs and/or mercury
- *Escherichia coli* (*E. coli*) bacteria
- cyanide
- oil and grease
- ammonia

Kankakee River Watershed

- impaired biotic communities
- fish consumption advisories for PCBs and/or mercury
- *E. coli*
- nutrients
- total dissolved solids

Stakeholders raised the concern that there are inconsistent requirements and goals for water quality data collection by agencies like IDEM and the Army Corps of Engineers. The data is inconsistent because some locations have been tested to the point that there is a wealth of information available and others have not or barely been tested. Another issue is that this data should be presented and made available to the public. In some instances organizations working to promote improved water quality are not made aware of all the existing data or they have a difficult time in obtaining it. Given the available information, the group decided for this plan to focus on the sampling and testing conducted by IDEM. Appendix III contains a complete list of impairments and specific stream segment impairments. *E. coli* and impaired biotic communities usually are considered to be indicators of a water quality problem, however they are listed as impairments by IDEM and so this plan will address them as such.

3.2.2 Impaired Biotic Communities

Impaired biotic communities occur when biotic communities cannot continue to sustain themselves in a waterbody as they previously had due to a change in the system. Changes could include those to the water chemistry, water temperature, or loss of vegetation along the perimeter of the water body. Pollutants in the waterbody can affect water chemistry by altering natural systems like increasing pH or altering the biological or chemical oxygen demand in the system. Removal of vegetation along streams, creeks, ditches, and rivers can increase water temperature by reducing the shade that once was provided. Increased sediment loads also can negatively affect the organisms living in the waterbody.

3.2.3 Fish Consumption Advisories

Fish consumption advisories exist in several segments of the Little Calumet-Galien and Kankakee River watersheds due to the bioaccumulation of mercury and/or PCBs in fish. Since these pollutants also can accumulate in humans when these fish are consumed, possibly causing serious health problems, the advisories suggest limits to the amount of fish that should be consumed from these waterbodies. IDNR publishes an annual guide to the fish consumption advisory containing information on the human health impacts and the current advisories. High levels of mercury can be caused by municipal and industrial discharges, urban and rural runoff, and atmospheric sources. Municipalities and industrial wastewater dischargers are required to obtain NPDES permits from IDEM for these discharges. PCBs were used primarily in hydraulic fluids up until 1978, when production was halted. Today’s PCB problems are legacy issues.

3.2.4 E.Coli

The most common impairment identified in both the Little Calumet-Galien and Kankakee River watersheds is *E. coli* bacteria. *E. coli* is listed as an impairment by IDEM for many waterbody segments throughout northwest Indiana. High levels of *E. coli* lead to the closure of Lake Michigan beaches every summer along the southern tip of Lake Michigan. Beach closures are the most visible impact *E. coli* has on water quality. Ingestion of high levels of *E. coli* can cause human health problems such as headaches, fatigue, nausea, and diarrhea**.** The Indiana water quality standard for *E. coli* bacteria requires *E. coli* levels to not exceed 125 colony forming units (CFU) per 100 milliliters as a geometric mean based on not less than 5 samples equally spaced over a 30 day period or 235 per 100 milliliters in any one sample in a 30 day period. High levels of *E. coli* can be caused by nonpoint source runoff, failing septic systems, pump station overflows, leaking sewer lines, direct discharges from septic systems, runoff from livestock operations, wildlife, combined sewer overflows (CSO), and urban stormwater.

3.2.5 Cyanide

Cyanide, found in three segments along the Grand Calumet River and two segments of the Little Calumet River in the Little Calumet-Galien watershed in Lake County, can cause chronic problems with the thyroid and central nervous system in addition to causing cyanosis, which is oxygen deprivation that causes blue skin color. Cyanide is used in manufacturing processes like glass manufacturing and metal finishing and may enter surface waters through industrial runoff.

3.2.6 Oil and Grease

Oil and Grease (found in two segments of the Grand Calumet River and one segment of Lake George in the Little Calumet-Galien watershed in Lake County) can be found in runoff from parking lots, roads, boats, and industrial runoff. Oil is used as a lubricant in some industrial processes and is used in automobiles and trucks.

3.2.7 Ammonia

High ammonia levels (2 segments along Grand Calumet River in the Little Calumet-Galien watershed) are associated with eutrophication, the process of high aquatic plant activity due to excessive nutrients. When ammonia is in an ionized state it can be a threat to benthic organisms and fish (IDNR, 2004). Both point and nonpoint sources can cause high ammonia levels. Septic effluent, decaying organic material that come from nonpoint source runoff, fertilizer, and bacterial decomposition of animal waste also contribute to ammonia levels in waterbodies.

3.2.8 Nutrients

Nutrients and total dissolved solids were both identified as impairments in the East Branch of Stoney Run (the only location in the Kankakee River watershed), which originates in Lake of the Four Seasons. The most common nutrients are nitrogen and phosphorus, which are found in fertilizers. An overabundance of phosphorus and/or nitrogen can cause nuisance algal blooms to grow and stimulate plant growth in low flow conditions. As plant and algae decompose the dissolved oxygen (DO) is also reduced. Low DO is a response to a process of oxygen depletion in the waterbody influenced by both nutrients and other pollutants that consume oxygen in their degradation process. Low DO threatens aquatic life communities and limits the diversity of fish populations. Sport fish are generally more sensitive to low DO conditions and are not present in waters exhibiting DO problems.

3.2.9 Total Dissolved Solids

Total Dissolved Solids are minerals, salts, metals, cations, or anions dissolved in water. This impairment can be caused by runoff from developed areas, road salts, fertilizers and pesticides, industrial waste and sewage, and organic sources.

3.2.10 Little Calumet-Galien Watershed Additional Impairments

In addition, the 2002 Little Calumet-Galien WRAS states that high levels of lead, copper, pesticides, and low dissolved oxygen (DO) have been found in the basin's waterbodies. The 2001 DNR Little Calumet-Galien River Watershed Diagnostic Study included acidic pH, zinc, nitrogen, phosphorus, and total suspended solids. These studies raise questions on whether there are potential impacts from these pollutants on the watershed and warrant further study on the sub-watershed level.

3.2.11 Kankakee River Watershed Additional Impairments

In addition to the impairments listed above, the priority problems identified by the KRBC for this watershed are sedimentation, flooding, and development pressures. These are not 303(d) parameters, but are major concerns for the basin and so they will be addressed in this plan. Flooding will be discussed in more detail in Chapter 5, Hydromodification, and development pressures will be discussed more in depth below in the stressors section.

Sedimentation is a problem that has been identified by many stakeholders in the Kankakee River watershed. The problem is primarily associated with soil erosion. Though erosion occurs naturally it has been exacerbated by channelization and the impacts of how the land is used. Channelization will be discussed in Chapter 5, Hydromodification, and the impacts of agricultural practices will be discussed in Chapter 4, Agriculture Sources.

New development is increasing in this basin, much of which occurs in unincorporated areas of the three counties. As this development continues to shift into this basin, erosion will continue to increase sediment loads in the Kankakee River and its tributaries unless proper erosion control practices are implemented. Disturbed soils can be eroded by the wind. Vegetation planted along creeks, ditches, streams and rivers can protect soils from eroding. Trees fall into these waterbodies, disturbing soils and increasing erosion. New development usually means increased impervious area (i.e., areas that do not allow runoff to filtrate into the ground) and runoff is sent directly into ditches and drainage basins that eventually direct the water into creeks and rivers. This runoff can carry sediment from construction sites, unprotected soil on already developed sites, and other pollutants into waterbodies. More information on the impacts of development on the region's watersheds is found in the stressor section of this chapter.

Since the channelization of the Kankakee River, the velocity at which the water moves has increased significantly, carrying the water and the sediment in it, faster and farther to the west. The Illinois section of the Kankakee River has more significant sedimentation problems. The Yellow River, which flows through Marshall and Starke Counties) enters the Kankakee River near the southwestern county line between LaPorte and Starke Counties carrying large amounts of sediment.

3.3 Problems, Causes, and Sources

Many of the causes of water quality degradation identified for northwest Indiana in this chapter are symptoms of sprawl. Characteristics of sprawl include development moving farther away from urban cores, increasing reliance on automobiles, and the loss of farmland or natural land to development at a rate that exceeds population growth for the area. Increased traffic congestion and travel times associated with sprawl factor into air pollution. Soil erosion and increased runoff from development can add additional stress to waterbodies. Infrastructure costs increase as roads and utilities need to be extended farther from the core of a community. Water quantity can become an issue as more consumers demand water. The loss of open space, or undeveloped land affects the water system as there is less natural infiltration and impervious surface area increases with development to unhealthy rates. The potential impacts already are being seen in northwest Indiana.

This plan and the 6217 plan have consistently identified the same issues relating to urban and rural areas. In an effort to send a consistent message, the Watershed Advisory Group has supplemented the sources identified in the 6217 plan for Urban and Rural Areas to include information on both the Little Calumet-Galien and Kankakee River Watersheds.

3.3.1 Developing Areas

Currently, development in northwest Indiana appears to be occurring with little thought to how this development affects the watershed. Urban stormwater runoff quantity and quality are significantly affected as the watershed undergoes development. Hydrological changes to a watershed are magnified due to an increase in impervious surfaces, such as rooftops, streets, sidewalks, and parking lots. Signs of declining stream health and water quality can be seen when a watershed's impervious cover exceeds 10 percent.

Increased peak runoff volumes from impervious surfaces can result in the alteration of stream channels, natural drainage ways, and riparian habitat. These impacts in turn may result in the elimination or reduction of aquatic vegetation and organisms and the degradation of water quality. Other potential effects include increased bank erosion, streambed scouring, siltation, increases in water temperature, decreases in dissolved oxygen, and changes to the morphology of the watercourse. Increased imperviousness also is an issue because it limits infiltration and groundwater recharge.

Stormwater runoff from impervious surfaces also results in an increased pollutant discharge. Pollutants associated with urban areas are specific to the type and intensity of the land use. Some examples of pollutants include sediments, nutrients, oxygen demanding substances, road salt, heavy metals, oil and grease, hydrocarbons, and bacteria.

Runoff from commercial land areas such as shopping centers, business districts, office parks, and parking lots or garages may contain high hydrocarbon loadings and metal concentrations. Loadings from these types of land use can be a significant pollutant source in stormwater runoff and can be attributed to heavy traffic volumes and large impervious surface areas.

Gas stations, in most communities, are designated as a commercial land use and are subject to the same controls as shopping centers and office parks. However, gas stations may generate higher concentrations of heavy metals, hydrocarbons, and other automobile-related pollutants because of the type of day-to-day activities associated with the industry and the volume of clientele that use the facilities.

There is increasing support for new movements like Smart Growth and Low Impact Development that can be applied to new developments. Smart Growth focuses on the following principles: mix of land uses; compact building design; range of housing choices; walkable neighborhoods; communities with a strong sense of place; preservation of open space, farmland, and environmental areas; development towards existing communities and not sprawling away from them; variety of transportation choices; predictable, fair and cost-effective development decisions; and community and stakeholder collaboration in the decision making process.

Low Impact Development uses Best Management Practices (BMPs) to control stormwater in a way that is similar to what the volume and rate of runoff would be if it were not disturbed. This allows more water to infiltrate naturally into the soils instead of all flowing into a conventional stormwater system. These BMPs include, but are not limited to, buffer strips, green roofs, permeable pavements, rain gardens, swales, and tree box filters. As northwest Indiana continues to struggle with the loss of open space to development, these techniques should be incorporated into planning in order to reduce the impacts on the already compromised water quality. During subwatershed planning efforts, detailed BMPs should be chosen to address site-specific water quality issues.

During this plan's development, the need for proactive stormwater management was recognized early on. To guide communities in developing with minimal impact on water quality, NIRPC produced the Model Stormwater Management Ordinances and Guidance (Appendix X).

