Trail Creek during dry weather

A TALE OF TWO CREEKS

Trail Creek Watershed Management Plan

A Guide for Cleaner Water

Trail Creek after heavy rainfall

Prepared by:	American Structurepoint, Inc.
Address:	7260 Shadeland Station Indianapolis, Indiana 46256
Phone:	317.547.5580

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"Through collaborative efforts, we can not only reduce the financial impacts resulting from a polluted Trail Creek, but more importantly, we can provide the stewardship and leadership required now in order for future generations to be able to enjoy the natural beauty of Trail Creek for decades to come."

Maggi Spartz, President of the Unity Foundation

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Acknowledgements

THIS UPDATED Trail Creek Watershed Management Plan would not have been possible without the participation and input of many concerned citizens from northwestern LaPorte County. In January of 2006, the Sanitary District of Michigan City invited dozens of local organizations and the public at large to engage with water quality professionals in a focused effort aimed at reducing pollution in Trail Creek. We thank the many concerned citizens who attended our public meetings, participated as Steering Committee members, asked many questions, and challenged us to find common sense solutions for reducing pollution. The collective voice of local citizens concerned about water pollution forms the basis for this report. Thus, first and foremost, we thank the citizens who gave freely of their time to develop this plan for achieving cleaner water in Trail Creek.

SECONDLY, we must acknowledge the exemplary efforts and technical abilities of our State regulatory agencies that helped guide us through this year-long process. Specifically, we thank the Indiana Department of Environmental Management representatives Sky Schelle, Steve West, and Linda Schmidt; and Indiana Department of Natural Resource representative Joe Exl. The collective watershed acumen of our regulatory agency consultants has been critical to the success of this watershed management plan update and we commend them for being outstanding stewards of our state's water resources.

LASTLY, the vision to re-engage LaPorte County's citizenry for the purpose of updating the 1993 Trail Creek Watershed Management Plan began with a commitment from the Unity Foundation of LaPorte County to help our local environment. In the Summer of 2003, the Unity Foundation approached the city of Michigan City to discuss opportunities for collaboration that would lead to long-lasting improvements in our environment. Rather than pursue a site-specific individual project, both entities quickly agreed that combining local resources to leverage additional outside grant funding for a wide-spread initiative would provide the greatest return for northwest LaPorte County. We applaud the foresight and vision of the Unity Foundation Board of Directors for embarking on this effort that will result in cleaner water in LaPorte County for generations to come.

Introduction

UNDER the Clean Water Act, each state was mandated by the US Environmental Protection Agency to determine designated uses and water quality standards for each waterbody within their state. For the State of Indiana, all waterbodies have been designated as fishable and swimable. Each state was also mandated to develop a Total Maximum Daily Load (TMDL) calculation of the maximum amount of a pollutant that a waterbody can receive and still meet state water quality standards. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and non-point sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the State has designated.

IN DECEMBER of 2003, the Indiana Department of Environmental Management (IDEM) issued a detailed technical report regarding excessive *E. coli* levels in Trail Creek entitled "Trail Creek Escherichia Coli TMDL (Total Maximum Daily Load) Report." This report indicates that for point sources of *E. coli* pollution, such as wastewater treatment plants, the "NPDES permitting and monitoring requirements will provide the necessary reasonable assurance that these sources are not contributing to violations of state *E. coli* standards." For non-point sources of *E. coli* pollution, the report concludes that: "non-point sources will need to be monitored locally for implementation of BMPs (best management practices) or in providing access to watershed grants to assist in reducing non-point sources to meet the load allocations (LA) developed under this TMDL." The preparation of this watershed management plan update is the next logical step in achieving cleaner water in northwestern LaPorte County as envisioned by IDEM in 2003.

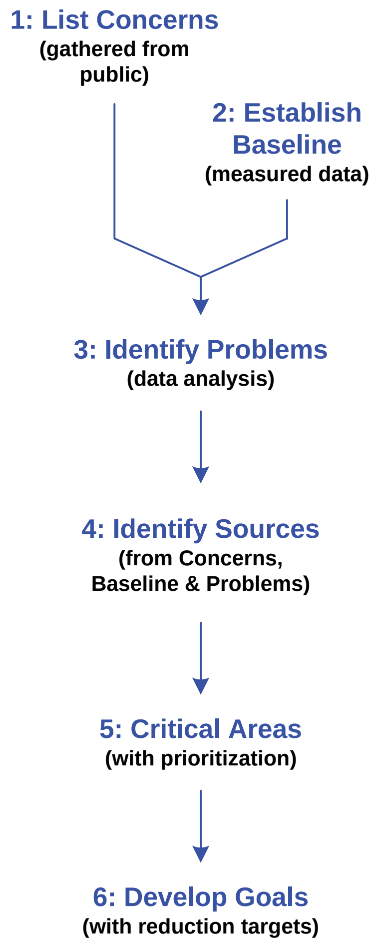
WITHIN the Trail Creek Watershed, there are naturally occurring non-point sources of pollution along with man-made point and non-point sources of pollution. As the 2003 Trail Creek TMDL report indicates, the total elimination of all pollutant sources within the watershed is not realistic and not economically feasible. However, through the efforts of multiple entities and utilizing a variety of different approaches, it is possible to reduce the pollutant loading to a level which will not adversely affect either human health or water quality. As local citizens, we must rely on the technical expertise of water quality professionals to set maximum levels of pollution (load allocations) that will not cause long-term harm to human and aquatic health. But as local citizens, we must also educate ourselves with respect to practices that, if implemented, will result in verifiable reduction in levels of pollution in our local watershed.

AT THIS point in time, Trail Creek is a tale of two creeks, heavily influenced by stormwater and watershed land use. The first creek is a rich, vibrant, high quality, cold water habitat full of salmon, steelhead and trout. This creek's water is clear and flows gently over cobble riffles. The streambanks are stable and vegetation covers the entire width of the creek. This creek is a source of pride and enjoyment for the community with multiple parks and recreational areas along the creek.

THE SECOND creek, the one influenced by stormwater pollutants during rain events, is murky and muddy carrying untold pollutants and trash. Sediment carried by the creek fills the riffles and high water flows cause streambank erosion. Pollutant loads associated with stormwater runoff, including bacterial contamination, are excessive and warnings are issued to avoid touching the creek's water and to avoid entering Lake Michigan as a result.

WITH all of the complexities and time demands of modern day life, why concern ourselves with 'watershed management'? We must engage ourselves in watershed management to educate all citizens that every drop of water is a precious resource. As a drop of rain falls to the ground, one of two things can happen: the drop of water can become a carrier of pollution rushing into Trail Creek and its tributaries; or, if we can educate enough people, each raindrop can help replenish our watershed and Lake Michigan with clean water that can help sustain future generations. We believe that the Trail Creek Watershed Management Plan provides comprehensive guidance for voluntary efforts that will result in the latter: a cleaner source of water.

Report Format



The Trail Creek Watershed is made of three distinct branches: the East Branch, West Branch and the Main Branch. Each branch has a unique 14-Digit Hydraulic Unit Code, or HUC. Across Indiana, there are 2,407 individual 14-digit watersheds. Thus, to ensure consistency regarding watershed management planning, IDEM has issued technical guidance documents to aide communities with watershed management planning. A critical document that all watershed management plans must comply with is the "Watershed Management Plan Checklist." The checklist provides a general framework for the preparation of watershed management plans and includes specific and sequenced plan components.

All watershed management plans must begin with the engagement of local citizens to determine the concerns of the general public living in the watershed. Through Public Involvement and Stakeholder Meetings and working with local steering committee members, the first step in the sequenced plan is to **List Concerns** gathered from the public.

The second step is working with water quality professionals to assess actual measured data obtained throughout the watershed to **Establish Baseline** water quality conditions. Typically, data acquisition involves physical, chemical, and biological attributes of the watershed.

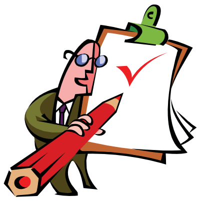
The third step in IDEM's framework sequence is the analysis of the baseline data with the list of concerns to **Identify Problems** in the watershed. The marriage of the concerns raised by the general public with the measured data provides a scientific basis for problem identification. Once problem identification has been accomplished via Step 1 through Step 3, the work of the community can then focus on the "where" and "what" components of the watershed management plan.

The fourth step in the sequence is to **Identify Sources** throughout the watershed that cause the identified problems. However, with limited resources to address pollution, watershed management plans are required to define **Critical Areas** that can be prioritized for implementation. Finally, the community must **Develop Goals** with specific reduction targets. This last step allows the community to assess the success of the plan's implementation from year to year and revise the plan in order to achieve the desired results.

Accordingly, the Trail Creek Watershed Management Plan Update report format was based on IDEM's recommended "Watershed Management Plan Checklist" sequence of: concerns, baseline, problems, sources, critical areas, and goals.

Various Appendices are attached including additional reference material or data. A list of acronyms is included in Appendix C for reference. Full size versions of the mapping included in the text are included in the Appendix L.

And finally with respect to format, the arrangement of the text columns, footnotes, photographs, and illustrations follows the example set forth in Beautiful Evidence, written by Edward Tufte.



WATERSHED MANAGEMENT PLAN CHECKLIST

(Updated 2003 Checklist)

Please see the *Watershed Management Plan Guidance* document for additional information and guidance on meeting these checklist elements.

INTRODUCE WATERSHED

Page #

O __6_ Define the mission, vision, or purpose statement that the group came up with for the watershed
Included in Overview of Trail Creek Watershed Management

O 12-34 Include map(s) of the watershed
Included in Baseline Watershed Information

O 12-34 Give a detailed description of the watershed
Included in Baseline Watershed Information

IDENTIFY PROBLEMS AND CAUSES

O 10-11 List the stakeholders' concerns that were gathered from the public meetings
Included in Watershed Concerns

O 12-34 List and briefly summarize information/data gathered to establish baseline conditions
Included in Baseline Watershed Information

O 35-38 Identify problems in the watershed based on the information gathered
Included in Water Quality Problems

O 35-45 Identify known or probable causes of water quality impairments and threats. Tie concerns, benchmarks, problems, and causes together so there is a clear thought process.
Included in report format, Water Quality Problems, and Sources of Water Quality Problems.

IDENTIFY SOURCES

O 39-45 Identify specific sources for each pollutant or condition that will need to be controlled to achieve the load reductions estimated and the goals in the plan. Include enough information to explain the magnitude of the source.
Included in Sources of Water Quality Problems.

IDENTIFY CRITICAL AREAS

O 29-30 Estimate existing loads for pollutants to assist with prioritization
Included in 2006 Watershed Management Plan Baseline Assessment

O 46-48 Identify critical areas where measures will be needed to implement the plan. Summarize the thought process used for targeting and prioritization.
Included in Critical Areas.

SET GOALS & SELECT INDICATORS

O 35-38 Develop water quality improvement or protection goals
Included in Water Quality Problems and in Implementation

O 49-51 For each goal, determine what indicators can be measured to determine whether pollutant load reductions are being achieved and progress is being made towards attaining water quality standards, and if not, criteria for determining whether the plan or an existing NPS TMDL needs to be revised.
Included in Goals and Decisions

O _vi_ There is a clearly understandable train of thought from problems, causes and sources to critical areas, goals, and indicators.
Included in Report Format

CHOOSE MEASURES/BMPS TO APPLY

O 53-70 Determine BMPs or measures that will need to be implemented to achieve the load reductions required to reach the goals.
Included in Implementation

O 53_ Describe how the stakeholders were involved in selecting, designing, and implementing the NPS management measures. Discuss what information/education techniques will be used to enhance public understanding and encourage continued participation in implementing the chosen NPS management measures.
Included in Implementation

O 53-55 Estimate load reductions for the management measures identified.
Included in Goals and Decisions

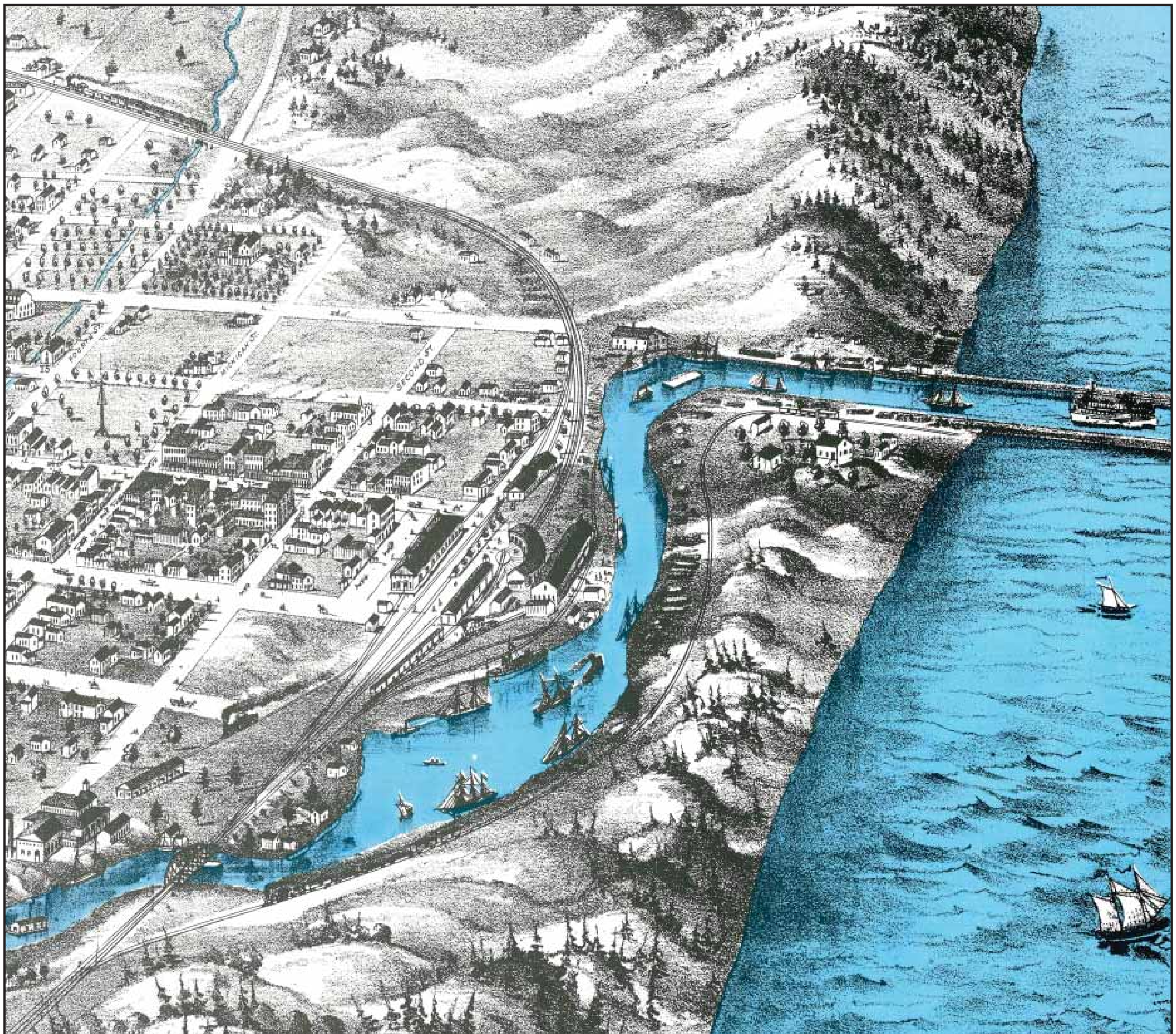
O 53-70 Describe the planned order of implementation, the time requirements for implementing the plan, and who is responsible for carrying out tasks.
Included in Implementation

O 53-70 Estimate financial and technical assistance needed to implement the plan.
Included in Implementation

O 53-70 Describe interim measurable milestones for determining whether NPS management measures or other control actions are being implemented.
Included in Implementation

MONITOR EFFECTIVENESS (INDICATORS)

O 49-51 Develop a monitoring plan to track the indicators and evaluate the effectiveness of the implementation efforts over time.
Included in Goals and Decisions


MICHIGAN ST
SECOND ST

Overview of Trail Creek Watershed Management

THE USE of Trail Creek for economic purposes began in earnest as early as 1836, with the construction of port facilities and the dredging of a navigable channel, allowing commercial shipping access from Lake Michigan.[1] An 1869 artist's rendering of Trail Creek's navigable waters depicts 21 sailboats, three steam-powered tugboats, multiple railroad lines, a major railroad depot with roundhouse, and two swing bridges within the last mile of Trail Creek.

[1]"Early History of Michigan City, Indiana," Michigan City Public Library Pamphlet File, *Michigan City-History*

While the alteration of Trail Creek near Lake Michigan transpired rather quickly, water quality degradation in Trail Creek upstream of the harbor area occurred more gradually, as a result of changing land use practices over several decades. The Trail Creek Watershed Management Plan of 1993 described this process as follows:

"Watersheds become degraded because there is no tradition of planning or management at the watershed level. Management is difficult because of the segmented property ownership where numerous decision makers, each pursuing different objectives, modify their land without considering the full impact of such modifications. In addition, there is lack of effective control by any single level of government over land use changes in watersheds as they affect water and adjacent land resources."[2]

[2] Trail Creek Watershed Management Plan, September 30, 1993

This quotation from the 1993 Watershed Management Plan underscores two significant challenges that have existed and remain today: land use planning and multiple governmental jurisdictions.

From a land use aspect, we must recognize that many scattered, incremental changes over time can have a cumulative impact that degrades the watershed, while also recognizing that a single, large scale land use change can immediately impact the watershed for decades. One historical example of a single land use change that has forever altered the landscape of Trail Creek occurred at the mouth of Trail Creek and involved what was once known as Hoosier Slide. One account of the history of Hoosier Slide is found in the Michigan City Public Library archives

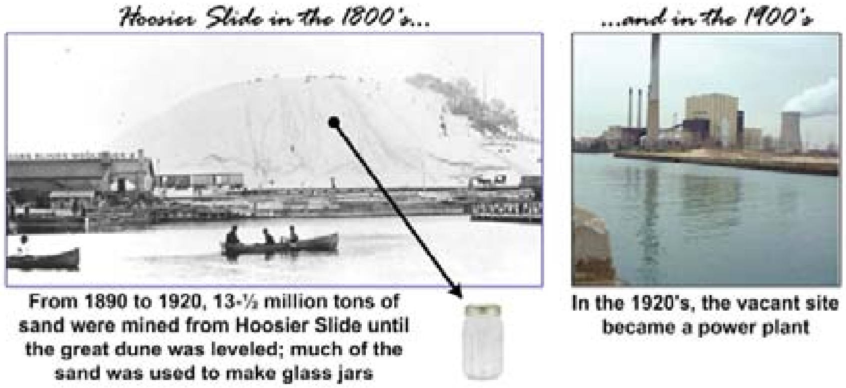
"Once Indiana's most famous landmark, Hoosier Slide was a huge sand dune bordering the west side of Trail Creek where it entered Lake Michigan. At one time it was nearly 200 feet tall, mantled with trees. Cow paths marked its slopes and people picnicked upon its crest. With the development of Michigan City, the timber was cut for building construction and the sand began to blow, sometimes blanketing the main business district of the town on Front Street, which nestled near its base.

Climbing Hoosier Slide was very popular in the late 1800's with the excursionist crowds who arrived in town by boat and train from Chicago and other cities. The summit, where weddings were sometimes held, afforded an excellent view of the vast lumberyards which then covered the Washington Park area.

Bird's Eye View of Michigan City, 1869, A. Ruger, partial print shown opposite page.

When it was discovered that the clean sands of Hoosier Slide were useful for glassmaking, the huge dune began to be mined away. Dock workers loaded the sand into railroad cars with shovel and wheelbarrow to be shipped to glassmakers in the U. S. and Mexico. Much of the sand also went to Chicago in the 1890's as fill for Jackson Park and for the Illinois Central RR right-of-way. Over a period of 30 years, from about 1890 to 1920, 13-1/2 million tons of sand were shipped from Hoosier Slide until the great dune was leveled and, chances are, little, if any, of it was moved via the Monon. NIPSCO acquired the site for use as a generating plant in the late 1920's."[3]

[3] *"Hoosier Slide,"* http://www.mclib.org/port3.htm



Mt. Baldy as seen from Lake Michigan; Mt. Baldy is ~120 ft. high, as compared to the former Hoosier Slide that was ~200 ft. tall

Conversely, the Mount Baldy sand dune, approximately 120 feet high and located only 1-1/2 miles west of the former Hoosier Slide, was preserved as part of the Indiana Dunes National Lakeshore Park which opened in 1966 and now hosts approximately two million visitors each year.[4] This is just one historical example of how one land use decision has forever altered the Trail Creek watershed landscape.

[4] North *End Redevelopment Strategy, Michigan City, Indiana"* prepared by Anderson and Camiros, October 2001, page 38.

The second significant challenge in the Trail Creek watershed noted in 1993 was the number of governmental jurisdictions who have authority throughout the watershed. Since the Trail Creek Watershed drainage area includes more than 59 square miles of northwestern LaPorte County, the many complexities arising from multiple governmental jurisdictions presents significant challenges for improving water quality.

An overlay of Trail Creek's tributaries onto a map of local units of government (Figure 1) yields the involvement of four townships: Michigan, Springfield, Center and Coolspring; two towns: Town of Trail Creek and Town of Pottawattamie Park; one City: Michigan City; and the entire watershed lies within the jurisdiction of LaPorte County.

Concerns with respect to specific water quality problems in Trail Creek began to be identified with the 1988-89 Indiana 305(b) Report[5] issued by the Indiana Department of Environmental Management (IDEM). Problems identified at that time included poor aquatic life support due to low dissolved oxygen levels, impairment of recreational uses due to *E. coli* bacteria levels, and substandard water clarity due to urban/rural runoff and stream bank erosion.

[5] Trail Creek Watershed Management Plan of 1993

After the issuance of the IDEM report, local civic leaders recognized the importance of addressing water quality issues in Trail Creek. In the "Horizon 2000 Michigan City Area Strategic Plan" issued on March 30, 1992, a plan that was prepared for and in conjunction with the citizens of Michigan City, a specific lakefront and Trail Creek water quality goal was identified:

"Our goal is to have the highest quality of water for recreation and aquatic production in the area by eliminating debris, pollutants and sediment build-up in the creeks."[6]

[6] http://www.lc-link.org/horizon2000/

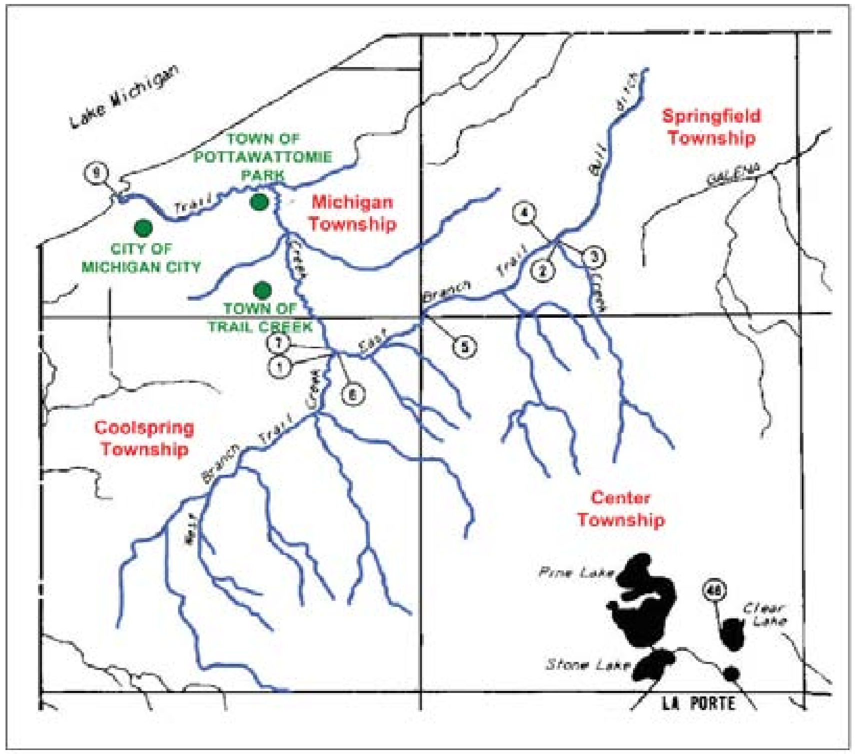


Figure 1: Trail Creek
Map Source: DNR website, http://www.in.gov/dnr/water/surface_water/drainage_area/pdf/laporte.pdf; coloring added

The Horizon 2000 report also identified several action items: work with local, state and federal agencies to characterize sediments in all lake tributaries and identify sources of pollution; monitor sources of pollution after they are identified and encourage enforcement and compliance with regulations; clean up current sediments in all lake tributaries and prevent future sediment build-up; provide better aquatic reproduction; and, develop soil conservation and management regulations.

An immediate product of these early efforts included the preparation and completion of the “Trail Creek Watershed Management Plan of 1993”. This report offered a multi-faceted and substantive plan focused on nonpoint sources of pollution, with recommendations to reduce sedimentation and nutrient loading to the stream of Trail Creek. Several demonstration projects including 4 streambank restoration projects and a constructed wetland for residential sewage disposal were implemented with grant monies as a result of the 1993 Trail Creek Watershed Management Plan; however long term monitoring was implemented nor were additional grant monies sought for implementation. The Watershed Management plan stated that a “Lead Agency” needed to be identified to coordinate watershed improvement activities. In hindsight, a fatal shortcoming of the implementation of the 1993 Watershed management plan was that no “Lead Agency” was ever identified.

