WILDCAT CREEK STAHL DITCH-KITTY RUN WATERSHED MANAGEMENT PLAN

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TABLE OF CONTENTS

LIST OF TABLES ..... **iv**

LIST OF FIGURES ..... **v**

LIST OF EXHIBITS ..... **v**

1.0 INTRODUCTION **1**
1.1 WATERSHED-BASED PLANNING 1
1.2 WATERSHED PARTNERSHIPS 4
1.3 PUBLIC PARTICIPATION 6
1.4 WATERSHED LOCATION 7
1.5 DESCRIPTION & HISTORY 8
2.0 IDENTIFICATION OF WATER QUALITY PROBLEMS AND CAUSES **13**
2.1 PERCIEVED PROBLEMS 13
2.2 WATER QUALITY BASELINE STUDIES 14
2.2.1 2004 and 2006 Indiana 305(b) Report *14*
2.2.2 2004 and 2006 303(d) List of Impaired Waters *15*
2.2.3 Fish Consumption Advisory (FCA) *15*
2.2.4 2002 Stream Reach Characterization and Evaluation Report (SRCER) *16*
2.2.5 2003 Wildcat Creek TMDL Project Data Collection *24*
2.2.6 1991 – 2005 Fixed Station Water Quality Results *27*
2.2.7 1998 AIMS Database Fish Community Sampling *28*
2.2.8 1998 AIMS Database Macro Invertebrate Sampling *29*
2.2.9 An Assessment of Pesticides in the Upper Wabash River Basin *29*
2.3 SUMMARY OF IDENTIFIED PROBLEMS 30
3.0 IDENTIFYING POLLUTANT SOURCES **33**
3.1 POINT SOURCES OF POLLUTION 33
3.2 NON-POINT SOURCES OF POLLUTION 34
3.2.1 Non-Point Sources From Agricultural Lands *34*
3.2.1 Non-Point Sources From Urbanization *39*
3.3 SUMMARY OF POLLUTANT SOURCES 47
4.0 CRITICAL AREAS **47**
4.1 BENEFICIAL CRITICAL AREAS 47
4.2 CRITICAL AREAS AS POTENTIAL SOURCES OF POLLUTION 55
4.3 ESTIMATING POLLUTANT LOADS 62
5.0 GOALS AND DECISIONS **67**
5.1 POTENTIAL IMPLEMENTATION TIMELINE 81
6.0 MONITORING EFFECTIVENESS **84**

LIST OF TABLES

Table 1-1: Watershed Management Units 2
Table 1-2: Steering Committee Schedule 5
Table 1-3: Land Use 9
Table 1-4: Soil Associations 10
Table 1-5: Endangered, Threatened and Rare Species 11
Table 2-1: Stakeholder Concerns in the Wildcat Creek Stahl Ditch-Kitty Run Watershed 13
Table 2-2: Wildcat Creek Stahl Ditch-Kitty Run Watershed 2004 and 2006 305(b) Report 14
Table 2-3: Stahl Ditch-Kitty Run Watershed 2004 and 2006 303(d) Impaired Waters 15
Table 2-4: Wildcat Creek Sampling Sites from the City of Kokomo SRCER 16
Table 2-5: Recommended Nutrient Concentration Thresholds 17
Table 2-6: Hoosier Riverwatch's TSS Guideline 17
Table 2-7: Wet and Dry Weather *E.coli* Concentrations from the City of Kokomo SRCER 18
Table 2-8: SRCER Habitat Assessment Scores 19
Table 2-9: SRCER Sampling Site Water Quality Rankings 22
Table 2-10: 2003 Wildcat Creek Project Mean *E.coli* Concentrations 25
Table 2-11: Fixed Station Sampling Site Locations and Mean Concentration 28
Table 2-12: Index of Biotic Integrity 29
Table 2-13: Pesticide Concentrations, MCLs, and Runoff 30
Table 2-14: Water Quality Pollutants and Potential Agricultural and Urban Sources 31
Table 3-1: NPDES Facilities in the Wildcat Creek Stahl Ditch-Kitty Run Watershed 33
Table 3-2: Estimate of Nutrient Applications 35
Table 3-3: Percent of Crop Acres in Conservation Tillage 37
Table 3-4: Stream Classification Based on Imperviousness in Watershed 44
Table 3-5: Low-Head Dams on Wildcat Creek 45
Table 4-2: Subdivision Suspected of Having Septic System Problems 55
Table 4-3: Log Jams along Wildcat Creek 60
Table 4-4: Estimated Pollutant Loads and Target Load Reductions 64
Table 4-5: Estimated Potential Load Reductions and Critical Area Management Measures 65
Table 5-1: Agricultural Management Measures 67
Table 5-2: Wastewater Treatment 70
Table 5-3: Education Management Measure 73
Table 5-4: Landuse Management Measure 77
Table 5-5: Proposed Agricultural Implementation Timeline 82
Table 5-6: Proposed Wastewater Treatment Implementation Timeline 82
Table 5-7: Proposed Public Education Implementation Timeline 83
Table 5-8: Proposed Land Use Implementation Timeline 83

LIST OF APPENDICIES

Appendix 1: Steering Committee Meeting Agendas and Summaries
Appendix 2: Press Releases and Media Coverage
Appendix 3: Public Meeting and Water Quality Workshop Sign-In Sheets
Appendix 4: Load Reduction Calculations

LIST OF FIGURES

Figure 2-1: 2003 Wildcat Creek TMDL Project Geometric Mean *E.coli* Concentrations
Figure 2-2: 2003 Wildcat Creek TMDL Project *E.coli* Grab Sample Concentrations
Figure 3-1: Inadequate Filter Strip
Figure 3-2: Adequate Filter Strip
Figure 3-3: Small Hobby Farm
Figure 3-4: Continental Steel Superfund Site
Figure 3-5: Streambank Erosion just west of the CR 400 East bridge crossing
Figure 3-6: Bank Erosion on Edwards Ditch/ Dan Gamble Drain (Mayfield Rolling Acres)
Figure 3-7: Guillotine Dam
Figure 3-8: Illegal Dumping and Channel Alteration
Figure 3-9: Illegal Dumping and Channel Alteration
Figure 4-1: Well Buffered Stretch of Wildcat Creek
Figure 4-2: Wildcat Creek Walk of Excellence
Figure 4-3: Paddlers on a Stretch of Wildcat Creek
Figure 4-4: Paddlers on a Forested Stretch of Wildcat Creek
Figure 4-5: Catch and Release Fishing Occurs Regularly on Wildcat Creek
Figure 4-6: Unbuffered Stretch of Wildcat Creek
Figure 4-7: Crystal Street Dam
Figure 4-8: Log Jam on Wildcat Creek
Figure 4-8: Streambank Erosion and Littering
Figure 4-10: Wildcat Creek at Foster Park

LIST OF EXHIBITS

Exhibit 1-1: Location Map
Exhibit 1-2: Waterways
Exhibit 1-3: Land Use
Exhibit 1-4: Wetlands
Exhibit 2-1: SRCER Sampling Sites and 2003 Wildcat Creek Project TMDL
Exhibit 3-1: NPDES Facilities and Confined Feeding Operations
Exhibit 3-2: Highly Erodible Lands
Exhibit 3-3: Areas in Need of Conservation Measures
Exhibit 3-4: Subdivisions with Septic System Problems and Soils Extremely Limited for Onsite Wastewater Treatment
Exhibit 4-1: Potential Public Access Sites
Exhibit 4-2: Areas Known to be Implementing Conservation Measures
Exhibit 4-3: MS4 Areas
Exhibit 4-4: Agricultural Lands on Highly Erodible Lands within 500-Feet of Waterways
Exhibit 4-5: Low Head Dams and Log Jams
Exhibit 4-6: Beneficial Critical Areas
Exhibit 4-7: Critical Areas as Potential Sources of Pollution

1.0 INTRODUCTION

1.1 WATERSHED-BASED PLANNING

A watershed is an area of land that collects and drains water to a specific point. Similar to water poured into a bowl, a portion of the precipitation that falls on a watershed will move through the landscape, collecting and concentrating in low areas, creeks, and streams, until it exits through an outlet point. All water, whether in the ground or traveling over the ground surface, moves from the highest to the lowest points in an area of land. Using this definition, watersheds can be defined for any location. For planning purposes, the watershed is a measurable and practical landscape feature that is based on how water moves, interacts with, and behaves on the landscape.

Water in the form of precipitation can take several paths once it has reached the earth. Some portion of the precipitation will never reach the ground; instead it is caught by vegetation and/or ground litter and evaporates. That portion of precipitation that does reach the ground can infiltrate the ground, becoming shallow or deep groundwater, or travel over the surface as runoff. Runoff is excess water, from rainfall, snowmelt, and numerous others sources that can not be absorbed or retained in the landscape. As water travels through the watershed by these pathways it interacts with the landscape, in a physical and chemical manner, that interaction determines the character of water quality in a receiving waterbody. Human activities alter the landscape and thus influence the physical and chemical interaction of water in a watershed. Recognition and an understanding of the hydrologic cycle in the context of human influence on watershed processes are fundamental to good watershed management planning.

Human interaction with the environment helps to define the characteristics of the watershed, and thus, the quality of the water. A logical way to approach water resource management is to use the watershed as the primary management unit. Since water collects and moves through the landscape via watersheds, the physical, chemical, and biological conditions of the water will be unique to each watershed. Therefore, planning and management would be most effective if they address the unique character and conditions of the watershed in question.

Watersheds, and watershed management areas, can be considered at a regional or very local level. Watersheds can be as small as a ¼-acre plot or as large as the Missouri River Basin that covers millions of square miles. The Center for Watershed Protection classifies watersheds into five management units; these are catchment, sub-watershed, watershed, sub-basin, and basin and are listed in **Table 1-1**. The primary planning authority and suggested management focus for each of the five management units varies depending on the size of the watershed. According to this classification system the Stahl Ditch-Kitty Run Watershed (approximately 46 square miles) would be considered a “Watershed” and is therefore best managed at the local or multi-local level.

Table 1-1: Watershed Management Units

Watershed Management Unit	Typical Area (sq. mi.)	Primary Planning Authority	Suggested Management Focus
Catchment	0.05 - .050	Local property owner	Best Management Practices
Sub-watershed	1 - 10	Local Government	Stream Management & Classification
Watershed	10 - 100	Local or multi-local	Watershed-based Planning
Sub-basin	100 – 1,000	Local, regional, and State	Basin Planning
Basin	1,000 – 10,000	State, multi-state, federal	Basin Planning

(Schueler, 2003)

Watershed Planning

A Watershed Management Plan (WMP) is intended to benefit communities in the watershed by helping to improve the local economy, increase effectiveness of government, and preserve the environment through comprehensive water resource planning. Watershed planning can benefit the local economy by helping to protect drinking water supply, decrease losses related to floods, and increase property values by providing attractive and safe living and recreation areas. Good watershed planning can improve the effectiveness of government through more direct public involvement that earns the trust and support of the community and guarantees that all community interests are treated fairly. The planning effort also helps to ensure that current water quality in the community is preserved and that the community will not suffer significant financial losses due to loss of natural resource buffers and other natural resources.

The planning process is not without some complications as members of watershed communities can have competing desires for how water is used. For example, a large proportion of the Stahl Ditch-Kitty Run watershed is agricultural with many farming interests. A farmer will view water quality issues differently than will others in the community. However, the interests of that farmer must be taken into consideration if the WMP is to be a benefit to the whole community. Likewise, the homeowner in Kokomo that uses a municipal well for water supply has an interest in clean drinking water that is not polluted from other watershed users. Further complication of the planning process is realized when there are several government jurisdictions with different sets of ordinances and rules for water use. Nonetheless, it is imperative that the planning process formulate a workable WMP that is sensitive to the values and desires of all members of the community and is developed with the input and support of a good cross-section of the community. Input from the farmer, home-owner, government administrator, elected official and others in the community will help to ensure that there is balance and equitable distribution of responsibility for and benefits of good water quality in the watershed.

Watershed planning is especially important to help prevent future water resource problems, preserve watershed functions, and ensure future economic, political, and environmental health. Everyone in a watershed is involved in watershed management; however, there are typically no water resource specific agreements on how water should be used and managed by all users in a community. Many activities throughout the watershed have an impact on watershed users, but the efforts are not organized, and occasionally are counter-productive and may limit economic

growth and value of land. However, a WMP is a start toward a better understanding of community values and watershed processes and can provide guidance toward the betterment of watershed management and living conditions in the community.

Regulatory Context of Watershed Planning

Watershed management has been widely promoted by the Environmental Protection Agency (EPA) and other public and private organizations concerned with water quality. In fact, by developing WMPs, targeted areas become eligible for funding to implement a wide array of water quality related projects. Funding sources include, but are not limited to, the Indiana Department of Environmental Management (IDEM), the Environmental Protection Agency (EPA), the Indiana Department of Natural Resources (IDNR), and the United States Department of Agriculture (USDA).

Watershed planning can also be a response to regulatory interest in impaired water quality in the watershed. Section 303(d) of the Clean Water Act requires states to identify waters that do not, or are not expected to, meet federal water quality standards. States are also required to develop a priority ranking for these waters taking into account the severity of the pollution and state defined designated uses of the waters. For those waters identified as having impaired water quality, the states are required to develop Total Maximum Daily Loads (TMDLs) in order to achieve compliance with federal water quality standards and the Clean Water Act.

The IDEM has identified the entire reach of Wildcat Creek as it flows through the Stahl Ditch-Kitty Run Watershed as having impaired water quality due to elevated levels of pathogens (*E. coli*) polychlorinated biphenyls (PCBs), cyanide. The severity ranking for Wildcat Creek is high and TMDL data collection has already been completed. An effective watershed plan can help to address the water quality impairment identified by the IDEM. Furthermore, the WMP will help to demonstrate community involvement and commitment to address impaired water quality in the watershed.

Stahl Ditch-Kitty Run Watershed Management Plan

A WMP is a guiding document that examines the historical and existing water resource issues in a particular watershed and presents specific actions to address those water resource issues based on the values and needs of the community. The intent of the WMP is to provide better living conditions, economic viability, and environmental health benefits for those that reside in the watershed and for communities downstream. Developers of the WMP are interested stakeholders that investigate prior and existing watershed conditions, identify watershed priority areas, and formulate strategies for implementing specific actions. The WMP document represents the earnest efforts of the community to understand, analyze, and be an integral part of the solution to improve impaired water quality in the watershed. Furthermore, active community involvement in the development of the WMP helps to ensure that there is commitment by the community to implement projects identified in the WMP.

The interest to prepare a WMP for the Stahl Ditch-Kitty Run Watershed stems from the numerous known water quality problems in the watershed and the fact that the watershed is typical of the water quality problems facing many urban-rural fringe watersheds throughout the State. At the heart of the watershed is the City of Kokomo, the 14th largest city in Indiana and home to 46,113 people. The land use in the City is predominantly impervious (roads, parking lots, roof tops, etc.) which results in the discharge of untreated stormwater directly into Wildcat Creek. This stretch of Wildcat Creek also receives the untreated wastewater discharge from 18

combined sewer overflows as well as contamination from the Continental Steel Superfund Site (CSSS).

Areas surrounding the City of Kokomo are experiencing development pressures. The once rural landscape is quickly converting to suburban land uses. Changes in land use are directly linked to water quality problems including increases in bacteria levels, additions of toxic materials, increases of sediment loads, alterations of water temperature, and reductions in oxygen concentrations.

Approximately 65% of the Stahl Ditch-Kitty Run Watershed remains in agriculture use including livestock and crop production. The National Water Quality Inventory, sponsored by EPA, reports that agriculture non-point source (NPS) pollution is the leading source of water quality impairments to surveyed rivers and lakes. Nutrients, pesticides, and sediment can migrate from agricultural lands to surface waters via runoff and erosion.

The Stahl Ditch-Kitty Run WMP presents the overall watershed analysis and inventory conducted by CBBEL, the project Steering Committee, and the public, and offers recommendations for water quality improvement, preservation, and protection. This WMP meets the requirements of the IDEM 2003 "What Needs to be in a Watershed Management Plan" Checklist.

1.2 WATERSHED PARTNERSHIPS

Partnerships among water resource professionals and interested citizens are essential to the successful development and implementation of the Ditch– Kitty Run WMP. This WMP is being prepared at two distinct levels - the local level using the resources of CBBEL and a Steering Committee as well as at the regional level by the 7-county not-for-profit Wildcat Creek Watershed Alliance, Inc.

Wildcat Creek Watershed Alliance, Inc.

The Wildcat Creek Watershed Alliance, Inc. (WCWA) is a partnership of concerned citizens, comprised of over 500 individuals representing local government, industry, agriculture, development, environmental, and concerned citizens in the Wildcat Creek Watershed. The seven counties in the watershed include: Grant County, Madison County, Tipton County, Howard County, Carroll County, Clinton County, and Tippecanoe County. Membership into the WCWA is open to:

1) Any individual person over the age of 18 who resides in, owns real property in, or does business in the watershed,
2) Any business, community or industry group concerned about water resources in the watershed, or
3) Any governmental entity whose geographic jurisdiction lies in the whole or part in the watershed.

The mission of the WCWA is to develop and implement successful watershed plans to improve and protect the water resources of the Wildcat Creek Watershed.

The efforts of the WCWA are led by a 13-member Advisory Board. Each member of the Advisory Board is elected at the WCWA Annual Meeting and serves a 3-year term. Current members of the Advisory Board include:

- **Jack Rhoda**, *WCWA President* representing City of Lafayette City Council
- **Keith Morgan**, *WCWA Vice President* representing Indiana-American Water Company
- **Tracie Bergin,** Treasurer
- **Rae Schnapp,** Secretary representing Wildcat Creek Foundation
- **Glen Boise**, City of Kokomo-Howard County Plan Commission
- **Ben Franklin,** Local Business Representative
- **Tony Bonaccorsi**, Daimler Chrysler
- **Ralph Kirkpatrick**, Grant County SWCD
- **Joseph O'Donnell**, Carroll County NRCS
- **Wayne Williams**, Clinton County Commissioners
- **Christian Chauret,** Indiana University Kokomo

In the fall of 2003, the WCWA submitted a Section 319 Non Point Source Program grant application to IDEM to develop a WMP for the Stahl Ditch-Kitty Run Watershed in Howard County. The grant application was accepted and the WCWA received $87,200 in November 2004. The WCWA retained Christopher B. Burke Engineering, Ltd. (CBBEL) to serve as the Watershed Coordinator for the development of the WMP. The Watershed Coordinator organizes the watershed plan steering committee, facilitates stakeholder discussion, presents data and information about the watershed to the committee and the public, and drafts a WMP.

Stahl Ditch-Kitty Run Watershed Steering Committee

In February 2005, a Steering Committee of local water resource experts and interested citizens from the Stahl Ditch-Kitty Run Watershed was formed to review and evaluate existing chemical, biological, and physical water quality data for the WMP. Membership of the Steering Committee includes:

- **Glen Boise**, *WCWA Board Member*, Kokomo-Howard County Plan Commission
- **Don Cree,** City of Kokomo Engineering Department
- **Michelle Gilbert,** Howard County Health Department
- **Calvin Hartman,** Howard County SWCD
- **Mike Karickhoff**, Kokomo City Council
- **Greg Lake**, Howard County Surveyor's Office
- **Paul Raver,** Howard County Commissioner
- **Ryan Smith**, Indiana-American Water Company
- **Carey Stranahan**, City of Kokomo Engineering Department

The Committee met on a bi-monthly basis beginning in March 2005 through November 2006. CBBEL prepared for and facilitated the Steering Committee meetings. **Table 1-2** outlines the meeting schedule and topics discussed. Each of these topics will be discussed in more detail in the following chapters of this Plan. **Appendix 1** includes Steering Committee Meeting agendas and summaries.

Table 1-2: Steering Committee Schedule

Meeting Date	Topic Discussed
31-Mar-05	Introduction to Project
26-May-05	**Agriculture - Crop Production & Livestock Production**
28-Jul-05	Agriculture - Recommendations & Implementation Projects
22-Sep-05	**Urban - Human & Animal Waste**

Meeting Date	Topic Discussed
	Failing Septic Systems
	Wildlife & Pets
10-Nov-05	Urban - Recommendations & Implementation Projects
26-Jan-06	**Urban - Development Practices**
	Land Use Planning
	Stormwater
	Erosion & Sediment Control
23-Mar-06	**Urban - Development Practices cont'd**
	Impervious Areas
	Riparian Corridors
	Dams & Logjams
25-May-06	Urban - Recommendations & Implementation Projects
27-Jul-06	**Urban - Household & Yard Waste**
	Toxic Materials
	Lawn & Garden Chemicals
	Urban - Recommendations & Implementation Projects
28-Sep-06	Revisit Septic System Recommendations & Implementation Projects
27-Sep-06 *20-Oct-06*	*Workshops – Water Quality Forums*
16-Nov-06	Management Measures Review and Implementation Timelines
25-Jan-07	Review of Draft Plan
February-07	*Public Meeting - Present DRAFT Plan*
Mar-07	If Needed
May-07	If Needed
May-07	*Plan due to IDEM*

1.3 PUBLIC PARTICIPATION

The WCWA is volunteer-based and public participation is essential to maintaining the strength of the organization. Education and outreach efforts can effectively change the general public's behaviors and habits toward water quality and make a strong connection between land use and water quality and how the decisions people make everyday directly affect water quality. Information to the membership is disseminated through the WCWA webpage, newspaper articles, workshops, annual and quarterly membership meetings as well as regularly scheduled Advisory Board meetings.

As part of this planning process, information was gathered from the public during special interest group meetings, water quality workshops, and public presentations.

Special Interest Groups

A number of agencies, city departments, and interested groups in the City of Kokomo and Howard County have collected water quality data or have a unique awareness of water quality issues in the Stahl Ditch-Kitty Run Watershed. However, much of this data and information has been collected independently, specifically to address one issue, without consideration on the impact or influence of the entire watershed. Throughout the planning process, CBBEL met with many of these individual groups, summarized their water quality information and presented it

back to the Steering Committee so they could assess the information and develop effective management measures to improve the water quality in the watershed. These groups include: Howard County Health Department, Howard County Natural Resource Conservation Service (NRCS)/ Soil and Water Conservation District (SWCD), the City of Kokomo Parks Board, Howard County Drainage Board, City of Kokomo-Howard County Stormwater Phase II Committee, IDEM TMDL Development Team, and the Wildcat Guardians.

Without input and guidance from these groups, the recommendations made in **Section 5** of this plan would not be nearly as site specific and the likelihood of future implementation efforts would be greatly reduced. Local stakeholders groups provided the Stahl Ditch-Kitty Run WMP with a wealth of local knowledge that otherwise would have been unattainable.

Water Quality Workshops

On September 27, 2006 and October 20, 2006 interactive workshop style meetings were held. One was held during the day to attract agency and department staff and the second in the evening to better accommodate the general public. At the workshops CBBEL presented a summary of the in-depth review and evaluation of existing water quality data. The workshops also featured Dr. Christian Chauret, Associate Professor of Microbiology and his student Laura Fincher, both from IU Kokomo. Dr. Chauret and Ms. Fincher discussed the research they have been conducting related to *E. coli* bacteria in the Wildcat Creek Watershed and the relative risks associated with the presence of *E. coli* in recreational water bodies. Sign in sheets from both workshops are included in **Appendix 2.**

Public Presentations

Once the draft WMP was completed, CBBEL posted it on the WCWA webpage and in the Main Branch of the Kokomo-Howard County Public Library. Two town hall style public meetings were held in February 2007. Similar to the Water Quality Workshops, one was held during the day to attract agency and department staff and the second in the evening to better accommodate the general public. CBBEL presented an overview of the known water quality problems, goals, management measures, and action plan for improving water quality in the Stahl Ditch-Kitty Run Watershed. Comments on the draft WMP were collected from the public through April 2007. Sign in sheets from both public meetings are included in Appendix 2.

Media Releases

Throughout the planning process quarterly media releases were submitted to local newspapers, radio stations, and other media outlets. Media releases announced important milestones and events associated with the WMP process, such as the beginning of the planning process, issues being covered at Steering Committee Meetings, announcements for Water Quality Workshops and public meetings, and how to review and submit comments on the draft WMP. All media releases and their subsequent newspaper articles are included in **Appendix 3.**

1.4 WATERSHED LOCATION

The Stahl Ditch-Kitty Run Watershed accounts for 2 of 44 subwatersheds within the 8-digit hydrologic unit code (HUC) Wildcat Creek Watershed located in North Central Indiana. **Exhibit 1-1** identifies both the Wildcat Creek Watershed and the Stahl Ditch-Kitty Run Watershed**.** The 14-digit HUC number for the Wildcat Creek–Stahl Ditch/Cannon Goyer Ditch Watershed is 05120107010100 and Wildcat Creek–Kitty Run/Edwards Ditch Watershed is 05120107020010. For simplicity, these two watersheds will be referred to throughout this WMP as Stahl Ditch–Kitty Run.

The combined drainage area for the Stahl Ditch-Kitty Run Watershed is 29,445-acres. The watershed drains land in central Howard County including the City of Kokomo. There are approximately 39 miles of perennial streams and drainage ditches in the Stahl Ditch-Kitty Run Watershed, all of which eventually drain to the Wildcat Creek. **Exhibit 1-2** identifies waterways of the Stahl Ditch-Kitty Run Watershed.

1.5 DESCRIPTION & HISTORY

Natural History

The Wisconsin Glacier formed the present landscape of the Stahl Ditch-Kitty Run Watershed. When the glacier receded it deposited as much as 50 to 100-feet of glacial till over the limestone bedrock. The soils found in the Stahl Ditch-Kitty Run Watershed are the result of direct glacial deposits or materials carried by the streams of melting ice and snow.