3.3.2 Construction Sites

Typically, the pollutant most associated with runoff from construction sites or land disturbance is sediment. Sediment ranks as the number one pollutant by volume of surface waters in the United States and is the pollutant primarily considered by state and local officials when regulating a construction project. However, other pollutants, such as pesticides, petroleum products, nutrients, solid wastes, and construction chemicals are often associated with construction activities.

Types of pollutants associated with construction activities are dependent on several factors such as the nature of the construction activity and the physical characteristics of the project site. For example, the efficiency by which pollutants are discharged off-site or to surface waters or groundwater can be significantly impacted by the following factors: amount, intensity, and frequency of rainfall; soil type; infiltration rate; organic matter content; soil surface roughness; slope length and steepness; and ground cover. The overall impact of stormwater discharge as related to water quality also depends on the location of the construction site in relation to the receiving waters.

The nature of the construction activity also plays an important part in the types of pollutants that may be released from a construction site. For example, construction activity that results in massive earthmoving is likely to have a higher potential for off-site pollutant discharge. On projects where heavy equipment is utilized potential exists for pollutants from vehicle refueling, fuel storage facilities, and equipment maintenance areas.

It should be noted that some erosion and soil loss is unavoidable during land-disturbing activities. While proper siting and design will help prevent areas prone to erosion from being developed, construction activities will invariably produce conditions where erosion may occur. To reduce the adverse impacts associated with construction, a system of nonstructural and structural erosion and sediment controls should be incorporated into an erosion and sediment control plan for each site. During subwatershed planning efforts, detailed BMPs/management measures should be chosen to address site-specific water quality issues.

3.3.3 On-site Sewage Disposal Systems

Surface water and groundwater contamination from failed septic systems are becoming a growing concern. Currently, more septic systems are being added in unincorporated areas and areas without access to sewer systems. In areas with poor soils, it is important for development to tie into sewer systems wherever possible. Septic systems that do exist need to be properly maintained and failing systems need to be identified. The capacity of wastewater treatment facilities needs to be analyzed to identify which systems are at capacity and in need of expansion to handle the projected growth in the vicinity.

On-site sewage disposal systems are designed and installed for the purpose of wastewater treatment. Design and installation is site specific. The systems may require high maintenance. Failure of these systems can have a significant impact on the health and well being of a community and its waterbodies.

Failure can often be attributed to incorrectly characterizing waste loads and not taking into account limiting soil or geologic features when the system is designed. Soil and geologic features that need to be considered include depth to impermeable soil layers (e.g., glacial till, bedrock), depth to a highly permeable layer (e.g., sand and gravel) that does not allow for proper treatment of effluent, depth to a seasonal water table, organic loading, and hydraulic loading. An increase in water usage over a period of time also can exceed the design capability of a system and result in failure.

The inherent properties of soils in Indiana also are limited with regard to supporting on-site sewage disposal systems. Severe limitations as described in the table below do not necessarily restrict the use of an on-site sewage disposal system, but is an indication that the soil conditions may not necessarily support a system without modification to the design.

Table 3-3 Wastewater Disposal Data by County

	Percent of Households with Onsite Wastewater Disposal (Septic)	Number of Households with Onsite Wastewater Disposal (Septic)	County Area (acres)	Density of Septic Systems (ac/septic system)	Percent of Area with Soils Having "Severe Limitations" for Septic Systems
Lake	10.0%	18,274	396,962	21.7	96.0%
LaPorte	43.0%	18,002	389,865	21.7	74.0%
Porter	31.0%	14,444	334,267	23.1	83.0%

Sources: 1990 U.S. Census
Natural Resources Conservation Service Soil Survey

Discharge of wastes associated with failing systems can introduce pathogens, parasites, bacteria, and viruses which can cause communicable diseases through indirect or direct body contact or ingestion of contaminated water. Pathogens pose a particular threat when sewage pools on soil surface or migrates to waters that are used for recreation.

In addition, nitrogen and phosphorous are pollutants associated with on-site sewage disposal systems. Nitrogen and phosphorous are nutrients that contribute to eutrophication and depletion of oxygen in surface waters. Excessive nitrate-nitrogen in drinking water can also cause metheoglobinemia in infants and complications for pregnant women. Livestock also can suffer health impacts from drinking water high in nitrate.

Technology associated with on-site sewage disposal systems has progressed over the years and continues to do so. In addition, state and local requirements for the installation of systems continues to be updated to ensure that the best available technology is used in the design and installation of systems. The issue is most often with existing systems' operation and maintenance.

3.3.4 General Sources (Including Household, Commercial, and Landscaping)

General sources of pollutants are those that are generated as the result of day-to-day activities by the public and businesses. The primary sources include household activities, lawn and garden care, turfgrass management, vehicle use and maintenance, illegal discharges, and pet and domesticated animal waste.

Everyday household activities generate numerous pollutants that may affect water quality. Common household waste includes, paint, solvents, lawn and garden care products, detergents and cleansers, and automotive products such as antifreeze and oil. A household product that contains hazardous substances becomes household hazardous waste once the consumer no longer has a use for it and disposes of it. These pollutants are typically introduced into the environment due to ignorance on the part of the user or the lack of proper disposal options. The public unknowingly assumes that storm drains discharge into sanitary sewers and dump materials into storm drains under the assumption that treatment will occur at the sewage treatment plant. Users commonly dump or dispose many of these products directly onto the ground, not realizing that the materials can be carried to surface waters by runoff or pollute groundwater if they leach through the soil. Hazardous waste from households is not regulated as hazardous waste under federal and Indiana laws.

Landscaping (e.g., homeowners, golf courses) can contribute to the pollutant loading of waterbodies within a watershed. For example, improper application or over-application of fertilizers and pesticides can impair surface waters. Over-application of nitrogen can contribute to water impairment either through entry into surface water bodies by runoff or it can pollute groundwater when it leaches through highly permeable soils. Improper disposal of lawn trimmings also can lead to increased nutrient levels in water runoff. Lawn trimmings deposited in street gutters can be washed into the storm sewer system and result in elevated nutrient loadings in the receiving waterbody.

Litter and debris can be significant contributors to the degradation of surface water and groundwater. Smaller materials can be carried by runoff and deposited in surface waters. Larger items such as refrigerators and air conditioners can impair water quality through the release of fluids into surface water and groundwater. These items also degrade the aesthetic and recreational value of surface waters and may be a hazard to some species of wildlife and aquatic organisms.

Domestic pet droppings have been found to be an important contributor of nonpoint source pollution. It has been shown that these waste materials can elevate fecal coliform and fecal streptococcal bacteria levels of waterbodies. This type of pollutant is most commonly associated with dogs. However, other urban animals such as domesticated or semi-wild ducks and Canadian geese can be major contributors to the nonpoint source problem in areas where their populations are high.

3.3.5 Contaminated Sites

Contaminated sites and sites with the potential to contaminate waterbodies and the water supply in northwest Indiana have been an issue of concern for some time and it continues to be an evolving issue. As development is moving away from the urban cores, more potential Brownfield sites will remain rather than be redeveloped with existing infrastructure. Brownfield sites typically are commercial, manufacturing, or industrial sites that are left behind when the owner relocates or closes the facility. These sites have the potential to pollute waterbodies in the region. A Brownfield site is contaminated or there is a perception that it is contaminated. These sites can be costly to redevelop. Superfund sites are contaminated sites that pose a risk to human health and the environment. Those that have an immediate risk to human health may be placed on the National Priority List. Issues surrounding landfills have been evolving as well. Landfills also have the potential to impact the region's water quality. Appendix VIII identifies Superfund sites in northwest Indiana.

3.3.6 Roads, Highways, and Bridges

Pollutant sources associated with roads, highways, and bridges include both those generated during construction activity as well as those that are generated once the roadway becomes operational. Sources of pollutants associated with construction activities include sediment, on-site fuel storage and fueling operations, solid waste generation, chemicals associated with day-to-day operations, and fertilizer used during site stabilization. Pollutants associated with operational activities include roadway maintenance operations, solid waste generated from littering, and pollutants washed from the pavement (e.g., hydrocarbons, heavy metals, deicing chemicals).

Highway maintenance garages and rest areas also can be major contributors to pollutant loadings. Maintenance garages are typically used for refueling and storage of sand and salt materials. If not properly managed, these substances can become potential pollutants. Rest areas can contribute to pollutant loadings because of their large, impervious parking areas and the high volume of vehicles that utilize these facilities.

3.3.7 Combined Sewer Overflows

Combined sewers are a system designed to carry both sanitary wastewater and stormwater through the same pipe. Indiana stopped approving combined sewer systems in the 1960s and now requires separate sanitary and stormwater sewer systems. These systems are designed to overflow when capacity is exceeded, with the result a combined sewer overflow (CSO) discharging directly into surface waters. CSOs contain raw sewage along with stormwater and contribute pathogens, solids, debris, and toxic pollutants to receiving waters. CSOs can effect public health, water quality, and potentially contaminate drinking water supplies. In northwest Indiana, CSOs have contributed to high levels of *E. coli* and beach closures. CSO communities are required to submit a Long-Term Control Plan establishing the communities plan for eliminating CSOs with an implementation schedule of 10-15 years. In northwest Indiana, the following communities are listed by IDEM as having CSO problems: Chesterton, Crown Point, East Chicago, Gary, Hammond, LaPorte, Michigan City, and Valparaiso.

3.3.8 Sanitary Sewer Overflows

Sanitary sewer systems are separate from stormwater systems. An overflow of the sanitary system can occur when capacity is exceeded due to wet weather, when the flow is blocked, or when a mechanical failure occurs preventing the system from operating properly. When a sanitary sewer overflow (SSO) occurs raw sewage can enter waterways or overflow onto land. SSOs can potentially affect public health and has environmental concerns. Table 3-4, 2004 Sewer Overflows, shows the gallons of sewer overflow, as reported in 2004 by County.

Table 3-4 2004 Sewer Overflows, by County

County	Gallons Reported	Events Reported	SSO-Related (gallons reported)	Not Rain-Related (gallons reported)
Porter	1,256,247	44	114,787	29,739
Lake	4,795,345	38	821,105	4,379,070
LaPorte	307,900	7	0	117,900

3.3.9 Water Supply

As development moves away from Lake Michigan, drinking water sources will require more planning and study. The Little Calumet-Galien relies heavily on Lake Michigan as a drinking water source. There are areas that rely on well water where recharge issues need to be addressed. Quality drinking water in the Kankakee River basin given the current growth projections and the reliance on groundwater sources was identified as a major concern. The Water Conservation and Protection Tool Kit developed by NIRPC under a grant from the Joyce Foundation (Appendix IX) is an important tool designed to educate consumers on source water issues in the region. This series of fact sheets provides resources for elected officials, land-use professionals, developers, utilities, and homeowners on protecting and conserving the region's water assets.

3.4 Critical Areas

Based on various factors including ease of implementation, agencies involved, and funding availability, the Watershed Advisory Group and the Lake Michigan Coastal Program identified the following priority critical areas on which to focus efforts to reduce the nonpoint source pollutants in the identified impaired waterbodies:

1. New development
2. Existing development
3. Failing on-site sewage systems
4. Roads, highways and bridges

3.5 Goal and Objectives

The Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan and the Regional Watershed Plan for northwest Indiana have consistently identified the same issues relating to urban and rural areas. In an effort to send a consistent message, the Watershed Advisory Group adopted and modified the Goal and the Objectives in the Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan for Urban and Rural Areas.

Goal: Implement urban and rural nonpoint source practices in northwest Indiana to the extent practicable to achieve and maintain applicable water quality standards and improve quality of life.

Objectives: The following tables describe the objectives developed to achieve the goal. The objectives were developed to execute management measures discussed in depth in the Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan, Chapter 4 and have been grouped here by critical area. Each of the objectives is accompanied by action items (tasks), resources needed, a listing of responsible entities, costs, measures of success (indicators), and a time frame for accomplishing each objective. Possible funding sources for the action items are listed in Appendix XI.

