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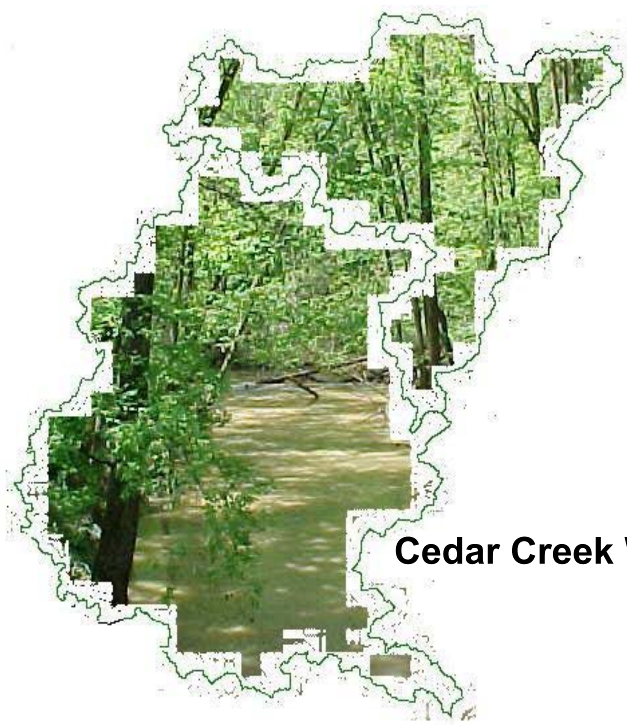

Cedar Creek Watershed Management Plan

September 9, 2005

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See also:
Attachment A: Water Quality Monitoring Analysis for the Cedar Creek Watershed

Attachment B: Aerial Photographs of Various Areas of Concern in the Cedar Creek Watershed

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Cedar Creek Watershed Management Plan

Executive Summary

Cedar Creek is a significant area of natural beauty within the St. Joseph River watershed in northeastern Indiana. A mix of farms and agricultural lands, small towns and cities, and significant geological features mark the watershed. Its confluence with the St. Joseph River in northern Allen County lies directly north of Fort Wayne, the second largest city in Indiana. Fort Wayne draws its drinking water from the St. Joseph River downstream of its confluence with the Cedar Creek.

When the St. Joseph River Watershed Plan was approved by the Indiana Department of Environmental Management (IDEM) in 2000, the stated philosophy indicated the St. Joseph River Watershed Initiative would act as a coordinator and help to develop sub-watershed planning groups in each sub-watershed. The Cedar Creek Watershed Plan is the first of this focused series of sub-watershed plans to be developed.

The Cedar Creek has been on the State of Indiana's 303(d) list of impaired waters for E. coli contamination for several years and was scheduled for a Total Maximum Daily Load (TMDL) in 2004. The Cedar Creek watershed management planning effort began in 2002 with an agreement between IDEM and the St. Joseph River Watershed Initiative (SJRWI) that the TMDL would be delayed while the Initiative, funded by a Section 319 planning grant, attempted to work in the community to develop a watershed management plan and support implementation of voluntary best management practices (BMPs) in the watershed. As this process progressed over the first year of the project, the Cedar Creek Watershed Management plan became a pilot effort to develop a Watershed Management Plan (WMP) in lieu of the TMDL through the mechanism of a voluntary, community-based and community-led watershed management process. Because of this agreement, the Cedar Creek Watershed Management Plan contains some documentation normally found in a TMDL assessment, including load allocation, load reduction, load

Cedar Creek Watershed Management Plan

duration curves, as well as a SWAT (Soil & Water Assessment Tool) model.

This watershed plan also incorporates research findings of the Initiative's Bacteria Source Tracking (BST) project, funded by the same Section 319 grant, as well as research from the Source Water Protection Initiative (SWPI) project located in the Upper Cedar Creek watershed.

The Cedar Creek watershed which is addressed in this plan actually consists of two 11-digit HUC (hydrologic unit code) areas, the Upper Cedar Creek (04100003080) and the Lower Cedar Creek (04100003090). There are subtle differences in the two sub-watersheds, specifically in the rate of urbanization, the geomorphology of the streams, and in the population density of the areas. Whenever possible, noteworthy differences are identified in this document.

A series of public meetings held in DeKalb County from April through July of 2003, coordinated by the St. Joseph River Watershed Initiative, focused on gathering input from Cedar Creek stakeholders regarding perceived problems, goals and activities in the watershed. The meetings also served to introduce groups, agencies and individuals currently working within the watershed to various land use and water quality and quantity issues. From attendees at these meetings a core group of interested citizens formed a steering committee which continued to meet and develop this document.

The Cedar Creek Watershed Planning Group will sponsor events in the Cedar Creek watershed which will enable people to become more familiar with and enjoy the use of this high quality natural resource, including one or more canoe trips on the Creek, as well as walking/hiking tours of scenic and park areas bordering the Cedar Creek. Other activities include volunteer monitoring of the streams and educational outreach highlighting the biotic communities of the Cedar Creek.

This Cedar Creek Watershed Management Plan is intended to be a living document designed to assist watershed stakeholders in their efforts toward restoration and protection of the Cedar Creek, the largest tributary of the St. Joseph River in the Maumee River Basin. This document describes a sub-watershed of the St. Joseph River and is intended to be a subsection of the St. Joseph River Watershed Management Plan. The plan will be reevaluated in five years by the St. Joseph River Watershed Initiative to determine whether goals are being met and to adjust tasks, cost estimates and load reduction estimates as necessary.

To receive a copy of this watershed plan, please contact the St. Joseph River Watershed Initiative at the address on the front cover, or download an electronic copy at www.sjrwi.org.

Cedar Creek Watershed Management Plan

Distribution List

ACRES Land Trust, Inc.
Allen County Parks Department
Allen County Partnership for Water Quality
Allen County Planning Department
Allen County Public Library
Allen County Soil & Water Conservation District
Allen County Surveyor
Alliance of Indiana Rural Water
Cedar Creek Wildlife Project
City of Auburn, Office of the Mayor
City of Auburn, Parks & Recreation
City of Auburn, Wastewater Treatment Facility
City of Fort Wayne, Parks Department
City of Fort Wayne Planning Department
City of Fort Wayne, Water Utilities Department
City of Leo-Cedarville
DeKalb Central School District
DeKalb Eastern School District
DeKalb County Health Department
DeKalb County Planning Department
DeKalb County Soil & Water Conservation District
DeKalb County Surveyor
Eckhart Public Library, Auburn
Fort Wayne - Allen County Health Department
Friends Of Metea Park
Garrett Public Library
Hoosier Environmental Council
Hoosier Riverwatch
IDEM – Watershed Management Section
Indiana Department of Agriculture
Indiana Department of Natural Resources
Indiana University-Purdue University Fort Wayne, Biology Department
Indiana University-Purdue University Fort Wayne, Geology Department
Izaak Walton League – Allen County Chapter
Izaak Walton League – DeKalb County Chapter
Maumee River Basin Commission
Natural Resources Conservation Service – Northeast Indiana Area Office
Noble County Department of Health
Noble County Soil & Water Conservation District
Noble County Surveyor
Purdue Cooperative Extension Service – Allen County
Purdue Cooperative Extension Servcie – DeKalb County
Purdue Cooperative Extension Service – Noble County
St. Francis University, Biology Department
St. Joseph River Watershed Initiative
The Nature Conservancy – Upper St. Joseph River Project Office
Wood-Land-Lakes RC&D
Waterloo Public Library
Fort Wayne - Allen County Health Department

Cedar Creek
Watershed
Management Plan

Our Vision for the Cedar Creek Watershed

"The Cedar Creek Watershed is a resource that provides diverse benefits, functionality and habitat to all that it serves. Given an ever-changing environment, our goal is to protect the Cedar Creek and its watershed from degradation and to enhance this resource so it remains a valued asset to our community."

Cedar Creek Watershed Steering Group
January, 2005

Location of the Cedar Creek Watershed

The Cedar Creek Watershed is located within the St. Joseph (Maumee Basin) Watershed in Northeastern Indiana.

Cedar Creek drains two 11-digit HUC (hydrologic unit code) watersheds, the Upper Cedar (04100003080) and the Lower Cedar (04100003090).

Cedar Creek is the largest tributary of the St. Joseph (Maumee) River, which originates in south-central Michigan, flows through Williams and Defiance Counties in Ohio, before entering Indiana. The St. Joseph is on the western border of the Lake Erie Basin.

The St. Joseph's confluence with the St. Mary's River in Fort Wayne, Indiana, marks the beginning of the Maumee River, which flows northeasterly to the city of Toledo, Ohio, on the Maumee Bay of Lake Erie.

Acronyms and Abbreviations Used in this Document

ACPWQ	Allen County Partnership for Water Quality
ACRES	ACRES Land Trust
ACWF	America's Clean Water Foundation
AIRW	Alliance of Indiana Rural Water
ARS	Agriculture Research Service
BMP	Best management practice
BST	Bacteria Source Tracking
CAFO	Confined Animal Feeding Operations
CCWP	Cedar Creek Wildlife Project, Inc.
CEAP	Conservation Effects Assessment Program
CES	Cooperative Extension Service
CFU	Colony forming units
CRP	Conservation Reserve Program
CSO	Combined sewer overflow
CSP	Conservation Security Program
CTIC	Conservation Technology Information Center
DEM	Digital elevation model
DNR	Department of Natural Resources
EQIP	Environmental Quality Incentives Program
EPA	Environmental Protection Agency
FSA	Farm Service Agency
GIS	Geographic information system
GLC	Great Lakes Commission
HEC	Hoosier Environmental Council
HUC	Hydrologic unit code
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
INDOT	Indiana Department of Transportation
IPFW	Indiana University – Purdue University Fort Wayne
IT	Information technology
LARE	Lake and river enhancement
MCL	Maximum contaminant level
MRBC	Maumee River Basin Commission
NED	National elevation dataset
NHD	National hydrography dataset
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Non-point source (pollution)
NRCS	Natural Resource Conservation Service
NRWA	National Rural Water Association
NSERL	National Soil Erosion Research Laboratory (West Lafayette, Indiana)
NTNC	Non-Transient non-community systems
NTU	Nephelometric turbidity units
OSS	Onsite septic systems
PCS	Public community system, also:
PCS	Permit control system
PWS	Public Water Systems
RC&D	Resource Conservation and Development
RUP	Restricted use pesticide
SJRWI	St. Joseph River Watershed Initiative, Inc.
SSURGO	Soil Survey Geographic
SWAT	Soil & water assessment tool
SWCD	Soil and Water Conservation District
SWP	Source water protection
SWPI	Source Water Protection Initiative
TMDL	Total maximum daily load
TNC	The Nature Conservancy
TNC	Transient non-community systems
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USGS	United States Geological Service
USF	University of Saint Francis
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Service
WLL	Wood-Land-Lakes RC&D
WMP	Watershed management plan
WMS	Watershed Management Section (IDEM)
WQ	Water quality
WQS	Water quality standard
WRAS	Watershed restoration action strategy
WWTP	Waste water treatment plant

Part 1. Partnerships and Scope of the Plan

1.1 Charge for developing the watershed plan

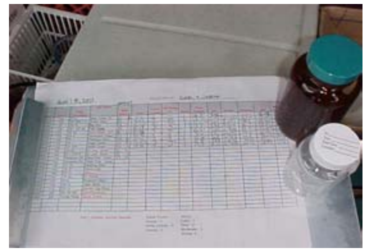


Figure 1 The St. Joseph River Watershed Initiative has been collecting water quality data on the St. Joseph River and its tributaries since 1996.

The creation of the Cedar Creek Watershed Management Plan has been organized by the St. Joseph River Watershed Initiative ("the Initiative") under requirements of a Clean Water Act §319 grant (ARN 01-383). The plan supports an effort by the Indiana Department of Environmental Management (IDEM) to increase local control over remediation of water quality problems of the Cedar Creek and its tributaries. Cedar Creek has been listed for E. coli impairment on the 1998 and the 2002 303(d) list of impaired water bodies and was slated for a Total Maximum Daily Load (TMDL) development in 2004. The IDEM informally agreed to delay this TMDL in order to allow the Initiative to organize watershed stakeholders to begin to address the problems of pollution in the Cedar Creek. Load allocation for E. coli can be found in this document.

This document will serve as an inventory of the current state of the Cedar Creek watershed, as well as a guide for protection and restoration of the waters of the Cedar Creek and its tributaries. It will also be referenced as a section of the comprehensive St. Joseph River Watershed Plan.

1.2 Organizing the community

The following groups and organizations have been identified as stakeholders in the Cedar Creek Watershed. These groups have taken part in the planning process in various ways, including attendance at planning meetings, participation in the steering committee, or providing information, input, and analysis of documents during the planning process.

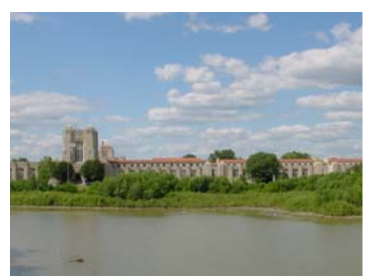


Figure 2 The Three Rivers Water Filtration Plant processes 34 million gallons of water per day for residents of Fort Wayne and New Haven. Photo courtesy of the City of Fort Wayne.

1.2.1 The St. Joseph River Watershed Initiative

The St. Joseph River Watershed Initiative is a not-for-profit 501(c)(3) partnership organization that promotes land use practices that are both economically and environmentally compatible with clean water in the St. Joseph River. The Initiative strives to educate watershed citizens and to facilitate cooperation and eliminate duplication of efforts among the many watershed stakeholders in the quest for improved water quality in the St. Joseph River watershed. Its board of directors and members are agencies, citizens and representatives from conservation agencies, businesses, industry, local government, and educational institutions from three states (Indiana, Ohio and Michigan) and six counties.

1.2.2 The Alliance of Indiana Rural Water

The Alliance of Indiana Rural Water (AIRL) is a non-for-profit organization that assists rural communities throughout Indiana with their water and wastewater needs. As the only Indiana affiliate of the National Rural Water Association (NRWA), the AIRL's mission is to provide water and wastewater systems with high quality professional support, services, and solutions.

The Alliance provides solutions to the daily water and wastewater challenges of communities through training and continuing education, on-site technical assistance, leak detection, line location, and Wellhead and Source Water Protection. The Alliance also works to lobby at the Statehouse for small water and wastewater utilities. More information about the Alliance is available at www.inh2o.org.

1.2.3 Cedar Creek Wildlife Project, Inc.

The Cedar Creek Wildlife Project (CCWP), whose members are mainly property owners in the Cedar Creek watershed, was created in 1965 to protect the stream in its natural state. Since then, according to the organization's literature, CCWP has participated directly in creating public policy to fulfill that preservation purpose, including:

- designation of the entire stream in Allen County and a mile into DeKalb County as a scenic river under the Indiana Natural, Scenic and Recreational Rivers Act;
- supporting the dedication of a number of private and public properties along the stream under the Indiana Nature Preserves Act;
- encouraging the conveyance of protective and restrictive easements, as well as outright land gifts contributing to the preservation goal; and
- consistently opposing all public and private actions incompatible with protecting the natural features of Cedar Creek and its associated ecosystem.

1.2.4 Soil & water conservation districts

The Allen, Noble and DeKalb County Soil and Water Conservation Districts (SWCD) assist land users and residents in the protection and improvement of soil and water resources in the Cedar Creek area. Staff assistance and information is available to stakeholders throughout the Cedar Creek watershed from all of these county agencies. The county conservation districts have offered programs promoting Best Management Practices (BMP) such as conservation tillage, assistance with failing septic systems, nutrient management, proper grazing and livestock management.

Figure 3 The Garrett City Ditch is a tributary of the Cedar Creek. Photo by Jane Loomis.

1.2.5 Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS), under the

U.S. Department of Agriculture (USDA) provides financial, technical and educational assistance through Allen, DeKalb and Noble county offices to implement conservation practices on privately owned land.

1.2.6 The cities of Fort Wayne, Auburn, Garrett and Waterloo

Local municipal government from four cities in the Cedar Creek watershed has important input to the Cedar Creek plan. The St. Joseph River, of which the Cedar Creek is the largest tributary, is the source of drinking water for the City of Fort Wayne. Waterloo, Garrett and Auburn, all upstream, have wastewater treatment plants that empty into Cedar Creek. These three smaller cities get their municipal drinking water from groundwater sources.

Huntertown is also in the Cedar Creek watershed, located a few miles north of Fort Wayne in Allen County. Huntertown contracts with the City of Fort Wayne for sewage disposal via Fort Wayne's sewage treatment plant. The city sits atop a significant aquifer area.

1.2.7 County Surveyors' offices and drainage boards

County Drainage Boards were created under the Indiana Drainage Code IC-36-9-27. Maintenance and reconstruction work on county drains and ditches are designed, bid and managed by the surveyor's office. The Noble County Drainage Board is an appointed board composed of members of the Board of Commissioners and Scott Ziegler serves as Noble County surveyor. In DeKalb County, the Board of Commissioners also serves as members of the Drainage Board where Mark Strong is the county surveyor.
DeKalb County has 650 regulated drains with about 1,600 miles of tile and open drains. In Allen County the county commissioners serve on the drainage board and Allan Frisinger is the elected surveyor. Allen County has 2,500 miles of regulated drains.

Figure 4 Construction activity in 2003 upgraded the Garrett Wastewater Treatment Plant. Photo by Jane Loomis.

1.2.8 The Nature Conservancy

A group of ecologists incorporated The Nature Conservancy (TNC) in 1951 to foster direct action to stem the loss of
natural areas. The Conservancy focuses on using the best scientific information available to protect habitat for rare and endangered species. In Indiana, the Conservancy has a strong presence in the St. Joseph River watershed through its Upper St. Joseph River project, and has taken an active role participating in the St. Joseph River Watershed Initiative. The Conservancy's Douglas Woods preserve in northeastern DeKalb County is a close neighbor to the Cedar Creek watershed. The Nature Conservancy's Upper St. Joseph Project office is located in Steuben County at Peachtree Plaza, Suite G, 1220 N 200 W, Angola, IN 46703.

1.2.9 Wood-Land-Lakes Resource Conservation and Development

Established in 1996, Wood-Land-Lakes RC&D (WWL) is a six-county natural resource based volunteer organization in northeast Indiana. DeKalb and Noble counties are within its district; Allen County is not. Wood-Land-Lakes provides a way for people to plan and implement projects such as conservation easements, farmland, woodland, pasture and wetland protection. They have provided educational programming for on-site wastewater treatment systems and are currently working with other local conservation groups on a program highlighting drainage issues. Wood-Land-Lakes is located in Angola, Indiana.

1.2.10 ACRES Land Trust

Located at 2000 North Wells Street, Fort Wayne, Indiana, ACRES is a membership organization that protects 50 nature preserves in 14 Northeast Indiana counties, including the Cedar Creek Preserves.

Figure 5 State Nature Preserves protect some of the land in the Cedar Creek Watershed. Photo by Jane Loomis.

Figure 6 Chapter House of the Izaak Walton League in Allen County. Photo by Jane Loomis.

1.2.11 Izaak Walton League

The Fort Wayne chapter of the Izaak Walton League is located along the Cedar Creek at 17100 Griffin Road, Huntertown, IN, in Allen County. Other Indiana chapters of this group include the DeKalb County Chapter in Auburn, and the Gene Straton Porter Chapter, also in Huntertown. The mission of the Izaak Walton League is to conserve, maintain, protect and restore the soil, forest, water and other natural resources of the United States and other lands; and to promote means and opportunities for the education of the public with respect to such resources and their enjoyment and wholesome utilization.

1.2.12 County health departments

The county health departments are charged with protection of public health in the area that includes the Cedar Creek watershed. Standing water, insect infestation, licensing and inspection of on-site waste treatment systems and detention ponds are within the purview of these health departments. Fort Wayne-Allen County, DeKalb County, and Noble County health departments have jurisdiction in the watershed.

1.2.13 Indiana University – Purdue University Fort Wayne (IPFW)

The Department of Biology at IPFW has been a partner over the past several years with the St. Joseph River Watershed Initiative and during this time has worked closely with the Initiative on a Bacteria Source Tracking project to help identify the source of fecal coli from bacteria in the

St. Joseph River and its tributaries. Monitoring and testing work was done with a particular focus on the Cedar Creek sub watershed in order to further support this watershed plan. Additionally, biologists from IPFW are researching amphibians, fish and other aquatic life in the Cedar Creek and the St. Joseph River in general. Their input is included in this document.

1.2.14 DeKalb County Planning Board

Since a large portion of the Cedar Creek watershed lies within DeKalb County, the county's emerging comprehensive plan will have a direct impact on the management of the Cedar Creek watershed. Likewise, input from Cedar Creek watershed stakeholders at this point in the development of the comprehensive plan will directly impact the future effectiveness of the Cedar Creek Watershed Management Plan. According to the DeKalb County Plan, adopted in 2004, the County undertook the comprehensive planning initiative as a step toward proactively planning for the community's future. Its goal is to identify future goals and challenges and to capitalize on opportunities. DeKalb County seeks to balance the conflicting issues of growth, development, economic prosperity, environmental quality, government services and quality of life.

Figure 7 Conservation tillage practices help to protect the watershed by reducing topsoil erosion. Photo courtesy of Allen County SWCD.

1.2.15 Allen County Parks and Friends of Metea Park

Allen County has three county parks within the Lower Cedar Creek Watershed: Metea County Park, 8401 Union Chapel Rd., Fort Wayne, IN 46845; Cook's Landing County Park, corner of Shoaf and Coldwater Roads; and Payton County Park, 13928 Dunton Road between Hathaway and Gump Roads. The *Friends of Metea Park* is a non-profit organization which supports outreach conservation education in and around Metea Park.

1.2.16 Fort Wayne-Allen County comprehensive plan

Allen County and the City of Fort Wayne launched an historic effort to create the community's first-ever comprehensive land use and development plan in January, 2004. The comprehensive plan is intended to create a unified approach to infrastructure expansion and economic development. Its goals also include preservation of the community's character and assets, improvements in quality of life and the promotion of actions that are in the best long-term interests of the community as a whole. As is the case in DeKalb County, the involvement of stakeholders of the Cedar Creek watershed in this planning process will influence the comprehensive plan, and the finished plan will be a limiting factor in management of the watershed.

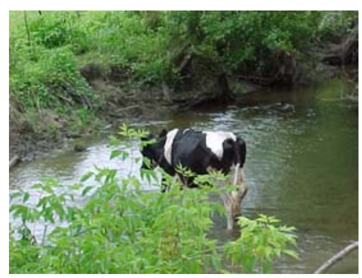


Figure 8 Fencing livestock from the stream can help reduce pollution from bacteria. Photo by J. Kirby Thompson.

1.2.17 Auburn Parks and Recreation

The Goal of Auburn City Parks and Recreation Department is to maintain the city parks and to provide recreational and educational opportunities for the community. Community parks include Eckhart Park, Memorial Park, Smith Acres Park and Thomas Park.

1.2.18 Allen County Partnership for Water Quality

The Allen County Partnership for Water Quality (ACPWQ) is an effort to combine efforts, funding and outreach to address water quality and storm water management issues. The partners in this effort include the City of Fort Wayne, Allen County and the City of New Haven. Also represented on the partnership board are the Fort Wayne-Allen County Health Department, the St. Joseph River Watershed Initiative, and the Maumee River Basin Commission. The ACPWQ has produced brochures dealing with storm water pollution, West Nile virus, solid waste, drinking water, septic systems, waste water and various other water quality subjects. It is also a center for Project WET, a water resources education effort aimed at elementary and secondary school teachers, and provides educational outreach focused on children at local summer festivals. ACPWQ and the St. Joseph River Watershed Initiative launched a successful first effort to celebrate 2004 Drinking Water Week, reaching nearly 1,200 elementary school students throughout Allen County. The ACPWQ is housed at the Allen County SWCD office in the USDA Service Center.

1.2.19 Hoosier Environmental Council

Since 1983, the Hoosier Environmental Council (HEC) has worked to protect the health and quality of life for Indiana residents. The HEC has 25,000 individual and 61 organization members, and a high-quality professional staff. It considers itself prepared to tackle Indiana's major environmental issues. The HEC was the group responsible for collecting local tap water samples for pesticide analysis for the Environmental Working Group's 1995 "Weed Killers by the Glass" report.

Figure 9 Jan Hosier of IDNR's Hoosier Riverwatch works with a group of volunteer trainees along Cedar Creek in Auburn, July 2004. Photo by Jane Loomis.

1.2.20 Hoosier Riverwatch

Hoosier Riverwatch is an organization sponsored by the state Department of Natural Resources (DNR). The organization started in 1994 to increase public awareness of water quality issues and concerns by training volunteers to monitor stream water quality. Hoosier Riverwatch increases public involvement in water quality through hands-on training of volunteers in stream monitoring and clean up activities, educates local communities about the relationship between land use and water quality, and provides water quality information through its volunteer monitoring database. Hoosier Riverwatch offers a grant program that provides water quality test kits to organizations and citizen groups that agree to monitor stream segments in their home area for a specific period of time.

1.2.21 Maumee River Basin Commission

The Cedar Creek watershed lies within the boundaries of the Maumee River Basin Commission (MRBC). The MRBC was established by State Law (I.C. 36-7-6.1) to assist communities in the

Indiana portion of the Maumee Basin to reduce flood losses by exercising sound watershed management. The MRBC staff provide assistance in the areas of flood control project planning and administration, flood mitigation assistance grant writing, 319 water quality improvement grant writing, erosion and sediment control, flood insurance, floodplain ordinances, inventories of flood prone properties, storm water and erosion control ordinances, soil and water conservation, and public information programs.

1.2.22 Other active groups

Other conservation groups are active in the region, including Ducks Unlimited, Pheasants Forever, and several local conservation clubs located in this watershed. Additionally, several middle and high schools conduct environmental classes and the IPFW Biology Club sponsors an annual celebration on Earth Day during the spring. Various Girl Scout and Boy Scout troops also work on environmental issues within the watershed. Greenway organizations in adjoining watersheds envision extended greenway paths that may include the Cedar Creek watershed at some point in the future.

1.3 Structure of the planning group

The Cedar Creek Watershed Planning Group began meeting at the invitation of the St. Joseph River Watershed Initiative. At the time, Toby Days, source water specialist with the Alliance of Indiana Rural Water, was working on Source Water Protection plans for small communities in the Cedar Creek area. It was determined that joint meetings would be beneficial to the stakeholders of the Cedar Creek. Also at that time, DeKalb County was working on its comprehensive plan for development and was holding public input meetings. Many of the stakeholders and agencies were interested in all three. In an attempt to consolidate the public meetings, the Initiative and the Alliance joined forces to present and gather information. Invitations were extended to the general public, as well as many organizations and agencies, for an organizational meeting held on April 22, 2003 at a central location, the Eckhart Public Library in Auburn, Indiana. The invitation was circulated via newsletters, posters, Allen, DeKalb and Noble Soil and Water Conservation Districts, news releases, and direct mail to Cedar Creek stakeholders already identified to the Initiative and/or the Alliance.

Figure 10 Spring blooms in the Cedar Creek Watershed. Photo by J. Kirby Thompson.

Two meetings were held on April 22, 2003, one in the early afternoon and a second in the evening, with approximately 30 persons attending each meeting. Attendees represented interested citizens, landowners, local governments, soil and water conservation districts, universities, DNR, IDEM, newspapers, conservation clubs, agricultural producers, crop advisors, non-profit organizations and environmental organizations. Attendees at the initial meeting are listed in *Appendix A* at the end of this document.

Follow-up meetings were held on May 13, June 10, and July 16, 2003 at the Auburn library community room.

The first three meetings in the series were facilitated and focused on gathering information from the stakeholders regarding the perceived problems in the watershed, the importance of those problems, and possible solutions to the problems. The June meeting consisted of five-minute presentations by representatives of approximately 19 of the organizations and agencies working in the watershed. Representatives summarized their mission, capabilities and/or projects which address the problems enumerated during the first meeting.

Beginning with the July 16 meeting, the members who wished to be further involved in the development and writing of the watershed plan began to focus on the gathering and organizing of information needed to complete the document. Approximately 13-15 members of the group continued to work as the steering group, meeting monthly through December, 2003. Karen Griggs served as recording secretary. Meeting notices were mailed or emailed directly to the group by the Initiative office. Meeting notices, agendas, records of previous meetings and a draft of the watershed document were also published on the St. Joseph River Watershed Initiative website (www.sjrwi.org).

During the spring, summer, and fall of 2004, the steering group continued to focus on various elements of the plan. Meetings and updates were often distributed by email and advertised on the SJRWI website. Other efforts included ongoing outreach to stakeholders within the Cedar Creek watershed area who may not have been identified in our initial outreach, or who may have chosen not to participate initially.

Figure 11 Erosion from the roadside enters the Peckhart Ditch. Photo courtesy of the St. Joseph River Watershed Initiative.

A canoe trip planned for June 12 was canceled due to storms and high water and the group was unable to reschedule it for later in the summer or fall. A training for volunteer citizen water quality monitors facilitated by Hoosier Riverwatch, and sponsored by the St. Joseph River Watershed Initiative, was held on July 30 in Auburn with approximately 15 volunteers participating.

1.4 Concerns of stakeholders

The public meetings held in April and May, 2003, focused on gathering input on perceived problems in the Cedar Creek watershed. Ample opportunity was given to the 30-plus attendees to identify problems they felt needed to be included in the plan. Several iterations allowed the group to exhaust their lists.

Following is a list of perceived problems identified by stakeholders, sorted into loosely organized groups by category. Some concerns fit into more than one category.

Figure 12 Corn fields flooded by heavy rains. Photo courtesy of Allen County SWCD.

- **Erosion**

Erosion control; excessive runoff velocity due to channelization; stream bank erosion;
getting rid of the water; damage to creek banks and drains; unbuffered streams and ditches.

- **Flooding**

Flooding control; flood plain filling; log jams; log jams cleaned out (for recreation); sustained flooding causing crop damage, tree death and an increase in mosquito populations.

- **Wetlands**

Wetland protection; loss of functional wetlands; loss of natural mitigation areas; no aquifer mapping of DeKalb County.

- **Farming**

Excessive tillage; lack of buffer strips around agricultural fields; pesticide management; unbuffered streams and ditches; nutrient management; animal waste; confined feeding run-off; surface run-off: pesticides, herbicides, nitrates, fertilizer; lack of cropland drainage; lack of conservation practices.

- **Development**

Growth at any cost; allowing land development while trying to protect Cedar Creek; conversion of marginal land for development; bigger, wider (losing land); loss of natural resources due to building; permeable v. impermeable ground surfaces; preserving riparian corridors; no absorption or less absorption due to development; damage to creek banks and drains; urban sprawl; surface run-off; urban/suburban pesticide and fertilizer runoff.

Figure 13 Lack of shading along streams and ditches affects wildlife and aquatic habitat because of thermal pollution. Photo courtesy of St. Joseph River Watershed Initiative.

- **Water quality**

Groundwater protection; surface water quality; runoff from agriculture, golf courses, yards; bacteria in surface water; excessive E. coli (fecal bacteria); septic systems; failed septic systems; combined sewer overflows; municipal bypass and overflow; municipal problem reporting; storm water runoff; road salt pulses; industrial waste (storm water and direct).

- **Wildlife**

Wildlife habitat; drastic decline of freshwater mussel population; lack of woodland management plans.

- **Laws and related issues**

Outdated laws and practices v. current state of environmental knowledge; Indiana Drainage Code; lack of improvement incentives; enforcement of laws on discharge of sewage plants; lack of enforcement of environmental regulations; no central leadership over creek management; too much red tape.

- **Education**

Lack of knowledge of benefit of Cedar Creek; keeping everyone happy; education about recharge zones for water supply; need for education about the geological significance (unique natural features) of the waterway; lack of environmental education for youth; lack of education about problems and solutions.

- **Other issues**

Thermal pollution; air quality; recreation; dumping of trash.

At the May, 2003 meeting, the stakeholders were asked to prioritize these concerns. A simple ballot with the above list was presented, and each stakeholder was requested to prioritize his/her top five problems. This was not a scientific survey. From the 26 persons present, approximately19 stakeholders submitted ballots. A few respondents selected category headings or prioritized in each category. However, most respondents chose five overall problems, ranking them most important to least important. Table 1, below, shows the result of the prioritization of the stakeholders' perceived problems:

Table 1 Prioritization of stakeholders' perceived problems, 2003.

Priority Rank #	Natural Resource Problem
1	**Getting Rid of the Water**
2	**Log jams**
3	**Erosion**
4 (tie)	**Surface water quality**
4 (tie)	**Ground water quality**

Cedar Creek is listed by the State of Indiana on its 303(d) list as impaired for E. coli contamination, and there seemed to be widespread acknowledgement of E. coli problems in the watershed.

The canyon area of the lower Cedar Creek is not particularly suited to agriculture due to its steep topography. This area is primarily wooded and rural residential, with small farm operations and several nature preserves. However, north of the canyon the land becomes rolling to level, and agricultural and urban land uses require intensive drainage to prevent flooding of residences and farm fields.

Issues of drainage and log jams have been controversial in DeKalb County over the last several years. Conflicts have arisen concerning maintenance of legal drains, as well as both the removal of logjams and methods of removal. In 2002-03, under protest from some landowners, work on a large logjam from Cedar Creek along County Road 68 generated a heated debate as well as extensive press coverage.

Part 2. Description of the Cedar Creek Watershed

This chapter contains information about the Cedar Creek watershed: its location, physical description and statistics.

2.1 Location of the Cedar Creek watershed

The Cedar Creek Watershed is located within the St. Joseph (Maumee Basin) Watershed in Northeastern Indiana. The watershed is located within the United States Geological Survey (USGS) hydrologic unit region 04 Great Lakes; sub region 0410 Western Lake Erie; accounting unit 041000 Western Lake Erie-Indiana, Michigan, Ohio; and cataloging unit 04100003 St. Joseph-Indiana, Michigan, Ohio. Cedar Creek drains two 11-digit HUC watersheds, the Upper Cedar and the Lower Cedar.

Cedar Creek is the largest tributary of the St. Joseph (Maumee) River, which originates in south-central Michigan, flows through Williams and Defiance Counties in Ohio, before entering Indiana. The St. Joseph's confluence with the St. Mary's River in Fort Wayne, Indiana, marks the beginning of the Maumee River, which flows northeasterly to the city of Toledo, Ohio, on the Maumee Bay of Lake Erie.

The Cedar Creek watershed is intersected from north to south by Interstate 69 on the watershed's eastern border. U.S. Highway 6 intersects the watershed from east to west in the northern half, and Indiana State Route 8 intersects the watershed from east to west at about midpoint.

Cedar Creek originates at the outlet of Cedar Lake in northwestern DeKalb County, Indiana. Cedar Lake is fed by two major upstream tributaries, Leins Ditch and McCullough Ditch. It flows southeast from Cedar Lake towards the town of Waterloo, and then turns generally south until it empties into the St. Joseph River approximately one mile southwest of the Cedarville Reservoir. The St. Joseph River is the source of drinking water for the City of Fort Wayne, Indiana, the largest city in the St. Joseph River watershed, with 219,495 residents as of 2003 (www.stats.indiana.edu).

2.2 Drainage area and population in the watershed

Cedar Creek drains approximately 273 square miles of northeast Indiana, including approximately 39,526 acres in Noble County, 112,037 acres in DeKalb County, and 23,210 acres in Allen County.

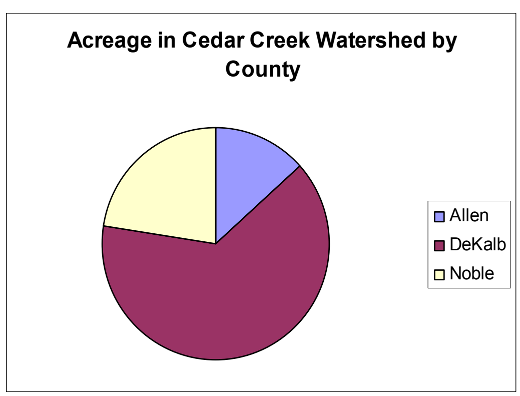


Figure 14 Acres of the Cedar Creek Watershed occupied by county. Chart courtesy of Allen County SWCD

Huntertown (Allen County)	**2,335**
Auburn (DeKalb County)	**12,497**
Garrett (DeKalb County)	**5,762**
Waterloo (DeKalb County)	**2,209**
Avilla (Noble County)	**2,240**

Table 2 Population of cities and towns in the Cedar Creek Watershed. Source: www.statsindiana.edu

DeKalb County contains 390.9 miles of ditches, streams and rivers. The channels of almost all of these ditches and streams have been modified (straightened, lengthened, and deepened) to drain poorly drained soils throughout the county. The very southeastern corner of the county drains directly into the Maumee River and the northwest corner of the county drains into the Turkey Creek watershed (St. Joseph – Lake Michigan basin). The bulk of the county is in the St. Joseph (Maumee - Lake Erie basin) watershed, drained by the Cedar Creek and its tributaries.

The Noble County portion of the watershed is 60% agricultural. The county SWCD reports that 3,800 acres of the watershed have been enrolled in nutrient and pest management programs over a three-year period (2002-2004). Nearly 4,000 acres are enrolled in the Conservation Reserve Program (CSP), and 15 acres of filter strips were installed during the 2004-2005 time frame. (2005. Stacey McGinnis, Noble County SWCD manager)

Cedar Creek is the largest sub-watershed in DeKalb County, and as the largest tributary, is also the largest sub-watershed of the entire St. Joseph River watershed.

Although Allen is the most populous and urbanized of the three counties that claim drainage to the Cedar Creek, Noble and DeKalb counties are both growing at a faster rate than is Allen. This growth is exerting pressure on the traditionally rural landscape, with increasing amounts of acreage being used by residential, commercial, public utility, and recreational (e.g. golf courses) land uses. Areas most pressured by urban expansion include northern Allen/southern DeKalb counties near the scenic Cedar Creek; Auburn (Union Township), and Garrett, particularly along transportation corridors. The western part of DeKalb County has seen greater industrial development, in part because of the I-69 transportation corridor.

The largest urban area in the watershed is Auburn, Indiana. Other towns within the watershed include Garrett, Waterloo and Corunna in DeKalb County; Avilla and Laotto in Noble County, and Huntertown and Cedarville in Allen County. Fort Wayne lies just below the Cedar Creek in Allen County, along the St. Joseph River.

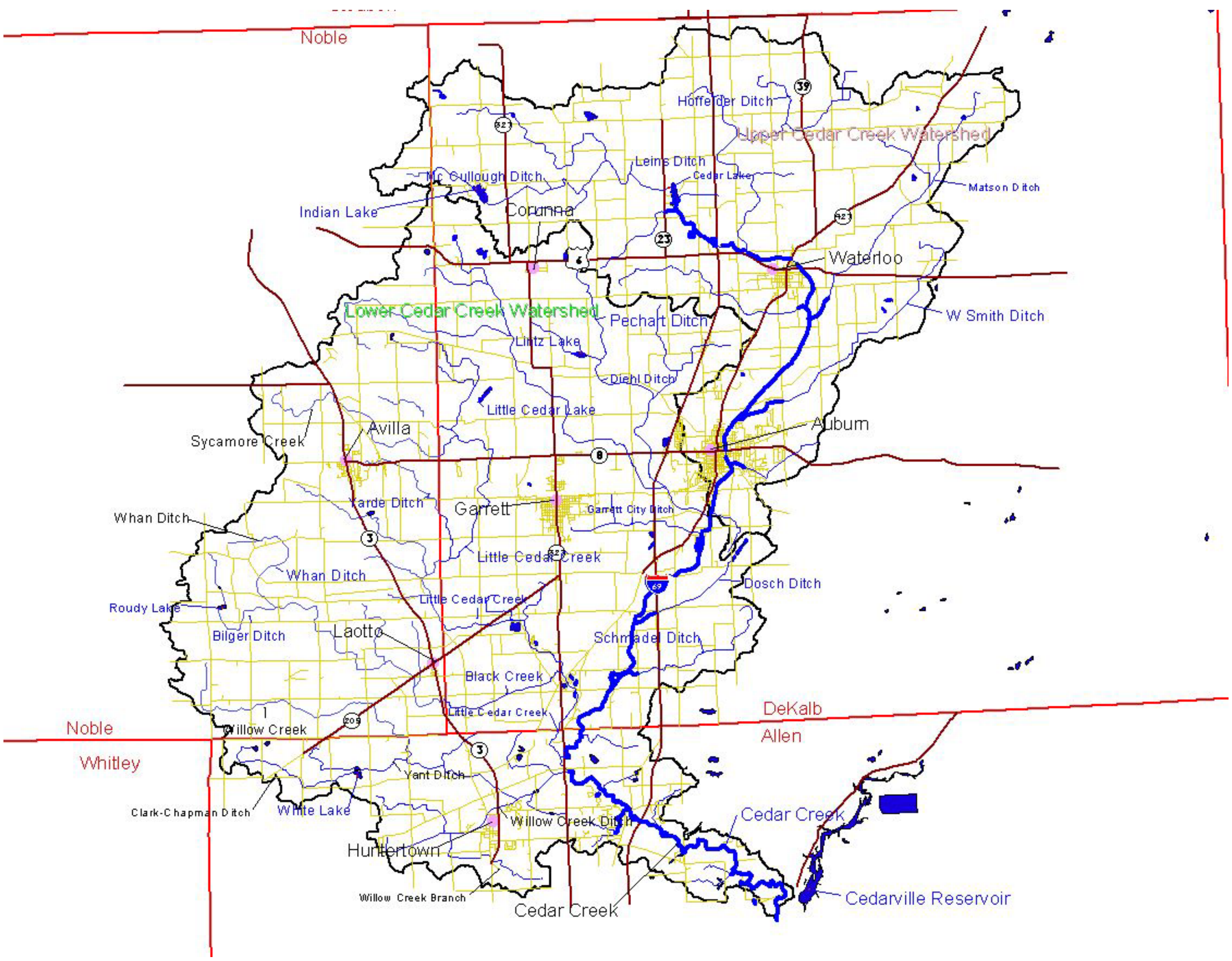


Figure 15 The Cedar Creek watershed is bisected north to south by Interstate 69. Other important transportation routes are S. R. 8 and U.S. 6.

2.3 Physical description of the watershed

2.3.1 Topography

The topography of DeKalb County, which forms 64% of the Cedar Creek watershed, is generally flat to gently rolling. The landscape has many areas of depression or potholes that hold water after heavy rains. The elevation slopes generally northwest to southeast, with the highest elevation at 1070.36 near Fairfield Center, to a low elevation of 781.861 feet in the extreme southeast near the confluence of the Creek with the St. Joseph River (USGS National Elevation Dataset).

The following information about Cedar Creek is taken from Anthony Fleming's geological survey of Allen County. (Fleming, IGS Special Report 57):

The receding glaciers formed much of the surface topography that marks the St. Joseph River and Cedar Creek. As much as 60 feet of outwash sand is present below some of the outwash terraces, particularly in the lowest reaches of the St. Joseph River valley near Fort Wayne. The striking Cedar Creek Canyon is a remarkably straight, 50- to 100-foot deep, narrow gorge that cuts straight across the Wabash Moraine.

Figure 16 Cedar Creek canyon area features striking topography. Photo by Tom Dustin, courtesy of Cedar Creek Wildlife Project website.