Prior to settlement in the mid-1800s, much of the Stahl Ditch-Kitty Run Watershed was covered in wetlands and woods. The trees removed by the early settlers to make room for farming would have consisted of upland hardwood forest species characteristic of a Maple-Beech association. Plant associations or communities are broad generalizations of vegetation based on a geographic region. The upland areas of the Stahl Ditch-Kitty Run Watershed would have been densely covered in sugar maple, basswood, beech, yellow birch, American elm, ironwood, and red maple. Species such as silver maple, American elm, willow, basswood, sycamore, and ash would have been more abundant in the river corridors and low-lying marsh areas.

According to the 1992 Gap Analysis Program (GAP) datum, only 5% of the Stahl Ditch-Kitty Run Watershed land use is wooded or wetland. Although nonnative and invasive species such as serviceberry now dominate much of the under story of existing wooded areas, evidence of the native hardwood forest still prevails. Fragmentation of wooded and natural areas caused by increased human settlement as well as trapping and hunting has limited the number of wildcats, bears, foxes, and poisonous snakes that once were abundant in the Stahl Ditch-Kitty Run Watershed.

Climate

According to Midwest Climate Data Center records, the average winter temperature is 30°F and the average daily minimum temperature is 21°F. The average temperature during the summer is 74°F and the average daily maximum temperature is 85°F. Average annual precipitation in the area is 40.5”. Approximately 60%, or 24”, typically accumulates between April and September of any given year. The 2-year, 1-hour duration storm event is approximately 1.44”. The watershed receives an average seasonal snowfall of 29” and 15 days out of the year have at least 1” of accumulated snow on the ground. Tornadoes, hailstorms, and severe thunderstorms do occur in the area and typically affect the watershed in late spring and early summer.

Land Use

The land use of the Stahl Ditch-Kitty Run Watershed began to significantly change from dense woods and wetlands to agriculture following settlement of the Europeans in the mid-1800s. Historically the upland areas were cleared and drained to facilitate better crop production. As shown in **Table 1-3 and Exhibit 1-3**, agricultural land uses continue to dominate the Stahl Ditch-Kitty Run Watershed landscape today. Sixty-five percent of the watershed is in

agricultural production. Row crops dominate the land use of the watershed with 16,591-acres (56%) in production.

Table 1-3: Land Use

Land Use	Acres	Percentage
Unclassified	15.24	0.05
Open Water	219.65	0.75
Low Intensity Residential	4,450.50	15.11
High Intensity Residential	541.04	1.84
Commercial/Industrial/Transportation	2,067.94	7.02
Transitional	1.89	0.01
Quarries/Strip Mines/Gravel Pits	19.56	0.07
Deciduous Forest	939.45	3.19
Evergreen Forest	2.07	0.01
Mixed Forest	0.44	0.00
Pasture/Hay	2,460.81	8.36
Row Crops	16,591.22	56.34
Urban/Recreational Grasses	1,594.04	5.41
Woody Wetlands	521.84	1.77
Emergent Herbaceous Wetlands	20.63	0.07
Total	**29,446.32**	**100.00**

(USGS, 1992)

Although the Wildcat Creek runs through the Stahl Ditch-Kitty Run Watershed, the other waterways are small headwater streams or drainage ditches. Very little of the watershed, 762-acres (2.6%) is classified as wetland or open water. **Exhibit 1-4** identifies wetlands in the Stahl Ditch-Kitty Run Watershed.

Approximately 7,059-acres (24%) of the watershed have been converted for residential, commercial, and industrial land uses. The City of Kokomo is centrally located in Stahl Ditch-Kitty Run Watershed. Land use will continue to transition from rural to urban land uses as both the City of Kokomo and Howard County continue to increase in population and become more developed.

Soils

The soils of the Stahl Ditch-Kitty Run Watershed formed from Wisconsin glacial till, glacial outwash, and recently deposited alluvium. According to the Soil Surveys for Howard County and shown in **Table 1-4**, there are five predominant soil associations in the Stahl Ditch-Kitty Run Watershed. In the low-lying, floodplain areas the Genesee-Shoals and Sloan-Tuscola-Strawn Association dominate, whereas in the upland areas, the Miami Russell-Morley, Crosby-Brookston, and Patton-Del Rey-Crosby Association are more prevalent.

Table 1-4: Soil Associations

Soil Association	Characteristics
Genesee-Shoals	Deep, well-drained and somewhat poorly drained, medium-textured, nearly level soils; on alluvial bottoms
Sloan Tuscola-Strawn	Nearly level to moderately sloping, very poorly drained, moderately well-drained, and well-drained soils that formed in the alluvium, in stratified silty, loamy, and sandy sediments over loamy glacial till, or in loamy glacial till; on floodplains, lake plains, and till plains
Miami Russell-Morley	Deep, well-drained, medium-textured and moderately fine textured, gently sloping to strongly sloping soils; on uplands
Crosby-Brookston	Deep, somewhat poorly drained and very poorly drained, medium textured and moderately fine textured, nearly level soils; on uplands
Patton-Del Rey-Crosby	Nearly level, poorly drained and somewhat poorly drained soils that formed in silty sediments, in silty and sandy sediments, or in a thin mantle of silty material and the underlying loamy and clayey glacial till; on lake plains and till plains

(USDA, 1971)

The NRCS has assigned a soil erodibility index to each soil type. This value is based on the soils chemical and physical properties, as well as climatic conditions. Highly erodible soils in the Stahl Ditch-Kitty Run Watershed are primarily from the Miami Russell-Morley association. These include: Fox (FsC3), Hennepin (HeE), Miami (MlC2, MmC3, MmD3), and Morley (MsC3).

Septic systems need well-drained soils to properly function. Much of the soil in the Stahl Ditch-Kitty Run Watershed has severe limitations for septic systems due to seasonal high water table and slow permeability. In the Stahl Ditch-Kitty Run Watershed, the well-drained Sloan Tuscola-Strawn association is best suited for septic system development.

Agriculture is the predominant land use in the Stahl Ditch-Kitty Run Watershed. Soil is a determining factor in agriculture production. The Crosby-Brookston association including Del Rey, Patton, Pella, Sloan, Tuscola, and Williamstown are soils in the Stahl Ditch-Kitty Run Watershed that represent prime agricultural soils.

Topography

The topography of the Stahl Ditch-Kitty Run Watershed is relatively flat. The change in elevation from the highest point of the watershed to the lowest point at the confluence of the Wildcat Creek is only 68-feet (0.3% slope).

Hydrology

There are approximately 40 miles of waterways in the Stahl Ditch-Kitty Run Watershed. These include: Canon Goyer Ditch, Edwards Ditch, Fork Creek, Kitty Run, Kokomo Creek, Michael Hallihan Ditch, Prairie Creek Ditch, Spring Run, Stahl Ditch, Villa Run, and Wildcat Creek. The watershed drains into a 15 mile stretch of the Wildcat Creek which flows predominantly from the east to west.

Only 2.6% of the watershed is classified as open water or wetland. Natural drainage in the Stahl Ditch-Kitty Run Watershed is poor. Prior to settlement in the mid-1800s, marshes and swamps were common and subsurface drains remain a necessity for crop production.

CBBEL conducted a windshield survey of the drainage ditches and stream corridors in the Stahl Ditch-Kitty Run Watershed. Filter strips along drainage ditches and riparian corridors adjacent to natural streams are an effective technique to improve water quality by trapping and filtering sediments and pollutants carried by stormwater runoff. Although of varying sizes, a substantial number of the drainage ditches in the Stahl Ditch-Kitty Run Watershed do have filter strips. The riparian corridor along the natural streams appeared to be healthy with little evidence of erosion. However, streambank erosion problems were evident where the floodplain of the Wildcat Creek, Prairie Creek Ditch, Cannon Goyer Ditch, and Kitty Run have been encroached upon by development, lawn mowing, and depositing of leaf litter.

Endangered, Threatened, and Rare Species

In addition to a wide variety of native tree species, the Stahl Ditch-Kitty Run Watershed is home to several unique plant and animal species. As shown in **Table 1-5**, there are a number of endangered, threatened, and rare plants and animals that have been identified in Howard County. The WCWA did not conduct a detailed study to verify if these plants and animals were located in the Stahl Ditch-Kitty Run Watershed.

Table 1-5: Endangered, Threatened and Rare Species

Species Name	Common Name	State Listing	Federal Listing
Crataegus pedicellata	Scarlet Hawthorn	Threatened	Not Listed
Crataegus prona	Illinois Hawthorn	Endangered	Not Listed
Crataegus succulenta	Fleshy Hawthorn	Rare	Not Listed
Glyceria grandis	American Manna-grass	Extirpated	Not Listed
Thamnophis butleri	Butler's Garter Snake	Endangered	Not Listed
Ardea herodias	Great Blue Heron	Warrants Concern	Not Listed
Lynx rufus	Bobcat	Endangered	Not Listed
Myotis sodalis	Indiana Bat or Social Myotis	Endangered	Endangered
Forest – Flatwoods	Central Till Plain Flatwoods	Significant	Not Listed

(IDNR, 1999)

Land Settlement/Early Settlement

David Foster first settled the area around the Stahl Ditch-Kitty Run Watershed in 1842. Foster selected a location on the Wildcat Creek to establish a trading post. Foster traded firearms, ammunition, blankets, small tools, and whiskey for furs from the Miami Indians (Blanchard, 1883). Treaties signed with the Miami Indians in the mid-1800s made it possible for an influx of white settlers. In 1855, the Town of Kokomo, with a population of 600, was established as the County Seat of Justice for Howard County (previously known as Richardville). The population of Kokomo continued to grow rapidly and in 1865, with a population of 2,000, Kokomo was incorporated as a city.

The discovery of natural gas in 1886 rapidly transformed the City of Kokomo into a regional industrial center. Early inventors gravitated toward the area and soon coined Kokomo as the "City of Firsts". Some of these first inventions include: the first automobile (by Elwood Haynes in 1893); the first pneumatic tire (by D.C. Spraker in 1893); and the first carburetor (by George

Kingston in 1902). The first all metal lifeboat (1941) and life raft (1943) were invented by Kokomo-based industries. Delco Radio Corporation continued the tradition with the invention of the first push button radio (1938), first signal-seeking car radio (1947), and the first all transistor car radio (1957).

Since the mid-1930's, Daimler-Chrysler Corporation (formerly Chrysler Corporation) and Delphi Delco Electronic Systems (formerly Delco Radio Corporation) have maintained successful operations in Kokomo. Both corporations directly employ a significant number of individuals themselves as well as sustain a number of support businesses and industries in the north central Indiana region.

Demographics

According to the 2000 Census, the population of Kokomo has increased 3% to 46,113 since 1990. Howard County has experienced a 5% increase in population (84,964) over the same time period. The Census data does not provide information by watershed but based on the increase in population in Kokomo and Howard County as well as the desire of the Kokomo-Howard County Plan Commission to continue to develop the US 31 corridor toward Indianapolis, the WCWA assumes the population in the Stahl Ditch-Kitty Run Watershed will continue to grow as well.

Land Ownership

The vast majority of Public Land in the Stahl Ditch-Kitty Run Watershed is privately owned. The Parks Department has the highest acreage of publicly held land in the watershed, with approximately, 137-acres of land. There are no known significant holdings of land by the State, land trust, or military.

2.0 IDENTIFICATION OF WATER QUALITY PROBLEMS AND CAUSES

As part of the watershed planning process, an inventory and assessment of the watershed and existing water quality studies relevant to the watershed must be conducted. Examination of previous work may show that data already gathered is sufficient for determining the magnitude and extent of water quality conditions, or it may indicate that additional studies are needed to characterize the water quality problems. In either case, assessing water quality information that has already been completed is part of the initial process of developing a WMP and will help to guide the identification of water quality problems and links to pollution sources in the watershed. The following section provides a summary of water quality assessments for the Stahl Ditch-Kitty Run Watershed.

2.1 PERCIEVED PROBLEMS

Individuals living and working in the Stahl Ditch-Kitty Run Watershed have proven to have a wealth of knowledge as it relates to water quality, water quantity, and other natural resource issues in the watershed. Listed in **Table 2-1** are water quality issues of concern that were identified by members of the Stahl Ditch-Kitty Run Steering Committee and other stakeholders in the watershed. In general, issues of concern can be broken down into urban water quality issues and agricultural water quality issues.

Table 2-1: Stakeholder Concerns in the Wildcat Creek Stahl Ditch-Kitty Run Watershed

Areas and Issues of Concern
AGRICULTURAL WATER QUALITY ISSUES
Nutrients
Pesticides and Toxicants
Erosion and Sedimentation
Tillage Practices/ Highly Erodible Lands
Bacteria and Pathogens
Manure Management
Cattle with Access to Creeks and Pasture Management
URBAN WATER QUALITY ISSUES
Bacteria and Pathogens
Failing and Inadequate Septic Systems and Straight Pipe Discharges
Combined Sewer Overflows (CSOs)
Wildlife and Pet Waste
Package Wastewater Treatment Plants
Nutrients
Commercial and Residential Fertilizer Applications
Toxicants
Industry/Continental Steel Superfund Site
Commercial and Residential Pesticide Application
Sedimentation, Streambank Erosion, and Channel Alterations
Urban Development and Construction and Post-Construction Practices
Stormwater Management and Impervious Surfaces
Streamside and Illicit Dumping
Low-Head Dams and Log Jams
Lack of Recreational Access Points

2.2 WATER QUALITY BASELINE STUDIES

In addition to stakeholder input, a wide variety of water quality information was evaluated in order to ensure that the planning process considered the best available water quality information relevant to the Stahl Ditch-Kitty Run Watershed. The following sections provide a summary of baseline water quality studies completed within the Stahl Ditch-Kitty Run Watershed.

2.2.1 2004 and 2006 Indiana 305(b) Report

The Indiana Department of Environmental Management (IDEM) is the primary agency involved in surface water quality monitoring and assessment in the State of Indiana. In conjunction with the requirements of the Clean Water Act and the State's goals for protecting its natural and recreational resources, the IDEM operates several monitoring programs designed to monitor and assess the chemical, physical, and biological conditions of Indiana's rivers, streams, and lakes.

The IDEM's Office of Water Quality's surface water quality basin strategy is designed to describe the overall environmental quality of each major river basin in the state and to identify monitored water bodies that do not fully support designated uses. The IDEM's surface water monitoring program was revised in 2001 to meet the goals of assessing all waters of the state within five years.

The 305(b) report is completed and submitted by the IDEM to the US EPA every two years. The report provides a compilation and summary of all of the IDEM's water quality monitoring and assessment data (compiled from AIMS database and other datasets/reports within the IDEM). All IDEM water quality data is evaluated by IDEM's 305(b) Coordinator and interpreted for each 14-digit HUC subwatershed. Each subwatershed is given a water quality rating relative to its streams status in meeting Indiana's Water Quality Standards (WQS). WQS are set at levels necessary for protecting a waterway's designated use(s), such as swim-able, fishable, or drinkable. Each subwatershed is given a rating of fully, partially, or not supportive of its designated uses. **Table 2-2** below identifies known impairments of the Stahl Ditch-Kitty Run Watershed according to the 2004 and 2006 305(b) reports.

Table 2-2: Wildcat Creek Stahl Ditch-Kitty Run Watershed 2004 and 2006 305(b) Report

Waterbody Name	Use Support	Cause (stressor) Rating
Wildcat Creek	Partially Supporting Fish Consumption Primary Contact Fully Supporting None	Highly Impaired PCBs Medium Impairment Pathogens Threatened Lead
Cannon Goyer Ditch	Fully Supporting Aquatic Life Not Supporting Primary Contact	Slight Impairment Pathogens

Waterbody Name	Use Support	Cause (stressor) Rating
Prairie Creek Ditch	Fully Supporting Aquatic Life Not Supporting Primary Contact	Medium Impairment Pathogens
Kitty Run	Partially Supporting Primary Contact	Slightly Impaired Pathogens

(IDEM, 2004; IDEM, 2006)

2.2.2 2004 and 2006 303(d) List of Impaired Waters

Chapter 303(d) of the Clean Water Act requires states to identify waters that do not or are not expected to meet applicable water quality standards with technology based standards alone. States are also required to develop a priority ranking for these waters, taking into account the severity of the pollution and the designated use of the waters. Once this listing and ranking of waters is completed, States are required to develop Total Maximum Daily Loads (TMDL) for these waters in order to achieve water quality standards. As shown in **Table 2-3** waterbodies within the Wildcat Creek Stahl Ditch-Kitty Run Watershed are listed on both the 2004 and 2006 303(d) List of Impaired Waters.

Table 2-3: Stahl Ditch-Kitty Run Watershed 2004 and 2006 303(d) Impaired Waters

Waterbody Name	Impairments
Wildcat Creek	Fish Consumption Advisory (FCA) for PCBs, *Cyanide, *E.coli*
Cannon Goyer Ditch	*E.coli*
Prairie Creek Ditch	*E.coli*
Kitty Run	*E.coli*
Michael Hallihan Ditch	*E.coli*

*The relevance of the Cyanide listing is currently being reviewed and evaluated by IDEM.
(IDEM, 2004; IDEM, 2006)

2.2.3 Fish Consumption Advisory (FCA)

Each year since 1972, three agencies have collaborated to create the Indiana Fish Consumption Advisory. These agencies include the Indiana Department of Environmental Management (IDEM), the Indiana Department of Natural Resources (IDNR), and the Indiana State Board of Health (ISBH). Each year, members from these agencies meet to discuss the findings of recent fish monitoring data and to develop the new statewide fish consumption advisory.

The 2006 advisory is based on levels of polychlorinated biphenyls (PCBs) and mercury found in fish tissue. In each area, samples were taken of bottom-feeding fish, top-feeding fish, and fish feeding in between. Fish tissue samples were analyzed for polychlorinated biphenyls (PCBs), pesticides, and heavy metals. Of those samples, the majority contained at least some mercury. However, not all fish tissue samples had mercury at levels considered harmful to human health. The main stem of Wildcat Creek in the Stahl Ditch-Kitty Run Watershed has a Category 5 (Do Not Eat) Fish Consumption Advisory for all species.

2.2.4 2002 Stream Reach Characterization and Evaluation Report (SRCER)

The Kokomo Sanitation Utility operates and maintains 24 combined sewer overflows (CSO) that discharge to either Kokomo Creek or Wildcat Creek. Six of the CSOs discharge to Kokomo Creek and the remaining 18 discharge to Wildcat Creek. In February 2002, the Kokomo Sanitation Utility in partnership with Strand Associates, Inc. completed a Stream Reach Characterization Evaluation Report (SRCER) as a component of the City of Kokomo's National Pollutant Discharge Elimination System (NPDES) Permit. The purpose of the SRCER was to characterize the effects that CSO discharges may have on the water quality of Wildcat and Kokomo Creeks. The SRCER included chemical, physical, and biological assessments of both creeks. For the purposes of this plan, only information relevant to Wildcat Creek will be discussed.

SRCER Chemical Monitoring

The chemical monitoring portion of the SRCER study involved wet weather and dry weather in-stream sampling. As shown in **Table 2-4** and **Exhibit 2-1** water quality samples were collected from a total of seven sites along Wildcat Creek. During wet weather, three of the seven samples were collected from CSO outfalls utilizing automatic composite samplers. The remaining four samples were collected from in-stream, also using composite samples, which were collected from each bank and the center of the creek. In-stream sampling took place at one site upstream of all CSO outfalls (W1), at two sites between CSO outfalls (W2 and W3), and one site downstream of all outfalls (W4). During dry weather, samples were collected from the four in-stream sites following a 72-hour period without rain or snowmelt.

Table 2-4: Wildcat Creek Sampling Sites from the City of Kokomo SRCER

Site Number	Location
W1	Carter Street
CSO #2	Ohio Street (North Bank)
CSO #6	Apperson Way (North Bank)
CSO #14	Washington Street (North Bank)
W2	McCann Street
W3	WWTP at Low-Head Dam
W3A	Upstream of Low-Head Dam at WWTP
W3B	Downstream of Low-Head Dam at WWTP
W4	CR 300 West

(SRCER, 2002)

SRCER Nutrients

Indiana currently does not have a water quality standard for Total Nitrogen or Total Phosphorus, and average concentrations of these parameters throughout Indiana and the Upper Wabash River Basin can vary substantially. Wildcat Creek is the third largest tributary to the Upper Wabash River. Data collected by IDEM in 1998 indicates that 0.12 mg/L is the average concentration of Total Phosphorus during periods of dry weather within the Wildcat Creek Watershed. The same report indicates that the average dry weather Total Phosphorus concentration within the larger Upper Wabash River Basin is 0.15 mg/L. However, according to EPA guidance on State Water Quality Standards, the recommended threshold concentration for Total Phosphorus is 0.076 mg/L, and current IDEM TMDL development in Indiana is recommending that 0.3 mg/L be used as the threshold Total Phosphorus concentration.

Similarly, EPA guidance on Water Quality Standards recommends that 2.18 mg/L be used as the threshold concentration for Total Nitrogen, and current IDEM TMDL development in Indiana is recommending that 10 mg/L be used as the threshold Total Nitrogen concentration. **Table 2-5** identifies the Total Phosphorus and Total Nitrogen concentration thresholds as identified by current Indiana TMDL development and EPA Guidance on Water Quality Standards.

Table 2-5: Recommended Nutrient Concentration Thresholds

Water Quality Standard/ Target	Recommended Total Phosphorus Concentration	Recommended Total Nitrogen Concentration
Indiana TMDL Development	0.3 mg/L	10 mg/L
EPA Guidance on Water Quality Standards	0.076 mg/L	2.18 mg/L

(IDEM, 2006: USEPA, 2006)

Considering the variance in recommended nutrient threshold concentrations, the relative extent of nutrient problems within the Wildcat Creek Stahl Ditch-Kitty Run Watershed is dependent upon the threshold concentration used for comparison. For example, if the EPA recommended Total Phosphorus concentration threshold of 0.076 mg/L is utilized as the basis for the comparison, sites W1, W2, and, W3 all had concentrations of Total Phosphorus during dry weather that exceeded EPA's recommended threshold. However, utilizing other thresholds as comparisons, such as the IDEM TMDL recommended threshold of 0.3 mg/L, none of the monitoring sites had concentrations of Total Phosphorus that were considered to be elevated. With regard to Total Nitrogen, all four sites had average dry weather concentrations below laboratory detection limits of 0.1 mg/L, which is substantially lower than both EPA and IDEM TMDL recommended standards.

During wet weather events, all sites had average Total Phosphorus concentrations, which exceeded both the EPA and IDEM TMDL recommended thresholds. Similarly, Total Nitrogen concentrations increased during wet weather sampling. However, only site W3, which had an average Total Nitrogen concentration of 2.2 mg/L, exceeded the EPA recommended threshold of 2.18 mg/L. Site W3 did not exceed the TMDL recommended concentration of 10 mg/L.

SRCER Total Suspended Solids (TSS)

Although there is currently not an ambient water quality standard for TSS in Indiana, the IDNR's Hoosier Riverwatch program has published a "rule of thumb" guideline for evaluating TSS concentrations in water samples. **Table 2-6** identifies the Hoosier Riverwatch's TSS guideline.

Table 2-6: Hoosier Riverwatch's TSS Guideline

Water Quality Characterization	TSS Ranges
Very Clean Water	0 - 3 mg/L
Normal Ambient Concentrations	4 – 11 mg/L
Elevated Concentrations with potential for impairment	12 – 16 mg/L
High Concentrations with Stream Impairments Likely	17 mg/L or above

(IDNR, 2005)

Based on this criteria, average dry weather concentrations collected from sites W1, W2, and W3 were considered elevated, and average wet weather sample concentrations collected from all sites were considered likely to be impaired.

SRCER Bacteria

As recommended by the EPA, the Water Quality Standard for full body contact recreation in Indiana is based on *E.coli* bacteria. Water quality monitoring results for *E. coli* are given in terms of the number of *E. coli* colony forming units (or CFU) in 100ml of water. For water to meet recreational standards, the geometric mean of 5 samples over a 30-day period is required to be less than 125 CFU/100ml, with no single sample testing higher than 235 CFU/100ml.

SRCER dry weather bacteria sampling conduced at each sample site indicated that average concentrations were below the grab sample Water Quality Standard for E.coli of 235 CFU/100 ml. However, during wet weather sampling events, the *E.coli* concentration at each sampling site exceeded the Water Quality Standard.

In addition to the standard wet and dry weather sampling conducted as a component of the SRCER, bacteria samples were also taken every few days on Wildcat Creek regardless of weather conditions, at sites W1, which is located just upstream of the City of Kokomo, and W3, which located just upstream of the confluence of Kokomo Creek near the Kokomo Municipal Wastewater Treatment Plant. The purpose of this analysis was to develop a baseline for bacterial contamination in Wildcat Creek, by studying bacteria trends both within and outside the CSO impact area. The results of this data collection program are summarized in **Table 2-7**.

Table 2-7: Wet and Dry Weather *E.coli* Concentrations from the City of Kokomo SRCER

Sample Site	All Samples (Mean)	Dry Weather Samples (Mean)	Wet Weather Samples (Mean)
W1	1,266 CFU/100 ml	143 CFU/100ml	3,996 CFU/100ml
W3	1,351 CFU/100 ml	146 CFU/100ml	4,281 CFU/100ml

(SRCER, 2002)

The results shown in Table 2-7 indicate that *E.coli* concentrations in the Stahl Ditch-Kitty Run watershed are in violation of the State Water Quality Standard for *E.coli* during both wet and dry weather conditions, and that *E.coli* concentrations are significantly elevated during wet weather as compared with dry weather conditions.

SRCER Physical Monitoring

Physical evaluations conducted as a component of the SRCER included a Sediment Profile Survey and a Habitat Assessment. The Sediment Profile Survey was conducted in order to identify the boundaries of the contaminated sediments associated with the Continental Steel Superfund Site (CSSS) and to identify pollutants of concern within the sediment. The purpose of the Habitat Analysis was to evaluate the physical habitats that influence the quality of the waterbody and the condition of the resident aquatic community.

