VFC Index - Watershed (Plan)

Program: Watershed

IDEM Document Type: Plan

Document Date: 5/14/2008

Security Group: Public

Project Name: Lower Eel WMP

Plan Type: Watershed Management Plan

HUC Code: 05120203 Eel (WFWR)

Sponsor: Clay Co. SWCD

Contract #: 5-134

County: Clay

Cross Reference ID: 16338119

Comments: Greene, Owen, Vigo

Additional WMP Information

Checklist: 2003 Checklist

Grant type: 319

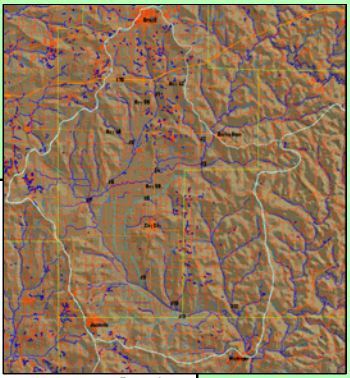
Fiscal Year: 2005

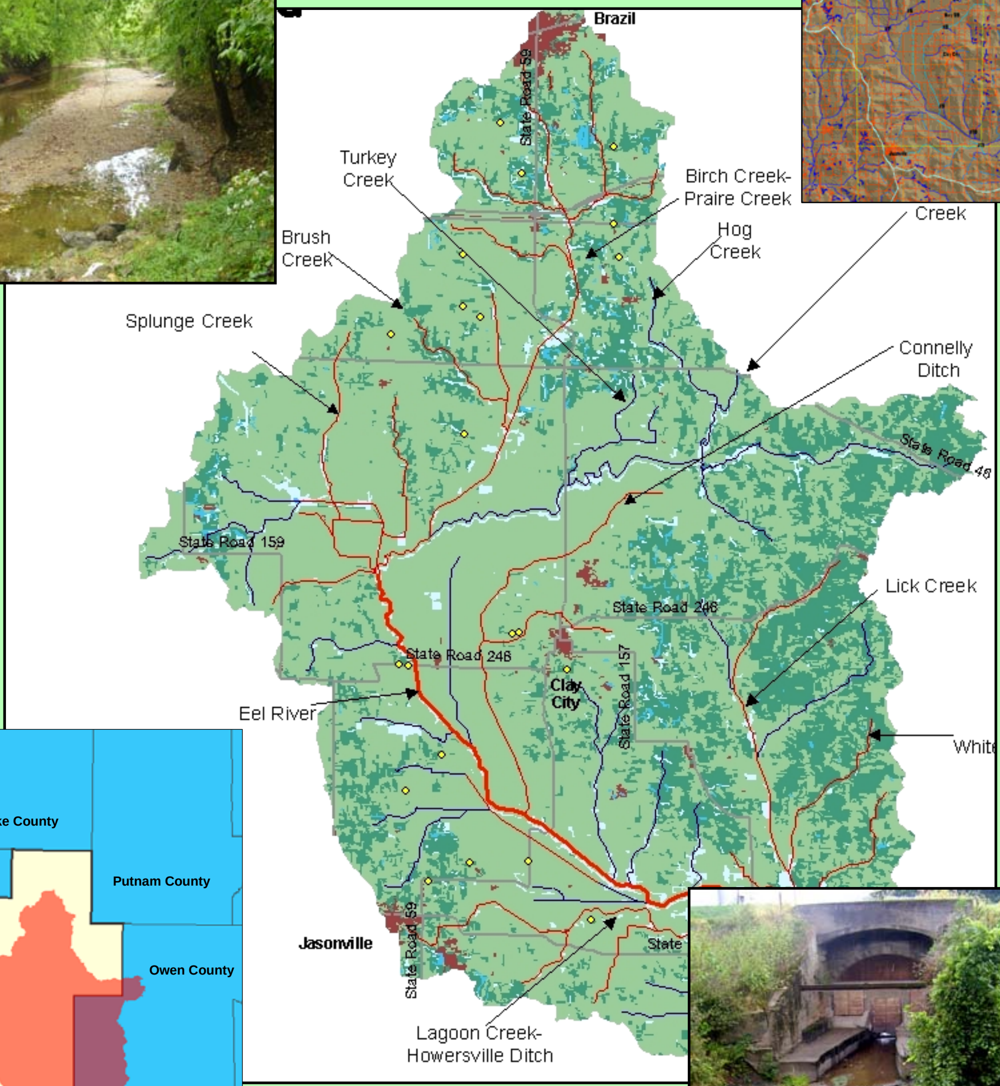
IDEM Approval Date: 5/14/2008

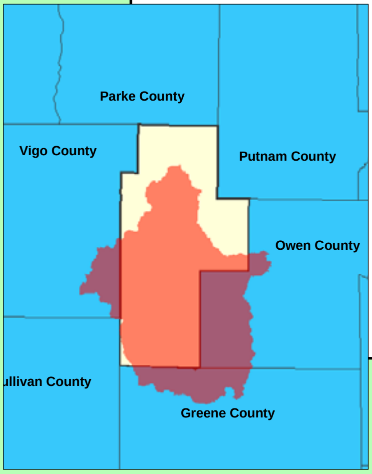
EPA Approval Date:

Project Manager: Sky Schelle

Lower Eel River Watershed Management Plan







Prepared with funding from IDEM 319 Grant

By Nathan Stoelting & Patricia Wilkinson

and the Clay County Soil & Water Conservation District

Date March 2008

Lower Eel River Watershed Management Plan

Funding provided by:

IDEM Section 319 Grant
Contract ARN # A305-5-134

Prepared by:

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ARN 5-134 Final Report

(September15, 2005 to March 8, 2008)

List of Figures, Tables, and Plates

1.0 INTRODUCTION

Due to high E. coli counts, sections of the Eel River and several of its tributaries were listed on Indiana's 2006 list of "Impaired Waterbodies" published by the Indiana Department of Environmental Management (IDEM). The Eel River and several of its tributaries were also listed as impaired in 1996, 1998, 2002, and 2004. As a result, Total Maximum Daily Loads (TDMLs) have been created for the Eel River and streams on the list. (http://www.state.in.us/idem/programs/water/303d/index.html.) Also, the Fish Consumption Advisory (FCA) lists consumption advisories for fish caught in the Lower Eel River Watershed streams due to high levels of mercury and PCB's found in the fish. Prompted by these listings, the Clay County Soil and Water Conservation District (SWCD) applied for and received a Section 319 Grant from the Indiana Department of Environmental Management (IDEM) to write a Watershed Management Plan (WMP) for the Lower Eel River Watershed.

This Watershed Management Plan is a cumulative assessment of the thoughts and findings of the Lower Eel River Steering Committee. Upon the approval of an IDEM 319 Grant, the Clay County Soil and Water Conservation District held their first public meeting regarding water quality issues in the Lower Eel River Watershed. During the meeting several volunteers offered their time, and the Lower Eel River Steering Committee was formed. (See the list of Steering Committee Members in the Appendix.) This watershed plan provides a guide for determining additional watershed concerns, educating stakeholders on the importance of protecting and improving water quality in the watershed, and a plan for improving the water quality. This plan will be updated annually to reflect changes in the watershed, updated status of work completed, and action items to be addressed. Vision and mission statements were developed to guide the steering committee in developing programs and practices to improve the water quality within the Lower Eel River Watershed.

1.1 Our Vision:

Improved water quality for future generations living in the Lower Eel River Watershed.

1.2 Our Mission:

Identify opportunities for developing and implementing a successful management plan for improvement of the natural resources of the Lower Eel River Watershed community.

1.3 Our Goal

The overall goal of this watershed plan is to improve the water quality in the Lower Eel River Watershed by reducing contaminants to meet or surpass state pollutant benchmarks and standards.

1.4 Our Objectives

- Identify sources of water quality impairments.
- Educate the community about sound conservation practices impacting water quality.
- Promote and facilitate sound conservation practices impacting water quality.

- Seek financial resources to facilitate project activities
- Reduce the current level of E. coli by 10 % during the five (5) years of implementing remedial actions.
- Reduce current levels of sediment loads 10 % in five years.
- Reduce nitrogen loads 10 % in five years.

The Lower Eel River watershed is located in parts of the following counties:
Clay (63.06%)
Owen (20.10%)
Greene (14.18%)
Vigo (2.64%)

2.0 WATERSHED OVERVIEW

2.1 Watershed Location

Figure 2.0 shows Clay County located in the west central part of Indiana and the location of the entire Eel River Watershed in Indiana. Figure 2.1 is a close-up of Clay County with the location of the entire Eel River Watershed in Clay and the eight adjoining counties. The Eel River Watershed covers most of Clay County and parts of eight nearby counties: Vigo to the west, Parke to the north, Putnam to the northeast, Owen to the east, Greene to the south, and Morgan, Hendricks, and Boone to the northeast.

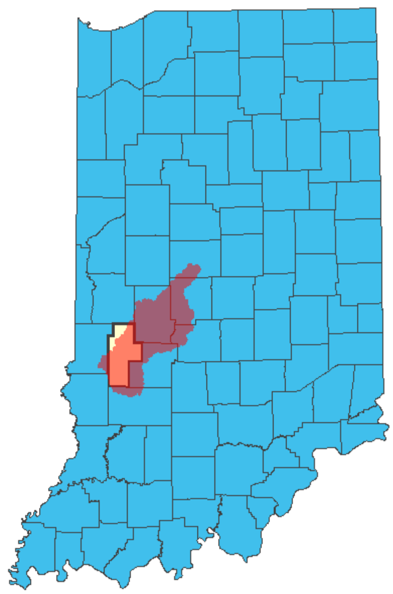

Figure 2.0
Location of Eel River Watershed in west central Indiana

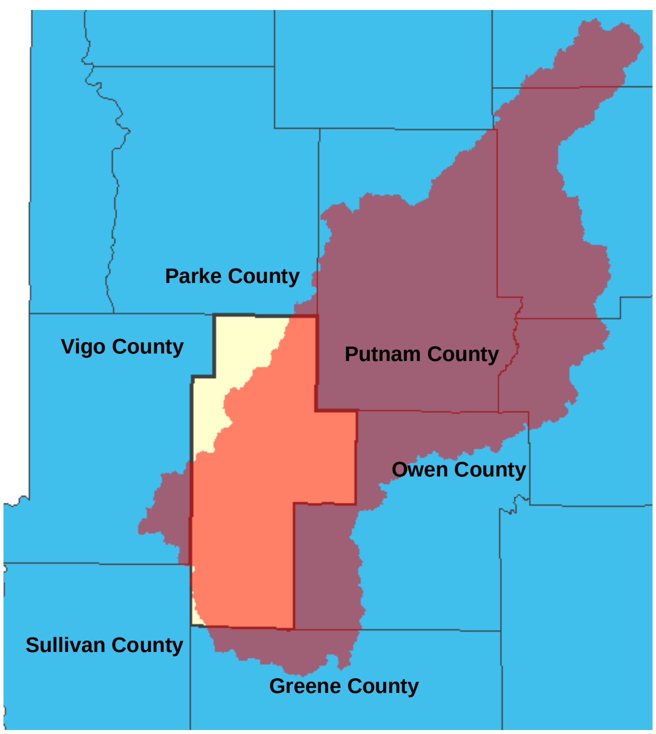

Figure 2.1
Location of the entire Eel River Watershed in Clay County and adjacent counties**.**

The boundaries of the Eel River Watershed were determined with the assistance of the Natural Resources Conservation Services and the Indiana Department of Natural Resources, Division of Soil Conservation. The Lower Eel River Watershed is divided into two sub-watersheds.

The Lower Eel River Watershed is located in the southern 2/3rds of Clay County starting just south of U. S. Hwy. 40 in Brazil and continuing south to the Clay/Sullivan County line. The majority of the Lower Eel River Watershed encompasses the Clay County from east to west. (See Figure 2.3) The Lower Eel River Watershed is sub-divided into two 11-digit Hydrologic Unit Code (HUC) drainage areas which are included in this study: HUC 05120203080 and HUC

05120203090; they combine for a total of 241,265 acres. HUC 05120203080 is divided into eight (8) separate 14-digit drainage areas, which total 77,383 acres, and HUC 05120203090 is divided into thirteen (13) 14-digit drainage areas, which total 163,882 acres.
(See Figure 2.6)

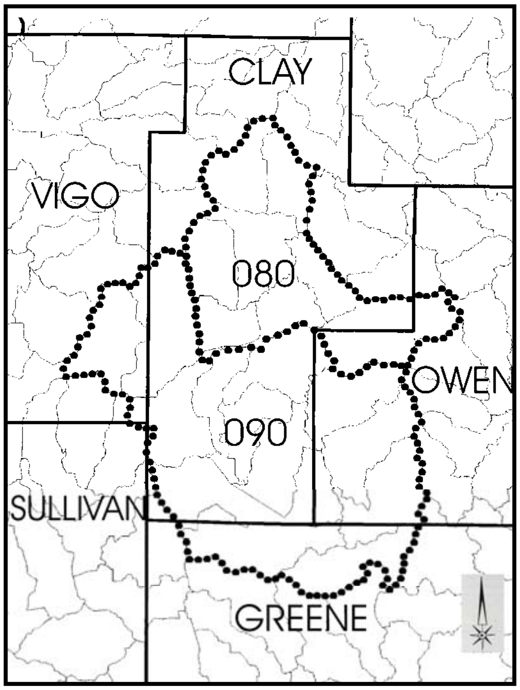

Figure 2.2 Two 11-digit HUCs are included in the Lower Eel River Watershed:

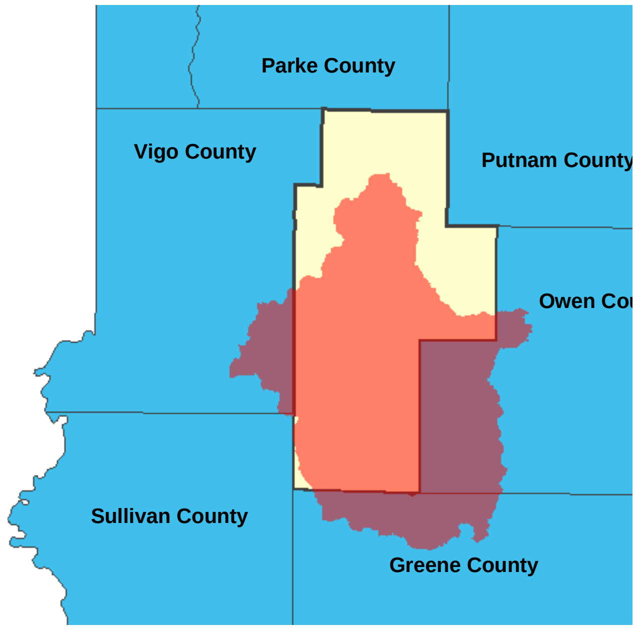

Figure 2.3 Lower Eel River Watershed in Clay and adjacent counties.

2.2 Description of the Watershed

The two largest towns in the Watershed are Brazil in the north and Clay City in the south. The largest of these is Brazil, which consists of about 2,040 acres and is the home for around 10,000 people; however, only the southern most portion of Brazil is in the northern most portion of the Lower Eel River Watershed. The Lower Eel River Watershed is largely a rural community. Clay City encompasses around 1,000 acres and has a population of about 2,000 people. The Lower Eel River Watershed is mostly a farming community. There are still several "small farmers" in the Lower Eel River Watershed. Many of the agricultural producers in The Lower Eel River Watershed still farm less than 1,200 acres. The watershed is over 80% agriculture most of which is row crops. Corn and soybeans make up the majority of the row crops; wheat and hay make up a small part of the row crops. There are three remaining dairy operations in the northern half of the watershed and one in the southern half of the watershed. There are three swine confinement areas in the central part of the watershed and two in the south. There is also a beef operation, which is located in the central part of the county. Several non-permitted livestock operations are located throughout the watershed. Since the beginning of the 19th Century, almost 50% of the land has been or is being mined for coal. Much of the mined land has been reclaimed and brought back into production. Other previously mined land has become residential.

2.3 Physical Description and Natural History

With the exception of a small part on the eastern side, which is in the Crawford Upland, the Lower Eel River Watershed is within the Wabash Lowland physiographic unit. The physiography of the county is characterized by broad, flat uplands that are dissected by moderately sloping to very steep drainage ways and flat bottomlands along streams. The highest elevation is about 790 feet in the northeastern part of the county near the small settlement of Lena. The lowest elevation is about 500 feet in the southeastern part of the county along the Eel River.

The parent material in which the soils of The Lower Eel River Watershed formed consists of glacial till or outwash, lacustrine deposits or lakebed materials, and windblown sand and silt. Also, in a few areas a thin mantle of glacial till covers residuum from sandstone and shale. Recently deposited alluvium occurs along the rivers and streams. Glacial till, which consists of a mixture of stone, sand, silt, and clay, has been deposited over the material weathered from bedrock or over drift from an earlier glacial age. An example of the soils that formed in this material is the Hickory Soils.

As the glacial ice receded, lacustrine materials were deposited from till or ponded, glacial melt water. In these temporary glacial lakes, as typified by the broad flat area south of Cory, melt water and local runoff were ponded, and fine materials of clay and silt size settled out.

A layer of loess has been deposited over the upland area of the county. This mantle of mostly silt-size material ranges from a few inches to 7 feet or more in thickness. In steeper areas, most of the loess was washed away. Loess remained on nearly level to moderately sloping areas, however, and is the material in which many of the present soils formed. Examples of soils that formed more than 5 feet of loess are Iva and Muren Soils. The loess mantle is generally thicker in the northern and western parts of the county and thinner in the southern and eastern parts. Examples of soils that formed in loess and the underlying glacial till are Cincinnati and Ava.

Silt and sand material was carried by the wind and deposited as dunes on the uplands adjacent to the eastern side of the Eel River flood plain. This material was first deposited in the valley by glacial melt water. These deposits range from a few feet to 20 feet or more in thickness: Alvin Soil formed in this material. In a few areas along the sides of deep valleys and areas near Poland and Bowling Green, the soils formed in a thin mantle of glacial till and the underlying residuum from sandstone and shale bedrock. The Cincinnati Variant Soils formed in this material.[1]

2.4 Hydrology

The Lower Eel River Watershed is drained by the Eel River and its tributaries: Croy's Creek, Birch Creek, Brush Creek, Hog Creek, Jordan Creek, Lick Creek, McIntyre Creek, Six Mile Creek, Splunge Creek, Turkey Creek, White Oak Creek, Connelly Ditch, and Erie Canal. (See

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[1] McCarter, Jr., Paul. . Soil Survey of Clay County, Indiana. USDA/Purdue University Agricultural Experiment Station; Washington, DC. March 1882. Page 91.

Figure 2.5 Lower Eel River & Tributaries) Otter Creek drains the northwestern part of the county, which is not part of the Lower Eel River Watershed, and Jordan Creek drains the northeastern part of Clay County, which is not a part of the Lower Eel River Watershed. The Eel River flows into the watershed from the northeast, travels to the southwest, and flows out of the southeast corner of Clay County. The Eel River empties into the White River at Worthington, Indiana. The Lower Eel River Watershed is made up of two 11-digit HUC areas that are subdivided into twenty-one (21) sub-watersheds, which are named for the bodies of water that flow through them to the Eel River. (See Figure 2.6) To more accurately isolate and address the water quality issues, the sub-watersheds were analyzed individually and compared to each other.

Drainage in the watershed is needed on the nearly level, somewhat poorly drained to very poorly drained soils on uplands or bottomlands. In addition, protection from flooding is generally needed for soils on bottomland. Several of the streams in the watershed are more along the line of ditches (i.e. Connelly Ditch) rather than streams. These ditches were cut years ago in order to drain the flat, clay soils that make up much of Clay County. For the most part these ditches have only grass buffers with little or no trees. This lack of trees leads to above average water temperatures and an increase of sediment in the stream due to the lack of a buffered area and severe bank erosion. Despite the fact that these streams don't fit the mold of a traditional streams or creeks, they are an important part of drainage in the watershed and transport much of the runoff from our agricultural lands.

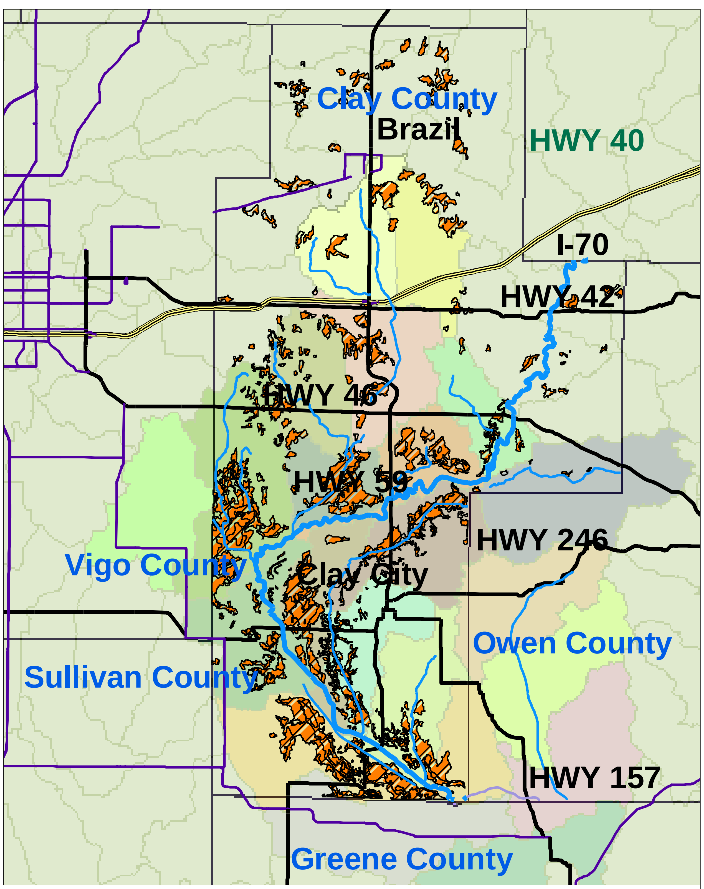

Figure 2.4 Location of hydric soils in the Lower Eel River Watershed.

Clay County has several soil types that are considered hydric soils. Soils are labeled hydric because of rapid permeability or an impermeable layer near the surface; the soil may not adequately filter effluent (sewage that has been treated in a septic tank or sewage treatment plant) from a waste disposal system. (See Lower Eel River Watershed Soil Series in Appendix)

The map on the left shows the locations of nine hydric soils that have been determined by the Natural Resource Conservation Service as hydric soils in Clay County: Bonnie (Bo), Evansville (Ev), Hoosierville (Ho), Lyles (Ly), Montgomery (Mt), Peoga (Pf), Petrolia (Pg), Zipp (Zp), and Zipp (Zs).

There is a high percentage of these soil types near Connley Ditch, Splunge Creek, Birch Creek, Turkey Creek, and Wabash Erie Canal Watersheds.

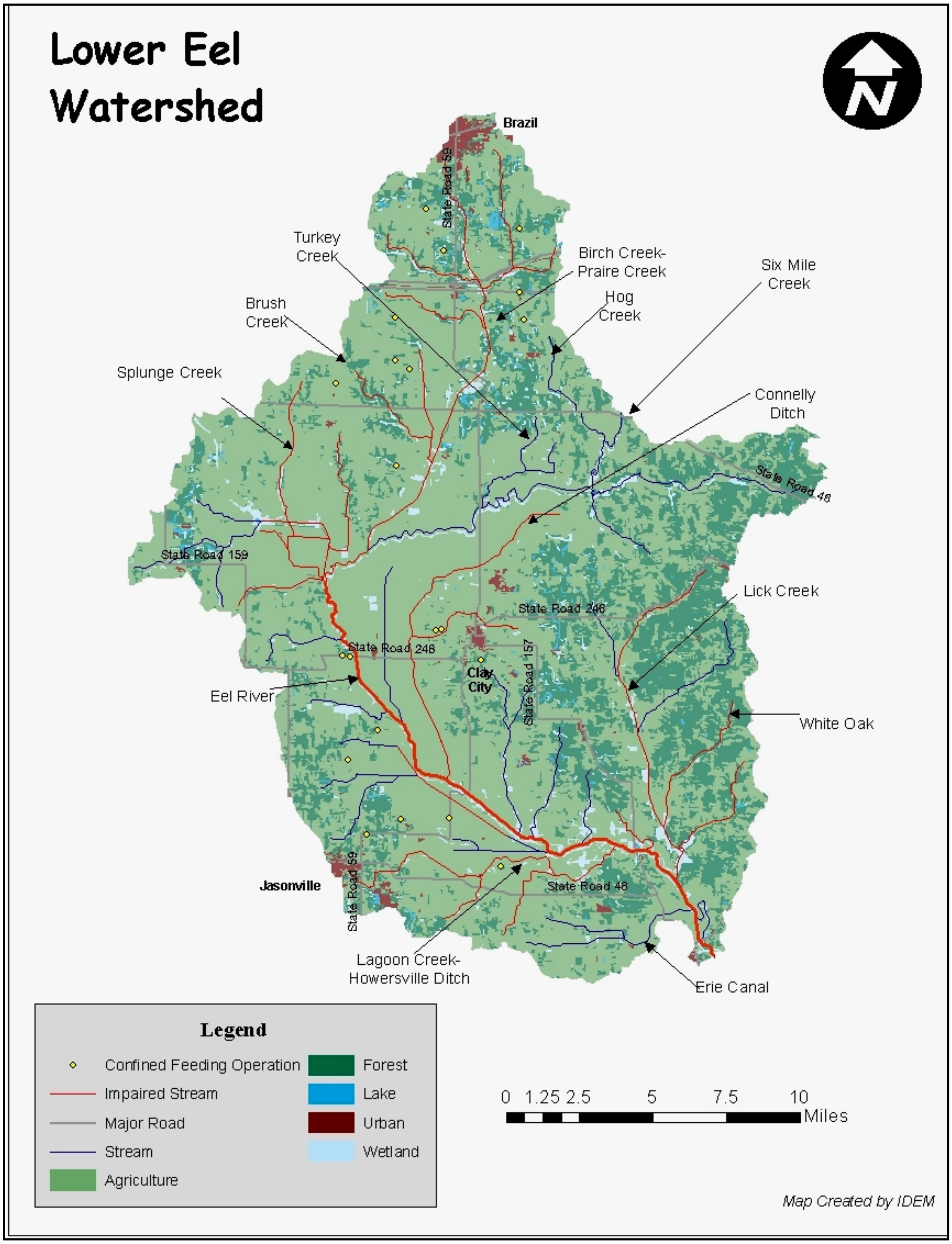

Figure 2.5 Lower Eel River Watershed showing Eel River and its tributaries.

The Lower Eel River Watershed's two 11-digit HUCs are sub-divided into twenty-one 14-digit HUCs; each one has a unique three-digit code added to the end of the larger 11-digit HUC's code. Sub-dividing the larger watersheds into smaller areas makes it helpful when prioritizing problem areas.

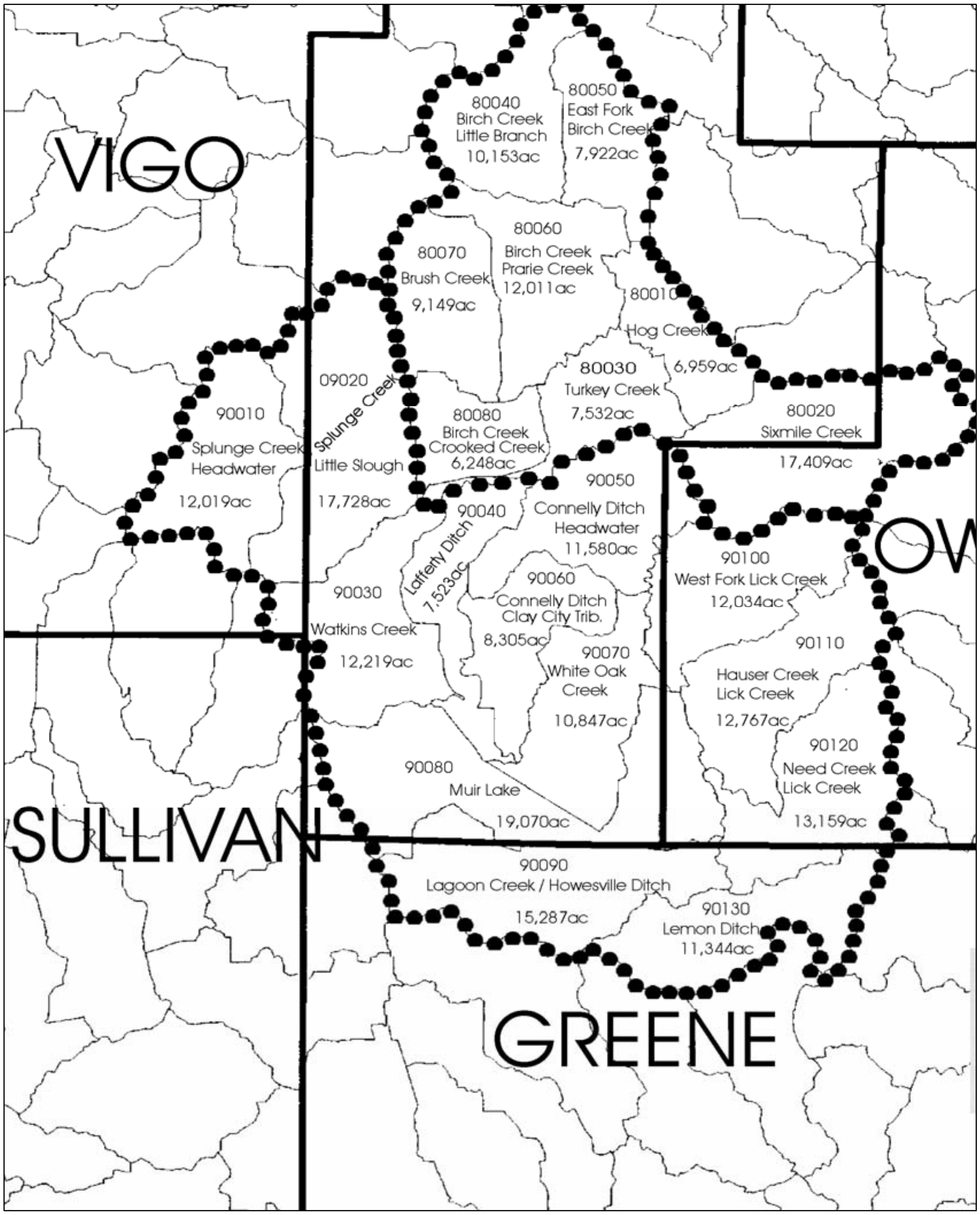

Figure 2.6 Twenty-one 14-digit HUCs of the Lower Eel River Watershed

2.5 Soils and Topography

The Lower Eel River Watershed is dominantly a nearly level and gently sloping, highly productive till plain. Nine (9) major soil series identified in the Lower Eel River Watershed are Ava, Chagrin, Cincinnati, Evansville, Fairpoint, Hoosierville, Iva, Muren, and Stendal. (See Appendix II: Watershed Soil Types.). Most of the soils in the basin have high water holding capacity, and erosion is a moderate concern on gently sloping areas. The nearly level soils are very wet in the spring and have free water within a foot of the surface or are ponded. According to the Sanitary Facilities Table 13 located in the [2]Soil Survey of Clay County, Indiana, all nine of these major soil series are unsuitable for septic systems. They are in the severe category due to one or more of the following problems: wetness, percs slowly, and/or flooding. Severe is defined in the Soil Survey of Clay County, Indiana as "soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required."
(See Lower Eel River Watershed Soil Series in Appendix)

The soils in the southern portion of the basin are silty loess covering, older, deeper weathered, Illinoian-age till. In the eastern part of this area many soils have a brittle fragipan at a 2 to 3 foot depth, which severely limits downward water movement and water holding capacity. These soils are moderately productive and erosion is a moderate concern.

