VFC Index - Watershed (Plan)

Program: Watershed

IDEM Document Type: Plan

Document Date: 7/11/2011

Security Group: Public

Project Name: West Fork Whitewater River Watershed Management Plan

Plan Type: Watershed Management Plan

HUC Code: 05080003 Whitewater

Sponsor: Wayne County SWCD

Contract #: 8-56

County: Wayne

Cross Reference ID: 28948014; 63495959

Comments: Randolph, Henry, Fayette, Union

Additional WMP Information

Checklist: 2003 Checklist

Grant type: 319

Fiscal Year: 2007

IDEM Approval Date: 7/11/2011

EPA Approval Date:

Project Manager: Leanne Whitesell

West Fork of the Whitewater River
Watershed Management Plan

Watershed Management Plan
June 2011

Prepared by: West Fork Watershed steering Committee and the Wayne County Soil and Water Conservation District
823 S. Round Barn Road, Richmond, Indiana 47374

Funded through the Indiana Department of Environmental Management Section 319 Grant Program

Watershed Management Plan: West Fork of the Whitewater River Watershed

Table of Contents

List of Tables

List of Figures

1.0 Introduction

The West Fork Watershed Management Plan addresses the current conditions of the West Fork Watershed that have been determined by a preliminary assessment of the watershed conducted by the West Fork Watershed Partnership (WFWP) and assisting partners. The project is volunteer-based and is overseen by the Wayne County Soil and Water Conservation District (SWCD). The obtained information provides guidance for future projects within the watershed boundaries (10 digit hydrologic unit codes: 0508000301, 0508000302, and 0508000303) and will help educate stakeholders about current conditions of the watershed. The watershed plan will be updated by the committee on an annual basis to include any changes, including work completed or currently in progress.

1.2 Steering Committee

In the spring of 2008 a steering committee began to form by phone calls, newspaper ads, and word of mouth. Currently we have 15 members from the watershed community with diverse backgrounds forming the WFWP. The WFWP is the governing body of the West Fork Watershed project and oversees the watershed coordinator's activities. Current members are:

- Jim Howell, Watershed Farmer
- Shane Edington, Attorney
- Jonathan Ferris, Purdue Extension
- Cathy Becker, Watershed Farmer
- Richard Roeper, Biology Professor at IU East
- Harold Routson, Watershed Farmer and Chairman of the Wayne County SWCD Board of Supervisors
- Kelly Dungan, Middle School Science Teacher and Previous Watershed Coordinator
- Ron Brown, Excavating Contractor
- Bob Warner, City Manager for Hagerstown
- Diana Bowman, High School Science Teacher
- Al Gentry, President of The Society for the Preservation and Use of Resources (SPUR)
- Glen Gentry, Environmental Enthusiast
- Tim McConaha, Watershed Farmer
- David Drake, Watershed Farmer

1.2 Mission and Vision Statements

Mission and vision statements were developed by the WFWP to guide the committee in developing a focus for the management plan.

Our mission:
To improve the quality of life for West Fork of the Whitewater River Watershed residents by promoting education, conservation, and stewardship for our aquatic resources.

Our vision:
Enhanced water quality in the West Fork of the Whitewater River Watershed.

1.3 Stakeholders

Several sign-ups at field days, public meetings, and community events provided a list of stakeholders in the watershed. These stakeholders were mailed newsletters with information outlining past, present, and future watershed activities as well as general project information. The list of stakeholders will continue to grow as more people sign-up during future watershed activities.

1.4 Public Participation

To encourage public participation in the project newspaper articles were submitted to area newspapers informing the public of the project and ways to become involved (e.g. become a steering committee member). Announcements were also made at local events sponsored by the Wayne County Soil and Water Conservation District. A watershed survey was sent out to a majority of West Fork Watershed residents to gauge their knowledge of watersheds and best management practices, and what they feel may be contributing to poor water quality. Public meetings were held in Hagerstown, Cambridge City, and Fountain City. Overall 33 community members attended to gain more information on the West Fork of the Whitewater River Watershed project. Future public meetings will be conducted in Cambridge City and Fountain City.

1.5 Partnerships

Many watershed partnerships have been established. These partners have assisted with obtaining watershed information, advertising watershed events, providing technical assistance, or have given monetary support.

Community Partnerships:
- Wayne County SWCD: provides office space, supplies, and staff support
- Wayne County Surveyor's Office: GIS support and address list generation
- Wayne County NRCS: technical support and assistance
- Wayne County FSA: statistics and records
- Richmond Sanitary District: aiding in water sampling processing
- Hagerstown High School, Mrs. Bowman's Environmental Science Class: aided in preparation of WMP
- Hagerstown High School, donation of steering committee meeting space

- Hagerstown Masonic Lodge: use of their building
- Fountain City Lions Club: use of building
- Local residents: voice questions/concerns on the watershed, assisting with water monitoring
- Indiana-American Water Company: technical support
- Youth Empowered to Serve: aided in storm drain labeling
- City of Hagerstown: aided in storm drain labeling
- Wayne County Conservation Education Coordinator: website support
- Earlham College, Jay Robert's class: aided in river clean-up
- City of Greens Fork: aided in storm drain labeling
- Wayne County Health Department: provided speakers for Rural Homeowner Workshop
- Wayne County Fairgrounds: donated meeting space

Media Partnerships

- Palladium-Item, Richmond area daily newspaper
- Western Wayne News, newspaper that serves the western portion of Wayne County
- Nettle Creek Gazette, newspaper that serves the northwestern portion of Wayne County
- Kicks 96, local radio station

2.0 Watershed Description

2.1 Watershed Location

The West Fork of the Whitewater River Watershed is located in East Central Indiana in the western half of Wayne County (Figure 1), with headwaters located in southern Randolph County (Figure 2). The watershed also extends into southeastern portions of Henry County, northern portions of Fayette County and a very small part of northwestern Union County (Table 1). The watershed covers approximately 412 mi^2. The watershed lies within the 1,329 mi^2 Whitewater River Basin (Figure 1). About two miles east of the Indiana-Ohio state line, the Whitewater River joins the Miami River, which empties into the Ohio River at the intersection of Ohio, Indiana, and Kentucky.

Figure 1. The West Fork of the Whitewater River Watershed (depicted in blue) is located within the HUC 8 Whitewater River Watershed in east central Indiana.

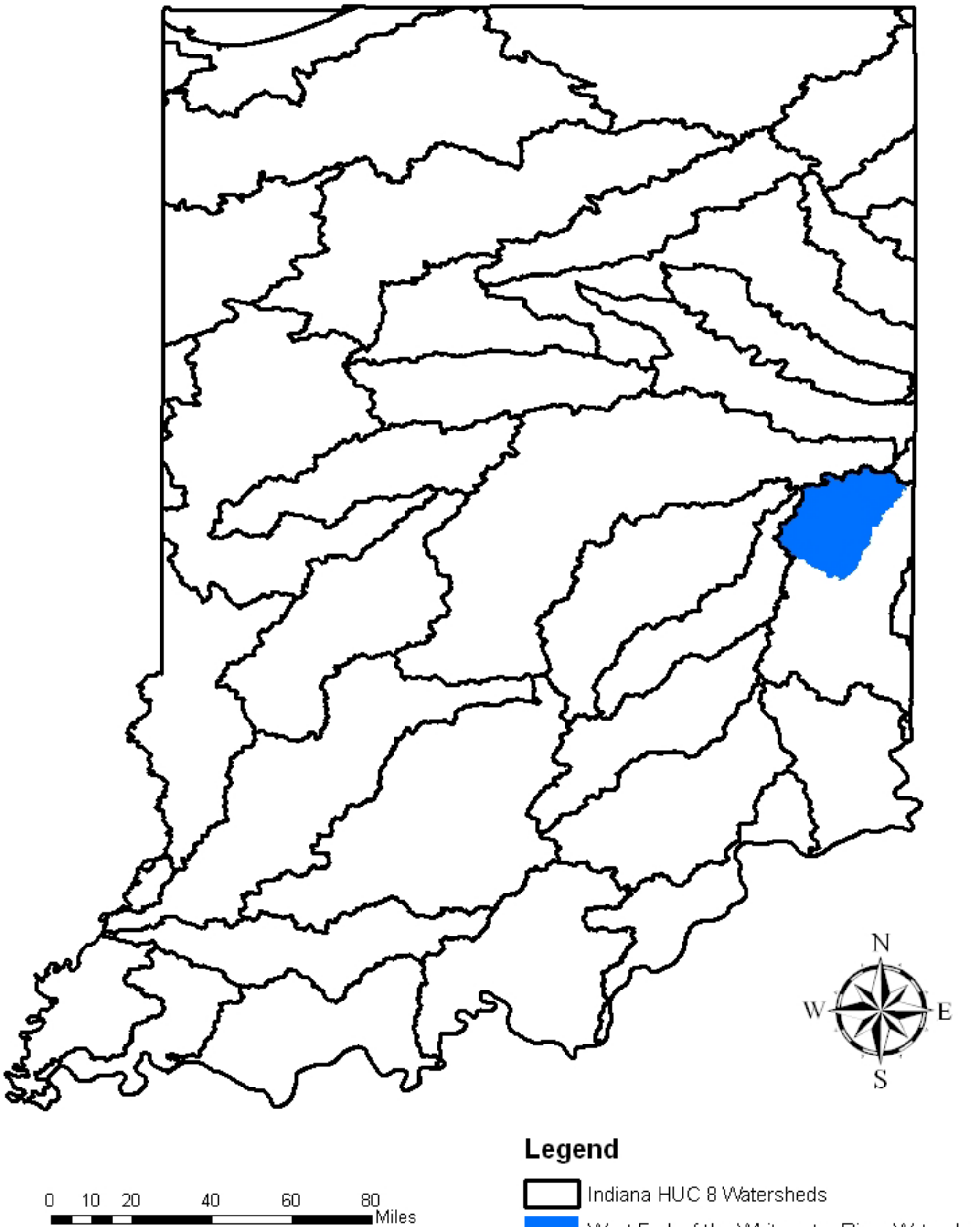
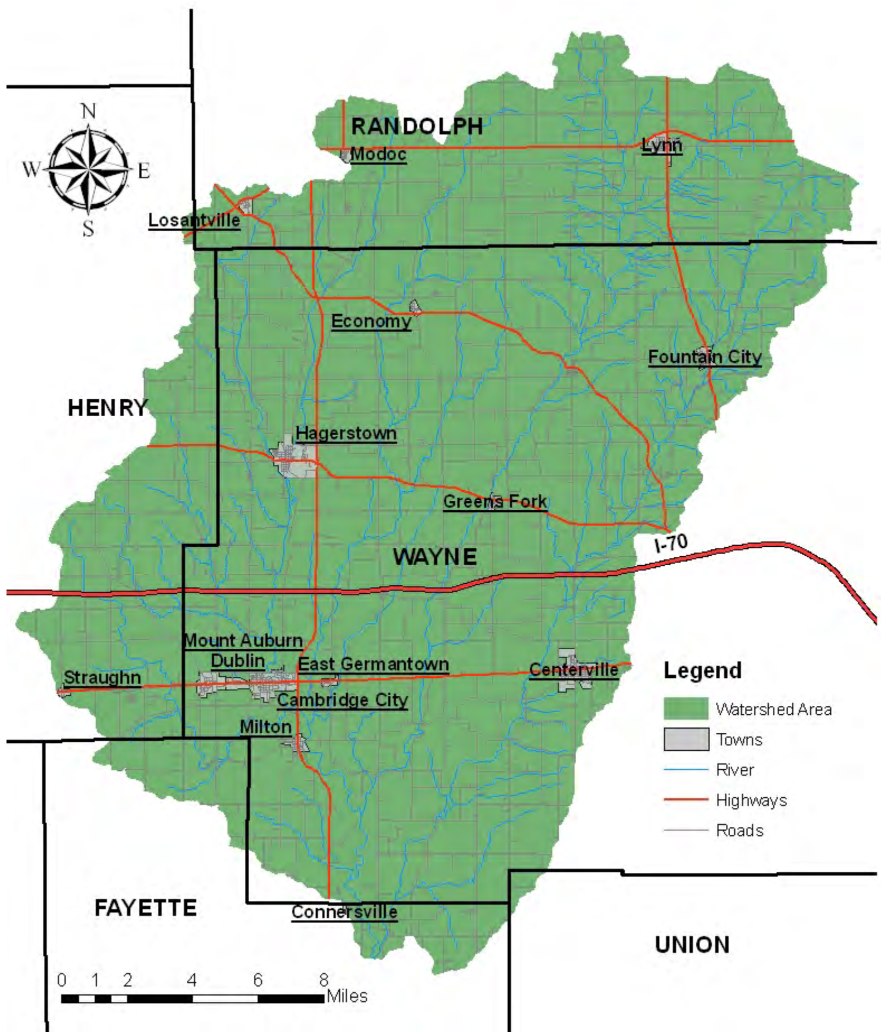


Table 1. Acreages and percent of the West Fork of the Whitewater River Watershed in each county.

County	Acres	%
Wayne	173,923.53	65.90
Randolph	51,873.75	19.64
Henry	27,607.68	10.46
Fayette	10,017.57	3.80
Union	516.44	0.20

Figure 2. The West Fork of the Whitewater River Watershed land area located in Randolph, Henry, Wayne, Fayette, and Union counties. Towns (underlined) within the watershed include: Hagerstown, Greens Fork, Modoc, Losantvile, Economy, Fountain City, Lynn, Centerville, East Germantown, Cambridge City, Milton, Mount Auburn, Dublin, and Straughn. Interstate highway 70 spans the watershed.



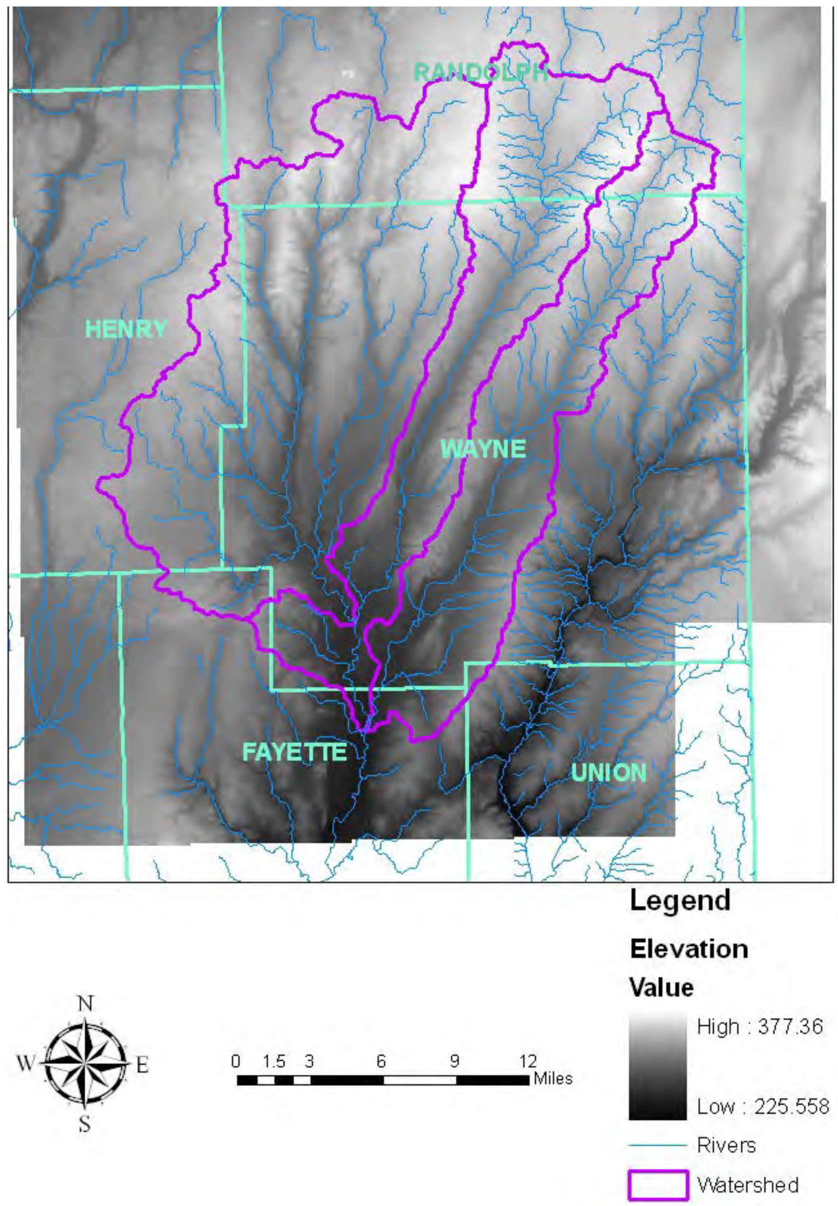
2.2 Physical Setting

The watershed is comprised of glacial outwash deposits of silty sand and gravel. The parent material of the soils in the watershed was deposited by glaciers or by melt water from glaciers that covered the area 10,000 – 20,000 years ago. The stream network becomes more deeply incised into the valleys at downstream locations. The West Fork of the Whitewater River Watershed is in the New Castle Till Plains and Drainageways physiographic region, which is part of the larger Central Till Plain. The till plains were formed from glacial deposits and are characterized by fairly low relief with occasional terminal moraines and knolls that rise above level ground. The region is part of the till plains section of the Central Lowland Province of the United States. The bedrock geology consists of Silurian rocks of limestone, dolomite, and shale. The watershed is within the southern limit of the Wisconsin Glacial Movement (Indiana Water Resources, 2003).

2.3 Topography

The United States Geological Survey (USGS) developed the National Elevation Dataset which portrays elevation in decimal meters (Figure 3). Since the watershed is located within the Newcastle Till Plain the topography can be described as nearly flat to gently rolling.

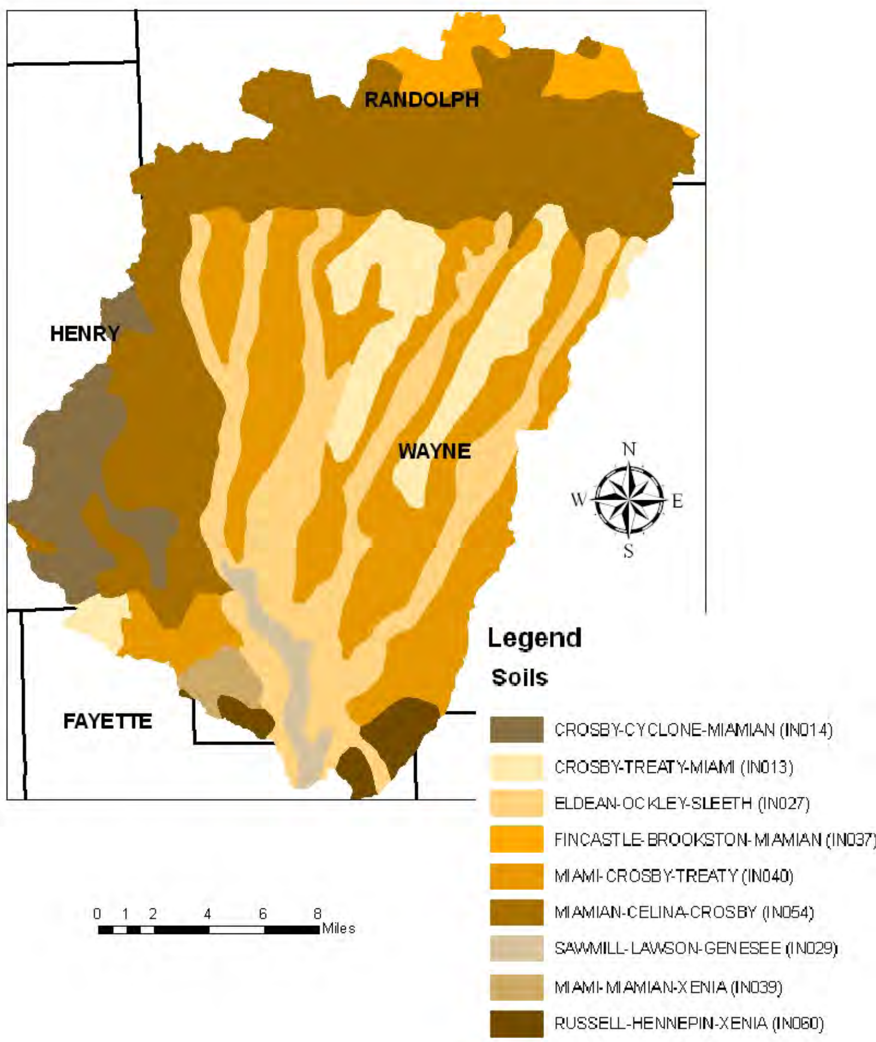
Figure 3. Elevation for the West Fork of the Whitewater River Watershed represented in decimal meters. Elevation is highest at the headwaters in Randolph County and gradually lessens as the river progresses southward.



2.4 Soils

The three dominant soil types in the West Fork are Miamian, Miami, and Eldean (Figure 4). Both the Miamian and Miami series consists of very deep, well-drained soils with moderately deep to dense till, and are good for septic systems. Miami soil is the state soil of Indiana. Miami soils are fertile and have a moderately available water capacity. Indiana is nationally ranked for agricultural production because of the highly productive Miami soils along with other prime farmland soils in the state. Miami soils formed in calcareous, loamy till on the Wisconsin Till Plains. The Eldean series consists of very deep well drained soils that have moderately deep to calcareous sandy and gravelly material. They formed in outwash materials dominantly of limestone origin on outwash terraces, kames, and moraines (National Cooperative Soil Survey Program, NRCS).

Figure 4. The spatial distribution of soil types in the West Fork of the Whitewater River.



2.5 Hydrology

The West Fork of the Whitewater River Watershed is comprised of 3 10-digit Hydrologic Unit Codes (HUCs). HUCs are a way of identifying watersheds in a nested arrangement from largest, with shorter HUCs, to smallest, with longer HUCs. The West Fork of the Whitewater River, Greens Fork River, and Nolands Fork River comprise the 3 10-digit HUCs, 0508000301, 0508000302, and 0508000303, respectively. Each 10-digit HUC is broken down further into 18 12-digit HUCs, representing sub-watersheds comprised of smaller tributaries of the West Fork (Table 2; Figure 5).

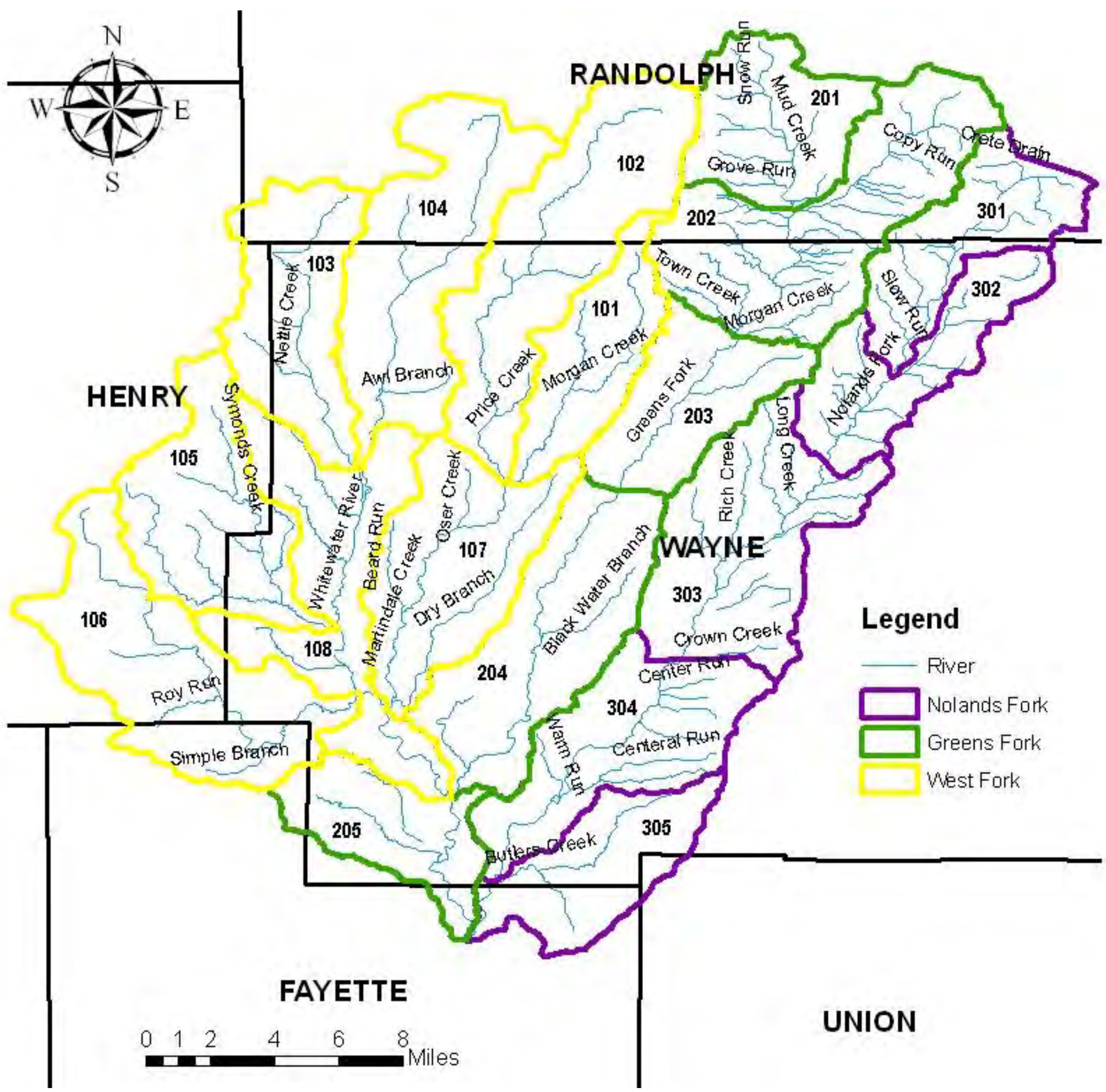
Table 2. List of 10- and 12-digit HUCs within the watershed.