Physical evaluations were conducted along Wildcat Creek at sites W1, W2, W3A and W3B, and W4. The locations of these sites are identified in Table 2-4. There is a low-head dam located at Site W3. Site W3A is located up stream of the low-head dam and site W3B is located on the down-stream side of the low-head dam. According to the Sediment Profile Survey the impact of the CSSS is evident in sediment samples from Site W3A upstream to the next low-head dam, which is located near the Phillips Street bridge crossing. The limited extent of bioturbation that occurred along this stretch the Wildcat Creek indicated that sediments were indeed contaminated with pollutants associated with the CSSS. SRCER sediment studies up stream of the low-head dam at Phillips Street and down stream of the low-head dam at Kokomo Municipal

WWTP did not indicate that sediments were contaminated. However, as will be discussed later, according to the IDEM's records, sediment contamination from the CSSS did extent downstream of the low-head dam at the Kokomo WWTP.

A physical habitat assessment of Wildcat Creek was also conducted as a component of the SRCER. Habitat assessments were conducted at the same five sites utilizing EPA's Rapid Bio-Assessment Protocols for low gradient streams. Each of the 5 sites were evaluated in terms of their epifaunal substrate/available cover, pool substrate, pool variability, sediment deposition, channel flow status, channel alteration, channel sinuosity, bank stability, vegetative protection, and width of riparian vegetation. Each of these habitat parameters was given a score ranging from 0-20, with 20 being the highest score. For each habitat parameter evaluated, a score of 0 to 5 was considered poor, a score of 6 to10 was considered marginal, a score of 11 to 15 was considered suboptimal, and a score of 16-20 was considered optimal.

For each assessed site, a total habitat raking is determined by summing all scores for each assessed habitat parameter. Sites considered to have poor habitat quality score less than 60, sites considered to have marginal habitat quality score between 60 to 109, sites considered to have sub-optimal habitat score from 110 to 159, and sites considered to have optimal habitat quality score from 160 to 200. **Table 2-8** identifies how each sampling site scored for all evaluated habitat parameters.

Table 2-8: SRCER Habitat Assessment Scores

Habitat Parameter	W1 Carter Street	W2 McCann Street	W3A WWTP (Up-stream Dam)	W3B WWTP (Down-stream Dam)	W4 CR 300 W
Epifaunal Substrate	Poor (4)	Poor (3)	Poor (5)	Suboptimal (15)	Suboptimal (15)
Pool Substrate Characterization	Poor (0)	Poor (0)	Poor (0)	Poor (0)	Poor (0)
Pool Variability	Poor (0)	Poor (0)	Poor (0)	Poor (0)	Poor (0)
Sediment Deposition	Poor (2)	Poor (3)	Poor (2)	Marginal (6)	Suboptimal (15)
Channel Flow Status	Optimal (20)	Optimal (19)	Optimal (19)	Optimal (20)	Optimal (19)
Channel Alterations	Marginal (6)	Marginal (6)	Poor (2)	Marginal (9)	Optimal (19)
Channel Sinuosity	Poor (1)	Poor (1)	Poor (0)	Poor (4)	Marginal (6)
Bank Stability (Left)	Poor (2)	Poor (3)	Poor (3)	Poor (1)	Poor (2)
Bank Stability (Right)	Poor (4)	Poor (3)	Poor (3)	Poor (2)	Poor (4)
Vegetative Protection (Left)	Poor (4)	Poor (4)	Poor (5)	Poor (4)	Poor (1)

Habitat Parameter	W1 Carter Street	W2 McCann Street	W3A WWTP (Up-stream Dam)	W3B WWTP (Down-stream Dam)	W4 CR 300 W
Vegetative Protection (Right)	Marginal (7)	Poor (4)	Poor (5)	Poor (4)	Poor (3)
Riparian Zone Width (Left)	Poor (5)	Poor (4)	Poor (1)	Poor (2)	Marginal (10)
Riparian Zone Width (Right)	Poor (2)	Poor (1)	Poor (3)	Poor (2)	Marginal (10)
Total Score	**Poor (57)**	**Poor (51)**	**Poor (48)**	**Marginal (69)**	**Marginal (104)**

(SRCER, 2002) (Numbers shown in parenthesis indicate the scored habitat value for a given site. Bank Stability, Vegetative Protection and Riparian Zone Width evaluate each bank independently.)

As shown in Table 2-10, habitats along Wildcat Creek range from marginal to poor. In general, habitat assessment results indicate that Wildcat Creek is suffering from a lack of in-stream vegetative cover, increased sediment deposition, altered stream channels, unstable stream banks, and narrow riparian buffers. These problems are typical of many riparian habitats located in urbanized areas. Site W3A scored the lowest of all sites.

SRCER Biological Monitoring

The SRCER also included an evaluation of benthic macroinvertebrates and fish populations from the same five sampling sites along Wildcat Creek. Macroinvertebrate samples were collected using the EPA Rapid Bioassessment Multi-habitat Approach, and fish samples were taken utilizing electroshock technology.

In general SRCER data indicates that stream reaches with fewer habitat modifications had improved macroinvertebrate scores, and overall, lower species richness was correlated to decreased habitat scores. Not surprisingly the ratio of pollution tolerant to pollution intolerant macroinvertebrate species rose with increased habitat scores and fell with decreased habitat scores.

Once again, site W3A showed the greatest peak in pollutant tolerant organisms, which according to the SRCER, indicates elevated organic pollution loading and low level toxicity at this site. The SRCER also concluded that the sediment contamination associated with the CSSS is the primary cause of negative species richness scores at this site. This conclusion was largely based on the fact that site W2, which is located within the stream segment considered to be impacted by CSOs, but outside of the CSSS impact area, did not appear to have such a significant increase in pollution tolerant species.

Overall the results of the fish survey indicated that a healthy fish community exists throughout Wildcat Creek. However, depressed habitat conditions at site W2 led to depressed species diversity and abundance at that site relative to others.

In an effort to prioritize projects and identify critical areas, SRCER sample sites were ranked in terms of their overall water quality. Each site was ranked with regard to Total Phosphorus concentrations, Total Nitrogen concentration, *E.coli* concentration, habitat quality, and the ratio

of pollutant tolerant to pollutant intolerant macroinvertebrate species. Each site was given a rank from 1 through 5 for each parameter. A ranking of 1 indicates that a given site had the best water quality for a particular parameter, and a score of 5 indicates that a site had the lowest water quality for a given parameter. Once each parameter was ranked for every site, each site was given a total water quality score, which was determined by summing all parameter rankings for a given site. **Table 2-9** identifies how each SRCER sampling site ranked for each parameter and shows how each site ranked in terms of overall water quality. Site W3A is considered to have the poorest water quality of all SRCER sampling sites, and is the top priority of all SRCER sampling sites.

The site rankings shown below were not conducted as a component of the 2002 SRCER study. Rather, data from the 2002 SRCER study were reevaluated using a holistic watershed management approach as a component of the Stahl Ditch-Kitty Run Watershed Management Planning Process. Both individual parameter rankings and total site rankings will be useful in identifying critical areas in Section 4.

Table 2-9: SRCER Sampling Site Water Quality Rankings

Sampling Sites	Total Phosphorus Dry		Total Phosphorus Wet		Total Nitrogen Dry		Total Nitrogen Wet	
	Average (mg/L)	Rank	Average (mg/L)	Rank	Average (mg/L)	Rank	Average (mg/L)	Rank
W1	0.8	2	0.13	1	ND	1	0.7	1
W2	0.105	4	0.19	2	ND	1	0.9	2
W3	0.9	3	0.59	4	ND	1	2.2	4
W3A								
W3B								
W4	ND	1	0.38	3	ND	1	1.6	3

Sampling Sites	E.coli Dry		E.coli Wet		TSS Dry		TSS Wet	
	Average (mg/L)	Rank	Average (CFU/100ml)	Rank	Average (mg/L)	Rank	Average (mg/L)	Rank
W1	50	4	2934	1	13	3	27	1
W2	29	3	14043	2	14	4	37	3
W3	10	1	27778	4	12.4	2	29	2
W3A								
W3B								
W4	12	2	17375	3	9.3	1	125	4

Sampling Sites	Habitat Scores	Habitat Rank	Macro Rank
W1	57	3	3
W2	51	4	4
W3			
W3A	48	5	5
W3B	69	2	1
W4	104	1	2

Sampling Sites	Water Quality Score	Water Quality Rank
W1	20	1
W2	29	4
W3		
W3A	31	5
W3B	24	3
W4	21	2

As mentioned, the purpose of the SRCER was to characterize the water quality impacts of CSOs on water quality in Wildcat Creek. The following is a summary of water quality information pulled from the City's SRCER as they pertain to the impacts of CSOs on Wildcat Creek.

- During dry weather, Wildcat Creek is relatively healthy with respect to water quality with the exception of *E. coli* bacteria.

- Average Dissolved Oxygen levels never dropped below the minimum water quality criteria.

- Ammonia-nitrogen levels appear to be slightly impacted by CSO discharges and other non-point sources of pollution. However, samples from site W1, which is located upstream of CSO impact area indicate that non-point sources of pollution are contributing to elevated ammonia-nitrogen levels.

- Total Phosphorus concentrations are generally greater downstream of CSOs. The Kokomo Municipal WWTP is likely a large contributor to phosphorus concentrations. However, even samples taken upstream of CSOs show concentrations exceeding .1mg/L, which was the recommended Total Phosphorus concentration identified by the Dissolved Oxygen and Ammonia TMDL for Kokomo Creek. These elevated upstream concentrations are indicative of non-point source pollution.

- CSOs have a definite impact on *E. coli* concentrations, however, samples taken upstream of CSO outfalls suggest significant non-point source *E.coli* loadings. This indicates that even with total elimination of CSOs water quality in Wildcat Creek would not meet the *E.coli* Water Quality Standard.

The City of Kokomo' CSO Long Term Control Plan is designed to minimize the water quality impacts associated with the City's CSOs. The purpose of the Stahl Ditch-Kitty Run Watershed Plan is to minimize non-point sources of pollution that are contributing to elevated pollutant concentrations in the entire Stahl Ditch-Kitty Run Watershed.

2.2.5 2003 Wildcat Creek TMDL Project Data Collection

During the fall of 2003, the IDEM collected water quality sampling throughout the Stahl Ditch-Kitty Run Watershed in order to assess water quality in the watershed with respect to *E.coli* bacteria. The purpose of the study was to determine whether to remove the watershed from the 303(d) List of Impaired Waters, if an *E.coli* or to develop a TMDL to eliminate the impairment, if it was confirmed. The result of this sampling program confirmed that *E. coli* concentrations in the Stahl Ditch-Kitty Run Watershed are in violation of State Water Quality Standards. According to IDEM representatives, TMDL development for the Stahl Ditch-Kitty Run Watershed is scheduled to begin in 2007.

During the 2003 study, IDEM collected five water quality samples at eleven sites within the Stahl Ditch-Kitty Run Watershed. The 5-week geometric mean State Water Quality Standard was violated at 10 of the 11 sampling locations. **Table 2-10** identifies the location of each sampling site, the 5-week geometric mean *E. coli* concentration, and the overall priority ranking for each of the eleven sites sampled as part of the TMDL study. **Figure 2-1** provides a graphical display

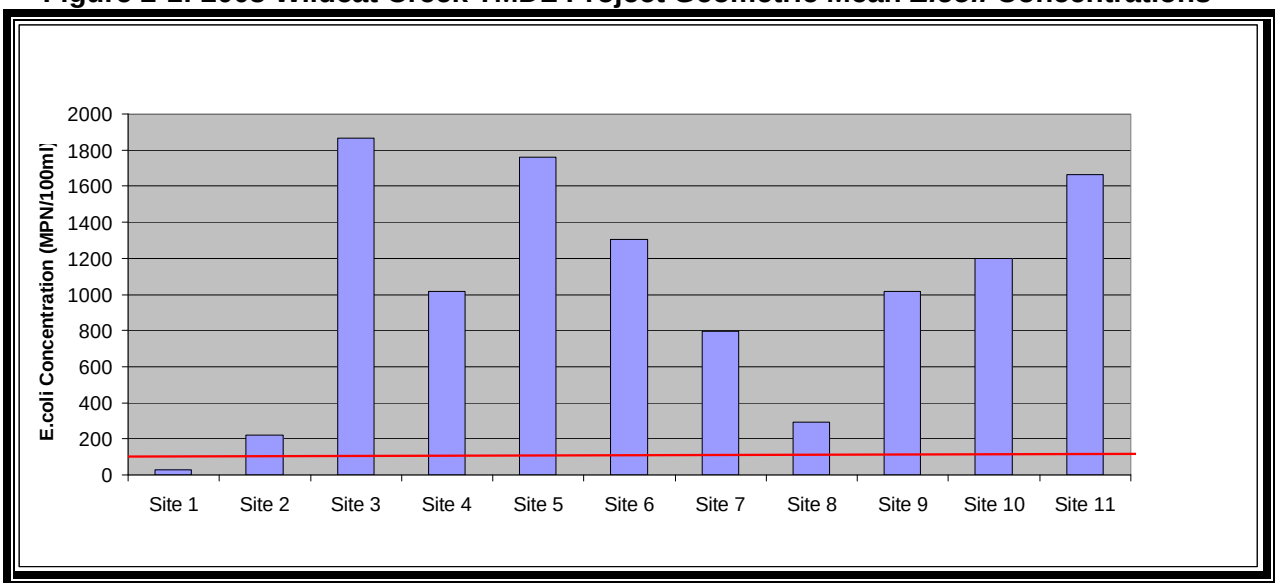
of mean *E.coli* concentrations from the project. The exact locations of the sampling sites from the IDEM study are also shown **Exhibit 2-1.**

Table 2-10: 2003 Wildcat Creek Project Mean *E.coli* Concentrations

Site Number	Stream Name	Location	Average *E.coli* Concentration (MPN/100ml)	*E.coli* Concentration Ranking
Site 1	Wildcat Creek	CR 400 East	30.56	**1**
Site 2	Wildcat Creek	CR 300 East	219.92	**2**
Site 3	Stahl Ditch	Carter Street (Cr 50 North)	1,865.7	**11**
Site 4	Cannon – Goyer Ditch	CR 150 East	1,015.58	**5**
Site 5	Prairie Creek Ditch	Jefferson Road	1,762.52	**10**
Site 6	Cannon – Goyer Ditch	Carter Street (Near US 31)	1,306.04	**8**
Site 7	Wildcat Creek	Carter Street	796.62	**4**
Site 8	Wildcat Creek	Washington Street	290.92	**3**
Site 9	Wildcat Creek	Markland Avenue	1,018.96	**6**
Site 10	Wildcat Creek	CR 440 West	1,199.76	**7**
Site 11	Michael Hallihan Ditch	CR 00 North	1,664.56	**9**

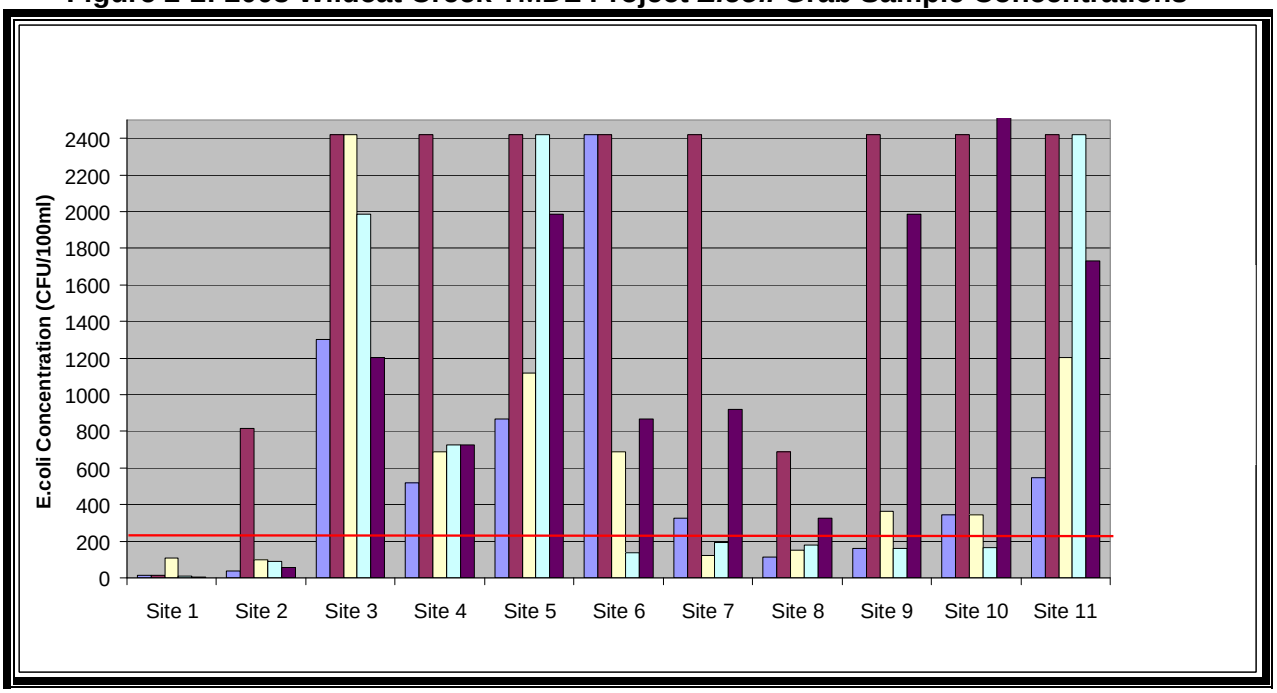
(IDEM, 2003)

Figure 2-1: 2003 Wildcat Creek TMDL Project Geometric Mean *E.coli* Concentrations



Red line identifies the monthly mean State Water Quality Standard of 125 CFU/100ml for *E.coli.* (IDEM, 2003)

Figure 2-2: 2003 Wildcat Creek TMDL Project *E.coli* Grab Sample Concentrations



Red line identifies the single grab sample State Water Quality Standard for *E.coli* of 235 CFU/100ml. (IDEM, 2003)

As shown in **Figure 2-2**, the single grab sample Water Quality Standard for *E.coli* of 235 CFU/100ml was also violated consistently in the 2003 Wildcat Creek TMDL Project. As was the case with the geometric mean Water Quality Standard, 10 of the 11 sites violated the single grab sample Water Quality Standard on at least one occasion and 9 of the 11 sites violated the single grab sample standard at least twice. In total, 67 percent of samples collected violated the single grab sample Water Quality Standard for *E.coli.*

The Kokomo Water Works Dam #2, which is located along CR 400 East in Howard County, forms the eastern border of the Stahl Ditch-Kitty Run Watershed. According to IDEM's 2003 Wildcat Creek TMDL Project, water discharged from the dam contains relatively little bacterial contamination. Site 1, which is located just downstream of the dam's spillway was the only site not to violate the *E.coli* Water Quality Standard. Site 2, which is located downstream from site 1, also on Wildcat Creek, also contained relatively little bacteria pollution and only exceeded the State Water Quality Standard for *E.coli* on one occasion. Potential sources of contamination associated with site 2 include both inadequately functioning septic systems and land application of manure. Land use adjacent to the portion of Wildcat Creek located up stream of site 2 consists of a residential subdivision served by septic systems to the north and an agricultural field to the south.

Site 3, located on Stahl Ditch at CR 50 North, and site 4, located on Cannon Goyer Ditch at County Road 150 East were both identified as having substantial concentrations of *E.coli* bacteria. The probable source associated with the elevated *E.coli* concentrations identified at these sites is the Darrough Chapel Subdivision, which is located directly between both waterways on both sides of State Road 22. There is a long history of on-site wastewater treatment problems associated with this subdivision.

Sites 5, 6, 7, 8, and 9 are all located within or directly adjacent to the City of Kokomo's municipal boundary. Land uses surrounding these sites typically consist of both light industrial and residential uses, and potential sources of *E.coli* bacteria associated with these sites are likely associated with straight pipe discharges of septic systems, illicit septic system connections to the storm sewer system, CSOs, and runoff of pet and wildlife waste.

Site 10, located on Wildcat Creek at the CR 440 West bridge crossing, had an average *E.coli* concentration of 1,200 cfu/100 ml. This site is located downstream of the confluence of Edwards Ditch/Dan Gamble Drain, which drains Breezy Hill subdivision. Breezy Hill subdivision has been identified as a residential subdivision with potential septic system problems. Site 10 is also located down stream of the confluence of Villa Run, which drains, Four Mile Hill, a residential subdivision served by a package treatment plant.

Site 11 is located on Michael Hallihan Ditch at the CR 00 North bridge crossing. Michael Hallihan Ditch drains portions of the Derbyshire Subdivision, which has been identified as a subdivision with potential septic system problems.

2.2.6 1991 – 2005 Fixed Station Water Quality Results

Under IDEM's Fixed Station Water Quality Monitoring Program, IDEM scientists collect water samples and field analytical data every month from 160 sampling sites at selected rivers, streams, and lakes throughout the state. This program has been collecting water quality samples from two sites on Wildcat Creek within the Stahl Ditch-Kitty Run Watershed since January of 1991. The first site is located within the City of Kokomo at the US 31 bridge crossing, and the second site is located west of the City of Kokomo and downstream of the confluence of Kokomo Creek at the CR 300 West bridge crossing.

Fixed Station Nutrients

Nutrient parameter sampling associated with the fixed station program included but was not limited to Total Phosphorus, Total Nitrogen, and Ammonia. The US 31 site had an average Total Phosphorus concentration of 0.10 mg/L. Of the 161 samples taken only 3 exceeded the typical TMDL target of 0.3 mg/L; however 97 samples exceeded the recommended EPA water quality criteria of 0.076 mg/L. The CR 300 West site had an average Total Phosphorus concentration of 0.32 mg/L. Of the 166 samples taken, 61 exceeded the typical TMDL target of 0.3 mg/L, while 150 samples exceeded the recommended EPA water quality criteria of 0.076 mg/L.

The US 31 site had an average Total Nitrogen value of 4.96 mg/L. Of the 161 samples, 16 exceeded the typical TMDL target and drinking water standard of 10 mg/L while 113 samples exceeded the EPA recommended threshold of 2.18 mg/L. The CR 300 West site had an average Total Nitrogen value of 5.57 mg/L. Of the 166 samples taken, 11 exceeded the typical TMDL target and drinking water standard of 10 mg/L while 150 samples exceeded the EPA recommended threshold of 2.18 mg/L.

The majority of Ammonia concentrations from both sites were below detectable limits. Of those concentrations that were detectable the US 31 site had an average concentration of 0.24 mg/L and the CR 300 West site had an average concentration of 0.16 mg/L.

Fixed Station Bacteria

E.coli concentration data for the fixed station sites was only available between 1991 and 1998. The US 31 site had an average *E.coli* concentration of 328 cfu/100ml. Of the 81 samples collected the *E.coli* Water Quality Standard of 235 cfu/100ml was violated 20 times. The CR 300 West site had an average *E.coli* concentration of 2,937 cfu/100ml. Of the 84 samples collected, the *E.coli* Water Quality Standard was violated 47 times.

Fixed Station Total Suspended Solids

The US 31 site had an average TSS concentration of 19.73 mg/L. Of the 161 samples taken, 42 had TSS concentrations in the potential to be impaired range (12 -16 mg/L) and 60 had concentrations in the likely to be impaired range (>16 mg/L). The CR 300W site had an average TSS concentration of 21.9 mg/L. Of the 166 samples taken, 33 had TSS concentrations in the potential to be impaired range (12 -16 mg/L) and 67 had concentrations in the likely to be impaired range (>16 mg/L). **Table 2-11** identifies the location of each fixed station sampling site, as well as the mean concentration associated with Total Phosphorus, Total Nitrogen, Ammonia, E.coli, and TSS.

Table 2-11: Fixed Station Sampling Site Locations and Mean Concentration

Location	Stream Name	Average Phosphorus (mg/L)	Average Nitrogen (mg/L)	Average Ammonia (mg/L)	Average E.coli (CFU/100mL)	Average TSS (mg/L)
US 31 Bridge Crossing	Wildcat Creek	.10	4.96	.24	328	19.7
CR 300 West Bridge Crossing	Wildcat Creek	.32	5.57	.16	2,937	21.9

(IDEM, 2002)

2.2.7 1998 AIMS Database Fish Community Sampling

The objective of IDEM's Fish Community Sampling Program is to assess water quality using resident fish communities as a tool to monitor the biological integrity of a stream. This monitoring aids in the classification of streams that exhibit very poor to excellent water quality conditions as well as habitat availability and quality. In 1998, fish community sampling was completed on the Wildcat Creek near East Vaile Street in Kokomo Indiana. Utilizing Qualitative Habitat Evaluation Index (QHEI) protocols habitat at the site received a QHEI score of 47 out of 100, which is classified as poor. Poor habitat quality often has a negative impact on the biological communities present.

Fish communities at this site were evaluated using the Index of Biotic Integrity (IBI), which is made up of 12 metrics that assess a community's species and trophic composition and fish condition and health, this site scored 38 out of a possible 60. As shown by **Table 2-12**, this site rated somewhere between poor and fair on the IBI scale

Table 2-12: Index of Biotic Integrity

Integrity Class	Total IBI Score	Attributes
Excellent	58-60	Comparable to pristine conditions, exceptional assemblages of species.
Good	48-52	Decreased species richness, intolerant species in particular; sensitive species present.
Fair	40-44	Intolerant and sensitive species absent; skewed trophic structure.
Poor	28-34	Top carnivores and many expected species absent or rare: omnivores and tolerant species dominant
Very Poor	12-22	Few species and individuals present; tolerant species dominant; diseased fish frequent.
No Fish	0-12	Repeated sampling finds no fish.

(IDEM, 2005)

2.2.8 1998 AIMS Database Macro Invertebrate Sampling

The objective of IDEM's Macroinvertebrate Sampling is to assess water quality using resident macroinvertebrate communities as a tool to monitor the biological integrity of a stream. This assessment is completed using the macroinvertebrate Index of Biotic Integrity (MIBI). In Indiana a stream segment is considered non-supporting of aquatic life uses when the monitored macroinvertebrate community receives and MIBI score of less than 2.2 for Kick samples. In 1991 and 1998 macroinvertebrate samples were conducted downstream from the Kokomo Reservoir along Wildcat Creek. The 1991 assessment resulted in a MIBI score of 3.6 and the 1998 assessment resulted in an MIBI score of 2.4. Based on this analysis, the portion of Wildcat Creek directly down stream from the Kokomo Reservoir is supporting aquatic life.