Siltstone, sandstone, and shale underlie most of the basin. Generally, bedrock is a part of the soil only on the steeper slopes and may be exposed adjacent to major streams. On steeper soils, runoff is a hazard and limits water infiltration causing these soils to be lower in productivity.

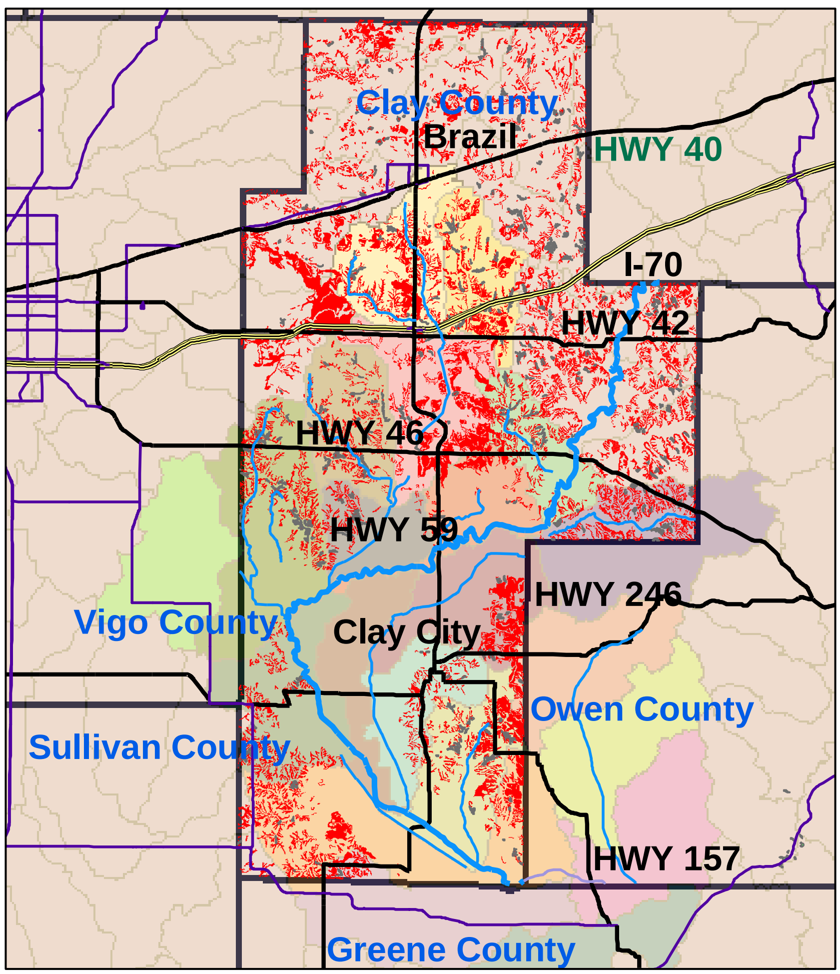

Figure 2.8 HEL soils in the watershed

[2] McCarter, Jr., Paul. . Soil Survey of Clay County, Indiana. USDA/Purdue University Agricultural Experiment Station; Washington, DC. March 1882.

Generally, the flood plain soils have strata of highly permeable sands, which are easily contaminated. These soils are highly to moderately productive. Soils in the basin have erosion potential that ranges from low through high. The majority of the basin is in the low erosion potential category. A small portion of the soils is medium to highly erodible land (HEL), with a small amount of very high erosion potential on the eastern edge. " HEL has an erodibility index of 8 or larger. The erodibility index is the ratio of inherent erodibility to the soil loss tolerance. Inherent erodibility for a given soil is the rate of erosion (tons per acre per year) that would occur on land that was continuously clean tilled throughout the year. The soil loss tolerance, or T value, is an estimate of the rate of soil erosion that can occur on a given soil without significant long-term productivity loss. Land can be highly erodible based on the potential for water-borne erosion, wind erosion, or both. About 25 percent of all U.S. cropland is highly erodible. The Food Security Act of 1985 required farmers to engage in conservation activities in order to receive government payments. Compliance requires producers to apply and maintain conservation systems on HEL cropland that was already in crop production in 1985 or risk losing farm income support, price support, and conservation payments from voluntary programs. 'Sodbuster' requires similar (albeit more stringent) plans on HEL brought into crop production after 1985." [3] Erosion may result in a significant impact to water quality due to nutrients and pesticides carried in the sediment loads from eroding areas.

2.6 Endangered Species

The only known endangered species within the waters of the Lower Eel River Basin is the Rare Blue Sucker (cycletus elongates) in the Eel River at Old Hill, which is near the Splunge Creek Reservoir in the southern end of the watershed. It is listed as (S2) imperiled in the state, (G3) rare or uncommon globally, and (G4) widespread and abundant in the state but with long-term concern.
(See Endangered, Threatened, and Rare Species in Clay County in the Appendix on page 98.)

2.7 Land Use

According to the Soil Survey of Clay County, Indiana, written in 1986 in cooperation with the Purdue University Agricultural Experiment Station, about 174,000 acres or nearly 75 percent of Clay County met the soil requirements for prime farmland. (See Figure 2.5) These acres were scattered throughout the county and were in all map units of the general soil map. At that time nearly all of the prime farmland was used for the production of corn and soybeans.[4]

Some parts of the county have been losing prime farmland to industrial, residential, and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, susceptible to drought, difficult to cultivate, and usually less productive.

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[3] "Have Conservation Compliance Incentives Reduced Spoil Erosion?" http://www.ers.usda.gov/AmberWaves/June04/Features/HaveConservation.htm

[4] McCarter, Jr., Paul. . Soil Survey of Clay County, Indiana. USDA NRCS in cooperation with the Purdue University Agricultural Experiment Station; Washington, DC. March 1882.

Presently the majority (57.82%) of the land in the Lower Eel River Watershed is planted in row crops; corn and beans make up the majority of row crops. The next highest use of land is pasture and hay at 21.26%. The third highest use of land is deciduous forest at 15.85%. Low intensity residential comes in a distant fourth with only 1.26 % of land use. After open water at 1.19%, the rest of the land usage is under one percent.
(See "Lower Eel River Watershed Land Usage" in the Appendix)

2.8 Land Ownership

There are no state or national forests, state parks, reservoir boundaries, or military holdings in The Lower Eel River Watershed. In the summer of 2007, large land areas owned by Amax Coal Company were sub-divided and sold at public auction. Much of the land that had been mined for coal in the past is now privately owned. There is a closed landfill located northwest of Center Point. North of Clay City is a church camp, and a little over a mile east of the junction of State Roads 46 and 59 is Dietz Lake, a privately owned recreation area located south of Center Point between State Road 46 and County Road 100 South. The Clay County 4-H Fairgrounds are located south of Brazil along State Highway 59. The Chinook State Fishing Area is located between Cory and Staunton. There are two sawmills located in the Lower Eel River Watershed; one is located southwest of Clay City, and one is located southwest of Center Point. BrickCraft is a brick-making factory located at the junction of State Roads 46 and 59 southwest of Center Point.

3.1 . Concerns

Concerns of the stakeholders in the Watershed were discussed at the first public meeting. Those present were asked to write down what potential problems concerned them the most. Then a list of 19 water quality concerns was compiled. Using this list, the steering committee discussed the significance of the various concerns and their visual evidence. The chart below shows how the 19 concerns were narrowed to five major concerns. To help in this narrowing process the concerns were grouped into the following areas.

1) Concerns deemed not relevant (NR)
2) Concerns deemed beyond the scope of this work (BSW)

The following abbreviations were used in the "Concern" column of the following Table to further explain why the concern was chosen as a major concern, if it was beyond the scope of this work or if it was not relevant. The following abbreviations were used in the Table:

Included in other concern (IOC)
Beyond scope of this work (BSW)
Not Relevant (NR)

Concern #1 E. coli
Concern #2 Nutrients
Concern #3 Erosion & Sedimentation
Concern #4 Livestock & Wildlife Waste
Concern #5 Runoff from Feedlots

Table 3.0 Steering Committee Developed List of Concerns

Concern	Significance in The Lower Eel River Watershed	Visual Evidence
Runoff from Industrial Sites **NR**	There is not a lot of industry in The Lower Eel River Watershed. Most of the industry that does exist is generally in the northern part of the county and east of the Lower Eel River Watershed.	There are some temporary sites that have significant runoff at various times.
Runoff from Feed lots **Concern #5 & IOC #1**	Small livestock operations have decreased in The Lower Eel River Watershed over the past twenty years. However, the small operations are usually the ones that need the most help. Lack of cover and buffers around these feedlots is certainly a problem. This is an issue of quality more than quantity. Overlaps with Concern #1	Feedlots on slopes with little or no grass around them can be spotted throughout the watershed; they are especially evident in the southeast section of the watershed.
Nutrients (fertilizer and manure) **Concern #2 & IOC #1**	This is certainly a concern. A quick glance at the land use map throughout the watershed shows that the majority of land in the Lower Eel River Watershed is used for agriculture. Where there is agriculture there will be nutrients, namely potash, phosphorus, and nitrogen. Overlaps with Concern #1.	One can see fertilizer being applied at various times, but the real concern is over fertilization, which is more difficult to see.
Pesticides **IOC #2**	Pesticides will be abundant in areas of high agriculture production. However, technology now offers pesticide treated seed corn, which reduces the over-use of these chemicals.	Like the nutrients, pesticides are not visually evident.
Herbicides **IOC #2**	Farmers apply herbicides throughout the watershed to battle weeds in corn and soybean fields. Homeowners also use herbicides to prevent mowing steep ditches on their property, to kill grass and weeds in driveways, and to kill weeds in fencerows. This is of great concern in The Lower Eel River Watershed.	It is easy to spot herbicide use. Grass and weeds turn brown and black when herbicide is applied. It is common to spot dead foliage throughout the year and the watershed.
Erosion and sedimentation **Concerns #1 & #3**	There are fourteen different types of soil in the Lower Eel River watershed that are considered Highly Erodible (HEL). Despite the overall level topography of the area, there are still several areas of erosion. Erosion is highly evident along the banks of some streams and especially the Eel River. Any time there is erosion, the soil could contain E. coli, nutrients, and nitrates.	Both erosion and sedimentation are very easily located. Gullies and washes can be seen in various locations, and sedimentation can be spotted in the Eel River and other streams after any significant rain event.

Tillage practices **IOC #3**	Clay County, which makes up the majority of the Lower Eel Watershed, is an agriculture community that still uses a lot of tillage. While we have seen an increase in conservation tillage over the last five years, it still remains a concept not practiced by most of the farmers. A tillage transect done annually by the Soil and Water Conservation Office showed that soybeans were only being planted via conservation tillage at a rate of about 55%. No-Till corn was only about 30%. These are numbers that can be increased, and need to be increased throughout the county.	Driving around the watershed one can see a lot of tillage. Molboard plowing, while not as common as it once was, is still a practice used in the watershed.
Conservation field buffers **IOC #1, #2, #3, & #4**	Not a lot of buffers can be found in the watershed. Some streams have natural buffers, but overall the watershed lacks good filters and buffers around the agriculture fields. Most farmers plant as much ground as they possibly can.	These buffers are pretty easy to see, or in this case not see.
Livestock Production **IOC #1 & #4**	While overall livestock production has been on the decline in this area there are still some operations that consist of swine, dairy, and beef.	Most of the visible livestock operations are in the southern portion of the watershed. Several operations are confined now.
Human and animal waste **IOC #1 & #4**	This is certainly a concern. E. coli is the main concern of the community and testing results have shown that it is a problem. E. coli can come from human and animal waste, so locating areas where these two things could be entering the streams is vital for the project.	This is not always easy to spot. Some cattle can be found in streams and it is very easy to spot streams that do not have adequate fencing.
Failing septic systems **BSW**	Due to soil types, septic systems are certainly a problem throughout the watershed. Some homes don't even have one; those that do may or may not be functioning correctly. In other places hydric soils may limit the septic systems workability.	Some times septic systems can be easy to spot, but overall its difficult to know which ones are working and which ones are not.
Wildlife and pet waste **BSW**	Wildlife and pet waste could lead to some of the pollutants such as E. coli. The problem that was discussed by the steering committee is locating it and controlling it. While this was recognized as a potential problem, the committee members agreed that addressing other concerns first could make more progress.	Various types of wildlife are abundant in the LER watershed, including Canada geese, which have become abundant in recent years. They pollute several of the local streams and lakes.

Household and yard waste **BSW**	Not thought of to be a major issue. Most waste appears to be taken care of appropriately. The county has recently passed an ordinance to hopefully reduce the problem even more.	A drive through the watershed will not show much evidence of this.
Toxic materials **NR**	Not a large number of toxic materials in the county; therefore, it was not thought to be a major issue.	Little to no visual evidence of this.
Lawn & garden practices **BSW**	Over fertilization is not thought to be a major concern here; most of the urban population is in the northern part of the Lower Eel River Watershed.	Some evidence of spraying can be seen, but overall it's hard to spot problems in this area.
Stream bank stabilization **IOC # 1 & #3**	An aerial photograph of the watershed will show the Eel River with its many sharp turns and curves. These turns and curves mixed with the sandy soils along the river's banks result in severe erosion and sedimentation. Beside the obvious problem of losing productive topsoil as a result of this erosion, the real concern is the possible pollutants that may be contained in the eroded soils. The Eel River is not the only stream with this problem. A lack of riparian and conservation buffers causes similar problems for several of the streams in the area.	Although visual evidence may not always be obvious just driving around or a canoe trip down many of the streams in the watershed would show the stream bank problems that exist.
Wildlife corridors **IOC #1 & #2**	There are not a lot of areas left for the wildlife. Most ground that can be farmed has been cleared for agriculture.	While finding wildlife in agriculture fields is not a problem, spotting their homes after the crops are gone is.
Roads/parking lots **BSW**	This is less of a problem in the rural area of the Lower Eel River Watershed than it may be in other areas in Indiana. However, some of the older farm equipment that travels these roads may leave pollutants on the road. Again, the committee thought this problem would still be difficult to pinpoint.	Spotting pollutants on the road is usually very easy; the older gravel roads however, make visual evidence more difficult.
Illegal Dumping **NR**	Recent ordinances by the county have made this less of a concern. However, it abandoned landfills from long ago is a major concern due to unknown effects on the ground water. Occasionally, in some areas, trash has been dumped into the streams.	Most of the landfills have been filled in now, but some infrequent dumping of trash into the streams and along their banks is evident.

From the preceding Table the Lower Eel River Steering Committee chose to address five areas of most concern: E. coli, nutrients, erosion and sedimentation, livestock and wildlife waste, and runoff from feedlots.

Current Loads of Pollutants
October 2007

Pollutant	Current Load Tons/Year	Target Load Tons/Year	Reduction Needed Tons/Year % Reduction Needed
Nitrates (Turkey Creek, Brush Creek) Only	61.59	54.15	7.45 12.1%
Phosphates	5.69	1.35	4.33 76.2%
E. coli Cfu/year	2.89E+13	1.21E+14	9.21E+13 76.1%
Sediment	700.52	676.83	23.69 3.4%

Table 3.1. Current Loads of Pollutants

3.2 Concern #1: E. coli

The problem of most concern was E. coli contamination. "E. coli, is a bacterium found in the intestinal tracts of warm-bloomed animals; it is used as a convenient indicator for the presence of fecal material in water. Certain strains of E. coli can cause illness or death. E. coli can also be an indication that other pathogens may be present, including Cryptosporidium, the organism that killed and sickened so many people in Milwaukee in 1990. Indiana's water quality standard for a single grab sample of E. coli is 235 colony-forming units (CFU) per milliliter (ml). Many states use total fecal coliforms as the basis of their water quality standards, but Indiana is more specific and used only E. coli as its standard."[5]

Several of the streams in this watershed have been listed as Impaired Streams because of the high levels of E. coli found during IDEM sampling. (See Figure 1.5; impaired streams are highlighted

[5] Tools for Addressing E. coli.
http://www.hecweb.org/Programs%20and%20Initatives/Watershed/toolkit%20ch3A%20human%20Ecoli.pdf

in red.) In February of 2005, a Total Maximum Daily Load (TMDL) program was completed for the Lower Eel River Watershed.

The high levels of E. coli recorded during our study further emphasized the need for a Watershed Management Plan. IDEM's 2001 E. coli data was supported by data collected by the Clay County SWCD, which showed that the WQ Standard of 235 cfu/100 mL was consistently exceeded at all sites sampled during this study. The current load for E. coli in the Lower Eel River Watershed is 2.89E+13 cfu/year, which is more than double the target load of 1.21E+14 cfu/year. These loads show the reduction needed to be over 76%. There are several possible sources causing E. coli contamination: Failing septic systems, runoff from feedlots, improper manure application, lack of buffers and filtering strips, and wildlife and livestock access to streams. This plan will use the WQ Standard of 235 cfu/100 mL as our E. coli benchmark.

According to Brett Sherer, "The presence of *Escherichia coli* (*E. coli*) in surface waters is often attributed to fecal contamination from agricultural and urban/residential areas. However, variation in *E. coli* concentrations from site to site and the contribution of human vs. agricultural sources are not readily understood. In addition, *E. coli* concentrations at a particular site may vary depending on the baseline bacteria level already in the river, inputs from other sources, dilution with precipitation events, and die-off or multiplication of the organism within the river water and sediments. The concentration of *E. coli* in surface water depends for the most part on the runoff from various sources of contamination and is thus related to the land use and hydrology of the contributing watersheds (Sherer and others 1992)."[6]

3.3 Concern #2: Nutrients

A second problem of concern identified by the Steering Committee was the nutrients entering the streams. At the time this concern was developed specific nutrients were not identified by the Steering Committee. Possible nutrient sources that were discussed included: excessive chemical fertilizer application on fields and lawns, improper manure application, and human wastewater and wildlife waste. The current phosphate concentrations (.42 mg/L) are considerably higher than the benchmark of 0.1 mg/L. The average nitrate concentrations (2.3 mg/L) are lower than the benchmark of 4 mg/L except for two streams listed in the chart below. These amounts result in a current load average of 61.59 tons per year for nitrates; our target load for nitrates is 54.15 tons per year.

Pollutant	Current Load	Target Load Tons/Year	(%) Reduction needed to meet goal	(%) Reduction needed to meet goal
Phosphates	5.69 tons/yr	1.35 tons/yr	(11.9%)	4.33 tons/yr 76.2% tons/yr
Nitrates (Turkey Creek & Brush Creek – only)	61.59	54.15	7.45 12.1%	Nitrates (Turkey Creek & Brush Creek only)

Figure 3.2 Current Load Averages for Phosphates & Nitrates in October 2007

6 & 5 **Sherer**, Brett M., J. Ronald Miner, James A. Moore, and John C. Buckhouse. 1992. Indicator bacterial survival in stream sediments. Journal of Environmental Quality 21: 591-595

3.4 Concern #3: Erosion and Sedimentation

A third problem of concern identified by the Steering Committee was erosion and excessive sediment loads in the streams. The turbidity tests showed that their concerns were justified. Turbidity is a measure of the degree to which the water losses it's transparency due to the presence of suspended solids. It is measured by pouring water in a 60 cm tube with a symbol on the bottom. Once the symbol is no longer visible, the height of water in the tube is measured. Higher turbidity scores represent water with less suspended solids. A reading of 60 cm indicated that the stream contained little or no sediment load. As the reading number decreased, the amount of sediment load increased. The Steering Committee has set a goal of 50 cm for all streams. Nine of the streams tested were above the 50 cm benchmark; however, Turkey Creek averaged 45.5 cm, Splunge Creek averaged 44 cm, and Erie Canal was extremely high with an average of 38 cm. The committee wants to bring those three streams turbidity level up to or above the other nine streams in the watershed. The current average load for sediments in these three streams is 639.45 tons per year; our target load is 543.53 tons per year. The reduction of 15% is needed.

"Sediments may affect the survival of E. coli and often act as a reservoir for *E. coli* in streams. Sedimentation and adsorption, which offer protection from bacteriophages and microbial toxicants, can lead to higher concentrations of *E. coli* in sediments than in the overlying water column (Burton and others 1987). In addition, fecal bacteria may persist in stream sediments and contribute to concentrations in overlying waters for months after initial contamination (Sherer and others 1992)."[7]

Plate 3.1 ATV trails at Wabash & Erie Canal testing site.

"Until very recently, it was believed that E. coli did not survive long outside the animal gut. However, new research results indicate that E. coli not only survives in the wild, but also multiplies. It is now believed that E. coli may be reproducing in sediments at the bottom of streams and in farm fields where animal manure has been incorporated into the soil. These findings have major implications for how we handle animal manure and human wastes." [8]

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[8] Tools for Addressing E. coli.
http://www.hecweb.org/Programs%20and%20Initatives/Watershed/toolkit%20ch3A%20human%20Ecoli.pdf

Sedimentation enters the streams from many sources: field runoff from poor tillage practices, bank erosion from stream crossings formed by ATVs (See Figure 3.1), and wildlife or livestock traffic. A few of the sources of bank destabilization are wildlife such as beaver or muskrats, old mining sites, construction sites, and lack of maintenance on existing BMPs.

3.5 Concern #4: Livestock and Wildlife Waste

A fourth problem of concern is livestock and wildlife waste. Although the numbers of livestock operations within the county are limited, the ones that are in operation have very little to no conservation practices. Owners of CFOs (large operations) manage the manure from their operations well because conservation compliance requires producers to apply and maintain conservation systems as they relate to their livestock operation or risk fines, the loss of farm income support, price support, and conservation payments from voluntary programs. Smaller farmers spread liquefied manure from Concentrated Feeding Operations (CFOs) onto their fields without working it under. Manure from several of the smaller livestock operations located on elevated land washes into streams.

Livestock have direct access to streams or ponds in many cattle and some hog operations. As can be seen in Figure 3.2 where livestock have direct access to streams, they trample the sides of the streams causing the banks to break down thus adding sediment to streams. Another concern is the lack of pasture for the amount of fenced livestock. Cattle and horses consume more grass than the land can produce. Because of this, these areas become highly susceptible to erosion. GPS computers, fertilizer applicators, winter feeders, and fencing/rotational grazing practices are greatly needed on these livestock farms.

Plate 3.2 Hog Creek bank erosion caused from livestock with access to the stream.

Wildlife is also thought to be great contributors to waste in our streams. The Lower Eel River Watershed has a diverse and large number of wildlife throughout the watershed. Of course, controlling these wild animals is nearly impossible; however, the addition of filter strips, buffer strips, and wildlife plots could greatly help keep the wildlife a little further away from the streams.

3.6 Concern #5: Runoff from feedlots

A fifth area of concern for the Steering Committee is open feedlots close to streams, which are a potential nonpoint source of water pollution. Pollution problems can occur when an open feedlot has no provisions for runoff control such as winter feedlots or manure management facilities. In open feedlots, large amounts of manure accumulate in relatively small areas. When these feedlots are on slopes with little or no vegetation, runoff is even more prevalent. In the photo to the right, the feedlot is next to Lick Creek, where livestock have access to the stream. The stream lacks vegetation and buffers or any other means of preventing manure from entering the stream. are mismanaged, poorly designed, or poorly constructed.

Plate 3.3 Open feedlot next to a stream showing streambank erosion and animal access to the stream.

4.0 Baseline Conditions

4.1 Introduction

In order to know where you are going, it helps to know where you have been. Therefore, this section will be dedicated to establishing what we know about the Lower Eel Watershed through water sampling and observation. These baseline conditions will be used in the future to determine if practices implemented in the watershed are improving the water quality conditions.

The baseline conditions were developed using two sets of sampling data. IDEM gathered one set of data, which was strictly limited to E. Coli results, and the SWCD of Clay County, Indiana, in conjunction with an IDEM 319 grant, gathered a more detailed set of data. SWCD data included dissolved oxygen, phosphorus, pH, E. coli, biochemical oxygen demand, turbidity, temperature, nitrates, and nitrites. The Steering Committee elected to use Indiana State Standards, when available, to attain their goals. (See Attachment A: Lower Eel River Watershed E. coli Data)

Orthophosphates: Indiana has a draft benchmark for phosphorus of 0.3 mg/L, and Ohio's EPA suggests using 0.28 mg/L for wadeable streams that support warm water fish. Since testing was done only for orthophosphates, the committee averaged the Indiana draft benchmark and Ohio's EPA suggested level and elected to use a benchmark of 0.29 mg/L.

Nitrates: Indiana does not have a standard for nitrate + nitrites for streams. However, the Indiana drinking water standard for nitrate + nitrites is 10 mg/L. According to Hoosier Riverwatch, nitrate levels above 4mg/L indicate possible pollution. Only three sites (Turkey Creek, Brush Creek, and Connley Ditch north) had a two-year average above 4 mg/L. We would like to see all nitrate levels below 4 mg/L.

pH: The Indiana State Standard for pH is between 6 and 9.

Dissolved Oxygen: The state water quality standard for dissolved oxygen is an avg. > 5 mg/L, not < 4 mg/L.

Turbidity: Turbidity is the relative clarity of the water, which is measured using a water column with an object at the bottom. If the object can be clearly seen, the measurement is 60 cm. There is no state standard in Indiana for turbidity. The Steering Committee wants to achieve a standard of 50 cm for all the streams in The Lower Eel River Watershed.

E. coli: The state water quality standard for a single grab sample E. coli is less than 235 cfu / 100 mL. The typical range for E. coli is 133 to 1,157 cfu / 100 mL. The Indiana average is 645 cfu / 100 mL. Every SWCD testing site was not only over the state standard, but seven sites were also well over the state average of 645 cfu / 100 mL.

4.2 IDEM Sampling

In 1996 and again in 2001, IDEM sampled streams throughout the Lower Eel River Watershed. Some of these streams were the same as the streams sampled by the SWCD. The results of SWCD's tests can be viewed in the Appendix under Sample Results 2006, Sample Results 2007. The sampling done by IDEM included only E. coli; the E. coli results from those samples will be compared to the ones gathered by the SWCD. (See Attachment A: Lower Eel River Watershed E. coli Data in Appendix.)

4.3 Hoosier Riverwatch (SWCD Water Sampling)

Over a two-year period the Clay County Soil and Water Conservation District tested ten (10) different tributaries of the Eel River at twelve (12) different locations. Stream sites were tested every month from April through October. See Figure 4.0: Clay Co. SWCD Sites.

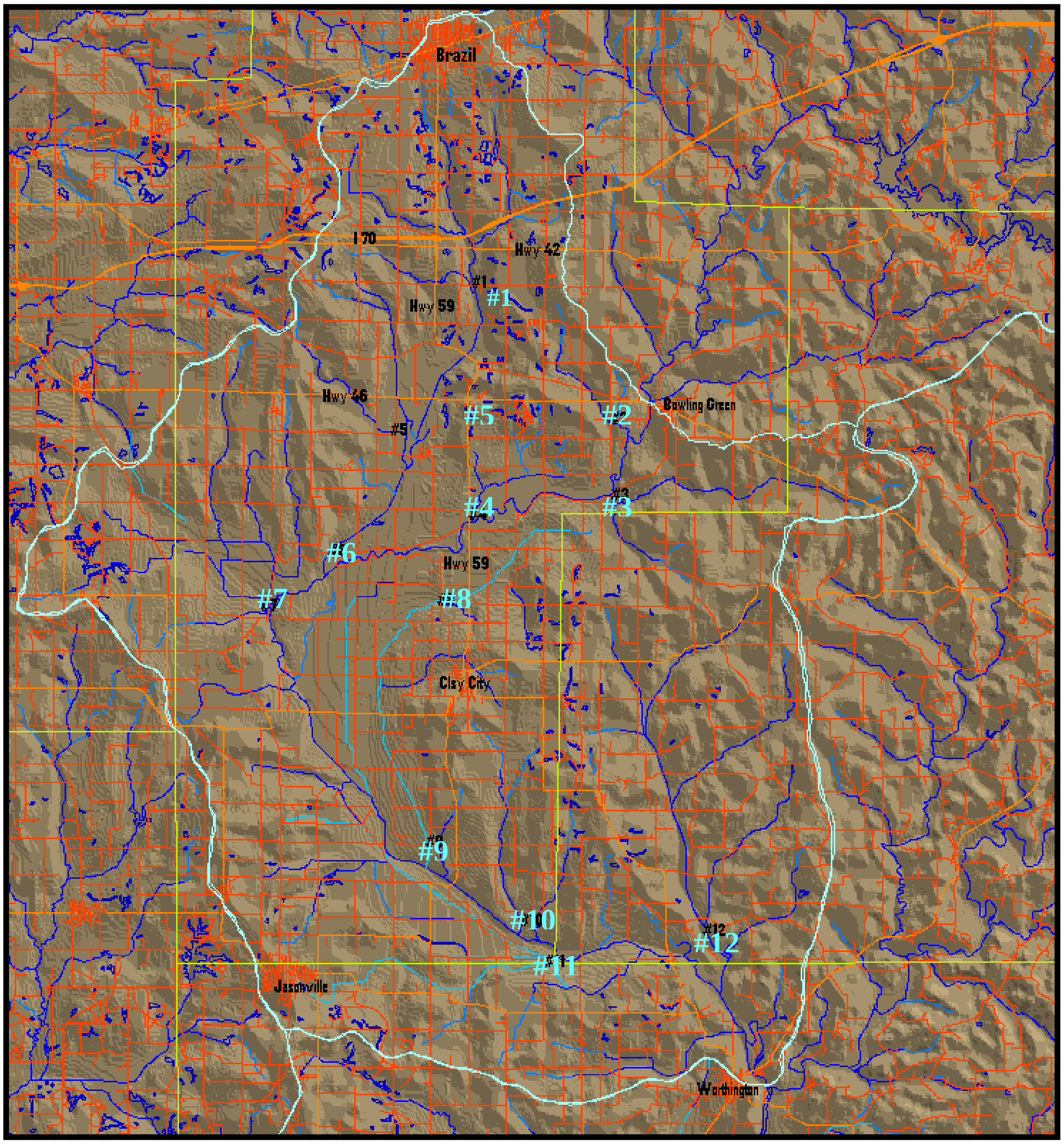


Figure 4.0 Clay County SWCD Water Monitoring Sites

HUC 05120203080

#1) **Birch Creek** @ Co. Rd. 300 N. (Jackson Twp. – SW) HUC 05120203080040
#2) **Hog Creek** @ Co. Rd. 375 E. (Washington Twp.) HUC 05120203080010
#3) **Six Mile Creek** @ River Road (Washington Twp.) HUC 05120203080020
#4) **Turkey Creek** @ So. Edge of Sugar Ridge Twp. – Center HUC 05120203080030
#5) **Brush Creek** @ Co. Rd. 200 W. (Perry Twp. – NE) HUC 05120203080070
#6) **Birch Creek** @ Tow Path Rd. (Sugar Ridge Twp. – South) HUC 05120203080080

HUC 05120203090

#7) **Splunge Creek** @ Co. Rd. 535 W. (Perry Twp. – South) HUC 05120203090020
#8) **Connelly Ditch** (north) @ Co. Rd. 75 W. (Harrison Twp. – NE) HUC 05120203090050
#9) **Connelly Ditch** (south) @ Co. Rd. 1200 S. (Harrison Twp. – SW) HUC 05120203090060
#10) **Lick Creek** @ Co. Rd. 750 S. (Jefferson Twp – Owen Co.) HUC 05120203090110
#11) **Erie Canal** @ Co. Rd. 1500 S. (Lewis Twp. – SE) HUC 05120203090080
#12) **White Oak Creek** @ Co. Rd. 1375 S. (Harrison Twp. – SE) HUC 05120203090070

4.31 Dissolved Oxygen

Oxygen is as important to life in water as it is to life on land. Aquatic plants and animals require oxygen for survival. Although oxygen atoms are present in the water molecule (H_2O), most aquatic life requires oxygen in the free elemental state (O_2) as a dissolved gas. The amount of oxygen in water is called the dissolved oxygen (DO) concentration. Oxygen dissolves into the water from the atmosphere until the water is saturated. Aquatic plants, algae, and plankton also produce oxygen as a by-product of photosynthesis. Oxygen levels rise during the day during photosynthesis and fall at night during respiration. Dissolved oxygen is an important measure of stream health.