Main River	10-digit HUC	12-digit HUC
West Fork of the Whitewater	0508000301	050800030101
West Fork of the Whitewater	0508000301	050800030102
West Fork of the Whitewater	0508000301	050800030103
West Fork of the Whitewater	0508000301	050800030104
West Fork of the Whitewater	0508000301	050800030105
West Fork of the Whitewater	0508000301	050800030106
West Fork of the Whitewater	0508000301	050800030107
West Fork of the Whitewater	0508000301	050800030108
Greens Fork	0508000302	050800030201
Greens Fork	0508000302	050800030202
Greens Fork	0508000302	050800030203
Greens Fork	0508000302	050800030204
Greens Fork	0508000302	050800030205
Nolands Fork	0508000303	050800030301
Nolands Fork	0508000303	050800030302
Nolands Fork	0508000303	050800030303
Nolands Fork	0508000303	050800030304
Nolands Fork	0508000303	050800030305

The watershed has a diverse network of streams. Tributaries of the West Fork of the Whitewater River include the Greens Fork, Nolands Fork, Martindale Creek, Mud Creek, Symonds Creek, Morgan Creek, Nettle Creek, and Long Creek among others (Figure 5). Overall the watershed drains approximately 412 mi^2. The headwaters of the watershed resemble channelized agricultural ditches with little riparian cover, but as one moves from Randolph County into Wayne County, the river system begins to both widen and meander, and riparian cover improves as well. Agricultural fields in the area are drained using tiles because otherwise it would be too wet to farm and there are a few legal drains in the watershed. It has been estimated that Indiana has lost 85% of its wetlands to various practices including agricultural drainage (http://www.in.gov/dnr/fishwild/files/statusof.pdf). Streams in the headwaters of the watershed show signs of previous channelization.

Groundwater is available from glacial deposits and from bedrock and is characterized by having high alkalinity and hardness and mostly basic PH. Iron concentrations commonly exceed the secondary drinking water standard of 0.3 mg/L. Groundwater is the main drinking water source in the watershed. The USGS has 5 groundwater monitoring wells in the watershed.

Figure 5. Subwatershed boundaries (HUC-12) of the West Fork of the Whitewater River. The last three digits of the 12-digit HUC are shown.



2.6 Geology

The bedrock geology is comprised mainly of limestone, calcareous shale, and dolomite (Figure 6). Deposits from glacial movement include loam till, alluvial materials, mixed drift, and more shale and limestone (Figure 6). Limestone and shale deposits create "hard" water causing many watershed residents to purchase a water softener. A private well just outside of the watershed, north of Richmond was found to be contaminated with high levels of arsenic. Since arsenic is a naturally occurring substance that can cause health problems if consumed in mass quantities it is something to keep an eye out for in the watershed.

Figure 6. Spatial distribution of bedrock geology in the West Fork of the Whitewater River Watershed and surrounding area.

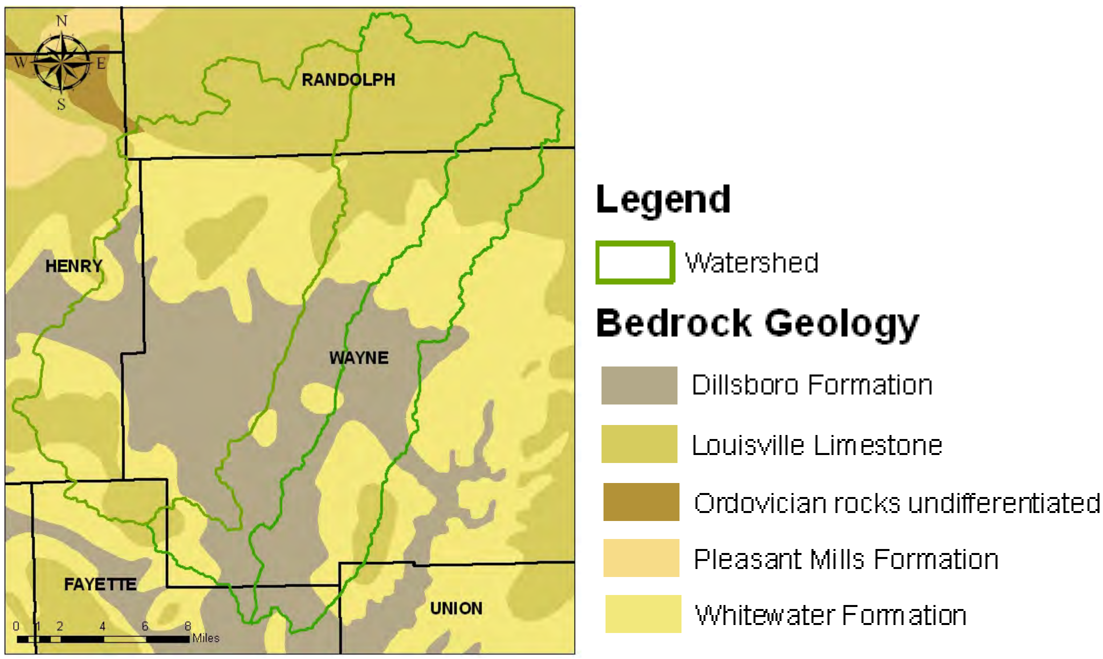
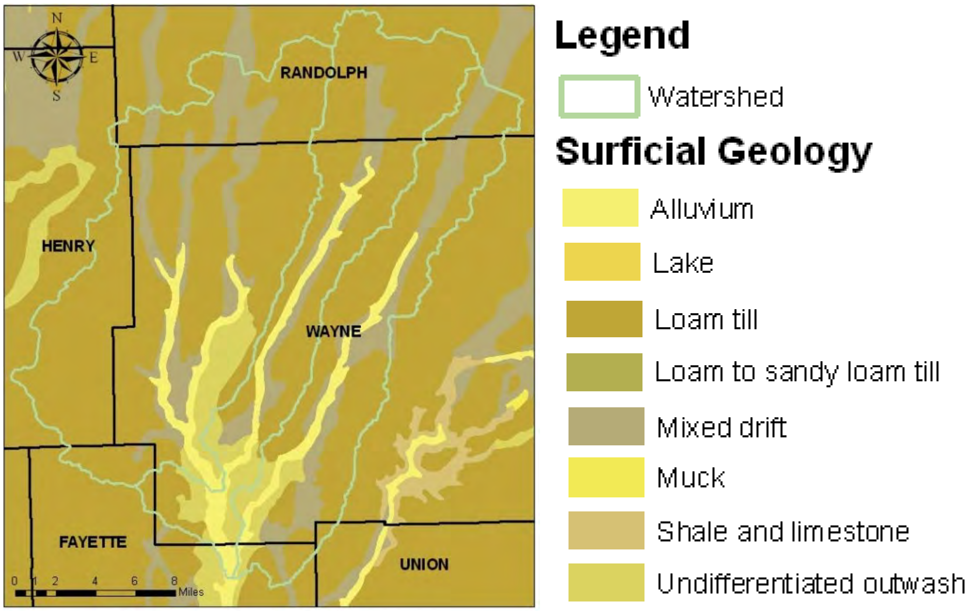


Figure 7. Spatial distribution of surficial geology in the West Fork of the Whitewater River Watershed and surrounding area.



2.7 Watershed Climate

1971-2000 Mean Monthly Precipitation Readings (inches) From Cambridge City, IN

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
2.44	2.33	3.35	4.19	4.89	4.41	4.18	3.51	2.8	2.81	3.55	3.05	41.51

1971-2000 Mean Monthly Temperature Readings (^{o}F) From Cambridge City, IN

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
24	27	38	48	59	68	72	70	63	51	40	29

(Data obtained from the Indiana State Climate Office, 2008)

The climate in the watershed is humid and temperate with precipitation well distributed throughout the year. The average annual precipitation is 41.51 inches. The mean temperature in January is 24^{o}F and for July it is 72^{o}F.

2.8 Land Use
The watershed land was originally obtained by the United States in the Treaty of Greenville (1795) and the Twelve Mile Purchase (1809). In 1836 the construction of the Whitewater Canal began, and eventually extended from Hagerstown to Lawrenceburg, IN, near the Ohio River. When the canal was finished in 1847 it was 79 miles in length. The canal provided transportation of commodities. Unfortunately destructive floods, inadequate financial returns, and the railroad helped lead to the demise of the canal system, which exists only in small disjointed sections today (Canal Society of Indiana). In the West Fork, agriculture, along with the manufacturing of carriages, wagons, and a great variety of machinery and farming utensils, were carried out extensively during the 19th century. In the 20th century agricultural practices and manufacturing have remained prevalent (Indiana County History Preservation Society).

Many towns within the watershed have adopted modern waste water treatment plants for their water needs and have abandoned drinking wells and septic systems. These towns include Fountain City, Hagerstown, Lynn, Greens Fork, Cambridge City, and Centerville. Milton is currently in the process of building a waste water treatment plant. There is one Regional Sewer District (RSD) in the area. Western Wayne RSD services Dublin, Mount Auburn, Cambridge City, and East Germantown, and extends northward to include the Gateway Industrial Park located at State Road 1 and US Highway 70.

The towns of Williamsburg, Economy, Modoc, and Losantville all rely on septic systems, as well as the outlying rural areas. One group of rural residents who rely on septic systems and wells is the Amish. Hundreds of Amish reside in the watershed and continue to use outdated farming practices. The Amish are mainly located north of I-70 and near the towns of Fountain City, Williamsburg, and Hagerstown. Outdated farming practices include horse drawn plows, conventional tillage, horse drawn corn pickers, and hand picking of crops. We are currently conducting outreach to this group in hopes of learning more about their behaviors and attitudes towards water quality and environmental conservation.

In a recent SIPES survey mailed out to watershed residents, roughly 50% of residents who use septic systems cited that they do regular servicing of their system. Another 50% of septic users indicated that they are either unfamiliar with regular servicing or know how to do regular servicing, but are not doing it. Only 25% of respondents said that they would be willing to try regular servicing. Not surprising, several respondents cited problems with their septic systems. This information indicates a need for further outreach/education in the watershed on the topic of proper septic system maintenance.

Data from the National Land Cover Data Classification as of 2001 outlines the land use in the West Fork of the Whitewater River Watershed as follows:

Table 3: Acres of Land Use in the West Fork

Land Use	Acres	Percent (%)
Open Water	596.32	0.23
Developed	19,066.46	7.22
Forested	27,582.03	10.45
Grassland/Herbaceous	3,376.74	1.28
Pasture/Hay	29,930.18	11.34
Cultivated Crops	182,931.22	69.32
Wetlands	420.98	0.16

The dominant land use is cultivated crops at almost 70%. The top three cultivated crops in Wayne County are corn, soybeans, and wheat. Conservation tillage is utilized on 59% of corn fields and 88% on soy bean fields (NRCS 2007 tillage transects). Conventional tillage is still performed on 27% of corn fields and 4% of soybean fields (NRCS 2007 tillage transects). In 2007, 69,900 acres of corn, 57,900 acres of soybeans, and 3,600 acres of wheat were harvested in Wayne County (USDA NASS 2008). Atrazine is a common herbicide used to kill weeds before planting in the spring. It can have deleterious effects on aquatic life through endocrine disruption, and therefore the amount that drains from farm fields into local streams needs to be continually monitored. Of the atrazine that ends up in streams, approximately 90% will runoff with water (i.e. rain), while 10% will adhere to soil particles and then drain into a local stream (http://www.ksre.ksu.edu/library/crpsl2/mf2208.pdf). Because atrazine can easily be moved from a row crop field to the stream via rain it is important for farmers to use conservation tillage practices since the amount of runoff from a no-till field is considerable less than a conventionally tilled field (http://www.ces.purdue.edu/extmedia/WQ/ WQ-20.html).

At 11.34% pasture and hay comprise the second most dominant land use. As a consumer and resident of hay and pasture, cattle number around 13,700 head in Wayne County as of January of 2008 (USDA NASS 2008). Anecdotal evidence suggests that several cattle farms allow their cattle access to the river. Other livestock include 22,657 hogs, 1,311 sheep, and 708 chickens in the county as of 2002 (USDA NASS 2008).

Forest comprises the third highest use of land with roughly 28,000 acres. As of 2006, an estimated 5,000 acres in the watershed are enrolled in the Indiana Classified Forest program (Figure 9; Department of Natural Resources, Division of Forestry Personal Communication). The Classified Forest Program encourages timber production, watershed protection, and wildlife habitat management on private lands in Indiana. Program landowners receive a property tax reduction in return for following a professionally written management plan. In addition to the tax incentive, landowners receive free technical assistance from DNR foresters and wildlife biologists, priority for cost share to offset the cost of doing management, and the ability to "green" certify their forests (http://www.in.gov/dnr/forestry/4801.htm).

Figure 8. Spatial representation of land use in the West Fork of the Whitewater River Watershed as of 2009.

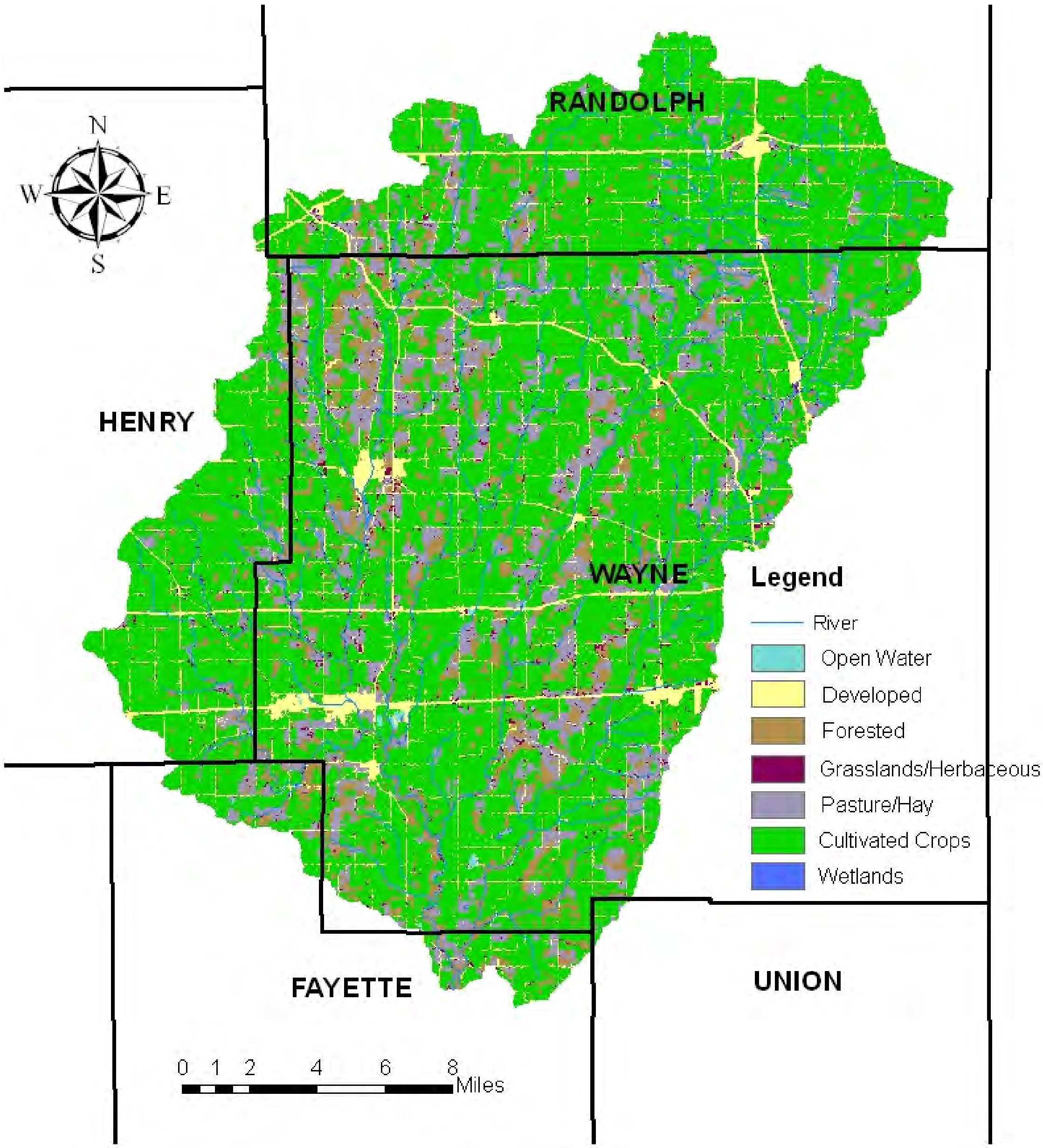
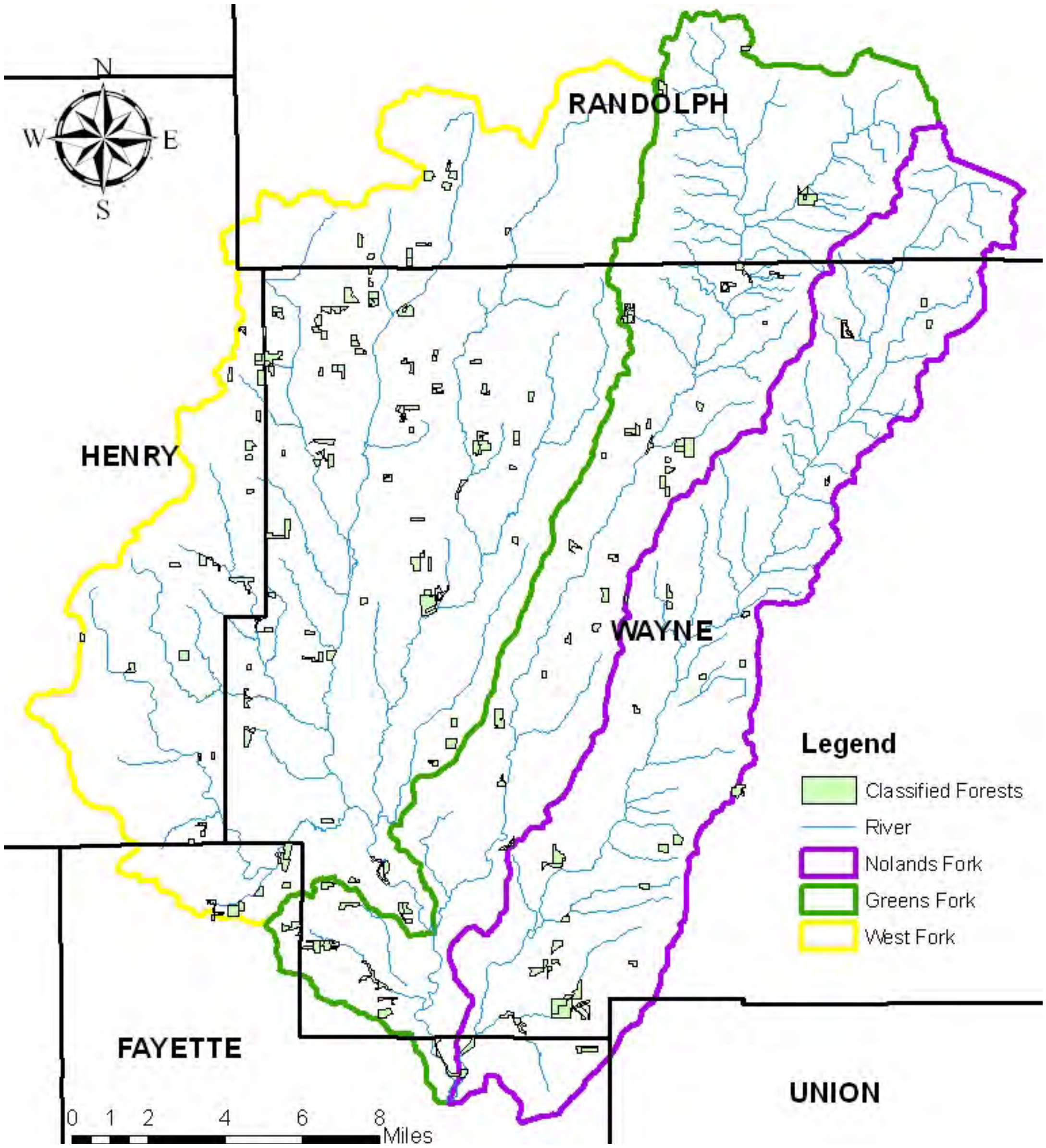


Figure 9. Spatial distribution of classified forests in the West Fork of the Whitewater River Watershed as of 2006.



Major businesses in the watershed are as follows:

- Landfill in Modoc
- Gravel Pit in Hagerstown and Modoc
- CFO: Randolph County Farms
- Amish Farms
- Housing Development south of Hagerstown, “Teetor Pines”
- Parks: Dublin, Hagerstown
- Hagerstown Airport
- Autocar factory in Hagerstown

- Schools: Hagerstown, Cambridge City, Union-Modoc, Centerville
- Bell's Strawberry Farm in Hagerstown
- Dougherty Orchard outside of Cambridge City
- Amish Cheese Shop outside of Cambridge City
- Lakeview and Willow Springs Restaurants in Mount Auburn and Hagerstown, respectively
- Gateway Industrial Park, Hagerstown

There are 12 National Pollutant Discharge Elimination System (NPDES) permits that have been assigned to the watershed area, as well as 8 Confined Feeding Operations (CFO) and 4 Concentrated Animal Feeding Operations (CAFOs) (Figure 10).

Table 4: List of NPDES permits in the West Fork:

Facilities with E. coli and Total Residual Chlorine Limits

Permit #	Facility Name	Receiving Waters
IN0022535	Centerville WWTP	Nolands Fk
IN0038849	Stop-One Truck Plaza	Martindale Cr
IN0039560	Woodview MHP	Unnamed trib to Pinhook Drain
IN0043371	Stucky's Restaurant	Unnamed trib to Nolands Fork
IN0051870	Len-Del MHP	Unnamed trib to Franklin Cr
IN0053791	McDonalds #0881	Martindale Cr

Facilities with E. coli Limits

Permit #	Facility Name	Receiving Waters
IN0020010	Hagerstown WWTP	W Fk Whitewater R
IN0031321	Centerville Rest Area	Unnamed trib to Nolands Fk
IN0053643	Hoosier Heartland Travel Center	Symons Cr
IN0040967	Lynn Municipal WWTP	Mud Cr

Facilities with Total Residual Chlorine Limits

Permit #	Facility Name	Receiving Waters
IN0060488	Whitewater Industrial Park	Martindale Cr

Facilities with Lagoon Systems

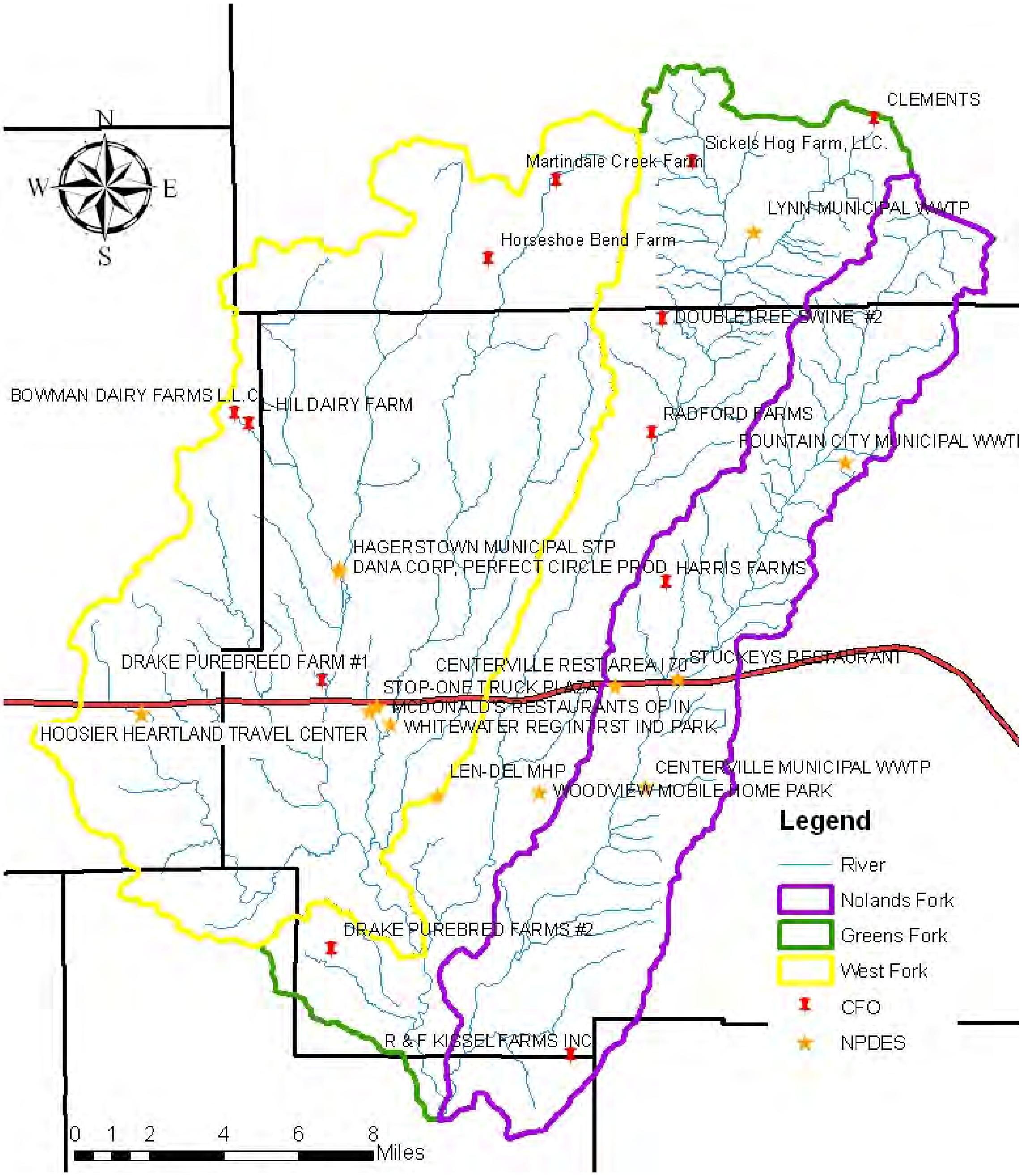
Permit #	Facility Name	Receiving Waters
IN0040029	Fountain City WWTP	Fountain Cr

Of the 12 NPDES permits, only Woodview MHP has been found in violation of its permit for *E. coli* once in February of 2006 and again in May of 2007.

CFO and CAFOs located in the watershed:

Watershed	Permit #	Permit Type	Operation Name	Status	Hogs	Cattle
West Fork	363	CAFO	Drake Purebreed Farms #1	ACTIVE	3150	
West Fork	6413	CAFO	Horseshoe Bend Farm	ACTIVE	7742	
West Fork	6412	CAFO	Martindale Creek Farm	ACTIVE	7742	
Greens Fork	6419	CAFO	Sickels Hog Farm LLC	ACTIVE	8000	
West Fork	1431	CFO	L-Hil Dairy Farm	ACTIVE		100
West Fork	511	CFO	Bowman Dairy Farm LLC	ACTIVE		300
Greens Fork	428	CFO	Drake Purebreed Farms #2	ACTIVE	464	
Greens Fork	4619	CFO	Radford Farms	ACTIVE	2130	
Greens Fork	759	CFO	Doubletree Swine #2	ACTIVE	Out of business	
Greens Fork	4334	CFO	Rex Clements	ACTIVE	1985	
Nolands Fork	4955	CFO	R & F Kissel	ACTIVE	2112	
Nolands Fork	3542	CFO	Harris Farms	ACTIVE	796	

Figure 10. Locations of NPDES permits and CFO/CAFOS (denoted by "CFO" on map) in the West Fork of the Whitewater River Watershed.