The example activities described in the table are intended to represent the types of practices that could be employed to achieve the goals and objectives but are not meant to include all potential activities. The relative costs are provided to indicate the potential costs to be incurred by the groups implementing the activities and may vary considerably depending on the practices that are followed ($ = $10,000 to $50,000; $$ = $50,000 to $250,000; $$$ = $250,000 +). The relative size and scope of specific projects are provided in the table.

Critical Areas 1 – New Development

Objective 1A (Objective 1 in 6217 Coastal Plan)
Ensure the reduction of pollution and stormwater associated with new development and induced changes in hydrology

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Ensure that post development average annual Total Suspended Solids loadings are no greater than predevelopment loadings (ii) Maintain post development peak runoff and average volume similar to pre-development levels	• Partnerships with local entities • Education & Outreach • Technical assistance o Pre-construction – Developers and local government o Post-construction – Public and other • Funding • Staff • Policy/Program guidance/structure	• Local Planning and Zoning • SWCDs • Drainage Boards • IDEM • IDNR • ACOE • Illinois-IN Sea Grant • Homebuilders Associations	Provide technical assistance and outreach on Low Impact Development (LID) practices ($$) Revise ordinances and provide assistance to local zoning and planning commissions on LID practices ($$)	Total suspended solids Stormwater runoff volume	ongoing

Critical Areas 1 – New Development

Objective 1B (Objective 2 in 6217 Coastal Plan)
Encourage sound planning principles, management, and mitigation measures to protect, enhance, and restore natural resources and reduce runoff to surface waters

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Avoid conversion to the extent practicable of areas that are particularly susceptible to erosion and sediment loss; (ii) Preserve areas that provide important water quality benefits and/or are necessary to maintain riparian and aquatic biota (iii) Protect, to the extent practical, the natural integrity of waterbodies and natural drainage systems during site development	• Funding • Partnerships with: Local Watershed groups Local Entities State Entities Federal Entities Land trusts • Staff • Technical Support • Education & Outreach • Model ordinance language	• NIRPC • IDEM • IDNR • Sea Grant Planning with Power • Project WET • Hoosier Riverwatch • Indiana Local Technical Assistance Program • Indiana Conservation Districts • Planning & Zoning Boards • Drainage Boards	Regional planning/zoning to direct development away from sensitive areas ($$) Purchase conservation easements to protect sensitive water resources ($$/100 ft.)	• TSS • Amount of highly erodible land left undeveloped • Quality of riparian and aquatic biota • Acres of land placed in either public or private protection through acquisition, conservation easements, etc.	ongoing

Critical Areas 1 – New Development

Objective 1C (Objective 3 in 6217 Coastal Plan)
Ensure that site-specific development designs protect, enhance, and restore natural resources and reduce runoff to surface waters

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss; (ii) Limit increases of impervious areas, except where necessary; (iii) Limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss (iv) Limit disturbance of natural drainage features and vegetation.	• Pilot Projects/Demonstration Sites • Funding • Technical Assistance/Education & Outreach • Model Ordinances	• NIRPC • Planning & Zoning Boards • Drainage Boards • ACOE • Sea Grant • LMCP • SWCDs • DNR/IDEM • IDEM • IDNR • Project WET • Hoosier Riverwatch • Indiana Local Technical Assistance Program	Regional planning/zoning to direct development away from sensitive areas ($$) Technical assistance and Outreach for developers ($) Purchase conservation easements to protect sensitive water resources ($$/100 ft.)	• Protected land/land features • Percent imperviousness of site • TSS • Number of communities that require or promote erosion control practices be used in new developments and/or limit the disturbance of natural drainage patterns	Years 1-15

Critical Area 2 - Existing Development

Objective 2A (Objective 4 in 6217 Coastal Plan)
Ensure the decrease of pollution being discharged from existing residential and industrial facilities

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Identify priority local and/or regional watershed pollutant reduction opportunities, e.g., improvements to existing urban runoff control structures (ii) Limit destruction of natural conveyance systems (iii) Where appropriate, preserve, enhance, or establish buffers along surface waterbodies and their tributaries.	• Funding (for BMPs) • Staffing • Model Ordinances • Technical Assistance • Education & Outreach	• IDNR • IDEM • Counties • Cities • SWCDs • Homeowners/Lake Associations • RC&Ds	Municipal stormwater BMP retrofits ($$$/acre) Technical assistance and outreach for property managers ($$)	• E.coli • Phosphorus • Nitrogen • Ammonia • Riparian buffers	**Years 10-15**

Critical Area 2 - Existing Development

Objective 2B (Objective 7 in 6217 Coastal Plan)
Reduce the amount of nonpoint source pollution from everyday residential and commercial uses and activities

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Properly store, use, and dispose of household hazardous chemicals, including automobiles fluids, pesticides, paints, solvents, etc.; (ii) Properly apply and dispose of lawn and garden care products and leaves and yard trimmings; (iii) Manage turf on golf courses, parks, and recreational areas with minimal application of pesticides and fertilizer; (iv) Properly operate and maintain onsite sewage disposal systems; (v) Stop the discharge of pollutants into storm drains including floatables, waste oil, and litter; (vi) Ensure commercial activities including parking lots, gas stations and other entities not under NPDES purview implement BMPs (vii) Properly dispose of pet excrement	Partnerships with o Solid Waste Districts o Park Districts o Private Entities o Sanitary Districts o City Services Model Ordinances Local Entities/IOSHA/IDEM Education/Outreach	• Cities/Towns/Park Districts/State Parks • State Chemist Office • Purdue Extension • Solid Waste Management Districts • Sanitary Districts • IDEM • Hoosier Riverwatch • Project WET	Provide household hazardous waste collection days ($$$) Public education and outreach ($) Technical assistance and outreach for property owners ($$) New ordinances and technical assistance for septic system management ($$)	• Amount of household hazardous waste collected annually • Decrease in the amounts of fertilizer and pesticide applied • Phosphorous and/or nitrogen loads • On-site sewage disposal system inspections • Decrease presence of floatables, litter, and waste oil in storm drains and/or local waterbodies that storm drains empty into • Decrease in impervious surface coverage associated with new commercial activities	Year 1-15

Critical Area 3 - Failing On-site Sewage Systems

Objective 3A (Objective 5 in 6217 Coastal Plan)
Ensure state officials permit the use of best available technology for installation and maintenance of new onsite sewage disposal systems

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Ensure that new on-site sewage disposal systems are located, designed, installed, operated, inspected, and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into groundwater that is hydrologically connected to surface waters (ii) Placement of on-site sewage disposal systems away from unsuitable areas (iii) Establish protective setbacks from surface waters, wetlands, and floodplains for conventional as well as alternative on-site sewage disposal systems	• Funding • Staff • Model Ordinances • BMPs • Education/Outreach • Partnerships with o Cities o Counties o Planning Depts. o Researchers o Sanitary Districts o ISDH o County Dept Health o SWCDs	• Indiana State Dept of Health • County Health Departments • Sanitary Districts • Purdue Extension • IDEM • Planning with Power	Create septic system management utilities ($$) Implement ordinances governing site-specific septic system sizing and siting requirements ($$)	• On-site sewage disposal systems permits (location of such facilities) • Inspections of on-site sewage disposal systems • Number of maintenance calls • Nitrogen load • Pathogen load • Number of failed septic systems	Years 1-15

Critical Area 3 - Failing On-site Sewage Systems

Objective 3B (Objective 6 in 6217 Coastal Plan)
Reduce non-point source pollution resulting from onsite disposal system

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Establish and implement policies and systems to ensure that existing on-site sewage disposal systems are operated and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into groundwater that is hydrologically connected to surface waters. (ii) Inspect on-site sewage disposal systems at a frequency adequate to ascertain whether the systems are failing; (iii) Reduce total nitrogen loadings in the effluent by 50 percent.	• Funding • Partnerships with o Local entities o Regulators (State) o Private maintenance companies • Staff • Septic systems maps	• County Health Departments • Sanitary Districts • Property Owners with septic systems • ISDH • IDEM	Create septic system management utilities ($$) Implement ordinances governing site-specific septic system sizing and siting requirements ($$)	• On-site disposal system maintenance calls • Nitrogen load • Number of on-site sewage disposal system inspections and findings from the inspections • Number of failed septic systems	Years 1-15

Critical Area 4 - Roads, Highways and Bridges

Objective 4A (Objective 8 in 6217 Coastal Plan)
Ensure that state officials plan, site, and develop roads and highways away from areas classified as eco-significant and susceptible to erosion and sediment loss

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss (ii) Limit land disturbance such as clearing and grading and cut and fill to reduce erosion and sediment loss (iii) Limit disturbance of natural drainage features and vegetation	• Partnerships with o Cities o Counties o Planning Depts. o SWCD	• Toll Road Commission • INDOT • NIRPC • IDNR • IDEM • IL/IN Sea Grant - Planning with Power • Indiana Local Technical Assistance Program	Create maps of sensitive areas and distribute to municipalities ($$$) Distribute example natural resource protection ordinances ($$) Purchase conservation easements to protect sensitive water resources ($$/100 ft.)	• Acres of land placed in either public or private protection through acquisition, conservation easements, etc. • Number of communities that require or promote erosion control practices be used in new developments and/or limit the disturbance of natural drainage patterns • Inspections of soil and erosion control	Years 1-15

Critical Area 4 - Roads, Highways and Bridges

Objective 4B (Objective 9 in 6217 Coastal Plan)
Ensure runoff associated with bridges is assessed and that appropriate stormwater quality measures and treatment is utilized to protect critical habitat, wetlands, fisheries, and water supplies

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Site, design, and maintain bridge structure so that sensitive and valuable aquatic ecosystems and areas providing important water quality benefits are protected from adverse effects.	• Partnerships with o Cities o Counties o Planning Depts. o SWCD	• Toll Road Commission • INDOT • NIRPC • IDNR • IDEM • Planning with Power • Indiana LTAP	Draft guidance for road contractors ($$)	• Critical habitat assessment associated with bridge construction and/or maintenance • Inspections after rain events to assess impact of runoff	Years 1-15

Objective 4C (Objective 10 in 6217 Coastal Plan)
Utilize operation and maintenance controls to reduce pollutant loadings to receiving waters from roads, highways, and bridges

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Incorporate pollution prevention procedures into the operation and maintenance of roads, highways, and bridges to reduce pollutant loadings to surface waters	• Partnerships with o Cities o Counties o Planning Depts. o SWCDs o Highway Departments o Toll Road Authority o Drainage Boards	• Toll Road Commission • INDOT • Highway Department • County Gov. • City Gov. • State Gov. • IDNR • IDEM	Draft technical guidance reducing road salt applications ($$) Require stormwater collection systems include oil/grease separators and wet detention ($$$)	• Number of favorable inspections of BMPs • Implementation of pollution prevention procedures • Pollutant loads	**Years 1-15**

Critical Area 4 - Roads, Highways and Bridges

Objective 4D (Objective 11 in 6217 Coastal Plan)
Runoff management systems for existing roads, highways, and bridges should identify priority pollutant reduction opportunities and schedule implementation of retrofit projects to protect impacted areas and threatened surface waters

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
(i) Identify priority and watershed pollutant reduction opportunities (e.g., improvements to existing urban runoff control structures)	• Partnerships with o Cities o Counties o Planning Depts. o SWCDs o Highway Departments o Toll Road Authority o Drainage Boards	• Toll Road Commission • INDOT • Highway Department • County Gov. • City Gov. • State Gov. • IDNR • IDEM	Draft technical guidance reducing road salt applications ($$) Require stormwater collection systems include oil/grease separators and wet detention ($$$)	• Implementation of identified pollutant reduction opportunities • Pollutant load of impacted waterbodies	Years 1-15

Chapter 4
Agricultural Sources

4.1 Introduction

The issues related to agriculture for the Little Calumet-Galien and Kankakee River watersheds are essentially the same, it is the degree at which some of the uses exist in each basin in addition to the topography, hydrology, and soils that establish the extent of the impact on the region's water quality. This chapter was developed and adapted based on the information obtained through discussions with Kankakee River watershed stakeholders, the Little Calumet-Galien Technical Team, and information found in the 6217 plan in an effort to provide a consistent approach to agricultural nonpoint pollution reduction.