Nonetheless, despite not having a Lead Agency to implement Trail Creek watershed improvements, successes have occurred: agricultural best management practices such as wildlife watering areas, grass waterways and filter strips have been constructed in Springfield Township; the ecological integrity of the stream has been restored in some locations with the use of lunkers and j-hooks; the levels of the primary pollutant (*E. coli*) in Trail Creek have been reduced through storm sewer separation, sanitary sewer expansions and the disinfection of the J.B. Gifford Wastewater Treatment Plant’s combined sewer overflow discharge (Figure 2, Appendix L); and public access along Trail Creek within Michigan City has been expanded significantly with the opening of the Trail Creek Greenway, Winding Creek Cove, Karwick Nature Park and a renovated Hansen Park. For reference to the grassed waterways and stream structures implemented previously see the photographs on page 5. A previous implementation

Michigan City's Combined Sewer Overflow Control: A National Success Story

Progress thru 1983	Progress thru 1990	Progress thru 1996	Progress thru 2003	Progress thru 2006
35% of original combined sewers were separated	A 54" relief sewer was constructed in the city's north end	60% of original combined sewers were separated	91% of original combined sewers were separated	94% of original combined sewers were separated
Sewer system had 18 CSO points into Trail Creek	18 sewer system CSO points **RE-DUCED** to only 6	Investment in sewer separation since 1962 was >$50 mill.	Investment in sewer separation since 1962 was >$80 mill.	Investment in sewer separation since 1962 was >$85 mill.
41 million gallons of CSO discharge yearly to Trail Creek	6.15 mill. gal. Storm Retention Basin built at WWTP	All 6 sewer system CSO points were **ELIMINATED**	From 1990-1997, the Storm Basin CSO rate was 19 events per yr.; from 1998-2003 the Storm Basin CSO rate was 1 per yr.; a **95% REDUCTION**	Headworks upgrade achieves **15 MGD** wet weather flow
CSO's during rain events **VIOLATE** the >7.0 mg/l DO criteria in Trail Creek for salmon	Coll. Sys. CSO flow **REDUCED** by 75%; strength of CSO reduced by 70%	The **ONLY** CSO point in Michigan City is the Storm Basin overflow; the Storm Basin provides the equivalent of primary & secondary treatment; thus, the only CSO Water Quality impairment is E. Coli		Storm Basin Disinfection Project leads to **ATTAINMENT** of acute Water Qual. Standards for CSO
	WWTP CSO flow **REDUCED** by 95%; strength of CSO reduced by 75%		WWTP wet weather flow rating is 15 MGD, but due to equip. wear the max. wet weath. flow is only 13.9 MGD	Watershed approach leads to >500 homes removed from a floodplain; marina, urban & rural BMPs planned for the creek
			For Oct. 2001 CSO, creek DO was 9.6!	**For Jan. 2005 CSO, creek DO was 10.6!**

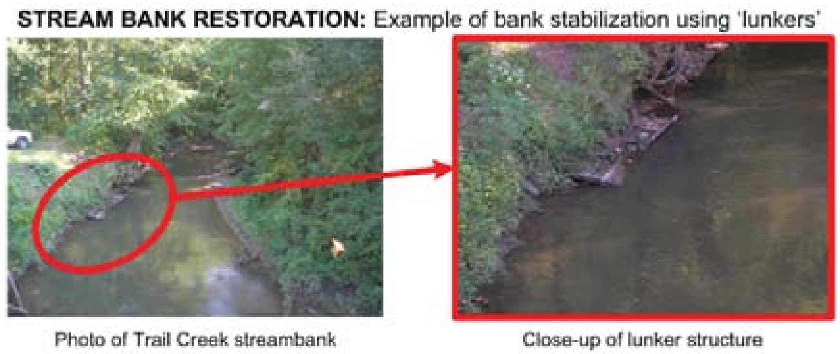
This comprehensive multi-part strategy for improved stormwater controls at the J.B. Gifford WWTP has led to dramatic success in reducing CSO events in Michigan City as one can see from the following table:

Historical Number of CSO Events per Year

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
47	24	2	32	3	0	19	14	1	0	0	1	1	0	0	1

Figure 2: Michigan City's Combined Sewer Overflow Control - A National Success Story (appendix page 64)

Grassed waterway photos provided by Anton Ekovich, Springfield Township



A LETTER OF UNDERSTANDING BETWEEN THE SANITARY DISTRICT OF MICHIGAN CITY ("DISTRICT") & THE MICHIGAN CITY BOARD OF PUBLIC WORKS & SAFETY ("BOARD") REGARDING WATER QUALITY ISSUES IN TRAIL CREEK RELATING TO: THE ADMINISTRATION OF THE MUNICIPAL SEPARATE STORM SEWER SYSTEM ("MS4") PROGRAM OF 327 IAC 15-13 (RULE 13) & TRAIL CREEK WATERSHED PLANNING EFFORTS

WHERAS, the City of Michigan City (herein after referred to as the "City") is a designated Municipal Separate Storm Sewer (MS4) entity resulting from the designation as a municipality mapped in the 2000 United States Census Bureau as an Urbanized Area and/or other criteria of 327 IAC 15-13-3; and,

WHEREAS, the City, as a designated MS4 entity, is required by the Indiana Department of Environmental Management (IDEM) to obtain a permit for, develop and operate a MS4 program under IAC 15-13 (Rule 13); and,

WHEREAS, the MS4 program includes, over time, among other requirements, the necessity for the development, passage, and enforcement of new zoning ordinances relating to construction site runoff and post-construction site monitoring; along with municipal operations pollution prevention practices by of other City Departments; and,

WHEREAS, the District has responsibility for storm sewer systems and discharges within District boundaries and has current involvement in other requirements of the MS4 program and District Staff has the personnel and experience to administer the MS4 program for the City; and,

WHEREAS, water quality problems in Trail Creek were identified in the 1988-89 Indiana 305(b) Report issued by the Indiana Department of Environmental Management; and,

WHEREAS, the "Horizon 2000 Michigan City Area Strategic Plan" issued on March 30, 1992, prepared for and in conjunction with the citizens of the Michigan City, identified a specific lakefront and Trail Creek water quality goal as follows: "Our goal is to have the highest quality of water for recreation and aquatic production in the area by eliminating debris, pollutants and sediment build-up in the creeks"; and,

WHEREAS, the "Trail Creek Watershed Management Plan" issued on September 30, 1993, proffered a multi-faceted and substantive plan focused on nonpoint sources of pollution with recommendations to reduce sedimentation and nutrient loading to the stream of Trail Creek; and,

WHEREAS, the Indiana Department of Environmental Management, Office of Water Quality, issued a "Draft Trail Creek Total Maximum Daily Load (TMDL) Report" in September 2003, with said report including draft nonpoint source E. coli pollutant limits and instructions that some "nonpoint sources will need to be monitored locally for implementation of BMP's or in providing access to watershed grants to assist in reducing nonpoint sources to meet the Load Allocation developed under this TMDL".

NOW, THEREFORE the District and Board agree as follows:

Section 1: The District will consider options and develop recommendations to ensure the City's compliance with the MS4 requirements of IAC 15-13 (Rule 13) and submit said recommendations to the Board for review; and,

Section 2: The District will act as the temporary "City Lead Agency", not necessarily as the implementer but as the facilitator, to coordinate activities that focus on nonpoint source water pollution abatement strategies among local, county, state and federal agencies, until such time as a partnership is established representing a variety of stakeholders including riparian owners, agricultural community, environmental community, commerce/industry, private citizens and local government entities located in the 59 square mile Trail Creek Watershed.

Approved by the **Sanitary District of Michigan City** Board of Commissioners September 24, 2003	Approved by the **Michigan City Board of Public Works and Safety** September 24, 2003
President	President
ATTEST: Secretary	ATTEST: City Clerk

Figure 4: Letter of Understanding, larger version included (appendix page 4).

In 2003, grassroots efforts for improving Trail Creek's water quality produced results once again. Since the Mission of the Sanitary District of Michigan City includes providing for "the efficient drainage of storm water through best management practices" and "protecting the designated uses for the Trail Creek Watershed and Lake Michigan through environmental stewardship," the District agreed to outreach efforts by the city of Michigan City and a local nonprofit agency, the Unity Foundation of LaPorte County, to pursue a Section 319 Grant for funding an update to the "Trail Creek Watershed Management Plan of 1993." With a $10,000 contribution from the Unity Foundation and a $5,000 funding commitment from the Sanitary District, Michigan City received a $45,000 grant from IDEM to fund the preparation of this Watershed Management Plan Update to comply with current standards. The creation of a Watershed Management Plan is a voluntary process, enabling a community or watershed organization to apply for additional implementation funding and assistance from several state and federal agencies. Once the updated Watershed Management Plan is completed, local watershed advocates would be eligible for additional grants to begin implementation and start achieving the desired Trail Creek water quality improvements envisioned by local civic leaders back in 1992.

The first step in this Watershed Management Plan Update process was the designation by Michigan City that the Sanitary District would facilitate the City's renewed efforts to mitigate pollution in Trail Creek. Through a Letter of Understanding between the Board of Public Works and Safety of Michigan City and the Sanitary District of Michigan City (Figure 4), the following was agreed to:

"The District will act as the temporary 'Lead Agency', not necessarily as the implementer but as the facilitator, to coordinate activities that focus on nonpoint source water pollution abatement strategies among local, county, state and federal agencies, until such time as a partnership is established representing a variety of stakeholders including riparian owners, the agricultural community, environmental community, commerce/industry, private citizens and local government entities located in the 59 square mile Trail Creek Watershed." [7]

[7] Letter of understanding between the Michigan City Board of Public Works and Safety and the Sanitary District of michigan City, September 24, 2003.

Once the designation of the Sanitary District as the Lead Agency to facilitate Trail Creek watershed improvements was formalized, the next step was to reconnect, reinvigorate, and recommit the original stakeholder participants from 1993 to participate in this critical update of the watershed management plan. Through these outreach efforts, additional new stakeholders have agreed to participate and a total of 25 entities and organizations are now part of substantive watershed management planning in LaPorte County. The original stakeholders from 1993 and the additional stakeholders from 2003 are identified as follows in Figure 3.

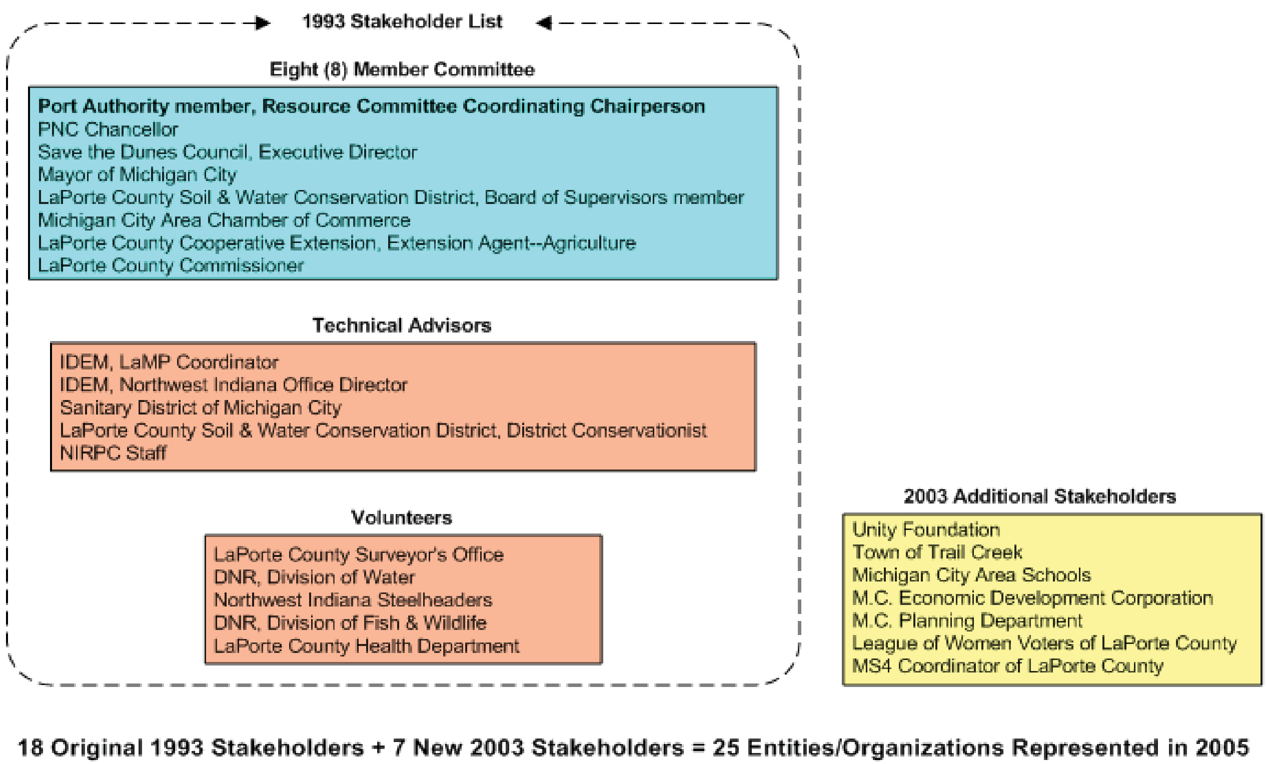


Figure 3: Stakeholders

The efforts of the collective local watershed community in 1993, coupled with the successes noted above, provide evidence that water quality improvements can be achieved in the Trail Creek Watershed. Thus, the volunteers who committed themselves to the development of this Trail Creek Watershed Management Plan update have defined our vision and mission for moving forward as follows:

Vision: *Through collaborative efforts, we can provide the stewardship and leadership required now in order for future generations to enjoy the natural beauty and prosperity of a clean Trail Creek.*

Mission: *Citizens of the Trail Creek Watershed will assess water quality issues and develop meaningful implementation strategies targeted to improve the quality of life within the watershed through water quality enhancement and realization of the long term goals with regard to the environmental, recreational, and aesthetic use of our Lake Michigan lakefront and Trail Creek.*

Watershed Concerns

THE KEY to success in the Trail Creek Watershed management is the participation and inclusion of local citizens and as many public and private institutions as possible. To achieve this desired participation, selected stakeholders were invited to participate in the Trail Creek Watershed Management Plan as Steering Committee members. Thus, representatives of the City Lead Agency, funding partners, local citizens, local conservation agencies, and local and state resource agencies were invited and agreed to serve on the Trail Creek Watershed Management Plan Steering Committee. Organizations and entities represented on the Steering Committee include: the Sanitary District of Michigan City, the Indiana Department of Environmental Management (IDEM), the Unity Foundation, local property owners including farmers, the Save the Dunes Council, the Indiana Department of Natural Resources (IDNR), the LaPorte County Soil and Water Conservation District, the LaPorte Field Office of the Natural Resources Conservation Service, the Purdue University Cooperative Extension Service, and the Northwestern Indiana Regional Planning Commission. Contact information for the Steering Committee members are included as an Appendix A to this report.

The role of the Steering Committee is to provide detailed input and direction from the local community with regard to the Trail Creek Watershed Management Plan including identifying the mission of the plan, problems within the watershed, and potential solutions. The first Steering Committee meeting was held on January 19, 2006 and those meetings have continued on approximately a monthly basis throughout 2006. At the first meeting, the history of watershed management planning in the Trail Creek Watershed was reviewed. For reference see Appendix E. Members were provided with a handbook and relevant materials to be used during the planning process. Data collected to date in support of the Trail Creek Watershed Management Plan were reviewed and other sources of available data within the watershed were discussed.

The first windshield tour of the Trail Creek Watershed and sampling locations with Steering Committee Members was conducted with Kevin Lackman, the LaPorte County MS4 Coordinator, on January 27, 2006 to assess potential problem areas within the watershed.

The second Steering Committee meeting was held on February 2, 2006. At that meeting, the role of individuals with their sub-committee assignments, the mission and vision of the Trail Creek Watershed Management Plan, problem identification measures, and the future public involvement opportunities were addressed. Seven sub-committees were established to focus the efforts of the Trial Creek Watershed Management Plan including problem identification, data management, and implementation. Each Steering Committee member was selected for at least one specific sub-committee. Additional sub-committee members were selected based on interest and specialized knowledge from the public and stakeholders. These sub-committees are as shown in Figure 5:

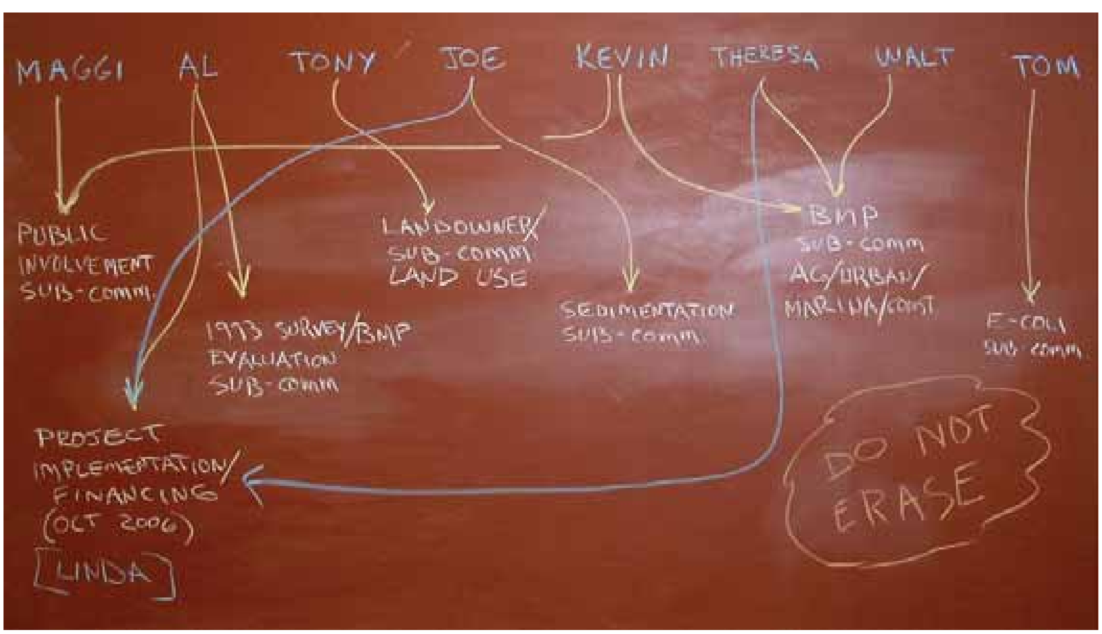


Figure 5: Steering committee and sub-committee

The Steering Committee met on April 3, May 5, and June 29, 2006 to review water quality data collected and problem areas within the watershed in preparation for presentation to the public. The second windshield tour of the watershed with Steering Committee Members was conducted on June 27, 2006.

The Steering Committee continued to meet during the summer and fall to discuss the critical areas within the watershed and goals and management strategies. Meetings were held on July 13, August 2, September 26, and October 4, 2006.

In addition to the Steering Committee, public participation into the plan development was solicited at three separate Public Involvement and Stakeholder meetings. A significant amount of work by the Steering Committee was preparation for substantive dialog with the general public at quarterly public meetings. The first Public Involvement and Stakeholder meeting was held on February 8, 2006 at 7:00 pm in the City Hall Council Chambers in Michigan City. The press release advertising the first Public Involvement and Stakeholder meeting, the agenda and the informational materials distributed are included in the Appendix F and G. The public was encouraged to attend this first meeting and provide input on concerns regarding Trail Creek water quality issues. The agenda of the first Public Involvement and Stakeholder meeting included an historical overview of Trail Creek watershed management planning; a summary of water sampling results from the past year; the identification of problem issues affecting the Trail Creek watershed; and an open discussion with all attendees regarding the purpose, mission, and vision of the Watershed Management Plan and problem issues to be addressed. Approximately 45 people were present at this meeting.

The second Public Involvement and Stakeholder meeting occurred on June 29, 2006, 7:00 pm, at Springfield Elementary School in Michigan City. This venue was selected for its location within the watershed, outside of Michigan City, in order to gain wider participation in the public involvement process. The press release for this public meeting, the agenda, and the informational materials distributed are is included in the Appendix H and I. This meeting was used to inform the public of the progress that has taken place in the study associated with the writing of the Trail Creek Watershed Management Plan and to gather specific input on the location of possible nonpoint pollution locations. The beginning portion of the meeting was spent giving the public a general background of the knowledge and information associated with watersheds and pollution, followed by an overview of the current data and its analysis. The remaining portion of the public meeting was used to allow the public to physically become involved by examining aerial photography, marking the printouts with areas of concern, and allowing their voice to help guide the creation of the Trail Creek Watershed Management Plan. This method provide an in-valuable insight into parts of the watershed that otherwise would have not been reasonably able to be examined. Approximately 20 people were present at this meeting.

The third Public Involvement and Stakeholder meeting occurred on October 16, 2006, 7:00 pm, at in the City Hall Council Chambers in Michigan City. The press release for this public meeting, the agenda, and the informational materials distributed are is included in the Appendix J and K. This meeting was used to inform the public of the progress that has taken place in the study and to review the goals of the Trail Creek Watershed Management Plan. Comments regarding critical areas, pollutants of concern, and watershed management goals were discussed. In addition, the project approach for the Watershed Management Plan as seen in Figure 6 was discussed. Approximately 25 people were present at this meeting.

In addition to being open to the public, each of the three public meetings were also filmed and re-broadcast on the local cable access channel.

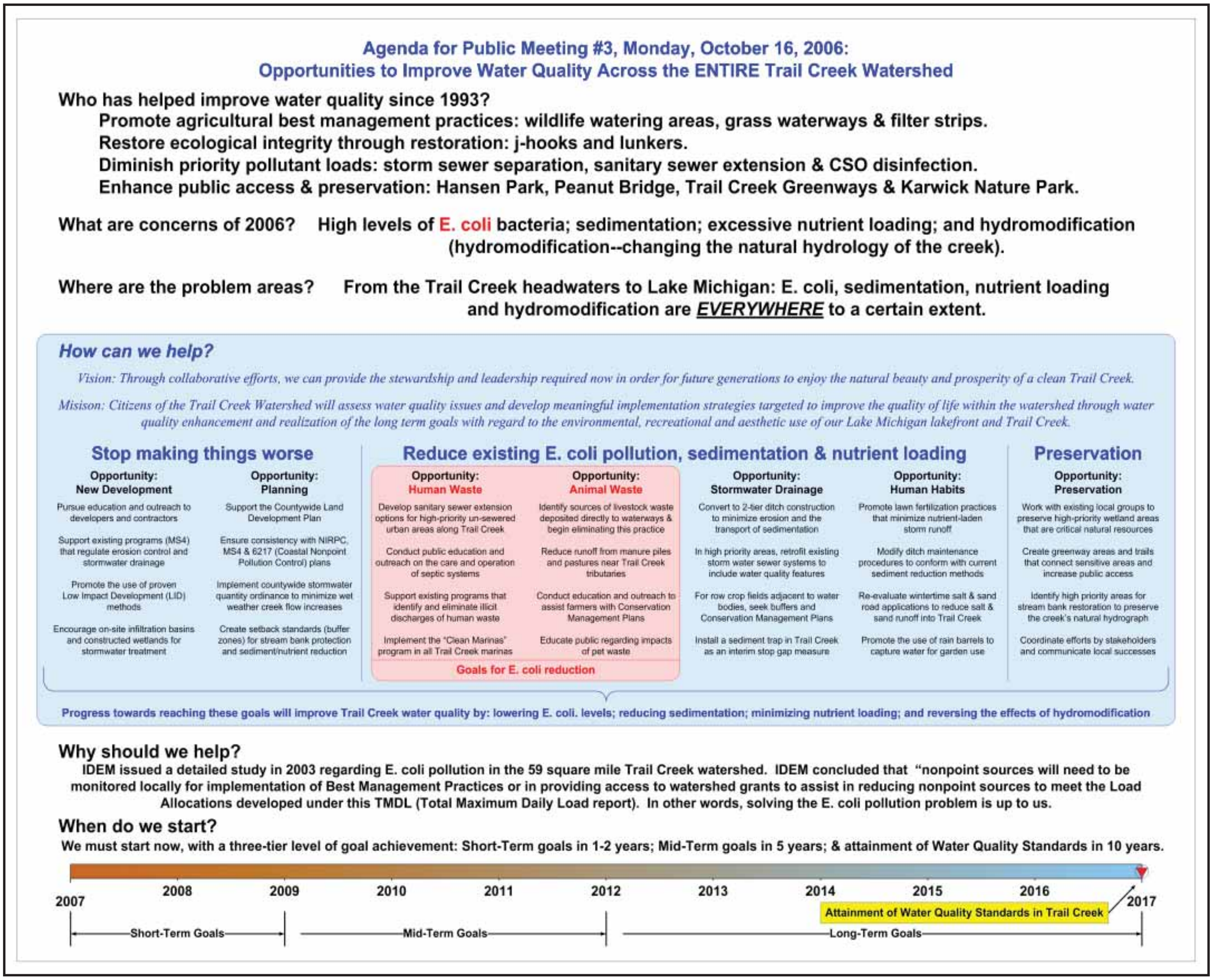


Figure 6: Agenda for Public Meeting No. 3. Monday, October 16, 2006. Opportunities to Improve Water Quality Across the entire Trail Creek Watershed

A telephone survey of 600 random LaPorte County residents was conducted in 2000 and utilized to prepare the 2001 LaPorte County Resource and Needs Assessment on Environmental Concerns. Key indicators from that survey indicated that "Environment" ranked No. 5 in importance out of ten quality of life categories to those surveyed; Water Quality was considered the highest environmental issue by respondents, with air quality and the environment in general trailing. Focus groups and telephone respondents identified E-coli, water & beach quality, septic systems, soil/water conservation and industrial chemical leakage into drinking water as some of their environmental concerns.

In addition to the LaPorte County Resource and Needs Assessment on Environmental Concerns, through coordination and collaboration of the watershed partners a variety of concerns with regard to Trail Creek and the Trail Creek Watershed have been expressed during the preparation of this plan. Concerns included in this report represent those concerns of the general public, the stakeholders, and the Steering Committee members. Following is a summary of the concerns expressed. The majority of the concerns fall into a few major categories. As project planning progresses these concerns will be narrowed to problem areas.

Areas of Concern Expressed by Steering Committee Members, Stakeholders, and the Public

- Stream and Water Quality
  - Combined sewer overflows
  - Agricultural impacts to water quality
  - *E. coli* within the stream and impacts to human health
  - Stormwater runoff from commercial and industrial sites, especially truck stops
  - Illegal discharges from permitted point sources
  - Livestock (cattle and horses) allowed access to streams
  - Illegal discharge of manure to streams
  - Runoff from roadways including sand and salt
  - Runoff from roadways from tire wear
  - Impacts to streams from construction runoff
  - Water clarity and aesthetics
  - Runoff and discharge from industrial and commercial sites
  - Nutrient loading to streams
  - Algae growth
  - Riparian buffers
  - Lake water levels
  - Water and beach quality
  - Airborne particulate depostion from NIPSCO Generating Station's emissions
- Aquatic Health and Fisheries
  - Fish advisories
  - Aquatic health and fisheries, native fisheries
  - Invasive species
  - Lowered water levels in the streams
  - Cold water stream impacts/temperature
  - Nuisance wildlife
  - Fish kills
  - Soil and water conservation
- Public Health
  - Beach closings
  - Atrazine and other herbicides and pesticides in the water
  - Failing septic systems and installation of systems in areas with unsuitable soils
  - Superfund site and potential contamination in streams
  - Contaminated sediment in Trail Creek
  - Fish advisories
  - Septic systems
  - Pollutants from marinas
- Sedimentation and Streambank Erosion
  - Streambank stability
  - Streambank stability at brownfield sites
  - Channel modification
  - Regrading of ditches and impacts to streams and natural areas from county highway department maintenance operations
  - Sedimentation within the navigable channel and dredging, sedimentation upstream
  - Habitat degradation
  - Salmonoid and trout fisheries, particularly native reproducing fisheries

- Operational and Planning Organization
    - Property rights of owners along streams being informed of activities along stream
    - Low impact development
    - Recreational boating
    - Recreational opportunities and greenways
    - Interferences with projects
    - Regional detention
    - Coordination with county planners
    - Coordination with MS4
    - Funding
    - Implementation of plan and lead agency
    - Coordination of agencies within county and overlap of efforts
    - Education and outreach
    - Preservation and restoration of wetlands and natural areas
    - Coordination with agencies and organizations working towards better water quality in Lake Michigan
    - Data gathering and mapping of point and non-point source discharges and sharing of data
    - Marina's and coordination with Lake Michigan Costal Program (LMCP)

Baseline Watershed Information

TRAIL Creek is located in LaPorte County in northwest Indiana and flows into Lake Michigan at Michigan City's lakefront park and marina, Figure 7. The creek flows 14.5 linear miles through various land uses including urban residential and industrial areas as well as rural agricultural and residential. Trail Creek has both an east and a west branch which drain predominantly low density housing, farmland, and wooded tracts. The land that drains to the main stem of Trail Creek downstream from Johnson Road and US 20 is essentially totally developed and includes Michigan City, Potawatomie Park, and the Town of Trail Creek.