The presence of oxygen in water is a positive sign; its absence from water often indicates water pollution. Aquatic organisms require different levels of DO. Dissolved oxygen levels below 3 parts per million (ppm) are stressful to most aquatic life. Dissolved oxygen levels below 2 or 1 ppm will not support fish. Levels of 5 to 6 ppm are usually required for healthy growth and activity of aquatic life. The stakeholders elected to use the standard of >5 mg/L and not <4 mg/L.

4.32 E. coli

Fecal coliform bacteria 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. Fecal coliform bacteria typically enter water via combined sewer overflows (CSOs), poor septic systems, livestock with stream access, and runoff from agricultural feedlots. The bacteria can enter the body through the mouth, nose, eyes, ears, or cuts in the skin. *E*. coli is a specific species of fecal coliform bacteria used to assess Indiana's state water quality standards. Forty-one percent, a total of 8,660 miles, of Indiana streams do not support primary contact recreation due to high *E*. coli bacteria levels. The E. coli samples were pulled from the monitoring streams then incubated in a dark place at room temperature for 48 hours before counting and recording. The state water quality standard requires less than 235 cfu /100 mL; the Steering Committee will strive to meet that standard for the Lower Eel River Watershed.

4.33 pH

The "power of hydrogen' (pH) test is one of the most common analyses in water testing. Water (H_2O) contains both hydrogen ions (H+) and hydroxide ions (OH-). The relative concentrations of these ions determine whether a solution is acidic or basic. A pH range of 6.5 to 8.2 is optimal for most organisms. The Indiana State Standard for pH is between 6 and 9; the Steering Committee's goal is to meet that standard for the Lower Eel River Watershed.

4.34 Biochemical Oxygen Demand (BOD)

Biochemical oxygen demand (BOD5) is a measure of the amount of oxygen used by aerobic (oxygen-consuming) bacteria as they break down organic wastes over five days. Polluted streams or streams with a lot of plant growth and decay generally have high BOD5 levels. High levels indicate that large amounts of organic matter are present in the stream. Streams that are relatively clean and free from excessive plant growth typically have low BOD5 levels.

4.35 Water Temperature

Water temperature is very important to overall water and stream quality. Temperature affects dissolved oxygen levels and the rate of photosynthesis. Colder water can hold more dissolved oxygen than warmer water; thus colder water generally has higher macroinvertebrate diversity. Warmer water has less dissolved oxygen; lower oxygen levels weaken fish and aquatic insects, which makes them more susceptible to illness and disease.

Photosynthesis by algae and aquatic plants increases with increased temperature. Increased plant/algal growth leads to increased death and decomposition, resulting in increased oxygen consumption (BOD_5) by bacteria.

Many animals require specific temperatures to survive. Water temperature controls their metabolic rates, and most organisms operate efficiently within a limited temperature range. Aquatic organisms die when temperatures are too high or too low. Water temperature varies naturally with changes of the seasons, the amount of rainfall, and flow rates. Thermal pollution (temperature increases) can threaten the balance of aquatic ecosystems. To determine if a river or stream is thermally polluted one must take a temperature reading at two different locations. Increased water temperature may be caused by many sources. If water temperature decreases within a mile of the sampling site, there may be a source of cold water, such as a spring, entering the stream.

4.36 Total Phosphate and Orthophosphates

Phosphorus (P) is essential to plant and animal life, and its presence in the environment is natural. Phosphates exist in three forms: orthophosphate, metaphosphate (or polyphosphate), and organically bound phosphate; each compound contains phosphorous in a different chemical arrangement. These forms of phosphate occur in living and decaying plant an animal remains, as free ions or as weakly chemically bounded in aqueous systems, chemically bounded to sediments and soils, or as mineralized compounds in soil, rocks, and sediments.

Problems with phosphorus, as a water pollutant, result not from its presence but from the addition of excessive amounts. Aquatic ecosystems develop with very low levels of phosphorus. When added to aquatic systems, seemingly small amounts of phosphorus can lead to problematic algal blooms. Phosphorus enters surface waters as organic matter (dead plants and animals, animal waste) attached or adsorbed to soil particles or in a number of man-made products (detergents, fertilizers, and industry wastes). Phosphorus is an important nutrient in fertilizer because it increases terrestrial plant growth (vegetation). When transported into aquatic systems, phosphorus increases aquatic plant growth (e.g. algae, weeds). When phosphorus levels are too high, excess plant and algal growth creates water quality problems. Plants begin to die and decompose, depleting the dissolved oxygen supply in the water; this condition is known as **hypoxia**, which can lead to fish kills in some cases. Phosphorus is also released from the sediments and decomposing plants back into the water, continuing the cycle. The reaction of the aquatic system to an overloading of nutrients is known as **eutrophication.** Hypoxia and eutrophication, to some extent, occur within many of our lakes and streams every year and occur on a larger scale at the mouth of the Mississippi River where there is a large "dead zone" in the Gulf of Mexico.

Natural processes produce orthophosphate forms, but they can also be produced by man-influenced sources such as: partially treated and untreated sewage, runoff from agricultural sites, and application of some lawn fertilizers. Fertilizers generally contain phosphorous in the form of orthophosphate. Phosphates tend to remain attached to soil particles rather than dissolving in water. However, if too much fertilizer is applied, the phosphates are carried into surface waters with flooding, storm runoff, and melting snow. Soil erosion can also carry a considerable amount of particulate phosphate to streams. Phosphate runoff is an issue where cattle feedlots, hog farms, dairies, and barnyards drain into nearby streams or lakes.

No national or state criteria have been established for concentrations of phosphorus compounds in water. However, to control overloading of nutrients the EPA makes the following recommendations: "Total phosphate should not exceed 0.05 mg/L (as phosphorus) in a stream at a point where it enters a lake or reservoir, and should not exceed 0.1 mg/L in streams that do not discharge directly into lakes or reservoirs" (Muller and Helsel, 1999). The Steering Committee chose to use 0.29 mg/L as their benchmark for orthophosphorus.

4.37 Nitrate and Nitrite

Nitrogen makes up about 80% of the air we breathe; it is found in all living things. Nitrogen occurs in water as nitrate (NO_3), nitrite (NO_2), and ammonia (NH_3). 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.

Like phosphates, nitrogen is a main ingredient in fertilizers and can lead to increased aquatic plant growth and eutrophication. Unpolluted waters generally have a nitrate level below 4 mg/L. Nitrate (NO_3) levels above 4 mg/L and nitrite (NO_2) levels above 3.3 mg/L are considered unsafe for drinking water. Indiana does not have a standard for nitrates. Therefore, we will strive to meet a benchmark of 4 mg/L in our streams.

4.38 Turbidity and Transparency

Turbidity is the relative clarity of the water and is measured by shining a light through a water column. Turbid water is cloudy; suspended matter including clay, silt, organic and inorganic matter, and algae cause the water to be cloudy. These materials scatter and absorb light, rather than allowing it to shine through the water column in a straight line. Turbidity should not be confused with color, since darkly colored water (like tea) can still be clear and not turbid.

Turbid water may be the result of soil erosion, urban runoff, algal blooms, and bottom sediment disturbances caused by boat traffic, animals in the stream, or abundant bottom feeding fish. If a stream is very turbid, light will not reach through the water column and many reactions, especially photosynthesis, will be limited. When water is turbid, the floating particles absorb heat from the sun, which raises water temperature; increased water temperature lowers dissolved oxygen levels.

Particles in the water can also kill fish and aquatic invertebrates by clogging their gills and smothering their habitat.

Transparency measures the scattering of light and is observed by the depth at which one can see an object in a water column. There is no state standard in Indiana for turbidity. The Steering Committee wants to achieve a standard of 50 cm for all the streams in The Lower Eel River Watershed.

4.4 Testing Sites: Locations and Conditions

4.41 Testing Site #1: Birch Creek (north)

Site #1 was at the headwaters of Birch Creek, which is located in the northern-most section of the Birch Creek Watershed. Site #1 (HUC 05120203080040) is one of the two 14-Digit HUC Codes sampled in the Birch Creek Watershed. This watershed consists of over 10,153 acres and is almost solely used for agriculture; however, the southern portion of the city of Brazil, is located in the northern most section of the Birch Creek Watershed. Due to the size of this stream, which is 9.90 miles long, it was tested at the northern end of the stream and the southern section of the stream.

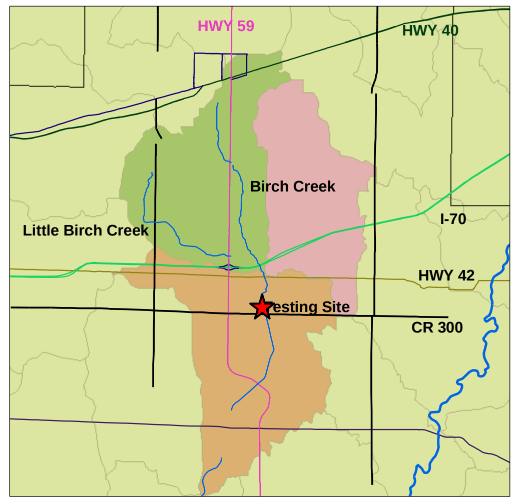


Figure 4.0 Birch Creek Watershed

Dissolved oxygen did not show up as a real problem at Site #1. The percentage of saturation of oxygen in the stream ranged between 70% and 90% . The low of 70% was hit during a July test when water levels were very low. This suggests that low flow may be limiting DO entrainment or that decomposition may be occurring faster than DO can be replaced. Nitrate and nitrite levels were always low and under the committee benchmark of 4 mg/L; the two-year average was around 1.4 mg/L.

Plate 4.1 Testing Site #1: Birch Creek (north)

Phosphorus tests also came back lower than the committee benchmark of .29 mg/L. The E. coli at Birch Creek averaged 400 cfu /100 mL over the two-year testing period. The range for the E. coli was between 0 and 2,500 cfu/100 mL. The test that showed 2,500 cfu/100 mL occurred during testing after a significant rain event in September of 2006. The highest count, other than that sample, was 900 cfu/100 mL on October 16, 2006, when all sites sampled were higher than normal. While the average of 400 cfu/100 mL was above the state average, other streams in the watershed had even higher E. coli counts. IDEM sampled Birth Creek in two different locations. One site was identical to the SWCD Site #6 at Birch Creek (south), which showed a needed reduction of 50.45% to meet water quality standards for E. coli.

4.42 Testing Site #2: Six Mile Creek

Six Mile Creek is a well-buffered stream that begins to the east of Clay County in neighboring Owen County and runs 8.09 miles. Each side of Six Mile Creek is lined with 20 feet of trees and vegetation, which is the minimum width of a buffer recommended by the Natural Resource Service. Most of the 17,409 acres that drain into Six Mile Creek are used for agriculture. The terrain in the Six Mile Creek Watershed has the steepest slopes of any of the sub-watersheds. Because of this, it also contains a large amount of HEL Soils. The flow from this stream is generally low despite the rather large watershed, which drains into it. Six Mile Creek dumps directly into the Eel River at River Road. Our testing site was only 50 feet from where the creek dumps into the river.

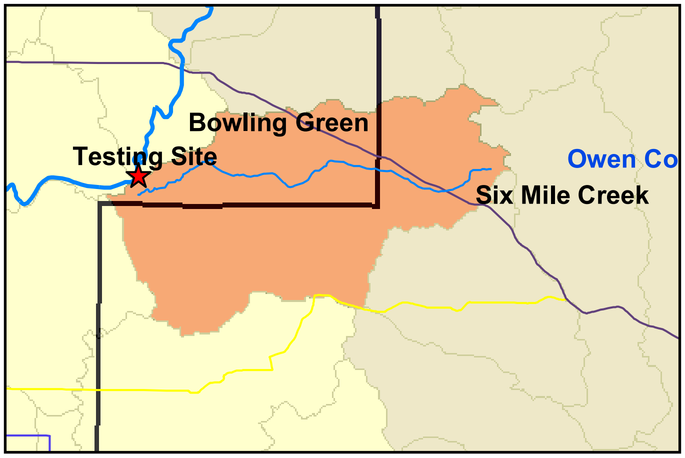


Figure 4.1. Six Mile Creek Watershed

The Six Mile Creek Watershed contains several small cattle operations. While this area may not have the most cattle in numbers, it may very well contain the most non-permitted operations.

The saturation of oxygen in the stream ranged between 70 mg/L and 90 mg/L. The low of 70 mg/L was hit in July of 2006, a date in which water levels were very low. This may indicate that decomposition is occurring faster than the dissolved oxygen can be replaced, or the flow may be limiting the dissolved oxygen total.

The two-year average levels of nitrate and nitrite, which were around 1.4 mg/L, were always low and under our benchmark. Phosphorus tests came back lower than our benchmark of 0.29 mg/L. The E. coli count came in at 475 cfu /100 mL, which was over our benchmark, but, unlike Site #1, Six Mile Creek did not have a large spike in any one month. Over the two-year testing period, the range for E. coli came in between 100 and 1,000 cfu /100 mL. IDEM did not sample Six Mile Creek.

Plate 4.2. Testing Site #2: Six Mile Creek

4.43 Testing Site #3: Hog Creek

Hog Creek is only 3.49 miles long, but it has a big impact on the water quality of the Eel River. The Hog Creek Watershed is located directly north of Six Mile Creek Watershed; it contains

6,959 acres, which drain into Hog Creek. Compared to the other sub-watersheds, Hog Creek contains a large amount of HEL Soils. This sub-watershed contains one large and three small cattle operations. There are also two large swine operations, which are classified as Confined Feeding Operations (CFO's).

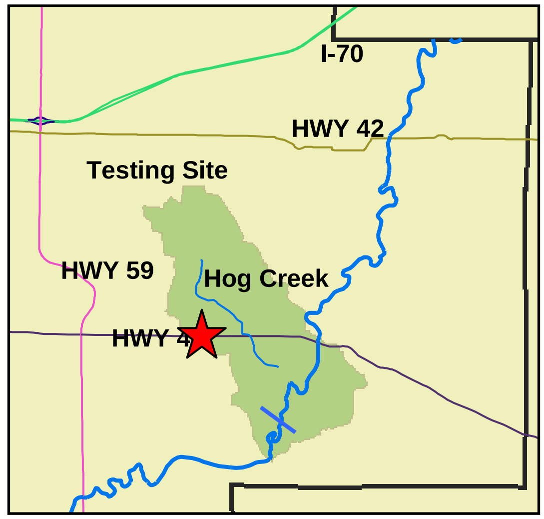


Figure 4.2. Hog Creek Watershed

Hog Creek is unique from the standpoint that it contains a large feline rescue center, which houses animals such as lions, tigers, panthers, cougars, and bobcats. Close to 200 felines are contained in this area of the Lower Eel River Watershed. This is a possible source of E. coli, manure is composted then spread on area fields. Cattle from one farm in the watershed have waded in Hog Creek for years contributing to the E. coli contamination and causing the banks of Hog Creek to erode where they enter and exit the stream. (See Plate 3.2) Currently there are a few sheep with direct access to Hog Creek just east of Center Point, and just west of that area, three horses are pastured on a barren lot. Runoff from this lot goes into a ditch that runs directly into Hog Creek. The small, incorporated town of Center Point sits near the headwaters of Hog Creek. The town of Center Point has a Class I wastewater treatment plant, which is a two-stage lagoon sewage treatment system. Inflow is monitored by flow meters and NPDES parameters; a certified Wastewater Operator with a class II license checks influence one time per month. Any time there is a discharge a certified lab also checks the discharge parameters. The effluent is tested for five parameters: pH, TSS, $CBOD_5$, ammonia, and E. coli. Center Point has always been under the set parameters for everything. The remainder of the watershed consists of a few strip pits and large areas of row crops and pasture.

Plate 4.3 Testing Site #3: Hog Creek

The sampling at Site #3, located a mile west of the Eel River, yielded interesting results. In back to back months of July and August of 2007, the dissolved oxygen showed only 4 mg/L. When taking the temperature into account for the month of August, the percent of saturation showed only 44%. The water flow was extremely low both times; therefore, the low level of saturation could be attributed to low flow limiting DO entrainment, or decomposition may be occurring faster than DO can be replaced. The average percentage of saturation in Hog Creek was only about 75%. Other levels in the stream were at or below the state average except for the E. coli count, which averaged 3,125 cfu /100 mL over the two years of testing. The E. coli count ranged between 0 and 12,000 cfu /100 mL. The 12,000 count was not the only spike; there were also readings of 4,000 cfu /100 mL and over 2,000 cfu /100 mL on two different occasions. The amount of E. coli in this stream is a huge concern. IDEM did not sample Hog Creek.

4.44 Testing Site #4: Turkey Creek

Turkey Creek is a natural creek, which runs through the Eel River bottoms. The creek's headwaters begin in a cattle pasture just south of Dietz Lake Recreation Camp Grounds, which is one quarter of a mile north of County Road 100 South. In some areas the stream has an adequate natural riparian buffer; however, through the river bottoms most of the buffer has been cleared in order to farm more acres. The flat ground surrounding this stream is drained by tile; most of the tile drains directly into the Turkey Creek. When flood stage for the Eel River is breached, water often backflows into Turkey Creek, which in turn causes it to flood as well. The Eel River floods at least once per year. Flooding is of especial concern due to the concentrated amounts of HEL soils. Two cattle operations and one small confined swine operation are located in the Turkey Creek Watershed. Most of the land in this watershed is used primarily for row crops. There are some residential areas in the watershed, and Dietz Lake, a private campground, also contains several permanent homes. This area is a concern due lack of a sewage treatment system.

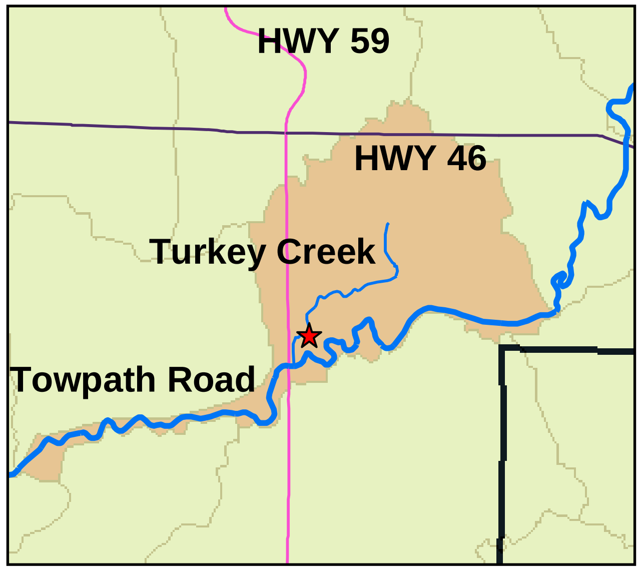


Figure 4.3 Turkey Creek Watershed

In October of 2007 the dissolved oxygen in Turkey Creek was at a low of 4 mg/L. When the lower than average temperature is taken into account with this reading, the saturation percentage of dissolved oxygen totals only 41%. In August of 2006 the dissolved oxygen also reached a low of 4 mg/L. However, the warmer water temperature kept the percent of saturation at 46%. The average dissolved oxygen for this area was 7.05 mg/L, which is much lower than the state average of 9 mg/L. The amount of available oxygen for organisms in Turkey Creek is a serious concern.

Plate 4.4 Testing Site #4: Turkey Creek

The pH results for Turkey Creek were normal as were the tests for orthophosphates. However, the stream had the highest nitrates of all twelve sampling sites. The two-year average was 1.4 mg/L. While this number is below the watershed benchmark, it still draws some attention due to its ranking in comparison with the remaining streams.

The average turbidity of 42 cm was below the state average; however, it was the second lowest average in the watershed. One turbidity test on the stream showed a reading of only 7 cm. At various times the high did reach 60 cm. (a full tube of water), but that was only during very dry conditions. It was not uncommon for results to be lower than 20 cm., which was two points from the state average of 22 cm. The reduced clarity of the water can be linked to the tillage practices in this watershed. Many farmers in this area use little or no reduced tillage, and it is common for several farmers to still use fall tillage. This creates more runoff and erosion, which in turn results in increased sediment in the stream.

Finally, we have what is perhaps the biggest concern for this stream, which is the high E. coli count. The two-year average for E. coli was an alarming 1,720 cfu /100 mL. In 2007 the E. coli counts ranged from 250 to 17,000 cfu /100 mL. The only test below 575 cfu /100 mL was the April test of 250 cfu /100 mL. In September of 2007 the E. coli reached 17,000 cfu /100 mL; it was 1,000 cfu /100 mL in both September and October of 2006. With very little manure being spread in this area, one has to believe that faulty septic systems could very well be linked to the E. coli problems of Turkey Creek. IDEM did not have any test samples pulled from Turkey Creek.

4.45 Testing Site #5: Brush Creek

Brush Creek is a small tributary of the Eel River; including its tributaries, it is 12.81 miles along. The creek runs through only rural areas east of the town of Cory. The majority of the 9,149 acres in the Brush Creek Watershed is used for row crops. It does contain some forest and a few residential areas. Brush Creek dumps into Birch Creek, one of the other tested tributaries of the Lower Eel River Watershed.

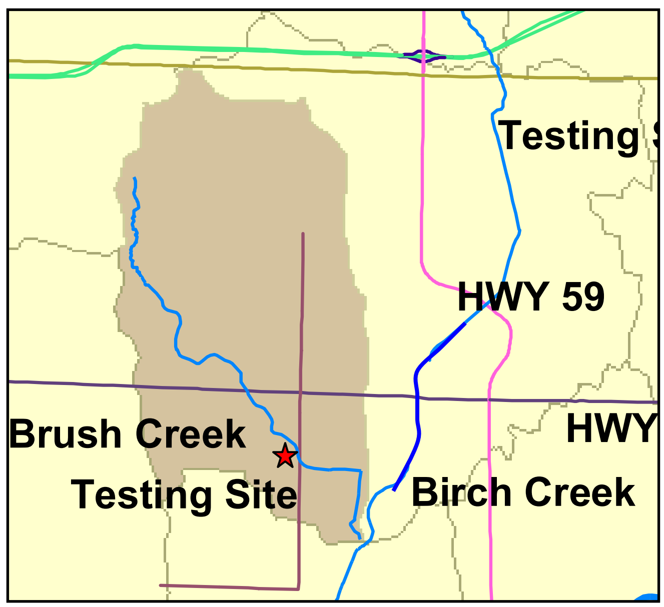


Plate 4.4 Testing Site #5: Brush Creek

The dissolved oxygen readings for Brush Creek ranged consistently between 6 mg/L and 9 mg/L and had an average reading of 7.65 mg/L. There were no real concerns here as dissolved oxygen readings were usually very consistent.

The same can be said for most of the other tests in this stream. Orthophosphates averaged 0.2 mg/L and pH held an average of 8.2; both were well below our benchmarks of 0.29 mg/L for Orthophosphates and between 6 and 9 for pH. The turbidity of this stream was excellent. The average reading on the tube was 57.5 cm. The water was generally very clear.

At times the E. coli counts for Brush Creek yielded alarming results. In April of 2007 the E. coli was 10,000 cfu /100 mL. It maintained an average of almost 1,000 cfu /100 mL in 2006;

Plate 4.5 Brush Creek Testing Site

however, after the spike that occurred in April, the stream only averaged 370 cfu /100 mL for the rest of 2007. One can only speculate that top applications of dairy manure over the winter followed by heavy spring showers in April resulted in the large spike. Despite the heavy showers that preceded the April test, all but one of the other testing sites tested that day yielded lower than average counts of E. coli. Therefore, one can deduce that while the rain likely increased the number, it was not the only factor in the spike. The results from IDEM's sampling of Brush Creek should not be confused with the SWCD's results from Brush Creek, which occurred in Clay County. The sampling results from Brush Creek, which a tributary of Lick Creek in Owen County, can be found under the Lick Creek Testing information in Section 4.410.

4.46 Testing Site #6: Birch Creek (south)

The visual data remains the same on the south end of this tributary as it was at testing site #1, Birch Creek (north). Because of the size of this stream, which is 22.88 miles long and 26,181 acres, it was tested at its headwaters as well as a quarter mile up steam from where it empties into the Eel River The main difference between the two sites is the surrounding topography. Due to the close proximity of the Eel River at the lower site, the surrounding area is much flatter. The soil types, of course, are much different as well. One of the biggest differences in the soils is the fact that this watershed contains a high concentration of HEL Soils.

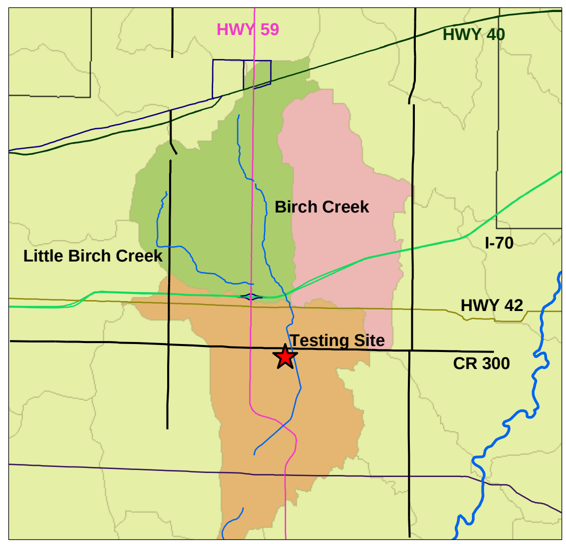


Figure 4.5 Birch Creek Watershed

Plate 4.6. Testing Site #6: Birch Creek (south)

Among all of the testing sites, Birch Creek south held the highest average of dissolved oxygen. During the two years of testing, the average dissolved oxygen was 8.35 mg/L. Its range was between 7 and 11 mg/L. It also had the highest turbidity results with a two-year average of 58 cm. All readings were above 57 cm, except during a test in April of 2007, when the tube reading was only 43 cm. Birch Creek (south) orthophosphate levels held an average of .53 mg/L, and 8.35 were the average pH. The average nitrate tests in the streams were 1.0 mg/L and had a range of 0 mg/L to 2.2 mg/L.

The E. coli results were also among the best of all the streams tested. The two-year average was 375 cfu /100 mL, which was the second lowest total of all twelve testing sites. While this stream may not be without its problems, it should be considered one of the healthiest tributaries of the Lower Eel River Watershed. IDEM sampled Birch Creek, but not at this site; the site they sampled was more closely located to our testing site at Birch Creek (north).

4.47 Testing Site #7: Splunge Creek

At the testing site, Splunge Creek has a shale bottom and is buffered on one side by a grassed levee and on the other side by a narrow row of trees and natural vegetation. This creek drains 29,747 acres of farming land in the "reservoir," as it is known in The Lower Eel River Watershed. In the past the Big Slough Reservoir held water for the Wabash & Erie Canal. Now the reservoir, a flat area of land, is used solely for the production of row crops. Locks and gates are used to control flooding in the area. When water levels reach a certain point, the gates are opened and water is released into Splunge Creek, which then drains into the Eel River. The Splunge Creek-Cutoff / Little Slough runs for 25.79 miles.

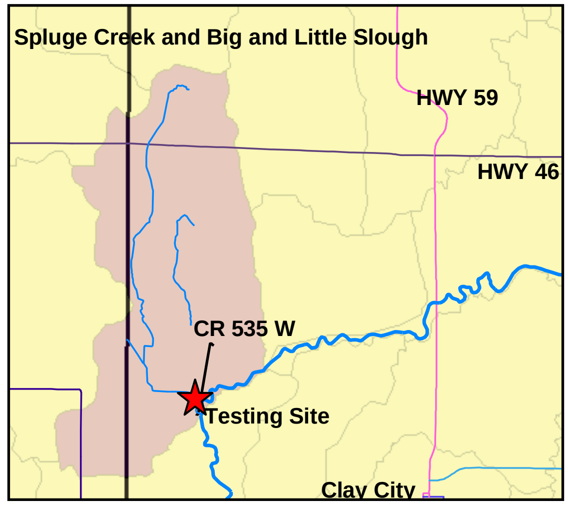


Figure 4.6 Splunge Creek Watershed

Dissolved Oxygen for Splunge Creek had an average of 6.95 mg/L. It had a low of 3 mg/L in June of 2006, which was only 31½% saturation. In April of the same year the DO was 11mg/L, which was 116 %. The results in 2007 had a more consistent range, which fell between 5 and 10 mg/L.

