VFC Index - Watershed (Plan)

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The Little Vermillion River Watershed: A Plan for the Future

Adopted by the
Little Vermillion River Advisory Group

Project Mission Statement

To assess the water quality of the Little Vermillion River Watershed and promote, protect, and enhance watershed health for the benefit of the residents.

This project was made possible by a $304,272.00 Clean Water Act Section 319 grant to the

Vermillion County Soil and Water Conservation District from the

Indiana Department of Environmental Management.

The Little Vermillion River Watershed: A Plan for the Future

Executive Summary

The Little Vermillion River Watershed project was contracted for three 14-digit watersheds. The 14-digit watersheds have now been divided into four 12-digit watersheds. The Little Vermillion River Watershed is located in west central Indiana, and borders the state of Illinois. The Little Vermillion River originates in Champaign County, Illinois and runs across the state line through Indiana to the Wabash River.

Some local residents and landowners formed the Little Vermillion River Watershed Group (LVRWG) to be of assistance in writing the Watershed Management Plan (WMP). The WMP consists of the LVRWG prioritized concerns of local residents, data collection, critical area identification, best management practices (BMPs), and load reductions. Prior data collection, chemical, biological, and visual assessments were collected and reviewed to determine critical areas. Critical areas were determined by the overall 12-digit watersheds based on criteria, including the Little Vermillion River Watershed Group chemical and biological test results, windshield survey, flyover survey, land-use, and the Illinois TMDL. Load averages were calculated for each parameter in the 12-digit watershed. From the critical areas the concerns were linked to the subwatersheds. Upon determining critical areas the plan provides BMPs in those areas to improve water quality standards.

Future actions as a result of this plan include expanded programs and activities focused on nonpoint source pollution (NPS) education in the watershed, increased opportunities for watershed landowners to implement conservation practices, and attempts of further cooperation and involvement among watershed stakeholders.

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Acronyms and Initialisms

BMP	Best Management Practices
BOD	Biological (or Biochemical) Oxygen Demand
CCSI	Conservation Cropping Systems Initiative
CRP	Conservation Reserve Program
CTIC	Conservation Technology Information Center
CWA	Clean Water Act
CWP	Center for Watershed Protection
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
GAP	Gap Analysis Program
GIS	Geographic Information System
GPS	Global Positioning System
HEL	Highly Erodible Land
HUC	Hydrologic Unit Code
IAC	Indiana Administrative Code
ICM	Impervious Cover Model
IBRC	Indiana Business Research Center
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
ISDH	Indiana State Department of Health
LVRWG	Little Vermillion River Watershed Group
MRCC	Midwestern Regional Climate Center
NPDES	National Pollutant Discharge Elimination System
NPS	Non-Point Source
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
QHEI	Qualitative Habitat Evaluation Index
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USGS	United States Geological Survey

UWA	Unified Watershed Assessment
WHIP	Wildlife Habitat Incentives Program
WWTP	Wastewater Treatment Plant

Glossary of Terms

303 (d) List – a list identifying water bodies that are impaired by one or more water quality elements thereby limiting the performance of designated beneficial uses.

Aquifer – any geologic formation containing water, especially one that supplies water for wells, springs, etc.

Best Management Practice (BMP) – a device, practice, or method implemented to control or reduce nonpoint source pollution from reaching receiving waters.

Biochemical Oxygen Demand - measure of the quantity of oxygen used by macroorganisms (e.g. aerobic bacteria) in the oxidation of organic matter.

Canopy Cover – the overhanging vegetation over a given area, typically full-grown trees.

Channelization – straightening of a stream; often the result of human activity.

Coliform – intestinal waterborne bacteria that indicates fecal contamination. Exposure may lead to human health risk

Combined Sewer System- systems are designed to transport both stormwater run-off and sewage in the same pipe.

Designated Uses – state established uses that waters should support (e.g. fishing, swimming, aquatic life).

Detention Pond – a basin designed to slow the rate of stormwater run-off by temporarily storing the run-off and releasing it at a specific rate.

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

Downstream – in the direction of a stream's current.

Dredge – to clean, deepen, or widen a water body using a scoop, usually done to remove sediment from a streambed.

Easement – a right, such as a right-of-way, afforded an entity to make limited use of another's real property.

Eco-region – a geographic area characterized by climate, soils, geology, and vegetation.

Ecosystem – a community of living organisms and their interrelated physical and chemical environment.

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

Escherichia coli (*E. coli*) – a type of coli form bacteria found in the intestines of warm-blooded organisms, including humans.

Eutrophication- process whereby water bodies, such as lakes, estuaries, or slow-moving streams receive excess nutrients that stimulate excessive plant growth (algae, periphyton attached algae, and nuisance plants weeds).

Glide – an area common to most modified stream channels that do not have distinguishable pool, run, and riffle habitats; the current and flow is similar to that of a canal

Geographic Information System (GIS) – integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographical referenced information.

Global Positioning System (GPS) – a U.S. space-based radio navigation system that provides reliable positioning, navigation, and timing service to civilian users on a continuous worldwide basis

Gradient – measure of a degree of incline; the steepness of a slope.

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.

Impervious Surface – any material covering the ground that does not allow water to pass through or infiltrate (e.g. roads, driveways, roofs).

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

Macroinvertebrates – animals lacking a backbone that are large enough to see without a microscope.

Maximum Contaminant Load (MCL) – the highest level of a contaminant that is allowed in drinking water.

National Pollutant Discharge Elimination System (NPDES) – national program in which pollutant dischargers such as factories and treatment plants are given permits with set limits of discharge allowable.

Nonpoint Source Pollution (NPS) – pollution generated from large areas with no identifiable source (e.g. storm water run-off from streets, development, commercial and residential areas, agricultural run-off).

Permeable – capable of conveying water (e.g. soil, porous materials).

Point Source Pollution – pollution originating from a "point," such as a pipe, vent, 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."

Pollution Tolerance Index- is based on the concept of indicator organisms and tolerance levels; any reading above 23 is considered "Excellent"

Pool – an area of relatively deep, slow-moving water in a stream.

Retention Pond – A basin designed to retain storm water run-off so that a permanent pool is established.

Riffle – an area of shallow, swift moving water in a stream.

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

Run – an area of rapid, non-turbulent flow; runs are deeper than riffles with a faster current

Run-off – water from precipitation, snowmelt, or irrigation that flows over the ground to a water body, Run-off can pick up pollutants from the air or land and carry them into lakes, and rivers.

Sediment – soil, sand, and minerals washed from the land into a water body.

Sedimentation – the processes by which soil particles (sediment) enter, accumulate, and settle to the bottom of a water body.

Soil Association – a landscape that has a distinctive pattern of soils in defined proportions, typically named for the major soils.

Stormwater – the surface water run-off resulting from precipitation falling within a watershed.

Substrate – the material that makes up the bottom layer of a stream.

Subsurface drainage- removes excess water from the soil profile, usually through a network of perforated tubes installed 2 to 4 feet below the soil surface.

Surface drainage- is the removal of water that collects on the land surface.

Topographic Map – map showing natural and/or physical features of a landscape, including altitude contours.

Total Maximum Daily Load (TMDL) **–** calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and allocates pollutant loadings among point and non-point sources.

Tributary – a stream that contributes its water to another stream or water body.

Turbidity – presence of sediment or other particles in water, making it unclear, murky or opaque.

Upstream – against the current.

Water-friendly behavior- being respectful and mindful of your own actions in protecting and preserving the ecosystems within the watershed.

Water Quality – the condition of water with regard to the presence or absence of pollution.

Water Quality Standard – recommended or enforceable maximum contaminant levels of chemicals or materials in water.

Watershed – area above a body of water or watercourse that partially surrounds it and contributes water from rain and/or other drainage sources.

Wetlands – lands where water saturation is the dominant factor in determining the nature of soil development and the types of plant and animal communities.

Zoning - to designate, by ordinance, areas of land reserved and regulated for specific uses, such as residential, industrial, or open space.

Section I: Project Introduction

The Vermillion County Soil and Water Conservation District (SWCD) successfully submitted an application in 2007 for an EPA 319 Non-point Source Management Program grant for the Little Vermillion River Watershed Project. The watershed program, which began in May 2008, enabled the SWCD to identify water quality, land use, and natural resource characteristics within the Little Vermillion River Watershed. In addition, the Watershed Program was designed to involve local stakeholders in identifying threats to local water quality resources and developing strategies to protect them. After approval of this watershed management plan on July 12, 2010 the cost-share implementation plan was developed to help encourage stakeholders to implement best management practices (BMP).

The design of the Watershed Program was based strongly on the watershed approach for environmental management. The watershed approach is a coordinating framework that focuses public and private sector efforts to address water quality concerns within a watershed. This type of management approach integrates four major topics: 1.) targeting priority problems, 2.) involving stakeholders, 3.) developing integrated solutions, 4.) measuring success (USEPA 1995). This approach ensures diverse interests are represented in the planning process, and it helps to form lasting partnerships to achieve success.

The Watershed Program provided the first thorough examination of concerns and issues facing residents of this watershed. This resulting plan is a living document and is intended as a guide to be used by local decision makers for outreach, education, implementation, and assistance efforts. Further, it is to be used by landowners and citizens of the watershed to increase their understanding of water quality issues. The suggestions made under this management plan do not establish legal requirements, but instead provide a framework to coordinate voluntary efforts to improve and maintain water quality.

Designating the Study Area

A watershed is an area of land that water flows over or under on the way to a particular water body. In the United States, watersheds are identified using a hierarchical coding system, Hydrologic Unit Codes (HUC), developed in the mid-1970's by the U.S. Geological Survey (USGS). Based on topographical surface features, this system divided the country into regions, sub-regions, accounting units, and cataloging units. A unique number was assigned to identify each level. The resulting system provides a watershed coding system organized in a nested hierarchy by size; the more digits contained in the code, the smaller the watershed. In Figure 1 the location of Vermillion County is located in red, which allows one to be able to locate the approximate watershed region Vermillion County falls within on the watershed HUC map.

The Vermillion County SWCD established the watershed grant area through the project proposal and grant application. The SWCD choose three 14-digit HUC watersheds within the Little Vermillion River Watershed. The focus of the Little Vermillion River Watershed Project planning efforts were determined to be in 05120108140040, 05120108140050, and 05120108140060. The United States Geological Survey (USGS) re-coded all watersheds in the country to 12-digit HUCs at the beginning of the grant agreement and the watershed group decided it would benefit the group to pioneer the change and incorporate the 12-digit HUCs into the plan. The 14-digit and 12-digit HUCs locations are similar; however the boundaries have expanded in some drainage areas and split the largest 14-digit watershed into two 12-digit HUC. Within Figure 2 the differences between the 12-digit and the 14 digit watersheds are visually distinguishable. One can also see the areas in the 14-digit watershed 05120108140040 and the

05120108140050 watershed have increased. A section of the Little Vermillion River Watershed is located within Parke County, Indiana. The watersheds within the scope of the grant can be seen in Figure 2 highlighted in the teal color.

The Little Vermillion River drains water from within these three watersheds. In 2006 & 2007 a watershed inventory was conducted prior to the grant approval. During these two years sampling was conducted at six testing locations. Data was collected from these six testing sites. However, the data was not collected on a monthly basis. In 2008, the first year for the grant, it was decided to continue testing at the prior six sampling locations which are located within the three hydrological unit codes designated in Figure 3. With the six sampling locations this allows for testing to be conducted in each of the watersheds. After completion of our 2008 samplings and review of the data we decided we needed to modify the sampling locations to better determine potential areas of concern. There was an addition of one more site plus a change of location from the main branch of the Little Vermillion to Jonathan Creek, a tributary. The seven test sites were chosen due to their geographic locations and their convenience to reach the riverbank to obtain water samples. Also, in 2009 IDEM conducted a study on the river at three testing locations. In Figure 4 one can visualize approximate locations of the testing sites.

The county seat of Newport, the periphery of the towns of Cayuga, Highland, Hillsdale, Eugene, Quaker and Georgetown, IL are all in the watershed. The major roadways of US 71 and US 63 also pass through portions of the watershed. There are several small tributaries that start out as farm drainage ditches and eventually end up draining into the Little Vermillion River. Within the watershed there is only one named tributary draining into the Little Vermillion River, the tributary is known as Jonathan Creek.

Throughout the rest of the Little Vermillion River Watershed Plan the four 12-digit HUCs will be referred to as follows: 051201081102- Jonathan Creek Watershed; 051201081103- Horseshoe Bend Watershed; 051201081104- Newport Watershed; and 051201081603-SE Wabash Watershed. The correlation between the HUC and the name is shown in Figure 2.

Figure 1: Watershed HUC (data source: HUCS)

This map is intended to serve as an aid in graphic representation only.
This information is not warranted for accuracy or other purposes.

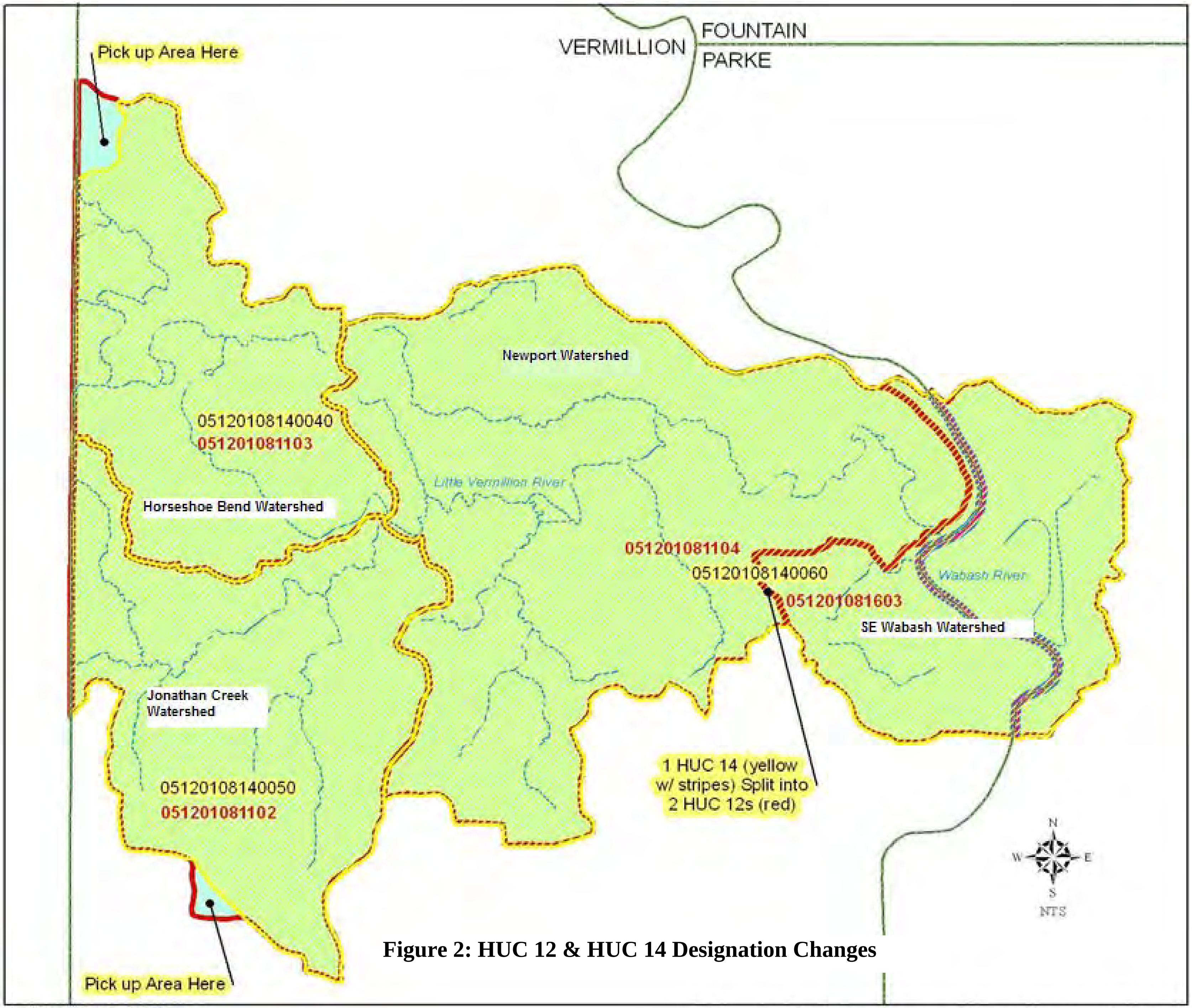

Figure 2: HUC 12 & HUC 14 Designation Changes

IDEM/Office of Water Quality/NPS Program
Draft By: J. Wood / October 09, 2008
Projection/Datum: UTM, Zone 16, NAD 83

This map is intended to serve as an aid in graphic representation only.
This information is not warranted for accuracy or other purposes.

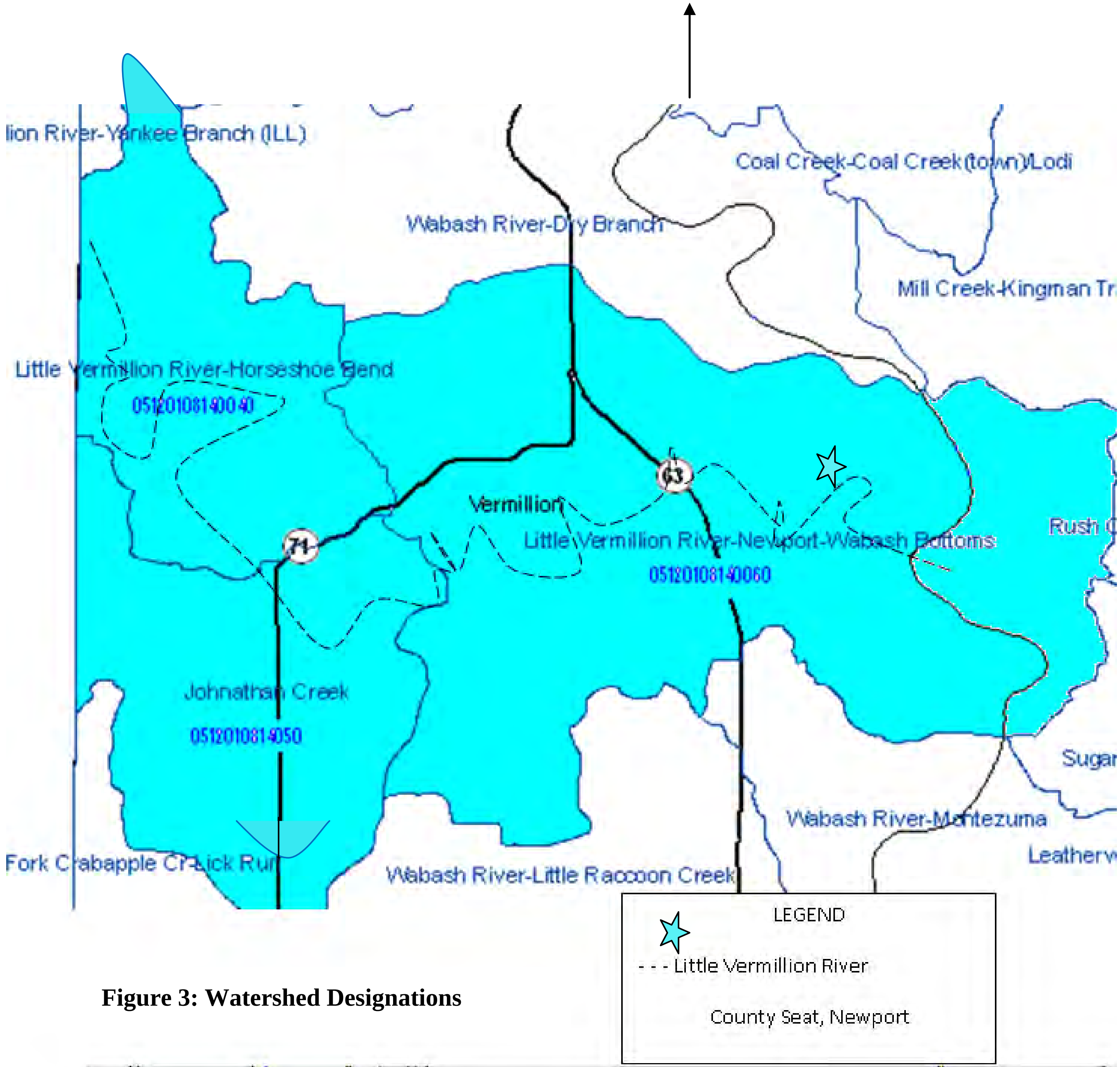

Figure 3: Watershed Designations

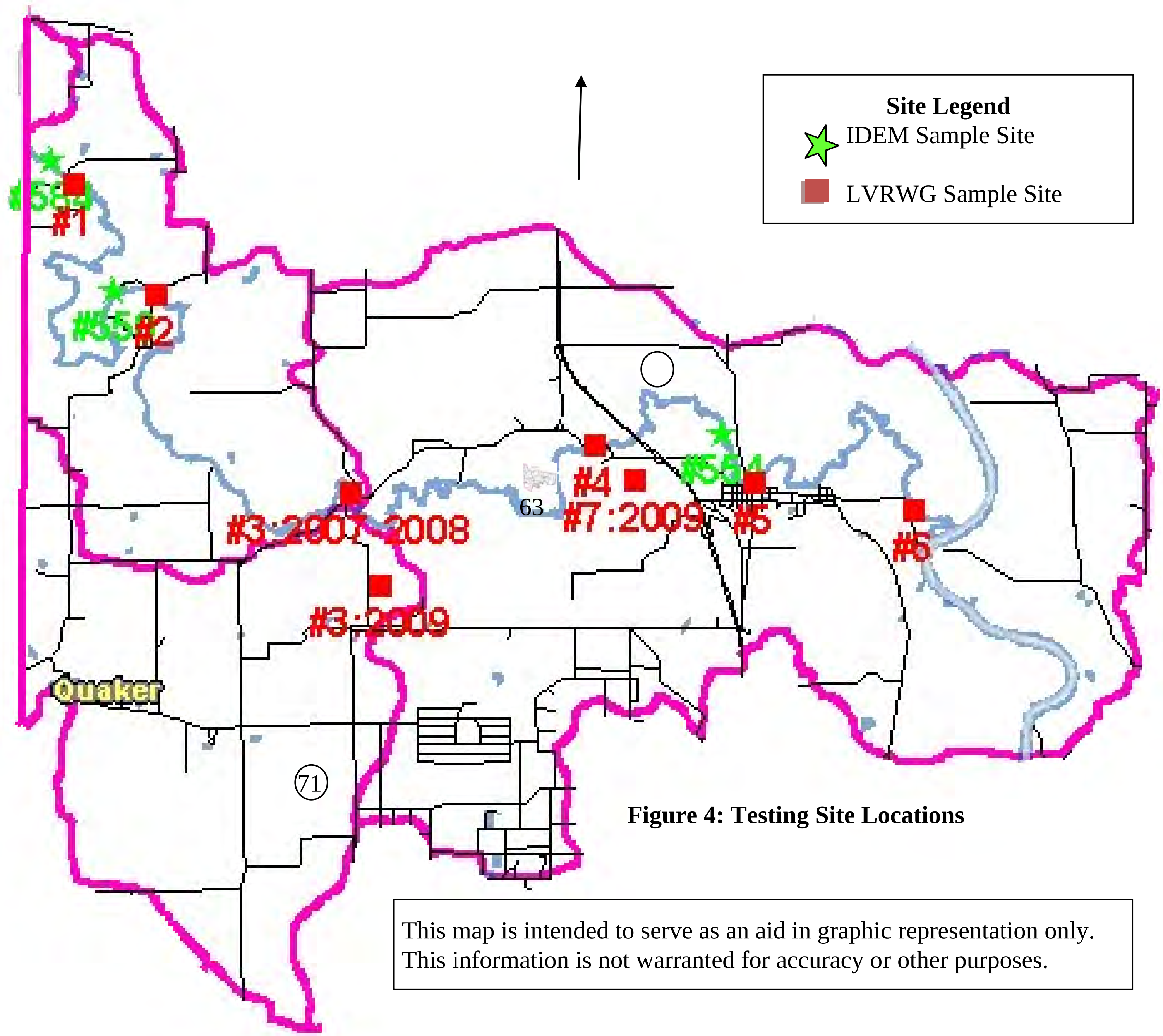

Figure 4: Testing Site Locations

This map is intended to serve as an aid in graphic representation only.
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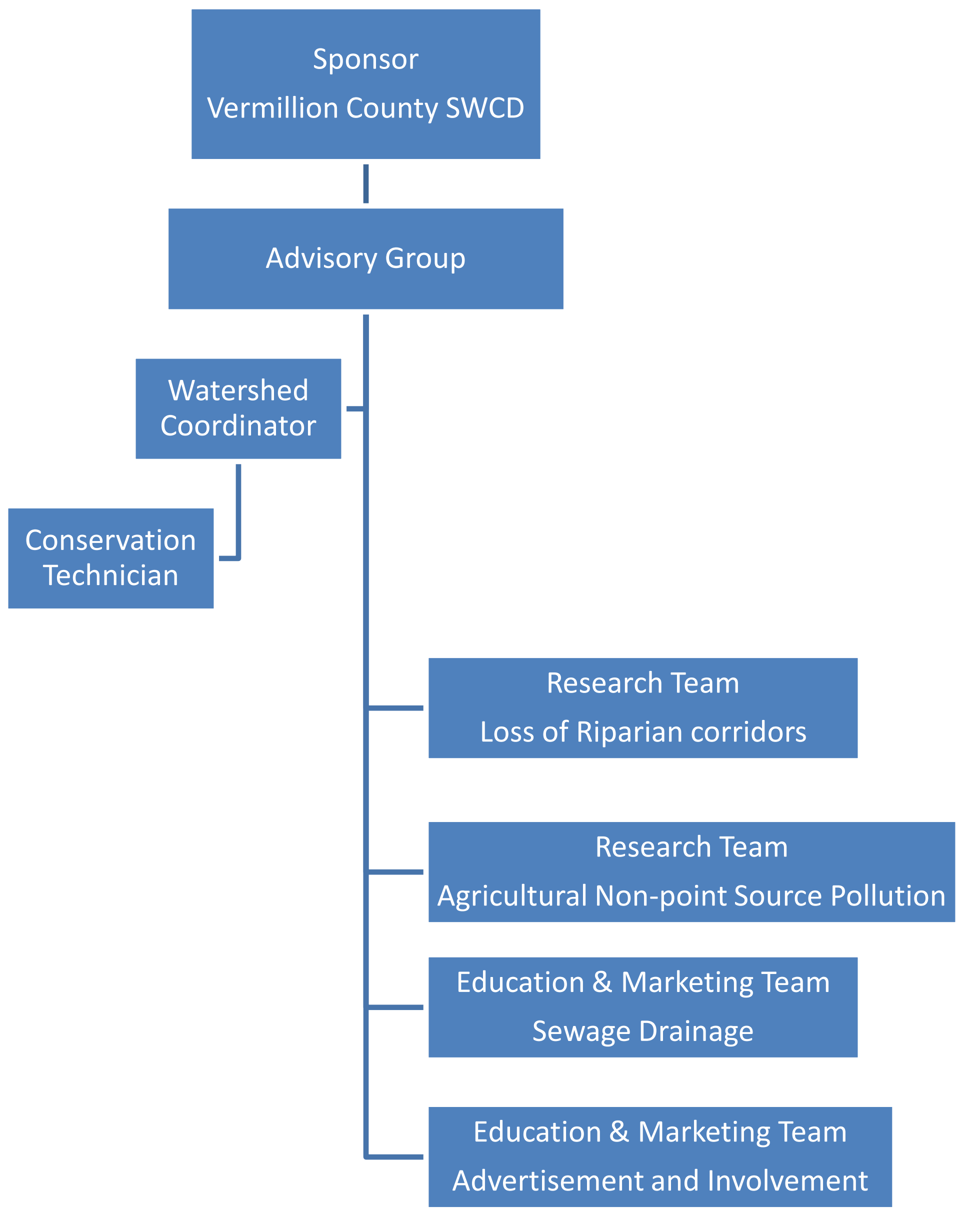
Building Partnerships

The projects organizational structure is shown in Figure 5. Assessment of the Little Vermillion River Watershed water resource problems was sponsored by the SWCD Board of Supervisors. The SWCD and the watershed coordinator led efforts to develop the advisory group. Once established, the advisory group determined the direction of planning efforts.

Figure 5: Organizational structure of the Vermillion County Watershed Program



The SWCD's planning efforts began with the formation of a watershed Advisory Group shown in Figure 5. In June of 2008, an initial public meeting was held to introduce the Little Vermillion River Watershed Project to the public and to form the Advisory Group. Citizens were encouraged to attend this meeting through press releases in the Daily Clintonian and the Vermillion County Purdue Extension Newsletter, and 120 individual invitations were mailed to stakeholders within the watershed areas. A mailing list of stakeholders was determined using Vermillion County property tax information forms. According to Parke County property tax information one landowner owned the bottomland within the watershed area. This individual was sent a personal letter inviting him to participate. The members of the Little Vermillion River Watershed Group (LVRWG) represent diverse interests and backgrounds within the watershed, and include government officials, farmers, planners, and concerned citizens. Appendix A lists the members who participated in developing the watershed management plan (WMP). This group was responsible for ensuring local values were taken into account during the plan development, execution of planning activities, and coordinating plan implementation. The LVRWG adopted the following mission statement:

"To assess the water quality of the Little Vermillion River Watershed and promote, protect, and enhance watershed health for the benefit of the residents."

In order to identify issues of concern among residents in the watershed, a public meeting was held in June of 2008 at the Vermillion County Courthouse in Newport, Indiana. The meeting introduced the watershed coordinator, watershed project and provided the residents with a forum to express their concerns. In addition, a questionnaire was handed out during the presentation for residents to further express their opinions. The concerns identified during this meeting were compiled and distributed to the LVRWG. The steering committee reviewed the four main concerns the citizens stated during the meeting and determined there were two more concerns that should be considered throughout this Watershed Management Plan, which are listed in Table 1.

As the plan progressed the LVRWG determined a few other concerns that needed to be considered when writing this plan. Part B of Table 1 indicates the new concerns brought forth after review of all data sources and discussion of the windshield and aerial surveys. Part C of Table lists the final concerns that shall be touched on throughout this WMP. Some concerns from Parts A & B have been grouped in Part C.