Within LaPorte County, the area included in the Trail Creek Watershed is the most rapidly developing land use due to proximity to Michigan City, interstate transportation, and public services. The steering committee for the LaPorte County Plan Commission Countywide Land Development Plan has indicated that much of the anticipated future growth within the county will be encouraged to take place within the Trail Creek Watershed.

Figure 7: Trail Creek Watershed Location Mapping (see appendix page 71)

Watershed Location

The Trail Creek Watershed is located in northwestern Indiana, in LaPorte County, and drains into Lake Michigan at Michigan City, Indiana. The 37,800 acre watershed lies almost entirely within Michigan, Center, Coolspring, and Springfield Townships.

The drainage area for Trail Creek is approximately 59.1 square miles. The main stem of the creek divides into two main tributaries – East Branch and West Branch, Figure 8.

Figure 8: Trail Creek Watershed Topographic Mapping (see appendix page 72)

Description and History

Natural History

LaPorte County, Indiana is located in the Great Lakes section of the Central Lowland physiographic province. The present landscape of LaPorte County is subdivided into three distinct physiographic subsections including the Calumet Lacustrine Plain located along Lake Michigan, the Valparaiso Morainal Plain located in the central portion of the county, and the Kankakee Outwash Lacustrine Plain located in the southern portion of the county, Figure 9. These physiographic subsections resulted from the last major glaciation event during which continental glaciers and associated depositional processes produced the current surface features (Soil Survey of LaPorte County, 1978)

Watershed Land and Stream Use

The Trail Creek Watershed, located along the southeastern shoreline of Lake Michigan in LaPorte County, Indiana is composed of a combination of different land uses. These land uses include moderate to dense residential, major shipping, multiple levels of industrial, commercial, agricultural, and recreational land use. The agricultural and less developed areas of the watershed lie further from the watershed's mouth at Lake Michigan. Of the three sub-watersheds, the Trail Creek-Otter Creek Sub-watershed or the Main Branch has the greatest amount of developed land. Table 1 and Figure 10 display land use acreage throughout the Trail Creek Watershed and for each of the three individual sub-watersheds, the East Branch, the West Branch, and the Trail Creek-Otter Creek Branch, see Figure 10.

Figure 9: Physiographic Areas (see appendix page 73)

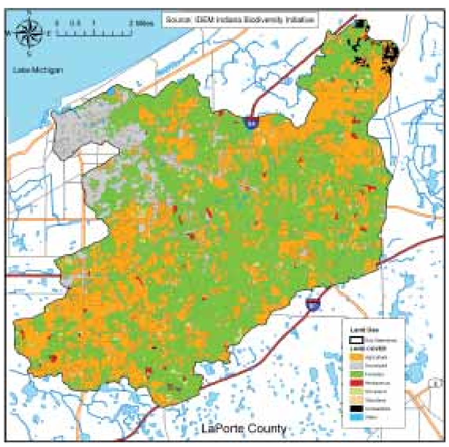


Figure 10: Watershed Land Use (see appendix page 74

Current land use within the Trail Creek Watershed is approximately 39% agricultural, 9% developed, 51% forested or natural areas, and 1% water or unclassified. Land use within the sub-watersheds of Trail Creek Watershed is as follows. The Main Branch of Trail Creek including the majority of Michigan City, the Town of Trail Creek, and Potawatomi Park includes approximately 23% agricultural, 32% developed, 44% forested or natural areas, and 1% water or unclassified. The East Branch of Trail Creek includes approximately 47% agricultural, 3% developed, 49% forested or natural areas, and 1% water or unclassified. The West Branch of Trail Creek includes approximately 39% agricultural, 2% developed, 58% forested or natural areas, and 1% water or unclassified.

Land use within a watershed directly influences the quantity and quality of non-point stormwater run-off which in turn influences the overall water quality and health of a stream or tributary. Agricultural land uses can contribute a variety of pollutant loadings to streams and tributaries including sediment, nutrients including fertilizers, bacteria, and agricultural chemicals of concerns. Storm water discharges from developed or urbanized areas are generally increased due to large areas of impervious surfaces, such as city streets, driveways, parking lots, and sidewalks. Pollutant loadings from these developed areas can include sediment, nutrients including fertilizers, oils, salt, litter, bacteria, and other chemicals of concern. Natural land uses such as forests or wetlands and riparian buffers can decrease pollutant loadings to streams due to non-point source pollution.

Historically, Trail Creek has been utilized as a major industrial shipping port and recreational destination. The stream of Trail Creek was originally named Riviere du Chermin (River of the Trail) by French traders because trails of the Potawatomie Indians converged along the stream. The first survey of the Lake Michigan shore in 1816 indicated Trail Creek was 30 feet wide at its mouth. Hoosier Slide, a giant sand dune, stood at the harbor entrance until it was removed by sand mining. Michigan City was founded in 1832 and with it began the utilization of Trail Creek for shipping and recreation.

In the 1800s 13 grist mills were located on the banks of Trail Creek. Trail Creek also served as a major port for farm goods and passengers. Goods shipped from the port include lumber and farm products. Passenger traffic, particularly day trips from Chicago to Washington Park, was also strong until the Eastland disaster in 1915.

According to the LaPorte County Historical Society, prior to 1830, all of LaPorte County was a part of the Potawatomie Nation. In 1838, the Potawatomie were removed by the United States Government to Osage County, Kansas. LaPorte officially became a county on May 28, 1832, consisting then of 462 square miles and extended only as far south as the southern line of present Clinton Township. Due to difficulty in crossing the Kankakee River, the southern portion of what is today LaPorte County requested to be annexed to LaPorte County. This was completed in January 28, 1842. On January 10, 1850, twenty sections of land were taken from St. Joseph County on the east and added to LaPorte County to give LaPorte County its present boundaries.

Michigan City arose from the ambition of Isaac Elston to create a harbor on Lake Michigan, and a road to transport supplies to homesteaders in Indianapolis and central Indiana. Isaac Elston purchased 160 acres of land including Trail Creek and the harbor in 1830. Early visitors to the region were captivated by its rugged beauty, its abundance of wildflowers and berries, and especially the majestic sand dunes, one towering to 200-foot height. The land, however, was not suitable for farming. The growth of Michigan City was due to the flowing waters of Trail Creek which afforded good locations for lumber and gristmills. Farmers came from miles around to have their wheat ground into flour.

By 1836, the year of its incorporation, Michigan City had 1,500 residents, a

		Trail Creek Land Use Data					
Watershed		**Land Use Type**	**Acres**	**% of watershed**	**Wetland Type***	**Acres**	**watershed**
Trail Creek							
	Agricultural	Developed Agriculture Pasture/Grassland	4974.53	13.21%	Palustrine emergent	453.23	1.20%
		Developed Agriculture Row Crop	9657.30	25.64%	Palustrine forested	2804.27	7.45%
	Developed	Developed Non-Vegetated	533.94	1.42%	Palustrine scrub/shrub	209.90	0.56%
		Developed Urban High Density	1360.45	3.61%	Palustrine submergent	5.78	0.02%
		Developed Urban Low Density	1567.46	4.16%	Ponds	25.94	0.07%
	Forested	Terrestrial Forest Deciduous	14251.35	37.84%	Riverine	9.31	0.02%
		Terrestrial Forest Evergreen	208.63	0.55%			
		Terrestrial Forest Mixed	82.46	0.22%			
		Palustrine Forest Deciduous	3470.64	9.21%			
	Woodland	Terrestrial Woodland Deciduous	402.57	1.07%			
		Palustrine Woodland Deciduous	3.15	0.01%			
	Herbaceous	Palustrine Herbaceous Deciduous	285.72	0.76%			
	Shrubland	Palustrine Shrubland Deciduous	20.37	0.05%			
		Terrestrial Shrubland Deciduous	684.48	1.82%			
	Water	Water	160.68	0.43%			
	Unclassified	Unclassified Cloud/Shadow	234.54	0.62%			
	Total Acres		**37663.73**			**3508.43**	
	Percentage of Trail Creek Watershed		**100.00%**	Percentage of Trail Creek Watershed		**9.32%**	
Main Branch of Trail Creek							
	Agricultural	Developed Agriculture Pasture/Grassland	896.65	10.43%	Palustrine emergent	60.99	0.71%
		Developed Agriculture Row Crop	1067.30	12.41%	Palustrine forested	654.17	7.61%
	Developed	Developed Non-Vegetated	173.34	2.02%	Palustrine scrub/shrub	36.96	0.43%
		Developed Urban High Density	1213.18	14.11%	Palustrine submergent	2.22	0.03%
		Developed Urban Low Density	1353.46	15.74%	Ponds	3.96	0.05%
	Forested	Terrestrial Forest Deciduous	2770.09	32.21%	Riverine	9.31	0.11%
		Terrestrial Forest Mixed	2.86	0.03%			
		Palustrine Forest Deciduous	802.14	9.33%			
	Woodland	Terrestrial Woodland Deciduous	126.48	1.47%			
		Palustrine Woodland Deciduous	3.15	0.04%			
	Herbaceous	Palustrine Herbaceous Deciduous	21.02	0.24%			
	Shrubland	Terrestrial Shrubland Deciduous	97.69	1.14%			
	Water	Water	71.61	0.83%			
	Total Acres		**8598.97**			**767.70**	
	Percentage of Trail Creek Watershed		**22.83%**	Percentage Sub-Watershed containing		**8.93%**	
West Branch Of Trail Creek							
	Agricultural	Developed Agriculture Pasture/Grassland	1521.60	11.09%	Palustrine emergent	210.47	1.53%
		Developed Agriculture Row Crop	3876.38	28.25%	Palustrine forested	1330.28	9.70%
	Developed	Developed Non-Vegetated	152.67	1.11%	Palustrine scrub/shrub	36.39	0.27%
		Developed Urban High Density	20.10	0.15%	Palustrine submergent	1.89	0.01%
		Developed Urban Low Density	63.10	0.46%	Ponds	6.80	0.05%
	Forested	Terrestrial Forest Deciduous	5756.76	41.96%			
		Terrestrial Forest Evergreen	126.88	0.92%			
		Terrestrial Forest Mixed	29.66	0.22%			
		Palustrine Forest Deciduous	1620.26	11.81%			
	Woodland	Terrestrial Woodland Deciduous	93.72	0.68%			
	Herbaceous	Palustrine Herbaceous Deciduous	129.83	0.95%			
	Shrubland	Palustrine Shrubland Deciduous	6.42	0.05%			
		Terrestrial Shrubland Deciduous	254.80	1.86%			
	Water	Water	68.81	0.50%			
	Unclassified	Unclassified Cloud/Shadow	229.07	1.67%			
	Total Acres		**13721.02**			**1585.83**	
	Percentage of Trail Creek Watershed		**36.43%**	Percentage Sub-Watershed containing		**11.56%**	
East Branch Of Trail Creek							
	Agricultural	Developed Agriculture Pasture/Grassland	2556.28	16.65%	Palustrine emergent	181.77	1.18%
		Developed Agriculture Row Crop	4713.62	30.71%	Palustrine forested	819.82	5.34%
	Developed	Developed Non-Vegetated	207.93	1.35%	Palustrine scrub/shrub	136.55	0.89%
		Developed Urban High Density	127.17	0.83%	Palustrine submergent	1.66	0.01%
		Developed Urban Low Density	150.90	0.98%	Ponds	15.19	0.10%
	Forested	Terrestrial Forest Deciduous	5724.49	37.30%			
		Terrestrial Forest Evergreen	81.74	0.53%			
		Terrestrial Forest Mixed	49.94	0.33%			
		Palustrine Forest Deciduous	1048.24	6.83%			
	Woodland	Terrestrial Woodland Deciduous	182.37	1.19%			
	Herbaceous	Palustrine Herbaceous Deciduous	134.86	0.88%			
	Shrubland	Palustrine Shrubland Deciduous	13.95	0.09%			
		Terrestrial Shrubland Deciduous	332.00	2.16%			
	Water	Water	20.26	0.13%			
	Unclassified	Unclassified Cloud/Shadow	5.47	0.04%			
	Total Acres		**15349.21**			**1154.98**	
	Percentage of Trail Creek Watershed		**40.75%**	Percentage Sub-Watershed containing		**7.52%**	

*Subset of land use data pertaining to Wetlands, These figures are included in the adjacent data set

Table 1: Trail Creek Land Use

* GIS Data Obtained from IDEM Indiana Biodiversity Initiative. All data was gathered from 2005 Aerial Photography with on the ground land proofing.

Marina

Trail Creek Navigable Channel upstream of Franklin Street bridge

church, post office, newspaper, and a thriving commercial district with twelve dry goods stores and ten hotels. Although some progress was made on the harbor, the project was afflicted by under-funding, competition from Chicago, political wrangling, shipwrecks, and the drifting sands which kept clogging the dredged waterways.

Today the most prominent use within Trail Creek and the marina is recreational boating and fishing as seen in the photographs on this page. Trail Creek from the outlet at the marina to the E Street Bridge, which encompasses the entire navigable channel, is lined with residential and commercial structures, marinas and docks, and the Blue Chip casino. An increased focus on the recreational aspects of Trail Creek is on-going with the addition and enhancement of greenways and parks along the stream, including a canoe launch constructed in 2006.

Additionally, recreational fishing along Trail Creek, particularly at the IDNR and local designated fishing locations is a predominant use of the stream. Trail Creek has six public fishing sites. These include the access site adjacent to the IDNR building, Robert Peo Public Access located on Liberty Trail, US 35, Trail Creek Forks located at US 20, Johnson Road and Creek Ridge Park. Creek Ridge Park located five miles east of US 421 on County Road 400 in Michigan City is also a LaPorte County park.

Trail Creek is a designated trout and salmonoid stream supporting one of the few remaining cold water fisheries in Indiana. In the early 1970's the IDNR Division of Fish and Wildlife began stocking Trail Creek with Chinook salmon, Coho salmon, Skamania summer-run steelhead, and winter-run steelhead. Trail Creek has supported and continue to support a trout and salmon fishery along with other native game and non-game species.

Soils

Unlike most parts of northern Indiana which are dominated by clay-rich soils of glacial origin, soils within the Trail Creek Watershed are comprised of mostly sand. Soils range from loose sandy soils of beach deposit and eolian origin to black sandy and loamy soils of lacustrine origin. All soils within the basin are highly transmissive because of their high sand content. As a result, drainage within the watershed is good despite low topographic relief (USACOE, 1992). Table 2 and Figure 11 indicate the various soil types located within the watershed.

Soil types and soil associations found within the Trail Creek Watershed are generally poorly suited to sanitary facilities and building site development. Slow permeability or moderately slow permeability, ponding and wetness, flooding, and pollution of groundwater due to poor filtering qualities of sandy soils are limitations within the watershed. These limitations can affect stormwater run-off quantity and quality potentially leading to increased pollutant loading to streams and tributaries in the watershed.

Soils of the Trail Creek Watershed

A thorough survey of the soils in LaPorte County, Indiana was completed in

Watershed				Trail Creek Watershed		East Branch Trail		Trail Creek-Otter		West Branch Trail	
Common Name	Map Symbol	Drainage Value	Hydric	Total Acres	% Of Watershed	Total Acres	% Of Watershed	Total Acres	% Of Watershed	Total Acres	% Of Watershed
ADRIAN	Ad	Very Poorly	Yes	597.78	1.58	252.85	1.81	10.18	0.12	334.75	2.18
BLOUNT	BaA	Somewhat Poorly	No	4556.57	12.02	1157.74	8.30	992.55	11.54	2406.28	15.68
BOURBON	Br	Somewhat Poorly	No	1243.98	3.28	97.62	0.70	82.22	0.96	1064.14	6.93
BREMS	BtA	Moderately Well	No	2922.93	7.71	1730.86	12.41	722.55	8.40	469.53	3.06
CHEEKTOWAGA	Cd	Poorly	Yes	154.90	0.41	60.99	0.44	91.65	1.07	2.26	0.01
CHELSEA	ChB	Excessive	No	2674.58	7.06	1294.88	9.28	N/A	N/A	1379.70	8.99
CHELSEA	ChC	Excessive	No	1842.23	4.86	886.10	6.35	N/A	N/A	956.13	6.23
CHELSEA	ChD	Excessive	No	561.54	1.48	313.96	2.25	N/A	N/A	247.58	1.61
COHOCTAH	Ck	Very Poorly	Yes	130.83	0.35	16.06	0.12	N/A	N/A	114.77	0.75
DUNELAND	Du	Well	No	45.28	0.12	10.65	0.08	45.28	0.53	N/A	N/A
EDWARDS	Ed	Very Poorly	Yes	73.69	0.19	468.16	3.36	N/A	N/A	63.04	0.41
FLUVAQUENTS	Fh	Well	No	1286.99	3.40	204.76	1.47	514.49	5.98	304.34	1.98
GILFORD	Gf	Poorly	Yes	649.91	1.71	29.06	0.21	22.75	0.26	422.39	2.75
HANNA	HaA	Moderately Well	No	258.41	0.68	81.40	0.58	10.77	0.13	218.59	1.42
HISTOSOLS	Hh	Well	Yes	366.88	0.97	303.00	2.17	5.92	0.07	279.55	1.82
HOMER	Hk	Somewhat Poorly	No	807.87	2.13	177.05	1.27	8.58	0.10	496.30	3.23
HOUGHTON	Hm	Very Poorly	Yes	391.09	1.03	82.85	0.59	18.62	0.22	195.41	1.27
HOUGHTON	Ho	Very Poorly	Yes	82.85	0.22	N/A	N/A	N/A	N/A	N/A	N/A
MARTISCO	Md	Very Poorly	Yes	259.37	0.68	183.11	1.31	N/A	N/A	76.27	0.50
MAUMEE	Mm	Poorly	Yes	374.18	0.99	216.21	1.55	96.78	1.13	61.18	0.40
MILFORD	Mp	Very Poorly	Yes	69.72	0.18	69.72	0.50	N/A	N/A	N/A	N/A
MORLEY	MrB2	Moderately Well	No	365.29	0.96	121.58	0.87	43.27	0.50	200.45	1.31
MORLEY	MrC2	Moderately Well	No	109.54	0.29	34.39	0.25	4.87	0.06	70.28	0.46
MORLEY	MrD2	Moderately Well	No	40.90	0.11	29.57	0.21	N/A	N/A	11.33	0.07
MOROCCO	Mx	Somewhat Poorly	No	2413.61	6.37	1639.45	11.75	495.43	5.76	278.72	1.82
NEWTON	Nf	Poorly	Yes	512.98	1.35	244.53	1.75	242.66	2.82	25.79	0.17
OAKVILLE	OaC	Well	No	1660.45	4.38	639.38	4.58	877.25	10.20	143.82	0.94
OAKVILLE	OaE	Well	No	14.97	0.04	7.46	0.05	7.52	0.09	N/A	N/A
PALMS	Pa	Very Poorly	Yes	25.22	0.07	25.22	0.18	N/A	N/A	N/A	N/A
PEWAMO	Pe	Poorly	Yes	680.00	1.79	242.09	1.74	98.02	1.14	339.90	2.21
PINHOOK	Ph	Poorly	Yes	70.47	0.19	4.21	0.03	N/A	N/A	66.25	0.43
QUINN	Qu	Poorly	Yes	105.81	0.28	105.81	0.76	N/A	N/A	N/A	N/A
RIDDLES	RlA	Well	No	16.98	0.04	9.51	0.07	N/A	N/A	7.47	0.05
RIDDLES	RlB2	Well	No	755.24	1.99	273.97	1.96	N/A	N/A	481.28	3.14
RIDDLES	RlC2	Well	No	580.36	1.53	147.66	1.06	N/A	N/A	432.70	2.82
RIDDLES	RlD2	Well	No	382.36	1.01	69.26	0.50	5.19	0.06	307.91	2.01
RIDDLES	RlF	Well	No	95.01	0.25	N/A	N/A	N/A	N/A	95.01	0.62
SAUGATUCK	Sa	Poorly	Yes	462.37	1.22	98.59	0.71	363.78	4.23	N/A	N/A
SEBEWA	Sb	Very Poorly	Yes	408.71	1.08	124.57	0.89	11.65	0.14	272.50	1.78
SELFRIDGE	SeA	Somewhat Poorly	No	1371.14	3.62	634.91	4.55	709.57	8.25	26.66	0.17
SELFRIDGE	SeB	Somewhat Poorly	No	662.93	1.75	297.69	2.13	177.82	2.07	187.42	1.22
SUMAN	So	Very Poorly	Yes	117.11	0.31	22.45	0.16	82.94	0.96	11.73	0.08
TRACY	TcA	Well	No	200.62	0.53	60.26	0.43	6.93	0.08	140.37	0.91
TRACY	TcB	Well	No	1226.26	3.24	216.82	1.55	N/A	N/A	1009.44	6.58
TRACY	TcC2	Well	No	1124.99	2.97	280.84	2.01	N/A	N/A	844.15	5.50
TRACY	TcD2	Well	No	598.87	1.58	105.94	0.76	N/A	N/A	492.94	3.21
TRACY	TcF	Well	No	31.97	0.08	N/A	N/A	N/A	N/A	31.97	0.21
TROXEL	Tr	Well	No	5.73	0.02	N/A	N/A	N/A	N/A	5.73	0.04
TYNER	TyA	Somewhat Excessive	No	918.48	2.42	519.89	3.73	N/A	N/A	391.65	2.55
UDORTHENTS	Ua	Well	No	565.13	1.49	189.04	1.36	223.33	2.60	152.76	1.00
URBAN LAND	UoC	Well	No	1686.75	4.45	N/A	N/A	1683.48	19.58	3.27	0.02
URBAN LAND	Uv	Well	No	819.20	2.16	N/A	N/A	819.20	9.53	N/A	N/A
WATER	W	Well	Yes	192.04	0.51	79.83	0.57	77.86	0.91	34.35	0.22
WALLKILL	Wa	Very Poorly	Yes	63.33	0.17	4.37	0.03	2.46	0.03	56.50	0.37
WARNERS	We	Very Poorly	Yes	65.75	0.17	14.04	0.10	43.68	0.51	8.02	0.05
WASHTENAW	Wh	Poorly	Yes	196.38	0.52	69.73	0.50	N/A	N/A	126.65	0.83
Total				37898.52	100.00	13950.08	100.00	8599.23	100.00	15349.21	100.00

Trail Creek Watershed		East Branch Trail		Trail Creek-Otter		West Branch Trail	
Soil Type	% Of Watershed	Soil Type	% Of Watershed	Soil Type	% Of Watershed	Soil Type	% Of Watershed
BaA	12.02	BtA	12.41	BaA	15.68	BaA	15.68
BtA	7.71	Mx	11.75	ChB	8.99	ChB	8.99
ChB	7.06	ChB	9.28	Br	6.93	Br	6.93
Mx	6.37	BaA	8.30	TcB	6.58	TcB	6.58
ChC	4.86	ChC	6.35	ChC	6.23	ChC	6.23

Table 2: Soils of the Trail Creek Watershed

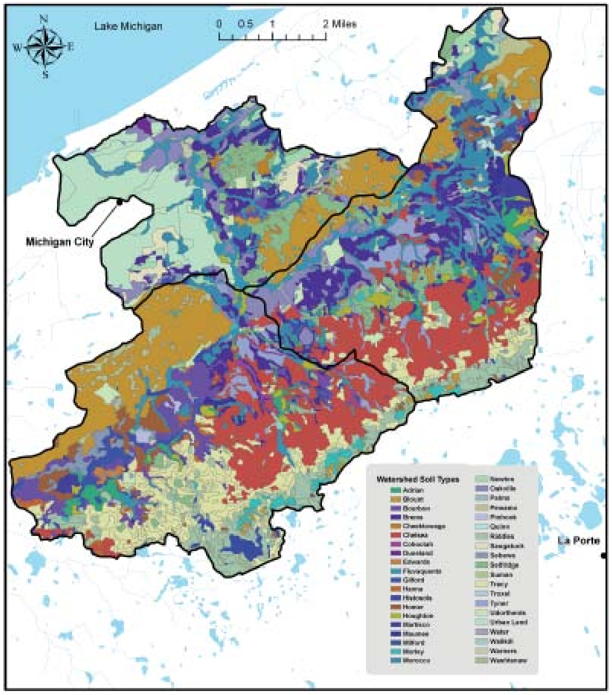


Figure 11: Soil Types within the Trail Creek Watershed (see appendix page 76)

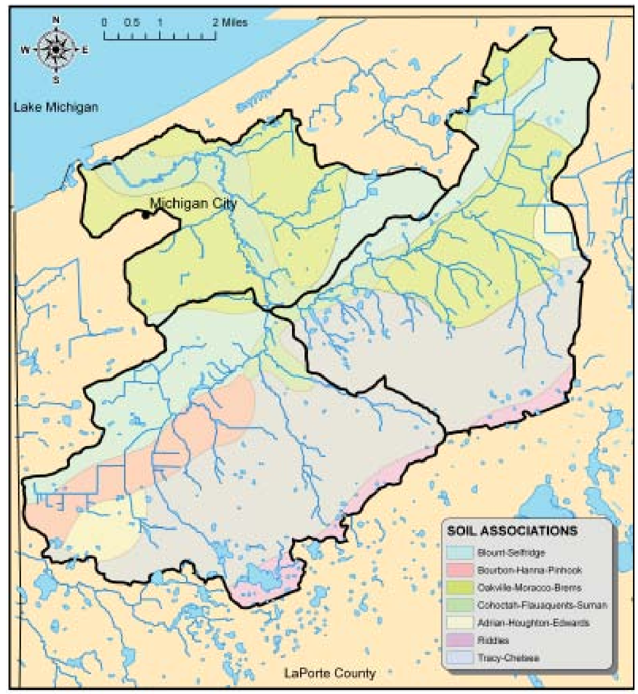


Figure 12: Trail Creek Watershed Soil Associations (see appendix page 75)

the time between 1971 and 1977; these soil names and descriptions were approved in 1976. Due to the vast area of the watershed and the extensive numbers of soils present in the watershed, this report deals mainly with the general soils map of the county and the soils associations it displays. Soils associations are typed after the most common soils type in the area and give a broad overview of the soils within each association.