2.2.9 An Assessment of Pesticides in the Upper Wabash River Basin

In 1998, surface water samples from the Upper Wabash Basin were analyzed for 142 pesticides, pesticide degradation products, and urban chemicals. Atrazine, metolachlor, and acetochlor were the most represented pesticides during the study. Average concentrations for the three respective pesticides were 3.31ug/L, 2.17ug/L, and 1.04ug/L. The drinking water Maximum Contaminant Level (MCL) for each of these pesticides is 3.0ug/L for atrazine, there is no MCL for metolachlor, and 2.0ug/L for acetochlor. The study also utilized flow data and mathematical calculations to determine estimated loadings of each pesticide. Table 2-13 identifies the average concentration, Drinking Water MCL, and the percent runoff for each pesticide.

Table 2-13: Pesticide Concentrations, MCLs, and Runoff Percentages in the Upper Wabash Basin

Pesticide	Average Concentration	Drinking Water MCL	% Runoff
Atrazine	3.31 ug/L	3.0 ug/L	1.14%
Metolachlor	2.17 ug/L	N/A	1.2%
Acetochlor	1.04 ug/L	2.0 ug/L	.49%

(IDEM, 2001)

The study also evaluated which tributary watersheds to the Upper Wabash River contribute the largest pesticide loadings. In general, it was determined that pesticide loadings were correlated with a watersheds contributing land use. Large watersheds tended to contribute larger pesticide loadings and vice versa. However, the correlation was not absolute, as factors such as soil composition, rainfall totals, the timing of sampling events, and land use all influence the pollutant loadings of a watershed. The entire Wildcat Creek Watershed accounts for 10.9% of the land area in the Upper Wabash River Basin, and accounts for 13.3% of total atrazine loadings, 11.5% of total acetochlor loadings, and 16.6% of metolachlor loadings.

Overall the Wildcat Creek Watershed is the third largest tributary watershed to the Upper Wabash River and is the third largest contributor of atrazine and metolachlor loadings to the river. The report concluded that identification of tributaries contributing the greatest pesticide loads was important and that priority should be given to federally funded Clean Water Act Section 319 grant projects within these basins to help alleviate pesticide runoff potential. Currently EPA requires a 66' setback for atrazine use; numerous county landowners are utilizing federal cost share dollars to implement filter strips in order to abide by this regulation.

2.3 SUMMARY OF IDENTIFIED PROBLEMS

In subsections 2.2.1 through 2.2.9 the results of eight water quality studies were evaluated in order to identify water quality problems in the Stahl Ditch-Kitty Run Watershed. Based on data collected the following water quality problems in the watershed have been confirmed.

- Elevated Toxicant (PCBs and Pesticides) concentrations
- Elevated bacteria concentrations
- Elevated nutrient (Total Nitrogen and Total Phosphorus) concentrations
- Elevated TSS concentrations
- Degraded habitats
- Stressed biological communities (fish and macroinvertebrate)

Table 2-14 identifies the primary agricultural and urban sources of pollution suspected to be contributing to water quality problems in the Stahl Ditch-Kitty Run Watershed. These and other sources of pollution within the Stahl Ditch-Kitty Run Watershed will be discussed in more detail in Section 3.

Table 2-14: Water Quality Pollutants and Potential Agricultural and Urban Sources

Water Quality Problems	Agricultural Source	Urbanized Source	Concern
Toxicants	Pesticide Application	Industry/ Continental Steel Superfund Site	Fish Consumption
		Lawn and Garden Practices	Biological Communities Public Health
Bacteria	Poor Manure Management	Failing and Inadequate Septic Systems	Public Health Public Recreation
		Straight Pipe Discharges	
	Cattle with Creek Access	Package Wastewater Treatment Plants	Public Health Public Recreation Biological Communities
		Combined Sewer Overflows	
		Canada Geese	
Nutrients	Poor Manure Management	Failing and Inadequate Septic Systems	Biological Communities
	Cattle with Creek Access	Straight Pipe Discharges	Biological Communities
	Nutrient Applications	Package Treatment Plants	Biological Communities
		Combined Sewer Overflows	Biological Communities
		Lawn and Garden Practices	Biological Communities
TSS	Tillage Practices	Urban Development and Construction and Post-Construction Practices	Biological Communities
	Cattle with Creek Access		
Degraded Habitat	Tillage Practices	Urban Development and Construction and Post-Construction Practices	Biological Communities Public Recreation
		Impervious Areas	Biological Communities Public Recreation
	Cattle with Creek Access	Low - Head Dams	Biological Communities Public Recreation
		Log Jams	Biological Communities Public Recreation
		Streamside and Illegal Dumping	Biological Communities Public Recreation

As shown in Table 2-14, there is a clear connection between the perceived problems identified in Section 2.1 and Table 2-1 and the water quality pollutants identified via a thorough review of baseline water quality studies of the Stahl Ditch-Kitty Run Watershed. Section 3 will include a detailed discussion of the sources of water quality problems in the Stahl Ditch-Kitty Run Watershed and will lay the groundwork for the identification of critical areas and management measures in Sections 4 and 5.

3.0 IDENTIFYING POLLUTANT SOURCES

In any watershed there are two main sources of pollution, point source and non-point source pollution. This section will identify and discuss potential sources of water quality pollution problems identified in the Stahl Ditch-Kitty Run Watershed.

3.1 POINT SOURCES OF POLLUTION

Point source pollution refers to discharges that enter surface waters through a pipe, ditch, or other well-defined point of discharge. The term applies to wastewater and stormwater discharges from a variety of sources. Wastewater point source discharges include municipal (city, town, or county) and industrial wastewater treatment plants and small domestic wastewater treatment systems that may serve schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater discharges associated with industrial activities and stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s) operated by municipalities and counties. Large portions of the City of Kokomo and Howard County MS4 areas are located in the Stahl Ditch-Kitty Run Watershed. However, for the purposes of this plan, urban stormwater pollutant sources are discussed in the context of non-point source pollution.

The primary pollutants associated with point source discharges are oxygen demanding wastes, nutrients, sediments, toxic substances, ammonia, and metals. Point source dischargers in Indiana must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state. Discharge permits are issued under the NPDES program, which is delegated to Indiana by the EPA.

As shown in **Table 3-1**, there are five active permitted NPDES facilities within the Stahl Ditch-Kitty Run Watershed. **Exhibit 3-1** illustrates where in the Stahl Ditch-Kitty Run Watershed the NPDES permitted facilities are located.

Table 3-1: NPDES Facilities in the Wildcat Creek Stahl Ditch-Kitty Run Watershed

Permit Number	Facility Name	City	County	Receiving Stream
IN0023353	Four Mile Hill Sewage Treatment Plant	Kokomo	Howard	Wildcat Creek
IN0032875	Kokomo Municipal Sewage Treatment Plant	Kokomo	Howard	Wildcat Creek
IN0036935	Forest Lodge Mobile Home Park	Kokomo	Howard	Wildcat Creek via Harrison/ Harlan Ditch
IN0038784	Woodland Estates Mobile Home Park	Kokomo	Howard	Wildcat Creek via Prairie Creek Diversion
IN0044652	Devon Woods Utilities	Kokomo	Howard	Wildcat Creek

(IDEM, 2005)

According to IDEM records, over 200 permit violations have occurred from NPDES permit facilities in the Wildcat Creek Watershed. These violations include but are not limited to

violations of *E.coli*, TSS, Total Chlorine, pH, Biological Oxygen Demand (BOD), and ammonia. The extent that these point sources of pollution are contributing water quality problems in the Stahl Ditch-Kitty Run Watershed is beyond the scope of this plan. However, in order to minimize water quality impacts, these facilities should ensure that they consistently fulfill their NPDES Permit requirements.

3.2 NON-POINT SOURCES OF POLLUTION

Non-point Source (NPS) pollution refers to runoff that enters surface waters by stormwater runoff, contaminated ground water, snowmelt, or atmospheric deposition. There are many types of land use activities that can serve as sources of non-point source pollution due to the presence of impervious surfaces, including land development, construction, mining operations, crop production, animal feeding lots, agricultural drainage tiles, failing septic systems, landfills, roads and paved areas, and wildlife. These sources may contribute a single pollutant or a combination of pollutants such as, *E. coli* bacteria, heavy metals, pesticides, oil and grease, and any other substance that may be washed off the ground or removed from the atmosphere and carried into surface waters.

3.2.1 Non-Point Sources From Agricultural Lands

The National Water Quality Inventory (NWQI), sponsored by the EPA, reports that agricultural non-point source pollution is the leading source of water quality impacts to surveyed rivers and lakes, the third largest source of impairments to surveyed estuaries, and a major contributor to ground water contamination and wetlands degradation.

NPS pollutants that result from agricultural activities include nutrients, pesticides, sediment, and pathogens. These pollutants can migrate from agricultural lands to surface and ground waters through processes including surface runoff, erosion, and infiltration. It is important to note that these pollutants are not specific to agriculture and can originate from residential and urban lands as well. Urban sources of these pollutants will be discussed in **Section 3.3.** Agricultural sources of these pollutants include conventional tillage practices, fertilizer and pesticide application, poor manure management practices, and cattle with access to creeks. The remainder of this subsection identifies agricultural non-point sources of pollution within the Stahl Ditch-Kitty Run Watershed.

Agriculture is the predominant land use in the Stahl Ditch-Kitty Run Watershed. According to the Howard County SWCD there are currently 892 cropped fields and approximately 19,000 cropped acres in the Stahl Ditch-Kitty Run Watershed. Like most of Indiana, corn and soybeans dominate the crops grown in Howard County. In 2003, Howard County producers planted 73,000 acres of soybeans, 67,000-acres of corn, 1,600-acres of wheat, and 1,800-acres for forage. The County ranks 36th in the State for both corn and soybean production.

Nutrients and Agricultural Lands

Nutrients such as phosphorus and nitrogen in the form of commercial fertilizers, manure, sludge, legumes, and crop residues are applied to enhance crop production. In small amounts, nitrogen and phosphorus are beneficial to aquatic life, however, in over abundance; they can stimulate the occurrence of algal blooms and excessive plant growth.

Algal blooms and excessive plant growth often reduce the dissolved oxygen content of surface waters through plant respiration and decomposition of dead algae and other plants. This

situation can be accelerated in hot weather and low flow conditions because of the reduced capacity of the water to retain dissolved oxygen in these conditions. Fish and aquatic insects need the oxygen that is dissolved in water to live, and when decaying algae uses up that oxygen, fish kills can result. There are currently no known specific waterways that are experiencing rapid plant growth or eutrophication. However, considering that approximately 64% of the watershed is currently associated with agricultural land uses, there is a concern that excessive plant and algae growth could soon result. As the WCWA and other groups begin implementing and continue updating this plan, efforts should be made to identify and prioritize these areas.

The Office of Indiana State Chemist annually publishes the total tonnages of commercial fertilizers sold in each Indiana County. The list includes single nutrient fertilizers, multi-nutrient fertilizers, as well as, organic and micronutrient fertilizers. **Table 3-2** estimates the annual nutrient application in the watershed. Total county-wide application rates were multiplied by the percent of the County's land area within the Stahl Ditch-Kitty Run Watershed in order to estimate watershed wide application.

Table 3-2: Estimate of Nutrient Applications

County	% of County in Watershed	x	Total Nutrients (tons)		X 2,000 lbs/ton	Nutrients in watershed (lbs)	
			N	P2O5		N	P2O5
Howard County	15.69	x	3,209	973	X 2000	1,006,984	305,327

(Purdue University, 2000)

The table shown above describes an estimate of the amount of fertilizer applied in the Stahl Ditch-Kitty Run Watershed and is not an estimate of loadings to waterways. Based upon crop removal rates, it is expected that only a portion of the applied fertilizer nutrients would be mobilized to local waterways as a majority of the macronutrient would be utilized by the crop to which it was applied.

Pesticides and Toxic Chemicals and Agricultural Lands

Pesticides include a broad array of chemicals used to control plant growth (herbicides), insects (insecticides), and fungi (fungicides). These chemicals have the potential to enter and contaminate water through direct application, runoff, wind transport, and atmospheric deposition. They can kill fish and wildlife, contaminate food and drinking water sources, and destroy the habitat that animals use for protective cover.

While some pesticides undergo biological degradation by soil and water bacteria, others are very resistant to degradation. Such non-biodegradable compounds may become "fixed" or bound to clay particles and organic matter in the soil, making them less available. However, many pesticides are not permanently fixed by the soil. Instead they collect on plant surfaces and enter the food chain, eventually accumulating in wildlife such as fish and birds. Many pesticides have been found to negatively affect both humans and wildlife by damaging the nervous, endocrine, and reproductive systems or causing cancer (Kormondy 1996).

According to IDEM's 1998 Assessment of Pesticides in the Upper Wabash River Basin, the Wildcat Creek Watershed is the third largest contributor of atrazine and metolachlor loadings to

the Upper Wabash River. The extent that the Stahl Ditch-Kitty Run Watershed is contributing to this loading is not clear, but given the large amounts of agricultural land in the watershed, pesticide management programs should be implemented in the watershed.

Erosion and Sedimentation and Agricultural Lands

Erosion and sedimentation occur when wind or water runoff carries soil particles from an area, such as a farm field or stream bank, and transports them to a water body, such as a stream or lake. Excessive sedimentation clouds the water, which reduces the amount of sunlight reaching aquatic plants; covers fish spawning areas and food supplies; and clogs the gills of fish.

Furthermore, pollutants such as phosphorus, pathogens, and heavy metals move through the landscape attached to microscopic soil and organic particles. These same microscopic particles are easily transported in overland flow and are stored in and carried by streams throughout the watershed.

Highly Erodible Lands (HEL), if not managed properly, can erode at an accelerated rate and may lead to excessive soil deposition in waterways. HELs are determined based on slope and other erodibility factors and if not managed properly can erode at a rate higher than the tolerable rate. According to the USDA, the soil of an entire crop field is considered erodible if at least one-third of the field has highly erodible soils.

Erosion from highly erodible lands has been identified as concern, as land disturbing activities occurring on these lands such as livestock grazing, crop tillage, or clearing and grading associated with new development are likely to increase sediment loadings to nearby waterbodies. HELs in the Stahl Ditch-Kitty Run Watershed are illustrated in **Exhibit 3-2**.

One way to minimize sedimentation and erosion associated with agricultural activities is to implement conservation tillage practices. According to the 2004 Cropland Tillage Data from Indiana DNR, 4% of corn and 39% of soybeans acreage in Howard County was in no-till or mulch till production. No till refers to any direct seeding system including strip preparation, with minimal soil disturbance. Mulch till refers to any tillage system leaving greater than 30% crop residue cover after planting, excluding no-till. No-till and mulch till are often grouped together into conservation tillage.

Table 3-3 was created to compare various tillage methods utilized within the watershed. It is clear that while no-till soybeans seem to be an accepted practice throughout the watershed, no-till corn has not been widely established. Resistance to utilizing conservation tillage in corn production can be attributed to several rationale including the needed acreage for manure application and associated incorporation methods, increased moisture attributed to the combination of poorly draining soils and excess fodder, and the concern of inconsistent plant populations and yield reductions. Reduced tillage, with 15-30% residue remaining following the harvest and present during the critical erosion period, utilized for corn production does seem to be a more operator-accepted practice.

Table 3-3: Percent of Crop Acres in Conservation Tillage

County	Crop	% No Till (2004)	% Mulch-Till	% Conventional Till	State Rank
Howard	Corn	2%	9%	89%	89 of 92
Howard	Soybeans	27%	65%	18%	88 of 92

An increase in conservation tillage practices in the Stahl Ditch-Kitty Run Watershed will likely reduce the loading of fine clay particulates and surface erosion materials that are delivered to adjacent waterways. Load reductions associated with increased conservation tillage practices and other agricultural field practices are identified in **Section 4.3**.

In addition to promoting and improving the implementation of conservation tillage on agricultural grounds, natural conservation buffers along natural waterways and filter strips along drainage ditches should be promoted. Buffers and filter strips are an integral part of the form and function of a healthy waterway system. Although the appearance of conservation buffers differs between natural streams and drainage ditches, the functions remain the same - to improve water quality by filtering and trapping sediments, nutrients, and other pollutants carried by stormwater runoff, to store large quantities of stormwater and gradually release it to receiving waterways, and to create important aquatic and terrestrial habitats.

Figure 3-1: Inadequate Filter Strip

Conservation buffers along natural streams usually consist of a natural and dense network of grasses, shrubs, and trees. Buffers along drainage ditches usually consist of swaths of mowed cool season grasses, regularly maintained to prevent the development of woody plants. Funds are available through the Conservation Reserve Program (CRP) and the Environmental Quality Incentives Program (EQIP) to assist with the implementation of a conservation buffer initiative. These programs function as cost-share programs and are accessible through the Howard County SWCD offices.

In an effort to identify natural streams and drainage ditches that lacked sufficient conservation buffers, a windshield survey of the watershed was conducted and 2004 aerial photography was reviewed. Of the approximately 40 miles of waterways in the Stahl Ditch-Kitty Run Watershed, approximately 11 miles of waterways lacked sufficient conservation buffers. Priority areas for conservation buffer or filter strip creation are identified in **Exhibit 3-3**. Priority areas should be field verified, prior to implementation. **Figure 3-1** identifies a stretch of Cannon Goyer Ditch, which is not adequately protected by a filter strip. **Figure 3-2** identifies a stretch of Michael Hallihan Ditch, which has received cost-share funding through the NRCS to implement filter strips.

Figure 3-2: Adequate Filter Strip

Based on a 2005 review of Howard County SWCD records, approximately 20-acres of land are currently enrolled in filter strip programs. While this is a strong start, many additional areas in the watershed should be targeted for filter strip implementation.

The Howard County Surveyor's Office has developed an excellent program to encourage the implementation of filter strips along county regulated drainage ditches. Under this policy, anytime the Surveyor's Office cleans a regulated drain, they request that the adjacent property owner implement a 30-foot filter along that stretch of regulated drain. If the owner denies the request, they are required to fund future maintenance activities along that stretch of drain.

Bacteria, other Pathogens and Agricultural Lands

Manure, whether being stored, applied for crop nutrition, or simply the by-product of grazing is a water quality concern in the Stahl Ditch-Kitty Run Watershed. The nitrogen and phosphorus that make manure so productive on farm fields can create an over-fertilized "soup" when they run off into waterways, leading to undesirable algae blooms.

Nutrients in manure are generally less available than nutrients in most fertilizers and therefore the use of manure as a fertilizer is slightly more complicated than more traditional fertilizers. Despite this, many studies have determined that yields on land application areas are equivalent or superior to those attainable with inorganic fertilizers. However, the potential pollutants in manure such as organic material, nutrients, and pathogens certainly pose a risk to surface water quality. The best way to manage for and mitigate the potential water quality impacts of manure application and storage is to ensure that storage, application rates, and timing aspects are appropriately addressed through the implementation nutrient management plans.

Livestock and pasture lands are also contributors of bacteria and pathogens to local waterways. Howard County ranks 12th in the State for hog production with approximately 85,400 head of hog, 75th in the State for cattle production with approximately 3,700 head of cattle, and 61st in the State for sheep production with 267 head of sheep.

A Confined Feeding Operation (CFO) is a livestock operation that has in excess of 600 hogs, 300 cattle, or 600 sheep. These facilities are required, by IAC 16-2-5, to obtain a permit from IDEM's Office of Land Quality. According to IDEM's records, there are two Confined Feeding Operations (CFOs) located in the Stahl Ditch-Kitty Run Watershed. These facilities are identified in Exhibit 3-1. Based on the evaluation of IDEM records there have been no violations or enforcement actions taken on these CFOs, and they are both believed to be going through voidance and will soon no longer meet the Confined Feeding Operation (CFO) definition. It is important to identify that these facilities exist in the Stahl Ditch-Kitty Run Watershed, but that identification is not intended to indicate that these specific facilities are negatively impacting water quality.

Figure 3-3: Small Farm

As shown in **Figure 3-3**, there are a few small farms in the Stahl Ditch-Kitty Run Watershed with small numbers of cattle, horse, sheep, and/or poultry. Pasture management can be an effective management measure to reduce any impacts that livestock operations have on water quality. Pasture management leads to better weed

control, better soil structure, increased productivity over longer periods of time, and healthier animals. It also helps the soil absorb excess water, manure, nutrients and other pollutants and ultimately protects water quality by reducing the amount and improving the quality of runoff.

Pastures can be grazed intensively during peak periods of growth, but they need regular attention. Rest periods are critical to proper pasture growth. A grazing rotation that allows 21 to 28 days of regrowth between grazing periods is usually best. Pasturing too many animals on a given parcel of land or allowing them to graze for too long in the same area reduces plant vigor and compacts soils, reducing absorption capacity and pasture recovery. Overgrazing can lead to additional runoff and a poorer quality of runoff. Relative to other similar watersheds, there seems to be relatively few livestock operations within the Stahl Ditch-Kitty Run Watershed. In addition to managing pastures, it is important to ensure that livestock on these lands to not have access to waterways.

3.2.2 Non-Point Sources From Urbanization

The potential pollutants associated with urban land uses are generally very similar to common agricultural pollutants. Nutrients, toxicants and pesticides, sediment, and pathogens are the primary pollutants associated with both rural and urban land uses. However, the sources of those pollutants vary substantially between urban and agricultural areas. A change in land use, especially from field or forest to urban development, has a significant impact on water quality. Not only is the permeability of the soil affected by construction compaction and impervious coverage such as rooftops, driveways, and parking areas, but there is an increase of biological and chemical waste from human use. The primary sources of pollutants from urbanized areas within the Stahl Ditch-Kitty Run Watershed include but are not limited to CSOs, human & animal waste, development practices, impervious surfaces, illegal dumping, and the CSSS. There is also a concern that the four low-head dams along Wildcat Creek are compounding water quality problems. The remainder of this subsection identifies urban non-point sources of pollution within the Stahl Ditch-Kitty Run Watershed.

Bacteria, other Pathogens and Urban Lands

As discussed in Section 2, the water quality impacts of the City of Kokomo's CSOs have been well studied and documented. The Stahl Ditch-Kitty Run Watershed Management Plan was developed under the assumption that the City of Kokomo's CSO Long Term Control Plan will adequately address the impacts that CSOs have on water quality in the watershed. However, CSOs are not the only contributing source of bacteria and pathogens in the watershed, and the Stahl Ditch-Kitty Run Watershed Management Plan has been developed with the goal of minimizing the water quality impacts of other contributing sources of bacteria and other pathogens such as inadequately functioning septic systems and wildlife and pet wastes.

Septic systems can be a safe and effective method for treating wastewater if they are sized, sited, and maintained properly. However, in Howard County 94% of soils are unsuitable for conventional septic systems. **Exhibit 3-4** identifies soils severely limited for septic systems within the Stahl Ditch-Kitty Run Watershed.

The Howard County Health Department has been electronically tracking all new septic system installations since 1998. Information related to soil type, permit application, legal plat, inspection reports, and permit issuance is currently being tracked. In the future the Howard County Health Department is hopeful that they will be able to identify and track all newly installed or repaired septic systems within the County.

Outside the City of Kokomo, septic systems are the primary source of wastewater treatment. However, in many cases, homeowners are often unaware of how septic systems function, where their system is located, or how they should maintain their system. In addition, sometimes septic systems are tied directly into local drainage tiles or ditches. While this connection may have been intentional at one time, often times current home owners or tenants are unaware that their wastewater is tied directly into nearby drainage structures. In addition, numerous septic systems are believed to be located in floodplains, which pose an additional risk during floods. During the planning process for the Stahl Ditch-Kitty Run Watershed Management Plan, stakeholders and Steering Committee members made numerous comments regarding instances of failing septic systems or straight pipe discharges in the watershed, and discussions with staff from the Howard County Health Department confirmed that improperly functioning septic systems are a significant source of water quality problems in the watershed. **Exhibit 3-4** identifies sub-divisions believed to have a high number of failing and/or inadequate septic systems in the watershed.

In the past the Howard County Health Department has conducted detailed studies of subdivisions and neighborhoods suspected of having high incidences of failing septic systems and straight pipe discharges. In addition, the Health Department responds to complaints regarding septic systems that are believed to be functioning improperly, and as Stormwater Phase II communities, Howard County and the City of Kokomo will soon begin implementing proactive programs to identify and eliminate all illicit discharges to the storm sewer system. The County's Ordinance went into effect on January 1, 2007 and the County's Ordinance is anticipated to go into effect on April 1, 2007.

Wildlife and pet wastes can also contribute significantly to the concentrations of bacteria and pathogens in surface water. Habitually, ducks and geese nest in colonies located in trees and bushes around rivers, streams, and lakes. The presence of waterfowl has been shown to result in elevated levels of ammonia, organic nitrogen, and bacteria. In addition, waterfowl activity can increase sediment loadings by pulling up grasses and sprouts and trampling emergent vegetation along streambanks and shorelines, significantly impacting erosion and causing sedimentation.

Canada geese are believed to be a substantial contributor of nutrients and bacteria to waterbodies within the Stahl Ditch-Kitty Run Watershed. In addition to local retention and detention ponds, Canada geese are believed to be impacting the water quality of the Wildcat Creek as it flows through both Foster and Waterworks Parks within the City of Kokomo.

Lake Access is a Minnesota based initiative that began in 1999 to deliver real-time water quality information on Minneapolis metropolitan lakes to the public using advanced sensor technology and the Internet. According to their research, the average goose dropping has a dry weight of 1.2 grams and each goose is responsible for approximately 82 grams of feces per day. Dropping are typically made up of 1.3% phosphorus. Therefore, assuming that there are an average of 40 resident Canada geese at both Foster and Waterworks Parks, it is estimated that Canada geese are responsible for approximately 64 lbs of phosphorus per year. However, it is important to note that only a portion of this phosphorus actually makes its way into Wildcat Creek.