The total land area for the three-county region is 968,532 acre (Table 4-1). 517,008 acres (53%) are considered agricultural land. Agricultural uses in the Kankakee River watershed represent a much larger percentage of the land use than in the Little-Calumet Galien. The majority of the agricultural land is in LaPorte County. The primary agricultural land use is row cropland which includes corn and soybean production. The balance of the land described as agricultural is primarily in hay and pasture which includes land used for recreational horses; perennial grass and legume cover; enrolled in the Conservation Reserve Program; or year-round vegetative cover while waiting to be developed.

Table 4-1: Agriculture Land Use Within the Three-County Region (1,000s acres)

Category	Lake	Porter	LaPorte	Total
Corn	62	65.4	117	244.4
Soybean	53.4	54.5	82.6	190.5
Winter Wheat	3.7	3	5.8	12.5
Hay	3.3	4.3	9	16.6
Cattle	2.7	5.2	15.9	23.8

Source: NRCS (www.nass.usda.gov.in accessed 9/2/05)

Agricultural uses contribute to nonpoint pollution problems throughout northwest Indiana. *E. coli*, nutrients (phosphorus and nitrogen), and impaired biotic communities are all associated with agricultural uses. Agricultural practices can impact water quality by farming up to waterbodies, allowing livestock to graze through waterbodies, and the application of pesticides and fertilizer. The issues of greatest concern to the Kankakee River Basin Commission include practices that contribute to or accelerate soil erosion and the erosion of streambanks.

4.2 Problems, Causes, and Sources

4.2.1 Erosion from Cropland

Erosion of soils is a significant issue, especially in the Kankakee River watershed. As described in the previous chapter, urban and rural areas contribute runoff that can contain soils. However, disturbed soils associated with agriculture may contribute more soil than uses associated with developed communities. When vegetation is cleared from land, soils become exposed to natural elements like wind and rain which cause erosion. Farming the banks of ditches, creeks, streams, and rivers can exacerbate erosion as well. The vegetation that grows along these waterbodies is necessary to hold soils in place. The erosion of soils into waterbodies can impact biotic communities and lead to nutrient overloading. Storm events can further contribute to the problem by moving more sediment into waterbodies.

Soil erosion can be characterized as the transport of particles that are detached by rainfall, flowing water, or wind. Eroded soil is either re-deposited in the same field or transported from the field in stormwater runoff. Sediment that leaves the cropland and enters waterbodies becomes an agricultural nonpoint source pollutant. Sediment that originates from cropland has a higher pollution potential than from other agricultural land uses. The topsoil of a crop field is usually richer in nutrients and other chemicals because of past fertilizer and pesticide applications, as well as nutrient cycling and biological activity. Unprotected cropland with slopes greater than two percent may be the most susceptible to the erosive effects of rainfall and subsequent water movement over its surface. Table 4-2 shows the estimated number of acres of cropland within Lake, Porter, and LaPorte Counties with slopes of two percent or greater by county.

Table 4-2 Acres of Row Cropland with 2 percent Slopes or Greater

County	Acres of Cropland
Lake	14,578
LaPorte	18,887
Porter	10,126
Total	**43,591**

Source: Information gathered from local USDA/NRCS, DNR/DSC, SWCD, and USDA/FSA Personnel April 25, 2003.

Sediment affects the use of water in many ways. Suspended solids reduce the amount of sunlight available to aquatic plants, cover fish spawning areas and food supplies, clog the filtering capacity of filter feeders, and clog and harm the gills of fish. Turbidity interferes with the feeding habits of fish. These effects combine to reduce fish, shellfish, and plant populations and decrease the overall productivity of lakes, streams, estuaries, and coastal waters. In addition, recreation is limited because of the decreased fish population and the water's unappealing, turbid appearance. Turbidity also reduces visibility, making swimming less safe.

The most effective practices that can be applied on working row cropland to reduce erosion and resulting off-site sedimentation are conservation tillage and no-till. Conservation tillage is defined as leaving at least 30% of the soil surface covered with crop residue after planting. Conservation tillage can reduce soil losses to about half of the losses expected when a field is clean-tilled. No-till is even more effective at reducing soil losses. No-till maintains higher vegetative cover because the soil is only disturbed during seeding. Typical no-till practice knifes the seed into the ground thus minimizes the soil exposed to possible erosion. The second strategy is to route runoff from fields through practices that remove sediment. Practices that could be used to accomplish this are filter strips, field borders, grade stabilization structures, sediment retention ponds, water and sediment control basins, and conservation reserve acres. Site conditions will dictate the appropriate combination of practices for any given situation. Site-specific practices should be suggested during the development of subwatershed plans.

4.2.2 Facility Wastewater and Runoff Control from Confined Animal Facilities

"Indiana Agricultural Statistics 2001-2002" issued cooperatively by the USDA National Agricultural Statistics Service and Purdue University Agricultural Research Programs documented the following livestock numbers in Lake, Porter, and LaPorte Counties: 33,800 cattle (*2002*); 50,679 hogs, and 1,546 sheep (*1997*). Poultry numbers were insignificant. The number of small livestock operations in the target area is limited. IDEM reports only one (1) permitted Confined Feeding Operation (CFO) subject to 327 IAC5-4-3, Rule 3, Concentrated Animal Feeding Operations, operating in the Little Calumet-Galien Watershed (located in Lake County) and 30 IDEM permitted CFOs in the Kankakee River basin. Most of the CFOs in the Kankakee River watershed are in LaPorte County with only four each in Lake and Porter Counties. Table 4-3 provides an estimate provided by local technical experts of the number and types of small livestock operations within the Little Calumet-Galien watershed that, because of their size, currently are not required to hold permits from IDEM. Information for the Kankakee Basin will need to be gathered in future subwatershed planning efforts.

Table 4-3 Estimated Number & Types of Livestock Operations Not Requiring IDEM CFO Permits within the Little Calumet – Galien Watershed

County	Swine	Beef	Dairy	Ducks	Chickens	Turkeys	Sheep	Horses*
Lake	4	15	1	0	0	0	3	10
LaPorte	2	3	5	0	0	0	0	1
Porter	1	6	1	0	0	0	0	1
Totals	7	24	7	0	0	0	3	12

**Includes only operations with an average of 20 or more horses.*
Data Source: Information gathered from local USDA/NRCS, DNR/DSC, SWCD, and USDA/FSA Personnel April 25, 2003.

There is potential for more of these facilities to locate in Lake, Porter, and LaPorte Counties, primarily in the Kankakee River watershed. It is important that these facilities are properly permitted and developed according to the current IDEM guidelines.

Monitoring nearby waterbodies should be considered by sub-watersheds to determine if negative water quality impacts associated with this type of use are occurring.

Facility Wastewater

Animal waste (manure) includes the fecal and urinary wastes of livestock and poultry; process water from milking parlors; and the feed, bedding, litter, etc. from livestock operations. Confinement operations concentrate animal wastes from large numbers of animals on feeding floors, concrete pits below animal housing units, lagoons, settling basins, and other temporary holding structures designed to store animal wastes until they can be applied to cropland. Unless adequate storage capacity is planned for the storage of animal wastes, overflows from confined animal facilities have the potential of contributing to offsite water quality problems. The potential for additional pollution problems is often compounded by rainfall, which if not handled properly, has the effect of adding volume to feeding floors and manure storage areas.

Wastewater from confined animal facilities often contains the following pollutants: oxygen demanding substances; nitrogen, phosphorus, and many other major and minor plant nutrients; organic solids; salts; bacteria, viruses, and other microorganisms; and sediments. When runoff, wastewater, and manure from confined feeding operations occur in surface waters, fish kills often result because of oxygen depletion or dissolved ammonia. Decomposing organic material in surface waters often results in the depletion of dissolved oxygen. The result is anoxic or anaerobic conditions. Under these conditions, the water has an unpleasant taste, odor, and appearance due to the accumulation of methane, sulfides, and amines. Domestic or recreational uses of the water are then rendered unsuitable. Because of the high nutrient and salt content of manure and runoff from confined feeding areas, eutrophication of waterbodies may be accelerated over time by the release of nutrients from solids. The potential also exists for groundwater pollution if inadequate storage/seepage of livestock wastes occurs.

Runoff

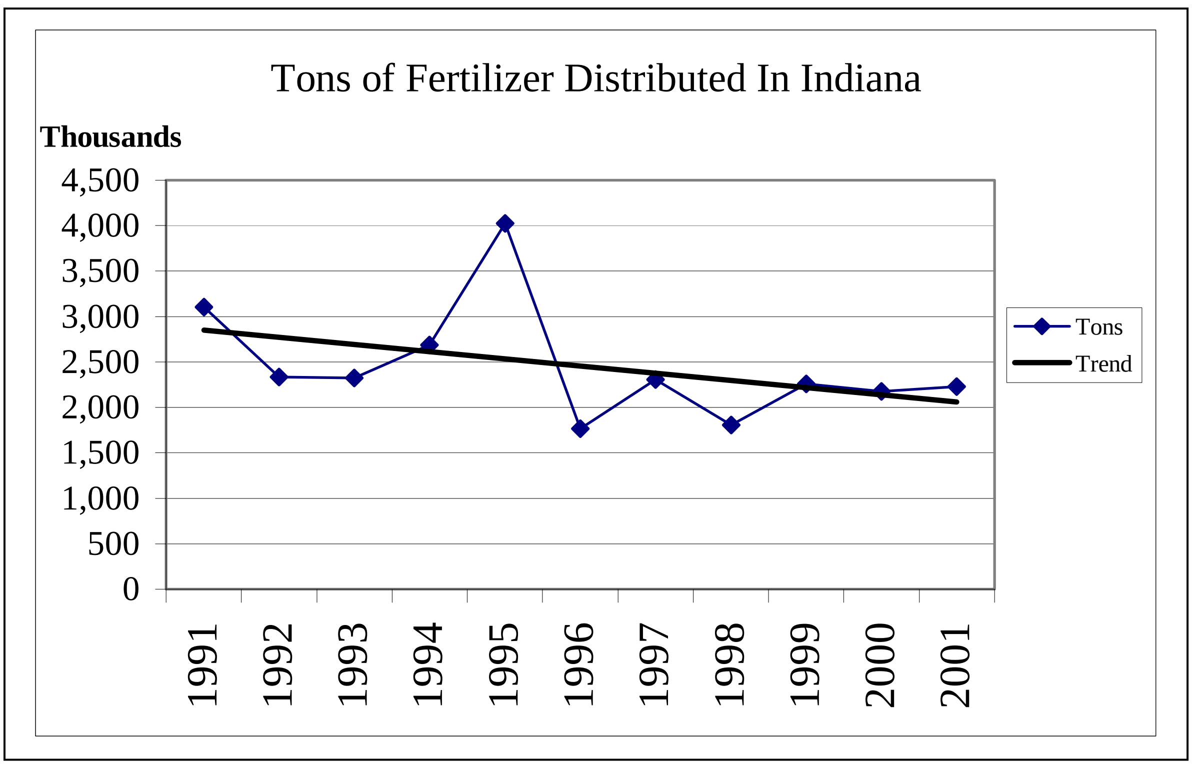
Water quality contamination from livestock wastes is most often affected by the method of application, timing, and the amount applied. Manure applied to the surface has the greatest potential for runoff. When livestock wastes are applied to frozen ground, the potential for runoff is even greater during rainfall or snow melt. When livestock manures are “knifed into” the soil, the potential for runoff and the pollution of surface water is reduced significantly.

Manure from livestock operations contains high numbers of pathogens. Runoff from cropland receiving livestock manure that has not been incorporated exhibits high numbers of bacteria. The result can be high coliform counts, stream advisories, and beach closings.