There are seven soils associations within the Trail Creek Watershed: Bourbon-Hanna-Pinhook, Adrian-Houghton-Edwards, Riddles, Blount-Selfridge, Tracy-Chelsea, Oakville-Morocco-Brems, and Cohoctah-Fluvaquents-Suman. Table 3 indicates the total acreage, percentage of the watershed it covers, and a brief description of each particular soils association. Figure 12 depicts the soil association locations for the Trail Creek Watershed.

Watershed Soil Associations

Trail Creek Watershed Soils Associations			
Soil Association	Total Acreage	% of Watershed	Description
Bourbon-Hanna-Pinhook	2235.71	5.90%	Nearly level and gently sloping, poorly drained to moderately well drained soils that formed in loamy and sandy outwash sediment.
Adrian-Houghton-Edwards	1262.66	3.33%	Nearly level, very poorly drained soils that formed in organic material over sand and marl.
Riddles	1291.23	3.41%	Nearly level to very steep, well drained soils that formed in loamy glacial till.
Blount-Selfridge	6688.03	17.65%	Nearly level and gently sloping poorly drained soils that formed in loamy glacial till and in sandy deposits over loamy material.
Tracy-Chelsea	13126.49	34.64%	Nearly level to very steep, well drained and excessively drained soils that formed in loamy and sandy outwash and eolian material.
Oakville-Moracco-Brems	10387.27	27.41%	Nearly level to moderately steep, well drained to somewhat poorly drained soils that formed in sandy outwash and eolian material.
Cohoctah-Fluvaquents-Suman	2906.52	7.67%	Nearly level, very poorly drained and somewhat poorly drained soils that formed in loamy and sandy alluvium.

Table 3: Watershed Soil Associations

Topography

The topography of LaPorte County is a broad, flat plain sloping from southeast to northwest with a band of knob and kettle topography coincident with the Valparaiso Morainal Plain, Figure 13. The highest point in LaPorte County is 957 feet above sea level and is located on a knoll several miles north of the city of LaPorte. The shore of Lake Michigan is 581 feet above sea level and is the lowest point in the county. The average elevation of the county is 730 feet above sea level, which is 149 feet above the level of Lake Michigan.

The topographic relief of LaPorte County varies within each physiographic subsection. The southern portion of the county, or the Kankakee Outwash Plain, is nearly flat or depressional to gently sloping. The Valparaiso Morainal Plain, in the northern portion of the county, consists of a dissected gently sloping to moderately steep ridge than contains the highest point in the county. The local relief ranges from 100 to 150 feet. The elevations are lowest where streams have cut down through the range to the level of Lake Michigan.

The Valparaiso Morainal Plain forms a drainage divide in LaPorte County. Small streams and agricultural channels on the south side of the Valparaiso Morainal Plain flow into the Kankakee River and are part of the Mississippi River drainage. Small rivers and streams north of the Valparaiso Morainal Plain flow into Lake Michigan and are part of the St. Lawrence Seaway drainage basin. The Trail Creek watershed is located within the Valparaiso Morainal Plain and therefore drains to Lake Michigan. As such, any water quality impairment within Trail Creek can directly affect Lake Michigan and other Great Lakes.

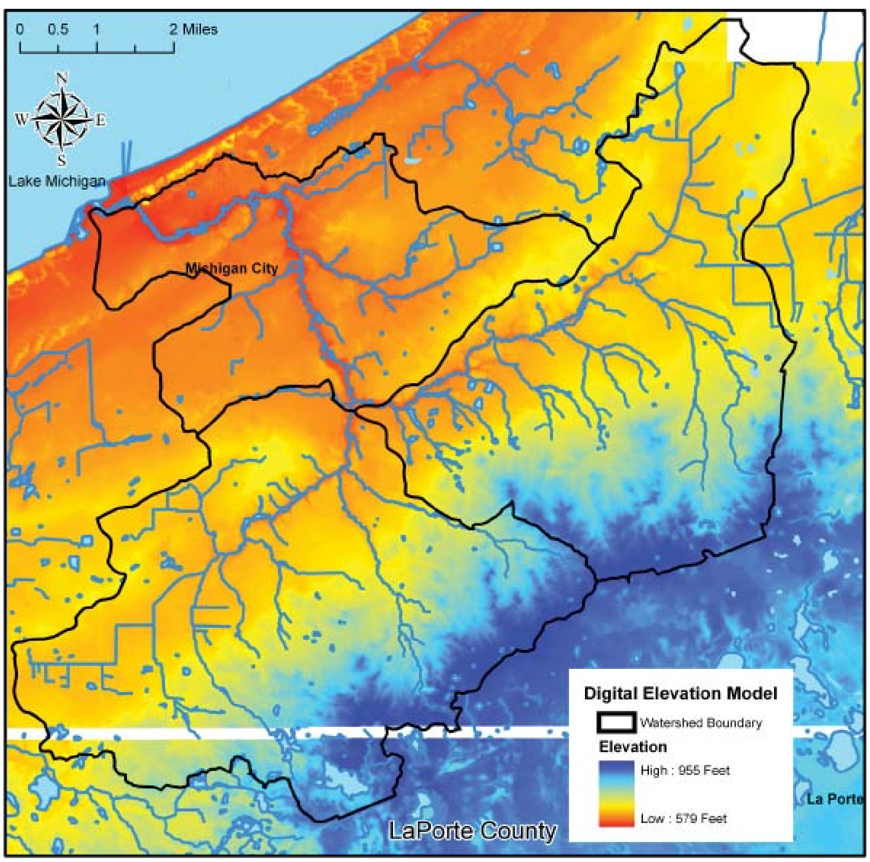


Figure 13: Topography of the Trail Creek Watershed (see appendix page 77)

Hydrology

The Trail Creek Watershed covers approximately 37,824 acres and is made up of three sub watersheds: the East Branch, approximately 13,875 acres; the Main Branch, approximately 8,595 acres; and the West Branch, approximately

15,194 acres. The watershed itself drains approximately 59 square miles within LaPorte County and is made up of multiple smaller tributaries. The West Branch of the watershed has two main tributaries, Waterford Creek and Wolf Run. The East Branch sub watershed has five main tributaries, Bull Ditch, Brown Ditch, South Arm, Bosserman Creek, and Moon Ditch. The Main Branch has one major stream, Trail Creek, which extends for 14.5 linear miles through LaPorte County. Three lakes are contributing factors to this watershed and include Dingler Lake, Ohms Lake, and Browdy Lake.

Within the Trial Creek Watershed, several tributaries are included in the LaPorte County Legal Drain System, Figure 14. As part of the Legal Drain System, the LaPorte County Surveyor and Drainage Board are charged with the maintenance of these streams and maintaining drainage to the adjacent property owners. Maintenance of these legal drains is funded from residents living within the legal drain watershed boundary. Maintenance can include herbicide treatment, dredg-

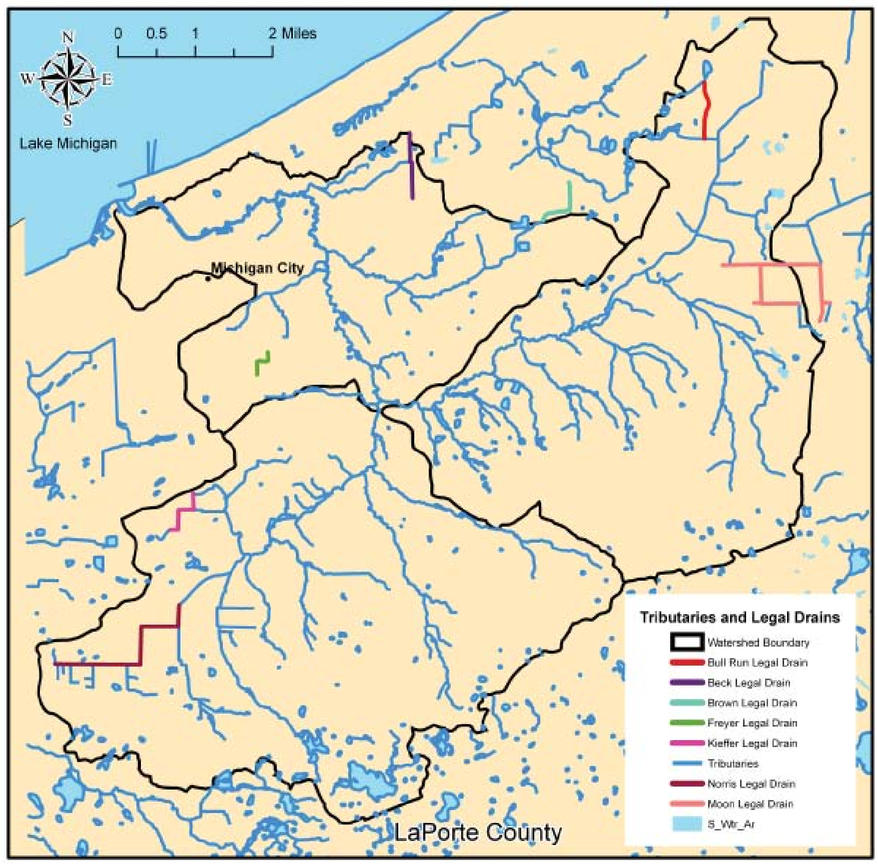


Figure 14: Trail Creek and Tributaries including Legal Drains (see appendix page 78)

ing, and removal of sediment and debris. Within the corporate limits of Michigan City, the Sanitary District of Michigan City has jurisdiction and maintenance responsibility for the legal drain system.

The Trail Creek discharge rate into Lake Michigan at the mouth of the stream ranged between 84 and 294 cubic feet per second in 1998 and had a average of 131 cubic feet per second; between 67 and 318 cubic feet per second in 1999 and an average of 125 cubic feet per second; between 45 and 396 cubic feet per second in 2000 and an average of 114 cubic feet per second; and between 34 and 144 cubic feet per second in 2001 and an average of 93 cubic feet per second.

Long term average flow for the stream at the USGS Gaging Station at Springland Avenue in Michigan City is 72.6 cubic feet per second (cfs), which is equivalent to 18.2 inches of runoff. The minimum daily flow observed in the stream was 20 cfs in August 1977. The maximum instantaneous flow recorded was 2,430 cfs in July 1986 (USGS, Suspended Sediment in Trail Creek at Michigan City, Indiana, 1992).

Due to the natural seiche action of Lake Michigan, Trail Creek is subject to frequent flow reversals at its mouth. Seiches are periodic oscillations of lake levels caused by wind, earthquakes, changes in barometric pressure, or other natural forces. Seiche can last seconds to minutes and reoccur at intervals of tens of minutes to more than eight hours. Seiche action occurs in Lake Michigan when sustained high winds blowing from the north drag water toward the south end of the lake, causing the water level to rise at Indiana's coast, with a corresponding water level drop of the same amount at the north end of the lake. The result is a tilt of Lake Michigan's water surface and water within the lake tributaries to rise. As long as the sustained high wind continues to blow, the tilt in the lake's surface is maintained. Once the winds have ceased the lake levels return to normal. This reversal results in water level fluctuations of between one and two inches. The flow reversals are capable and do extend past two miles upstream.

As part of the development of this plan, a flow study was undertaken in order to calculate pollutant loading within the stream at various sampling locations. This study is included in Appendix O.

Land Ownership

Throughout the entire watershed are various private and public land owners including several areas of land owned by various land conservation organizations. Preservation of sensitive and high quality riparian areas and rare or endangered communities is a critical component of the Trail Creek Watershed Management Plan.

Cultural Resources

Based on a review of the National Register of Historic Places there are 15 properties listed in LaPorte County. Of the places listed on the National Register of Historic Places, several are within the Trail Creek Watershed and are of particular interest to watershed management along Trail Creek. These include

Figure 15: Location of properties on the National Register of Historic Places (see appendix page 79)

http://www.nature.nps.gov/nnl/registry/usa_map/States/Indiana/nnl/pb/index.cfm

http://www.southeasternoutdoors.com/wildlife/mammals/indiana-bat.html

http://www3.nationalgeographic.com/animals/birds/bald-eagle.html

http://www.btinternet.com/~tellhicks/details/e-massasauga-d.htm

http://www.ecsltd.com/mitchells_satyr.htm

the Michigan City East Pierhead Light Tower and Elevated Walk located at the Michigan City Harbor at the mouth of Trail Creek, the Michigan City Lighthouse located at Washington Park along Trail Creek, and Washington Park located along Trail Creek, Figure 15. (LaPorte County Interim Report, March 1989.)

Unique Natural Resources

Pinhook Bog located in the Trail Creek Watershed was designated a National Natural Landmark in 1965 and is part of the Indiana Dunes National Lakeshore. Pinhook Bog is the only true bog in located within Indiana. A bog is a specific type of wetlands that accumulates acidic peat from dead plant material. This bog was formed by glacial meltwater on a clay bed. Pinhook Bog consists of about 580 acres of which approximately 145 acres are a floating peat mat with approximately 45 acres of wetland separating the bog from the adjacent uplands.

Endangered Species

Based on review of data available from the US Fish and Wildlife Service Region 3 Database, the Indiana bat (*Myotis sodalis*), the bald eagle (*Haliaeetus leucocephalus*), the eastern massasauga (*Sistrurus c. catenatus*), and Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*) are the only federally threatened, endangered, or candidate species noted in LaPorte County.

Based on the Indiana Department of Natural Resources listing of endangered, threatened, and rare species documented from LaPorte County as of December 11, 2005, there are 128 species of vascular plants, 1 species of mollusk, 2 species of insects, 1 species of fish, 1 species of amphibians, 7 species of reptiles, 28 species of birds, 6 species of mammals, and 20 high quality natural community types listed within LaPorte County. A listing of each of these is located in the Appendix M.

Natural Heritage Database information on the Trail Creek Watershed was provided by the Indiana Department of Natural Resources. This information is an account of threatened, endangered, or rare species that have been observed inside the hydrological boundaries of the Trail Creek Watershed. This information relies on the observation of many individuals and is not the result of comprehensive field surveys conducted at the site.

The Natural Heritage Database indicated 3 bird species, 2 mammal species, 3 reptile species, 48 plant species, and 2 insect species that are either threatened, endangered, or rare which have been observed in the Trail Creek Watershed. Also noted in the database are 9 high quality natural communities. Listing of each of these is located in the Appendix N.

In addition to threatened and endangered species within the Trail Creek Watershed, Trail Creek is noted as one of the few streams within the State of Indiana which can support a cold water fisheries including populations of trout and salmon.

Wetlands

According the 1993 Watershed Management Plan, there were approximately 5,400 acres of wetlands present within the Trail Creek Watershed. Current land use data (Table 1 and Figure 10) indicate there are approximately 3,500 acres of wetland present within the Trail Creek Watershed, with 1,155 acres of wetland within the East Branch of Trail Creek watershed, 1,585 acres of wetland in the West Branch of Trail Creek watershed, and 767 acres of wetland in the Trail Creek and Otter Creek watershed The National Wetlands Inventory prepared by the US Fish and Wildlife Services includes mapping and characterization of wetlands in the United States. According to the National Wetlands Inventory there are approximately 3,850 acres of wetland present in the Trail Creek Watershed with 1,725 acres of wetland within the East Branch of Trail Creek watershed, 1,251 acres of wetland in the West Branch of Trail Creek watershed, and 870 acres of wetland in the Trail Creek and Otter Creek watershed, Figure 17.

Historically, wetland loss within the State of Indiana since pre-settlement times is approximately 85% with the majority of wetland loss due to draining of agricultural lands. Mapping of areas with hydric or wetland soil types indicates the historic location of wetlands within the watershed, see Figure 16. Wetlands are an important portion of the watershed due to the water quantity and quality functions which are present within a wetland. Wetlands reduce flood levels and flood damage and act as a natural water filtration system.

Within LaPorte County large areas of wetlands have been drained or altered so they are no longer providing flood storage, water quality treatment, or habitat. Wetland and natural area restoration or enhancement can be an effective tool in watershed management. Wetland restoration within areas which previously demonstrated wetland characteristics but have been drained or altered are generally the most successful projects in terms of water quality enhancement. Within the Trail Creek Watershed, areas mapped with hydric soils are indicative of potentially drained or altered wetlands. The Figure 16 indicates areas of hydric soils within the watershed which may be suitable for wetland restoration.

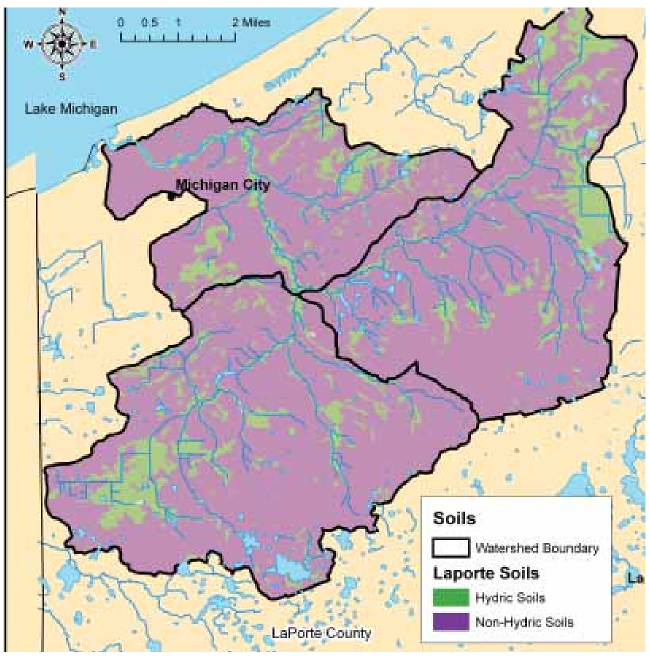


Figure 16: Hydric Soils (see appendix page 80)

Figure 17: Trail Creek Watershed - National Wetlands Inventory (see appendix page 81)

Previous Water Quality within Trail Creek Watershed

East branch of Trail Creek at
Sample Point E1

AS PART of the preparation of this report and a variety of other reports, multiple water quality studies have been completed within the Trail Creek Watershed. An initial assessment of the data collected as part of this study between January 2005 and April 2006 as well as review of previous studies indicates the majority of water quality problems in the watershed are associated with abnormally high spikes in concentration levels of pollutants including total suspended solids and *E. coli*. Further calculations of loading and statistical analysis of the loads, concentrations, and precipitation events indicate water quality problems are associated with non-point source pollutant loading and recurring spikes in the levels of pollutants in the watershed. These spikes are able to be directly linked to precipitation event and their intensity, indicating runoff is a major contributor to the poor water quality in the Trail Creek Watershed.

The Trail Creek Watershed has been extensively studied by the Sanitary District of Michigan City, the Indiana Department of Environmental Management, the Indiana Department of Natural Resources, and various other agencies. The following is a summary of the various studies which have been conducted and their conclusions.

2006 Watershed Management Plan Baseline Assessment

The Trail Creek Escherichia Coli TMDL Report (Triad, 2003) recommended continued monitoring in the watershed. Based on that report, goals of this study include identifying potential sources of non-point pollutants (both biological and physical), quantifying the extent of that pollution, and evaluating potential programs to effectively reduce pollutant loading. Data was collected to identify potential sources of pollutants, establish baseline conditions of the watershed, and calculate pollutant loading. Future monitoring data will be compared against the baseline to gauge the success of the prevention and remediation methodologies that will be developed.

Sampling Locations

Throughout the course of this study, 12 separate water quality sampling locations were sampled from a period of January 2005 through April 2006. For reference to these locations see Figure 18 and the photographs through this section of the report. Sample locations were strategically chosen by the Sanitary District of Michigan City and the Indiana Department of Environmental Management to be representative of common land use types within the watershed as indicated in Figure 10. Water quality monitoring was designed to provide proper spatial coverage of the watershed and collect data during both wet and dry weather conditions in order to assess potential sources of pollutants. Three sample sites are located within the West Branch Sub-Watershed, three within the East Branch Sub-Watershed and six within the Main Branch Watershed. Water samples from each site were analyzed in the field and at the on-site laboratory in the Sanitary District of Michigan City's Wastewater Treatment Plant.

East branch of Trail Creek at
Sample Point E2

Water quality sampling locations were selected to determine potential sources of non-point source pollutants and the effects of land use on water quality. Sample locations located in the West Branch of Trail Creek include primarily rural agricultural including both livestock and row crops, rapidly developing areas, large lot rural housing, and forested areas. Sample locations within the East Branch of Trail Creek include primarily rural agricultural including livestock and row crops, large lot rural housing, and small lot rural subdivisions. Sample locations located in the Main Branch of Trail Creek include primarily urban and suburban land uses including the un-sewered towns of Trail Creek and Potawatomie Park, Michigan City, and the majority of the commercial and industrial sites within the watershed. One sample location was selected near the USGS Gage station at the mouth of Trail Creek in order to correlate data collected with stream flow. A second sample location was selected at the former USGS Gage Station at Springland Avenue. As part of this study, the USGS Gage Station at Springland Avenue was re-activated in order to correlate future sampling data with stream flow. Sample locations were located throughout the watershed along all major branches within both rural and urban settings in order to evaluate non-point source contributions from each branch and land use within the watershed.

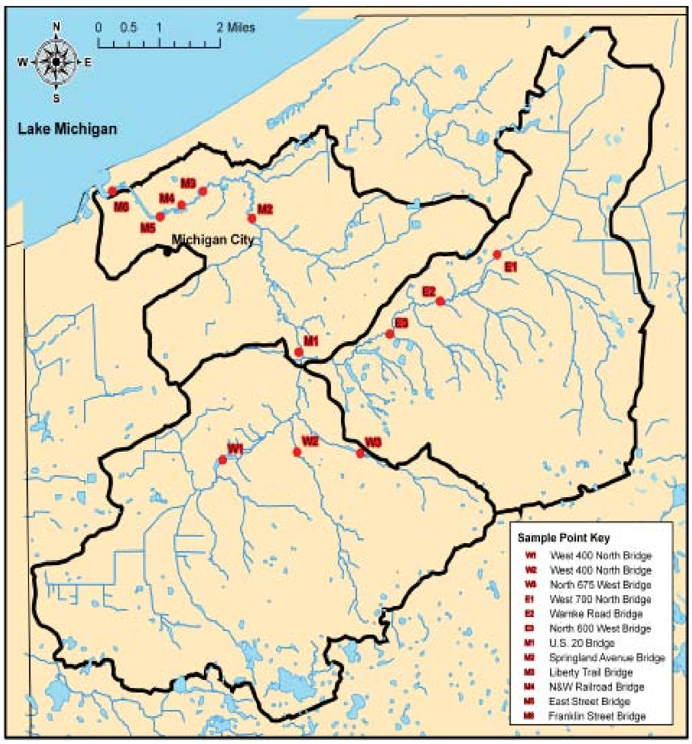


Figure 18 (see appendix page 82)

Physical and Chemical Measurements

Sampling within the Trail Creek Watershed was conducted at twelve locations throughout the watershed. Data collection was performed bi-monthly during winter months (November through March) and weekly during the summer (April through October) at each of sample location. The following parameters were evaluated:

- Conductivity
- pH
- Temperature
- Dissolved oxygen
- Turbidity
- Total suspended solids (TSS)
- Nitrogen ammonia
- Ortho phosphorus
- Total phosphorus
- *E. coli*
- Biological oxygen demand (BOD) (once monthly)
- TKN
- Nitrate/Nitrite

Samples were collected from January 2005 through April 2006. Sampling was used to determine loading of various pollutants to Trail Creek.

The following table indicates the maximum, minimum, and mean values for sampling data collected at each sample site.

Sample Site	Field Analysis		Concentration Data Statistics For Trail Creek Watershed Sampleing Points										
Parameter	Conductivity	pH	Temperature	Dissolved Oxygen	Turbidity	TSS	Nitrogen Ammonia	Ortho Phosphorus	Total Phosphorus	*E.Coli*	BOD_5	TKN	Nitrate + Nitrite
Unit of Measurement	uS	I.U.	ºC	(mg/l)	NTU	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(col/100)	(mg/l)	(mg/l)	(mg/l)
Target Concentrations	N/A	N/A	N/A	7.00	N/A	15.00	0.25-0.01*	0.05	0.05	235	N/A	1.00	10.00
E1													
Averages	545.94	8.15	12.01	10.28	12.19	12.27	0.06	0.02	0.04	696.00	0.76	0.52	0.38
MAX	753.00	9.40	22.10	19.70	166.00	134.00	0.21	0.08	0.46	4100.00	4.90	2.10	1.38
MIN	261.00	7.00	1.90	7.60	2.90	1.80	0.03	0.02	0.02	40.00	2.00	0.50	0.19
E2													
Averages	510.85	8.18	12.29	10.31	10.20	11.20	0.06	0.02	0.04	837.21	0.72	0.49	0.38
MAX	703.00	8.60	21.90	19.80	123.00	78.00	0.25	0.06	0.32	5060.00	3.80	1.60	1.24
MIN	269.00	7.80	0.90	8.00	3.30	1.80	0.03	0.02	0.02	20.00	2.00	0.50	0.19
E3													0.37
Averages	529.00	8.13	12.10	10.23	11.75	14.32	0.05	0.02	0.04	663.09	0.73	0.47	
MAX	725.00	8.50	20.90	18.90	192.00	172.00	0.20	0.08	0.48	5050.00	4.20	1.80	1.24
MIN	285.00	7.00	1.20	7.80	3.30	1.80	0.03	0.02	0.02	20.00	2.00	0.50	0.04
M1													
Averages	509.28	8.04	12.87	9.67	22.21	25.35	0.06	0.02	0.05	768.87	0.76	0.49	0.29
MAX	745.00	8.60	23.50	17.40	605.00	552.00	0.24	0.05	0.94	6440.00	5.80	2.40	1.10
MIN	279.00	7.60	1.30	7.50	3.40	1.80	0.04	0.02	0.02	65.00	2.00	0.50	0.14
M2													
Averages	541.32	8.19	12.94	10.09	22.73	26.40	0.06	0.02	0.06	719.72	0.85	0.56	0.33
MAX	758.00	8.50	23.60	20.10	553.00	516.00	0.21	0.07	1.00	5440.00	5.90	3.30	1.60
MIN	274.00	7.90	1.00	7.40	3.70	1.80	0.02	0.02	0.02	40.00	2.00	0.50	0.16
M3													
Averages	551.81	8.18	13.14	9.96	21.22	24.91	0.07	0.02	0.06	900.55	1.01	0.58	0.36
MAX	761.00	8.50	24.00	20.20	436.00	428.00	0.28	0.06	0.88	9100.00	8.20	3.10	1.90
MIN	298.00	7.90	0.20	7.00	3.40	1.80	0.04	0.02	0.02	40.00	2.00	0.50	0.10
M4													
Averages	546.68	7.99	13.44	9.39	19.58	27.89	0.07	0.01	0.07	586.98	0.79	0.50	0.34
MAX	758.00	8.70	23.80	19.90	425.00	556.00	0.25	0.03	0.90	3540.00	6.40	2.70	2.10
MIN	304.00	7.70	1.80	6.50	3.70	1.80	0.05	0.02	0.02	53.00	2.00	0.50	0.10
M5													
Averages	592.68	8.08	13.89	9.57	17.78	18.85	0.08	0.05	0.10	685.47	0.85	0.56	1.53
MAX	795.00	8.40	25.00	19.00	424.00	358.00	0.27	0.21	0.74	6100.00	5.90	2.50	4.40
MIN	331.00	6.80	2.00	6.60	3.40	1.80	0.04	0.03	0.05	15.00	2.00	0.50	0.50
M6													
Averages	557.17	8.10	14.53	9.80	10.46	11.40	0.09	0.04	0.07	293.17	0.76	0.57	1.37
MAX	801.00	8.70	26.50	18.70	158.00	144.00	0.39	0.12	0.32	2050.00	4.20	2.20	4.40
MIN	342.00	6.80	0.50	6.40	2.00	1.80	0.04	0.02	0.05	10.00	2.00	0.50	0.10
W1													
Averages	532.06	8.19	16.29	10.08	27.52	27.27	0.10	0.02	0.06	2637.09	0.79	0.60	0.28
MAX	846.00	8.60	189.30	18.70	403.00	264.00	0.40	0.08	0.74	9000.00	5.60	2.70	1.73
MIN	237.00	7.60	1.50	7.70	4.40	1.80	0.02	0.02	0.03	70.00	2.00	0.50	0.10
W2													
Averages	468.09	8.23	11.46	10.40	28.60	33.89	0.05	0.01	0.05	402.49	0.74	0.43	0.21
MAX	696.00	8.70	18.50	18.20	784.00	732.00	0.20	0.05	0.98	2900.00	3.60	2.90	0.93
MIN	255.00	7.80	2.80	8.10	3.20	1.80	0.03	0.02	0.02	16.00	2.00	0.50	0.10
W3													
Averages	477.32	7.94	11.79	9.04	10.58	21.31	0.04	0.02	0.03	204.96	0.68	0.35	0.08
MAX	674.00	8.30	18.20	14.60	46.30	153.00	0.16	0.05	0.13	1250.00	2.00	1.10	0.43
MIN	278.00	7.00	4.60	7.50	4.20	1.80	0.03	0.02	0.02	2.00	2.00	0.50	0.04

Table 4: * Target Ammonia Concentrations are a function of the relative toxicity of the Ammonia at the time of a given sample event. The Toxicity of Ammonia is a variable which is dependent on the pH and the Temperature of the water during the time of the sampling event.