PUBLIC CONCERNS FOR LITTLE VERMILLION RIVER WATERSHED

1.) **Bank Erosion**
2.) **Riparian Loss**
3.) **Land Loss**
4.) ***E. coli* contamination**

Table 1: Concern Prioritization

Concern	Total Votes	% of Voters n=7
Part A: Initial concerns		
Bank Erosion	7	100%
Riparian Loss	5	71.4%
Land Loss	5	71.4%
E. coli contamination	4	57.1%
Ag Nonpoint Source Pollution	3	42.8%
Need for Education	3	42.8%
Part B: Added Concerns		
Log Jams		
Septic Systems		
Part C: Final Concerns		
Concerns	**From…**	**Incorporates**
Bank and Land Loss	Part A	Bank Erosion Riparian Loss Land Loss
Log Jam	Part B	Log Jams Logging Practices Bank Erosion
E. coli Contamination	Part A	Georgetown WWTP Town of Newport Septic Systems Livestock Access
Need for Education	Part A & B	Septic Systems No-Till Cover Crops Wetlands
Ag. Nonpoint Source Pollution	Part A	Chemical Loads Farming Practices

Among the steering committee members listed in Appendix A during one of the first monthly meetings the group discussed a feasibility timeline of events for the three -year grant period. The following Figure 6 depicts the timeline of events.

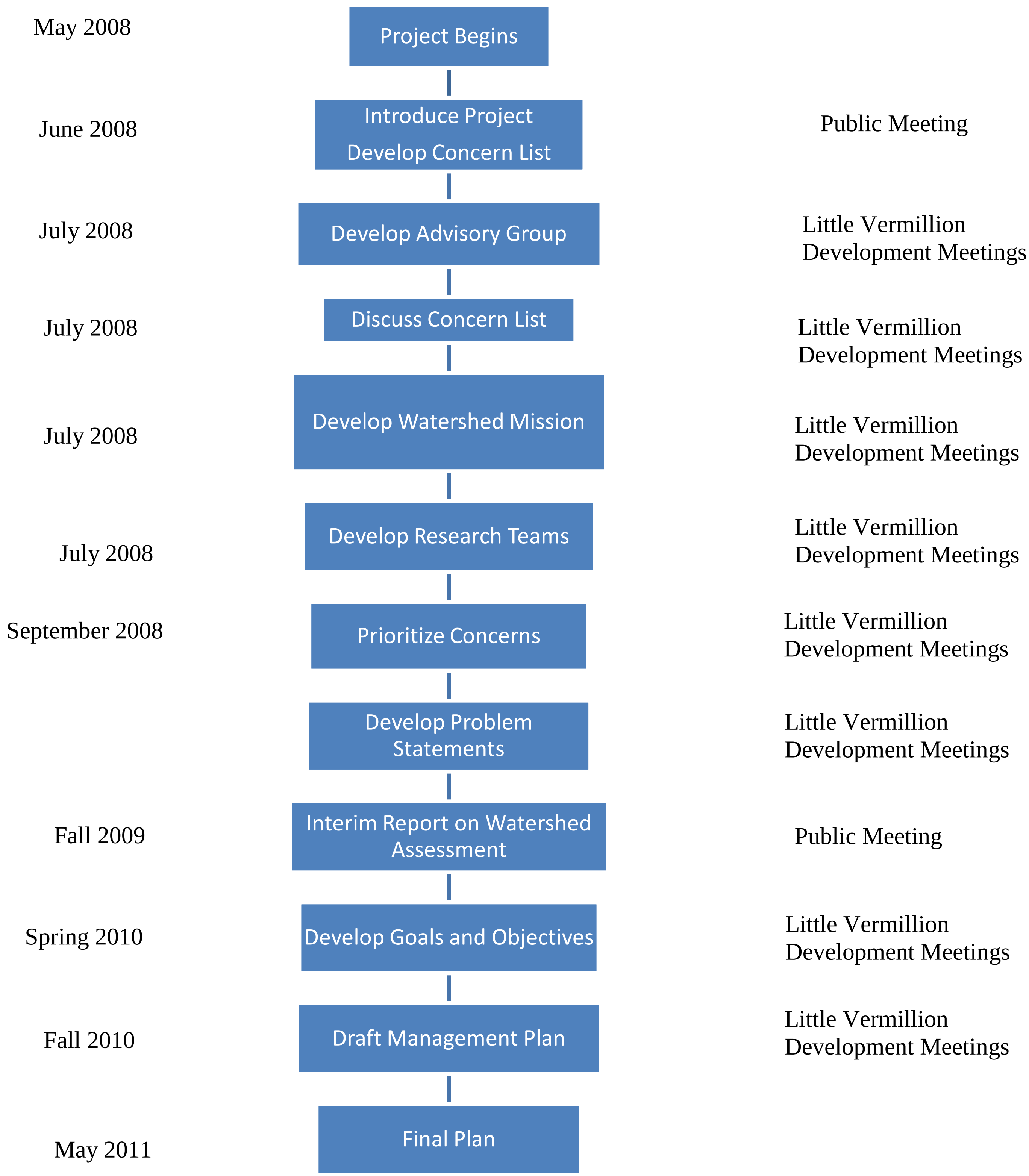


Figure 6: Little Vermillion River Watershed Planning Process

Surrounding TMDLs

The Little Vermillion River Watershed Project lies between the Illinois border and just East of the Wabash River. The Little Vermillion River begins in east-central Illinois and drains approximately 128,548 acres within Illinois before entering into Vermillion County, Indiana. Before emptying into the Wabash River it drains approximately 35,368 acres or 21% of Vermillion County, Indiana. The Little Vermillion River located within Indiana is not listed on the Indiana 303(d) List of Impaired Waters. However, the section of the Little Vermillion River in Illinois and the Wabash River which it drains into on the east are both on the list.

The Little Vermilion River is listed on the 303(d) list with the Illinois Environmental Protection Agency (IEPA). The Little Vermilion River is listed for the impairments of fecal coliform. According to the *Fecal Coliform* TMDL Development for the Little Vermilion River, Illinois final report "the potential sources of impairment are unknown for the river." The river is listed as not supporting for primary contact/swimming but is fully supporting for aquatic life according to Illinois regulations.

The Little Vermillion River meanders through central Vermillion County, IN before finally emptying into the Wabash River. The Indiana Department of Environmental Management (IDEM) has the Wabash River listed on the Indiana 303(d) List of Impaired Waters from the Upper Wabash Watershed down until entering into Illinois. The Wabash River is listed as impaired for *E. coli* and nutrients. According to the Wabash TMDL final report the area from which the Little Vermillion River discharges, INBO8E6_M1022, clear to the Illinois border is listed as likely impaired for *E. coli*.

Section II: Physical Description of the Watershed

This section provides an understanding of the physical setting of the watershed. This background information includes descriptions of the area's geologic history, physiography, water supply, wetlands, floodplains, soils, hydrologic features, local climatic information, and the natural history of the watershed.

Geological History and Physiographic Features

Geologically the Little Vermillion River Watershed lies entirely within the Pennsylvanian system. According to Todd Thompson's article "Bedrock Geology of Indiana" is comprised of a hierarchy to identify the different layers of sedimentary bedrock. Beds with similar characteristics and distribution are combined together and identified as "formations." Formations can be combined into "groups." The groups can be broken down into "systems." The map on the following page identifies the system in the counties. According to the Indiana Geological survey from Indiana University the depth of the bedrock in Vermillion County and Parke County ranges from 260 to 470 feet in thickness. Limestone and four of Indiana's commercially important coals are constant across the counties. As indicated in Figure 7 below the green color indicates the Pennsylvanian bedrock geology.

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Figure 7: Watershed Geology

Physiography is defined as the study of physical features of the earth's surfaces caused by glaciations, karsts, tectonics or volcanism. By looking at the physiography of our area we can better determine the soil types present within our county to give us a better understanding of the soil characteristics. Understanding the soil characteristics can aid in determining BMP uses on the land.

Vermillion and Parke Counties were affected by the Wisconsin Glacial Period. This glacial period advanced throughout Indiana approximately 50,000 years ago (Indiana Geological Society). These glaciers deposited glacial till, scattered sand and gravel deposits, silt, lake clays, and alluvial materials on the land surface. These deposits helped to create mineral and nutrient rich soil. Along with the Wisconsin glacial period parts of the watershed were affected by the Illinoisan and pre-Illinoisan glacial periods. While the Wisconsin Glacial Period deposits occurred around 50,000 years ago the Illinoisan occurred sometime between 300,000 to 140,000 years ago and the pre-Illinoisan was prior to the Illinoisan time. Figure 8 delineates the glacial periods that occurred in Indiana.

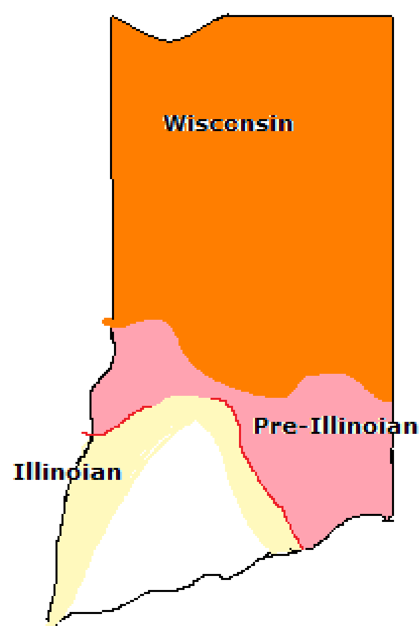
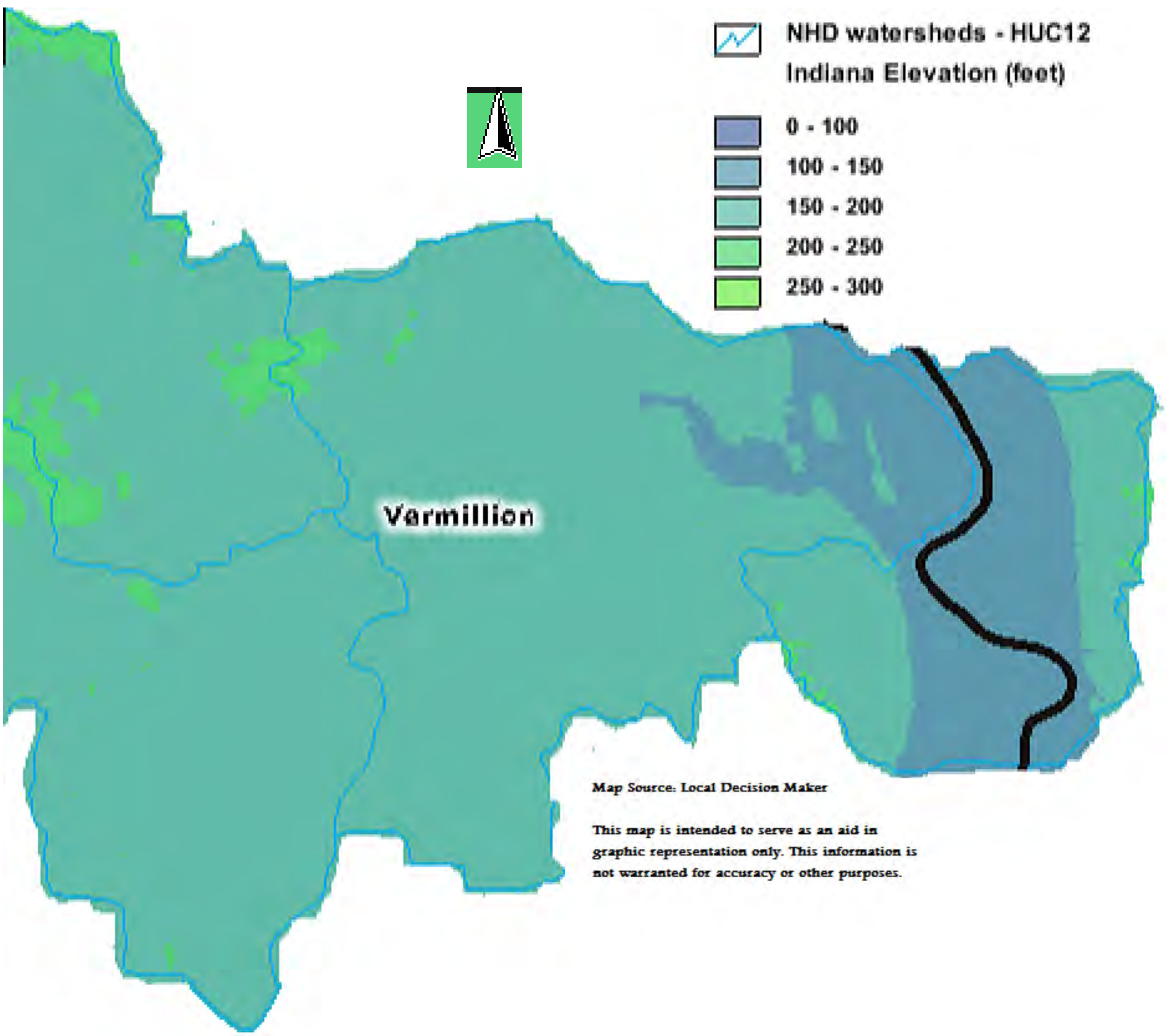


Figure 8: Glacial Periods

Slope and Elevation

According to the 2004 Vermillion Co. Indiana Soils Survey, land within the Little Vermillion River Watershed ranges in elevation from 0 feet above sea level to 300 feet above sea level. The terrain is gently sloping, slightly rolling hills, to flat farm land with large gullies. Figure 9 represents the delineation of the watersheds elevations according to the Local Decision Maker software tools. Figure 10 gives a topographic look at the watershed.

Figure 9: Elevation

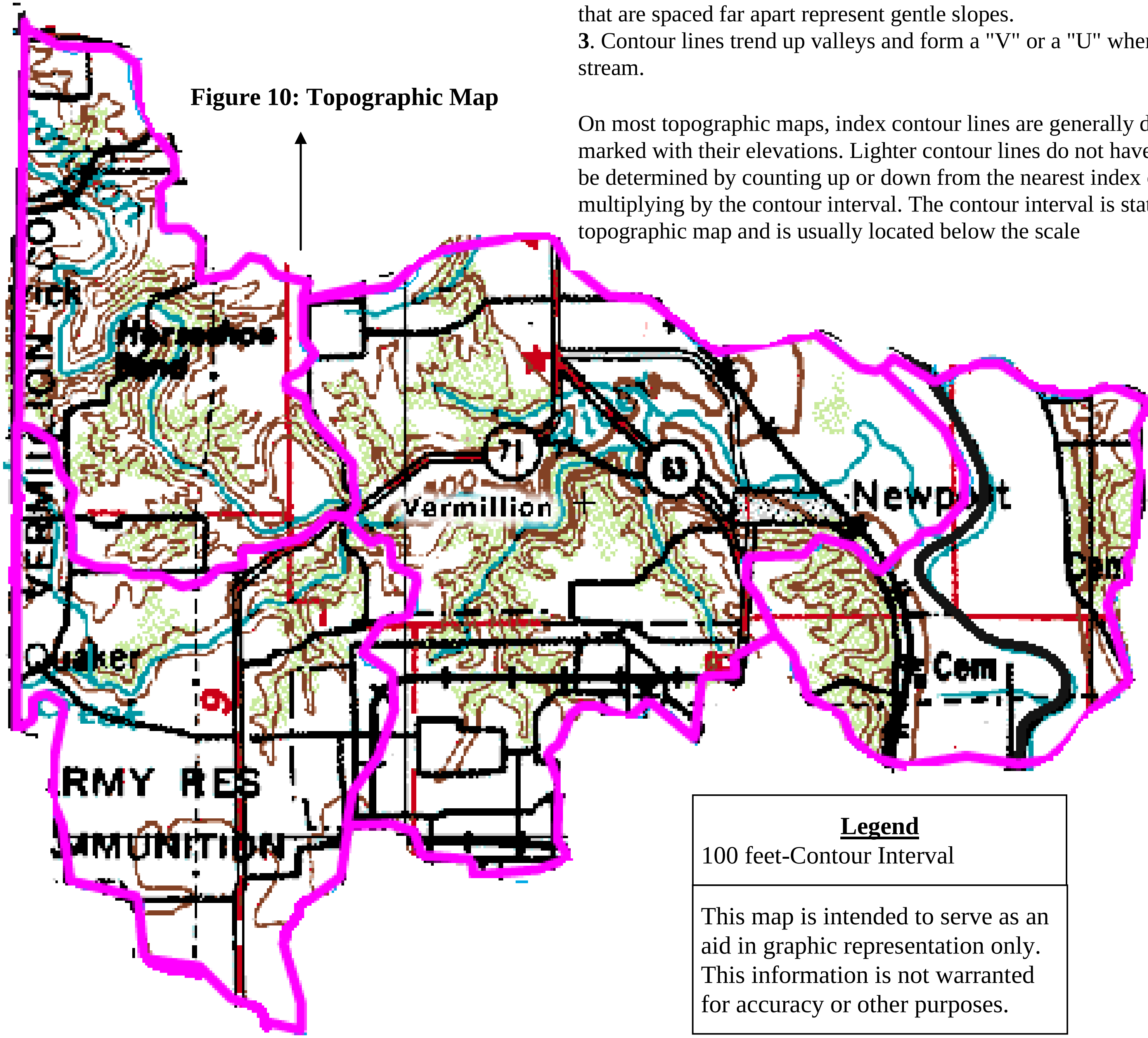


The following are general characteristics of contour lines:

1. Contour lines do not cross each other, divide or split.
2. Closely spaced contour lines represent steep slopes, conversely, contour lines that are spaced far apart represent gentle slopes.
3. Contour lines trend up valleys and form a "V" or a "U" where they cross a stream.

On most topographic maps, index contour lines are generally darker and are marked with their elevations. Lighter contour lines do not have elevations, but can be determined by counting up or down from the nearest index contour line and multiplying by the contour interval. The contour interval is stated on every topographic map and is usually located below the scale

Figure 10: Topographic Map



Legend
100 feet-Contour Interval

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Water Supply

Drinking water is provided through both private wells and municipal water systems for the residents of the Little Vermillion River Watershed. The municipal water system only provides water for the town of Newport. The drilled well for the town is located east of town near the Little Vermillion River. There is also a back-up well located near the Old Jail in Newport. Private wells are utilized primarily in unincorporated areas of the county. Drilled wells are the most common within the watershed, being drilled in terraces and in the bottom land along the Wabash River. Respectfully, Figure 11 on page 21 represents the relative location of known privately drilled water wells within the watersheds. More than likely there are more drilled wells within the watershed; however, they may not be documented because they were drilled before records were required to be filed.

Wetlands and Floodplains

The Little Vermillion River Watershed has floodplains located along the Little Vermillion River. The floodplains are utilized when heavy amounts of rain occur not only within the county but also when heavy amounts of rainfall occur within the prairies of Vermilion County Illinois. Several small wetlands still exist within and along the floodplains of the Little Vermillion River and the Wabash River. Most of the wetlands are in the Newport Watershed, north of Newport Bridge along County Road 350 E and along State Road 63. These areas of wetlands continue to hold water throughout the summer and long dry periods. As with most counties wetlands were drained to make farmland. Figure 12 on page 22 represents the relative locations of floodplains and wetlands within the Little Vermillion River watershed that still exist.

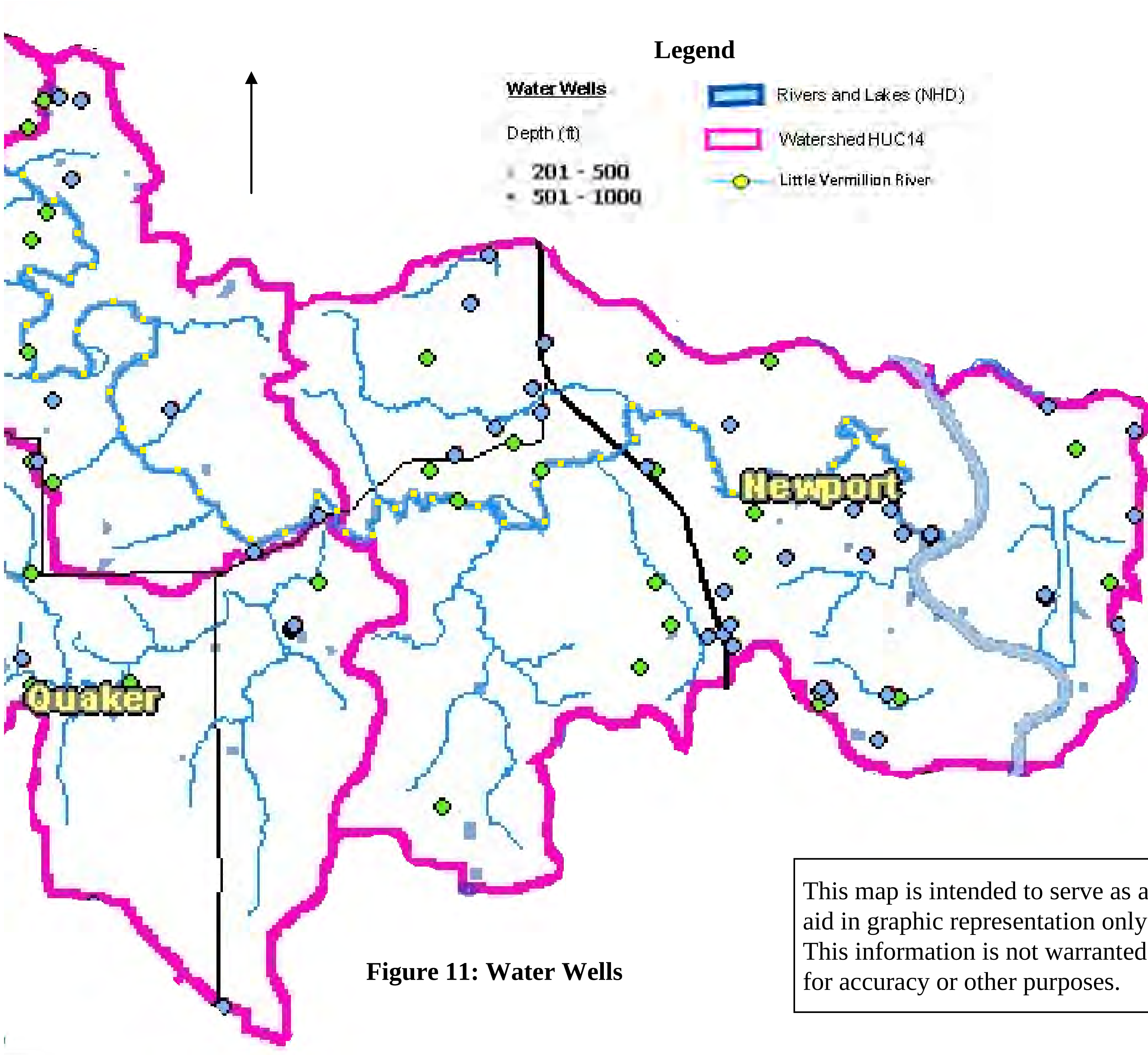

Figure 11: Water Wells

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

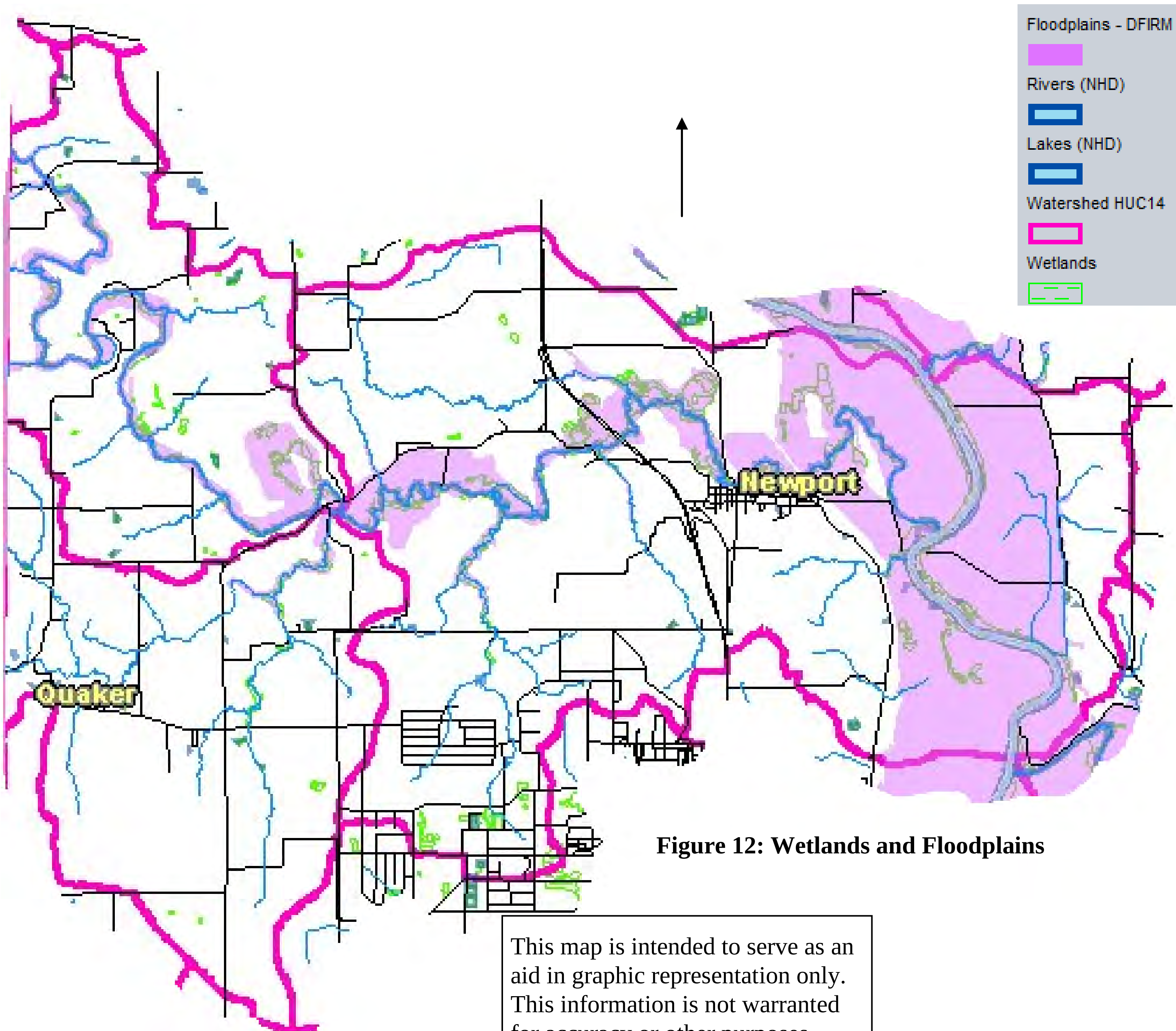

Figure 12: Wetlands and Floodplains

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Soils

An extensive survey of soils in Vermillion and Parke Counties were completed in 1976 and updated in 2004. The watersheds lie in the region of gray-brown podzolic soils of the east-central portion of the United States. These soils developed under heavy forest cover of deciduous trees, with sufficient rainfall to maintain a moist condition throughout the soil, except for short periods of time. Due to the large number of individual soil types within the Little Vermillion River Watershed, this report discusses soil associations. A soil association is a landscape that is comprised of a distinctive pattern of individual soils in defined proportions. The soil association is named for the most prevalent soil types within the association.

There are six (6) major soil associations in the Vermillion River Watershed: (1) Xenia-Russell-Fincastle, (2) Genesee-Armiesburg, (3) Sable-Flanagan, (4) Reesville-Ragsdale-Fincastle, (5) Shipshe-Fox-Elston, (6) Hennepin-Miami. Table 2 lists the soil associations, the amount of watershed area classified in each and a brief description (USDA SCS, 1978). Genesee, Shoals, Sloan, Eel, Hennepin, Whitaker, Westland, and Wea soil types are associated with Table 2's major soil associations. These listed soil types in the watershed have some severe limitations for septic tank absorption fields.

Table 2: Soil Association in Watershed Area

Soil Association	% of Watershed	Description
Xenia-Russell-Fincastle	30%	Deep, nearly level to moderately sloping, well drained, moderately well drained, and somewhat poorly drained soils formed in loess and loamy glacial till
Genesee-Armiesburg	20%	Deep, nearly level, well drained soils formed in loamy alluvial deposits
Sable-Flanagan	20%	Deep, nearly level, somewhat poorly drained and very poorly drained soils formed in loess or in loess and the underlying loamy glacial till
Reesville-Ragsdale-Fincastle	15%	Deep, nearly level, somewhat poorly drained and very poorly drained soils formed in loess and loamy glacial till
Shipshe-Fox-Elston	10%	Deep , nearly level to moderately sloping , well drained soils formed in glacial outwash over stratified very gravelly sand
Hennepin-Miami	5%	Deep, moderately sloping to very steep, well drained soils formed in loamy glacial till.

K-Factor

A commonly used soil attribute is the K-Factor, a component of the Universal Soil Loss Equation (USLE) (Wischmeier and Smith, 1978). The K-factor is a dimensionless measure of a soil's natural susceptibility to erosion and factor values may range from 0 for water surfaces, to 1.00. Large K-factor values reflect greater inherent soil erosion. The distribution of K-factor values in the Little Vermillion River Watershed is shown in Figure 13. The figure indicates soils with moderate erosion potential (i.e. K-factors ranging from 0.10-0.43) compose most of the watershed. Table 3 represents the estimation of K-factor for each soil texture within a hydrologic soil group. Areas susceptible to moderate erosion occur throughout the watershed and are typically associated with sandy soils with moderate infiltration rates. The largest K-factors are recorded in a portion of the watershed located at the southwestern region of the watershed near the area of Quaker.