Groundwater and surface water also are susceptible to pollution when the application rate of livestock waste to cropland exceeds the amount of nitrogen, phosphorus, and potassium utilized by the crop. Soils generally have the capacity to adsorb the phosphorus contained in livestock manures; however, surface water may still be impacted with phosphorus if soil particles are transported offsite through the soil erosion process. Phosphorus is also water-soluble and moves with the drainage water. Nitrates are water-soluble and can move freely with drainage water into both surface and ground water supplies.

4.2.3 Application of Nutrients to Cropland

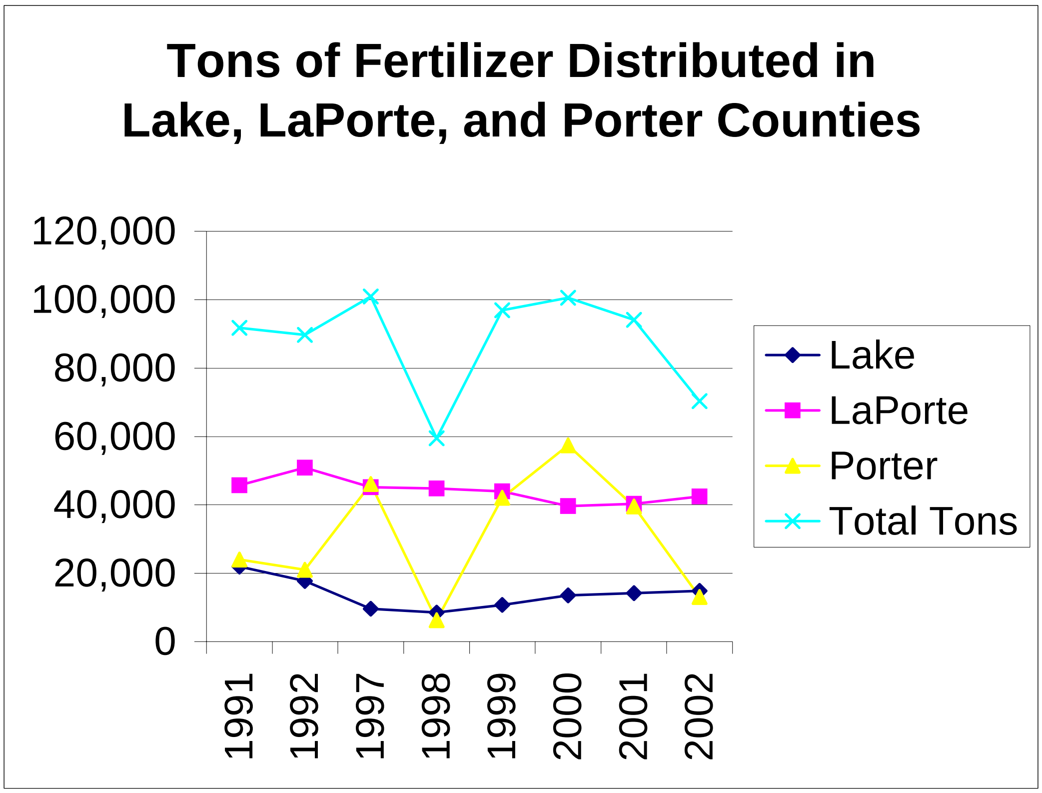
In addition to the nutrient sources discussed in Chapter 3, Urban and Rural Areas, the application of fertilizer to crops, especially grain producing crops such as corn, soybeans and wheat, is a common practice on cropland and for the most part a necessary production practice to achieve economically viable crop yields. Nitrogen (N) and phosphorus (P) are the two major nutrients applied to cropland that have the potential to degrade water quality. Agricultural fertilizer is applied to cropland in several different forms including dry, liquid and gas (anhydrous ammonia) and is applied a variety of ways including broadcasting, banding, injecting and incorporating. Data obtained from the Indiana Agricultural Statistics Report (2001-2002) shows a small decrease in the total tons of fertilizer sold statewide from 1991 to 2001 (Figure 4-1). The distribution of fertilizer in 1991 was 3,101,533 tons compared to 2,227,300 tons in 2001.



Data Source: Indiana State Chemist Office. Indiana Aaricultural Statistics

Figure 4-1 Tons of Fertilizer Distributed in Indiana (1990-2002)

The Indiana Agricultural Statistics Service also was able to supply historical information on the amount of agricultural fertilizer distributed countywide in each of the three counties that encompass the Little Calumet-Galien Watershed and Kankakee River watersheds. As illustrated in Figure 4-2, the downward trend in agricultural fertilizer sales in the three counties was more significant than the statewide trend. The total tons distributed in the three counties were 70,345 in 2002 as compared to 91,756 in 1991, a reduction of 21,411 tons.



Source: Indiana State Chemist Office, Indiana Agricultural Statistics

Figure 4-2 Tons of Fertilizer Distributed in Lake, LaPorte and Porter Counties

All living things require adequate nutrients for growth. In aquatic environments, low nutrient availability usually limits plant growth. Nitrogen and phosphorus generally are present in aquatic environments at background or natural levels below 0.3 and 0.05 mg/L, respectively. When these nutrients are introduced into a stream, lake, or estuary at higher rates, aquatic plant productivity may increase dramatically. This process, referred to as cultural eutrophication, may adversely affect the suitability of the water for recreation, swimming and other uses. Increased aquatic plant productivity results in more organic material. The organic material eventually dies and decays. The decaying organic matter produces unpleasant odors and depletes the oxygen supply required by aquatic organisms. Depleted oxygen levels, especially in colder bottom waters where dead organic matter tends to accumulate, can reduce the quality of fish habitat and encourage the propagation of fish that are adapted to less oxygen or to warmer surface waters. Highly enriched waters will stimulate algae production, with consequent increased turbidity and color. Increased turbidity results in less sunlight penetration and availability to submerged aquatic vegetation (SAV). Since SAV provides habitat for small or juvenile fish, the loss of SAV has severe consequences for the food chain.

Nitrogen

Nitrogen is naturally present in soils but must be added to increase crop production. Nitrogen is added to the soil primarily by applying commercial fertilizers and manure, but also by growing legumes (biological nitrogen fixation), and incorporating crop residues.

The chemical form of nitrogen affects its impact on water quality. The most biologically important inorganic forms of nitrogen are ammonium (NH4-N), nitrate (NO3-N), and nitrite (NO2-N). Nitrate-nitrogen is highly mobile and can move readily below the crop root zone, especially in sandy soils. It also can be transported with surface runoff, but not usually in large quantities. Ammonium, on the other hand, becomes adsorbed to the soil and is lost primarily with eroding sediment. Even if nitrogen is not in a readily available form as it leaves the field, it can be converted to an available form either during transport or after delivery to waterbodies.

All forms of transported nitrogen are potential contributors to eutrophication in lakes, estuaries, and some coastal waters. In addition to contributing to eutrophication, excessive nitrogen causes other water quality problems. Dissolved ammonia at concentrations above 0.2 mg/L may be toxic to fish, especially trout. Nitrates in drinking water are potentially dangerous, especially to newborn infants. The U.S. Environmental Protection Agency has set a limit of 10-mg/L nitrate-nitrogen in water used for human consumption (*USEPA, 1989*).

Phosphorus

Phosphorus typically plays the controlling role in algae growth in freshwater systems. The phosphorus content of most soils in their natural condition is low and can be found in dissolved, colloidal, or particulate forms. Manure and fertilizers increase the level of available phosphorus in the soil to promote plant growth, but many soils now contain higher phosphorus levels than plants need.

Runoff and erosion can carry some of the applied phosphorus to nearby waterbodies. Dissolved inorganic phosphorus (orthophosphate phosphorus) is probably the only form directly available to algae. Particulate and organic phosphorus delivered to waterbodies may later be released and made available to algae when the bottom sediment of a stream becomes anaerobic, causing water quality problems.

Though the application of nutrients is a contributor to nonpoint source concerns, the Kankakee River Basin Commission does not identify this as a primary concern. Nitrates can be found in waterbodies, but they are not found in alarming proportions.

4.2.4 Pesticide Application to Cropland

The term *pesticide* includes any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest or intended for use as a plant regulator, defoliant, or desiccant. Herbicides, insecticides, fungicides, miticides, and nematicides all fall under the general term pesticides. The principal pesticidal pollutants that may be detected in surface water and in groundwater are the active and inert ingredients and any persistent degradation products. Pesticides may enter ground and surface water in solution, in emulsion, or bound to soil colloids. Despite the documented benefits of using pesticides to control plant pests and enhance production, these chemicals may, in some instances, cause impairments to the uses of surface water and groundwater. Some types of pesticides are resistant to degradation and may persist and accumulate in aquatic ecosystems.

The application of pesticides to cropland to control weeds, insects and other pests during crop production is a common and most often-necessary production practice. According to Indiana Agricultural Statistics 2001-2002 report, herbicides were applied to 99 percent of the corn in Indiana and 98 percent of the soybeans in the state. Insecticides were applied to 47 percent of the corn. The most predominate herbicide used on corn was atrazine at 94 percent of the corn acreage. Metolachlor was 32 percent and acetochlor was applied to 27 percent of the corn. All other corn herbicides listed were used on less than 15 percent of the corn ground in 2001. The highest used insecticide for corn was Tefluthrin at only 14 percent of the corn acreage. No other insecticides listed were greater than 10 percent of the acreage. The most predominately used herbicide on soybeans was glyphosate at 85 percent of the acreage. No other herbicide listed for soybeans was greater than 10 percent of the acreage.

No county data on agricultural pesticide use was available for the Lake, Porter, and LaPorte Counties, however, local agency personnel indicated on April 25, 2003 that the types of pesticides used and the percentage of corn and soybean acreage in the watershed treated with pesticides would mirror the patterns documented above for statewide use.

If pesticides move offsite into rivers, streams, and lakes they may impact water quality and the environment by eliminating or reducing populations of desirable organisms, including endangered species. Sub-lethal effects include the behavioral and structural changes of an organism that jeopardize its survival. For example, certain pesticides were found to inhibit bone development in young fish or to affect reproduction by inducing abortion.

Herbicides in the aquatic environment can destroy the food source for higher organisms, which may then starve. Herbicides also can reduce the amount of vegetation available for protective cover and the laying of eggs by aquatic species.

Sources of pesticide contamination include: atmospheric deposition; spray drift during the application process; misuse; and spills, leaks, and discharges that may be associated with pesticide storage, handling, and waste disposal.

Pesticide losses are generally greatest when rainfall is intense and occurs shortly after pesticide application, a condition for which water runoff and erosion losses also are greatest. Pesticides can be transported to receiving waters either in dissolved form or attached to sediment. Dissolved pesticides may be leached to groundwater supplies. Both the degradation and adsorption characteristics of pesticides are highly variable.

Though the application of pesticides is a contributor to nonpoint source pollution, the Kankakee River Basin Commission does not identify this as a primary concern. Waterbodies within the watershed show the presence of pesticides, but they are not found in alarming proportions.

4.2.5 Grazing Management

Surface water quality problems associated with livestock grazing become evident when livestock are allowed free access to sensitive areas such as streambanks, wetlands, estuaries, ponds, lakeshores, and riparian areas. The actual physical disturbance caused by livestock denudes vegetative cover and increases streambank, shoreline, and riparian area soil erosion and sedimentation. In addition, the direct loading of animal wastes caused by livestock seeking water from surface waterbodies is increased significantly and can be reflected in the presence of *E. coli* bacteria in waterbodies. Finally, overgrazing and overstocking also can lead to diminished vegetative cover and increase soil erosion accompanied with offsite sedimentation and nutrient problems.

Local investigations indicate there is a limited amount of grazing by cattle and horses adjacent to streams in the Little Calumet-Galien watershed as well as some access by other types of livestock. At a technical information gathering meeting held on April 25, 2003, local USDA/NRCS, IDNR/DSC, SWCD, and USDA/FSA personnel provided the following estimates of acres of grazing land and miles of streams impacted in the Little Calumet - Galien Watershed: Lake - 850 acres, two miles of streams impacted; LaPorte - 750 acres, two miles of streams impacted; and Porter – 300 acres, three miles of streams impacted. The total estimated grazing acreage and streams impacted in the watershed was 1,900 acres and seven miles of streams. Information for the Kankakee River Basin will need to be gathered in future subwatershed planning efforts.