Management strategies for controlling Canada geese and other waterfowl include reducing or eliminating all mowing activities within 50' – 75' of a waterbody, minimizing watering and

fertilizing activities within 50' – 75' of a waterbody, planting less palatable species of grass and plants along the waters edge, prohibiting feeding, and utilizing auditory, visual, and physical scare tactics.

Additionally, recent water quality studies done by the Maryland Department of the Environment Pet waste is the second most common source of bacteria in the Washington DC area. Pet wastes can be controlled through ordinances requiring collection and removal of the waste from curbsides, yards, parks, roadways, and other areas where the waste can be washed directly into receiving waters. Load reductions associated with implementing management measures designed to minimize microbial loadings will be discussed in Section 4.3.

Nutrients and Urban Lands

As discussed previously, CSOs, septic systems, and wildlife and pet wastes are also substantial contributors of nutrients to the waterbodies of the Stahl Ditch-Kitty Run Watershed. However, lawn and garden practices are also a substantial source of nutrients in the watershed. Professional lawn and garden chemical applicators receive training and are required to maintain application records, but the average homeowner does not. Therefore, the average homeowner often over-applies lawn and garden chemicals, which are easily washed away and contribute significant nutrient loads to adjacent waterbodies.

Additionally, yard wastes such as grass clippings, leaves, and dead plants are high in organic matter, and when piled or dumped on nearby stream banks they can potentially smother naturally stabilizing vegetation, which can lead to increased bank erosion and decreased levels of dissolved oxygen. Yard wastes are considered a source of pollution in the Stahl Ditch-Kitty Run Watershed, however the relative extent of that pollution is not known at this time. The Howard County Solid Waste District has educational information on the benefits of composting or mulching yard waste as opposed to disposing of it. Load reductions associated with implementing management measures designed to minimize nutrient loadings will be discussed in Section 4.3.

Toxicants and Urban Lands

Lawn and garden chemicals include both fertilizers and pesticides. Just as over application of fertilizers can lead to increased nutrient concentrations, over application of pesticides can result in fish kills and drinking water contamination. However, residential land uses are not the urban land use of greatest concern, when it comes to toxicants.

Figure 3-4: Continental Steel Superfund

The byproducts of industrial processes can have negative impacts on water quality. As mentioned in Section 2, the main stem of Wildcat Creek in the Stahl Ditch-Kitty Run Watershed is contaminated with PCBs. Much of this contamination is the result of former industrial processes conducted at the Continental Steel Superfund Site.

The Continental Steel Superfund Site is located along West Markland Avenue in the City of Kokomo, and is identified in **Figure 3-4.** The site was operated by Continental Steel and its predecessors from approximately 1914 to 1986, when it ceased operations after filling bankruptcy. The facility produced nails, wire, and wire fence from scrap metal. Operations included reheating, casting rolling, drawing, pickling, galvanizing, tinning, and tempering. To facilitate site clean-up, the 183- acre site has been divided into six operable units consisting of an abandoned steel manufacturing facility (Main Plant Area), pickling liquor treatment lagoons (Acid Lagoon Area), a former waste disposal area (Markland Quarry), a former waste disposal and slag processing area (Slag Processing Area), onsite creeks, and the groundwater located under the site.

Contaminants and threats associated with the site include volatile organic compounds (VOC), PCBs, Polynuclear Aromatic Hydrocarbons (PAHs), and metals associated with site activities. These substances were found in the groundwater, soil, sludges, and sediments around the site. The CSSS is currently undergoing clean-up, and at the time of final draft of this plan, PCB contaminated sediments from stretches of Wildcat Creek were being removed. Remediation practices are discussed in more detail on Section 4.0.

Sedimentation, Streambank Erosion, and Channel Alteration and Urban Lands

Nationwide, more than 1.5 million acres of land are developed each year. Improperly managed growth and development can lead to rapid sedimentation of waterways, increased runoff volumes, streambank erosion, as well as the loss of riparian buffers, habitat corridors, and floodwater storage.

When construction and development activities are left uncontrolled, large amounts of soil and other small particles collectively called sediment can move off of construction sites and into adjacent waterbodies. By volume, sediment is the greatest pollutant entering our nation's surface waters. Suspended sediment increases the solar heating of water, scours aquatic life in streams, and clogs the gills of fish and aquatic insects. Once deposited, sediment buries and destroys plant and animal habitat critical to healthy streams, lakes, and wetlands.

Figure 3-5: Streambank Erosion just west of the CR 400 East Bridge Crossing.

Unfortunately, the water quality impacts of new development often last long beyond the construction phase. As development increases in a watershed, the amount of impervious area increases and the amount of open space and pervious areas in the watershed decrease. One of the most beneficial types of open space in any watershed are riparian corridors. These areas consist of large overstory trees, smaller woody shrubs, and herbaceous groundcover. Riparian corridors naturally function to filter and trap sediments and

pollutants, anchor the stream bank to prevent erosion, and shade the creek making it more habitable for aquatic species.

The eastern most stretch of Wildcat Creek between the Kokomo Reservoir Spillway located at CR 400 East and the City of Kokomo's municipal boundary, and the western most stretch of the of Wildcat Creek from the City of Kokomo's western boundary to the confluence of the Little Wildcat Creek has a fairly healthy riparian buffer system. These existing riparian buffers provide a valuable water quality benefit and should be protected from encroaching development or neighboring land uses and stretches lacking sufficient cover should be prioritized for reestablishment of buffers.

As identified in **Figure 3-5 and Figure 3-6**, another result of development and increasing amounts of impervious area is streambank erosion. Increased runoff volumes associated with impervious areas often result in substantial and sometimes very rapid streambank erosion. When stream flow rates exceed the resistance ability of nearby soils and vegetation, bank erosion occurs. Over the course of this project, Section Coordinators from the Wildcat Guardians and other volunteers inventoried stream corridors along Wildcat Creek and identified several areas where stream bank erosion was occurring. These problems are identified in **Section 4.2.**

Figure 3-6: Bank Erosion on Edwards Ditch/ Dan Gamble Drain (Mayfield Rolling Acres)

Considering the water quality impacts that new development can result in, it is not surprising that the amount of imperviousness in a watershed can be directly related to the health of the receiving streams within that watershed. As shown in **Table 3-4**, the Center for Watershed Protection (CWP) has developed a classification system for managing headwater streams based on the percent of impervious land in the watershed. According to the CWP, watersheds with more than 10% imperviousness are considered impaired and pose an additional challenge to achieve water quality standards.

Table 3-4: Stream Classification Based on Imperviousness in Watershed

Urban Stream Classification	Sensitive Stream (0-10% Impervious)	Impacted Stream (11-25% Impervious)	Non-supporting Stream (26-100% Impervious)
Channel stability	Stable	Unstable	Highly Unstable
Water quality	Good	Fair	Fair-Poor
Stream biodiversity	Good-Excellent	Fair-Good	Poor
Resource objective	Protect biodiversity and channel stability	Maintain critical elements of stream quality	Minimize downstream pollutant loads
Water quality objectives	Sediment and temperature	Nutrient and metal loads	Control bacteria
Stormwater practice selection factors	Secondary environmental impacts	Removal efficiency	Removal efficiency
Land use controls	Watershed-wide	Site limits	Additional infill and redevelopment
Monitoring and enforcement	GIS mapping of impervious areas and biomonitoring	GIS mapping of impervious areas and biomonitoring	Pollutant load modeling
Development rights	Transferred out	None	Transferred in
Riparian buffers	Widest buffer network	Average buffer width	Greenways

(Schueler, 2000)

In the Stahl Ditch-Kitty Run Watershed there are approximately 7,000-acres of land classified as either high density residential, low density residential, commercial, industrial, or transportation. According to guidance from the CWP each land use type can be assumed to have a certain percentage of impervious surfaces. In order to estimate impervious surface acreages within the Stahl Ditch-Kitty Run Watershed, the total acreage of a given land use was multiplied by its land use coefficient (percent of impervious surfaces associated with a given land use).

Depending on the land use coefficient used, the Stahl Ditch-Kitty Run Watershed is estimated to have between 2,680 (9%) and 3,700 (11%) impervious acres of land, and falls somewhere between sensitive and impacted on the CWP's stream classification based on imperviousness. In order to prevent further degradation of waterways in the watershed, the CWP suggests implementing strict zoning practices, site imperviousness restrictions, stream buffers, and stormwater management practices.

The City of Kokomo and Howard County have done a good job of controlling haphazard and unplanned growth outside of designated urban areas, and of minimizing the natural resource and water quality impacts of growth and development. Both the City and County Comprehensive Plans include numerous environmental objectives such as:

- Protecting the water quality of Wildcat Creek
- Conserving natural areas such as floodplains and forests
- Establishing and maintaining streamside vegetation buffers
- Reserving quality open space for recreational areas and wildlife habitat
- Minimizing conflicts between growth and the natural environment
- Protecting and preserving natural drainage areas and the 100-year floodplain

The City and County have also adopted provisions in their local ordinances that prohibit a net loss of 100-year floodplain capacity due to building or filling. Additionally, as a component of the federal stormwater requirements all new and redevelopment projects disturbing greater than or equal to one acre of land in Howard County and the City of Kokomo are required to develop and implement stormwater pollution prevention plans, which specify how a given development will minimize stormwater pollution both during and after the construction phase.

In addition, to water quality impacts associated with growth and development, stream reaches in urban areas are often impacted by man-made alterations. As previously mentioned, the eastern most boundary of the Stahl Ditch-Kitty Run Watershed begins at the Kokomo Waterworks Dam, which forms the Kokomo Reservoir. While this is likely the most significant dam along the Wildcat Creek within Howard County, it is certainly not the only dam along the creek. Within the Stahl Ditch-Kitty Run Watershed there are 4 low-head dams that restrict the flow of the river. **Table 3-5** identifies the four low-head dams located in the Stahl Ditch-Kitty Run Watershed (starting with the most upstream dam). **Figure 3-7** shows the Guillotine Dam, which is located just upstream from of the Phillips Street Bridge.

Table 3-5: Low-Head Dams on Wildcat Creek

Name	Location
Waterworks Dam	Upstream of Carter Street Bridge
Crystal Street Dam	Upstream of Crystal Street Bridge
Guillotine Dam	Upstream of Phillips Street Bridge
Continental Steel Dam	South of Markland Avenue near the Kokomo Wastewater Treatment Plant

Figure 3-7: Guillotine Dam

Throughout the planning process these low-head dams were frequently mentioned as an issue of concern. Stakeholders and Steering Committee members are concerned that the dams are compounding water quality problems along Wildcat Creek and are acting as impediments to recreational opportunities on Wildcat Creek.

Nationally, the water quality impacts of low head dams have been the target of limited study. However, one such study completed in 1995 entitled *Effects of Multiple Low-Head Dams on Fish, Macroinvertebrates, Habitat, and Water Quality in the Fox River, Illinois* examined a 171 kilometer reach of a Midwestern warm water river that was divided by some 15 dams into a series of free flowing and impounded habitats. This study showed that fish communities, macroinvertebrate communities, habitats,

and overall water quality were better in free flowing stretches of the river as compared with impounded stretches.

While a detailed study of the water quality impacts of the low-head dams along Wildcat Creek has not been completed, results of the water quality sampling completed as a part of the City of Kokomo's SRCER indicated that site 3A, which is located upstream of the Kokomo Wastewater Treatment Plant Dam had the poorest water quality of all sites sampled as a part of the SRCER. According to a summary report from the *2002 River Restoration Workshop: A Hands-On Workshop on the Latest Techniques for Dam Removal,* which covered the basic environmental, regulatory, and socio-political issues related to small dams, decision makers considering dam removal are encouraged to consider:

- Who owns the dam, or has it been abandoned?
- Does the dam serve any economic or recreational function? To what degree is the dam a public safety hazard, environmental problem, or barrier to recreation?
- How do local residents perceive the dam? What functional, safety, economic, environmental, and cultural values does the public attribute to the structure?
- How much would it cost to remove the dam? Who will pay for removal?
- Who will remove the dam? What is the time frame? What permits are needed?
- What affect will dam removal have on adjacent property values?
- What will the upstream and downstream impacts be during and after the dam is removed or repaired? How will riparian habitat be affected?

In addition, there are several areas within the watershed that have experienced illegal filling, illegal dumping, and a variety of other channel alterations. These activities can increase sediment loadings to waterways, reduce native habitat and vegetation, and provide invasive species with opportunities to out compete natural vegetation. In addition, channel alteration is typically not visually pleasing and reduces the aesthetic value of the waterways on which it occurs. **Figure 3-8** identifies a stretch of Wildcat Creek between Apperson Way and North Union Street within the City of Kokomo, where excess concrete has been disposed of along the banks of the Wildcat. This is typical of many streambanks throughout much of Wildcat Creek as it runs through the City of Kokomo. **Figure 3-9**, identifies illegal dumping activities observed by volunteers from the Wildcat Guardians. This site is located approximately 500 to 1000-feet downstream of the confluence of Kokomo Creek.

Figure 3-8: Illegal Dumping/ Channel Alteration along Wildcat Creek

Figure 3-9: Illegal Dumping/ Channel Alteration along Wildcat Creek

Log Jams have also been identified as an issue of concern in the Stahl Ditch-Kitty Run Watershed. The term "log-jam" is defined by the Indiana Administrative Code as the accumulation of lodged trees, root wads, or other debris that impedes the ordinary flow of water through a waterway. As these log jams are created, areas of significant erosion and stream bank destabilization are created further degrading water quality through sedimentation. Log jams may range in severity from leaning trees that need to be removed and utilized to stabilize the nearby streambank, to areas requiring large excavation equipment from both land and within the stream for proper removal. With each degree of severity and corresponding workload, restrictions and guidelines provided by IDNR and the Army Corps of Engineers (ACoE) must be adhered to rigorously. Plans of work and permits are also required for more intensive situations. Historic and existing log jams occurring along Wildcat Creek are identified in Table 4.3 in Section 4.

3.3 SUMMARY OF POLLUTANT SOURCES

As discussed in Section 3.1 and 3.2, there are a variety of urban and agricultural sources of pollution in the Stahl Ditch-Kitty Run Watershed. These sources are contributing to elevated concentrations of PCBs, bacteria, nutrients, pesticides, and TSS and are resulting in degraded habitats and stressed biological communities in the watershed. In order to effectively reduce the impacts of these pollutants are having, critical areas in the watershed, which need to be either enhanced or mitigated, need to be targeted for the implementation of management measures designed to enhance and improve water quality. Specific critical areas are identified and discussed in detail in Section 4.0.

4.0 CRITICAL AREAS

Water quality data, trends in land use development, and comments from stakeholders in the watershed were utilized to identify critical areas within the Stahl Ditch-Kitty Run Watershed. Critical areas include both areas that are of benefit to water quality in the watershed as well as areas that are suspected of degrading water quality. Areas that are considered to be beneficial to water quality in the Stahl Ditch-Kitty Run Watershed should be protected or enhanced, and those areas or activities suspected of degrading water quality should be targeted for implementation of management measures.

4.1 BENEFICIAL CRITICAL AREAS

Identifying land uses and activities that have a negative impact on water quality is usually the first and is often times the primary focus of watershed planning, and while managing the impacts of those activities can and does improve water quality, it is equally important to identify the existing land use conditions and activities in a watershed that enhance or protect water quality. Beneficial critical areas in the Stahl Ditch-Kitty Run Watershed are identified in **Exhibit 4-6**. Management measures designed to protect and enhance these areas are targeted in **Tables 5-1, 5-2, 5-3,** and **5-4**.

Well Buffered Waterways

Buffered stream reaches can be beneficial to the watershed in many ways. Loadings of sediments, nutrients, and pesticides can be significantly reduced after passing though a vegetated buffer adjacent to a stream or ditch. These corridors are also important to the wildlife of the area as they provide habitat and food sources perhaps not found elsewhere in the watershed. Overhanging vegetation, even if only tall grasses, allows the water course to be shaded in areas, thus creating a cooler environment, maintaining more consistent dissolved oxygen levels within the water and providing a conducive habitat for aquatic organisms.

Based on information collected during windshield assessments of the watershed and through the examination of aerial photography it has been determined that approximately 72% (28 miles) of natural and manmade waterways in the watershed have adequate riparian buffers. Natural streams and waterways were considered to be adequately buffered if existing streamside buffers on both banks exceeded 100-feet. Drainage ditches were considered to be adequately buffered if existing buffers on both banks exceeded 50-feet. Buffers along ditches are more difficult to assess, and should be continually evaluated. Future maintenance on ditches may result in a loss of buffers along ditches. If and when maintenance on these areas occurs, filter strip implementation should be promoted and encouraged.

Figure 4-1: Well Buffered Stretch of Wildcat Creek

As shown in **Exhibit 4-6**, the eastern most stretch of Wildcat Creek between the Kokomo Reservoir Spillway located at CR 400 East and the City of Kokomo's municipal boundary (approximately 3.8 miles), and the western most stretch of the of Wildcat Creek from the City of Kokomo's western boundary to the confluence of the Little Wildcat Creek (approximately 6.1 miles) has a healthy riparian buffer system that exceeds 100-feet in most stretches.

Several methods can be utilized to protect these well buffered waterways. One potential method involves amending the City Zoning Ordinance to restrict certain new land use activities from occurring within certain distances from waterways. The Howard County Zoning Ordinance restricts uses within 75-feet of streams and ditches. Another potential method involves developing a countywide Greenways Plan, which would ensure long term protection of these areas and would provide the public with additional recreational areas within the watershed. A third potential method to protect these areas would include promoting conservation easements, which would provide landowners with financial incentives to conserve well buffered stream reaches. **Figure 4-1** identifies a well buffered stretch of Wildcat Creek. The promotion of existing Federal Incentive programs such as Conservation Reserve Program (CRP), Conservation Security Program (CSP), and Environmental Quality Incentive Program (EQIP) can lead to the establishment of various forms of stream buffers providing benefits not only to Wildcat Creek, but also to the individual landowners.

Pollutant/Water Quality Problem Addressed: By protecting and enhancing existing well buffered waterways in the Stahl Ditch-Kitty Run Watershed, nutrient, sediments, toxicant, and bacteria loadings will be reduced and aquatic and terrestrial habitat will be improved. Protecting and enhancing well buffered waterways will minimize pollutants associated with the following sources:

- Agricultural Tillage Practices
- Nutrient and Pesticide Application
- Poor Manure Management
- Wildlife and Canada Geese
- Lawn and Garden Practices

Public Parks

The City of Kokomo Parks and Recreation Department currently manages 18 City Parks accounting for approximately 156-acres of land within the Stahl Ditch-Kitty Run Watershed. Parks, recreational areas, and open space areas allow for the increased potential for infiltration of stormwater, uptake of nutrients and entrapment of solids such as sediment, thus reducing loadings to nearby streams, rivers, and ditches. These areas serve as powerful tools through which to enhance the appreciation that residents and visitors have for parks, open spaces, and environmental demonstration projects, such as reforestation projects and stormwater quality treatment projects that have the potential to improve water quality, and enhance aquatic and terrestrial habitat, simultaneously. Efforts should be made to maintain and enhance these existing parks. **Table 4-1** identifies the 18 City Parks located in the Stahl Ditch-Kitty Run Watershed.

Table 4-1: Kokomo City Parks within the Stahl Ditch-Kitty Run Watershed

City of Kokomo Parks	
Berkley Park (5.15-acres)	Northwest Park (32.00-acres)
Bon Air Park (3.21-acres)	Riley Park (1.60-acres)
Cutler Park (9.56-acres)	Robbins A (1.40-acres)
Darrough Chapel Park (24.89-acres)	Robbins B (.50-acres)
Foster Park (7.21-acres)*	Robbins C (.25-acres)
Huston Park (15.0-acres)	Somers Park (4.23-acres)
Mehlig Park (3.13-acres)	Studebaker Park (10.00-acres)
Meridian Park (1.60-acres)	Waterworks Park (5.00-acres)*
Mohr Park (8.53-acres)	Westdale Park (3.80-acres)

These parks vary in terms of their ability to benefit water quality, but because each is utilized by residents and visitors of the Stahl Ditch-Kitty Run Watershed, each should be considered as a potential implementation site for management measures ranging from education and outreach campaigns, to stormwater retrofits and demonstration projects, to open space preservation and enhancement projects.

Pollutant/ Water Quality Problem Addressed: By protecting and enhancing existing public parks, nutrient and sediment loadings in the watershed will likely be reduced and public education efforts will likely be enhanced. Protecting and enhancing existing public parks will minimize pollutants associated with the following sources :

- Impervious Areas
- Urban Development and Construction and Post-Construction Practices

Wildcat Creek Walk of Excellence (WCWE)

The WCWE is a 3 phased greenway trail, approximately 4.3 miles in length, which provides residents and visitors with recreational and alternative transportation opportunities along Wildcat Creek in the City of Kokomo. The greenway is intended to provide a natural recreation and interpretive experience within the City of Kokomo. While many of the views along the trail are of urbanized areas, immediate surroundings around the trail are currently being re-naturalized with the addition of tree plantings and stream bank restoration projects. The approximate area of the WCWE is shown in **Figure 4-2.**

Phase I of this project is already complete and provides a recreational hiking trail connecting Foster Park and Kokomo Beach. Phase II of the project will connect with the east side of Phase I near Main Street and will follow Wildcat Creek past Kokomo Middle School, around Pioneer Monument as far east as the intersection of Elizabeth Street and Carter Street. Phase III will connect with the West side of Phase I near Miller Highland Park and will follow Wildcat Creek south along Park Avenue.

The WCWE could be enhanced through implementation of additional conservation buffer projects, streambank restoration projects, and reforestation projects along its path. These projects could be enhanced through the implementation of educational signage discussing the pollutant removal capabilities of riparian buffers, the benefits of stream bank restoration, and environmental benefits associated with other potential demonstration projects that might be implemented along the WCWE path. The implementation of these projects would serve as an excellent tool through which to minimize the impacts of urban stormwater runoff and to

enhance water quality and natural resource awareness among the many recreational users of the pathway.

Figure 4-2: Wildcat Creek Walk of Excellence

Pollutant/ Water Quality Problem Addressed: The Wildcat Creek Walk of Excellence will likely reduce nutrient and sediment loadings in the Stahl Ditch-Kitty Run Watershed and will enhance water quality and natural resource awareness among watershed stakeholders. Protecting and enhancing the Wildcat Creek Walk of Excellence will minimize pollutants associated with the following sources:

- Habitat and Channel Alterations
- Streamside and Illegal Dumping

Wildcat Creek Public Access Points

Within the Stahl Ditch-Kitty Run Watershed, Wildcat Creek is wide, easily paddled (with the exception of several low-head dams that pose a safety risk), and drains a complex watershed consisting of forests, farm fields, and ultra urban areas. As shown, in **Figures 4-3, 4-4,** and **4-5,** Wildcat Creek within the Stahl Ditch-Kitty Run Watershed provides canoers, kayakers, fisherman, bird watchers, and other nature enthusiasts with a tremendously diverse and valuable recreational resource. However, there is currently only one public access site along Wildcat Creek within the Stahl Ditch-Kitty Run Watershed that provides recreational users with safe and easy access to Wildcat Creek. This site is located at Water Works Park. However, there are four possible public access sites that are well suited for future enhancement.

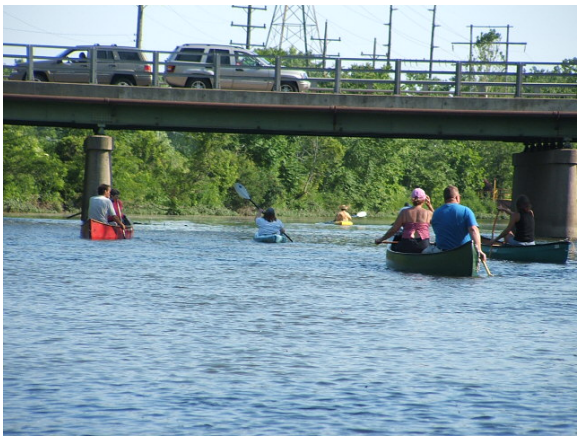


Figure 4-3: Paddlers on an Urban Stretch of Wildcat Creek

The first site is located at the Kokomo Reservoir Spillway along County Road 400 East. Located approximately 4.5 miles upstream from the existing public access site at Waterworks Park, this site is already frequently used by fisherman, and with the addition of certain amenities such as expanded parking and waste receptacles, would

make an ideal public access site to Wildcat Creek. The second site is located at the Continental Steel Dam, and is located approximately 4.5 miles downstream of the existing public access site located at Waterworks Park. The City of Kokomo is already considering incorporating this access site into the Continental Steel Main Plant Redevelopment Plan. The third site is located approximately 6.1 miles downstream from the proposed Continental Steel Site at CR 440 West. This site is adjacent to property owned by Martin Marietta (MM). MM will need to be approached regarding their interest in developing this area into a public access site. Minimal construction would be needed to convert this site into a viable public access site. Finally, although located outside of the Stahl Ditch-Kitty Run Watershed, it is recommended that an access point be developed near CR 950 West, which is located approximately 8.1 miles from the proposed public access site located at CR 440 West. The benefit to this site is that it would serve as a connection point to the existing IDNR public access site, which is located approximately 6.9 miles downstream in Burlington, Indiana. Potential public access sites are identified in **Exhibit 4-1**.

Figure 4-4: Paddlers on a Forested Stretch of Wildcat Creek

Public access to waterways is critical to any watershed restoration and planning effort. In order for watershed residents and visitors to truly appreciate the recreational, aesthetic, and environmental resources that a local waterway such as Wildcat Creek offers, they need to be provided with easy access to the waterway. Without adequate accessibility to the public, waterways, especially those located within densely urbanized areas, are often taken for granted and not fully appreciated.