Cedar Creek Canyon, which runs from southwestern DeKalb County into northeastern Allen County, began forming during the late Wisconsin Age approximately 22,000 years ago. The canyon is geologically unusual in that it consists of two segments of widely differing morphology and hydrology, both draining the same watershed. The upper segment begins at the drainage divide separating the Eel River Valley (draining to the Wabash and Mississippi), and the St. Joseph River Valley (draining to the Maumee and Lake Erie). The lower segment begins four miles downstream of the drainage divide, commencing at a sharp bend in Cedar Creek located on the boundary between Perry and Cedar Townships in DeKalb County.

The upper segment is physically characterized by its straight course running perpendicular to the crest of the Wabash Moraine. The canyon floor is flat and consistently about 1500 feet wide, bordered by near-vertical walls 50 to 80 feet high. This segment was originally formed as a tunnel valley in the substrate beneath the Erie Lobe. During the time that the glacier stood at the Wabash Moraine, the tunnel valley was the primary drainage for the lobe, resulting in the deep valley we see today. At the time of formation, the tunnel valley discharged and deposited much of its load in an outwash fan in the Eel River Valley. A smaller amount of outwash was carried away by the Eel River.

The lower segment of the canyon is of less clear origin than the upper, although it is understood that the lower portion also carried melt water from the Erie Lobe. The most accepted hypothesis suggests the lower segment was formed as the Erie Lobe retreated from the Wabash Moraine. The outwash originally flowing to the northeast eventually clogged the mouth of the former tunnel valley, allowing the rapidly eroding lower Cedar Creek to capture and reverse the flow toward the newly formed St. Joseph River. (Fleming, 1994)

In 1975, the Indiana Department of Natural Resources, Division of Outdoor Recreation, published a Natural, Scenic and Recreational Rivers Study for the Cedar Creek. This study found that "Cedar Creek in Allen and DeKalb counties, Indiana, from river mile 13.7 downstream to the confluence with the St. Joseph River is a body of water possessing outstanding natural, scenic and recreational characteristics and that this segment of the river should be set aside and preserved for the benefit of present and future generations."

2.3.2 Endangered species

Indiana classifies as *Endangered* any animal species whose prospects for survival or recruitment within the state are in immediate jeopardy and are in danger of disappearing from the state. This includes all species classified as endangered by the federal government that occur in Indiana.

The state classifies as *Special Concern* any animal species about which some problems of limited abundance or distribution in Indiana are known or suspected and should be closely monitored. Indiana classifies as *Extirpated* any animal species that has been absent from Indiana as a naturally occurring breeding population for more than 15 years.

Lists of species in each of the three classifications above can be found in *Appendix B* at the end of this document. Birds and other animals in the Cedar Creek watershed have been tracked and counted by members of the Cedar Creek Wildlife Project, Inc. for many years.

2.3.3 Soils

Soils in the watershed were formed from compacted glacial till. Outwash sediments of sand and gravel occur in small valley trains along the St. Joseph River and Cedar Creek.

Figure 17 Field depression tile system installation in the SWPI project area, spring 2005. Photo by Jane Loomis.

The predominate soil textures in the Cedar Creek canyon area are silt loam, silty clay loam, and clay loam. The majority of the soils along Cedar Creek itself are Morley-Blount association and the Eel-Martinsville-Genesee association. The Moreley-Blount association indicates deep, moderately to poorly drained, nearly level to steep, medium textured soils and usually occurs on uplands. Of this association, Morley soils represent 50 % and Blount soils 40%. The gently sloping soils support meadow crops, corn, soybeans and small grain crops. The steeply sloping soils maintain some native vegetation because erosion is a hazard.

The Eel-Martinsville-Genesee association consists of deep, moderately well-drained, nearly level, medium to moderately fine-textured soils on bottom lands and stream terraces. Soils in this association are suited to meadow crops, corn, soybeans and small grain crops. Eel and Genesee soils are inundated occasionally by flooding and the Martinsville soils are subject to erosion. The breakdown of Cedar Creek soils can be seen in Plate 3. (IDNR, 1975.)

Across DeKalb County there are 31 identified soil types; however the predominant types in the county are Blount silt loam (33%) Pewamo silty clay (19%), Glynwood loam (14%) and Morley silty clay (6%). Drainage is a major issue in the county due to the soil types. 31% of the soil types formed under wetland conditions (hydric soil conditions) and 64% of the soils have the potential to have hydric soil conditions. (Soil Resources in DeKalb County, DeKalb County SWCD, undated.)

The Noble County portion and the upper Cedar Creek area west of the Matson Ditch are typically the Glynwood soils that are gently sloping and moderately well drained.

Compaction is a potential problem on most soils in the watershed. Compaction, or compressing the soil particles together, reduces the ability of the soil to let water and air pass through it. It will commonly result in stunted plant growth, plant stress during dry weather, and lower yields. It can be caused by wheel and tillage on wet soils. (DeKalb County SWCD, undated.)

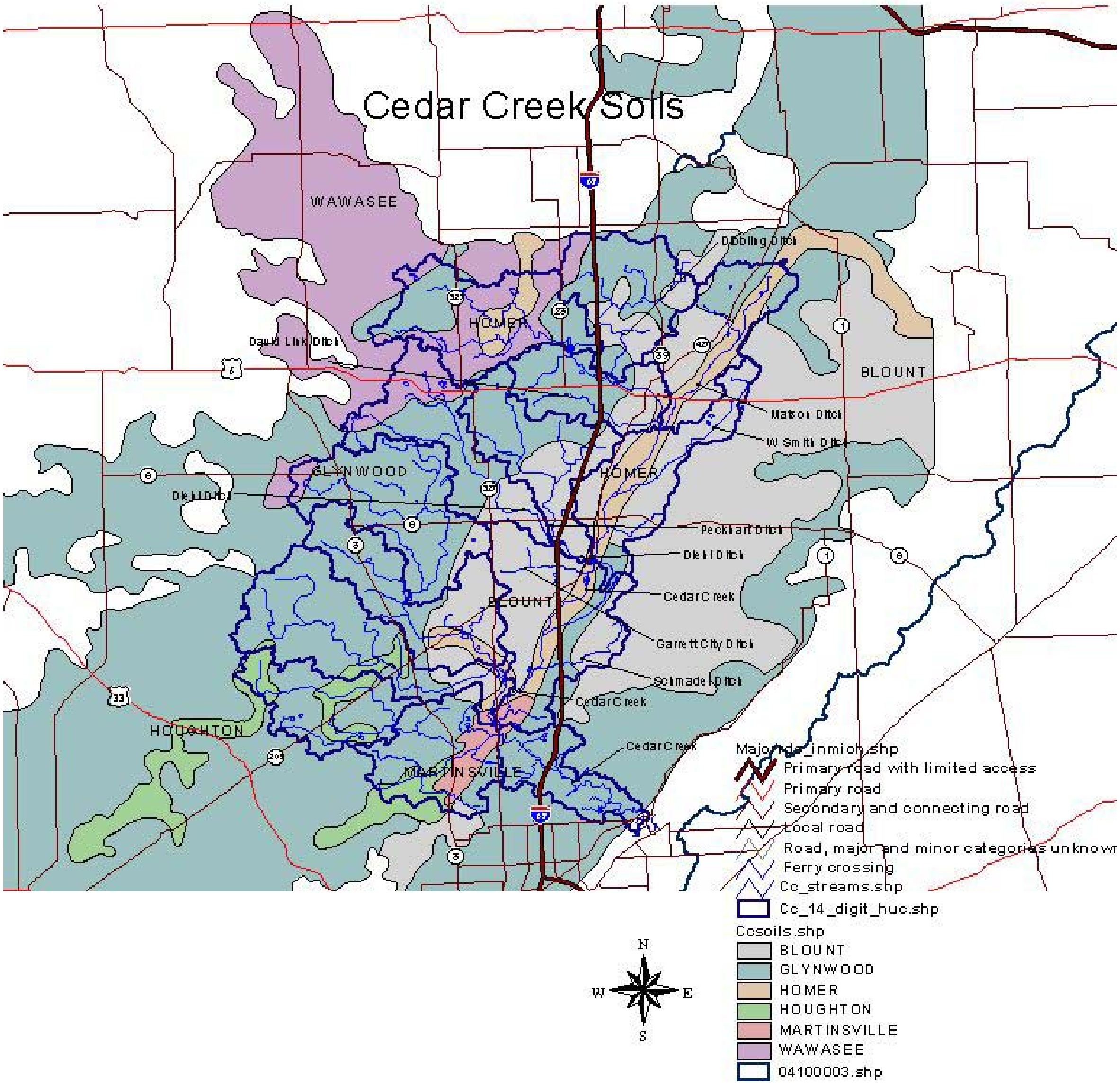


Figure 18 Soils of the Cedar Creek Watershed. Map courtesy of the St. Joseph River Watershed Initiative.

2.3.4 Vegetation

The native vegetation of Cedar Creek is influenced by topography, geological features, and land uses. Vegetation consists mainly of deciduous trees, water-tolerant grasses and sedges, and some water-tolerant trees. As described in the earliest land surveys, vegetation was in three plant groups in the area: 1) elm-ash swamp forests; 2) beech forests; and 3) mixed oak forests. A 1975 Indiana Department of Natural Resources document noted that along the river banks, vegetative cover consisted of a band of trees and shrubs comprised of cottonwood, sycamore and red maples, box elder, bladdernut, ash, black haw, silky dogwood, redbud, smooth sumac, witch hazel, winterberry, red elm and various willows. Common groundcovers included poison ivy, jewelweed, stinging nettle, wild rye and occasionally large clumps of cinnamon ferns. Much of the wetland forests that once existed had disappeared by that time as a result of clearing and drainage for agriculture. (1975, IDNR)

Figure 19 Field tiles discharge into a ditch in the watershed. Photo courtesy of St. Joseph River Watershed Initiative.

According to that same 1975 document, native vegetation in the watershed was characterized as an upland mixed, hardwood forest in varied stages of succession. Understory plant material located in areas least disturbed by grazing and occasional fires included ferns, trilliums, jack-in-the-pulpit, white baneberry, sweet cicely, bloodroot, spring beauty, hepatica, bellwort, Dutchman's breeches, wild ginger, jewelweed, sneezeweed, monkey flower, turtlehead, ragweed, celandine poppy, columbine, and skunk cabbage. As disturbance increased, plant succession included millet, sedges, rushes, asters, goldenrods, and invading blackberry. Some of the most unusual flowers discovered in isolated parts of the valley included the rare Indian paint brush and the yellow ladyslipper orchid. (1975, IDNR) Along the scenic and recreational area of the Cedar Creek, the vegetation has not changed significantly from the time of this report.

Drainage for agriculture and development is provided by extensive tile and open ditch systems. In DeKalb County north of the Cedar Canyon, cropland is still the major land use in the county. Corn, soybeans, wheat and alfalfa hay are the predominant crops. The DeKalb County SWCD reports that trends (1985-2000) show more acres of corn and soybeans, and fewer acres of wheat and alfalfa, a trend tied to the loss of dairy operations and lower income potential for wheat. Without adequate drainage, crop yields are reduced by at least 25%. Northern Allen County and eastern Noble County areas included in the watershed are also predominantly agricultural and also have extensive tile and ditch systems. Residential subdivisions are rapidly replacing farmland in Allen County north of Fort Wayne between the I-69 and U.S. 3 corridors where row crops and some woodlands and wetlands are being replaced by turf and other landscape vegetation and retention/detention ponds.

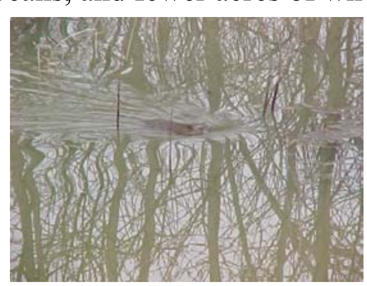


Figure 20 Wildlife swimming in one of Cedar Creek's tributaries. Photo by J. Kirby Thompson.

2.3.5 Fauna

Farming practices have had an important influence on the population of wildlife. Well-managed farms provide food for wildlife, but generally lack cover for small animals. Soils that become depleted of vegetative cover increase the population of insects and rodents. In 1975 the IDNR reported that in the woody and bushy areas in the Cedar Creek, the only large game animal is the white-tailed deer. Occasionally reported were coyote and badger; in fair to good populations were red and gray fox, mink, weasel, skunk, raccoon, muskrat, woodchuck and opossum. Four squirrels represent the area; fox, gray, red and southern flying squirrel. Cottontail rabbits exist in low to medium numbers. (1975, IDNR)

The 1975 DNR report goes on to note that in the large bottomland woods, wood ducks had good to excellent habitats for nesting. Mallard and Black duck make up the greatest portion of migrating ducks and provide moderate wildfowl hunting. The Great Blue Heron has about 25 active nests in a
rookery in the southern part of DeKalb County along Cedar Creek. Ring-necked pheasant and bobwhite quail are occasionally present in the area. (1975, IDNR)

Canada geese are also present in large numbers in the Cedar Creek watershed. IDNR biologists suggest there may be as many as 100,000 nuisance geese in the state; calculations used for our model used a figure of nearly 6,600 geese within the Cedar Creek watershed.

Cedar Creek, in the canyon area, is a rocky-bottomed stream with ripples and cool water containing habitat suitable for smallmouth and rock bass. However, this creek is not known as a good sport fishing destination. Also present are bluegill, channel catfish, buffalo fish, pan fish and suckers. By 1975, put-and-take trout operations that once existed in the creek were no longer existing due to water quality. (IDNR, 1975)

2.3.6 Hydrology and morphology

The St. Joseph River supports the largest number and the highest volume of high-capacity surface water withdrawals, primarily for public supply. The river supports a large drainage area, the presence of outwash deposits which sustain stream flow, and high water quality. Approximately 50 % of the base flow of the St. Joseph is related to the presence of permeable sandy soils and outwash sand and gravel deposits (Indiana DNR, 1996, p. 186).

The Cedar Creek watershed lies within the boundaries of the Huntertown aquifer system. The Huntertown system consists of interlinked outwash, stratified till, and lacustrine sand aquifers, as well as a number of surficial sand units along the Eel and St. Joseph Rivers. Although much of the aquifer system is confined by the tills of the Lagro formation, it is largely unconfined along the St. Joseph River and within the Cedar Creek Watershed. The lower segment of Cedar Creek is a significant local discharge region, receiving groundwater from the upper portions of the aquifer system.

The Cedarville and Eel River-Cedar Creek aquifers in the Cedar Creek watershed are unconsolidated systems. Sediments that comprise these systems were deposited by glaciers and their meltwaters during the ice age. Groundwater availability is good in these systems. The highest estimated rate of recharge to aquifers in the entire Maumee River basin is approximately

500,000 gallons per day per square mile, and occurs in the unconfined parts of both the Cedarville and the Eel River-Cedar Creek aquifer systems. Infiltration of direct precipitation to these two aquifer systems is high because of thinly developed soils on thick, surficial sands. (Water Resource Availability in the Maumee River Basin, Indiana. Indiana DNR, 1996)

Most areas of the Cedar Creek watershed have been extensively ditched and dredged to increase agricultural land and enhance drainage. This type of work modifies the hydrology of the streams. Removal of trees and other vegetation on one or both sides of the ditches and streams affects the flow, capacity, temperature and energy of the waterway.

2.3.7 Climate of Northwestern Indiana

Precipitation norms in northwestern Indiana average 38.56 inches annually. From October through March the average normal precipitation is 2.59 inches per month; from April to September, the average normal is 3.84 inches.

The monthly mean for temperature is 49.6 calculated on an annual basis. Average normal highs are 43.71° October through March and 75.12° April through September. Average normal lows are 25.95° October through March and 53.48 April through September.

2.4 Land use

Land use changes have an effect on the water in the watershed, both in quantity and quality. Historically, changing the land from forest and swampland to productive agricultural land, cities and towns required cutting of trees, eradication of many native plant species, creation of ditches to drain the soil, and extensive road building. During the last fifty years, increased intensity of development from agricultural production to residential and commercial/industrial use has had a profound impact on the amount of water rushing downstream, as well as the load of pollutants that water carries. The effects of these changes are also seen in wildlife and aquatic biodiversity, as their natural habitats are reduced.

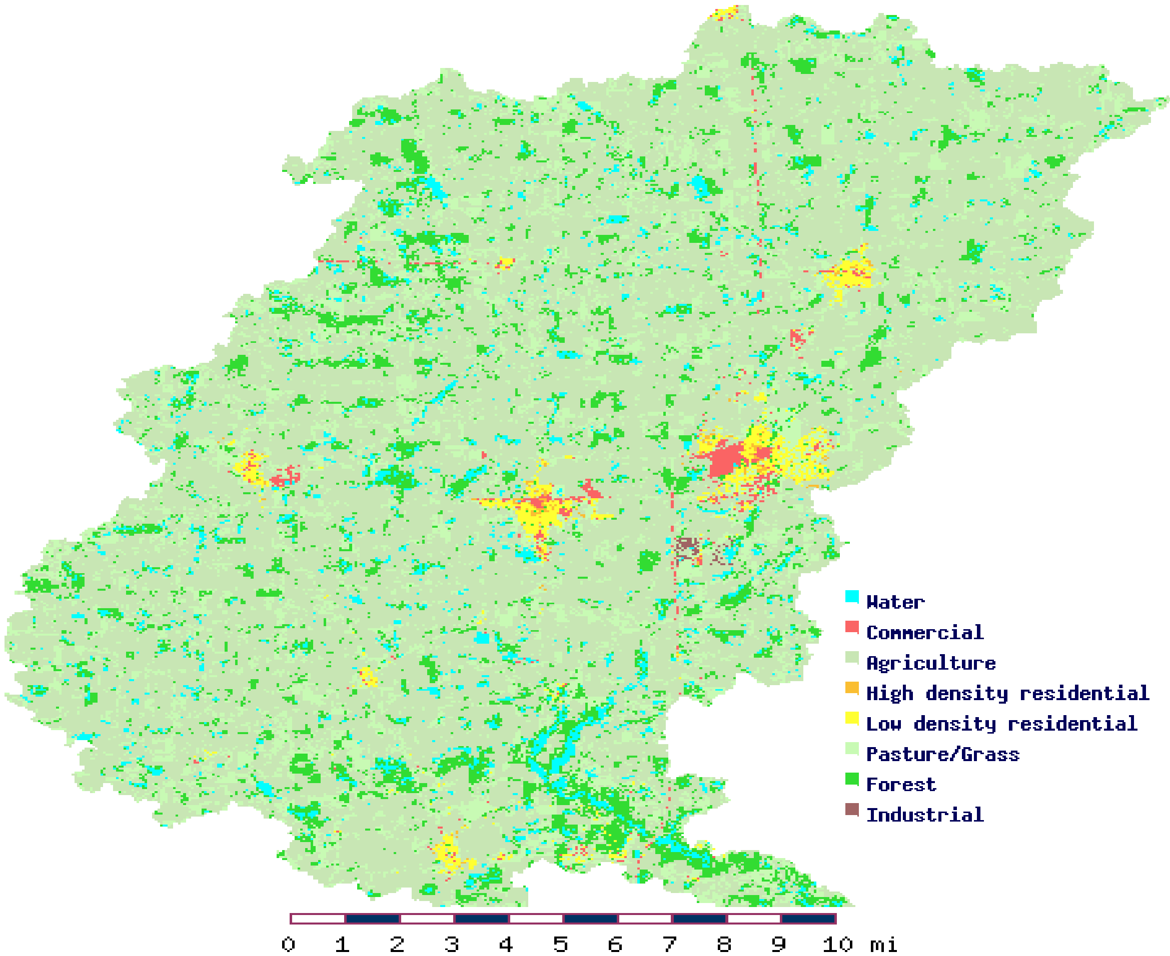


Figure 21 Land uses in the Cedar Creek Watershed. Map courtesy of the St. Joseph River Watershed Initiative.

2.4.1 Settlement and historical changes

The area of land comprising the Cedar Creek watershed was part of the Northwest Territory established by the U.S. Congress through the Ordinance of 1787. The Indiana Territory was organized in 1800, and in 1816 became the nineteenth state of the Union. The earliest settlement in DeKalb County occurred along the St. Joseph River around 1825. The town of Auburn was platted on the Cedar Creek in 1835 by Wesley Park and John Badlam Howe, and was named the county seat in 1837.

Rivers were the first corridors of transportation, with the confluence of the St. Marys and St. Joseph Rivers in Fort Wayne opening the area to the Great Lakes. However, railroads replaced the rivers as transportation corridors in the second half of the 19th century. The railroads opened up the area for livestock and agricultural markets as well as enabling manufacturers to bring in raw materials and ship out finished products.

Immigrants into the area during the 19th century were predominantly of English and German heritage. Later, many Eastern Europeans came into the area. Agriculture has historically been the largest industry in the area; however, industrial uses have become prominent and agriculture has evolved into passive grain farming as opposed to livestock farming. Increasingly, tourism and lodging industry have become important in the area.

Traditional agriculture was also impacted after World War II as personal automobiles affected not only the building of roadways, but also access to rural areas by urban dwellers and easy access to cities and towns by farmers. Interstate 69 was completed in 1965. (Source: DeKalb County Comprehensive Plan, Draft C, 2004)

Land in the Cedar Creek watershed is predominately used for agricultural purposes, with nearly equal portions of crop, pasture, and wooded areas. There is significant industrial and residential development in and around incorporated communities in the watershed as shown in Table 5.

2.4.2 Current statistics

A general picture of the land use for the Cedar Creek area as of 1975 indicated roughly 76% agriculture, 21% forested lands and 3% urban environment. The majority of the agricultural land at that time was rotationally tilled with predominantly corn and soybeans, with lesser amounts of wheat and legumes. (1975, IDNR) It has been estimated that 92% of Allen County's total land area qualifies as prime farmland. Allen County also has the highest total acreage of prime farmland of all Indiana counties. (*Indiana Farmland Protection Plan*, 2003)

A Department of Natural Resources document entitled "Cedar Creek Information Sheet" (circa 1994) lists the following land use characteristics in the Cedar Creek watershed:

Urban	**4%**		**6,989 acres**
Woods	**10%**		**17,473 acres**
Wetlands	**13%**		**22,714 acres**
CRP	**14%**		**24,462 acres**
Cropland	**51%**		**89,109 acres**
Other	**8%**		**13,978 acres**
		Total	174,725 acres

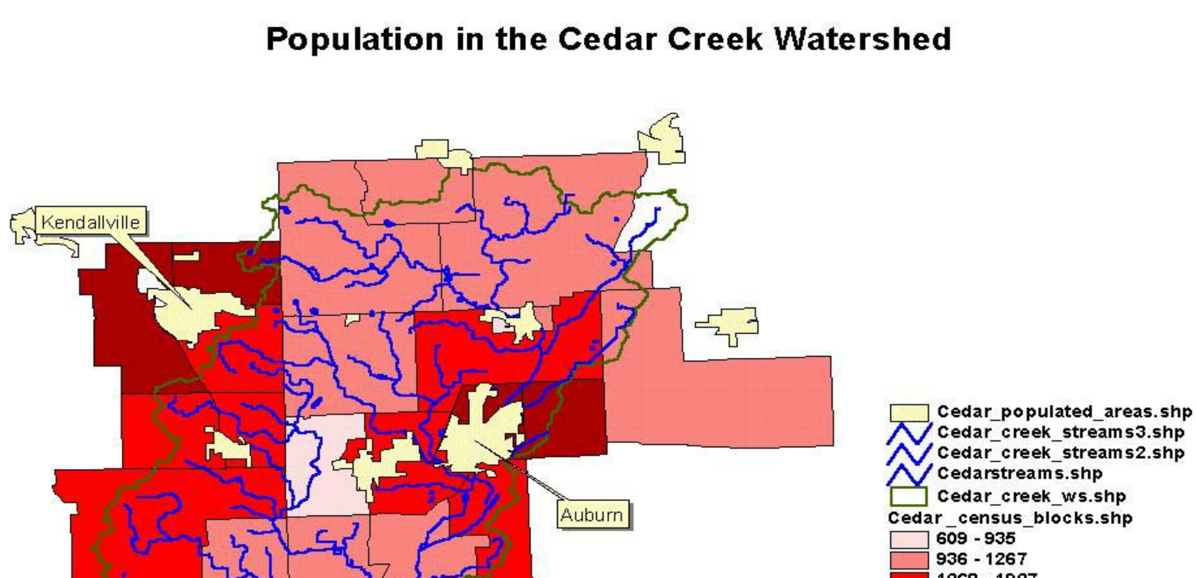
Table 3 Land use characteristics, circa 1994

The 1997 Census of Agriculture reflected a steady decrease in the total amount of farmland during the last century. During the first fifty years, the amount of farmland in DeKalb County decreased by 2%; in the next fifty years, the amount of farmland decreased by over 25%. Harvested cropland and woodland areas have decreased over the last 15 years while land in pasture has increased. (DeKalb County Comprehensive Plan, Draft C, 2004). However, agriculture remains robust within the Cedar Creek and the St. Joseph River watersheds. Several national programs support the agricultural industry in the region, including the Conservation Reserve Program (CRP) and the Environmental Quality Incentives Program (EQIP).

Project Type	Number of Projects	Disturbed Acres
Housing developments	**26**	**1255.16**
Urban developments	**14**	**260.87**
Country development	**4**	**86.00**
Industry	**3**	**31.50**
State projects	**6**	**68.90**
Totals	53	1702.43

Table 4. Approximately 53 active Rule 5 projects and activities were reported in DeKalb County at the end of July, 2003. (DeKalb County SWCD)

Figure 22 U.S. Census block population, 2000. Numbers indicate total population per block.



	Allen	DeKalb	Noble
Population			
1990	**300,836**	**35,324**	**37,877**
2002	**337,512**	**40,525**	**47,209**
2003	**340,153**	**41,129**	**47,039**
(Projected) 2010	**346,653**	**41,993**	**47,627**
% change 1990-2000	**10.3%**	**14.0%**	**22.2%**
Households in 2000	**128,745**	**15,134**	**16,696**
Vital Statistics			
Births, 2002	**5,371**	**616**	**717**
Births, 2003	**5,161**	**591**	**669**
Deaths, 2002	**2,580**	**340**	**358**
Deaths, 2003	**2,701**	**318**	**375**
Total Housing Units 2002	**143,052**	**16,540**	**18,754**
Total Housing Units, 2003 estimate	**145,300**	**16,675**	**18,906**
Annual personal income (per capita, 2001)	**$29,265**	**$25,630**	**$22,876**
Annual personal income (per capita, 2002)	**$29,493**	**$26,551**	**$23,728**
Unemployment Rate 2002	**5.1%**	**5.7%**	**6.2%**
Unemployment Rate 2003	**5.5%**	**6.3%**	**6.8%**

Farm Proprietors, 2003	**1,632**	**846**	**1,031**
Farm Employment 2003	**1,829**	**963**	**1,205**
Non-farm proprietors 2003	**27,570**	**4,655**	**4,664**
Non-farm employment 2003	**224,980**	**27,286**	**25,440**
Assessed Property Value 1999, % by type			
Commercial & Industrial	**45.9%**	**53.5%**	**42.9%**
Residential	**45.5%**	**29.1%**	**32.8%**
Agricultural	**4.5%**	**13.2%**	**19.2%**
Utilities	**4.1%**	**4.3%**	**5.1%**
Total Building Permits Filed, 2002	**2,505**	**188**	**209**
Total Building Permits Filed, 2003	**2,312**	**252**	**248**

Table 4 Vital statistics in three Cedar Creek counties.

In June, 2004 the St. Joseph River watershed was selected as one of 18 priority watersheds nationally for the newly enacted Conservation Security Program (CSP) authorized under the 2002 Farm Bill. The CSP is designed to reward good stewardship for conservation of land. Payments are based on tiers, with Tier III requiring the most rigorous conservation practices and commanding the highest payoff. The Natural Resource Conservation Service (NRCS) personnel conducted regional meetings and sign-ups with landowners through June and July. By the end of August, 2004 when evaluations, applications and approvals were complete, there were 218 approved contracts covering 111,123 acres with approved payments of $4,071,500 across the St. Joseph River watershed. Table 4 reflects the contracts for the counties comprising land within the Cedar Creek watershed.

	Allen	DeKalb	Noble	Total
Total Contracts	**10**	**68**	**9**	**87**
Total Acres Affected	**6,110**	**36,054**	**3,398**	**45,562**
FY 2004 Total Payments	**$253,165**	**$1,297,486**	**$175,344**	**$1,725,995**

Table 5. Conservation Security Program contracts in place by county after the 2004 sign-ups. (USDA Natural Resources Conservation Service)

2.4.3 Future development plans

Although Allen is the most populous and urbanized of the three counties that claim drainage from the Cedar Creek, Noble and DeKalb counties are both growing in population at a faster rate than is Allen. This growth is exerting pressure on the traditionally rural landscape, with increasing amounts of acreage being used by residential, commercial, public utility, and recreational (e.g. golf courses) land uses. Areas most pressured by urban expansion include northern Allen/southern DeKalb counties near the scenic Cedar Creek; Auburn (Union Township), and Garrett, particularly along transportation corridors. The western part of DeKalb County has seen greater industrial development, in part because of the I-69 transportation corridor. In Allen County's Cedar Creek Township, a total of 124 acres of woodland were lost between 1964 and 1975: 64 acres to agriculture, 29 acres to residential development, and 31 acres to miscellaneous changes. In Perry Township, Allen County, a total of 87 acres was lost in that time period: 60 to agriculture and 27 to residential development. (IDNR, 1975)

Figure 23. Limberlost Girl Scouts' McMillen Program Center is located adjacent to the Cedar Creek in Allen County.

2.4.4 Significant sites in the watershed

The lower 13.7 miles of the Cedar Creek watershed, from DeKalb County Road 68 downstream to the confluence with the St. Joseph River in Cedarville, Allen County, is designated as an Outstanding State Resource (327 IAC 2-2-2). Several natural communities, including forested, prairie, fen, bog, marsh and lake communities are included in this area (DNR, 1996). This site includes the 82-foot deep canyon cut by the glacier's ice-age melting. This Outstanding State Resource designation effectively protects the river from detrimental impacts, including construction of dams, docks and bridges, excavation operations, and drainage projects. The upper river miles include 92 active nests of great blue heron, up from a reported 25 in 1975. (Source: Cedar Creek Wildlife Project) The waters of the stream, according to the Indiana State code, "shall be maintained at their present high quality without degradation."

The designated put-in location for recreational canoeing for this stretch is Cook's Landing (Figure 25) at the intersection of Shoaff and Coldwater Roads, and the take-out is on Route 1, Cedarville. However, much of the lower Cedar Creek that has been left in its natural state is reportedly difficult to canoe, requiring multiple portages over private land during times of low or medium flow of the stream. One local canoe livery, Root's Outfitters, starts its canoe trips at the Tonkel Road location rather than at Cook's Landing.

The Indiana Nature Preserves Act of 1967 enabled the dedication of several outstanding natural areas, including nine by ACRES, Inc.; three by the Izaak Walton League, Allen County's Metea Park Nature Preserve, and Limberlost Girl Scouts' McMillen Program Center (see Figure 10).

These adjoin privately held forests, escarpments, floodplains and uplands. A listing of nature preserves can be seen in Table 6 on page 28.

Allen County has three county parks within the Lower Cedar Creek Watershed: Metea County Park, 8401 Union Chapel Rd., Fort Wayne, IN 46845; Cook's Landing County Park, corner of Shoaf and Coldwater roads; and Payton County Park, 13928 Dunton Road between Hathaway and Gump Roads.

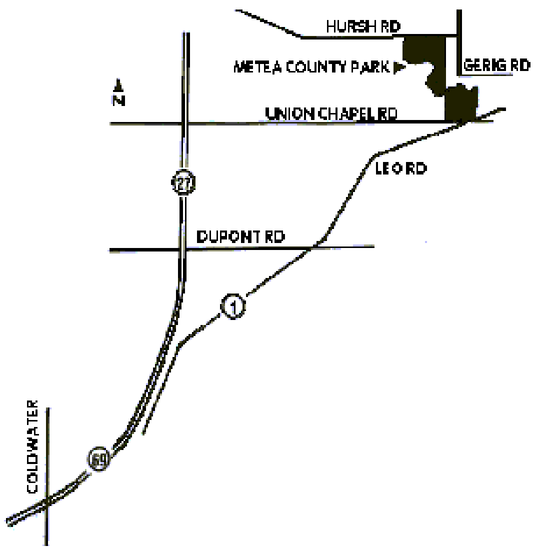


Figure 24 Metea County Park is located adjacent to the Cedar Creek near the town of Leo-Cedarville in Allen County. Map courtesy of Allen County Parks

Metea County Park covers about 250 acres of beautiful countryside in north central Allen County and borders on Cedar Creek. In the park land north of Cedar Creek, there is a hillside prairie area that is a state designated nature preserve. A park building is planned to be completed in 2005. A map of Metea County Park can be seen in Figure 24Figure 24. The park features two miles of hiking trails, a pond for swimming and fishing, picnic tables, restrooms, a picnic shelter, and open areas for baseball, softball, or soccer games, as well as areas for winter sports such as sledding and cross-country skiing. School groups are welcomed.

The Albert D. Rodenbeck Nature Preserve, which borders Cedar Creek, is a bottomland forest preserve with protected wetlands within its borders.

In Auburn, Eckhart City Park and the DeKalb County Fairgrounds straddle the Cedar Creek. 2003 marked the 10th year that the City of Auburn, Indiana has been recognized for its work towards helping to keep trees in our community by being awarded the *Tree City USA* award from the National Arbor Day Foundation and the state DNR. The city has at least 16 parks, including Rieke, Thomas, Riley, Lash, Desoto, Smith Acres, Hunters Glen, Memorial, Eckhart, Willennar, DusenbergV Park Areas I and II, Forest, Eagle Lake and Auburn Gear parks. A 17-acre wetlands is located at 15th Street and Touring Drive.

Nature Preserve	Features
Barrett Oak Hill Nature Preserve	**85-acres located in Allen and DeKalb counties, owned by ACRES Land Trust; high quality mesic upland forest and floodplain forest along Little Cedar Creek. Not open to the public.**

Figure 25 Shelter house at Cook's Landing on the banks of the Cedar Creek, at the intersection of SR 327 and Shoaff Road. Photo by Jane Loomis.

The City of Auburn celebrates its automotive heritage each year over Labor Day by hosting the largest collector car festival and auction in the world. The city is home to several museums: The Auburn Cord Duesenberg Museum; National Automotive and Truck Museum; American Heritage Village, home of the WWII
Victory Museum and the Kruse Automobile Collection; and the Hoosier Air Museum. Bridgewater Golf Club East and Bridgewater Golf Club West are located along the Cedar Creek in Auburn. (http://www.ci.auburn.in.us/communityprofile/)

Industries in Auburn include Auburn Foundry, Cooper Tire & Rubber Co., DeKalb County Airport, Tower Automotive, Kimball Electronics, Meridian Automotive Systems, Riecke Corporation, and Supreme Transit.

Table 6 Nature Preserves in the Cedar Creek watershed. Information compiled by St. Joseph River Watershed Initiative.

The City of Garrett has one community park (Feick), offering a municipal swimming pool, several ball diamonds and tennis courts; three neighborhood parks (East Side, Union Street and West Side); and two specialty recreation areas (Jordan Wetlands and Heritage Park). To further serve the expanding recreational needs of its citizens, the City of Garrett is currently developing Ocker Park, a 20-acre community park on the north side of town. Garrett also has The Garrett Historical Museum and the Garrett Country Club golf course.

Major industries in Garrett employing over 100 persons include Wal-Mart Distribution Center, TRW Automotive, Innovative Technologies, Garrett Products, Fleetwood Homes of Indiana, Electric Motors & Specialties, Dekko Custom Lights and CSX Transportation (www.DeKalbnet.org/garrett).

Bicentennial Woods	**Old growth forest remnant with trees over 200 years old; acquired to celebrate Fort Wayne's 1994 bicentennial; mature oaks, hickory, sugar maple, sycamore, black walnut, black cherry and flowering dogwood; 2 miles of walking trails.**
Little Cedar Creek Wildlife Sanctuary	**18 acres adjoining Barrett Oak Hill Preserve in northern Allen County; oxbow pond in floodplain. Not accessible to the public; owned and managed by ACRES Land Trust.**
Meno-Aki Nature Preserve	**In Metea County Park along Cedar Creek; features rare hill prairie community bordering the creek; steep ravines and bluffs characteristic to the Cedar Creek valley; trails open to the public.**
Rodenbeck Nature Preserve	**115 acres along both sides of Cedar Creek near Cedarville; bottomland forest as well as upland and ravine forest. Owned by the Fort Wayne Chapter Izaak Walton League, 45 acres are accessible by permission only.**
Vandolah Nature Preserve	**Located along Cedar Creek near Cedar Canyon and Cedar Shores; adjoins Rodenback Preserve to the north; features upland and floodplain forest communities and a marsh; well-marked 2-mile trail with scenic views of spectacular ravine and bluff topography.**

Part 3. Benchmarks: Current Status of the Watershed

The following segment outlines the current status of the Cedar Creek Watershed. This is the point from which we start to make improvements and measure changes to the watershed in terms of land use, water quality, and stakeholder involvement. This is the point from which we will try and predict the amount of work and the cost required to bring the Cedar Creek into compliance with Clean Water Act standards.

3.1 Cedar Creek on 303(d) list for E. coli and other impairments

The Cedar Creek and several of its tributaries have been placed on the 303(d) list of impaired waters for the State of Indiana. The Cedar Creek had been scheduled on earlier lists to undergo a TMDL for the pollutant E. coli for 2004; however, this schedule has been adjusted in the 2004 listing based an agreement with IDEM to postpone the TMDL based on the outcome of the Cedar Creek Watershed Management Plan and its anticipated implementation schedule.

Figure 26 Satellite photo of Lake Erie taken April 15, 2005. Light tan areas in the lake at lower left of the photo show sediment entering Lake Erie at Maumee Bay. Photo courtesy of Army Corps of Engineers.

The Indiana Integrated Water Quality Monitoring and Assessment Report of 2004 indicates that of the segments of Cedar Creek sampled, none support primary contact for recreational use.

3.2 Existing Water Quality Data

3.2.1 Local water quality monitoring efforts

There is a significant amount of water quality data available for the Cedar Creek Watershed. The St. Joseph River Watershed Initiative has been sampling the waterways in the St. Joseph watershed, including several sites in the Cedar Creek watershed. Additionally, the Indiana Department of Environmental Management has sampled locations in the creek. Local researchers from Indiana University-Purdue University Fort Wayne have conducted studies in the watershed, and a minimal amount of volunteer monitoring has been done through Hoosier Riverwatch, a program of the Indiana Department of Natural Resources.

The USDA Agricultural Research Service (ARS) has been conducting research in the Upper Cedar Creek watershed since approximately 2002 on the Source Water Protection Initiative project to measure the efficacy of BMPs on a watershed scale. This is an ongoing project which is scheduled to last until at least 2008 and produce a significant amount of research data on sediment, nutrient and pesticide runoff from agricultural fields.

Overall, studies show that there are high levels of bacteria present in the watershed streams, particularly after rainfall events. Additionally, high rainfall in the spring months usually brings increased levels of pesticides and sediment into the streams. Most historical documents indicate that the sediment, bacteria, nutrient and pesticide pollution documented are not a recent problem in the watershed.

The following highlights the various sampling and data collections efforts.

<u>3.2.1.1 The St. Joseph River Watershed Initiative</u>

The St. Joseph River Watershed Initiative has been monitoring the water of the Cedar Creek and the St. Joseph River since 1996 under an approved Quality Assurance Program Plan (QAPP) approved by the Indiana Department of Environmental Management. Sample locations and total number of sites sampled has varied based on the organization's budget, but several locations in the Cedar Creek watershed have been consistently sampled weekly between April and October since 1996. Other locations have been sampled for one or more seasons. The Initiative's water sampling program consists of grab samples taken from bridges along county roads and highways. Basic chemical analysis is done onsite with the use of a *Quanta Hydrolab* sonde, and includes water temperature, pH, conductivity, turbidity, total dissolved solids, and dissolved oxygen. Manual recording of air temperature, cloud cover, time, and general conditions are also recorded on the database. Bacteria, pesticide and nutrient analysis of samples is provided by the City of Fort Wayne at their water treatment plant and water pollution control laboratories.

Figure 27 Jeremy Palmer samples water from the Cedar Creek at the Tonkel Road bridge for the St. Joseph River Watershed Initiaitve. Photo by J. Kirby Thompson.

The Initiative's current sampling sites, located on the map in Figure 28 on page 33, include Cedar Creek on Tonkel Road (100); the Diehl/Peckhart Ditch (104) on old State Road 427; the Matson Ditch (106) on CR 39; Garrett City Ditch (117) on CR 15; Diehl Ditch (136) on CR 19; Peckhart Ditch (137) on SR 8; Walter Smith Ditch (141) on CR 39; David Link (Swartz) Ditch (142) on CR 37; and Dibbling Ditch (143) on CR 18. All sampling sites are in DeKalb County except Site 100, which is located in Allen County.

The Initiative's data is contained on an Access database with GIS capabilities, which permits easy access to information from any given site across the years 1996 to 2005, and allows measurement of trends across the years since 1996.

Overall, the Initiative's data shows show a general decline in average values of pesticides since 1996, with high values showing up after wet weather events during spring application season. Dry years (2001 and 2002) showed the lowest averages, while wet years 2003 and 2004 showed a small increase from those values. A few sites have shown off-season spikes which have been attributed to spills or clean-out of equipment.

Bacteria counts generally average far above the single sample standard for E. coli (235 colonies per 100 ml.) with the annual average percent of samples exceeding the standard generally above 50%. Bacteria averages fluctuate with rainfall, with wet years showing higher averages than dry years. Some sites show significantly high bacteria counts after rainfall events, often numbering above 10,000. Garrett City Ditch has been of particular concern, with 2003 counts reaching between 15,000 and 20,000 several times during 2003. Bacteria counts dropped significantly in early 2004 after the city's new wastewater treatment plant improvements were completed, but numbers spiked again in late summer, 2004. Other areas of particular concern for bacteria are Dibbling Ditch, David Link Ditch, Dosch Ditch, Walter Smith Ditch, and Cedar Creek at Site 100.

Turbidity levels are high in the Cedar Creek, indicating high loading of sediment and suspended solids. Site 100 showed seven weeks of 100+ readings during 2003. However, annual average turbidity values are showing a decline in the Creek, which could indicate that efforts at increasing conservation tillage, filter strips, and other conservation practices are having a positive effect on the water quality. The Initiative listed the Matson Ditch as a critical area for turbidity in 2003. The Dosch and Metcalf ditches, as well as Cedar and Little Cedar creeks are 303(d)-listed for impaired biotic communities, which often is the result of sediment and/or nutrients. Garrett City Ditch is 303(d)-listed for total suspended solids (TSS).

Generally speaking, pH and dissolved oxygen levels are not a major concern across the watershed as a whole at this point.