There is one Combined Sewer Overflow (CSO) in the watershed located in the town of Centerville. In May of 2002 Centerville submitted their Long-Term Control Plan which was approved; they acquired a NPDES permit for the CSO on March 9, 2007.

2.9 Endangered Species

A list of endangered species of each Indiana County was developed by the Indiana Department of Natural Resources, Division of Nature Preserves in 2005. The following table lists species that have been placed on the state and/or federal endangered, threatened, or rare species list. Loss of natural habitat is the greatest cause of many animals to be placed on the list. Many of the organisms suffer due to a loss of wetlands, forestlands, and other natural areas. Aquatic species are often listed due to increased sedimentation of waterways, channelization, and increased water pollution. While we have yet to observe any of these organisms in the watershed, we will contact the Indiana Department of Natural Resources if this occurs.

Common Name	State Rank	Federal Rank	County of occurrence
Insects			
Cobbleston Tiger Beetle	Endangered	NA	Wayne
Wabash River Cruiser	Endangered	NA	Wayne
A Northern Case Making Caddisfly	Endangered	NA	Wayne
Clamp-tipped Emerald	Rare	NA	Henry
Mollusk: Bivalvia			
Wavyrayed Lampmussel	Species of special concern	NA	Henry
Kidneyshell	Species of special concern	NA	Henry, Randolph
Purple Lilliput	Species of special concern	NA	Henry, Randolph
Little Spectalcase	Species of special concern	NA	Henry
Clubshell	Endangered	Endangered	Randolph
Fish			
Popeye Shiner	Extirpated	NA	Wayne, Henry
Redside Dace	Endangered	NA	Union
Varigate Darter	Endangered	NA	Union
Amphibians			
Northern Leopard Frog	Species of special concern	NA	Wayne, Henry
Four-toed salamander	Endangered	NA	Henry
Reptile			
Kirtland's Snake	Endangered	NA	Wayne, Henry, Randolph
Blanding's Turtle	Endangered	NA	Wayne
Butler's Garter Snake	Endangered	NA	Wayne
Bird			
Upland Sandpiper	Endangered	NA	Wayne
Cerulean Warbler	Species of special concern	NA	Wayne, Fayette, Union
Least Bittern	Endangered	NA	Wayne, Henry
Black-crowned Night-heron	Endangered	NA	Wayne, Henry
King Rail	Endangered	NA	Wayne, Henry
Barn Owl	Endangered	NA	Wayne, Henry,

			Randolph
Hooded Warbler	Species of special concern	NA	Wayne
Marsh Wren	Endangered	NA	Henry
Sedge Wren	Endangered	NA	Henry, Randolph, Union
Double-crested Cormorant	Extirpated	NA	Henry
Virginia Rail	Endangered	NA	Henry
American Bittern	Endangered	NA	Fayette
Golden-winged Warbler	Endangered	NA	Fayette
Loggerhead Shrike	Endangered	NA	Randolph
Osprey	Endangered	NA	Union
Mammal			
Indiana Bat	Endangered	Endangered	Wayne, Henry, Randolph
Least Weasel	Species of special concern	NA	Fayette
Evening Bat	Endangered	NA	Fayette
Vascular Plant			
Butternut	Watch list	NA	Wayne, Fayette
Ground Juniper	Rare	NA	Wayne
American Ginseng	Watch list	NA	Wayne, Randolph
Heart-leaved Plantain	Endangered	NA	Wayne
Calamint	Endangered	NA	Wayne
Shining Ladies'-tresses	Rare	NA	Wayne
Softleaf Arrow-wood	Rare	NA	Wayne
Barren Strawberry	Rare	NA	Wayne
Tower-mustard	Watch list	NA	Henry
Cypress-knee Sedge	Threatened	NA	Henry
Small White Lady's-slipper	Watch list	NA	Henry, Randolph
Golden Seal	Watch list	NA	Henry
Great St. John's-wort	Threatened	NA	Henry
Virginia Bunchflower	Endangered	NA	Henry
Small Purple-fringe Orchis	Rare	NA	Henry
Orange Coneflower	Watch list	NA	Henry, Randolph
Marsh Arrow-grass	Rare	NA	Henry, Randolph
Thinleaf Sedge	Endangered	NA	Fayette
Bog Bluegrass	Watch list	NA	Fayette
Horned Bladderwort	Threatened	NA	Fayette
Heavy Sedge	Endangered	NA	Randolph, Union
A Hawthorn	Endangered	NA	Randolph
Small Yellow Lady's-slipper	Rare	NA	Randolph
Three-flower Melic Grass	Threatened	NA	Randolph
False Asphodel	Rare	NA	Randolph

3.0 Identify Problems and Causes

3.1 Stakeholder concerns

Three public meetings were held in the West Fork to research stakeholder concerns:

12/8/2008	Hagerstown	11 stakeholders in attendance
2/10/2009	Cambridge City	12 stakeholders in attendance
2/11/2009	Fountain City	10 stakeholders in attendance

At these meetings the following concerns were voiced:

- *E. coli* contamination from septic systems, livestock, Confined Feeding Operations, and Confined Animal Feeding Operations
- The limited recreational use the river appears to have for fishing and swimming
- The effects of pollution on fish and wildlife in the area
- Mercury contamination in fish
- Septic systems in the following areas:
    - Milton
    - Cambridge City
    - Losantville
- The effects Amish farming practices have on water quality
- The erosion of topsoil into local rivers/streams
- Flood episodes in the watershed

A survey was also sent to watershed residents targeted at two distinct groups: the agriculture community and the urban community. We had a 43% (n=188) response rate for the agriculture community and a 27% (n=215) response rate for the urban community.

The top 5 water impairments in the West Fork according to the ag community:

1. Sedimentation/silt
2. *E. coli*
3. Turbidity
4. Nitrate
5. Suspended solids

The top 5 water impairments in the West Fork according to the urban community:

1. Nitrates
2. Phosphorus
3. Sedimentation/silt
4. *E. coli*
5. Ammonia

3.2 Data

According to the Indiana Department of Environmental Management's (IDEM) website:

The Indiana Department of Environmental Management (IDEM) develops the Integrated Water Monitoring and Assessment Report every two years to fulfill the requirements of Sections 305(b) and 303(d) of the federal Clean Water Act (CWA). The Integrated Report is submitted to U.S. EPA in even-numbered years.

Section 305(b) requires IDEM to assess and report on whether Indiana waters support the beneficial uses designated in the Indiana's water quality standards. These assessments are made in accordance with IDEM's Consolidated Assessment and Listing Methodology (CALM) by comparing existing and readily available water quality data to the applicable water quality criteria in the State's water quality standards.

Section 303(d) requires states to identify waters that are assessed as not meeting applicable water quality standards, also known as impaired, or for which one or more designated uses are threatened.

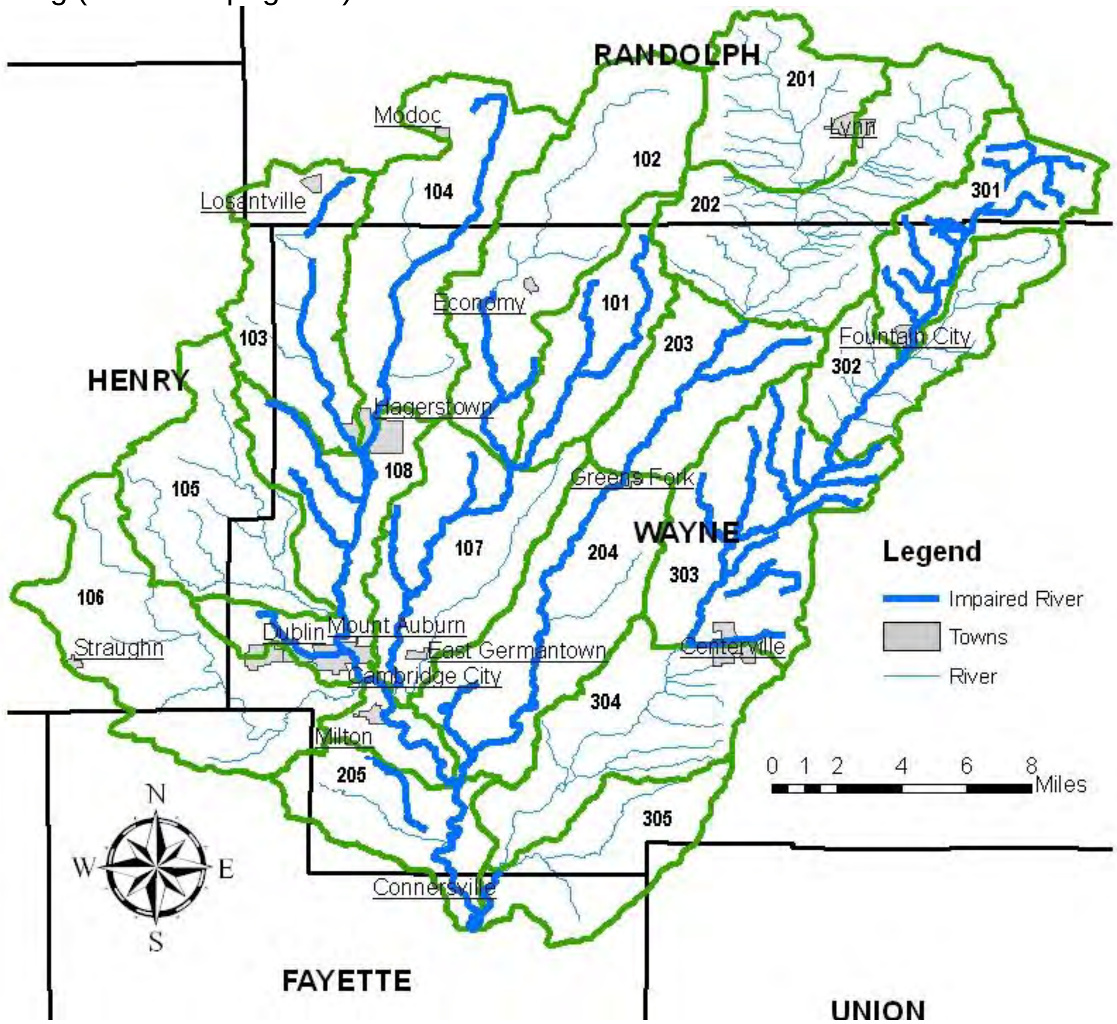
The Integrated Report includes the Consolidated List which places each of Indiana's waterbodies into one or more categories. The category a waterbody falls under depends on what is known about the water quality:

A TMDL has been developed and addresses *E. coli* impairments for the West Fork Whitewater Watershed. Two public meetings were held, one at the beginning of the project and the other at the end, to inform the public of the TMDL process. There was also a public comment period for people to comment on a draft TMDL available on the internet. A watershed tour with the Wayne County Watershed Coordinator and the County Commissioner, along with IDEM personnel was also completed during the TMDL process website: (http://www.in.gov/idem/nps/2835.htm)

303(d) listing for the West Fork of the Whitewater River Watershed (IDEM 2008):

12 Digit HUC	River Segment	Impairment
050800030101	WHITEWATER RIVER	E. coli
050800030102	WHITEWATER RIVER	E. coli
050800030103	NETTLE CREEK	E. coli
050800030104	WHITEWATER RIVER	PCBs in Fish Tissue
050800030104	WHITEWATER RIVER	PCBs in Fish Tissue
050800030106	WHITEWATER RIVER - CRIETZ CREEK	E. coli
050800030106	WHITEWATER RIVER	Impaired biotic communities
050800030106	WHITEWATER RIVER	E. coli
050800030108	MORGAN CREEK - WEST BROOK	E. coli
050800030101	MARTINDALE CREEK - ECONOMY	E. coli
050800030101	MARTINDALE CREEK - BEARD RUN	E. coli
050800030101	WHITEWATER RIVER - MILTON	E. coli
050800030204	GREENS FORK CREEK	E. coli
050800030204	GREENS FORK CREEK	Mercury in Fish Tissue
050800030205	GREENS FORK	E. coli
050800030206	GREENS FORK	E. coli
050800030206	FRANKLIN CREEK	E. coli
050800030207	MIXED CREEK	E. coli
050800030207	WHITEWATER RIVER, WEST FORK	E. coli
050800030207	WHITEWATER RIVER, WEST FORK	Mercury in Fish Tissue
050800030301	NOLANDS FORK	E. coli
050800030301	BOWEN DITCH	E. coli
050800030301	CRETE DRAIN	E. coli
050800030301	NOLANDS FORK	E. coli
050800030301	KELLY DITCH	E. coli
050800030301	NOLANDS FORK	E. coli
050800030301	NOLANDS FORK	E. coli
050800030301	POLE CREEK	E. coli
050800030301	LINE BROOK	E. coli
050800030301	SLOW RUN	E. coli
050800030302	NOLANDS FORK	E. coli
050800030303	NOLANDS FORK	Impaired biotic communities
050800030303	NOLANDS FORK	E. coli
050800030303	WEBSTER CREEK	Impaired biotic communities
050800030303	WEB BRANCH	Impaired biotic communities
050800030303	SINGLE CREEK	Impaired biotic communities
050800030303	LONG CREEK	Impaired biotic communities
050800030303	CAIN DITCH	Impaired biotic communities
050800030303	RICH CREEK	Impaired biotic communities
050800030303	FORK CREEK	Impaired biotic communities
050800030303	NOLANDS FORK	Impaired biotic communities
050800030303	GEPHART DITCH	Impaired biotic communities
050800030303	GEPHART DITCH	Impaired biotic communities

Figure 11. Spatial representation of all impaired rivers according to the 303(d) listing (see table page 22).



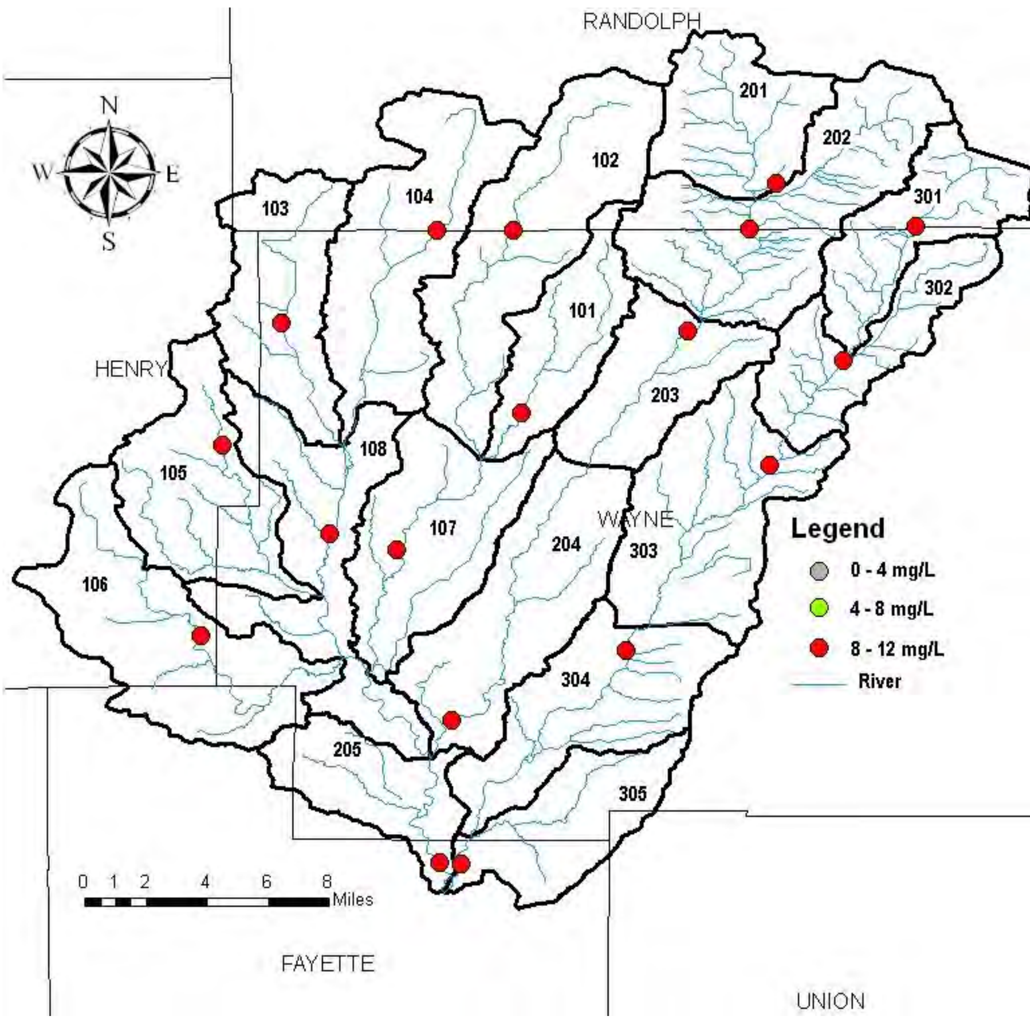
3.2.1 Preliminary Data

The following is chemical and *E. coli* data collected by volunteers following Hoosier Riverwatch standards and represented as an annual average (2009; raw data in Appendix A). Chemical parameters collected include dissolved oxygen (DO), Biochemical Oxygen Demand (BOD), turbidity, nitrate, and orthophosphate. We also calculated a Water Quality Index (WQI) and collected *E. coli* data. Boxes shaded in red represent a critical level for that particular parameter; boxes shaded in yellow represent a cautionary level for that particular parameter.

3.2.2 Dissolved Oxygen

DO is a measure of the amount of oxygen found in the water, as oxygen readily dissolves into the water from the atmosphere. DO is an important measure of stream health since aquatic organisms require different levels of DO to live. DO levels below 3 mg/L are stressful to most aquatic organisms, while DO levels of 5 to 6 mg/L are usually required for healthy growth and activity for aquatic life. A level above 12 mg/L indicates supersaturated waters, which might signal the presence of excessive algae or plant life that would deplete oxygen during the nighttime hours.

Figure 12. Spatial distribution of mean DO (mg/L) in the West Fork Watershed. All DO values are between 8 and 12 mg/L, and therefore considered good for healthy growth and activity for aquatic life.



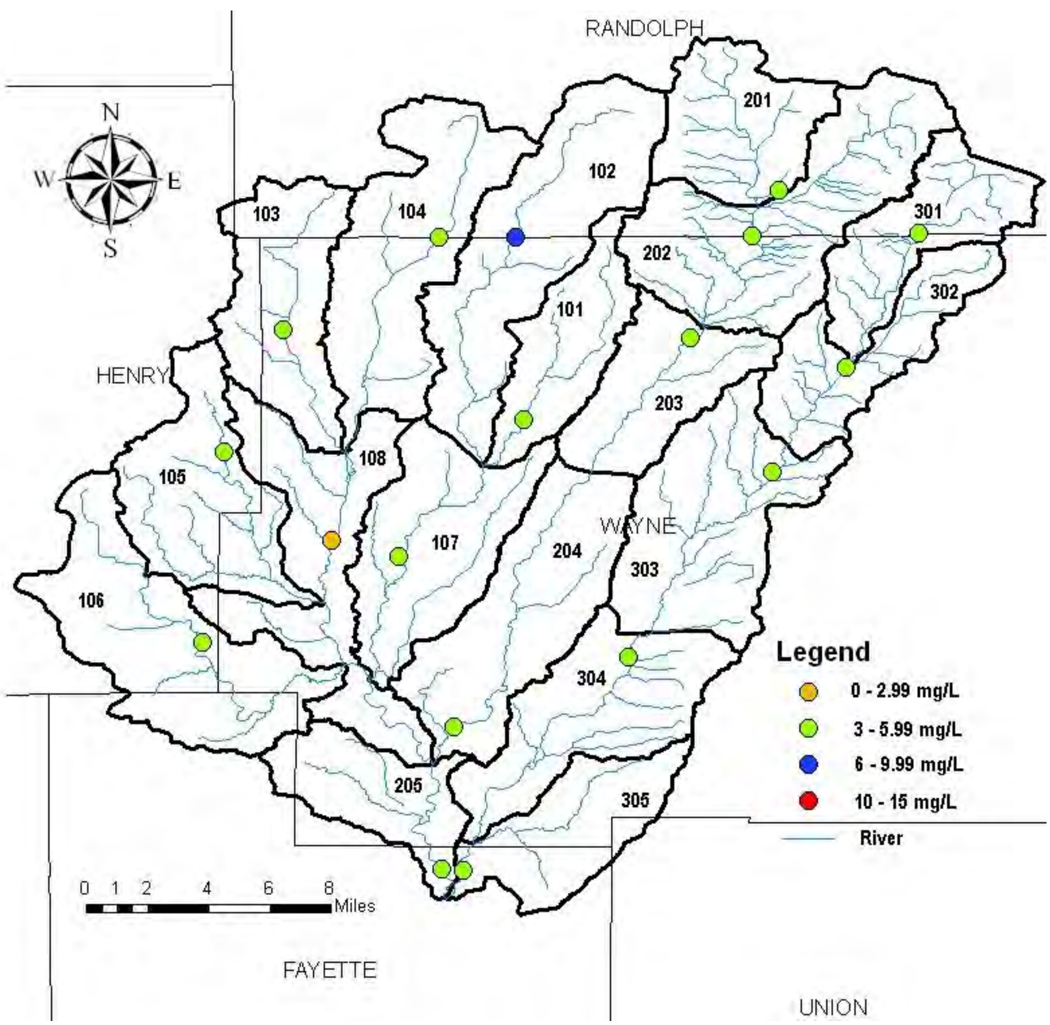
HUC	DO
101	9.67
102	10.06
103	9.10
104	9.31
105	10.91
106	8.19
107	8.66
108	9.55
201	11.57
202	9.89
203	8.92
204	8.67
205	8.64
301	9.72
302	9.83
303	10.00
304	8.00
305	9.13

3.2.3 Biochemical Oxygen Demand

BOD is a measure of the amount of oxygen used by aerobic (oxygen-consuming) bacteria as they break down organic wastes over 5 days. Polluted streams, or streams with a lot of plant growth (and decay), generally have high BOD levels indicating large amounts of organic matter present in the stream. Streams that are relatively clean and free from excessive plant growth typically have low BOD levels. The following is a rough guide to what various BOD levels indicate:

1-2 mg/L BOD	Clean water with little organic waste
3-5 mg/L BOD	Fairly clean water with some organic waste
6-9 mg/L BOD	Lots of organic material and bacteria
10+ mg/L BOD	Very poor water quality; large amounts of organic material

Figure 13. Spatial distribution of BOD (mg/L) in the West Fork Watershed. BOD averages in the Nolands and Greens Fork Rivers are below 6 mg/L. One site in the West Fork River is between 6 and 9 mg/L indicating lots of organic material and bacteria potentially caused by nutrient run-off from adjacent farm fields.

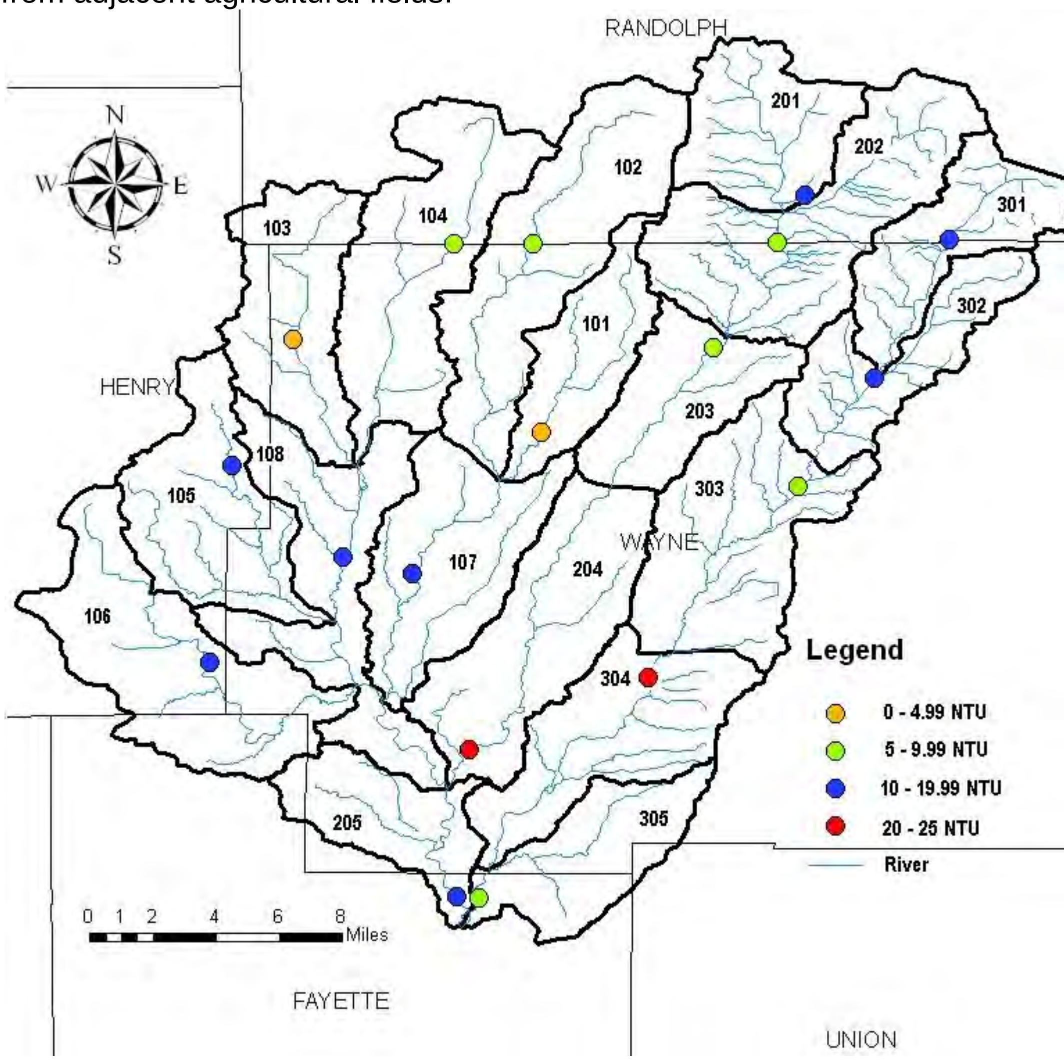


HUC	BOD
101	4.20
102	6.27
103	4.09
104	5.22
105	5.04
106	3.72
107	4.17
108	2.73
201	5.43
202	4.05
203	3.22
204	3.70
205	5.34
301	3.68
302	3.64
303	3.11
304	3.30
305	3.44

3.2.4 Turbidity

Turbidity is the relative clarity of the water and is measured by shining a light through the water column. Turbid water is cloudy, and is caused by suspended matter including clay, silt, organic and inorganic matter, and algae. Therefore, turbid water may result from soil erosion, urban runoff, algal blooms, or bottom sediment disturbances. If a stream is very turbid, light will not reach through the water column and many reactions, especially photosynthesis, will be limited. Turbid water can also be warmer than non-turbid water since the suspended particles absorb heat from the sun. Suspended particles can also kill fish and aquatic invertebrates by clogging gills and smothering habitat. The typical range for turbidity is 4.5 to 17.5 NTU; the Indiana average is 11 NTU.