Figure 4-5: Catch and Release Fishing Occurs Regularly along Wildcat Creek

The addition of public access sites along Wildcat Creek will provide residents and visitors of the Stahl Ditch-Kitty Run Watershed with an opportunity to experience Wildcat Creek from a completely different perspective. Unfortunately, many residents of the Stahl Ditch-Kitty Run Watershed currently only experience Wildcat Creek from the vehicular bridge crossings that span the waterway within the City of Kokomo. The addition of public access sites to Wildcat Creek will allow residents and visitors to better understand, appreciate, and value Wildcat Creek, and in the long run will likely increase the average citizen's desire to enhance and protect this valuable resource.

Pollutant/ Water Quality Problem Addressed: Increasing the number of public access points within the Stahl Ditch-Kitty Run Watershed will enhance water quality and natural resource awareness among watershed stakeholders and will minimize pollutants associated with the following sources:

- Habitat and Channel Alterations
- Streamside and Illegal Dumping

Lands Enrolled in Conservation Programs

In June 2005, it was determined that the Conservation Reserve Program (CRP) was currently providing local landowners with financial incentives to assist them with implementing approximately 2-acres of filter strips, 7.8-acres of grassed waterways, and 9.3-acres of tree plantings in the watershed. The areas enrolled in these programs are identified on **Exhibit 4-2.**

The intent of the CRP is to reduce soil erosion, reduce sedimentation in streams and lakes, improve water quality, establish wildlife habitat, and enhance forest and wetland resources, while protecting the nation's ability to produce food and fiber. The program encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers choosing to enroll in the program receive an annual rental payment for the term of a multi-year contract. Cost sharing is provided to establish certain vegetative cover practices and assistance cannot exceed 50% of the land owner's costs in establishing approved practices.

Existing Federal incentive programs such as Conservation Reserve Program (CRP), Conservation Security Program (CSP), and Environmental Quality Incentive Program (EQIP) should continue to be advertised, and new funding sources should be secured to provide landowners with additional financial incentives and cost-share opportunities to conserve lands on their properties. These programs should target landowners on both urban and rural lands.

Pollutant/ Water Quality Problem Addressed: Lands enrolled in conservation programs typically contribute less nutrient, sediment, and bacteria loadings to local waterways. Lands enrolled in conservation programs will minimize pollution associated with the following sources:

- Nutrient Applications
- Tillage Practices
- Cattle with Creek Access

Ridge Road Property Acquisition

The Hillsdale Subdivision is located approximately two miles east of Kokomo and one mile west of the Wildcat Creek Reservoir. It is south of E CR 100 N between N CR 300 E and 400 E. In total, there are about 75 lots in the subdivision. Twelve lots are bordered to the south by Wildcat Creek. Of those, at least 3 located along Ridge Road were extensively damaged by a 2003 flood event. These properties were purchased with Federal Emergency Management Agency (FEMA) and County funds, and are currently under County ownership.

The Wildcat Creek Foundation has approached the County about assuming ownership responsibility of these properties. If so granted, the Foundation would work with local neighbors and residents to develop a management and stewardship plan for the property. One potential management strategy involves dividing the property into three zones.

The front zone would mirror the general set-back of existing houses, about 40 to 50-feet, and would be managed to appear similar to other front yards with turf grasses and a few larger trees. The intensity of management would depend on the level of support available. At a minimum, the grass would need to be mowed.

The back or riparian zone is the low-lying land near Wildcat Creek that floods often and is now mainly wooded. It would be manage least intensively. It would be mainly left as it currently is, except that invasive plants, such as bush honeysuckle and garlic mustard would be removed with volunteer help.

The middle zone is between the other two zones and includes the area from which the damaged houses were removed. This area would be planted with trees. Specific information relative to tress size, species, and density would be determined through consultation and coordination with the Indiana DNR District Forester and local neighbors.

Pollutant/Water Quality Problem Addressed: By assuming ownership of the Ridge Road properties, the Wildcat Creek Foundation will help to minimize flood damages and reduce sediment and nutrient loads in the Stahl Ditch-Kitty Run Watershed. In addition, this project should also result in improved aquatic and terrestrial habitats and should reduce pollutants associated with the following sources:

- Lawn and Garden Practices
- Impervious Areas
- Urban Development and Construction and Post-Construction Practices.

NPDES Phase II Storm Water Program Requirements

On December 8, 1999, the EPA issued regulations that expanded the existing NPDES Stormwater Phase I Program to include discharges from small communities in “urbanized areas” serving populations ranging from 10,000 to 100,000 and stormwater discharges from construction activities that disturb more than one acre of land. These regulations are referred to as the NPDES Phase II Stormwater Program. The urbanized area of Howard County and the City of Kokomo were designated as Municipal Separate Storm Sewer Systems (MS4s) under Phase II and are currently implementing programs to minimize water quality impacts associated with stormwater discharges from their communities. **Exhibit 4-3** identifies the City of Kokomo and Howard County MS4 Boundaries.

In order to fulfill their requirements, both the City and County have developed Storm Water Quality Management Plans that address the following 6 Minimum Control Measures (MCMs) designed to minimize the water quality impacts of stormwater discharges from their communities.

1. Public Education and Outreach –
   This MCM requires both the City and County to educate citizens on the impact that their day -to-day activities have on the quality of stormwater runoff. These education efforts must target residents, visitors, public service employees, commercial and industrial facilities, and construction site personnel within the City and County MS4 areas.

2. Public Participation and Involvement
This MCM requires both the City and County to provide citizens with opportunities to participate in stormwater quality improvement programs, such as marking storm water inlets with messages such as "Do Not Dump – Drains to Creek." The City and County must document that sufficient opportunities were allotted to involve all citizens in their stormwater programs.

3. Illicit Discharge Detection and Elimination (IDDE)
This MCM has potential to greatly reduce the amount of pollution associated with stormwater entering the Stahl Ditch-Kitty Run Watershed. Under this MCM, both the City and County are required to adopt ordinances prohibiting any discharges to the storm sewer system that are not composed entirely of stormwater. In addition, this MCM requires both the City and the County to map all piped stormwater outfalls greater than or equal to 12 inches and all open channel stormwater outfalls with bottom widths greater than or equal to 2-feet. In addition, this MCM requires both the City and County to conduct screening and inspections of their storm sewer outfalls during periods of dry weather. Any flowing outfalls identified during dry weather conditions are required to be prioritized for future follow-up and any identified illicit discharges are required to be removed from the storm sewer system. Effective IDDE programs will greatly reduce nutrient and *E.coli* loadings to waterways within the Stahl Ditch-Kitty Run Watershed.

4. Construction Site Runoff Control
This MCM requires both the City and County to adopt ordinances requiring all areas of new development and redevelopment disturbing areas greater than or equal to 1-acre of land to implement erosion and sediment control practices. According to EPA, sediment runoff rates from construction sites are typically 10 to 20 times greater than those from agricultural lands and 1,000 to 2,000 times greater than those from forestlands. Improved erosion and sediment control practices on new and redevelopment sites will greatly reduce sediment loadings to waterways within the Stahl Ditch-Kitty Run Watershed.

5. Post-Construction Site Runoff Control
This MCM requires the City and County to develop, implement, manage, and enforce a program to address, discharges of post-construction stormwater runoff from new development and redevelopment areas that disturb greater than or equal to 1-acre of land. Post-Construction runoff contributes pollution to local waterways by increasing the type and quantity of pollutants entering the storm sewer system and through an increase in the amount of stormwater entering a waterway. Pervious surfaces such as grasslands and forested areas give way to impervious surfaces such as streets, rooftops, parking lots, greatly increasing the quantity of water making its way to nearby streams, which results in increased scouring, erosion, and downstream flooding. The implementation of Post-Construction BMPs should greatly reduce the nutrient and sediment loadings to waterways within the Stahl Ditch-Kitty Run Watershed.

6. Good Housekeeping and Municipal Pollution Prevention
This MCM requires the City and County to develop plans for reducing pollution runoff associated with municipal operations and equipment. The City and County are required to develop and implement management measures such as catch basin cleaning, street and parking lot sweeping, employee training, implementation of recycling programs, reduction in pesticide and fertilizer and salt and sand usage, and development of regular

facility and equipment maintenance schedules. Full implementation of these stormwater quality management measures will result in improved water quality and will reduce nutrient, sediment, and toxic material loadings to waterways within the Stahl Ditch-Kitty Run Watershed.

Pollutant/Water Quality Problem Addressed: Stormwater runoff from urban areas contributes substantial nutrient, sediment, toxicant, and bacteria loadings to local waterways. MS4 programs in the City of Kokomo and Howard County will minimize pollutants associated with the following sources:

- Industry
- Failing and Inadequate Septic Systems
- Impervious Areas
- Urban Development and Construction and Post Construction-Practices

4.2 CRITICAL AREAS AS POTENTIAL SOURCES OF POLLUTION

Critical areas identified below are considered to be potential sources of pollution in the watershed. In order to minimize the water quality impacts associated with these areas, it will be important to target the implementation of management measures identified in **Tables 5-1, 5-2, 5-3, and 5-4** toward these critical areas. **Exhibit 4-7** identifies critical areas as sources of pollution in the Stahl Ditch-Kitty Run Watershed.

Inadequate Septic Systems

Based on the evaluation of existing water quality data, Steering Committee meetings, information collected via meetings with local water resource groups, and conversations with stakeholders, 12 subdivisions in the Stahl Ditch-Kitty Run watershed have been prioritized as likely having septic system problems. As discussed in Sections 2 and 3, inadequately functioning septic systems contribute high nutrient and bacteria loadings to waterways in the Stahl Ditch-Kitty Run Watershed.

Septic system failures are believed to be occurring throughout the watershed, however, **Table 4-2,** and **Exhibit 3-4** identify the 12 subdivisions suspected as having the highest rate of septic system failure in the watershed.

Table 4-2: Subdivision Suspected of Having Septic System Problems

Subdivision Name	Approximate Location
Derbyshire Subdivision	CR 00 North and CR 600 West
Windwood Park Subdivision	Off of Dye Road (Between CR 00 North and SR 22)
Westpoint Subdivision	North side of CR 100 North (Between CR 300 West and CR 400 West)
Breezy Hill	Southside of CR 100 North (Between CR 300 West and CR 400 West)
Breezy Woods Subdivision	CR 400 West and CR 100 South
Mayfield Rolling Acres*	South of Breezy Hill Subdivision between CR 300 West and CR 400 West
Red Bird Subdivision	CR 300 West and CR 50 South
Fairview Subdivision	CR 300 West and CR 50 South

Subdivision Name	Approximate Location
Urbandale Subdivision	CR 300 West and CR 50 South
Darrough Chapel Park Subdivision	Markland Avenue (Just outside the City of Kokomo)
Pumpkin Vine Subdivision	CR 300 East and 100 South
Ruhl Gardens Subdivision	CR 00 North and CR 400 East

*A portion of the subdivision is on septic systems and a portion of the subdivision is on a package treatment plant. (Subdivisions were identified during Steering Committee meetings.)

In order to effectively manage the impacts that septic systems are having on water quality in the Stahl Ditch-Kitty Run Watershed, it will be important provide landowners with a variety of education and technical assistance related to septic system management, to research and identify innovative ways to improve long-term septic system operation and maintenance, and to provide landowners with financial assistance to ensure that septic systems are properly maintained over the long term.

It is estimated that pollutant load reductions in the watershed could be substantially reduced by repairing faulty septic systems. Assuming that there are 1,500 homes in the watershed currently utilizing failing or inadequate septic systems, it is estimated that upgrading those system would result in an annual pollutant load reduction of 6 tons of phosphorus per year and 25 tons of nitrogen per year. Repair and replacement of inadequately operating septic systems will greatly reduce *E.coli* loadings to the watershed, however, no load reduction estimates are currently available for *E.coli*.

Pollutant/Water Quality Problem Addressed: Inadequately functioning septic systems and wastewater treatment systems contribute substantial loadings of nutrients and bacteria to waterways. Improving and enhancing septic system management measures will minimize pollutants associated with the following sources:

- Failing and Inadequate Septic Systems
- Straight Pipe Discharges

Unbuffered Waterways

As discussed in Section 3, conservation buffers along natural streams usually consist of a natural and dense network of grasses, shrubs, and trees. Whereas buffers along drainage ditches usually consist of swaths of mowed cool season grasses, regularly maintained to prevent the development of woody plants. Buffers along waterways also reduced nutrient, sediment, and bacteria loadings, while enhancing wildlife habitat and the aesthetic value of a waterway.

Figure 4-6: Unbuffered Stretch of Wildcat Creek

There are approximately 11 miles of waterways within the Stahl Ditch-Kitty Run Watershed that lack appropriately sized riparian buffers. Buffer strips were evaluated using USDA and NRCS

guidance. Natural streams and waterways were considered to be adequately buffered if existing streamside buffers on both banks exceeded 100-feet. Drainage ditches were considered to be adequately buffered if existing buffers on both banks exceeded 50-feet. Stream corridors were evaluated by conducting windshield assessments of the watershed and by evaluating the most recent aerial photography of the watershed. If adequately sized buffer strips are installed on 100% of the 11 miles of waterways identified as needing enhancement, it is estimated that phosphorus loadings in the watershed could be reduced by 609 lbs/year, nitrogen loadings could be reduced by 1,212 lbs/year, and sediment loads could be reduced by 421 tons/year. It is important to note that this estimate does not consider water quality impact associated with discharges from field tile drainage systems, which would not be treated by filter strips or buffer strips. This load reduction also does not consider water quality impacts associated with adding buffer strips along the urbanized portion of Wildcat Creek. **Figure 4-6** identifies an unbuffered stretch of Wildcat Creek within the City of Kokomo.

Pollutant/Water Quality Problem Addressed: By installing buffers on waterways in the Stahl Ditch-Kitty Run Watershed, nutrient, sediments, toxicants, and bacteria loadings will be reduced and aquatic and terrestrial habitat will be improved. Enhancing unbuffered waterways will minimize pollutants associated with the following sources:

- Agricultural Tillage Practices
- Nutrient and Pesticide Application
- Poor Manure Management
- Wildlife and Canada Geese
- Lawn and Garden Practices

Highly Erodible Lands

Highly Erodible Land determinations, made by NRCS, are based on a mathematical equation, USLE, the Universal Soil Loss Equation. This equation takes into account the rainfall factor, erodibility of the soil type, allowable loss for that soil type and the length and the slope of the area. Soil map units may also be classified as Potentially Highly Erodible (PHEL) based on a varying range of length/slope values. In such instances, the final determination of erodibility must be made through an on-site investigation.

Land disturbing activities occurring on highly erodible lands such as livestock grazing, crop tillage, or clearing and grading associated with new development are likely to increase sediment and nutrient loadings to nearby waterbodies. There are approximately 3,730-acres of highly erodible lands in the Stahl Ditch-Kitty Run Watershed. In addition, there are approximately 608-acres of agricultural fields located on highly erodible lands located within 500-feet of a waterbody.

Areas of HEL or PHEL soils currently in production and within 500-feet of a waterway are considered critical. These areas will need to be further investigated in order to produce a conservation plan outlining potential BMPs and management techniques to reduce erosion.

Pollutant/Water Quality Problem Addressed: By improving management of land disturbing activities on highly erodible soils in the Stahl Ditch-Kitty Run Watershed, nutrient, sediment, and bacteria loadings will decrease, and pollutants associated with the following sources will be reduced:

- Tillage Practices
- Cattle with Access to Creeks
- Urban Development and Construction and Post Construction Practices

Conventionally Tilled Agricultural Lands

Conventional tillage of crop land allows the soil to remain exposed to the elements for extended periods of time. The majority of conventional tillage is completed following the crop harvest in the fall and no crop residue remains on the surface of the field. Thus, the topsoil is exposed to snow melt and spring rains. As the snow melts and the rain falls the potential for soil erosion is greatly increased and nearly guaranteed.

The primary tillage method for corn production in Howard County remains conventional tillage. The percentage of conventional tillage for corn producers in Howard County is estimated at 89%. However, conventional tillage is less prevalent amongst soybean producers, as only 18% of soybean producers are estimated to be implementing conventional tillage. Fields utilizing conventional tillage for crop production on highly erodible lands within 500-feet of a stream or tributary are considered to be critical areas due to increased erosion and pollution potential. If agricultural conservation practices, such as conservation tillage and critical area plantings were implemented on 20 additional 100-acre farms within the watershed it is estimated that the watershed would benefit from a reduction of phosphorus loadings by 3,522 lbs/year, nitrogen loading by 7,036 lbs/year, and sediment loadings by 2,395 tons/year.

Pollutant/Water Quality Problem Addressed: Improving tillage practices will reduce nutrient and sediment loadings in the Stahl Ditch-Kitty Run Watershed.

Low-Head Dams

According to Ohio DNR, a low-head dam is a dam of low height, usually less than fifteen feet, typically made of some combination of timber, stone, concrete, and other structural material, that extends from bank to bank across a stream channel. The original purpose of low-head dams typically vary in nature and include but are not limited to the following: agricultural irrigation supplies, industrial water cooling, and protection for utility line crossings.

There are 4 low-head dams along Wildcat Creek within the Stahl Ditch-Kitty Run Watershed. Water quality data, stakeholder input, and research indicate that these dams are potentially having a negative impact on water quality along Wildcat Creek. Common water quality problems associated with low-head dams include pollutant entrapment, reduction of dissolved oxygen levels, degradated aquatic habitat, and loss of stream biodiversity. Beyond concerns relating to water quality, the low-head dams serve as

Figure 4-7: Crystal Street Dam

a major risk and impediment to recreational users of Wildcat Creek. In 2002 alone, the Minnesota DNR estimated that there were approximately 53 deaths and 50 injuries at low-head dams in their state.

According to a summary report from the *2002 River Restoration Workshop: A Hands-On Workshop on the Latest Techniques for Dam Removal,* which covered the basic environmental, regulatory, and socio-political issues related to small dams, decision makers considering dam removal are encouraged to consider dam ownership, whether the dam serves any economic or recreational function, to what degree the dam is a public safety hazard, how the dam is perceived by the public, the affect that dam removal might have on property values, and the upstream and downstream impacts that may occur after the dam is removed. The location of each low-head dam in the Stahl Ditch-Kitty Run Watershed is shown in **Exhibit 4-5**.

In order to gain an accurate understanding of the overall impact that the low-head dams are currently having on water quality in the watershed, and to gain an accurate understanding of the potential short term and long term impacts that dam removal might have on water quality in Wildcat Creek, a feasibility study on low-head dam removal should be pursued. **Figure 4-7** identifies the low-head dam located near Crystal Street within the City of Kokomo.

Pollutant/Water Quality Problem Addressed: Gaining a better understanding of potential water quality problems such as nutrient, sediment, and toxicant loadings and degraded habitat that low-head dams may be contributing to the Wildcat Creek will enhance future watershed management efforts in the Stahl Ditch-Kitty Run Watershed.

Log Jams

The term log-jam is defined by the Indiana Administrative Code as the accumulation of lodged trees, root wads, or other debris that impedes the ordinary flow of water through a waterway. As these log jams are created, areas of significant erosion and stream bank destabilization are created, further degrading water quality through sedimentation. This is of particular importance in the Stahl Ditch-Kitty Run Watershed, as estimated TSS concentrations in the watershed are above recommended threshold criteria. Log jams can also result in elevated water temperatures and decreased dissolved oxygen levels. Log jams may range in severity from leaning trees that need to be removed and utilized to stabilize the nearby streambank, to areas requiring large excavation equipment from both land and within the stream for proper removal. With each degree of severity and corresponding workload, restrictions and guidelines provided by IDNR and the Army Corps of Engineers (ACOE) must be adhered to rigorously. Plans of work and permits are also required for more intensive situations.

Figure 4-8: Log Jam on Wildcat Creek

Based on log jam cataloging efforts conducted by the Wildcat Guardians, it is estimated that there are between 3 and 10 log jams present along Wildcat Creek in the Stahl Ditch-Kitty Run Watershed at any given time. **Table 4-3 and** Exhibit 4-5 identify the location of areas where log jams typically develop in the watershed. **Figure 4-8** identifies a log jam along Wildcat Creek. There is currently no known effective way to estimate sediment load reductions associated with removal and modification of log jams.

Table 4-3: Log Jams along Wildcat Creek

Waterbody	Location
Wildcat Creek	CR 250 West and Touby Pike
Wildcat Creek	Near the Shambaugh Ditch Railroad Tracks
Wildcat Creek	Near Devin Woods Subdivision
Wildcat Creek	Just West of CR 400 East
Wildcat Creek	Near Sleepy Tread Hollows
Wildcat Creek	Near the confluence of Edwards Ditch
Wildcat Creek	Near the confluence of Spring Run
Wildcat Creek	Near the confluence of Hallihan Ditch

(Wildcat Guardians, 2006)

Pollutant/Water Quality Problem Addressed: Log jams increase sediment loadings and degrade aquatic habitat in the Stahl Ditch-Kitty Run Watershed.

Streambank Erosion, Channel Alteration, and Illegal Dumping

It is important to note here that even rivers in undisturbed watersheds will experience bank erosion and sedimentation. However, in watersheds that have experienced dense urban development, numerous channel modifications, and floodplain encroachments, such as the Stahl Ditch-Kitty Run Watershed, streambank erosion can result in damage to public and private property and excess in-stream sediment loadings.

Figure 4-9: Stream Bank Erosion and Littering

As discussed in Section 3, streambank erosion, channel alteration, and illegal dumping are prevalent throughout the watershed. Severe streambank erosion is occurring along Edwards Ditch/ Dan Gamble Drain in the Mayfield Rolling Acres Subdivision, along Wildcat Creek just east of CR 400 East, and along several other stretches of Wildcat Creek.

It is estimated that restoration of eroded streambanks within the watershed will reduce phosphorus loadings in the watershed by 2,112 lbs/year, nitrogen loadings by 4,224 lbs/year, and sediment loadings by 2,112 tons/year.

Illegal dumping and channel alteration are also prevalent along the Wildcat Creek as it runs through the City of Kokomo, in particular between Apperson Way and N. Union Street. In addition, the stretch of Wildcat Creek downstream of the Continental Steel Dam to Dixon Road (CR 200 West) has been identified as having a problem with illegal dumping and filling activities. Channel alteration can increase sediment loadings to waterways, reduce native habitat and vegetation, and provide invasive species with opportunities to out-compete natural vegetation. In addition, streambank alteration is typically not visually pleasing and reduces the aesthetic value of the waterways on which it occurs.

Finally, littering and illegal dumping are extremely prevalent along the stretch of Wildcat Creek from the Kokomo Reservoir Spillway to approximately 100 yards down stream. No dumping signage and secured waste receptacles are needed to discourage such activities from occurring at this location. **Figure 4-9** identifies littering and bank erosion problems along Wildcat Creek near CR 400 East.

Pollutant/Water Quality Problem Addressed: Streambank erosion, channel alterations, and illegal dumping contribute nutrient, sediment, and toxicant loadings and degrade habit in the Stahl Ditch-Kitty Run Watershed.

Continental Steel Superfund Site (CSSS)

As discussed in Section 3, the Continental Steel Superfund Site is located along West Markland Avenue in the City of Kokomo. The site was operated by Continental Steel and its predecessors from approximately 1914 to 1986, when it ceased operations after filling for bankruptcy. The facility produced nails, wire, and wire fence from scrap metal. Operations included reheating, casting rolling, drawing, pickling, galvanizing, tinning, and tempering.

Water quality in the Stahl Ditch-Kitty Run Watershed was long ago impacted by Continental Steel's operations and stormwater discharges. Contaminated sediments associated with the CSSS have been identified on Wildcat Creek as far up stream as just past the Phillips Street bridge crossing and as far downstream as just past the Dixon Road bridge crossing. This stretch of the Wildcat, which is estimated at approximately 1.9 miles in length, is currently undergoing major restoration. Contaminated soil and sediments along Wildcat Creek are currently being removed and disposed of at a permitted facility located off site. Restoration efforts include the use of cross veins, W-Weirs, and J-Hooks, which have been successfully utilized in numerous river restoration projects across the United States, and are effective in providing bank stabilization, grade control, and enhancing fish habitat. This U.S. Environmental Protection Agency Region V is overseeing the $7 million riverbed excavation project, with consultation from IDEM. The project will enhance water quality and habitat along the Wildcat Creek for years to come. The stretch of Wildcat Creek currently undergoing restoration is identified in Exhibit 4-7. Estimated pollutant load reductions associated with this are currently unknown, however this project is expected to remove all stream and stream bank sediments contaminated by the Continental Steel Superfund Site.

Pollutant/Water Quality Problem Addressed: Improvements at the Continental Steel Superfund Site will reduce sediment and toxicant loadings, and will result in habitat restoration in the Stahl Ditch-Kitty Run Watershed.

Waterfowl Habitat

The presence of waterfowl has been shown to result in elevated levels of ammonia, organic nitrogen, and bacteria in local waterways. In addition, waterfowl activity can increase sediment loadings by pulling up grasses and sprouts and trampling emergent vegetation along streambanks and shorelines, significantly impacting erosion and causing sedimentation.

As discussed in Section 3, Canada geese populations are prevalent within the watershed. They are common to residential and commercial retention ponds as well as City Parks that are adjacent to Wildcat Creek such as Foster and Waterworks Parks. Management measures to minimize water quality impacts associated with geese should include practices such as reducing or eliminating all mowing activities within 50' – 75' of a waterbody to reduce access to Wildcat Creek, minimizing watering and fertilizing activities within 50' – 75' of a waterbody, planting less palatable species of grass and plants along the waters edge, prohibiting feeding, and utilizing auditory, visual, and physical scare tactics. **Figure 4-10** identifies a stretch of Wildcat Creek in Foster Park which is home to dozens of Canada geese. It is estimated that by controlling water fowl habitat, phosphorus loadings associated with goose droppings can be reduced by approximately 64 lbs/year.

Figure 4-10: Wildcat Creek at Foster Park

Pollutant/Water Quality Problem Addressed: By reducing the availability of waterfowl habitat, nutrient and bacteria loadings in the Stahl Ditch-Kitty Run Watershed will be reduced and aquatic habitats will be improved.