After reviewing Figure 13, one can locate the highest erodible, .43, soils within the watershed are located near Quaker. Quaker is a located in the Jonathan Creek subwatershed near the Illinois Stateline. The .43 color delineation can also be seen in the Horseshoe Bend subwatershed and the Newport subwatershed. As stated earlier most of the soil within the watershed has moderate potential for erosion. In the figure, areas delineated with a large “1” indicates .43, “2” indicate .37 K-factor, “3” indicates .27, “4” indicates .20, “5” indicates .32 and “6” indicates .26

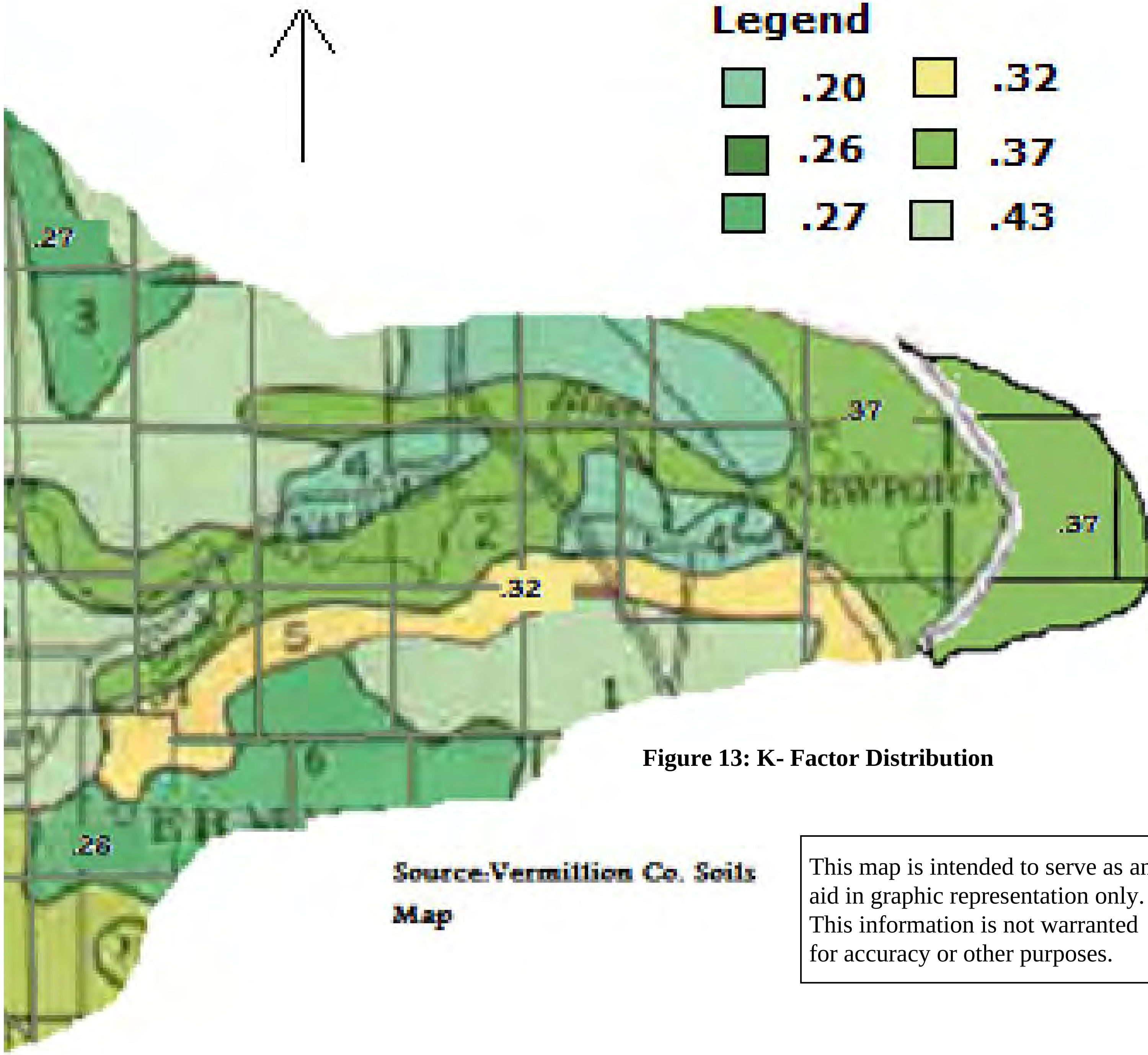


Figure 13: K- Factor Distribution

Source:Vermillion Co. Soils Map

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Table 3: Estimating K-factors

	Hydrologic Soil Group A	Hydrologic Soil Group B	Hydrologic Soil Group C	Hydrologic Soil Group D
Soil Surface Texture	Estimated Soil K-factor			
Clay	0.24	0.28	0.32	0.37
Clay Loams	0.28	0.32	0.37	0.43
Loams	0.32	0.37	0.43	0.49
Sandy Loams	0.20	0.24	0.32	0.37
Sand	0.15-0.17	0.20	0.24	0.28

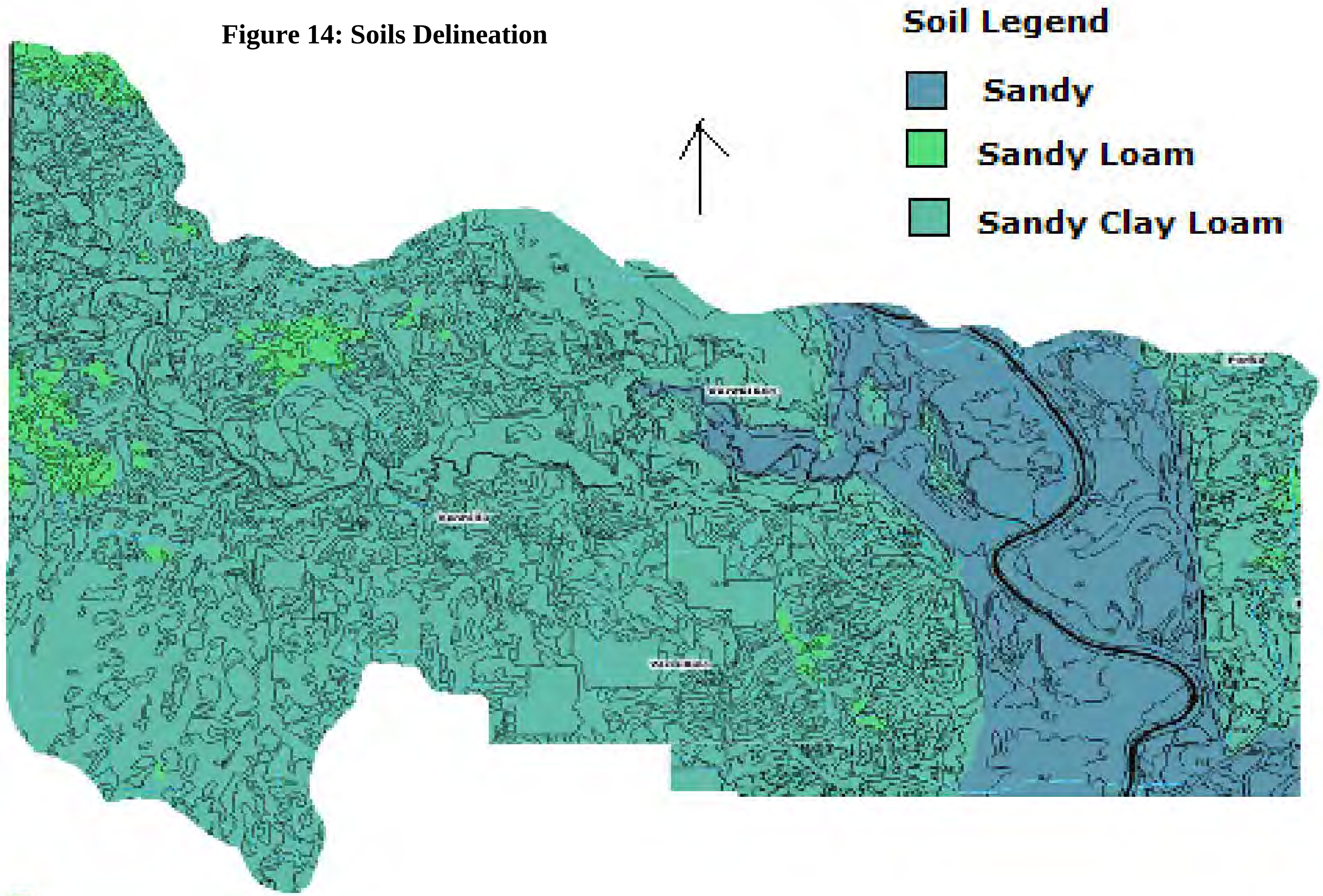
Hydrologic Soil Group

Hydrologic soil group classification is a way for grouping soils by similar infiltration and runoff characteristics during periods of prolonged wetness. Typically, poorly drained clay soils have lower infiltration rates; while sandy soils are well drained and have greater infiltration rates. Natural Resource Conservation Service (NRCS) (2001) has defined four hydrologic groups for soils. The four groups are described in Table 4. Upon comparisons, most of the soils within the watershed are sandy loam to sandy clay loam with K-factors as indicated in Figure 13. Comparing the K-Factors in Figure 13 to the estimated K-Factors associated with the NRCS soil groups in Table 3 most of the watershed is within the Hydrologic Soil Group C and D. In Table 4 below the description of hydrologic soil groups C and D indicates the soil has poor drainage concluding why there is a need for drainage tiles within the crop fields of the watershed. Once drainage tile are in place the soils become a group B NRCS hydrologic soil group.

Table 4: NRCS Hydrologic Soil Groups

Hydrologic Soil Group	Description
A	Soils with high infiltration rates. Usually deep, well drained sands or gravels. Little runoff.
B	Soils with moderate infiltration rates. Usually moderately deep, moderately well drained soils.
C	Soils with slow infiltration rates. Soils with finer textures and slow water movement.
D	Soils with very slow infiltration rates. Soils with high clay content and poor drainage. High amounts of runoff.

Figure 14: Soils Delineation



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Hydrologic Features

The Little Vermillion River starts in Illinois with 37.1 miles before entering into Indiana. The river begins as a drain for a significant portion of the prairie farmland in Illinois. As the river meanders through Illinois the Little Vermilion has the Georgetown Lake and dam located at Georgetown, Illinois holding some water. There are several small tributaries that drain the Illinois prairie into the Little Vermillion River. Once entering into Indiana the river drains approximately 21.5 miles long and flows from the northwest portion of the watershed to the southeast, where it drains approximately 35,368 acres into the Wabash River. However, the Georgetown Lake does not hold as much water has it used to as it has filled up with sediment. On the Indiana portion of the Little Vermillion River it receives water from several small tributaries; however the following tributary is the only named tributary to the Little Vermillion River (Figure 15): Jonathan Creek. There has not been any further proposition to name the other tributaries within the watershed.

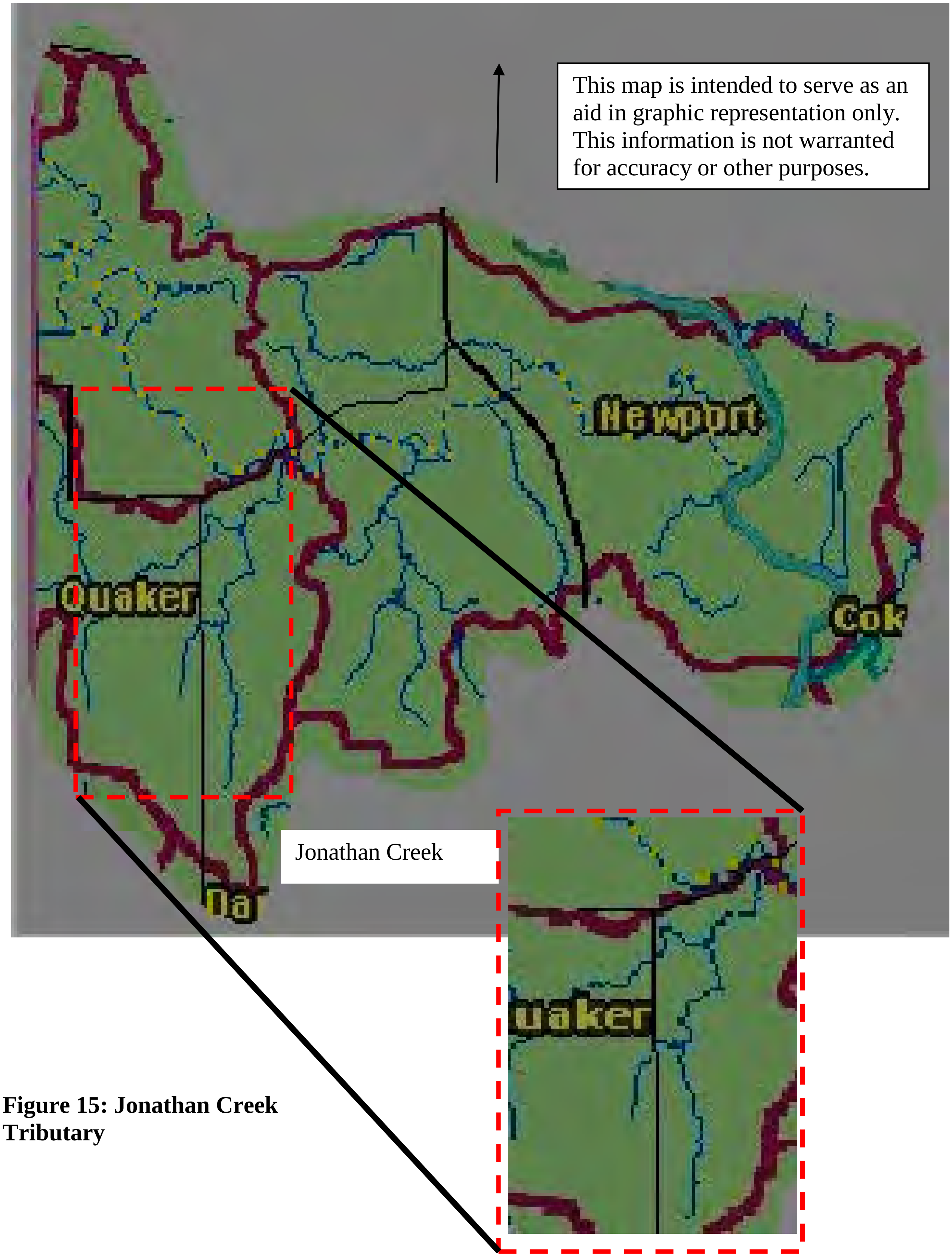


Figure 15: Jonathan Creek Tributary

Ecoregions

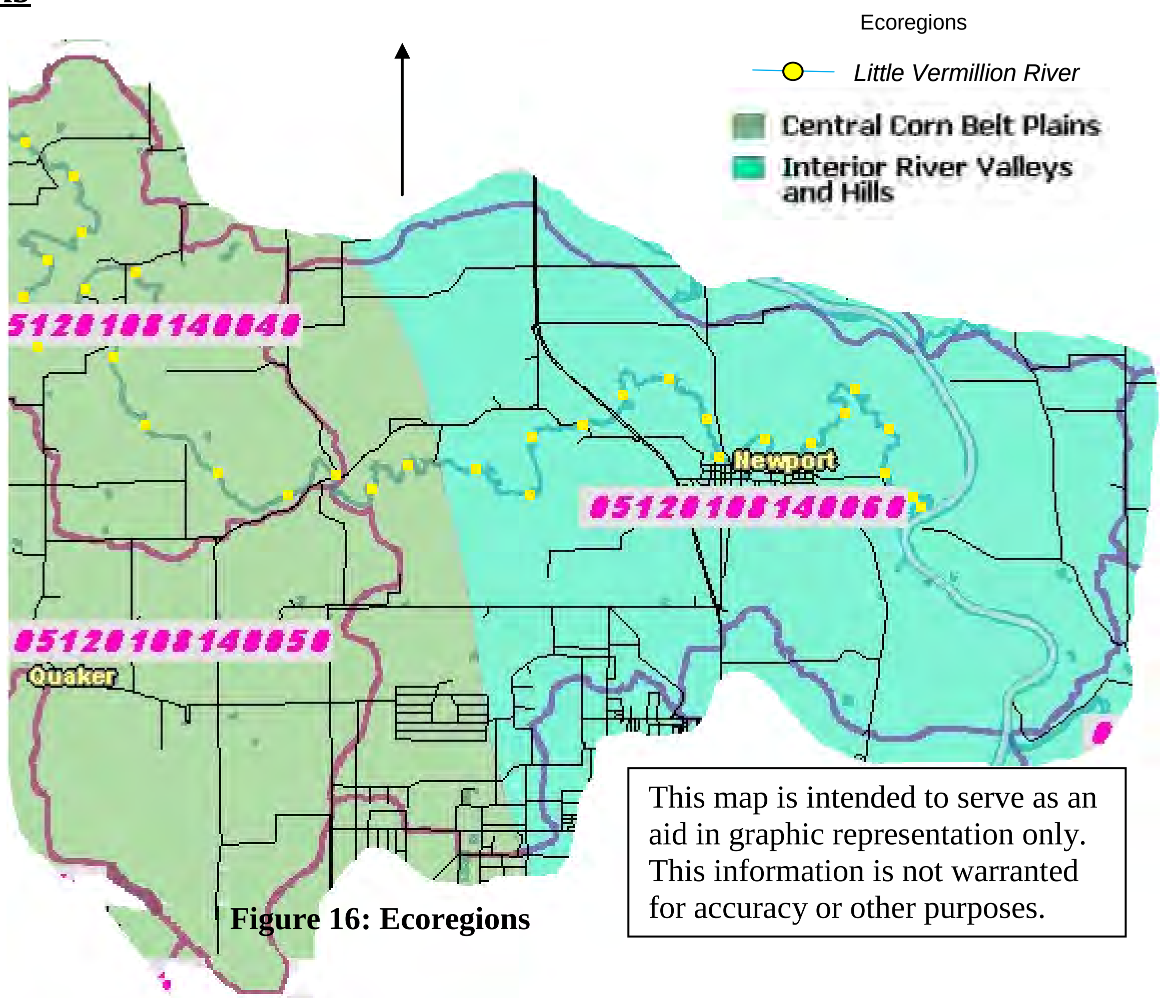


Figure 16: Ecoregions

An ecoregion is defined as an area with similar ecosystem functions based upon landform, soil, vegetation, and land-use. Ecoregions separate different patterns of human stresses on the environment and different patterns in attainable and existing quality of environmental resources. The ecoregions have proven to be an effective aid for inventorying and assessing national and regional environmental resources, for setting resource management goals, and for developing biological criteria and water quality standards. Ecoregions can be used to help set expectations, standards, and management practices within watersheds according to region.

The Little Vermillion Watershed lies within two distinct ecoregions: the Central Corn belt Plains and the Interior River Lowlands (EPA, National Map, 2008) shown in Figure 16. The Central Corn Belt Plains covers the western portion of the Watershed. This eco-region is typically characterized by rolling plains and loamy, rich, well-drained soils. Today, this eco-region is used extensively for corn, soybean, and livestock production. The rest of the watershed lies within the Interior River Lowlands eco-region. This ecoregion is typically characterized by lower lying land with silt rich soil. The dominate land-uses found near the banks of the Little Vermillion River on the Interior River Lowlands are forested and wetland areas. Farther away from the river the silt rich soil is used for corn, soybeans, and other small grain production.

Climate

West Central Indiana's climate is continental, humid, and temperate, with warm humid summers and moderately cold winters. The climate, temperatures, and precipitation for the Little Vermillion River Watershed are similar to most of the west central area. The median growing season in the region lasts 182 days, from the spring frost in mid-April to the first fall frost in mid-October. Monthly mean temperatures and precipitation values are represented in Figure 17. The figure shows that although precipitation occurs throughout the year, May through August are the months with the most precipitation per month. Much of the annual snowfall occurs in the months of December through February, with the greatest snowfalls occurring in January.

The historical average annual precipitation was determined from the Rockville Station, located at the Rockville Fire Station, 127 S. Jefferson St. Rockville, Indiana. (http://www.crh.noaa.gov/ind/print_localdata.php?loc=txtdat&data=COOP_PRECIP_2008.txt). The average annual precipitation is 44.9 inches; this is approximately 5 inches higher than the state average. The most precipitation in a 24-hour period was set in 1957 at a record of 8.74 inches. The watershed project area witnessed a 100 year flood during the month of May 2008.

The 100 year flood caused several areas in the watershed to scour, erode, and created several large log jams. Specifically speaking residents within the Horseshoe Bend watershed witnessed about 20 feet of their land along the Little Vermillion River collapsing into the river. This particular area was fenced from livestock and had a riparian buffer of about 300 feet, but the location was on an outer bend of the river. A log jam on State Road 71, within the same 12-digit HUC, became much larger than it had been previously. The flood caused a blockage across two of the three pillars on the bridge. Several farmers within the entire watershed witnessed out washing of substrate and debris into flood bottom fields.

Normal weather temperatures for the Little Vermillion River Watershed averages a maximum temperature around 64.1 ^{0}F and the minimum average temperature is 43.6 ^{0}F.

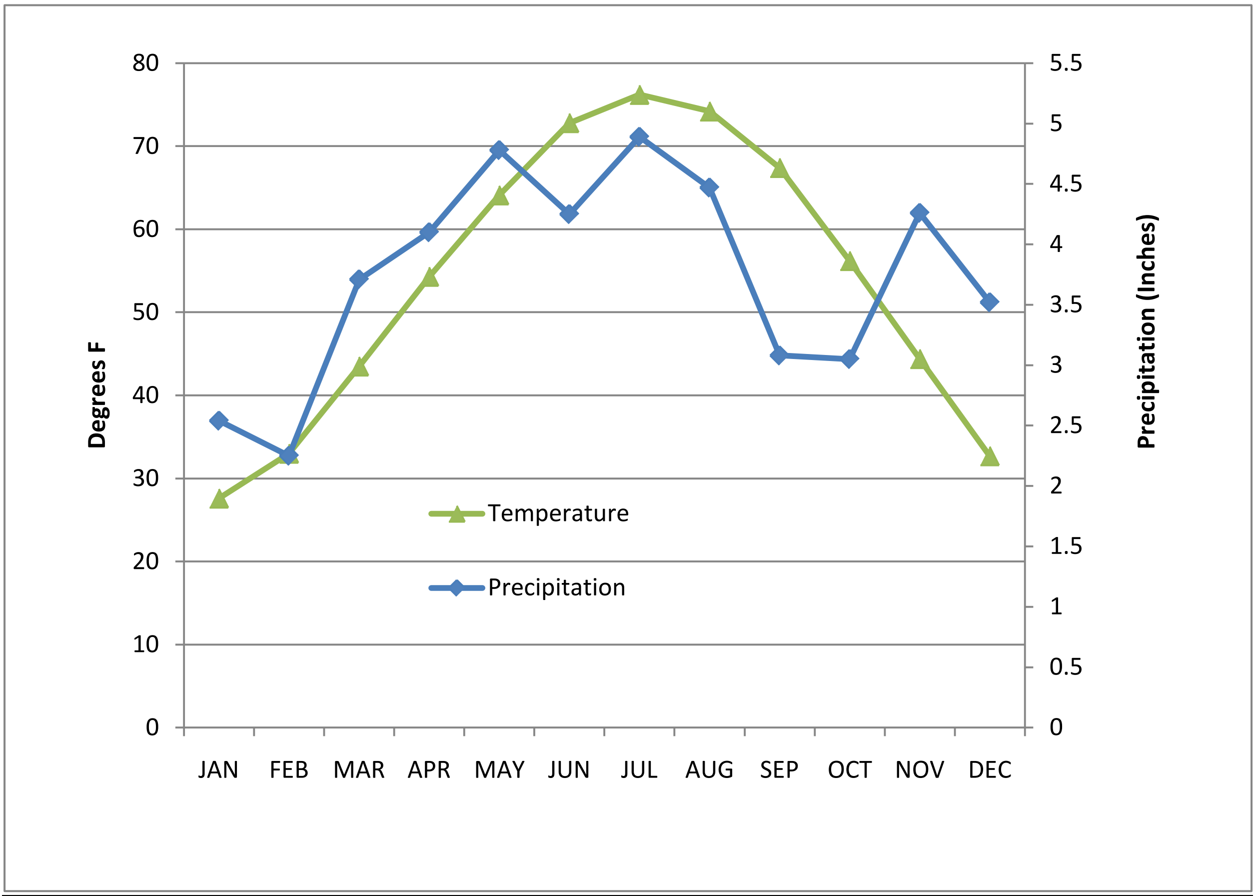


Figure 17: Central Indiana area monthly mean temperature and precipitation values

Source: Midwestern Regional Climate Center

Natural History

The natural history in the Little Vermillion River Watershed is summarized by a description of current forests and native tree species as well as a list of threatened and endangered species in the area.

Forests and Tree Species

Primary forest type is the maple-beech which includes black cherry, black walnut, and yellow birch. Other trees common within the area are sassafras, pignut hickory, sugar maple, white ash, sycamore, red maple, silver maple, red and white oaks, sweet gum, yellow poplar, American elm, shagbark hickory (Tormoehlen, Barbara, Forests of Indiana: A 1998 Overview. USDA).

During visual assessments the team was not actively identifying invasive species. Most likely there are invasive species within the Little Vermillion River Watershed. Invasive species can cause water quality issues by decreasing the amount of native undergrowth available to hold the topsoil in place along streambanks.

Endangered, Threatened and Rare Species

In addition to a variety of native tree species, Vermillion and Parke Counties are habitat to several unique plant and animal species. Listed within Table 5 are both state and federal species classified as endangered, threatened, or rare within Vermillion and Parke Counties. Although the Little Vermillion River Watershed Project only comprises a small portion of the overall counties, many of these species are likely to live within the watershed area.

According to the rare species list the DNR indicates the presence of mussels. Mussels are a very pollution intolerant species and need a clean environment to survive.

Table 5: State and Federal endangered, threatened, or rare species in Vermillion and Parke Counties. **(Source Indiana Department of Natural Resources, Division of Nature Preserves 11/22/2005)**

Common Name	State Rank	Federal Rank
	MOLLUSKS	
Eastern Fanshell Pearly Mussel	SE	LE
Purple Catspaw	SX	LE
Tennessee Riffleshell	SX	
Tubercled Blossom	SE	LE
Wavyrayed Lampmussel	SSC	
White Wartyback	SE	LE
Ring Pink	SX	LE
Round Hickorynut	SSC	
Sheepnose	SE	C
Clubshell	SE	LE
Ohio Pigtoe	SSC	
Pyramid Pigtoe	SE	
Kidneyshell	SSC	
Rabbitsfoot	SE	
Purple Lilliput	SSC	
	FISH	
Greater Redhorse	SE	
	BIRD	
Henslow's Sparrow	SE	
American Bittern	SE	
Sedge Wren	SE	
Bald Eagle	SE	LT, PDL
Virginia Rail	SE	
	MAMMAL	
Indiana Bat	SE	LE
Evening Bat	SE	
Franklin's Ground Squirrel	SE	
	VASCULAR PLANT	
Lake Cress	SE	
Heavy Sedge	SE	
Biltmore Hawthorn	SE	
Golden Seal	WL	
American Ginseng	WL	
Large-leaved Phlox	SR	
A Bramble	SX	
Royal Catchfly	ST	
Prairie Violet	ST	
Catbird Grape	SR	
Fed: LE = Endangered; LT = Threatened; C = candidate;	State: SE = state endangered; S =state threatened; SR =state rare; SSC = state species of special concern; SX=state extirpated; SG =state significant; WL=watch list	

Section III: Land use Description of the Watershed

This section includes an overview of the watershed's land-use in terms of settlement history, recent and historical population changes, recent land-use changes, an impervious surface analysis and particular areas of interest in the watershed, including locations of point source discharge facilities and unique recreational areas.

Land-use History

Even before the Peaukeshaws and Miami Indians were located in this area a sophisticated society known as the Mound Builders located themselves along the river banks. After them came several different Indian tribes as this was a passing ground during summer and winter months to the "Grand Prairies." The most prevalent Indian groups that inhabited what is now Vermillion County were the Peaukeshaws and Miami Indians. The Indians remained even while the land was taken into control by the French around 1717. According to the History of Parke and Vermillion County while the French were in control the Vermillion River, located north of the watershed area, was the boundary between Canada and Louisiana. Many of the first records for Vermillion County have been lost or ruined due to poor care.

Parke County was organized January 9, 1821 becoming effective April 2, 1821, and is divided into 13 Civil Townships as follows: Adams, Florida, Greene, Howard, Jackson, Liberty, Penn, Raccoon, Reserve, Sugar Creek, Union, Wabash and Washington.

The Parke County portion of the watershed is located within the present day Wabash Township. This portion of Parke County once had the Wabash-Erie Canal running along the Wabash River through the township. Figure 18 represents the location of the canal.

Before the third Legislation of the State of Indiana what is currently Vermillion County was originally part of Vigo County. Then by an act approved on January 9, 1821, by the state, organized Parke County with current Vermillion County attached as a civil township. In 1824 the above-mentioned civil township became the present day Vermillion County, the two counties being divided along the Wabash River. Vermillion County was named for the two Vermillion Rivers, Big and Little, located within the county. The Vermillion River was named from the French meaning “a bright red sulphuret of mercury” because of the mineral color that seeped out along the riverbank. In the same year of 1824 the county seat was determined to be located at Newport.

Originally, one-fourth of the area was prairie and three-fourths was timberland. From an excerpt from B.F. Bowen Company’s book “History of Parke and Vermillion Counties Indiana 1913” J.H Beadle describes Vermillion County as “Bottoms heavily timbered, but a large part of the terrace was devoid of timber possibly cleared by the Mound Builders.”

The book goes on to describe the county as “being blessed by springs bursting forth from below the boulder clay of the drift period. Many of these springs are exceedingly strong in their flow, but with the settlement of the county, artificial drainage, etc. have somewhat diminished.” The addition of these drainage ditches has allowed Vermillion County to become valuable farm land and agriculture became the primary land-use by 1900. In 1910, 91.8% of the land was used in farming. Roughly 1,355 farms existed in Vermillion County with an average of 110.2 acres per farm. However, farms have become larger and fewer in existence over the past 100 years, however much of Vermillion County is still farmland. There has been urban expansion around the larger cities but not much has occurred within the project area covered by the grant.

Figure 18: Wabash and Erie Canal (Source: Wikipedia)

Current Land-Use and Land Cover

According to the 2004 Vermillion County Soil Survey the majority of land encompassing the watershed is considered "prime farmland if drained" therefore, the Little Vermillion River Watershed drains land dominantly covered with corn and soybeans. Rural grassland/pastures and residential land account for a very small portion of the watershed. Many of the forests within Vermillion County according to the US Forest Department are under private ownership. Within the Little Vermillion River Watershed forested land accounts for approximately 31.4% of the land-use (http://199.128.173.26/fido/mastf/customrpt .html). As mentioned above in the natural history section the dominate forest type consists of hardwoods. There has been visual observation of logging of these hardwoods within the watersheds. The amount of timber logged is hard to determine because according to an e-mail from the district forester "there is no information I have as to the amount of timber logged out each year in Vermillion County. Only classified forest owners report sales to me and less than five percent of the woods are in classified forest in that (Vermillion) county."