Aquatic Macro invertebrates collected from Trail Creek

Biological and Habitat Sampling

Of the twelve water quality sampling locations, four sites were selected to conduct biological and habitat assessment. One sample location was selected in both the East and West Branches of Trail Creek, one near the confluence of the branches, and one within the urbanized area. All sites selected were shallow enough to be waded in order to facilitate proper sampling. Biological sampling was completed to supplement the chemical water quality data collected. Chemical water quality data represents a specific point in time at which the sample was collected and may not be representative of the overall health of the stream. Biological sampling and the calculation of an Index of Biotic Integrity utilizes species collected in the stream to determine the overall health of the stream and changes in water quality over time. The Index of Biotic Integrity utilizes parameters such as the EPT Index which is a measurement of the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) found within a stream. These species of macroinvertebrates are also those collected and used to determine water quality by volunteer programs such as Hoosier Riverwatch.

Biological assessment evaluations were completed at sampling stations W1, E3, M1, and M2, see Figure 18. Benthic macro-invertebrate communities were collected and analyzed using the Rapid Bio-assessment Protocol II in accordance with current operating procedures for aquatic macro-invertebrate sampling, water quality assessment, and habitat assessment according to the Indiana Department of Environmental Management Biological Studies Section Standard Operating Procedures and Rapid Bio-assessment Protocols for Use in Streams and Wadable Rivers (USEPA). Biological data collection for establishment of baseline conditions was performed on September 26, 2005. Samples collected at Site W1 during the September sampling event were collected downstream of the water quality sampling location and therefore samples for Site W1 were also collected on June 14, 2006 at the same location as the water quality sampling. For reference to the biological data collected see Appendix P.

Macro-invertebrate collection was performed using a kick-net. The net was held downstream of an area where substrate was agitated, which enabled macro-invertebrates to be carried by streamflow and collected in the net. Approximately 15 sampling passes were performed except in the events of a low specimen count in which case sampling continued until a minimum of 100 individuals were collected. Specimens were placed in a 70 percent isopropyl alcohol solution for preservation until they could be identified in a laboratory. Specimens were identified to at least the family level using taxonomic keys referenced in Aquatic Entomology (McCafferty, 1998).

After specimens were identified by family, several biotic indices were used to determine the quality of each sample location based on the presence or absence of various macro-invertebrates species, total number of specimens collected, and taxonomical richness.

Main branch of Trail Creek at Sample Point M2

Main branch of Trail Creek
at Sample Point M1

Nine metrics were calculated including the following:

- Family Level Hilsenhoff's Biotic Index
- Number of Taxa
- Number of Individuals
- Percent Dominant Taxa
- Ephemeroptera, Plecoptera, and Trichoptera Index
- Ephemeroptera, Plecoptera, and Trichoptera Count
- Ephemeroptera, Plecoptera, and Trichoptera Count to Total Number of Individuals
- Ephemeroptera, Plecoptera, and Trichoptera Count to Chironomid Count
- Chironomid Count

Hilsenhoff's Biotic Index

This index was proposed by Chutter (1972) and modified by Hilsenhoff (1977) for use with index values proposed by Hilsenhoff. The calculation can be used to evaluate organisms at the species level as well as the family level using the following formula:

$$HBI = \frac{\Sigma(ni\ ai)}{N}$$

where "ni" is the number of individuals in the "ith" taxa, "ai" is the index value of that taxa, and "N" is the total number of individuals in the sample. Hilsenhoff's family level Biotic Index uses the values 0-10.

The following are water quality value categories for Hilsenhoff's Biotic Index (1988a):

- 0.00-3.75 (excellent)
- 3.76-4.25 (very good)
- 4.26-5.00 (good)
- 5.01-5.75 (fair)
- 5.76-6.50 (fairly poor)
- 6.51-7.25 (poor)
- 7.26-10.00 (very poor)

Number of Taxa and Number of Individuals

The number of taxa is the total number of families identified in each sample. The number of individuals is the total number of individuals for all families identified in each sample. These numbers increase with increased water quality. The maximum number of taxa anticipated to be in a high quality Indiana stream is dependent on the natural conditions of the stream. A healthy stream could exhibit ten or more taxa equally distributed between sensitive, intermediate, and tolerant species.

West branch of Trail Creek
at Sample Point W2

Percent Dominant Taxa

The percent dominant taxa are an indication of the community balance. A community dominated by relatively few species would indicate some kind of environmental stress to the stream. Healthy streams should show large numbers in diversity and smaller population sizes with a fairly even composition of species. If the community is dominated by 1 or 2 species at 50% or greater there is some type of environmental stress on the community.

Main branch of Trail Creek at Sample Point M5

Ephemeroptera, Plecoptera, and Trichoptera Count
Ephemeroptera, Plecoptera, and Trichoptera Index
Ephemeroptera, Plecoptera, and Trichoptera Count to Total Number of Individuals

The Ephemeroptera, Plecoptera, and Trichoptera Count is the total number of individuals for Orders Ephemeroptera, Plecoptera, and Trichoptera. The Ephemeroptera, Plecoptera, and Trichoptera Index is the total number of families represented in the Orders Ephemeroptera, Plecoptera, and Trichoptera. These orders are generally considered to be pollution sensitive. This number increases with higher water quality. Typically, five or more species with an even distribution from all three orders (Ephemeroptera, Plecoptera, and Trichoptera) constitute a good indicator of a healthy stream. Likewise, the absence of these orders or the predominance of a single species can indicate a stress on the environment that has unbalanced the system.

Ephemeroptera, Plecoptera, and Trichoptera Count to Chironomid Count/ Chironomid Count

The Chironomid Count is the total number of Chironomids present in the sample. The Ratio of Ephemeroptera, Plecoptera, and Trichoptera to Chironomid is a measure of the community balance. Good biotic condition is reflected in the fairly even distribution among the four major groups, with a substantial representation of Ephemeroptera, Plecoptera, and Trichoptera (EPT). EPT includes the more sensitive groups of macro-invertebrates that will not be present in low quality waters. Chironomidae will exist in any water source. Often, Chironomidae are the most abundant taxa in highly impacted water. A healthy community will have at least an equal, and in more desirable cases, a greater ratio of EPT to Chironomidae. A community that exhibits a greater ratio of Chironomidae to EPT is an indication that the community is impacted in some way.

Table 5 is a summary of biological data collected on September 26, 2005. Samples collected at Site W1 during the September sampling event were collected downstream of the water quality sampling location and therefore samples for Site W1 were also collected on June 14, 2006 at the same location as the water quality sampling. For reference to the biological data collected see Appendix P.

Table 5: Summary of Index of Biotic Integrity Scores for Biological Sampling Sites

	W1	W1	E3	M1	M2
Family Level HBI	0.27	3.00	4.65	3.98	3.68
Number of Taxa	11.00	8.00	11.00	8.00	9.00
Number of Individuals	131.00	56.00	339.00	197.00	123.00
Percent Dominant Taxa	83.97	42.86	23.01	65.48	65.04
EPT Index	5.00	1.00	5.00	4.00	3.00
EPT Count	9.00	1.00	103.00	156.00	103.00
EPT Count to Total Number of Individuals	0.07	0.02	0.30	0.79	0.84
EPT Count to Chironomid Count	4.50	0.04	1.32	39.00	51.50
Chironomid Count	2.00	26.00	78.00	4.00	2.00
Aquatic Life Support Metric	**3.33**	**2.22**	**4.44**	**5.33**	**4.89**

A *Hilsenhoff's Biotic Index* or HBI for the sample locations indicated the streams sampled were rated as good to excellent. Additionally, the aquatic life support (ALUS) metric score was calculated for each site. An ALUS metric score of $\geq$2.2 is considered fully supporting of aquatic life, while a score of <2.2 is considered non-supporting of aquatic life. Sample location W1 was the lowest score calculated at 2.2, indicating that all four sample locations were fully supporting of aquatic life.

Main branch of Trail Creek
at Sample Point M3

West branch of Trail Creek
at Sample Point W3

Qualitative Habitat Evaluation Index (QHEI)

The Qualitative Habitat Evaluation Index (QHEI) is a visual habitat assessment method developed by the Ohio Environmental Protection Agency as a tool for designating aquatic life uses and assessing potential causes of impairment. QHEI data was collected at each of the four sample sites for which biological sampling was also completed in order to provide comparative analysis of habitat quality across the watershed and to establish baseline conditions during the initial monitoring effort. The following parameters were examined and scored according to QHEI methods:

- Substrate
- Instream Cover
- Channel Morphology
- Bank Erosion and Riparian Zone
- Pool/Glide Quality
- Riffle/Run Quality
- Gradient and Drainage Area

Each of the parameters scored are used to determine the availability and quality of instream habitat for macroinvertebrates and fish such as riffle and instream cover, the stability of the streambank, and the stream type. Determination of instream habitat and steam type were utilized to determine if water quality or habitat availability and quality were the factors most influencing species present in Trail Creek. Stream type was also used to determine which species would be anticipated to be found in that type of stream. For example, the upper reaches of Trail Creek have a natural sand bottom and therefore would not be anticipated to support a large population of Ephemeroptera, Plecoptera, and Trichoptera which generally prefer rocky riffles.

Sampling sites evaluated for QHEI cover a wide range of habitat types. Site M2 is a wide, low gradient stream, located in an urban area, and whereas, Site E3 is a smaller stream located in a more rural area. Furthermore, results of the QHEI assessment reveal general habitat quality from excellent to poor. QHEI scores reported will be used as baseline conditions for comparison to habitat changes in subsequent monitoring years. Results of the QHEI field data are summarized in the Table 6 below and in Appendix Q.

Table 6: Qualitative Habitat Evaluation Index

Sample Point	M1	M2	W1	E3	Maximum Score
Substrate	13	10	3	8	20
Instream Cover	14	14	6	15	20
Channel Morphology	16	16	13	17	20
Riparian Zone/ Bank Erosion	8	5	4.5	5.5	10
Pool/Glide Quality	9	9	5	5	12
Riffle/Run Quality	5	5	0	2	8
Gradient	8	4	10	6	10
Total QHEI Score	73	63	41.5	58.5	100
Narrative Rating*	Excellent	Good	Poor	Good	

*Narrative rating classes were designed to communicate general habitat classes to the public. Ratings are general and not always representative of aquatic assemblages at any given site.

Calculated Pollutant Loading

As part of the Watershed Management Plan, the calculation of pollutant loads is required. Pollutant loads were calculated for all parameters sampled. As flow data was not collected at the time of the sampling, estimated flows were calculated for each sample location and utilized to determine the pollutant loading.

Following is the summary of the estimated loading for each sample location for those pollutants of concern in the watershed. This loading was calculated using the calculated base flow.

Table 7: Trail Creek Watershed Sampling Data Analysis Results Using Calculated Base Flow Data

Sample Site E1 Descriptive Statistics	*E. coli* (cfu/year)	Total Suspended Solids	Ammonia	TKN	Nitrate + Nitrite	Ortho Phosphorus	Total Phosphorus
Max Load (tons/yr)	4.97E+14	1716.35	8.20	81.97	53.87	3.12	17.96
Min Load (tons/yr)	4.85E+12	23.06	1.17	19.52	7.42	0.78	0.78
Mean Load (tons/yr)	8.62E+13	157.19	3.79	31.75	23.54	1.20	2.68
Sample Site E2 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	7.85E+14	1334.39	4.28	27.37	21.21	1.03	5.47
Min Load (tons/yr)	3.10E+12	30.79	0.51	8.55	3.25	0.34	0.34
Mean Load (tons/yr)	1.30E+14	191.61	1.59	13.09	10.21	0.49	1.17
Sample Site E3 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	9.17E+14	3443.36	4.00	36.04	24.82	1.60	9.61
Min Load (tons/yr)	3.63E+12	36.04	0.60	10.01	0.80	0.40	0.40
Mean Load (tons/yr)	1.20E+14	286.66	1.67	14.78	11.46	0.61	1.39
Sample Site M1 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	2.79E+15	26331.84	11.45	114.49	52.47	2.39	44.84
Min Load (tons/yr)	2.81E+13	85.86	1.91	23.85	6.68	0.95	0.95
Mean Load (tons/yr)	3.40E+14	1235.50	4.67	38.24	22.72	1.23	4.15
Sample Site M2 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	2.81E+15	29416.65	11.97	188.13	91.21	3.99	57.01
Min Load (tons/yr)	2.07E+13	102.62	1.14	28.50	9.12	1.14	1.14
Mean Load (tons/yr)	3.72E+14	1504.80	5.78	49.81	29.23	1.56	5.28
Sample Site M3 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	4.91E+15	25444.06	16.65	184.29	112.95	3.57	52.31
Min Load (tons/yr)	2.16E+13	107.01	2.38	29.72	5.94	1.19	1.19
Mean Load (tons/yr)	4.86E+14	1480.65	6.90	54.30	33.27	1.53	5.39
Sample Site M4 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	1.92E+15	33206.65	14.93	161.26	125.42	1.79	53.75
Min Load (tons/yr)	2.87E+13	107.50	2.99	29.86	5.97	1.19	1.19
Mean Load (tons/yr)	3.25E+14	1701.88	6.57	48.52	32.62	1.42	7.19
Sample Site M5 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	3.33E+15	25519.10	16.25	150.47	264.82	12.64	44.54
Min Load (tons/yr)	8.19E+12	108.34	2.41	30.09	30.09	1.81	3.01
Mean Load (tons/yr)	3.74E+14	1218.84	7.20	52.80	144.01	5.04	9.43
Sample Site M6 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	1.14E+15	8853.86	23.98	116.82	270.53	7.38	9.22
Min Load (tons/yr)	5.58E+12	110.67	2.46	30.74	6.15	1.23	1.23
Mean Load (tons/yr)	1.50E+14	700.93	8.55	49.43	116.03	3.17	5.59
Sample Site W1 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	1.21E+15	3908.68	5.92	39.98	25.61	1.18	10.96
Min Load (tons/yr)	9.40E+12	26.65	0.30	7.40	1.48	0.30	0.44
Mean Load (tons/yr)	3.54E+14	403.78	2.24	13.92	6.56	0.42	1.46
Sample Site W2 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	1.07E+14	2974.07	0.81	11.78	3.78	0.20	3.98
Min Load (tons/yr)	5.90E+11	7.31	0.12	2.03	0.41	0.08	0.08
Mean Load (tons/yr)	1.48E+13	137.67	0.31	2.77	1.31	0.09	0.30
Sample Site W3 Descriptive Statistics	***E. coli* (cfu/year)**	**Total Suspended Solids**	**Ammonia**	**TKN**	**Nitrate + Nitrite**	**Ortho Phosphorus**	**Total Phosphorus**
Max Load (tons/yr)	2.25E+13	304.04	0.32	2.19	0.85	0.10	0.26
Min Load (tons/yr)	3.61E+10	3.58	0.06	0.99	0.08	0.04	0.04
Mean Load (tons/yr)	3.69E+12	42.36	0.12	1.10	0.24	0.05	0.08

For reference to calculated pollutant loads for other flow calculations, the calculations for the loading for Trail Creek, and the flow study see the Appendix R Load Calculations and Appendix O – Trail Creek Flow Study.

Results and Conclusions of 2006 Watershed Management Plan

Physical and chemical water quality measurements indicate the maximum recorded values for total suspended solids, nutrients (nitrogen and/or phosphorus), and *E. coli* exceed the target concentrations at all of the sample locations. Maximum recorded values are generally associated with higher flow events and increased stormwater run-off. This indicates that potential non-point source pollutant loading associated with significant rain events is an issue throughout the watershed. However, only sample locations located on the Main Branch of Trail Creek and at Sample Location W1 in the West Branch of Trail Creek exceed target concentrations for total suspended solids, nutrients (nitrogen and/or phosphorus), and *E. coli* for the average recorded value. Average recorded water quality records for sample locations within the East Branch of Trail Creek and at Sample Locations W2 and W3 did not exceed the target concentrations for total suspended solids, nutrients (nitrogen and/or phosphorus), and *E. coli*. These sample locations represent the least developed portions of the watershed and those agricultural areas which have through general observation have more farmers with implemented best management practices. This data indicate the Main Branch of Trail Creek and the western portion of the West Branch of Trail Creek may be more heavily influenced by non-point source pollutants of concern during a minor or typical rain event. Sample Location W1 is also heavily influenced by livestock in the stream which is reflected in the both the maximum and average recorded values for total suspended solids, nutrients, and *E. coli*.

Biological sampling indicate that all streams which were sampled ranged from good to excellent with the lowest rated Sample Location at W1 and the highest rated sample at M1. None of the sample locations indicated impaired aquatic life measurements and sample variation is most likely due to differences in stream type and habitat.

Qualitative Habitat Evaluation Indexes indicate that sample locations along the Main Branch of Trail Creek and the East Branch of Trail Creek are generally good to excellent with sufficient in-stream habitat, structure, stability, and cover to support aquatic life. The sample location at W1 was ranked as "poor" due to significant in-stream disturbance and erosion. Sample location M1 was ranked as "excellent" primarily due to stream restoration projects implemented at this site and preservation of the riparian corridor.

Sampling indicated degraded water quality due to various pollutants, particularly for the maximum recorded values throughout the watershed with the "hot spots" located in both the Main Branch of Trail Creek and western portion of the West Branch of Trail Creek. Stream health as indicated through aquatic sampling and habitat was rated as good and fully supporting of aquatic life for all except Sample Location W1 which was degraded due to in-stream disturbance from livestock in the stream.

Total Maximum Daily Load

Triad Engineering Incorporated, Milwaukee, Wisconsin, prepared a Trail Creek Escherichia coli TMDL Report for the Indiana Department of Environmental Management in December 2003. A TMDL (Total Maximum Daily Load),

West branch of Trail Creek
at Sample Point W1

established under Section 303(d) of the Federal Clean Water Act, is a calculation of the maximum amount of pollutant that a waterbody can receive and still meet water quality standards, and allocates pollutant loadings among point and non-point sources. The focus was a study designated toward the reduction of *E. coli* pollutant inputs into Trail Creek.

The calculation of the TMDL must include a margin of safety which accounts for scientific uncertainty and future growth. Seasonal variations are also included. The TMDL is calculated using the following equation:

TMDL = WLA + LA + MOS + SV

Where:

WLA = Waste Load Allocations (point sources)
LA = Load Allocations (nonpoint sources)
MOS = Margin of Safety
SV = Seasonal Variation

The TMDL target suggested in this report for *E. coli* is the state water quality standard which is a monthly geometric mean standard of 125 cfu/100 ml and a maximum daily standard of 235 cfu/100 ml. Triad Engineering Inc. found that high *E. coli* levels are present in the watershed in both wet and dry conditions, negating the need to use low-flow criteria in the development of their TMDL for the watershed. In order to obtain the TMDL concentration, limits on the four permitted point sources in the watershed have been suggested. The permitted flow anticipated to meet the TMDL for Trail Creek is limited to the following effluent limits from each permitted source. It should be noted that since the TMDL was completed for Trail Creek, the Indian Springs Subdivision wastewater treatment plan has been decommissioned and flow to this plant is now treated at the J.B. Gifford Wastewater Treatment Plant.

J. B Gifford Wastewater Treatment Plant (Michigan City) -- 12 million gallons per day (MGD)
Friendly Acres Mobile Home Park -- 0.015 MGD
Autumn Creek Mobile Home Park -- 0.010 MGD
Indian Springs Subdivision -- 0.018 MGD

The TMDL also indicated a significant loading to Trail Creek from non-point sources. Non-point sources of *E. coli* include agricultural drainage and run-off, livestock, failing septic systems, illicit connections/non-permitted discharges, urban stormwater runoff, and natural sources. Non-point source loading of *E. coli* needs to be reduced to meet the TMDL established for Trail Creek. The recommended waste load and load allocation for Trail Creek according to the TMDL ranges from 1.49×10^{11} to 5.48×10^{11} depending upon the month. The total estimated non-point source load for the year 2000 ranged from 7.34×10^{11} to 4.07×10^{13}. Therefore the reduction required to meet the TMDL can range up to 4.01×10^{13} based on the estimated load and load allocations.

1993 Trail Creek Watershed Management Plan

On September 30, 1993 the Northwestern Indiana Regional Planning Commission, under contract to the Indiana Department of Environmental Management, prepared the first Trail Creek Watershed Management Plan. The intent of that plan was to gain access to Section 319 funds and begin restoring the watershed. Although that plan was never fully implemented, multiple successes with regard to reduction in pollutant loading to the stream have occurred since the 1993 Watershed Management Plan was completed. This current plan serves as an update to the 1993 Watershed Management Plan.

Main branch of Trail Creek
at Sample Point M4

Main branch of Trail Creek
at Sample Point M6

Main branch of Trail Creek
at Sample Point M4

303(d) List of Impaired Waters

The 2004 303(d) List of Impaired Waters for Indiana contains six records of importance to our watershed. The East Branch of Trail Creek, Trail Creek, the West Branch of Trail Creek and tributaries, and Waterford Creek all have *E. coli* listed as a parameter of concern. Trail Creek and its tributary basin are listed as the parameter of impaired biotic communities. Trail Creek is also listed as having a fish advisory for both PCBs and mercury.

Fish Consumption Advisories

Trail Creek appears on the 2006 Indiana Fish Consumption Advisory of Streams and Rivers for three separate species of fish. These include carp, smallmouth bass, and walleye. Carp up to 23 inches are to be eaten for only one meal every two months, while carp 23 inches and larger are not to be eaten at all. Smallmouth bass between 14 and 19 inches are to be eaten in only one meal per month, while smallmouth bass larger than 19 inches are to be eaten only one meal every two months. Walleye between 18 and 27 inches are to be eaten in only one meal per month, while walleye larger than 27 inches are to be eaten only one meal every two months. There is a 14 inch size limit on smallmouth bass and walleye. All advisories are due to PCB contamination. See Figure 19.

In addition, Trail Creek appears on the 2006 Lake Michigan and Tributary

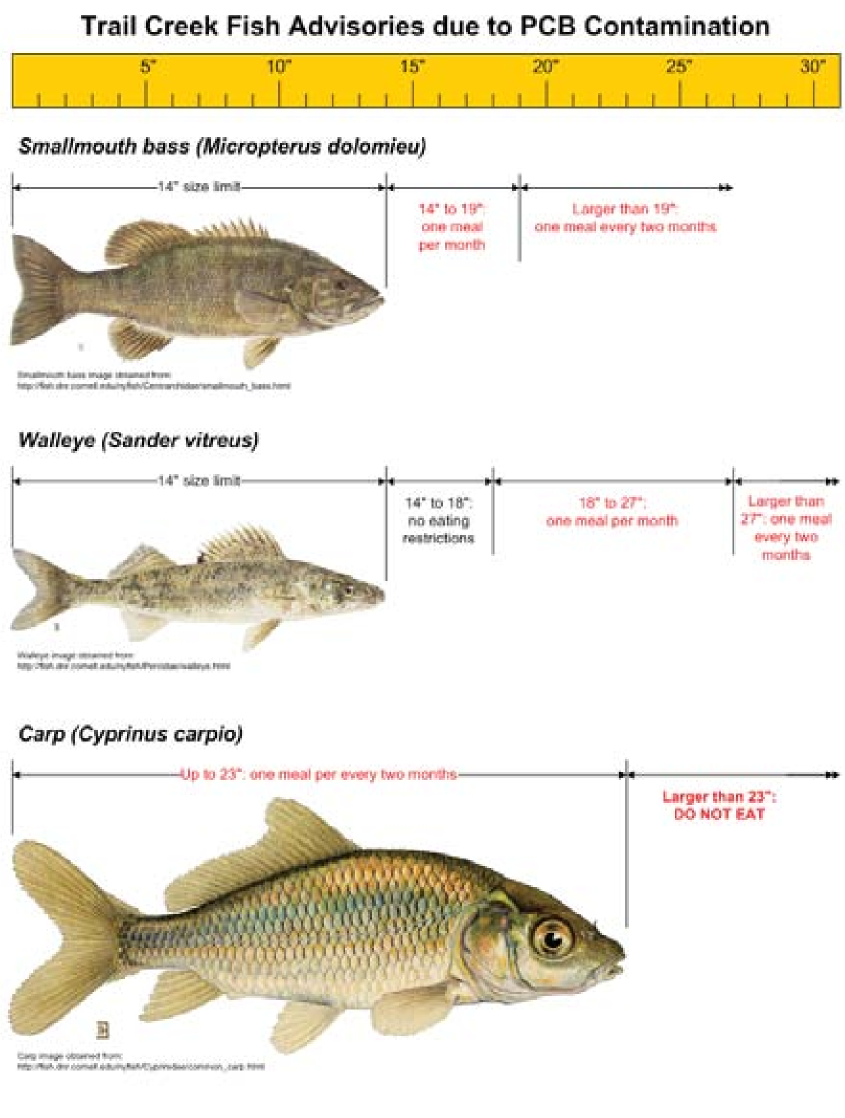


Figure 19: Fish Advisories

Fish Consumption Advisory for 24 separate species of fish. These include black crappie, bloater, bluegill, brook trout, brown trout, carp, channel catfish, Chinook salmon, chubs, Coho salmon, freshwater drum, lake trout, lake whitefish, large mouth bass, longnose sucker, northern pike, pink salmon, quillback, rainbow trout or steelhead, rock bass, silver redhorse, smallmouth bass, walleye, and white sucker. All advisories are due to contamination. For further reference to the 2006 Fish Consumption Advisories see http://www.state.in.us/isdh/dataandstats/fish/2006/index.htm.