4.3 ESTIMATING POLLUTANT LOADS

In order to determine the overall effectiveness of recommended management measures identified in this plan, it is important to have an understanding of the existing pollutant loads in the watershed.

Existing pollutant loads in the Stahl Ditch-Kitty Run Watershed were determined by:

- Identifying the nearest USGS gaging station (Station 03334000), which is located on Wildcat Creek within the City of Kokomo's municipal boundary just past the confluence of Kokomo Creek The gaging station is shown on Exhibit 1-2.
- Calculating the Stahl Ditch-Kitty Run Watershed's proportion of the gaging station's total contributing drainage area (SDKR Drainage Area / USGS Gaging Station Drainage Area = 26 square miles / 242 square miles = 10.7%).
- Assuming that the Stahl Ditch-Kitty Run Watershed's proportion of the gaging station's drainage area was equivalent to the Stahl Ditch-Kitty Run Watershed's proportion of the average flow rate.
- Calculating the Stahl Ditch-Kitty Run Watershed's proportion of the gaging station's average annual flow (USGS Gaging Station average annual flow of 243 cubic feet per second * 10.7% = 26 cubic feet per second)

- Multiplying the average annual flow rate of 26 cubic feet per second, by the mean pollution concentrations for nitrogen, phosphorus, TSS, and *E.coli*, based on samples collected as a component of IDEM's Fixed Station Monitoring Data.

Target pollutant loads were then determined by multiplying the average annual discharge rate of 26 cubic feet per second, by a target concentration determined for each pollutant. The target Total Nitrogen concentration was set at the Indiana TMDL recommended threshold concentration of 10 mg/L. The target Total Phosphorus concentration was set at the EPA recommended threshold concentration of .076 mg/L. The target TSS concentration was set at 11 mg/L, which is considered to be within the normal ambient concentration range for Indiana waters. The target *E.coli* concentration was set at the single grab sample water quality standard of 235 CFU/100ml.

Target load reductions needed were determined by subtracting the targeted loadings from the estimated existing loadings. Based on these calculations, the existing pollutant loads, targets, and target reductions shown in **Table 4-4** were developed for Total Phosphorus, Total Nitrogen, TSS, and *E.coli in* the Stahl Ditch-Kitty Run Watershed.

Table 4-4: Estimated Pollutant Loads and Target Load Reductions

Parameter	USGS Gaging Station Discharge Rate	Stahl Ditch-Kitty Run Proportion of Discharge Rate	Stahl Ditch-Kitty Run Estimated Discharge Rate	Existing Average Concentration	Stahl Ditch-Kitty Run Estimated Existing Loading	Target Concentration	Targeted Loadings	Target Load Reduction	Percent Reduction
Total Phosphorus	243 (cfs)	10.7%	26 (cfs)	.21 (mg/L)	10,742.8 (lbs/year)	.076* (mg/L)	3,888.38 (lbs/year)	6,854.42 (lbs/year)	63.8%
Total Nitrogen	243 (cfs)	10.7%	26 (cfs)	5.27 (mg/L)	269,601.48 (lbs/year)	10.0** (mg/L)	511,460 (lbs/year)	Below Target	N/A
TSS	243 (cfs)	10.7%	26 (cfs)	20.8 (mg/L)	532.04 (tons/year)	11 (mg/L)	281.36 (tons/year)	250.68 (tons/year)	47.1%
E.coli	243 (cfs)	10.7%	26 (cfs)	1,632.5 (CFU/100ml)	3.79E+14 (CFU/year)	235 (CFU/100ml)	5.45E+13 (CFU/year)	3.24E+14 (CFU/year)	85.6%

*Target Total Phosphorus concentrations are based on EPA recommended concentrations. The typical Indiana TMDL target of .3 mg/L is already being achieved.
**Target Total Nitrogen concentrations are based on targets commonly found in Indiana TMDLs.

As shown in Table 4-4, Total Phosphorus loadings in the Stahl Ditch-Kitty Run Watershed need to be reduced by 3,888.38 tons/year (63.8%). Total Nitrogen loadings in the watershed are already achieving their pollutant reduction target. TSS loadings in the watershed need to be reduced by 250.68 tons/year (47.1%), and *E.coli* loadings need to be reduced by 85.6%.

There is no known effective way to estimate load reductions associated with implementing all management measures recommended in this plan. However, by implementing buffer/filter strips, increasing agricultural landowner implementation of conservation field practices, conducting streambank restoration, and by ensuring that septic systems are functioning properly, pollutant loadings in the Stahl Ditch-Kitty Run Watershed will be largely reduced.

Table 4-5 identifies the estimated load reductions associated with implementing some of the management measures discussed above.

Table 4-5: Estimated Critical Area Load Reductions and Costs

Management Measure	Total Phosphorus Reduction	Total Sediment Reduction	Total Nitrogen Reduction	Estimated Costs
Septic System Improvements (Assumes correcting 1,500 inadequate septic systems)	12,000 (lbs/year)	N/A	50,000 (lbs/year)	Not Applicable- Cost estimates vary greatly from system to system.
Implementation of Filter/Buffer strips (Assumes implementation of 11 miles of buffer/filter strips)	609 (lbs/year)	421 (tons/year)	1,212 (lbs/year)	$66,500 - $133,000 ($250-$500/ acre)
Implementation of Agricultural Conservation Measures* (Assumes of implementation on 20 100-acre farms)	3,522 (lbs/year)	2,395 (tons/year)	7,036 (lbs/year)	Not Applicable- Cost estimates vary greatly depending on soil types and practices utilized.
Streambank Stabilization/Restoration (Assumes 2-miles of stabilization/restoration needed in the watershed)	2,112 (lbs/year)	2,112 (tons/year)	4,224 (lbs/year)	$40,000 - $80,000 ($20,000-$40,000/Mile)
Total	**18,243 (lbs/ year)**	**4,928 (tons/ year)**	**62,472 (lbs/ year)**	

*Could potentially includes all practices listed on the Region V Load Reduction Spreadsheet. (IDEM Region 5 Model, April 2007)

Estimates of potential load reductions for the implementation of buffer/filter strips, agricultural conservation measures, and streambank restoration are based on the EPA Region V Model, which is accepted by IDEM, Ohio Department of Natural Resources, Michigan Department of Environmental Quality, and the Illinois Environmental Protection Agency. While these spreadsheets are better utilized with field and site specific information, they are beneficial in this

application as they provide general estimates on pollutant removal efficiencies of BMPs. Load Reduction spreadsheets are included in **Appendix 4**.

Calculations to determine phosphorus and nitrogen loadings and potential load reductions were also produced utilizing estimated septic system inputs from household wastewater per person, per day, assuming 1,500 households within the watershed. Estimates were then produced to determine septic system outputs for systems that are failing, or non-existent, as well as systems that are efficiently and effectively treating the household wastewater. It is estimated that through regular septic system pumping, routine maintenance, and system replacements, approximately 6 tons of phosphorus and 25 tons of nitrogen per 1,500 homes can be reduced from the current pollutant loadings.

Through the implementation of management measures identified in Table 4-5, it is estimated that the pollutant reduction targets in Table 4-4 will be achieved. In fact, implementation of management measures in Table 4-5 are estimated to reduce phosphorus loadings by more than 18,200 lbs/year, which is 165% of the target reduction and sediment loadings by more 4,900 tons/year, which is more than 1800% of the target reduction. Nitrogen levels are already meeting the TMDL recommended target, however by implementing management measures in Table 4-5 nitrogen levels can be reduced by approximately 62,500 lbs/ year.

It is important that the established pollutant reduction targets be utilized as reference points and not as hard and fast indicators through which to evaluate the long-term success of this watershed management plan. Both existing pollutant loadings and pollutant reduction targets are subject to a wide variety of assumptions, and are based on the best data currently available. If existing pollutant loads are estimated too high, achieving target pollutant load reductions may not result in achieving in-stream pollutant concentrations. Alternatively, if existing pollutant loadings are estimated too low, in-stream target concentrations may be fulfilled prior to reaching target pollutant load reductions.

Once implementation of the Stahl Ditch-Kitty Run Watershed Management Plan begins, further evaluation of pollutant loading estimates should be revisited to gain a better understanding of the impact that implementation efforts are having on water quality. Relevant changes would then be incorporated into updated versions of the Stahl Ditch-Kitty Run Watershed Management Plan.

5.0 GOALS AND DECISIONS

Setting realistic and measurable goals is crucial to the successful implementation of this Plan. A goal is the desired change or outcome as a result of the watershed planning effort. Depending on the magnitude of the problem, goals may be general, specific, long-term, or short-term. The goals in this plan focus on improving water quality through the implementation of a variety of management measures. The IDEM suggests watershed groups focus on developing goals, management measures, action plans, resources, and legal matters as part of the watershed planning process.

According to the IDEM, management measures describe what needs to be controlled or changed in order to achieve the goal. The anticipated timeline for implementing individual management measures is identified in **Section 5.1**. In order to successfully implement the plan, resources such as people, programs, and money need to be identified. It is important to have the support of individuals identified as resources to successfully execute the goals of the plan. Successful implementation may require some legal matters such as obtaining permits, purchasing easements, or the adoption of an ordinance. The Steering Committee decided to develop goals that improve water quality in the Stahl Ditch-Kitty Run Watershed by focusing on both urban and agricultural issues.

The following goals were identified and agreed upon by the Steering Committee:

Agriculture Goal: Reduce *E. coli* and nutrient concentrations in the Stahl Ditch-Kitty Run Watershed through the implementation of better agricultural practices and management programs.

Agricultural management measures and action strategies identified in the following tables should be targeted toward relevant landowners. For example, educational efforts promoting cost-share programs available for land owners on highly erodible lands should be targeted only to the owners of highly erodible lands, and educational efforts promoting cost-share programs to implement exclusionary fencing and alternative watering systems should be targeted only to landowners known to have livestock on their property.

Wastewater Treatment Goal: Reduce *E. coli* and nutrient concentrations in the Stahl Ditch-Kitty Run Watershed through proper planning, design, installation, and long-term maintenance of wastewater treatment systems.

As discussed in Section 4, several areas have been identified as potential priority areas for implementation of septic system management measures in the watershed. Where appropriate, these areas should be considered first during the implementation of management measures relating to septic systems. However, some of the management measures are broader and will require implementation efforts that target all landowners in the watershed, and in some cases the management measures will require county-wide and city-wide participation.

Public Education Goal: Enhance public stewardship and awareness in the Stahl Ditch-Kitty Run Watershed through the implementation of a comprehensive water resources education and outreach program that focuses on changing stakeholder attitudes and behaviors.

Public education efforts will be wide spread and will likely reach all landowners in the watershed. However, specific management measures and action plans identified in the following tables will need to be targeted toward specific landowners and audiences.

Land Use Planning Goal: Improve water quality in the Stahl Ditch-Kitty Run Watershed through better land use planning and land development practices.

Both the City of Kokomo and urbanized portions of Howard County are growing. Much of this growth is occurring along Wildcat Creek, directly to the east and west of the City of Kokomo. In order to minimize the water quality impacts that new development has on water quality in the watershed, it will be important to continue to promote stormwater and land use practices and policies that benefit water quality in the watershed.

Tables 5-1, 5-2, 5-3, and 5-4 located on the following pages identify management measures, action plans, resources/cost, legal matters, progress indicators, and critical areas and audiences associated with achieving agriculture, wastewater treatment, education, and land use planning goals in the Stahl Ditch-Kitty Run Watershed. Table 5-1 identifies all management measures designed to achieve the agricultural goal. Table 5-2 identifies all management measures designed to achieve the wastewater treatment goal. Table 5-3 identifies all management measures designed to achieve the education goal. Table 5-4 identifies all management measures designed to achieve the land use goal. Management measures have been categorized in terms of which watershed goal they are expected to address most effectively, however it is important to note that most of the management measures identified will likely be effective in achieving more than one goal.

In order to determine the relative priorities of management measures listed in the tables, Steering Committee members evaluated each measure in terms of its ability to improve water quality within 5-years, the relative ease at which it could be implemented, and the overall public sentiment expressed towards a given measure. It is important to note that regardless of their overall ranking, all management measures listed in these tables are considered priorities. Without input from the Steering Committee and numerous other stakeholder groups in the Wildcat Creek Watershed, the recommendations in this plan would not be as site specific and would be much less likely to be implemented.

Estimated costs in the tables are identified as either “Low”, “Medium” or “High”. Those activities, materials, or programs estimated to cost less than $5,000 will be considered Low Cost. Those activities, materials, and programs estimated to cost between $5,000 and $15,000 are considered Medium Cost. Activities, materials, and programs estimated to cost more than $15,000 are considered High Cost.

“Local Resources” in the tables are intended to provide a list of local organizations that could potentially provide support, advice, or consultation on a particular management measure. These lists are not intended to be comprehensive and are not intended to exclude non-listed organizations from participating in the development or implementation of a particular management measure. Other non-listed organizations are encouraged to participate as available.

Table 5-1: Agricultural Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Buffer/Filter Strips
 	
Establish 8.25 miles of buffer and filter strips along natural streams and drainage ditches. A total of 11 miles need buffered.
 	
High Priority
 	
Estimated Load Reductions
Phosphorus - 609 lbs/year
Nitrogen – 1,212 lbs/year
Sediment – 421 tons/year
	☒ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Overlay stretches of waterways identified as needing buffers on City & County parcel information in order to further prioritize critical areas to the landowner level.
		• Conduct a workshop and/or develop educational materials on the benefits of implementing buffer and filter strips along natural streams and drainage ditches.
		• Develop a cost-share program to assist landowners with implementing buffer and filter strips.
		• Use GIS to maintain a geographical database of the installation of buffer and filter strips in the watershed.
			• Local Resources
			  • Howard County SWCD
			  • Howard County Surveyor's Office
			  • NRCS
			  • Department of Agriculture
			  • Purdue Extension Service
			  • Wildcat Creek Foundation
			  • WCWA
			• Section 319 Grant
			• High Cost
			(~$250-$500 per acre)
				Indiana Filter Strip Program	Number of feet of filter and buffer strips installed throughout the watershed.
					
					Improved aquatic and terrestrial habitats.
						Areas in need of buffer and filter strips are identified in Exhibit 3-3.
						
						Incorporate filter strip and buffer strip projects into the Wildcat Creek Walk of Excellence.
						
						Wildcat Creek through Foster Park.
						
						<u>Proposed Timeline</u>
						2008-2010

Nutrient and Pest Management
 	
Increase nutrient management and pest management practices among crop producers.
 	
High Priority
	☒ Toxicants
	☒ Bacteria
	☒ Nutrients
	☐ TSS
	☐ Degraded Habitat
		• Identify landowners and evaluate current manure, nutrient, and /or pest management practices.
		• Develop targeted educational material promoting the benefits of conducting nutrient and pesticide management.
		• Develop a cost-share program to provide land-owners with assistance in developing nutrient and pest management plans.
			• Local Resources
			  • Howard County SWCD
			  • NRCS
			  • Department of Agriculture
			  • Purdue Extension
			  • WCWA
			• EQIP funds
			• Section 319 Grant
			• High Cost
				N/A	Stakeholders have changed behaviors and/or practices.
					
					E.coli and nutrient concentrations in the watershed.
						Agricultural landowners especially those along creeks and ditches.
						
						<u>Proposed Timeline</u>
						2008-2010

Financial Incentive Programs
 	
Secure funding for livestock and crop producers that may need financial and technical assistance with implementing conservation measures such as conducting alternative plantings on highly erodible soils, or implementing manure management BMPs.
 	
Medium Priority
	☒ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Research available financial assistance and incentive programs to assist livestock and crop producers with implementing BMPs.
		• Develop a cost-share program to assist landowners with implementing BMPs.
			• Local Resources
			  • Howard County SWCD
			  • NRCS
			  • Indiana DNR
			  • Purdue Extension
			  • WCWA
			• CRP and EQIP funds
			• Section 319 Grant
			• High Cost
				N/A	Financial assistance secured.
					
					E.coli, nutrient, and TSS concentrations in the watershed.
					
					Watershed wide participation in conservation programs.
						Agricultural landowners especially those along creeks and ditches.
						
						<u>Proposed Timeline</u>
						2008-2010

Table 5-1: Agricultural Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Conservation Tillage
 	
Increase the number of acres in no-till or mulch till practices.
 	
Medium Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Provide educational materials to farmers at SWCD annual meetings, Ag Days, the Howard County Fair, and other events.
		• Research and promote incentive programs to improve participation in conservation tillage practices.
		• Develop a cost-share program to assist landowners with implementing conservation tillage.
			• Local Resources
			  • Howard County SWCD
			  • Howard County Surveyor's Office
			  • NRCS
			  • Indiana DNR
			  • Purdue Extension
			  • WCWA
			• CRP and EQIP funds
			• Section 319 Grant
			• High Cost
				N/A	Stakeholders have changed behaviors and/or practices.
					
					E.coli and nutrient concentrations in the watershed.
						Agricultural landowners especially those along creeks and ditches.
						
						Proposed Timeline
						2008-2010

Grassed Waterways and Critical Seedings
 	
Promote the use of grassed waterways, concentrated flow areas, and critical seedings to reduce erosion and sedimentation within the watershed.
 	
Medium Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Provide educational materials regarding benefits to water quality and soil savings through establishing grassed waterways, concentrated flow areas, and seeding areas.
		• Obtain funding and provide economic incentives to landowners to stabilize areas of concern.
		• Complete pre and post implementation load reductions based on spreadsheets provided by IDEM and RUSLE 2 calculations.
			• Local Resources
			  • Howard County SWCD
			  • NRCS
			  • Department of Agriculture
			  • Purdue Extension
			  • WCWA
			• CTIC/Core 4 programs
			• Section 319 Grant
			• Federal incentive programs
			• High Cost
			(~$2,000/ acre)
				N/A	Stakeholders have changed behaviors and/or practices.
					
					Reduced sediment loadings to nearby streams and waterways
					
					Enhanced water quality in stream segments near to participants.
					
					E.coli and nutrient concentrations in the watershed.
						Agricultural landowners especially those along creeks and ditches.
						
						Proposed Timeline
						2008-2010

Winter Cover Crops
 	
Promote the use of winter cover crops to reduce erosion and sedimentation within the watershed.
 	
Medium Priority
	☐ Toxicants
	☐ Bacteria
	☐ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Target fall plowed fields within the watershed.
		• Provide informational materials regarding benefits to water quality and soil health through establishing winter cover crops.
			• Local Resources
			  • Howard County SWCD
			  • NRCS
			  • Department of Agriculture
			  • Purdue Extension
			  • CTIC/Core 4 programs
			  • Federal incentive programs
			• Low Cost
				N/A	Stakeholders have changed behaviors and/or practices.
					
					E.coli and nutrient concentrations in the watershed
						Agricultural landowners especially those along creeks and ditches.
						
						Proposed Timeline
						2008-2010

Drainage Water Management
 	
Promote the implementation of drainage water management practices on agricultural lands.
 	
Medium Priority
	☐ Toxicants
	☐ Bacteria
	☒ Nutrients
	☒ TSS
	☐ Degraded Habitat
		• Identify priority landowners for implementation of drainage water management practices.
		• Develop educational materials promoting drainage water management.
		• Develop a cost-share program to assist landowners with implementing drainage water management.
			• Local Resources
			  • Purdue Extension
			  • Howard County SWCD
			  • Department of Agriculture
			• EQIP
			• Section 319 Grant
			• High Cost
			(~$20 to $75/ acre)
				N/A	Stakeholders have changed behaviors and/or practices.
					
					E.coli and nutrient concentrations in the watershed
						Agricultural landowners especially those along creeks and ditches.
						
						Proposed Timeline
						2008-2010

Table 5-1: Agricultural Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Pasture Management and Exclusionary Fencing
 	
Improve pasture management techniques including rotational grazing and fencing livestock from waterways.
 	
Low Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Create educational materials for livestock landowners about pasture management and limiting access to waterways.
		• Develop a cost-share program to fence livestock from waterways and provide alternative watering mechanisms.
			• Local Resources
			  • Howard County SWCD
			  • NRCS
			  • Department of Agriculture
			  • Purdue Extension
			• Section 319 grant
			• EQIP Funding
			• High Cost
			(~$6-$12/ foot of fence)
			(~$200/ acre of filter strip)
				N/A	Stakeholders have changed behaviors and/or practices.
					
					Stakeholders have changed behaviors and/or practices.
						Livestock operations, especially those along creeks and ditches.
						
						<u>Proposed Timeline</u>
						2008-2010

Table 5-2: Wastewater Treatment Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Illicit Discharge Detection and Elimination (IDDE)
 	
Increase IDDE efforts in the watershed.
 	
High Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Develop a consistent tracking program to record physical, quantitative, and qualitative features of all identified stormwater outfalls.
		• Conduct a desktop assessment of the watershed to determine the Illicit Discharge Potential (IDP) of all waterways in the Stahl Ditch-Kitty Run Watershed.
		• Walk all open waterways in the Stahl Ditch-Kitty Run Watershed during dry weather, in order to identify illicit discharges and connections. Begin efforts in prioritized areas identified in the bullet point two above.
			• Local Resources
			  • Kokomo MS4 Operator
			  • Kokomo Engineering Office
			  • Howard County MS4 Operator
			  • Howard County Surveyor's Office
			  • Howard County Health Department
			• High Cost
				The Howard County Health Department, City and County MS4 Operators, as well as City Council members and County Commissioners will need to decide how to enforce an IDDE program that identifies failing septic systems in areas that may lack the financial resources necessary to correct identified problems.	Stormwater outfalls screened for illicit discharges and identified problems are eliminated.
					
					E.coli and nutrient concentrations in the watershed.
						Waterways draining subdivisions suspected of having septic system problems.
						
						Areas identified in Exhibit 3-4.
						
						Proposed Timeline
						2007-2010

Septic System Education
 	
Continue to provide education and outreach focusing on septic system operation and maintenance.
 	
High Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☐ TSS
	☐ Degraded Habitat
		• Continue to distribute educational brochures on septic system operation and maintenance with all newly issued septic permits.
		• Develop a mailing campaign targeting landowners in subdivisions suspected of having septic system problems, which provides landowners with educational information relating to septic systems.
		• Conduct an educational workshop focusing on septic system operation and maintenance.
			• Local Resources
			  • Howard County Health Department
			  • USDA Rural Community Assistance Program (RCAP)
			  • WCWA
			• Section 319 Grant
			• Low Cost
				N/A	Future correspondence indicates that stakeholders have changed behaviors and/or practices.
					
					E.coli and nutrient concentrations in the watershed.
						Howard County residents utilizing septic systems, especially those located in subdivisions suspected of having septic system problems.
						
						Areas identified in Exhibit 3-4.
						
						Real estate professionals.
						
						Proposed Timeline
						2008-2010

Septic System Tax Credit Program
 	
Research the feasibility of establishing a tax credit program for installation of new and/or repair of failing septic systems.
 	
High Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☐ TSS
	☐ Degraded Habitat
		• Research how other states have developed tax incentive programs.
		• Coordinate with other Indiana groups facing septic system management problems.
		• Begin lobbying state and federal officials.
			• Local Resources
			  • Howard County Health Department
			  • Indiana Board of Health
			  • Indiana Onsite Wastewater Professionals Association (IOWPA)
			  • WCWA
			  • USDA RCAP
			• High Cost
				Research on applicable laws and regulation will need to be extensive.	Research and investigation completed or underway.
					
					Lobbying efforts underway.
					
					Development of tax credit program.
						State and Federal representatives.
						
						Proposed Timeline
						2007-2011

Table 5-2: Wastewater Treatment Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Septic System Maintenance District
 	
Research the feasibility of developing a County-Wide Septic Maintenance District.
 	
High Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☐ TSS
	☐ Degraded Habitat
		• Develop a working group to investigate the feasibility of establishing a County-Wide Septic System Maintenance District.
		• Conduct a feasibility to study to determine the preferred mechanism for establishing and administering the District.
		• Implement recommendations identified in the feasibility study.
			• Local Resources
			  • Kokomo City Council
			  • Howard County Commissioners
			  • Howard County Health Department
			  • Kokomo-Howard County Plan Commission.
			  • Taylor Township Regional Sewer District.
			• Medium Cost
				If the feasibility study recommends moving forward, an ordinances and an equitable service fee will need to be passed and adopted.	Working group established.
					
					Feasibility study completed.
						Howard County residents utilizing septic systems, especially those located in subdivisions suspected of having septic system problems.
						
						Areas identified in Exhibit 3-4.
						
						Proposed Timeline
						2007-2011

Wastewater Treatment Demonstration Project
 	
Conduct an alternative wastewater treatment demonstration project.
 	
Medium Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☐ TSS
	☐ Degraded Habitat
		• Explore the feasibility of implementing an alternative treatment demonstration project.
		• Locate one or more landowners willing and interested in implementing an alternative treatment demonstration project.
		• Secure funding for and implement demonstration project.
			• Local Resources
			  • Howard County Health Department
			  • Kokomo Municipal Wastewater Treatment Plant
			  • Kokomo- Howard County Plan Commission.
			  • SRF
			• High Cost
				N/A	Funding for demonstration project secured.
					
					Demonstration project developed.
						Howard County residents utilizing septic systems, especially those located in subdivisions suspected of having septic system problems.
						
						Areas identified in Exhibit 3-4.
						
						Proposed Timeline
						2011-2012

Point of Sale Septic System Inspections
 	
Amend existing regulations to require a point of sale septic system verification process.
 	
Low Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☐ TSS
	☐ Degraded Habitat
		• Explore the feasibility of establishing a point of sales septic system verification process, by evaluating case studies from other Indiana or Midwestern communities.
		• Update existing Comprehensive Plans, zoning, subdivision control ordinances, or other ordinances as necessary.
			• Local Resources
			  • Howard County Health Department
			  • Howard County Commissioners
			  • Real Estate Professionals.
			  • Kokomo-Howard County Plan Commission
			• Low Cost
				Approval and adoption of updated planning documents and ordinances.	Ordinances adopted and verification process implemented.
					