Figure 14. Spatial distribution of mean turbidity (NTU) in the West Fork Watershed. Three sites exceed 17.5 NTUs, the additional sediment could be from adjacent agricultural fields.

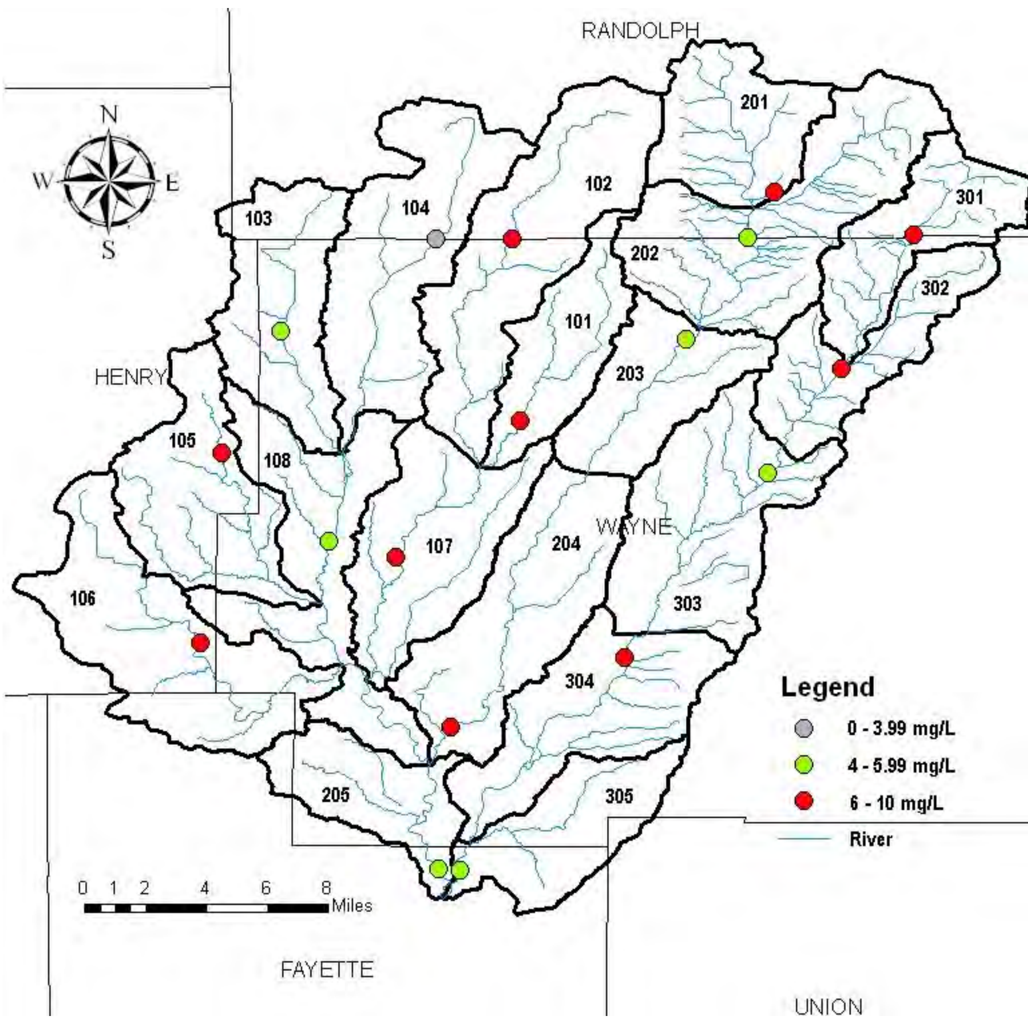


HUC	Turbidity
101	2.65
102	8.52
103	4.41
104	6.76
105	10.30
106	17.03
107	18.55
108	14.26
201	12.40
202	8.46
203	9.96
204	24.36
205	10.59
301	16.64
302	15.33
303	8.19
304	25.04
305	7.36

3.2.5 Nitrogen

Nitrogen occurs in water as nitrate, nitrite, and ammonia. It enters the water from human and animal waste, decomposing organic matter, and runoff of fertilizer from lawns and crops. Nitrates are an essential nutrient for plant growth, and therefore we collect information on this form of nitrogen. Unpolluted waters generally have a nitrate level below 4 mg/L. Nitrate levels above 10 mg/L are considered unsafe for drinking water.

Figure 15. Spatial distribution of mean nitrates (mg/L) in the West Fork Watershed. Overall, nitrate averages are currently good since they do not exceed 10 mg/L, although numerous sites throughout the watershed are approaching 10 mg/L mark. Therefore more work needs to be done to try and reduce this pollutant.

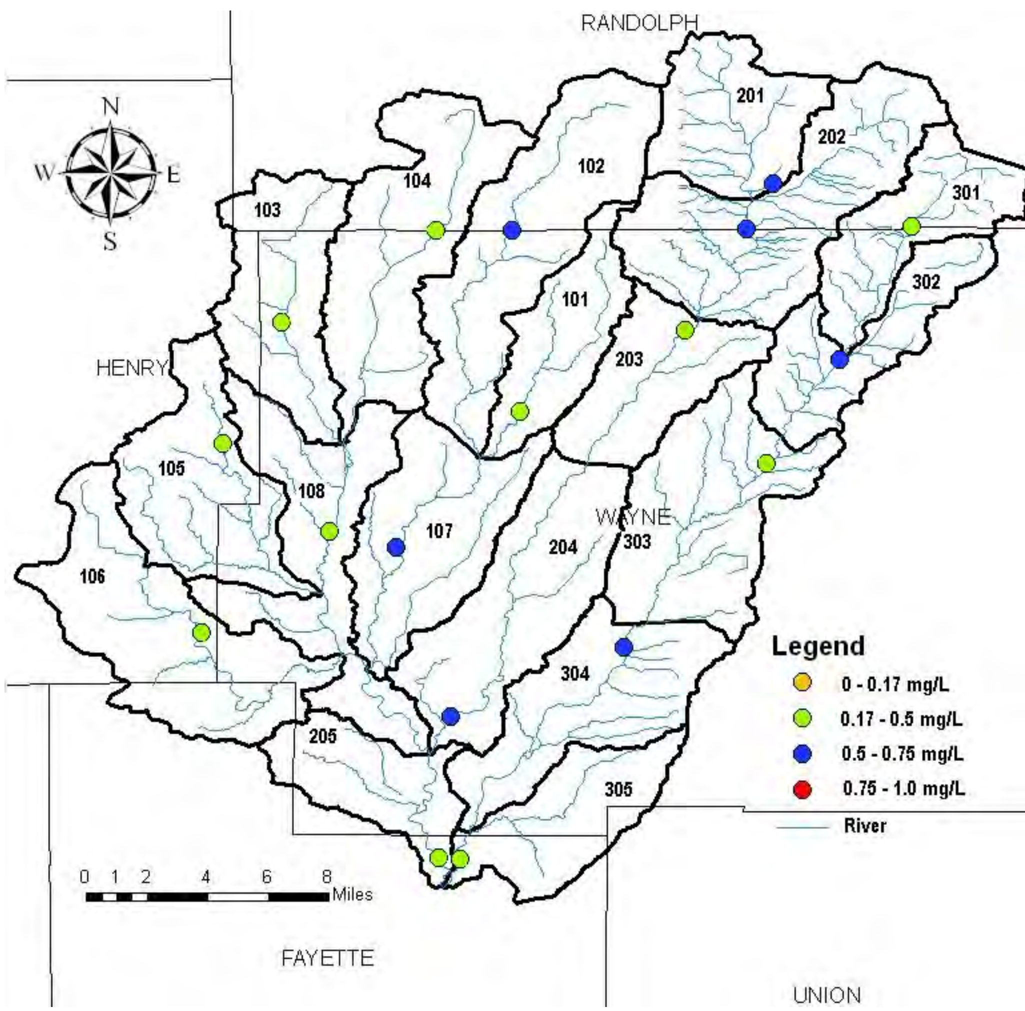


HUC	Nitrate
101	9.22
102	9.21
103	5.12
104	3.57
105	9.31
106	7.30
107	7.58
108	5.96
201	8.45
202	5.85
203	4.93
204	7.80
205	5.84
301	8.12
302	7.45
303	4.84
304	6.03
305	5.87

3.2.6 Phosphorus

Aquatic ecosystems develop with very low amounts of phosphorus. The addition of seemingly small amounts of phosphorus can lead to problematic algal blooms when added to aquatic systems through organic matter attached to soil particles or in a number of man-made products (ex. detergents, fertilizers, industry wastes). Orthophosphate is a form of phosphorus that is dissolved in water and readily available for plant uptake. Thus, orthophosphate concentration is useful as an indicator of current potential for algal blooms and nutrient overloading. The typical range for Total Phosphorus is 0.01 to 0.17 mg/L, and the Indiana average is 0.09 mg/L. Since orthophosphate is a component of total phosphate, we would expect orthophosphate to be lower than the total. Our 2009 annual averages of orthophosphate exceed the typical range of phosphate found in Indiana, indicating a major issue with this nutrient in the watershed.

Figure 16. Spatial distribution of mean orthophosphate (mg/L) in the West Fork Watershed. There appears to be an excessive amount of orthophosphate in the watershed and more research will need to be conducted to find the source.

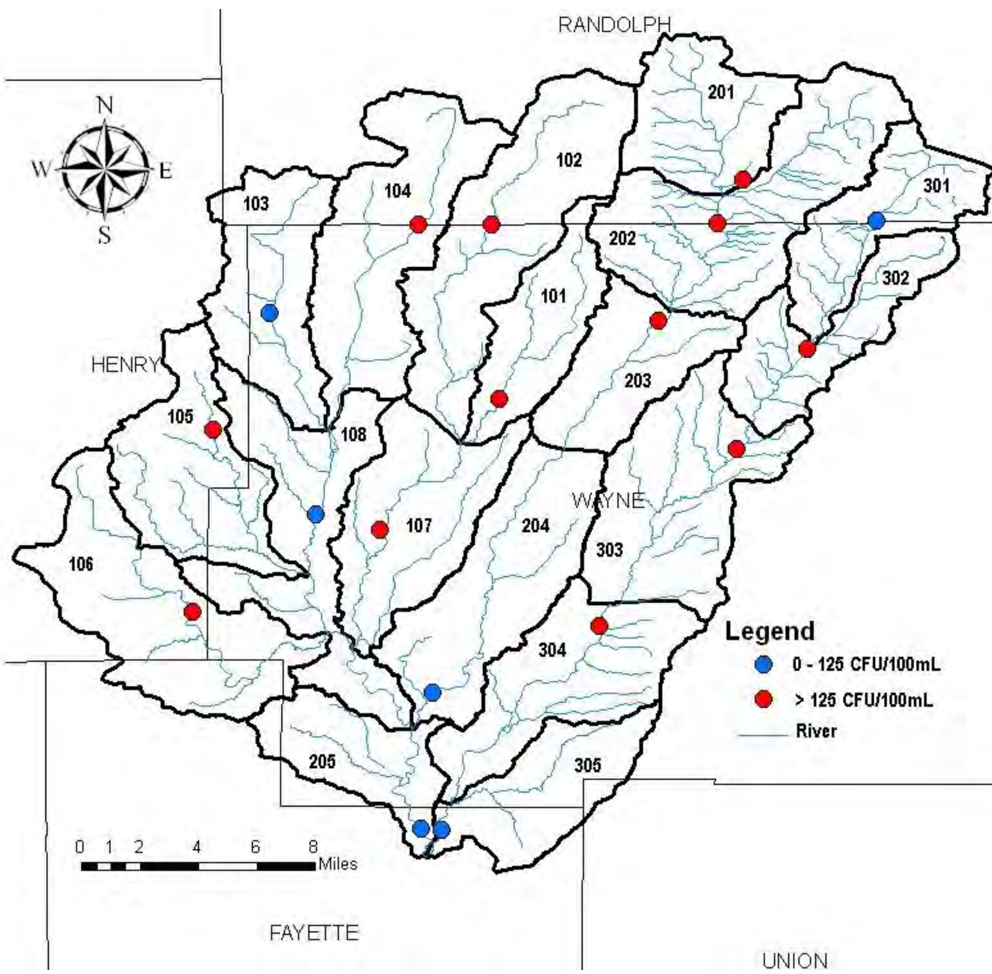


HUC	Ortho P
101	0.21
102	0.52
103	0.22
104	0.29
105	0.31
106	0.46
107	0.57
108	0.40
201	0.57
202	0.53
203	0.43
204	0.75
205	0.23
301	0.33
302	0.54
303	0.45
304	0.59
305	0.44

3.2.7 E. coli

E. coli is a specific species of fecal coliform bacteria, and are found in the feces of warm-blooded animals, including humans, livestock, and waterfowl. These bacteria are naturally present in the digestive tracts of animals, but are rare or absent in unpolluted waters. *E. coli* typically enters the water via failed/failing septic systems and runoff from agricultural feedlots. Indiana has determined that *E. coli* counts with a geometric mean above 125 colonies per 100mL indicate that more than 8 people out of 1,000 who come into contact with the water may become sick.

Figure 17. Spatial distribution of the geometric mean of *E. coli* in the West Fork Watershed. Several areas in the watershed exceed Indiana standards for primary contact recreation (red circles, > 125 CFU/100mL). This can be caused by numerous sources including livestock in the stream, failing septic systems, manure spreading, and runoff from feedlots.



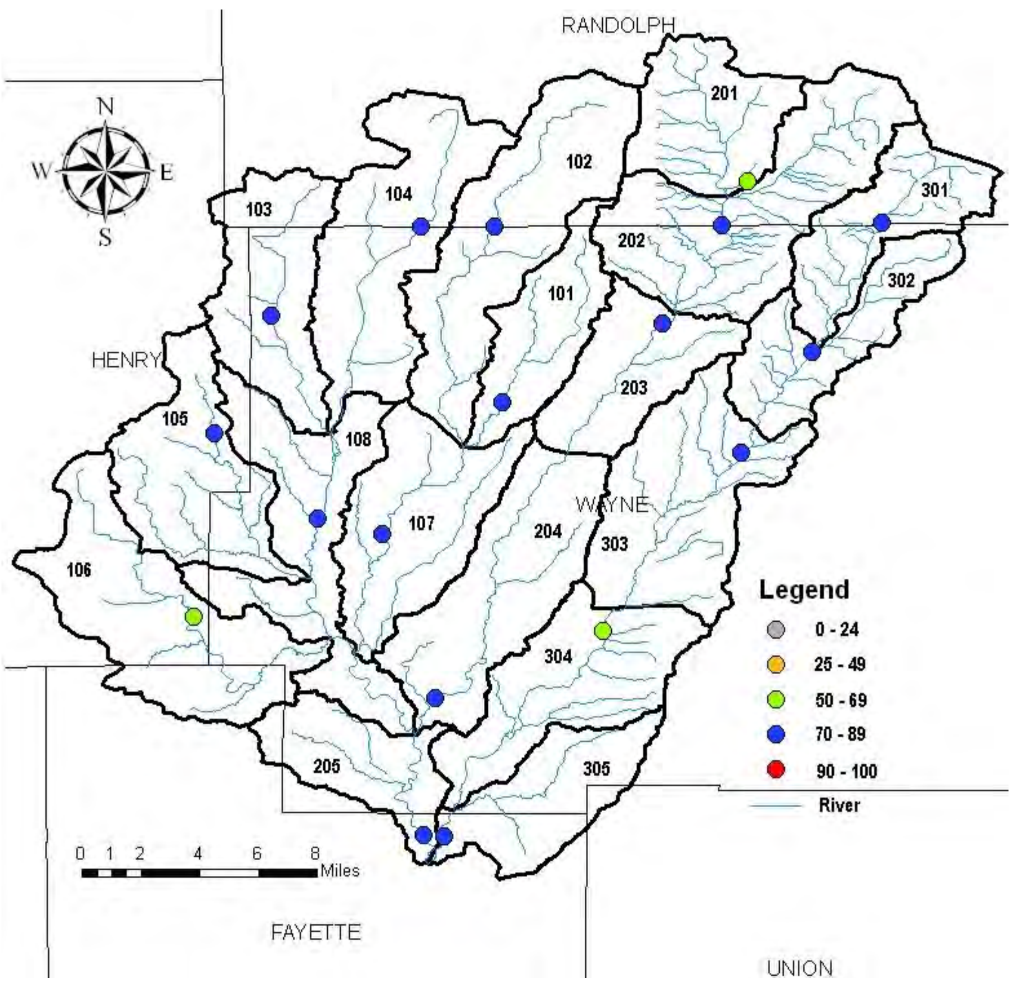
HUC	*E. coli*
101	310.37
102	370.91
103	81.52
104	187.38
105	384.46
106	328.75
107	282.52
108	65.44
201	324.53
202	496.73
203	130.88
204	36.64
205	58.75
301	56.97
302	701.80
303	709.81
304	357.99
305	56.97

3.2.8 Water Quality Index

The WQI takes into consideration the results of 8 different chemical tests: DO, BOD, pH, E. coli, water temperature change, total phosphate, nitrate, and turbidity. Each of the tests is weighted according to its level of importance to overall water quality. The weighting scheme allows analysts to condense complex tests into a common water quality measurement that can be readily communicated to the public. WQI scores can fall into 5 different water quality categories:

Excellent:	90-100
Good:	70-89
Medium:	50-69
Bad:	25-49
Very Bad:	0-24

Figure 18. Spatial distribution of mean WQI in the West Fork Watershed. Overall, the watershed falls into either the "good" or "medium" categories, indicating that there is room for water quality improvement in the watershed.



HUC	WQI
101	72.76
102	71.63
103	79.21
104	74.01
105	71.27
106	69.21
107	73.67
108	80.60
201	67.59
202	73.74
203	73.04
204	71.54
205	78.04
301	75.57
302	72.60
303	71.54
304	69.86
305	78.34

3.3 Data: Fish Community and Habitat Assessments

1. Indiana Division of Fish and Wildlife (Long 2007)
    a. Collected fish/habitat information at 12 sites along the West Fork of the Whitewater River in 2005, 4 sites were located within the watershed at river mile 78.2, 74.2, 69.4, and 65.6.
    b. Overall, 4,969 fish were collected
        i. 13 families of fish representing 56 species and 3 hybrids
        ii. Northern hogsucker was the most abundant by number, golden redhorse was the most abundant by weight
        iii. Gamefish comprised 5% of the sample by number
    c. Qualitative Habitat Evaluation Index (QHEI) scores ranged from 62.25 to 83.7, with an average of 73.8 (QHEI scores > 60 have been found to be generally conducive to the existence of warmwater fauna; Hoosier Riverwatch 2003)
    d. Species diversity of fishes in the West Fork was considered above average compared to other Indiana streams
2. IDEM (Sobat 2008)
    a. In 1997, 2002, and 2007 the IDEM Biological Studies Section collected fish community samples using pulsed-DC electrofishing equipment and completed habitat assessments in the West Fork of the Whitewater River Watershed. Below are 4 figures (Figure 19 – 22) depicting their findings from 30 different collection sites within the watershed.

Figure 19. Spatial Distribution of the Index of Biotic Integrity (IBI) scores, a multi-metric score for fish communities, for the West Fork of the Whitewater River Watershed. Two sites within the watershed have on IBI that indicates a poor fish community. Both sites are downstream of major urban areas, Cambridge City (western site) and Centerville (eastern site). When these samples were collected Centerville had an operational CSO just north of the site labeled for poor biotic communities. Since 2007 Centerville now has a NPDES permit.

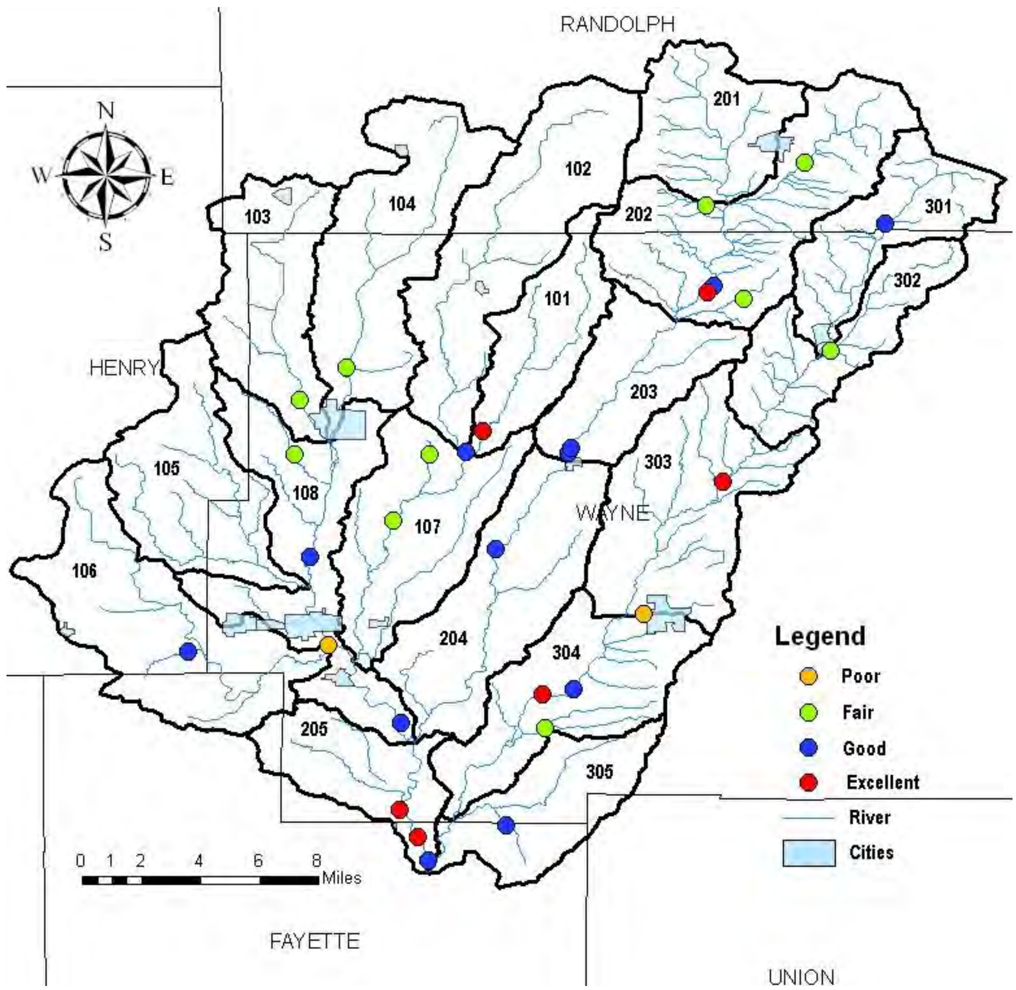
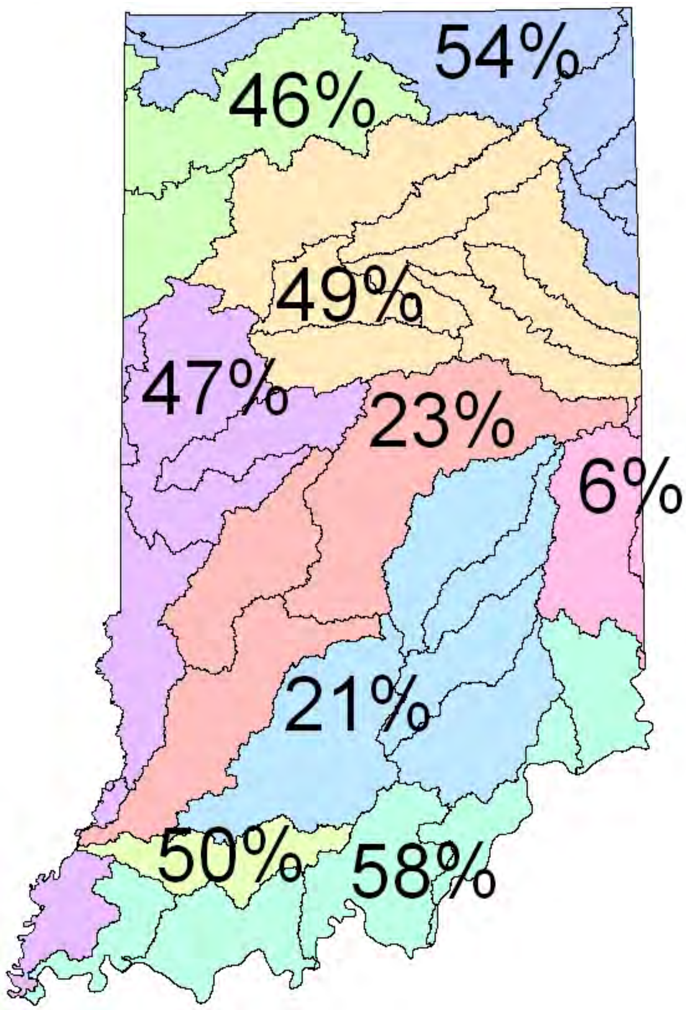


Figure 20. Estimated watershed non-attainment results per fish community IBI scores in Indiana watersheds (2001-2005; Sobat 2008). The West Fork Watershed is grouped in with the larger Great Miami River Watershed, depicted in pink.