Table 6: Land-use and Land Cover

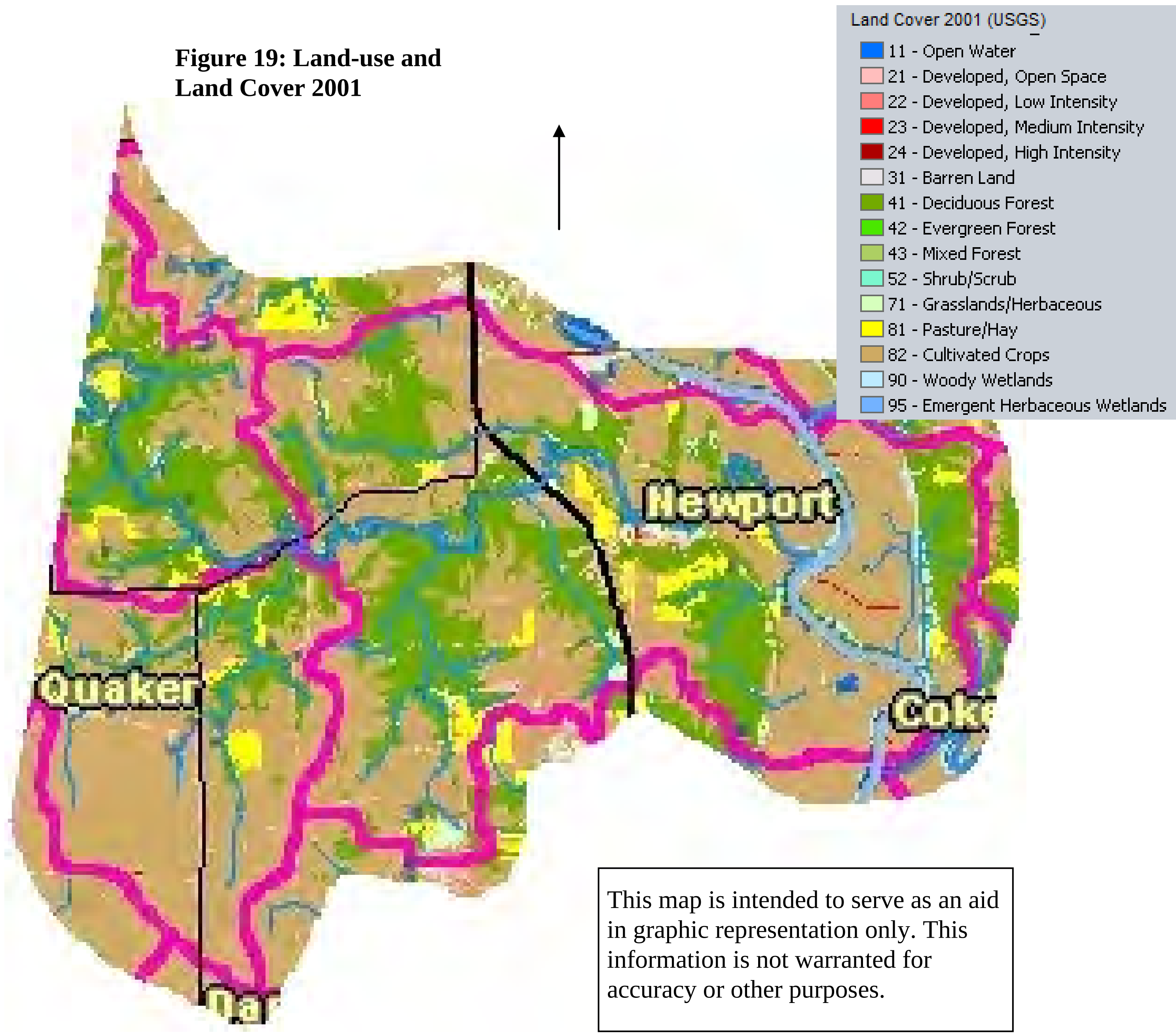
Land Use/ Land Cover Description	Total Verm.County	Total Parke County	Total Watershed	Approx. Percent of Watershed Area
	Acres (Approx.)	Acres (Approx.)	Acres (Approx.)	
Agricultural				
Corn	40,000	60,600	8,946	24%
Soybeans	23,400	64,700	5,497	14.4%
Hay (dry)	2,400	6,200	560	2%
Agricultural-other	23,669	30,836	5,248	14%
Total Ag.	89,499	162,336	20,251	54.4%
Forested	53,104	85,440	11,921	31.4%
Residential	4,090	28,480	1,116	3%
Undeveloped	15,577	2,848	3,297	8.7%
Other-Recreational, Transportation, etc.	3,133	5,696	714	2%
Total	165,373	284,800	37,299	~100%

The above data is according to the USDA NASS Quick Stats, Vermillion Co. Zoning Office, and Parke Co. Chamber of Commerce.

Data collected from the NASS Quick Stats and county plans only contain the total county land-use data. Therefore, the total county acres were collected to determine the approximate total watershed acres. The approximate county watershed acreage was divided by the total county acreage to obtain a percent of watershed area. The percent watershed area was divided by each of the total county crop acreages to obtain the approximate crop acreage in the watershed. The above Table 6 is divided into separate agricultural crops. The divisions include soybean, corn, hay, and “agricultural other”. “Agricultural other” is being defined as all acreage in pasture, grassland, or scrub land. Residential data includes the low intensity, high intensity, medium intensity and urban land-use. Other includes the recreational and transportation data which would include local nature preserves, parks and roadways. Within the Little Vermillion River Watershed Project area we do not have any nature preserves. Undeveloped is an indication of open space, these are areas of fallow that does not contain a structure and is not being used for agricultural or industrial purposes. Table 6 and Figure 19 represent the respective land-use cover for the Little Vermillion River Watershed.

The residential data indicates only about 3% of the land within the watershed is being used for dwellings or towns. Even this small of a percent can cause environmental issues. Within the 051201081104, Newport watershed is where the town of Newport is located. Unfortunately, Newport, IN does not have their own municipal sewage or waste water treatment plant for the town. Many of the older dwellings and businesses do not have a proper septic installed nor do they contain any type of waste holding tanks. Many of these buildings only contain a straight pipe to the river or to a small waterway or tributary that eventually flows into the Little Vermillion River or the Wabash River. In rural areas of the watershed there are dwellings that again do not have septic systems but drain directly into waterways and tributaries. This will be discussed further in the critical areas section of the WMP.

Figure 19: Land-use and Land Cover 2001



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Impervious Surface Analysis

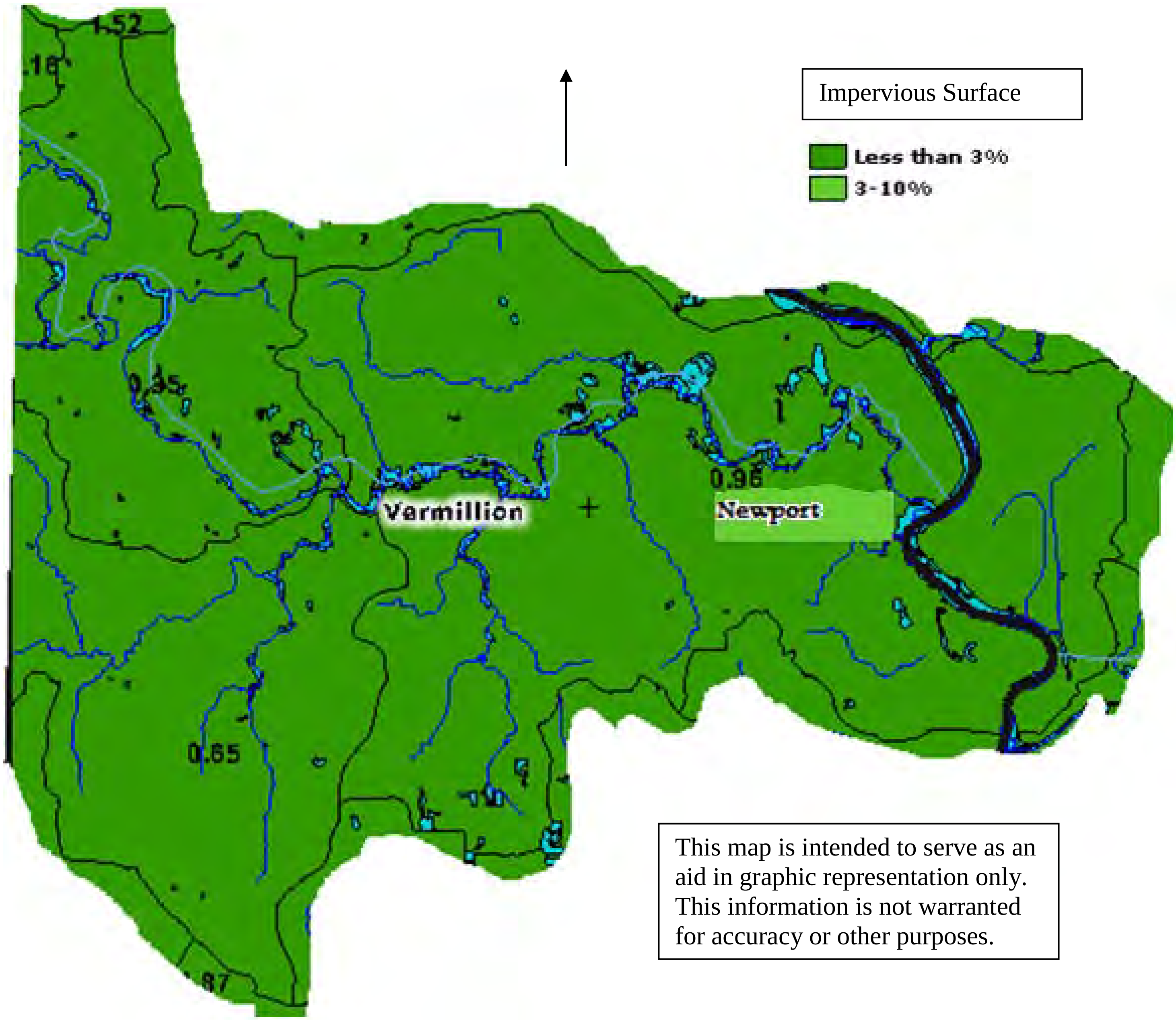


Figure 20: Impervious Surface

Within the watershed there has been no in-depth analysis pertaining to the amount of impervious surface water runoff. However, the Local Decision Maker GIS information system linked to Purdue University shows that most of the watershed is less than three percent. Figure

20 represents the impervious surface percentages. Among the most common areas of impervious surfaces are the town of Newport and all major roads and county paved roadways.

Population Characteristics and Population History

Population characteristics for Vermillion County according to the 2000 census indicate 48.1 % are male and 51.9% are female. The median age within the county is 40 years with an average age of 39.4 years. Eighty one (81.2%) percent of the population are high school graduates and 11.2% have obtained a bachelor's degree or higher education. The median income for a household in the county was $34,837, and the median income for a family was $41,809. Males had a median income of $32,279 versus $22,647 for females. The per capita income for the county was $18,579. About 9.50% of the population was below the poverty line including 10.40% of those under age 18 and 12.60% of those ages 65 or over. (http://www.vermillioncountyedc.com/index.cfm?page= Demographics).

Population characteristics according to the 2000 census for Parke County indicate 23% are males and 77% are females. The median age within the county was 39 years. The median income for a household in the county was $35,724, and the median income for a family was $40,656. Males had a median income of $32,578 versus $20,968 for females. The per capita income for Parke County was $16,986. About 11.50% of the population lives below the poverty line, including 18.30% of those under age 18 and 8.90% of those ages 65 or over. (PC Comp Plan).

Vermillion County's population was steadily increasing until the 1910's. From Table 7 the population rates from the 1840's through the 2000's shows the population growths and declines. In 1880 the total population gradually increased from 12,015 until reaching a high of 18,865 in 1910. By2007 the population had decreased to 16,417 people. In Table 8 the decrease in population can be easily seen by the percent change between 1910 and 2007 almost a century long decline in population.

Table 9 reflects Parke County's population over seven decades. The county reached a population of 17,358 people in the 1940's. The following three decades were steadily decreasing until the 1980's when population started increasing again. In 2005, there was a total population of 17,362 people with a population density of 39 people per square mile. (Parke County, Indiana).

Table 7: Population of Vermillion County: 1840, 1850, 1860, 1870, 1880, 1899, 1900, 1910

Vermillion County total Population										
Area	**1840**	**1850**	**1860**	**1870**	**1880**	**1899**	**1900**	**1910**	**1990**	**2007**
Vermillion	1,732	1,679	1,391	1,735	1,628	13,154	15,252	18,865	16,773	16,417

Population of cities entirely within the watershed									
Area	**1840**	**1850**	**1860**	**1870**	**1880**	**1900**	**1910**	**2000**	**2007**
Newport	192	328	287	398	587	610	732	578	549

Population of townships within the watershed					
Area	**1840**	**1850**	**1860**	**1870**	**1880**
Vermillion	1,732	1,679	1,391	2,215	1,628
Helt	2,125	2,121	2,359	3,027	2,657
Eugene	570	1,105	888	1,048	1,000

Table 8: Century Percent Population Change

Vermillion County total population				
Area	**1910**	**1990**	**2007**	**% change 1910-2007**
Vermillion	18,865	16,773	16,417	-12.9%
Population of cites entirely within the watershed				
Area	**1910**	**1990**	**2007**	**% change 1910-2007**
Newport	732	578	549	-25%

Table 9 Parke County Population

Decade	1940	1950	1960	1970	1980	1990	1997	2000
Population	17,358	15,674	14,804	14,628	16,372	15,410	16,446	17,241

Future Changes

As the Newport Chemical Depot comes to a close the Vermillion County Economic Development Commission has plans to construct an industrial park that could change the landscape. According to the statistics from Indiana Business Research Center (IBRC) at the Indiana University Kelley School of Business Vermillion County's population is projected to increase in 2010 to 18,410 with a continual increase in 2015 to 18,646 and in 2020 have a total population of 18,917. Within the town of Newport there is a goal among some local residents to eventually construct and install a wastewater treatment plant for the town. Currently, Newport has approval and funding from the town council to have a feasibility study conducted.

No significant land changes or development are known for Parke County at this time. They continue to try to increase tourism industry to Parke County.

Point Source Discharges

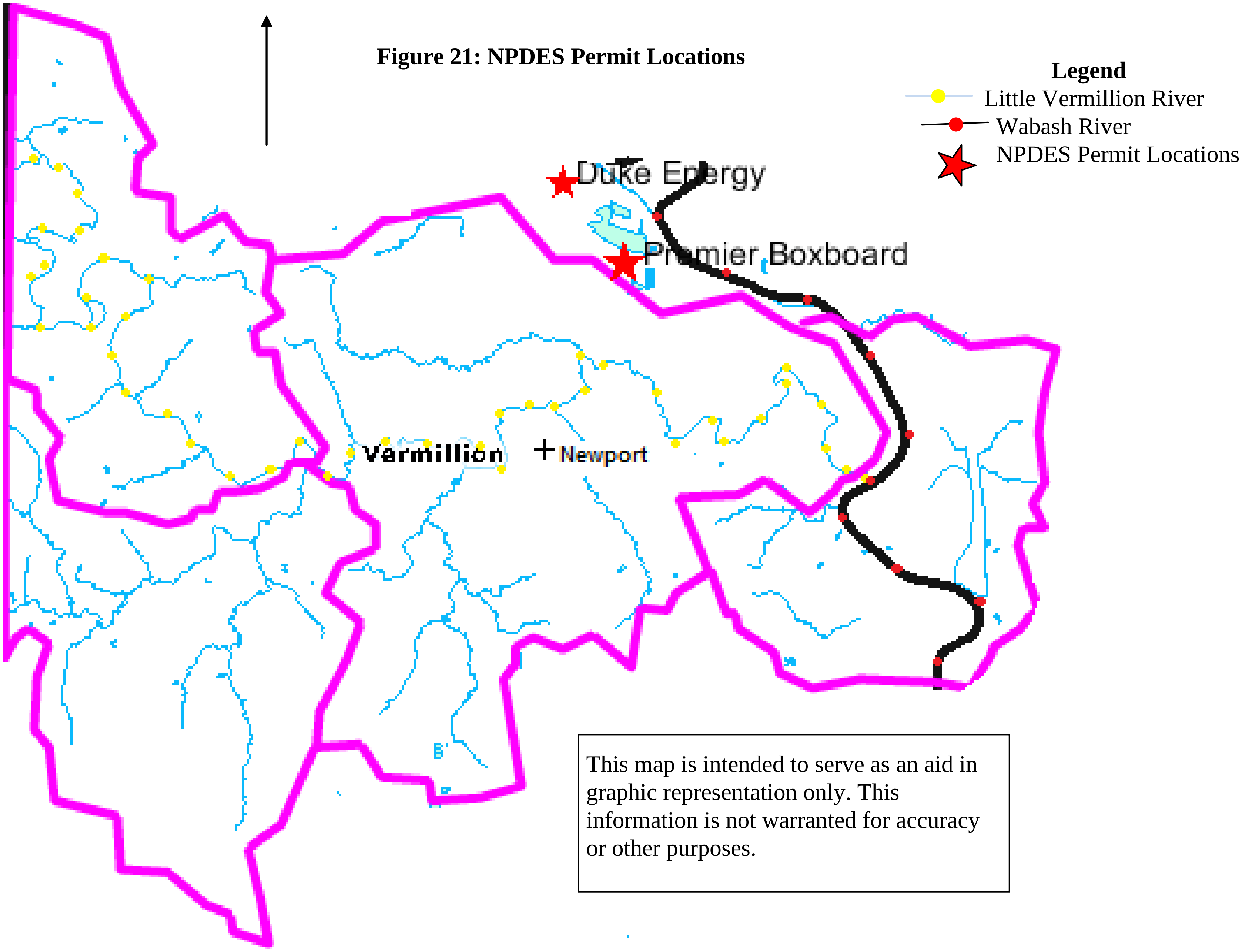
The Clean Water Act authorizes all point source discharges into U.S. waters be regulated by the National Pollution Discharge Elimination System (NPDES). Point source discharges are discrete channels, pipes, or man-made ditches that flow directly into surface water.

The Permit Compliance System (PCS) is a national information system designed to support the NPDES program. The NPDES program establishes permits which are managed by individual states that provide pollution limits and specify monitoring requirements for these point sources. The Indiana Department of Environmental Management (IDEM) has permitted three PCS facilities in Vermillion County. The Newport Water Treatment plant is the only facility located within and discharges directly into the Little Vermillion River. Both the Premier Boxboard Limited and the Duke Energy Cayuga Generating Station facilities do not directly discharge into the Little Vermillion River but they are within close proximity. Duke Energy and Premier Boxboard receive their cooling water from the Little Vermillion River and the plants both discharge into the Wabash River at locations above our watershed. Table 10 indicates the facilities and the permitted discharge load. Records indicate no violations have occurred with any of the facilities. Figure 21 represents the respective locations of the NPDES locations.

Table 10: NPDES PERMITS

Permit	Company	Discharge million gallons per day
IN0036447	Premier Boxboard Limited	1,700
IN0002763	Duke Energy Cayuga Generating Station	506,100
IN0062057	Newport Water Treatment Plant	--

Figure 21: NPDES Permit Locations



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Section IV: Investigation of Water Quality Issues and Benchmarks

This section provides the targets and standards for the parameters sampled based on the overview of existing water quality data in the watershed. After explaining how water bodies are deemed impaired, this section summarizes a number of water quality studies executed in the watershed (i.e. chemical and biological monitoring), examines county tillage transect data and local opinions about conservation tillage to better indicate water quality issues and establish benchmarks. In addition, this section contains the results of habitat and visual assessments (i.e. windshield and flyover surveys) conducted during the program.

Section IV will be divided into subsections representing the Little Vermillion River Watershed 2007 Inventory, IDEM sampling and evaluation and finally the Little Vermillion River Watershed Group (LVRWG) Present sampling data and exploration including the windshield and flyover surveys.

The 2007 Inventory and LVRWG present sampling was conducted at the same six sites with the 2009 sampling site adding an additional sampling site.

Targets and Standards

Under the Clean Water Act Section 303, states are required to establish water quality standards, and to review and update those standards at least every three years. These standards must include water quality criteria, which define the amounts of pollutants, in numeric and narrative form, that the waters can contain without impairment of their designated beneficial uses. They also include the actual designation of beneficial uses, such as water supply, recreation, fish propagation, or navigation, and anti-degradation requirements.

A target is defined as the desired measured level of a water quality or habitat/biological parameter that a group has decided streams in the watershed should meet. A specific value can be set as a target for each indicator to represent the desired conditions that will meet the watershed goals and management objectives. Targets can be based on water quality criteria or where numeric water quality criteria do not exist on data analysis, reference conditions, literature values, or expert examination of water quality conditions to identify values representative of conditions that support designated uses according to IDEM.

Table 11 represents the targets chosen by the LVRWG. The targets were selected by the group from the Indiana State Standards and Averages obtained from the Hoosier Riverwatch Manual. The targets established will aid LVRWG in determining the reduction levels needed to reduce our watersheds from critical levels. Critical levels are defined as levels of a pollutant being significantly higher than the standards and could be causing health risks.

Table 11: Targets and Standards

Parameter	Source	Concentration	Target Load- year
Dissolved Oxygen	IN State Standard	Minimum: 4.0 mg/L and Maximum: 7 mg/L	N/A
BOD	IN State Avg.	1.5 mg/L	N/A
pH	IN State Standard	Between 6-9	N/A
E. coli	IN State Standard	235cfu/ 100 mL	N/A
Nitrate	Ohio EPA Standard	1 mg/L	10.189 lbs/yr
Nitrite	Ohio EPA Standard	1 mg/L	10.189 lbs/yr
Orthophosphate	IN State Avg.	0.05 mg/L	0.51 lbs/yr
Turbidity	USEPA Standard	10.4 NTU	6,259 tons/yr

Little Vermillion River Watershed 2007 Inventory Data

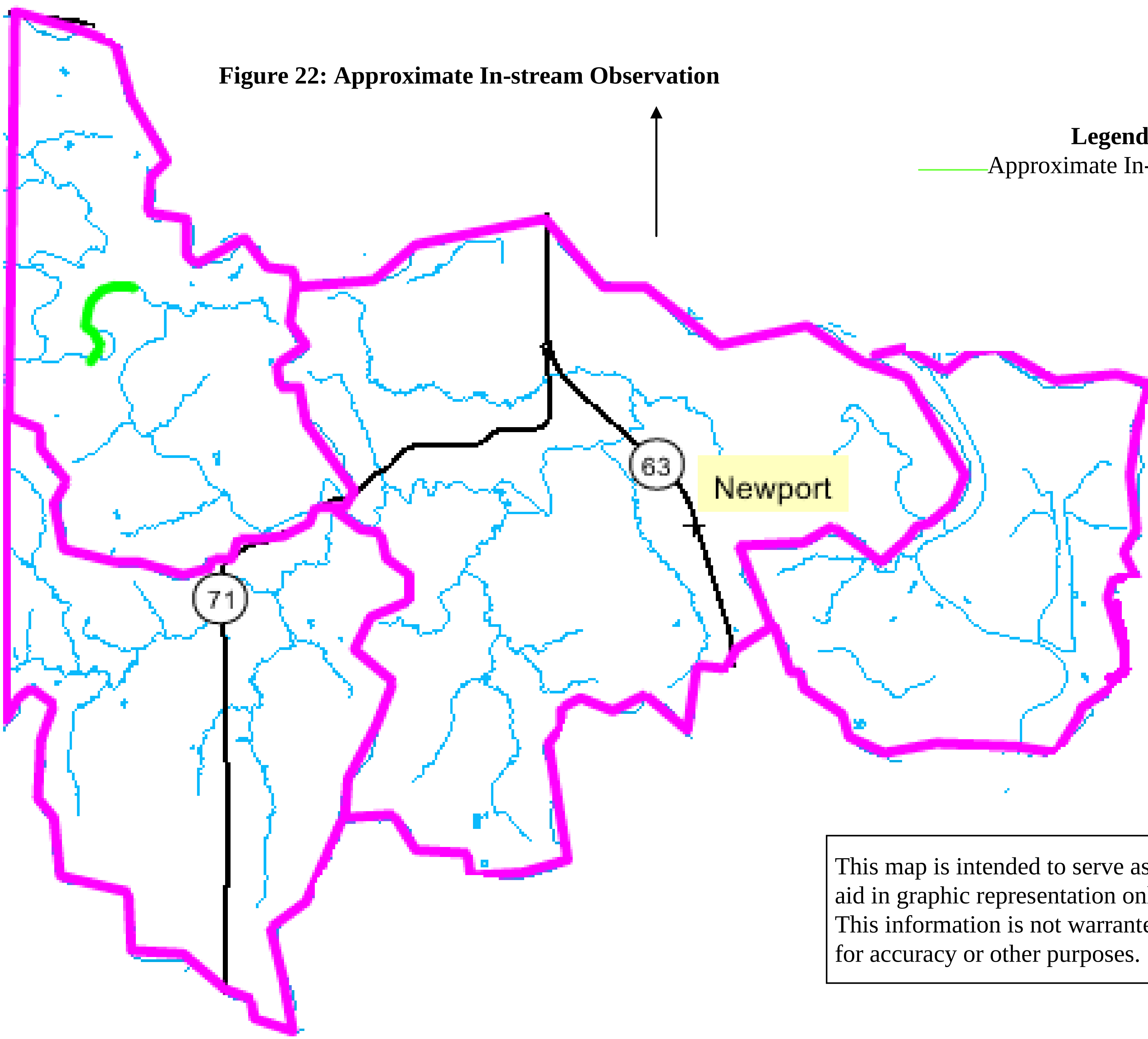
This section is a direct reference of data taken from the *Little Vermillion Watershed Characterization and Water Quality Analysis* conducted by an intern during the year 2007. Raw sampling data can be found in Appendix B.

Again, the following "In-stream Observation" information is directly taken from the 2007 Inventory report conducted by Brian Gum, Intern. Information in parentheses is additions and/or corrections made by the watershed coordinator. Bridges are referenced with the Little Vermillion River Watershed Groups 2008 and 2009 sampling sites for a better understanding of the location of the 2007 Inventory sampling. The full report can be read in Appendix G.

In-stream Observations

The watershed intern and conservation technician for the county canoed a portion of the river in order to get a better idea of land use practices along the banks. The approximately 6 mile portion selected was the Horseshoe Bend (seen in Figure 22). Sediment control issues were definitely present. These were not agriculture-related as we expected, but rather stream bank stabilization issues. Several of the banks are eroding dramatically. Some of the eroding banks were over 25 feet higher than the riverbed. Some attempts at stream bank stabilization have been made. Old concrete and rip-rap have been placed along the banks. We even encountered an old flatbed trailer that was placed on the bank in an effort to hold it in place. This practice has actually worked, because trees have grown up through the trailer. Some instances of farming too close to the riverbanks are present, but certainly not to the extent that was expected. For the most part, riparian cover is healthy along the horseshoe. Some minor log jams are present in the horseshoe, and we only encountered one that required carrying the boat across. Removing this log jam might require some effort, but could probably be accomplished with the right equipment. Local residents mentioned that there were probably some old cars in the river as well, but no evidence of any.

Figure 22: Approximate In-stream Observation



Legend

Approximate In-Stream Route

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

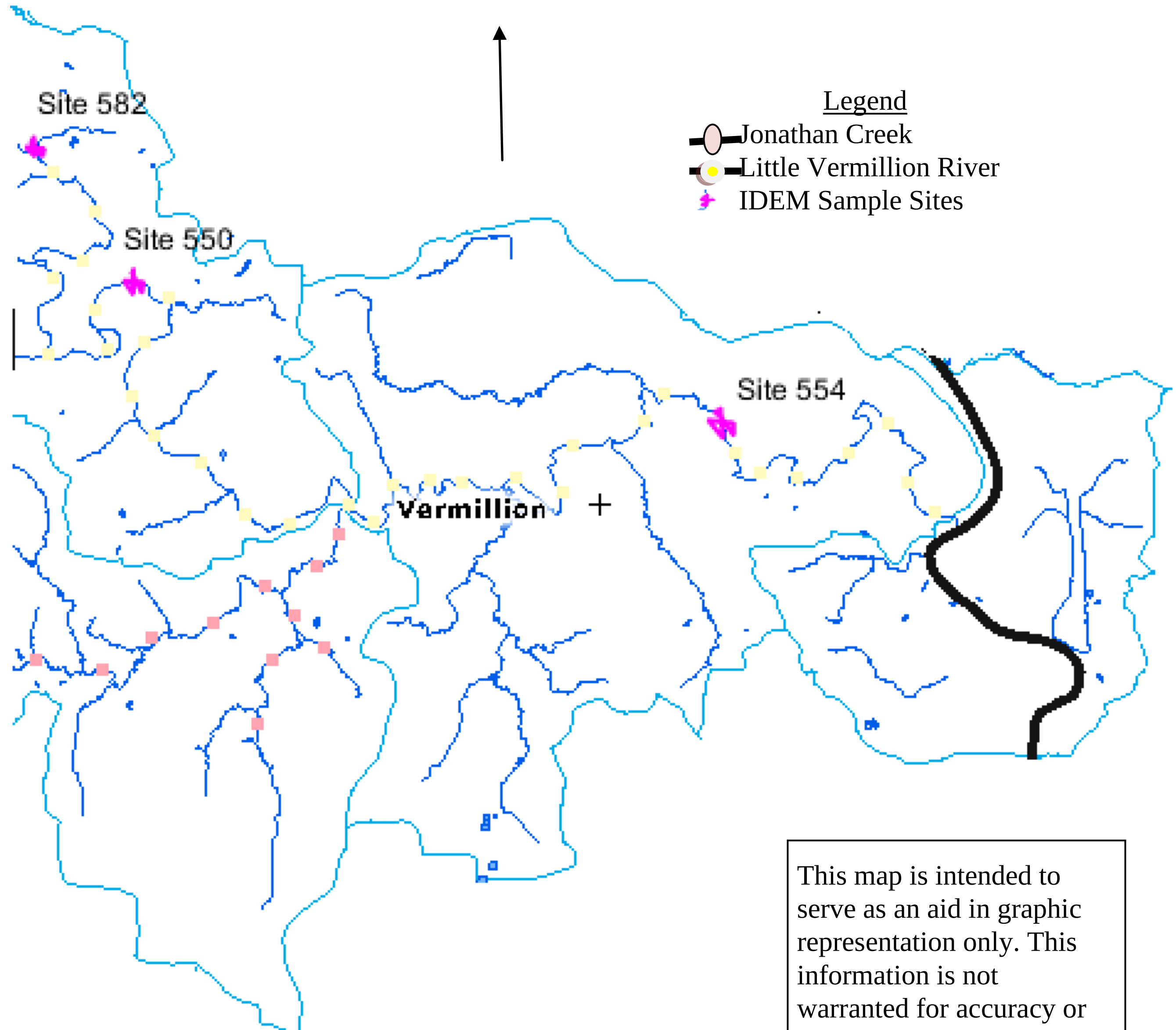
Governmental Based Data and Evaluation

The following information was gained through IDEM and Illinois Environmental Protection Agency (IEPA) sampling data collection.