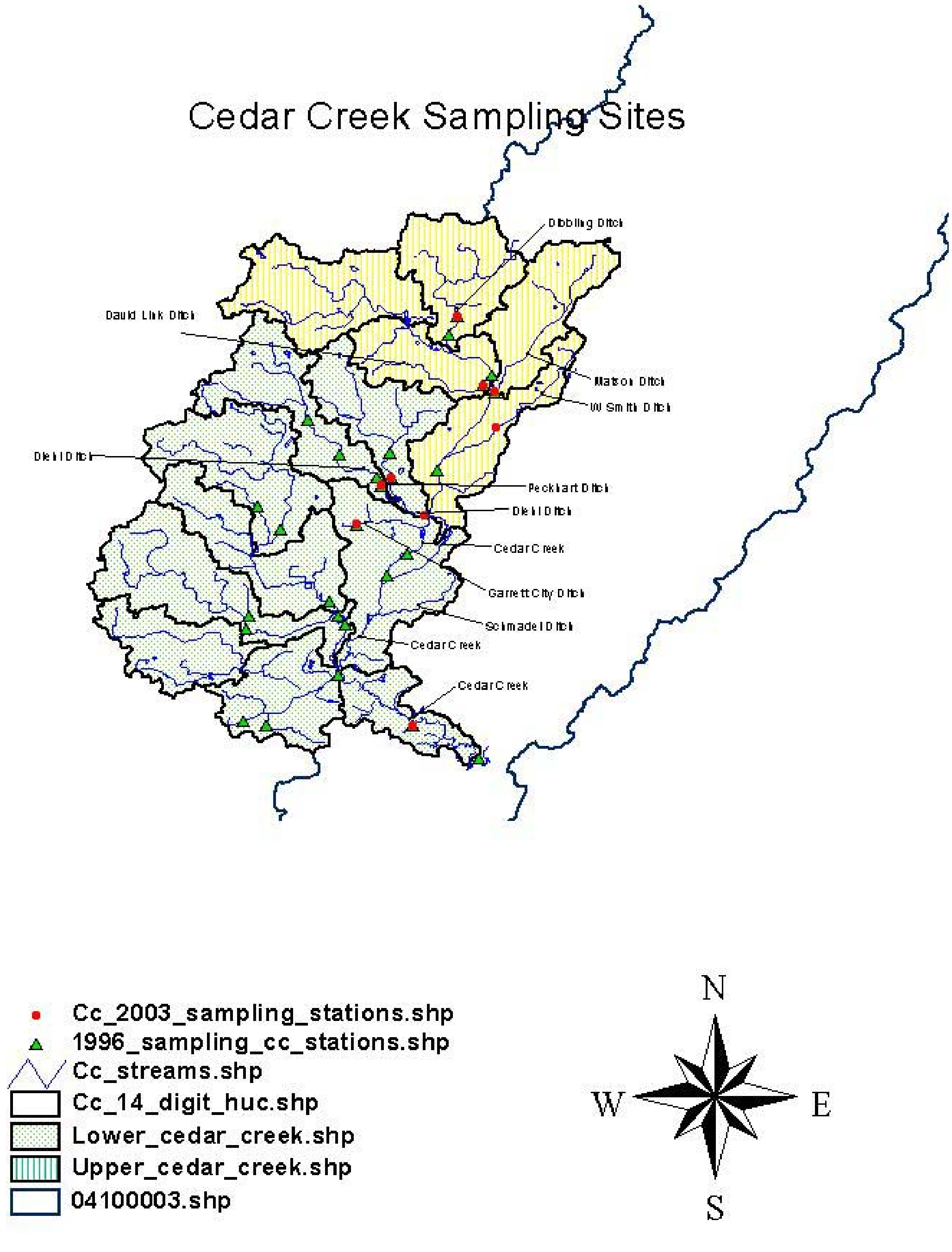


Figure 28 SJRWI sampling sites in the Cedar Creek watershed.

3.2.1.2 The City of Fort Wayne

The City of Fort Wayne samples raw and finished water at several locations throughout the city. In the St. Joseph River watershed, the City tests for pesticides, bacteria and nutrients at the Mayhew Road bridge just south of the river's confluence with the Cedar Creek, and at the Tennessee Street bridge. Raw water is also sampled at the Three Rivers Water Filtration Plant and at the main drinking water intake at the St. Joseph River dam near Coliseum Boulevard.

Levels of pesticides in the raw water help to determine the amount of powdered activated carbon that is used in the treatment process. Currently the City of Fort Wayne spends an average of $165,000 annually for powdered activated carbon.

Likewise, turbidity levels in the raw water determine the amount of flocculants needed for clarifying the water during the treatment process. The filtration plant uses ferric sulfate as a coagulant to remove turbidity from the water. Together with operational costs that include electricity and maintenance, the City of Fort Wayne spends approximately $300,000 annually on removal of turbidity before filtration of the water. The cost does not include upgrading and maintaining of filters. Reduction in turbidity will not necessarily reduce the city's cost of treatment by the same percentage, according to the filtration plant supervisor. The US EPA has been lowering the acceptable turbidity limits and that has impact on the cost. Reduction of turbidity in the river, however, will make the city's process more reliable and less prone to failure. (Chet Shastri, personal correspondence, February 11, 2004)

3.2.1.3 The Bacteria Source Tracking Project

The St. Joseph River Watershed Initiative was awarded a Section 319 grant (ARN 01-383) in 2002 that continued funding the Bacterial Source Tracking (BST) project, a joint effort of the Initiative and the Biological Sciences Department of Indiana University – Purdue University Fort Wayne (IPFW). Funding to begin this project was provided in 2001 by The Fort Wayne Community Foundation. IPFW microbiologist Dr. Deborah Ross is the principal investigator for the project.

While E. coli is the most common indicator of fecal contamination and is used in the Initiative's weekly water sampling program, other bacteria, such as fecal enterococci are also used as indicators. The BST project used a method of antibiotic patterning to identify sources of fecal contamination in the watershed. In the antibiotic resistance technique which utilizes replicating technology, bacterial strains are isolated from the environment and characterized as to their sensitivity to a range of antibiotics. The basis for this method is that if bacteria have been exposed to a given antibiotic, they will develop resistance to it; it they have not been exposed, they will not be resistant. Thus the growth pattern of bacterial strains from water is matched against standard strains from known sources.

The objectives of the BST study were to 1) develop a database ("library") for the St. Joseph River watershed from sources specific to northeastern Indiana; and 2) to determine source(s) of bacterial contamination in the St. Joseph River. The study included time and dilution studies to determine how long and how far contamination would remain viable and identifiable in the flowing tributaries.

Results of the study indicated that human contribution was generally low (less than 15%) even in areas known or suspected to have a source of such contribution. Contribution from human sources, however small, is most likely to be of high risk to those in contact with the water. Contribution from livestock operations likewise was generally minor in terms of percentage. However, geese and other wildlife, and a pattern of resistance identified as “horse” were found to be the main contributors of fecal contamination by this study.

Given its ability to detect sources along a tributary, BST is most valuable when used to examine segments of a watershed in greater detail. The use of information derived from BST analysis, and correlating results with land use, can facilitate pinpointing pollution sources. Once potential sources of pollution are known, landowners can find ways to reduce or eliminate pollution through management of the sources. The Initiative samples several locations in the Cedar Creek in its current water monitoring project, but these do not cover the complete watershed; in particular, the Little Cedar Creek and Willow Creek have not been sampled using BST analysis. See Appendix F for additional information on the BST. The final report on the BST study is available by request from the St. Joseph River Watershed Initiative in Fort Wayne, or can be accessed in on the Initiative’s website, www.sjrwi.org.

3.2.1.4 The Allen Co. Regional Water & Sewer District engineering report

The soils in the Cedar Creek area have a wide range of properties, which have a dramatic influence on their suitability for potential land uses. The pressure for urbanization is great, and the Cedar Creek area, especially in northern Allen County, is rapidly changing from an essentially rural area to one of expanding housing and development. Soils influence and limit the functioning of on-site septic systems in the watershed. An engineering report and recommendations on decentralized wastewater management planning for the Coldwater Road (SR 327) – Cedar Creek area of Allen County, prepared by Schnelker Engineering, Inc. in 2003, indicated that Martinsville soils are appropriate for on-site septic systems, and the Eel and Genesee soils are worth evaluation to determine their individual limitations for on-site systems. Over 60% of Allen County’s soils are designated as soils to avoid for the placement of onsite systems. These include Blount, Carlisle, Gravel pits, Morley and Pewamo.

The study encompassed approximately 2,080 acres in Allen County. The report indicated that approximately 130 acres (6.3%) are wetlands. Soils recommended for placement of onsite systems consisted of only 41 acres (1.9% of the available area). Areas with soils that have limitations but are worth evaluating encompass 273 acres (13.1% of available land), and soils to avoid in placement of onsite systems make up 1,636 acres (78.7% of available land). Much of the developed land in the study area lies on soils not suitable for the placement of onsite septic systems.

This report underscores the problem facing stakeholders in the lower portion of the watershed. Much of the developed area north of Fort Wayne would be best served by municipal sewers. However, capacity at the Fort Wayne Water Treatment Plant is limited at this time, resulting in a limit for developments in this area on connection to sewers.

In DeKalb County, based on the soils map in the previous chapter, Blount soils predominate in the Auburn area near the main stem of the Cedar Creek, as well as the Peckhart, Garrett, Matson, Smith and Dibbling Ditch areas. Blount is a soil type listed in the study as unsuitable for septic systems.

3.2.1.5 Waterloo Area Source Water Protection Plan

A Source Water Protection Plan for all public groundwater drinking sources in the Town of Waterloo, Indiana, within DeKalb County, was completed by the Waterloo Source Water Protection Steering Committee and the Alliance of Indiana Rural Water, Inc., in August 2003. Additional information on the Waterloo SWP is available from the Waterloo Town Manager or the Superintendent of the Waterloo waterworks department.

3.2.1.6 DeKalb County Well Testing Project, 1990

A survey of over 400 residential wells in rural DeKalb County revealed very low incidence of nitrate contamination. The County Well Testing Project was a joint effort of the county health department, the Cooperative Extension Service, and the Soil and Water Conservation District. Only five of the 400 wells tested had nitrates present, and only two of those had a nitrate level over the maximum acceptable level for human consumption established by the EPA. Most water quality problems tend to be associated with wells that are old, shallow, in poor condition or located too close to a livestock feedlot or faulty septic system. Less than 3 percent of the wells had some form of bacterial contamination. Problem wells were located in the three townships in the northwest corner of the county (Fairfield, Smithfield and Richland), and one in the southwest corner of the county (Butler). The northwest corner of the county drains into the Turkey Creek watershed and is not part of the Cedar Creek watershed.

3.2.2 State water quality monitoring

The State of Indiana has amassed water quality data for the Cedar Creek area for many years. Information is generally available on the IDEM website, www.in.gov/idem.

3.2.2.1 The 303(d) List of Impaired Streams

The 303(d) list includes the following streams in the Cedar Creek Watershed:

14 Digit Hydrologic Unit Code	County**	Segment ID Number	Waterbody Name	Parameters of Concern
4100003090080	ALLEN CO	INA0398_T1036	CEDAR CREEK	E. COLI
4100003090090	ALLEN CO	INA0399_T1037	CEDAR CREEK	E. COLI
4100003090080	ALLEN CO	INA0398_T1077	WILLOW CREEK AND TRIB	E. COLI
4100003080030	DEKALB CO	INA0383_T1028	CEDAR CREEK	IMPAIRED BIOTIC COMMUNITIES, E. COLI, NUTRIENTS
4100003080050	DEKALB CO	INA0385_T1029	CEDAR CREEK	IMPAIRED BIOTIC COMMUNITIES, E. COLI
4100003090030	DEKALB CO	INA0393_T1034	CEDAR CREEK	E. COLI
4100003090030	DEKALB CO	INA0393_T1033	CEDAR CREEK- MAINSTEM	E. COLI
4100003090020	DEKALB CO	INA0392_T1075	DIEHL DITCH	E. COLI
4100003090030	DEKALB CO	INA0393_T1060	DOSCH DITCH	IMPAIRED BIOTIC COMMUNITIES
4100003090030	DEKALB CO	INA0393_T1032	GARRETT CITY DITCH	E. COLI, TOTAL DISSOLVED SOLIDS
4100003090050	DEKALB CO	INA0395_T1062	LITTLE CEDAR CREEK	E. COLI, IMPAIRED BIOTIC COMMUNITIES
4100003090060	DEKALB CO	INA0396_T1069	LITTLE CEDAR CREEK	E. COLI
4100003060060	DEKALB CO	INA0366_T1057	METCALF DITCH AND TRIBS	IMPAIRED BIOTIC COMMUNITIES

Figure 29 303(d) list of impaired water bodies in the Cedar Creek watershed. (IDEM)

3.2.2.2 IDEM Intensive Segment Survey

An Intensive Segment Survey on Cedar Creek Segment 18, conducted for IDEM in June - July, 1992, indicated that there were 21 NPDES permit holders discharging water into the Cedar Creek, that water quality was generally very good except for high E. coli concentrations found at some sampling locations. Garret Ditch and Avilla Drain were found to be severely impacted by point source discharges from the Garrett and Avilla sewage treatment plants. Ammonia-nitrogen and dissolved oxygen violations were noted in both streams. High E. coli concentrations were also found on Smith Ditch. Ober Ditch, a tributary of the Peckhart, was found to have high E. coli, as did Peckhart near its tributary Grandstaff Ditch. Willow Creek, upstream from Willow Creek Ditch, was noted to have possible contamination by failing septic systems. Some areas of the Willow Creek and ditch system were noted to have low or sluggish flow, possibly contributing to the deficiencies noted in dissolved oxygen. Sycamore Creek, Bilger Ditch, Black Creek and Little Cedar Creek showed high concentrations of E. coli in this study.

3.2.2.3 IDEM Macroinvertebrate Study, 1995

Biodiversity of a stream serves as an indicator of the water quality within the watershed. While some species are pollution-tolerant, others do not survive or will be greatly reduced in number in highly polluted waters. Macroinvertebrates have short life cycles and do not migrate far; thus they provide a good snapshot of localized water conditions.

An IDEM macroinvertebrate study conducted on the St. Joseph River and its tributaries in 1995 sampled 15 sites, none of which were considered non-impaired. Eleven of the sites were classified as slightly impaired and four were moderately impaired.

3.2.2.4 Ranking of Indiana basins

The IDEM publishes ranking of Indiana basins based on pollution input and water quality requirements for recreational activities. The Cedar Creek is the largest tributary of the St. Joseph River. Basin score is a composite of five indicators of water quality. Suitable water quality for protection and propagation of desirable fish, shellfish and other aquatic organisms is available in only 10% of the waterways. Only 14% of the waterways are deemed safe for people to swim without risk of adverse health effects, such as catching waterborne diseases from raw sewage contamination.

The "Overall Quality" is a composite of the five indicators. The "Habitat Quality" was rated on the presence of vegetation on shorelines, the absence of damming, dredging and channelization. The "macroinvertebrates" indicator looks for the presence of a well-balanced aquatic community within the stream. A stream is ranked at the "worse" indicator for "Fish Advisories" if all species of fish are known to have significant contamination that may pose human health risks. A score of 1 reflects better water quality; 6 is poor. The St. Joseph's overall quality score is 4.

	St. Joseph
Habitat Quality	**5**
Macro Invertebrates	**5**
Aquatic Life	**1**
Fish Advisories	**4**
Recreation Swimming	**5**
Overall Quality	**4**

Table 7 Rating of the St. Joseph River for water quality by the Indiana Department of Environmental Management.

3.3 Point sources of pollution

Point source pollution refers to a pollutant that enters a surface water body from a pipe, ditch outfall or some identifiable point of discharge. The term applies to various sources of wastewater and storm water discharges, both public and private, including municipal and industrial waste treatment plants, small domestic treatment systems such as those serving schools, subdivisions, mobile home developments or individual homes. Storm water discharges from municipal separate storm sewer systems are point sources as are discharges from public and private detention and retention ponds and from industrial and commercial sites.

Based on river miles, the U.S. Environmental Protection Agency (EPA) calculated in 1996 that point sources accounted for 35% of the pollution in U.S. rivers. The breakdown was 1% CSO, 6% natural causes; 9% industrial point sources, 2% other unknown sources, and 17% municipal point sources. The remaining 65% of river pollution comes from non-point sources (NPS). (Water Resource Availability in the Maumee River Basin, Indiana. 1996)

3.4 NPDES Discharge Data

The Indiana Water Quality Monitoring and Assessment Report lists the following point sources of the causes of water pollution:

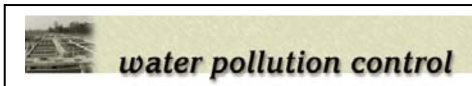
- Industrial point sources
- Municipal point sources
- Package treatment plants
- Combined sewer overflows
- Sewer collection system failures

(IDEM, 2002, table 10, p. 27 – 28)

Many point source dischargers must apply for and maintain discharge permits issued under the National Pollutant Discharge Elimination System (NPDES) program if they discharge directly to a surface water body.

Public treatment works and other sanitary and industrial discharges have been regulated by the NPDES program for decades. In 1990, Indiana implemented an NPDES permit program for communities with municipal separate storm sewer systems serving over 100,000 people. In 2003, Indiana adopted regulations implementing Phase II of the federal Storm water NPDES program. Under Phase II, storm water discharges from smaller urban areas as well as those coming from certain institutional, industrial, commercial, and construction sites will be considered point sources and will require permits. Individual homes that are connected to a municipal sewage system, use a septic system or have a surface water discharge do not need an NPDES permit.

Some point sources such as septic systems are regulated by county boards of health. Other point source discharges are unidentified, unmapped, unpermitted or unregulated. The primary pollutants associated with point source discharges are oxygen demanding wastes, nutrients, sediments, floatables (debris), and toxic substances including chlorine, PCBs, ammonia, metals and petroleum products.



CAUTION ALERT START DATE: 08-24-04 through 08-27-04

DUE TO CURRENT OR FORECAST WET WEATHER CONDITIONS THE CITY OF AUBURN IS ALERTING THE PUBLIC TO CURRENT/POTENTIAL COMBINED SEWER OVERFLOWS (CSO) TO CEDAR CREEK.

AUBURN'S WASTEWATER COLLECTION SYSTEM CONSISTS OF SEPARATED AND COMBINED SEWERS. THERE IS A LIKELIHOOD OF CSO OCCURRING AT ONE OR MORE OF AUBURN'S FOUR (4) CSO SITES. SEWAGE OR WASTEWATER MAY BE IN THIS WATER DURING AND FOR SEVERAL DAYS AFTER PERIODS OF RAINFALL OR SNOWMELT. PEOPLE WHO SWIM IN, WADE IN, OR INGEST THIS WATER MAY GET SICK.

FOR MORE INFORMATION CONTACT CITY REPRESENTATIVES AT 925-1714.

NPDES permitted facilities located in the Cedar Creek Watershed are listed in *Appendix C* of this document.

Significant violations during the past year 2004 were found at two sites: Auburn Foundry, Plant 1, for total residual chlorine, zinc and copper; and at Indian Springs Campground for total suspended solids (TSS) and total residual chlorine.

Combined sewer overflows, or CSOs, are outlets which discharge a combination of storm and sanitary sewer contents when the treatment plant and sewers cannot handle the volume of water. This generally happens during heavy rains or snow melt. The CSO outlet spills untreated sewage directly into the stream, and is considered a point source of pollution. Fort Wayne has CSOs but none are in the Cedar Creek Watershed. Auburn has CSOs located on Cedar Creek at 7th Street; at Eckhart Park, near Grandstaff Avenue and at the sewage treatment plant. The Town of Waterloo has three CSOs which empty into the Cedar Creek Watershed.

A Sanitary Sewer Overflow, or SSO, is a bypass of the sewer treatment facility, generally due to emergency or malfunction at the facility. An SSO also releases untreated sewage into the receiving stream.

Programs that are aimed at reducing point source pollution include:

- CSO control programs
- Storm water NPDES Phase II
- State regulations on septic system discharges
- NPDES permits for public treatment works
- NPDES permits for major industrial discharges.

3.5 Non-point sources of pollution

Sources of contamination such as agricultural runoff and atmospheric deposition are considered non-point sources of pollution and must also be considered in development of controls for water quality. With the large percentage of the land in the Cedar Creek Watershed and the larger St. Joseph River Watershed in agricultural usage, sources of such pollutants as agricultural chemicals (fertilizers, pesticides) have the potential to negatively impact the waterways. These chemicals can enter the water through field runoff, from overspraying, and by aerial deposition through atmospheric drift. Bacteria from rural septic systems which have failed, and bacteria from wildlife, small livestock operations and domestic pets can also impair the water in the watershed. Atmospheric deposition of toxic chemicals from power plants have been shown to impair the waters of the Midwest, and runoff from roadways and other transportation corridors can also negatively impact the waterways.

Approximately 1,391 permitted septic systems are on record in the Allen County portion of the Cedar Creek watershed. Many of these are located in soils which are not particularly suited for septic systems (see 3.2.5, page 35). There are widespread problems with failing septic systems in this area.

In DeKalb County, the number of septic systems in the county is unknown. However, the county's health department listed as concerns the following areas of the county:

- CSO operated by the Waterloo Wastewater Treatment Plan
- Holiday Lakes Residential development adjacent to Black Creek immediately upstream of the Cedar Creek main stem
- Cedar Lake: High density development all on septic systems
- Story Lake: High density development all on septic systems
- Indian Lake: High density development all on septic systems

- Auburn/ Cedar Creek Residential Development on CR 35 east and north of Auburn along the main stem of the Cedar Creek
- DeKalb Co. Municipal Airport area: 60+ homes, all on septic systems (Dosch Ditch area)
- Northeast Garret: residential development along and north of SR 8, west of the Wal-mart distribution center, not attached to local sewer
- Unincorporated Town of Sedan: comparatively dense area of 50+ older homes on septic systems
- Indian Springs Campground: Residential campground along the Little Cedar Creek west of SR 327, served by a package treatment system
- CR 26: Locally known as the "Horseshoe Road," sludge application area

See maps of the above locations on page H.

The predominant land use in the Cedar Creek watershed located within Noble County is cropland. Rural residential areas are served by on-site septic systems, except within the town of Avilla, which has a waste water treatment plant that discharged into the Avilla Drain (sampled in 1996 by Initiative, site 118).

3.6 Fish consumption advisories

Fish consumption advisories are based on the Indiana Administrative Code 317 IAC 2-1-9(45) defining toxic substances as those substances that are or may become harmful to plant or animal life or to food chains when present in sufficient concentrations or combinations. Toxic substances include but are not limited to those pollutants identified as toxic under Section 307(a)(1) of the Clean Water Act.

Toxic substances frequently encountered in Indiana streams include chlorine, ammonia, organics (including hydrocarbons and pesticides), heavy metals and pH. These materials are toxic to different organisms in varying amounts and the effects may be evident immediately or may only be manifested after long term exposure or accumulation in living tissue (IDEM 2002). Fish consumption advisories are based on data resulting from the bioaccumulation of pollutants in fish tissues (Indiana Integrated Water Quality Monitoring and Assessment Report, IDEM, 2002, p. 24).

The Indiana Fish Consumption Advisory identifies fish species that contain toxicants at levels of concern for human consumption using the Great Lakes Task Force risk-based approach (Indiana Integrated Water Quality Monitoring and Assessment Report, IDEM, 2002, p. 43). All rivers and streams in Indiana are considered to have PCB and Mercury impairments for carp (Angling in Indiana – 2003 Fish Consumption Advisory).

In the Cedar Creek watershed, a fish consumption advisory exists in Allen County, Indiana for River Chub four-inches or more in length. The advisory is based on PCB contamination. The advisory suggests consumption be limited to one meal per month and at-risk populations are warned not to eat this fish at all. (Angling in Indiana – 2003 Fish Consumption Advisory).

Two reaches of the Cedar Creek in Indiana are identified as having moderate impairment based on PCBs (Indiana Integrated Water Quality Monitoring and Assessment Report, IDEM, 2002,

Appendix B). One reach of the Cedar Creek in Indiana is identified as having moderate impairment for "other inorganics" (Indiana Integrated Water Quality Monitoring and Assessment Report, IDEM, 2002, Appendix B). One reach of the Cedar Creek in Indiana is identified as having moderate impairment for "organic enrichment" (Indiana Integrated Water Quality Monitoring and Assessment Report, IDEM, 2002, Appendix B). No part of the Cedar Creek in Indiana supports primary recreational contact (Indiana 305(b) Report, IDEM, 2002, Appendix B).

3.7 Other documentation and sources of information about the Watershed

3.7.1 St. Joseph WRAS

The St. Joseph/Maumee Watershed Restoration Action Strategy (WRAS) was prepared by Wittman Hydro Planning Associates, Inc., for the Indiana Department of Environmental Management in 2002. The stated goal of the St. Joseph/Maumee WRAS is that all water bodies meet the applicable water quality standards for their designated uses as determined by the State of Indiana, under the provisions of the Clean Water Act.

3.7.2 St. Joseph River WMP

The St. Joseph River Watershed Management Plan (WMP) was prepared by the St. Joseph River Watershed Initiative and approved by the Indiana Department of Environmental Management in 2001. This document does not currently meet the 2003 WMP guidelines.

3.7.3 St. Joseph River Watershed Initiative Strategic Plan

The St. Joseph River Watershed Initiative Strategic Plan was produced in May, 1997, and includes target issues of partnership/development, project coordination and administration, education, stakeholder involvement, legislation and funding.

3.7.4 The DeKalb County Comprehensive Plan

Chapter 5 of the DeKalb County Comprehensive Plan includes the following objectives:

- Protect the quality and quantity of water in DeKalb County's aquifers, streams rivers and water bodies
- Protect and enhance the character of the natural environment in DeKalb County
- Minimize the conflicts between growth and the natural environment
- Reduce damage to life and property from flood and other natural hazards.
- High density development all on septic systems

Implementation measures that are highly compatible with the protection of the Cedar Creek watershed are included for each of these objectives. These measures encourage sound management techniques, education, reduction of impervious surfaces, enforcement of wellhead protection areas, protecting wetlands, reserving open space for parks, conserving existing tree stands, discouraging development of environmentally sensitive areas, and best management practices for preventing soil erosion and preventing pollution.

3.7.5 The Fort Wayne-Allen County Comprehensive Plan

The Fort Wayne-Allen County comprehensive planning effort, known as *Plan-it Allen* was begun in early 2004 with widespread stakeholder meetings. The steering committee has released key findings and policy implications on such topics as physiography, ecoregions and geology; soils; land and vegetative cover; natural heritage features; groundwater resources; surface water resources; wetlands; riparian and other corridors; floodplains; air quality; and brownfields. Several individuals representing groups involved in the Cedar Creek WMP have also been active with the Allen County comprehensive effort, helping to keep watershed planning issues on the table for the comprehensive plan.

3.7.6 Indiana Stream Reach Characterization and Evaluation Report

This document is a report of an agreement between the City of Auburn and Triad Engineering, Inc., to prepare a Stream Monitoring and Sampling Plan for submittal to the IDEM, and includes protocol for determining the characterization of impacts of CSO discharges upon receiving stream(s) as part of the City's CSO Phase I requirements. The document is dated March, 1999. Among other purposes, the document was designed to identify water quality impacts related to CSO discharge.

Part 4. Problems, Causes and Stressors to the Cedar Creek

The Cedar Creek and its tributaries, as envisioned by the stakeholders, is a watershed that provides diverse benefits, functionality and habitat for all that it serves. Stakeholders understand that problems with water pollution can make the watershed fall short of that vision. In examining the perceived problems in the watershed (see Part 1), as well as the information that has been gathered over the course of compiling this watershed management plan, the Cedar Creek watershed management group identified the following problems that can or do impair this vision.

4.1 E. coli counts keep surface water of Cedar Creek in non-attainment for WQS

Bacteria and other disease causing organisms in the stream are a threat to drinking water and recreational use. Nationally, nearly 50% of the U.S. population gets its drinking water from surface water sources (reservoirs, rivers, streams). Locally, the City of Fort Wayne takes its drinking water from the St. Joseph River, serving over 250,000 permanent residents, as well as visitors to the area. Surface water used for drinking must be disinfected during processing and filtration to remove all bacteria. Other cities and towns in the Cedar Creek watershed have groundwater sources for drinking water.

Escherichia Coli is a bacterium in the family *Enterobacteriaceae*. These bacteria are a family of organisms so grouped because of their role in the intestinal tract of most mammalian species. E. coli and other bacteria in the same family are essential for proper digestion, vitamin production, and heart function. A comparatively rare E. coli strain, E. coli 0157:H7, is the E. coli variety that has been recently known to cause sickness in human beings. This strain differs from beneficial E. coli bacteria by producing a protein called Shiga-like toxin (SLT). SLT, sometimes called *Vero toxin*, causes severe intestinal damage and is potentially lethal to children and elderly victims. The 0157:H7 E. coli strain and resulting illness have been the source of a series of publicized illnesses during the last 15 years.

The presence of E. coli in surface waters does not necessarily indicate the presence of the harmful strain of the bacteria. Regulatory agencies and the St. Joseph River Watershed Initiative test for total coliform and E. coli as indicators of the amount of human and animal waste present in the waterways. High levels may indicate the presence of harmful bacterial strains, or the potential for such contamination.

Other pathogenic organisms may be present in water contaminated with sewage. Fecal matter in the stream brings with it a high risk for human disease, and ingestion of contaminated water through swimming or other contact (recreational use) has the potential for causing serious illness in human populations. Additionally, it places serious liability on municipal and other water treatment systems that may be using surface water as a source of drinking water. In some soils, untreated sewage can also contaminate groundwater sources of drinking water (wells) through subsurface transport.

Diseases caused by sewage-contaminated water include campylobacteriosis, cryptosporidiosis, Escherichia coli diarrhea, encephalitis, gastroenteritis, giardiasis, hepatitis A, poliomyelitis, salmonellosis, shigellosis, and typhoid fever.

Indiana state water quality standards state that E. coli bacteria shall not exceed 235 colony-forming units (cfu) per 100 milliliters in any one sample in a 30-day period, or 125 cfu per 100 milliliters as a geometric mean based on not less than five samples equally spaced over a 30-day period.

The St. Joseph River Watershed Initiative has sampled the Cedar Creek at varying locations on a weekly basis during the recreational season since 1996. The City of Fort Wayne's Three Rivers Water Filtration Plant laboratory analyzes the samples for E. coli. Additionally investigative testing for E. coli is performed by the Fort Wayne-Allen County and the DeKalb County Health Departments in response to complaints by property owners and the general public.

Cedar Creek water sampling data from the years 1996 though 2004 indicate that the average annual E. coli counts have dropped, yet generally remain above Indiana's water quality standards (WQS) during most of the recreational season at most sites.

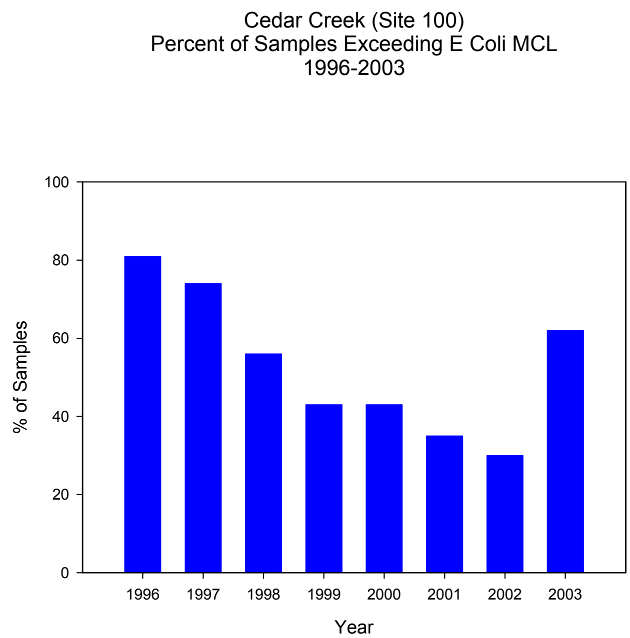


Figure 30 Percentage of samples annually that exceeded the E. coli WQS during 1996-2003 sampling at Site 100.

4.2 Pesticide and nutrient runoff threatens the surface and ground water quality

Pesticides are chemicals that are used to control weeds and insects on agricultural fields and on urban and suburban lawns and recreational areas such as golf courses and parks. Nutrients are manures and chemical fertilizers used to promote vegetative growth. Pesticides and nutrients can enter surface waters through surface runoff, aerial deposition and accidental spills. Pesticides and nutrients can also enter and contaminate groundwater through ground-surface water interchange and poorly constructed or abandoned wells that have not been properly closed.

Pesticides and nutrients also threaten aquatic life in surface streams and lakes by upsetting the balance of plant growth, interfering with reproduction, and poisoning small species of animals thereby interrupting the food chain.

Atrazine, a restricted use pesticide (RUP), has been used for many years in Indiana by farmers because it effectively controls broadleaf and grassy weeds that compete with corn and sorghum. Statewide, more than 80% of corn acreage is treated with Atrazine each year. It is reliable and cost effective weed control for farmers. But Atrazine is a water soluble herbicide that is normally applied during the April-May planting season, which coincides with heavy spring rain and saturated soil. The pesticide is slow to break down once it dissolves in water and moves easily out of farm fields and into community water resources. (Purdue Cooperative Extension Service)

Atrazine and other pesticides are a significant problem for water contamination throughout the watershed because of the high number of acres dedicated to agricultural production. The St. Joseph River Watershed Initiative's monitoring program has sampled the waters of the main stem of the Cedar Creek and its tributaries Matson Ditch, Dibbling Ditch, Garrett City Ditch, David Link (Swartz) Ditch, Diehl Ditch, Peckhart Ditch, Walter Smith Ditch, Little Cedar Creek, Black Creek and Willow Creek.

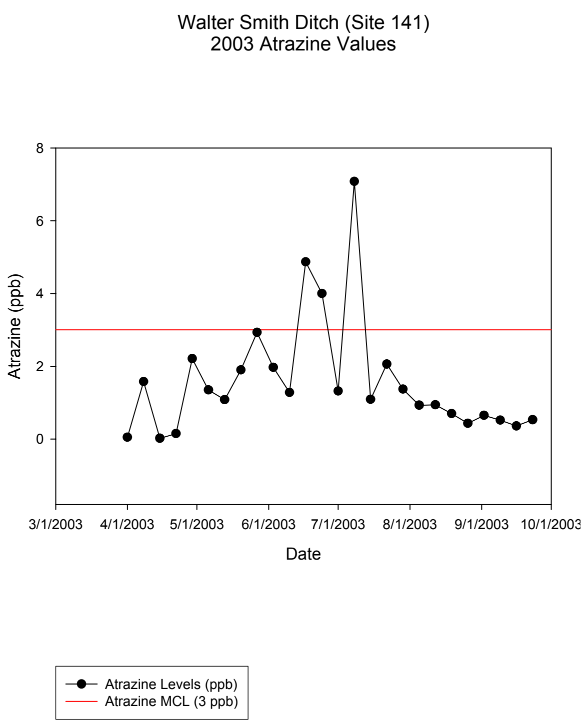


Figure 31 Atrazine levels for 2003 on the Walter Smith Ditch show three spikes above the MCL. Chart courtesy of the St. Joseph River Watershed Initiative

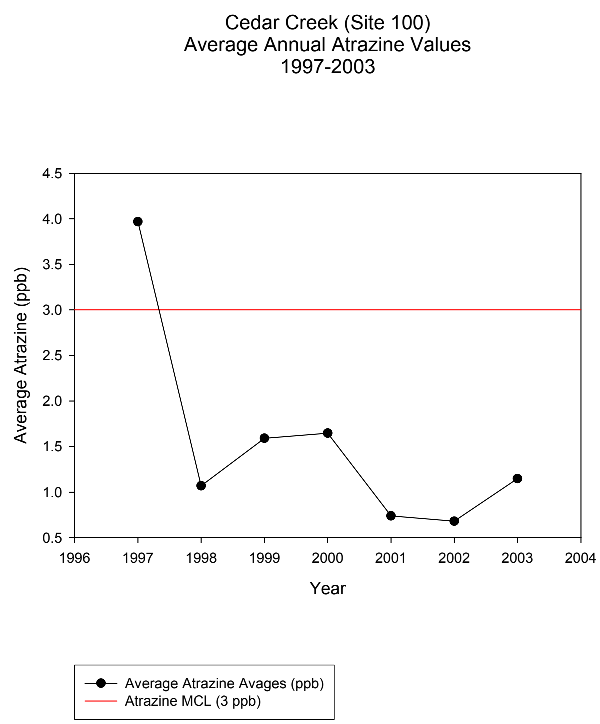


Figure 32 Average annual values for Atrazine at Cedar Creek Site 100 (Courtesy St. Joseph River Watershed Initiative)

The Walter Smith Ditch (Site 141) in the Upper Cedar Creek watershed recorded three Atrazine MCL exceedences in 2003, all between mid-June and mid-July. Results are charted in Figure 31. Consecutive exceedences in weeks 25 and 26 averaged 4.44 ppb, while the final exceedence took place in mid-July (week 28) with an Atrazine level of 7.08 ppb. These results were less numerous and earlier in the season than 2002 records show for that year. (Areas of Concern, St. Joseph River Watershed Initiative, 2003)

Average annual levels of Atrazine and other pesticides are generally below the maximum contaminant level (MCL) for drinking water, according to data from the Initiative's sampling program. These averages level out peaks and do not show the spikes in early spring that may occur after the chemical is applied to fields and is washed off by heavy spring rainfall.

According to the 2003 weekly monitoring of the Cedar Creek by the Initiative, Site 100 (Tonkel Road) recorded three instances when the pesticide Atrazine spikes above the 3.0 ppb MCL during summer months. (See Figure 32, above.) The overall average at the stream was below the MCL. However, spikes in the stream indicate times when spikes in raw water at the Fort Wayne Filtration Plant may require the use of additional carbon to remove the pesticide from drinking water.

Nutrients such as phosphorus from fertilizers entering waterways increase cloudiness (turbidity) in the water and support an overabundance of algae and weed growth. As these plants die and decay, they use oxygen from the stream, reducing oxygen levels available for fish and other aquatic animals and plants. This algae growth-death cycle can also produce discoloration and odor in the waterway, reducing its aesthetic value and negatively affecting drinking water quality. Five stream segments are listed in the 303(d) list for Cedar Creek as having impaired biotic communities. Excessive nutrients and sediment may be linked to these problems. The source of nutrients in the Cedar Creek may include fertilizers, manure, and leakage from failing septic systems or sewer overflows.

Nutrients phosphorus (P) and nitrogen (N) were analyzed in weekly water samples at three locations in the watershed from 1996-2003, Sites 100 (Cedar Creek @ Tonkel Rd.), 104 (Diehl Ditch) and 106 (Matson Ditch). This data, analyzed via a SWAT model, shows that P and N loading is highest during January through May, and lower during the months agricultural crops are growing.

Riparian buffers and filtering areas between cropland and perennial streams, seasonal streams, sinkholes, lakes and ponds can help to protect both surface and groundwater from the pesticides and nutrients that are present on the surface soils. Strips of grass, trees or shrubs, or a combination of them that provide a cushion, or buffer, between intensive farming operations and other lands and waterways are generally called "conservation buffers" and are considered best management practices (BMP). The most common buffers are filter strips of grass and shrub and tree (riparian) plantings along a stream or river. Contour grass strips in a crop field or surrounding a crop field, and field and farmstead windbreaks are also considered buffers.

Filter strips are typically 20 to 120 feet wide, and riparian buffers are greater than 35 feet wide. A 66-foot wide grass buffer along ditches, rivers and streams creates the label-required 66-foot setback for Atrazine applications near moving water. (*Atrazine and Drinking Water: Understanding the Needs of Farmers and Citizens.* Purdue Extension, 2004) Buffers can reduce nutrient loading in the watershed in proportion to their width: the greater the width of the vegetated border, the greater the load reduction that can be realized, according the a SWAT model prepared for the Cedar Creek watershed. (N. Rice, IDEM)

Land use data shows that a significant portion of the Cedar Creek watershed has minimal or no buffers and/or field borders that offer filtering of runoff water. Additionally, the extensive system of drainage tiles can deliver nutrients to receiving waters without filtration from existing buffered areas.

4.3 Erosion and sediment loading threaten drainage, water quality and aquatic habitat

Erosion occurs when land is disturbed and vegetation removed, allowing wind and rain to wash soil particles into the streams and rivers. Some erosion is natural. However, human activities such as agriculture, transportation, and construction generally increase erosion, affecting the streams, rivers and lakes. If conducted improperly or without adequate safeguards to the environment, human activities can cause intensive soil erosion and sedimentation of the streams and river. Each year, 38 million tons of topsoil erodes from U.S. cropland in the Great Lakes basin, resulting in reduced productivity and loss of nutrients valued at more than $96 billion annually. (Great Lakes Commission, 2004)

Sheet and rill erosion is the annual removal of a thin layer of soil. It accounts for the largest amount of soil eroded from land. Gully erosion happens where concentrated water flows over unprotected soils, such as where failing drainage systems cause all the water to flow over the top of the ground, and may deposit the eroded soil in depression areas or directly into drainage ditches. Wind erosion is generally confined to fine sandy soils or muck soils that are clean tilled. Conservation tillage methods helps to control this erosion.

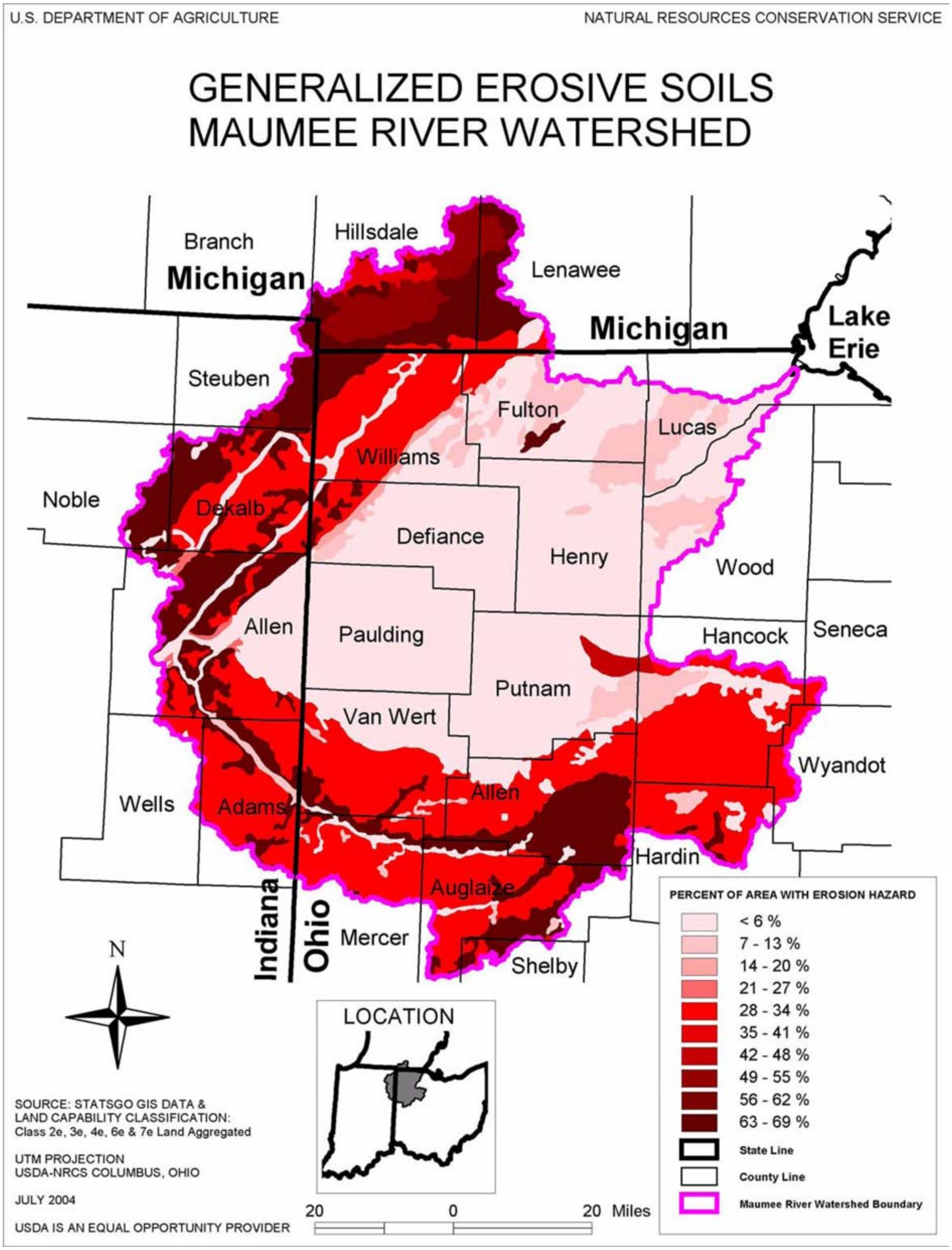


Figure 33 Highly erosive soils are prevalent in the St. Joseph River wateshed.