4.3 Critical Areas

The Watershed Advisory Group and the Lake Michigan Coastal Program have identified the following critical areas, or priorities, for northwest Indiana:

1. **Row cropland with 2 percent or greater slopes** within a watershed of a stream or lake listed on the state's 303(d) list for impaired biotic communities and /or pathogens
2. **Confined Animal Facilities** with animal units well below the numbers that require Confined Feeding Operation Permits (20-300 animal units) but located with ½ mile of a perennial stream or a lake
3. **Nutrients applied to cropland** within a watershed of a stream or lake listed on the state's 303(d) list for impaired biotic communities and /or pathogens without reference to a nutrient management plan
4. **Pesticides applied to cropland** within a watershed of a stream or lake listed on the state's 303(d) list for impaired biotic communities and /or pathogens without reference to a pesticide management plan
5. **Livestock grazing** within ½ mile of a perennial stream or a lake of 10 or more animal units

4.4 Goal and Objectives

The Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan and the Regional Watershed Plan for northwest Indiana have consistently identified the same issues relating to agricultural sources. In an effort to send a consistent message, the Watershed Advisory Group adopted and modified the Goal and the Objectives in the Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan for Agricultural Sources.

Goal: Implement agricultural nonpoint source practices in northwest Indiana to the extent practicable to achieve and maintain applicable water quality standards and improve quality of life.

Objectives: The following tables describe the objectives developed to achieve the goal. The objectives were developed to execute management measures discussed in depth in the Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan, Chapter 2 and have been grouped here by critical area. Each of the objectives is accompanied by action items (tasks), resources needed, a listing of responsible entities, costs, measures of success (indicators), and a time frame for accomplishing each objective. Possible funding sources for the action items are listed in Appendix XI.

The example activities described in the table are intended to represent the types of practices that could be employed to achieve the goals and objectives but are not meant to include all potential activities. The relative costs are provided to indicate the potential costs to be incurred by the groups implementing the activities and may vary considerably depending on the practices that are followed ($ = $10,000 to $50,000; $$ = $50,000 to $250,000; $$$ = $250,000 +). The relative size and scope of specific projects are provided in the table.

Critical Area 1- Row Cropland With 2 percent or Greater Slopes

Objective (Objective 1 in 6217 Coastal Plan)
Minimize the delivery of sediment from agricultural lands to surface waters

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Work with landowners and operators to develop and apply the erosion control component of a conservation management system (CMS) on their cropland to reduce erosion	• More technical personnel • More funds for cost-sharing/ incentives • Educational resources for educating the public • Cooperation and support from agricultural agencies, organizations and other interest groups	• Natural Resource Conservation Service • Indiana Department of Natural Resources • Purdue Cooperative Extension Service • Indiana Department of Environmental • Soil and Water Conservation Districts	Provide technical assistance and outreach regarding contour and conservation tillage ($$)	• Number of conservation plans developed that include the erosion control component of a conservation management system (CMS) • Number of erosion control practices and technologies implemented to settle solids and associated pollutants in runoff from the contributing area for storms up to and including a 10 year, 24 hour frequency. • Reduced sediments and attached pollutants in surface water	1-15 years

Critical Area 2- Confined Animal Facilities

Objective (Objective 2 in 6217 Coastal Plan)
Minimize the discharge of contaminants from facility wastewater and stormwater runoff

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Work with owners and operators of small confined animal facilities to design and implement animal waste storage and waste utilization systems	• Increased technical personnel • More funds for cost sharing/incentives • Educational resources for educating the public • Cooperation and support from agricultural agencies, organizations and other interest groups	• Indiana Department of Environmental Management • Natural Resource Conservation Service • Purdue Cooperative Extension Service • Indiana Department of Natural Resources • Soil and Water Conservation Districts	Inventory small animal feeding operations ($$) Provide technical assistance and outreach on manure management practices ($$) Provide grants for example facilities ($$$)	• Number of manure management plans developed which include the design of a system to collect, store, and properly utilize accumulated solids and wastewater from the confinement facility along with the runoff from storms up to and including 25 year, 24 hour frequency. • Number of animal waste storage facilities installed • Number of animal waste utilization systems implemented • Improved water quality by a reduction of pathogens in surface water	1-10 years

Critical Area 3- Nutrients Applied to Cropland

Objective (Objective 3 in 6217 Coastal Plan)
Reduce the potential for runoff and/or leaching of nutrients applied to cropland into surface and/or groundwater

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Work with landowners and operators to develop and implement nutrient management plans	• More technical personnel • More funds for cost-sharing/ incentives • Educational resources for educating the public • Cooperation and support from agricultural agencies, organizations and other interest groups	• Indiana Department of Environmental Management • Natural Resource Conservation Service • Indiana Department of Natural Resources • Purdue Cooperative Extension Service • Soil and Water Conservation Districts	Provide technical assistance and outreach on integrated nutrient management practices ($$)	• Number of nutrient management plans developed that describe the nutrient rates necessary to achieve realistic crop yields based on current soil tests and other agronomic information while maximizing nutrient use efficiency • Number of nutrient management plans implemented • Improved water quality as a result of a reduction of nutrients in surface and groundwater.	1-15 years

Critical Area 4- Pesticides Applied to Cropland

Objective (Objective 4 in 6217 Coastal Plan)
Reduce the potential for runoff and/or leaching of pesticides applied to cropland into surface and/or groundwater

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Work with landowners and operators to develop and implement pesticide management plans	• More technical personnel • More funds for cost-sharing/ incentives • Educational resources for educating the public • Cooperation and support from agricultural agencies, organizations and other interest groups	• Purdue Cooperative Extension Service • Natural Resource Conservation Service • Indiana Department of Natural Resources • Indiana Department of Environmental Management • Soil and Water Conservation Districts	Provide technical assistance and outreach on integrated pesticide management practices ($$)	• Number of pest management plans developed that evaluate pest problems and incorporate integrated pest management strategies to improve use efficiency and effectiveness while minimizing risk of runoff and/or leaching • Number of pest management plans implemented • Improved water quality as a result of a reduction of pesticides in surface and groundwater.	1-15 years

Critical Area 5- Livestock Grazing

Objective (Objective 5 in 6217 Coastal Plan)
Reduce physical disturbance and direct loading of animal waste and/or sediment caused by grazing livestock

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Work with landowners and operators to plan and apply the pasture components of a conservation management system on grazing land	• More grazing land specialists • More funds for cost-sharing/ incentives • Educational resources for educating the public • Cooperation and support from agricultural agencies, organizations and other interest groups • Promotion of conservation easements by local planning groups	• Natural Resource Conservation Service • Indiana Department of Natural Resources • Purdue Cooperative Extension Service • Indiana Department of Environmental Management • Soil and Water Conservation Districts	Conduct regional survey of livestock in streams ($) Provide technical assistance and outreach on availability of EQIP and other resources for livestock control ($)	• Number of grazing land management plans developed that include the pasture components of a conservation management system (CMS). • Number of grazing land management plans implemented • Number of rotational grazing systems established • Number of feet of fencing installed to remove access of livestock to streams, riparian areas and wetlands • Improved surface water quality from reduced input of sediment and pathogens related to livestock access to sensitive areas and/or runoff from poorly vegetated grazing lands.	1-10 years

Chapter 5
Hydromodification

5.1 Introduction

Rivers and streams are influenced by several variables and if one variable is changed, it produces change in the others. There are five variables that are controlling factors in rivers:

- **Flow**: The volume and velocity of water delivered to the stream.
- **Gradient**: The slope of the streambed.
- **Sediment Load**: The amount of natural sediment delivered to and transported by the river system.
- **Channel Width:** The width from bank to bank of the stream (usually varies)
- **Channel Depth:** The depth from the top of the bank to the bottom of the stream (usually varies)

Changes in flow, gradient, sediment load, channel width, or channel depth are hydromodifications and the affect on the river system can produce severe changes throughout the watershed. Hydromodification is the most prevalent source of degradation in streams, including primarily alterations caused by agricultural activities and urban development.

Historically, agricultural activities were the most prevalent source of hydromodification, however as urbanization has occurred this has begun to change. Currently, development trends show population shifts away from urban areas bringing new development further south and east into land that was previously open or used for agricultural purposes. As this occurs many activities associated with hydromodification are occurring. These activities not only impact a small stream or waterbody near where these activities are occurring, but potentially the entire watershed. These activities result in both short and long term water quality degradation, accelerated erosion and sedimentation, destruction of aquatic habitat, and impairment or elimination of certain beneficial functions performed by the region's waters.

Some of the common hydromodifications are listed below (for more detailed refer to the Indiana Coastal Program's Nonpoint Pollution Control Plan, Chapter 6):

- Channelization
- Stream relocating
- Headwater stream and wetlands fills
- Straightening
- Levee construction
- Bank armoring/bank stabilization
- Clearing and snagging
- Riparian encroachment

- Flow regulation
- Bridge and culvert construction
- Draining, filling
- Urbanization

The hydrology of northwest Indiana's two major watersheds has been severely altered from pre-settlement conditions. Both the Little Calumet-Galien and Kankakee watersheds have experienced channelization, diversions, dredging, and drainage of large expanses of marshland. These changes affect water quality. In Chapter 2, Watershed Descriptions, many of these issues were highlighted in the natural history and land use sections. This issue also is discussed specific to the Little Calumet-Galien watershed in the 6217 Coastal Plan and excerpts of that chapter are found below.

5.2 Kankakee River Watershed

The entire length of the Kankakee River has been channelized in Indiana by straightening and relocating the channel. The Kankakee River, pre-channelization, was a naturally meandering river through Indiana, with approximately 2000 bends upstream from Momence, Illinois (IDNR, 1990). Channelization of the Kankakee River was completed in the early twentieth century, by the beginning of World War I. Channelization of the Kankakee River through Indiana has reduced the river to one-third of its historic natural stream distance.

Most tributaries of the Kankakee River are manmade channels, particularly in downstream reaches that discharge into the river. Historically many of the larger tributaries of natural origin outletted into the Kankakee Marsh, however the marsh was drained by excavated ditches (IDNR, et al, 1976). These projects transpired between the late 1800s and early 1900s (IDNR, 1990). The Grand Kankakee Marsh covered over 400,000 acres with the main body varying from 3 to 10 miles in width from the headwaters (near South Bend) to the riverbed near Momence. Some smaller arms of the marsh extended 5 to 10 miles further into tributary valleys and low-lying areas within the floodplain (IDNR, 1990). The interior of the marsh contained isolated dunes and sand ridges. The marsh was drained primarily for agricultural purposes using ditches. In the late 1800s, technology allowed for large-scale drainage projects using the steam dredge. In the 1880s, Singleton Ditch (which drains most of southern Lake County) was the first of many ditching and dredging activities (IDNR, 1990).

Levees, dikes, and spoil banks also have been put into place throughout the basin to provide flood protection. Spoil banks, some of which are comprised of spoil from earlier dredging and ditching projects, provide some protection from flooding. Levees are used to provide protection for residential and resort communities. Levee breaks during flood events not only can affect these communities, but also wash out riverbanks, thus increasing sedimentation problems. Agricultural dikes and spoil banks are used to protect large areas of farmland. Pump stations usually are used to supplement these ditch and levee systems (IDNR, 1990).

5.3 Little Calumet-Galien Watershed

The Little Calumet-Galien watershed has undergone significant changes, as well. The changes along Lake Michigan have come mainly from development for residential, industrial, commercial and marine uses along the coastline. The current Grand Calumet and Little Calumet River systems have a long history of channel modifications, flow reversals, and diversions (see IDNR, 1994 for a full history).