Project Name	*%Attainment*	*%Non-Attainment*
Ohio River	42%	58%
Tributaries		n=16/38 Impaired
n=38		
Great Lakes	46%	54%
Tributaries		n=18/38 Impaired
n=38		
Patoka	50%	50%
River		n=13/26 Impaired
n=26		
Upper	51%	49%
Wabash		n=13/37 Impaired
River		
n=37		
Lower	53%	47%
Wabash		n=15/38 Impaired
River		
n=38		
Upper	54%	46%
Illinois		n=16/38 Impaired
River		
n=38		
West Fork	77%	23%
White River		n=8/36 Impaired
n=36		
East Fork	79%	21%
White River		n=7/38 Impaired
n=38		
Great Miami	94%	6%
River		n=1/38 Impaired
n=38		

Figure 21. Spatial Distribution of the Qualitative Habitat Evaluation Index (QHEI) scores for the West Fork of the Whitewater River Watershed from IDEM collections. Scores greater than 60 have been found to be generally conducive to the existence of warm water fauna. Sites with scores less than 60 are in areas with agriculture land use in the form of row crops.

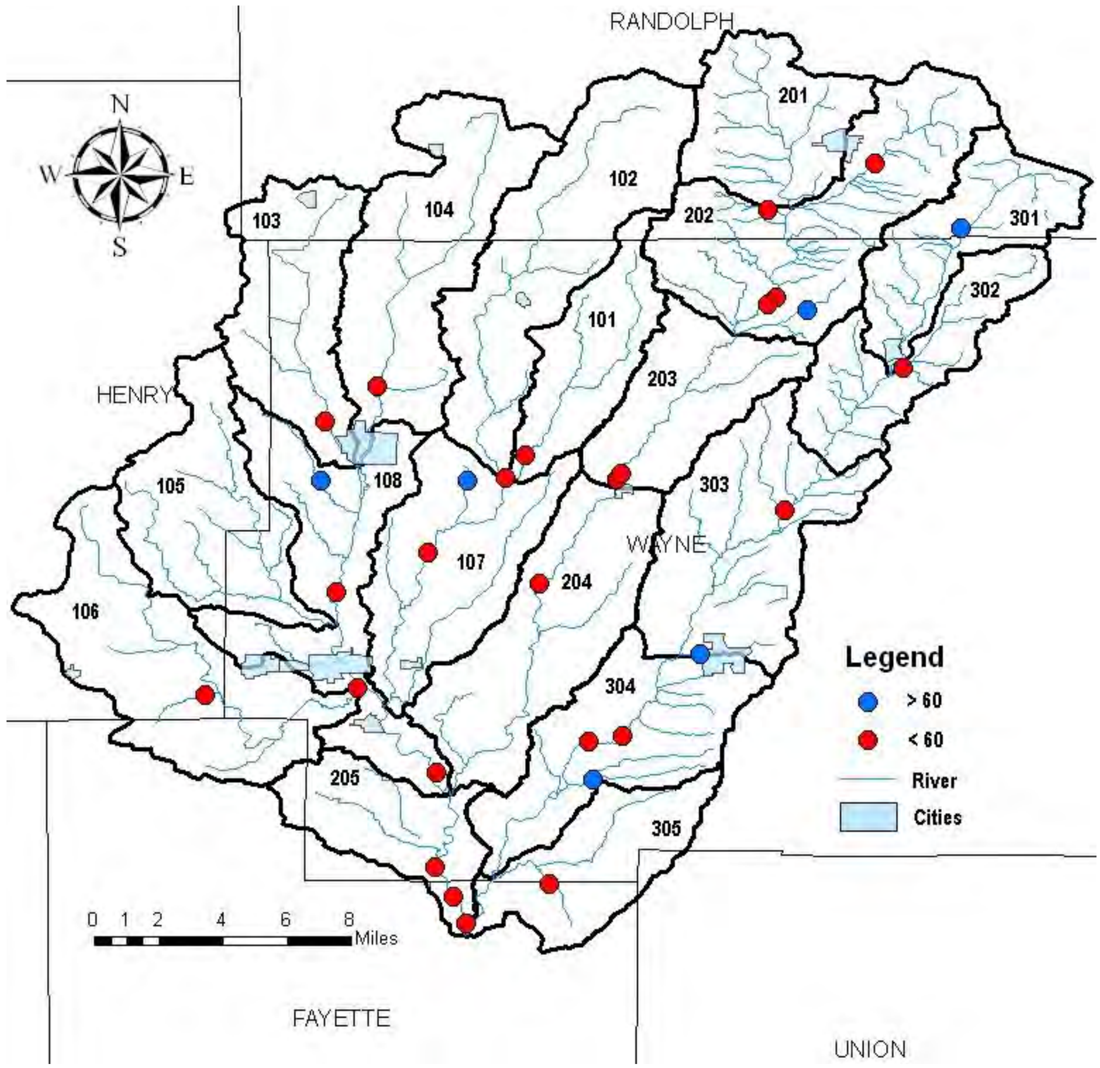
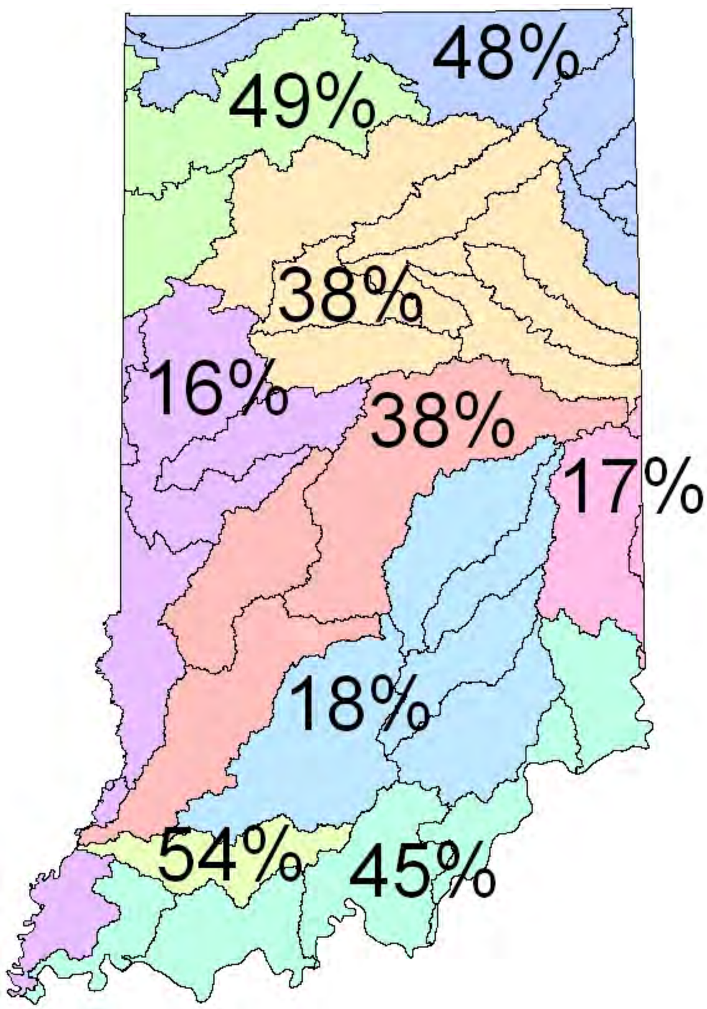


Figure 22. Estimated watershed non-attainment results per QHEI total scores in Indiana watersheds (2001-2005; Sobat 2008). The West Fork Watershed is grouped in with the larger Great Miami River Watershed, depicted in pink.



Project Name	*%Attainment*	*%Non-Attainment*
Patoka River n=26	46%	54% n=15/26 Impaired
Upper Illinois River n=38	51%	49% n=17/38 Impaired
Great Lakes Tributaries n=38	52%	48% n=15/38 Impaired
Ohio River Tributaries n=38	55%	45% n=12/38 Impaired
West Fork White River n=36	62%	38% n=12/36 Impaired
Upper Wabash River n=37	62%	38% n=9/37 Impaired
East Fork White River n=38	82%	18% n=8/38 Impaired
Great Miami River n=38	83%	17% n=3/38 Impaired
Low er Wabash River n=38	84%	16% n=4/38 Impaired

3.4 Data: Macroinvertebrates

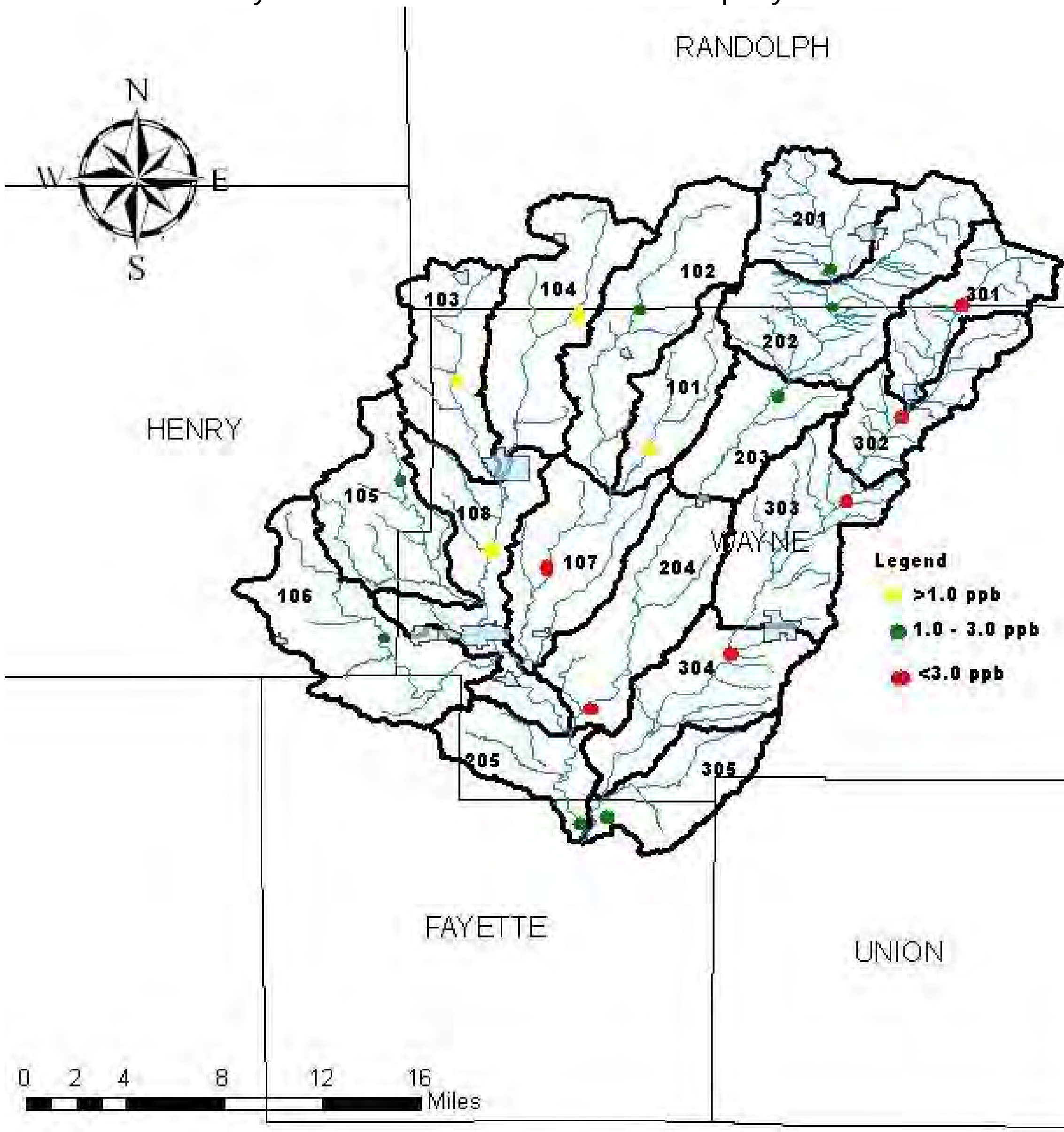
IDEM (Davis 2008)

a. The Macroinvertebrate Index of Biotic Integrity (mIBI) was calculated by IDEM's Biological Studies Section in 1994, 1997, and 2002 in the West Fork of the Whitewater River Watershed at 27 locations.
b. Scores ranged from 2.6 to 5.2 using KICK samples, and therefore no sites were considered "poor" or "very poor" and all sites were considered supporting for aquatic life use.

3.5 Data: Atrazine

1. United States Environmental Protection Agency (US EPA 2005-2006)
   a. The Ecological Watershed Monitoring Program analyzed 76 samples from Nolands Fork River for atrazine concentrations
   b. Of the 76 samples:
      i. 71 contained atrazine
      ii. 7 were found to be above 3ppb (EPA drinking water standard)
      iii. Out of the 7 samples above 3ppb, 3 were above 10 ppb, with a maximum reading of 21.11 ppb.
2. Indiana American Water Company
   a. Analyzed 18 samples in our watershed on 5/25/10 (Figure 23)
   b. There were six sites were found to exceed 3ppb
   c. The presence of atrazine in our local rivers and streams is seasonal, as farmers apply the herbicide in the spring, therefore there can be wide fluctuations of the chemical depending on the day and environmental conditions in which you sample (a wet day vs. a dry day for example). We have seen that from April to May that the atrazine will spike during this time period. Then will dispense during the following months. This information comes from research in the Middle Fork Watershed.

Figure 23. Spatial distribution of atrazine results (ppb) in the West Fork Watershed taken by the Indiana American Water Company.



HUC	Atrazine
101	0.88
102	1.46
103	0.17
104	0.62
105	1.26
106	1.08
107	4.03
108	0.27
201	2.26
202	2.46
203	2.64
204	4.79
205	2.00
301	3.36
302	3.83
303	3.84
304	3.23
305	1.26

3.6 Data: E.coli

1. IDEM Office of Water Quality, Total Maximum Daily Load (IDEM 2008b)
   a. Analyzed 30 sites within the West Fork Watershed:
      i. Found 23 sites to exceed *E. coli* standard
      ii. Attribute high E. coli levels to both point and non-point sources

3.7 Data: Windshield Survey

In the fall of 2009 steering committee members completed a windshield survey of the watershed; results of the survey are listed by sub-watershed, highlighted cells indicate where the greatest need for each category lies (ex. greatest need for livestock fencing based on the large number of livestock with river access):

Sub-watershed	# of areas with livestock access	# of farms with conventional tillage	# of known failing septics	# of farms with poor manure management	% of river lacking a riparian buffer
101	1	3	0	0	0
102	0	0	0	0	15
103	0	1	0	2	20
104	4	3	0	0	20
105	4	3	0	0	20
106	1	2	0	0	0
107	1	6	0	0	0
108	6	2	4	0	15
201	0	0	0	0	100
202	6	3	0	0	30
203	1	3	0	1	10
204	1	4	0	0	10
205	0	1	0	0	10
301	1	3	0	0	20
302	5	5	0	0	20
303	5	4	0	0	20
304	6	2	0	0	5
305	1	1	0	0	0
TOTAL	**43**	**46**	**4**	**3**	**N/A**

3.8 Data Summary:

While the West Fork of the Whitewater River appears to be doing very well comparatively to other watersheds in Indiana, more work needs to be done to improve surface water quality. The 303(d) list has several streams listed for impairments due to *E. coli*, sedimentation, and mercury deposition. Data collected by the WFWP has located areas that need more attention, and more data, to be able to pinpoint sources of pollution. Data supplied by IDEM and the Indiana Division of Fish and Wildlife show that overall the watershed has good habitat and macroinvertebrate and fish assemblages, especially when compared to watersheds across Indiana. Finally, a study by the US EPA found atrazine levels in the watershed exceeding drinking water standards. Overall, management of the watershed will help ensure that habitat and biological communities remain healthy and that the quality of surface water can be improved. Table 3 outlines major concerns, potential stressors, and problems associated with water quality issues in the West Fork.

Table 5. Potential concerns/problem areas, sources, and problem statements as determined by the steering committee based on information gathered.

Concern/Problem Area Water Quality	Sources	Problem Statement
Elevated E. coli levels	✓ Failing septic systems ✓ Livestock with river access ✓ Poor manure management ✓ Storm water run-off	There are 3 known failing septic systems located south of Hagerstown, and 1 failing septic in the town of Milton (sub-watershed 108; Figure 5). While 4 known failing septic systems is not a large number, it is believed that this is a vast underrepresentation of the issue due to survey results that showed that 50% of septic owners in the watershed did not properly maintain their septic system. There are approximately 45 farms throughout the watershed that allow livestock access to the river with an average herd size of 37. Cattle appear to be the most abundant livestock animal with access, horses and sheep have also been spotted in the river. Sub-watersheds with the most livestock in the river include 108, 202, 302, 303, and 304. Three farms in sub-watersheds 103 and 203 (Figure 5) have been labeled as having poor manure management. The communities of Dublin, Williamsburg, Modoc, Economy, Cambridge City, Losantville, Milton, Centerville, and Greens Fork all contribute to storm water runoff which brings domestic animal waste to the river. Sub-watersheds affected by storm water runoff include 103, 104, 106, 108, 202, 302, and 304.
Elevated atrazine levels	✓ Conventional tillage ✓ Highly erodible land ✓ Lack of riparian buffers ✓ Poor pest management	There are approximately 92 fields throughout the watershed that utilize conventional tillage with an average size of 18.1 acres. Sub-watersheds with the most conventionally tilled fields include 107, 204, and 302. Approximately 80% of the farms located in the watershed contain some highly erodible land. Approximately 51 miles of river lack sufficient riparian buffers, especially in the headwater areas. Sub-watersheds with the largest need for riparian buffers include 103, 104, 105, 201, 202, 301, 302, and 303.

Table 5. Potential concerns/problem areas, sources, and problem statements as determined by the steering committee based on information gathered.

Concern/Problem Area Water Quality	Sources	Problem Statement
Elevated nutrient levels	✓ Conventional tillage ✓ Lack of riparian buffers ✓ Failing septic systems ✓ Highly erodible land ✓ Livestock with river access ✓ Poor manure management ✓ Storm water run-off	There are approximately 92 fields throughout the watershed that utilize conventional tillage with an average size of 18.1 acres. Sub-watersheds with the most conventionally tilled fields include 107, 204, and 302. Approximately 51 miles of river lack sufficient riparian buffers, especially in the headwater areas. Sub-watersheds with the largest need for riparian buffers include 103, 104, 105, 201, 202, 301, 302, and 303. Approximately 80% of the farms located in the watershed contain some highly erodible land. There are 3 known failing septic systems located south of Hagerstown, and 1 failing septic in the town of Milton (sub-watershed 108; Figure 5). While 4 known failing septic systems is not a large number, it is believed that this is a vast underrepresentation of the issue due to survey results that showed that 50% of septic owners in the watershed did not properly maintain their septic system. There are approximately 45 farms throughout the watershed that allow livestock access to the river with an average herd size of 37. Cattle appear to be the most abundant livestock animal with access, horses and sheep have also been spotted in the river. Sub-watersheds with the most livestock in the river include 108, 202, 302, 303, and 304. Three farms in sub-watersheds 103 and 203 (Figure 5) have been labeled as having poor manure management. The communities of Dublin, Williamsburg, Modoc, Economy, Cambridge City, Losantville, Milton, Centerville, and Greens Fork all contribute to storm water runoff which brings domestic animal waste and excess lawn fertilizers to the river. Sub-watersheds affected by storm water runoff include 103, 104, 106, 108, 202, 302, and 304.

Table 5. Potential concerns/problem areas, sources, and problem statements as determined by the steering committee based on information gathered.

Concern/Problem Area Water Quality	***Sources***	***Problem Statement***
Elevated sediment	✓ Conventional tillage ✓ Lack of riparian buffers ✓ Highly erodible land ✓ Livestock with river access	There are approximately 92 fields throughout the watershed that utilize conventional tillage with an average size of 18.1 acres. Sub-watersheds with the most conventionally tilled fields include 107, 204, and 302. Approximately 51 miles of river lack sufficient riparian buffers, especially in the headwater areas. Sub-watersheds with the largest need for riparian buffers include 103, 104, 105, 201, 202, 301, 302, and 303. Approximately 80% of the farms located in the watershed contain some highly erodible land. There are approximately 45 farms throughout the watershed that allow livestock access to the river with an average herd size of 37. Cattle appear to be the most abundant livestock animal with access, horses and sheep have also been spotted in the river. Sub-watersheds with the most livestock in the river include 108, 202, 302, 303, and 304.
Mercury contamination	✓ Transported through precipitation from industries	Heavy metals may be present in our water sources due to industrial activities located outside the boundaries of the watershed.

Table 5. Potential concerns/problem areas, sources, and problem statements as determined by the steering committee based on information gathered.

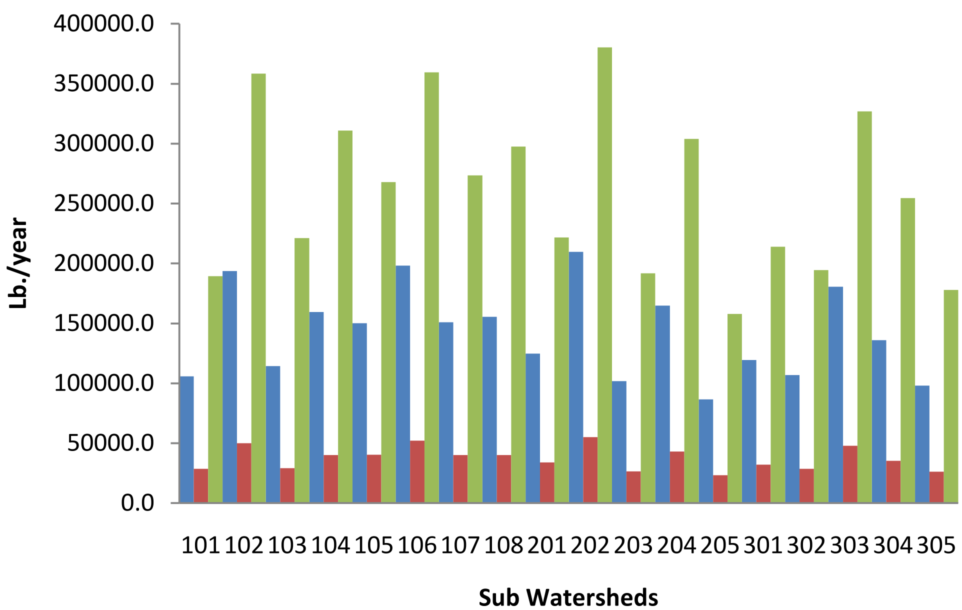
Concern/Problem Area Water Quality	***Sources***	***Problem Statement***
Flood episodes	✓ Lack of riparian buffers ✓ Lack of wooded acres ✓ Lack of wetlands	A lack of landscape features (ex. riparian buffers, wooded areas, wetlands) that can mitigate the effects of storm events reduces groundwater recharge, which increases flow rate and causes streams to flood more frequently and banks to erode more quickly.

4.0 Identify Critical Areas

4.1 Current Loading Estimates

Loading information for each sub-watershed was also determined (Figure 24, 25, and 26). This information was obtained from water monitoring testing each sub-watershed once a month and calculating the loading of the critical area for each sub-watershed per year. Loading information for each sub-watershed was also determined by using the EPA's Spreadsheet Tool for Estimating Pollutant Loads (Figure 24 and 25) and taken out of the Total Maximum Daily Load report created for the West Fork (Figure 26). A load is the quantity of material (ex. sediment) that is being carried by a stream or river per year (in our case).

Figure 24. Loading of nitrogen (N, lb/yr), phosphorus (P, lb/yr), and Biochemical Oxygen Demand (BOD, lb/yr) in each sub-watershed of the West Fork of the Whitewater River Watershed.



- N Load
- P Load
- BOD Load

Figure 25. Sediment loading (ton/yr) in each sub-watershed of the West Fork of the Whitewater River Watershed.

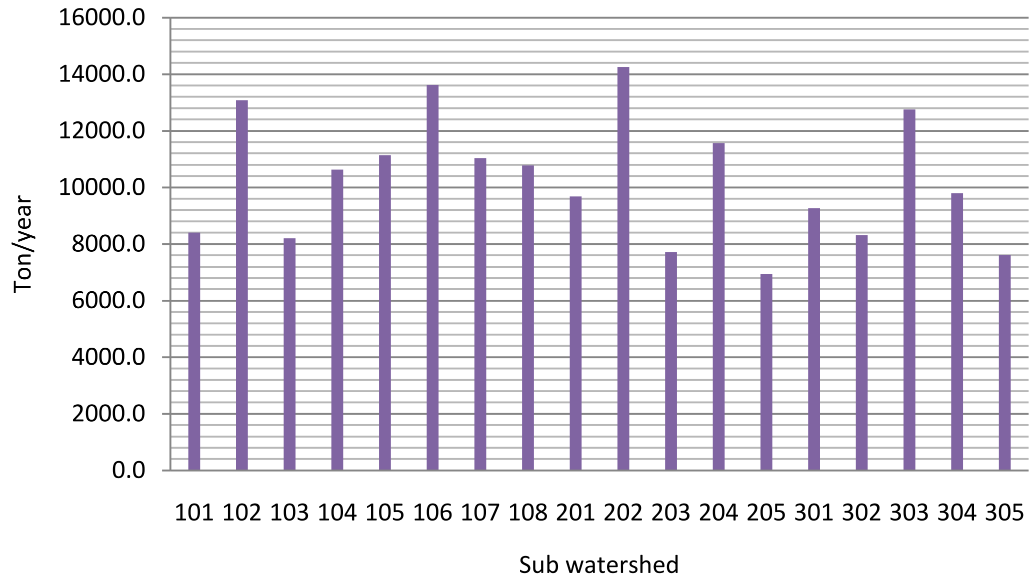
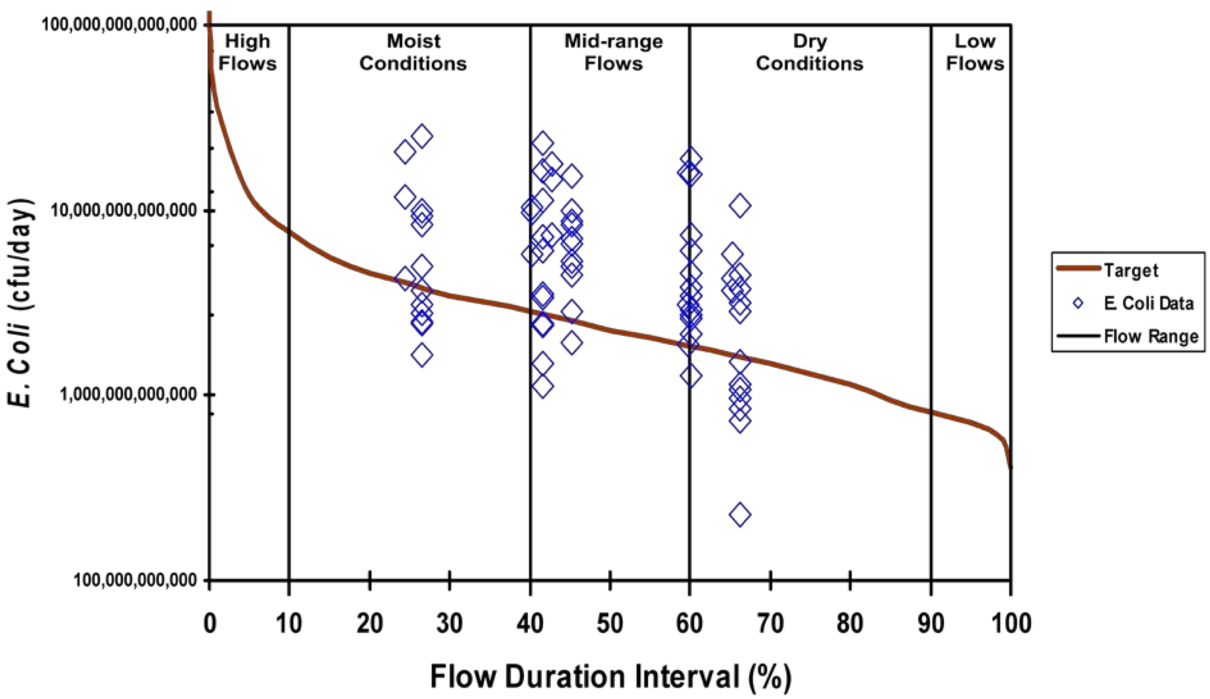


Figure 26. West Fork of the Whitewater River *E. coli* load duration curve.