Soils can regenerate over time. The rate that soil can erode but still remain over a long period of time is called "T" level or *tolerable level*. Most soils in DeKalb County, as an example, have a "T" level of 3-5 tons/acre/year. (DeKalb County SWCD, undated.) Sheet and rill erosion rates on cropland have been on the decline over the past 15 years (1985-2000) due to adoption of conservation tillage practices. Conservation tillage is defined as any tillage system leaving 30 percent or more crop residue cover on the soil surface after planting. No-till is the most effective conservation practice for reducing soil erosion on agricultural lands. Crop residue cover and infiltration rates associated with no-till maximize the volume reduction of agricultural runoff and contaminants when compared with other conservation tillage systems. The 30% crop residue cover is significant to reducing soil erosion by 50% or more compared to erosion on bare soil, the state of conventionally-tilled, plowed field in the fall or spring. No-till systems that leave at least 50% of ground cover can reduce sheet-rill erosion rates by 75%.

In 2002, conservation tillage was used on 39% of the corn, 84% of the soybean and 69% of the wheat acreage in DeKalb County. A DNR report published in 1994 listed no-till or mulch-till on 38% of the corn acres and 68% of soybean acres, indicating that adoption of conservation tillage for corn has remained virtually flat for nearly 10 years in the watershed, despite efforts to increase conservation tillage. Conservation tillage in wheat was reported at 72% adoption; however significantly less acreage is planted in wheat.

Since 1990, "T" level has been accomplished on 75% of the soils in the state of Indiana. However there continues to be more than 3 million acres across the state losing soil at a rate faster than "T."

Soil particles that build up in slowly moving streams and tributaries can cause reduced stream capacity and flow. Excessive sediment can fill wetlands, reducing their capacity to hold water during flood events and diminishing their ability to filter out contaminants. Sediment will fill spaces between the rocks and gravel in streambeds, smothering fish eggs and bottom-dwelling animals..

Figure 34 Dipping of ditches removes built-up sediment and vegetation from the bottom of the stream. The spoils placed along the side of the ditch and often creates a negative flow barrier between the stream and the ditch. Photo by Karen Griggs, 2003.

Many streams and ditches are "legal" or regulated drains that serve the function of relieving the excess water from saturated soils of farmland and cities. In order to preserve the functionality of ditches that fill with sediment, a cleaning process is undertaken to remove sediment that has built up over a period of years. This process generally includes debrushing or removal of vegetation and mechanical dredging for removal of the sediment from the bed and sides of the channel as seen in Figure 34.

Debrushing, dipping and other construction activities in the drainage ditches and streams make the waterway and surrounding area susceptible to increased erosion for a time period, at least until the banks are stabilized and revegetated. Changes in stream depth and shape will change velocity and flow of the stream and may increase downstream flooding or promote bank undercutting.

Removal of riparian cover can increase temperature of the stream (thermal pollution) and disturbance of the bank and stream bottom removes or interrupts the lifecycle of aquatic life. While the ditch supports the goal of aiding drainage and quickly removing water from fields, it can result in damage to habitat through scouring of the stream bed, increasing velocity of the moving water, undercutting of the banks, downstream flooding and movement and deposition of sediment further downstream.

Suspended sediment causes turbidity (cloudiness) in the water. When the water is slow-moving, the suspended sediment settles on the bottom of streams and lakes and clogs the streambed, affecting aquatic life. As the stream flow increases or is disturbed, such as during storms and high water events, sediment is re-suspended and sent downstream to the river, often settling in reservoirs.

Turbidity becomes a water quality problem because suspended soil sediment in the water increases the water temperature by absorbing heat. Poor water clarity also interferes with feeding in predators that hunt by sight and clogs gills of fish and other aquatic animals during breathing and feeding. As sediment settles out of the stream during low flow or otherwise quiet water times, it smothers nests and eggs and fills crevices in gravel beds required for bottom dwelling species. Eroded soils can carry attached toxic chemicals and phosphorus into the water.

The City of Fort Wayne's total suspended solids measurements for 2002 show a maximum of 208 mg/L in mid May at the Mayhew bridge. Other high levels at this location occurred at the beginning of May (176 mg/L) and in early August (120 mg/L). High suspended solids measurements can result from rainfall after tillage or construction disturbs the land, or from high velocity stream flows or other events that erode stream banks or disrupt the sediment already present on the stream bed.

According to the Initiative's water quality monitoring data for 2003, high turbidity values (100 NTU or greater) were recorded at various times during the year at Site 100 (Tonkel Road) shown in Figure 52. Matson Ditch (Site 106) recorded consistently high turbidity levels throughout the year, with a peak of over 250 NTU in late July. (*Areas of Concern*, St. Joseph River Watershed Initiative, 2003)

The City of Fort Wayne operates two reservoirs downstream of the Cedar Creek, the Hurshtown Reservoir and the Cedarville Reservoir. Both are noted to have increasing levels of sediment.

However, turbidity is of greater concern to the City Water Utilities than reduced drought capacity at this time. Turbidity removal is a key element of the water treatment process and one that requires reporting to the state on a monthly basis. The Filtration Plant uses ferric sulfate as a coagulant to remove turbidity prior to filtration. Adding the cost of electricity and equipment maintenance to the cost of this chemical results in a conservative estimate of about $300,000 in annually to reduce turbidity to acceptable levels. Any efforts to remove or reduce erosion and sediment from the river upstream results in reduction of costs at the Filtration Plant. (Shastri and Gensic, personal communication, 2004)

4.4 Urban sprawl and unregulated development contribute to loss of agricultural and forested lands.

"Prime farmland" is a term that identifies those areas that contain soils that have a greater efficiency in crop production and are therefore more economically rewarding to farmers than areas of poorer soils. In some areas of the Cedar Creek watershed urban development is resulting in changing these prime agricultural areas to pavement and turf grass.

Redevelopment of agricultural, open and wooded acreage into residential and commercial/industrial usage increases the amount of impervious surfaces in the watershed. This in turn affects the watershed by increasing the amount and velocity of runoff, decreasing the amount of water which infiltrates the soil and is available for vegetation and recharge of surface and groundwater reserves in aquifers. Redevelopment also changes the economic structure of the community, usually increasing traffic and air pollution. Increases in the amount of impervious surfaces can also raise land and water temperatures in a given area because the temperature of the surface runoff is higher. Additionally, decreases in woodlands and fields reduces the amount of land available for wildlife. The amount of vegetation available to function as buffers and filters for water entering the stream is also reduced as impervious surface is increased.

Figure 35 Farmland in the Cedar Creek watershed is highly productive. Farm land along major transportation corridors and near urban areas is being converted to other uses. Anonymous photo.

Community knowledge of storm water runoff and knowledge of its potential for pollution of land and water resources is generally low. This lack of understanding and concern can result in difficulties for municipal utilities seeking support for sound and effective management of water and wastewater treatment facilities. The cost for these facilities is high and communities often are opposed to the price of managing their resources based on the idea that water is "free" in the United States.

Scattered development outside of urban centers generally increases the inefficiency of providing public services such as water and sewer lines, electric service and public transportation. Low density growth in this area tends to include large areas of "yard" or turf that can increase runoff, as well as pollution from fertilizers and pesticides. Additionally, urban residents who move to the rural areas usually need education about water wells, on-site septic systems and their maintenance, regional sewer districts, and issues pertaining to legal drains and assessments.

4.5 Log jams and stream obstructions affect habitat, drainage, flooding

Log jams are evident in many streams in the watershed. Those that remain in place are likely to increase in size due to the large amount of wooded riparian area and the large scale flooding, generally during each spring and fall. Generally speaking, if very large logjams do form, their removal results in a greater cost and greater damage to the surrounding land and vegetation than would be present if the jams are cleared when they are small.

From an environmental standpoint, log jams and other woody obstructions in the streams are supportive of aquatic life and serve a healthy function in the waterway. However, obstructions also divert water flow, which in turn may change the course of a stream, inundating land that formerly was above the bank of the stream. The diverted flow scours the stream bank, cutting new channels, often increasing erosion. Sediment released may destroy wildlife and aquatic habitat, flood agricultural land, and reduce drainage in the area due to the back-up of water. Obstructions in the stream are also barriers to recreation such as canoeing and fishing.

Small log jams left in place can dismantle or dislodge with high flow, moving downstream. Or they can remain in place and grow larger as more debris is caught in the flow. Large jams greatly increase the potential for backup flooding of adjacent lands and the cutting of new channels. An example of this can be seen in Figure 36. At the point of removal of this 580-foot logjam, water had backed up 4.3 feet deep over a distance of approximately 650 lineal feet, creating eleven new pilot channels as the logjam increased in size. Each of the channels cut thousands of tons of soil which was released into the flow of the stream.

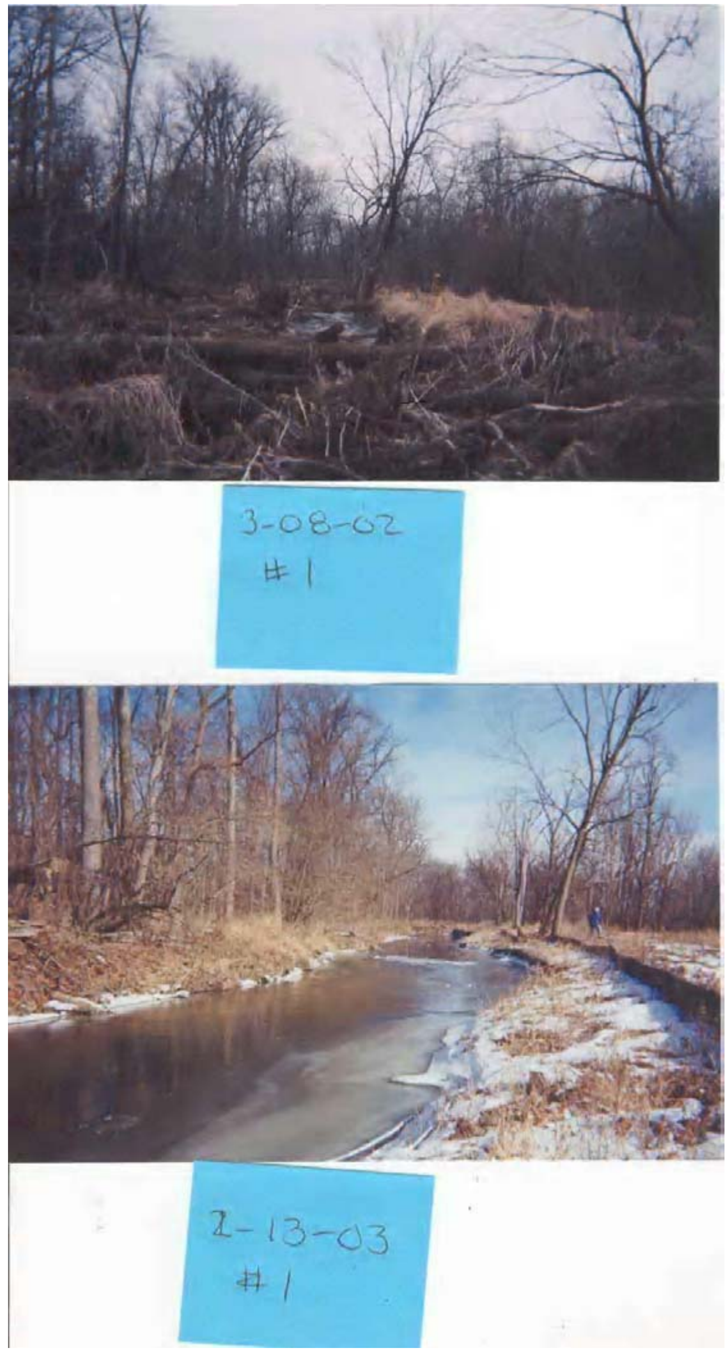


Figure 36 A very large log jam on the Cedar Creek near CR 68 in 2002. Photo courtesy of DeKalb County Surveyor's Office.

Large pieces of trees and other debris can cause damage to bridge structures downstream if they dislodge. While the county surveyor can remove obstructions that threaten bridge structures without waiting for a permit, other logjam removals require a permitting process that may take several years to complete. During this time an obstructed area can grow to encompass many acres of the watershed.

Log jams can reduce the safety and pleasure of canoeing in the stream, often creating hazardous currents and sometimes requiring lengthy portages around the barrier. Although some local enthusiasts canoe the Creek, a local provider of canoe livery, Roots Outdoor Outfitters, generally steer clear of the section of the creek designated as an Outstanding State Resource water, preferring put-in at Tonkel Road instead of Cook's Landing. They suggest that there are too many obstructions in the "natural" portions of the stream, resulting in required portage over private lands.

Removal of log jams remain topics of debate in the Cedar Creek and larger St. Joseph River watershed, due in large part to the effects on the morphology and ecology of the stream. The Indiana Drainage Handbook (revised 1999) details the notes that "localized logjam removal practices (401 and 402) are considered superior over large-scale river restoration techniques (403)" and therefore it is important that logjams are removed as soon as possible after they appear before they become too large to safely handle with practices 401 and 402.

The drainage handbook goes on to note that, "Effectiveness of large-scale river restoration or clearing and snagging projects in reducing flooding is limited only to small annual floods. Often times, the effect of these activities on reducing flood stages of larger, less frequent floods is negligible or at best limited to 2 or 3 inches of stage reduction. In most cases, similar hydraulic benefits may be achieved by … removing only localized log jams, at a fraction of cost and time." (Indiana Drainage Handbook, 1999, section 5.4, p.1)

This group did not find that there are any current intentions of a large-scale river restoration on Cedar Creek.

7 ways your watershed can benefit from Wetlands

- Improve water quality by breaking down, removing, using or retaining nutrients, organic waste and sediment carried to the wetland with runoff from the watershed
- Reduce severity of floods downstream by retaining water and releasing it during drier periods.
- Protect stream banks and shore lines from erosion.
- Recharge groundwater, potentially reducing water shortages during dry spells.
- Provide food and other products—such as commercial fish and shellfish—for human use.
- Provide fish and wildlife—including numerous rare and endangered species—food habitat, breeding grounds, and resting areas.
- Increase opportunities for recreation—bird watching, waterfowl hunting, photography—and outdoor education.

- Know Your Watershed.

Uhttp://www.ctic.purdue.edu/KYW/Brochures/Wetlands.html

Some stakeholders contend that the waterways as primarily drainage controls for the land. They may prefer a mechanical process of removal that relieves flooding and restores stream flow quickly. Others see the waterways as natural streams which should primarily support wildlife habitat and allow a natural regime of flooding and drying to occur. They may prefer to leave logjams in place or use manual methods if removal is necessary. In general the Cedar Creek watershed stakeholders agreed that logjams should be handled while they are small, before build-up occurs. All agreed that the permitting process for logjam removal can often be quite lengthy, allowing small logjams to grow during the time it takes the county surveyor to apply for and receive permits, respond to public hearings, and put the contract out to bid.

4.6 Loss and filling of wetlands decreases water quality and storage capacity

Indiana had an estimated 5.6 million acres of wetlands when European settlers arrived. Since then, more than 85 percent of many of the original wetlands drained and converted to farmland and urban areas. Most of the remaining 813,000 acres of wetlands are located in the northeastern portion of Indiana along river floodplains in southwestern Indiana, and in the Lake Michigan shoreline region in northwestern Indiana. (See Figure 48 in Chapter 5.)

Wetlands are the transition between dry land and water. They provide important ecological services, including flood control through water storage upstream, water quality improvement, groundwater recharge, and habitat and breeding areas for fish, birds and wildlife and insects. Other wetland benefits are listed in **Error! Reference source not found.**.

Wetlands are ecologically rich areas that are vulnerable to sedimentation. The loss of wetlands reduces water-holding capacity upstream and increases flooding downstream and reduces the diversity of wildlife and fish in the watershed.

4.7 Lack of education among stakeholders about the watershed hinders action

Although no one expects all stakeholders to be experts on watershed issues, there is generally a lack of working knowledge among a great majority of stakeholders of the Cedar Creek Watershed and its downstream neighbors about the watershed and its relationship to the health and welfare of residents of the region. The physical history that has shaped the environment of the Cedar Creek and the relationship of the Cedar Creek to the St. Joseph River and the Great Lakes is often unappreciated by many who live and work in Northeast Indiana. Because of this, the protection of water quality, water quantity, wetlands, soil fertility, recreational opportunities, aquatic and wildlife habitat, and aesthetic beauty are often economically and socially undervalued.

Figure 37 Wetland area along Chapman Road in the Cedar Creek canyons area. Photo by Jane Loomis.

A survey of City of Fort Wayne water customers that asked basic watershed questions was mailed with water bills in early 2004. The nearly 2,200 surveys returned from a broad and evenly-distributed sampling of the three main watersheds served by the City (St. Joseph, St. Marys, Maumee) indicated that only 20% of respondents knew in which watershed they lived. Eighty-seven percent of respondents considered the rivers valuable resources, and 80% believe that the rivers are polluted.

Stakeholders for the watershed plan, including staff of the St. Joseph River Watershed Initiative, the DeKalb County SWCD, and the Allen County Partnership for Water Quality (ACPWQ) have worked with elementary-aged school children on water quality projects, including DeKalb County's *Fifth Grade Field Days* (annual), the *Fort Wayne Drinking Water Week* (May 2004), and several summer festival events (Allen County Parks' *Sol Fest;* Children's Day at *Three Rivers Festival*). They have noted that the students often know the names of the local rivers and the Cedar Creek, but do not know the streams' origins or receiving waters. They also are unclear on the scope of our watershed, the economic impact of activities within the watershed, and how to protect the watershed. According to the ACPWQ educational specialist, the Fort Wayne City Schools science books use the Chesapeake Bay as the case study model for watersheds and the water cycle.

Addressing the problems enumerated in this chapter must include a directed educational effort. Appreciation for the environment of the Cedar Creek watershed and efforts for its protection start with knowledge and appreciation of the watershed's value to the community, and this educational effort must focus on the entire community, from children to retired adults.

Part 5. Sources of Problems and Stressors to the Cedar Creek

5.1 Sources of E. coli problems in the Cedar Creek watershed

Based on water quality data collected over a period of the past ten years, the Cedar Creek watershed does not meet the state water quality standard for E. coli. Generally, the percentage of samples annually that exceed E. coli water quality standards run from 30% to 80% during the recreational season.

The state of the art for urban construction during the last century called for a combined sewer system that allowed excess wastewater and storm water to be released directly to a water body during heavy rainfall events in order that treatment facilities not be overburdened. As population and demand for sewer hook-ups grew, these systems began to experience more flow than they were designed to handle, and combined sewer overflows (CSOs) occurred during even small wet weather events, resulting in sewage contamination of streams that happen frequently in several of our cities.

Additional sources of E. coli contamination in this watershed include failing on-site septic systems (OSS), sewage system overflows (SSO), wildlife sources, livestock waste contamination, and spreading of manure and/or sewage sludge onto fields. Researcher are beginning look at the stream itself as a source, focusing on stream sediment which may act as a sink for bacteria, releasing it when the water velocity is increased during storm or high-water events.

5.1.1 Failure of Onsite Septic Systems

The high prevalence of hydric soils in the Cedar Creek watershed poses significant problems to the siting of conventional onsite treatment systems. Septic systems located on lands that either do not have the soil capacity or the space to provide proper functionality will generally fail and leak sewage into the surrounding land and waterways. Groundwater contamination is also a threat if the system is positioned close to a well or area with groundwater/surface water interchange, such as a wetland. We have no data on the number of illegal direct connections (pipes directly connected to streams from the septic system) or indirect connections (septic outfall connected to drainage tiles). However, county health department officials have attempted to estimate the problem based upon documented failures and other local information.

Allen County: Cedar Creek/Canyon area. The Fort Wayne-Allen County Health Deaprtment documents the failure of septic systems as they are reported. A 2003 allen County Regional Water and Sewer District engineering report on the Cedar Creek area indicates that problems of aging systems in this area are coupled with tight soils prevalent in this part of the watershed that are not supportive of successfully functioning systems. In some areas, small parcels prevent soil-based solutions. There are pockets of subdivisions, but in general the area is rural, with low density housing development. Health officials do not speak of “if the septics fail,” but “when the septics fail.”

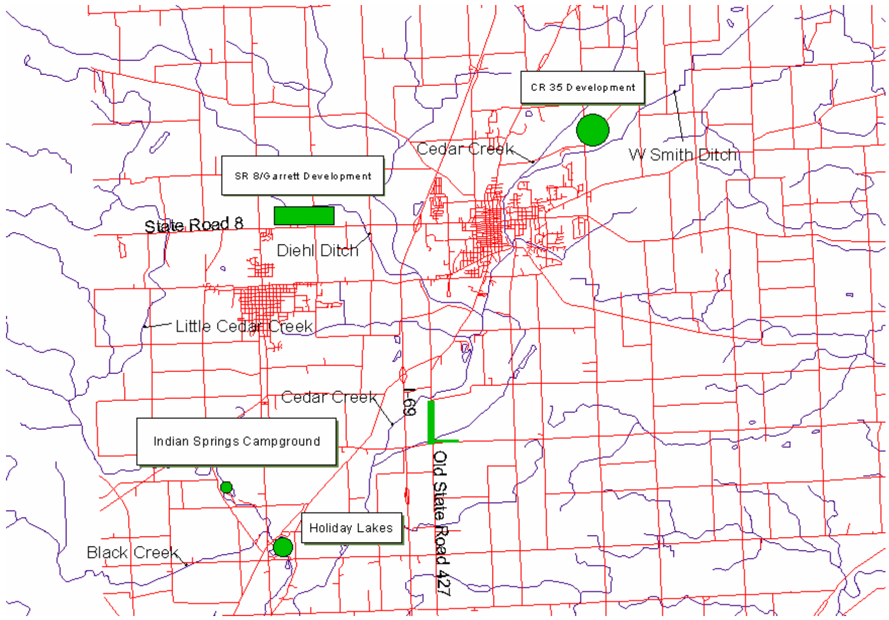


Figure 38 Areas of concern in DeKalb County. Courtesy IDEM and DeKalb Co. Health Department

The health department reports that there are 1,391 permitted systems in the Cedar Creek Watershed (See Figure 52 in Appendix E). They do not know how many aging systems are present for which there are no records, but estimate a total of approximately 2,500 systems with a 75% failure rate in the area (See Attachment A, *Water Quality Modeling Analysis for the Cedar Creek Watershed*, page 6). Connection to the Fort Wayne sewage system is not feasible for most of the area, based on limited capacity of the city's system. Fort Wayne currently processage sewage for the cities of Huntertown and Leo-Cedarville. The City of Fort Wayne estimates that there are more than 200 failing systems within the city limits, based upon the neighborhoods that have expressed interest in sanitary sewer extensions.

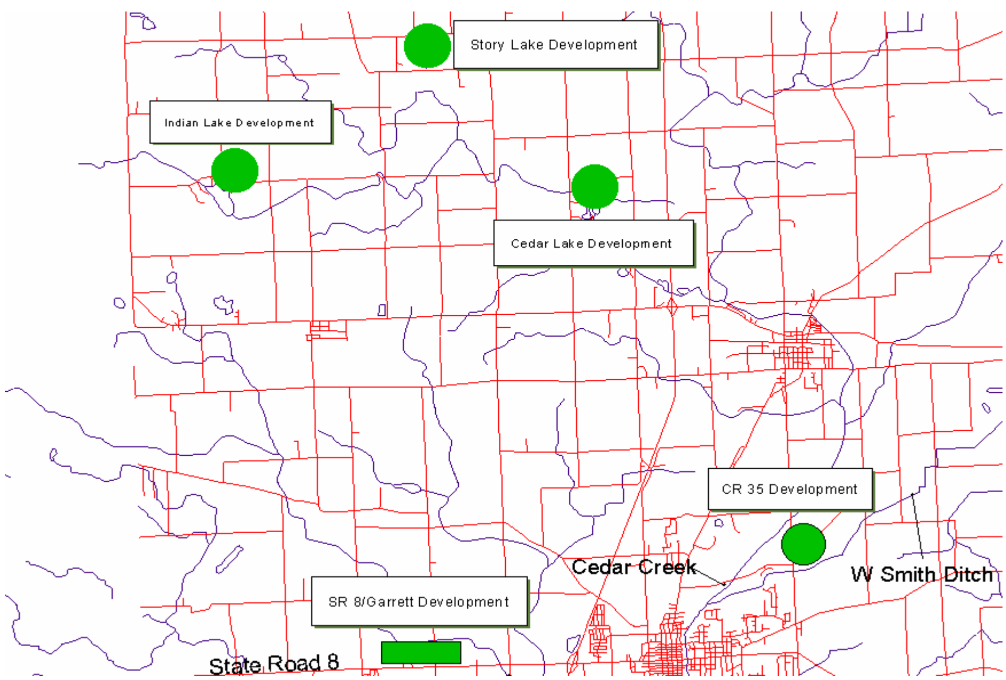


Figure 39 Additional areas of concern, DeKalb County. Courtesy IDEM, Department of Health and SWCD.

A change in state law was recently passed to allow permitting of discharging systems in Allen County only. Prior to 2005 there has not been any testing of the various types of discharge systems within the county which would allow documentation of their cost or reliability over the long term. There is a need to create some pilot projects to verify that these systems actually work efficiently in the watershed, as well as their cost-effectiveness for homeowners.

DeKalb County: The DeKalb County Department of Health recognizes an increased pressure within the county for low-density residential development and soils that prevent successful treatment by on-site septic systems (OSS). The health department receives an average of 30 reports of failed septic systems annually. Beside these reported failures, there are older systems and "repaired systems" ("repaired" by directly connecting to field tile) that contribute to the department's concern. Officials estimate there are approximately 4,000 on-site septic systems in the county, and estimate the failure rate to be around 40%. (M. Garrett, personal communication, 2005)

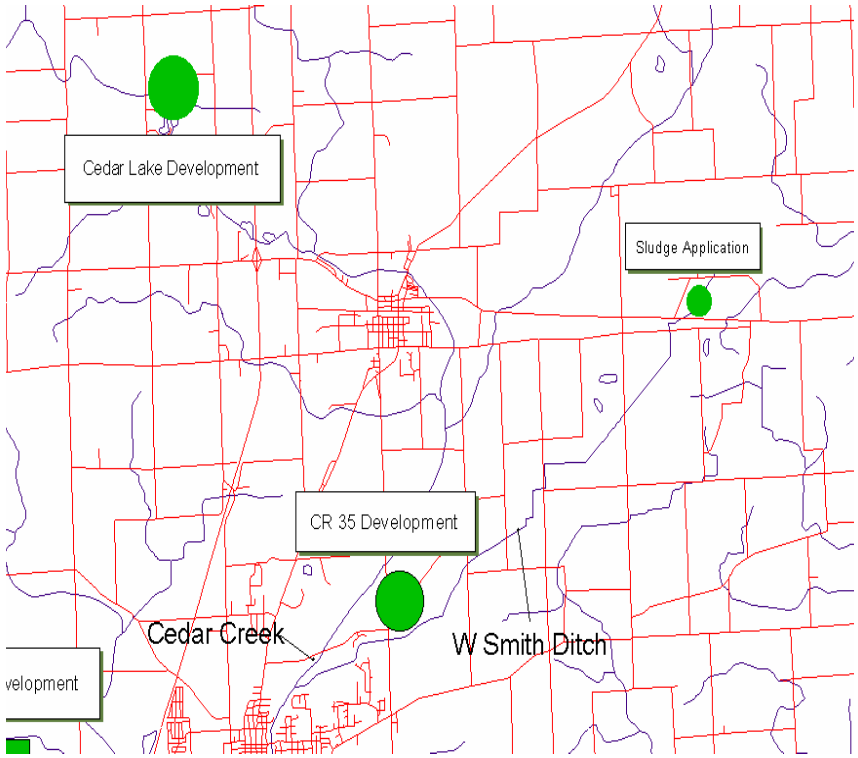


Figure 40 More areas of concern, Dekalb County. Courtesy IDEM, Dekalb Co. Department of Health, DeKalb Co. SWCD.

The areas of concern for DeKalb County, according to the SWCD and the health department, are Holiday Lakes Residential Development, Cedar Lake, Story Lake, Indiana Lake, Auburn/Cedar Creek Residential Development, DeKalb County Municipal Airport, Northeast Garrett Residential Development, Town of Sedan, Indiana Springs Campground and CR26. The DeKalb County SWCD has approved a grant-funded cost share program that can be used to address replacement of septic systems. There have been 24 septic systems replaced through this program.

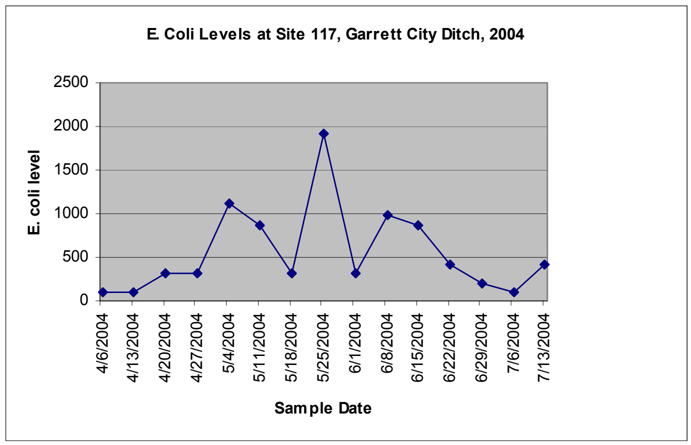
Noble County: Noble County's portion of the Cedar Creek basin is mostly rural; therefore a large number of residences have onsite septic systems. We have no data at this time regarding the total number of systems or estimates of failure rates. The town of Avilla has a wastewater treatment plant in the watershed and it has been a concern in the past (IDEM 1992). The SJRWI sampled the waters in the Avilla Drain in 1996 a total of 19 times during the recreational season. The annual average E. coli count at that time was 1,295; 73.7% of the samples taken that year were in excess of the State's water quality standard.

5.1.2 Combined Sewer Overflows (CSO)

The City of Auburn has four CSO outfalls into Cedar Creek. The town of Waterloo has three outfalls, including a CSO on Cedar Creek on CR 28 just above the confluence of the Swartz and Matson ditches.

The City of Garrett has historically had difficulty with treatment capacity at its sewage treatment plant. Records from the IDEM list 30 overflow events for the Garrett Wastewater Treatment Plant between August of 1997 and April of 2002, generally blamed on rain or snowmelt. The St. Joseph River Watershed Initiative's monitoring program found that high levels of E. coli contamination were common at the Garrett City Ditch at DeKalb CR 15 (Site 117) during 2003. Figures 24 and 25 show the results. Many samples were above 5,000 colonies per 100 ml, ranging upward to above 20,000 colonies. Garrett's $3.5 million upgrade and improvement project to the waste water treatment facility was completed by the beginning of February, 2004.

In a letter to the Initiative's Board of Directors dated May 27, 2004, the Mayor of Garrett reported greatly improved wastewater effluent discharge to the Garrett Ditch that subsequently flows to the Cedar Creek and the St. Joseph River. Water quality monitoring by the Initiative early in 2004 showed great improvement; however, only 6 of the 29 weekly samples were below the state single sample standard (235 colonies), and samples taken in the fall (September – October) showed high spikes, with at least one sample count above 11,000.



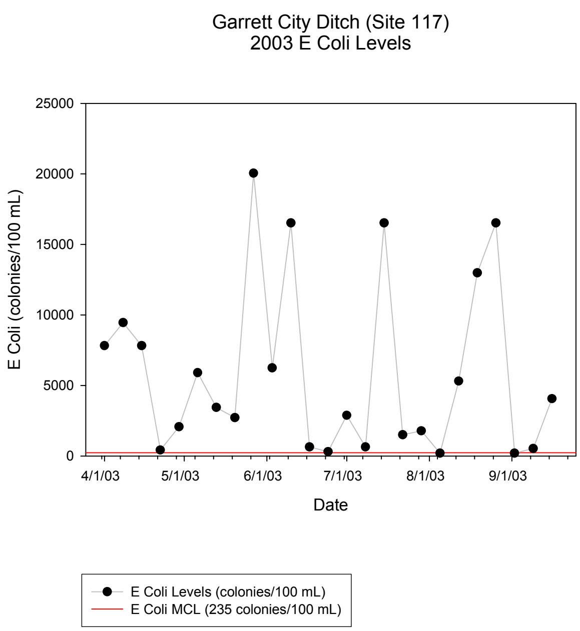


Figure 41 Comparison of E. coli levels from Garrett City Ditch, 2003 and 2004. Courtesy St. Joseph River Watershed Initiative

Figure 42 Geese congregate on well-manicured lawns where each individual animal drops 2-3 lbs. of fecal material daily. It is difficult to differentiate between migratory geese and local, non-migratory “nuisance” geese. Anonymous photo.

5.1.3 Geese and other wildlife

Waterfowl, including large populations of nuisance wildlife such as urban gulls, pigeons, and Canada geese have the capacity to add large amounts of fecal material to the surface water system. As an example, an individual Canada goose leaves two to three pounds of droppings each day. (http://www.cityofseattle.net/parks/communitynotices/goosefaq.htm. 2004)

The USDA National Wildlife Research Center conducted two studies, which suggest that geese may carry virulent strains of E. coli which pose a health risk for humans and cattle. The studies did not investigate whether geese transport pathogenic E. coli between farms and urban areas. (http://www.aphis.usda.gov/ws/nwrc/research/avian_disease/ 2004)

Calculations for the SWAT model done for this study used estimate from the wildlife biologists at the Indiana Department of Natural Resources: 6583 geese, 4813 deer, 1,185 opossum, 8,426 raccoon and 25,278 rabbits in the watershed. Wildlife can be a source of surface water pollution from runoff and in-stream contact.

The St. Joseph River Watershed Initiative’s Bacteria Source Tracking (BST) project has identified geese and other wildlife as a major source of fecal bacteria contamination in the Cedar Creek and St. Joseph River watersheds.
The graph in Figure 43 is typical of the results of the study, and shows five samplings of the Garrett City Ditch during 2003 and 2004. Human source shows up in three of these samples, but contribute a small percentage of the total. Wildlife (mainly geese) contributes a substantial proportion of the bacteria source in four of the five samples.

> Resident Canada geese are protected under the Migratory Bird Treaty Act. "Residential" Canada geese do not migrate to Arctic breeding grounds, preferring instead to remain year-round in continental U.S. urban and suburban neighborhoods. Why migration patterns have been abandoned is not yet clear. Whatever initially prompted Canada geese to remain in one location year-round, the lush green lawns surrounding park ponds, residential subdivisions, corporate centers, and golf courses encouraged them to stay. Unlike species of waterfowl that eat aquatic vegetation or aquatic animals, Canada geese prefer to graze on land. Fast-growing grass that is cut frequently stays succulent and makes an ideal forage for them. But because geese are flightless for long periods in summer and must raise flightless goslings for even longer periods, they are dependent on adjacent ponds or lakes that provide a safe refuge from predators.
> (Source: The Humane Society of the United States, Washington, DC., 2004)

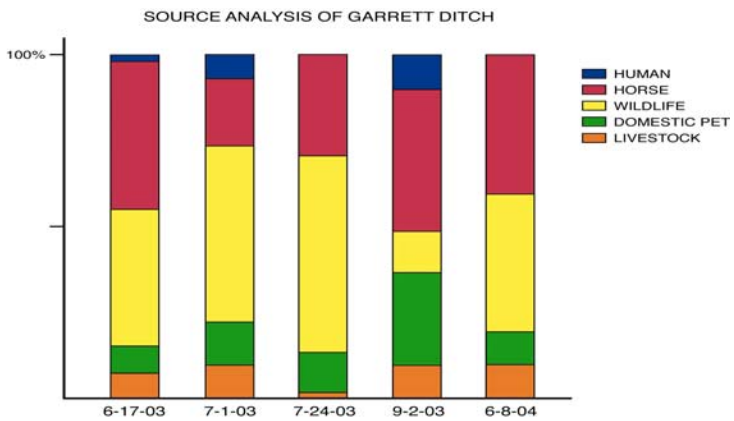


Figure 43 BST results from Garrett City Ditch indicate some human source bacteria, and significant animal sources, including geese, domestic pets, and livestock. Courtesy SJRWI, 2004

5.1.4 Improper management of livestock operations and manure disposal

The manure produced by livestock operations is a source of potentially dangerous bacteria that has been recognized in the watershed. Animals should be fenced out of the streams and ditches, and fields where livestock graze should be protected by buffers wide enough to filter out waste runoff. These management practices protect ground and surface water used as sources of drinking water and recreational activity from pathogens that can cause diseases in humans and other animals.

Figure 44. Dibbling Ditch. Complaints from stakeholders indicate manure infiltration. Photo by Karen Griggs, 2003

Winter manure application onto frozen fields is fairly common in sections of the watershed. If rains or snowmelt occur while ground is frozen, the runoff goes directly into water ways without any type of filtration. Excess rain or saturated soil conditions in warm weather, and subsurface tile drainage can cause manure to enter streams and waterways and to leach into old and/or shallow domestic wells. There is anecdotal evidence of livestock having access to streams in some areas, of winter application of manure, and of ditches without buffers, a condition that allows bacteria-laden waters to enter the stream unimpeded (see Figure 44).

County/Year	All Cattle	Hogs	Total	Change (% Change)
Allen 1996	**19,200**	**72,800**	**92,000**	
Allen 2003	**11,000**	**49,783**	**60,783**	**-31,217 (-51.36%)**
DeKalb 1996	**9900**	**25,700**	**35,600**	
DeKalb 2003	**10,700**	**18,355**	**29,055**	**-6,545 (-22,53%)**

Noble 1996	15,500	38,500	54,000	
Noble 2003	13,600	43,481	57,081	+3,081 (+5.40%)

DeKalb NRCS officials estimate that there are approximately seven farmers in the Cedar Creek watershed that may spread manure onto 700 to 1,000 acres. Several of these have storage capacity and work under permits from IDEM. Three operate without storage, meaning they haul manure daily during the times they are raising animals. All are small operators. At least one is developing a manure management plan for his operation. The two largest dairy operations in DeKalb County are outside of the Cedar Creek watershed.

There were 13 confined feeding operations (CAFOs) active in DeKalb County in 2002. These operations are regulated by IDEM and are required to have manure management plans in place in order to be eligible for federal funding. Many small operations that are below the level of regulation by IDEM exist throughout the watershed. The number of resident animals on these small operations can fluctuate easily and often from year to year. County SWCD offices work with small farms to establish nutrient management plans. LARE (Lake and River Enhancement) and EQIP (Environmental Quality Incentives Program) grants help to offset the cost of such plans.

Table 8 Indiana Ag Statistics (1005-96 and 2002-2003) show changes in the number of cattle and hogs in the three counties of the watershed.

Generally the overall numbers of livestock have decreased in the watershed, based on USDA farm census reports by county. Note that only small portions of Allen and Noble counties actually fall within the Cedar Creek watershed. The numbers in Table 8 do not include horses, sheep and fowl. Estimates provided by the Indiana Agricultural Statistics Service for the SWAT model included 6,959 cows, 19,0971 hogs, 911 sheep and 1,217 horses in the watershed. “Horse” bacteria represented a significant contribution in the BST study, prompting suggestions that some other animal, likely wildlife, had similar antibiotic signatures since the total number of horses in the watershed is relatively small. In specific areas in the Cedar Creek sub-watershed, visual reports confirm a substantial number of horses, although they are generally present in small numbers on any given farm or rural residential location.

5.1.5 Domestic animal sources

Domesticated animals, including small livestock and pets, can pose a threat to water quality through contamination of the water by fecal wastes. Urban areas are at particular risk for domestic pet wastes via storm water runoff. Rural residences and small farms, which generally do not normally house very large numbers of livestock and/or poultry, nevertheless may be sources of wastes that can leach into drainage ditches and tributaries because less attention is paid to manure management plans. The Initiative’s BST project identified domestic pets as a strong source of bacteria in some areas.

5.2 Sources of pesticide and nutrient runoff

The St. Joseph River Valley generally exhibits a high inherent sensitivity to potential groundwater contamination. Recharge to aquifers is extremely high in the Cedarville and Eel River-Cedar Creek aquifer systems, up to 500,000 gallons per day per square mile. (IDNR, 1996)

Wellhead protection plans are not currently in place for many of the small groundwater sources. Significant withdrawal wells should be carefully monitored to measure their effects on overall availability as well as their sensitivity to contamination. Policies for the protection of groundwater resources within the watershed must be included in city/county planning efforts in order to ensure the long-term economic and environmental health of the watershed.

Pesticides and nutrients enter the surface water via runoff unless specific measures are taken to prevent pollution. In order to meet the standards of the Safe Drinking Water Act, the City of Fort Wayne spends an average of $165,000 annually on powdered activated carbon to remove pesticides such as Atrazine from raw water when daily testing indicates such pollutants exceed the maximum contaminant level (MCL). Costs for the past two years were $114,773 in 2002 and $207,024 for 2003, according to Chet Shastri, manager of Fort Wayne's Three Rivers Filtration Plant. (*Fort Wayne Reader* October 2004, Issue 17)

Indiana does not have stream WQS for nutrients. Targets used in our SWAT model for total phosphorus (P) is 0.3 mg/l, and for nitrogen (N) is 1.0 mg/l. We have generally not seen excessive problems with nutrients in this watershed, although we do not wish to have any increases in nutrients in the watershed. The expected impact of the nutrients in this watershed affects biotic communities.

<u>5.2.1 Runoff from agricultural land</u>

The Source Water Protection Initiative Project (SWPI) is located in the Matson, Walter Smith, and David Link (formerly Swartz) ditches in the Cedar Creek watershed near Waterloo, Indiana. This project, begun in 2002, is a cooperative effort among America's Clean Water Foundation (ACWF), the Agriculture Research Service (ARS) and its National Soil Erosion Research Laboratory (NSERL) in West Lafayette, Indiana. The St. Joseph River Watershed Initiative is the local watershed partner and performs daily maintenance and sample collection for nine automated water samplers for the project from April through November.