IDEM Study: 2009 Probabilistic Sampling

During the months of May through October 2009 IDEM performed sampling activities at three sites on the Little Vermillion River. Sampling locations shown in Figure 23 are Site#550 Lat: 39-54-41.44 Long: -87-30-43.60, Site#554 Lat: 39-53-38.81, Long.:-87-24-49.68, Site#582: Lat: 39-55-43.20, Long:-87-31-43.71. The parameters for the sites included dissolved oxygen, pH, specific conductance, temperature, turbidity, metals, nutrients/organic, anions/physical and bacteriological. The three sample sites were sampled for the same parameters during the sampling date. Sampling was conducted the months of June, July and September. IDEM completed a fish communities sampling in addition to the chemical sampling.

IDEM's sampling data is located in Appendix B. The data indicated for the subwatersheds (Horseshoe Bend and Newport) which were tested on a weekly basis during the months of June, July, and September indicated total coliforms were greater than 2,419.6 most probable number (MPN)/100 mL and *E. coli* was all above 235 MPN/100 mL. The sampling indicated there was a presence of chloride, nitrogen, phosphorus, and sulfate present in the subwatershed. There were metals indicated within the watershed as well. The TSS recordings for the watershed indicated TSS was greater than 30 mg/L, the LVRWG target, for the sampling month of June. For the months of July and September the TSS recorded were well below the 30 mg/L. (Bell, 2010).



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Figure 23: IDEM Sampling Sites

IDEM also completed a fish study. The IBI is composed of 12 metrics that assess the communities' species and trophic composition (feeding and reproductive guilds) and fish condition and health. From 1990-1995, over 1,000 sites in Indiana were sampled to develop Index of Biotic Integrity (IBI) expectations for the six different Ecoregions in Indiana. Using the IBI developed based on Ecoregion and stream size, it aids in the determination if the stream is impaired for Aquatic Life Use due to poor fish community structure. An Indiana narrative biological criterion [327 IAC 2-1-3(2)] states that "all waters, except those designated as limited use, will be capable of supporting a well-balanced, warm water aquatic community." The water quality definition of a "well-balanced aquatic community" is "an aquatic community which is diverse in species composition, contains several different trophic levels, and is not composed of strictly pollution tolerant species" [327 IAC 2-1-9(49)]. If you look at the chart on the fact sheet (Karr et al. 1986), it defines the fish community characteristics for a certain IBI score. In Indiana, a stream segment is non-supporting for Aquatic Life Use when the monitored fish community receives an IBI score of less than 35 which is considered "Poor" or "Very Poor." For those samples listed as non-supporting due to poor fish community structure, identification of the possible cause and source was attempted using other data such as land use, point source mapping, habitat information, physical/chemical water parameters, and macroinvertebrate integrity. A source ID study will also be needed to determine the exact cause and source of impairment (Sobat, 2010).

Impaired Water bodies

Every two years, under Section 303 (d) of the Federal Clean Water Act, states are required to identify water bodies that do not meet water quality standards for designated uses. Impaired water bodies may be impacted by both point and nonpoint sources of pollution. From the 303 (d) list, states must establish priority rankings to develop Total Maximum Daily Loads (TMDL). A TMDL specifies the maximum amount of a pollutant a water body can receive and still meet water quality standards.

The upstream segment of the Little Vermilion River located in Illinois was listed on the Illinois Environmental Protection Agency (IEPA) 2002 303 (d) list. Impairments on the IEPA 2002 303(d) list in the river include nutrients/organic enrichment/ low DO/ excessive algal growth, sedimentation/siltation, and finally fecal coliform. On the 2004 IEPA 303 (d) list the Little Vermilion River was impaired for fecal coliform. Figure 24 represents the IEPA 303 (d) list segment of the Little Vermilion River.

The section of the Wabash River that lies downstream of where the Little Vermillion empties into the Wabash and lies within the watershed has been placed by IDEM on the Indiana 303 (d) list. The Wabash runs through the Southeast Wabash subwatershed and is impaired for nutrient, *E. coli*, and Polychlorinated Biphenyl's (PCBs). Figure 25 represents the IDEM 303 (d) list segment of the Wabash River

Fecal coliform is a widely-used indicator organism for the potential contamination from other more harmful microorganisms. High levels of fecal coliform can impair recreational uses by inducing human illness. Infections due to fecal coliform contaminated recreational waters include gastrointestinal, respiratory, eye, ear, nose, throat, and skin diseases (USEPA, 1986).

Designated Uses

Under the provisions of the Clean Water Act, the Indiana Water Pollution Control Board, part of the Indiana Legislative Services Agency (1997) has designated state waters, except waters within the Great Lake system (327 IAC 2-1.5), for the following uses (327 IAC 2-1-3): Full-body contact recreational (April-October); capable of supporting a well-balanced, warm water aquatic community and where temperatures permit, capable of supporting put-and-take trout fishing.

Within the Little Vermillion River Watershed, the exception to this rule is a section of river located outside our watershed boundary but in the Little Vermilion River. The section of land affected by this limitation is located just south of Georgetown, IL, south of the Georgetown sewage treatment plant and before entering into Indiana, which is designated for limited use by Illinois. According to the Illinois TMDL "based on the four fecal coliform samples collected in May and June of 2006, the load from the Georgetown STP likely ranges from 2,346 to 1,559,685 million cfu/day. A load allocation of 11,355 million cfu/d would require a reduction in fecal coliform loading ranging from zero to 99.3 percent. The combined sewer overflow at the Georgetown STP has reported loads ranging from 1,610 to 14,349,200 million cfu/day during high flow events. With a load allocation of 22,700 million cfu/d reductions in loading from the CSO range from zero to 99.9 percent "(ILFECAL TMDL). No permit violations were identified.

The IEPA TMDL states water bodies with naturally poor physical characteristics, including low or no flow, poor chemical quality, or harmful man-made conditions are classified as limited. This segment of the Little Vermilion River still must meet bacteriological criteria and be free from substances that settle out to form deposits, produce odor, color, sheen, or in amounts capable of killing or injuring the aquatic life

In the Illinois Little Vermilion River Watershed there are seven permitted NPDES facilities. According to the ILEPA website there are no violations that have been reported.

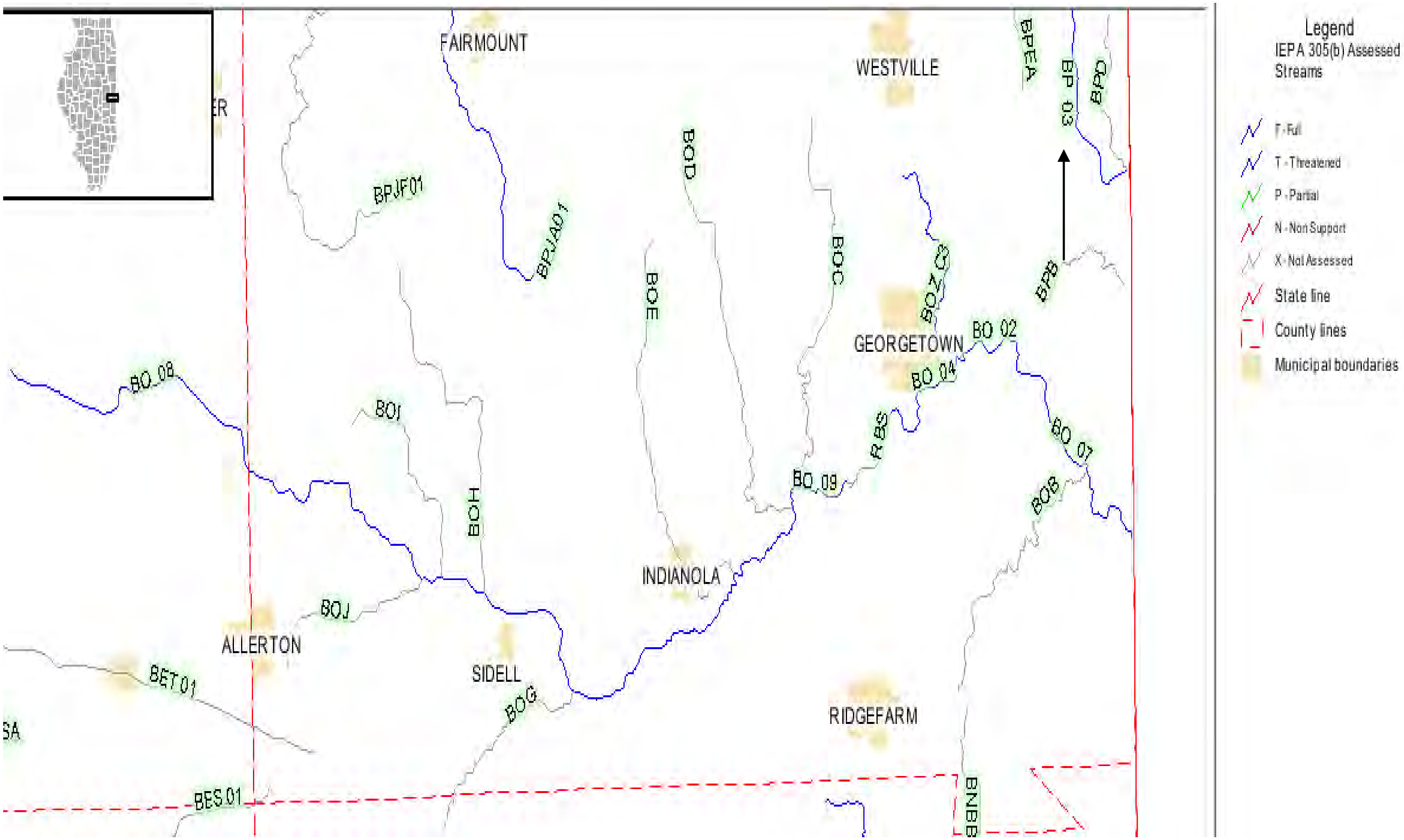


Figure 24: Little Vermilion River, IL Assessment- Source IEPA TMDL

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

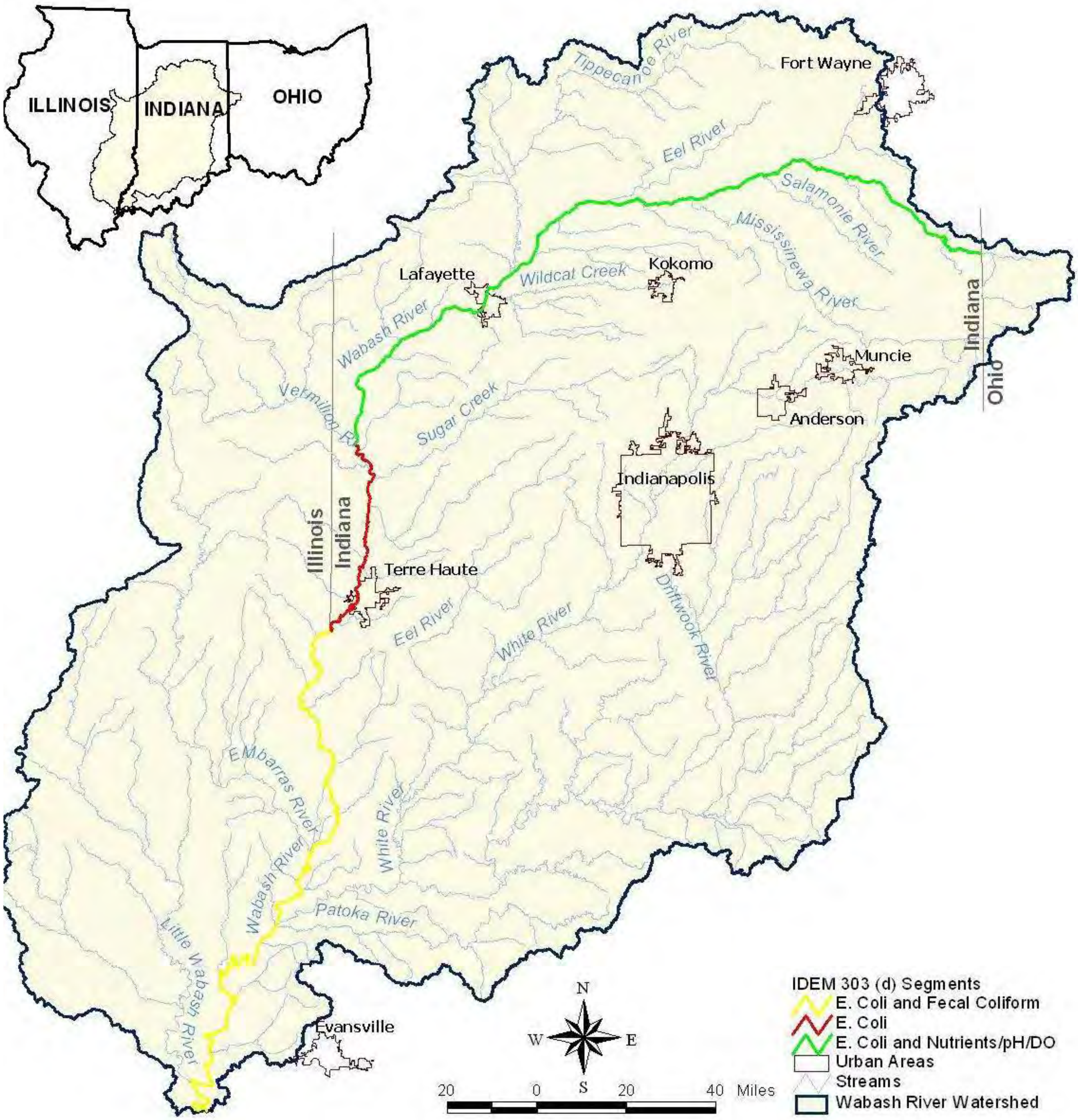


Figure 25: Wabash River Assessment-Source IDEM TMDL

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Little Vermillion River Watershed Group Present Sampling Data and Evaluation

The Little Vermillion River Watershed Group conducted chemical sampling for 2008 and 2009. This section will graphically depict the chemical sampling data for the 2008 and 2009 sampling years. Sampling was started in 2008 during the month of June after the Quality Assurance Project Plan (QAPP) was approved. The sampling was completed once monthly for all chemical parameters excluding *E. coli* and orthophosphate. Orthophosphate was only conducted in the 2009 sampling season. *E. coli* was conducted twice monthly with samples being sent to Environmental Certification (E.C.) Labs in Farmersburg, Indiana. The data depicted in the following graphs for *E. coli* consists of monthly averages.

LVRWG 2008 Sampling Data

In 2008 the sampling team conducted samples from June to October at six testing locations as seen in Figure 26. Chemical samples were collected for dissolved oxygen (DO), biochemical oxygen demand (BOD_5), percent saturation, nitrate, nitrite, pH, and *E. coli.* There were no nitrites identified during the sampling season.

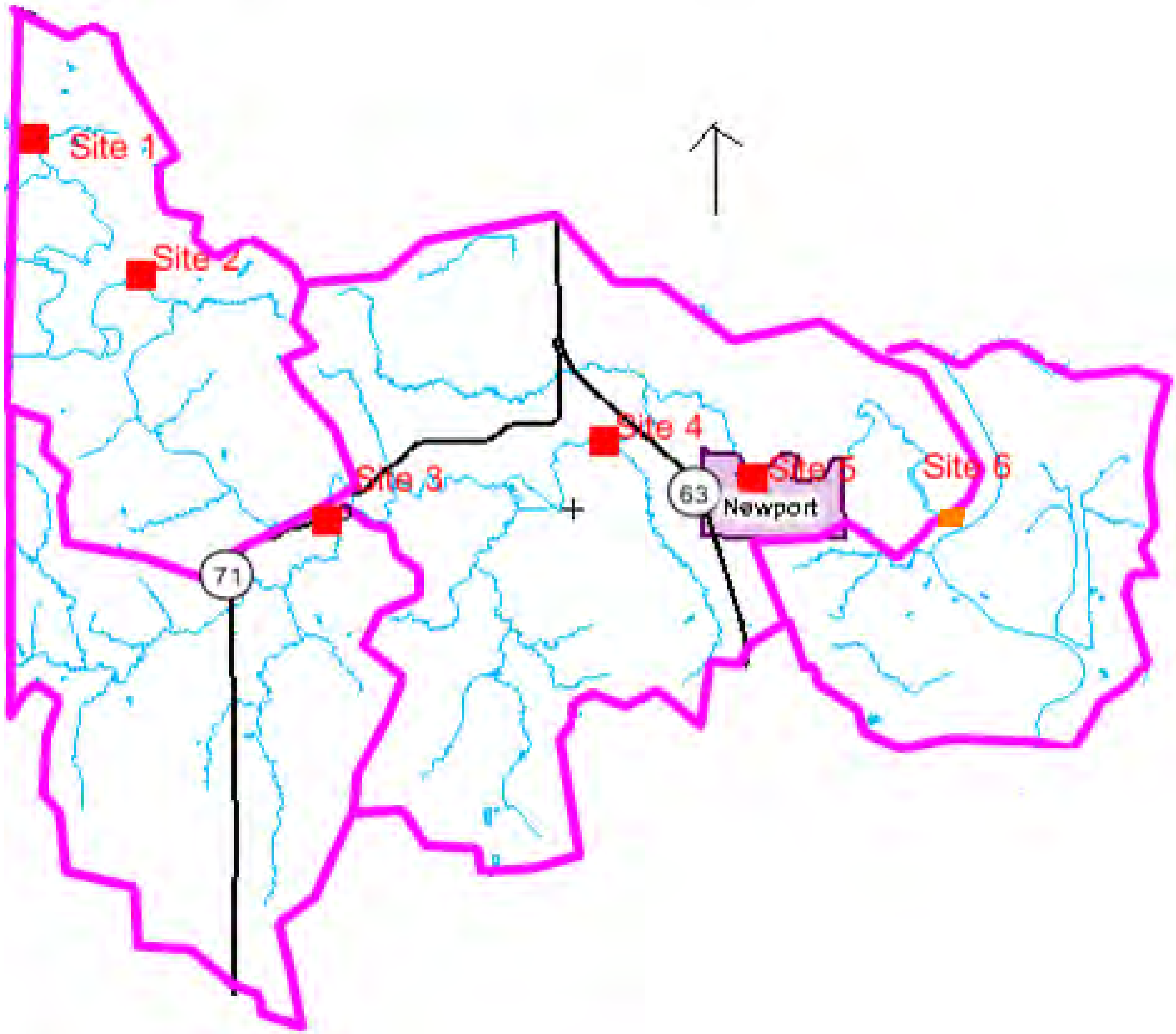
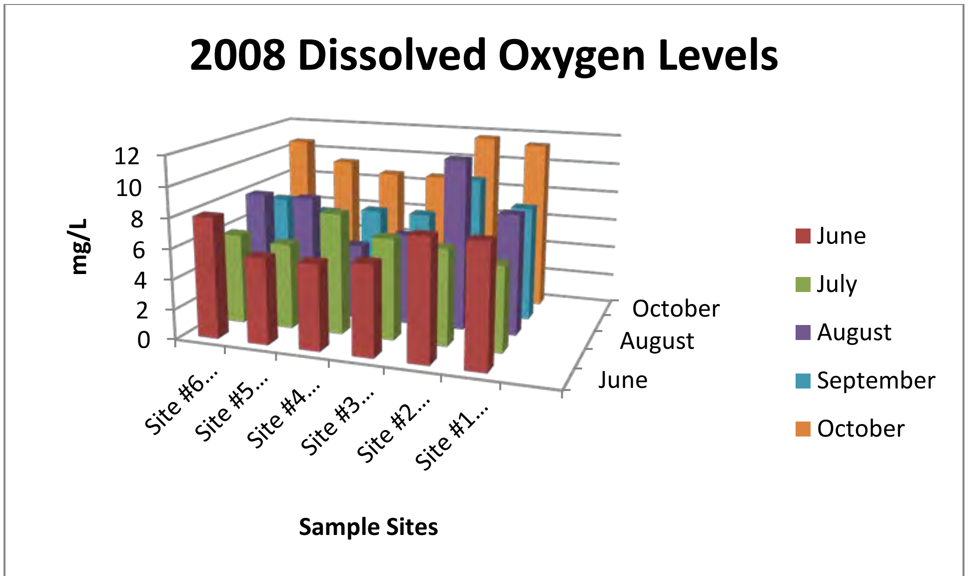
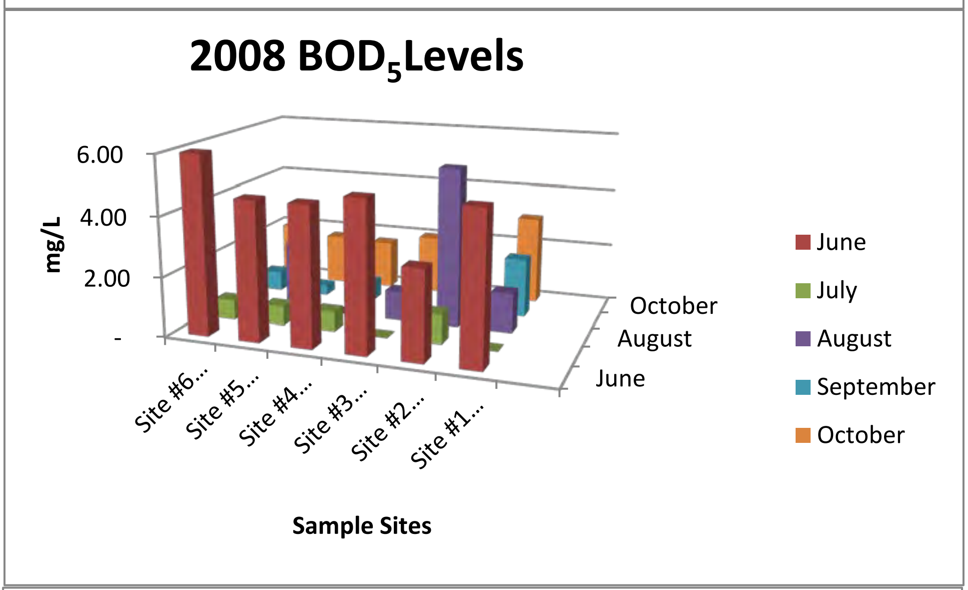
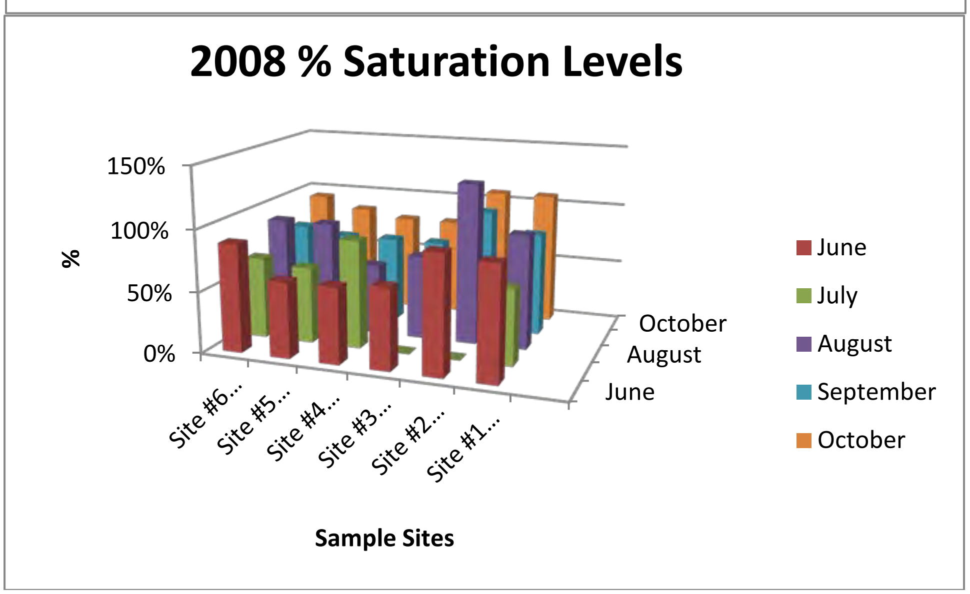
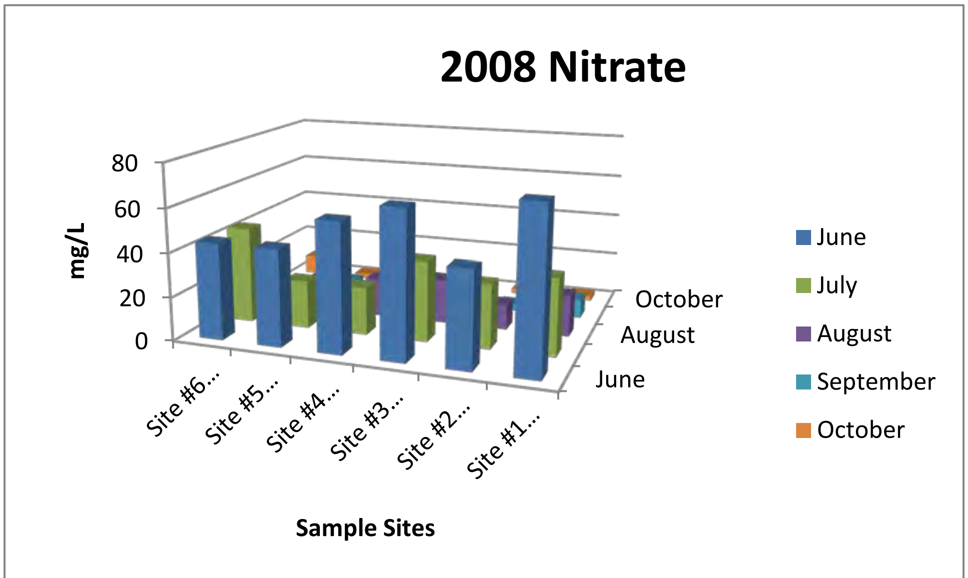


Figure 26: 2008 Sample Site Locations

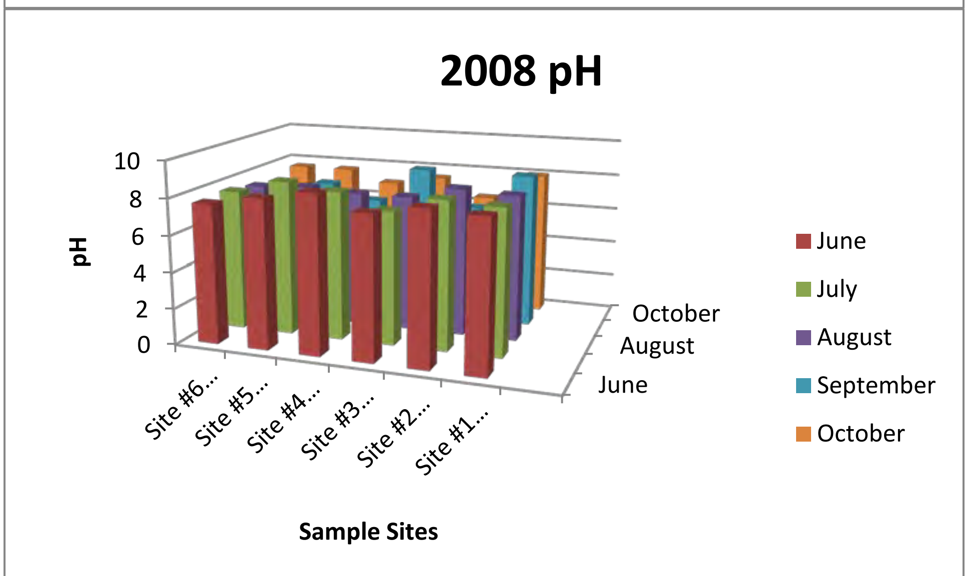

2008 Dissolved Oxygen Levels
mg/L
12
10
8
6
4
2
0
Site #6…
Site #5…
Site #4…
Site #3…
Site #2…
Site #1…
June
August
October
Sample Sites
June
July
August
September
October


2008 BOD5 Levels
mg/L
6.00
4.00
2.00
-
Site #6…
Site #5…
Site #4…
Site #3…
Site #2…
Site #1…
June
August
October
Sample Sites
June
July
August
September
October

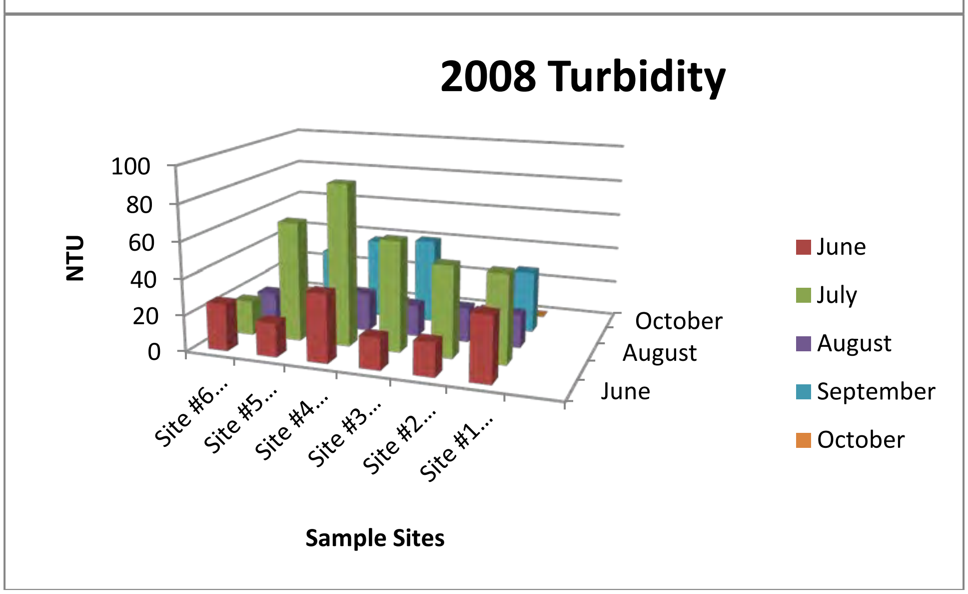

2008 % Saturation Levels
%
150%
100%
50%
0%
Site #6…
Site #5…
Site #4…
Site #3…
Site #2…
Site #1…
June
August
October
Sample Sites
June
July
August
September
October