4.2 Critical Area Selection

Critical areas for the above listed sources of *E. coli*, atrazine, sediment, and nutrients were determined by considering landscape features and water monitoring data on a sub-watershed level. For each cause a table was created that outlined which sub-watersheds exhibited sources in amounts considered to be critical (Table 4, 5, 6, and 7).

Table 6. All landscape features, loading information, and data collected used to determine critical areas for E.coli. Red shaded boxes are worth 2 points; yellow shaded boxes are worth 1 point. Any sub-watershed with an overall score of 5 or greater was considered critical.

12-digit HUC	*E. coli* (cfu/100 mL)	303d *E. coli*	TMDL	livestock access	failing septics	poor manure manage ment	urban	TOTAL RED	TOTAL YELLOW	TOTAL POINTS
TARGET	235+	impaired	125+	5+	1+	1+	1+			
101	310.37		Y	1	0	0	0	0	2	2
102	370.91	5A	Y	0	0	0	0	1	2	4
103	81.52	5A	Y	0	0	2	1	3	1	7
104	187.38	5A	Y	4	0	0	1	2	2	6
105	384.46			4	0	0	0	0	1	1
106	328.75	5A	Y	1	0	0	1	2	2	6
107	282.52	5A		1	0	0	0	1	1	3
108	65.44	5A	Y	6	4	0	1	4	1	9
201	324.53			0	0	0	0	0	1	1
202	496.73		Y	6	0	0	1	2	2	6
203	130.88	5A	Y	1	0	1	0	2	2	6
204	36.64	5A	Y	1	0	0	0	1	1	3
205	58.75	5A	Y	0	0	0	0	1	1	3
301	56.97	5A	Y	1	0	0	0	1	1	3
302	701.8			5	0	0	1	3	0	6
303	709.81		Y	5	0	0	0	2	1	5
304	357.99		Y	6	0	0	1	2	2	6
305	56.97	5A		1	0	0	0	1	0	2

Figure 27. Spatial representation of sub-watersheds considered to be critical due to *E. coli*. Critical areas are shaded in pink; towns are depicted in light blue.

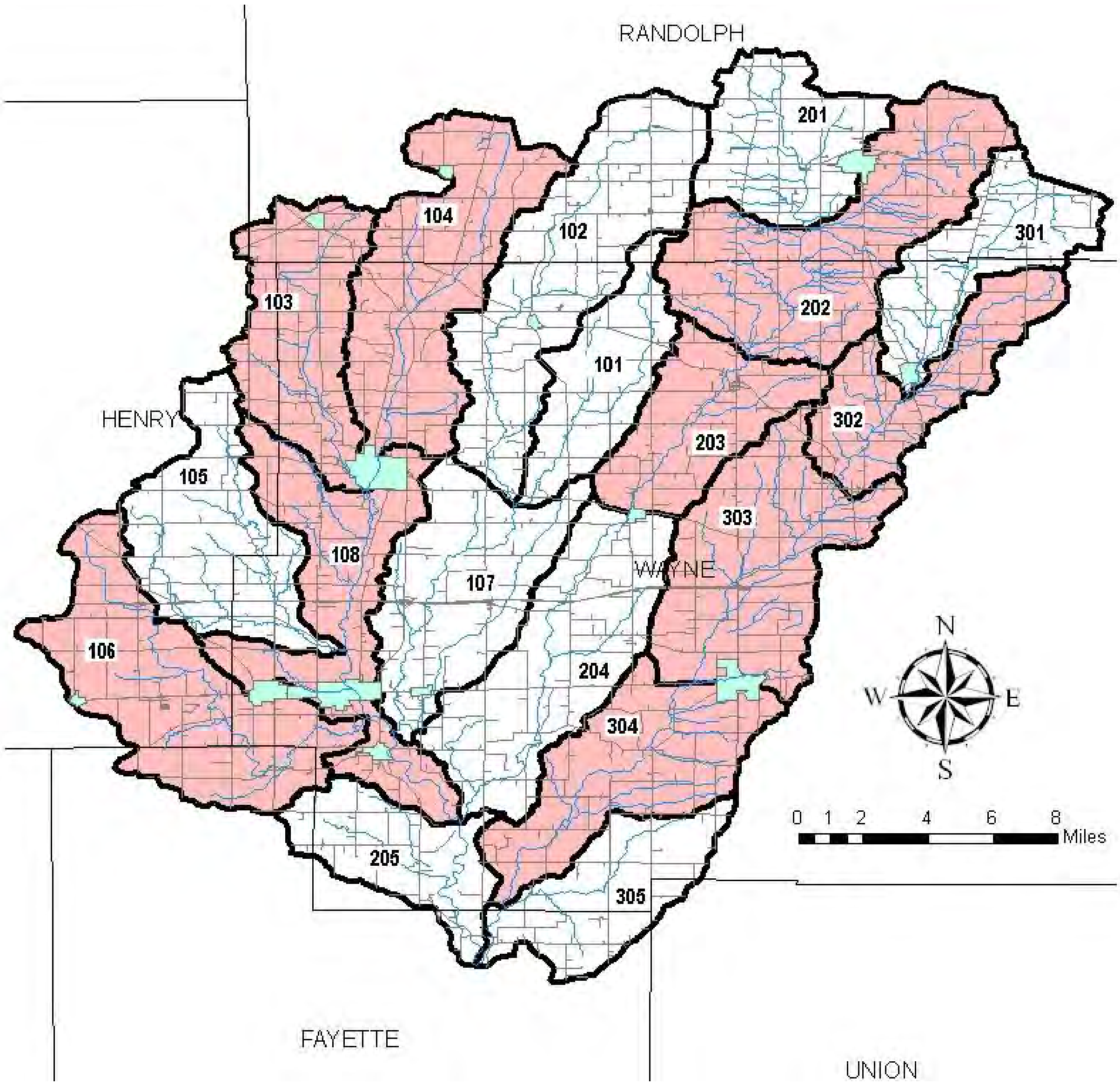


Table 7. All landscape features, loading information, and data collected used to determine critical areas for nutrients. Red shaded boxes are worth 2 points; yellow shaded boxes are worth 1 point. Any sub-watershed with an overall score of 5 or greater was considered critical.

12-digit HUC	Ortho P (mg/L)	Nitrate (mg/L)	303d IBC	IBI	conventional tillage	lacking riparian buffer	failing septics	livestock access	poor manure management	urban	Total Red	Total Yellow	TOTAL POINTS
TARGET	0.5	10	impaired		4+	20+	1+	5+	1+	1+			
101	0.21	9.22			3	0	0	1	0	0	0	1	1
102	0.52	9.21			0	15	0	0	0	0	1	1	3
103	0.22	5.12			1	20	0	0	2	1	2	1	5
104	0.29	3.57			3	20	0	4	0	1	1	1	3
105	0.31	9.31			3	20	0	4	0	0	0	2	2
106	0.46	7.3			2	0	0	1	0	1	1	0	2
107	0.57	7.58			6	0	0	1	0	0	2	0	4
108	0.4	5.96	5A	poor	2	15	4	6	0	1	5	0	10
201	0.57	8.45			0	100	0	0	0	0	2	1	5
202	0.53	5.85			3	30	0	6	0	1	4	0	8
203	0.43	4.93			3	10	0	1	1	0	1	0	2
204	0.75	7.8			4	10	0	1	0	0	1	1	3
205	0.23	5.84			1	10	0	0	0	0	0	0	0
301	0.33	8.12			3	20	0	1	0	0	0	2	2
302	0.54	7.45			5	20	0	5	0	1	4	1	9
303	0.45	4.84		poor	4	20	0	5	0	0	2	2	6
304	0.59	6.03			2	5	0	6	0	1	3	0	6
305	0.44	5.87			1	0	0	1	0	0	0	0	0

Figure 28. Spatial representation of sub-watersheds considered to be critical due to nutrients. Critical areas are shaded in pink; towns are depicted in light blue.

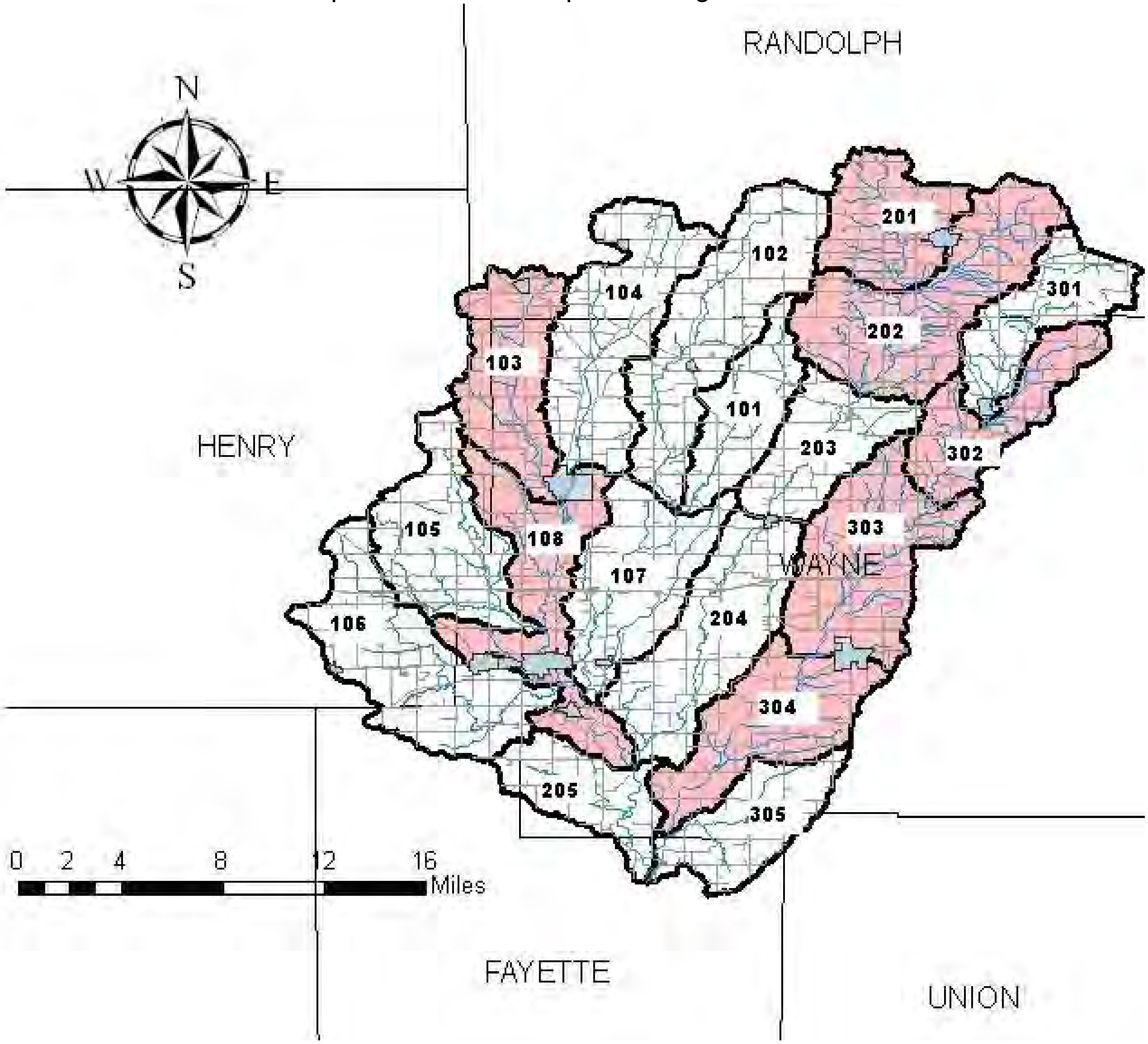


Table 8. All landscape features, loading information, and data collected used to determine critical areas for sediment. Red shaded boxes are worth 2 points, yellow shaded boxes are worth 1 point. Any sub-watershed with an overall score of 4 or greater was considered critical.

12-digit HUC	**Turbidity (NTU)**	**Sediment Load (Ton/yr)**	**303d IBC**	**IBI**	**livestock access**	**conventional tillage**	**poor manure management**	**lacking riparian buffer**	Total Red	Total Yellow	TOTAL POINTS
TARGET	25	11000	impaired		5+	4+	1+	20+			
101	2.65				1	3	0	0	0	0	0
102	8.52	11000+			0	0	0	15	0	1	1
103	4.41				0	1	2	20	1	1	3
104	6.76				4	3	0	20	0	1	1
105	10.3	11000+			4	3	0	20	0	2	2
106	17.03	11000+			1	2	0	0	0	1	1
107	18.55	11000+			1	6	0	0	2	1	5
108	14.26		5A	poor	6	2	0	15	3	0	6
201	12.4				0	0	0	100	1	0	2
202	8.46	15000+			6	3	0	30	3	0	6
203	9.96				1	3	1	10	1	0	2
204	24.36	11000+			1	4	0	10	1	2	4
205	10.59				0	1	0	10	0	0	0
301	16.64				1	3	0	20	0	1	1
302	15.33				5	5	0	20	2	1	5
303	8.19	11000+		poor	5	4	0	20	2	3	7
304	25.04				6	2	0	5	2	0	4
305	7.36				1	1	0	0	0	0	0

Figure 29. Spatial representation of sub-watersheds considered to be critical due to sediment. Critical areas are shaded in pink; towns are depicted in light blue.

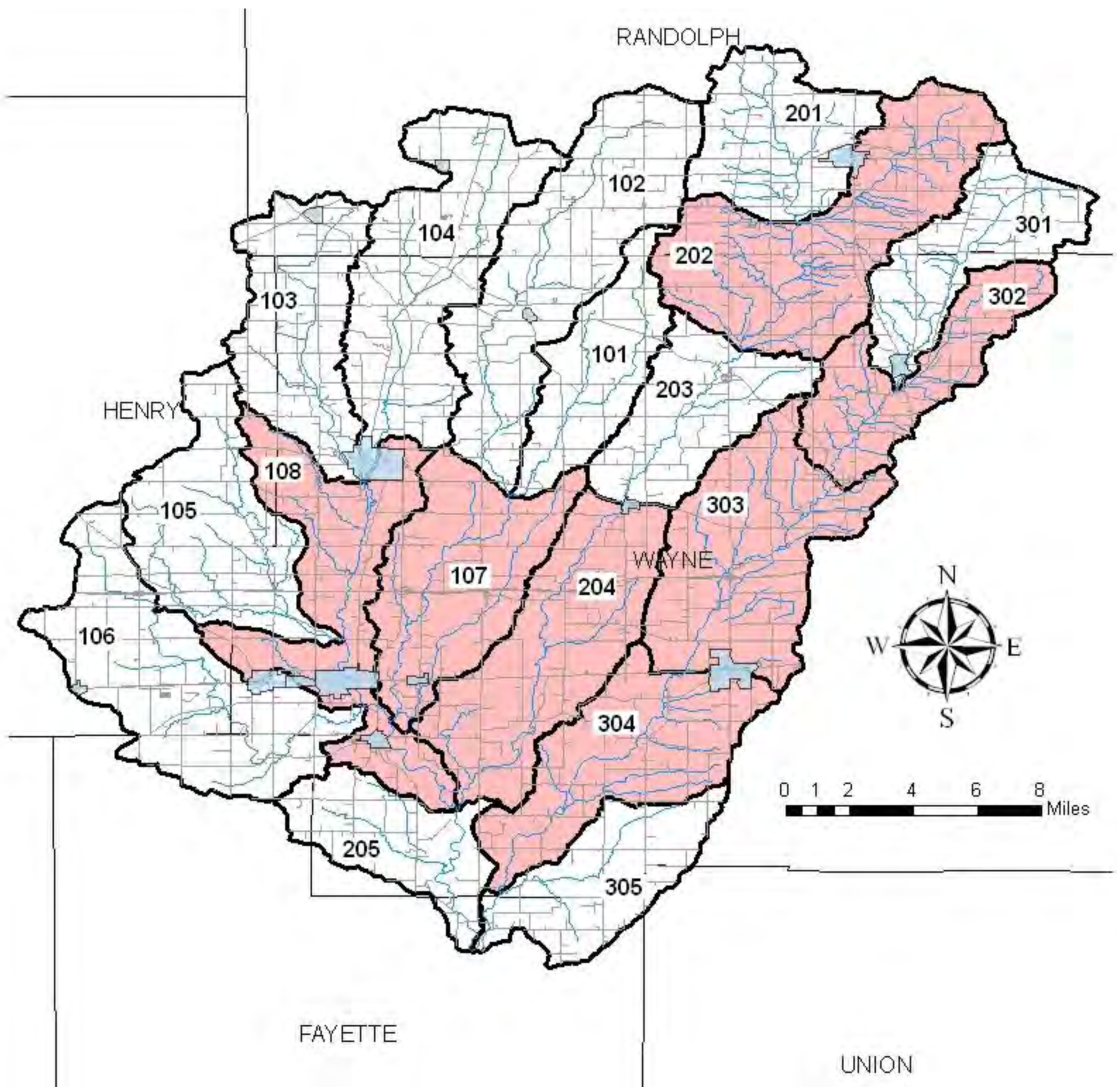
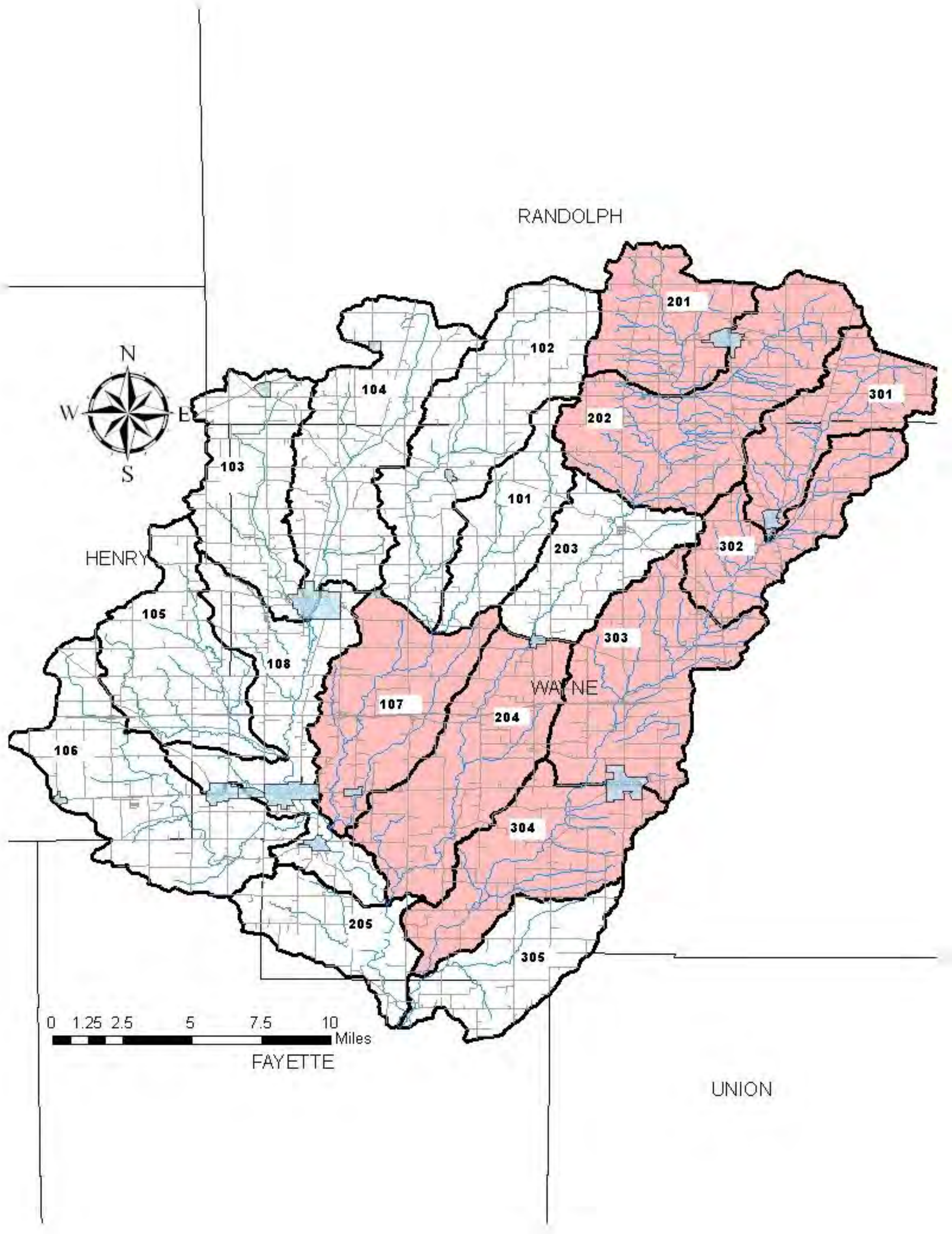


Table 9. All landscape features, loading information, and data collected used to determine critical areas for atrazine. The data was gathered in the spring of 2010. Red shaded boxes are worth 2 points, yellow shaded boxes are worth 1 point. Any sub-watershed with an overall score of 2 or greater was considered critical.

12-digit HUC	Atrazine (ppb)	conventional tillage	lacking riparian buffer	Total Red	Total Yellow	TOTAL POINTS
TARGET	3.0	4+	20+			
101	0.88	3	0	0	0	0
102	1.46	0	15	0	0	0
103	0.17	1	20	0	1	1
104	0.62	3	20	0	1	1
105	1.26	3	20	0	1	1
106	1.08	2	0	0	0	0
107	4.03	6	0	2	0	4
108	0.27	2	15	0	0	0
201	2.26	0	100	1	0	2
202	2.46	3	30	1	0	2
203	2.64	3	10	0	0	0
204	4.79	4	10	1	1	3
205	2.00	1	10	0	0	0
301	3.36	3	20	2	1	3
302	3.83	5	20	4	1	5
303	3.84	4	20	1	2	4
304	3.23	2	5	1	0	2
305	1.26	1	0	0	0	0

Figure 30. Spatial representation of sub-watersheds considered to be critical due to atrazine. Critical areas are shaded in pink; towns are depicted in light blue.



4.3 Implementation Prioritization

Critical areas were prioritized by which stressor has the largest perceived impact on human health (E.coli) down to the stressor with the least perceived impact on human health (atrazine).

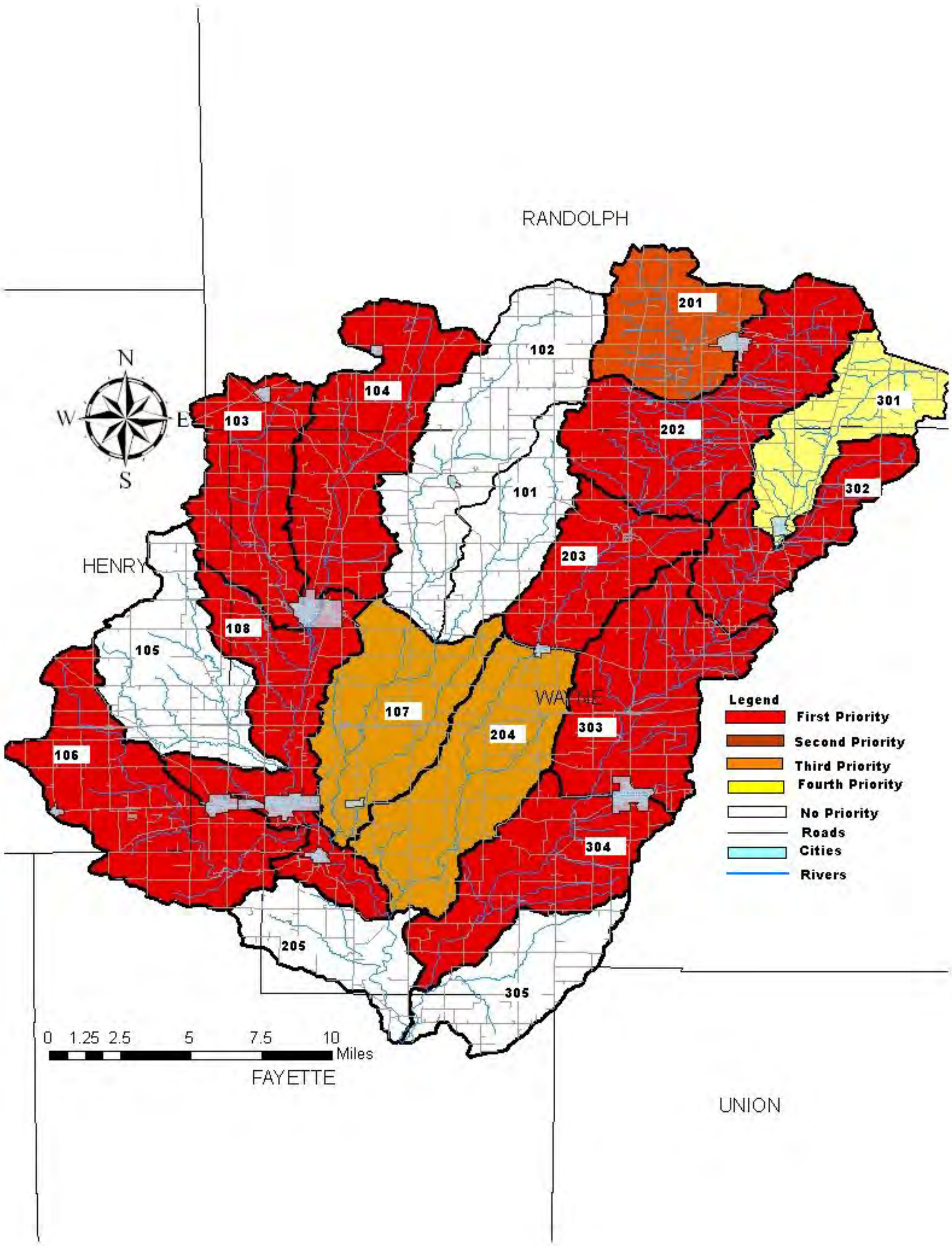
Critical areas have the following prioritization:

1. E.coli
2. Nutrients
3. Sediment
4. Atrazine

Table 10. The following table lists the sub watersheds and their priorities. This shows the priority areas for future work.