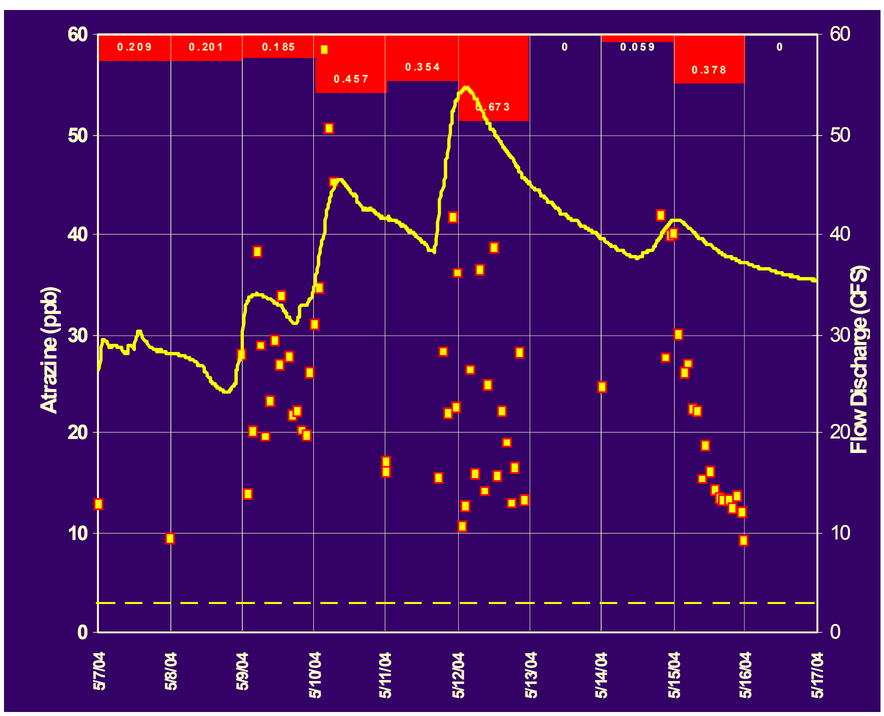


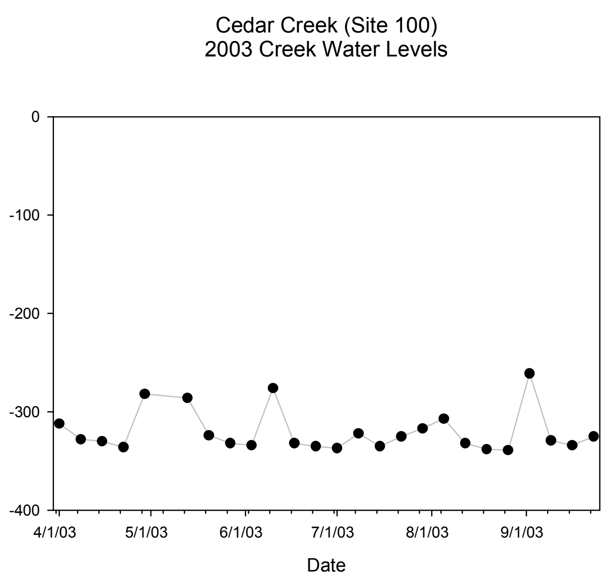
Figure 45 Matson Ditch sampling station output shows increases in pesticide runoff in relation to rainfall events in 2004. Courtesy ARS-NSERL.

The focus of the project is to measure the ability of various best management practices (BMPs) to remove or reduce sediment, pesticides and nutrients from field runoff on a watershed scale. Preliminary results from the study verify that pesticide levels in drainage ditches adjacent to agricultural fields spike significantly above the drinking water MCL, especially around the time of spring application as well as during and after significant wet weather events. Samples showed nearly 60 ppb in the stream adjacent to some fields during the first flush of runoff. The MCL for Atrazine is 3 ppb, represented by the dashed line on the chart below.

Preliminary testing of samples taken during rainfall events indicates some contamination by glyphosate (Roundup) from the small, localized (small field) watersheds of the SWPI project. In a few instances, amounts of greater than 200 ppb were identified in samples taken during late May. Although these numbers are higher than what has been detected in normal ditch samples, the amount is still low relative to the maximum contaminant load (MCL) of 700 ppb for glyphosate. There are no other sampling efforts focusing on glyphosate in the water system at this time in the watershed.

The City of Fort Wayne tests raw and finished water for Atrazine at the Three Rivers Filtration Plant. The City's results for 2003 show a series of 15 days in May from May 6 through May 20 when Atrazine values were high in the raw water and it was treated to bring finished water to the drinking water standard of 3.0 ppb. During that period, of the 13 days for which raw water was tested, Atrazine exceeded the MCL on 12 days and peaked at 5.01 ppb; the minimum was 2.99. During a series of dates in June, from June 15 – 30, Atrazine levels were above the 3.0 ppb MCL on every day except one (2.89 ppb). The maximum reading was 6.52 on June 17 and 18. The finished water on at least four dates, June 16 through 19, did not meet the 3.0 MCL. During that time period, 900 pounds of powered activated carbon were used to remove pesticides from the water. (*Pesticide Analysis for* 2003, City of Fort Wayne) The high readings obtained by city tests corresponded to high water levels in the Cedar Creek, indicating that rainfall had been plentiful at that time period. Figure 46 shows water levels in Cedar Creek at Site 100 during 2003 as bridge-to-water measurements taken by the SJRWI as part of its weekly sampling program.

Figure 46 Water levels at Cedar Creek (Site 100) during 2003. The level is taken from a bridge-to-water measurement and does not indicate flow. Chart courtesy St. Joseph River Watershed Initiative



High levels of pesticide runoff not only increase the cost of treatment of the water for drinking water purposes, it also decreases the profit of farmers when crops are not receiving the benefit of the chemical or fertilizer that has been applied. Stream waters at or near the application sites and times appear to be most vulnerable. Stakeholders concerns include human contact with surface waters during these times, as well as the current and cumulative effects of the pesticides on groundwater resources, surface drinking water sources and aquatic species.

5.2.2 Runoff from urban/suburban areas

Application of lawn chemicals to turf grass on urban, suburban and rural residential and commercial properties is a source of water pollution. Although retail-sale fertilizers and pesticides from local lawn and garden retailers are labeled with directions for proper application, homeowners are often lax in following these precautions, with resulting over-application or poorly-timed applications that may threaten water supply through storm water runoff. There is an abundance of turf grass in the watershed, especially in the low-density housing near the edges of cities and towns. Turf grass contributes a significant amount of water to the runoff stream because of its shallow, dense root structure. Turf grass management is an important business in the watershed. According to the Indiana State Chemist's Office, there are 71 registered lawn care businesses in Allen County, three in DeKalb County and five in Noble County. These companies regularly apply fertilizers and pesticides to lawns.

Other large users of lawn-care chemicals include golf courses. According to the Bureau of Labor Statistics, in 2002 there were 15 golf courses in Allen County and four each in DeKalb and Noble Counties. Some of these lie within the Cedar Creek watershed and close to waterways.

5.2.3 Pesticide application in or near drainage ditches

Drainage ditch maintenance by contractors and private landowners often includes application of pesticides to control woody vegetation in the ditch area adjacent to the waterway. This practice can create a direct conduit for pesticides entering the stream. Our study has been unable to quantify the amount of pesticides and herbicides actually applied in or adjacent to watershed ditches annually. Targeting education, BMPs for ditch maintenance and collection of data as this project progresses will help to identify and solve problems associated with this type of runoff.

5.3 Sources of erosion and sediment loading

Cedar Creek is generally a muddy, murky stream. Turbidity (cloudiness) values are measured in Nephelometric Turbidity Units (NTU). Although turbidity is not a measure of sediment, it does give us a measuring stick for non-clarity of the water. Values above 100 NTU are considered unsupportive for aquatic life.

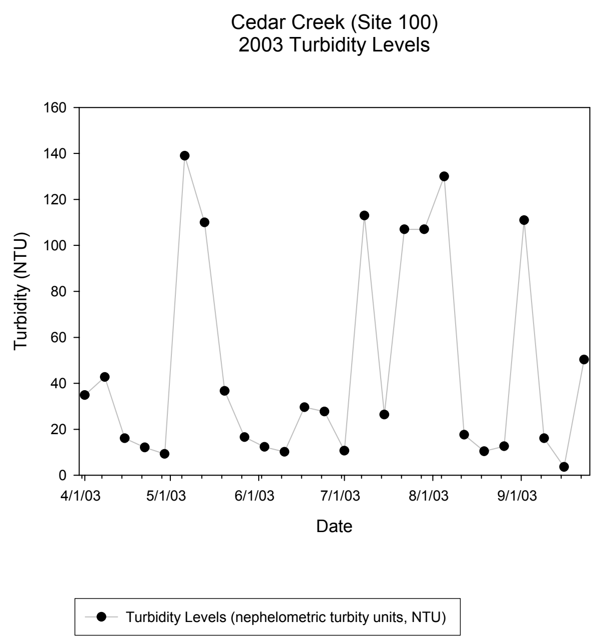
The issue of drainage is directly related to the concerns for the water resources in the watershed. The Cedar Creek watershed is an area that relies on a system of public and private tile, ditches, streams, and creeks to provide drainage for its agricultural land. The extensive drainage system increases the potential for surface water contamination from both agricultural and construction activities. Due both to this increased potential and the effects of essential ditch maintenance activity, drainage issues must be considered when discussing the water resource concerns.

5.3.1 Ditch maintenance activities

Lakes and streams in the upper watersheds are significant tributary sources to the Great Lakes Basin. Drainage maintenance and other types of construction along ditches and streams make the waterway and surrounding area susceptible to increased erosion during construction activity until the banks are stabilized and vegetation is reestablished. Removal of the meandering of the stream through engineered straightening and deepening of the channels for the purpose of improving drainage often increases the velocity of the flow. Increased flow velocity may result in bank erosion, undercutting and downstream flooding, all of which add sediment and associated pollutants to the stream.

Research conducted by the ARS on the dredge material taken from the 2004 dredging of the Walter Smith Ditch indicates that dredging also decreases the ability of a ditch to act as a filter for removing pollutants. (C. Huang, personal conversation, 2005)

Figure 47 Turbidity values measured in NTU at Site 100 for the year 2003



5.3.2 Urban runoff

Urban stream areas can also be causes of increased volume and velocity of runoff because of the amount of highly impervious surface areas in an urbanized locale. Generally storm water washes sediment, toxic road and highway chemicals, and lawn and garden fertilizers, pet wastes and urban litter from impervious urban and suburban surfaces into the stream in a high velocity flow.

5.3.3 Construction Activities

Construction activities for residential, commercial, industrial and agricultural operations are a significant threat to adjacent surface water, specifically because the potential exists to deposit very large amounts of soil to the stream flow over an extended period of time while the land is stripped of vegetation. Erosion control products and practices help to deter loss of soils, but must be installed and maintained in order to be of value. Additionally, the proper siting and design of construction projects, compliance with all permitting processes, and communication with affected watershed stakeholders affected by the construction activities are important for the protection of water resources.

As of July 2004, 75 projects that disturbed more than one acre of land were active in DeKalb County. Pond construction is required to be permitted in the county, and some of these active projects involve pond building projects that disturb more than one acre of land. No numbers have been collected for the watershed in Allen or Noble counties.

5.3.4 Gravel mining in or adjacent to streams

Gravel and sand mining is an important local business, especially in areas that are active in construction activities. According to the U.S. Bureau of Labor Statistics, there were 7 operational gravel and sand mining operations in DeKalb County in 2002. Gravel mining increases the sediment that can be released into the streams through runoff, airborne dust, heavy equipment and truck traffic, and surface or groundwater infiltration and exchange. Gravel pits that are located in or adjacent to streams need to adopt best management practices in order to keep contaminants from entering the stream. In Indiana, there is no single program specifically meant for the oversight of non-coal mineral extraction. Any controls that may exist will most likely be found in local regulation. Impacts of certain individual activities may be subject to certain requirements under the IDNR Division of Water and Division of Soil Conservation, and the IDEM Air Management Division.

5.4 Sources contributing to loss of prime agricultural and forested lands

Subdivision of farmland generally includes new rural residential construction, including roads and driveways, and installation of turf grass. Disturbance of the land during construction can increase the amount of eroded soil entering the waterways. Increasing area of impervious surfaces and turf grasses subsequently change drainage patterns, thus increasing runoff, which may increase flooding downstream during high rainfall events. Turf grasses generally are preferred by geese over taller native grasses for feeding and protection from predators, thus providing habitat for nuisance geese. Increased traffic in residential areas increases the amount of pollution from vehicles entering the streams with storm runoff.

County	Land (ac.)	Farm Acres		# Farms		Avg. Farm Size (ac.)	
		'87	'97	'87	'97	'87	'97
Allen	**420,662**	**291,200**	**276,385**	**1,649**	**1,440**	**177**	**192**
DeKalb	**232,259**	**175,200**	**162,936**	**824**	**785**	**223**	**208**
.Noble	**263,125**	**197,900**	**181,963**	**1,057**	**942**	**187**	**193**

Table 9 Farms in Indiana. Source: http://www.stats.indiana.edu/web/state/ftp/cmdty 406.csv.

Forests and woodlots have also been fragmented and lost, a process that negatively affects wildlife, including amphibians which use upland forested land for portions of their life cycle. Decisions in the past to remove native forestland were generally based on economics and tied to changes in development: a desire for additional agricultural land, residential lots or commercial/industrial development. Retention of remaining forested land may be closely tied to economics, but where urban development has not created a stressor, there is less likelihood of removing forests:

> The current forest landscape of Northern Indiana is composed of small, discrete, privately owned woodlots. The only remaining forest habitat in this predominantly agricultural region, these woodlots are the result of interactions between social and biophysical processes... Using geographic information systems, the results of a household survey have been linked to landcover outcomes derived from remotely sensed data at the parcel level. The results of this analysis show that in the context of a slight decrease in the total amount of forest land over the past 25 years, non-economic motivations have led to the retention of woodlots. A decision tree generated from household survey data shows that characteristics associated with agricultural use, such as large parcel size and lack of subdivision, are positively related to the presence of woodlots. (Source: Shanon Donnelly, Linking Landscape Pattern to Social Process. Retrieved from http://www.cipec.org/research/indiana/donnelly.html 9/24/04)

5.4.1 Changes in agricultural economy

The number of farms in Indiana has steadily decreased, as reflected in Table 10, as agriculture has changed from an economy of small family farms to a more specialized and competitive commercial venture.

Year	No. of Farms
1945	**177,000**
1955	**150,000**
1965	**115,000**
1975	**94,000**

Table 10. Number of farms in Indiana. (Indiana Ag Statistics 1992; Indiana Ag Statistics 2002-2003.)

Both the number of farms and the total acreage in farms decreased between 1987 and 1997. In Allen and Noble counties the average farm size has increased, as shown in Table 9, an indication of the breakup of small family farms. This is often accompanied by fragmentation of farmed acres due to sell-off of lots.

Changing Farms: The number of small farms between 10 and 49 acres is growing, although the number of farms is falling across the state. The trend is even more pronounced in northeast Indiana. The chart below shows the number of small farms in 2002, 1997 and the percentage change in counties included in the Cedar Creek watershed.

County	2002	1997	% Change
Allen	559	511	8.6
DeKalb	333	229	45
Noble	348	312	11.5
Total Indiana	18,595	17,937	3.7

Table 11. Changing farm scene. Source: 2002 Census of Agriculture

The number of persons in DeKalb County listing farming as their principal occupation declined from 381 in 1987 to 287 in 1997.

5.4.2 Urban sprawl

Urban development is claiming farm acreage in the Cedar Creek watershed, particularly near cities and along transportation corridors. An article published in the *Fort Wayne Journal Gazette* on October 10, 2004 highlighted the changes in farm size in northeast Indiana. The chart below was adapted from that article and includes the counties of the Cedar Creek sub-watershed.

Building permits in the Cedar Creek watershed's three counties have been steadily increasing over the recent past, reflecting the pressure for continued development of the rural landscape. Single family units are on the increase, as are multi-family dwellings shown in Table 15.

Year	1-family	2-family	3 & 4-family	5+ family	Total
1990	**1,603**	**54**	**8**	**214**	**1,879**
1995	**2,130**	**98**	**24**	**224**	**2,476**
2003	**2,403**	**78**	**16**	**345**	**2,812**

Table 11 Building Permits in Allen, DeKalb and Noble counties. Source: http://www.stats.indiana.edu/bp/

Both Allen and DeKalb counties are working on comprehensive development plans, which designate specific areas for development efforts, while others remain zoned agricultural. Efforts to provide policy and zoning to back up the plans will help determine whether agricultural and forested lands in the counties are developed into industrial, commercial and residential properties.

The following statement is taken from the preliminary analysis work of the Fort Wayne-Allen County comprehensive plan, but applies equally to the area of the Cedar Creek watershed in Allen, Noble and DeKalb counties:

> The original "natural" condition of most lands in this area was forested, with both upland and wetland deciduous forest communities represented depending upon variations in topography, drainage, soils, aspect, microclimate and other factors. While restoration to original conditions is not always a feasible or desirable goal for natural resource planning efforts, a forested condition represents the most appropriate ecological reference for such efforts and should at least be considered as a starting point for projects where ecological integrity figures prominently, such as acquisition or enhancement of nature preserves, wetland restoration projects, or restoration stream corridors.

5.5 Issues surrounding logjams and stream obstructions

Often the needs and values of stakeholders in a watershed create opposing interests and cross purposes. Lack of coordinated planning among stakeholders, or indifference to the needs of other stakeholders in the community can result in delays and frustration, and even legal actions. Removal of obstructions in the waterways is one of the issues that have created a great amount of controversy in the Cedar Creek watershed. Removal of a very large log jam near County Road 68 spawned a great amount of public controversy among environmentalists, farmers, landowners and the DeKalb County surveyor's office. Trust and cooperation is still lacking among these stakeholders.

5.5.1 Removal methods

The *Indiana Drainage Handbook* lists three logjam removal practices: Using hand-held tools (Practice 401); Using heavy machinery (Practice 402); and Large-scale river restoration (Practice 403). The handbook suggests that submerged and overhanging logs provide important wildlife habitat, and in many cases, the ripples caused by obstructions oxygenate the water to improve water quality. Therefore, classification of in-stream obstructions based on severity is important, and use of management practices based on the classification category is useful.

Many stakeholders suggest that logjams should be removed using the "Palmiter Technique," a method which combines clearing and snagging, and other inexpensive streambank protection measures to restore the stream channel to its perceived original, non-obstructed capacity. Logjams and severely leaning trees are removed and some of the removed materials is pinned to the bank for erosion protection. Sediment bars may be removed or raked, and stream banks are revegetated with trees to provide shade.

In some cases, drainage officials may feel that removal of logjams using hand-held tools is a process too risky to personnel or too labor-intensive and expensive to efficiently manage the labyrinth of man-made ditches and streams in the watershed. Heavy machinery is often employed to remove logjams that cause flooding sedimentation or destruction of wildlife habitat.

While this method restores natural flow of the stream and may reduce erosion, sedimentation and flood potential, thereby improving wildlife habitat and water quality, the method is potentially more damaging to the environment. It also may be time consuming, and labor intensive. The method generally requires restabilization of the stream bank, and can cause environmental damage to adjacent areas used for access to the stream, as well as temporary sedimentation during the work phase of the project. Machinery used may include backhoes, bulldozers, log skids and other heavy machinery equipped with brush hooks and snags. However, excavation implements are not used in this type logjam removal.

Large scale river restoration/clearing and snagging projects may be effective in reducing flooding from chronic, low-intensity annual floods. This type of project may also provide recreation benefits to hunters, fishermen and canoeists. Larger, less frequent floods are impacted by this practice marginally, often reducing the flood by 2 or 3 inches of stage reduction, and therefore may be questionably cost-effective. This method can potentially be more damaging to the environment than logjam removal alone. Hand tools, horses, and large machinery such as front-end loaders, log skidders and crawler tractors may be employed. Work may be done from boats or barges. Material that is not used for streambank stabilization must be removed from the stream and piled, chipped, burned or buried to prevent re-entry into the floodway. Sand and sediment bars may be removed, but often will shift and move of their own accord with the flowing stream. Bank erosion protection must be provided, as well as revegetation (providing shade) for the stream. Streams lacking shade become choked with weeds, which may have some filtering ability, but which will not function well as water conveyances since the growth will obstruct the flow of the water. (Indiana Drainage Handbook. Revised 1999)

In all cases, obtaining access to stream and ditch work may cause extensive damage; therefore routes must be carefully selected to minimize disturbance of wetlands, floodplains and riparian areas.

5.5.2 Public involvement in decision-making

The Indiana Drainage Code, enacted by the state legislature in 1965, places responsibility for the maintenance and proper functioning of all regulated drains on the county drainage board and the county surveyor of each county. The drainage board and surveyor must also respond to petitions by the public to create new regulated drains, reconstruct existing regulated drains, and perform regular maintenance activities. A right-of-entry easement extends 75 feet in each direction from the top edge of each bank of an open drain along both sides of the drains. Permission from the drainage board must be given in order to plant trees, shrubs and woody vegetation within the easement area, and such vegetation may be removed by the surveyor if it is necessary for proper functioning of the drain. Landowners may not be familiar with legal requirements of easements, drain operations and the maintenance of ditches and streams in their county. Or they may disagree with the laws or the methods used to carry out the responsibilities of the drainage board and the surveyor.

5.5.3 The permitting process

Obtaining of legal permission to work within the drainage area can be a long and drawn-out process, and may include approval from the Indiana Department of Natural Resources, Indiana

Department of Environmental Management, the Army Corps of Engineers, the Natural Resource Conservation Service, and the US Fish and Wildlife Service, in addition to local permits. The permitting process is a public process; however, unless a citizen is knowledgeable about a project and specifically asks to be advised about permit applications and/or hearings, he or she is unlikely to become party to early planning for stream maintenance. People who are not landowners within a specific project area generally become aware of the project through local news reports, issuance of a permit, or the appearance of machinery in a stream location. Stakeholders may become involved because they perceive a threat to their own property or to the goals of their organization or group.

Often, involvement at later stages of a project causes frustration and disagreement among stakeholders. Communication, and if necessary, negotiation, with all stakeholders of a project during the planning stage is important for the smooth operation of stream maintenance.

5.6 Loss of functional wetlands

According to the EPA, between 1986 and 1997 an estimated 58,500 acres of wetlands were lost each year in the conterminous United States. In addition to these losses, many other wetlands have suffered degradation of functionality, although calculating the magnitude of the degradation is difficult. The increase in flood damages, drought damages, and the declining migratory bird and amphibian populations are, in part, the result of wetlands degradation and destruction.

Human actions that degrade wetlands include drainage, dredging and stream channelization, deposition of fill material, diking and damming, tiling for crop production, levees, logging, mining, construction, runoff, air and water pollutants, changing nutrient levels, releasing toxic chemicals, introducing non-native species, and grazing by domestic animals. (US EPA, http://www.epa.gov/OWOW/wetlands/vital/status.html)

Wetlands are an important hydrologic feature in the watershed. They occur where the ground water table is at or near the land surface or where an area is periodically covered by shallow water. Once considered wasteland, the wetlands of Indiana have been ditched, dredged, tiled or filled in order to allow agricultural production or other economic development. However, wetlands not only play a role in the hydrologic cycle, they also provide benefits including floodwater retention, water quality protection, erosion control, fish and wildlife habitat, recreational and aesthetic opportunities, and stages for education

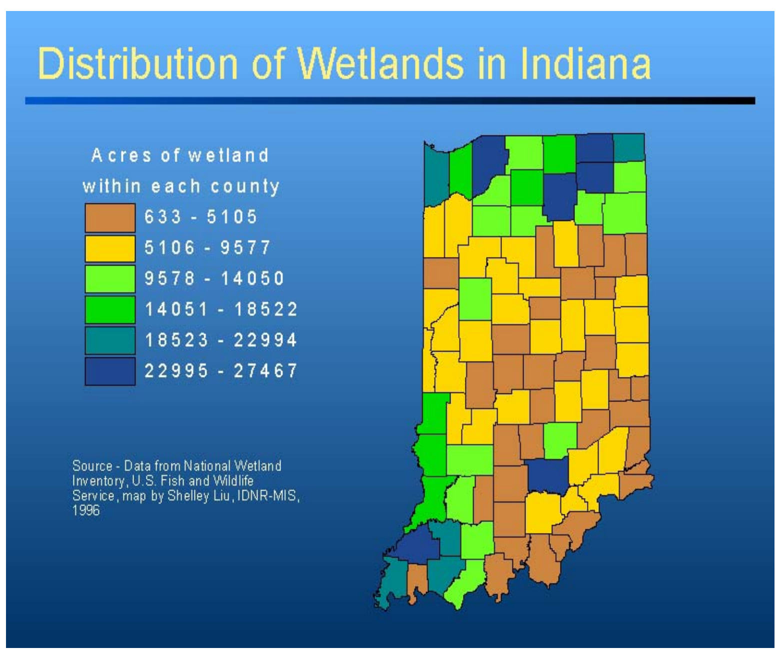


Figure 48. Distribution of Wetlands in Indiana. Courtesy of IDEM)

and research. (Water Resource Availability in the Maumee River Basin, Indiana. Indiana DNR, 1996)

Nationally, 50% of the wetlands in the lower 48 states have been converted for other uses. Indiana has also converted a large number of its wetlands. Before Indiana began converting its wetlands, there were over 5.6 million acres of wetlands in the state. In the 1700s, wetlands covered 25% of the total area of Indiana. By the late 1980s, over 4.7 million acres of wetlands had been lost - wetlands now cover less than 4% of Indiana. This means that more than 85% of the state's original wetlands have been drained or filled. (http://www.in.gov/idem/soe2003/water/wetlands.html) Much of Indiana's remaining wetland is here in the northeastern part of the state (see Figure 48) and is located on privately-owned property. This area is under increasing pressure for development.

The vast majority of Indiana's wetland loss as been to agricultural production. Figure 48 shows that Allen and DeKalb counties have a distribution range of between 9,578 and 14,050 acres of wetlands, while Noble county has in the range of 22,995 - 27,467 acres of wetlands.

Wetland preservation is complicated by lack of planning on a watershed scale. The lack of value placed on ecological commodities, i.e. lack of recognition of the social and environmental value of wetlands to the community's infrastructure (water supply and quality, flood control, habitat, etc.) also hinders preservation efforts for wetlands. If little or no economic value is placed on a wetland as an agent of the community's infrastructure, its true economic value may be eclipsed by the value placed on the land for agricultural production or commercial/residential development.

Given the Cedar Creek stakeholders' concern with loss of agricultural land, re-establishing wetlands on cropped lands may not be a popular activity. Agricultural land which is being sold for mini-farms and estates in the area are more sometimes redeveloped with ponds and wetlands. In these cases, loss of cropland may coincide with an increase of wetlands.

Part 6. Critical Areas of Concern, Pollution Loads and Reduction Targets in the Cedar Creek

The stakeholders within the Cedar Creek watershed are concerned because the Creek and many of its tributaries do not meet the water quality standards required by the Clean Water Act. Concern is especially high about pathogens and bacteria that may cause illness in those persons who are in full-body contact with the waters of the creek, ponds and lakes within the watershed. Issues revolving around the watershed's drainage system, including pollution from runoff and erosion, degradation of aquatic and riparian wildlife habitat, and community relations among stakeholders and local government over maintenance of environmentally sensitive waters and habitat are also of significant concern. The community is equally apprehensive about quality of life issues that include urban sprawl, loss of farmland and the rural character of the area.

A significant percentage of the residents and stakeholders in the Cedar Creek Watershed do not know the physical boundaries of the watershed or its relationship to the St. Joseph River and the Lake Erie Basin. Further, they do not understand how their actions affect the quality of water in the watershed, and the negative economic impact of polluted water on their watershed and City of Fort Wayne.

Critical areas of concern have been determined through analysis of data gathered for this and other projects in the watershed. The output of a SWAT model, prepared for this watershed plan by IDEM and Initiative staff, includes pollution loads, critical areas and targets for nutrients and sediment. The model has limitations. See Section 6.0 (*Results*) in Attachment A, *Water Quality Modeling Analysis for the Cedar Creek Watershed*. (N. Rice, August 2005, page 12). Calculated mean load values are presented below:

Pollutant	Calculated Mean Load Value
Sediment	**72,631 tons/yr***
Nitrogen (N)	**833,883 lbs/mo**
Phosphorus (P)	**259,879 lbs/yr**

* derived from measured turbidity data taken April through September

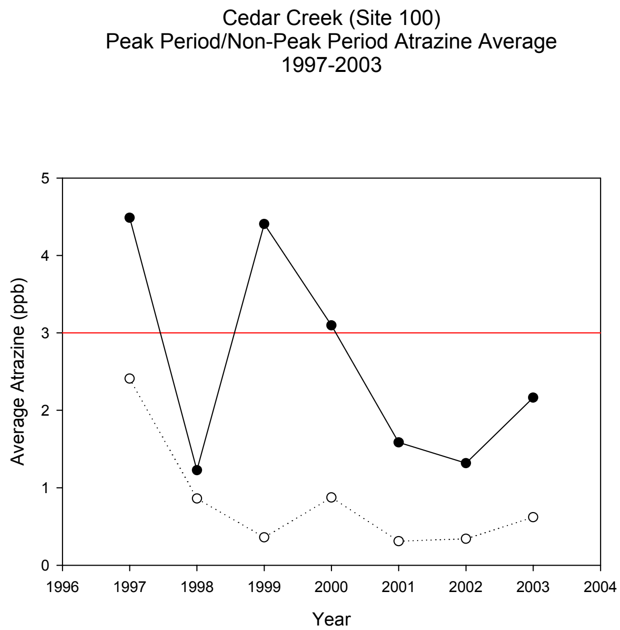


Figure 49 SJRWI sampling indicates higher average levels of Atrazine at Site 100 during spring application season (April-June).

Water quality data collected by the Initiative indicate that levels of pesticides in raw water of the Cedar Creek, including water-soluble Atrazine, are much higher during the spring. This is attributable to the combination of spring rainfall and activities of tillage and pesticide application to fields and urban lawns and gardens. Calculating average pesticide loads on an annual basis generally results in numbers below the drinking water standard of 3 ppb. However, an examination of data by date, using April-June as the peak application season, shows that average pesticide levels sometimes exceeded the 3 pbb standard for Atrazine in finished drinking water, but fall well below the standard during the non-peak season. It should be noted that for raw water, the chronic aquatic life criteria standard is 12 ppb. The Initiative's sampling program has rarely detected Atrazine at or near that level in the Cedar Creek watershed. However, ARS research has recorded runoff during rain events with Atrazine levels above 12 ppb in the Matson sub-watershed. (See Figure 45.)

Average loading of Atrazine during peak and non-peak months at Site 100 (Cedar Creek at Tonkel Road in Allen County) is shown in Table 12. Peak season includes all samples taken between April 1 and June 30.

Year	Avg. Daily Load (kg)	Avg. Daily Load during Peak Season (kg)
1996	1.167388764	2.187930569
1997	3.41209059	6.039677556
1998	0.212384777	0.309720895
1999	2.22172302	4.068865914
2000	1.296169131	1.626734197
2001	0.301477804	0.502385939
2002	0.592187494	1.037176771
2003	1.833604165	3.044334175

Data source: Weekly water sampling by the St. Joseph River Watershed Initiative

Table 12 Average daily loading of Atrazine at Site 100 comparing the full season with peak application months

E. coli

Current E. coli loads for locations in the Cedar Creek Watershed, which have been historically sampled in the St. Joseph River Watershed Initiative's weekly grab sampling monitoring, are included in *Appendix G* at the end of this document. The flow of various sampling locations were calculated by determining the land area drained upstream of each site as a percentage of the total area drained by the Cedar Creek at Site 100 at Tonkel Road (see table below) where a USGS station measures flow for the Cedar Creek. Site 100 is the most downstream location of the Initiative's sampling sites. These flow data were also used to calibrate our model, and load duration curves were created based on the same data. Modeling suggests that violations to the State WQS are highest at most locations during high flow events, suggesting impairment is related to rainfall event loading. Based on flow duration curves, Site 137 (Peckhart Ditch @ SR 8) was the only sampling site which indicated frequent exceedences of the WQS during dry conditions and low flow. Several sites have exceedences of the standard during all flow conditions. Clearly, the most effective restoration efforts for bacteria violations will be focused on wet-weather driven loading.

The Initiative's monitoring program has identified levels of E. coli that are consistently above the EPA's 235 colonies/100 ml. minimum for full-body contact standard throughout the Cedar Creek sub-watershed, particularly at Dibbling, Matson, Walter Smith, David Link (formerly Swartz), Garrett City and Diehl Ditches in the Upper Cedar Creek watershed. See Figure 51 in Appendix E for maps and charts of these areas. The 2003 303(d) list includes Cedar, Willow and Little Cedar Creeks and Garrett City, Diehl and Swartz ditches as impaired for E. coli. Willow and Little Cedar have limited data available through the Initiative's grab sampling program prior to 2004.

Cedar Creek (#100)			
Sampling Day	Disharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
4/8/2003	902	6.84112E+14	684111536380800
4/15/2003	231	3.61702E+14	361701772185600
4/22/2003	135	0	0
4/29/2003	84	2.05512E+13	20551237056000
5/6/2003	1500	3.66986E+14	366986376000000
5/13/2003	1490	1.56388E+16	15638757426864000
5/20/2003	318	3.26765E+14	326764669190400
5/27/2003	120	5.87178E+13	58717820160000
6/3/2003	99	2.42211E+13	24221100816000
6/10/2003	64	4.85401E+13	48540064665600
6/17/2003	164	0	0
6/24/2003	61	4.62647E+13	46264749134400
7/1/2003	32	7.82904E+12	7829042688000
7/8/2003	441	0	0
7/15/2003	81	8.97722E+14	897722072971200
7/22/2003	572	1.39944E+14	139944138048000
7/29/2003	626	1.35543E+16	13554274811184000
8/5/2003	884	1.14843E+16	11484324855993600
8/12/2003	124	6.27987E+14	627987086611200
8/19/2003	51	1.24775E+13	12477536784000
8/26/2003	51	3.86804E+13	38680364030400
9/2/2003	2620	3.39732E+15	3397315211424000
9/9/2003	219	6.34387E+15	6343873290086400
9/16/2003	78	8.01498E+13	80149824518400

9/23/2003	272	2.79497E+14	279496823961600
9/30/2003	438	1.01266E+16	10126622059344000

Table 13 E. coli loading at Site 100, Cedar Creek at the Tonkel Road bridge.

Annual discharge flow averages 269 ft^3/s under baseline conditions. Greatest stream flow is during February; lowest during July. The greatest potential for nutrient loading is January through May when crops are not in the fields to uptake the nutrients. The highest sediment loading occurs during May, coinciding with increased rainfall and spring planting. Based on digital elevation models (DEM) the areas of the watershed with the highest potential for soil loss are in the Upper Cedar watershed which are areas of greatest elevation changes in topography combined with the greatest agricultural land use. Pesticide loading is generally highest during the planting and growing season, April through June. Further information about specific locations can be found in Attachment A, *Water Quality Modeling Analysis for the Cedar Creek Watershed*. Figure 8 focuses on nutrients; figures 9-11 focus on E. coli.

Critical areas of concern and their associated water quality problems include those listed on the following tables in this chapter.

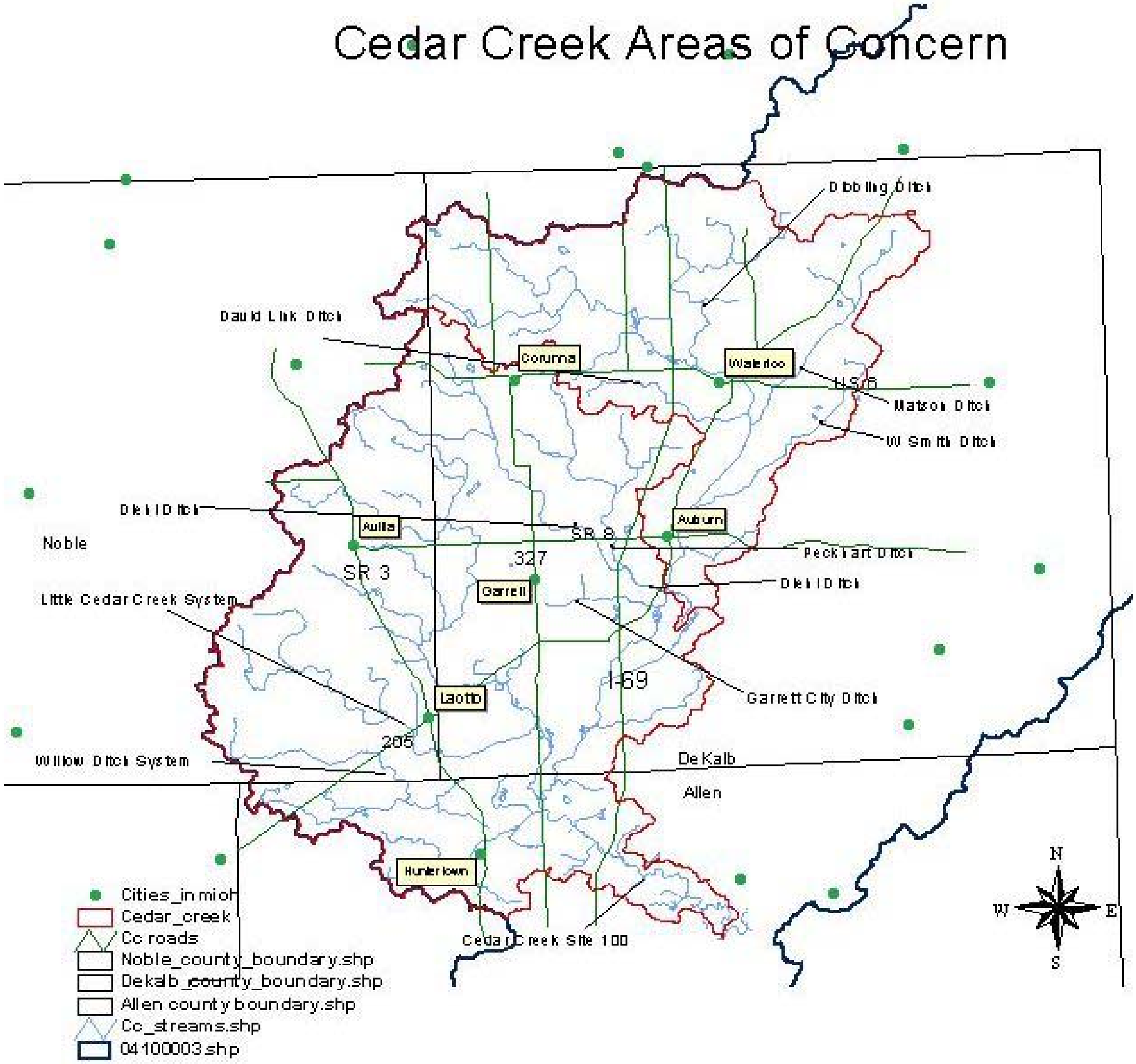


Figure 50 Locations of concern in the CC watershed on the map (above) are further explained in the tables that follow.