East branch of Trail Creek
at Sample Point E3

Other water quality studies and results

In March of 1984, Hydroqual, Inc., Mahwah, New Jersey, under contract from the Indiana State Board of Health, preformed the first Waste Load Allocation Study for Trail Creek. At that time, low levels of dissolved oxygen were the primary concern. Since that time, improvements in water quality though elimination of combined sewer overflows and point source pollutants have been implemented. Dissolved oxygen levels within Trail Creek are within the state water quality standard and are no longer an issue.

Fixed Station Data

Fixed Station Data provided by IDEM was reviewed for the Trail Creek Watershed. This data has been collected annually at three stations within Michigan City along Trail Creek since 1991. These stations include the Liberty Street Bridge, the Franklin Street Bridge, and the US 12 Bridge. The objective of this program is to provide basic information that will reveal water quality trends and provide data for the many existing and prospective users of surface water in Indiana. The program was developed to determine chemical, physical, and bacteriological characteristics of Indiana water under changing conditions. Table 8 is a summary of the data collected as part of the fixed station data collection for those parameters which were also studied as part of this Watershed Management Plan. This data indicated a wide fluctuation in pollutant concentrations over the sampling period.

	pH	TSS (mg/l)	Nitrogen	Total	E coli	TKN (mg/l)	Nitrate + Nitrite (mg/l)
Target Concentrations	N/A	**15.00**	**0.25-0.01***	**0.05**	**235**	**1.00**	**10.00**
E1							
Averages	7.9	19.30	0.17	0.09	1130	0.71	1.59
MAX	8.6	294	2.1	0.43	26100	2.8	4.5
MIN	6.6	4	0.1	0.03	6	0.2	0.1

Table 8: Summary of Fixed Station Data

In addition to the Fixed Station Sampling data obtained from IDEM, several other studies including an *E. coli* study conducted in 2000 were reviewed, however, given these were limited time period studies which occurred over 5 years ago this data was only utilized for general observation and trends, not to indicate the current status of the stream.

Water Quality Problems

WATER quality data collected as part of this study indicate that many of the concerns expressed by the stakeholders and Steering Committee members are measurable problems within Trail Creek and its tributaries. Water quality data indicate high levels of *E. coli*, total suspended solids and turbidity, nutrient loading, and hydromodifications leading to streambank erosion and instability are demonstrated water quality problems within the watershed. Based on the expressed concerns, water quality data gathered to date, and anticipated resources, four water quality problems were identified by the Steering Committee and stakeholders which will be the focus of this Watershed Management Plan. These include the following.

- *E. coli*
- Sedimentation
- Nutrient loading
- Hydromodifications

Information provided by the public, stakeholders and Steering Committee members indicated several major areas of concern with regard to the Trail Creek Watershed. These concerns are discussed in more detail in the previous Watershed Concerns section and break very generally into the following categories: stream and water quality issues, aquatic health and fisheries, public health concerns, sedimentation, streambank erosion, and operation and planning organization. The identified water quality problems are reflected within each of these areas of concern with the exception of Operation and Planning. While Operation and Planning is not a water quality problem in itself, poor operation and planning decisions within the watershed can negatively impact water quality, riparian areas and instream habitat.

For this reason, operation and planning will be addressed during implementation of the Trail Creek Watershed Management Plan.

Many of the concerns expressed will be addressed through implementation of best management practices within the four water quality problem areas. For example, through implementation of best management practices to reduce nutrient loading to Trail Creek, concerns caused by high levels of nutrients such as algae growth (stream and water quality concern), fish kills (aquatic health and fisheries concern), and failing septic systems (public health concern) will be addressed.

The majority of the water quality problems identified were also previously expressed in the 1993 Trail Creek Watershed Management Plan. That plan indicated stream quality, dissolved oxygen, bacteria, sedimentation, and fish advisories were the significant water quality problems within Trail Creek. Of those issues, only dissolved oxygen has been eliminated as a problem within Trail Creek since the 1993 Study was completed and dissolved oxygen is no longer an expressed concern or water quality problem.

E. coli bacteria

The *E. coli* bacteria is usually a frequently a helpful bacteria with a symbiotic relationship with most exothermic or warm blooded animals. This bacterium is found in the gut of warm blooded animals acting to aid in digestion of food. Rare strains of these bacteria can cause illness; however that in itself is not the reason *E. coli* is important and pertinent for a watershed study. Similar to other pollutants of concern like ammonia, *E. coli* comes from the excretion of solid animal

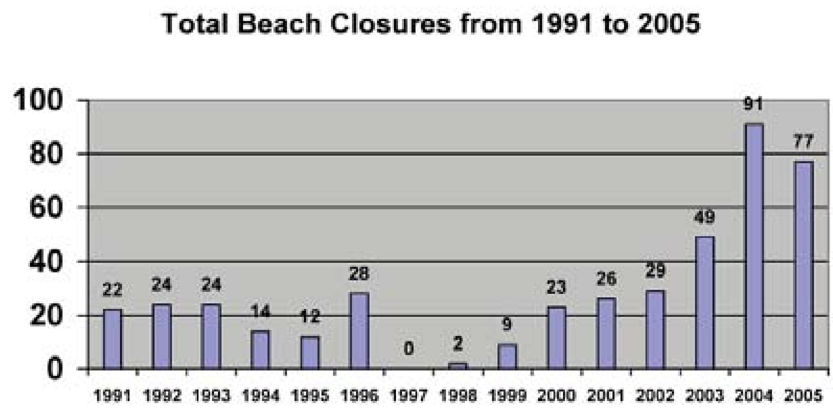


Figure 20: Data Provided by the LaPorte County Health Department with regards to Historical Beach Closings.

waste. Sources of *E. coli* can be, but are not limited to, runoff from animal pastures and livestock pens, poorly constructed or damaged septic tanks, runoff from areas with high concentrations of pet waste, combined sewer and storm water systems, illicit discharges, and natural wildlife. *E. coli* levels are directly correlated to the quantity of biological waste pollution in a given body of water. In this way, *E. coli* can be used as a measurement of general water quality. *E. coli* can also be an indicator of the likelihood of the presence of more infectious and dangerous bacteria in the water.

Stream water quality, aquatic health, fisheries populations, and public health were identified as concerns as part of this report. Water quality data gathered for this report, as part of the TMDL study prepared for Trail Creek, and in preparation of the list of Impaired Waters of the State, indicate that *E. coli* levels within Trail Creek and its tributaries rarely meet the State Water Quality Standard for *E. coli* at any of the sample locations. Trail Creek has been listed as an “impaired waterway” with respect to the levels of *E. coli* by the State of Indiana. Impaired water quality from Trail Creek has closed beaches in Washington Park and has resulted in the expenditure of federal funds to continually dredge the navigable waterways of Trail Creek, Figure 20.

As such, *E. coli* was identified as a problem in Trail Creek. The Steering Committee has established a goal to meet the State Water Quality Standard for *E. coli* of 125 cfu/100 ml as a geometric mean on not less than five samples equally spaced over a 30-day period nor exceeding 235 cfu/100 ml in any one sample within that 30-day period.

Erosion and Sedimentation

Erosion is the process by which larger objects are broken down into smaller particles and then carried to a separate site. Processes that cause erosion can be natural weathering, rainfall, runoff, wind and the actions of living organisms. Sedimentation occurs when the smaller particles can no longer be carried by the eroding medium and are allowed to be deposited. These two processes act together and directly affect each other’s severity. Erosion and sedimentation are problems in watersheds for multiple reasons including streambank stability and channel movement, boating hazards created due to sedimentation, increased risk of flooding, and aquatic health.

The origin of sediment in a stream can be natural or caused by human activity and development. Sediments can come from constructions sites, areas of high topography and erodible soils, exposed soils, channelization of a waterway, increased flow, increased runoff, recreational areas, poor agricultural practices, and natural events. While the transportation and erosion of sediment is a natural

Trail Creek at Sample Point M1 with high total suspended sediments

process, human activity has increased the rate and intensity of erosion to the point that sedimentation and erosion are a priority for most waterways, including the Trail Creek watershed as indicated by highly turbid waters at Sample Point M1.

Stream water quality, aquatic health, fisheries populations, public health, and sedimentation and streambank erosion were identified as concerns as part of this study. Sedimentation within Trail Creek has necessitated frequent and repeated dredging of the navigable channel within Trail Creek located downstream of the E Street Bridge in Michigan City. Sedimentation within Trail Creek has been identified as a water quality problem due to water clarity within the stream; nutrient and pollutant loading associated with sedimentation; and habitat degradation. Many sensitive aquatic species, including many of the salmonoid fisheries, cannot tolerate high sediment loads within a stream.

No state water quality standard has been established for sedimentation or turbidity within a stream nor have direct sedimentation measurements been studied within Trail Creek. Thomas Waters in his publication “Sediment in Streams” indicates that TSS concentrations of 25-80 mg/l are known to reduce fish yield within a stream system. Based on the best available data and a goal towards achieving a more aggressive water quality standard than the minimum concentration known to have an impact (25 mg/l), the Sediment Subcommittee recommended to the Steering Committee a water quality goal of 15 mg/l for TSS. The Steering Committee accepted this goal and established a benchmark of 15 mg/l for turbidity as a measurable water quality goal for sedimentation. Water quality sampling indicates that this benchmark is exceeded during high flow and stormwater runoff events. This is evident by water clarity in the stream and by the data collected.

Nutrient Loading

In small amounts, nutrients are needed and play a vital role in the base of most aquatic ecosystems. These nutrients help the growth of aquatic plants which serve dual roles in an aquatic ecosystem as the base of the food chain and as habitat. However, nutrient loading can lead to eutrophication and algae blooms which can in turn cause fish kills due to oxygen depletion during the decomposition of the organic plant litter (Salt Creek Fish kill). Sources of nutrients in the watershed include run-off from residential areas; erosion and runoff from pasture and cultivated land; discharges from point sources and septic systems; and river/streambank erosion. The two primary nutrients of concern with regard to water quality are phosphorus and nitrogen.

Fish kill in Salt Creek (IDNR)

Stream water quality, aquatic health, fisheries populations, and public health were identified as concerns as part of this study. Nutrient loading within Trail Creek has been identified as a water quality problem through water quality sampling and load calculations. The most common nutrients of concern are phosphorus and nitrogen, which are found naturally occurring in the watershed, in fertilizers, in sanitary sewer overflows, and septage. Nutrient loading is a significant contributor to eutrophication of lakes, nuisance algal blooms, and in-stream plant growth. No state water quality standard has been established for nutrient loading within a stream nor have TMDLs established for Lake Michigan indicated target load reduction or concentration goals for tributary streams. The Steering Committee has established a benchmark of a meeting the established target concentrations within 15 years as a measurable water quality goal for nutrient loading.

With regards to calculation of pollutant loading within Trial Creek, target concentrations were established as follows: 0.25 to 0.1 mg/l for nitrogen ammonia; 1.0 mg/l for TKN; and 10 mg/l for nitrate and nitrite. These targets were established based on the best available data with regards to water quality parameters and toxicity to aquatic organisms.

Ammonia can be an extremely toxic substance to a watershed. The toxicity of ammonia is a function of the temperature and pH. Along with temperature and pH, low levels of oxygen in water can increase the toxicity of ammonia and its likelihood of causing a fish kill. The most common source of ammonia that enters into a watershed is manure. Ammonia itself is a biological waste product of respiration.

There are two main sources of manure that enable the ammonia to enter a watershed. First is via the spreading of manure as fertilizer in agricultural areas. The use of manure as fertilizer is a valuable practice; however, during storage and after use it is vulnerable to the processes of erosion. Recently spread manure is easily carried into a stream system during the runoff of the first rain after application or during storage.

The second main source of manure from pasture and livestock holding areas immediately on, around, or too near the waterway. The close location of livestock to waterways allows the manure to be quickly carried to the stream either in water or physically on the animal itself, either before or after excretion.

Ammonia can also come from other types of animal waste including human. Ammonia from human waste enters a waterway from poorly constructed or maintained septic tanks and during the overflow of combined storm and sewer systems. High levels of ammonia and known locations of livestock in the waterways of the Trail Creek Watershed make this a high priority for this management plan.

Phosphorus is generally the limiting nutrient within a waterbody. By allowing and encouraging unregulated plant growth, phosphorous causes algal blooms that in turn create fish kills, by depleting oxygen levels during decomposition. Phosphorus can enter the waterway via runoff in high concentrations. The sources of the phosphorus pollutants include, but are not limited to, human and animal waste, lawn chemicals and fertilizers and some agricultural practices. With regards to calculation of pollutant loading within Trial Creek, a target concentration of 0.05 mg/l ortho-phosphorus and total phosphorus was established based on the best available data. The Steering Committee has established a benchmark of a meeting the established target concentrations within 15 years as a measurable water quality goal for nutrient loading.

Hydromodification

Hydromodification includes channelization and channel modification, stream relocation, headwater stream and wetlands fills, straightening, levee and dam construction, bank erosion and armoring/bank stabilization, clearing and snagging, riparian encroachment, bridge and culvert construction, draining, filling, and urbanization. Hydromodification can result in both short and long term water quality degradation, accelerated erosion and sedimentation, destruction of aquatic habitat, and impairment or elimination of certain aquatic functions. For reference to erosion and flooding issues see photographs of Cheney Run and Trail Creek before and during a storm event.

Stream water quality issues, aquatic health, fisheries populations, public health concerns, sedimentation and streambank erosion, and operation and planning organization were identified as sources of concern as part this study. Hydromodification is the most prevalent source of degradation in streams leading to erosion and sedimentation, nutrient loading, and a wide range of water quality issues. Historically within the Trail Creek Watershed, drainage practices for agricultural lands and dams were the most prevalent source of hydromodification. As development is expanding outside of the urbanized areas of Michigan City and Trail Creek, land that was previously fallow or used for agricultural purposes is being converted to developed land with the associated increased impervious surface and run-off, stream channelization, stream relocation, wetland degradation and destruction, bank erosion, and increased flows. The Steering Committee has established adopted the goal to ensure the protection of waterbodies with the Trail Creek Watershed from further impacts of hydromodification and wetland loss to meet and maintain applicable water quality standards.

Cheney Run Confluence with Trail Creek

Monday, November 27, 2006, after eight days of dry weather

Friday, December 1, 2006, after 3 days of rain (0.88+0.78+0.63 = 2.29")

Sources of Water Quality Problems

Point Sources of Pollution

A point source pollutant is a substance originating from a specific tangible point which makes its way into an environment in greater concentrations than would be present under natural conditions. Physically these sources are pipes, drainage ditches, leaking vessels, channels, sewers, tunnels, and smoke stacks. The threat this type of pollution creates to any watershed is great and one that in many cases may be permitted and legal. The discharge into the body of water may be within the boundaries of the law and therefore subject to regulation. Point source pollution can be any by-product created from manufacturing, leaking chemicals, runoff, sedimentation, and any substance which its discharge into the environment creates higher concentrations of the substance than were present before the point source existed. Three permitted point sources of pollution are located in the watershed (Figure 21), all of which are fully compliant with regulations imposed on them. Therefore, those point sources are not a current focus of this management plan. Continual monitoring of those sites is necessary to ensure against an accidental failure to comply with the regulations under which they have been permitted. This monitoring is part of the permits and falls of the hands of the permitting body and the operators of the permitted source.

Stormwater and polutent runoff from parking lot

Stormwater pipes discharging to Trail Creek

Figure 21: Point Source Discharges (see appendix page 83)

Non-point Sources of Pollution

The 1993 Trail Creek Watershed Management Plan indicated numerous non-point sources of pollutants within the watershed including rural sources, urban sources, stormwater runoff, landfills, CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System) or hazardous waste sites, Superfund sites, confined disposal sites, construction activities, and channel modifications. Many of these sources are still of concern within the watershed, particularly as development continues and the existing infrastructure ages.

Non-point sources of pollution exist everywhere and by definition are extremely difficult to locate and eliminate. As identified through the concerns expressed as part of the public involvement for this report and water quality testing, problems within the Trail Creek Watershed include excessive *E. coli*, sediment loading, nutrient loading, and hydromodifications. Many non-point sources found within the watershed can contribute to more than one pollutant of concern. For example, narrow riparian corridors can contribute to streambank erosion which leads to sedimentation and increased nutrient loading to the stream due to nutrients adhered to soil particles. Likewise, increased impervious surface in an urban area can contribute to increased storm flows leading to streambank erosion as well as *E. coli* and nutrient loading from urban stormwater. The following is a brief description of known and potential sources of pollutants within the Trail Creek Watershed.

E. coli

E. coli bacteria and other pathogens can have many sources of access to waterways, both natural and human influenced. Water quality issues related to human and animal waste include increased levels of nutrients, ammonia, and higher levels of *E. coli* and other bacteria in the watershed. Human and animal waste can either be introduced as a point source or a non-point source pollutant. This watershed management plan is primarily focused on non-point sources of pollutants to Trail Creek. Sources noted as part of this study include failing or ineffective septic tanks, livestock, pets, and natural sources.

Human and animal waste

Contribution of *E. coli* and other nutrients from septic systems, particularly septic systems either in areas with unsuitable soils or failing septic tanks is an identified problem within the watershed. The majority of both the East and West Branches of Trail Creek as well as the towns of Trail Creek and Pottawattomie Park do not currently have sanitary sewer service and therefore rely upon septic tanks. Many of these areas are located on soils which are not suited for septic tank placement, Figure 22. Unsuitable soils allow rapid movement of untreated biological waste from septic systems to enter into the waterway before it is able to be properly treated.

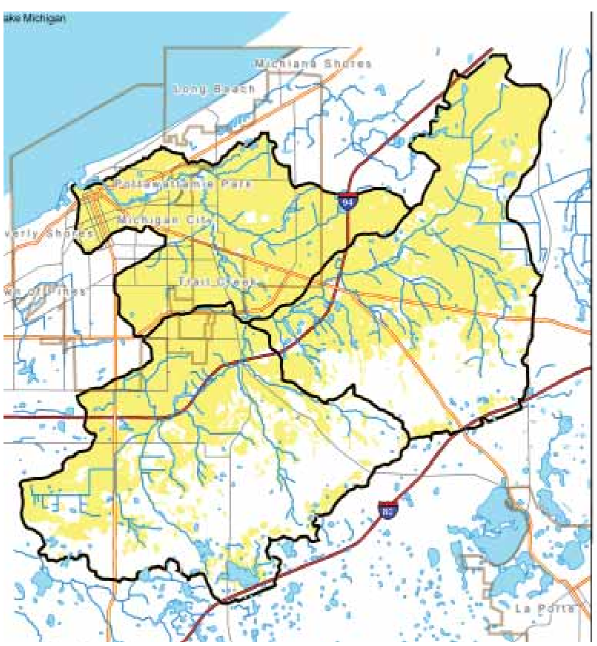


Figure 22: Soils Not Suited for Septic Tanks (see appendix page 84)

Failing Septic Systems in LaPorte County

Many of the septic tanks in place, particularly in older neighborhoods such as Trail Creek and Pottawattomie Park, are aging and with age the efficiency of


Watering hole for cattle within stream

the septic systems has declined. It is widely accepted that a 20-year lifespan is average for most septic tank systems. This lifespan varies depending upon usage and maintenance. As a septic tank ages and fails it begins to transport more untreated waste into the leaching field. This movement of solids clog the system, resulting in septic tank failure and release of untreated waste. These failing septic systems coupled with the location of the systems in soils not suited for use as septic fields allows rapid movement of the untreated waste to both ground water and the stream system.

Domestic pet waste is another source of pollution of concern for the Trail Creek Watershed. With the large number of homes in the urban and suburban areas of the watershed pet waste is easily transported to the adjacent waterways. Lack of riparian buffers in urban backyards, poor housekeeping, and inadequate removal of pet wastes can allow the waste into the water. Additionally, as Michigan City and other communities develop green spaces along Trail Creek the potential for pet waste to enter the waterway will increase.

Livestock production

Livestock production and unlimited access of livestock to the streams or runoff of manure to the stream is a recognized source for *E. coli*, nutrient loading, and erosion within the stream, whether from a production farm or hobby farm. No regulated confined animal feeding operations (CAFOs) are located within the Trail Creek Watershed; however, as part of this watershed management plan, several locations were identified as specific areas of concern within the East and West Branches of Trail Creek where livestock were either allowed direct access to the stream or where manure was allowed to run off into the stream channel, Figure 23. Water quality sampling within these areas confirm higher *E. coli* levels near or adjacent to pasture lands where livestock have unlimited access to the streams. It should be noted that Figure 23 is not intended to be an inclusive listing of areas of potential concern due to livestock in or near waterways nor to indicate that every designated area is a contributor to water quality problems within the watershed. Data including on this mapping was gathered from available land use mapping and through general observations and should be utilized for future planning and implementation purposes only.

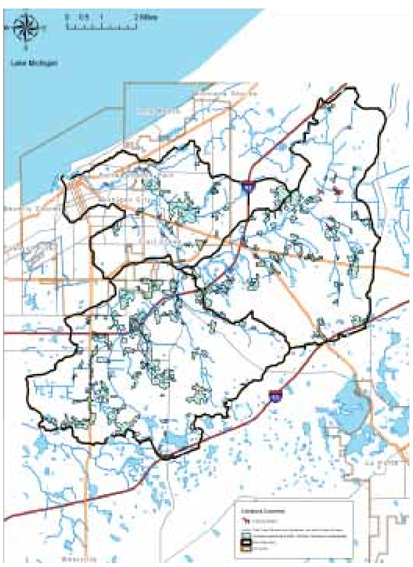


Figure 23: Areas of Livestock Production (see appendix page 87)

In addition to bacterial contamination, higher than normal levels of erosion, sedimentation, and nutrient loading were observed in areas where livestock were allowed access to the streams. Soil erosion occurs in these areas when large numbers of livestock are confined to small areas. The livestock can cause the erosion of the soil by overgrazing the land, trampling the streambank, exposing the soil to external means of erosion or by physically becoming covered in the soil and enabling it to be transported on the animal itself.

Erosion and Sedimentation

Erosion and sedimentation within the Trail Creek Watershed have been noted as a problem throughout the watershed although sediment transport and deposition of sediments in the navigable channel and downstream sections of the stream have received the majority of the focus. Sources of erosion and sedimentation within the watershed noted as part of this study include livestock in streams, agricultural practices, new and re-development, and roadway and roadside ditch maintenance.

Concurrently with the preparation of this Watershed Management Plan, the US Army Corps of Engineers has been preparing a sediment and erosion model for Trail Creek. This web-GIS based model is knows as the Burns Ditch and Trail Creek Watershed Management System. The model includes a number of very useful tools for watershed management including applicable BMPs, estimated sediment yields, estimated impervious cover, estimated peak runoff, estimated non-point pollution levels, and sediment and erosion control designs at specific locations. The model can be accessed at http://danpatch.ecn.purdue.edu/~eqip/erosion/. This model will be incorporated into the Trail Creek Watershed Management Plan and implementation.

Agricultural Practices

Agricultural practices have contributed to non-point source pollutant loading within the Trail Creek Watershed through lack of implementation of conservation practices and limitations on riparian buffers, Figure 24. Approximately 56 percent of all land in LaPorte County is used for agriculture, with 393 farms tilling 103,414 acres for grain production, according to the 2002 National Census of Agriculture. Of the land used for grain production, 71 farms farm with 18,773 acres of land were under irrigation. While farming practices have become more conservation minded, application of those practices within the Trail Creek Watershed is inconsistent.

Bank erosion due to cattle entering stream at Sample Point W1

Specific data on the farming practices for each farm within the watershed were not available however the NRCS indicated that approximately 40 percent of the farms in the watershed employed no-till practices, 40 percent employed reduced till practices and 20 percent employed conventional tillage. As defined by the NRCS, there are three main types of tillage practices for agricultural fields. Conservation tillage is any tillage and planting system in which at least 30 percent of the soil surface is covered by plant residue after planting to reduce soil erosion by water or wind. Conventional tillage includes tillage types that leave less than 15 percent residue cover after planting. Reduced tillage includes tillage types that leave 15-30 percent residue cover after planting.

Each tillage practice presents different benefits and problems to both the farmer and the watershed. The use of conservation tillage lowers the number of days in which soil is exposed and therefore lessens the potential for the soils to be eroded, thus lowering the amount of total suspended solids added to a watershed. However, conservation tillage is not suitable to all soil types or farming practices, especially in soils found in the East Branch of Trail Creek Watershed. As such, tillage practices in use throughout the watershed have been identified as a source of erosion and sedimentation.

In addition to conservation tillage practices, a wide variety of other conservation practices can be utilized on agricultural areas to reduce erosion and sedimentation as well as nutrient loading to streams. These include but are not limited to riparian buffers, wetland restoration or enhancement, and fencing of livestock from streams. The use of these practices within the Trail Creek Watershed is sporadic. The majority of the active farms in the East Branch of Trail Creek Watershed, particularly along streams maintained as legal drains, have no riparian buffers and row crops are planted to the top of the stream bank. General observations conducted during the watershed study indicated that these stream reaches were affected by sedimentation and algae growth more than downstream reaches with sufficient riparian buffers.

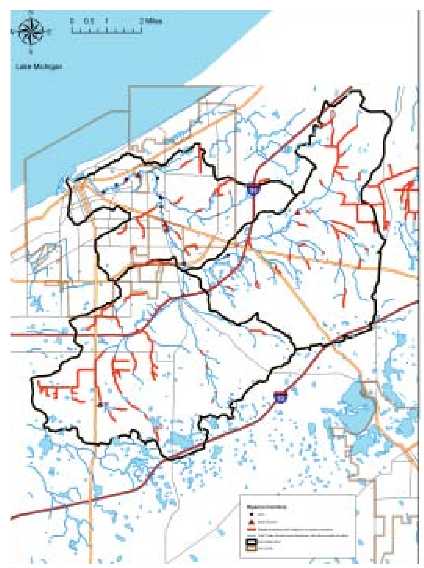


Figure 24: Areas with Limited Riparian Corridors (see appendix page 86)

New and Re-Development

Development of previously undeveloped land poses many threats to a watershed. With development comes disturbance of the soils surface, extended exposure of soils, removal of significant ecological areas (wetlands, forests, and natural riparian buffers), increased impervious surfaces, and increased pollution runoff. The effects of these actions include but are not limited to increased erosion, increased total suspended solids, increased runoff, greater flow variations, higher levels of pollutants in water, algal blooms, streambank erosion and channelization, loss of stream biodiversity, loss of stream canopy, and overall degradation of the water quality.