Like most of the other streams tested, orthophosphate, nitrates, and the pH in Splunge Creek were below the state averages. Turbidity in this stream was low at times and held a two-year average of just 44 cm. This total was the second lowest among streams tested. Turbidity ranged as high as a full tube (60 cm.) all the way down to a low of just 4 cm. in May of 2006. After the first two samples were taken at the beginning of the project, Splunge Creek's turbidity was averaging just 10 cm. However, as rain slowed down, the average increased.

Plate 4.7 Testing site #7: Splunge Creek

E. coli remained a problem in this watershed. During the two years of testing, the stream carried an average of 765 cfu /100 mL. In May of 2006 after heavy rains had gone through The Lower Eel River Watershed, the stream reached its high in E. coli with a count of 4,450 cfu /100 mL. However, if this number is taken out of the equation, the stream held an average of just 481 cfu /100 mL. In 2007 the stream carried an average of only 410 cfu /100 mL. While these numbers are still above the state averages, they are not nearly as alarming when the large spike from the May test is eliminated from the equation. IDEM's only sample of Splunge Creek was not sampled enough to compile a geometric mean of the site. The three samples that were pulled from Splunge Creek did not show any extremely high numbers.

4.48 Testing Site #8: Connley Ditch (north)

Three 14 Digit HUC Codes make up the Connley Ditch Watershed. The watershed consists of over 22,000 acres and is almost solely used for agriculture. Connley Ditch is a large stream that begins south of the Eel River and one mile east of Harmony Road (Co. Rd. 200 S.); from there it runs 12.76 miles to the southern tip of Clay County. Clay County SWCD test site #8 was located where Connley Ditch crossed County Road 75 West. Farmers created this stream to help drain their farmland. Only a small grass buffer separates the stream from the many surrounding acres of row crops. Little or no vegetation can be found in this stream. The stream's bottom is made up of sediment with little or no rocks. Again the site was tested in two separate locations; the first site was just about two miles north of the town of Clay City.

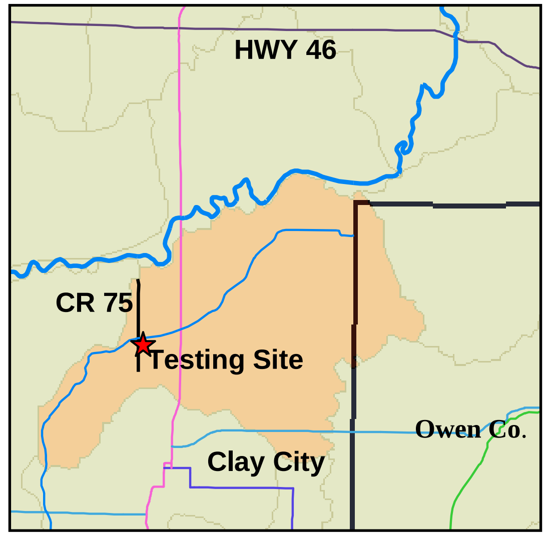


Figure 4.7 Connley Ditch (north) Watershed

Dissolved Oxygen in Connley Ditch (north) carried an average of 7.9 mg/L., which was the third highest of the twelve sites. One of the two sites higher than this one was Connley Ditch (south). The results ranged between 5 mg and 11 mg/L. The results for the orthophosphate and pH were all good as well. The average pH was 8.15; the average, orthophosphate was 0.23 mg/L. Nitrates here, however, were the highest of all the twelve sites tested. The average for nitrates was 5 mg/L, which is above the stakeholder's benchmark of 4 mg/L.

Plate 4.8 Testing Site Connley Ditch (north)

The average E. coli for Connley Ditch (north) was 280 cfu /100 mL, which was by far the lowest of all twelve tested sites. The range for E. coli fell between 0 and 800 cfu /100 mL. Much like Birch Creek, the Connelly Ditch (north) number for E. coli was still over the state average; however, it did not reach the level of concern that other streams did in the watershed. On average the stream showed an E. coli, which required a reduction of about 50%. IDEM tested Connley Ditch in several locations; one of these locations was at this same Connley Ditch (north) site. The IDEM test which required a reduction of 35%. However, only one of IDEM's five tests showed a high count, which was done on July 31, 2001. That spike drove the stream's number much higher than any of the other samples pulled.

4.49 Testing Site #9: Connley Ditch (south).

Connley Ditch is a large stream that drains 8,305 acres and begins south of the Eel River and one mile east of Harmony Road (Co. Rd. 200 S.); it runs 12.76 miles and ends in the southern tip of Clay County. Farmers created this stream to help drain their farmland. Only a small grass buffer separates the stream from the many acres of row crops that surround it. Little or no vegetation can be found in this stream. The stream's bottom is made up of sediment with little or no rocks. One possible reason for the sediment on the bottom of this stream is due to the high amount of HEL Soils in this sub watershed. This Connley Ditch site was closer to the river than Site #8; it too is surrounded by similar terrain as the site to the north.

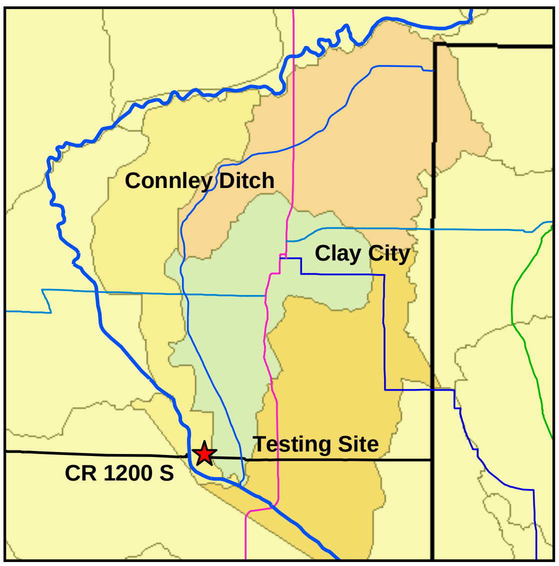


Figure 4.8 Connley Ditch (south) Watershed

Nearly all of the testing results for Site 9 mirrored that of the stream's upper waters. Dissolved Oxygen held an average of just 7.95 mg/L., which was five hundredths higher than the site to the north. The pH was just 8.25, which was very similar to the average pH of 8.15 upstream; orthophosphate held an average of only 0.45 mg/L.

As was written above, the stream's headwaters were relatively low in E. coli; however, the southern section was much different. Over the two years of testing, E. coli in the southern section of Connley Ditch averaged 800 cfu /100 mL, which is more than double the results of the northern section of Connley Ditch. Located between the two Connley Ditch testing sites #8 and #9 are two non-permitted hog operations and two non-permitted cattle operations. Connley Ditch also had a dramatic change from 2006 to 2007. In 2006 the E. coli count averaged almost 1,300 cfu /100 mL; however, in 2007 the same site yielded results of only 300 cfu /100 mL. Determining the causes of these results is nearly impossible. The turbidity

Plate 4.9 Testing Site #9 Connley Ditch (south)

at both sites was very good with an average of 54 cm. at the north site and 53.5 cm at the south site.

IDEM tested Connley Ditch in five different locations. IDEM also tested Clay County SWCD's Site #9 Connley Ditch (south) at two different times. The first one was in 1996, and the second test was in 2001. In 1996 the E. coli reduction needed came back at 49.3%; the 2001 test was not high enough to warrant a reduction amount. These inconsistent results fall right in line with our results. The stream has occasional spikes, but most numbers do not indicate a real concern for E. coli.

4.410 Testing Site #10: Lick Creek

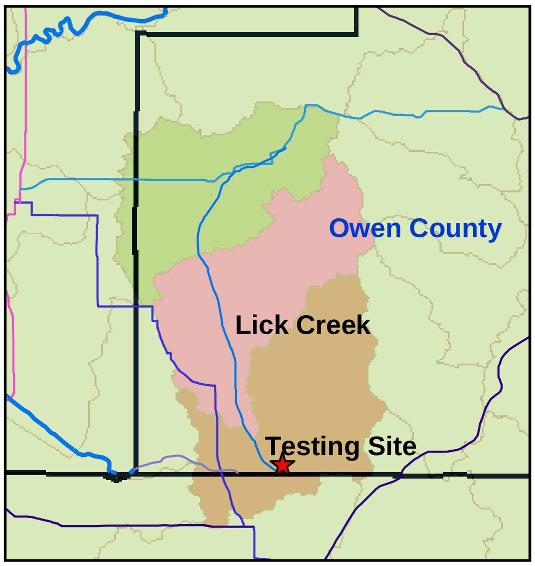


Figure 4.9 Lick Creek Watershed

Lick Creek, which is 12.74 miles in length, is located in southwestern Owen County and drains 25,926 acres. Clay County SWCD's testing site was where Lick Creek crossed Hubble Station Road. Surrounding Lick Creek are several small cattle operations. The creek is buffered on both sides by natural vegetation. Most of the land use in this area is for agriculture, and most of it is planted in row crops. There is an increased amount of conservation tillage due to the restrictions placed on farming HEL Soils that makes up a large amount of this watershed. This area contains more feedlots and pasture than any other area in the Lower Eel River Watershed.

The dissolved oxygen count for Lick Creek averaged 6.8 mg/L over the two-year period. The lowest count was in October of 2007 when the DO averaged only 4 mg/L. With the water temperature at only 16 C, the percent of saturation at only 40%. Most of the DO counts were much higher and the range fell between 4 and 9 mg/L.

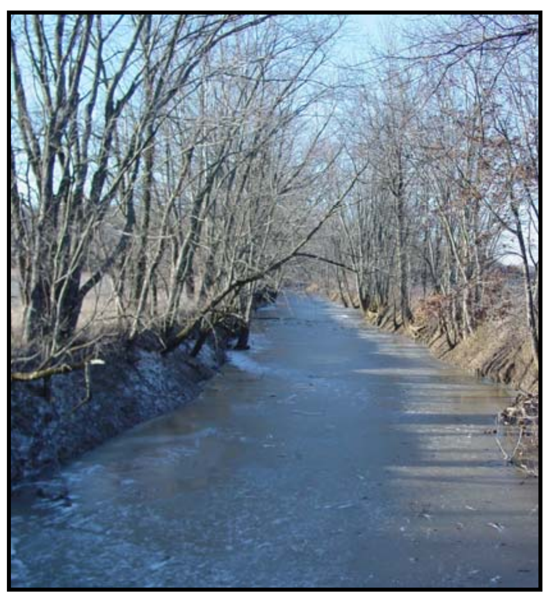


Plate 4.10 Testing Site: Lick Creek

Tests on orthophosphates, nitrates, and pH were all below the stakeholder's benchmarks of .29 mg/L, 4 mg/L, & 6-9 respectively. The pH held an average of 8.1, orthophosphate was 0.23 mg/L, and nitrates were 0.5 mg/L. The turbidity averaged 51.5 cm, which was good.

Over the two years, E. coli averaged 700 cfu /100 mL; however, it is important to note that in 2007 the average E. coli test resulted in a count of 280 cfu /100 mL. It appeared to be a more glaring problem in 2006 when the E. coli average was over 1,100 cfu /100 mL. The Lick Creek Watershed does contain several cattle feedlots; therefore, livestock manure could be an issue. There was more precipitation in 2006 than in 2007. However, the discrepancy of E. coli was not as apparent at any of the other sites that were tested during the same time periods.

IDEM tested Lick Creek in two locations during 2001 with similar results. Only two spikes, one at each site, were a real concern for the stream. One site showed a load reduction needed of 16.9%; the other site, which is closer to the river, indicated a reduction 15.1% was needed. IDEM also tested Brush Creek, a tributary of Lick Creek, and it showed a 57% reduction needed in E. coli. Beech Creek, which is also a tributary of Lick Creek in the same township as Brush Creek, showed a reduction needed of 81.45%. SWCD tests during 2006 and 2007 showed spikes in this stream that appear to be related to cattle with access to the creeks upstream. Flushes of manure after heavy rain could be the reason for sudden high counts of E. coli. IDEM's individual results of these test sites can be found in the Appendix in IDEM's Total Maximum Daily Load for Escherichia coli.

4.411 Testing Site #11: Wabash & Erie Canal

The Wabash & Erie Canal is exactly what it sounds like. This stream was part of the Wabash & Erie Canal that ran through the southern Eel River bottoms; 4.93 miles of the former canal is kept open to drain the 19,070 acres of flat, river-bottom farmland adjacent to the canal. Despite the overall majority of the ground being flat, there is a great deal of HEL soils in this sub-watershed. The area contains one large confined swine operation. There are some residential areas; however, most of the watershed is dedicated to corn and soybean production.

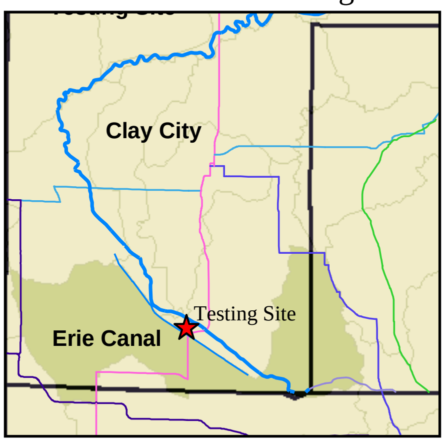


Figure 4.10 Wabash & Erie Canal Watershed

The Wabash & Erie Canal contained the lowest dissolved oxygen of all the testing sites. The average percent saturation was only 64%. Rates of DO ranged from a low of 2.5 mg/L to a high of 9 mg/L. In August of 2007 the DO rate hit a low of 2.5 mg/L with less than 27% saturation. Once dissolved oxygen reaches a point below 3mg/L the environment becomes stressful to the stream's organisms. The lack of DO in this stream is a major concern.

Nitrates, orthophosphates, and pH were normal for this stream. The average nitrates were 1 mg/L, orthophosphates were 0.3 mg/L, and the pH was 7.8. Another concern, however, was the stream's turbidity. The two-year average resulted in a 38 cm. reading for turbidity, which was the lowest of all tested streams. The turbidity of the Wabash & Erie Canal is a serious concern. Turbidity results ranged

Plate 4.11. Testing Site #11: Wabash & Erie Canal

from 4 cm. to 60 cm. Nearby soil is considered muck; it consists of Zip and Evansville soils, which are considered Hydric soils by the Natural Resource Conservation Service.
Muck soil, usually dark black in color and a clay texture, can be found in the bottom of the stream. The darker than normal color of this sediment is believed to be a big reason for the poor turbidity of the stream. However, if best management practices can be installed to reduce erosion and runoff, this should increase the clarity of the water.

The two-year average for E. coli in this stream was 1,235 cfu /100 mL, which was alarmingly above the state standard of 235 cfu /100 mL. It was also well above the average of the other eleven streams that were tested. The remaining eleven streams held an average of about 950 cfu /100 mL. The E. coli ranged from 0 cfu /100mgL in April of 2006 to 10,300 cfu /100 mL in May of 2006; the high reading occurred after a significant rain event. IDEM's testing of the same stream in 2001 showed a problem in only one of their three testing locations. Their testing Site #19 yielded a geometric mean of 251.42 cfu /100 mL for E. coli. All three testing locations used by IDEM were different than the site used for testing by the Clay County SWCD.

4.412 Testing Site #12: White Oak Creek

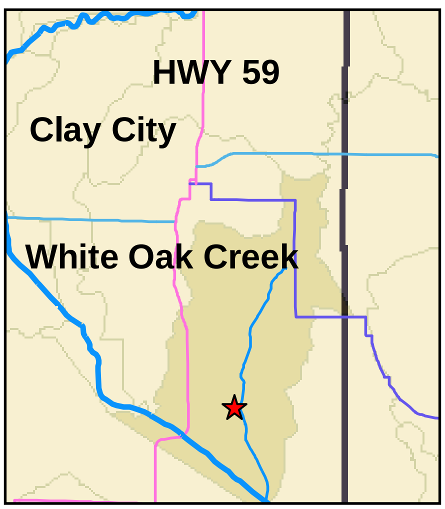


Figure 4.11 White Oak Watershed

White Oak Creek is a natural creek in the southeastern part of Clay County that flows approximately five miles through flat bottom ground south of the town of Clay City. The White Oak Watershed drains 10,847 acres. In the past, coal was mined from a considerable portion of the ground in this watershed. Like most of the other streams, row crops surround the majority of White Oak Creek. Many of these crops are planted on reclaimed mine ground, which has been abandoned for many years.

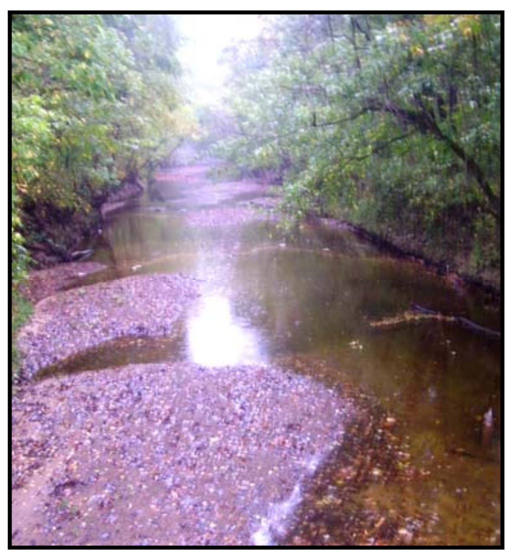


Plate 4.12 Testing Site #12: White Oak Creek

Dissolved oxygen was consistently low in White Oak Creek; it averaged 6.55 mg/L for the two-year testing period. The lowest test was 4 mg/L, but that was during warmer temperatures, so the percent of saturation remained at 55% or above. The dissolved oxygen averaged around 73% for the two-year sampling period. The average nitrate level over the two-year testing period yielded a result of only 1.0 mg/L.
The E. coli in White Oak Creek averaged 570 cfu /100 mL, which fell in the mid-range of all creeks tested. The E. coli range was 50-1,250 cfu /100 mL. Of the fourteen sampling dates, only five samples showed E. coli under the state standard of 235 cfu /100 mL; three of those five samples had a count of 200 cfu /100 mL.

The data collected by IDEM in this same stream showed the geometric mean from their samples at 218.66 cfu /100 mL with a reduction needed of over 42%. IDEM and SWCD sampled the data differently; however, the samples were pulled from the same site.

The Clay County SWCD Water Quality Testing Averages for 2006-2007 are shown in the table below.

Testing Sites	E. Coli cfu/100	DO	pH	Orthophosphates	Nitrate	Turbidity
Birch Creek North	400	7.7 mg/L	8.25	1.3 mg/L	1.4 mg/L	57.5 cm
Hog Creek	3125	7.2 mg/L	7.9	0.35 mg/L	2.3 mg/L	54.5 cm
Six Mile Creek	475	7.4 mg/L	7.9	0.16 mg/L	0.7 mg/L	54 cm
Turkey Creek	1720	7.05 mg/L	8.05	0.27 mg/L	4.9 mg/L	45.5 cm
Brush Creek	1370	7.65 mg/L	8.2	0.2 mg/L	4.2 mg/L	57.5 cm
Birch Creek South	375	8.35 mg/L	8.35	0.53 mg/L	1 mg/L	58 cm
Splunge Creek	765	6.95 mg/L	8	0.9 mg/L	2 mg/L	44 cm
Connelly Ditch North	280	7.9 mg/L	8.15	0.23 mg/L	5 mg/L	54 cm
Connelly Ditch South	800	7.95 mg/L	8.25	0.48 mg/L	3.6 mg/L	53.5 cm
White Oak	570	6.55 mg/L	8.15	0.11 mg/L	1 mg/L	53 cm
Erie Canal	1235	5.9 mg/L	7.8	0.3 mg/L	1 mg/L	38 cm
Lick Creek	700	6.8 mg/L	8.1	0.23 mg/L	0.5 mg/L	51.5 cm

Table 4.0 Water Quality Testing Averages for 2006-2007

5.0 PROBLEM STATEMENTS

5.1 Problem Statement #1: E. coli

E. coli levels throughout the watershed contain pathogen levels in excess of the state standard of 235 cfu /100 mL, and several areas have an excess of 1000 cfu /100 mL, which is above the safety standards for partial human contact with the water.

Stressor: E. coli bacteria

Sources: Human and animal waste

Possible sources of the E. coli bacteria could be residential on-site inadequate or failing septic systems, which are located in hydric soils found throughout the watershed (see Figure 2.4); leaking manure pits at confined animal feeding operations, and polluted runoff from farmland where manure is being spread. Animal manure is often applied to farm fields to make use of its nutrient content. In spite of the fact that some diseases can migrate from animals to humans, there is no requirement for treatment of pathogens in animal manure before land application. Municipal sludge must be treated to reduce pathogens before land application, and septage must be treated with lime to reduce pathogens, but many people still worry about the presence of disease organisms. Bacterial pollution can also come from underground; over-application of wastes to the land can result in leaching into the water table. Animal waste storage pits and septic systems can fail in a manner that contaminates underground water supplies. These may, in turn, pollute nearby streams and lakes.

Critical Areas: Hog Creek, Turkey Creek, Brush Creek, Connley Ditch South, Six Mile Creek, Lick Creek, and Wabash & Erie Canal Watersheds all are critical areas. Manure is spread on agricultural fields in the Hog Creek Watershed from one cattle operation, one swine operation, and one feline rescue center containing close to 200 felines. In the Turkey Creek Watershed there is one small swine operation that spreads manure, and the Connley Ditch Watershed contains two cattle operations and two swine operations that have to spread manure from time to time as well. Six Mile Creek has a relatively large cattle operation that spreads manure. Lick Creek has several small cattle operations; it is unknown how many of these operations spread manure; however, several of them allow livestock access to the streams. Also, Connley Ditch South, Six Mile Creek, and Hog Creek have livestock with access to streams.

5.2 Problem Statement #2: Nutrients

Nitrates were in excess of the 4-mg/L benchmark chosen by the Steering Committee. Nitrate levels above 10 mg/L are considered unsafe for drinking water. Turkey Creek, Connley Ditch (north), and Brush Creek had two-year nitrate averages over 4.0 mg/L. Of the three, Turkey Creek is in most need of buffers. The Phosphates load for the two-year sampling period was 5.69 tons/year. The steering committee has developed a target load of l.35 tons/year. Many streams in the Lower Eel River Watershed would benefit from added or improved buffers and improved tillage practices, which would reduce the amount of fertilizer reaching streams. Livestock manure is a beneficial nutrient to crop production; however, if it is not applied properly or over applied, E. coli and ammonia from it infiltrate waterways. A portion of the E. coli found in the Lower Eel River Watershed streams can be attributed to incorrect and over application of manure; another source of the excessive E. coli found comes from livestock with access to streams. As was stated above, several streams tested in excess of 1,000 cfu /100 mL during the two-year testing period.

Stressor: Excessive nutrients from farming practices and/or livestock production.

Sources: Sources of nutrients are aggressive tillage practices, lack of buffers, ammonia and manure from human and/or animal waste, fertilizers, and nitrogen application.

Critical Areas: River bottom farmland in Turkey Creek, and Connley Ditch (north) are critical areas for excessive nutrients. Also, manure is being spread in Connley Ditch (south), Hog Creek, Six Mile Creek, Brush Creek, and Birch Creek, which also makes these areas critical.

5.3 Problem Statement #3: Erosion and Sedimentation

Excessive sediment flows into streams following storm events causing excess nutrients and soil in streams. The lack of riparian buffers and natural vegetation along Lafferty Ditch, a major stream in the Connley Ditch sub-watershed, and Connley Ditch allows sediments and nutrients from the soil to enter the ditches. Only fifty percent of the bean crop planted in the Lower Eel River Watershed and twenty-five percent of the 2006 corn crops were planted with no-till or minimum till. During the two-year testing period, Turkey Creek, Splunge Creek, and the Wabash & Erie Canal had an average turbidity of less than 50 cm. The Steering Committee wants to achieve a standard of 50 cm for all of the streams in The Lower Eel River Watershed. Increasing no-till, minimum till, and adding cover crops would reduce the amount of soil and nutrients entering streams.

Stressor: Erosion and sedimentation.

Sources: Stream bank erosion, tillage practices, and lack of buffers

Critical Areas: Banks of Eel River and streambanks:
Lafferty Ditch, Connley Ditch, Six Mile Creek, Splunge Creek, Turkey Creek and the Wabash & Erie Canal
Areas where the river and streams make sharp curves
River bottoms farm land and farmland with steep inclines

5.4 Problem Statement #4: Livestock and Human Waste

Leaking manure pits at confined animal feeding operations, polluted runoff from farmland where manure is being spread, livestock with access to streams, and residential on-site septic systems that are inadequate or failing. Residents lack knowledge regarding proper disposal of manure, the implications of livestock with stream access, and how septic systems work.

Stressor: Lack of public education, an absence of composters and manure storage facilities, and an abundance of hydric soils, which are characterized by rapid permeability or an impermeable layer near the surface. (See Figure 2.4 showing location of hydric soils.)

Sources: Livestock operations, manure being spread on fields, faulty septic systems, and septic systems installed without permits.

Critical Areas: livestock operations, improper application of manure on fields, livestock in streams, camp grounds, rural areas without proper septic systems, small towns without sewage disposal systems (Bowling Green, Saline City, Ashboro, and Cory) and residences and/or summer homes without any septic system at all.

5.5 Problem Statement #5: Runoff from feedlots

Non-point sources of water pollution are feedlots, which have little or no provisions for runoff control. A large amount of manure accumulates in these relatively small areas. When feedlots close to streams are on slopes with little or no vegetation, runoff is even more prevalent.

Stressor: Lack of farmer/producer education. (No provisions for runoff control or mismanaged, poorly designed, or poorly constructed feedlots.) Due to the lack of financial assistance, there is a lack of winter feeders. Having winter feeders prevent cattle from spreading the manure throughout the pasture instead of in an area under roof that can be cleaned. Brush Creek Watershed has a large cattle operation; steers are pastured on a hill, where a stream runs through the pasture with no winter feeder. There are two non-permitted cattle operations in the Hog Creek Watershed and one non-permitted cattle operation in the Turkey Creek Watershed without winter feeders. See Plate 5.1; in Splunge Creek Watershed there is a small feedlot without winters feeds, where cattle have direct access to Big Slough, which is a tributary of Splunge Creek. In the Connley Ditch Watershed there is a small cattle operation that sits right along Connley Ditch

Sources: Sources of pollution are over populated feedlots, which are close to stream, and a lack of winter feeders, buffers and vegetation between feedlots and drainage ways.

Critical Areas: Hog Creek, Lick Creek, Brush Creek, Connley Ditch South, Splunge Creek, and Turkey Creek.

Plate 5.0 Critical Area in Hog Creek Watershed. The photo to the left was taken in Clay County. It is shows Hog Creek in the foreground. Behind the trees on the hill is a barren feedlot with three horses. Wastes from the feedlot drains down the hill into a ditch that runs directly into Hog Creek. This creek runs through a pasture for sheep; they have direct access to the creek.

Plate 5.1 Critical Area in Lick Creek Watershed. The photo to the left was taken at Lick Creek in Owen County, which is a part of the Lower Eel River Watershed. The feedlot drains directly into the creek, and the cattle have direct access to the stream. Streambank erosion has taken place over a number of years where the livestock have entered and exited the stream.

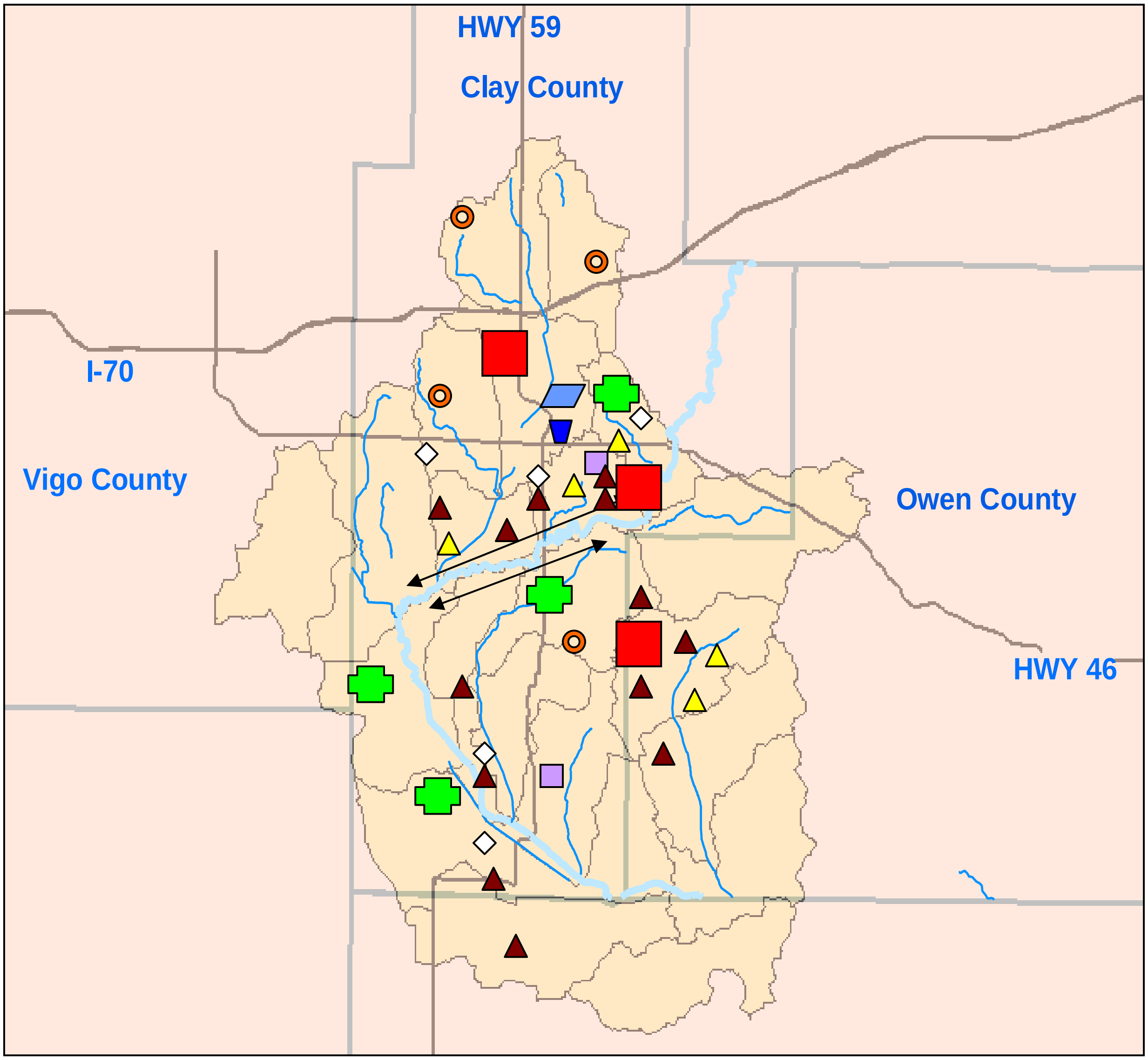


Figure 5.0 Probable Sources of Pollution Map

MAP KEY

CFO Beef Operation	Livestock with stream access
CFO Swine Operations	Areas where manure is spread
CFO Dairy Operations	Poorly buffered streams
Campgrounds (No Sewage System)	Industrial Site
Heavy Streambank Erosion Areas	Tested Streams
Eel River	Livestock operations not CFO's

6.0 PROBABLE POLLUTION SOURCES

While nothing can be proven regarding exactly what is to blame for water quality problems in the watershed; however, it is important to note possible sources throughout the watershed. The Probable Sources of Pollution Map (Figure 5.0) shows several of these sources. The baseline narrative describes source locations and magnitude, and the following narrative will sum up each of these sources and explain them in greater detail.