6.1 Bacteria and Pathogens

Critical Area of Concern	Reason for Concern	Associated Water Quality/Environmental Problem
Northern Allen County: Cedar Creek and tributaries	**Failing on-site septic systems (OSS); soils not well suited for OSS; limited additional sewer capacity from Fort Wayne; high pressure from development; limited streamside buffers.**	**Bacteria and nutrient pollution entering streams via runoff.**
Southern DeKalb County: Cedar Creek and tributaries	**Failing on-site septic systems (OSS); soils not well suited for OSS; limited access and/or requirement to connect to city sewer systems; high pressure for rural residential development; limited streamside buffers.**	**Bacteria and nutrient pollution entering streams via runoff and OSS failure. Increasing area of turf grass, impervious surfaces and roadways is increasing runoff.**
David Link (Swartz) Ditch	**On 2002 303(d) list for E. coli; minimal buffers on the ditch; increased residential development pressure south of Waterloo along SR 427 corridor; increasing areas of turf grass replacing crop lands and/or filter strips.**	**Bacteria and nutrient pollution entering stream from the following possible sources: OSS, wildlife, domesticated animals and livestock.**
Eastern Noble and Western DeKalb counties: Little Cedar and Willow Creeks	**Minimal buffers on Little Cedar and tributaries; Willow Creek and tributaries; both creeks 303(d)-listed for 2004 for E. coli (both) and impaired biotic communities (Little Cedar).**	**Bacteria and nutrient pollution from the following possible sources: OSS and wildlife, domesticated animals**
Auburn-Waterloo Corridor	**High pressure for residential development; limited stream buffers; need increase in public participation for CSO/sewer issues**	**Bacteria and nutrient pollution from the following possible sources: CSOs, OSS and wildlife, domesticated animals**
Garrett: Garrett City Ditch	**Increased pressure for development; limited streamside buffers; need for continued monitoring to validate improvements in WWTP**	**Runoff containing bacteria pollution from the following possible sources: geese and wildlife; release of untreated wastewater**
Matson Ditch	**Limited streamside buffers; intensive tile drainage in agricultural fields can transport pollutants directly to ditch/stream**	**Runoff containing bacteria pollution from the following possible sources: geese, wildlife; OSS; livestock and farm animals**

Auburn: Cedar Creek, Walter Smith Ditch, Metcalf Ditch	**Storm water runoff, impervious surfaces with very limited buffers; lack of public knowledge about the stream and its importance**	**Bacteria and nutrient pollution from the following possible sources: CSOs and wildlife, domestic animals, OSS; lack of education re. storm water and CSO issues**
Dibbling Ditch	**Limited streamside buffers; livestock access to stream**	**Runoff containing bacteria and nutrient pollution from livestock, OSS.**
Diehl Ditch	**Limited streamside buffers; tile drainage allows direct access to stream for pollutants**	**Runoff containing bacteria pollution from OSS, domestic pets, livestock, wildlife**
Peckhart Ditch	**Dry weather loading violates WQS**	**Unknown source(s); investigation needed**
Cedar Creek, main stem and tributaries	**Lack of or inadequate manure management planning, storage, and runoff filtration**	**Runoff containing bacteria enter waterways from field application of manure, improper/inadequate storage of manure; barnyard/milkhouse runoff; application of manure onto frozen or saturated soils**

6.2 Pesticides and Fertilizers

Critical Area of Concern	Reason for Concern	Associated Water Quality/Environmental Problem
Cedar Creek, main stem and tributaries	**Limited streamside buffers; subsurface drainage systems; application of chemicals near streams and over sinkholes and tile risers**	**Agricultural chemicals entering surface waters; also risk of contaminating wetlands and ground water**
Cedar Creek, main stem and tributaries	**Conventional tillage for corn production averages approximately 40% in the three counties**	**Increased runoff of Atrazine-contaminated water into streams, ditches, wetlands and lakes, especially in spring time during application and heavy precipitation**
Cedar Creek, main stem and tributaries	**Drainage ditch maintenance programs use pesticides to control vegetation, including woody vegetation**	**Pesticide use adjacent to streams and ditches is high-risk for water contamination through runoff and vapor distribution**

Golf Courses, recreation areas along streams in the watershed	**Extensive areas of turf; use of pesticides and fertilizers**	**Potential risk for contamination is high**
Agricultural producers and suppliers	**Storage, maintenance and cleaning of pesticide equipment**	**Potential risk for spikes in pesticide contamination from spills and from pesticide equipment rinse-off water entering streams**
Cedar Creek watershed urban areas, rural residential areas	**Improper use of lawn chemicals; application during or immediately preceding wet weather events; lack of buffer strips along stream banks in many urban areas; lack of education among urban/suburban homeowners about pesticide storage and use.**	**Contaminated runoff from lawn and garden application of pesticides**
Cedar Creek watershed urban areas, rural residential areas	**Lack of education about pesticide and fertilizer use; improper application and use of household pesticides; improper disposal of pesticide containers**	**Contaminated runoff from household application of pesticides, including aerial deposition**
Cedar Creek, main stem and tributaries, livestock and dairy operations	**Lack of or inadequate manure management planning, storage, and runoff filtration**	**Runoff containing bacteria enter waterways from field application of manure, improper/inadequate storage of manure; barnyard/milkhouse runoff; application of manure onto frozen or saturated soils**

6.3 Sediment and Erosion

Critical Area of Concern	Reason for Concern	Associated Water Quality/Environmental Problem
Cedar Creek and tributaries: northern Allen County	**Rapid residential and commercial growth and development of this area; increasing acres of turf grass and non-native landscaping**	**Rapid runoff of storm water; sediment and pollutants entering streams from construction sites and residential landscapes**
Cedar Creek, main stem and tributaries	**Conventional tillage averages > 36% for corn and >8 % for soybeans in the four counties**	**Excessive tillage contributes to soil loss via water and wind erosion; lack of plant residue reduces percolation of precipitation into the soil**

Cedar Creek, main stem and tributaries	**Many of the watershed's streams do not have adequate riparian and/or vegetative buffer zones between intensive agriculture and waterways**	**Rapid runoff; lack of buffers and filter strips increases the potential for sediment to reach the waterways.**
Auburn – Garrett - Waterloo triangle; Cedar Creek and Tributaries	**Rapid development; identified by DeKalb Comprehensive Plan's Future Land Use Map as residential/industrial**	**Rapid runoff; lack of buffers and filter strips increases the potential for sediment to reach the waterways; extensive areas of turf grass, construction activity and urban landscapes increase runoff potential**
Dosch Ditch – Schmadel Ditch Tributaries to Cedar Creek, south of Auburn	**Development of airport and aviation complex area; loss of existing woodlands**	**Sediment and associated runoff, thermal pollution impairs aquatic communities**
Upper Dibbling, Hoffelder Ditch Area	**Limited buffers around streams**	**Rapid runoff and sediment loading from agricultural fields**
Cedar Creek west of Waterloo: **I-69 US 6 interchange area**	**Gravel mining, limited buffer areas, high traffic, transportation and industry**	**Rapid runoff from impervious surfaces; interchange between gravel mines and creek; sediment runoff from roads and highways, construction sites; lack of buffer strips along streams**
Noble and Allen Counties: Willow Creek	**Minimal buffer strips along stream**	**Rapid runoff and sediment loading from impervious surfaces and agricultural fields**
McCullough and Leins Ditch areas	**Limited buffer strips along streams**	**Rapid runoff and sediment loading from agricultural fields**
Little Cedar Creek: Noble and DeKalb counties	**Minimal buffers along streams; intensive agriculture**	**Rapid runoff and sediment loading from agricultural fields, highways and roadways**

6.4 Loss of Agricultural and Forested Lands

Critical Area of Concern	Reason for concern	Associated Water Quality/Environmental Problem
Northern Allen County/ southern DeKalb County	**Rapid development & growth**	**Increased impervious surfaces and storm water runoff; increasing risk for bacteria, pesticide, and thermal pollution of tributaries; loss of wildlife habitat and agricultural production; loss of carbon sequestration capability**
Entire watershed	**Subdivision of farms; increases in rural residential development**	**Increased impervious surfaces; increased storm runoff and decreased percolation; increased traffic adds toxics to storm water runoff from roads and bridges**
Entire watershed	**Increases in rural residential development**	**New residents' lack of knowledge about drainage, OSS, impervious surfaces, landscaping with turf grasses, and associated water quality issues**
Entire watershed	**Loss of contiguous forested lands, riparian buffers along streams**	**Impacts wildlife diversity and habitat along stream; impacts aquatic diversity and habitat; increases thermal pollution in receiving waters**

6.5 Log jams and Stream Obstructions

Critical Area of Concern	Reason for concern	Associated Water Quality/ Use Problem
Cedar Creek, main stem, Cook's Landing to Rt. 1	**Log jams / stream obstructions**	**Recreational boating, canoeing limited; extensive portages over private lands**
Entire watershed area	**Extensive log jams in various locations**	**Erosion of adjacent agricultural and residential land**
Entire watershed area	**Policy, process and funding to remove small log jams**	**Log jams grow to extensive size and cause major problems with erosion and flooding.**
Entire watershed area	**Use of heavy equipment used to remove large log jams**	**Destruction of trees and wildlife, aquatic habitat**

Entire watershed area	**Lack of public knowledge about, and process for involvement in, decision-making regarding drainage issues**	**Lack of cooperation within the region for the management of waterways, resulting in distrust, disagreement, litigation, and delays in logjam removal and drain maintenance**

6.6 Loss of Wetlands

Critical Area of Concern	Reason for concern	Associated Water Quality Problem
Huntertown area: Willow Creek and Tributaries	**Rapid urbanization & development**	**Loss of wetlands and sinkholes in aquifer recharge area**
Drainage ditches and streams: Entire Cedar Creek watershed area	**Agricultural development**	**Loss of wetlands and swamps to agricultural production**
	Straightening, deepening of ditches; loss of adjacent upland wetland areas to development and agriculture	**Loss of functionality of wetlands and loss of overflow areas; loss of amphibian habitat.**
	Pesticide application to ditch banks and adjacent agricultural fields	**Destruction of wetland aquatic habitat and wetland species**

6.7 Lack of education about the Cedar Creek Watershed among stakeholders

Critical Area of Concern	Reason for concern	Associated Water Quality Problem
Elementary and secondary school students	**Lack of understanding of the boundaries of the watershed in which they live and the water cycle within their watershed; lack of understanding of the far-reaching impact of clean water on their everyday lives**	**Lack of concern for the watershed and water quality, lack of future supporters of water quality and watershed protection**
General public and stakeholders including land developers, farmers, real estate agencies, landowners, homeowners (urban and rural), commercial and industrial corporations, lake and neighborhood associations, wildlife and environmental organizations	**Lack of understanding and/or concern about the effects of human activities on water quality, flooding, recreational activities, wildlife, and regional economics; lack of true cost-benefit analysis for many activities in the watershed.**	**Prevalence of short-term planning that discounts or ignores the impacts of water quality on the region; reluctant support for initiatives aimed at protecting the watershed**

General public and stakeholders, local, state and federal agencies and government	**Lack of public input and participation in watershed protection and water quality regulation**	**After-the-fact public disagreement and concern about regulations enacted to protect water quality**

Part 7. Goals and Indicators for Cedar Creek Watershed Management and Improvement

This chapter links goals and locations to the critical issues identified in Chapter 6, along with targets and time frames for achieving the goals.

Conservation tillage

Conservation tillage is effective in reducing the amount of sediment in the water. Stubble from previous crops helps to slow the water from rain or snowmelt, allowing it to percolate into the soil, and preventing loss of particles and any attached nutrients in suspension in that water. Many pesticides, including Atrazine, are water soluble and move with the water. Conventional tillage, which disturbs the soil, allows soil particles, to move out of the fields with water runoff and wind erosion. It also removes the stubble of previous crops, which allows water to run off without impediment. Conservation tillage also decreases soil compaction, improves soil tilth, and increases organic matter in the soil.

Conservation tillage in soybean production has been more highly adopted than conservation tillage for corn in the counties that comprise the Cedar Creek Watershed. However, improvement in technology and expertise has generally increased the use of conservation tillage in the Cedar Creek watershed. The following data for 2004 are provided by the Conservation Technology Information Center (CTIC).

Conservation Tillage for Corn

County	Rank in State	% No-Till	% Mulch Till	% Reduced Till	% Conventional Tillage
Noble	**28**	**29**	**27**	**23**	**20**
DeKalb	**31**	**28**	**5**	**12**	**56**
Allen	**46**	**24**	**14**	**16**	**46**

Table 14 Conservation tillage for corn in Noble, DeKalb and Allen counties, 2004. Courtesy CTIC

Conservation Tillage for Soybeans

County	Rank in State	% No-Till	% Mulch Till	% Reduced Till	% Conventional Tillage
DeKalb	**10**	**82**	**3**	**3**	**11**
Noble	**28**	**16**	**7**	**6**	**28**
Allen	**50**	**63**	**21**	**3**	**13**

Table 15 Conservation tillage for soybeans in Noble, DeKalb and Allen counties, 2004. Courtesy CTIC

Buffers and filter strips
Conservation buffers improve water quality. The vegetation slows runoff water, allowing sediment, nutrients and pesticides to settle out in the buffer instead of rushing quickly into streams, carrying the pollutants into the waterways. The combination of plant types, such as variation in grasses and inclusion of trees (riparian buffers) affect the removal rate of pollutants. Vegetation in buffers is also a source of food and cover for wildlife. However both habitat for wildlife and water filtering effects are enhanced in wider buffers as opposed to more narrow strips. Generally, the wider the plant diversity in the buffer, the wider the wildlife diversity.

Best management practices (BMP) for shorelines and stream banks include observing appropriate setbacks for homes and leaving adequate vegetative cover to anchor stream banks during storm events.

Removal or repair of failing OSS; removal of CSO and SSO from urban areas
Human sewage should never be present in the streams of this watershed. Therefore, our goal is the removal of all failing on-site septic systems, combined sewer overflows and sanitary sewer overflows from the watershed.

Animal waste management
Bacteria and nutrients from livestock and domesticated animals should not be present in the waterways; therefore to the extent possible, livestock should be fenced from streams and runoff from barnyards, fields and confinement spaces should be suitably filtered or treated before it enters the stream. Manure application should be limited to the amount soils can absorb, and should be incorporated into soils to deter surface runoff. Domestic pet waste should likewise be treated or filtered before it enters the stream. Buffers along all streams, and landscaping practices that deter nuisance geese and waterfowl will help to reduce the bacteria input from these sources.

Education
All changes in the management of this watershed must coincide with education of and input from stakeholders in order to promote the most efficient and cost-efficient, sustainable conservtion practices.

The following chart outlines goals for the Cedar Creek, the specific locations at which the goal is targeted.

Problem	Goal	Location	Indicator	Target	Timeframe
1. The Cedar Creek and many of its tributaries do not meet the State recreational water E. coli daily standard of 235 cfu/100 ml. water	**1. The Cedar Creek and its main tributaries shall show consistent and significant water quality improvement with the goal of meeting the E. coli standard for recreational waters set by the State of Indiana by 2015.**	**All 14-digit HUC subwatersheds in the CCW**	**Water quality monitoring**	**E. coli: 235 colonies/100 ml water during the recreational season as measured at SJRWI sampling locations on the Cedar Creek and its tributaries**	**10 years**
2. Pesticides and nutrients in runoff water threaten the surface and ground water quality in the Cedar Creek Watershed	**2. Pesticides in the raw water of the Cedar Creek and its tributaries will be reduced by 30% based upon weekly monitoring during the peak application season (April-June). Nutrient levels in the raw water will be reduced by 50% based on annual sampling averages.**	**All 14-digit HUC subwatersheds in the CCW**	**Water quality monitoring during peak season and during recreational season; Filtration plant monitoring year-round.l**	**No exceedences of the chronic aquatic (12 ppb) standard for Atrazine in raw water at Site 100 and the main tributaries; no exceedence of DW standard (3 ppb) in finished drinking water for Fort Wayne or local domestic groundwater sources .**	**10 years**
3. Erosion and sediment loading threaten drainage, water quality and aquatic habitat in the Cedar Creek Watershed	**3. Sediment loading from the Cedar Creek watershed shall be reduced by 50%**	**Sample Cedar Creek at Tonkel Road (Site 100) for total loading; minimum one upstream tributary location in each 14-digit HUC (for macroinvertebrate population measurements)**	**Per weekly water quality monitoring of turbidity and TSS during the recreational season (at Site 100); also benthic macroinvertebrate and aquatic habitat evaluation**	**Average annual turbidity and TSS measurements at the Cedar Creek Site 100 shall be reduced by one-half. Benthic macroinvertebrate population and aquatic vertebrate population measurements shall reflect at least no degradation , at best, improved water quality conditions in all tributaries**	**10 years**

Problem	Goal	Location	Indicator	Target	Timeframe
4. Urban Sprawl and unfettered development contribute to loss of prime agricultural and forested land, increasing impervious surface area and disrupting contiguous wildlife corridors	**4. The stakeholders of the Cedar Creek watershed shall support growth and development that balances economic interests with protection of the economic and environmental resources of the Cedar Creek watershed**	**All land within the Cedar Creek watershed, as well as watershed boundary areas**	**Measure changes via GIS and aerial photographs**	**25% increase in contiguous vegetative and riparian buffer areas with no net loss of forested lands; preservation of at least 80% of the existing prime farmland that is supportive of a solid economic and social base for the agricultural community in the watershed**	**20 years**
5. Log jams and stream obstructions negatively affect drainage, flooding, and recreational use, and disagreement over process has negatively affected the community	**5. The stakeholders of the Cedar Creek watershed shall encourage management of stream obstructions in a balanced, proactive program that protects habitat, reduces flooding and fosters communication among stakeholders**	**All waterways within the Cedar Creek watershed**	**Measure major citizen-drainage board conflicts**	**Creation of a proactive, community-backed management plan for control and removal of log jams and other stream obstructions**	**10 years**
6. Loss and filling of wetlands negatively affects water quality decreases aquifer recharge, and reduces important wildlife habitat	**6. High-quality wetlands in the Cedar Creek watershed shall be protected and their total acreage increased in order to protect aquifer recharge zones, provide habitat and nursery area for wildlife and aquatic wildlife, as well as to provide flood storage and improvement of water quality**	**Huntertown Aquifer, Cedar Canyons, and areas of hydric soils; land adjacent to streams**	**Change in number of wetland acres**	**10% increase in wetland acres; measurement and mapping of water quality and biological communities in existing wetlands; protection and improvement of existing wetlands and aquifer recharge areas**	**20 years**

7. Stakeholders' lack of knowledge about the Cedar Creek watershed and its relationship to the Great Lakes Basin contributes to lack of concern, low levels of public input and lack of participation in water quality protection and improvement efforts.	**7. Change the behavior of all Cedar Creek stakeholders so as improve water quality by increasing their knowledge about the Cedar Creek watershed and its significance to the Lake Erie Basin.**	**The Cedar Creek watershed as well as adjoining watersheds, including the City of Fort Wayne, which is dependent upon the Cedar Creek**	**Pre and post survey of behaviors relating to water quality issues; rate of adoption of BMPs relating to conservation tillage, fertilizer and pesticide use, pet clean-up, urban stormwater management, etc.**	**Stakeholders of the watershed show a 50% improvement in knowledge of the physical history, boundaries, ecology, and economic and environmental significance of the Cedar Creek watershed to their water supply and the Great Lakes Basin.**	**10 years**

Part 8. Application of Measures to Achieve Goals in the Cedar Creek Watershed

This chapter outlines the measures which have been identified by the Cedar Creek WMP working group to apply to the watershed in order to meet the goals outlined in Chapter 7.

Load reduction estimates have been calculated based upon information gained from the SWAT model and the Bacterial Indicator Tool, as well as trend analysis of SJRWI water sampling data combined with general knowledge of the programs and practices occurring in the watershed. Because many of the BMPs listed in "tasks" in the following table will affect more than one indicator of water quality, it is impossible to calculate the cumulative effect of the various practices across the watershed. Therefore, in many cases, load reductions are simply "best guess" targets. Reevaluation of data and conditions after a five-year BMP implementation program will give us a better grasp of the load reduction capabilities of the various practices in this watershed.

Other conservation program activities in the watershed have had or will have an impact on the state of the environment in the watershed, as well as the information available to watershed planners. These activities include research activities and placement of BMPs through existing programs.

Great Lakes Commission grants: Farmer-to-farmer outreach
In 2002-03, the St. Joseph River Watershed Initiative completed a grant project entitled the *Farmer-to-Farmer* that focused on reducing erosion and sediment in the St. Joseph River watershed. The grant supported the inclusion of over 1,000 acres of land into riparian borders, buffer strips and grassed waterways in Williams County, Ohio and Hillsdale County, Michigan, with the goal of reducing sediment loads in the river. A follow-up grant, the St. Joseph River Sediment Reduction Project, aimed at broadening the scope of the Farmer-to-Farmer project, was secured for an 18-month period beginning July 1, 2004. This grant also aims at reduction of erosion and sediments through BMPs, and targets specific sub-watersheds in the Cedar Creek watershed during the first nine months of the grant project.

Section 319 grants for conservation tillage
A Section 319 grant from the Indiana Department of Environmental Management to the St. Joseph River Watershed Initiative makes rental of conservation tillage equipment and access to expert help available in the St. Joseph watershed. The grant also offers cost-sharing dollars to farmers for implementation of long-term conservation tillage for corn. The program's aim is to increase the acreage under some type of conservation tillage, and to offer support services and expertise to farmers wishing to move from traditional tillage methods to conservation tillage. The grant program has helped to sponsor the annual Tri-State Conservation Tillage Expo in Auburn each spring since 2001.

Hoosier Riverwatch volunteer stream monitoring
The St. Joseph River Watershed Initiative sponsored Hoosier Riverwatch trainings in July, 2004, in Auburn, and July, 2005 in Hamilton, with the specific goal of attracting volunteer stream monitors to the Cedar Creek and its waterways. In 2003, DeKalb County SWCD sponsored a training session, held in St. Joe, Indiana along the main stem of the St Joseph River. New

chemical testing kits were adopted by Hoosier Riverwatch for the 2004 season and subsequent trainings covered the new kit methods. Both the DeKalb SWCD and the Allen SWCD/SJRWI offices have volunteer monitoring equipment kits available to loan to trained volunteer monitors. Regular water quality monitoring, including macroinvertebrate surveying, of the 14-digit HUCs within Cedar Creek by volunteer monitors has not yet been implemented, but are in the planning stages.

Stream Information Records (SIRS)

Cedar Creek steering committee members and stakeholders were asked to visually report land use and other information about any section of the Cedar Creek or its tributaries with which they are familiar or have regular contact. A sample of the SIR form can be found in *Appendix D* of this document. Some members of the task group completed these surveys but the effort was not an overwhelming success and the documents are not in general use. The stream characterization in the Hoosier Riverwatch survey will also provide this information and may be employed in place of the SIRS.

St. Joseph River Watershed CEAP

The Conservation Effects Assessment Program (CEAP) evaluation mandated by Congress and directed by USDA's NRCS, focuses on programs supported by the 2002 Farm Bill. The St. Joseph River watershed is one of 12 watersheds nationally in the study. Focus in the St. Joseph watershed is primarily on the Source Water Protection Initiative project in the Cedar Creek watershed, and is being conducted by the Agricultural Research Service (ARS). This effort is expected to create an extensive amount of research and data.

St. Joseph River Watershed CSP

The Conservation Security Program (CSP) was begun by NRCS in the St. Joseph River watershed in 2004 and reopened in 2005. The CSP rewards existing conservation BMPs and encourages increased conservation through a tiered system of payouts: landowners in Tier 1 can advance to Tier 2 or 3 and higher payments by increasing the BMPs on their land. We expect private and public conservation initiatives to positively impact the overall level of adoption of conservation BMPs in the Cedar Creek watershed based on the CSP program. BMPs include but are not limited to manure management plans, conservation tillage, woodlot management, filter strips, grassed waterways, windbreaks and wetlands.

Goal	Objective	Task (linked to objectives)	Start/end dates and groups involved (besides CCW group)	Progress Indicators	Product	Cost Estimate	Estimated Load Reduction
1. The Cedar Creek and its main tributaries shall show consistent and significant water quality improvement with the goal of meeting the E. coli standards for recreational waters set by the State of Indiana by 2015.	**A. Decrease the total number of OSS that are contributing bacterial pollution to the CCW through OSS replacement, improvement or installation of alternative systems, or connection to WWTP.**	**Hire consultant or technician to work with stakeholders to implement cost-share program and demonstration projects, publicity and public relations**	**2005-2016** **Landowners, Allen, Noble and DeKalb Co. Health Depts. and SWCD's, Allen Co. Sewer Task Force, local WWTP, local governments in the watershed, SJRWI**	**Minimum 25 failing septic systems will be replaced during the first 3 years; 5-7 alternative systems will be demonstrated to the public; public education and outreach re. OSS issues will reach 1000 residences in critical areas**	**Develop and implement a cost-share program for replacement of failing septic systems and demonstration of new or alternative systems within the CCW;** **Educational/outreach brochure for homeowners re. maintenance of OSS to encourage proper functionality of OSS**	**$600,000**	**Reduction of total watershed E. coli by ½ of 1%.** **(Current loading from OSS is 6.52 x 10^{10} cfu/da.)**
	B. Decrease the acreage of goose-friendly habitat, especially adjacent to waterways, in order to decrease the number of geese and fecal contamination from nuisance waterfowl	**Hire consultant or technician to work with involved groups; identify interested landowners to set up alternative landscaping sites; monitor water and** **contract for BST analysis as required**	**2005-2010** **NRCS, Purdue CES, Co. Health Depts. and SWCD's, Allen, Noble and DeKalb, environmental organizations, landscape service companies, SJRWI**	**Establish minimum 5 demonstration sites; Collect water quality monitoring data from sites as necessary; conduct BST analysis at demonstration sites as necessary; Track reduction of density of geese from current estimated 22.5/mi^s**	**Educational Brochures;** **Demonstration sites established;** **Published WQ data and BST analysis of focus stream segments;** **Data and publicity on success of various techniques and reductions**	**$50,000 - $100,000**	**10% reduction in geese population and of current estimated E. coli load from geese (0.68 x 10^9 cfu/da)**

C. Discourage development in areas where central sewage is unavailable, and where soils are incompatible with properly functioning OSS; work with local gov't to encourage policies of hook up to local central sewage systems where available	**Hire consultant to work with local government to develop land use management plans and zoning regulations based on topography, soils, and infrastructure availability**	**2005 – 2016** **Watershed groups, local government, county health departments, city/county planners, developers, county surveyors**	**Counties will have or be working on comprehensive planning & policies;** **Developers and local government, watershed group will have open dialog about effect of development on WQ;** **Outreach education program on local soils, OSS issues**	**Informational/educational brochures;** **Outreach education meetings and/or program for each county or local arena;**	**$50,000**	**No increase in loading of E. coli from septic systems**

D. Continue the use of Bacteria Source Tracking (BST) analysis as appropriate, in order to identify the sources of bacteria in the CCW; continue to sample the river system and maintain and update the SJRWI water quality database	**Contact w/ IPFW to continue to refine the BST database for Northeastern Indiana and perform analysis on specific stream segments;** **Hire technician to continue programs of professional and volunteer watershed sampling and WQ database/GIS mapping updates, Identify critical areas of concern and track progress.**	**2005-2010** **IPFW Biology Department, landowners, City of Fort Wayne, Allen County SWCD, St. Joseph River Watershed Initiative**	**Current overlap in pattern identification will be clarified through additional sampling of source and water samples; BST will be employed and further tested on stream segments in conjunction with land use information;** **Data collection on WQ of the Cedar Creek**	**Annual report of Water Quality;** **Report of BST analysis on specific stream segments involved in projects;** **Water quality database and GIS mapping updates**	**$300,000**	**No increase in loading; decreases based on actions resulting from this data**

E. Reduce E. coli input from livestock operations, feedlot and barnyard/milkhouse sources	**Hire technician to work with livestock producers and small farmers to quantify the numbers of various livestock in the watershed and their current practices; establish manure runoff control system BMPs to limit runoff from fields, feedlots and barnyards**	**2005-2012** **County SWCDs and CES; NRCS, IN Dept of Agriculture, IDEM, St. Joseph River Watershed Initiative, livestock producers, small (mini or part-time) farmers & livestock owners, farm organizations, veterinarians**	**Establish 3 demonstration sites to highlight runoff management techniques; Install BMPs on 10 additional sites in the watershed; Monitor WQ of runoff into nearest waterway or drain tile**	**Three manure runoff control demonstration sites and publication of associated water sampling data;** **Create and publish educational outreach effort materials;** **Publicize success of various techniques; WQ data**	**$100,000**	**10% reduction in current loads from cows (1.85 x 10^8), hogs (3.72 x 10^8), sheep (1.71 x 10^9), horses (4.61 x 10^6).**
F. Establish the extent of E.coli input from domestic animals/pets and reduce same.	**Hire technician or consultant to educate urban populations and ex-urban landowners about E. coli contamination from domestic animals; establish publicity effort in each locality for pet clean up programs**	**2005-2010** **County SWCDs, CES; SJRWI, neighborhood groups and local government; small landowners and urban households; retail pet businesses, local veterinarians.**	**"Clean up after your pet" programs established in each local town/city; survey or other compilation of data re. pet waste problems in neighborhoods and parks annually to track progress**	**Creation and distribution of new and/or existing pet-related brochures relating to contamination and clean up procedures;** **Publication of data resulting from outreach efforts and surveys;** **WQ data**	**$25,000**	**Current loading unknown; loads and reduction will be determined via this task.**

Goal	Objective	Task (linked to objectives)	Start/end dates and groups involved (other than CCW group)	Progress Indicators	Products	Cost Estimate	Estimated Load Reduction
2. Pesticide and nutrient levels in the Cedar Creek and its tributaries be reduced by 50% based upon weekly monitoring during the recreational season.	**A. Increase nutrient management efforts and reduce total nutrient application; encourage incorporation of fertilizers into soil; reduce surface application**	**Hire agricultural technician**	**2005-2012** **SWCDs, NRCS, landowners, certified crop advisors; ag seed, chemical and implement retailers; ag soil & drainage researchers; soil test labs**	**Establish outreach effort to cost share soil testing, nutrient management /nutrient reduction programs; Track acreage in management programs and track runoff WQ from fields.**	**Cost-share of 15 crop advisor management contracts annually affecting ~ 100 acres each;** **Minimum one annual local (per county) workshop and/or meeting relevant to task (A); soil testing cost-share program aimed at appropriate application of nutrients; WQ data**	**$500,000**	**P: 25.7 %** **N: 16.7% reduction from baseline annual level**

B. Increase manure management planning, field borders, and fencing of livestock from streams to control nutrient runoff	**Hire agricultural technician**	**2005-2012** **County SWCDs and CES; NRCS, IN Dept of Agriculture, IDEM, St. Joseph River Watershed Initiative, livestock producers, small (mini or part-time) farmers & livestock owners, farm organizations, veterinarians**	**10% annual increase in manure management plans in each county;** **Development of fencing cost-share support program w/ minimum of 3 contracts per county annually; increase field border width in critical areas.**	**Fencing cost-share support contracts;** **Manure management plans;** **Incentive program for field borders;** **Publications and outreach re. nutrient reduction;** **WQ data**	**$600,000**	**Overall 6% P and N reduction from baseline over 6 years**
C. Establish programs that decrease use of pesticides on agricultural fields and urban landscapes, and encourage the installation of barrier and/or filtering systems that reduce the amount of pesticides entering the stream	**Hire ag technician and urban watershed specialist**	**2006-2016** **SJRWI, CES, SWCDs, NRCS, landowners, producers/operato rs, ag chemical companies including local retailers, certified crop advisors, Purdue University**	**Acres of filter strips, buffers, grassed waterways installed; water quality data on pesticide loading in ditches and tributaries, particularly during peak application season; decrease in actual application rates of pesticides per acre.**	**Weekly water quality data; digital maps locating installed conservation practices in the watershed; aquatic habitat and animal population evaluations;**	**$600,000**	**10% reduction in pounds of pesticides applied and 30% total reduction in current (3.044334 kg at Site 100) loading of Atrazine during peak season**

D. Establish WQ monitoring for nutrients P and N and sediment year round	**Hire WQ technician**	**2005-2011** **SJRWI, City of Fort Wayne and/or independent WQ testing laboratory**	**Nutrient data for Nov-March will be collected weekly and included in SJRWI WQ database to establish annual loading levels**	**Nutrient loading WQ data for non-recreational season months for minimum 1 representative site in the Cedar Creek watershed (Site 100)**	**$9,600**	**N/A**
E. Support appropriate licensing and proper application of nutrients and pesticides	**Support/sponsor pesticide applicator training opportunities**	**2005-2011** **SWCDs, CES, certified crop advisors, private applicators, SJRWI**	**Data: Track number, locations, and participation in pesticide applicator trainings we sponsor;** **Show increase in appropriate record-keeping efforts by watershed producers regarding field inputs**	**Pesticide applicator training opportunities;** **Field input records available for BMP research**	**$25,000**	**No increase in nutrient loading**
F. Increase buffers and vegetative filters on agricultural fields and along waterways to reduce pesticide runoff	**Hire agricultural technician** **See also Goal 3-B**	**2005-2011** **SWCDs, NRCS, FSA, SJRWI, landowners, seed dealers, foresters**	**Establish incentive program; Create local outreach education and sales effort for buffers; encourage 66-ft. buffer for Atrazine products around drains and waterways**	**10% annual increase in new agricultural field / streamside buffers per county; WQ data**	**$500,000**	**10% reduction at local installation area**

G. Educate urban/suburban landowners about pesticide and fertilizer application, runoff reduction	**Hire consultant or technician to identify landowners/homeowners interested in demonstration projects;** **Create cost-share program for urban homeowner soil testing**	**2005-2011** **SJRWI, NRCS, SWCDs, Purdue CES, Fort Wayne and other cities in watershed, real estate agents and developers, local landscape/garden businesses, local/regional soil testing laboratories**	**Track towns/ neighborhood groups involved and number of homeowners involved;** **Track number and location of demonstration projects;** **Track annual soil tests; survey knowledge and behavioral changes**	**Local spring/summer meetings/outreach events;** **Minimum 5 rain garden demonstration projects;** **Cost-share program for urban soil testing;** **Publicity/news publications;** **Educational brochures**	**$30,000**	**Minimal reduction in % overall pollutant loading based on current watershed land use; 25% increase in positive behavior changes**
H. Continue to sample the river system and maintain and update the SJRWI water quality database	**See Goal #1-D**					**N/A**

Goal	Objective	Task (linked to objectives)	Start/end dates and groups involved (other than CCW group)	Progress Indicators	Products	Cost Estimate	Estimated Load Reductions
3. Sediment loading from the Cedar Creek watershed shall be reduced by 25%; macroinvertebrate populations shall show improvement and no decline	**A. Increase % of acres in conservation tillage of corn across the watershed**	**Hire agricultural technician**	**2005-2011** **NRCS, SWCDs, FSA, landowners, certified crop advisors, SJRWI**	**10 contracts/yr. (1,000 ac/yr) increase in conservation tillage acreage for corn (rate currently at ~44%); No decrease in acreage in conservation tillage for soybeans (~89%) and other crops.**	**Cost-share assistance plan for CT in corn acreage;** **Local annual CT conference and/or workshops;** **WQ monitoring data**	**$300,000**	**9.1% decrease in sediment from baseline 72,631 tons/yr**
	B. Increase the percentage of minimum 10-ft wide buffers along all streams and ditches, and around agricultural fields in critical areas **See also Goal #5**	**Hire technician/ consultant**	**2005-2011** **Local surveyors and drainage boards, landowners, MRBC, SWCDs, FSA, NRCS, forest and crop consultants, local and regional environmental and wildlife groups, local governments, universities**	**Incentive program in place;** **Local outreach education and sales effort in place;** **Annual reduction noted** **See Goal 2-E**	**Incentive program;** **10% annual increase in agricultural field buffers per county;** **10% annual increase in buffers in urban/suburban areas** **WQ monitoring data**	**See 2-E**	**9.25% decrease in sediment from baseline of 72,531 tons/yr**

	C. Where appropriate, increase the use of natural bioswales, two-stage ditching, and wetlands to detain water and trap sediment **See also 6-B**	**Hire technician /wetland engineering consultant;**	**2005-2011** **Same as above, plus environmental engineering consultants**	**Landowners on critical acres identified;** **incentive or cost-share program developed;** **Acres in projects and WQ tracked; outreach ed. program established**	**Incentive/cost share program;** **Minimum 5 bioswale projects;** **30 acres of wetland protection and/or restoration; alternative ditch maintenance workshop/conference;** **WQ data**	**$300,000**	**7% decrease in sediment from baseline of 72,531 tons/yr**
	D. Support and assist biological assessment in CCW wetlands	**See Goal #6-D** **and Goal #7-C**					**N/A**

Goal	Objective	Task (linked to objectives)	Start/end dates and groups involved (other than CCW group)	Progress Indicators	Products	Cost Estimate	Estimated Load Reductions
4. The stakeholders of the Cedar Creek watershed shall support growth and development that balances economic interests with	**A. 70% of existing prime farmland in the watershed will be protected**	**Work with existing farm agencies and businesses to identify prime farmland and county development plans;** **Help to educate stakeholders about the value of agricultural lands to the CCW**	**2005-2016** **SWCDs, NRCS, FSA, Purdue CES, SJRWI, county planning agencies; agricultural businesses and corporations; landowners**	**Track current agricultural acreage, usage;** **Work with county planning depts. to create digital maps;** **Create outreach educational effort**	**Current digital maps of existing prime agricultural land for entire watershed w/ overlays of county development plans;** **Educational brochure**	**25,000**	**N/A**

B. Increase riparian corridor and forest land in the CCW by 5%	**Hire technician or consultant;** **Identify forestland owners and critical need areas for riparian corridors.** **See also Goal 3-B.**	**2005-2020** **NRCS, forestry consultants, IDNR, SWCDs, Purdue CES, SJRWI, local wildlife/ hunting organizations; city/county parks departments, ACRES, local government, City of Fort Wayne**	**Track current forested land and plan contiguous riparian corridor in CCW;** **Create database of targeted landowners;** **Create incentive or cost-share program to re-establish woodlands; Track thermal data in adjacent streams**	**Current digital maps of existing forested land for entire watershed; Digital map of planned county development and proposed riparian corridor;** **Educational brochures;** **WQ & benthic macroinvertebrate data**	**100,000**	**Reduce thermal change in adjacent streams by 50% based on avg. stream temps; reduce sediment/ nutrient/ pesticide loading per 2-E, 3-B**
C. All stakeholders shall be exposed to the geography, geology, geomorphology and ecology of the CCW	**Hire outreach educational consultant;** **See also Goal 7-A;** **Build partnerships with local companies and universities for advertising and communication;** **Develop surveys to track behavior changes that come w/ education**	**2005-2008** **SJRWI, Allen, Noble, & DeKalb counties, NRCS, USGS, local colleges & universities, Fort Wayne, Auburn, Garrett, Waterloo, INDOT, local businesses, park depts.**	**Signage will be erected at appropriate locations;** **Outreach education effort will be visible in community;** **Pre-post survey will measure impact of educational effort**	**Watershed signage along major roadways of the watershed;** **Various educational outreach pieces created**	**$45,000**	**N/A**

D. Wellhead protection plans will be in place in all watershed communities and a voluntary testing program for local private wells will be established	**Support local efforts for wellhead protection plans for all public and private wells;** **Develop cost-share program for private well WQ testing**	**2005-2011** **IDEM, local health departments, SWCDs, county GIS depts., CES, local WQ testing laboratories**	**Review of listing of current wellhead protection plans to identify needs;** **Number of private wells tested annually in each county.**	**List of areas needing protection plans;** **Creation of program for annual voluntary water quality testing for private domestic wells**	**$10,000**	**N/A; reduction depends on needs and follow up activities**
E. Continue to sample the river system and maintain and update the SJRWI water quality database	**See Goal #1-D**					

Goal	Objective	Task (linked to objectives)	Start/end dates and groups involved (other than CCW group)	Progress Indicators	Products	Cost Estimate	Estimated Load Reductions
5. The stakeholders of the Cedar Creek watershed shall encourage management of stream obstructions that in a balanced, proactive program that protects habitat, supports rural and urban drainage, reduces flooding, and fosters communication among stakeholders	**A. Create a working process that involves public participation in local efforts to remove log jams** **B. Create a working process that involves public discourse and participation in local drainage maintenance** **C. Sponsor and/or support local outreach education efforts on drainage issues**	**Hire consultant or coordinator;** **Build working partnership that includes local decision-makers**	**2005-2010** **Landowners** **County drainage boards and surveyors** **SWCDs** **Local government** **DNR** **MRBC** **SJRWI** **Regional conservation & environmental groups Agricultural producers** **Local business and industry** **Local parks departments** **Environmental engineering consultants**	**Partnership established among groups involved;** **Public discourse begins;** **Education/outreach goals identified;** **Community goals are identified;** **Working process for participation developed**	**Public meetings/discussion groups;** **Outreach education brochures;** **Educational conferences;** **Community Plan of Action for Log jams;** **Community guidance document for drain maintenance**	**$150,000**	**N/A**

Goal	Objective	Task (linked to objectives)	Start/end dates and groups involved (other than CCW group)	Progress Indicators	Products	Cost Estimate	Estimated Load Reduction
6. Quality wetlands in the Cedar Creek watershed shall be protected and their total acreage increased in order to protect aquifer recharge zones, provide habitat and nursery area for wildlife and aquatic wildlife, as well as to provide flood storage and improvement of water quality	A. No net loss of high-quality wetland acres in CCW	Hire coordinator; Identify landowners;	2005-2016 Maumee River Basin Commission; SWCDs; County drainage boards and surveyors; IPFW, USF, Tri-State University;	Maps created identifying existing wetlands; Landowners identified and contacted	Digitized mapping of all wetlands in CCW	$150,000	N/A
	B. Wetland acres will be increased through constructed wetlands or restoration of wetlands	Build partnership with local universities, state and federal agencies; Sponsor citizen biological assessment training;	The Nature Conservancy, Pheasants Forever, Ducks Unlimited, Izaak Walton League and other local environmental/wildlife conservation groups;	Cost share incentive program developed for wetland restoration	Restoration of 100 acres of wetlands. See also 3-C	$600,000	Storage of minimum 100 million gallons of floodwater; reduction of sediment by up to 25%
	C. Collect/create/ distribute wetland education information to various stakeholders in the watershed	Build partnership with other conservation groups to create funding source for wetland restoration and stakeholder involvement	IDNR, NRCS, FSA	Partnership creates educational outreach effort	Educational brochures, posters specific to CCW	$5,000	N/A
	D. Support and assist biological assessment in CCW wetlands			Citizen Training Program created; Assess and track a minimum of 10 wetlands per year; Update database	Biological assessment on 75% of CCW wetlands	$15,000	N/A

Goal	Objective	Task (linked to objectives)	Start/end dates and groups involved (other than besides CCW group)	Progress Indicators	Products	Cost Estimate	Estimated Load Reduction
7. Educate the public about the Cedar Creek watershed and its significance to the health and welfare of Northeast Indiana	**A. Increase watershed residents' knowledge and understanding of their watershed and its resources in order to induce behavioral changes.** **See also Goal #4-C**	**Hire consultant to develop outreach education program for all stakeholders of the CCW**	**2005-2011** **Landowners, local government, business owners, lake residents, developers and real estate agents;** **SWCD, IDEM, local conservation groups, SJRWI**	**See Goal #4-C. Watershed signage installed;** **Educational partnership developed;** **Community pre-surveys;** **Development of educational outreach tools;** **Community post-surveys**	**Pre- and post-survey of stakeholder knowledge of watershed;** **Educational outreach materials**	**$60,000**	**N/A**
	B. Increase knowledge about the CCW among school-aged residents of the watershed	**Hire educational consultant to work with CCW and local schools**	**2005-2008** **Elementary schools within the Cedar Creek watershed**	**Curriculum partnership created;** **Curriculum development meetings;** **Teaching packets distributed and teacher in-service trainings held**	**Curriculum for elementary/middle schools that teaches CCW specific information, meets Indiana state science guidelines**	**$30,000-$40,000**	**N/A**

C. Create a corps of volunteer stream monitors in the CCW that will monitor all 14-digit HUCS	**Hire coordinator to work with DNR/Hoosier Riverwatch to organize and train citizen volunteers**	**2005-2011** **SJRWI, SWCDs, Hoosier Riverwatch, all stakeholders and landowners**	**Number of training sessions completed;** **Number of volunteers actively monitoring & number of locations;** **Data input to DNR/HR database;** **Increase in citizen knowledge of watershed**	**Minimum 2 annual training sessions hosted;** **"Lending library" of volunteer WQ monitoring kits and information;** **Annual data set;** **Group of active volunteers**	**$15,000-$20,000**	**N/A**
D. Increase public knowledge of E. coli contamination issues and public participation in local efforts to control pollutant	**Hire educational coordinator or consultant;** **See also Goal #1 A-D**	**2005-2011** **Cities of Waterloo, Garrett, Auburn and Fort Wayne; County departments of health and SWCDs; IDEM, university resources**	**Citizen participation in CSO and sewage task force meetings;** **Citizen participation in Storm Water Phase II efforts; Stakeholder understanding of OSS issues and public health threats**	**Educational brochures;** **Outreach educ. Programs/meetings; behavior changes based on surveys**	**See Goal #1 A-D**	**N/A**
E. Continue to sample the river system and maintain and update the SJRWI water quality database	**See Goal #1-D**					

Appendices

Appendix A: List of Committee Members and Working Group

Organizational Meeting: April 22, 2003

<u>Meeting Attendees:</u>

Wade Amos	Goode & Associates, City of Fort Wayne
Marvin Basse	Property owner
Kathleen Bassett	The Evening Star (Auburn)
Bill Bauer	Crop Advisor, Pioneer OH
Bob Bowman	Waterloo farmer
Bob Caylor	Fort Wayne News Sentinel
Toby Days	Alliance of Indiana Rural Water
Dick Dircksen	Farmer
Bob Davis	Fort Wayne, Cedar Creek Wildlife Project
Marvin Dietsch	SJRWI, farmer, Ohio
Jane Dustin	CCWP and Izaak League, Huntertown
Karen Farlow	Auburn
M. A. Feitler	Landowner, Auburn
Dan Harm	Landowner, Auburn
Allen Haynes	Auburn SWCD/ NRCS
David Hines	NRCS, Auburn
Julie Knudson	DeKalb Co SWCD
Bob Koerner	SJRWI, Edgerton OH, Williams Co. SWCD
Andy Kratz	Auburn
David Kurtz	Auburn (newspaper)
Bill Lambert	NRCS Auburn
Larry LaRowe	Interested citizen
Kathy Latz	Wood Land Lakes (Facilitator)
David Lefforge	DNR
Jane Loomis	SJRWI
Stacey McGinnis	Albion, Noble Co SWCD
John McGuire	Crop Advisor, Montpelier OH
Brian Miller	Cedar Creek Board, Fort Wayne
Joe Nester	Nester Ag, Bryan OH
Dewayne Nodine	Waterloo Town Manager
Steve Provines	DeKalb SWCD
Warren Pryor	University of St. Francis
Rod Renkenberger	Maumee River Basin Commission
Jim Rodman	Waterloo Water Works
Janel Roger	Landowner, Auburn
Rev. Paul Row	St. Joe, Indiana, St. Joseph River Greenway
Jim Soper	Alliance of Indiana Rural Water
Roger Stebing	Farmer, Garrett IN
Mark Strong	DeKalb Co. Surveyor
Max Wallace	Auburn Conservation Club, landowner
Michael Walter	Cedar Creek Wildlife Project (Auburn)
Richard Waring	Landowner, Auburn
Gary Whonsether	Huntertown
Sherri Winters	Alliance of Indiana Rural Water
Norman Yoder	Mayor, City of Auburn

<u>Plan Writing Task Group:</u>

Toby Days	Alliance of Indiana Rural Water
Jane Dustin, d. 2003	Cedar Creek Wildlife Project, ACRES
Karen Griggs	IPFW, Cedar Creek Wildlife Project
Allen Haynes	DeKalb Co. SWCD
Julie Knudson	DeKalb Co. SWCD
Jane Loomis	St. Joseph River Watershed Initiative
Gretel Smith	Izaak Walton League, ACRES Land Trust
Richard Waring	DeKalb County resident