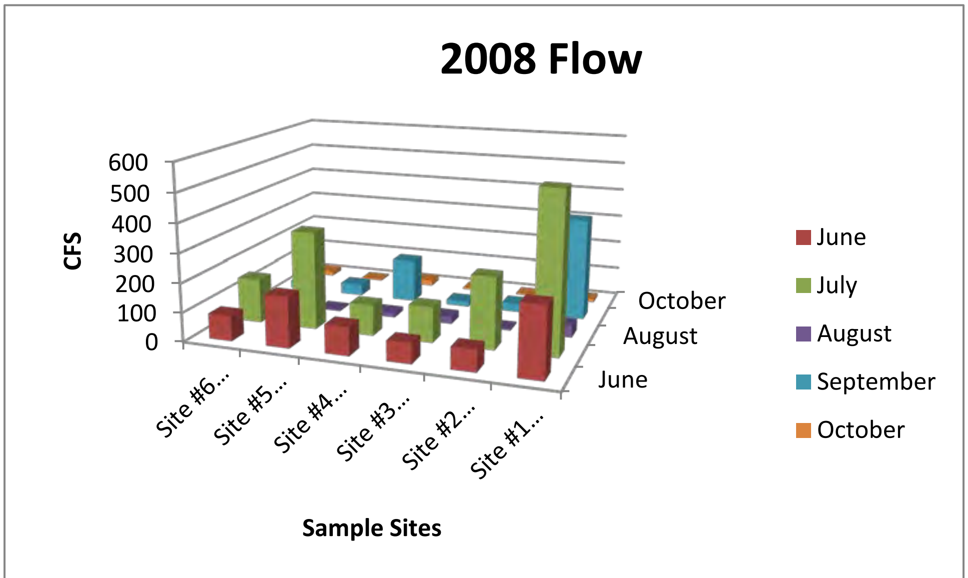
2008 Nitrate
mg/L
80
60
40
20
0
Site #6...
Site #5...
Site #4...
Site #3...
Site #2...
Site #1...
June
August
October
Sample Sites
June
July
August
September
October

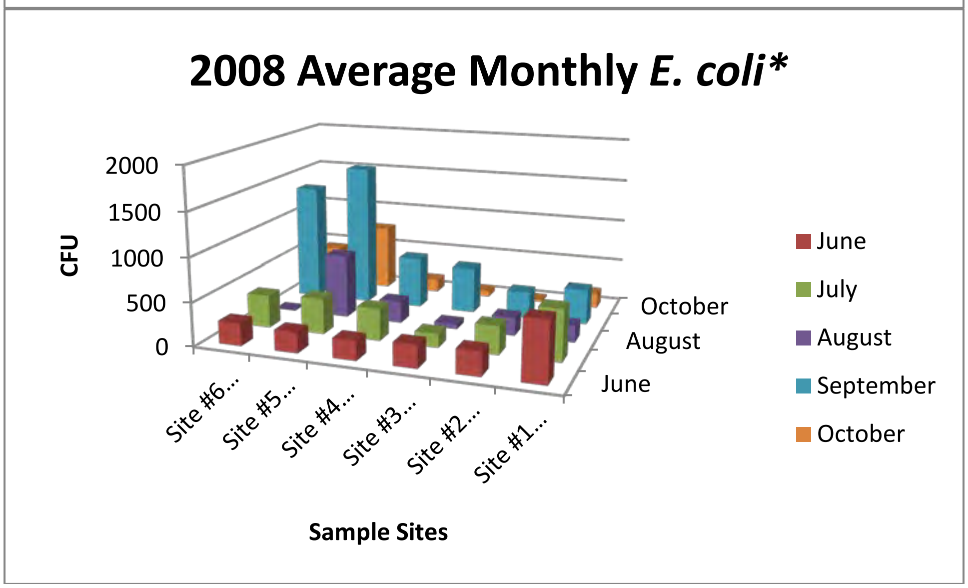


2008 pH
pH
10
8
6
4
2
0
Site #6...
Site #5...
Site #4...
Site #3...
Site #2...
Site #1...
June
August
October
Sample Sites
June
July
August
September
October



2008 Turbidity
NTU
100
80
60
40
20
0
Site #6...
Site #5...
Site #4...
Site #3...
Site #2...
Site #1...
June
August
October
Sample Sites
June
July
August
September
October

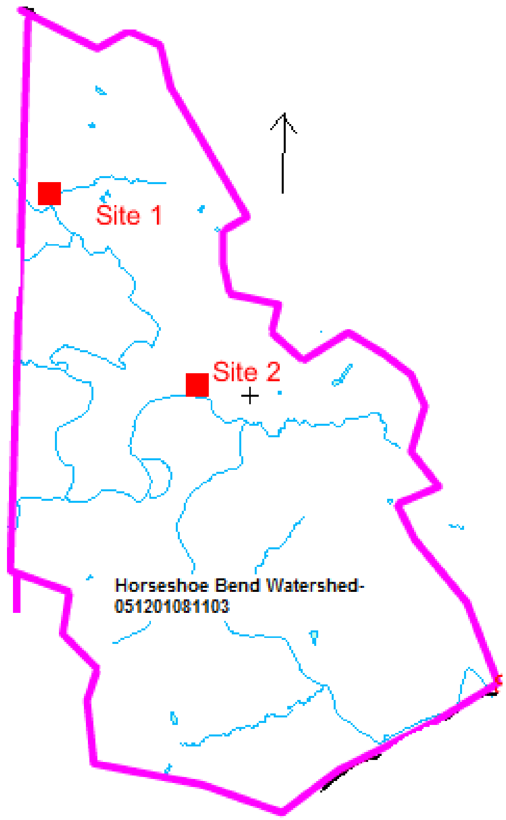




*Site #6 August data omitted (30,881 cfu/100mL)

2008 Data Summary by Sub-watersheds

Horseshoe Bend Watershed



Site #1 and Site #2

During the month of October the watershed experienced cooler temperatures aiding in higher DO levels. Site #1 DO levels were above the Indiana average of 9.8 mg/L during the month of October. Site #2 had readings for August and October DO levels being higher than the Indiana average. Site#1 and Site #2 DO levels for the sampling season were never below the 3 ppm that is considered stressful to most aquatic life. DO were within the target range of 4mg/L and 7mg/L.

BOD_5 levels for site #1 were below the target of 1.5 mg/L for the month of June and then were within the target for the rest of the sampling season. BOD_5 levels for site #2 were at or above the target.

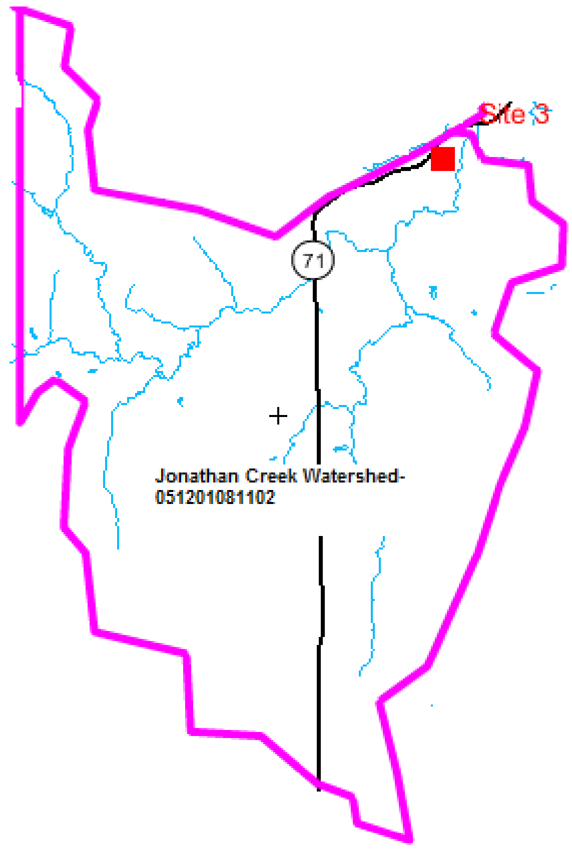
The highest reading of nitrate appeared during June and July and showed a decrease throughout the rest of the sampling season. The amount of nitrate was above the target amount of 1 mg/L throughout the entire sampling season.

The pH level throughout the sampling season was relatively constant for Site #1 except for a small spike during the month of September. Site #2 has a small spike in August then a decrease in September and October. The pH for all months was within the typical Indiana range of 7.2-8.8 for all sampling months therefore making them between the target range of 6-9.

During the heavy rainfalls of June, July, and September the watershed received large amounts of rainfall increasing the river to high flow stage. During these months high turbidity readings were recorded which is associated with high levels of flow.

During these months the data indicates a higher amount of *E. coli* present compared to the low flow stage present during the months of August and October. Site # 1 data indicates both August and October were below the 235 cfu/100 mg/L standards for *E. coli*. Site #2 only had *E. coli* levels below the state standards in the month of October.

Jonathan Creek Watershed



Site #3

The DO levels at site #3 were all within the target range of 4mg/L and 7 mg/L. BOD_5 were within the target range of 1.5mg/L except for the month of June when the data shows it was slightly below.

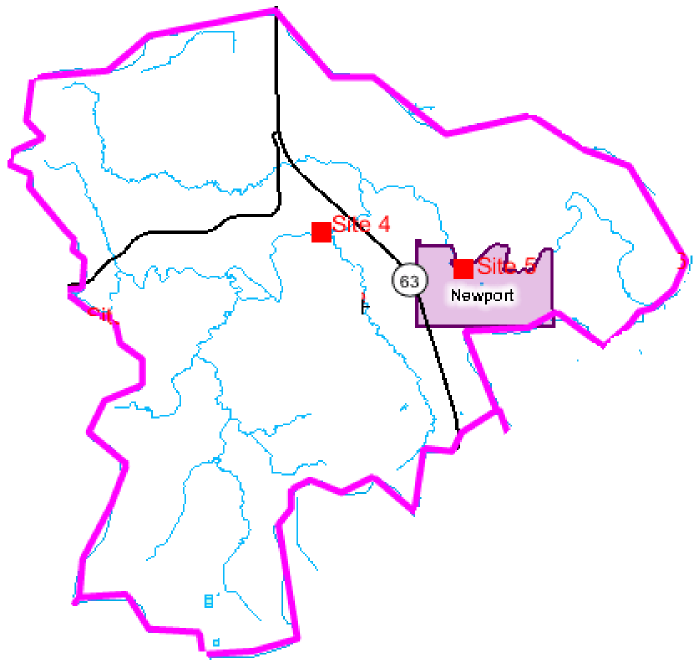
The months of June, July, and September the Little Vermillion Watershed experienced high amounts of rainfall. Higher turbidity ratings for these months were expected as increased run-off would be present. The highest reading of nitrate appeared during June through July.

The highest readings of nitrate appeared during June and July when we had heavy rainfall contributing large amounts of chemical fertilizers from the planting season. The amounts of nitrate present were above the target of 1 mg/L.

The pH level throughout the sampling season was relatively constant for Site #3 except for a small spike during the month of September. The pH for all months was within the typical Indiana range of 7.2-8.8 for all sampling months and within the target range.

The *E. coli* levels for site #3 were above state standards in June but slowly decreased to only spike in the month of September probably due to the increased rainfall.

Newport Watershed



Site #4 and Site #5

DO for the season was reasonably stable and within the target range of 4mg/L and 7mg/L. BOD_5 levels were all within the target range of 1.5 mg/L including that of August.

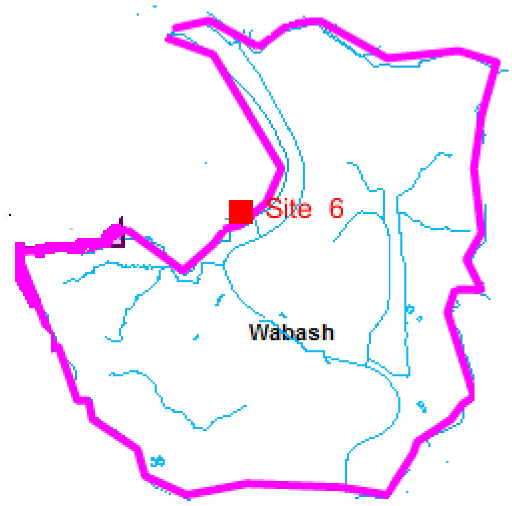
The highest readings of nitrate appeared during June and July when we had heavy rainfall contributing large amounts of chemical fertilizers from the planting season. The amounts of nitrate present were above the target of 1 mg/L.

The pH level was relatively consistent throughout the sampling period. The pH was within the target range of 6-9.

During the months of June, July, and September the watershed experienced heavy periods of rainfall. During these months we experienced high turbidity readings which are parallel with high levels of rainfall.

In June and July we had low *E. coli* amounts present, they slowly increased until spiking in September. This could be due to the warmer temperatures and more rain possibly causing greater amounts *E. coli* to be present in the water. Consistently throughout the entire sampling season site #5 in the Newport subwatershed ran slightly higher *E. coli* counts than the other sampling sites. The high *E. coli* levels can cause health risks to humans when using the waters for recreational reasons, but the effect of *E. coli* can also have an effect on livestock, pets, and wildlife health when the water is consumed. The presence of *E. coli* in surface waters does not necessarily indicate the presence of the harmful strain of the bacteria, known as *E. coli* 0157:H7. Other pathogenic organisms may be present in water contaminated with sewage. Fecal matter in the stream brings with it a high risk for human disease, and ingestion of contaminated water through swimming or other contact (recreational use) has the potential for causing serious illness in human populations.

Southeast Wabash Watershed



Site #6

DO for the season was reasonably stable but below the Indiana average of 9.8 mg/L but within target of 4mg/L and 7 mg/L. BOD_5 levels were all within the target range of 1.5 mg/L including that of August.

The highest reading of nitrate appeared during June and July and showed a decrease throughout the rest of the sampling season. The amount of nitrate was above the target amount of 1 mg/L throughout the entire sampling season.

The pH level was relatively consistent throughout the sampling period. The pH was within the target range of 6-9.

During June, July, and September we recorded high flow and we also had higher turbidity readings due to the higher rainfall we received during these three months. In August we had a very large outlier of 30,881 cfu, which we feel is an anomaly. The reasoning behind us discarding the August sampling outlier is because the other test sites upstream did not have large amounts of *E. coli* indicated during that day and once we reviewed all the data from 2008 and 2009 we decided to remove the outlier due to the unexplainable nature of the outlier.

Summary of 2008 Data

Prior to our sampling season we experienced a 100 year flood that caused many changes within the river prior to our sampling. During our sampling period of June-October we experienced high flow in June, July and September. August and October were our driest months and we experienced low flow stage. Our DO levels throughout the entire sampling season indicated the oxygen levels were within the tolerable range. The sites were within the targeted range of 4 mg/L and 7 mg/L. During October when we experienced cooler temperatures we had DO above the average range at sites #1, 2, and 6.

BOD_5 levels for the testing sites indicated we were within the target range of 1.5mg/L except for the month of July at Sites #1 and #3 where the data indicates lower levels. The pH levels indicated by the data are within the 6-9 target range for all sampling sites.

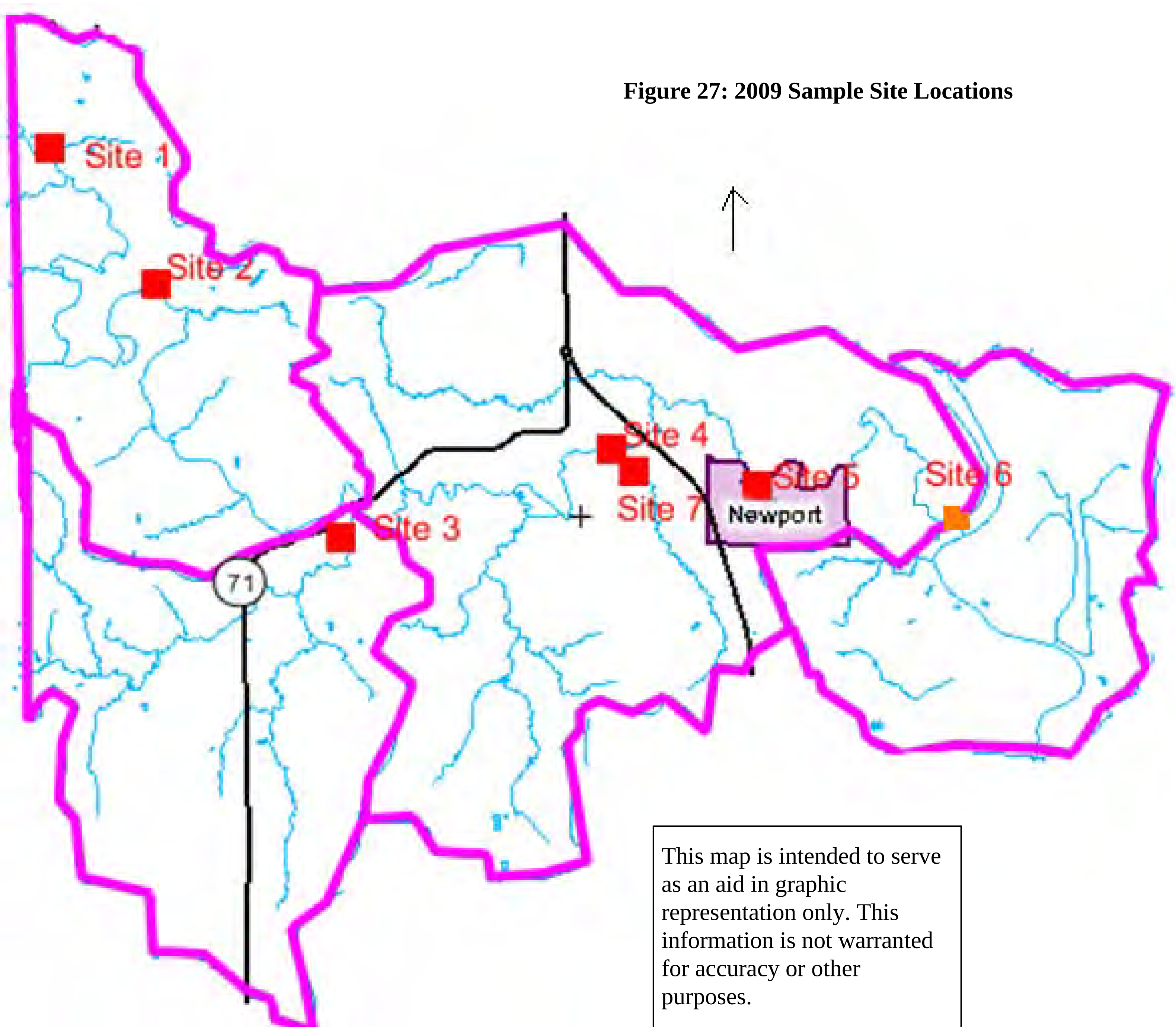
The nitrate samples in June and July were well above target of 1mg/L or 4,501 lbs/yr for nitrates. The estimated load for nitrate for the sampling season was 173,537.52 lbs/year. The Little Vermillion Rivers group goal of reducing nitrates within the watershed would need to be reduced by 169,026.349 lbs/year to meet our target of 4,501 lbs/year. Stakeholder's concerns about high levels of nitrates within the watershed are substantiated and our theory that we have agricultural fertilizers run-off from crop fields is also supported. Sampling did not reveal any nitrites present within our water. During the high flow stage our levels of turbidity (sediment) within the watershed was very high. After converting our turbidity (NTU) into TSS we then determined in June and July (high flow) we averaged 28 tons/year flowing into the Wabash River (Stream Ecology).

The overall data collected for each month indicated above state standards (235 cfu) in *E. coli* for June, July, and September. All the testing locations spiked for the month of September assumedly due to the high rainfall as is usually the main transporter of our higher *E. coli* levels. Our sample sites #1, #4, #5, #6 averaged well above the state standard. These sites need to be reduced by a minimum of 81 cfu to meet our target. The data indicates the river had extremely large amounts of nitrates within our watershed during the high flow stage. As the sampling season continued the nitrate levels decreased.

LWRWG 2009 Sample Data

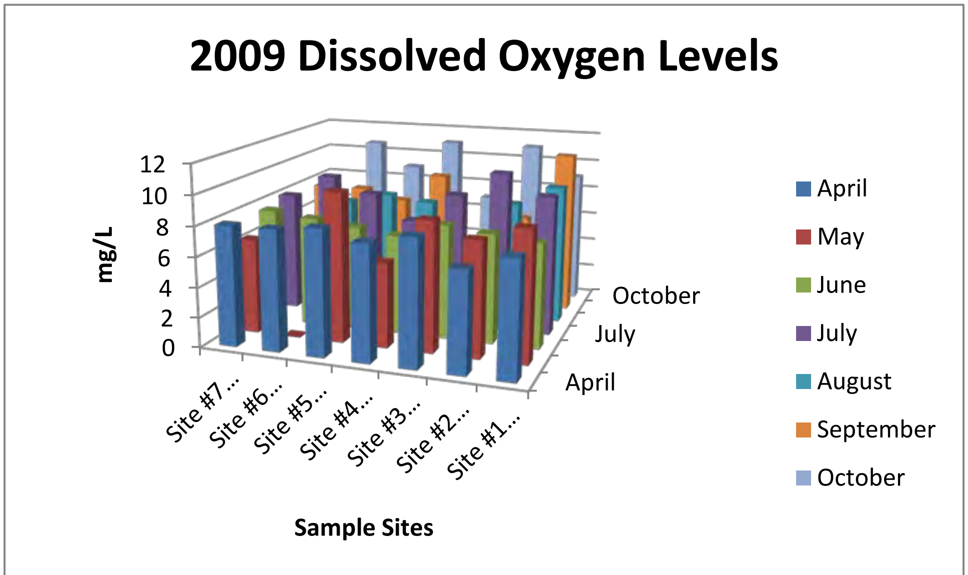
In 2009 the sampling team conducted samples from April to October at seven testing locations as seen in Figure 27. Chemical samples were collected for dissolved oxygen, biochemical oxygen demand, percent saturation, nitrate, nitrite, pH, turbidity, flow, *E. coli*, and orthophosphate. The recreational sampling season did not reveal any nitrites present within our sampling sites. A very small trace (0.1) of orthophosphate was located during the month of August (Site #1) and September (Site #1& #2). No traces of orthophosphate were identified during October. During these sampling months we saw high flow for the months of April –June and low flow for the other months.

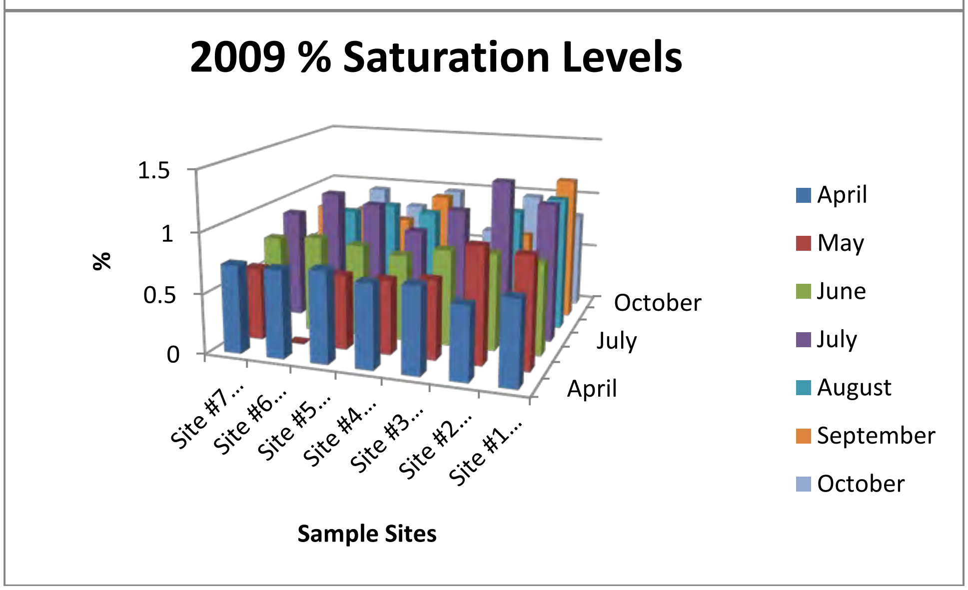
Figure 27: 2009 Sample Site Locations

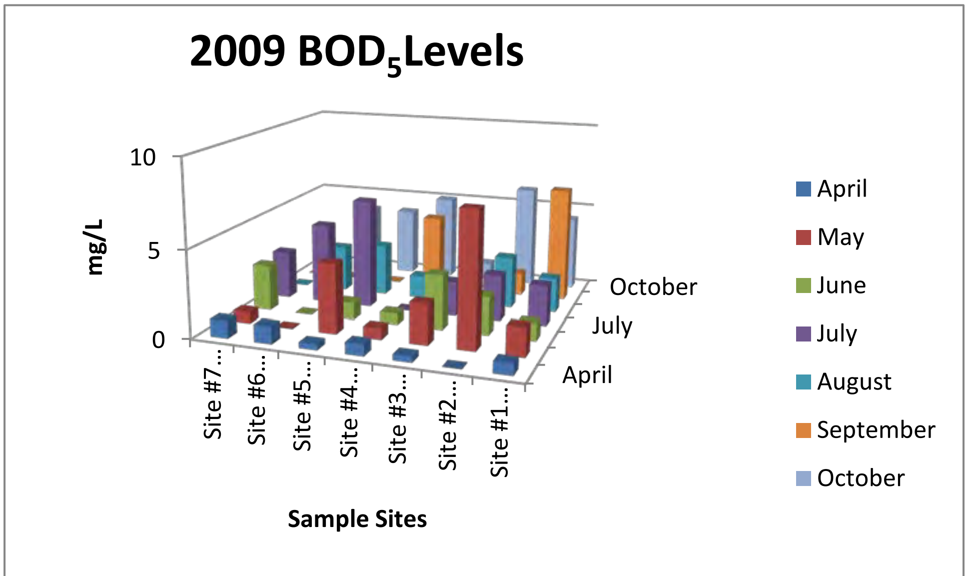


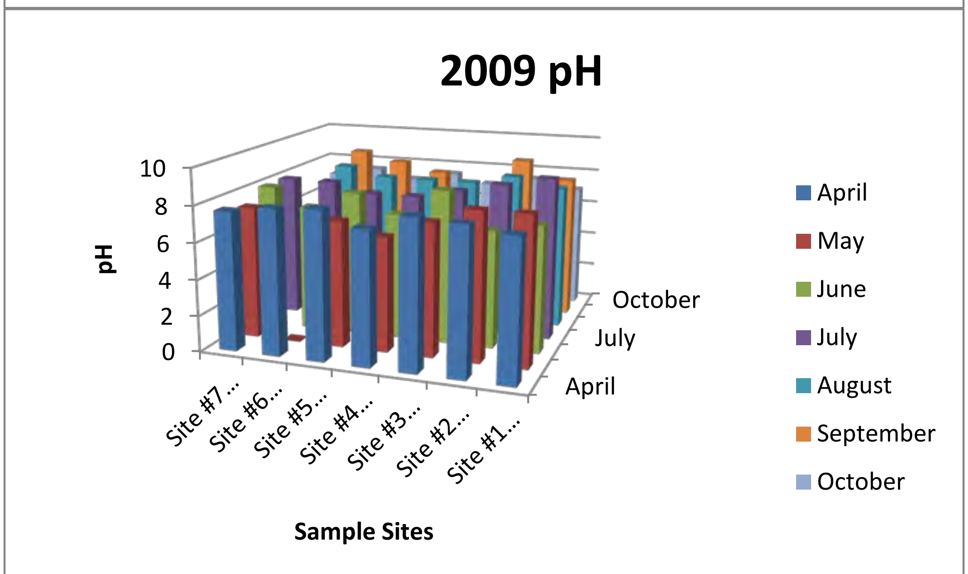
This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