6.1 Beef Operations

There are several cattle operations located throughout the watershed. (See Figure 5.0) None of these operations are known to fence the cattle out of streams on their property. While the watershed does not contain any really large cattle operations, it does contain several small cattle operations. Smaller operations are not required to be permitted as a Concentrated Animal Feeding Operation (CAFO). Therefore, livestock owners may not always be conservation minded while managing their operation. A lack of winter feeders on feedlots near streams is also a concern. Most feedlots do not have any buffers around them, and because of the number of animals in these areas, there is usually a highly concentrated flow of manure that has direct access to road ditches or streams. On a positive note these smaller operations do not have a need to spread manure on a consistent basis. When manure is spread, over-spreading is certainly a concern, but again this does not happen very often. The operations that do spread consistently need upgrades in equipment so that they do not spread on the same areas over and over again. GPS systems and/or manure injectors would be of benefit to these operators.

6.2 Swine Operations

The days of every farmer having a few hogs are long past. Due to changes in the swine market, the new rule of thumb is to “get big or get out.” Three large swine operations are present: two in the Hog Creek Watershed and one in the Wabash & Erie Canal Watershed. These are permitted facilities. There are a few small swine operations throughout the watershed, and there are several very small operations, with swine grown for 4-H projects. These operations all contain less than twenty (20) sows for most of the year and less than that at times. The major swine operations are all confined, and due to the regulations they have to meet as a CAFO, they are usually prepared to handle manure issues appropriately. (See Figure 5.0)

6.3 Dairy Operations

We have five dairy operations left in the watershed. (See Figure 5.0) The largest of these is located less than two miles north of the town of Cory, which is located in the Brush Creek Watershed. There is also an operation located in the northwest corner of the watershed. Another is located in the northeast corner; both of those operations are in the Birch Creek Watershed. There is an operation on County Road 700 West, which is the Clay/Vigo County Line. Finally, there is another operation located in the southern part of the county in the Connley Ditch Watershed. One of the five dairy operations is an organic dairy, which certifies that the product is being produced without persistent toxic chemical inputs. There is also one natural, pasture-based dairy, which uses absolutely no grain in their feeding process. Three of the dairy operations top spread manure. Injector knives could really help reduce manure runoff in the watershed. All of our dairy producers continue conventional tillage practices. Most of these producers need buffers on their farms and upgrades in equipment to improve conservation on their farms.

6.4 Campgrounds

There are two campgrounds in the Lower Eel River Watershed. (See Figure 5.0) One of these is only in use on the weekends. However, the other one is in use year round and very busy from Memorial Day until Labor Day. The second recreation area is located in the Turkey Creek Watershed. It contains over 300 cabins and has no sewer treatment system. The septic systems in this area were mainly constructed in the 1960's and were likely not permitted at that time. Faulty septic systems from this area are a likely possibility. An educational workshop on septic systems for the residents of this area would be helpful.

6.5 Heavy Stream Bank Erosion Areas

Due to a number of different factors, there are areas where several stream banks are eroding at a high rate. On the map in Figure 5.0 Probable Sources of Pollution, there are arrows indicating severely eroding areas along the Eel River where the river bends sharply. Lack of buffers and tillage practices in these areas allow greater than normal erosion to occur. Excessive erosion is also occurring where livestock access to streams. (See Figure 5.0)

6.6 Livestock with Stream Access

Livestock in the streams is a big concern in the watershed. Driving around the watershed has shown that cattle, sheep, and horses have access to streams; of course, cattle are the main concern. Any livestock in the streams results in unfiltered ammonia from urine and manure contaminating their drinking water and flushing the waste downstream. Most of the livestock in The Lower Eel River Watershed have access to streams when a waterway is present. Brush Creek, Hog Creek, Turkey Creek, and the Birch Creek watersheds all have livestock with access to the streams. These areas need fencing to keep livestock out. (See Figure 5.0)

6.7 Manure Used as Fertilizer

Spreading manure is a concern in the watershed. Multiple CFO's in the watershed as well as non-permitted livestock operations contribute to a large amount of manure being spread on the ground. Too often local producers can be seen still spreading manure on top of the ground when modern technology offers more conservation-minded alternatives. Injector knives, equipped with a GPS system, is one way to reduce the over spreading of manure as a fertilizer technique. (See Figure 5.0 where manure is being heavily spread in Brush Creek, Birch Creek, and Hog Creek Watersheds)

6.8 Poorly Buffered Streams

There are several tributaries flowing into the Eel River that are man-made ditches rather than natural streams. Two of these tributaries are Lafferty Ditch and Connley Ditch. These two streams have no riparian buffer or natural vegetation. Grass banks and narrow grass strips along the sides of these ditches are the only buffer between the stream and the agriculture fields that the ditches run through. Due to the restrictions that surround the Conservation Reserve Program (CRP) programs, landowners have been apprehensive about installing buffers on their farmland. Additional buffers throughout the Lower Eel River Watershed are essential for water quality improvement. (See Figure 5.0)

6.9 Tillage Practices

The common tillage practices in Clay County are a possible source of the pollution in the streams of the Lower Eel River Watershed. Efforts to increase conservation tillage have had a very positive impact in recent years; however, when compared with surrounding counties, Clay County still has room for improvement. Twenty-five percent of the 2006 corn crop was planted with reduced tillage while fifty percent of the bean crop was planted either with no-till or minimum till. Surrounding counties with similar soil types are much more conservation minded when it comes to planting their crops. Increasing no-till and the use of cover crops would go a long way in improving water quality.

6. 10 Industry

Industry in the watershed accounts for less than one half of one percent of the land. (See Figure 5.0) The biggest concern regarding industry is temporary building sites, which are occasionally developed in the Lower Eel River Watershed. These sites have the potential to produce a considerable amount of erosion over a short amount of time. Most of the industry takes place in the North Birch Creek Watershed. During and after construction most of these sites are monitored through Rule 5, a storm water prevention effort of the district. Some small sites such as home sites are not required by law to adhere to these regulations. These temporary construction sites can be a short-term source of pollution; however, there are no temporary construction sites in the Lower Eel River Watershed at this time.

6.11 Fertilizer and Pesticide Applications

Certainly fertilizer and pesticide applications will be linked to agriculture. Considering the tillage practices and lack of buffers in the watershed, it is certainly a source. However, residential areas are also a possible source of fertilizer and pesticide pollution. There are only a few residential areas, and most of these can be found in the small towns throughout the watershed. The southern tip of Brazil drains into the Birch Creek Watershed and is likely the biggest concern for residential pollution. Home sites and subdivisions are located in this area, as well as a golf course; Fertilizer is used in these areas for garden and lawn maintenance. Other possible residential sources include Clay City, Cory, Center Point, Bowling Green, Ashboro, and Saline City.

7.0 GOALS & INDICATORS

Below is a list of concerns the stakeholders have chosen. In order to reach our goals, the Lower Eel River Watershed group will implement a number of BMPs. For a complete list of the average loads for all streams see the E. coli Target Reductions Chart in the Appendix. The most beneficial BMPs will be chosen from the Best Management Practices Summary Guide in the Appendix.

Concerns	Current Averages	Benchmarks	Reduction Goals
E. coli	985 cfu/100mL	235 cfu/100mL	10 %
Phosphate Nutrients	0.42 mg/L	0.29 mg/L	10%
Nitrate Nutrients	2.3 mg/L	4 mg/L	10%
Erosion and Sedimentation	Turbidity – 51.75 cm	Turbidity – 50 cm	10%
Livestock and Human Waste	N/A	N/A	N/A
Runoff from feedlots.	N/A	N/A	N/A

Table 7.0 SWCD 2006-2007 Test Averages

7.1 Goal #1: Receive Section 319 Nonpoint Source Management Program Grant and implement water quality in the Lower Eel River Watershed

Objective #1: Receive funding by 2010

Associated Cost: SWCD technician salary @ $17.50 per hour, office equipment, space and supplies $500, and training workshops $150.

Milestones:
- Submit grant 2008
- Receive grant 2010
- Hire watershed coordinator 2010

Indicators: Received funding from grant.

Objective #2: Implementation of 319 Water Quality Grant

Associated Cost: Watershed Coordinator salary @ $32,500. per year and mileage @ $1,500 per year.

7.2 Goal #2: Educate the public

Objective #1: Workshops, seminars, brochures, school presentations, field days, and media releases.

Associated Cost: $400 for signs, posters, and printed brochures; $1,500 for curriculum materials, $500 for advertising and media releases, $500 meeting facilities, $600 speakers for events.

Potential Targets: Students, farmers, landowners, fertilizer dealers, and other concerned citizens in the Lower Eel River Watershed

Milestones:

- January 2010 first public meeting to be followed by annual public meetings.
- Septic training workshop April 2010
- Brochures on septic systems will be made available to the public at various locations by April 2010
- Annual SWCD Conservation Field Day beginning in August of 2010
- SWCD Annual Nature Bowl and school presentations as requested
- Quarterly media announcements

Indicators: Attendance at meeting, workshops, and other events. Landowners and producers applying for assistance in implementing BMPs.

7.3 Goal #3 Reduce E. coli in the Lower Eel River Watershed

This is the problem that stakeholders have deemed to be the most critical of all those in the watershed. All streams tested have showed E. coli results higher than the state standard of 235 cfu 100/mL. The stakeholders believe that addressing this concern will in turn address several other problems in the watershed.

Objective #1: Reduce E. coli by 10% by the year 2014.

Appropriate BMPs: Included in practices to be implemented are buffer strips, livestock fencing, equipment modification such as GPS and liquid manure injector knives, and winter feeders.

Associated Cost: Winter feeders cost almost $40,000 each. These structures are excellent ways to contain manure in one area. Livestock fencing will vary depending on the length of the stream to be fenced. Fencing costs at least $1.20/foot; although, it could be more depending on the type of fence being built. Equipment modifications for GPS can be as much as $40,000 or as little as a $1,000 depending on the equipment. A good start would be to set aside $60,000 to upgrade equipment in two livestock operations located in the critical areas of the watershed. Buffer strips run $500 /acre.

Potential Targets: Small livestock operations located in the Hog Creek and Connley Ditch Watersheds would be a primary focus. Turkey Creek Watershed is also noted as a critical area; however, it does not contain as many livestock operations. The focus here would be more education on septic systems. Brush Creek contains the watersheds largest dairy operation, and the Wabash & Erie Canal also contains several livestock operations. We would also address all livestock operations in this area.

Milestones:

- Beginning in 2010 test water annually.
- By 2014 get at least one cattle herd fenced out of a stream.
- Convert a minimum of two livestock operations from top spreading manure to injecting liquid manure.

Indicators: Examine water-testing results. Results should show a 10% decrease in E. coli by the year 2014.

7.4 Goal #4: Reduce Nutrient Loads in the Lower Eel River Watershed

A serious concern among the stakeholders is the excess amount of nutrients that get into streams in the watershed. The phosphate load averages were 5.69 tons per year. The nitrate levels for nine of twelve streams were below our benchmark of 54.15 tons per year. Turkey Creek, Brush Creek, and Connley Ditch South nitrate loads were above our benchmark at 61.59 tons per year. Fertilizer from agriculture fields and manure are two of the biggest sources of excess nutrients entering streams. There are several possible options to address excessive nutrient loads and improve the quality of water. Garden, residential lawns and golf courses are not considered possible sources in the watershed.

Objective #1: Reduce nitrates in Turkey Creek, Brush Creek, & Connley Ditch South by 10% by 2014

Goal Time Frame: Implementation of BMPs will begin as soon as possible and continue to be ongoing. These practices will take some time before results can be seen in the watershed; the goal is a 10% reduction of nutrient loads in the watershed by 2014.

Appropriate BMPs: Among BMPs to be implemented are buffer strips, livestock fencing, equipment modification such as GPS systems and liquid manure injector knives, winter feeders, and nutrient management plans.

Associated Cost: Winter feeders cost almost $40,000 each. These structures are excellent ways to contain manure in one area. Livestock fencing will vary depending on the length of the stream to be fenced. Fencing costs at least $1.20/foot; although, it could be more depending on the type of fence being built. Equipment modifications for GPS can be as much as $40,000 or as little as a $1,000 depending on the equipment. A good start would be to set aside $60,000 to upgrade equipment in two livestock operations located in the critical areas of the watershed. Buffer strips would be around $500.00/acre. Nutrient Management Plans may cost up to $10,000 each; however, it is a one-time payment to have the plan developed.

Potential Targets: Due to the abundance of farmland, several livestock operations, and the high E. coli count, the Turkey Creek Watershed will be one of the first target areas for implementation of BMPs. Turkey Creek lacks adequate buffers, and there are several BMPs that would improve livestock operations in the watershed.

Milestones:

- Beginning in 2011 test water annually.
- By 2014 get at least one cattle herd fenced out of a stream.
- Convert a minimum of one livestock operation from a top spreading manure operation to an operation that injects liquid manure by January 2012.
- Convert an additional livestock operation from a top spreading manure operation to an operation that injects liquid manure by January 2014.
- Filter a minimum of 5 acres along the streams of the Lower Eel River Watershed by October of 2011.
- Filter a minimum of 5 acres along the streams of the Lower Eel River Watershed by October of 2012.
- Filter a minimum of 5 acres along the streams of the Lower Eel River Watershed by October of 2013.
- Filter a minimum of 5 acres along the streams of the Lower Eel River Watershed by October of 2014.
- Construct one winter feeder within the Lower Eel River Watershed by 2014.

Indicators: Indicators will be determined using water testing results. In 2010, after one full year of implementation, water sampling will be done annually**.**

Objective #2: Reduce phosphates by 10% by 2014.

Goal Time Frame: Implementation of BMPs will begin as soon as possible and continue to be ongoing. These practices will take some time before results can be seen in the watershed; the goal is a 10% reduction of nutrient loads in the watershed by 2014.

Appropriate BMPs: Among BMPs to be implemented are buffer strips, livestock fencing, equipment modification such as GPS systems and liquid manure injector knives, winter feeders, and nutrient management plans.

Associated Cost: Winter feeders cost almost $40,000 each. These structures are excellent ways to contain manure in one area. Livestock fencing will vary depending on the length of the stream to be fenced. Fencing costs at least $1.20/foot; although, it could be more depending on the type of fence being built. Equipment modifications for GPS can be as much as $40,000 or as little as a $1,000 depending on the equipment. A good start would be to set aside $60,000 to upgrade equipment in two livestock operations located in the critical areas of the watershed. Buffer strips would be around $500.00/Acre. Nutrient Management Plans may cost up to $10,000 each; however, it is a one-time payment to have the plan developed.

Potential Targets: Due to the abundance of farmland, several livestock operations, and the high E. coli count, the Turkey Creek Watershed will be one of the first target areas for implementation of BMPs. Turkey Creek lacks adequate buffers, and there are several BMPs that would improve livestock operations in the watershed

Milestones:

- Beginning 2011 test water annually.
- By 2014 fence at least one herd of cattle out of a stream.
- Convert a minimum of one livestock operation from a top spreading manure operation to an operation that injects liquid manure by January 2012.
- Convert an additional livestock operation from a top spreading manure operation to an operation that injects liquid manure by January 2014.
- Filter a minimum of 5 acres along the streams of the Lower Eel River Watershed by October of 2011.
- Filter a minimum of 5 additional acres along the streams of the Lower Eel River Watershed by October of 2012.
- Filter a minimum of 5 additional acres along the streams of the Lower Eel River Watershed by October of 2013.
- Filter a minimum of 5 additional acres along the streams of the Lower Eel River Watershed by October of 2014.
- Construct one winter feeder within the Lower Eel River Watershed by 2014.

Indicators: Indicators will be determined using water testing results. In 2010, after one full year of implementation water sampling will be done annually**.**

7.5 Goal #5: Reduce Sediment Loads in the Lower Eel River Watershed

Erosion and runoff is a problem throughout the watershed, which leads to sediment in the streams. Decreasing the amount of runoff and erosion would decrease soil and other pollutants from entering the streams.

Objective: Decrease total sediment loads by no less than 10% in the Lower Eel River Watershed.

Goal Time Frame: Implementation of Best Management Practices (BMPs) will begin immediately, continue throughout the project, and continue into the future. As the project progresses we will continue to look at potential problem areas and address them.

Appropriate BMPs: Buffers, conservation tillage, streambank stabilization, and drop structures will be encouraged by the Clay County SWCD and the Steering Committee.

Associated Cost: Costs could be significant. Installing buffers is around $500.00/Acre. Conservation tillage programs can be found through the Conservation Reserve Program; depending on a variety of factors this may cost as much as $30.00/Acre.

Streambank stabilization can vary greatly depending on the situation. The cost for a project like this can range between $2.00 - $5.00 a square yard. The cost of drop structures could range greatly depending on the type and the size of the structure. Usually structures range in cost between $2,000 and $5,000 each.

Potential Targets: Conservation tillage can be improved throughout the watershed; however, focusing more on areas with HEL soils may see the most improvement. The eroded streambanks of the river where drastic turns are made need to be addressed. These sites are most critical at or around the Turkey Creek Watershed and Six Mile Creek Watershed. Buffers are needed around certain sections of Turkey Creek, Connley Ditch, and Hog Creek. Hog Creek and Lick Creek also have areas trampled by livestock that have caused streambank erosion that can be reversed with BMPs.

Milestones:

- Beginning in 2011 test water annually.
- Filter a minimum of 5 acres along the streams of the Lower Eel River Watershed by October of 2011.
- Filter a minimum of 5 additional acres along the streams of the Lower Eel River Watershed by October of 2012.
- Filter a minimum of 5 additional acres along the streams of the Lower Eel River Watershed by October of 2013.
- Filter a minimum of 5 additional acres along the streams of the Lower Eel River Watershed by October of 2014.
- Stabilize one aggressively eroding stream bank by October of 2012.
- Stabilize one aggressively eroding stream bank by October of 2014.
- Convert a minimum of 160 acres of previously aggressively tilled farmland to conservation tillage by August 2011.
- Convert a minimum of 160 additional acres of previously aggressively tilled farmland to conservation tillage by August 2012.
- Convert a minimum of 160 additional acres of previously aggressively tilled farmland to conservation tillage by August 2013.
- Convert a minimum of 160 additional acres of previously aggressively tilled farmland to conservation tillage by August 2014.
- By 2014 fence at least one herd of cattle out of a stream

Indicators: Indicators will be determined using water testing results beginning in 2010. Water sampling will be done annually**.**

7.6 Goal #6: Better control of Livestock and Human Waste in the Lower Eel River Watershed

Livestock waste is a problem in seven different streams in the watershed. As seen in Table # 3, the average E. coli counts in the watershed was 985 cfu/100mL; livestock waste is a major contributor to this high count. Human waste is also a contributor to the high E. coli count. Lack of public education, abundance of hydric soils, and an absence of faulty septic systems installed without permits have contributed to the E. coli contamination. Since livestock and human waste generate E. coli, controlling this waste will contribute to the reduction of the high E. coli counts in the watershed.

Objectives: Education and Outreach; Septic Workshop, Cost share on best management practices that deal with nutrient management practices.

Goal Time Frame: This goal will work hand in hand with our other goals. As progress begins with the others, this too should see improvement by 2014.

Appropriate BMPs: Among BMPs to be implemented to control livestock waste are buffer strips, livestock fencing, equipment modification such as GPS systems and liquid fertilizer injector knives, winter feeders, and nutrient management plans. In order to control human waste as a pollutant, public awareness is a major factor. Regular news articles, presentations at public meetings, presentations to school groups, and publication of pamphlets or brochures will be used to educate the public.

Associated Cost: Cost of livestock waste BMPs: Winter feeders cost almost $40,000 each. These structures are excellent ways to contain manure in one area. Livestock fencing will vary depending on the length of the stream to be fenced. Fencing costs at least $1.20/foot; although, it could be more depending on the type of fence being built. Equipment modifications and/or GPS can be as much as $40,000 or as little as a $1,000 depending on the equipment. A good start would be to set aside $60,000 to upgrade equipment in two livestock operations located in the critical areas of the watershed. Buffer strips would be around $500.00/Acre. Nutrient Management Plans may cost up to $10,000 each; however, it is a one-time payment to have the plan developed.
Cost of human waste BMPs: Publishing and distributing of brochures will cost approximately $2,000.00 Annual Workshops may cost around $1,000.00 each.

Potential Targets: Small livestock operations located in the Hog Creek and Connley Ditch Watersheds would be a primary focus. Turkey Creek Watershed is also noted as a critical area; however, it does not contain as many livestock operations. Brush Creek contains the watersheds largest dairy operation, and the Wabash & Erie Canal also contains several livestock operations. The focus on human waste would be more education on septic systems throughout the county.

Milestones:

- Beginning in 2010 test water annually.
- By 2014 get at least one cattle herd fenced out of a stream.
- Convert a minimum of one livestock operation from a top spreading manure operation to an operation that injects liquid manure by January 2012.
- Convert an additional livestock operation from a top spreading manure operation to an operation that injects liquid manure by January 2014.

- Educate local livestock producers on the importance of proper manure management during 2010.
- Educate public on septic systems at a septic workshop in April of 2010.

Indicators:

Further evaluations of livestock operations should have visual evidence of some improvement. E. coli results from water sampling will also be used as an indicator.

8.0 Measures/BMPs

8.1 Best Management Practices

According to data developed by the Clay County Soil and Water Conservation District, education, buffer strips, conservation tillage, nutrient management plans and/or livestock fencing, and streambank stabilization will have the most impact in improving water quality in critical areas. Of course, other BMPs will be used if they are deemed to be effective measures.

Education and outreach will be a big part of the project. This will be an opportunity to inform interested stakeholders on several of the things that could be causing problems and what steps can be taken to correct the problems. Public meetings will be held no less than annually to bring those interested up to date with the latest information on the project. Information will also be shared at various Soil and Water Conservation District (SWCD) events. A Septic Workshop will be held during the first year of the grant in order to better inform the public on how to see if their septic system is working properly and the correct process to repair or install a septic system if necessary. The Clay County SWCD office will produce informational brochures and purchase videos, software, booklets, and other informational materials dealing with watersheds and water quality issues. These educational materials will be used in workshops, local schools, field days, and other community events.

8.2 Pollutant Loads

Using a load calculation model developed by Pennsylvania State University in 2005, one can estimate the amount of pollutant reduction by using different practices.[9] The following Table shows the current Lower Eel River Watershed loads for sediment, phosphates, and nitrates and how the installation of filter strips could reduce those loads. The estimated reduction is based on the installation of a 30-foot filter strip along a 40-acre field, or approximately one acre of streamline.

Table # 8.0 Filter/Buffer strips needed to reach reduction in pollutant loads

Pollutant	Current Load Per Year	Estimated Reduction	Filter/Buffer Strips Needed to Reach Goal
Sediment	700.52 tons	23.69 tons	20 acres or 26,000 feet
Phosphates	5.69 tons	4.33 tons	2 acres or 2,600 feet
Nitrates	61.59 tons	7.45 tons	2 acres or 2,600 feet

[9] Beegle, D. Mid- Atlantic Regional Water Program. Pennsylvania State University: University Park, PA March 29, 2005.

8.3 Filter Strips and Riparian Buffer Strips

Plate # 8.0 Riparian buffer strips protect stream water quality. Photo courtesy of USDA Natural Resources Conservation Service.

The purpose of filter strips and riparian buffers is to improve water quality by filtering runoff to remove sediment and associated insoluble contaminants, to allow increased infiltration opportunities for soluble nutrients or pesticides to drain into the soil, and to provide shade to watercourses to help maintain temperature norms of the water thereby protecting and/or providing habitat for aquatic life.
Riparian buffers protect streambanks best; however, a second alternative, when it is not possible to install riparian buffers, would be the use of deep-rooted filter strip grasses such as big blue stem or switch grass.

Cropland or pastures next to streams typically result in stream eutrophication (excessive growth of aquatic plants due to excess nutrients), temperature extremes, water quality declines, channel instability, excessive erosion, and undesirable shifts in the aquatic life. Establishment of riparian buffer strips of either woody or grassy vegetation can help amend many of these problems. (Lyons, 1999).

The width and length of buffers determine their effectiveness. Buffers as narrow as 12 to 20 feet can stabilize streambanks and filter upland runoff, but minimum widths of 30 to 60 feet are better. Buffers of 600 to 1,200 feet in length will substantially reduce bank erosion, but minimum lengths of 0.5 to 2 miles would be ideal to maintain healthy stream biological communities (Lyons, 1999).

Filter strips will also reduce E. coli in the streams. Of course, the amount of reduction would be based on a number of factors including whether or not manure is spread on that particular field, if cattle are ever turned out on the field to gather missed corn, etc. Because of these factors the loads for E. coli are unknown.

Filter Strips and buffer strips will be installed by priority. The closeness of the field to a stream or waterway will determine the prioritization of that application. “Buffer strips in riparian zones have proven to reduce nutrient movement off the field into nearby surface water sources. Buffer strips consume excess nutrients before they flow into surface water and enhance opportunities for groundwater denitrification.” (Christopher Wand, Livestock Technology Branch, and Dr. Stewart Sweeney, Environmental Policy and Programs Branch, OMAFRA.)

8.4 Conservation Tillage

As its name implies, conservation tillage conserves soil by reducing erosion. The Conservation Technology Information Center (CTIC) defines conservation tillage as any tillage and planting system that leaves at least 30 percent of the soil surface covered by residue after planting. In the Midwest, erosion by water is a primary concern. Soil erosion removes the productive layer of topsoil, which reduces crop yields and land value. Soil removed from fields eventually ends up as sediment in streams, rivers, or lakes. Sediment collects in these bodies of water, which reduces their water-holding capacity. Some crop nutrients and pesticides attach to soil particles and are carried and deposited in waterways along with the soil. Conventional tillage, such as moldboard plowing, leaves the soil surface bare and loosens soil particles, which makes them susceptible to the erosive forces of wind and water. Conservation tillage practices reduce erosion by protecting the soil surface and allowing water to infiltrate instead of running off.

Residue cover	Precipitation Runoff	Soil Loss
0%	45%	12.4 ton/acre
41%	40%	3.2 tons/acre
71%	26%	1.4 tons/acre
93%	0.5%	0.3 tons/acre

Table 8.1 Relationship between residue cover and soil loss after rain events

The numbers in Table 8.2 below were based on the conversion of 40 acres to a conservation tillage practice with out the use of cover crops. The use of cover crops would increase the benefits of the conservation tillage, but determining the amount of increase in benefits would vary depending on the types of cover crops used, seeding rates, etc.

Pollutant	Current Load Per Year	Estimated Reduction	Conservation tillage acreage needed to reach goal
Sediment	700.52 tons	23.69 tons	640 acres
Phosphates	5.69 tons	4.33 tons	60 acres
Nitrates	61.59 tons	7.45 tons	80 acres

Table 8.2 Conservation tillage acreage needed to reach reduction goals

8.5 Conservation Tillage with Cover Crops

The addition of cover crops to the conservation tillage practice enhances the benefits of conservation tillage. With the cover crop practice, another crop (generally a non-cash crop) is planted in the fall of the year. This adds residue and "cover" through the winter months, further protecting the soil. In addition to the extra cover, other advantages have been recently found with cover crops. This includes their ability to gather and store nutrients. Rather than these nutrients leaching through the soil, they are now stored in the living plants all winter and made available to the soil the following year when the cover crop is killed off.

Plate 8.1 Below is a cover crop of rye grass, which has been killed off. Rows of corn are beginning to emerge through the mat of rye, which will protect the soil throughout the year from run-off due to heavy rain events.

8.6 Nutrient Management Plans

Nutrient Management is the control of crop fertility management and other production practices for efficient crop growth and water quality protection. Nutrient management plans for site-specific situations minimize undesired environmental effects while optimizing farm profits and production. Nutrient management plans detail the optimum use of nutrients to minimize nutrient loss while maintaining crop yield. Soils, plant tissue, manure and/or sludge tests are used to develop application rates that meet projected crop yields based on soil productivity or historic yields of a site. With plan implementation, nutrient applications follow guidelines for the amount, timing, and placement of nutrients on each crop. Plans are prepared by the Cooperative Extension Office and certified private consultants; nutrient plans are revised every two to three years to incorporate new knowledge and address changes in crop management.

Nutrient Management is a best management practice, which may include several additional BMPs. Examples of these would be grid sampling, manure storage units, composters, and winter feeders. All concepts of nutrient management will be considered when implementing practices; however, two practices that will be focused on the most include livestock fencing and limited access fencing.

8.7 Livestock Fencing

Pastured cattle and other livestock are recognized as a critical factor in stream bank degradation and erosion. Fencing cattle away from stream banks is an effective technique for improving water quality in pastured stream corridors.

When cattle graze in stream corridors, their hooves exert several times more pressure per square inch on the soil than the weight a bulldozer exerts per square inch. Livestock consume or trample vegetation, eliminating the stream's natural protective blanket of vegetation, and expose the soil, which increases its vulnerability to erosion. The vegetation along the stream bank is important for several reasons. It covers the soil helps dissipate the energy of high water; it slows runoff from surrounding pasture, crop fields, and feedlots; and it absorbs or breaks down the nutrients and chemicals during runoff.