<u>Technical Assistance:</u>

Laura Bieberich	IDEM Division of Watershed Management
Gary Chapple	Fort Wayne/Allen County Department of Health
Bruce Cleland	America's Clean Water Foundation; EPA
Mike Garrett	DeKalb County Department of Health
David Hines	DeKalb County NRCS
Greg Lake	Allen County Soil and Water Conservation District
Bill Lambert	DeKalb County NRCS
Sherman Liechty	Allen County Natural Resource Conservation Service
Nathan Rice	IDEM Division of Watershed Management
Mary Jane Slaton	City of Fort Wayne, Water Utilities
Mark Strong	DeKalb County Surveyor
Cassandra Vondron	IDNR, Division of Soils

Appendix B. Endangered, Special Concern, and Extirpated Species in Indiana

(Source: Indiana Department of Natural Resources)

AMPHIBIANS

Endangered

Four-toed salamander	*Hemidactylium scutatum*
Green salamander	*Aneides aeneus*
Hellbender	*Cryptobranchus alleganiensis alleganiensis*
Northern crawfish frog	*Rana areolata circulosa*
Northern red salamander	*Pseudotriton ruber ruber*

Special Concern

Blue-spotted salamander	*Ambystoma laterale*
Eastern spadefoot	*Scaphiopus holbrookii holbrookii*
Mudpuppy	*Necturus maculosus*
Northern leopard	*Rana pipiens*
Plains leopard frog	*Rana blairi*

BIRDS

Endangered

American bittern	*Botaurus lentiginosus*
Bachman's sparrow	*Aimophila aestivalis*
Bald eagle	*Haliaeetus leucocephalus*
Barn owl	*Tyto alba*
Bewick's wren	*Thryomanes bewickii*
Black rail	*Laterallus jamaicensis*
Black tern	*Chlidonias niger*
Black-crowned night-heron	*Nycticorax nycticorax*
Golden-winged warbler	*Vermivora chrysoptera*
Henslow's sparrow	*Ammodramus henslowii*
Interior least tern	*Sterna antillarum athalassos*
King rail	*Rallus elegans*
Kirtland's warbler	*Dendroica kirtlandii*
Least bittern	*Ixobrychus exilis*
Loggerhead shrike	*Lanius ludovicianus*
Marsh wren	*Cistothorus palustris*
Northern harrier	*Circus cyaneus*
Osprey	*Pandion haliaetus*
Peregrine falcon	*Falco peregrinus*
Piping plover	*Charadrius melodus*
Sedge wren	*Cistothorus platensis*
Short-eared owl	*Asio flammeus*
Trumpeter swan	*Cygnus buccinator*
Upland sandpiper	*Bartramia longicauda*
Virginia rail	*Rallus limicola*
Whooping crane	*Grus americana*
Yellow-crowned night-heron	*Nyctanassa violacea*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*

Special Concern

Black-and-white warbler	*Mniotilta varia*
Broad-winged hawk	*Buteo platypterus*
Cerulean warbler	*Dendroica cerulea*
Great egret	*Ardea alba*
Hooded warbler	*Wilsonia citrina*
Mississippi kite	*Ictinia mississippiensis*
Red-shouldered hawk	*Buteo lineatus*
Sandhill crane	*Grus canadensis*
Sharp-shinned hawk	*Accipiter striatus*
Western meadowlark	*Sturnella neglecta*
Worm-eating warbler	*Helmitheros vermivorus*

Extirpated

Common loon	*Gavia immer*
Common raven	*Corvus corax*
Double-crested cormorant	*Phalacrocorax auritus*
Greater prairie-chicken	*Tympanuchus cupido*
Swallow-tailed kite	*Elanoides forficatus*

Wilson's phalarope	*Phalaropus tricolor*

FISH

Endangered

Bluebreast darter	*Etheostoma camurum*
Gilt darter	*Percina evides*
Greater redhorse	*Moxostoma valenciennesi*
Harlequin darter	*Etheostoma histrio*
Lake sturgeon	*Acipenser fulvescens*
Northern cavefish	*Amblyopsis spelaea*
Redside dace	*Clinostomus elongatus*
Southern cavefish	*Typhlichthys subterraneus*
Spottail darter	*Etheostoma squamiceps*
Southern cavefish	*Typhlichthys subterraneus*
Spottail darter	*Etheostoma squamiceps*
Spotted darter	*Etheostoma maculatum*
Tippecanoe darter	*Etheostoma tippecanoe*
Variegate darter	*Etheostoma variatum*

Special Concern

Bantam sunfish	*Lepomis symmetricus*
Blue sucker	*Cycleptus elongatus*
Cisco	*Coregonus artedi*
Crystal darter	*Crystallaria asprella*
Eastern sand darter	*Ammocrypta pellucida*
Northern studfish	*Fundulus catenatus*
Ohio river muskellunge	*Esox masquinongy ohioensis*
River redhorse	*Moxostoma carinatum*

Extirpated

Alabama shad	*Alosa alabamae*
Blackfin cisco	*Coregonus nigripinnis*
Great Lakes muskellunge	*Esox masquinongy masquinongy*
Harelip sucker	*Lagochila lacera*
Popeye shiner	*Notropis ariommus*
Shortnose cisco	*Coregonus reighardi*
Stargazing darter	*Percina uranidea*

MAMMALS

Endangered

Allegheny woodrat	*Neotoma magister*
American badger	*Taxidea taxus*
Bobcat	*Lynx rufus*
Evening bat	*Nycticeius humeralis*
Franklin's ground squirrel	*Spermophilus franklinii*
Gray bat	*Myotis grisescens*
Indiana bat	*Myotis sodalis*
Northern river otter	*Lutra canadensis*
Southeastern bat	*Myotis austroriparius*
Swamp rabbit	*Sylvilagus aquaticus*

Special Concern

Least weasel	*Mustela nivalis*
Plains pocket gopher	*Geomys bursarius*
Pygmy shrew	*Sorex hoyi*
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*
Smoky shrew	*Sorex fumeus*
Star-nosed mole	*Condylura cristata*
Little brown bat	*Myotis lucifugus*
Northern long-eared bat	*Myotis septentrionalis*
Eastern pipistrel	*Pipistrellus subflavus*
Red bat	*Lasiurus borealis*
Hoary bat	*Lasiurus cinereus*
Silver-haired bat	*Lasionycteris noctivagans*

Extirpated

American bison	*Bos bison*
Black bear	*Ursus americanus*
Black rat	*Rattus rattus*
Common porcupine	*Erethizon dorsatum*
Eastern spotted skunk	*Spilogale putorius*

Elk	*Cervus elaphus*
Fisher	*Martes pennanti*
Gray wolf	*Canis lupus*
Lynx	*Lynx lynx*
Mountain lion	*Felis concolor*
Red wolf	*Canis rufus*
Wolverine	*Gulo gulo*

MOLLUSKS

Endangered

Clubshell	*Pleurobema clava*
Fanshell	*Cyprogenia stegaria*
Fat pocketbook	*Potamilus capax*
Longsolid	*Fusconaia subrotunda*
Northern riffleshell	*Epioblasma torulosa rangiana*
Orangefoot pimpleback	*Plethobasus cooperianus*
Pink mucket	*Lampsilis abrupta*
Pyramid pigtoe	*Pleurobema rubrum*
Rabbitsfoot	*Quadrula cylindrica cylindrica*
Rough pigtoe	*Pleurobema plenum*
Sheepnose	*Plethobasus cyphyus*
Snuffbox	*Epioblasma triquetra*
Tubercled blossom	*Epioblasma torulosa torulosa*
White catspaw	*Epioblasma obliquata perobliqua*
White wartyback	*Plethobasus cicatricosus*

Special Concern

Ellipse	*Venustaconcha ellipsiformis*
Kidneyshell	*Ptychobranchus fasciolaris*
Little spectaclecase	*Villosa lienosa*
Ohio pigtoe	*Pleurobema cordatum*
Pointed campeloma	*Campeloma decisum*
Purple lilliput	*Toxolasma lividus*
Rayed bean	*Villosa fabalis*
Round hickorynut	*Obovaria subrotunda*
Salamander mussel	*Simpsonaias ambigua*
Swamp lymnaea	*Lymnaea stagnalis*
Wavyrayed lampmussel	*Lampsilis fasciola*

Extirpated

Cracking pearlymussel	*Hemistena lata*
Leafshell	*Epioblasma flexuosa*
Catspaw	*Epioblasma obliquata obliquata*
Ring pink	*Obovaria retusa*
Round combshell	*Epioblasma personata*
Scaleshell	*Leptodea leptodon*
Spectaclecase	*Cumberlandia monodonta*
Tennessee riffleshell	*Epioblasma propinqua*
Wabash riffleshell	*Epioblasma sampsonii*
Winged mapleleaf	*Quadrula fragosa*

REPTILES

Endangered

Alligator snapping turtle	*Macroclemys temminckii*
Blanding's turtle	*Emydoidea blandingii*
Butler's garter snake	*Thamnophis butleri*
Eastern massasauga	*Sistrurus catenatus catenatus*
Eastern mud turtle	*Kinosternon subrubrum subrubrum*
Hieroglyphic river cooter	*Chrysemys concinna hieroglyphica*
Kirtland's snake	*Clonophis kirtlandii*
Northern copperbelly water snake	*Nerodia erythrogaster neglecta*
Northern scarlet snake	*Cemophora coccinea copei*
Ornate box turtle	*Terrapene ornata*
Smooth green snake	*Opheodrys vernalis*
Southeastern crowned snake	*Tantilla coronata*
Spotted turtle	*Clemmys guttata*
Timber rattlesnake	*Crotalus horridus*
Western cottonmouth	*Agkistrodon piscivorus leucostoma*

Special Concern

Rough green snake	*Opheodrys aestivus*
Western ribbon snake	*Thamnophis proximus*

Extirpated

Western mud snake	*Farancia abacura reinwardtii*

Appendix C: NPDES Permitted Facilities in the Cedar Creek Watershed

Permit Type	Permit No.	Owner Type	Plant Name	Facility Name	Address	City	Receiving Waters
STATE INDVL	INJ059731	PUB PRI	SUNSET LAKES ESTATES SUBD WWTP	SUNSET LAKES ESTATES SUBD.	327 LEY ROAD	FT WAYNE	CEDAR CRK VIA FOREST CANYON CRK
UNPERMITTED	INU059731	PUB PRI	SUNSET LAKES ESTATES SUBD WWTP	SUNSET LAKES ESTATES SUBD.	327 LEY ROAD	FT WAYNE	CEDAR CRK VIA FOREST CANYON CRK
STANDARD	IN0061255	PRIVATE	AUBURN FOUNDRY, INC. PLANT 1	AUBURN FOUNDRY, INC. PLANT 1	635 WEST ELEVENTH ST	AUBURN	CEDAR CR / PECKHART D / STORM SWR
COMBINED SE	INM020672	PUBLIC	AUBURN CSS	AUBURN COMBINED SEWER SYSTEM	CITY OF AUBURN	AUBURN	CEDAR CR AND JOHN DIEHL DRAIN
STANDARD	IN0000566	PRIVATE	AUBURN GEAR INC.	AUBURN GEAR INC.	400 EAST AUBURN DRIVE	AUBURN	CEDAR CR TO ST JOSEPH RIVER
STANDARD	IN0020672	PUBLIC	AUBURN MUNICIPAL STP	AUBURN WATER POLLUTION CTL PLT	BOX 506	AUBURN	CEDAR CR TO ST JOSEPH RIVER
STANDARD	IN0000868	PRIVATE	RIEKE CORPORATION	RIEKE CORPORATION	500 W. SEVENTH ST.	AUBURN	CEDAR CR TO ST JOSEPH RIVER
STANDARD	IN0020711	PUBLIC	WATERLOO MUNICIPAL STP	WATERLOO MUNICIPAL STP	P.O. BOX 96	WATERLOO	CEDAR CR TO ST JOSEPH RIVER
GENERAL	ING250048	PRIVATE	EATON CORPORATION, CLUTCH DIV.	EATON CORPORATION	CLUTCH DIVISION	AUBURN	CEDAR CR VIA CITY STORM SEWERS
STANDARD	IN0022969	PUBLIC	GARRETT MUNICIPAL STP	GARRETT MUNICIPAL UTILITIES	P. O. BOX 120	GARRETT	CEDAR CR VIA GARRETT CITY DITCH
STANDARD	IN0061590	PRIVATE	AUBURN FOUNDRY, CR 50 LANDFILL	AUBURN FOUNDRY LANDFILL	COUNTY ROAD 50	AUBURN	CEDAR CR VIA GARRETT DRAIN
STANDARD	IN0000361	PRIVATE	COOPER TIRE & RUBBER COMPANY	COOPER TIRE & RUBBER COMPANY	ENGINEERED PRODUCTS DIV	AUBURN	CEDAR CR VIA GRANDSTAFF DITCH
STANDARD	IN0046043	PRIVATE	SPX - CONTECH DIVISION	SPX - CONTECH DIVISION	1200 POWER DRIVE	AUBURN	CEDAR CR VIA GRANDSTAFF DITCH
STANDARD	IN0046761	PRIVATE	TOWER AUTOMOTIVE, INC.	TOWER AUTOMOTIVE, INC.	801 WEST FIFTEENTH ST	AUBURN	CEDAR CR VIA GRANDSTAFF DITCH
STANDARD	IN0047473	PUBLIC	CORUNNA MUNICIPAL STP	CORUNNA MUNICIPAL WWTP	TOWN OF CORUNNA	CORUNNA	CEDAR CR VIA JOHN DIEHL DITCH
GENERAL	ING340037	PRIVATE	MARATHON ASHLAND, WATERLOO ASP	MARATHON ASHLAND PETROLEUM LLC	WATERLOO ASPHALT TRMNL	FINDLAY	CEDAR CR VIA UNNAMED TRIBUTARY
STANDARD	IN0061263	PRIVATE	AUBURN FOUNDRY, INC. PLANT 2	AUBURN FOUNDRY, INC. PLANT 2	1537 WEST AUBURN RD	AUBURN	CEDAR CR/ DIEHL D/ WETLAND/ POND
STANDARD	IN0029955	PUB PRI	HIDDEN VALLEY MOBLE HOME PARK	HIDDEN VALLEY MOBILE HOME PARK	0168 SR 8	AVILLA,	CEDAR/LITTLE CEDAR/DITCH
STANDARD	IN0032107	PUB PRI	INDIAN SPRINGS REC. CAMPGROUND	INDIAN SPRINGS CAMPGROUND	P.O. BOX 216	GARRETT,	CEDAR/LITTLE CEDAR CRK
PRETREATER	INP000105	PRIVATE	PRINCE MANUFACTURING	PRINCE MANUFACTURING	WATERLOO DIVISION	WATERLOO	WATERLOO STP (CEDAR CREEK BASIN)
PRETREATER	INP000104	PRIVATE	PRINCE MANUFACTURING N	PRINCE MAUFACTURING	205 GREEN DRIVE	AVILLA	AVILLA STP (CEDAR CREEK BASIN)
PRETREATER	INP000217	PRIVATE	TERNET METAL FINISHING, #2	TERNET METAL FINISHING, INC.#2	150 GREEN DRIVE	AVILLA	AVILLA STP (ST. JOSEPH RIVER)
STANDARD	IN0020664	PUBLIC	AVILLA MUNICIPAL STP	TOWN OF AVILLA WWTP	P.O. BOX 49	AVILLA	LITTLE CEDAR CR VIA UNNAMED DITCH
STANDARD	IN0058611	PUBLIC	LAOTTO REGIONAL SEWER DISTRICT	LAOTTO REGIONAL SEWER DISTRICT	214 S. MAIN ST.	LAOTTO	CEDAR CR VIA BLACK CREEK
STANDARD	IN0052035	PUBLIC	AVILLA PUBLIC WATER SUPPLY	AVILLA PUBLIC WATER SUPPLY	TOWN HALL	AVILLA	CEDAR CR/KINGS LAKE/DITCH

Appendix D: Sample Stream Information Record

Location	Stream ID	Natural Resources	Potential Stressor	Comments
West of Rt 327, Butler Twp. Sec. 28,29, 31, 32, various points to SR 3.	**Black Creek**	**Tree cover fair along most banks**	**Corn/soybean row crops; Six bridge crossings in 2-3 mile stretch; Fallen trees and debris fill channel near CR 3 Bridge; Farm tiling.**	**At CR 3, plowing to bank top near bridge**
Crossing at SR 205, sec. 20 at CR 7A, CR 64	**Little Cedar Creek**	**Some tree cover from Coldwater Rd. NW across CR 64; Good tree cover between CR 64-CR 60 east of 7A**	**Gravel pit, gravel road runs along bank of creek into pit area for 100’. Gravel piles w/in a few feet of creek. Pit operation at CR 7A has 300-400’ material on bank.**	**Two gravel pit operations are problematic.**

Appendix E: Areas of Concern for bacteria contamination.

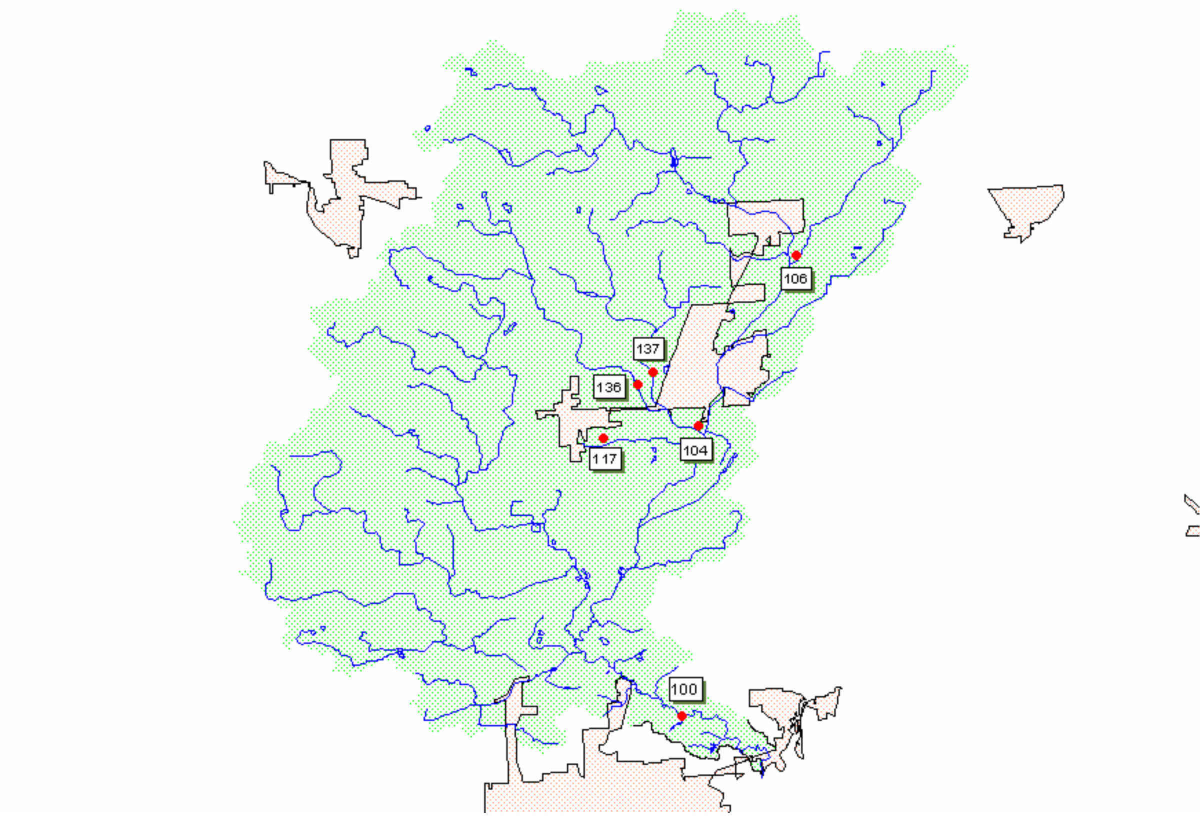


Figure 51 Site map for areas of concern in the Cedar Creek watershed based on SJRWI testing locations.

Areas of concern, based on the 2003 SJRWI *Areas of Concern* include Site 100, Cedar Creek @ Tonkel Rd. in Allen County; Site 104, Peckhart Ditch @ Old SR 427; Site 117, Garret City Ditch @ CR 15; Site 136, Diehl Ditch @ Cr 19; Site 137, Peckhart Ditch @ SR 8; Site 106, Matson Ditch @ CR 39. Additionally IDEM stream segment testing has identified Little Cedar and Willow Creek as areas of violation.

Site #	Location	Stream Name		Site #	Location	Stream Name
100	Tonkel Road	Cedar Creek		114	DeKalb CR 40	Peckhart Ditch
101	Coldwater Road	Willow Creek		115	DeKalb CR 22	Dibbling Ditch
102	DeKalb CR 7A	Black Creek		116	DeKalb CR 28	Cedar Creek
103	DeKalb CR 64	Little Cedar		117	DeKalb CR 15	Garrett City Ditch
104	Old SR 427	Diehl/Peckhart		118	Noble Baseline Rd.	Avilla Drain
105	First Street	Cedar Creek		119	DeKalb CR 60	Cedar Creek
106	DeKalb CR 39	Matson Ditch		136	DeKalb CR 19	Diehl Ditch
107	DeKalb CR 27	Cedar Creek		137	Indiana SR 8	Peckhart Ditch
108	Hand Road	Willow Creek		138	Indiana SR 205	Black Creek
109	Woods Road	Willow Creek		139	DeKalb CR 40	Diehl Ditch
110	Noble CR 500	South Black Creek		140	DeKalb CR 36A	Diehl Ditch
111	DeKalb CR 68	Little Cedar		141	DeKalb CR 39	Walter Smith Ditch
112	DeKalb CR 52	Little Cedar		142	DeKalb CR 37	David Link Ditch
113	Indiana SR 8	Diehl Ditch		143	DeKalb CR 18	Dibbling Ditch

Table 16 Current and historical SJRWI sampling sites in the Cedar Creek watershed

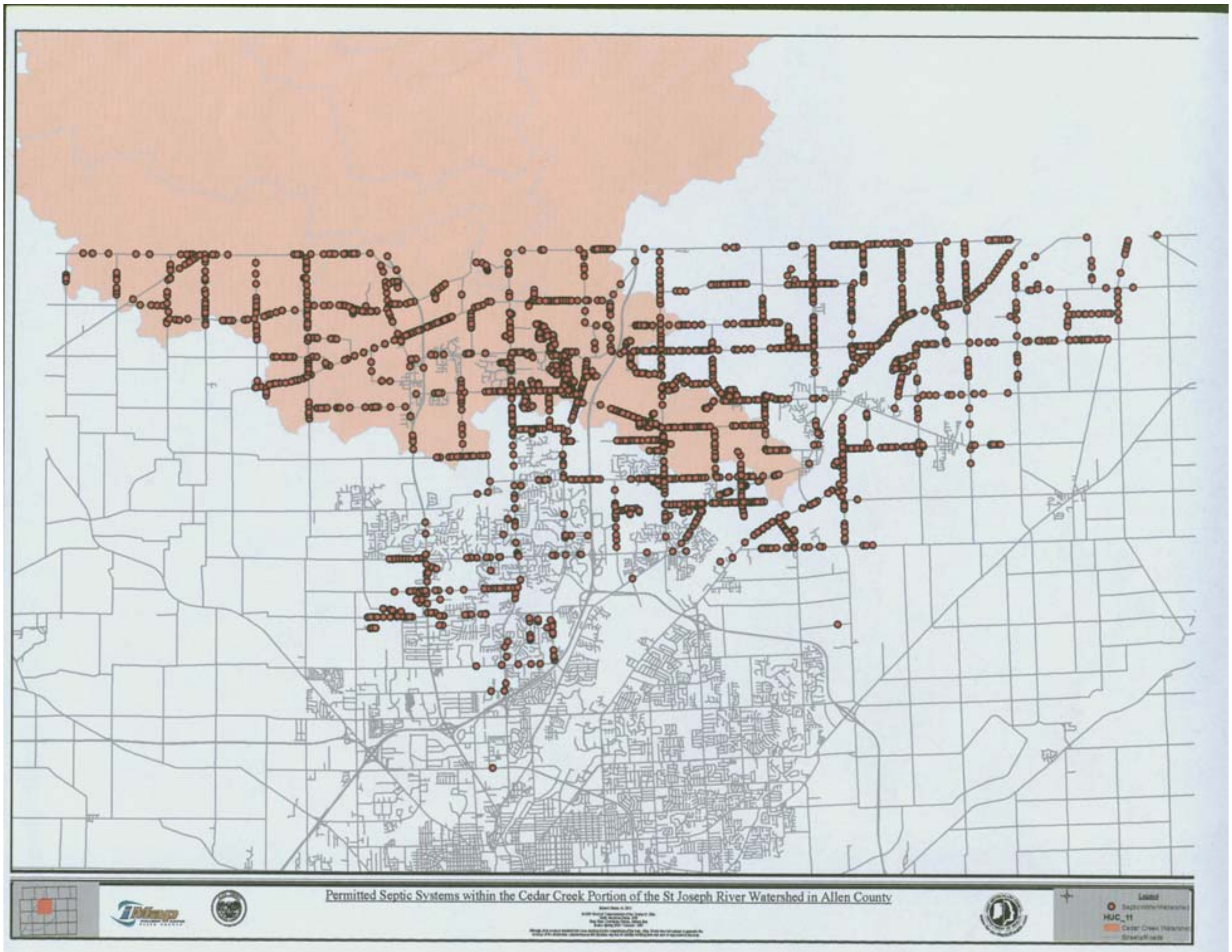


Figure 52 Septic systems in the Allen County portion of the Cedar Creek Watershed.

The shaded area on this map represents the Cedar Creek watershed. Red dots represent permitted septic systems within the watershed.

Appendix F: The Bacteria Source Tracking Project

A complete copy of the final report of the BST project is available on line at www.sjrwi.org.

The Bacteria Source Tracking (BST) project was begun in 2001 and concluded in 2004. Antibiotic Resistance Analysis (ARA) was used in an attempt to determine the source of bacterial contamination in the St. Joseph River Watershed. The St. Joseph River is the largest tributary to the Maumee River system, which empties into Lake Erie at Toledo, Ohio. The St. Joseph River and several of its tributaries, including the largest, Cedar Creek, are on Indiana's 303(d) list of impaired waters for *E. coli*.

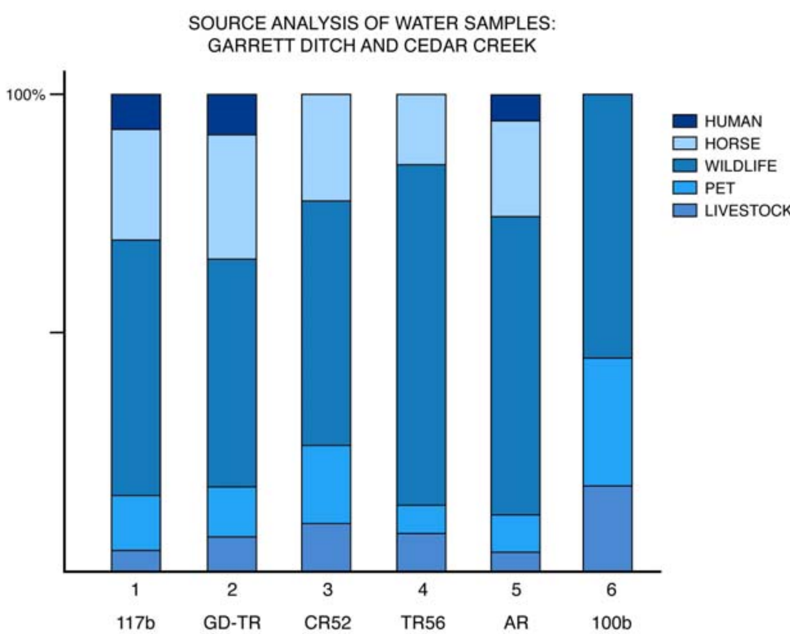
This research endeavor included development and refinement of a database particular to Northeast Indiana of known source patterns of resistance to antibiotics for humans, horses, beef and dairy cattle, deer, geese, hogs and domestic pets. Enterococci were extracted from water samples and tested against this database to determine sources of the contaminant.

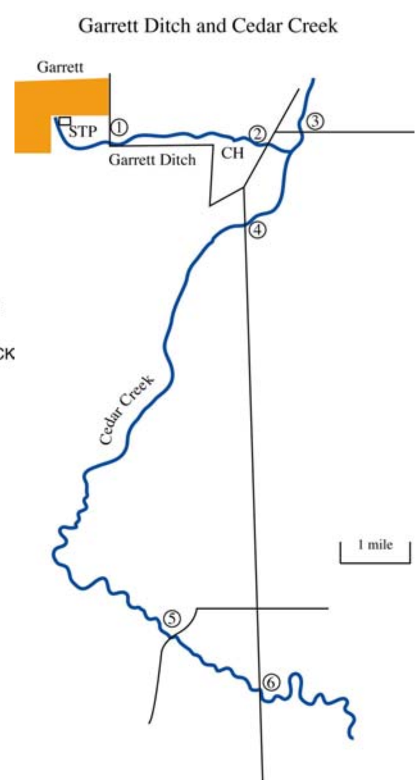
Results of the research indicates that wildlife, particularly geese, make a significant (greater than 50%) contribution to the bacterial pollution in this watershed. The human contribution of fecal contamination is localized to particular sub-watersheds and is generally low. Livestock (beef, dairy and swine) contribute little to the overall fecal pollution of the St. Joseph River watershed.

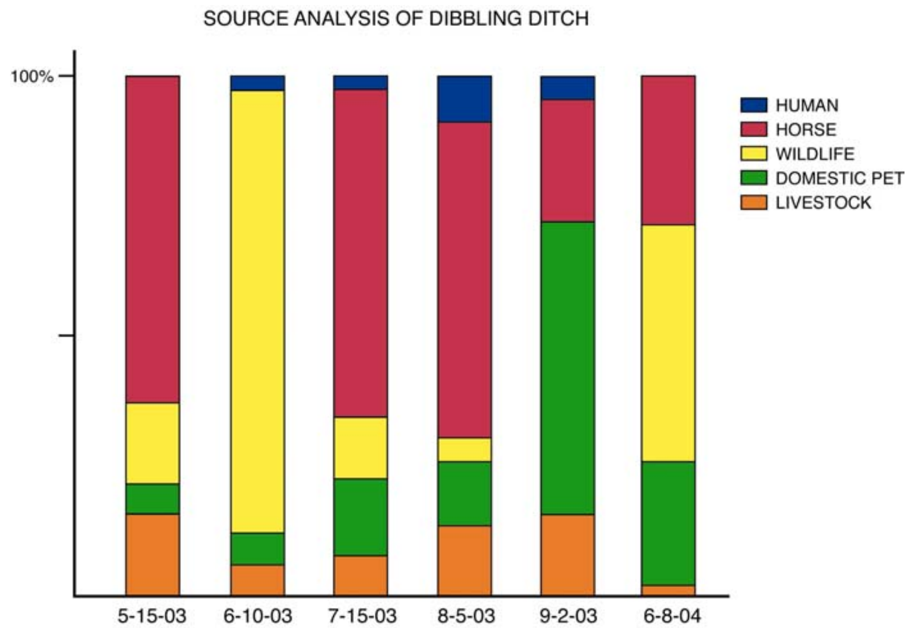
Significant contribution is shown from horses; however there is some question whether there is interference with horse from another source of contribution. It is known that this possible interference does not come from human sources.

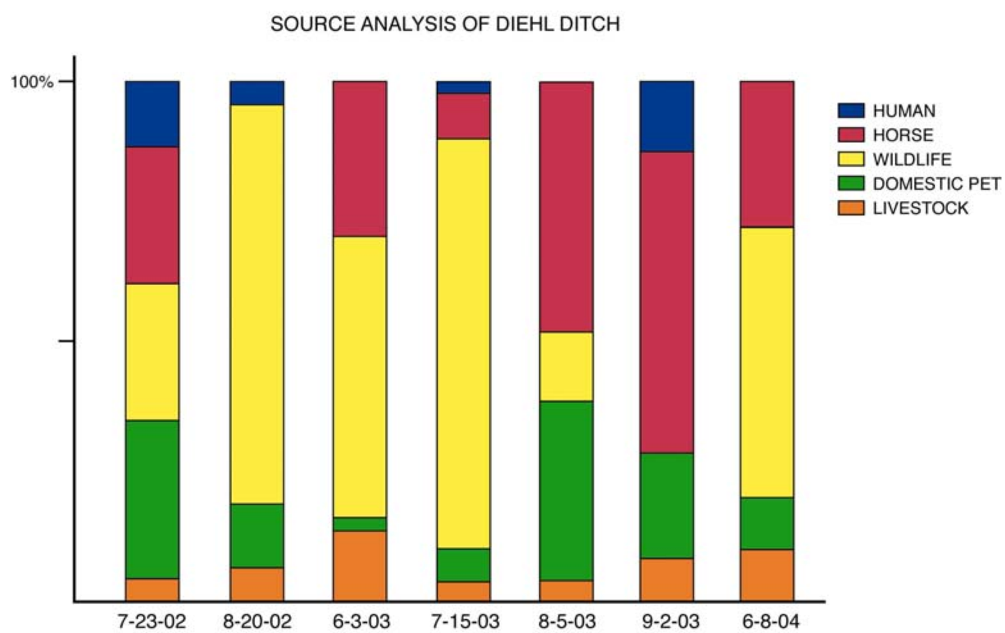
The knowledge of land uses is an essential component of bacteria source tracking through the use of ARA.

Sample Graphs









Conclusions of the Study

Some conclusions can be drawn from this research on the use of antibiotic resistance analysis (ARA) to track sources of bacterial contamination in the watershed. Although this research needs to be continued and expanded, ARA has been shown to be valuable in pinpointing the sources of bacterial pollution in watershed streams, especially when combined with land use data.

- The knowledge of land use is an essential component of bacterial source tracking, both in making the decision on which sources to include in the database and also in interpreting data from water samples.

- This study showed that livestock (beef, dairy and swine) contribute little to the overall fecal pollution in the St. Joseph River watershed in terms of percentage of contamination.

- The study also showed that the human contribution of fecal contamination is localized to particular sub-watersheds, and is generally low (not more than 10-15% of the fecal load).

- The study showed that wildfowl make a significant (greater than 50%) contribution to fecal contamination throughout the watershed. This contribution is more pronounced during some parts of the season, but is consistently a major source across the sub-watersheds tested.

- While humans as a source were ruled out as a possible interference with the horse source in the water samples, horse still presents a problem in interpretation.

Given the ability to detect sources along the length of a tributary, it remains very important to thoroughly examine the watershed and its land uses, and then use a combination of BST analysis and land use information to pinpoint pollution sources and work with landowners to find methods to reduce or eliminate the pollution. Obviously the methods will vary depending upon the source, i.e. reducing the impact of nuisance goose populations is a much different project than eliminating or replacing non-functioning septic systems or fencing livestock from the streams.

Land use data and knowledge of the watershed tells us that horses are not present in significant numbers in most of the sub-watersheds. Horses may be more of a problem within specific sub-watersheds, and/or there may be another source, such as a wildlife source, which is giving an antibiotic resistance pattern similar to that of horses. Expanding the database with additional wildlife samples may help to resolve this difficulty in interpretation.

While this study showed human sources to be small and localized, we do not wish to downplay the importance to human health of eliminating these sources of bacterial pollution from the waters of our streams and ditches. This study did not did not focus on quantifying risk based upon the sources of bacterial contamination. We do not wish to underestimate assessment of the risk of pathogens from animal sources. However, the risk to human health from human pathogens, even in low concentrations, is arguably higher than the risk to humans from pathogens from animal sources. Therefore, elimination of sources of human pathogens in the watershed should be a main focus in watershed planning and restoration.

Recommendations

This project has demonstrated the usefulness of antibiotic resistance analysis in identifying sources of fecal contamination within the St. Joseph River watershed. Some questions still remain, namely the role of horses and wildlife in contributing to the fecal load within the watershed. Additional work on the database as well as more detailed land use analysis could reduce the uncertainty regarding the contribution of these two sources.

Appendix G: Bacteria Loads for Various Sampling Sites in the Cedar Creek Watershed

Loading information is presented for the most current year of water quality data maintained on the St. Joseph River Watershed Initiative database.

Site 100: Cedar Creek at Tonkel Road, Allen County

Cedar Creek (#100)			
Sampling Day	Disharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
4/8/2003	902	6.84112E+14	684111536380800
4/15/2003	231	3.61702E+14	361701772185600
4/22/2003	135	0	0
4/29/2003	84	2.05512E+13	20551237056000
5/6/2003	1500	3.66986E+14	366986376000000
5/13/2003	1490	1.56388E+16	15638757426864000
5/20/2003	318	3.26765E+14	326764669190400
5/27/2003	120	5.87178E+13	58717820160000
6/3/2003	99	2.42211E+13	24221100816000
6/10/2003	64	4.85401E+13	48540064665600
6/17/2003	164	0	0
6/24/2003	61	4.62647E+13	46264749134400
7/1/2003	32	7.82904E+12	7829042688000
7/8/2003	441	0	0
7/15/2003	81	8.97722E+14	897722072971200
7/22/2003	572	1.39944E+14	139944138048000
7/29/2003	626	1.35543E+16	13554274811184000
8/5/2003	884	1.14843E+16	11484324855993600
8/12/2003	124	6.27987E+14	627987086611200
8/19/2003	51	1.24775E+13	12477536784000
8/26/2003	51	3.86804E+13	38680364030400
9/2/2003	2620	3.39732E+15	3397315211424000
9/9/2003	219	6.34387E+15	6343873290086400
9/16/2003	78	8.01498E+13	80149824518400
9/23/2003	272	2.79497E+14	279496823961600
9/30/2003	438	1.01266E+16	10126622059344000

Site 101: Willow Creek

Willow Creek (#101)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
3/31/1998	70.6128	3.45519E+13	34551914094950
4/7/1998	30.456	6.48262E+13	64826234991245
4/14/1998	59.22	1.26051E+14	126051012482976
4/21/1998	27.1848	1.33019E+13	13301934979046
4/28/1998	22.8984	5.60227E+12	5602267221466
5/5/1998	30.2304	7.3961E+12	7396096627354
5/12/1998	18.7248	2.42802E+13	24280170943081
5/19/1998	12.408	3.03571E+12	3035711302272
5/26/1998	11.28	5.51948E+12	5519475095040
6/2/1998	8.2344	4.02922E+12	4029216819379
6/16/1998	16.92	8.27921E+12	8279212642560
6/23/1998	9.8136	2.37696E+13	23769619496790
6/30/1998	9.7008	7.35746E+12	7357460301688
7/7/1998	10.0392	1.84212E+13	18421248129696
7/14/1998	5.9784	1.097E+13	10969956751392
7/21/1998	5.5272	5.67954E+12	5679539872796
7/28/1998	6.8808	1.68344E+12	1683439903987
8/4/1998	8.1216	3.97402E+12	3974022068429
8/11/1998	9.2496	6.5174E+13	65173961922232
8/18/1998	5.5272	2.70454E+12	2704542796570
8/25/1998	21.6576	1.6426E+13	16425957882839
9/1/1998	13.0848	6.40259E+12	6402591110246
9/8/1998	5.4144	1.32467E+12	1324674022810
9/15/1998	3.6096	0	0
9/22/1998	3.2712	8.00324E+11	800323888781
9/29/1998	2.9328	7.17532E+11	717531762355
10/6/1998	3.2712	1.60065E+12	1600647777562

Site 102: Black Creek

Black Creek (#102)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
3/31/1998	168.5192	4.12295E+13	41229500329613
4/7/1998	72.684	3.68102E+14	368101720993939
4/14/1998	141.33	3.00824E+14	300823870216464
4/21/1998	64.8772	4.92054E+13	49205366926923
4/28/1998	54.6476	1.33699E+13	13369949787398
5/5/1998	72.1456	0	0
5/12/1998	44.6872	8.1998E+13	81997967907936
5/19/1998	29.612	6.30298E+13	63029763283450
5/26/1998	26.92	0	0
6/2/1998	19.6516	1.49045E+13	14904530230977
6/16/1998	40.38	8.59497E+13	85949677204704
6/23/1998	23.4204	9.39716E+13	93971647077143
6/30/1998	23.1512	3.62503E+13	36250346615685
7/7/1998	23.9588	1.17234E+13	11723404247078
7/14/1998	14.2676	7.7493E+13	77493019309621
7/21/1998	13.1908	1.71043E+13	17104315072844
7/28/1998	16.4212	4.01757E+12	4017571118381
8/4/1998	19.3824	1.47004E+13	14700358583977
8/11/1998	22.0744	2.72194E+14	272193736361380
8/18/1998	13.1908	2.42042E+13	24204219442704
8/25/1998	51.6864	3.9201E+13	39200956223939
9/1/1998	31.2272	1.58147E+14	158147406056655
9/8/1998	12.9216	3.16137E+12	3161367437414
9/15/1998	8.6144	8.85183E+12	8851828824760
9/22/1998	7.8068	0	0
9/29/1998	6.9992	0	0
10/6/1998	7.8068	1.66169E+13	16616937592909

Site 103: Little Cedar Creek

Little Cedar (#103)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
3/31/1998	105.0428	5.1399E+13	51399035329190
4/7/1998	45.306	1.97303E+14	197303325712531
4/14/1998	88.095	0	0
4/21/1998	40.4398	5.24377E+13	52437689956849
4/28/1998	34.0634	4.41695E+13	44169506478176
5/5/1998	44.9704	8.25176E+13	82517620616352
5/12/1998	27.8548	5.11117E+13	51111660531024
5/19/1998	18.458	9.03178E+12	9031779370944
5/26/1998	16.78	1.27266E+13	12726598204512
6/2/1998	12.2494	0	0
6/16/1998	25.17	6.15803E+12	6158031389280
6/23/1998	14.5986	7.16117E+14	716117470259371
6/30/1998	14.4308	1.87122E+13	18712204714892
7/7/1998	14.9342	1.53458E+13	15345814222086
7/14/1998	8.8934	3.26376E+13	32637566363184
7/21/1998	8.2222	6.23603E+12	6236033120211
7/28/1998	10.2358	5.00853E+12	5008532196614
8/4/1998	12.0816	2.95586E+12	2955855066854
8/11/1998	13.7596	2.52479E+13	25247928696048
8/18/1998	8.2222	6.23603E+12	6236033120211
8/25/1998	32.2176	3.31056E+13	33105576748769
9/1/1998	19.4648	4.21456E+14	421455668282323
9/8/1998	8.0544	6.10877E+12	6108767138166
9/15/1998	5.3696	1.31371E+12	1313713363046
9/22/1998	4.8662	1.19055E+12	1190552735261
9/29/1998	4.3628	1.06739E+12	1067392107475
10/6/1998	4.8662	0	0