Photo Conservation tillage gives this central Iowa field the protection it needs from wind and water erosion (photo by Lynn Betts, USDA, Natural Resources Conservation Service).

Erosion from new and re-development (Figure 25) can be increased by a variety of reasons included construction activities, an increase in impervious surface, increased stormwater volumes, and lack of post-construction stormwater practices. Development exposes soils that would other wise be protected by vegetation to the natural processes of wind and water erosion. Recent state regulation mandates stormwater pollution prevention plans during construction for all developments greater than one acre under Rule 5 (Construction Stormwater Pollution Prevention). Sites less than one acre are not governed and the regulation of sites which are regulated is inconsistent. The West Branch of Trail Creek Watershed is the most rapidly developing of the three sub-watersheds. General observations with regard to implementation of construction stormwater practices indicate that construction activities are a source of erosion and sedimentation within the watershed. Within Trail Creek, sedimentation and the formation of sediment bars was noted at the confluence with smaller tributaries affected by new development.

Rule 5 applies to construction activities that result in the disturbance of one (1) or more acres of land. By definition in the rule, "land disturbing activity means any manmade change of the land surface, including removing vegetative cover that exposes the underlying soil, excavating, filling, transporting, and grading." If a developer or project site owner conducts a land disturbing activity that disturbs one (1) or more acres of land, the project site owner must apply for coverage under a Rule 5 general stormwater permit. As part of this, the project site owner must develop and implement a Stormwater Pollution Prevention Plan which is generally submitted to either the local MS4 or LaPorte County for review and approval.

In addition to construction stormwater pollution prevention, new and re-developments within urban areas must comply with Rule 13 which requires the implementation of best management practices in order to treat non-point source stormwater associated with runoff from Municipal Separate Storm Sewer Systems (MS4). Rule 13 governs urban stormwater within federal, state, municipal, county, public or private entity storm water conveyance systems that are not combined with sewage conveyances. A regulated conveyance system includes roads with drains, municipal streets, catch basins, curbs, gutters, storm drains, piping, channels, ditches, tunnels, and conduits. Within LaPorte County, Michigan City, the City of LaPorte, the town of Long Beach, the town of Trail Creek, and portions of LaPorte County between the two cities (Figure 26) are regulated MS4 communities and have formed a partnership to implement these regulations jointly. As the Stormwater Pollution Prevention Plan for LaPorte County is implemented, it will be vital that stormwater ordinances be adopted and implemented uniformly across the watershed.

Figure 25: Areas of Existing and Proposed Development (see appendix page 85)

The increased percentage of impervious surfaces associated with the development of new land increases runoff which in turn increases the flow of a stream and its load carrying capacity, Figure 27. The Center for Watershed Protection has documented that stream degradation begins to occur within a watershed when approximately 10% of the land surface is comprised of impervious cover. When impervious land cover ranges from 10 to 25% stream impairment becomes evident, from 25-60% streams become damaged, and with greater than 60% impervious cover streams are severely damaged. Using the impervious tool in the Burns Ditch and Trail Creek Watershed Management System, the Trail Creek Waters as a whole currently has an impervious surface of nearly 7% and some of the smaller tributaries in the developed area of the Trail Creek Watershed have impervious surface areas exceeding 20%. Based on these guidelines, the developed area tributaries would fall in the "stream impairment becomes evident" category.

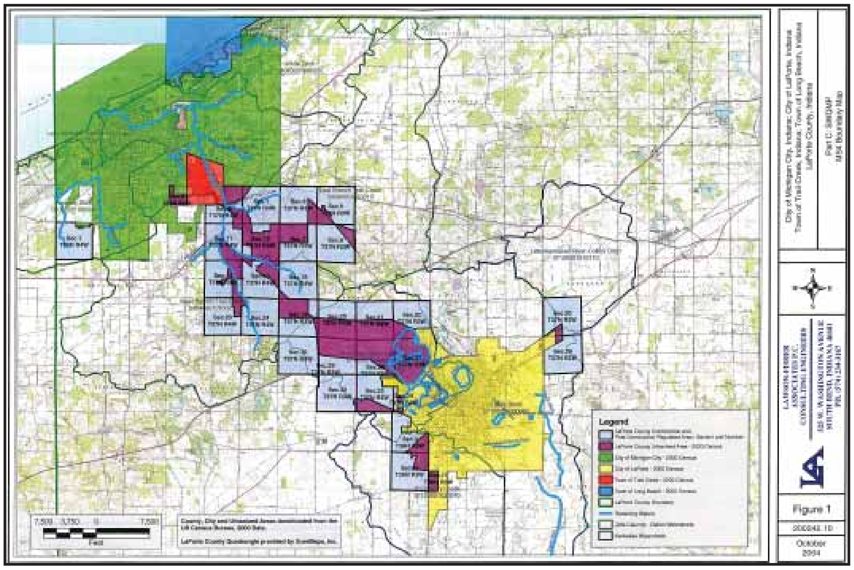


Figure 26: Area covered by MS4 (see appendix 88)

Roadway and Roadside Ditch Maintenance

LaPorte County and Michigan City generally maintain the roadways during the winter through the application of both sand and salt. During the watershed study, it was observed that sand from the roadways accumulated on and near bridges crossing the streams, contributing to sedimentation within the stream at those crossings. It was also noted during the watershed study that roadside ditches within the County are sometimes maintained by dredging and piling of dredged material adjacent to the ditch, contributing to sedimentation within the roadside ditches and waterways.

In addition to maintenance of the existing roadways and ditches, inappropriate placement of new roadways or expansion of existing roadways can contribute to water quality problems including streambank erosion, sedimentation, and increased nutrient loading. Attention to proper siting and design of new roadways and bridges as well as rehabilitation of existing roadways and bridges to protect water quality will be an important aspect of the Watershed Management Plan so that new sources of pollutants are not added to the watershed. As an example, during the reconstruction of the roadway into Washington Park during the summer of 2006, stormwater treatments basins were retrofitted into the project to treat stormwater prior to discharge to Trail Creek.

Roadway drainage as it enters Tributary to Trail Creek

Nutrient Loading

Nutrient loading within the Trail Creek Watershed has been noted as a problem and confirmed through water quality testing. Sources of nutrient loading to the watershed include a variety of sources previously mentioned including human and animal wastes, erosion and sedimentation, and agricultural practices, as well as application of lawn fertilizers.

Runoff from parking lot entering stormwater treatment basin at Washington Park

Lawn and garden practices

Varied lawn and garden practices are sources of water quality issues in the Trail Creek Watershed. Unregulated application of fertilizers, pesticides, and herbicides to yards and public areas such as golf courses inevitably move into the local waterways. Over application of these products or the use of them in close proximity to a body of water increases the possibility and rate at which these end up in the water system. Many of these products contain animal waste, ammonia, nitrogen, and possibly bacteria, all of which are of concern in the Trail Creek Watershed.

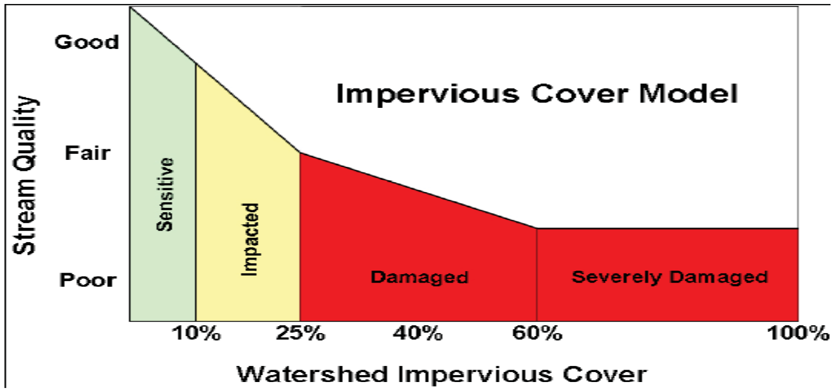


Figure 27: Watershed Impervious Cover

Hydromodifications

Vortechs Swirl Concentration stormwater BMP to be installed at Washington Park

As part of this study, hydromodifications, particularly those leading to streambank erosion, sedimentation, and changes in stream elevation and flow were noted as concerns. Hydromodification activities adversely affect stream flow, stream gradient, sediment load, channel width, and channel depth. Hydromodification activities which can contribute to these issues and which were noted within the Trail Creek Watershed include channelization, stream relocating, headwater stream and wetland fills, straightening, riparian encroachment, flow restriction through dams and bridges, and urbanization.

Channel Modification

Channel modification is generally used to describe channel engineering completed for flood control, navigation, and drainage improvement. Typically this type of hydromodification includes straightening, widening, deepening or relocation of stream channels. Within the Trail Creek Watershed there are approximately 158 linear miles of stream channel of which approximately 7.8 linear miles of stream channel are classified as legal drains subject to maintenance including riparian clearing, channelization and dredging by the County Drainage Board. The majority of streams classified as legal drains are located within the East Branch of Trail Creek sub-watershed. Additionally, responsibility for maintenance of all former legal drains within the Michigan City limits has been assumed by the Sanitary District of Michigan City. As these streams are maintained for drainage they can contribute to problems noted within the watershed including increased loading of *E. coli* and nutrients, streambank erosion and sedimentation.

Structures and Dams

Dams or structures which impound water within the stream channel beyond the normal capacity of the channel can contribute to a variety of non-point pollution problems including alterations to sediment transport within a stream system, impacts to wetlands and natural areas, nutrient loading, and alteration to the natural hydrology of a stream. As part of the Indiana Coastal Non-point Pollution Control Program, 16 dams were noted within the Little Calumet-Galien Watershed. A total of 9 dams were identified through review of available mapping and general observations within the watershed. These include the Dingler Lake dam which is approximately 16 feet in height, the Lakeside Estate dam which is 17.2 feet in height, the Michigan City Golf Course dam which is 12 feet in height, and the Siebert dam which is 6 feet in height.

Infiltration BMPs installed at Washington Park

Critical Areas

AS THE Trail Creek Watershed Management Plan was developed, three factors were examined to determine critical areas within the watershed. These include areas critical for preservation, areas with soils or land uses which may be sensitive for development and critical for implementation of best management and planning practices during that development; and areas critical for implementation of conservation and restoration strategies or enhancement of existing water quality treatment and strategies. These three factors can be found within the entire Trail Creek Watershed, Figure 28.

As part of this study, it was noted that the entirety of Michigan City is not included within the officially mapped watershed boundary for Trail Creek; however, storm sewers and urbanization within the city have altered the natural watershed boundary. As a result, for the purposes of this watershed management plan and future implementation, the entirety of Michigan City is included in the Trail Creek Watershed.

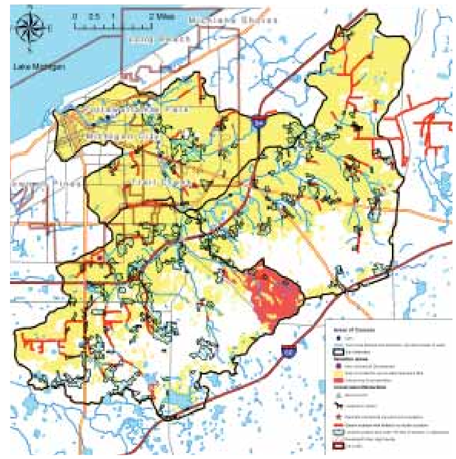


Figure 28: Critical Areas Mapping (see appendix page 89)

Preservation

As the watershed management plan was prepared, land use within the sub-watersheds of the West Branch of Trail Creek was noted to include a predominance of forested and natural areas. This sub-watershed is typified by Sample Point W3 (Figure 29). Water quality samples at this location indicated that water quality impairment was relatively low due in large part to the undeveloped nature of the watershed, large riparian buffers, and low density development. As such, two of the three sub-watersheds within the West Branch of Trail Creek were designated as critical areas for preservation in order to maintain or reduce the existing loading to the streams from these areas.

Although preservation is not a typical water quality best management practice, the Steering Committee felt that within the Trail Creek Watershed preservation of the existing high quality areas and buffers was a critical component for the watershed in order to meet the established water quality goals. Water quality goals will be achieved by an overall reduction of pollutant loading to the stream both by reducing existing sources of pollutant loading to the stream and by minimizing new sources of pollutant loading to the stream. Now sources of pollutent loading to the stream include development of agricultural and natural area and increased imperious cover. The Trail Creek Watershed is anticipated to experience high development pressure over the next 10 to 15 years and as such, it will be critical to minimize any increase in pollutant loading to the streams from areas which are not currently significant contributors. The need for designation of the sub-watersheds for preservation is reflected in the Base Flow Loading calculations completed as part of this watershed study. The estimated load reduction necessary to meet the State Water Quality Standard for *E. coli* and the number of sampling days for which a load reduction was required were the lowest at Sample Point W3. The estimated mean load reduction for *E. coli* required at Sample Point W3 is 37%. The estimated mean load reduction for the remaining sample points for *E. coli* is more than 46% with most sample points requiring a load reduction of *E. coli* between 50% and 60%. At Sample Point W1, which is highly impacted by livestock access to the stream, the mean load reduction required for *E. coli* is 82%. For reference to the load reduction calculations see Table 9 (page 50) and Appendix R.

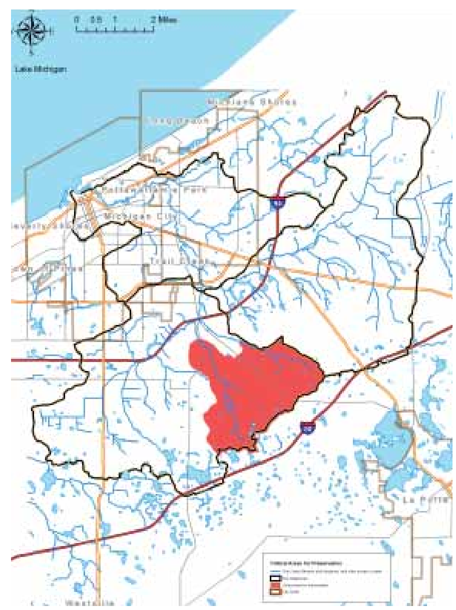


Figure 29: Areas Critical for Preservation (see appendix page 90)

As previously stated, the West Branch of Trail Creek sub-watershed is the most rapidly developing of the three watersheds and each of the three sub-watersheds is anticipated to be subject to increasing development pressure in the future. The LaPorte County Comprehensive Plan is currently being developed; however, preliminary goals of the plan include encouraging development within the county to be concentrated within the Trail Creek Watershed. As such, preservation of existing natural areas and riparian buffers using smart growth and low impact development principles within these watersheds is critical to implementation of this watershed management plan and the pollutant load reductions required.

Sensitive Areas

Areas with soils or land uses deemed sensitive areas by the Steering Committee include those privately owned lands which are currently being developed or which are proposed for future development, areas which are not currently serviced by municipal utilities, and areas which are not subject to development restrictions such as riparian setbacks. For purposes of this study, these sensitive areas were mapped as those areas with soils not suitable for septic systems, streams with at least minimal existing riparian buffers, and those areas proposed for future development, Figure 29. It should be noted that the majority of the undeveloped portions of the Trail Creek Watershed are anticipated to be subject to development pressures over the next 10 to 15 years and therefore deemed as sensitive areas critical for implementation of best management practices during development. These areas are typified by Samples Points W1, W2, E1, E2, and E3.

Contribution of *E. coli* and other nutrients from septic systems was identified as a source of pollutant loading to Trail Creek, especially in areas with aging septic systems which may not have been properly maintained or areas with unsuitable soils. This includes the majority of both the East and West Branches of Trail Creek as well as the towns of Trail Creek and Pottawattomie Park. These areas were determined to be critical areas for installation of sanitary sewers and implementation of best management practices as part of the Trail Creek Watershed Management Plan. Extension of municipal utilities to the entire watershed is the long term implementation goal intended to reduce *E. coli* and nutrient loading; however, the installation of sanitary sewers to the entire watershed is anticipated to take longer than 15 years. As such, critical areas to be addressed in both the short and intermediate term include preparation of a Sanitary Sewer Master Plan and implementation of initial phases of that plan to provide sanitary sewer service to urban areas not currently serviced such as Pottawattomie Park and Trail Creek, thus reducing the pollutant loading of *E. coli* and other nutrients from these areas. Additionally, ensuring that existing septic systems in areas with unsuitable soils, which will not be serviced by municipal utilities in the short or intermediate time frames, are functioning properly is critical to addressing pollutant loading to Trail Creek.

Another sensitive area identified by the Steering Committee is cooridors of natural areas along existing riparian. As discussed previously, preservation of existing areas is critical to ensuring pollutant loading does not increase. A riparian buffer can decrease sediment and nutrient loading to a stream and therefore preservation of any existing buffers is critical to implementation of this plan. Areas particularly susceptible to encroachment on existing riparian buffers are those which are planned for future development.

In addition to the mapped sensitive areas, several areas within the watershed have been identified as sensitive land uses for preservation but were not individually included on the mapping. These include sensitive areas such as Pinhook Bog and other publicly or privately owned natural areas such as Trail Creek Fen and areas with unique or rare habitat or species. As one of the few cold water fisheries in the State of Indiana, Trail Creek itself is also considered a sensitive area.

The third sensitive area identified by the Steering Committee are those areas proposed for future development within the East and West Branch of Trail Creek. As indicated previously, these areas are not serviced by municipal utilities and have soils which are generally not suited for septic systems. The Steering Committee felt that identification of these areas as critical for implementation with the intent that these limitations were considered prior to development. As with preservation of existing natural areas, these proposed development areas are considered critical areas in order to ensure that future pollutant loading from these lands does not exceed the current levels and is ultimately reduced through the implementation of smart growth and low impact development concepts including restoration of riparian buffers, stream set-backs, and greenspaces.

Conservation and Restoration Areas

According to the IDNR Coastal Program, there are six categories of sensitive areas for preservation or restoration. These include areas of unique, scarce, fragile or vulnerable natural habitats; areas of historical significance, cultural value, or substantial recreational value or opportunity; areas of high natural productivity or essential habitat for living resources, including fish, wildlife, endangered species, and the various trophic levels in the food web critical to their well-being; areas needed to protect, maintain, or replenish coastal lands or resources including coastal flood plains, aquifers and their recharge areas, sand dunes, and offshore sand deposits; areas where development and facilities are dependent upon the use of, or access to, coastal waters or areas of unique features for industrial or commercial uses or dredge spoil disposal; and areas where if development were permitted, it might be subject to significant hazard due to storm, slides, floods, erosion, and settlement.

The Steering Committee determined that restoration of riparian buffers along Trail Creek and its tributaries was critical to implementation. Riparian buffers are areas or strips of permanent vegetation established along stream channels, predominately within agricultural areas but with increasing rural development, more frequently found in residential and commercial developments. Buffers are created to intercept sediment and nutrients and decrease the amount of soil erosion along waterways. Additionally, riparian buffers serve as greenways, greenspace, and habitat corridors linking fragmented natural areas. Assessment of the most recent aerial photography indicted that an estimated 40 miles of streams within the Trail Creek Watershed, 7.4 miles located within the Main Branch of Trail Creek Watershed, 18.4 miles within the East Branch of Trail Creek Watershed, and 14.2 miles within the West Branch of Trail Creek Watershed, have inadequate riparian buffers. For the purposes of this study inadequate buffers were determined to be those areas along Trail Creek and its tributaries without visible woody or natural vegetation adjacent to the streambank . Areas with inadequate buffers were generally agricultural or residential areas which were farmed to the stream edge or were residential yard . It should be noted that this assessment was completed through analysis of aerial photography and was not confirmed through ground proofing.

The lack of a riparian buffer can increase run-off to a stream and thus pollutant loading of nutrients and sediment, can contribute to streambank instability, and can lead to increased water temperature. Areas particularly susceptible are those agricultural areas in the East and West Branch of the watershed which do not currently have riparian buffers and are farmed with row crops to the top of bank.

Goals and Decisions

FOUR goals and a variety of objectives were identified within the 1993 Trail Creek Watershed Management Plan. Many of those goals and objectives remain valid with the current plan update. The goals from the 1993 Watershed Management Plan are as follows

1. Reduce potential health hazards due to poor water quality in the stream of Trail Creek.
2. Improve aquatic life support.
3. Increase quality/quantity of recreational opportunities to stimulate economic growth.
4. Develop a public awareness of the unique and diverse opportunities the stream of Trail Creek Provides.

As this plan was developed, the Steering Committee determined that the goals and objectives of the Watershed Management Plan for Lake, Porter, and LaPorte Counties prepared by the Northwestern Indiana Regional Planning Commission (October 2005) and the Indiana Coastal Non-point Pollution Control Program prepared by the Indiana Lake Michigan Coast Program (February 2005) would be incorporated by reference. Specific water quality goals for the Trail Creek Watershed Management Plan include the following.

1. Meet the State Water Quality Standard for *E. coli* of a monthly geometric mean of 125 cfu/100 ml and a maximum daily standard of 235 cfu/100 ml;
2. Decrease sedimentation and dredging of the navigable channel. Total Suspended Solid goal of 15 mg/l;
3. Decrease nutrient loading in Trail Creek to the target concentrations (0.05 mg/l ortho-phosphorus, 0.05 mg/l total phosphorus, 0.25 to 0.1 mg/l nitrogen ammonia, 1.0 mg/l TKN, and 10 mg/l nitrate-nitrite);
4. Maintain a natural stream channel and flow.

Measurable indicators of each of these goals include both qualitative and quantitative measurements. Qualitative measurements include the number of implementation projects constructed or realized as a result of the Watershed Management Plan and cooperative efforts in LaPorte County. Measurements can include riparian corridors preserved or enhanced, number of BMPs installed, planning conducted or programs implemented. The lead agency will track implementation projects and planning projects on an annual basis.

Quantitative measurements include water quality assessment of Trail Creek at each of the 12 sample locations discussed in this report. At the minimum, *E. coli*, TSS, turbidity, total phosphorus, nitrogen ammonia, TKN, nitrate-nitrate, and flow will be sampled. Sampling will occur at least twice annually during the growing season, once during base flow and once during peak flow. Additionally aquatic macroinvertebrate and habitat sampling will be conducted a minimum of every five years to access water quality trends in the Trail Creek Watershed. This data will be supplemented with data gathered by governmental agencies such as IDEM to determine water quality trends within Trail Creek. These trends will be used to quantitatively determine if pollutant load reductions are occurring within the watershed.

Table 9 summarizes the maximum, minimum, and mean calculated loading for the parameters of concern for each sample site and the pollutant reduction needed to reach the target water quality goal. The calculated base flow data was utilized as non-point source pollutants associated with stormwater runoff are generally the concern. For reference to how these loadings were calculated see the Appendix R.