Industrialization and urbanization of the Little Calumet-Galien watershed during the 20th century have altered the basin including the constant threat of destruction from excavation and sand mining of the dunes, while the beaches along Lake Michigan were threatened with filling. Ten square miles of land have been transformed in this manner. At the same time, the region's hydrology also has been impacted by channelization, construction of drainage canals, and the draining and filling of wetlands. Specific impacts include channelization of the Little Calumet River, the Grand Calumet River and other tributaries to Lake Michigan, and the construction of drainage canals, in particular the Indiana Harbor Canal. Additional changes include drainage and filling of vast acreages of wetlands while native soil surfaces have been replaced with impermeable, urban surfaces.

5.4 Problems, Causes, and Sources

As discussed in previous sections of this chapter, hydromodification has severely altered the watersheds in northwest Indiana. Some of the most frequent hydromodifications include channel modifications, dams, wetland loss, and streambank and shoreline erosion.

5.4.1 Channel Modification

Channel modifications have occurred to improve flood control, navigation, and drainage. Examples of channel modification include straightening, widening, deepening or relocating existing stream channels. The channelization of the Kankakee River in the early twentieth century is one such channel modification. Another would be the use of dykes and levees to improve drainage for surrounding property.

In the Little Calumet-Galien watershed, the alteration of the flow of the Calumet River and the subsequent changes creating the Little Calumet and Grand Calumet Rivers is another modification. The creation of the Calumet Sag Channel permanently altered the Little Calumet-Galien watershed, forever diverting a portion of the watershed to the Mississippi Basin. Channel modifications have sped up the flow of water in some instances carrying larger amounts of sediment downstream and further degrading an already stressed system.

5.4.2 Dams

A dam is a structure which impounds water exceeding the normal capacity of the channel during average flows and acts as a barrier to downstream and upstream transport in the river. Locating and construction of a dam can be undertaken for many purposes, including flood control, power generation, irrigation, livestock watering, fish farming, navigation, municipal water supplies, and recreation.

Dams are associated with hydromodification for many reasons. Locating a new dam can overwhelm wetlands, riparian areas, and upland areas with excess water or reduce, and sometimes eliminate, downstream flooding needed by some wetlands and riparian areas. Dams also can block migration routes of fish. The construction of a dam can increase turbidity and sedimentation in the waterway. Leaking of fuel and chemical spills from construction equipment may occur during construction and operation. The operation of dams can generate nonpoint pollution from the controlled release of water including increased loads of organic materials, phosphorus, nitrogen; changes in pH; increased erosion of the streambed by scouring the channel below the dam; and changes in water temperature downstream.

Numerous dams were built at the turn of the century for power to cut timber and grind grain. Locations and details about dams in the Little Calumet-Galien Watershed are shown in Table 5-1 below. There are no dams located along the Kankakee River. However there are some small dams found in tributaries of the Kankakee River. Information for the Kankakee River Basin will need to be gathered in future subwatershed planning efforts.

Table 5-1 Dams in Little Calumet-Galien Watershed

Dam	State ID #	Height In feet	Surface Area-acres
LAKE COUNTY			
Hobart Deep River (in channel)	45-1	Approx. 10	?
Hooseline &Molchan Lake Dam	45-10	16 – 20	12
Lake George Dam	45-2	22	242
Doubletree Lake Estates N.	45-11	28.5	90
Doubletree Lake Estates W.	45-12	6	90
PORTER COUNTY			
Cyrus Noayad Lake Dam	64-10	10-20	9.6
Lake Louise Dam	64-8	45	228
Lake of Four Seasons (dam “A”)	64-13	27	56.84
Lake of Four Seasons (dam “B)	64-12	31	14.35
Lake of the Woods Dam	64-2	22	20.41
Linde Dam (in channel)	64-21	11	11
Loomis Lake Dam	64-9	17	49.72
Norman Olson Lake Dam	64-6	20	14
Old Longs Mill Dam	64-3	15	9.91
Rice Lake Dam	64-7	15	17.03
Robbins Pond Dam	64-14	10	20
Roy Nicholson Dam	64-4	10	1
Bethlehem Steel Check Dam #1	64-16	4	1
Bethlehem Steel Check Dam #2	64-17	4	1
Bethlehem Steel Check Dam #3	64-18	4	1
Bethlehem Steel Check Dam #4	64-19	4	1
Bethlehem Steel Check Dam #5	64-20	?	16
Bethlehem Steel Check Dam #6	64-22	?	21
LAPORTE COUNTY			

Camp Red Mill Lake Dam	46-8	21	21.69
Dingler Lake Dam	46-1	Approx. 16	10
Jack Ragle Low Head Dam	46-12	4.3	1
La Lumiere	46-11	15	15
Seven Springs Lake Dam	46-4	12	42.2
Seybert Lake Dam	46-3	6	1
Wallace Lake Dam	46-9	Approx. 15	38
Walton Lake Dam	46-10	8	19.44
Lakeside Estates Dam	46-13	17.2	2.5
Michigan City Golf Course	46-14	12	1

5.4.3 Wetland Loss

Wetland loss due to hydromodifications and urban development is significant in these watersheds. Historical wetlands estimates based on NRCS hydric soils determinations for Lake, Porter, and LaPorte Counties place one-time wetlands acreage at approximately 360,000 acres. 1986 inventories place the current amount of wetlands at approximately 63,000 acres, or about 82.5 percent loss of previous wetlands acreages in the region. Figure 5-1 represents the wetland change over time.

Roughly five percent, 100 to 200 square miles, of the total land area of the Kankakee River watershed (which lies within all or portions of 9 counties in Indiana and drains 2,989 square miles) is covered by 17,000 to 27,000 wetlands. Of that, approximately four percent are one acre or smaller; 42 percent are between one acre and 10 acres; 42 percent are between 10 acres and 40 acres; and 12 percent are greater than 40 acres (IDNR, 1990). In comparison, approximately 11 percent, 65 to 68 square miles, of the total land area of the Little Calumet-Galien Watershed (which lies within portions of 3 counties in Indiana and encompasses approximately 604 square miles) is covered by 7,242 wetlands. Of that, about 40 percent are one acre or smaller; 48 percent are one acre to 10 acres; 10 percent range from 10 to 40 acres; and 2 percent are greater than 40 acres (IDNR, 1994).

The region's hydrology also has been impacted by urbanization and hydromodification, as described above. Additional changes include draining and filling of vast acreages of wetlands while native soil surfaces have been replaced with impermeable, urban surfaces. The rich habitat types within the watershed wetland areas are particularly susceptible to degraded water quality. While wetlands often are referred to as the "kidneys" of a natural system due to their ability to filter, contain, and transform nutrients, excessive levels of nutrients tend to drive biologically diverse wetland plant communities toward weedy species. As a result, emergent marshes tend to become dominated by invasive species like narrow leaved cattail or phragmites; sedge meadows are replaced with reed canary grass; and bottomland forests are replaced with sandbar willow and box elder. Animal diversity tends to decline as plant diversity declines.

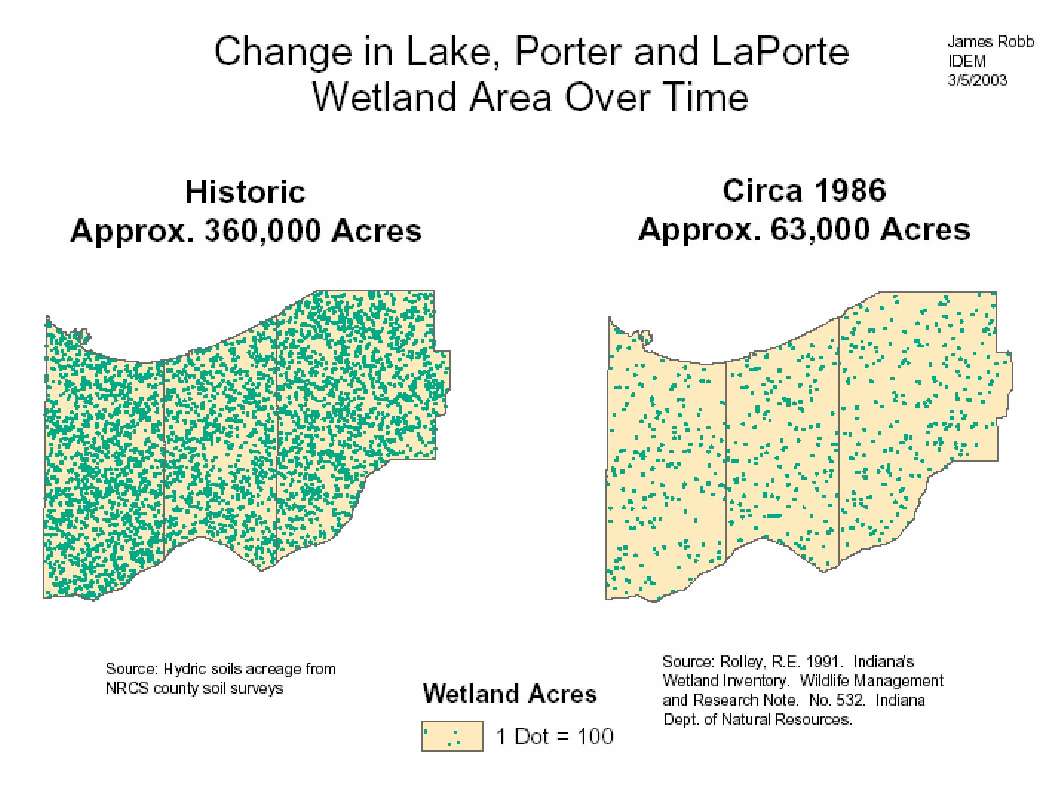


Figure 5-1 Change in Lake, Porter and LaPorte Wetlands

5.4.4 Streambank and Shoreline Erosion

Erosion is the wearing away of land by wind or water, which occurs naturally, however it can be intensified by human activities. Streambank erosion is the loss of land along rivers and creeks and shoreline erosion is the loss of beach along lakes including Lake Michigan.

Excessive erosion of shorelines and streambanks can have adverse impacts on riparian habitats due to increased sediment loads, turbidity, and nutrients. Development, or the change in land use from open space to residential or something of a higher intensity, can increase erosion impacts. The impacts of increased impervious surfaces caused by development were discussed in Chapter 3. Development up to streambanks or the removal of riparian vegetation for whatever purpose can accelerate erosion because this vegetation helps hold soils in place, reducing the rate of erosion. Without the riparian buffers, stormwater from nearby development or human activities can increase the rate that streambanks and the shoreline are eroded.

Streambank erosion is of great concern in the Kankakee River watershed. The banks of the Kankakee and Yellow Rivers also serve as flood levees providing protection from major storm events. Any erosion to the streambank can compromise the stability of the levee and threaten widespread flooding. Thus any erosion is cause for concern and immediate maintenance.

In the Kankakee River watershed, there are two primary tributaries that contribute significant amounts of sediment to the Kankakee River due to streambank erosion. The confluence of the Yellow River into the Kankakee River is at the LaPorte County border. The Yellow River is partially channelized upstream which increases its flow and as it flows through highly erodible soil in Starke County it carries a large amount of sand into the Kankakee River. Even though this occurs outside of the study area, it is important to note the occurrence as it does ultimately affect Lake, Porter, and LaPorte Counties.

In Lake County, streambank erosion occurs along drainage ditches and streams that empty into the Singleton Ditch. The Singleton Ditch was originally dug to drain the marsh that covered much of southern Lake County. The Singleton Ditch has been channelized and today the sediment flows into Illinois and into the Kankakee River.

5.5 Critical Areas

The Watershed Advisory Group and the Lake Michigan Coastal Program have identified the following critical areas, or priorities, for northwest Indiana:

1. Channelization
2. Wetland Loss
3. Erosion and sediment control associated with dams
4. Streambank and shoreline erosion

5.6 Goal and Objectives

The Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan and the Regional Watershed Plan for northwest Indiana have consistently identified the same issues relating to hydromodifications. In an effort to send a consistent message, the Watershed Advisory Group adopted and modified the Goal and the Objectives in the Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan for Hydromodifications.