Site 104: Dehl/Peckhart Ditch

Diehl/Peckhart (#104)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
4/15/2003	33.5874	8.21741E+12	8217412136841.60
4/22/2003	19.629	4.80238E+12	4802383716336.00
4/29/2003	12.2136	0	0.00
5/6/2003	218.1	0	0.00
5/13/2003	216.646	2.80922E+14	280921660799299.00
5/20/2003	46.2372	2.26246E+13	22624563285849.60
5/27/2003	17.448	1.79289E+13	17928899207654.40
6/3/2003	14.3946	3.52175E+12	3521748058646.40
6/10/2003	9.3056	9.56208E+12	9562079577415.68
6/17/2003	23.8456	5.83401E+12	5834006885030.40
6/24/2003	8.8694	1.21518E+14	121518094629658.00
7/1/2003	4.6528	1.13834E+12	1138342806835.20
7/8/2003	64.1214	3.13756E+13	31375573613395.20
7/15/2003	11.7774	3.57297E+13	35729734849539.80
7/22/2003	83.1688	2.03479E+13	20347877672179.20
7/29/2003	91.0204	2.63663E+15	2636629609191690.00
8/5/2003	128.5336	4.71701E+14	471700800582336.00
8/12/2003	18.0296	6.04318E+13	60431773757863.70
8/19/2003	7.4154	5.62412E+12	5624124930020.16
8/26/2003	7.4154	1.81423E+12	1814233848393.60
9/2/2003	380.948	8.10856E+14	810855810593798.00
9/9/2003	31.8426	3.72388E+14	372387505328507.00
9/16/2003	11.3412	2.77471E+12	2774710591660.80
9/23/2003	39.5488	4.06388E+13	40638838204016.60
9/30/2003	63.6852	5.67151E+14	567150844935467.00

Site 105: Cedar Creek at First Street, Auburn

Cedar Creek @ First St. (#105)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	126.4395	3.40278E+13	34027820851385
5/21/1996	355.311	1.21701E+15	1217013431600740
5/28/1996	265.683	1.36503E+15	1365028578687310
6/4/1996	99.5511	1.46136E+14	146135589663254
6/11/1996	662.607	3.89068E+15	3890683866275710
6/18/1996	457.743	1.1199E+16	11199029647291200
6/25/1996	95.0697	2.32595E+14	232595231136048
7/2/1996	40.3326	1.67751E+14	167750500031453
7/9/1996	29.1291	2.20926E+14	220926312132926
7/16/1996	26.2482	1.79811E+14	179810993497766
7/23/1996	35.8512	9.64839E+13	96483947730509
7/30/1996	36.1713	1.76992E+14	176991657362784
8/6/1996	19.8462	3.88442E+13	38844186748646
8/13/1996	15.3648	1.50365E+13	15036459386573
8/20/1996	61.1391	2.16893E+15	2168930951620490
8/27/1996	36.4914	1.87486E+14	187485852976330
9/24/1996	13.4442	3.28923E+12	3289225490813
10/1/1996	18.5658	5.63241E+13	56324070785537
10/15/1996	11.5236	1.80438E+13	18043751263887
11/5/1996	18.8859	2.44891E+13	24489066928028
11/12/1996	69.7818	8.45096E+13	84509600646097

Site 106: Matson Ditch

Matson Ditch (#106)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
4/8/2003	57.6378	5.31895E+15	7500536471697210000000000.00
4/15/2003	14.7609	1.36242E+15	492021184301450000000000.00
4/22/2003	8.6265	7.9637E+14	168076870984835000000000.00
4/29/2003	5.3676	4.95611E+14	65084796273212100000000.00
5/6/2003	95.85	8.85183E+15	20757929902746100000000000.00
5/13/2003	95.211	8.79445E+15	20485878382161000000000000.00
5/20/2003	20.3202	1.87728E+15	933290421673047000000000.00
5/27/2003	7.668	7.08541E+14	132924660980429000000000.00
6/3/2003	6.3261	5.84654E+14	90488615620951800000000.00
6/10/2003	4.0896	3.78028E+14	37823696796159400000000.00
6/17/2003	10.4796	9.68877E+14	248411774611665000000000.00
6/24/2003	3.8979	3.60442E+14	34373566228088100000000.00
7/1/2003	2.0448	1.89119E+14	9461179993020590000000.00
7/8/2003	28.1799	2.60678E+15	1797227015213890000000000.00
7/15/2003	5.1759	4.78885E+14	60642373805742000000000.00
7/22/2003	36.5508	3.38238E+15	3024674147006090000000000.00
7/29/2003	40.0014	3.70239E+15	3623394072566010000000000.00
8/5/2003	56.4876	5.22926E+15	7226895662950100000000000.00
8/12/2003	7.9236	7.33651E+14	142223368895683000000000.00
8/19/2003	3.2589	3.018E+14	24062916577651900000000.00
8/26/2003	3.2589	3.01855E+14	24067366551657100000000.00
9/2/2003	167.418	1.55099E+16	63528864805365700000000000.00
9/9/2003	13.9941	1.29668E+15	443953024832968000000000.00
9/16/2003	4.9842	4.61917E+14	56327212235995400000000.00
9/23/2003	17.3808	1.61109E+15	685089178956168000000000.00
9/30/2003	27.9882	2.5948E+15	1776796760015890000000000.00

Site 107: Cedar Creek at DeKalb County Road 27

Cedar Creek @ CR 27 (#107)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
3/31/1998	321.6388	0	0
4/7/1998	138.726	1.4255E+14	142549545591533
4/14/1998	269.745	0	0
4/21/1998	123.8258	6.72547E+14	672547247640052
4/28/1998	104.3014	2.55181E+13	25518128531818
5/5/1998	137.6984	0	0
5/12/1998	85.2908	0	0
5/19/1998	56.518	0	0
5/26/1998	51.38	1.25705E+13	12570506665920
6/2/1998	37.5074	1.83529E+13	18352939732243
6/16/1998	77.07	1.88558E+13	18855759998880
6/23/1998	44.7006	2.09978E+14	209977743347528
6/30/1998	44.1868	4.54047E+13	45404670077303
7/7/1998	45.7282	0	0
7/14/1998	27.2314	3.53106E+13	35310553224569
7/21/1998	25.1762	7.63784E+13	76378398502130
7/28/1998	31.3418	1.5336E+13	15336018132422
8/4/1998	36.9936	3.80132E+13	38013212157742
8/11/1998	42.1316	3.19542E+13	31954227944769
8/18/1998	25.1762	0	0
8/25/1998	98.6496	1.54466E+14	154466385910825
9/1/1998	59.6008	2.92365E+15	2923648440359670
9/8/1998	24.6624	1.20677E+13	12067686399283
9/15/1998	16.4416	4.02256E+12	4022562133094
9/22/1998	14.9002	1.13009E+13	11300885492662
9/29/1998	13.3588	1.3727E+13	13726993279185
10/6/1998	14.9002	3.64545E+12	3645446933117

Site 109: Willow Creek at Woods Road

Willow Creek @ Woods Rd. (#109)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	0.2765	40588693186	40588693186
5/21/1996	0.777	3.80198E+11	380197885536
5/28/1996	0.581	1.27931E+12	1279314506736
6/4/1996	0.2177	53261956037	53261956037
6/11/1996	1.449	1.13443E+13	11344282854912
6/18/1996	1.001	4.89804E+12	4898044831680
6/25/1996	0.2079	5.59507E+11	559507428850
7/2/1996	0.0882	3.45261E+11	345260782541
7/9/1996	0.0637	1.09093E+11	109092816706
7/16/1996	0.0574	98303417251	98303417251
7/23/1996	0.0784	7.09703E+11	709702719667
7/30/1996	0.0791	5.41868E+11	541867617043
8/6/1996	0.0434	10618139146	10618139146
8/13/1996	0.0336	32881979290	32881979290
8/20/1996	0.1337	2.94396E+11	294396470827
9/24/1996	0.0294	0	0
10/15/1996	0.0252	19112650462	19112650462

Site 110: Black Creek at Allen County Road 500 N

Black Creek @ CR 500N (#110)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	30.2965	4.44736E+13	44473610961936
5/21/1996	85.137	1.04147E+14	104147063645040
5/28/1996	63.661	4.04954E+14	404953807830624
6/4/1996	23.8537	1.7508E+14	175079658343824
6/11/1996	158.769	1.12648E+15	1126477158668780
6/18/1996	109.681	1.23438E+15	1234377269652380
6/25/1996	22.7799	5.57328E+13	55732752977616
7/2/1996	9.6642	1.18221E+13	11822099116464
7/9/1996	6.9797	1.02458E+13	10245819234269
7/16/1996	6.2894	4.61625E+12	4616248226429
7/23/1996	8.5904	1.05085E+13	10508532547968
7/30/1996	8.6671	1.7812E+14	178119626688058
8/6/1996	4.7554	6.98067E+12	6980668049722
8/13/1996	3.6816	1.80146E+12	1801462722509
8/20/1996	14.6497	1.50535E+14	150534728749642
8/27/1996	8.7438	1.92531E+13	19253132846813
9/24/1996	3.2214	9.77294E+12	9772935269610
10/1/1996	4.4486	0	0
10/8/1996	2.8379	0	0
10/15/1996	2.7612	9.25501E+12	9255014736889
11/5/1996	4.5253	3.58716E+13	35871626461957

Site 111: Little Cedar Creek at DeKalb County Road 68

Little Cedar @ CR 68 (#111)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	106.9265	1.09874E+14	109873592453419
5/21/1996	300.477	3.74921E+15	3749212820245970
5/28/1996	224.681	1.6491E+15	1649097318921120
6/4/1996	84.1877	2.05972E+14	205971592845168
6/11/1996	560.349	5.07246E+15	5072464403862190
6/18/1996	387.101	1.61002E+15	1610022322207730
6/25/1996	80.3979	1.967E+14	196699559726736
7/2/1996	34.1082	3.33793E+13	33379319226355
7/9/1996	24.6337	5.72548E+13	57254804506318
7/16/1996	22.1974	8.68922E+13	86892196081306
7/23/1996	30.3184	8.15939E+13	81593891442202
7/30/1996	30.5891	1.72129E+14	172128671962891
8/6/1996	16.7834	1.23186E+13	12318558285917
8/13/1996	12.9936	9.53695E+12	9536948350387
8/20/1996	51.7037	2.68174E+15	2681736893082490
11/5/1996	15.9713	1.21132E+13	12113248981152

Site 112: Little Cedar Creek at DeKalb County Road 52

Little Cedar @ CR 52 (#112)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	32.706	1.92043E+13	19204250261530
5/21/1996	91.908	1.88882E+15	1888823095342850
5/28/1996	68.724	4.20346E+14	420346195070400
6/4/1996	25.7508	3.15006E+13	31500642570336
6/11/1996	171.396	9.64467E+14	964466619147072
6/18/1996	118.404	1.0139E+15	1013895280157760
6/25/1996	24.5916	1.2033E+14	120330428853888
7/2/1996	10.4328	3.06296E+13	30629563708262
7/9/1996	7.5348	1.84345E+13	18434459639232
7/16/1996	6.7896	3.32225E+12	3322254264653
7/23/1996	9.2736	2.04197E+13	20419709138842
7/30/1996	9.3564	1.14456E+14	114455710946880
8/6/1996	5.1336	7.53585E+12	7535845039334
8/13/1996	3.9744	1.94473E+12	1944734203699
8/20/1996	15.8148	5.8812E+14	588120035435366
8/27/1996	9.4392	9.23749E+12	9237487467571
9/24/1996	3.4776	3.57345E+12	3573449099297
10/1/1996	4.8024	1.17494E+12	1174943581402
10/15/1996	2.9808	7.29275E+11	729275326387

Site 113: Diehl Ditch at State Road 8

Diehl Ditch @ SR 8 (#113)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	29.1905	1.92825E+13	19282528455530
5/21/1996	82.029	6.62278E+14	662277559611888
5/28/1996	61.337	2.10092E+14	210091871217312
6/4/1996	22.9829	2.24918E+13	22491763149254
6/11/1996	152.973	7.11094E+14	711094087347408
6/18/1996	105.677	9.82478E+14	982477821165984
6/25/1996	21.9483	5.36982E+13	53698180509072
7/2/1996	9.3114	1.13905E+13	11390523138288
7/9/1996	6.7249	2.46795E+13	24679466799624
7/16/1996	6.0598	2.96515E+12	2965152055046
7/23/1996	8.2768	1.61999E+13	16199855130010
7/30/1996	8.3507	4.90335E+13	49033490081011
8/6/1996	4.5818	1.34517E+13	13451665420454
8/13/1996	3.5472	8.67849E+12	8678493819648
8/20/1996	14.1149	3.21159E+14	321158511913349
8/27/1996	8.4246	2.06114E+13	20611422821664
9/24/1996	3.1038	2.35404E+12	2354041448580
10/1/1996	4.2862	0	0
10/15/1996	2.6604	1.30177E+12	1301774072947

Site 114: Peckhart Ditch at DeKalb County Road 40

Peckhart Ditch @ CR 40 (#114)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	21.5275	2.89678E+13	28967763767580
5/21/1996	60.495	1.13964E+15	1139643161894160
5/28/1996	45.235	7.19361E+14	719360577795600
6/4/1996	16.9495	1.07817E+14	107817416720208
6/11/1996	112.815	7.72829E+14	772829269490880
6/18/1996	77.935	2.7457E+15	2745703988501760
6/25/1996	16.1865	3.96015E+13	39601499834160
7/2/1996	6.867	2.01608E+13	20160763551936
7/9/1996	4.9595	3.15479E+13	31547861484048
7/16/1996	4.469	1.85874E+13	18587370629232
7/23/1996	6.104	7.46695E+12	7466949463680
7/30/1996	6.1585	2.03408E+14	203407703693640
8/6/1996	3.379	9.09368E+12	9093677739696
8/13/1996	2.616	2.5601E+12	2560096958976
8/20/1996	10.4095	6.9272E+14	692719568816256
8/27/1996	6.213	2.28009E+13	22800863540880
9/24/1996	2.289	5.60021E+11	560021209776
10/1/1996	3.161	6.72825E+12	6728254820309
10/15/1996	1.962	1.48806E+12	1488056357405

Site 115: Dibbling Ditch at DeKalb County Road 22

Dibbling Ditch @ CR 22 (#115)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	25.3195	3.40703E+13	34070342339484
5/21/1996	71.151	1.34039E+15	1340387645457170
5/28/1996	53.203	8.46074E+14	846073633700880
6/4/1996	19.9351	1.26809E+14	126809108472758
6/11/1996	132.687	9.08961E+14	908960663749824
6/18/1996	91.663	3.22935E+15	3229350929595650
6/25/1996	19.0377	4.65772E+13	46577176869168
7/2/1996	8.0766	2.3712E+13	23712017315213
7/9/1996	5.8331	3.71049E+13	37104915983990
7/16/1996	5.2562	2.18615E+13	21861476281354
7/23/1996	7.1792	8.78223E+12	8782228635264
7/30/1996	7.2433	2.39237E+14	239237317555272
8/6/1996	3.9742	1.06955E+13	10695499873661
8/13/1996	3.0768	3.01105E+12	3011049817805
8/20/1996	12.2431	8.1474E+14	814739896534349
8/27/1996	7.3074	2.68172E+13	26817162439824
9/24/1996	2.6922	6.58667E+11	658667147645
10/1/1996	3.7178	7.91342E+12	7913415302418
10/15/1996	2.3076	1.75017E+12	1750172706599

Site 116: Cedar Creek at DeKalb County Road 28

Cedar Creek @ CR 28 (#116)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	76.1165	5.02807E+13	50280693279847
5/21/1996	213.897	1.36062E+15	1360619604366050
5/28/1996	159.941	1.05653E+15	1056531023348690
6/4/1996	59.9297	2.93245E+13	29324511223690
6/11/1996	398.889	2.53737E+15	2537371694628580
6/18/1996	275.561	3.97767E+15	3977667221772820
6/25/1996	57.2319	1.40022E+14	140022183817296
7/2/1996	24.2802	1.18807E+14	118806701420736
7/9/1996	17.5357	2.83156E+14	283155971719421
7/23/1996	21.5824	9.50454E+13	95045361136589
7/30/1996	21.7751	4.3685E+14	436850355303389
8/27/1996	21.9678	8.06188E+13	80618833106928
9/24/1996	8.0934	1.98011E+12	1980111690346
10/15/1996	6.9372	1.4766E+13	14765975748006
11/12/1996	11.3693	2.78159E+12	2781585469771

Site 117: Garrett City Ditch

Garrett City Ditch (#117)			
Sampling Day	Disharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
4/15/2003	1.3167	1.21531E+14	391500027624200000000000.00
4/22/2003	0.7695	7.10377E+13	133738346504277000000000.00
4/29/2003	0.4788	4.42094E+13	51787809858338500000000.00
5/6/2003	8.55	7.896E+14	1651703298483840000000000.00
5/13/2003	8.493	7.84482E+14	1630056226930310000000000.00
5/20/2003	1.8126	1.67457E+14	742616857819149000000000.00
5/27/2003	0.684	6.32032E+13	105767820789382000000000.00
6/3/2003	0.5643	5.21523E+13	72001565472379000000000.00
6/10/2003	0.3648	3.37208E+13	30096221083589100000000.00
6/17/2003	0.9348	8.64257E+13	197660628699797000000000.00
6/24/2003	0.3477	3.21521E+13	27350960806585500000000.00
7/1/2003	0.1824	1.68698E+13	7528237293042460000000.00
7/8/2003	2.5137	2.3253E+14	1430049047790820000000000.00
7/15/2003	0.4617	4.27175E+13	48252985395033700000000.00
7/22/2003	3.2604	3.01715E+14	2406725665254250000000000.00
7/29/2003	3.5682	3.3026E+14	2883125614839050000000000.00
8/5/2003	5.0388	4.6646E+14	5750422831283450000000000.00
8/12/2003	0.7068	6.54431E+13	113166779455888000000000.00
8/19/2003	0.2907	2.69211E+13	19146802628518000000000.00
8/26/2003	0.2907	2.69261E+13	19150343461721000000000.00
9/2/2003	14.934	1.38352E+15	50549759075000600000000000.00
9/9/2003	1.2483	1.15666E+14	353252313175740000000000.00
9/16/2003	0.4446	4.12039E+13	44819422110239000000000.00
9/23/2003	1.5504	1.43712E+14	545123748822272000000000.00
9/30/2003	2.4966	2.31461E+14	1413792744750240000000000.00

Site 118: Avilla Drain

Avilla Drain (#118)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	1.501	2.93785E+11	293784826867
5/21/1996	4.218	5.8822E+13	58822044290784
5/28/1996	3.154	2.31495E+12	2314950059808
6/4/1996	1.1818	1.15655E+12	1156545331085
6/11/1996	7.866	3.27161E+13	32716101447648
6/18/1996	5.434	5.45082E+13	54508241769696
6/25/1996	1.1286	2.76121E+12	2761205493024
7/2/1996	0.4788	9.37136E+11	937136409754
7/9/1996	0.3458	2.53808E+11	253807777642
7/16/1996	0.3116	1.52471E+11	152470606349
7/23/1996	0.4256	4.16505E+11	416505071002
7/30/1996	0.4294	3.04662E+12	3046623030518
8/6/1996	0.2356	57641326790	57641326790
8/13/1996	0.1824	44625543322	44625543322
8/20/1996	0.7258	8.70105E+12	8701051248893
8/27/1996	0.4332	1.05986E+12	1059856653888
9/24/1996	0.1596	39047350406	39047350406
10/15/1996	0.1368	0	0
11/5/1996	0.2242	2.90717E+11	290716820764

Site 119: Cedar Creek at DeKalb County Road 119

Cedar Creek @ CR 60 (#119)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
5/14/1996	209.5475	2.81971E+14	281970617957820
5/21/1996	588.855	5.18644E+15	5186442298547520
5/28/1996	440.315	8.29493E+15	8294933115619920
6/4/1996	164.9855	6.45839E+14	645839261200512
6/11/1996	1098.135	7.25401E+15	7254010512157680
6/18/1996	758.615	9.28005E+15	9280045654308000
6/25/1996	157.5585	3.85479E+14	385478819486640
7/2/1996	66.843	8.17682E+13	81768234436560
7/9/1996	48.2755	7.08658E+13	70865803178352
7/16/1996	43.501	3.19285E+13	31928548684752
7/23/1996	59.416	1.74439E+14	174438900131328
7/30/1996	59.9465	1.49597E+15	1495969317644110
8/6/1996	32.891	8.04703E+12	8047032595344
8/13/1996	25.464	1.86899E+13	18689882156928
8/20/1996	101.3255	5.75129E+15	5751292070401340
8/27/1996	60.477	1.03573E+14	103573096952976
9/24/1996	22.281	1.68988E+13	16898768450222
10/15/1996	19.098	1.44847E+13	14484658671619
11/5/1996	31.2995	7.58108E+13	75810834499039

Site 138: Black Creek at State Road 205

Black Creek @ SR 205 (#138)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
4/18/2000	6.7431	1.05584E+13	10558403549891
4/25/2000	29.1954	0	0
5/2/2000	15.4128	7.54172E+12	7541716821350
5/9/2000	7.7805	5.90103E+12	5901030830167
5/16/2000	8.8179	4.31473E+12	4314732219907
5/23/2000	23.1192	0	0
5/30/2000	47.7945	2.33866E+13	23386573796976
6/6/2000	46.9794	0	0
6/13/2000	11.5596	2.46049E+13	24604851129656
6/20/2000	18.5991	7.51728E+14	751727875818891
6/27/2000	59.6505	4.52412E+13	45241236364615
7/4/2000	21.1185	5.11513E+13	51151331758270
7/11/2000	7.41	1.35968E+13	13596845230800
7/18/2000	4.8165	8.83795E+12	8837949400020
7/25/2000	3.6309	1.77665E+12	1776654443491
8/1/2000	4.3719	0	0
8/8/2000	16.1538	0	0
8/15/2000	3.6309	8.88327E+11	888327221746
8/22/2000	2.8158	0	0
8/29/2000	18.0804	0	0
9/5/2000	3.8532	1.88543E+12	1885429205338
9/12/2000	98.553	4.82235E+13	48223477751904
9/19/2000	12.4488	9.31982E+13	93198215949996

Site 139: Diehl Ditch at DeKalb County Road 40

Diehl Ditch @ CR 40 (#139)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
4/18/2000	5.4145	0	0
4/25/2000	23.443	5.73551E+12	5735507741712
5/2/2000	12.376	3.02788E+12	3027882259584
5/9/2000	6.2475	6.41969E+12	6419692675368
5/16/2000	7.0805	1.7323E+12	1732298023512
5/23/2000	18.564	4.54182E+12	4541823389376
5/30/2000	38.3775	9.38935E+12	9389346429960
6/6/2000	37.723	9.22922E+12	9229218041232
6/13/2000	9.282	2.81593E+13	28159305014131
6/20/2000	14.9345	7.30768E+12	7307677376496
6/27/2000	47.8975	4.92176E+13	49217643844488
7/4/2000	16.9575	1.74249E+13	17424880118856
7/11/2000	5.95	2.91143E+12	2911425249600
7/18/2000	3.8675	1.29631E+13	12963120923844
7/25/2000	2.9155	2.99586E+12	2995856581838
8/1/2000	3.5105	3.60726E+12	3607255884254
8/8/2000	12.971	3.52253E+13	35225334094910
8/15/2000	2.9155	2.0543E+13	20543016561178
8/22/2000	2.261	3.54029E+12	3540293103514
8/29/2000	14.518	3.94265E+13	39426520730083
9/5/2000	3.094	1.24143E+13	12414317264294
9/12/2000	79.135	1.02613E+14	102613182922152
9/19/2000	9.996	2.31109E+14	231108936313248

Site 140: Diehl Ditch at DeKalb County Road 36A

Diehl Ditch @ CR 36A (#140)			
Sampling Day	Discharge (cf/day)	E Coli Load (colonies/day)	Non-Scientific #
4/18/2000	4.5409	2.22193E+12	2221931246371
4/25/2000	19.6606	0	0
5/2/2000	10.3792	0	0
5/9/2000	5.2395	6.79398E+12	6793982080250
5/16/2000	5.9381	4.50368E+12	4503683718606
5/23/2000	15.5688	1.1808E+13	11807977480716
5/30/2000	32.1855	1.57489E+13	15748853339664
6/6/2000	31.6366	7.74013E+12	7740134121974
6/13/2000	7.7844	7.99895E+12	7998952486936
6/20/2000	12.5249	2.29823E+13	22982338303812
6/27/2000	40.1695	3.04661E+13	30466095743513
7/4/2000	14.2215	3.4794E+12	3479397830856
7/11/2000	4.99	0	0
7/18/2000	3.2435	3.3329E+12	3332896869557
7/25/2000	2.4451	5.9223E+12	5922301360520
8/1/2000	2.9441	3.81757E+12	3817570883188
8/8/2000	10.8782	1.1178E+13	11178023347129
8/15/2000	2.4451	4.48659E+12	4486591939788
8/22/2000	1.8962	3.4794E+12	3479397830856
8/29/2000	12.1756	0	0
9/5/2000	2.5948	7.0467E+12	7046696238492
9/12/2000	66.367	1.62372E+13	16237189877328
9/19/2000	8.3832	1.51365E+14	151364793214333

Appendix H Atrazine Loads for Cedar Creek, Site 100

USGS Flow data for site 100		100			Atrazine	Micro grams atz	Grams	Kg Atz
		Flow	Total Flow	Liters				
4/16/1996	16	113	9763200	276463037	0	0	0	0
4/30/1996	18	352	30412800	861194592	0.37	318641999.1	318.6419991	0.318641999
5/7/1996	19	250	21600000	611643886	0	0	0	0
5/14/1996	20	395	34128000	966397340	0	0	0	0
5/28/1996	22	830	71712000	2.031E+09	0	0	0	0
6/4/1996	23	311	26870400	760884995	0.94	715231895	715.231895	0.715231895
6/11/1996	24	2070	1.79E+08	5.064E+09	2.82	14281640090	14281.64009	14.28164009
7/30/1996	31	113	9763200	276463037	0.51	140996148.7	140.9961487	0.140996149
8/27/1996	35	114	9849600	278909612	0	0	0	0
9/3/1996	36	55	4752000	134561655	0.5	67280827.5	67.2808275	0.067280828
9/24/1996	39	42	3628800	102756173	0	0	0	0
10/22/1996	43	54	4665600	132115079	0.16	21138412.71	21.13841271	0.021138413
11/26/1996	48	234	20217600	572498678	0.27	154574643	154.574643	0.154574643
12/24/1996	52	1880	1.62E+08	4.6E+09	0.14	643938683.6	643.9386836	0.643938684
							Sum	16.3434427
							Average	1.167388764
3/11/1997	10	426	36806400	1.042E+09	0.11	114646530.1	114.6465301	0.11464653
4/8/1997	14	268	23155200	655682246	0.28	183591028.9	183.5910289	0.183591029
5/6/1997	18	393	33955200	961504189	6.86	6595918739	6595.918739	6.595918739
5/20/1997	20	864	74649600	2.114E+09	5.84	12344833025	12344.83302	12.34483302
5/27/1997	21	701	60566400	1.715E+09	6.27	10753360098	10753.3601	10.7533601
6/3/1997	22	773	66787200	1.891E+09	8	15129623174	15129.62317	15.12962317
6/10/1997	23	165	14256000	403684965	3.71	1497671220	1497.67122	1.49767122
6/17/1997	24	176	15206400	430597296	2	861194592	861.194592	0.861194592
6/24/1997	25	144	12441600	352306879	2.7	951228572.1	951.2285721	0.951228572
7/1/1997	26	307	26524800	751098692	4.46	3349900168	3349.900168	3.349900168
7/8/1997	27	176	15206400	430597296	2.63	1132470889	1132.470889	1.132470889
7/15/1997	28	126	10886400	308268519	2.19	675108056	675.108056	0.675108056
7/22/1997	29	394	34041600	963950765	0.77	742242089	742.242089	0.742242089

7/29/1997	30	116	10022400	283802763	0.53	150415464.5	150.4154645	0.150415465
8/5/1997	31	61	5270400	149241108	0.52	77605376.3	77.6053763	0.077605376
8/12/1997	32	55	4752000	134561655	0.25	33640413.75	33.64041375	0.033640414
							Sum	54.59344944
							Average	3.41209059
3/24/1998	12	564	48729600	1.38E+09	0.1	137986860.8	137.9868608	0.137986861
4/21/1998	16	241	20822400	589624706	0.21	123821188.4	123.8211884	0.123821188
4/28/1998	17	203	17539200	496654836	0.79	392357320.2	392.3573202	0.39235732
5/5/1998	18	268	23155200	655682246	0.45	295057010.8	295.0570108	0.295057011
5/12/1998	19	166	14342400	406131541	0.22	89348938.92	89.34893892	0.089348939
5/19/1998	20	110	9504000	269123310	2.26	608218680.6	608.2186806	0.608218681
5/26/1998	21	100	8640000	244657555	1.1	269123310	269.12331	0.26912331
6/2/1998	22	73	6307200	178600015	0.51	91086007.56	91.08600756	0.091086008
6/9/1998	23	61	5270400	149241108	1.94	289527750.1	289.5277501	0.28952775
6/16/1998	24	150	12960000	366986332	2.04	748652116.9	748.6521169	0.748652117
6/23/1998	25	87	7516800	212852072	1.3	276707694.2	276.7076942	0.276707694
6/30/1998	26	86	7430400	210405497	1.06	223029826.7	223.0298267	0.223029827
7/7/1998	27	89	7689600	217745224	1.41	307020765.2	307.0207652	0.307020765
7/14/1998	28	53	4579200	129668504	0.44	57054141.72	57.05414172	0.057054142
7/21/1998	29	49	4233600	119882202	0.99	118683379.7	118.6833797	0.11868338
7/28/1998	30	61	5270400	149241108	0.47	70143320.89	70.14332089	0.070143321
8/4/1998	31	72	6220800	176153439	0.38	66938306.93	66.93830693	0.066938307
8/11/1998	32	82	7084800	200619195	0.12	24074303.37	24.07430337	0.024074303
8/18/1998	33	49	4233600	119882202	0.06	7192932.104	7.192932104	0.007192932
8/25/1998	34	192	16588800	469742505	0.11	51671675.52	51.67167552	0.051671676
							Sum	4.247695531
							Average	0.212384777
4/6/1999	14	189	16329600	462402778	0.15	69360416.72	69.36041672	0.069360417
4/13/1999	15	744	64281600	1.82E+09	0.19	345847919.1	345.8479191	0.345847919
4/20/1999	16	547	47260800	1.338E+09	0.28	374717510.6	374.7175106	0.374717511
4/27/1999	17	737	63676800	1.803E+09	0.13	234406403	234.406403	0.234406403
5/4/1999	18	264	22809600	645895944	0.09	58130634.96	58.13063496	0.058130635
5/11/1999	19	176	15206400	430597296	0.32	137791134.7	137.7911347	0.137791135
5/18/1999	20	163	14083200	398791814	4.89	1950091970	1950.09197	1.95009197
5/25/1999	21	622	53740800	1.522E+09	8.66	13178528108	13178.52811	13.17852811

6/1/1999	22	1360	1.18E+08	3.327E+09	6.66	22160102661	22160.10266	22.16010266
6/8/1999	23	166	14342400	406131541	2.64	1072187267	1072.187267	1.072187267
6/15/1999	24	405	34992000	990863096	12.35	12237159235	12237.15923	12.23715923
6/22/1999	25	94	8121600	229978101	2.44	561146567.1	561.1465671	0.561146567
6/29/1999	26	127	10972800	310715094	1.66	515787056.5	515.7870565	0.515787057
7/6/1999	27	68	5875200	166367137	0.9	149730423.4	149.7304234	0.149730423
7/13/1999	28	52	4492800	127221928	0.46	58522087.05	58.52208705	0.058522087
7/20/1999	29	47	4060800	114989051	0.3	34496715.19	34.49671519	0.034496715
7/27/1999	30	50	4320000	122328777	0.47	57494525.32	57.49452532	0.057494525
8/3/1999	31	37	3196800	90523295	0.32	28967454.46	28.96745446	0.028967454
8/10/1999	32	35	3024000	85630144	0.21	17982330.26	17.98233026	0.01798233
8/17/1999	33	35	3024000	85630144	0.16	13700823.06	13.70082306	0.013700823
8/24/1999	34	34	2937600	83183569	0.2	16636713.71	16.63671371	0.016636714
8/31/1999	35	33	2851200	80736993	0.34	27450577.62	27.45057762	0.027450578
9/7/1999	36	25	2160000	61164389	0.21	12844521.61	12.84452161	0.012844522
9/14/1999	37	26	2246400	63610964	0.13	8269425.344	8.269425344	0.008269425
							Sum	53.32135248
							Average	2.22172302
4/11/2000	15	124	10713600	303375368	0.15	45506305.15	45.50630515	0.045506305
4/18/2000	16	91	7862400	222638375	0.15	33395756.2	33.3957562	0.033395756
4/25/2000	17	394	34041600	963950765	0.14	134953107.1	134.9531071	0.134953107
5/2/2000	18	208	17971200	508887713	0.1	50888771.35	50.88877135	0.050888771
5/9/2000	19	105	9072000	256890432	0.05	12844521.61	12.84452161	0.012844522
5/16/2000	20	119	10281600	291142490	0.53	154305519.7	154.3055197	0.15430552
5/23/2000	21	312	26956800	763331570	1.12	854931358.6	854.9313586	0.854931359
5/30/2000	22	645	55728000	1.578E+09	0.74	1167750508	1167.750508	1.167750508
6/6/2000	23	634	54777600	1.551E+09	0.43	666985425.2	666.9854252	0.666985425
6/13/2000	24	156	13478400	381665785	2.25	858748016.5	858.7480165	0.858748016
6/20/2000	25	251	21686400	614090462	5.39	3309947590	3309.94759	3.30994759
6/27/2000	26	805	69552000	1.969E+09	6.21	12230553481	12230.55348	12.23055348
7/4/2000	27	285	24624000	697274030	6.09	4246398846	4246.398846	4.246398846
7/11/2000	28	100	8640000	244657555	5.56	1360296003	1360.296003	1.360296003
7/18/2000	29	65	5616000	159027410	1.94	308513176.3	308.5131763	0.308513176
7/25/2000	30	49	4233600	119882202	2.38	285319640.1	285.3196401	0.28531964
8/1/2000	31	59	5097600	144347957	2.57	370974250	370.97425	0.37097425

8/8/2000	32	218	18835200	533353469	2.89	1541391525	1541.391525	1.541391525
8/15/2000	33	49	4233600	119882202	1.08	129472777.9	129.4727779	0.129472778
8/22/2000	34	38	3283200	92969871	0.83	77164992.71	77.16499271	0.077164993
8/29/2000	35	244	21081600	596964433	0.46	274603639.2	274.6036392	0.274603639
9/5/2000	36	52	4492800	127221928	0.55	69972060.6	69.9720606	0.069972061
9/12/2000	37	1330	1.15E+08	3.254E+09	0.5	1626972738	1626.972738	1.626972738
							Sum	29.81189001
							Average	1.296169131
4/11/2001	15	606	52358400	1.483E+09	2.13	3157990783	3157.990783	3.157990783
4/18/2001	16	274	23673600	670361699	2.01	1347427016	1347.427016	1.347427016
4/25/2001	17	228	19699200	557819224	0.43	239862266.5	239.8622665	0.239862266
5/2/2001	18	132	11404800	322947972	0.32	103343351	103.343351	0.103343351
5/9/2001	19	100	8640000	244657555	0.24	58717813.09	58.71781309	0.058717813
5/16/2001	20	137	11836800	335180850	0.18	60332552.95	60.33255295	0.060332553
5/23/2001	21	110	9504000	269123310	0.41	110340557.1	110.3405571	0.110340557
5/30/2001	22	211	18230400	516227440	1.27	655608848.9	655.6088489	0.655608849
6/6/2001	23	827	71452800	2.023E+09	0.1	202331797.6	202.3317976	0.202331798
6/13/2001	24	157	13564800	384112361	0.08	30728988.85	30.72898885	0.030728989
6/20/2001	25	126	10886400	308268519	0.14	43157592.62	43.15759262	0.043157593
6/27/2001	26	96	8294400	234871252	0.08	18789700.19	18.78970019	0.0187897
7/4/2001	27	79	6825600	193279468	0.57	110169296.8	110.1692968	0.110169297
7/11/2001	28	45	3888000	110095900	0.27	29725892.88	29.72589288	0.029725893
7/18/2001	29	40	3456000	97863022	3.87	378729894.5	378.7298945	0.378729894
7/25/2001	30	57	4924800	139454806	2.38	331902438.5	331.9024385	0.331902439
8/1/2001	31	28	2419200	68504115	0.86	58913539.14	58.91353914	0.058913539
8/8/2001	32	22	1900800	53824662	2.17	116799516.5	116.7995165	0.116799517
8/15/2001	33	20	1728000	48931511	1.55	75843841.91	75.84384191	0.075843842
8/22/2001	34	44	3801600	107649324	1.01	108725817.2	108.7258172	0.108725817
8/29/2001	35	47	4060800	114989051	0.59	67843539.88	67.84353988	0.06784354
9/5/2001	36	27	2332800	66057540	0.69	45579702.41	45.57970241	0.045579702
9/12/2001	37	47	4060800	114989051	0.31	35646605.7	35.6466057	0.035646606
9/19/2001	38	82	7084800	200619195	0.6	120371516.8	120.3715168	0.120371517
9/26/2001	39	37	3196800	90523295	0.31	28062221.51	28.06222151	0.028062222
							Sum	7.536945091
							Average	0.301477804

4/3/2002	14	1820	1.57E+08	4.453E+09	0.34	1513940948	1513.940948	1.513940948
4/10/2002	15	1430	1.24E+08	3.499E+09	0.27	944622818.1	944.6228181	0.944622818
4/17/2002	16	476	41126400	1.165E+09	0.4	465827983.9	465.8279839	0.465827984
4/24/2002	17	360	31104000	880767196	0.2	176153439.3	176.1534393	0.176153439
5/1/2002	18	299	25833600	731526088	0.12	87783130.57	87.78313057	0.087783131
5/8/2002	19	348	30067200	851408290	0.06	51084497.39	51.08449739	0.051084497
5/15/2002	20	923	79747200	2.258E+09	3.15	7113296070	7113.29607	7.11329607
5/22/2002	21	255	22032000	623876764	0.57	355609755.5	355.6097555	0.355609756
5/29/2002	22	199	17193600	486868534	0.88	428444309.5	428.4443095	0.42844431
6/5/2002	23	192	16588800	469742505	1.91	897208184.1	897.2081841	0.897208184
6/12/2002	24	103	8899200	251997281	1.96	493914671.1	493.9146711	0.493914671
6/19/2002	25	80	6912000	195726044	1.08	211384127.1	211.3841271	0.211384127
6/26/2002	26	327	28252800	800030203	0.93	744028089.2	744.0280892	0.744028089
7/3/2002	27	77	6652800	188386317	1.46	275044022.8	275.0440228	0.275044023
7/10/2002	28	96	8294400	234871252	0.49	115086913.7	115.0869137	0.115086914
7/17/2002	29	46	3974400	112542475	0.54	60772936.55	60.77293655	0.060772937
7/24/2002	30	43	3715200	105202748	0.41	43133126.87	43.13312687	0.043133127
7/31/2002	31	82	7084800	200619195	0.51	102315789.3	102.3157893	0.102315789
8/7/2002	32	38	3283200	92969871	0.33	30680057.34	30.68005734	0.030680057
8/14/2002	33	43	3715200	105202748	0.15	15780412.27	15.78041227	0.015780412
8/21/2002	34	46	3974400	112542475	0.39	43891565.29	43.89156529	0.043891565
8/28/2002	35	34	2937600	83183569	0.26	21627727.82	21.62772782	0.021627728
9/4/2002	36	27	2332800	66057540	0.12	7926904.768	7.926904768	0.007926905
9/11/2002	37	23	1987200	56271238	0.23	12942384.64	12.94238464	0.012942385
							Sum	14.21249986
							Average	0.592187494
4/1/2003	13	504	43545600	1.233E+09	0.27	332930000.2	332.9300002	0.33293
4/8/2003	14	902	77932800	2.207E+09	0.36	794452011.2	794.4520112	0.794452011
4/15/2003	15	231	19958400	565158951	0.25	141289737.8	141.2897378	0.141289738
4/22/2003	16	135	11664000	330287699	0.08	26423015.89	26.42301589	0.026423016
4/29/2003	17	84	7257600	205512346	0.14	28771728.42	28.77172842	0.028771728
5/6/2003	18	1500	1.3E+08	3.67E+09	5.44	19964056452	19964.05645	19.96405645
5/13/2003	19	1490	1.29E+08	3.645E+09	4.22	15383577715	15383.57772	15.38357772
5/20/2003	20	318	27475200	778011023	1.58	1229257417	1229.257417	1.229257417
5/27/2003	21	120	10368000	293589065	1.75	513780864.6	513.7808646	0.513780865

6/3/2003	22	99	8553600	242210979	0.85	205879332.2	205.8793322	0.205879332
6/10/2003	23	64	5529600	156580835	0.63	98645926	98.645926	0.098645926
6/17/2003	24	164	14169600	401238389	1.72	690130029.9	690.1300299	0.69013003
6/24/2003	25	61	5270400	149241108	1.12	167150041.3	167.1500413	0.167150041
7/1/2003	26	32	2764800	78290417	0.64	50105867.17	50.10586717	0.050105867
7/8/2003	27	441	38102400	1.079E+09	3.27	3528133197	3528.133197	3.528133197
7/15/2003	28	81	6998400	198172619	1.15	227898512.1	227.8985121	0.227898512
7/22/2003	29	572	49420800	1.399E+09	0.72	1007597673	1007.597673	1.007597673
7/29/2003	30	626	54086400	1.532E+09	1.05	1608134106	1608.134106	1.608134106
8/5/2003	31	884	76377600	2.163E+09	0.63	1362546853	1362.546853	1.362546853
8/12/2003	32	124	10713600	303375368	0.47	142586422.8	142.5864228	0.142586423
8/19/2003	33	51	4406400	124775353	0.36	44919127.02	44.91912702	0.044919127
8/26/2003	34	51	4406400	124775353	0.46	57396662.3	57.3966623	0.057396662
9/2/2003	35	2620	2.26E+08	6.41E+09	0.25	1602506982	1602.506982	1.602506982
9/9/2003	36	219	18921600	535800044	0.13	69654005.78	69.65400578	0.069654006
9/16/2003	37	78	6739200	190832893	0.3	57249867.77	57.24986777	0.057249868
9/23/2003	38	272	23500800	665468548	0.13	86510911.29	86.51091129	0.086510911
9/30/2003	39	438	37843200	1.072E+09	0.08	85728007.12	85.72800712	0.085728007
							Sum	49.50731247
							Average	1.833604165

Glossary

Basin A basin is a land area drained by a large river or lake and the smaller streams and rivers that run into the larger waterbody. A basin can be a group of watersheds that all drain to a large river or lake.

Construction (drain) the building of a new ditch or channelization of a natural stream for the first time.

Debrushing Removal of vegetation and mechanical dredging and removal of the sediment from the bed and sides of the drain channel

Endangered Any animal species whose prospects for survival or recruitment within the state are in immediate jeopardy and are in danger of disappearing from the state. This includes all species classified as endangered by the federal government that occur in Indiana.

Extirpated Any animal species that has been absent from Indiana as a naturally occurring breeding population for more than 15 years.

Maintenance (drain) Routine work that helps keep the ditch operating at specification

Reconstruction (drain) An extensive new project on an existing ditch

Special Concern Any animal species about which some problems of limited abundance or distribution in Indiana are known or suspected and should be closely monitored.

Watershed A watershed is a land area that drains to a waterbody. Activities in the land area affect the waterbody's flow and its level of pollutants.

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