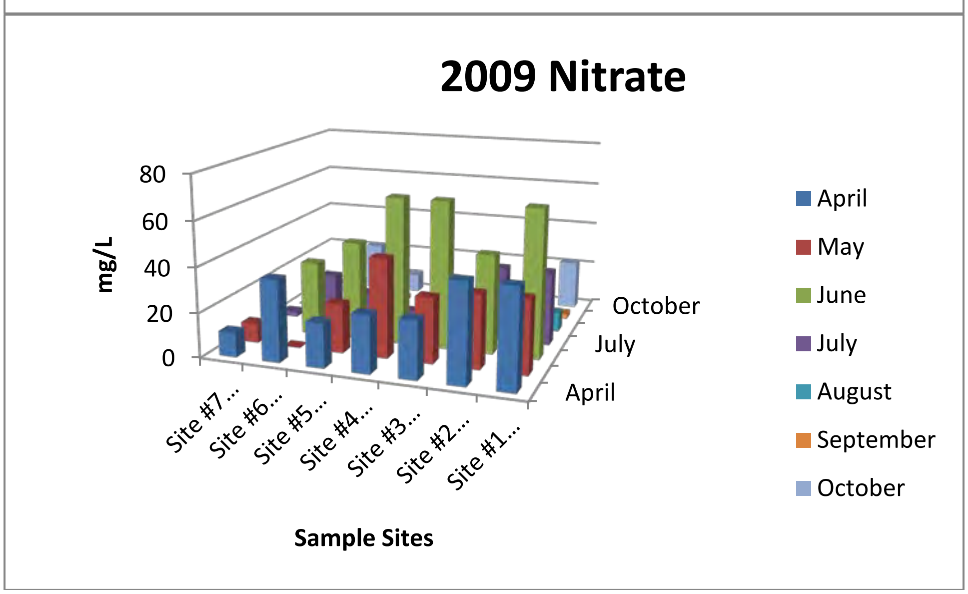
Sampling Data 2009

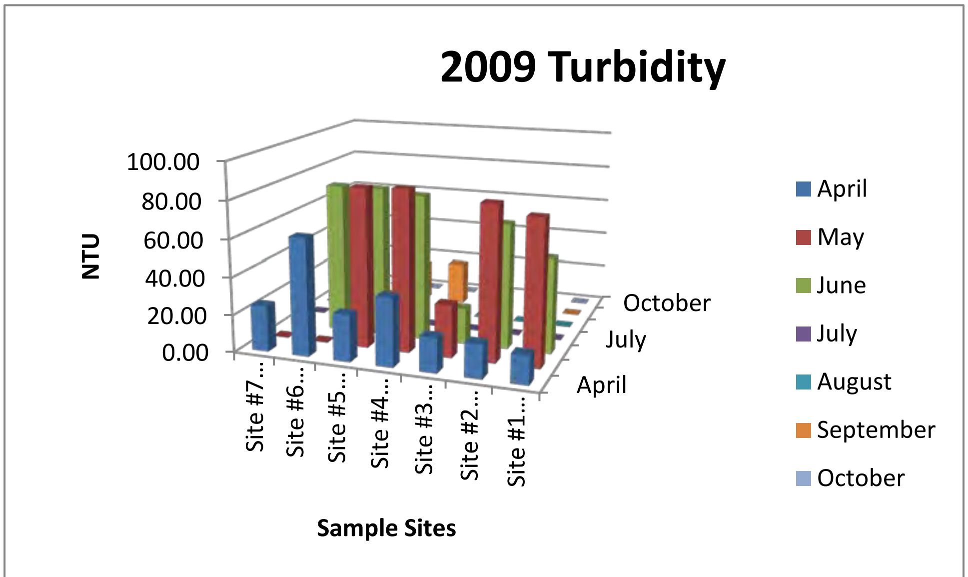


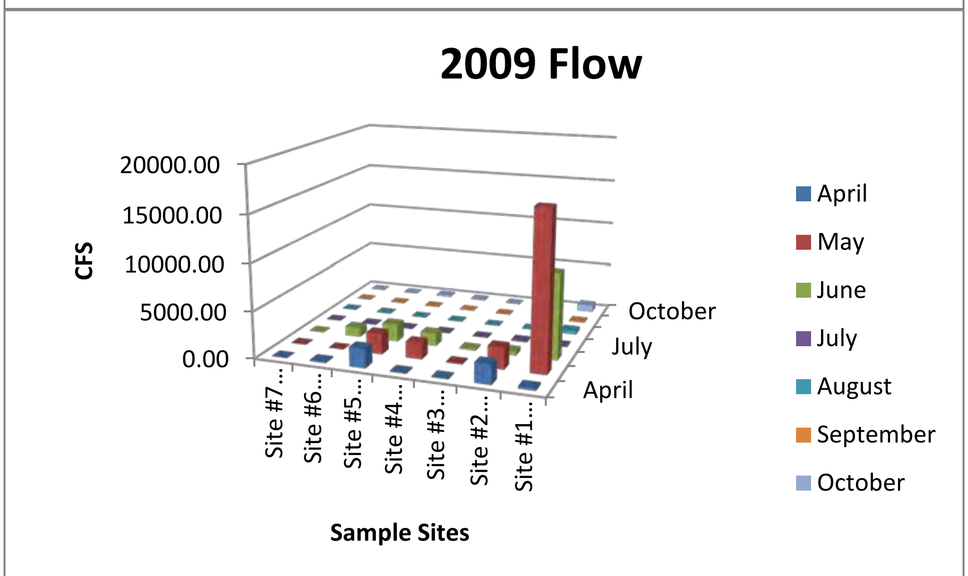


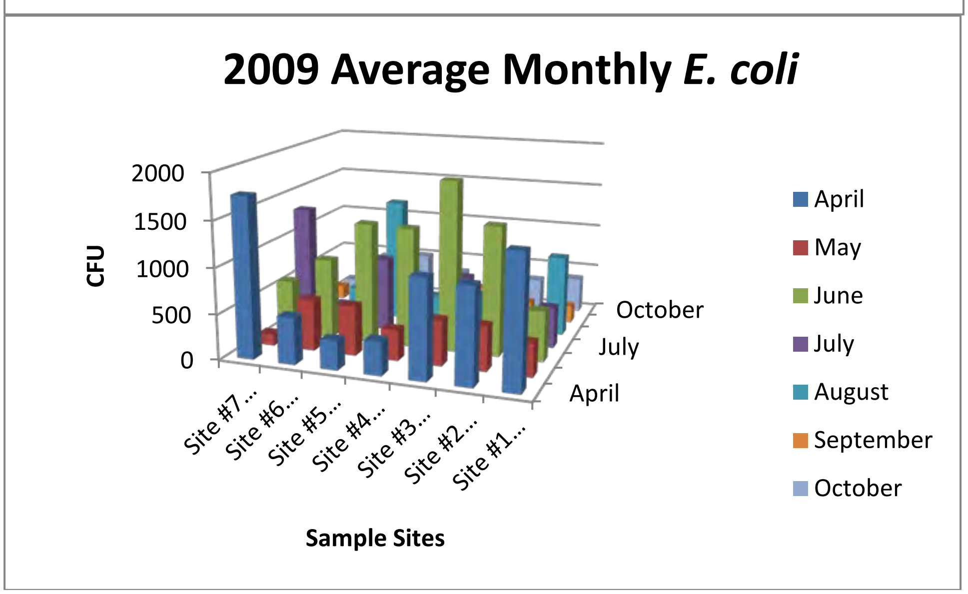

2009 BOD$_5$ Levels
mg/L
10
5
0
Site #7…
Site #6…
Site #5…
Site #4…
Site #3…
Site #2…
Site #1…
April
July
October
Sample Sites
April
May
June
July
August
September
October


2009 pH
pH
10
8
6
4
2
0
Site #7 …
Site #6…
Site #5…
Site #4…
Site #3…
Site #2…
Site #1…
April
July
October
Sample Sites
April
May
June
July
August
September
October


2009 Nitrate
mg/L
80
60
40
20
0
Site #7 …
Site #6…
Site #5…
Site #4…
Site #3…
Site #2…
Site #1…
April
July
October
Sample Sites
April
May
June
July
August
September
October

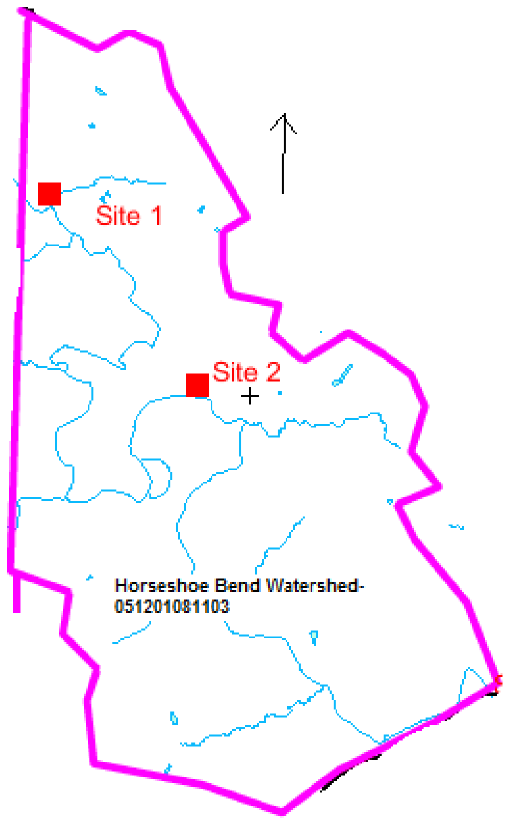

2009 Turbidity
100.00
80.00
60.00
40.00
20.00
0.00
NTU
Site #7...
Site #6...
Site #5...
Site #4...
Site #3...
Site #2...
Site #1...
Sample Sites
October
July
April
April
May
June
July
August
September
October


2009 Flow
20000.00
15000.00
10000.00
5000.00
0.00
CFS
Site #7...
Site #6...
Site #5...
Site #4...
Site #3...
Site #2...
Site #1...
Sample Sites
October
July
April
April
May
June
July
August
September
October


2009 Average Monthly E. coli
2000
1500
1000
500
0
CFU
Site #7 ...
Site #6...
Site #5...
Site #4...
Site #3...
Site #2...
Site #1...
Sample Sites
October
July
April
April
May
June
July
August
September
October

2009 Data Summary by Sub-watershed

Horseshoe Bend Watershed



Site #1 and Site #2

DO levels were within the target range of 4mg/L and 7mg/L. Site#1 and Site #2 DO levels for the sampling season were never below the 3 ppm that is considered stressful to most aquatic life.

BOD_5 levels for site #1 and #2 were below the target of 1.5 mg/L for the month of April and then were above the target for the rest of the sampling season.

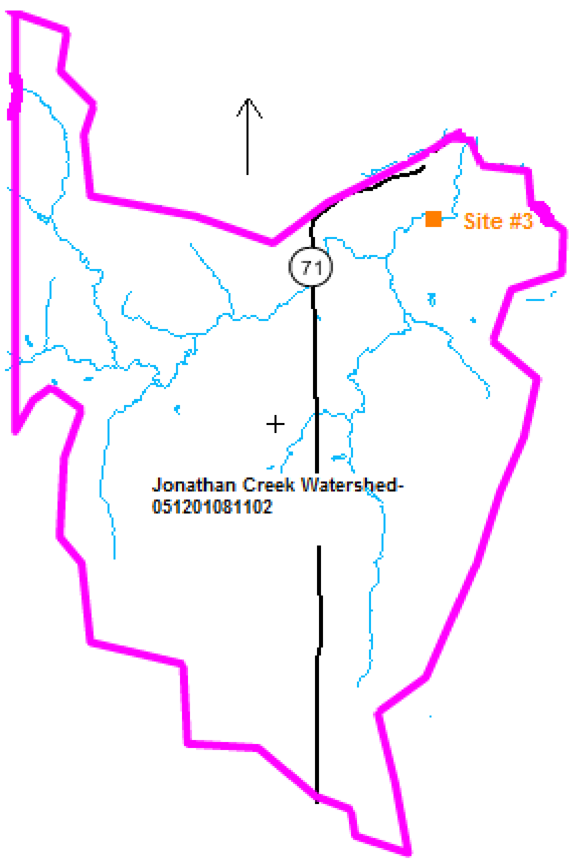
The highest reading of nitrate appeared during June. Data indicates a consistently high reading from April to July before nitrates started decreasing throughout the rest of the sampling season. The amount of nitrate was above the target amount of 1 mg/L throughout the entire sampling season.

The pH for all months was within the target range of 6-9.

During the heavy rainfalls of May and June the watershed received large amounts of rainfall increasing the river to high flow stage. During these months high turbidity readings were recorded which is associated with high levels of rainfall.

During April (high flow) and August (low flow) there was an elevated level of *E. coli* present within our river at sampling site #1. During the month of August we had very little to no rainfall in the watershed. But there was rainfall in the Little Vermilion watershed in Illinois in August that did slightly increase our water level, which could have caused our high *E. coli* levels.   The data indicates the sites were above the 235 cfu/100mg/L target for every month except for September when it was below the target.

Jonathan Creek Watershed



Site #3

Samples could not be collected for the months of August and September due to this tributary being dry. The DO levels at site #3 were within the target range of 4mg/L and 7 mg/L for samples collected. BOD_5 were within the target range of 1.5mg/L except for the month of April when it was well below.

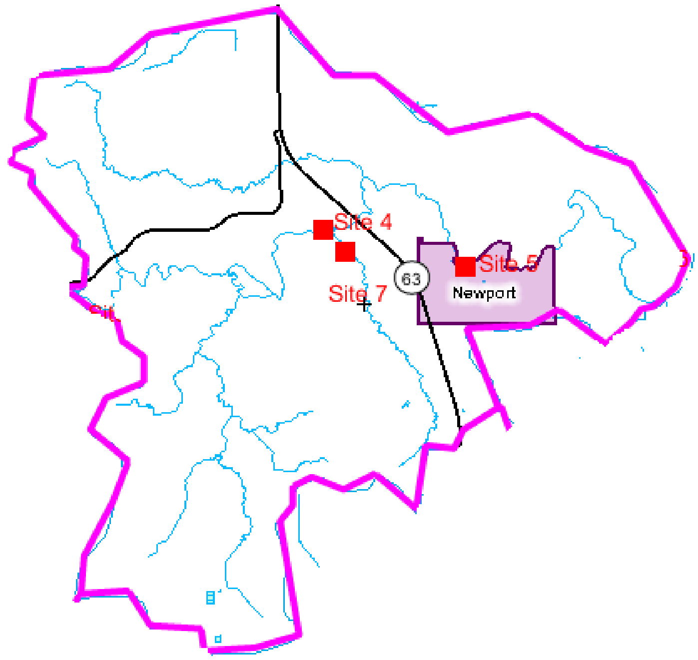
The highest readings of nitrate appeared during June when we had heavy rainfall contributing large amounts of chemical fertilizers from the planting season. The amounts of nitrate present were above the target of 1 mg/L.

The pH level throughout the sampling season was relatively constant for Site #3 except for a small spike during the month of September. The pH for all months was within the typical Indiana range of 7.2-8.8 for all sampling months and within the target range.

The months of June, July, and September the Little Vermillion Watershed experienced high amounts of rainfall. Higher turbidity ratings for these months were expected as increased run-off would be present. The highest reading of nitrate appeared during June through July.

The *E. coli* levels for site #3 were above the 235 cfu/ 100 mg/L state standard for the entire sampling season.

Newport Watershed



Site #4, Site #5, Site #7

DO for the season was reasonably stable and within the target range of 4mg/L and 7mg/L. BOD_5 levels were below the target range of 1.5 mg/L for a majority of the sampling months.

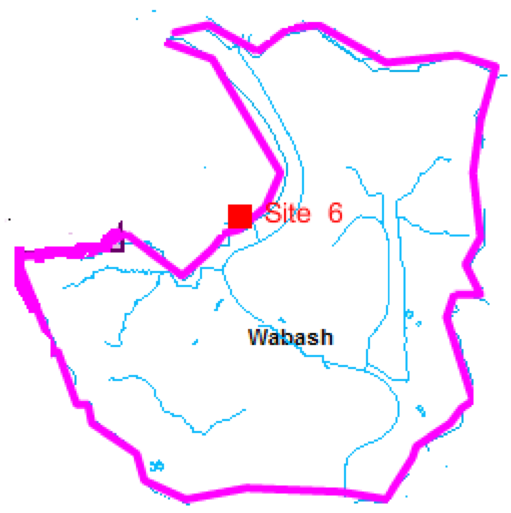
The highest readings of nitrate appeared during April through June when we had heavy rainfall contributing large amounts of chemical fertilizers from the planting season. The amounts of nitrate present were above the target of 1 mg/L.

The pH level was relatively consistent throughout the sampling period. The pH was within the target range of 6-9.

During the months of April, May, and June the watershed experienced heavy periods of rainfall. During these months we experienced high turbidity readings which are parallel with high levels of rainfall.

The data indicates Site #7 was below the 235 cfu/100mg/L state standard for the months of May, August, September and October. Site #4 was below the state standard for the month of October. Site #5 was never below the target of 235 cfu/100mg/L.

Southeast Wabash Watershed



Site #6

Chemical samples could not be obtained during the month of May due to flooding. DO for the season was reasonably stable but below the Indiana average of 9.8 mg/L but within target of 4mg/L and 7 mg/L. BOD_5 levels were below the target range of 1.5 mg/L until July.

The highest reading of nitrate appeared during April through June and showed a decrease throughout the rest of the sampling season. The amount of nitrate was above the target amount of 1 mg/L throughout the entire sampling season.

The pH level was relatively consistent throughout the sampling period. The pH was within the target range of 6-9.

During April through June we recorded high flow and we also had higher turbidity readings due to the higher rainfall we received during these months.

The data indicates the sites were above the 235 cfu/100mg/L target for every month except for September when it was below the target.

2009 Sample Summary

Our overall samples indicated our DO levels within the entire watershed are within average range. The BOD_5 data also indicates the levels are within average range.

During our sampling period of April-October we experienced high flow April, May, June and the first part of July. We had above average rainfall during July and cooler temperatures. The overall data collected for each month indicated most sites were well above state standards (235 cfu) in *E. coli* concentration. Over the 2008 and 2009 sampling seasons site #5 on average was consistently above the target of 235 cfu/100 mg/L. The *E. coli* counts could be contributed by Newport, Indiana not having a proper wastewater management system.

The month of June sampling data indicated the river had extremely large amounts of nitrates present within our entire watershed. Nitrates were more prevalent throughout the entire sampling season within the Horseshoe Bend sub-watershed. The samples throughout the entire sampling season were well above the target of 1mg/L or 4,501 lbs/year. The estimated nitrate loads during sampling averaged 10,743 lbs/year for 2008 and 99,934 lbs/year for 2009 for the watershed. Sampling did not reveal any nitrites present within our water.

We also sampled for orthophosphate during the 2009 recreational period. Our data did not reveal any orthophosphate being present within the waterbody until August and September. In August we only located Site #1 Entrance, Horseshoe Bend watershed, having orthophosphate present in the water. It was the smallest trace possible 0.1ppm. During September sampling we located it at the Site #1 and at Site #2 which is located approximately 1 mile downstream from Site #1. October sampling revealed no orthophosphate within any of our water bodies in the watershed. During the high flow stage (April, May, June) our levels of suspended solids (sediment) within the watershed were very high. In these four months we averaged 341 tons of sediment flowing into the Wabash River.

Little Vermillion Sampling Data Summary

Over the two year sampling period the LVRWG discovered on average DO levels were within our target range for the watershed. There were high amounts of nitrate within our watershed which was indicated by sampling data. *E.coli* was on average above the standard of 235 cfu/100 mg/L. Table 12 indicates the estimated loads for 2008 and 2009 from the current data. The figures in Table 12 reflect the average for the given parameter within the 12-digit watersheds sampling sites.

Table 12: Estimated Loads

2009 Watershed	Average Flow	N mg/L	Estimated N Load (lbs/yr)	DO Load-mg/L	BOD5 Load-mg/L	Turbidity Load-NTU	E.coli Load-cfu	Estimated TSS Load-mg/L	Sediment Load-lbs/year
051201081103	2322.17	27.3	341,985.63	8.54	2.86	22.11	572.2	24.41	472,711.11
051201081102	48.6	23	6,029.97	6.38	1.26	9.43	732.2	16.55	6,706.73
051201081603	176	16.8	15,950.46	7.23	1.4	20.35	417.7	23.32	34,225.63
051201081104	460.5	14.4	35,772.01	7.5	1.86	21.86	574	24.25	93,146.11
Little Vermillion River Est. Loads			99,934.52	7.41	1.845	18.4375	574.0	22.13	151,697.40

2008 Watershed	Average Flow	N Avg Load-mg/L	Estimated N Load	DO-mg/L	BOD 5-mg/L	Turbidity-NTU	E.coli-cfu	Estimated TSS Load-mg/L	Sediment Load-lbs/year
051201081103	155.2	22.73	19,030.16	7.75	2.38	28.04	319.3	28.0848	36,352.07
051201081102	48	21.4	5,541.23	5.665	1.5	28.46	216.6	28.3452	11,347.15
051201081603	58.1	26.9	8,431.01	7.61	2.402	23.61	608.25	25.3382	12,277.73
051201081104	94.8	19.5	9,972.27	6.26	1.575	37.49	535.9	33.9438	26,837.05
Little Vermillion River Est. Loads			10,743.67	6.82	1.964	29.4	420.0	28.928	21,703.50

Existing Loads

In this part of the WMP we will review the existing loads for the watershed. Loads for DO, pH, *E. coli*, orthophosphate were calculated from LVRWG data. Nitrate and sediment loads were calculated by using the STEPL model. Loads are calculated simply by taking the concentration at that particular site and multiplying it by the current flow at that given time.

The reason for calculating loads is to determine the total pollutant load that a body of water, such as a lake or river, currently contains to determine if it meets the water quality standards (IDEM). As previously mentioned the group has determined the targets and water quality standards we would like to meet for the Little Vermillion River Watershed. Upon looking at the existing loads one can then determine the overall reduction needed for the river to meet the water quality standards established. Loads were calculated for nutrients by taking flow (cfs) x data (mg/L) x5.3945. TSS= flow (cfs) x data (mg/L) x (5.3945/2000). Nitrates and sediment were calculated using the STEPL model by inputting the base information.

Table 13 reflects the load reductions needed to meet our targets. The data is based on the LVRWG current sampling data unless otherwise noted. As noted in Table 13 STEPL models were completed to determine the average pounds or tons per year for nitrate and sediment loading to determine the reduction required for the Little Vermillion River Watershed. Our group sampled only for turbidity and we used the earlier mentioned model for TSS.

Our data clearly indicates higher levels of *E. coli* present than the state standard. The data shows continuous high loads of *E. coli* passing throughout the watershed.

Our data shows high loads of nitrate in the water during the months of May, June and July. After July 2008 and 2009 the nitrate loads dip below 1,000 mg/L/ cf^3. This indicates there was less nitrogen entering the water source. The higher nitrate levels are probably due to large amounts of rainfall and the amount of nitrogen still present within the soil at this time of year because of farming practices.

Nitrate, an agricultural nonpoint source pollution and urban nonpoint source pollution leads to a number of water quality and human health problems, such as aquatic life use impairments and blue-baby syndrome. Nitrogen can come from manure, commercial fertilizers, and sewage. A probable cause for the 2008 nitrogen loads being high during the months of June and July could be because farmers had a later planting season due to the floods. As the corn absorbs more nitrogen throughout the growing season less is available for runoff. But prior to absorption the amount present can easily drain from the farm field tiles directly into the surrounding tributaries and river.

Table 13: Current Load Reductions

Sample Sites	Parameter	DO		pH		E.coli		Turbidity	
	Target	> 4mg/L: <7 mg/L		>6<9		<235 cfu		10.4 NTU	
	Source	327 IAC 2-1-6		327 IAC 2-1-6		IN State Std		US-EPA	
	12-digit HUC	Avg mg/L (Apr.-Oct.)	Improvement	pH	Improvement	Avg. cfu (Apr.-Oct.)	Reduction	Avg. NTU (Apr.-Oct.)	Reduction
c	051201081103	8.32		7.97		481.6	246.6	20.43	10
Site #2: Horseshoe Br.	051201081103	8.01		7.15		382.4	147.4	23.8	13.4
Site #3: SR 71- 2008	051201081102	5.66		6.44		216.6	-18.4		
Site #3: Jonathan Cr.-09	051201081102	6.38		6.71		688.3	453.3	9.43	-
Site #4: Covered Br.	051201081104	7.26		7.41		355.7	120.7	31.9	21.5
Site #5: Newport Br.	051201081104	7.06		6.95		707.5	472.5	30.14	29.7
Site #6: Exit-South Site	051201081603	7.43		7.16		513	277.97	20.36	10
Site #7: Tributary-09	051201081104	6.39		5.42	0.58	580.3	345.3	3.51	-

Sample Sites	Parameter	Nitrate			Sediment		TSS		
	Target	<1 mg/L					<30mg/L		
	Source	327 IAC 2-1-6					IDEM Draft TMDL		
	12-digit HUC	Avg. mg/L	Avg. lbs/yr (STEPL Model)	Reduction	Tons/yr (STEPL Model)	Reduction	Avg. mg/L	Avg. Sediment /yr (tons)	Reduction
Site #1: State Line	051201081103	29.8	119049.0	28.8	7437.4		25.2	11062	
Site #2: Horseshoe Br.	051201081103	19.9	119049	18.9	7437.4		29.0	10672	
Site #3: SR 71- 2008	051201081102	21.4	172016	29.4	428601		32.3	11958	2.3
Site #3: Jonathan Cr.-09	051201081102	23.1	172016	22.1	428601		18.9	8093	
Site #4: Covered Br.	051201081104	23.1	114054	22.1	71918		36.5	13917	6.5
Site #5: Newport Br.	051201081104	16.22	114054	15.2	71918		32.5	11959	2.5
Site #6: Exit-South Site	051201081603	21.86	7263	20.9	754		28.9	8948	
Site #7: Tributary-09	051201081104	4.03	7263	3.03	754		21.2	7734	

Qualitative Habitat Evaluation Index & Pollution Tolerance Index

The Little Vermillion River Watershed Group conducted two indexes for biological monitoring. The LVRWG used the Citizens Qualitative Habitat Evaluation Index (CQHEI) and the Pollution Tolerance Index (PTI). The monitoring team conducted the biological monitoring on September 23 & 24, 2008 and September 21, 2009 when the Little Vermillion River had a normal low water mark. This allowed the monitoring team to better identify benthic macroinvertebrates while being in the streambed. There were six sites for 2008; reference page 65 Figure 26 for 2008 sample sites and seven sites for 2009; reference page 78 Figure 27 2009 sample sites that were monitored. These sites were the same as our chemical sites; reference page 8 for the sampling locations map. Although, for 2009 the sampling team was unable to collect macroinvertebrates at the Site #7 Tributary due to the fact this is an intermittent stream and was completely dry at the time of sampling. However, a CQHEI was completed on Site #7.

The Qualitative Habitat Evaluation Index (QHEI) was developed by the Ohio EPA to provide a qualitative evaluation of the stream habitat by measuring the physical features affecting aquatic communities. The index provides information on a stream's ability to support fish and macroinvertebrate communities (Rankin, 1989). The Citizens Qualitative Habitat Evaluation Index (CQHEI) is a more easily used and understood version of the QHEI. The CQHEI is composed of six parameters related to stream fish communities: substrate, in-stream cover, channel morphology, riparian and bank conditions, pool and riffle quality, and gradient. The results obtained from the (CQHEI) are shown in Table 14.

Table 14: CQHEI Results

	Citizens Qualitative Habitat Evaluation Index (CQHEI)												
	Site #6- Exit		Site #5- Newport Bridge		Site #4- Covered Bridge		Site #3- Jonathan Creek	Site #3- SR 71 Bridge	Site #2 Horseshoe Bend		Site #1- State Line Bridge		Site #7- Tributary
	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
I. Substrate Score	0	0	19	13	15	10	0	10	0	0	0	10	20
II. Fish Cover Score	8	6	6	8	8	12	2	12	4	16	8	14	2
III. Stream Shape and Human Alterations	15	15	15	17	15	12	12	12	12	15	12	14	15
IV. Stream Forests & Wetlands Score	15	14	13	18	17	20	13	13	17	17	15	13	13
V. Depth and Velocity Score	1	5	4	11	5	8	0	9	4	9	2	9	0
VI. Riffles/ Runs Score	4	4	11	13	8	0	0	0	0	0	0	0	0
Total CQHEI	43	44	68	80	68	62	27	56	37	57	37	60	50

The CQHEI scores can range from 0 to 114 points. If the score is over 100, consider it 'extra credit' and it is an exceptionally high-quality stream. Ranges for excellent, medium, poor, and very poor have not yet been set for this CQHEI index but generally scores greater than 60 are considered to be "generally conducive to the existence of warm water fauna" (p. 23, Hoosier Riverwatch Guide).

Out of our six tests sites, 2008, Table 15 reflects the total scores with three of the sampling sites being equal to or greater than 60. The other three sampling sites were not far from 60 with the exception of Site #6 being 44.

Out of the seven 2009 test sites only five could successfully be sampled for macroinvertebrates. The two tributaries (Site #3 and Site #7) we conducted the CQHEI but didn't complete the PTI as they were dry and therefore no macroinvertebrates could be located. For the seven sample sites we had two sites scoring greater than 60. Jonathan Creek tributary (Site #3:2009) had the lowest measured score. The other sites did not fare well in the CQHEI for their habitat quality. The 2009 data reflects similar findings as the 2008 data.

Next the PTI will need to be considered to obtain an overall picture of the watershed. The PTI was developed to provide an overview of populations of benthic macroinvertebrates living within the stream. Benthic macroinvertebrates are important to sample because they are reasonably easy to capture, relatively immobile, and spend most of their life cycles within the stream itself. Benthic macroinvertebrates are continuous indicators of environmental quality. A plethora of pollution-sensitive benthic macroinvertebrates can indicate a healthy aquatic habitat. The PTI is divided into different sections based on how tolerant a macroinvertebrate is to pollution. Table 15 shows the results of the 2008 and 2009 PTI scores for each of the subwatersheds.

Group 1 contains those benthic macroinvertebrates that are intolerant of pollution. In other words, group 1 macroinvertebrates will not survive when changes, such as pollution, occur with their habitat. Group 2 contains those benthic macroinvertebrates that are moderately intolerant to pollution. These macroinvertebrates can adjust and survive very small changes and pollution to their environment. Group 3 contains the macroinvertebrates which are fairly tolerant to pollution and can handle the effects of physical or chemical changes to their environment. Group 4 contains the macroinvertebrates that are less susceptible to changes in physical and chemical parameters in a stream. The presence or absence of these benthic macroinvertebrates is an indirect measure of pollution.

The PTI is broken into four categories. Any score less than 10 is considered poor, 11-16 is fair, 17-22 is good and 23 or more is considered excellent. When the biological sampling was completed our sampling sites ranged from poor to excellent.

Table 15: PTI Table

	Site #6- Exit		Site #5- Newport Bridge		Site #4- Covered Bridge		Site #3- Jonathan Creek	Site #3- SR 71 Bridge	Site #2- Horseshoe Bend -		Site #1- State Line Bridge		Site #7- Tributary
	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Pollution Tolerance Index Rating	**15**	**7**	**12**	**16**	**11**	**16**	**22**	**16**	**11**	**4**	**11**	**24**	**0**
	Fair	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Excellent	Poor

Summary of Biological Data for 2008 and 2009

The results from our PTI can be compared to our CQHEI. Normally a small correlation between PTI scores and CQHEI scores can be seen. Where there is a low CQHEI a low PTI score can be expected. At the sites the CQHEI results were within close proximity of 60. The PTI being an indication of pollution is indicating there is a presence of water quality pollutants having an effect on the water quality of the Little Vermillion River. The PTI averages for the watershed indicate the watershed was overall fair for pollution intolerant macroinvertebrates. As discussed above in the chemical monitoring section the DO levels indicated the river was within the average range. DO levels are important because the amount of DO available aids in the survival of these macroinvertebrates.

The two small tributaries sampled are intermittent streams and during our biological monitoring they were completely dry and therefore no benthic macroinvertebrates could be located. Site #1, Horseshoe Bend watershed, in 2008 indicates a high “good” CQHEI at 60 and 24 for PTI being an excellent area where several pollution intolerant macroinvertebrates were located. In 2009, Site #1 rated a much lower PTI at only 11 and the habitat dropped significantly to only 37. Theoretically, we could consider sediment because the high velocity of water during 2008 floods was not present to “flush” the silt and sediment on downstream. There is noticeably more sediment on the river bottom in 2009 than 2008. Site #6, Newport subwatershed, had both a poor CQHEI of 44 and a poor PTI rating of 7. In 2009, Site #6 had close to the same habitat score as last year but a much greater PTI. We located several intolerant macroinvertebrates, this site ranked the highest at 15 PTI.