Table 9: Trail Creek Watershed Sampling Data Analysis Results Using Calculated Peak Flow Data (Loads calculated in tons per year)

Sample Site E1	Dissolved Oxygen	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load	252.33	1716.35	8.20	3.12	17.96	4.97E+14	81.97	53.87
Min Load	97.35	23.06	1.17	0.78	0.78	4.85E+12	19.52	7.42
Mean Load	131.63	157.19	3.79	1.20	2.68	8.62E+13	31.75	23.54
Mean Target Load	89.66	192.13	5.37	1.95	2.93	4.06E+13	39.04	390.36
Mean Reduction Needed (%)	N/A	33.08	49.47	37.50	9.95	55.52	24.68	N/A
Sample Site E2	Dissolved Oxygen	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load	338.73	1334.39	4.28	1.03	5.47	7.85E+14	27.37	21.21
Min Load	136.86	30.79	0.51	0.34	0.34	3.10E+12	8.55	3.25
Mean Load	176.43	191.61	1.59	0.49	1.17	1.30E+14	13.09	10.21
Mean Target Load	119.75	256.61	2.35	0.86	1.28	5.20E+13	17.11	171.08
Mean Reduction Needed (%)	N/A	34.08	44.50	16.67	40.59	57.42	18.09	N/A
Sample Site E3	Dissolved Oxygen	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load	378.37	3443.36	4.00	1.60	9.61	9.17E+14	36.04	24.82
Min Load	156.15	36.04	0.60	0.40	0.40	3.63E+12	10.01	0.80
Mean Load	204.71	286.66	1.67	0.61	1.39	1.20E+14	14.78	11.46
Mean Target Load	140.14	300.29	2.56	1.00	1.50	6.08E+13	20.02	200.20
Mean Reduction Needed (%)	N/A	38.18	43.11	23.61	42.16	61.63	23.40	N/A
Sample Site M1	Dissolved Oxygen	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load	830.03	26331.84	11.45	2.39	44.84	2.79E+15	114.49	52.47
Min Load	357.77	85.86	1.91	0.95	0.95	2.81E+13	23.85	6.68
Mean Load	471.43	1235.50	4.67	1.23	4.15	3.40E+14	38.24	22.72
Mean Target Load	333.92	715.54	6.87	2.39	3.58	1.02E+14	47.70	477.03
Mean Reduction Needed (%)	N/A	40.95	39.44	N/A	47.14	59.49	25.85	N/A
Sample Site M2	Dissolved Oxygen	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load	1145.88	29416.65	11.97	3.99	57.01	2.81E+15	188.13	91.21
Min Load	421.87	102.62	1.14	1.14	1.14	2.07E+13	28.50	9.12
Mean Load	574.94	1504.80	5.78	1.56	5.28	3.72E+14	49.81	29.23
Mean Target Load	399.06	855.14	8.32	2.85	4.28	1.22E+14	57.01	570.09
Mean Reduction Needed (%)	N/A	42.41	37.56	28.57	50.11	63.20	32.76	N/A
Sample Site M3	Dissolved Oxygen	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load	1200.86	25444.06	16.65	3.57	52.31	4.91E+15	184.29	112.95
Min Load	416.14	107.01	2.38	1.19	1.19	2.16E+13	29.72	5.94
Mean Load	592.08	1480.65	6.90	1.53	5.39	4.86E+14	54.30	33.27
Mean Target Load	416.14	891.73	8.58	2.97	4.46	1.27E+14	59.30	594.49
Mean Reduction Needed (%)	N/A	46.08	47.18	16.67	45.43	60.13	38.57	N/A
Sample Site M4	Dissolved Oxygen	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load	1188.51	33206.65	14.93	1.79	53.75	1.92E+15	161.26	125.42
Min Load	388.21	107.50	2.99	1.19	1.19	2.87E+13	29.86	5.97
Mean Load	573.09	1701.88	6.57	1.42	7.19	3.25E+14	48.52	32.62
Mean Target Load	418.07	895.86	8.35	2.99	4.48	1.27E+14	59.72	597.24
Mean Reduction Needed (%)	N/A	51.18	47.38	N/A	48.57	54.55	27.95	N/A
Sample Site M5	Dissolved Oxygen	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load	1143.54	25519.10	16.25	12.64	44.54	3.33E+15	150.47	264.82
Min Load	397.23	108.34	2.41	1.81	3.01	8.19E+12	30.09	30.09
Mean Load	575.74	1218.84	7.20	5.04	9.43	3.74E+14	52.80	144.01
Mean Target Load	421.31	902.80	11.38	3.01	4.51	1.28E+14	60.19	601.87
Mean Reduction Needed (%)	N/A	43.42	42.77	48.38	60.15	54.87	29.00	N/A
Sample Site M6	Dissolved Oxygen	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load	1149.77	8853.86	23.98	7.38	9.22	1.14E+15	116.82	270.53
Min Load	393.50	110.67	2.46	1.23	1.23	5.58E+12	30.74	6.15
Mean Load	602.29	700.93	8.55	3.17	5.59	1.50E+14	49.43	116.03
Mean Target Load	430.40	922.28	4.66	3.07	4.61	1.31E+14	61.49	614.85
Mean Reduction Needed (%)	N/A	48.67	38.95	33.84	48.80	45.75	27.32	N/A

Table 9 (continued)

Sample Site W1	Dissolved Oxygen	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load	276.87	3908.68	5.92	1.18	10.96	1.21E+15	39.98	25.61
Min Load	114.00	26.65	0.30	0.30	0.44	9.40E+12	7.40	1.42
148.06Mean Load	149.22	403.78	2.24	0.42	1.46	3.54E+14	13.92	6.56
Mean Target Load	103.64	222.08	2.06	0.74	1.11	3.16E+13	14.81	148.06
Mean Reduction Needed (%)	N/A	49.22	43.66	27.08	43.06	82.11	26.08	N/A
Sample Site W2	**Dissolved Oxygen**	**Total Suspended Solids**	**Ammonia**	**Ortho Phosphorus**	**Total Phosphorus**	***E. coli* (cfu/year)**	**TKN**	**Nitrate + Nitrite**
Max Load	73.95	2974.07	0.81	0.20	3.98	1.07E+14	11.78	3.78
Min Load	32.91	7.31	0.12	0.08	0.08	5.90E+11	2.03	0.41
Mean Load	42.25	137.67	0.31	0.09	0.30	1.48E+13	2.77	1.31
Mean Target Load	28.44	60.94	0.51	0.20	0.30	8.66E+12	4.06	40.63
Mean Reduction Needed (%)	N/A	40.64	33.26	N/A	92.01	53.94	56.44	N/A
Sample Site W3	**Dissolved Oxygen**	**Total Suspended Solids**	**Ammonia**	**Ortho Phosphorus**	**Total Phosphorus**	***E. coli* (cfu/year)**	**TKN**	**Nitrate + Nitrite**
Max Load	29.01	304.04	0.32	0.10	0.26	2.25E+13	2.19	0.85
Min Load	14.90	3.58	0.06	0.04	0.04	3.61E+10	0.99	0.08
Mean Load	17.97	42.36	0.12	0.05	0.08	3.69E+12	1.10	0.24
Mean Target Load	13.91	29.81	0.21	0.10	0.15	4.24E+12	1.99	19.87
Mean Reduction Needed (%)	N/A	45.28	35.02	N/A	38.18	36.65	9.09	N/A

Prioritization of Water Quality Problems and Implementation Goals

THE TRAIL Creek Watershed is a highly privately owned watershed, one in which the cooperation of the public is top priority in order to restore it to a clean waterway. In order to best manage the problems associated in the Trail Creek Watershed, prioritization of problems must occur on a basis of the willingness of landowners and organizations associated with the water quality problems to participate. With this in mind, the water quality problem of highest priority is participation, education, and cooperation of the general public. Once the public has become knowledgeable and involved through outreach programs, the prioritization of the water quality problem can occur on a site specific basis. Once a willing land owner participating party has been selected for implementation of one or more of the Best Management Practices the land or area can be examined and assessed with relation to the practicality, functionality, and necessity of the goals and problems to be addressed. Once willing land owner or participating parties have been identified and appropriate Best Management Practices selected, implementation will occur.

Implementation

SPECIFIC implementation goals, action items, required resources, estimated costs, funding sources, and the timeframe for implementation of the Trail Creek Watershed Management Plan have been determined by the Steering Committee. These Implementation Goals including realistic timeframes and success criteria were discussed in great length during Steering Committee meetings. All members of the Steering Committee were invited to contribute to the discussion and their comments were incorporated into the final implementation goals as set out in Table 11. These implementation goals were selected as measures which could be implemented within the Trail Creek Watershed in order to address the known water quality concerns and problems. In addition to the stated implementation goals and objectives included in this report, the goals and objectives of the Watershed Management Plan for Lake, Porter, and LaPorte Counties prepared by the Northwestern Indiana Regional Planning Commission (October 2005) and the Indiana Coastal Non-point Pollution Control Program prepared by the Indiana Lake Michigan Coast Program (February 2005) are incorporated by reference. For reference to additional Funding Sources see Appendix T, Funding Sources from Nonpoint Source Pollution Management Plan for Indiana, FFY 2000-2004, Indiana Department of Environmental Management - Office of Water Quality, October 1999.

Community education and involvement with regards to how enhanced water quality can affect and benefit the community, business, organizations, municipalities, families, developers and construction companies, outdoor enthusiasts including boaters, fisherman, and bicyclist, farmers, schools and teachers, students, legislators, and policy makers and how those groups can contribute to enhanced water quality within the Trail Creek Watershed is a primarily concern of the Steering Committee. As such, many of the Implementation Goals include a short term goal of education and outreach with the community as the first step to implementation. The Steering Committee believes that public education and outreach is a key factor to ensure that the 2007 Trail Creek Watershed Management Plan will be accepted by the pubic and to ensure significant action will be taken in the watershed to meet the established goals. Public education and outreach may include but is not limited to outreach to the agricultural community and farmers geared towards increasing participation in conservation management programs, outreach and education to property owners with septic system to encourage proper installation and maintenance of those systems, implementation of volunteer water quality monitoring programs, and outreach to developers and governmental agencies with regards to low impact development Opportunities for public education and outreach could also include distribution of education materials to residents within the watershed and to recreation users of Trail Creek.

Estimated pollutant load reduction through implementation of best management practices indicated below has been calculated through STEPL 4.0 Model provided by the US EPA, the Region 5 Model for Estimating Pollutant Loads, and data produced by the Center for Watershed Protection. For more detailed information on the load reduction calculations see the attached Appendix S.

For the purposes of determining BMPs to be implemented to meet the load reduction required, the maximum loading for each parameter of concern at Sample Site M6 for the calculated base flow condition was utilized. These reductions are as follows in Table 10. This sample site was utilized as it is the downstream sample site and levels at this location should reflect actual pollutant loading to Lake Michigan and from the entire Trail Creek Watershed. Additionally, the maximum values were utilized as a worst case scenario.

Table 10: Load Reduction for Sample Site M6 using the calculated base flow conditions

Sample Site M6	Total Suspended Solids	Ammonia	Ortho Phosphorus	Total Phosphorus	*E. coli* (cfu/year)	TKN	Nitrate + Nitrite
Max Load (tons/yr)	8853.86	23.98	7.38	9.22	1.14E+15	116.82	270.53
Mean Target Load (tons/yr)	922.28	4.66	3.07	4.61	1.31E+14	61.49	614.85
Load Reduction Required (tons/yr)	7931.58	19.32	4.30	4.61	1.01E+15	55.34	None
Percentage Load Reduction Required	90%	81%	58%	50%	89%	47%	None
Implementation of Conservation Management on Agricultural Lands including Conservation Tillage							
Load Reduction Anticipated with Conservation Management	75%	25%	30%	30%	NA	25%	25%
Load Reduction from Practices (tons/yr)	6640.40	6.00	2.21	2.77	NA	29.21	67.63
Load Remaining (tons/yd)	2213.47	17.99	5.17	6.45	NA	87.62	202.90
Conservation and Restoration of Riparian Buffers							
Load Reduction Anticipated with Conservation and Restoration of Riparian Buffers	50%	50%	75%	75%	NA	50%	50%
Load Reduction from Practices (tons/yr)	4426.93	11.99	5.54	6.92	NA	58.41	135.27
Load Remaining (tons/yd)	-2213.47	6.00	-0.37	-0.46	NA	29.21	67.63
Installation of Sanitary Sewers							
Load Reduction Anticipated with Conservation and Restoration of Riparian Buffers	NA	55%	NA	NA	NA	55%	55%
Load Reduction from Practices (tons/yr)	NA	13.19	NA	NA	NA	64.25	148.79
Load Remaining (tons/yd)	NA	-7.19	NA	NA	NA	-35.05	-81.16

Within the Trail Creek Watershed, implementation of any single BMP is not anticipated to reduce the pollutant loading to the established goals. Implementation is anticipated to encompass a wide variety of BMPS. For the purposes of determining the minimum BMPs to be implemented to order to meet the load reduction goals, the load reduction anticipated as a result of each BMP was calculated. Additional BMPs were added until the load reduction goals were meet (Table 10). Implementation of multiple best management practices including agricultural conservation management practices, preservation, and restoration of riparian buffers, and expansion of sanitary sewer service as a combined program has been calculated to meet the watershed management goals for the reduction of total suspended solids, nitrogen, and phosphorus. For the purposes of these calculations, full implementation of each practice throughout the watershed was anticipated. Conservation management including conservation tillage within the Trail Creek Watershed is estimated to reduce total suspended solid loading by 75%, phosphorus loading by 30%, and nitrogen loading by 25%. Conservation and restoration of riparian buffers is estimated to reduce total suspended solid loading by 50-75%, phosphorus loading by 50-75%, and nitrogen loading by 17-57%. Implementation of conservation management on agricultural lands and conservation and restoration of riparian buffers throughout the watershed will meet the anticipated load reductions for total suspended solids and phosphorus. Installation of sanitary sewers and removal of septic tanks is anticipated to reduce nitrogen loading by 55%. Implementation of sanitary sewers throughout the watershed in addition to conservation management and conservation and restoration of riparian buffers will meet anticipated load reductions for nitrogen.

Implementation of conservation tillage and riparian buffers is anticipated to meet the total suspended solids and phosphorus goals at an estimated cost of $2,000,000. It should be noted that cost calculations associated with these implementation goals are rough estimations and should be used for planning purposes only. Implementation of these practices is anticipated to be the most costs efficient method for reduction of total suspended solids and nutrient loading.

Estimated cost to provide sanitary sewer service to the entire Trail Creek Watershed and meet the nitrogen loading goals is an estimated $99,000,000. Installation of sanitary sewers in the most densely populated areas can be completed for an estimated $5-10,000,000 and in conjunction with the conservation tillage and buffer goals is estimate will meet the pollutant loading goals for nitrogen.

In addition to total suspended solids, phosphorus and nitrogen, the implementation goals will also reduce *E. coli* within the stream. Additionally, exclusion of livestock from the stream will be an important implementation goal in order to meet the pollutant loading goal for *E. coli*.

In addition to the above implementation goals, a wide variety of other implementation practices were discussed by the Steering Committee members as appropriate goals within the Trail Creek Watershed to be implemented concurrently with the agricultural conservation management practices, preservation, and restoration of riparian buffers, and expansion of sanitary sewer service goals. These goals are summarized in Table 11 on following pages. Within the Trail Creek Watershed, *E. coli*, sedimentation and streambank erosion, nutrient loading, and hydromodification have been identified as areas of concern. With regards to implementation goals, these concerns are intertwined in that many of the implementation goals will address more than one concern. For example, exclusion of livestock from streams will reduce *E. coli* and nutrient loading, limit future streambank erosion due to livestock entering the stream, and reduce sedimentation from livestock in the stream and bank erosion. As a result, the Implementation Goals listed below are not tied to a specific water quality problem and pollutant loading reduction for several pollutants may have been calculated. Under each Implementation Goal the primary goals anticipated to be met by implementation are indicated.

Table 11: Implementation

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
Eliminate livestock access to streams 1, 2, 3	Through observation and reporting, determine locations at which livestock have unlimited access to streams and tributaries. Potential sources include farms, boarding facilities, and small acreage farmsteads.	NRCS, MS4	No cost estimate included. Implementation of this task is anticipated to be through the normal operations of the MS4.		Short Term	Removal of livestock from streams will also reduce bank erosion and sedimentation and nutrient loading to stream.
	Coordinate with property owners and educate them on the importance of eliminating livestock access to streams and tributaries. Encourage property owners to eliminate access to streams for livestock. Enroll farmers in appropriate conservation programs.	NRCS, MS4, IDNR, IDEM	$.1 per unit per year	EQUIP, CRP	Short-Long Term	Implementation of Waste Management Plan can reduce Phosphorus load by 5 lbs/yr and nitrogen load by 40 lbs/yr per acre per animal.

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
Eliminate non-point source *E. coli* and nutrient loading to streams from livestock and not allow pets access to streams 1, 2	Through observation and reporting determine locations at which non-point sources of *E. coli* and nutrients are affecting the stream and tributaries. Potential sources include feedlots, boarding facilities, dog parks, nuisance birds, and small acreage farmsteads.	NRCS, MS4, IDNR, IDEM	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the MS4.		Short Term	
	Coordinate with property owners and educate them on the importance of eliminating *E. coli* and nutrient loading to streams from livestock. Encourage property owners to eliminate access to streams for livestock. Enroll farmers in appropriate conservation programs.	NRCS	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the MS4.		Short-Long Term	Implementation of Waste Management Plan can reduce Phosphorus load by 5 lbs/yr and nitrogen load by 40 lbs/yr per acre per animal.

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
	Coordinate with parks and recreation facilities to ensure appropriate BMPs are installed at all parks including pet waste receptacles.	NRCS	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of MS4 and lead agency.		Short-Intermediate Term	
Encourage all farmers within watershed to implement Conservation Management Plans specific for each farm and farming practice 1, 2, 3, 4	Through NRCS and IDNR identify all farms within the watershed and evaluate current practices being implemented. Encourage the implementation of a Conservation Management Plan for all farms which do not currently one in place.	NRCS	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the NRCS and IDNR.		Short Term	
	Implement appropriate BMPs on each farm including riparian buffers, conservation tillage, and nutrient management.	NRCS	$20-50/farm	NRCS, private	Short-Long Term	Pollutant load reduction varies by practice. Conservation tillage practices are estimated to reduce nitrogen loading by 25%, phosphorus loading by 30%, and TSS loading by 75%.

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
Reduce erosion and sediment loading from row crops and agricultural lands 2, 3	Identify farms not currently enrolled in NRCS conservation programs or without a Conservation Management Plan.	NRCS, USDA, IDNR	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of NRCS.	IDNR	Short Term	
	Coordinate with property owners and encourage enrollment in appropriate conservation programs. Encourage Conservation Management Plan to be created for each farm. Potential conservation practices to be implemented may include riparian buffers, wetland restoration, nutrient management, fencing of streams.	NRCS, USDA, IDNR	$5-10 per acre	NRCS	Intermediate-Long Term	Conservation Management Plans will address all sources of potential runoff.

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
Eliminate discharges from septic tanks 1, 3	Coordinate with LaPorte County and other appropriate agencies to implement policies and procedures to eliminate the placement of new septic tanks in sensitive areas, including those areas adjacent to streams or with unsuitable soils.	LaPorte County Plan Commission, City governments,	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency and local government.		Short Term	
	Coordinate with LaPorte County and other appropriate agencies to implement policies and procedures to inspect existing septic tanks and ensure they are functioning appropriately.	LaPorte County Health Department, NIRPC, Michigan City	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency and local government.		Short Term	

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
	Coordinate with LaPorte County Health Department and NIRPC to promote educational program with regard to maintenance of septic systems. Identify potential incentives for property owners to have septic systems inspected and maintained.	LaPorte County Health Department, NIRPC, Michigan City	No cost estimate included. Implementation of this task is anticipated to be through the normal operations of the lead agency and local government.		Short-Intermediate Term	
	Prepare Sanitary Sewer Long Term Master Plan with the objective to provide sanitary sewer service to the majority of the Trail Creek Watershed. Plan shall recommend phased implementation plan. First phase of implementation plan is anticipated to include providing sanitary sewer service to Pottawatomi Park. Second phase of is anticipated to provide sanitary sewer service to the Town of Trail Creek.	Michigan City Sanitary District, County Plan Commission	$75	Local	Short Term	Septic connections and hookups are estimated to reduce nitrogen loading by 55%.

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
	Implement Phase I of Sanitary Sewer Long Term Master Plan.	Michigan City Sanitary District	$18 per household	DOC grants, SRF loans	Intermediate Term	
	Implement Phase II of Sanitary Sewer Long Term Master Plan	Michigan City Sanitary District	$20 per household	DOC grants, SRF loans	Intermediate Term	
	Provide sanitary sewer service to entire Trail Creek Watershed.	Michigan City Sanitary District	$18-35 per household	DOC grants, SRF loans	Long Term	
Eliminate illicit discharges 1, 2, 3	Implement MS4 Plan and Illicit Discharge Detection Plan and support MS4 Program.	Michigan City, LaPorte County, MS4	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency and MS4.	MS4	Short-Long Term	Elimination of illicit discharges will also potential influence nutrient loading to the stream.
Reduce discharges from stormwater runoff 1, 2, 3, 4	Implement and support MS4 Stormwater Pollution Prevision Plan.	Michigan City, LaPorte County, MS4	No cost estimate included. Implementation of this task is anticipated to be through the normal operations of the lead agency and MS4.	MS4	Short-Long Term	Implementation of MS4 Stormwater Pollution Prevision Plan addresses all pollutant loadings to stream.

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
	Implement relevant ordinances and stormwater quality guidance to maintain cold water habitat.	Michigan City, LaPorte County, MS4	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency and MS4.	MS4	Short-Long Term	
Preserve existing riparian corridors and buffers 1, 2, 3, 4	Further refine critical area mapping and identify specific properties with existing riparian corridors and buffers for preservation	MS4, NRCS	$2.5 per acre	NRCS, MS4, local government, local conservation agencies	Short Term	Riparian buffers are estimated to reduce nitrogen loading by 17-57%, phosphorus loading by 50-75%, and TSS loading by 50-75%.
	Coordinate with LaPorte County and other appropriate agencies to implement policies and procedures to preserve existing riparian corridors including mandatory setbacks and easements.	Michigan City Sanitary District, County Plan Commission	$2.5 per acre	NRCS, MS4, local government, local conservation agencies	Intermediate-Long-Term	

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
Protect, enhance and restore riparian corridors and wetlands, 2, 3, 4	Further refined critical area mapping and identify specific existing riparian corridors and buffers for restoration.	MS4, NRCS, private landowners, local conservations organizations	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency and MS4.		Short Term	
	Coordinate with LaPorte County and other appropriate agencies to implement policies and procedures to encourage riparian buffer restoration including mandatory setbacks and easements.	Michigan City Sanitary District, County Plan Commission	$5 per acre	Section 319	Intermediate-Long Term	Stormwater wetlands are estimated to reduce nitrogen loading by 30%, phosphorus loading by 50%, and TSS loading by 80%.
	Identify significant areas of streambank erosion and instability.	MS4, NRCS	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency and MS4.		Short Term	
	Implement streambank stabilization projects at priority locations.	MS4, Michigan City, NRCS	$.5 per linear foot	Local government, local conservation agencies	Intermediate-Long-Term	

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
Restore natural hydrology to Trail Creek 1, 2, 3, 4	Identify critical areas of within watershed.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	No cost estimate included due to unknown costs associated with this task.		Short Term	
	Implement stormwater quantity ordinances which encourage the use of Best Management Practices such as infiltration and regional detention rather than "beat the peak" practices.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	$15	Local government	Short Term	
	Retrofit Best Management Practices and develop restoration projects such as Streuble Pond within the watershed.	MS4, Michigan City, NRCS	$ 10-25 per acre	Local government	Intermediate-Long Term	
Evaluate the potential effects of proposed channel modifications to the physical and chemical characteristics and instream and riparian habitat of Trail Creek Plan and design channel modifications to reduce/eliminate to the physical and chemical characteristics and instream and riparian habitat of Trail Creek 1, 2, 3, 4	Implement stormwater quantity ordinances which encourage the use of Best Management Practices such as infiltration and regional detention rather than "beat the peak" practices.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency and MS4.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	Short Term	

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
	Develop model for Trail Creek. Coordinate with US Army Corps of Engineers regarding sediment model.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	No cost estimate included. Model already completed by US Army Corps of Engineers.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	Short-Intermediate Term	
	Locate potential sites for installation of channel modification BMPS. Modifications can include lamprey barriers, removal of log jams and blockages within the channel, or streambank restoration.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency and MS4.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	Short-Long Term	
	Implement channel modification Project. Removal of logjams should be completed using the palmiter methodology if possible. Dredging and clearing of riparian buffer should be avoided.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor, local conservation agency	$50	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor, local conservation agency, IDNR	Short-Long Term	
Assess the impacts that dams located on Trail Creek have on water quality, instream and riparian habitat, fish passage and the potential for improvement 1, 2, 3, 4	Locate and evaluate dams within Watershed	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency and MS4.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	Short-Long Term	Dams along Trail Creek alter the natural flow of the stream and channel morphology, affecting the natural channel and potential ability of the channel to transport sediment and nutrients.

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
Implement channel modification Project. 1, 2, 3, 4	Implement dam project.	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	$50	MS4, Michigan City, NRCS, County Drainage Board, County Surveyor	Intermediate-Long Term	
Remove existing sediment deposits to restore natural channel and investigate the use of sediment traps for future use 2, 4	Investigate legacy program and partner with US Army Corps of Engineers to determine sustainable long term management plan for navigable channel.	Michigan City	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency.	Local government	Short Term	
	Support MS4 program and encourage the use of Best Management Practices to reduce urban non-point source sedimentation.	MS4, local governments	$5	Local government	Short-Long Term	
	Fully implement Construction and Post Construction Programs.	MS4, local governments	$5	Local government	Short-Long Term	
Increase recreational access for fishing and recreational use 2	Provide better access points through the acquisition of easements	Local government, IDNR, local conservation organizations, agricultural community	$ 5-40 per acre	Local government, IDNR, local conservation organizations	Short-Long Term	Better access will decrease trespassing on private lands and decrease damage to streambanks at existing access points. Increase in recreation access will also increase revenue due to recreational use.

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
	Preservation and restoration of existing access points	Local government, IDNR, local conservation organizations	$ 0.5 per foot	Local government, IDNR, local conservation organizations	Short- Long Term	Streambank stabilization at existing access points.
	Creation of greenways and blueways/canoe trails	Local government, IDNR, local conservation organizations	$5-10 per acre land; $.05 per foot trail	Local government, IDNR, local conservation organizations	Short-Long Term	Increase recreational use of stream will increase community awareness. Increase in recreation access will also increase revenue due to recreational use.
Encourage Low Impact Development 1, 2, 3, 4	Coordinate with LaPorte County Comprehensive Plan regarding inclusion of low impact development guidance and ordinances	Local government	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency.	Local government	Short Term	Low impact development philosophy includes many of the previously mentioned implementation goals including riparian buffers and BMPS.
Coordinate Trail Creek Watershed Efforts with regional goals 1, 2, 3, 4	Lead agency shall coordinate with other local and regional watershed planners with regards to pollutant loads to Lake Michigan.	Local government, regional government, state government	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency.		Short Term	Regional planning and implementation of TMDLs and Watershed Plans will be required to ensure water quality within Lake Michigan.

Table 11 (continued)

Implementation Goal	Action/Indicator	Resources	Cost Estimate (in thousands)	Potential Funding sources	Timeframe	Additional benefit/ Estimated Load Reduction
Coordinate all data gathering and GIS gathering within County 1, 2, 3, 4	Lead agency shall coordinate with other local agencies to create a single point of contact for water quality data and GIS mapping.	Local Government, MS4	No cost estimate included due to unknown costs associated with this task. Implementation of this task is anticipated to be through the normal operations of the lead agency.	Local government, MS4	Short-Long Term	As part of the MS4 implementation, all point sources and storm sewer systems are to be mapped. A single point of contact and sharing of this data between municipalities and water quality organizations will facilitate future planning efforts.
Reduce or eliminate pollutant loading from marinas 1, 3	Implement Clean Marina initiatives	IDNR, marinas, local conservation agencies	No cost estimate included due to unknown costs associated with this task.	Marinas	Short-Intermediate Term	Implementation of Clean Marinas initiatives will reduce multiple sources of pollutant loading.
	Have at least one Designated Clean Marina in Michigan City	IDNR, marinas, local conservation agencies	No cost estimate included due to unknown costs associated with this task.	Marinas	Intermediate-Long Term	
	Encourage clean boating programs	IDNR, marinas, local conservation agencies	No cost estimate included due to unknown costs associated with this task.	Marinas	Short-Intermediate Term	

1. Implementation Goal which will reduce *E. coli* loading to stream
2. Implementation Goal which will reduce sediment loading to stream and streambank erosion
3. Implementation Goal which will reduce nutrient loading to stream
4. Implementation Goal which will restore the natural hydrology of Trail Creek

In addition to those Implementation Goals found in Table 11, the Indiana Department of Natural Resources, the Indiana Lake Michigan Coastal Program, and the National Oceanic and Atmospheric Administration have prepared several brochures with implementation strategies applicable to Trail Creek. These can be found in Appendix U.

Implementation of the Trail Creek Watershed Management Plan is anticipated to start in the Spring of 2007. Full implementation of the plan is anticipated to take 5 to 10 years at which time it is likely the plan should be re-visited and updated to current conditions within the watershed. Short term implementation goals are anticipated to be started in year 1 and 2 of the Trail Creek Watershed Management Plan. These goals include but are not limited to selection of a lead agency, forming partnerships and interagency agreements for plan implementation, community education and outreach, refinement of critical areas and building partnerships with property owners for implementation, and implementing the first projects. Intermediate term goals are anticipated to occur in years 2 through 5 of the Trail Creek Watershed Management Plan and include continuation of the plan implementation including sanitary sewer installation and implementation of conservation management projects. Long term goals are anticipated to occur in years 5 through 10+ of the Trail Creek Watershed Management Plan and include continuation of the plan implementation including sanitary sewer installation for as much of the watershed as is practical.

The first step in the implementation of the Trail Creek Watershed Management Plan will be selection of a lead agency and completion of any necessary interagency agreements necessary to fully implement the plan. It is anticipated that each of the Stakeholder agencies, including those which participated as Steering Committee members, will be active in the implementation of the Trail Creek Watershed Management Plan either in their area of expertise or in their jurisdictional area. For example, implementation of the agricultural conservation management plan on a single farm may take action by the MS4 Coordinator, NRCS, IDNR, and Soil and Water Conservation. Only though interagency cooperation and action, and undergraded by the voluntery participation of private land owners, will the Trail Creek Watershed Management Plan be fully implemented.