8.8 Limited Access Fencing:

When livestock need to cross streams, they should be provided with controlled stream crossings that are lined with coarse gravel to provide animals with firm footing, while discouraging them from congregating or wallowing in the stream (Undersander and Pillsbury, 1999). In areas where streambanks or riparian vegetation is degraded and livestock exclusion is necessary, high tensile fence, solar-powered electric fences, and woven fence can be used relatively inexpensively to exclude livestock from streams. Encouraging animals to drink or cross at managed points will reduce random trampling of streambanks and decrease the risk of animal injury. (Lyons, 1999)**.**

Plate 8.2 Pictured to the left is an example of "limited access fencing" with a stream crossing, which reduces livestock time in the stream, erosion, and pollution. The sides of these banks were stabilized using rip rap.
Photo courtesy of USDA Natural Resources Conservation Service.

Plate 8.3 A nose water pump for livestock reduces the need of streams for drinking water . Using a nose pump provides cleaner water for livestock.
Photo courtesy of USDA Natural Resources Conservation Service.

The following tables show approximately the pounds of nutrients that can be expected to come from a pound of manure, and therefore, how many pounds of phosphates and nitrates are being produced by livestock in the Lower Eel River Watershed.

Livestock In Watershed	**Number Of Animals** X	**Avg. lbs. of manure per day** =	**Avg. lbs. of manure per yr.**	X **Phosphorus =**	**P in manure per yr.**
Beef Cattle	500	75 lbs	37,500 lbs	0.0065 lbs	243.75 lbs
Dairy Cattle	1000	115 lbs	115,000 lbs	0.002 lbs	230 lbs
Swine	10,000	11.7 lbs	117,000 lbs	0.004 lbs	468 lbs

Table 8.3 Pounds of phosphates produced in manure per year

Livestock In Watershed	**Number Of Animals** X	**Avg. lbs. of manure per day** =	**Avg. lbs. of manure per yr.**	X **Nitrogen =**	**N in manure per yr.**
Beef Cattle	500	75 lbs	37,500 lbs	0.008 lbs	300 lbs
Dairy Cattle	1000	115 lbs	115,000 lbs	0.0045 lbs	517.5 lbs
Swine	10,000	11.7 lbs	117,000 lbs	0.0045 lbs	526.5 lbs

Table 8.4 Pounds of nitrates produced in manure per year

8.9 Streambank Stabilization

With the several miles of streams in the Lower Eel River Watershed, there are bound to be some streambanks that naturally erode on the outside banks of curved portions. The process can be mitigated by planting hardy species such as willows, whose roots hold some of the soil in place, thereby reducing sediment load in the stream and slowing the erosion of streambanks over time. Other options/practices that help with streambank stabilization are protective mats and rock weirs. Stabilizing these banks would improve the water quality in the Lower Eel River. The following Table shows load reductions that can be expected with the stabilization of a bank that is 300 feet in length with a height of 20 feet. This is thought by the Steering Committee to be the typical size of an eroding bank along the Eel River; other results should be expected in smaller streams.

Pollutant	Current Load	Estimated Reduction	Streambank plantings needed to reach goal.
Sediment	700.52 tons	23.69 tons	900 ft
Phosphates	5.69 tons	4.33 tons	100 ft
Nitrates	61.59 tons	7.45 tons	100 ft

Table 8.5 Streambank plantings required to reduce current loads

9.0 MONITORING PLAN

Table 9.0 Implementation Plan

Time	Task	Time Frame	Carried Out By Whom
September 2008	Apply for Funding	Fall 2008	District/SWCD Technician
December 2009	Hire Watershed Coordinator	Two Weeks	District
January 2010	Public Meeting	One Month	District/SWCD Technician
February 2010	Announce Cost Share Opportunities, Sign Up	Two Months	Watershed Coordinator, District/SWCD Technician
March 2010	Media Announcements	One Week	Watershed Coordinator
April 2010	Septic Training Workshop	One Month	Watershed Coordinator, District/SWCD Technician
April 2009	Steering Committee Meeting	One Week	Coordinator
April 2010-September 2010	Design/Planning on Cost Share Projects	Six Months	Watershed Coordinator SWCD Technician

June 2010	Media Announcements	One Week	Watershed Coordinator
July 2010	Steering Committee Meeting	One Week	Coordinator
August 2010	Field Day/Education	One Month	District/Coordinator
September 2010	Media Announcements	One Week	Watershed Coordinator
October 2010	Steering Committee Meeting	One Week	Coordinator
December 2010	Media Announcements	One Week	Watershed Coordinator
January 2011	Public Meeting	One Month	Coordinator
March 2011	Media Announcements	One Week	Watershed Coordinator
March 2011-October 2011	Implementation of Cost Share Projects	Eight Months	Watershed Coordinator, District/SWCD Technician
March 2011-October 2011	Indicator Check/ Water Testing	Eight Months	District/Coordinator
June 2011	Media Announcements	One Week	Watershed Coordinator
August 2011	Field Day/Education	One Month	District/Coordinator
September 2011	Media Announcements	One Week	Watershed Coordinator
November 2011	Steering Committee Meeting	One Week	Coordinator
December 2011	Media Announcements	One Week	Watershed Coordinator
January 2011	Cost Share Sign Up/ Public Meeting	One Month	Watershed Coordinator, District/SWCD Technician
March 2012	Media Announcements	One Week	Watershed Coordinator
March 2012-October 2012	Cost Share Implementation	Eight Months	Watershed Coordinator, District/SWCD Technician
March 2012-October 2012	Indicator Check/ Water Testing	Eight Months	District/Coordinator
June 2012	Media Announcements	One Week	Watershed Coordinator
September 2012	Media Announcements	One Week	Watershed Coordinator
January 2013	Cost Share Sign Up/ Public Meeting	One Month	Watershed Coordinator, District/SWCD Technician
March 2013-October 2013	Cost Share Implementation	Eight Months	Watershed Coordinator, District/SWCD Technician
March 2013-October 2013	Indicator Check/ Water Testing	Eight Months	District/Coordinator
January 2014	Public Meeting	One Month	Watershed Coordinator, District/SWCD Technician
March 2014-October 2014	Indicator Check/ Water Testing	Eight Months	District/Coordinator
September 2014	Apply for additional Funding	One Month	District/Coordinator
March 2015-October 2015	Indicator Check/ Water Testing	Eight Months	District/Coordinator
December 2015	Report/ Project Wrap-Up	One Month	Watershed Coordinator, District/SWCD Technician

In order to evaluate the effectiveness of the plan, water sampling will be done and results will be compared with the baseline conditions established in this plan. By looking at Table 9.0 one will see that we plan to begin implementation in 2011; therefore, we will not begin to sample water until 2012, which gives the practices one year to begin working. Beginning in 2012 water sampling will be done annually beginning in March of each year. Samples will be pulled and data will be collected monthly through October. Biological testing will be done in March and October in order to gather even more data. Figure 4.0 shows the water sampling sites used to gather baseline conditions. These same sampling sites will be used again, and three sites will be added. The following map and Table will show the locations of these three additional sites.

Stream Name	14-digit HUC	New Locations
Hog Creek (north)	05120203080010	On Co. Rd. 300 E.; ½ mi. north of SR 46
Connley Ditch (central)	05120203090060	On SR 246; 1 ¾ mi. west of SR 246/59 Junction
Erie Canal (west)	05120203090080	On Co. Rd. 1100 S.; ¾ mi. east of Co. Rd. 400 W.

Table 9.1 Additional testing sites for Section 319 Nonpoint Source Management Program Grant

The watershed plan will be evaluated annually beginning 2011 by our locally lead steering committee, SWCD staff, watershed coordinator, and the SWCD supervisors. This same group will also be responsible for any revisions or additions needed to this plan.

9.1 Current/previous Monitoring Program

Six (6) sites in each 14-digit watershed were sampled monthly from April 2006 through October 2007 for the following parameters: Dissolved oxygen, *E. coli*, PH, Total Phosphate, Nitrates/Nitrites, Temperature, Turbidity. Macroinvertebrates testing was conducted two (2) times per year in April and October at each of the twelve (12) sites.
(See Figure 1.3 for Monitoring Sites and pages 69-74.)

10.0 PUBLIC AWARENESS

The steering committee believes that public awareness is a major factor in the success of watershed improvement and management. Public meetings have been held, articles have been published in local newspapers, water quality information was incorporated into the annual fall Nature Bowl for the 7th grade students in Clay County, and demonstrations have been given at various public meetings. Plans are being made to improve public awareness and education with regular news articles, presentations at public meetings, presentations to school groups, and publication of pamphlets or brochures for distribution to the public.

In December of 2005 we held our first public meeting in Clay City, Indiana. At the meeting we invited interested stakeholders to become a part of a group, which would direct our project for the future. Several community members volunteered to serve on the steering committee. In addition to those volunteers, representatives from the Clay County Council, Clay County Commissioners, and Clay County Farm Bureau Co-op also choose to serve on the committee. This group became known as the Lower Eel River Steering Committee on January 5, 2006, at the first public meeting. Participants were mainly farmers and agriculture producers from throughout the watershed. Also in attendance were agriculture merchants, members of the media, politicians, county commissioners, county councilmen, and town board members from various towns in the watershed. Also attending the meeting were supervisors and employees from surrounding county Soil and Water Conservation Districts. Interested members of the general public also attended.

The second public meeting was held in August of 2007. Participants were mainly farmers and agriculture producers from throughout the watershed. Also, in attendance were agriculture merchants, members of the media, politicians, county commissioners, county councilmen, and town board members from various towns in the watershed. In addition supervisors and employees attended the meeting from surrounding county Soil and Water Conservation Districts. Interested members of the general public also attended

On July 19, 2007, Nathan Stoelting gave a presentation about watershed management to those attending the Private Pesticide Applicator Recertification Program (PARP) training session held at the Schopmeyer Farm Supply site in the northern part of Clay County.

Seven news articles have been submitted and published in local newspapers. (See Appendix for copies of articles and dates submitted; pages 96 -101)

Schopmeyer Farm Supply Presentation in February 2007: This was a PARP Training for area farmers in which the SWCD was offered time to present information regarding the Lower Eel Watershed Project. District Employee, Nathan Stoelting, attended and spoke in detail about the project. Topics discussed were the problems and concerns that had been developed by the steering committee, sample results that were being found, and the group's goals were for the next few years.

The Lower Eel River Watershed project was discussed at each annual SWCD meeting in 2006, 2007, and 2008.

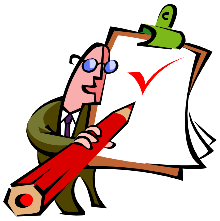
Nature Bowl presentation (October 2007): This annual event for the 7th grade students in Clay County. This year a total of seventy-five students from Clay City Junior High School and North Clay Junior High School attended. Each year water quality is one of the topics addressed.

We are planning on creating a pamphlet and or brochure that can be distributed at public meeting and in public places such as: Howesville, Bowling Green Feed & Grain, Clay City Ceres Solutions, Schopmeyer Farm Supply, Brazil Ceres Solutions, Cory at McCullough's, soil & water offices and extension offices in Clay, Owen, Vigo, and Greene counties, Blackhawk Farm

Service, Six-Points on Hwy 46, and Worthington. Information for a website is also being considered.

Letters were sent to over 1,300 landowners in the Lower Eel River Watershed publicizing the final meeting, which was scheduled for February 21, 2008, in Clay City. That meeting had to be postponed due to weather conditions and was rescheduled for March 11, 2006.

Appendices



WATERSHED MANAGEMENT PLAN CHECKLIST

(Updated 2003 Checklist)

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

INTRODUCE WATERSHED

Page #

O ____ Define the mission, vision, or purpose statement that the group came up with for the watershed

O ____ Include map(s) of the watershed

O ____ Give a detailed description of the watershed

IDENTIFY PROBLEMS AND CAUSES

O ____ List the stakeholders’ concerns that were gathered from the public meetings

O ____ List and briefly summarize information/data gathered to establish baseline conditions

O ____ Identify problems in the watershed based on the information gathered

O ____ Identify known or probable causes of water quality impairments and threats. Tie concerns, benchmarks, problems, and causes together so there is a clear thought process.

IDENTIFY SOURCES

O ____ Identify specific sources for each pollutant or condition that will need to be controlled to achieve the load reductions estimated and the goals in the plan. Include enough information to explain the magnitude of the source.

IDENTIFY CRITICAL AREAS

O ____ Estimate existing loads for pollutants to assist with prioritization

O ____ Identify critical areas where measures will be needed to implement the plan. Summarize the thought process used for targeting and prioritization.

SET GOALS & SELECT INDICATORS

O ____ Develop water quality improvement or protection goals

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

O ____ There is a clearly understandable train of thought from problems, causes and sources to critical areas, goals, and indicators.

CHOOSE MEASURES/BMPS TO APPLY

O ____ Determine BMPs or measures that will need to be implemented to achieve the load reductions required to reach the goals.

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

O ____ Estimate load reductions for the management measures identified.

O ____ Describe the planned order of implementation, the time requirements for implementing the plan, and who is responsible for carrying out tasks.

O ____ Estimate financial and technical assistance needed to implement the plan.

O ____ Describe interim measurable milestones for determining whether NPS management measures or other control actions are being implemented.

MONITOR EFFECTIVENESS (INDICATORS)

O ____ Develop a monitoring plan to track the indicators and evaluate the effectiveness of the implementation efforts over time.

EXHIBIT B

Schedule for Project Tasks

The tasks and the associated time periods necessary for the project are as follows:

Contract Commencement through Third Month	Form steering committee. Hold steering committee meeting. Begin work on WMP. Submit QAPP for approval. Submit information to media.
Fourth Month	First quarterly progress report due for work accomplished during the period, if not previously submitted this quarter.
Fourth Month through Sixth Month	Hold steering committee meeting. Hold first public meeting. Continue work on WMP. Begin monitoring. Submit information to media. Submit draft WMP containing at least the Introduction.
Seventh Month	Second quarterly progress report due for work accomplished during the period, if not previously submitted this quarter.
Seventh Month through Ninth Month	Hold steering committee meeting. Continue work on WMP. Continue monitoring. Submit information to media.
Tenth Month	Third quarterly progress report due for work accomplished during the period, if not previously submitted this quarter.
Tenth Month through Twelfth Month	Hold steering committee meeting. Continue work on WMP. Continue monitoring. Hold second public meeting. Submit information to media. Submit draft WMP containing at least the Introduction and Problem Identification.
Thirteenth Month	Fourth quarterly progress report due for work accomplished during the period, if not previously submitted this quarter.

Thirteenth Month through Fifteenth Month	Hold steering committee meeting. Continue work on WMP. Continue monitoring. Submit information to media.
Sixteenth Month	Fifth quarterly progress report due for work accomplished during the period, if not previously submitted this quarter.
Sixteenth Month through Eighteenth Month	Hold steering committee meeting. Continue work on WMP. Continue monitoring. Submit information to media. Submit draft WMP containing at least the Introduction, Problem Identification and Goals & Decisions.
Nineteenth Month	Sixth quarterly progress report due for work accomplished during the period, if not previously submitted this quarter.
Nineteenth Month through Twenty-first Month	Hold steering committee meeting. Continue work on WMP. Continue monitoring. Submit information to media.
Twenty-second Month	Seventh quarterly progress report due for work accomplished during the period, if not previously submitted this quarter.
Twenty-second through Twenty-fourth Month	Hold steering committee meeting. Continue work on WMP. Continue monitoring. Submit information to media. Submit draft WMP containing all required elements for review and comment prior to finalizing the Plan.
Twenty-fifth Month	Eighth quarterly progress report due for work accomplished during the period, if not previously submitted this quarter.
Twenty-fifth through Twenty-Seventh Month	Hold steering committee meeting. Hold third public meeting. Continue WMP. Continue monitoring. Submit information to media.
Twenty-Eighth Month	Ninth quarterly progress report due for work accomplished during the period, if not previously submitted this quarter.
Twenty-Eighth through Thirtieth Month	Hold steering committee meeting. Finish WMP. Finish monitoring. Submit information

EXHIBIT C

Total Estimated Project Expense Budget

The Contractor will be reimbursed by the State for estimated expenses in the following areas not to exceed the indicated amounts. Payment of up to $87,400.00 will be made in arrears, upon submittal of an invoice and progress reports to the State, for the specified purposes. Funds cannot be released by the State until the work has been completed and the appropriate invoice and progress reports have been submitted to the State. The $87,400.00 has been identified as the amount necessary to complete the project. Costs in excess of $87,400.00 are to be paid by the Contractor with non-federal matching funds not being used as a match for another federal grant.

Type of Expenditure	Amount
Task A	54,285.00
Task B	28,745.00
Task C	4,370.00
TOTAL	**$87,400.00**

Each invoice submitted by the Contractor shall be accompanied by a statement indicating that sufficient non-federal funds, either in-kind services or cash, have been expended within the invoice period. Each such invoice shall identify the source and amount of non-federal fund expenditures.

The non-federal funds provided by the Contractor and expended under this contract shall total $29,667.00. The Contractor, who may receive contributions toward such in-kind services and/or cash match from project partners, shall contribute this as either an in-kind services and/or cash match. The Contractor, however, is solely responsible under this contract for such in-kind services and/or cash match.

Exhibit D: Raw Data Collected for Lower Eel River Watershed Plan

Six (6) sites in each 14-digit watershed were sampled monthly from April 2006 through October 2007 for the following parameters: Dissolved oxygen, E. coli, pH, total phosphate, nitrates/nitrites, temperature, and turbidity. Macroinvertebrates testing was conducted two (2) times per year in April and October at each of the twelve (12) sites.

Apr-06

Site	Date	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	10-Apr	50	9	7.9	0.3	2.2	50	57.4	0
Hog Creek	10-Apr	0	9	7.4	0.15	4.4	47	10.1	0
6 mile Creek	28-Apr	100	9	7.9	0	0.13	60	11.1	0
Turkey Creek	27-Apr	100	9	7.8	0.1	8.8	60	8.8	0
Brush Creek	11-Apr	0	9	7.8	0.5	2.2	60	3.8	0
Birch Creek S.	27-Apr	100	8.5	8.1	0.2	2.2	60	20.0	0.5
Splunge Creek	28-Apr	100	11	8	0.1	13.2	16	25.6	1
Connelly Ditch N	10-Apr	0	9	7.4	0.5	13.2	36	41.0	0
Connelly Ditch S	28-Apr	150	9	8.2	0.1	0.44	60	24.4	0
White Oak	28-Apr	50	9	8.2	0.1	0.13	60	13.8	0
Erie Canal	11-Apr	0	9	7.5	0.1	4.4	20	73.7	0
Lick Creek	11-Apr	0	9	7.7	0	1.1	50	96.3	0
Blank	19-Apr	0	9	6.9	0	0	60		0

May-06

Site	Date	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	16-May	150	9	8.2	0.3	4.4	60	30.8	0
Hog Creek	16-May	1000	9	7.9	0.1	8.8	60	1.6	1
6 mile Creek	24-May	250	9	8.3	0.15	1.1	60	9.3	0
Turkey Creek	24-May	200	9	8.1	0.1	17.6	38	11.2	0
Brush Creek	16-May	350	9	8	0.3	35.2	60	11.8	2
Birch Creek S.	24-May	50	9	8.3	0.35	0.22	60	39.9	0
Splunge Creek	25-May	4450	7	7.6	7	4.4	4	513.4	2.5
Connelly Ditch N	16-May	100	11	7.9	0.2	26.4	58	1.9	2
Connelly Ditch S	25-May	5950	8	7.7	1	30.8	8	456.1	2
White Oak	25-May	1250	7	7.6	0.1	8.8	14	76.4	2
Erie Canal	25-May	10300	7	7.6	1.5	4.4	4	347.5	3
Lick Creek	25-May	2800	8	7.7	0.9	1.1	9	170.1	2
Blank	26-May	0	9	7	0	0	60		0

Jun-06

Site	Date	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	9-Jun	550	8	8.2	2	2.2	60	32.9	1
Hog Creek	9-Jun	1000	9	8.2	0.2	8.8	60	0.8	2
6 mile Creek	9-Jun	450	7	8	0.1	4.4	60	12.8	1
Turkey Creek	9-Jun	800	8	8	0.2	15.4	26.5	3.8	2
Brush Creek	9-Jun	750	9	8.2	0.3	2.2	60	1.7	1.5
Birch Creek S.	9-Jun	400	9	8.4	0.7	4.4	60	42.0	1
Splunge Creek	21-Jun	480	3	7.7	0.8	2.2	47	16.8	0
Connelly Ditch N	21-Jun	50	7	8	0.3	8.8	60	13.3	0
Connelly Ditch S	21-Jun	150	7	8	0.8	4.4	60	19.9	0
White Oak	21-Jun	200	5	8.1	0.3	4.4	52	26.8	0
Erie Canal	21-Jun	650	5	7.8	0.6	1.2	42	34.8	1
Lick Creek	21-Jun	500	7	8.1	0.3	0.88	60	12.2	1
Blank	6/52/06	0	9	6.9	0	0	60		0
State Ave.		Limit-235	9.8	8	0.3	12.32	22		

Jul-06

Site	Date	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	12-Jul	200	7	8.4	3	0.3	60	20.1	0
Hog Creek	12-Jul	50	6	8.1	0.3	0.2	60	0.4	0
6 mile Creek	12-Jul	900	6	7.9	0.2	0	60	4.7	2
Turkey Creek	12-Jul	400	6	8	0.3	0	60	2.2	1
Brush Creek	12-Jul	2050	6	7.9	0.3	0	60	1.1	2
Birch Creek S.	12-Jul	400	7	8.4	1.5	0	60	36.3	1
Splunge Creek	20-Jul	1150	5	8	0	0	60	20.2	2
Connelly Ditch N	20-Jul	100	5	8.1	0	0.2	60	1.3	0
Connelly Ditch S	20-Jul	150	7	8.2	0	0.1	60	8.7	0
White Oak	20-Jul	500	7	8	0	0	60	4.0	1
Erie Canal	20-Jul	450	6	8	0	0	60	7.9	1
Lick Creek	20-Jul	750	6	8	0	0	60	3.2	2
Blank	20-Jul	0	9	7	0	0	60		0

Aug-06

Site	***Date***	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	21-Aug	0	7	8.2	2.5	0	60	9.0	0
Hog Creek	21-Aug	1050	6	8.1	0.2	0.2	60	0.6	2
6 mile Creek	21-Aug	600	8	8	0.2	0	60	0.8	2
Turkey Creek	21-Aug	150	4	7.8	0.5	0.4	60	0.5	0
Brush Creek	21-Aug	0	4	8.5	0.2	0	60	1.9	0
Birch Creek S.	21-Aug	50	7	8.5	0.6	0.5	60	15.6	0
Splunge Creek	21-Aug	50	7	6.3	0.2	0	60	11.2	0
Connelly Ditch N	21-Aug	0	9	7.7	0.3	0	60	1.7	0
Connelly Ditch S	21-Aug	100	9	7.9	0.4	0	60	3.4	0
White Oak	29-Aug	1000	7	8.4	0.2	0	60	0.9	2
Erie Canal	29-Aug	50	4.5	8	0.2	0.4	60	3.6	0
Lick Creek	29-Aug	1000	5	8.4	0.1	0	60	1.9	2
Erie Canal North	29-Aug	0	4	7.9	0.2	0.1	60	2.7	
Clear Branch	21-Aug	50	7	8.7	0.9	0	60	0.9	
Blank	29-Aug	0	9	6.9	0	0	60		0

Sep-06

Site	Date	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	13-Sep	2500	9	8.2	1	0.08	36	7.7	3
Hog Creek	13-Sep	21250	7	7.8	0.2	0.2	19	1.1	4
6 mile Creek	25-Sep	350	8	7.9	0.1	0.12	60	8.8	1
Turkey Creek	22-Sep	1000	9	8.3	0.6	0.8	38	5.9	2
Brush Creek	13-Sep	2500	7	8.5	0.9	0.4	34	2.2	2.5
Birch Creek S.	25-Sep	500	8	7.8	0.3	0.8	60	25.9	1
Splunge Creek	25-Sep	500	6	7.8	0.8	0.15	36	25.2	1
Connelly Ditch N	22-Sep	600	7	8.1	0.8	1	36	26.9	1
Connelly Ditch S	22-Sep	1250	8	8.1	0.6	2	33	34.9	3
White Oak	22-Sep	1050	7	7.8	0.6	0.4	24	10.2	2
Erie Canal	22-Sep	250	6	7.9	0.4	0.12	51	11.4	0
Lick Creek	22-Sep	1600	8	8	0.3	0.8	49	10.3	2.5
Erie Canal North	22-Sep	250	7	7.8	0.1	0.5	34	10.3	0
Clear Branch	25-Sep	350	7	7.7	0.6	0.3	35	2.5	
Blank	25-Sep	0	9	7	0	0	60		0

Supplemental samples

Upstream Feline	29-Sep	1650
Downstream	29-Sep	1300
Hog Creek	29-Sep	350

Oct-06

Site	Date	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	16-Oct	900	8	7.9	0.2	0	60	8.5	2
Hog Creek	16-Oct	1200	6	7.9	0.3	0	60	0.6	1.5
6 mile Creek	16-Oct	750	8	7.9	0.1	0	60	1.8	1.5
Turkey Creek	16-Oct	1000	6	7.9	0.1	0	60	3.1	2
Brush Creek	16-Oct	2000	9	7.9	1.2	0	60	0.8	2
Birch Creek S.	16-Oct	350	7	7.9	0.8	0	60	12.9	0
Splunge Creek	25-Oct	0	7	8	0.2	0.4	60	18.4	0
Connelly Ditch N	25-Oct	50	9	8.3	0.1	0.4	60	2.1	0
Connelly Ditch S	25-Oct	100	9	7.6	0.2	0.8	60	3.3	0
White Oak	25-Oct	50	9	7.8	0.1	0.8	60	4.1	0
Erie Canal	25-Oct	50	9	7.9	0.1	0.4	60	5.7	0
Lick Creek	25-Oct	50	8	7.9	0.1	0.8	60	5.2	0
Blank	25-Oct	0	9	6.9	0	0	60		0
Birch Creek N.		575	8	8.2	1.62	1.82	58	30.0	
Hog Creek		4058.333	7.8	7.9	0.19	4.48	57.4	2.7	
6 mile Creek		441.6667	7.8	8.0	0.13	1.13	60	7.7	
Turkey Creek		441.6667	7.2	7.9	0.24	8.44	48.9	5.3	
Brush Creek		941.6667	7.4	8.1	0.32	7.92	60	4.1	
Birch Creek S.		250	8.1	8.3	0.67	1.46	60	30.7	
Splunge Creek		1121.667	6.6	7.5	1.62	3.96	37.4	117.5	
Connelly Ditch N		141.6667	8.2	7.8	0.26	9.72	54.8	11.8	
Connelly Ditch S		1291.667	8	8.0	0.46	7.15	49.6	102.5	
White Oak		675	7	8.1	0.14	2.67	49.2	24.4	
Erie Canal		1950	6.3	7.8	0.48	2.08	37.2	93.5	
Lick Creek		1108.333	7	8.0	0.26	0.62	47.8	56.7	
State Ave.		Limit-235	9.8	8	0.3	12.32	22		

Apr-07

Site	Date	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	22-Apr	50	9	7.9	0.5	1.1	50	45.2	0
Hog Creek	22-Apr	600	9	8.2	0.1	0	60	0.7	1
6 mile Creek	22-Apr	300	9	8.2	0.05	1	60	37.4	0
Turkey Creek	22-Apr	250	10	8.3	0.15	1	60	20.2	1
Brush Creek	22-Apr	10000	8	8.1	0.1	0.22	60	9.3	1
Birch Creek S.	22-Apr	250	9	8	0.4	0.08	43	3.4	0
Splunge Creek	22-Apr	350	7	8	0.1	0.08	24.5	63.0	0
Connelly Ditch N	22-Apr	250	10	8	0.2	1.2	60	24.5	1
Connelly Ditch S	22-Apr	0	9	8.2	0.3	4.4	60	20.3	0
White Oak	22-Apr	900	8	8.1	0.1	0	33	11.3	1
Erie Canal	22-Apr	50	6	7.9	0.3	0	30	15.0	0
Lick Creek	22-Apr	150	9	8.4	0.1	0	60	20.7	0
Blank	23-Apr	0	9	7	0	0	60		

May-07

Site	Date	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	18-May	0	9	8.1	0.9	2.2	60	14.7	0
Hog Creek	18-May	150	8.5	8.2	0.2	0	60	1.4	0.5
6 mile Creek	18-May	450	8	8.1	0.2	0	41	5.4	1
Turkey Creek	18-May	750	7	7.9	0.3	8.8	50	3.9	2
Brush Creek	18-May	350	9	8.4	0.1	0	60	0.8	0
Birch Creek S.	18-May	550	10	8.2	0.4	2.2	60	0.3	1
Splunge Creek	18-May	100	8	8.1	0.3	0	60	31.0	0
Connelly Ditch N	18-May	50	9	8.2	0.15	2	60	50.5	0
Connelly Ditch S	18-May	100	9	8.2	0.15	8	60	3.4	0
White Oak	18-May	350	7.5	8.2	0.15	1	60	16.1	0.5
Erie Canal	18-May	50	7	7.7	0.15	0	60	16.8	0
Lick Creek	18-May	50	7	8.2	0.1	0	60	30.6	0
Blank	18-May	0	9	6.9	0	0	60		

Jun-07

Site	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	0	9	8.1	0.9	2	60	29.9	0
Hog Creek	400	8	8.1	0.3	0	60	1.0	0.5
6 mile Creek	350	7	8.3	0.1	0	51	21.3	0
Turkey Creek	600	8	8.1	0.3	0	60	20.7	0
Brush Creek	425	9	8.4	0.2	2	60	12.9	0.5
Birch Creek S.	450	8	8.2	0.4	0	60	2.7	0.5
Splunge Creek	850	8	8.4	0.2	0	60	11.4	0
Connelly Ditch N	450	7	8.1	0.2	0	60	9.6	0
Connelly Ditch S	250	8	8	0.2	2.2	60	1.9	0.5
White Oak	200	7	8.1	0.1	0	60	8.5	0
Erie Canal	1650	6.5	7.8	0.1	0	60	43.9	0.5
Lick Creek	450	7	8.2	0.1	0	60	7.2	0
Blank								