Sub watershed	First Priority	Second Priority	Third Priority	Fourth Priority
	E. coli	Nutrients	Sediment	Atrazine
103	priority	priority		
104	priority			
106	priority			
108	priority	priority	priority	
202	priority	priority	priority	priority
203	priority			
302	priority	priority	priority	priority
303	priority	priority	priority	priority
304	priority	priority	priority	priority
201		priority	priority	priority
107			priority	priority
204			priority	priority
301				priority

Figure 31. Sub-watersheds will have the following priority for future work based on their critical area prioritization:



5.0 Goals

- Reduce *E. coli* levels below the state standard of 235 colonies/100mL at all testing locations by 2020
  - Indication of completion would be that all 9 water monitoring sites would be below the state standard.
  - Number of producers implementing *E. coli* reducing conservation practices can also be tracked.
- Reduce nutrient levels to those typically found in Indiana by 2020
  - Indication of completion would be that all 7 water monitoring sites levels of ortho phosphate below 0.17 mg/L and nitrate levels below 5.0 mg/L
  - Number of producers implementing nutrient reducing conservation practices can also be tracked
- Reduce excess sedimentation from flood event and overland run-off occurring in the watershed by 2020
  - Indication of reduction would be monitored through the number of BMPs installed and calculation of sediment loading via the collection of total suspended solids data at our 7 sub watershed prioritized monitoring sites.
  - Sediment loading in all sub-watersheds should be below 6000 tons/year
  - Number of producers implementing sediment reducing conservation practices can also be tracked.
- Reduce atrazine levels in the watershed below the state standard of 3 ppb by 2020
  - Indication of completion would be that 8 sub watershed prioritized water monitoring sites would be below the state standard.
  - Number of producers implementing atrazine reducing conservation practices can also be tracked.
- Increase the general public's knowledge about watersheds and water quality
  - Indications of increase in knowledge tracked by counting the number of people who come to watershed sponsored events, participate in the cost share program, participate in water monitoring, and through the number of newsletters and press releases submitted.

6.0 Choosing Measures to Apply

In order to reach the goals documented, the steering committee met every month to developed measures to address the problems. We had a consensus on each problem and a way to solve them. Each measure is listed below the appropriate goal. All BMP measures installed should meet the Natural Resource Conservation Service's technical guide standards. All accomplishments will be recorded by the project coordinator and updated within the watershed management plan.

Problem #1: Elevated E. coli levels

Cause #1: In stream access of livestock throughout the watershed.

Location: Livestock operation in the critical sub watersheds (Figure 27).

Measure #1: Fence 200 head of the cattle which have regular access to the river and/or its tributaries.

Measure #2: Develop watering systems for the livestock which have been fenced out of the river and/or its tributary and need a source of drinking water.

Measure #3: Develop a demonstration site which highlights an exclusion and watering system for livestock and includes a manure management system.

Cause #2: Improperly maintained septic systems within the watershed

Location: Households over 20 years old.

Measure #1: Steering committee will schedule a public meeting with guest speakers from the Wayne County Health Department to discuss proper maintenance and testing of septic systems.

Measure #2: Watershed Coordinator will update the current brochure and explore existing information about septic systems.

Measure #3: Steering committee will explore any possible grants that people could apply for to replace or improve existing septic systems
.

Measure #4: Watershed Coordinator will write a press release about septic system which will be submitted to local news media.

Cause #3: Storm water from storm drains and land runoff.

Location: Local Communities.

Measure #1: Educate the local communities about where storm water goes and keeping the domestic animal waste from reaching the river.

Measure #2: Develop nutrient management plans to properly address animal waste usage.

Cause #4: Poor Manure Management

Location: Livestock operation throughout watershed.

Measure #1: Educate the livestock producers on the proper way to dispose of livestock waste.

Measure #2: Develop nutrient management plans to handle animal waste.

Problem #2: High nutrient levels of Phosphate and Nitrates within the watershed

Cause #1: Excess nutrients coming from cropland and livestock.

Location: Cropland in the critical sub watersheds (Figure 28)

Measure #1: Work with 15 farmers each year on conservation planning and nutrient management.

Measure #2: Work with 10 farmers on animal waste management and livestock access to streams.

Measure #3: Encourage landowners to enter their cropland into the Conservation Reserve Program, especially along riparian areas.

Measure #4: Encourage the use of cover crops and buffer strips in the watershed to protect streams from storm runoff.

Cause #2: Excess nutrients from septic systems

Measure #1: Steering committee will schedule a public meeting with guest speakers from the Wayne County Health Department to discuss proper maintenance and testing of septic systems.

Problem #3: Elevated sediment load

Cause #1: Lack of riparian buffers located along the river and its tributaries.

Location: Insufficiently buffered riparian areas in the critical sub watershed (Figure 29).

Measure #1: Promote riparian buffer planting around agriculture land through the Conservation Reserve Program, with a goal of 25 acres during the next three years.

Measure #2: Installation of stream bank stabilization, stream crossing, and the removal of any down tree in the floodway.

Measure #3: Provide cost-share to those wanting to establish riparian areas that aren't eligible for the Conservation Reserve Program

Measure #4: Promote wetlands to help control runoff and flooding.

Measure #5: Promote hay and pasture planting to help control sediment runoff.
.
Cause #2: Conventional tillage used on cropland in the watershed
.
Measure #1: Increase best management practices on cropland and increase conservation tillage practices by 200 acres.

Measure #2: Encourage farms to plant cover crops on their fields which lay bare during times of the year.

Measure #3: Work on conservation planning with at least 15 watershed landowners each year.

Measure #4: Educate farmers about the effects of cropping practices on water quality.

Measure #5: Install grassed waterways and WASCOB's to reduce sedimentation from gully erosion.

Cause #3: Livestock with in stream access which causes stream bank erosion.

Location: Livestock farms though out the critical sub watersheds (Figure 29).

Measure #1: Educate landowners on the effects of livestock in streams.

Measure #2: Fence 200 head of livestock out of streams/river by 2020.

Problem #4: Elevated Atrazine levels

Cause #1: Lack of riparian buffers.

Location: Insufficiently buffered riparian areas in the critical sub watersheds (Figure 30)

Measure #1: Promote riparian buffer plantings around agricultural land through the Conservation Reserve Program, with a goal of 25 acres per year.

Cause #2: Wide usage and large amount of atrazine being applied to farmland.

Measure #1: Include proper application of chemicals in the Watershed Memos Newsletter.

Measurer #2: Discuss the need for proper application and care when applying atrazine at public meeting and/or field days.

Measure #3: Offer cost-share to farmers reducing application rates of atrazine to ½ lb/acre.

Measure #4: Work on pest management with at least 15 watershed landowners each year.

Cause #3: Conventional Tillage

Measure #1: Promote more no-till in the watershed to reduce the amount of atrazine runoff in the streams.

Measue #2: Promote more no-till on Highly erodible land in the watershed.

Problem #5: Lack of local watershed/water quality education

Cause: Lack of education opportunities for watershed landowners.

Measure #1: Increase watershed awareness through continued community outreach through informational booth set-ups at 4-H fairs, Earth Day Events, and other relevant activities.

Measure #2: Continue mailing quarterly newsletters to all stakeholders containing relevant information pertaining to water quality issues.

Measure #3: Increase information about urban/small land owner issues which effect local water quality.

Measure #4: Promote one field day per year to educate the landowners in watershed.

Here is a list of practices that will be used to reduce loading in the watershed:

Crop and Riparian Reductions Methods
Waterways
Riparian Buffers
Establishment of Cover Crops
Conservation Tillage
WASCOB's
Conservation Farming Planning
Nutrient and Pest Management
Stream Bank Protection
Pasture and hay planting

Livestock Reductions
Alternative Watering Systems
Fencing
Stream Crossings
Animal Waste Holding Facilities
Animal Waste Management Planning
Nutrient Management

Section 7.0: Calculating load reductions

The estimated sediment loading of the West Fork River was based upon 18 measurements of total suspended solids taken during the winter and Spring of 2009-2010. -These measurements were correlated with measurements of turbidity (2009-2010) and discharge readings from the Greens Fork watershed at Kirlin Road, Nolands Fork at Waterloo Rd, and West Fork at state Rd. 1. The stream flow statistics from the USGS gauge at County Line road 1100 South (USGS 03274650) were used. It was found that approximately 47 percent of the discharge was contributed by the West Fork, 26 percent by Nolands Fork, and 27 percent by the Greens Fork Watershed.

The estimated yearly average of the watershed's total suspended solids was found to be 280 mg/liter. Estimated yearly average discharge of the watershed was calculated to be 662.3 cubic feet per second. Thus the estimated loading of sediments from the watershed is calculated to be 184,021 tons/year (see load calculations in Appendix B). This means that 184,021 tons or an average of 0.70 tons/acre of sediment are transported downstream into the river on an annual base. Erosion rates coming from cropland are believed to be much greater than the 0.70 tons/acre, which would be the case if all the land within the watershed were eroding at even rates.

Table 9:

Load Reduction of Manure

Livestock	# of animals	x	Avg. Amount of manure produce daily*	=	Amount of manure produced (lbs/day)	Fraction of N in a pound of manure	Fraction of P in a pound of manure	=	Pounds of N in the Manure per day	Pounds of P in Manure per day
Cattle	200	x	35 lbs/day	=	7,000	0.008	0.0065	=	56.0 lbs	45.5 lbs

(*information is determined by an estimate of 35 lbs/cow/day directly entering the water)

According to the Watershed Inventory Tool for Indiana, if 200 head of cattle are excluded from waterway access as much as 2.6×10^6 pounds (assuming 35 lbs of 75 lbs produced by each cow per day) of manure could be reduced from entering the river. This will reduce nitrogen and phosphorus contamination of the watershed, as seen in the calculation above for a total of 20,440 lbs. of nitrogen and 16,607 lbs. of phosphorus.

IDEM Load Reduction Calculations

In order to determine the water quality improvements made by converting conventional tilled farmland and installing filter strips the IDEM load reduction calculation worksheets were used. In order to estimate these changes we averaged the "C" value of switching from clean-till to no-till of corn before beans and beans before corn. We also changed the worksheet "LS" value to correlate with the value most appropriate for the watershed. It's also important to note that the values represent those that would be expected for Crosby soils, which are the predominant soil type within the watershed. Using the Agricultural Fields and Filter Strip Worksheet Calculations we determined estimated load reductions

It is projected that changing 200 acres of conventional tillage cropland with a 0% residue after planting to a no-till system with 40-50% residue after planting will reduce the load of sediment by 505 tons/year. Moreover, the phosphorus load will be reduced by 529 lbs/year and the nitrogen load will be reduced by 1,058 lbs/year.

It is also projected that the installation of 25 acres of filter strips/riparian buffers will reduce sediment by 167 tons/year, the phosphorus load will be reduced by 208 lbs/year and the nitrogen load will be reduced by 271 lb/year.

With the application cover crops in a no-till operation will reduce sediment by 61,709 tons/year, the phosphorus load will be reduced by 87,842 pounds/year and the nitrogen load will be reduced by 175,684 pounds/year when it is applied to the watershed cropland.

In a WASCOB project, the sediment reduction will be 72 tons/year, the phosphorus will be reduced by 72 pounds/year and the nitrogen will be reduced by 143 pounds/year.

It is projected that the installation of a stream bank stabilization will reduce sediment load by 1036 tons/year, the phosphorus load will be reduce by 1036 pounds/year and the nitrogen load by 2072 pounds/year.

The reduction of nutrients in a nutrient management plan if applied to one-quarter the cropland in the watershed would amount to 14,516 pounds of phosphorus and 28,990 pounds of nitrogen. This figure will be more, also if the manure is applied according to a nutrient management plan.

We are targeting to get 200 head of cattle removed from the stream to reduce E.coli. and assuming the E.coli production rate of 6.3×10^{10} CFU/animal/day, we estimate the total E.coli loading from these animals to be:

Total livestock Load=1.26×10^{9} colony forming units

We will be testing the streams during the spring time to check for the amount of atrazine in the streams. This time of year is where we have seen the pike of the atrazine in the streams and after a rain event to cause water runoff. We will check to see if the atrazine level is below the 3ppb level.

Section 8.0: Implementing the measures

Goals set forth by the West Fork Watershed Plan aim to improve local water quality for a positive impact on both landowners and the environment. Through educational efforts and implementation of proper conservation practices the goals formulated within this document can be accomplished.

The main goal of the entire watershed project is to increase local water quality through improved land practices. Lack of riparian buffers and water contamination through farm chemicals and livestock are major concerns of West Fork Steering Committee and many local residents. By addressing these problems and installing best management practices we can make a difference in the local environment.

Educational goals aim to show adults and children ways that they impact local water quality. These goals should also aim to provide solutions to identified problems. Educating about non-point source pollution, watersheds, and solutions to water quality problems will hopefully impact people's view of their impact of the local environment. By working to attain our goals within the West Fork Watershed we are also doing our part in positively impacting downstream water bodies which flow into the Great Miami River and the Ohio River.

The following goals have been organized according to the land area of focus. The steering committee also adopted targets in order to measure the success of the implementation phase of the project.

8.1 Cropland (to address sediment and nutrient goals)

Objective	Action Item	Responsible Party	Schedule/ Budget	Baseline	Target Goals	Indicators
Increase conservation tillage practices and install other cropland BMPs	Develop criteria for cost-share program Advertise cost-share program Encourage landowners to apply for EQIP	Project Coordinator 319 grant and Watershed landowners	September 2011 Feb.2014 $100,000	27 % of corn and 4% of soybeans still being conventional tilled	Increase conservation tilled farmland by 200 acres by 2014	Number of projects funded Number of acres converted to conservation tillage practices Water quality indicators improved Number of people applying for EQIP
Encourage farmers to attend Wayne County's Annual conservation workshop	Advertise through newsletters and press releases	Project Coordinator and Wayne County SWCD staff/ 319 grant	February each year $1000/ annually	Unknown	20 watershed farmers attending the event each year	Number of farmers attending the conservation workshop
Educate landowners about cropping and water quality issues	Educate through newsletters and press releases.	Project Coordinator 319 grant	Ongoing $4,000	Unknown	At least two publications each year	Number of mailings sent out Number of press releases used
Provide information about using cover crops and planting pasture to prevent erosion	Use various sources to develop informational packet and share with farmers	Project Coordinator 319 grant	Fall 2012 $4,000	None	Share information with at least 15 watershed farmers	Number of people receiving information Number of acres planted to pasture and/or hay
Increase farmers knowledge of proper conservation farming methods	Conduct and/or review conservation planning and nutrient/pest management with 10 farmers per year	Project Coordinator and NRCS staff 319 grant	Ongoing $20,000	—	Review existing plans or create new plans for 10 people each year	Number of farmers creating and reviewing conservation plans

8.2 Livestock (to address E.coli, sediment, and nutrients goals)

Objective	Action Item	Responsible Party	Schedule/ Budget	Baseline	Target Goals	Indicators
Encourage livestock exclusion and increased quality of pasture land with cost-share program , create alternative watering systems for excluded animals and manure holding facilities	Develop criteria for cost-share program Advertise cost-share program	Watershed Committee/ Coordinator 319 grant and Wayne SWCD	Sept. 11- Feb. 14 $101,752	Livestock with access to river *E.coli* levels as high as 3,500 colonies/100mL	Exclude 200 animals from the river and its tributaries *E. coli* levels below state standard of 235 colonies/100 ml	Number of farmers participating Number of livestock excluded from waterways
Develop demo. site to highlight a fencing & watering system and manure management system.	Develop criteria for demonstration site. Pick location for the site Host tour of the site to highlight successes	Watershed Coordinator/ NRCS Staff Wayne SWCD, landowner, and 319 grant	Nov 11- 13 $40,000	—	Develop demonstration site which highlights livestock exclusion and a manure	Number of livestock exclusion Number of people attending farm tour.
Educate livestock producers about alternative watering systems, manure management systems, rotational grazing and livestock exclusion	Contact livestock producers about meeting with NRCS grazing specialist. Schedule a meeting with specialist for livestock owner Include information in newsletters and at public events	Watershed Coordinator/ NRCS Grazing Specialist 319 grant	Nov. 11 - Nov. 13 $4,000	—	Educate 10 livestock produces about conservation livestock practices each year.	Number of producers meeting with grazing specialist Number of articles published

8.3 Septic Systems (to address E.coli and nutrient goals)

Objective	Action Item	Responsible Party	Schedule/ Budget	Baseline	Target Goals	Indicators
Hold public meeting concerning septic system maintenance	Schedule members of the Wayne County Health Department to speak at meeting Advertise meeting through press releases and newsletters	Project Coordinator and Wayne County Health Department 319 grant and Wayne County Health Depart.	Winter 2013 $5,000	__	Fifty people in attendance at public meeting	Attendance at public meeting
Develop educational campaign about importance of septic system maintenance	Sub-committee to research resources available for education Update brochure with information about septic maintenance. Develop press release concerning septic system maintenance for the newspaper	Watershed Coordinator 319 grant and Wayne County Health Dept.	Winter 2012 $24,000	__	Distribute information to landowners through mailing list and at watershed event	Number of people receiving information
Research possible grants for septic system repair and maintenance	Gather information about possible grants to fund septic system projects. Distribute information through public meetings & newsletter	Steering Committee 319 grant	Winter 2013 $3,000	__	Distribute information found at public meeting and in newsletter	Number of people receiving information

8.4 Riparian Areas (to address sediment and nutrient goals)

Objective	Action Item	Responsible Party	Schedule/ Budget	Baseline	Target Goal	Indicator
Create riparian buffers using willow trees plantings	Plant willow trees along riparian corridors.	Watershed Coordinator and volunteers 319 grant and landowners	Ongoing $2,000	—	Plant at least one acre of trees using the help of volunteers each year.	Amount of riparian land planted with willows.
Promote tree planting along agricultural fields through the Conservation Reserve Program.	Include information about the CRP program in newsletters and include information with display	Watershed Coordinator 319 grant	Ongoing $1,000 annually	None to date	Discuss the CRP riparian program with 5 landowners each year Enroll 25 riparian acres into the CRP program by 2018.	Number of people informed about CRP program
Encourage riparian buffers and filter strip plantings	Develop cost-share criteria Promote cost-share program Develop a riparian buffer demo plot	Watershed Coordinator 319 grant and landowners	Nov. 2011-2013 $50,000	71% of rivers sufficiently buffered 60% of sub-watersheds sufficiently buffered	Increase buffer areas along rivers by 5% Increase buffer areas along tributaries by 10%	Numbers of riparian acres planted Number of people participating

8.5 Atrazine Goals

Objective	Action Item	Responsible Party	Schedule/ Budget	Baseline	Target Goal	Indicator
Educate farmer about proper land application and consequences of spills	Include information about atrazine through newsletter and press releases	Watershed coordinator 319 grant	Ongoing $2,000	As high as 4.8 ppb and averaging above the state standard of 3 ppb during the spring of 2010.	Atrazine levels below 3ppb	Number of people receiving newsletter Number of press releases published
Offer cost-share money to farmers decreasing their application rates of atrazine and those not applying within 200 ft of water bodies.	Develop cost-share program Promote cost-share program	Watershed Steering Committee/ Coordinator 319 grant	Nov. 11-13 $42,000	Atrazine currently being applied at a rate of 1.3 lb/acre Atrazine levels more than 1 ½ times the state standard of 3 ppb	Atrazine levels below 3 ppb	Number of farm acres not receiving atrazine spray Number of farmers decreasing atrazine application rates.

8.6 Habitat (to address sediment and nutrient goals)

Objective	Action Item	Responsible Party	Schedule/ Budget	Baseline	Target Goal	Indicator
Educate landowners about the importance of wetlands and forests	Educate through publications	Watershed coordinator 319 grant	Ongoing $400/ annually	Low percentage of wetlands and forested land	Addition of forest acres and/or wetland	Number of people receiving newsletter
Encourage landowners to classify existing forests	Personal meetings with landowners	Watershed Landowners/District Forester DNR staff/319 grant	Ongoing $900/ annually	Current classified forest	Goal 20 acres of additional classified forest by 2018	Number of people met with to discuss classifying their forest
Encourage landowners to convert cropland to grassland and forestland	Educate landowners about the CRP program	Watershed coordinator/ NRCS Staff Wayne Co. SWCD and 319 grant	Ongoing/ $1,000/ annually	Approximately 15 percent of cropland enrolled in CRP	25 additional acres entered into CRP	Increase of acreage in the CRP program Increase of acreage planted to pasture and/or hay land

8.7 Overall Education Goals

Objective	Action Item	Responsible Party	Schedule/ Budget	Baseline	Target Goal	Indicator
Educated about watershed concerns to adults and children, including information about fish consumption advisories.	Set-up informational booth at 4-H Fair, Conservation Days, American Recycle Days, and Earth Day Activities.	Watershed Coordinator/ Steering Committee Wayne County SWCD and 319 grant	Ongoing $7,000 annually	To-date 2,000 people have been educated about the West Fork Project	5,000 people educated about the West Fork Watershed Project	Number of events participated in. Number of children and adults receiving information.
Conduct an urban/small landowner workshop	Plan a watershed meeting which addressed urban issues such as tree plantings, erosion control, and, chemical disposal	Watershed Coordinator/ Steering Committee 319 grant	Spring 2014 $5,000	--	50 people attending urban landowner workshop	Number of people attending event.
Educate about urban water quality issues	Create an urban homeowner brochure to be passed out at watershed events.	Watershed Coordinator/ Steering Committee 319 grant	Winter 2013 $5,000	--	100 watershed residents receiving brochure	Number of people receiving brochure.

9.0 Measuring Progress

9.1 Progress Indicators

In order to determine the success of the project and how efforts will improve water quality. Below is a list of items, which will help determine the progress throughout the program.

1. The Coordinator will track attendance at all field days, workshops, and public meetings held within and concerning the watershed project.

2. Success of educational programs will be measured by the increased participation of each activity, including programs, water monitoring, field days, and presentations.

3. The Steering committee will evaluate the management plans and make any changes or adjustments to ensure all changes and improvements remain current within the management plan.

4. Success of cost-share program will be measured by several different criteria:
   a. Number of landowners and amount of land enrolled in the 319 cost-share program
   b. Number of landowners and amount of land enrolled in EQIP, CRP, and other Federal Conservation Programs.
   c. Sediment and nutrients saved from implementation of conservation practices calculated by using IDEM's Load Reduction Calculation Program.

5. Water quality changes and improvements conducted throughout the grant period will aid in determining the success of the project.

9.2 Monitoring Progress

Water Monitoring Plan

A third party will be responsible for conducting water monitoring in the West Fork Watershed during Phase II. The parameters that will be tested include: temperature, pH, dissolved oxygen, total dissolved solids, nitrate, total phosphorus, hardness, conductivity, and *E. coli*. Testing materials from the first phase will be used and any additional supplies will be purchased through the grant. A quality assurance project plan (QAPP) will be written for the monitoring methods. The testing schedule and locations will change in order to monitoring the effectiveness of BMPs installed during the project. Changes and improvements in water quality will be updated in the watershed management plan.

Additional Monitoring

1. Atrazine - Indiana-American Water Company will continue monitoring atrazine levels within the watershed. These records will be compared to existing data. The data will be compared to established management goals.

2. Sediment - Load reduction calculations will be completed for applicable management practices installed within the watershed. Overall sediment reductions will be calculated and compared to previous calculations.

Operation and Maintenance

Landowners are responsible for properly installing and maintaining any management practice installed on their property through the cost-share program. Vegetative practices must be implemented for a period of 5 years and must meet NRCS technical guide standards. Structural practices must remain implemented for a period of 10 years and meet NRCS technical guide standards. Each installed practice will be checked annually throughout the duration of the project. Local agencies will provide technical assistance to landowners for practices installed within the watershed.

Works Cited

Canal Society of Indiana. 2009. http://www.indcanal.org/canals-whitewater.html.

Davis, Todd E. November 6, 2008. [Personal Communication]. Located at: Indiana Department of Environmental Management (IDEM), Assessment Information Management System (AIMS) Database, Indianapolis, Indiana.

IDEM, 2008. http://www.in.gov/idem/files/303d_list_2008_approved.xls.

IDEM, 2008b. http://www.in.gov/idem/files/tmdl_whitewaterwestfork_final_report.pdf

IDNR. The Status of Wetlands in Indiana. http://www.in.gov/dnr/fishwild/files/ statusof.pdf

Indiana County History Preservation Society. 2009. http://www.county history.com/

Indiana Water Resources Association. 2003. Exploring the Whitewater River Basin: Past and Present.

Kansas State University. Managing to minimize atrazine runoff. http://www.ksre.ksu.edu/library/crpsl2/mf2208.pdf

Long, Christopher. 2007. Whitewater River and West Fork Whitewater River Dearborn, Fayette, Franklin, and Wayne Counties: 2005 Fish Management Report.

Naitonal Cooperative Soil Survey Program. 2009. http://soils.usda.gov/partnerships/ncss/

Purdue University. Conservation tillage and water quality. http://www.ces.purdue.edu/extmedia/WQ/WQ-20.html

Sobat, Stacey L. November 5, 2008. [Personal Communication]. Located at: Indiana Department of Environmental Management (IDEM), Assessment Information Management System (AIMS) Database, Indianapolis, Indiana.

US EPA, Atrazine Ecological Watershed Monitoring Data, http://www.epa.gov/pesticides/reregistration/atrazine/atrazine_update.htm#ewmp

USDA NASS. 2008. http://www.nass.usda.gov/

Volunteer Stream Monitoring Training Manual: Hoosier Riverwatch – Indiana's Volunteer Stream Monitoring Program. Indiana Department of Natural Resources, 2003.