Goal: Ensure the protection of northwest Indiana's waterbodies from further impacts of hydromodification and wetland loss to meet and maintain applicable water quality standards.

Objectives: The following tables describe the objectives developed to achieve the goal. The objectives were developed to execute management measures discussed in depth in the Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan, Chapters 6 and 7 and have been grouped here by critical area. Each of the objectives is accompanied by action items (tasks), resources needed, a listing of responsible entities, costs, measures of success (indicators), and a time frame for accomplishing each objective. Possible funding sources for the action items are listed in Appendix XI.

The example activities described in the table are intended to represent the types of practices that could be employed to achieve the goals and objectives but are not meant to include all potential activities. The relative costs are provided to indicate the potential costs to be incurred by the groups implementing the activities and may vary considerably depending on the practices that are followed ($ = $10,000 to $50,000; $$ = $50,000 to $250,000; $$$ = $250,000 +). The relative size and scope of specific projects are provided in the table.

Critical Area 1 – Channelization

Objective 1A (Objective 1 in 6217 Coastal Plan)
Evaluate the potential effects of proposed channelization on instream and riparian habitats

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Conduct an environmental assessment of proposed channelization projects prior to development	Technical consultant	Owners of properties affecting channel County Drainage Board	Environmental Assessment ($$)	Percentage of proposed projects with environmental assessments	1 to 5 years

Objective 1B (Objective 1 in 6217 Coastal Plan)
Plan and design channelization to reduce undesirable impacts

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Plan and design channelization projects to minimize the impact on water volume, rate, and quality	Technical consultant	Owners of properties affecting channel County Drainage Board	Develop design criteria ($$)	Project designs with minimal impact on the environment	2 to 5 years

Critical Area 1 – Channelization

Objective 1C (Objective 1 in 6217 Coastal Plan)
Develop an operation and maintenance program with specific timetables for existing modified channels which includes opportunity to restore instream and riparian habitat

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Inventory existing modified channels Assess potential for the restoration of instream and riparian habitats	• Technical consultant • Funding	IDNR-DOW	Channelization inventory ($$)	Number of Operation and Maintenance plans developed for existing modified channels	3 to 5 years

Critical Area 2 – Wetland Loss

Objective 2A (Objective 5 in 6217 Coastal Plan)
Protect wetlands and riparian areas

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
• Inventory wetlands • Develop site plans that minimize disturbance of high quality wetlands and riparian areas • Investigate land protection measures for high quality wetlands and riparian areas	• Funding • Technical Assistance • Educational • Land Trusts	• IDEM • IDNR • SWCD • US Army Corps of Engineers • USDA • US Fish & Wildlife	Create and field check wetland maps ($$) Develop ordinances requiring wetland protection and mitigation ($) Investigate creation of regional wetland mitigation banks in disturbed areas ($$)	No net loss of wetlands and riparian areas	1-5 years

Critical Area 2 – Wetland Loss

Objective 2B (Objective 6 in 6217 Coastal Plan)
Restore and enhance wetlands and riparian areas

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Inventory wetlands Assess quality of wetlands and riparian areas Develop restoration plan for designated wetlands and riparian areas	• Funding • Technical Assistance • Educational Assistance	• IDEM • IDNR • SWCD • US Army Corps of Engineers • USDA • US Fish & Wildlife	Create and field check wetland maps ($$) Develop ordinances requiring wetland protection and mitigation ($) Investigate creation of regional wetland mitigation banks in disturbed areas ($$)	Increase in quantity and quality of wetlands and riparian areas	1-5 years

Critical Area 3 – Dams

Objective 3A (Objective 2 in 6217 Coastal Plan)
Construction and maintenance of dams must comply with MS4 guidelines

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Review plans for new construction and maintenance of dams	Technical assistance	The agencies with jurisdiction over the various MS4 areas	Construction plan reviews ($$)	• Percent of dam project in compliance with MS4 guidelines	Currently in effect

Objective 3B (Objective 3 in 6217 Coastal Plan)
Develop and implement a program to manage dams for the improvement of surface water quality and instream and riparian habitat

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
• Maintain standards for releasing waters from dams to address water quality problems and minimize them •	• Technical assistance • Funding	• Owners of dams • IDNR-DOW	Program development ($$)	Reduced stream scouring and streambank erosion and stable water levels	1 to 2 years

Critical Area 3 – Dams

Objective 3C (Objective 3 in 6217 Coastal Plan)
Develop and implement a program to manage dams to minimize problems caused by excess water withdrawal

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
• Dialogue with any industry or group withdrawing waters from dammed pools	• Technical assistance • Funding	• Owners of Dams and agencies withdrawing water from pools • IDNR-DOW	Program development ($$)	Improved water quality	1 to 2 years

Critical Area 4 – Streambank and Shoreline Erosion

Objective 4A (Objective 4 in 6217 Coastal Plan)
Stabilize streambanks with vegetative materials

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Minimize erosion by planting streambanks	• Funds for designing and implementing (bioengineering) plantings along streambanks and shorelines • Local agencies and interest groups to monitor progress of growth and to watch for damaged areas which need maintenance	• Owners of the property • IDNR-DOW • Local interest groups	Identify areas of high streambank erosion potential and property owners ($) Provide technical assistance and local match for 319 and other grant sources for erosion control projects ($$)	• No loss of streambanks • Improved water quality	2 to 5 years

Critical Area 4 – Streambank and Shoreline Erosion

Objective 4B (Objective 4 in 6217 Coastal Plan)
Protect streambank and shoreline features with the potential to reduce nonpoint source pollution

Action Items (Tasks)	Resources Needed	Responsible Entities	Example Activities and Relative Cost	Measure of Success/Indicator	Time Frame
Reduce nonpoint source pollution utilizing protective vegetation to trap soil and sediments and utilize nutrient in growth cycle	• Funds for designing and implementing (bioengineering) plantings along streambanks and shorelines • Local agencies and interest groups to monitor progress of growth and to watch for damaged areas which need maintenance	• Owners of the property • IDNR-DOW • Local interest groups	Identify areas of high streambank erosion potential and property owners ($) Provide technical assistance and local match for 319 and other grant sources for erosion control projects ($$	• No loss of streambanks • Improved water quality	2 to 5 years

Chapter 6
Adoption and Evaluation

6.1 Plan Adoption

This plan and any amendments will be approved by NIRPC's Environmental Management Policy Committee and then adopted by the full NIRPC Commission. It will be consistently reviewed for updates every five (5) years with a comprehensive review every 15 years. Amendments and changes may be made more frequently as laws change or new information becomes available that will assist in providing a better outlook on the Little Calumet-Galien and Kankakee River Watersheds within northwest Indiana. The responsibility for overseeing implementation of the plan falls on the Watershed Advisory Group housed at NIRPC.

Additionally, as the 5-year action steps for implementation of objectives are adopted for the Indiana Lake Michigan Coastal Program Nonpoint Pollution Control Plan they will be sent to the Watershed Advisory Group for review and adoption as an amendment to this plan.

Total Maximum Daily Loads (TMDLs) are scheduled for various waterbodies throughout the implementation time of this plan. As these TMDLs are developed, NIRPC will track and participate in the process. When TMDLs are completed, information and recommendations pertinent to this plan will be integrated into this document.

6.2 Subwatershed Plan Development

This plan was developed to provide a framework for subwatershed plan development. In order to develop detailed subwatershed plans that meet the USEPA/IDEM criteria for watershed plans, the following steps should be followed. (Detailed guidance is available through IDEM's Watershed Management Section - http://www.state.in.us/idem/water/planbr/wsm/index.html):

Task	Relationship to Regional Watershed Plan
Define Watershed	Look at Chapter 2 for existing efforts and use the watershed description as a general description. The subwatershed group should provide more detail for their subwatershed including summarizing any additional subwatershed information or data.
Identify Problems & Causes	Reference and build upon appropriate sections from Chapters 3-5
Identify Sources	Reference and build upon appropriate sections from Chapters 3-5 including providing details on each source (e.g., number of acres of corn) and an estimate of existing loads especially for the Kankakee River watershed were many details were not available for this framework plan.
Identify Critical Areas	Reference and build upon appropriate sections from Chapters 3-5 including the development of load estimates.
Set Goals and Indicators	Build upon the goals and objectives presented in Chapters 3-5 with numeric goals and objectives and corresponding indicators. This should include estimates of load reductions (or target loads) needed to meet water quality standards for each pollutant or target parameter.
Choose Measures/ BMPs	Develop specific management measures/actions by subwatershed for the specific problems, causes, and sources noted including: the identification of tasks, funding sources, estimated load reductions, time frame, responsible parties, and resource needs (i.e., technical assistance and financial). In addition, the planned order of implementation of the measures should be outlined.
Monitor Effectiveness	Develop schedule of milestones and monitoring plan for specific subwatershed.

6.3 Evaluation

Evaluation provides a feedback mechanism for periodically assessing the effectiveness of management practices and allows stakeholders to identify areas where program improvement is possible. Programs that are periodically reviewed and evaluated (with results reported to participants, funders, and the general public) are more effective and are more likely to receive the public and political support necessary to achieve success (Friends of the St. Joe River Association, 2005).

Typically, evaluation programs include two types of measures: quantitative and qualitative. In the subwatershed planning process, as a specific management measure is chosen, the specific approach to its evaluation must be determined. Below are some examples of the two approaches (Friends of the St. Joe River Association, 2005):

Quantitative Measures

- Chemical monitoring of surface waters (e.g. temperature, nutrients, dissolved oxygen, bacteria)
- Biological monitoring of surface waters (e.g. fish, macroinvertebrate, plant communities)
- Stream flow monitoring (e.g. volume, velocity)
- Sediment monitoring (e.g. deposition, composition)
- Increases in the amount of sediment/debris removed from streets and catch basins
- Number of buffer ordinances adopted by townships and cities
- Increase in the number of construction sites that are implementing soil erosion control BMPs
- Educational workshop attendance levels

Qualitative Measures

- Public opinion surveys
- Public assessments of surface water clarity, odor, color, etc.
- Increased awareness of impacts of nonpoint source pollutants on aquatic habitats
- More positive feelings about vegetated buffer strips along urban creeks
- Increased cooperation and networking among watershed groups
- Public confidence that groundwater is safe
- Belief that information from NIRPC or other groups is accurate, non-partisan, and valuable

6.4 Monitoring

The most common environmental assessment tool used to measure the effectiveness of watershed management practices is water quality monitoring. This type of monitoring typically consists of chemical, biological, and habitat assessments. It can provide valuable information and offers a fairly objective and verifiable way to track water quality over the short and long term once a baseline is established.

As this plan is implemented, these agencies and other partners such as the Indiana Lake Michigan Coastal Program, the Kankakee River Basin Commission, and subwatershed organization, will need to develop a coordinated environmental monitoring program. Depending on the scale of future watershed planning efforts, each subwatershed may need to develop their own monitoring plan.

Regional monitoring strategies should be utilized whenever possible, especially if the goal is to get an accurate picture of water quality trends on a watershed-wide scale over time or if multiple pollutant sources are involved. IDEM's Office of Water Quality (www.in.gov/idem/water/assessbr) has a water quality monitoring program that conducts ongoing biological, chemical and habitat assessments. IDEM conducts its monitoring statewide in targeted basins on a five-year rotating basin cycle. In addition, Hoosier Riverwatch (www.hoosierriverwatch.com), the United States Geological Survey (www.usgs.gov), the Indiana Clean Lakes program (www.spea.indiana.edu/clp), and county health departments also have monitoring programs in place. Riverwatch relies on volunteers to collect samples and do field testing. USGS maintains gauges that measure water level and flow data and occasionally conducts special assessments. Health departments primarily monitor for *E. coli* bacteria. When little or no funding is available for monitoring key indicators, visual observations of qualitative changes such as fewer algal blooms, clearer water, or increased recreational use can be helpful in assessing the effectiveness of the project.