Jul-07

Site	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	600	6	8.1	0.1	0	52	12.9	0
Hog Creek	650	4	8.3	0.2	0	56	11.3	0.5
6 mile Creek	400	7	7.9	0.1	0.1	46	12.9	0.5
Turkey Creek	575	6	8.4	0.1	0	59	22.5	0
Brush Creek	525	6	7.9	0.3	0.3	42	11.8	0.5
Birch Creek S.	300	7	8.1	0.2	0	57	18.4	0
Splunge Creek	475	5	8.3	0.1	0	32	7.4	0
Connelly Ditch N	800	6	8.5	0.4	0.2	60	8.9	0.5
Connelly Ditch S	225	7	8	0	0	39	11.9	0
White Oak	425	4	7.9	0.1	0	60	10.2	0
Erie Canal	825	6	8.1	0	0.1	41	9.1	0.5
Lick Creek	175	6	8.2	0.4	0	58	8.8	0.5
Blank								

Aug-07

Site	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	250	6	8.5	0	0	60	14.7	0
Hog Creek	500	4	7.9	0.2	0.1	60	9.7	0.5
6 mile Creek	575	6	7.8	0.1	0	39	12.4	0.5
Turkey Creek	625	6	7.5	0.5	0	17	19.7	0
Brush Creek	900	8	8.7	0.1	0	50	14.5	0
Birch Creek S.	375	7	8.5	0.5	0.3	60	15.2	0.5
Splunge Creek	350	6	8.4	0.2	0	60	8.2	0.5
Connelly Ditch N	250	6	8.4	0.1	0	60	13.5	0.5
Connelly Ditch S	350	7	8.5	0.2	0	60	9.8	0
White Oak	400	4	8.1	0.1	0	60	11.9	0
Erie Canal	500	2.5	7.5	0.2	0	18	6.3	0.5
Lick Creek	375	7	8.3	0.2	0.3	28	7.5	0
Blank								

Sep-07

Site	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD
Birch Creek N.	400	6.5	8.5	2.5	1	55	8.2	0
Hog Creek	12,750	7	6	2.5	0.5	9	57.8	0.5
6 mile Creek	1000	6	7.8	0.1	0	40	12.4	0.5
Turkey Creek	17,000	7	8.3	0.5	0	7	67.3	0
Brush Creek	25	8	8.7	0.1	0	50	11.4	0
Birch Creek S.	1,200	7	8.5	0.5	0.3	60	9.2	0
Splunge Creek	125	7	9.5	0.1	0	60	7.6	0
Connelly Ditch N	625	5	8.9	0.3	0	29	7.2	0.5
Connelly Ditch S	475	8	9.4	2	0.2	60	10.4	0
White Oak	725	5	8.1	0	0	57	13.2	0.5
Erie Canal	200	4	8	0.1	0	41	12.4	0
Lick Creek	525	6	8	0.1	0	60	14.9	0.5
Blank								

Oct-07

Site	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm	Flow-cfs	BOD

Birch Creek N.	300	7	9.1	2	0.1	60	9.6
Hog Creek	450	6	8.6	0.2	0.1	56	13.5
6 mile Creek	350	7	6.8	0.2	1	60	11.8
Turkey Creek	700	4	8.7	0.2	0	46	14.8
Brush Creek	400	7	8.1	0.1	0.1	60	9.4
Birch Creek S.	350	11	9.2	0.5	0.3	60	10.5
Splunge Creek	650	10	9	0	0	60	8.2
Connelly Ditch N	500	10	9.2	0.2	0.2	45	8.9
Connelly Ditch S	650	7	8.9	0.5	0.3	60	12.4
White Oak	200	7	8.9	0.4	0.3	60	10.1
Erie Canal	350	6	8.7	0.1	0	25	7.9
Lick Creek	250	4	8.3	0.2	0	60	21.9
Blank							
State Ave.	Limit-235	9.8	8	0.3	12.32	22	

Birch Creek N.	230	7.4	8.3	1	1	57
Hog Creek	2,200	6.6	7.9	0.5	0.03	52
6 mile Creek	500	7.1	7.8	0.2	0.3	48
Turkey Creek	3,000	6.9	8.2	0.3	1.4	42
Brush Creek	1,800	7.9	8.3	0.1	0.4	55
Birch Creek S.	500	8.6	8.4	0.4	0.6	57
Splunge Creek	410	7.3	8.5	0.2	0.01	51
Connelly Ditch N	420	7.6	8.5	0.2	0.5	53
Connelly Ditch S	300	7.9	8.5	0.5	0.2	57
White Oak	460	6.1	8.2	0.1	0.2	56
Erie Canal	520	5.5	7.8	0.1	0.03	39
Lick Creek	280	6.6	8.2	0.2	0.04	55

2006/2007 Averages

Site	Date	E. coli cfu	DO-mg/L	pH	Orthophosphate-mg/L	Nitrate-mg/L	Turbidity-cm
Birch Creek N.		400	7.7	8.25	1.3	1.4	57.5
Hog Creek		3125	7.2	7.9	0.35	2.3	54.5
6 mile Creek		475	7.4	7.9	0.16	0.7	54
Turkey Creek		1720	7.05	8.05	0.27	4.9	45.5
Brush Creek		1370	7.65	8.2	0.2	4.2	57.5
Birch Creek S.		375	8.35	8.35	0.53	1	58
Splunge Creek		765	6.95	8	0.9	2	44
Connelly Ditch N		280	7.9	8.15	0.23	5	54
Connelly Ditch S		800	7.95	8.25	0.48	3.6	53.5
White Oak		570	6.55	8.15	0.11	1	53
Erie Canal		1235	5.9	7.8	0.3	1	38
Lick Creek		700	6.8	8.1	0.23	0.5	51.5

Attachment A

Lower Eel River Watershed *E. coli* Data

Attachment A: Lower Eel River Watershed *E. coli* Data

Site #	Project ID	L-Site #	Stream Name	Description	14 digit HUCs	Sample #	Sample Date	E. coli (MPN/100mL)	Geometric Mean
1	1996 Synoptic	WWE080-0003	Birch Creek	SR 46 – Clay County Plat Directory, page 35 Perry Township - NE	05120203080060	D120352	02/29/1996	30 (JH)	NC
						D122351	11/22/1996	100 (JH)	
2	2001 E. coli - Lower WFWR and Eel River	WWE080-0009	Birch Creek	CR 300 S, West of 200 W Clay County Plat, page 37 Perry Twp.-East Center	05120203080080	AA06599	07/31/2001	**387.3**	**252.29**
						AA06942	08/07/2001	60.5	
						AA07098	08/14/2001	172.6	
						AA07401	08/21/2001	**770.1**	
						AA08147	08/29/2001	**328.2**	
3	1996 Synoptic	WWE090-0002	Splunge Creek	CR 535 W - CR 550 W Clay County Plat, page 38 Perry Twp - South	05120203090020	D120354	02/29/1996	120 (JH)	NC
						D121721	07/17/1996	80	
						D122353	11/22/1996	70	
4	2001 *E. coli* – Lower WFWR and Eel River	WWE090-0014	Eel River	CR 600 S, Old Hill, IN Clay County Plat, page 38 Perry Twp - South	05120203090030	AA06601	07/31/2001	**2419.17**	**487.83**
						AA06943	08/07/2001	198.9	
						AA07097	08/14/2001	52.8	
						AA07400	08/21/2001	**1986.28**	
						AA08146	08/29/2001	**547.5**	
5	2001 Conneley Ditch TMDL e. coli	WWE090-0033	Unnamed Tributary	CR400S & CR150E Clay County Plat, page 23 Harrison Twp – NE	05120203090050	AA06504	07/24/2001	**770.1**	**305.58**
						AA06694	07/31/2001	**2419.2**	
						AA06815	08/07/2001	155.3	
						AA07060	08/14/2001	93.3	
						AA07270	08/21/2001	98.7	
6	2001 Conneley Ditch TMDL e. coli	WWE090-0034	Unnamed Tributary	CR500S & CR100E Clay County Plat, page 23 Harrison Twp – NE	05120203090050	AA06505	07/24/2001	**1299.65**	**678.20**
						AA06695	07/31/2001	**1203.31**	
						AA06816	08/07/2001	**770.1**	
						AA07061	08/14/2001	**387.3**	
						AA07272	08/21/2001	**307.6**	
7	2001 Conneley Ditch TMDL e. coli	WWE090-0035	Connelley Ditch	CR50E Clay County Plat, page 23 Harrison Twp – NE	05120203090050	AA06506	07/24/2001	**770.1**	**1004.31**
						AA06507	07/24/2001	**980.4 Dup**	
						AA06696	07/31/2001	**1203.31**	
						AA06818	08/07/2001	**461.1**	
						AA07062	08/14/2001	**1413.6**	
						AA07273	08/21/2001	**1732.87**	

Attachment A: Lower Eel River Watershed *E. coli* Data

Site #	Project ID	L-Site #	Stream Name	Description	14 digit HUCs	Sample #	Sample Date	E. coli (MPN/100mL)	Geometric Mean
8	2001 Conneley Ditch TMDL e. coli	WWE090-0036	Connelley Ditch	CR600S Clay County Plat, page 22 Harrison Twp - NW	05120203090050	AA06509	07/24/2001	66.9	**192.65**
						AA06698	07/31/2001	**1413.6**	
						AA6819	08/07/2001	143.9	
						AA07063	08/14/2001	135.4	
						AA07274	08/21/2001	144	
9	2001 Conneley Ditch TMDL e. coli	WWE090-0038	Connelley Ditch	SR246 Clay County Plat, p 22 Harrison Twp - NW	05120203090050	AA06511	07/24/2001	35.9	63.90
						AA06700	07/31/2001	214.2	
						AA06821	08/07/2001	68.9	
						AA07065	08/14/2002	58.3	
						AA07276	08/21/2001	34.5	
10	2001 Conneley Ditch TMDL e. coli	WWE090-0037	Clay City WWTP Effluent	Clay City WWTP Outfall Clay County Plat, page 22 Harrison Twp - NW	05120203090050	AA06510	07/24/2001	86.2	**652.33**
						AA06699	07/31/2001	**>2419.2**	
						AA06820	08/07/2001	**686.7**	
						AA07064	08/14/2001	**4611**	
						AA07275	08/21/2001	178.9	
	2001 Conneley Ditch TMDL *E. coli*	WWE090-0039	Connelley Ditch	CR1100S Clay County Plat, page 24 Harrison Twp - SW	05120203090060	AA06512	07/24/2001	**285.1**	85.50
						AA06701	07/31/2001	**344.8**	
						AA06822	08/07/2001	37.9	
						AA07066	08/14/2001	25.6	
						AA07277	08/21/2001	47.9	
12	2001 Conneley Ditch TMDL *E. coli*	WWE090-0040	Connelley Ditch	CR1200S Clay County Plat, p 24 Harrison Twp - SW	05120203090060	AA06697	07/31/2001	**304.4**	NC
						AA06823	08/07/2001	**770.1**	
						AA07067	08/14/2001	139.6	
						AA07278	08/21/2001	85.7	
13	1996 Synoptic	WWE090-0003	Connelley Ditch	CR1200S Clay County Plat, page 24 Harrison Twp - SW	05120203090060	D120355	03/01/1996	40 (JH)	**246.76**
						D121338	06/11/1996	**2400**	
						D121722	07/18/1996	130	
						D122196	10/11/1996	100	
						D122354	11/22/1996	170	

Attachment A: Lower Eel River Watershed *E. coli* Data

Site #	Project ID	L-Site #	Stream Name	Description	14 digit HUCs	Sample #	Sample Date	E. coli (MPN/100mL)	Geometric Mean
14	1996 Synoptic	WWE090-0004	Eel River	SR59 Clay County Plat, page 25 Harrison Twp - SE	05120203090070	D120357	03/01/1996	**400 (JH)**	**224.95**
						D121340	06/11/1996	**2000 (JH)**	
						D121724	07/18/1996	80	
						D122197	10/11/1996	60	
						D122356	11/22/1996	150	
	2001 Eel River TMDL					AA06514	07/23/2001	**>2419.2**	**915.03**
						AA06646	07/30/2001	**4884**	
						AA06795	08/06/2001	195.6	
						AA07049	08/13/2001	67.6	
						AA07295	08/20/2001	**4106**	
15	2001Conneley Ditch TMDL *E. coli*	WWE090-0032	Connelley Ditch	CR400S near River Rd Clay County Plat, page 23 Harrison Township - NE	05120203090070	AA06502	07/24/2001	**579.4**	**203.16**
						AA06690	07/31/2001	**648.8**	
						AA06812	08/07/2001	111.9	
						AA07057	08/14/2001	70.8	
						AA07267	08/21/2001	116.2	
16	2001 Eel River TMDL	WWE090-0021	White Oak Creek	CR1250S Clay County Plat, page 25 Harrison TWp - SE	05120203090070	AA06517	07/23/2001	**435.2**	**218.66**
						AA06650	07/30/2001	**1732.87**	
						AA06800	08/06/2001	135.4	
						AA07053	08/13/2001	75.9	
						AA07299	08/20/2001	64.5	
17	2001 Wabash and Erie Canal TMDL	WWE090-0042	DrainageDitch to Wabash & Erie Canal (Old K&E Canal)	CR 500 W Just South of CR 1000 S Clay County Plat, page 31 Lewis Twp - North	05120203090030	AA0621	07/23/2001	27.8	93.84
						AA06630	07/30/2001	111.9	
						AA06788	08/06/2001	**290.9**	
						AA07025	08/13/2001	177.9	
						AA07288	08/20/2001	45.2	
18	2001 Wabash and Erie Canal TMDL	WWE090-0016	Unnamed Trib of Wabash and Erie Canal (Old K & E Canal)	CR 1200 S – Between CR 400 W & CR 300 W Clay County Plat, page 31 Lewis Twp - North	05120203090080	AA06523	07/23/2001	55.7	39.31
						AA06642	07/30/2001	90.9	
						AA06794	08/06/2001	23.1	
						AA07028	08/13/2001	14.5	
						AA07291	08/20/2001	55.4	
19	2001 Wabash and Erie Canal TMDL	WWE090-0017	Unnamed Trib of Wabash and Erie Canal (Old K & E Canal)	CR 400 W – Between CR 1300 S and CR 1350 S Clay County Plat, page 32 Lewis Twp - SW	05120203090080	AA06524	07/23/2001	**726**	**251.42**
						AA06644	07/30/2001	196.8	
						AA06791	08/06/2001	**365.4**	
						AA07029	08/13/2001	166.9	
						AA07292	08/20/2001	115.3	

Attachment A: Lower Eel River Watershed *E. coli* Data

Site #	Project ID	L-Site #	Stream Name	Description	14 digit HUCs	Sample #	Sample Date	E. coli (MPN/100mL)	Geometric Mean
20	1996 Synoptic	WWE090-0005	Wabash & Erie Canal (Old K & E Canal)	CR 1300 S – Between CR 200 W & CR 100 W Clay County Plat, page 33 Lewis Twp - SE	05120203090080	D120356	03/01/1996	10 (JH)	**151.27**
						D121339	06/11/1996	**2200 (JH)**	
						D121723	07/18/1996	**250**	
						D122198	10/11/1996	160	
						D122355	11/22/1996	90	
21	2001 Eel River TMDL	WWE090-0023	Lagoon Creek	CR 850 S – Between CR 1425 W and SR 157 Owen County Plat, page 22 Jefferson Twp	05120203090080	AA06518	07/23/2001	**579.4**	**285.09**
						AA06651	07/30/2001	**1203.31**	
						AA06801	08/06/2001	146.7	
						AA07054	08/13/2001	84.2	
						AA07300	08/20/2001	218.7	
22	2001 Wabash and Erie Canal	WWE090-0018	Wabash and Erie Canal (Old K & E Canal) – Lateral #4	SR 59 & CR 1400 S Clay County Plat, page 33 Lewis Twp - SE	05120203090090	AA06525	07/23/2001	**980.4**	**700.41**
						AA06645	07/30/2001	**365.4**	
						AA06792	08/06/2001	**770.1**	
						AA07030	08/13/2001	**1986.3**	
						AA07293	08/20/2001	**307.6**	
23	2001 Eel River TMDL	WWE090-0024	Eel River	SR 157 W Owen County Plat, Page 22 Jefferson Township	05120203090120	AA06519	07/23/2001	**>2419.2**	**816.93**
						AA06648	07/30/2001	**>2419.2**	
						AA06798	08/06/2001	198.9	
						AA07052	08/13/2001	64	
						AA07298	08/20/2001	**4884**	
24	2001 Lick Creek TMDL	WWE090-0025	Lick Creek	CR 150 S, East of Bond Rd. Owen County Plat, Page 30 Marion Township	05120203090100	AA06474	07/24/2001	**290.9**	**150.47**
						AA06688	07/31/2001	**547.5**	
						AA06803	08/07/2001	66.3	
						AA07040	08/14/2001	63.8	
						AA07279	08/21/2001	114.5	
25	2001 Lick Creek TMDL	WWE090-0026	Lick Creek	CR 300 S, Black Beauty Coal Company Owen County Plat, Page 23 Jefferson Twp – West Part	05120203090110	AA06494	07/24/2001	39.3	**147.28**
						AA06689	07/31/2001	**980.4**	
						AA06806	08/07/2001	155.3	
						AA07043	08/14/2001	93.4	
						AA07282	08/21/2001	124	

Attachment A: Lower Eel River Watershed *E. coli* Data

Site #	Project ID	L-Site #	Stream Name	Description	14 digit HUCs	Sample #	Sample Date	E. coli (MPN/100 mL)	Geometric Mean
26	2001 Lick Creek TMDL	WWE090-0027	Hauser Creek (Tributary of Lick Creek)	CR 350 S (Stockton Rd) Owen County Plat, Page 23 Jefferson Twp – West Part	05120203090110	AA06495	07/24/2001	152.9	106.20
						AA06681	07/31/2001	**292.4**	
						AA06807	08/07/2001	209.8	
						AA07044	08/14/2001	55.6	
						AA07283	08/21/2001	25.9	
27	2001 Lick Creek TMDL	WWE090-0028	Lick Creek	CR 450 S Owen County Plat, Page 23 Jefferson Twp – West Part	05120203090110	AA06496	07/24/2001	195.6	**342.69**
						AA06684	07/31/2001	**816.4**	
						AA06808	08/07/2001	**613.1**	
						AA07045	08/14/2001	**298.7**	
						AA07284	08/21/2001	161.6	
28	1996 Synoptic	WWE090-0006	Lick Creek	CR 750 S (H-S Rd ?) Owen County Plat, Page 22 Jefferson Twp	05120203090110	D120358	03/01/1996	40 (JH)	NC
						D121341	06/11/1996	**3200 (JH)**	
						D121725	07/18/1996	120	
						D122357	11/22/1996	80	
29	2001 Lick Creek TMDL	WWE090-0029	Beech Creek (Need Ditch / Beach Creek) (Tributary of Lick Creek)	Arney Road Owen County Plat, Page 22 Jefferson Twp	05120203090120	AA06497	07/24/2001	**579.4**	**674.23**
						AA06685	07/31/2001	**686.7**	
						AA06809	08/14/2001	**791.5**	
						AA07046	08/14/2001	**1413.6**	
						AA07285	08/21/2001	**313**	
30	2001 Lick Creek TMDL	WWE090-0030	Brush Creek (Tributary of Lick Creek)	CR 700 S Owen County Plat, Page 24 Jefferson Twp	05120203090120	AA06498	07/24/2001	69.1	**295.33**
						AA06686	07/31/2001	**1203.31**	
						AA06810	08/07/2001	**1732.87**	
						AA07047	08/14/2001	90.5	
						AA07286	08/21/2001	172.3	
31	2001 Eel River TMDL	WWE090-0001	Eel River	SR 67 Greene County Jefferson Twp	05120203090130	AA06529	07/23/2001	**259.5**	**639.80**
						AA06652	07/30/2001	**4352**	
						AA06802	08/06/2001	143.9	
						AA07055	08/13/2001	107.6	
						AA07301	08/20/2001	**6131**	
	1996 Synoptic					D120359	03/01/1996	230 (JH)	NC
						D121342	06/11/1996	**4200 (JH)**	
						D121726	07/18/1996	100	
						D122358	11/22/1996	120	

Attachment A: Lower Eel River Watershed *E. coli* Data

Site #	Project ID	L-Site #	Stream Name	Description	14 digit HUCs	Sample #	Sample Date	E. coli (MPN/100 mL)	Geometric Mean
Cont. 31	1991 – 2000 Fixed Station Data	WWE090-0001	Eel River	SR 67 - Greene County Jefferson Township	05120203090130	D105619	01/31/1991	100	NC
						D17472	04/24/1991	30	
						D19293	08/07/1991	**440**	
						D19608	12/05/1991	**2000**	
						D18105	03/12/1992	**3400**	
						DI13531	11/30/1992	120	
						DI14537	10/21/1993	**1200**	
						DI16622	05/25/1994	**310**	
						DI17930	11/02/1994	200	
						DI18511	05/10/1995	190	
						DI19813	08/15/1995	170	
						DI18985	10/12/1995	40	
						DI20525	11/29/1995	60	
						DI20837	02/15/1996	30	
						DI21550	06/26/1996	**390**	
						DI22573	09/26/1996	**290**	
						DI22885	11/18/1996	**290**	
						DI23105	01/09/1997	**280**	
						DI23428	04/09/1997	10	
						DI23772	06/25/1997	**1000**	
						DI24244	10/30/1997	10	
						DI24707	01/22/1998	40 (H)	
						DI26841	03/10/1999	**390**	
						DI27494	06/10/1999	137	
						DI27675	07/22/1999	**1800**	
						DI28086	09/22/1999	110	
						DI28298	10/20/1999	49 (H)	
						DI28517	11/19/1999	66	
						DI29097	02/17/2000	50 (JH)	
						DI29433	04/18/2000	**8200**	
						DI30234	08/08/2000	**1550**	
						DI30437	09/14/2000	220 (JH)	

WQS Violations are in RED
> - Greater Than
Dup – Duplicate Sample
H – Holding Time Exceeded
J – Estimated Value
NC – Not Calculated - Geometric Means was only calculated on sites with 5 samples in 30 days as IN WQS dictates

Lower Eel River Watershed Soil Series

(Information excerpted from McCarter, Jr., Paul. Soil Survey of Clay County, Indiana. USDA, Soil Conservation Service in cooperation with Purdue University Agricultural Experiment Station, March 1982.)

Ava series – silt loam, 2 to 6 percent slopes
(AvB2 – (Severe) wetness, percs slowly)

The Ava series consists of deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in loess and the underlying glacial till. Slope ranges from 2 to 6 percent.

These soils have low chroma mottles higher in the subsoil than is definitive for the Ava series. This difference does not alter the usefulness or behavior of these soils.

Ava soils are similar to Cincinnati and Muren soils and are adjacent to Cincinnati, Hickory, and Iva soils. Muren soils are on knolls and ridge tops, do not have a fragipan, and have more silt and less sand in the lower part of the solum than Ava soils. Well-drained Cincinnati soils are on knolls and breaks and have browner subsoil. Hickory soils are in draws and on breaks, do not have a fragipan and have browner subsoil. Iva soils are on flats between draws, do not have a fragipan, have more silt and less sand in the lower part of the solum, and have grayer subsoil.

Typical pedon of Ava silt loam, 2 to 6 percent slopes, eroded, in an idle field; 700 feet west and 125 feet north of southeast corner sec. 21, T. 10 N., R. 6 W. (Page 68.)

AvB2 soils are **not suitable for septic tank** absorption fields or sewage lagoon areas due to wetness and slow percolation; they are not suitable for sewage lagoon area due to wetness. (Page 131)

Chagrin: silt loam, occasionally flooded
(Ca – (Severe) flooding, wetness)

The Chagrin series consists of deep, well-drained, moderately permeable soils on bottomlands. These soils formed in loamy and silty alluvium. Slope is 0 to 1 percent.

These soils have less clay than is definitive for the chagrin series. This difference does not alter the usefulness or behavior of these soils.

Chagrin soils are similar to Nolin and Wilburn soils and are commonly adjacent to Lobdell and Stonelick soils. Nolin soils have more clay and less and throughout the profile than Chagrin soils. Wilbur soils have grayish mottoes and less sand in the substratum. Lobdell soils have grayish mottles in the substratum. Stonelick soils have more sand and less silt in the substratum. All of these soils are on bottomlands.

Typical pedon of Chagrin silt loam, occasionally flooded, in a cultivated field; 750 feet east and 350 feet south of center sec. 33, T. 11 n., R. 6 W. (Pages 16 & 17 and 71 & 72.)

Due to flooding, Chagrin Ca soils are listed as **"severe" in all four columns relating to sanitary on** Table 13. -- Sanitary Facilities. (Page 131)

Chagrin: Stonelick complex, occasionally flooded
(Cb -- (Severe) flooding, wetness)

These soils are nearly level, deep, and well drained. They are on broad bottomlands. These soils formed inside the bends of streams that have changed course and built a series of sandbars in the bottomland. Medium textured more recent alluvium has partially filled in the swales between the sandbars. Alternating, narrow, parallel strips of chagrin silt loam are in the swales, and Stonelick fine sandy loam is on the low rises. Areas range from about 30 to 200 acres. (Page 16)

These soils are **severely limited** and are generally not suitable for building sites and sanitary facilities because they are subject to flooding. (Page 17)

Cincinnati series: silt loam, 6 to 12 percent slopes, severely eroded
(CcC2 – (Severe)) percs slowly)

The Cincinnati series consists of deep, well-drained, slowly permeable soils on uplands. These soils formed in loess and the underlying glacial till. Slope ranges from 6 to 12 percent.

Cincinnati soils are similar to Ava soils and commonly near hickory and Iva soils. Ava soils are on the knolls and have brownish mottled subsoil. Hickory soils are in draws or on breaks, do not have a fragipan, and have less silt in the upper part of the solum than Cincinnati soils. Iva soils are on flats, do not have a fragipan, have more silt in the lower part of the solum, and have a grayish mottled subsoil.

Typical pedon of Cincinnati silt loam, 6 to 12 percent slopes, severely erodes, in a cultivated field; 550 feet west and 1,075 feet south of northeast corner sect. 26, T. 12 N. R. 6W. (Page 73.)

CcC3 Slow permeability is a **severe limitation for septic tank absorption fields.** Excavating the slowly permeable material and replacing it with more permeable material reduces the effect of this limitation. (Page 20)

Evansville series: silt loam, occasionally flooded
(Ev -- (Severe) flooding)

The Evansville series consists of deep, poorly drained, moderately permeable soils on low terraces. These soils formed in stratified, silty sediment. Slope is 0 to 1 percent.

Evansville soils are similar to Petrolia soils and re adjacent to Montgomery Variant, Peoga, and Zipp soils.

Typical pedon of Evansville silt loam, occasionally flooded, in a cultivated field; 900 feet west And 1,000 feet south of center of sec. 4, T. 10 n., R. 6W. (Page 75)

Areas are irregular in shape and range from 50 to 400 acres. Water capacity is high, and permeability is moderate. This soil is **severely limited and generally not suitable** for building sites and sanitary facilities because it is subject to flooding. (Page 22-23)

Fairpoint – shaly silt loam, 0 to 8 percent slopes.
(FcB -- (Severe) percs slowly)

This soil is nearly level to moderately sloping, deep, and well drained. It is on uplands. Areas consist of partially smoothed mine spoil. Slopes are undulating and mainly 50 to 200 feet long. Many depress ional areas have no outlets for surface drainage, and some contain water part of the year. Mine spoil remains after an area has been surfaced mined for coal and consists mainly of masses of soft shale fragments, moderately fine and medium textured soil, loamy glacial till, and sandstone fragments. Most of the spoil is neutral in reaction, but some small spots are extremely acid, and some areas are mildly alkaline. Most sandstone fragments larger than 6 inches have been buried at least 6 inches deep or have been removed. Areas mainly range from 20 to 600 acres.

Septic tank absorption fields are **severely limited** because of moderately slow permeability. Excavating the soil material and replacing it with more permeable material can reduce this concern. (Page 23-24)

Fairpoint -- shaly silty clay loam, 33 to 90 percent slopes
(FcG -- (Severe) percs slowly, slope, slippage)

This soil is very steep, deep, and well drained. It is on uplands. Areas consist of a series of narrow, elongated mounds about 15 to 40 feet high. The mounds are piles of spoil from surface mining for coal and consist mainly of masses of shale, soil, glacial till, and sandstone. Most areas of spoil are neutral in reaction, but some areas are extremely acid and some are mildly alkaline. Most areas range from 20 to 600 acres.

This soil is **severely limited and generally not suitable** for building sites and sanitary facilities because of steep slopes and soil slippage. (Page 24-25)

Hickory series – silt loam or loam, 17 to 70 percent slope
(HcD, HcD3, HcE, HcF

The Hickory series consists of deep, well-drained, moderately permeable soils on uplands. These soils formed in a thin layer of loess and loamy glacial till, or in loamy glacial till. Slope ranges from 12 to 70 percent.

HcD is moderately limited for building sites because of slope and moderate shrink-swell. Moderate permeability and slope are **moderate limitations for septic tank** absorption fields.

HcD3 is generally not suited to cultivated crops, such as corn and soybeans, because of the hazards of surface runoff and erosion. It is severely limited for building sites and septic tank absorption fields because of strong slopes.

HcE The moderately steep slopes hinder the use of farm machinery. This soil is **severely limited for building sites and septic tank absorption fields** because of moderately steep slopes.

HcF soil is steep and very steep, deep, and well drained. It is not suited to corn, soybeans, or small grain because of the hazard of excessive runoff and subsequent erosion. It is severely limited and generally not suitable for building sites and sanitary facilities.

Typical pedron of Hickory loam, 18-25 percent slope, in woods; 1,800 feet east and 200 feet south of northwest corner sec. 1, T. 13 N., R. 6W. (Page 77-78)

Hoosierville series:
(Ho -- (Severe) wetness, percs slowly)

The Hoosierville series consists of deep, poorly drained soils on uplands. These soils formed in loess. Permeability is moderately slow. Areas are mainly broad, irregular in shape, and range from 40 to 600 acres. Slope ranges from 0 to 2 percent.

Hoosierville soils are similar to Peoga and Vigo soils and adjacent to Ava, Cincinnati, Iva, and Muren soils. Peoga soils have more clay in the lower part of the solum than

Hoosierville soils and are on lowest position in the landscape. Vigo soils have less silt and more sand in the lower part of the solum and are on flats and ridgetops. Iva soils are browner in the upper part of the subsoil and are on adjacent flats and ridgetops. More soils have browner subsoil and are on knolls and ridge tops.

Hoosierville soil is **severely limited** for building sites because of wetness.

Typical pedon of Hoosierville silt loam, in a cultivated field: 1,550 feet west and 600 feet north of southeast corner sec. 6 T. 11 N., R. 6 W. (Pages 31 & 78.)

Iva series: silt loam, 0 to 2 percent slopes
(**Iva – (Severe) wetness, percs slowly)**

The Iva series consists of deep, nearly level, and somewhat poorly drained. It is on broad flats and nearly level divides between draws on uplands. Areas are irregular in shape and range from 20 to 300 acres.