Appendix A: WFWP 2009 Water Quality Data

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
101	5/22/2009	1010	10.82	800	5.07	0.11	3.39	4.00	75.38	
101	6/8/2009	1212	9.70	300		0.29	3.52	1.50	80.24	
101	6/15/2009			400		0.08	3.96	4.30	74.60	
101	6/23/2009	1045	8.14	400	3.34	0.29	8.36	3.20	72.02	
101	6/30/2009			200		0.19	6.16	2.20	68.56	0.36
101	7/7/2009			300		0.37	12.76	3.10	67.20	
101	9/10/2009	1426	11.60	0		0.00	34.30	1.44	76.59	
101	11/18/2009	914	8.10	100		0.31	1.32	1.48	67.50	
102	3/3/2009	1725	15.50	200	8.40	1.27	7.50	4.40	69.47	
102	5/12/2009	1640	14.30	0	6.50	0.54	3.70	5.70	69.63	
102	6/5/2009	1020	8.53	200		0.24	14.52	4.30	71.53	
102	6/15/2009	1511	8.47	1300		1.21	28.60	28.50	55.88	
102	6/23/2009	1120	8.38	900	3.91	0.17	14.08	11.20	68.91	
102	6/30/2009	1149	8.00	100		0.11	1.32	9.10	78.44	0.67
102	7/7/2009	1244	9.30	300		0.43	4.84	5.60	74.75	
102	9/8/2009	1705	9.80	0		0.29	3.52	3.13	86.24	
102	11/18/2009	944	8.30	200		0.44	4.84	4.72	69.78	
103	5/22/2009	1038	10.51	0	4.11	0.21	6.16	3.10	82.92	
103	6/5/2009	1200	9.72	0		0.40	6.60	5.50	86.51	
103	6/15/2009	1444	9.10	100		0.03	7.92	3.30	80.72	
103	6/23/2009	1145	9.07	300	4.15	0.35	2.64	7.10	75.17	
103	6/30/2009	1123	8.20	300		0.12	3.96	2.30	74.85	0.01
103	7/7/2009	1222	8.90	400		0.07	3.96	7.20	76.65	
103	9/8/2009	1740	8.80	200	4.00	0.21	8.80	2.65	70.65	
103	11/18/2009	1006	8.50	0		0.39	0.88	4.16	86.22	
104	3/3/2009	1745	14.60	0	7.50	0.63	4.40	10.30	76.85	
104	5/12/2009	1628	11.60	300	5.00	0.28	0.00	3.30	73.91	
104	6/5/2009	1120	8.64	500		0.45	5.28	7.80	83.37	
104	6/15/2009	1501	7.80	1100		0.19	6.60	6.30	67.77	

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
104	6/23/2009	1100	7.58	1400	3.17	0.18	0.88	11.20	74.18	
104	6/30/2009	1141	7.30	0		0.19	3.96	4.90	81.28	0.32
104	7/7/2009	1237	7.90	300		0.10	6.16	9.10	73.09	
104	9/8/2009	1720	10.80	100		0.13	0.00	3.80	77.61	
104	11/18/2009	951	7.60	500		0.50	4.84	4.15	58.05	
105	5/22/2009	1110	12.98	200	4.23	0.00	5.72	8.80	74.14	
105	6/5/2009	1300	8.60	300		0.66	12.36	4.60	77.97	
105	6/15/2009	1425	9.80	200				43.20		
105	6/23/2009	1205	11.59	400	7.69	0.37	15.40	5.90	66.20	
105	6/30/2009	1105	10.90	500		0.26	12.32	3.00	68.98	0.60
105	7/7/2009	1204	11.90	700		0.15	8.36	7.20	68.09	
105	9/8/2009	1810	12.50	0	3.20	0.33	3.52	4.87	73.56	
105	11/18/2009	1020	9.00	100		0.43	7.48	4.80	69.93	
106	5/14/2009	1245	7.50	400	3.70	1.67	0.00	99.90	59.18	
106	5/22/2009	1250	9.66	300	2.26	0.11	10.56	4.70	77.34	
106	6/8/2009	1135	7.80	200		0.42	5.72	5.10	65.77	
106	6/15/2009	1353	8.10	400		0.61	0.00	19.20	72.13	
106	6/16/2009	1300	9.16	400	5.20		1.32	14.90	72.58	
106	6/23/2009		8.62	400		0.26	31.24	10.50	61.32	
106	6/30/2009	1026	7.70	600		0.21	9.68	3.50	70.10	0.65
106	7/7/2009	1121	7.70	200		0.04	4.40	3.40	73.93	
106	9/10/2009	1323	6.50	100		0.71	3.08	5.63	65.45	
106	11/17/2009	939	9.20	200		0.13	7.04	3.47	74.34	
107	5/14/2009	1230	8.70	400	4.30	3.30	0.00	99.90	58.01	
107	5/22/2009	1225	10.00	0	4.20	0.10	3.52	4.70	88.82	
107	6/8/2009	1155	8.30	100		0.17	4.84	2.30	80.77	
107	6/16/2009	1350	8.98	600	4.00		12.32	23.80	66.28	
107	6/23/2009	1245	8.16	500		0.09	20.68	18.80	60.95	
107	6/30/2009	1044	7.70	300		0.23	9.68	3.70	76.49	0.40

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
107	7/7/2009	1143	8.40	200		0.10	11.00	4.50	73.18	
107	9/10/2009	1347	8.30	0		0.51	3.52	6.57	79.42	
107	11/18/2009	1038	9.40	100		0.05	2.64	2.66	79.10	
108	5/14/2009	1315	8.60	600	3.00	1.54	0.00	99.90	60.61	
108	5/22/2009	1136	9.55	0	2.47	0.24	0.00	3.70	92.59	
108	6/5/2009	1400	11.28	200		0.06	2.20	3.50	90.63	
108	6/16/2009	1428	10.13	200		0.80	10.56	3.10	76.86	
108	6/23/2009	1225	8.37	100		0.08	20.24	8.00	75.78	
108	6/30/2009	1052	8.10	300		0.15	4.84	2.30	73.64	0.07
108	7/7/2009	1151	9.20	0		0.10	4.40	2.70	88.86	
108	9/10/2009	1355	11.10	0		0.47	8.36	3.28	77.09	
108	11/18/2009	1031	9.60	0		0.20	3.08	1.82	89.36	
201	3/25/2009	1130	9.70	600	1.70	0.00	1.32	14.00	76.25	
201	4/8/2009	1445	11.60	200		0.22	14.50	36.40	70.76	
201	4/8/2009	1415	11.40	200		0.53	14.10	38.40	57.82	
201	5/12/2009	1710	13.90	0	4.90	0.18	10.10	3.90	74.67	
201	5/12/2009	1700	13.70	300	6.70	0.79	21.56	4.30	55.65	
201	5/26/2009	1140	11.00	300	5.88	0.07	6.16	14.60	72.63	
201	5/26/2009	1155	11.41	300	5.43	0.29	5.28	8.80	72.26	
201	6/9/2009	1200	8.94	500		1.87	0.00	12.60	70.15	
201	6/20/2009	1250	7.80	600	3.06	0.00	7.04	7.70	73.52	
201	6/24/2009	1530	11.20	400	8.60	0.83	9.68	8.70	59.66	
201	7/2/2009	945	10.62	300	4.12	0.19	1.76	4.50	77.39	
201	7/7/2009	1401	15.40	100	8.80	0.05	3.96	6.00	63.17	
201	9/9/2009	1638	13.20	200	5.10	1.64	0.44	7.85	57.04	
201	11/17/2009	950	12.10	200		1.28	22.44	5.80	65.25	
202	3/3/2009	1716	15.30	0	7.90	0.34	6.16	9.10	82.76	
202	3/25/2009	1155	8.50	300	2.10	1.35	15.84	14.00	63.03	
202	5/26/2009	1200	9.95	200	4.12	0.06	0.88	9.80	79.10	

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
202	6/9/2009	1220	7.24	400	2.89	0.19	0.00	7.90	78.06	
202	6/20/2009	1300	7.12	1200	2.90	0.09	14.08	11.20	68.15	
202	6/24/2009	1540	9.80	700		0.70	1.32	11.80	68.36	
202	7/2/2009	1000	8.82	300	4.40	0.20	7.48	6.90	72.83	
202	7/7/2009	1358	9.50	300	4.76	0.17	5.72	4.90	77.08	
202	9/9/2009	1640	11.40	0		0.56	2.64	3.23	82.64	
202	11/17/2009	1010	11.30	100	3.30	1.60	4.40	5.74	65.43	
203	3/25/2009	1215	9.00	100	1.80	0.32	11.44	6.80	74.39	
203	5/22/2009	930	9.04	100	2.40	0.14	0.00	16.40	81.82	
203	5/22/2009	945	9.39	300		0.29	4.00	10.10	75.75	
203	6/5/2009	940	8.23	0		0.22	10.56	3.80	83.89	
203	6/16/2009			400		1.78	7.04	41.70	56.64	
203	6/23/2009	940	7.77	400	3.98	0.42	0.00	8.00	72.61	
203	6/30/2009			800		0.25	5.72	5.90	64.87	0.45
203	7/7/2009			300		0.09	5.72	3.00	71.59	
203	9/9/2009	1650	10.60	100	4.70	0.26	0.00	1.97	75.63	
203	11/18/2009	929	8.40	100		0.51	4.84	1.93	73.17	
204	3/25/2009	1500	12.40	0	5.30	0.21	20.20	6.80	78.89	
204	5/14/2009	1215	9.00	1800	2.70	0.44	0.00	99.90	62.79	
204	5/22/2009	1315	10.12	100	3.52	0.04	1.32	6.10	80.02	
204	6/8/2009	1037	7.70	200		2.16	5.72	1.00	68.63	
204	6/15/2009	939	7.00	1100		1.87	11.44	99.90	49.61	
204	6/16/2009	1037	8.63	1100	3.30	0.76	7.48	25.50	65.31	
204	6/23/2009		7.50	300		0.30	10.12	11.20	69.88	
204	6/30/2009	847	7.30	0		0.23	9.24	5.60	80.85	0.34
204	7/7/2009	1030	8.30	0		0.10	3.96	4.30	86.60	
204	9/7/2009	1735	8.70	400		1.79	5.28	4.95	61.85	
204	11/17/2009	904	8.70	0		0.37	11.00	2.67	82.50	
205	5/22/2009	1350	9.39	200	3.49	0.29	3.91	10.40	74.45	

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
205	6/8/2009	1057	8.40	0		0.15	4.40	5.10	90.23	
205	6/16/2009	1200	8.85	700	7.20	0.23	0.00	29.90	74.58	
205	6/23/2009	814	7.27	100		0.20	3.52	18.30	75.48	
205	6/30/2009	823	7.10	100		0.42	7.92	5.20	70.76	0.30
205	7/7/2009	1055	9.00	100		0.06	9.68	3.00	76.80	
205	9/7/2009	1758	10.50	0		0.25	11.44	2.23	83.97	
301	3/25/2009	1110	9.00	0	0.30	0.56	1.76	12.10	85.57	
301	5/12/2009	1730	13.30	0	4.50	0.86	19.36	6.00	66.79	
301	5/26/2009	1105	10.57	200	6.35	0.14	2.64	13.10	76.34	
301	5/26/2009	1125	9.54	300	4.89	0.04	0.00	8.00	78.99	
301	6/9/2009	1126	7.26	200	2.01	0.14	0.44	99.90	73.61	
301	6/20/2009	1231	8.40	0	4.35	0.16	28.16	8.40	82.68	
301	6/24/2009	1440	10.90	200	7.00	0.73	11.44	9.20	63.62	
301	7/2/2009	920	7.60	300		0.20	7.92	5.60	74.20	
301	7/7/2009	1422	10.80	50	5.00	0.25	7.48	6.30	73.50	
301	9/7/2009	1615	10.10	0	1.50	0.15	7.92	8.70	82.35	
301	11/16/2009	933	9.40	0	0.90	0.38	2.20	5.77	73.63	
302	3/3/2009	1655	14.90	0	6.30	0.09	0.00	4.10	88.64	
302	3/10/2009	1445	13.50	100	4.50	0.38	0.96	5.00	76.16	
302	3/25/2009	1030	7.70	0	0.20	1.32	4.40	7.10	79.00	
302	4/8/2009	1430	12.20	300		0.32	34.30	19.70	70.27	
302	5/26/2009	910	8.10	400	2.98	3.30	7.04	13.70	65.08	
302	6/9/2009	1024	6.82	3800	3.75	0.36		99.90	61.54	
302	6/20/2009	1325	6.27	800	2.10	0.08	9.68	8.40	69.44	
302	6/24/2009	1556	8.60	200	4.60	0.16	3.96	4.60	76.19	
302	6/30/2009	1211	7.90	400		0.12	0.44	7.80	73.63	0.36
302	7/2/2009	1000	8.96	400	3.76	0.09	7.48	8.00	72.72	
302	7/7/2009			700		0.15	7.04	8.80	65.50	
302	9/9/2009	1700	9.20	300	4.70	0.60	6.60	6.73	65.40	

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
302	11/16/2009	1435	13.80	100	3.50	0.00	7.50	5.40	80.28	
303	3/10/2009	1410	12.80	100	3.90	0.36	2.60	6.20	72.37	
303	3/25/2009	1010	8.80	0	1.30	0.17	4.40	4.40	88.35	
303	5/22/2009	910	8.41	700	2.91	0.33	4.84	6.10	74.64	
303	6/9/2009	948	6.71	700	3.43	0.27	4.40	7.00	70.28	
303	6/16/2009			1100		0.20	6.16	6.50	70.17	
303	6/23/2009			1300		2.54	3.52	23.30	54.10	
303	6/30/2009			300		0.14	1.76	11.20	69.44	0.52
303	7/7/2009			600		0.05	5.28	9.20	66.60	
303	9/9/2009	1630	10.60	100		0.22	7.48	3.35	74.16	
303	11/16/2009	1400	12.70	100	4.00	0.17	7.92	4.68	75.30	
304	3/25/2009	1318	10.60	500		0.08	4.40	3.90	75.01	
304	5/14/2009	1200	8.40	10000	5.00	1.89	14.52	99.90	48.41	
304	6/8/2009	1016	7.60	100		0.18	1.32	1.10	82.09	
304	6/15/2009	857	6.90	2800		1.31	3.52	99.90	56.15	
304	6/16/2009	945	7.20	200	1.60	1.01	0.00	18.00	71.26	
304	6/23/2009		7.07	300		0.20	14.08	14.30	70.28	
304	6/30/2009	910	7.10	100		0.17	10.56	4.10	73.18	0.44
304	7/7/2009	1014	7.50	700		0.17	4.40	4.40	67.80	
304	9/7/2009	1710	9.50	0		0.55	3.52	2.20	82.07	
304	11/17/2009	854	8.10	400		0.29	3.96	2.57	72.39	
305	3/25/2009	1400	10.80	0	2.70	2.38	5.72	5.80	76.93	
305	5/22/2009	1335	9.13	100	3.43	0.22	8.36	7.00	75.90	
305	6/8/2009	1109	9.40	0		0.11	6.16	2.00	88.14	
305	6/16/2009	1127	8.91	300	4.20	0.41	1.32	24.00	73.76	
305	6/23/2009		7.70	200		0.16	4.40	15.20	73.23	
305	6/30/2009	830	7.70	100		0.18	15.40	5.00	71.43	0.50
305	7/7/2009	1044	9.00	100		0.19	2.64	3.20	80.70	
305	9/7/2009	1747	10.10	0		0.12	0.88	1.66	90.31	

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
305	11/17/2009	914	9.40	100		0.22	7.92	2.38	74.66	
101	6/1/2010		8	1000		0.67	1.76	46.4	64.74	
101	9/1/2010	918	6.5	400		0.07	0.88	4.6	74.52	
101	9/30/2010	1041	7.8	200		0.26	3.52	2.3	75.44	
101	11/12/2010	1106	8.8	200		0.18	1.31	1.8	77.83	
101	11/26/2010	1206	10.1	500		0.52	3.96	28.7	62.6	
102	4/1/2010	1117	8.6	1100	3.7	0.25	0	10.3	66.36	
102	5/25/2010									1.4591
102	6/1/2010	905	7.2	2000		0.47	0	99.9	64.85	
102	8/18/2010	1028	5.9	100		0.61	0.44	9.5	72.13	
102	9/15/2010	1005	5.7	500		0.17	3.52	10.3	63.81	
102	11/9/2010	230	11.9	0		0.09	7.48	4.5	87.36	
102	11/26/2010	1053	9.8	1100		0.98	10.56	48.6	53	
103	5/25/2010									0.1714
103	6/1/2010	1030	8.1	1700		0.1	3.96	13.6	70.62	
103	8/18/2010	1106	7.1	200		2.7	7.92	6.2	62	
103	9/15/2010	1049	8.5	1200		0.15	3.96	5.5	72.26	
103	11/12/2010	1008	8.7	300		0.27	0.88	3.4	75.02	
103	11/26/2010	1113	9.5	1000		0.38	6.16	11.9	64.7	
104	4/1/2010	1130	9.9	200	3.4	0.16	0	6.2	74.24	
104	5/25/2010									0.6211
104	6/1/2010	1005	7.9	2100		0.52	6.16	71.1	62.05	
104	8/18/2010	1044	6.9	100		0.38	4.84	8.6	74.43	
104	9/15/2010	1015	6.3	0		0.26	6.16	8.7	80.99	
104	11/9/2010	240	9.1	600		0.17	2.2	3.7	75.26	
104	11/26/2010	1058	9.8	600		0.73	2.64	32.9	60.3	
105	5/25/2010									1.2575
105	6/1/2010	1057	8.7	700		0.48	8.8	5.8	67.84	
105	8/18/2010	1131	4.6			0.18	7.48	12.9	73.07	

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
105	9/15/2010	1105	4.8	1000		0.24	1.76	13	61.56	
105	11/12/2010	1030	7.6	600		0.14	2.2	9.9	66.73	
105	11/26/2010	1128	9.7	500		1.66	14.08	18.3	55.72	
106	6/1/2010		8.8	400		0.24	0		76.32	1.0768
106	8/18/2010	111	7.7	400		0.27	7.48	6.8	71.23	
106	9/17/2010	746								
107	4/1/2010	1240	7.8	0		0.54	4.84	6.8	76.02	
107	4/8/2010	1755	7.15	600		1.07	12.32	99.9	54.64	
107	6/1/2010	1125	7.7	1700		0.46	0	99.9	67.45	4.0328
107	8/18/2010	1250	7.9			1.6	3.08	15.5	73.48	
107	9/1/2010	1058	6.8	500		0.14	0.88	13.4	74.22	
107	9/15/2010	130	7.6	200		0.13	3.96	12	71.94	
107	11/4/2010	347	10.6	1500		0.45	9.24	2.3	65.13	
107	11/26/2010	1151	10	600		0.92	13.64	51.9	54.43	
108	4/1/2010	1155	8.2	200	3.37	0.25	7.92	5	66.88	
108	4/8/2010	1730	6.18	1100		1.31	19.8	57.8	50.06	
108	5/25/2010									0.2737
108	6/1/2010	1110	8	600		0.29	3.08	5.8	75.65	
108	8/18/2010	1150	7.9	300		0.26	8.8	8.3	70.68	
108	9/1/2010	1040	7.4	200		0.14	3.96	13	75.67	
108	9/15/2010	1125	8.3	500		0.2	3.96	7.5	71.57	
108	9/14/2010	835	7.2	200		0.44	7.04	3.8	68.19	
108	9/30/2010	825	7.6	300		0.32	3.52	2.8	69.41	
108	11/4/2010	428	11.6	600		0.29	4.84	3.1	70.05	
108	11/26/2010	1139	10.2	600		1.12	7.48	13	59.45	
108	11/10/2010	1100	10.5	800		0.06	3.96	2.5	72.95	
201	3/29/2010	1030	9.1	400	4.8	0.61	8.96	62.8	57.36	
201	5/19/2010									2.2627
201	6/8/2010	1003	8.5	1800	4.3	0.42	0	17.4	67.37	

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
201	9/17/2010	1215	8	700		3.3		6.9	59.21	
201	9/15/2010	935	9	0		0.28	4.84	6.9	87.78	
201	9/15/2010	945	7.5	700		1.19	6.16	5.8	58.78	
201	9/29/2010	1000	2.6	0		0.43	6.6	7	66.02	
201	9/29/2010	1010	7.7	800		1.73	4.4	4.7	56.91	
202	3/29/2010	1020	8.5	300	3.5	1.52	7.48	56.2	54.94	
202	5/19/2010									2.456
202	6/1/2010	937	7.7	2000		3.3	1.32	87.1	54.93	
202	8/18/2010	1005	6.1	400						
202	9/9/2010	302	8.8			0.46	2.64	6.2	85.43	
202	9/29/2010	1021	8.8	200		0.39	5.28	5.6	71.58	
202	11/9/2010	200	11.8	3900		0.03	7.92	5.6	68.68	
202	11/26/2010	1039	10.1	600		0.71	5.72	64.9	56.6	
203	4/1/2010	1050	8.1	500	4.9	0.56	0	10.4	64.98	
203	4/1/2010	1050	6.84			0.1	25.5	22.3	69.57	
203	5/19/2010									2.6426
203	6/1/2010		7.3	1400		2.35	12.32	9.2	60.51	
203	8/18/2010	950	6.1	800		0.26	13.2	6.4	67.7	
203	9/1/2010	912	8	300		0.22	2.64	7.4	69.42	
203	9/30/2010	1005	6.3	400		0.27	4.4	4.4	65.16	
203	11/12/2010	930	7.8	100		0.18	1.76	2.4	75.17	
203	11/26/2010	1218	9.9	500		0.72	8.36	94.1	55.77	
204	4/1/2010	1320	10.2	0		0.46	6.6	11.1	80.39	
204	4/8/2010	1815	4.2	800		0.35	2.22	99.9	51.61	
204	6/1/2010		7.2	1200		1.62	0	99.9	60.67	4.7933
204	8/19/2010	825	6.8	100		0.18	5.72	10.8	75.2	
205	4/1/2010	1340	9.2	100	4.8	0.18	8.36	12.4	70.4	
205	4/8/2010	1830	4.5	1200		0.6	16.28	99.9	48.4	
205	6/1/2010		7.3	1400		1.21	6.16	99.9	56.56	2.0036

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
205	8/19/2010	747	6.8	100		0.41	3.08	6.1	74.83	
205	9/14/2010	927	7.2	200		0.13	4.84	5	71.9	
205	9/30/2010	900	7.8	300		0.77	5.28	3.6	64.96	
205	11/10/2010	1000	9.1	0		1.1	6.16	2.5	78.84	
301	5/19/2010									3.3594
301	6/8/2010	1038	8.8	300	4.4	0.36	4.4	30.4	67.7	
301	8/17/2010	1200	12.4	0		0.88		3	82.94	
301	9/9/2010	1000	5.8			0.15	2.2	4.6	82.34	
301	9/29/2010	945	3.7	0		0.28	9.24	6.6	70.2	
301	11/9/2010	230	9.4	800		0.11	8.36	6.1	70.53	
301	11/26/2010	1022	9.3	2500		0.68	4.84	30.8	56.46	
302	3/29/2010	1005	7.6	400	5	0.56	0.88	46	61.42	
302	5/19/2010									3.829
302	6/8/2010	934	7.4	200		0.17	8.8	8.6	69.64	
302	9/17/2010	1235	8.4	500		2.05		8.5	72.73	
302	9/15/2010	330	6.2	600		2.1	5.28	6.1	54.67	
302	9/29/2010	927	6.3	300		0.15	6.16	4.2	65.9	
302	11/9/2010	125	9.3	1800		0.47	6.16	6.6	64.35	
302	11/26/2010	1004	10.1	3500		0.16	9.24	52.8	58.05	
303	4/1/2010	1030	7	300		0.68	17.6	8.2	56.77	
303	5/19/2010									3.8405
303	6/1/2010	905	7.2	2200		0.2	5.72	40.3	65.71	
303	8/18/2010	841	6.1	100		1.49	5.28	9.9	62.81	
303	9/1/2010	845	8	800		0.64	7.04	7.4	64.6	
303	9/15/2010	900	6.2	400		0.2	3.96	5.6	65.57	
303	9/29/2010	905	6.2	100		0.21	5.25	3	69.25	
303	11/9/2010	100	10	100		0.18	11.44	1.8	75.57	
303	11/26/2010	944	9.8	1600		0.56	7.92	47.6	56.54	
304	6/1/2010		8	2000		0.57	0	92	65.29	3.2325

HUC	Date	Time	DO	E. coli	BOD	Ortho P	Nitrate	Turbidity	WQI	atrazine
304	8/18/2010	130	8	100		0.52	7.84	5	70.57	
304	9/1/2010	1120	6.8	300		4.5	0.88	6.3	67.39	
304	9/14/2010	1000	6.9	600		0.86	0.4	5.3	65.44	
305	4/1/2010	1343	9.2	200		0.6	5.72	8.6	66.55	
305	4/8/2010	1845	4.35	800		1.13	9.68	99.9	40.88	
305	6/1/2010		8.1	1100		0.32	0	31.8	72.95	1.2546
305	8/19/2010	759	7.2	500		0.23	6.6	4.3	69.13	
305	9/14/2010	900	7.9	1200		0.4	3.08	3.5	69.74	
305	9/30/2010	846	8.2	500		0.59	4.84	2.2	65.77	
305	11/10/2010	1035	10.3	0		0.09	16.72	3.6	85.63	
	9/1/2010	935	6.2	200		0.25	3.52	4.67	63.18	
	9/1/2010	1010		400		0.18	2.64	6.6	76.51	

Appendix B: Sediment load calculation

Calculations below based on the following average concentration and flow rates:
Average concentration: 280 mg/L
Average flow rate: 662.33 ft^3/sec

280 mg/L * 1g/1000mg = 0.28g/L

0.28g/L * 1lb/454g = 0.00061674 lb/L

0.00061674 lb/L * 1L/0.035ft^3 = 0.01762 lb/ft^3

0.01762 lb/ft^3 * 662.3ft^3/sec = 11.67 lb/sec

11.67 lb/sec * 3,600 sec/hr = 42,014 lb/hr

42,014 lb/hr * 24 hr/day = 1,008,336 lb/day

1,008,336 lb/day * 365 days/yr = 368 x 10^6 lb/year

368 x 10^6 lb/year * 1 ton/2000 lb = 184,021 tons/year