					E.coli and nutrient concentrations in the watershed.
						Howard County residents utilizing septic systems, especially those located in subdivisions suspected of having septic system problems.
						
						Areas identified in Exhibit 3-4.
						
						Proposed Timeline
						2012

Table 5-2: Wastewater Treatment Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Funding for Connecting to Wastewater Treatment Plants
 	
Secure funding or cost-share assistance to assist landowners with connecting to local wastewater treatment plants.
 	
Low Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☐ TSS
	☐ Degraded Habitat
		• Work with Taylor Township Regional Sewer District and the City of Kokomo Municipal Wastewater Treatment Plant to ensure technical feasibility as well as political support.
		• Research all available private and public sources of funding for providing landowners with financial assistance.
		• Secure a funding mechanism to provide financial support to assist landowners with connecting.
		• Develop and conduct an education and marketing campaign educating priority landowners on benefits associated with connecting to treatment plants.
		• Begin connecting interested landowners to wastewater treatment plants.
			• Local Resources
			  • Howard County Commissioners
			  • Kokomo City Council
			  • Kokomo Wastewater Treatment Plant
			  • Howard County Health Department
			  • USDA RCAP
			  • SRF
			  • Taylor Township Regional Sewer District.
			• High Cost
				N/A	Funding mechanism established and new connections being made.
					
					E.coli and nutrient concentrations in the watershed.
						Howard County residents utilizing septic systems and living directly adjacent to existing sanitary sewer service areas.
						
						Darrough Chapel subdivision should be targeted first.
						
						<u>Proposed Timeline</u>
						2012-2015

Table 5-3: Education Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences
Household Hazardous Waste Program Promotion Enhance existing household hazardous waste and recycling education programs in order to provide residents and businesses with information on the safe storage, use, and disposal of household hazardous wastes. **High Priority**	☒ Toxicants ☐ Bacteria ☒ Nutrients ☐ TSS ☒ Degraded Habitat	• Include pollution prevention information in published or distributed materials and at local events and workshops.	• Local Resources • Howard County Solid Waste Management District • Low Cost	N/A	Stakeholders have changed behaviors and/or practices. Increase in amount of material collected.	Howard County and City of Kokomo residents. **Proposed Timeline** 2007

Lawn and Garden Chemical Education Program
 	
Develop an education and outreach campaign designed to educate citizens on the benefits of proper lawn and garden chemical management.
 	
High Priority
	☐ Toxicants
	☐ Bacteria
	☒ Nutrients
	☐ TSS
	☐ Degraded Habitat
		• Develop targeted educational material that will promote the wise use of lawn and garden chemicals.
		• Distribute educational material to targeted residential and commercial landowners.
		• Seek grant funds to develop an organic gardening demonstration project.
			• Local Resources
			  • Howard County SWCD
			  • Local Master Gardner's
			  • WCWA
			  • Wildcat Guardians
			• Section 319 Grant
			• Low Cost
				N/A	Stakeholders have changed behaviors and/or practices.
					
					Demonstration project developed.
						Residents and business within Howard County and the City of Kokomo.
						
						Proposed Timeline
						2008-2010

Rainwater Garden Demonstration Project
 	
Develop a rainwater garden demonstration project to serve as an example of how to successfully minimize fertilizer and pesticide application in residential lawn and gardens.
 	
High Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☐ TSS
	☒ Degraded Habitat
		• Develop an education and outreach campaign in order to educate citizens on the benefits of lawn and garden management.
		• Seek grant funds to develop a rainwater garden demonstration project.
			• Local Resources
			  • Kokomo MS4 Operator
			  • Howard County SWCD
			  • Kokomo Engineering Office
			  • WCWA
			  • Wildcat Guardians
			• Section 319 Grant
			• Medium Cost
				N/A	Stakeholders have changed behaviors and/or practices.
					
					Demonstration project developed.
						Residential neighborhoods, subdivisions, and Home Owners Associations (HOA).
						
						City of Kokomo Parks Department.
						
						Proposed Timeline
						2008-2010

Erosion and Sediment Control Workshop
 	
Develop and implement an erosion and sediment control workshop for the local development and construction community.
 	
High Priority
	☐ Toxicants
	☐ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Develop a comprehensive list of local developers, builders, and construction industry professionals.
		• Develop promotional materials and solicit participation from local construction professionals.
		• Develop training/workshop materials.
		• Implement Erosion and Sediment Control Workshop.
			• Local Resources
			  • Kokomo MS4 Operator
			  • Kokomo Engineering Office
			  • Howard County MS4 Operator
			  • Howard County Surveyor's Office
			  • Kokomo – Howard County Plan Commission
			  • Howard County SWCD
			  • IDEM
			• Medium Cost
				N/A	Attendance at workshops.
					
					Development sites implementing erosion and sediment control practices.
					
					TSS concentrations reduced in the watershed
					
					Stakeholders have changed behaviors and/or practices.
						Local developers, builders, and construction industry professionals.
						
						Proposed Timeline
						2008

Table 5-3: Education Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Flood Hazard Education
 	
Continue to provide watershed residents with educational information on Flood Hazard Mitigation, Floodplain Management, and the National Flood Insurance Program.
 	
High Priority
	☐ Toxicants
	☐ Bacteria
	☐ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Continue to distribute educational information to watershed residents in flood prone areas.
		• Evaluate areas subject to repetitive flooding for existing structural relocation, buy out and flood-proofing.
			• Local Resources
			  • Kokomo-Howard County Plan Commission
			  • Kokomo Engineering Office
			  • FEMA
			  • Indiana DNR
			  • Wildcat Creek Foundation
			• Low Cost
				N/A	Stakeholders have changed behaviors and/or practices.
					
					Reduction in flood losses.
						Howard County and City of Kokomo landowners located in floodplains.
						
						Proposed Timeline
						2007

Stream Corridor Inspection Program
 	
Develop and conduct a regular stream inspection and maintenance program to identify and prioritize areas of streambank erosion, log jams, illegal dumping sites, and other problem areas along Wildcat Creek.
 	
High Priority
	☐ Toxicants
	☐ Bacteria
	☐ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Coordinate program with Wildcat Guardians Section Coordinators.
		• Develop an educational training program to ensure that inspectors are educated on proper inspection procedures.
		• Seek funding to ensure adequate resources are available to conduct regular inspections and to ensure that identified problems are appropriately addressed and mitigated.
			• Local Resources
			  • Kokomo Engineering Department
			  • Kokomo Street Department
			  • Howard County Surveyor's Office
			  • Wildcat Guardian's Section Coordinators.
			  • Indiana DNR
			• Low Cost - Inspection
			• High Cost –Remediation (~$20,000 -$40,000/ mile)
				Coordinate with IDEM and IDNR to determine whether any permits are needed to remediate identified problems areas.	Stream corridor inspection program implemented.
					
					Problem areas identified and restoration efforts being implemented.
					
					Problem areas and restoration projects incorporated into GIS.
						Wildcat Creek.
						
						Exhibit 4-5 identifies the location of existing and historic log jams.
						
						Proposed Timeline
						2007-2011

Low-Head Dam Removal Feasibility Study
 	
Research and investigate the feasibility of removing low-head dams along Wildcat Creek.
 	
High Priority
	☐ Toxicants
	☐ Bacteria
	☐ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Develop a working group to investigate the feasibility of removing low-head dams along Wildcat Creek.
		• Hire a third party to conduct a feasibility study on the economic and environmental impacts associated with dam removal.
		• Implement recommendations from the feasibility study.
			• Local Resources
			  • Kokomo Engineering Office
			  • Howard County Surveyor's Office
			  • Low-Head Dam Owners
			  • IDEM
			  • IDNR
			  • USACOE
			• High Cost
				Coordination between City, County, IDEM, IDNR, and USACOE will be crucial to ensure that all local, state, and federal regulations are adhered to.	Working group established.
					
					Feasibility Study completed.
					
					Recommendations of study being implemented.
						Exhibit 4-5 identifies the location of low-head dams on Wildcat Creek*
						
						*Low-Head Dam on Kokomo Creek, which is a substantial tributary to Wildcat Creek, should also be considered in Feasibility Study.
						
						Proposed Timeline
						2010-2011

USGS Gaging Stations
 	
Maintain the number of gaging stations recording flow data in the watershed.
 	
High Priority
	☐ Toxicants
	☐ Bacteria
	☐ Nutrients
	☐ TSS
	☒ Degraded Habitat
		• Research potential funding mechanisms to ensure that local gaging stations remain in service.
		• Secure adequate funding to appropriately maintain existing gages.
			• Local Resources
			  • Kokomo Engineering Office
			  • Howard County Surveyor's Office
			  • Kokomo-Howard County Plan Commission.
			  • USGS
			• Medium Cost (~15,000/ station/year)
				N/A	Funding for gaging station's operation and maintenance is continued.	Existing station located on Wildcat Creek just downstream from the Kokomo Creek confluence.
						
						Proposed Timeline
						2007

Table 5-3: Education Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Wildlife and Pet Waste Management
 	
Minimize water quality impacts of wildlife and pets.
 	
High Priority
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Research effective waterfowl management measures implemented by other Midwestern communities.
		• Provide Home Owners Associations with information on how to reduce the habitat suitability of local retention ponds.
		• Reduce mowing and activities along all public property adjacent to waterways.
		• Install pet-stations in all public parks.
			• Local Resources
			  • Kokomo Parks Department
			  • WCWA
			  • Howard County Health Department
			• Medium Cost
				N/A	Stakeholders have changed behaviors and/or practices.
					.
					Urban waterfowl populations.
						Foster Park.
						
						Waterworks Park.
						
						Retention Ponds.
						
						<u>Proposed Timeline</u>
						2007-2009

Public Access Sites
 	
Increase the number of public access sites to Wildcat Creek.
 	
High Priority
	☐ Toxicants
	☐ Bacteria
	☐ Nutrients
	☐ TSS
	☒ Degraded Habitat
		• Develop an outreach campaign focusing on recreational opportunities along Wildcat Creek.
		• Research public and private funding opportunities.
		• Secure funding and begin constructing public access sites.
			• Local Resources
			  • Wildcat Guardians
			  • Kokomo Parks Department
			  • Indiana DNR
			  • WCWA
			• High Cost
				Work with private property owners to gain easements as necessary.	Public access sites funded and constructed.
					
					Usage and stewardship of Wildcat Creek.
						Potential public access sites are identified in Exhibit 4-1.
						
						Kokomo Reservoir Spillway
						
						Continental Steel Dam
						
						CR 440 West
						
						CR 950 West (outside watershed)
						
						<u>Proposed Timeline</u>
						2008-2009

Business Education Program
 	
Develop a business education and on-site assessment program focusing on potential industrial and commercial sources of pollution such as gas stations, dry-clearers, manufacturing facilities, and automobile repair shops.
 	
Low Priority
	☒ Toxicants
	☐ Bacteria
	☐ Nutrients
	☐ TSS
	☐ Degraded Habitat
		• Coordinate with Indiana-American Water Company's Wellhead Protection Program to identify potential industrial and commercial sources of pollution in the watershed.
		• Develop a targeted education program that will educate facility owners on best practices they can implement at their facilities to minimize potential surface and groundwater contamination.
			• Local Resources
			  • Indiana American Water Company
			  • Kokomo MS4 Operator
			  • Kokomo Engineering Office
			  • Howard County MS4 Operator
			  • Howard County Surveyor's Office
			  • Kokomo – Howard County Plan Commission.
			• High Cost
				N/A	Stakeholders have changed behaviors and/or practices.	Potential sources of contamination identified in Indiana American's Wellhead Protection Management Plan located in the Stahl Ditch-Kitty Run Watershed.
						
						UST, LUST, Hazardous Materials Facilities, Tier II Facilities, Waste Transfer Facilities.
						
						<u>Proposed Timeline</u>
						2012-2015

Table 5-3: Education Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Water Quality Monitoring
 	
Develop a water quality monitoring program to document and track long term water quality trends in the Stahl Ditch-Kitty Run Watershed.
 	
Low Priority
	☒ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Seek grant funding from the IDEM to develop and implement a water quality monitoring program.
		• Develop a quality assurance project plan to ensure the accuracy, precision, and reliability of water quality samples collected.
		• Select laboratory to conduct analysis on collected samples.
			• Local Resources
			  • WCWA
			  • Wildcat Guardians
			  • Kokomo Municipal Wastewater Treatment Plant
			  • IDEM
			  • Hoosier RiverWatch
			• High Cost
				N/A	Water quality monitoring program developed.
					
					E.coli and nutrient concentrations in the watershed.
						Conduct sampling at 11 sites utilized for the 2003 Wildcat Creek TMDL Project, as identified in Table 2-10.
						
						Proposed Timeline
						2012

Table 5-4: Land Use Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Geographic Information Systems (GIS)
 	
Continue to utilize Geographic Information Systems as a tool to assist with managing future land use decisions.
 	
High Priority
	☒ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Utilize City and County GIS layers to develop a watershed wide GIS layer to assist in future planning and decision making.	• Digital soil, property, and drainage layers
			• Local Resources
			  • Kokomo Engineering Office
			  • Howard County Surveyor's Office
			  • Howard County Auditor's Office
			  • Kokomo – Howard County Plan Commission
			  • Howard County SWCD
			• Medium Cost
				N/A	Watershed-wide GIS information enhanced.
					
					GIS used in land use decisions.
					
					GIS data integrated and shared among all City and County departments and agencies.
						Auditor's Office, Surveyor's Office, City Engineering Office, Plan Commission Office, and SWCD.
						
						<u>Proposed Timeline</u>
						2007

Post-Construction Runoff Management
 	
Improve water quality and quantity management by promoting urban suburban, and rural stormwater treatment practices (bio-retention basins, rain gardens, constructed wetlands, etc.)
 	
High Priority
	☒ Toxicants
	☐ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Develop a comprehensive list of local developers, builders, and construction industry professionals.
		• Implement an educational program and develop promotional materials focusing on the benefits of implementing stormwater BMPs into new development.
		• Promote the use of certain Low Impact Development (LID) techniques.
		• Distribute promotional materials to local developers, builders, and construction professionals.
			• Local Resources
			  • Kokomo MS4 Operator
			  • Kokomo Engineering Office
			  • Howard County MS4 Operator
			  • Howard County Surveyor's Office
			  • Kokomo – Howard County Plan Commission
			  • Howard County SWCD
			  • WCWA
			  • IDEM
			• Medium Cost
				N/A	Post-Construction practices implemented in.
					
					Stakeholders have changed behaviors and/or practices.
						Local developers, builders, and construction industry professionals.
						
						<u>Proposed Timeline</u>
						2007

Water Quality BMPS and Flood Control
 	
Incorporate water quality BMPs into future flood control projects designed and implemented in the watershed by continuing to implement on-going Rule 13 program.
 	
High Priority
	☒ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Update existing Comprehensive Plans, zoning ordinances, subdivision control ordinances, or other ordinances as necessary.	• Local Resources
			  • Kokomo-Howard County Plan Commission
			  • Howard County Surveyor's Office
			  • Kokomo Engineering Office.
			  • Kokomo City Council
			  • Howard County Commissioners
			• Low Cost
				Approval and adoption of updated planning documents and ordinances.	BMPs implemented into flood control projects.	Local developers, builders, and construction industry professionals.
						
						<u>Proposed Timeline</u>
						2007

Table 5-4: Land Use Management Measures

Management Measures	Water Quality Problem Addressed	Action Plan	Resources/Cost	Legal Matters	Progress Indicators	Critical Areas and Audiences

Stormwater Retrofits
 	
Conduct a storm water retrofit design and demonstration project at three locations in the watershed.
 	
High Priority
	☒ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Inventory existing commercial, industrial areas in the watershed including but not limited to those sites listed in the critical areas and audiences column.
		• Solicit property owner interest in participating in such a project.
		• Prepare preliminary site plan and design.
		• Seek and secure funding to assist with project design and construction.
			• Local Resources
			  • Howard County Surveyor's Office
			  • Kokomo Engineering Office
			  • Local landowners
			  • WCWA
			  • Wildcat Guardians
			• Section 319 Grant
			• High Cost
				Secure proper permits from local, state, and federal regulators.	Retrofit inventory completed.
					
					Property owner cooperation established.
					
					Stormwater retrofits designed and constructed.
						Markland Mall.
						
						Industrial facilities.
						
						Local government maintenance facilities.
						
						Proposed Timeline
						2010-2012

Wetland Preservation and Enhancement
Preserve, restore, and enhance existing wetlands in the Watershed.
	☐ Toxicants
	☒ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Identify critical areas for wetland construction or preservation.
		• Inform landowners existing Federal funding programs.
			• Local Resources
			  • Howard County Surveyor's Office
			  • Kokomo Engineering Office
			  • Howard County SWCD/NRCS
			  • Indiana DNR
			  • Wildcat Creek Foundation
			• Section 319 Grant
			• High Cost
			(~$1,500- $3,500/ acre)
				It may be necessary to purchase conservation easements prior to construction of wetlands. Contractual agreements will need to be obtained.	• Acres of wetland preserved, enhanced, and restored.
					• Flooding damages have been reduced due to this project.
						Potential areas identified in Exhibit 4-1
						
						Proposed Timeline
						2010-2012

Greenways Plan
 	
Write a Greenways Plan to maintain a system of healthy riparian/aquatic buffers along Wildcat Creek.
 	
Medium Priority
	☐ Toxicants
	☐ Bacteria
	☒ Nutrients
	☒ TSS
	☒ Degraded Habitat
		• Research available financial support for developing a Greenways Plan.
		• Secure funding to finance Greenway Planning efforts.
		• Establish a working group to lead a greenways planning effort.
			• Local Resources
			  • Kokomo-Howard County Plan Commission
			  • Kokomo Parks Department
			  • Wildcat Guardians
			  • WCWA
			  • Wildcat Creek Foundation
			• High Cost
				Amendments to the Zoning Ordinance and Comprehensive Plan may be necessary. City and County approval of amendments will be necessary.	Greenways Plan developed and riparian buffers maintained.	Wildcat Creek stream corridors directly adjacent to the WCWE.
						
						Waterworks Park.
						
						Proposed Timeline
						2010-2012

Detailed Flood Studies
 	
Conduct detailed flood studies of all stream reaches that have no floodplain designation or have approximated floodplain delineations in the Stahl Ditch–Kitty Run Watershed.
 	
Low Priority
	☐ Toxicants
	☐ Bacteria
	☐ Nutrients
	☐ TSS
	☒ Degraded Habitat
		• Initiate detailed research regarding potential sources of funding.
		• Prioritize stream reaches for detailed study.
		• Obtain and secure funds necessary to complete study (ies).
			• Local Resources
			  • Kokomo – Howard County Plan Commission
			  • Kokomo Engineering Department
			  • Indiana Department of Homeland Security
			  • Pre-Disaster Mitigation Grant
			• High Cost
				N/A	Detailed flood studies completed.
					
					Reduction in future flood losses.
						Unstudied Stream Reaches
						
						Proposed Timeline
						2012-2013

5.1 POTENTIAL IMPLEMENTATION TIMELINE

Management measures listed in the tables above as high priorities are likely to provide the greatest short term benefit to water quality in the watershed, however these activities are not always the easiest measures to implement. Likewise some of the measures that may be considered medium or low priorities may be relatively easy to implement. Therefore, implementation of certain medium priority measures may occur prior to certain high priority measures, and implementation of certain low priority measures may occur prior to certain medium priority measures. Additionally, new information or changes in political and economic circumstances may result in a change in the implementation schedule shown below.

While a variety of circumstances may influence when, where, and how a given measure is implemented, **Table 5-5, 5-6, 5-7, and 5-8** detail the anticipated timeline for when each management measures will be implemented. This table is not intended to identify the length of time that a measure will be implemented, but rather is intended to provide an overall indication of when implementation of a management measure is likely to begin.

Table 5-5: Proposed Agricultural Implementation Timeline

Management Measure	2007	2008	2009	2010	2011	2012	2013	2014	2015
Buffer/Filter Strips		**H**	**H**	**H**	H	H	H	H	H
Nutrient and Pest Management		**H**	**H**	**H**	H	H	H	H	H
Financial Incentive Programs		**M**	**M**	**M**	M	M	M	M	M
Conservation Tillage		**M**	**M**	**M**	M	M	M	M	M
Grassed Waterways and Critical Seedings		**M**	**M**	**M**					
Winter Cover Crops		**M**	**M**	**M**	M	M	M	M	M
Drainage Water Management		**M**	**M**	**M**	M	M	M	M	M
Pasture Management and Exclusionary Fencing		**L**	**L**	**L**	L	L	L	L	L

Table 5-6: Proposed Wastewater Treatment Implementation Timeline

Management Measure	2007	2008	2009	2010	2011	2012	2013	2014	2015
Illicit Discharge Detection and Elimination (IDDE)	**H**	H	H	H	H	H	H	H	H
Septic System Education		**H**	**H**	**H**	H	H	H	H	H
Septic System Tax Credit Program	**H**	**H**	**H**	**H**	**H**	H	H	H	H
Septic System Maintenance District	**H**	**H**	**H**	**H**	**H**	Begin implementing recommendations of feasibility study.			
Wastewater Treatment Demonstration Project					**M**	**M**			
Point of Sale Septic System Inspections						**L**	L	L	L
Funding for Connecting to Wastewater Treatment Plants						**L**	**L**	**L**	**L**

Table 5-7: Proposed Public Education Implementation Timeline

Management Measure	2007	2008	2009	2010	2011	2012	2013	2014	2015
Household Hazardous Waste Program Promotion	**H**	H	H	H	H	H	H	H	H
Lawn and Garden Chemical Education Program		**H**	**H**	**H**	H	H	H	H	H
Rainwater Garden Demonstration Project		**H**	**H**	**H**	H	H	H	H	H
Erosion and Sediment Control Workshop		**H**	H	H	H	H	H	H	H
Flood Hazard Education	**H**	H	H	H	H	H	H	H	H
Stream Corridor Inspection Program	**H**	**H**	**H**	**H**	**H**	H	H	H	H
Low-Head Dam Removal Feasibility Study				**H**	**H**	Begin implementing recommendations of feasibility study.			
USGS Gaging Stations	**H**	H	H	H	H	H	H	H	H
Wildlife and Pet Waste Management	**H**	**H**	**H**	H	H	H	H	H	H
Public Access Sites		**H**	**H**	H	H	H	H	H	H
Business Education Program						**L**	**L**	**L**	**L**
Water Quality Monitoring						**L**	L	L	L

Table 5-8: Proposed Land Use Implementation Timeline

Management Measure	2007	2008	2009	2010	2011	2012	2013	2014	2015
Geographic Information Systems (GIS)	H	H	H	H	H	H	H	H	H
Post-Construction Runoff Management	**H**	H	H	H	H	H	H	H	H
Water Quality BMPS and Flood Control	**H**	H	H	H	H	H	H	H	H
Stormwater Retrofits				**H**	**H**	**H**			
Wetland Preservation and Enhancement				**M**	**M**	**M**	M	M	M
Greenways Plan				**M**	**M**	**M**	M	M	M
Detailed Flood Studies						**L**	**L**	L	L

6.0 MONITORING EFFECTIVENESS

Progress indicators are used to gage the progress and success of the watershed planning effort. Indicators may be administrative, such as language added to an ordinance, environmental, indicating the total acreage added to a filter strip program, or social, indicating changes in stakeholder attitudes and behaviors. Monitoring describes how the above mentioned indicators will be evaluated to determine the level of success reached toward achieving the goal. Monitoring progress can be general, or very specific, such as increasing the number of participants at quarterly meetings or through improvements observed in biological or chemical measurements.

Goal Monitoring and Progress Indicators

For each goal, it is suggested that progress toward meeting each indicator be documented on a biannual basis. Biannual tracking of progress for each milestone will help to maintain focus on goal objectives and progress, but also to troubleshoot issues where it is clear that tasks may need to be adjusted or modified in order to achieve the goal objective.

Administrative, social, or environmental indicators can be utilized to determine progress made toward achieving the goals identified in this plan. Social indicators such as the number or percentage of stakeholders that have changed their behavior and/or practices can be measured by conducting surveys of stakeholders.

Environmental indicators, such as in-stream *E.coli*, nutrient, and TSS concentrations can be measured by conducting water quality monitoring and comparing new information with baseline information summarized within this plan or as collected by other local organizations or volunteers. Other environmental Indicators such as the number of feet of buffer/filter strips installed can be measured by tracking landowner participation in conservation programs and the number of feet of buffer/filter strips installed per landowner.

Finally administrative indicators such as the adoption of an ordinance or the completion of a feasibility study can be measured by coordinating with local government officials to determine progress made on such administrative indicators. Future monitoring of progress indicators will help identify the relative success and short comings associated with implemented management measures, and should be used to adjust and revise certain portions of the plan as necessary.

Plan Evaluation

The WCWA in partnership with the Steering Committee will be responsible for the regular review and update of the Stahl Ditch-Kitty Run Watershed Management Plan. This plan should be evaluated on a biannual basis to document and celebrate progress; assess effectiveness of efforts; modify activities to better target water quality issues; and keep implementation of the plan on schedule. The plan should be revised as needed to better meet the needs of the watershed stakeholders and to meet water quality goals.

Chemical Monitoring Re-evaluation

In order to evaluate if management measures are having a beneficial impact on water quality, future chemical monitoring of the watershed should be conducted at the same monitoring locations that were utilized in the 2003 IDEM TMDL Project. This monitoring should be

coordinated with the IDEM and any other groups studying water quality in the Stahl Ditch-Kitty Run Watershed. These data will be used to measure the effectiveness of all measures implemented in achieving goals of improving water quality, reducing concentrations of nutrients, sediment, and *E.coli*, and reaching targeted load reductions as identified in Section 4.3. By identifying existing pollutant loads and targeting future pollutant loads, the WCWA has created a framework through which the overall success of individual management measures and goals identified in this plan can be evaluated. As was the case with the future evaluation of progress indicators, results of future water quality monitoring efforts will identify the relative success and short comings associated with implemented management measures, and can be used to adjust and revise certain portions of the plan as necessary.

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