Iva soils are commonly near Ava, Cincinnati, and Muren soils. Ava and Cincinnati soils have a browner subsoil than Iva soils. Also, they have a fragipan, more sand and gravel in the lower part of the solum, and are in draws and on knolls. Muren soils have a browner subsoil and are on knolls or ridges.

Available water capacity is high; organic matter content is moderately low, and surface runoff is slow. This soil is severely limited for building sites because of wetness. Slow permeability and wetness are **severe limitations for septic tank absorption fields.**

Typical pedon of Iva silt loam, 0-2 percent slopes, in a cultivated field; 1,400 feet west and 250 feet south of northeast corner sec. 18. T. 13N, R. 6 W. (Pages 32 & 79.)

Muren series: silt loam, 0–2 percent slopes for MuA and MuB2 has 2-6 percent slopes, eroded
(MuA, MuB2 – (Severe) wetness, percs slowly)

The Muren series consists of deep, moderately well drained soils on uplands. These soils formed in loess. Permeability is moderately slow. Slope ranges fro 0 to 6 percent.

These soils have lower base saturation than is definitive for the Muren series. This difference does not alter the usefulness or behavior of these soils.

Muren soils are similar to Ava soils and adjacent to Cincinnati, Hickory, and Iva soils. Ava and Cincinnati soils have a fragipan, have more sand in the lower part of the solum than Muren soils, and re on knolls and on breaks. Cincinnati soils have browner subsoil. Hickory soils have more sand throughout the solum, have browner subsoil, and are in draws and on breaks. Iva soils have grayer subsoil and are on flats.

Both MuA and MuB2 are identified as follows: “Wetness and moderately slow permeability are **severe limitations for septic tank absorption fields**.” (Page 35)

Typical pedon of Muren silt loam, 2 to 6 percent slopes, eroded, in a cultivated field; 1,350 feet east and 225 feet north of southwest corner sec. 2, T. 12 N., R. 7 W. (Page 81)

Stendal series: silt loam, frequently flooded
(Sn – (Severe) flooding and wetness)

This soil is nearly level, deep, and somewhat poorly drained. Available water capacity is high, and permeability is moderate. The organic matter content is moderately low, and surface runoff is very slow. The surface layer is friable and easy to work but ends to puddle and crust after hey rains. The seasonal high water table fluctuates between a depth of 1 foot and 3 feet during winter and early in spring. It is in narrow bands along small streams and in irregularly shaped areas on broad bottomlands. Most areas range from 10 to 600 acres.

The soil is severely limited and is generally **not suitable for building sites and sanitary facilities** because of the hazard of flooding and wetness. (Page 44)

Typical pedon of Stendal silt loam, frequently flooded, in a cultivated field: 1,300 feet east and 150 feet north of southwest corner sec. 23, T. 10 N., R. 7W. (Page 87)

Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent (sewage that has been treated in a septic tank or sewage treatment plant) from a waste disposal system.

Lower Eel River Watershed HEL/PHEL/Hydric Soils

HEL Soils	**PHEL Soils**	**Hydric Soils**
Berks (BdF)	Alvin (AnC)	Atkins (At)
Bloomfield (BmF)	Ava (AvB2)	Bonnie (Bo)
Cincinnati (CcC2)	Bloomfield (BmD)	Evansville (Ev)
Cincinnati (CcC3)	Fairpoint (FcB)	Hoosierville (Ho)
Cincinnati (CeC3)	Henshaw (HbA)	Lyles (Ly)
Chagrin (ChF)	Muren (MuB2)	Montgomery (Mt)
Fairpoint (FcG)	Pike (PkB2)	Montgomery (Mn)
Gilpin (GmE)	Pike (PkC2)	Muck (Mk)
Hickory (HcD)	Princeton (PnB)	Peoga (Pf)
Hickory (HcD3)	Princeton (PnC)	Petrolia (Pg)
Hickory (HcE)		Robinson (Ro)
Hickory (HcF)		Vincennes (Vn)
Parke (PaD2)		Zipp (Zp)-silty clay
Wellston (WeD2)		Zipp (Zs)-silty clay loam

Current Loads and Conditions of Pollutants
October 2007

Pollutant	Current Load	Target Load Tons/Year	Reduction Needed to meet Goal	Reduction Needed to meet Goal
Nitrates (Turkey Creek & Brush Creek)	61.59 tons/yr	54.15 tons/yr	(12.1%)	7.45 tons/yr 12.1% tons/yr
Phosphates	5.69 tons/yr	1.35 tons/yr	(11.9%)	4.33 tons/yr 76.2% tons/yr
E.coli Cfu/year	2.89E+13	1.21E+14	(10.1%)	9.21E+13 76.1%
Sediment	700.52 tons/yr	676.83 tons/yr	(1.9%)	23.69 tons/yr 3.4% tons/yr

Lower Eel River Watershed E. coli Averages

- **#1 Birch Creek 400**
- **#2 Hog Creek 3,125**
- **#3 Six Mile Creek . . . 475**
- **#4 Turkey Creek . . . 1,720**
- **#5 Brush Creek 1,370**
- **#6 Birch Creek 375**
- **#7 Splunge Creek 765**
- **#8 Connley Ditch N. . . .280**
- **#9 Connley Ditch S. . . . 800**
- **#10 Lick Creek 700**
- **#11 Eric Canal. 1,235**
- **#12 White Oak Creek . 570**

Indiana Water Quality Standard for E. coli is 235 CFU/100 mL (Colony Forming Units per 100 milliliters)

Streams in order of E. coli CFU/100 mL (high to low)

Hog Creek	**3,125**	**Lick Creek**	**700**
Turkey Creek	**1,720**	**White Oak Creek**	**570**
Brush Creek	**1,370**	**Six Mile Creek**	**475**
Eric Canal	**1,235**	**Birch Creek**	**400**
Connley Ditch South	**800**	**Birch Creek**	**375**
Splunge Creek	**765**	**Connley Ditch North**	**280**

Lower Eel River Watershed Land Use

Land use in each sub-watershed of the Lower Eel River	Birch Creek	Brush Creek	Connley Ditch Head	Connely Ditch	Erie Canal	Hog Creek	Lick Creek	Sixmile Creek	Splunge Creek	Turkey Creek	White Oak Creek	Total Averages
Row Crops	41.74%	61.09%	66.00%	69.02%	61.13%	60.65%	42.62%	42.21%	57.45%	68.39%	65.72%	**57.82%**
Pasture/Hay	21.68%	23.60%	17.49%	20.37%	17.80%	17.48%	20.04%	21.36%	32.68%	20.45%	20.95%	**21.26%**
Deciduous Forest	18.02%	13.39%	10.31%	4.44%	15.26%	18.78%	34.61%	35.47%	7.41%	6.55%	10.07%	**15.85%**
Low Intensity Residential	7.17%	0.04%	0.12%	4.23%	1.43%	0.57%	0.11%	0.11%	0.03%	0.06%	0.01%	**1.26%**
Open Water	2.39%	0.33%	2.05%	0.23%	1.37%	1.30%	0.84%	0.40%	0.20%	2.40%	1.62%	**1.19%**
Evergreen Forest	0.91%	0.03%	2.64%	0.03%	1.41%	0.55%	1.44%	0.19%	0.23%	0.95%	0.64%	**0.82%**
Mixed Forest	1.96%	1.00%	0.47%		0.31%	0.11%	0.14%	0.01%	0.64%	0.41%	0.17%	**0.47%**
Woody Wetlands	0.85%	0.34%	0.07%	0.01%	0.50%	0.49%	0.18%	0.25%	1.19%	0.75%	0.46%	**0.46%**
Urban/Recreational Grasses	1.82%	0.03%		0.59%	0.42%				0.00%			**0.26%**
Commercial/ Industrial/ Transportation	2.00%	0.00%	0.06%	0.58%	0.21%	0.04%	0.01%	0.00%	0.00%	0.01%	0.00%	**0.26%**
Grasslands/ Herbaceous	0.07%	0.05%	2.64%		0.02%				0.08%			**0.26%**
Quarries/Strip mines/Gravel Pits			0.78%	0.26%						0.01%	0.36%	**0.13%**
High Intensity Residential	0.84%	0.01%	0.00%	0.25%	0.11%	0.03%	0.01%	0.01%	0.02%			**0.12%**
Emergent Herbaceous Wetlands	0.54%		0.01%		0.02%	0.00%	0.00%			0.01%	0.01%	**0.05%**
Small Farms		0.01%							0.00%			**0.00%**

Best Management Practices	Best Management Practices Summary Guide								
	Surface Water Quality								
	Human Waste	Temperature	Sediment	Nutrients Manure	Nutrients Fertilizer	Erosion	Absorbed Pesticides	Aquatic Plants/Fish	E. coli
Management Practices									
Nutrient Management Plans	NA.	No to Low	No to Low	Med. to High	Med. to High	No to Low	No to Low	Low to Med.	Med. To High
Water Table Control	NA	NA	No to Low	Med. to High	Med. to High	No to Low	No to Low	Low to Med.	Low to Med.
Waste Management System*	NA	No to Low	NA	Med. to High	Med. to High	NA	No to Low	Med. to High	Med. to High
Runoff Management System*	NA	NA	Med. to High	Med. to High	Med. to High	Med. To High	No to Low	Med. to High	Med. to High
Vegetative and Tillage Practices									
Conservation Tillage	NA	NA	Med. to High	Med. to High	Med. to High	Med. to High	Med. to High	No to Low	Med. to High
Public Awareness	Med. to High	Low to Med.	Med. to High	Med. to High	Med. to High	Med. to High		Med. to High	Med. to High
Field Border	NA	No to Low	Med. to High	Low to Med.	Low to Med.	Low to Med.	Low to Med.	No to Low	Low to Med.
Filter Strips/Riparian Buffers	NA	Med. to High	Med. to High	Low to Med.	Med. to High	Med. to High		Med. to High	Low to Med.
Cover and Green Manure Crop	NA	NA.	Med. to High	Med. to High	NA	Med. To High	Low to Med.	Med. to High	Med. to High
Pasture and Hayland Management	NA	No to Low	Med. to High	Low to Med.	Low to Med.	Med. To High	No to Low	No to Low	Med. to High

Structural Practices									
Terrace	NA	NA	Med. to High	Low to Med.	Med. to High	Med. to High	Med. to High	Low to Med.	Low to Med.
Liquid Manure Injector Knives	NA	NA	Low to Med.	Med. to High	Med. to High	No to Low	NA	No to Low	Med. to High
GPS Systems	NA	NA	NA	Med. to High	Med. to High	No to Low	NA	No to Low	Med. to High
Livestock Fencing	NA	NA	Low to Med.	Med. to High	NA	Low to Med.	NA	No to Low	Med. to High
Winter Feeder	NA	NA	Low to Med.	Med. to High	NA	Low to Med.	NA	No to Low	Med. to High
Water and Sediment Control Basin	NA	NA	Med. to High	Low to Med.	Med. to High	Med. to High	Med. to High	Low to Med.	No to Low
Diversion	NA	NA	Med. To High	Low to Med	Med. To High	Med. To High	Low to Med.	Low to Med	Low to Med.
Grade Stabilization Structure	NA	NA	Med. To High	Low to Med.	Med. To High	Med. To High	No to Low	Med. To High	Low to Med.
Grassed Waterway	NA	NA	Med. To High	Low to Med	Med. To High	Med. To High	Low to Med.	Low to Med	Low to Med.
Streambank Protection	NA	NA	Med. to High	Low to Med.	Med. to High	Med to High	No to Low	Med to High	Low to Med.

Amount of Effectiveness is indicated by NA (Not Applicable), No to Low, Low to Medium, and Medium to High
* Includes all appropriate structural, vegetative, and management characteristics.

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Water Quality Concerns

Runoff from Industrial Sites _______
Runoff from Feed lots _______
Nutrients (fertilizer, manure) _______
Pesticides _______
Herbicides _______
Erosion and sedimentation _______
Tillage practices _______
Conservation field buffers _______
Livestock Production _______
Human and animal waste _______
Failing septic systems _______
Wildlife and pet waste _______
Household and yard waste _______
Toxic materials _______
Lawn and garden practices _______
Stream bank stabilization _______
Wildlife corridors _______
Roads/parking lots _______
Illegal Dumping _______

Concerns:____
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Detailed TMDL Report

TMDL Document Information

TMDL ID: 11316

TMDL Name: LOWER EEL RIVER WATERSHED

TMDL Status: APPROVED/ESTABLISHED

EPA Action: EPA APPROVED

Lead State: IN

TMDL Date: 03/28/2005

No TMDL Documents have been uploaded for this TMDL.

TMDL Pollutants

Pollutant: PATHOGENS

TMDL Type: POINT/NONPOINT SOURCE

Total Waste Load Allocation:

Total Load Allocation:

Margin Of Safety:

Implicit Margin Of Safety: Not Reported

Units for Total Waste Load Allocation, Total Load Allocation, and Margin of Safety:

TMDL End Point: E. COLI WQS OF 125 CFU PER 100ML AS A 30-DAY GEOMETRIC MEAN AND 235 CFU PER 100ML AS A SINGLE-SAMPLE MAXIMUM.

NPDES Allocation for Pollutants PATHOGENS			
NPDES ID	**Other Non PCS Identification**	**Waste Load Allocation**	**Units**
IN0021211			
IN0039861			
IN0050695			
IN0030783			
IN0021008			

Listed Water Causes of Impairment for PATHOGENS Click on the underlined List ID for a Listed Water Information Report. Click on the underlined "MAP 303(d)" literal for a map of the Listed Water.					
List ID	**State List ID**	**Waterbody Name**	**Listed Water Map**	**Cycles Listed**	**Cause of Impairment**

INW0384_00		BIRCH CREEK-LITTLE BIRCH CREEK	MAP 303(d)	2004	PATHOGENS
INW0385_00		EAST FORK BIRCH CREEK	MAP 303(d)	2004	PATHOGENS
INW0386_00		BIRCH CREEK-PRAIRIE CREEK	MAP 303(d)	2004	PATHOGENS
INW0387_00		BRUSH CREEK-CROOKED CREEK	MAP 303(d)	2004	PATHOGENS
INW0388_00		BIRCH CREEK-OUTLET (ZION CHURCH)	MAP 303(d)	2004	PATHOGENS
INW0392_00		SPLUNGE CREEK-CUTOFF/LITTLE SLOUGH	MAP 303(d)		UNLISTED BUT IMPAIRED
INW0393_T1014		EEL RIVER	MAP 303(d)		UNLISTED BUT IMPAIRED
INW0394_T1016		EEL RIVER	MAP 303(d)		UNLISTED BUT IMPAIRED
INW0395_T1019	INW0395_T1019	CONNELLY DITCH-HEADWATERS	MAP 303(d)	2002	PATHOGENS
INW0396_00		CLAY CITY TRIB	MAP 303(d)	2004	PATHOGENS
INW0396_T1020	INW0396_T1020	CONNELLY DITCH	MAP 303(d)	2002	PATHOGENS
INW0397_T1018	INW0397_T1018	EEL RIVER	MAP 303(d)	2002	PATHOGENS
INW0398_T1015	INW0398_T1015	EEL RIVER	MAP 303(d)	2002	PATHOGENS
INW0398_T1017	INW0398_T1017	WABASH & ERIE CANAL	MAP 303(d)	2002	PATHOGENS
INW0399_00		LAGOON CREEK-HOWESVILLE DITCH	MAP 303(d)	2004	PATHOGENS
INW039A_T1021	INW039A_T1021	LICK CREEK	MAP 303(d)	2002	PATHOGENS
INW039B_T1022	INW039B_T1022	LICK CREEK	MAP 303(d)	2002	PATHOGENS
INW039C_00		NEED/BRUSH CREEK AND OTHER TRIBS	MAP 303(d)	2004	PATHOGENS

INW039C_T1023		LICK CREEK	MAP 303(d)	2004	PATHOGENS
INW039C_T1024	INW039C_T1024	EEL RIVER	MAP 303(d)	2002	PATHOGENS
INW039D_T1025	INW039D_T1025	EEL RIVER	MAP 303(d)	2002	PATHOGENS

No methods have been reported to EPA for this TMDL.
Click here to see metadata for this report.

[1]

[1] United States Environmental Protection Agency (EPA) http://www.epa.gov/ March 7, 2008

http://www.in.gov/dnr/naturepr/species/clay.pdf

Indiana County Endangered, Threatened and Rare Species List

County: Clay

Species Name	Common Name	FED	STATE	GRANK	SRANK
Fish					
Ammocrypta pellucida	Eastern Sand Darter			G3	S2
Cycleptus elongatus	Blue Sucker			G3G4	S2
Reptile					
Clonophis kirtlandii	Kirtland's Snake		SE	G2	S2
Crotalus horridus	Timber Rattlesnake		SE	G4	S2
Nerodia erythrogaster neglecta	Copperbelly Water Snake	PS:LT	SE	G5T2T3	S2
Terrapene ornata	Ornate Box Turtle		SE	G5	S2
Thamnophis proximus	Western Ribbon Snake		SSC	G5	S3
Bird					
Bartramia longicauda	Upland Sandpiper		SE	G5	S3B
Buteo lineatus	Red-shouldered Hawk		SSC	G5	S3
Lanius ludovicianus	Loggerhead Shrike	No Status	SE	G4	S3B
Mammal					
Lutra canadensis	Northern River Otter			G5	S2
Lynx rufus	Bobcat	No Status		G5	S1
Myotis sodalis	Indiana Bat or Social Myotis	LE	SE	G2	S1
Nycticeius humeralis	Evening Bat		SE	G5	S1
Taxidea taxus	American Badger			G5	S2
Vascular Plant					
Carex atlantica ssp. atlantica	Atlantic Sedge		ST	G5T4	S2
High Quality Natural Community					
Wetland - seep acid	Acid Seep		SG	GU	S1

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting

State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list

GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank

SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

December 20, 2005

Clay County SWCD Receives Grant

Unfortunately, the Eel River and many of the streams in the Lower Eel River watershed are not healthy. Several streams have been listed by the Indiana Department of Environmental Management as ‘Impaired Streams’. As a result of this listing, the Clay County Soil and Water Conservation District (SWCD) received a grant from the Indiana Department of Environmental Management to help define the problems.

The major concern or ‘Impairment’ is E-Coli bacteria levels which exceed health standards. E-Coli is used as an indicator of Fecal Coliform bacteria. The presence of Fecal Coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man or other animals. At the time this occurred, the source water may have been contaminated by pathogens or disease producing bacteria or viruses which can also exist in fecal material. Some waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis and hepatitis A. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

The purpose of this grant is to conduct stream sampling and assess the activities in the Lower Eel River Watershed. All information gathered will be combined to write a Watershed Management Plan. Once this plan is developed, the next step will be to apply for a grant to provide financial assistance for landowners to correct problems or implement Best Management Practices.

A vital part of the successful completion of this project is community involvement. Your input, ideas and concerns are needed to ensure that a comprehensive plan is developed. We will be holding our first meeting at 7:00 pm on Thursday, January 5th. The meeting will be held at the First Financial Bank Community Center, 502 Main St. in Clay City. If you, your children, grandma or anyone in your family is interested in clean water and a healthy environment, please plan to attend this short informational meeting.

If you have any questions or want more information, please contact the watershed coordinator Daryl Rumbley at the SWCD office (812) 448-1108 (ext. 3).

March 27, 2006

Work Continues on the Lower Eel Watershed Project

The Clay County Soil and Water Conservation District (SWCD) is continuing their work on a Section 319 Grant from the Indiana Department of Environmental Management (IDEM). This grant is for the development of a Watershed Management Plan for the Lower Eel River Watershed.

A group of concerned citizens has come together to form a Steering Committee. This committee will be guiding the development of the Plan. Like most companies and organizations, this group has a Mission: "Identify opportunities for developing and implementing a successful management plan for improvement of the natural resources of the Lower Eel River Watershed." One of the initial steps toward improvement, is to discover what environmental problems or concerns exist in the watershed. Once problems are found, the committee will work toward finding a solution and help with financial assistance for implementing needed corrective action.

IDEM is providing funding, guidance and support for this project, but the watershed group is a separate, independent organization. We are not in any way an enforcement arm of IDEM. We are not here to cause problems for individuals or industry. We are here to work out solutions, not levy fines or mandate compliance. Participation in our program is totally voluntary.

Our next Steering Committee meeting will be held in the Commissioners' room at the Clay County Court House at 7:00pm on April 4th. These meetings are open to the public, so if you wish to express a concern or get involved, please attend our meeting. If you prefer to remain more anonymous, write me a letter expressing your concern and we will include it in our sessions. Like I mentioned above, we are not here to point fingers or get people in trouble, we are here to help.

Daryl Rumbley
Watershed Coordinator
Clay County SWCD
955 W. Craig Ave.
Brazil, IN 47834
(812) 448-1108 ext. 3

June 22, 2006

Clay County SWCD samples water

The Clay County Soil and Water Conservation District (SWCD) is conducting water quality sampling in the Lower Eel River Watershed. The major focus of this sampling project is to define critical areas in the watershed. There are several parameters being monitored, but E-Coli bacteria is the primary concern.

The sampling began in April and will continue thru October of this year. The water quality monitoring will be conducted again next year, beginning in April. Initially, there are 12 sample locations throughout the watershed. Additional sites will be added as needed to better define critical drainage areas. This first round of collecting samples will provide the base line data needed for developing a Watershed Management Plan.

If any problems are found, the Steering Committee will work toward finding a solution. SWCD will apply for Implementation Grants from IDEM, which will help with the cost of implementing needed corrective action.

Daryl Rumbley
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955 W. Craig Ave.
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October 03, 2006

E-coli…Coming to a Stream Near You

Everyone who has watched a news broadcast, listened to the radio or read a newspaper in the past few weeks, has heard about the dangers of E-coli. IDEM (Indiana Department of Environmental Management) and the EPA (Environmental Protection Agency) know of the dangers and have been concerned for many years. In an attempt to clean up our streams and help prevent illness, IDEM is awarding Grants which are funded through the EPA.

The Clay County Soil and Water Conservation District has received a grant to develop a Watershed Management Plan (WMP) for the Lower Eel River Watershed. The focus of this grant is on Non-Point Sources (NPS) of pollution. Municipal treatment plants are monitored and controlled by permit requirements. NPS pollution does not come from a single definable source, like a discharge pipe. NPS can come from many sources, failing septic systems, livestock, wildlife and pets are a few of the possible ways E-coli can enter streams. The WMP will give an overview of the Watershed and the health of the streams. It will not only list problems, but offer possible solutions to maintain a healthy environment for the future.

A Steering Committee consisting of stakeholders in the Watershed, has been established to guide the formulation of the Plan. Like most organizations, they have a Vision and a Mission. Their Vision: *Develop and identify opportunities for the lasting quality improvement for present and future generations of the Lower Eel River Watershed.* Their Mission: *Identify opportunities for developing and implementing a successful management plan for improvement of the natural resources of the Lower Eel River Watershed.*

Based on public input, the Steering Committee has decided on the top 5 concerns in the Watershed. In addition to E-coli the major concerns are: Excess nutrients (fertilizer, manure), Runoff from Feed lots, Erosion and sedimentation, Stream bank stabilization and Human and animal waste. Each of these concerns will be addressed in the WMP.

Before the Plan can be written, baseline water quality data must be obtained. Beginning this past March, monthly samples of 12 locations have been taken. This sampling will continue thru October of next year. The preliminary results have shown that E-coli counts have exceeded the maximum State standards at all of the 12 sites at least once during this summer. As expected, the counts are highest after rainfall events have carried contaminates into the stream. The last samples for this year will be taken in October. Once all of the data has been tabulated, a public meeting will be held to present the results.

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February 12, 2007

Lower Eel River Watershed 319 Project

During 2006 the Clay County SWCD continued work on improving the overall water quality of streams in the county. This project is being funded through a section 319 grant received through the Indiana Department of Environmental Management (IDEM).

The first step in water quality improvement is to determine the current status of the streams. The Watershed Coordinator, Daryl Rumbley, along with Nathan Stoelting and Gloria Rhue, have collected over 100 samples from area streams. These strategically selected sample sites will provide an overview of the Watershed. Data is collected on water temperature, dissolved oxygen, biochemical oxygen demand (BOD), *E.coli*, pH, orthophosphate, nitrates, turbidity, and stream flow. This data, along with biological sampling of macroinvertebrates, will provide information on the health of our streams. This information will also help determine critical areas within the Watershed which may require remedial action.

A group of interested stakeholders in the Watershed have volunteered to serve on a Steering Committee. This Committee is in the process of writing a Watershed Management Plan. This comprehensive plan will help ensure the continued improvement in water quality. As with any organization, this group has agreed upon a Vision and Mission. Their Vision is to Develop and identify opportunities for the lasting quality improvement for present and future generations of the Lower Eel River Watershed.
The Mission Statement for this group is to Identify opportunities for developing and implementing a successful management plan for improvement of the natural resources of the Lower Eel River Watershed. Anyone who is concerned about E-coli contamination or other water quality problems, will be welcome to join our effort.

The data collection phase of the project will conclude in March of 2007. The next step in the process will be to secure Implementation grants. This funding will be used to implement Best Management Practices (BMP) as a means of improving water quality.

Daryl Rumbley
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February 2008

You Can Help Improve Water Quality in Your Area

The Indiana State Standard for E. coli in Indiana streams is 235 colonies/100 cfu. The average stream in the Lower Eel River Watershed has an E. coli count of almost 1,000 colonies/100 cfu.

E. coli is just one of the water quality concerns in Indiana and the Lower Eel River Watershed. Many of you may have heard about the problems with nitrates in the Gulf of Mexico, but did you know that almost 1/3 of the nitrates entering the Gulf of Mexico come from Indiana? The water quality in our watershed does not just affect those of us who live here but also affects millions of other people.

The Clay County Soil and Water Conservation District has spent the last two and a half years sampling and evaluating the quality of water in the Lower Eel River Watershed streams. Many of our streams are polluted with nitrates and phosphates as well as sediment; every stream tested was above the state standard for E. coli, and most of the streams tested five times higher than the state standard of 235 colonies/100 cfu.

We need your help to correct these problems. Please join us for the Watershed Planning Meeting on February 21, 2008, at the Clay City Volunteer Fire Department Building at 7:00 to learn how you can help. We invite all landowners, farm operators, and livestock producers to attend. If you are a homeowner with a septic system or are just concerned about the water quality in the Lower Eel River Watershed streams, we invite you to join us and discuss possible solutions.

The Clay County SWCD and Lower Eel River Steering Committee have put a considerable amount of time and effort into this project and have developed a Lower Eel River Watershed Plan that we would like to present; together we can improve the water quality in the Lower Eel River Watershed. Please mark February 21, 2008, on your calendar now, and join us on the 21st. If you have any questions regarding the meeting or the project in general please don't hesitate to contact us. We hope to see you there.

Phone: 812-448-1108
E-Mail Nathan.stoelting@in.nacdnet.net
Web http://www.clayswcd.iaswcd.org

The State Standard for E. coli in Indiana streams is
<u>235 colonies/100 Cfu</u>.

The average stream in Clay County has an E. coli count of almost <u>1,000 colonies/100 Cfu.</u>

FEBRUARY 21, 2008
WATERSHED PLANNING MEETING
CLAY CITY VOLUNTEER FIRE DEPARTMENT----7:00 p.m.

E. coli is just one of the water quality concerns in Indiana and the Lower Eel River Watershed. Many of you may have heard about the problems with nitrates in the Gulf of Mexico, but did you know that almost 1/3 of the nitrates entering the Gulf of Mexico come from Indiana? The water quality in our watershed does not just affect those of us who live here but also affects millions of other people.

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Phone: 812-448-1108
E-Mail <u>Nathan.stoelting@in.nacdnet.net</u>
Web http://www.clayswcd.iaswcd.org

GLOSSARY OF TERMS

Coliform – intestinal bacteria, the presence of which in streams indicates fecal contamination. Exposure may lead to human health risks.

Dissolved Oxygen- oxygen dissolved in water that is available for aquatic organisms.

E. coli – a type of coliform bacteria found in the intestines of warm-blooded organisms, including humans.

Erosion – the removal of soil particles by the action of water, wind, ice, or other agent.

Effluent - sewage that has been treated in a septic tank or sewage treatment plant.

Groundwater – water that flows or seeps downward and saturates soil or rock.

Headwater – the origins of a stream.

Hydrologic Unit code (HUC) – unique numerical code created by the U. S. Geological survey to indicate the size and location of a watershed within the United States.

Impaired Waterway – a waterway, which does not meet federal or state water quality standards. Waterways may be impaired for recreational use due to the presence of E. coli, for fish consumption due to high levels of PCBs or mercury, for high leve3ls of nutrients, or other causes.

Impervious Surface- any material covering the ground that does not allow water to pass through or infiltrate, e.g. roads, roofs, parking lots.

Infiltration – downward movement of water through the uppermost layer of soil.

Non-point Source Pollution (NPS) **–** pollution generated from large areas with no identifiable source, e. g. storm water runoff from commercial areas, sediment laden runoff from farm fields.

Nutrients – nitrogen (nitrate) and phosphorous (orthophosphate)

Permeable – capable of being passed through.

Point Source Pollution – pollution originating from a point such as a pipe or culvert.

Pollutant – as defined by the clean Water Act (Section 502(6)): "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes. Biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water.

Riparian Zone – and area adjacent to a water body, which is often vegetated and constitutes a buffer zone between land and water.

Run off – water from precipitation, snowmelt, or irrigation that flows over the ground to a water body.

Sedimentation – the process by which soil particles enter, accumulate, and settle to the bottom of a water body.

Acronyms

303(d): The specific list of waters that are impaired and need restoration in order to meet state water quality standards.
305(b): State water quality reports
319: Section 319 of the clean Water Act; funding through IDEM
BMP – Best Management Practice
EPA – Environmental Protection Agency
GPS – Global Positioning system
HUC – Hydrologic Unit Code
IDEM – Indiana Department of Environmental Management
IDNR – Indiana Department of Natural Resources
NPDES – National Pollutant Discharge Elimination
NPS – Nonpoint Source
NRCS – Natural Resources Conservation Service
QAAP – Quality Assurance Project Plan
SWCD – Soil and Water Conservation District
TMDL – Total Maximum Daily Load
USDA – United States Department of Agriculture
USFWS – United States Fish & Wildlife Service
USGS – United States Geological Survey
WMP – Watershed Management Plan

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Tools for Addressing E. coli.
http://www.hecweb.org/Programs%20and%20Initatives/Watershed/toolkit%20ch3A%20human%20Ecoli.pdf