Between Site #1, Horseshoe Bend and Site #5, Newport subwatershed, not very many species of macroinvertebrates were located along this stretch of stream. At most locations for both 2008 & 2009 the available habitat is a heavy sediment river bottom with deep cut banks with little vegetation or riparian buffers. In 2008 we viewed more rock and gravel particles present in the sample sites than in 2009. However, even with the more gravel and rock particles present in 2008 we did not see a difference in the PTI scores among the watersheds.

2009 Cropland Transect Survey

In the spring of 2009 the local Soil and Water Conservation Districts conducted a cropland transect survey throughout their respective county. The roadside survey is designed to collect information about tillage practices within the county on an annual basis, if possible, but is required by NRCS to be completed every two years at a minimum. The transect survey is based upon crop residue. Parke County employees classified 515 fields with zero fields being within the watershed. Employees of Vermillion County classified approximately 234 fields within the county. Forty-five of those fields were located within the watershed in Vermillion County. The fields were classified as implementing one of the following tillage methods: no-till, strip-till, ridge-till, mulch-till, reduced-till, or conventional till. Table 16: Tillage Practices within Watershed reflects the data collected for the Little Vermillion River Watershed. The following set of standardized conservation tillage system definitions are defined to provide a better understanding of how fields were classified. The definitions were taken from the National Crop Residue Management Survey (CTIC, 1994).

Conservation tillage includes any tillage and planting system that covers 30% or more of the soil surface with crop residue after planting to reduce soil erosion by water. If, soil erosion is the primary concern then a conservation tillage system is any system that maintains at least 1,000 pounds per acre of flat small grain residue on the surface throughout the critical erosion periods. Conservation tillage practices include no-till, ridge-till, and mulch-till systems.

In a no-till system, the soil is left undisturbed from harvest to planting except for strips up to one-third of the row width. Planting or drilling is accomplished using disc openers, coulter, row cleaners, in-row chisels, or rototillers. Weed control is accomplished primarily with crop protection products, such as herbicides. Cultivation may be used for emergency weed control.

In a ridge-till system soil is also left undisturbed from harvest to planting except for strips up to one-third of the row width. Planting is completed on the ridge and usually involves the removal of the top of the ridge. Planting is completed with sweeps, disk openers, coulters, or row cleaners. Residue is left on the surface between ridges. Weed control is accomplished with crop protection products (frequently banded) and /or cultivation. Ridges are rebuilt during row cultivation.

Mulch-till systems use full-width tillage that involves one or more tillage trips, disturbs the entire soil surfaces and is done prior to and/or during planting. Tillage tools such as chisels, field cultivators, disks, sweeps, or blades are used. Weed control is accomplished with crop protection products and/or cultivation.

Tillage systems that cannot be classified as conservation tillage include reduced-till and conventional till. A reduced-till system uses full width tillage that involves one or more tillage trips, disturbs the entire soil surface and is performed prior to and/or during planting. There is 15-30 percent residue cover after planting or 500-1,000 pounds per acre of small grain residue equivalent throughout the critical wind erosion period. Weed control is accomplished with crop protection products and/or row cultivation.

Conventional or intensive till systems also use full-width tillage that involves one or more tillage trips, disturbs the entire soil surface, and is performed prior to and/or during planting. There is less than 15 percent residue cover after planting, or less than 500 pounds per acre of small grain residue equivalent throughout the critical wind erosion period. Weed control is accomplished with crop protection products and/or row cultivation.

The data collected during the transect survey provides accurate records on the adoption of conservation tillage methods. It also provides information to SWCDs and other agencies in establishing priorities for improvements. Further, it evaluates the progress in reaching county or state goals for tolerable soil loss.

Conservation tillage systems can help mitigate the impact of soil erosion and reduce run-off. At the field level, erosion causes the loss of productive land and reduces infiltration rates. Productive soil is important because it covers seedlings and provides support as they grow. Soil particles also hold on to nutrients, either applied or found naturally and gradually deliver them to growing plants (Daily et al,. 1997). As soil particles wash into a waterway, water quality is reduced. Aquatic communities may be impacted as increased sediment levels may smother spawning beds, reduce sunlight available for photosynthesis, or increase water temperatures. Further sedimentation may increase flooding potential due to barriers in water flow and increase costs for maintenance (i.e. dredging).

Table 16 represents the watersheds current land usage and tillage practices. According to the 2009 transect data the cropland within the watershed only has 18.42% of the land being no-tilled. Factoring in the other low impact tillage practices still 34% of the watershed is in some form of conservation tillage. There is a large disparity between the percent of corn acres using conservation tillage methods and the percent using conventional till. Soybeans, however, show the greatest percentage in conservation tillage versus conventional tillage methods (Table 16). This acreage is still considerably lower than the majority of other Indiana counties. The low percentage of corn acres in conservation tillage systems compared to beans may be because local farmers have seen positive trends in yields and lower costs with no-till beans. No-till beans are also better able to deal with weather-related stress unlike no-till corn.

Table 16: Tillage Practices within Watershed

Crop	Percent Planted	Total Fields
Corn	60.00%	27
Beans	20.00%	9
Drilled	6.67%	3
Narrow	13.33%	6
Wide	0.00%	0
Hay	4.44%	2
Grain	2%	1
Fallow	11.11%	5
Other	0.00%	0
Unknown	2.22%	1
	Total:	54
Tillage Practice	**Percent Planted**	**Total Fields**
No-Till	18.42%	7
Corn	5.26%	2
Beans	13.16%	5
Conventional	65.79%	25
Corn	65.79%	25
Beans	0.00%	0
Mulch	7.89%	3
Corn	0.00%	0
Beans	7.89%	3
Reduced	7.89%	3
Corn	5.26%	2
Beans	2.63%	1

Tillage Transect Summary by Subwatershed

Horseshoe Watershed – 051201081103

This subwatershed is 20% of the watershed or approximately 7,000 acres. Overall, this watershed consists of heavily cropped land-use. Approximately 1,800 acres of land is cropped. The watershed has several acres of corn; approximately 470 acres planted using conventional tillage practices. Even with substantial conventional tillage practiced in the Horseshoe subwatershed this subwatershed represents the highest no-till cropping of beans approximately 1,330 acres within our Little Vermillion Watershed.

Jonathan Creek Subwatershed- 051201081102

This subwatershed is 21% of the watershed or approximately 7,500 acres. Approximately 2,000 acres of land is cropped. This portion of the watershed had mostly conventionally tilled corn, approximately 400 acres but also had two fields of no-tilled corn, approximately 100 acres. It also had a substantial amount of no-till beans planted, approximately 900 acres. This subwatershed has a few larger farms that have adopted the no-till practices for both corn and beans.

Newport Subwatershed- 051201081104

This subwatershed is 40% of the watershed or approximately 14,000 acres. This subwatershed has about 5,000 acres in cropland. This portion of the watershed had the two fields of hay (~225 acres) and the field of wheat (~100 acres) located within this subwatershed. From visual observations of other crop fields revealed within this subwatershed conventional tillage practices for corn. Assuming a relative relationship of conventional and no-till use practices are the same for this subwatershed as the above subwatersheds which had fields in the transect data. An assumption of approximately 2,000 acres of corn are planted using conventional tillage and approximately 600 acres of no-till beans. Our visual observations did reveal some farmers are using no-till for soybeans but we did not locate any corn fields.

South East Wabash Subwatershed- 051201081603

This subwatershed represents 19% of the watershed or approximately 6,500 acres. This portion of the watershed did not have any fields selected for the tillage survey. Even though no fields were selected for the tillage transect, a visual observation revealed many of these fields in the floodplains were being planted using conventional tillage methods. The primary crop planted in the floodplains for the 2009 growing season was corn.

Tillage and Land Questionnaire

The LVRWG research team developed a tillage and land survey (Appendix E), targeted at individuals in the rural and agricultural communities. The LVRWG wanted to determine what landowners were doing on their land and why conservation tillage practices were not being adopted, especially on corn crops. Obtaining a better understanding of why conservation tillage practices have not been adopted since there are so many benefits such as reduced labor, time savings, reduced machinery wear, fuel savings, improved long- term productivity, improved surface water quality, reduced soil erosion, and improved water infiltration. In addition, the group wanted to know what sources of technology (i.e. GIS, auto-steer, Swath-control, etc.) operators used in the operations. The survey was distributed at the Vermillion County SWCD’s Annual Meeting in February 2009.

Of the 15 respondents, 40% of respondents did know about conservation tillage and use conservation tillage. The average number of years respondents have used conservation tillage practices is 20 years. The large percentage of farmers using conservation tillage in this survey, despite the small number of acres throughout the watershed, was most likely due to the conservation-based nature of the meeting where the survey was distributed. The audience at the meetings consists of people involved and interested in soil and water conservation, however not all those that are interested in conservation use conservation tillage practices. The survey results still provide valuable information regarding local perceptions about conservation tillage and as to why these famers use the methods. The information will enable the Little Vermillion River Watershed Group and other partners to develop effective outreach programs.

Table 17 shows the number of responses illustrating why individuals started using conservation tillage. The dominate reasons were as follows: 1) reduced soil erosion 2) saved fuel and time and lowered production costs

Table 17: Responses to Tillage Questionnaire

Question: I started using conservation tillage because (check all that apply):

Choice	Number of Responses
Government Mandated- (NRCS/FSA contracts)	2
Other farmers had success	1
Saved Fuel and Time	3
Lowered production costs	3
Reduced soil erosion	5
Increased yield per acre	2
Other	0

This survey also requested information not only about agricultural fields but also the residential area. The results from the survey indicated out of 15 respondents, 13 had problems with erosion control, 11 grew conventional gardens, 2 organic gardens, 2 no gardens and properly functioning septic systems was only a priority to three respondents. Discovering the presence of conventional gardens can help target gardeners with newer ways of gardening (i.e.

organic, reduced till) similar to that of conservation till to reduce the sediment runoff and erosion that can be present not only in farm fields but also the gardens.

The results from this survey will enable the SWCD staff to tailor strategies and programs to increase the acreage in conservation tillage systems and erosion control measures. Continued research on no-till systems, especially corn, has led to the development of new technologies and a better ways to manage fields. This information needs to be disseminated throughout the watershed so farmers are aware that there are options, adaptations, and funds available to begin using no-till. Furthermore, there needs to be an increased awareness of the impact of soil erosion on personal property and water bodies.

Visual Assessment Results

The Little Vermillion River Watershed Group took two approaches to the visual observation of the watershed. In 2008-2009 a windshield survey was conducted which entails driving around the watersheds locating possible points of concern. Then, we completed a flyover survey, which consisted of going up in a small airplane and flying over the watershed looking for new areas that could not be located from the roadways. The same criteria for identify problem areas was used for both the windshield survey and flyover. Each survey is divided into subwatersheds to better discern problem areas observed. All points of concern regarding the windshield and flyover are differentiated in Figure 29 on page 127 of the WMP.

Windshield Survey Conducted by Little Vermillion River Watershed Group

As part of the watershed assessment, a windshield survey was conducted to obtain direct visual observations of streams and the surrounding land. In order to efficiently observe as many streams and creeks as possible while respecting private property, observations were made from roadside stops and bridges. The following pictures illustrate possible sources of agricultural nonpoint source pollutants. Figure 28 on page 122 represents the respective locations of the pictures.

Observation sites were photographed with a digital camera and survey observations were recorded on data sheets (Appendix D). Parameters recorded for each observation site included basic stream characteristics, surrounding land-use, riparian buffer width, potential sources of pollution (i.e. drain pipes), streambank erosion, and livestock access to the streams. The following gives an overview of the survey results for the watershed.

While traveling through the watershed visual observations were made in the Jonathan Creek subwatershed of roughly 100 livestock (cattle, horses, goats) with full access to Jonathan

Creek (Pictures 1& 2). In the Newport subwatershed roughly 35 cattle had full access to a small tributary.

Picture #1: Livestock standing in the streambed (Jonathan Creek tributary)

Picture #2: Downstream from where livestock had access (Jonathan Creek tributary)

The animals had access to drink and defecate in the stream. The stream banks looked degraded in several of the locations. Livestock with direct access to streams can cause water quality concerns for both humans and aquatic organisms. When livestock have access to a stream, their trampling can destabilize the banks, cause erosion, and disturb aquatic habitat. The two livestock operations observed in the Horseshoe Bend subwatershed and one livestock operation in the Newport subwatershed did not have access to a tributary or the Little Vermillion River.

Along sections of the river that were viewable during the windshield survey severe erosion could be located in some areas. Streambank erosion occurs when flowing water directly removes a stream's banks and beds. This problem is often initiated by excess run-off during heavy rain events. Fast-flowing streams scour their banks, often contributing high sediment loads to the stream. As the stream slows, this sediment is deposited downstream. Although, streambank erosion is a natural process that typically occurs during periods of high-flow, it can be aggravated by the lack of vegetated riparian buffer, decreased wetlands and floodplains, increased agricultural field tiling, and direct livestock access, etc. There were points along the tributaries located in the Jonathan Creek watershed that were identified as having bank erosion. Along the main stem of the Little Vermillion River in the Newport and Horseshoe Bend watersheds there were five locations that showed streambank erosion.

Picture #3: Sediment Runoff into the Little Vermillion River near Site #1: Horseshoe Bend Watershed

As was discussed sediment runoff in picture 3 shows sediment washing into the river. The picture 3 water running into the Little Vermillion River is flowing from a well-buffered (trees, shrubs and grass) tributary in Indiana. The tributary starts 1.5 miles upstream in Illinois where it is a grassed waterway that is poorly buffered from farm fields. Sediment can clearly be seen running from the side tributary into the Little Vermillion River. This is considered a problem area within the Horseshoe Bend subwatershed because this tributary is delivering large quantities of sediment loads into the beginning section of our watershed project area.

To prevent this sediment load coming from Illinois we will need to work closely with the Soil and Water Conservation District in the Little Vermilion River, Illinois watershed to encourage farmers to implement grassed waterways into cropped fields and buffer strips along tributaries as well as the Little Vermillion River.

Sediment loss is evident within our watershed as seen in pictures #4, #5 and #6. The need to prevent soil loss upstream will help decrease the amount of sediment being delivered to the Wabash River.

The following three pictures represent the same location over a time lapse of 15 years. Picture #4 represents a small path along the Little Vermillion River (the right edge of picture) prior to the 1993 flood. Represented by this picture is a healthy and wide riparian buffer zone. Picture 5 represents the same location after the flood in 1993. The riparian buffer that did exist was completely wiped out. The final picture represents the disaster that occurred during the May 2008 flood. Only the entrance to the road is identifiable, almost 20 foot of bank was lost during that flood. There was so much water flowing downstream towards the unprotected bank that it completely took out the last of the trees on the bank and stole the soil from the woods and surrounding area.

Picture #4: Prior to 1993 Flood

Picture #5: After the 1993 Flood

Picture #6: Bank, Sediment, and Riparian Loss over a 15 year period.

Picture #7: Bank Erosion on a hillside along Jonathan Creek.

Bank erosion occurs along several of the steep banks, not only along the main river also along tributaries. Most of these banks are steep and slowly erode sediment into the stream. Eventually the loss of soil and riparian groundcover will allow the trees above to fall down into the stream and be swept along until becoming lodged to create log jams.

Log jams were observed next to some bridges within the watershed. Log jams are areas where one log has become lodged and other logs (large or small) flow downstream and become lodged to the first one. Log jams may create natural pools for aquatic habitat but in addition they can cause issues for bridge structures and cause higher flows upstream (i.e. flooding).

Picture #8: Log Jam at State Road 71

Log jams can become very large in size if not removed when small. The log jam located at State Road 71, Horseshoe Bend watershed, could be creating structural issues to the highway bridge. Also, this log jam was so massive in size it was blocking the flow of water downstream. When heavy precipitation occurs upstream more logs become lodged, thus causing scouring and out-washing along the east side of the bank. This caused some of the trees to fall into the streambed. Also, with these log jams come a collection of trash (i.e. fast food bags, cups, cans, etc) in and around the log jams.

This specific log jam was a priority because it may have been causing structural issues to the bridge because of the buildup of pressure. Also, the longer the log jam remains the more bank erosion and loss of riparian corridor we will experience. This log jam was finally removed in September 2009 by the state highway department.

Picture #9: Log Jam in the Horseshoe Subwatershed in the Little Vermillion River-

The log jam in photo #9, located in Horseshoe Bend watershed, created a barrier and forced the river to change course, causing bank out-washing and bank collapse. The new channel was causing the riparian buffer (at one time 20 feet) of wooded area to collapse and fall into the river. The farmer took corrective action on this massive log jam by opening the old channel and taking the trees and debris from the opening and damming up the new river channel. The basic theory is when the river floods sediment will deposit on top of the cut channel filling it up and preventing anymore land loss.

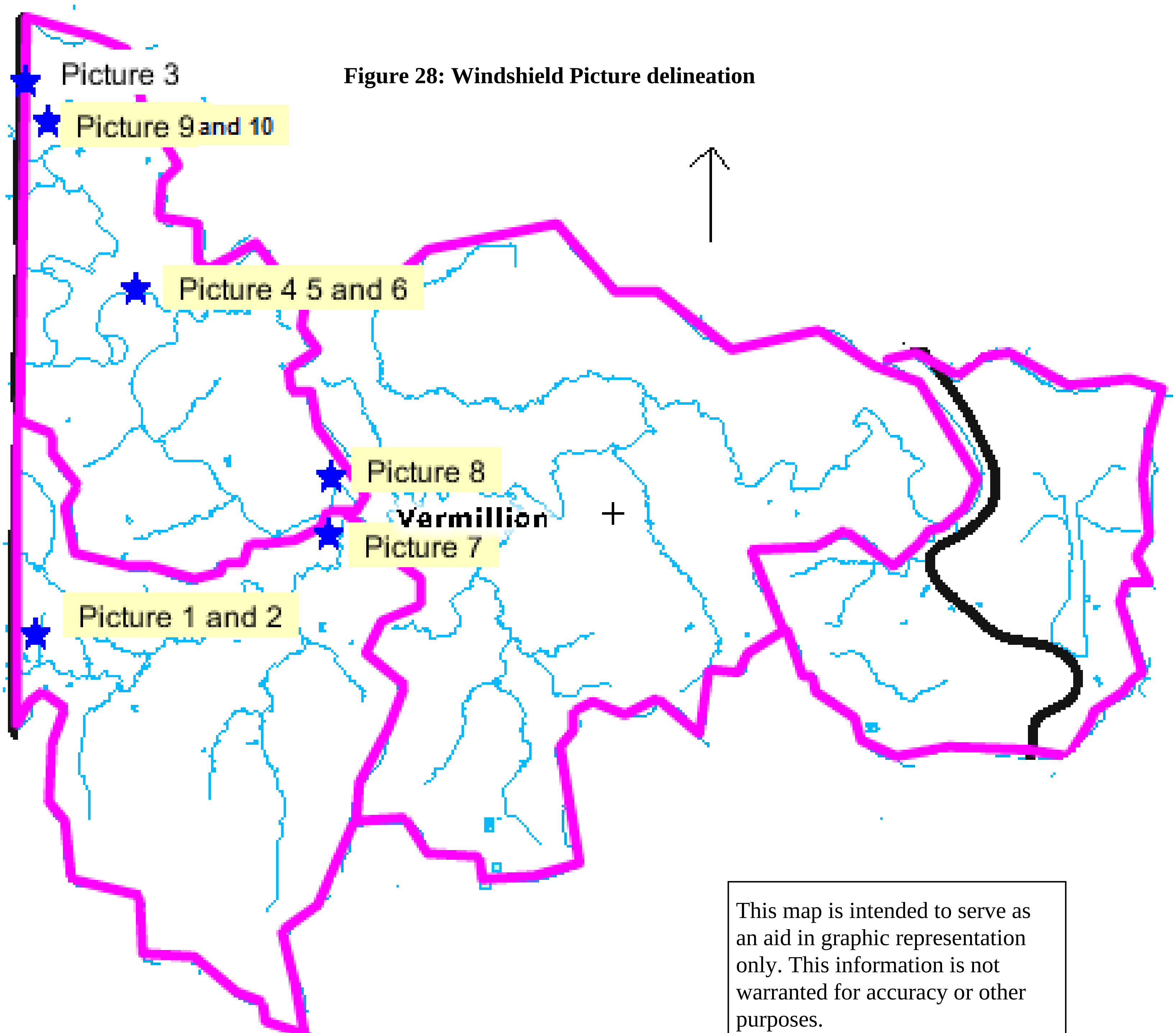
From the above log jam the potential problems existing with their presence makes a strong argument in preventing log jams from gaining in size. In the watershed there are other log jams currently in the small stages of forming. There is a log jam starting at the Entrance/State Line Bridge site which is of concern because it is collecting logs along the pillars of the bridge; similar to how the log jam at SR 71 began. There are also other sites throughout the watershed that are beginning to form log jams. The priority in selecting problem areas is the amount of overall damage (i.e. structural issues to bridges/severe land-loss, etc.) the log jams are doing to the present site and the potential cause of damage that may occur to personal property (houses, buildings etc.) upstream due to flooding.

Row crop agriculture constitutes the largest land-use in the watershed by area, and most streams in the watershed are surrounded, at least in part, by agricultural land. Several grassed waterways were observed throughout the watersheds. Waterways are grass-lined sections through a field where natural drainage occurs. During large periods of rainfall these sections of grass protect the area from erosion and help filter nutrient, chemical, and sediment run-off. An area where a grassed waterway should exist but does not can cause gullies. Some of these grassed waterways are slowly being encroached by farming practices but are still maintained and prevent erosion. There were two locations observed where water naturally flows and cut deep gullies into farm fields. These locations would benefit from having a grassed waterway installed. These locations are considered problem areas. We located two grassed waterways in the Jonathan Creek subwatershed and one in the Newport subwatershed.

Along our route we located one agricultural drain tiles and there were two locations were unknown pipes were located entering into tributaries. The pipes that could not be identified as strictly agricultural may or may not be residential tiles from basement drains, perimeter drains, or septic systems. These pipes could be adding unknown pollutants to the water and affecting water quality an aquatic organisms.

Along our route we also located the two wetlands located within the Newport subwatershed. Wetlands are important to buffer the river by filtering nutrients, provide habitat for wildlife, slow the flow of surface water, and help prevent soil erosion by reducing the velocity of water.

Figure 28: Windshield Picture delineation



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Flyover Survey

As part of the watershed assessment, a flyover survey was conducted to obtain a direct visual observation of streams and the surrounding land. The flyover allowed observations to be made in areas that were not accessible by the windshield survey due to private property access issues. The flight enabled us to have a better perspective on the watersheds topographical layout and to better locate areas of concern such as log jams, washouts, and bank erosion.

This visual assessment was started on the Illinois side of the watershed and flew southeasterly following the flow of the Little Vermillion River. In the Horseshoe Bend watershed we observed locations where the bank and farm fields are severally eroding. These fields are located far off the roadways with no public access to them. Several more log jams were located, some just beginning while others massive in size. We located two small log jams starting to form in the Jonathan Creek tributary located in the Jonathan Creek subwatershed. Three log jams in the Little Vermillion River in the Horseshoe Bend subwatershed, and there were four small log jams starting in the Newport watershed. We located the massive log jam that had cut a new channel into the river in the Horseshoe Bend watershed (picture 9 above). From the air a better overall picture of amount of damage created by the log jam was seen. It had eaten away the riparian buffer zone and nearing the edge of a crop field. The large log jam located in the Horseshoe Bend watershed was out-washing the bank, leading to more trees falling into the river. Picture 10 reflects the aerial photo of picture #9. This photo is after the log jam had been cleared and the original channel opened again.

Picture # 10: Aerial Photo of picture #9, Log Jam in Horseshoe Bend Subwatershed.

Our flyover ended in the section of watershed located in Parke County on the east side of the Wabash River, no areas of concern were located at that time. But, at the time of our flight the Wabash River had flooded the floodplains of the watershed. Nothing severe could be determined but logs could be seen floating down the Wabash River. The Little Vermillion River was bank full, water is at the top of the river bank but not flooding the floodplain, the agriculture fields and banks were easily viewable making it easy to determine more areas that may be aiding in water quality issues. Some crop fields had been planted but a majority of them had not therefore not giving a true perspective on what fields would be conservation tillage or conventional tillage. The flyover was conducted the first of May so that most of the leaves would not be on the trees to give a better view of the tributaries and the Little Vermillion River.

The flyover allowed us to identify the vegetated riparian buffer width. A riparian buffer refers to the zone of land directly adjacent to the stream channels. When left undisturbed, this buffer zone helps maintain stream water quality and healthy aquatic life. Tall grass or woody vegetation along this riparian buffer provides important water quality benefits. Vegetation filters sediment, nutrients, and other pollutants from run-off water during rain events, and riparian buffers reduce erosion potential by stabilizing stream banks. In addition to direct water quality benefits, vegetated buffers provide habitat to wildlife, they help to shade the surface water and reduce the stream temperature, and they help slow and store floodwater.

During our flyover, buffers were determined by simply locating areas where crop fields were directly next to the river bank with little to no protection or locations that looked to have less than a target 30 foot buffer width approximation in the air, then those locations were marked down and those areas were checked by measuring the buffer width using Google Earth and double checking with the Local Decision Maker. Those revealing less than the target 30 feet of buffer between the fields and water were marked on our map. The visual assessment revealed areas along crop fields that were poorly vegetated with less than 30 feet of buffer. Within the Newport watershed we located nine fields that had less than a 30 foot buffer, Jonathan Creek watershed had one area along Jonathan Creek, and Horseshoe Bend watershed had three locations along the Little Vermillion River with a lack of riparian buffers.

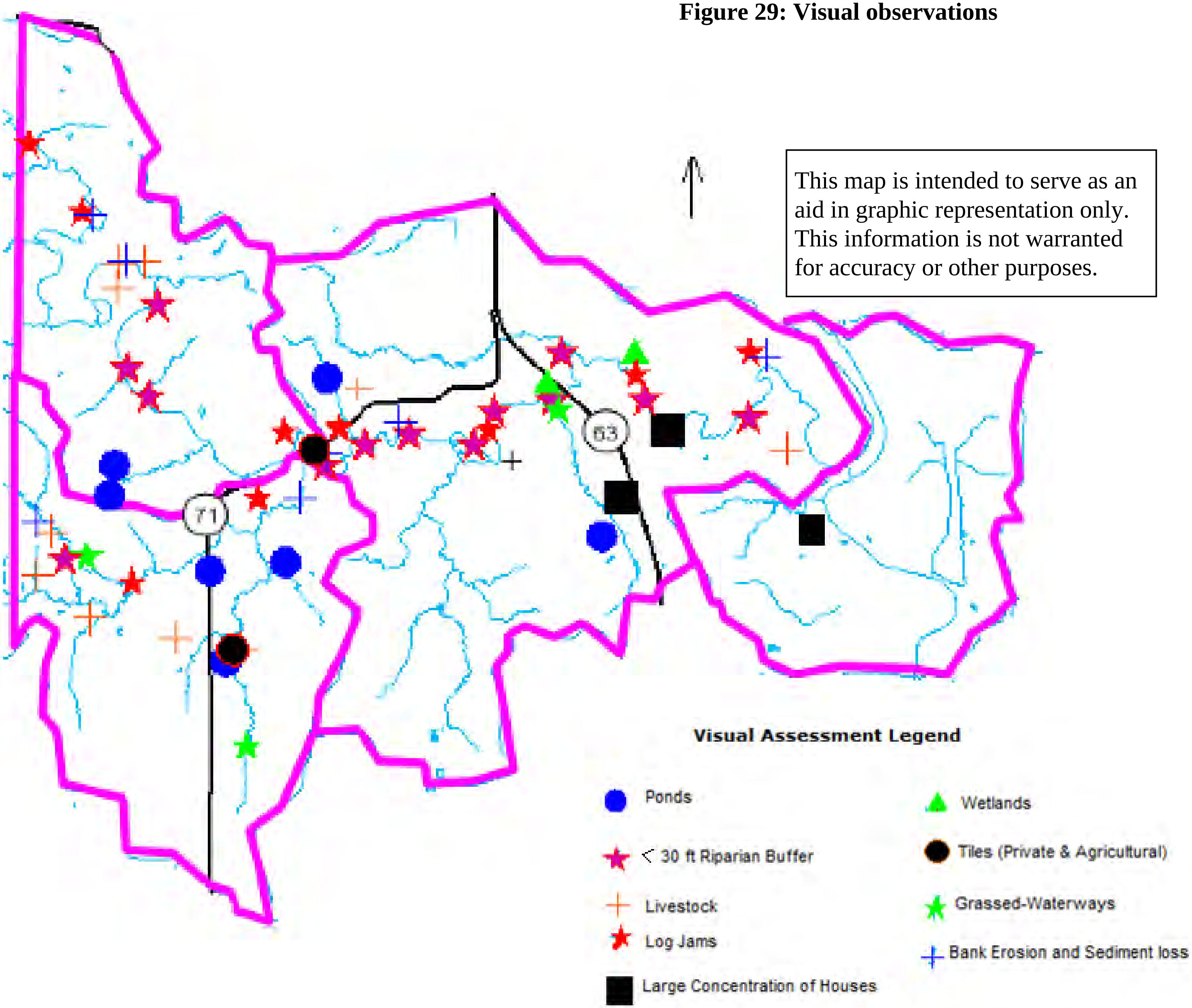
Along our flyover we located areas where large concentrations of houses were present. There are two locations located within the Newport subwatershed. The town of Newport and

Potters Lane has a large concentration of houses. These areas are considered because they could be contributing to present nitrate loads established in the LVRWG data. Nitrates could be contributed from residents by the use lawn chemicals. In the Southeast Wabash subwatershed a large concentration of fishing shacks are located along the Wabash River. The lack of proper septic systems in these areas could be contributing to high *E. coli* levels.

The visual assessment also allowed us to view eight ponds two in the Newport subwatershed one of which had a broken levy, three located in the Jonathan Creek subwatershed, and two located in the Horseshoe subwatershed.

We used the same criteria and worksheet (Appendix D) used during our windshield survey to check the same observations made previously during our windshield survey (i.e. animals in tributaries, log jams) and locate new problem areas within our watershed. All the data has been entered into the following Figure 29.

Figure 29: Visual observations



Data Summary by Subwatershed

In this section of the watershed inventory, including existing water quality data, flyover, and windshield survey will be used to help determine the critical areas of concern. The subsections above commented on problem areas at and around the watershed. By reviewing these elements in one section and defining the problems it will function as an aid in determining the most critical watersheds.

Horseshoe Watershed – 051201081103

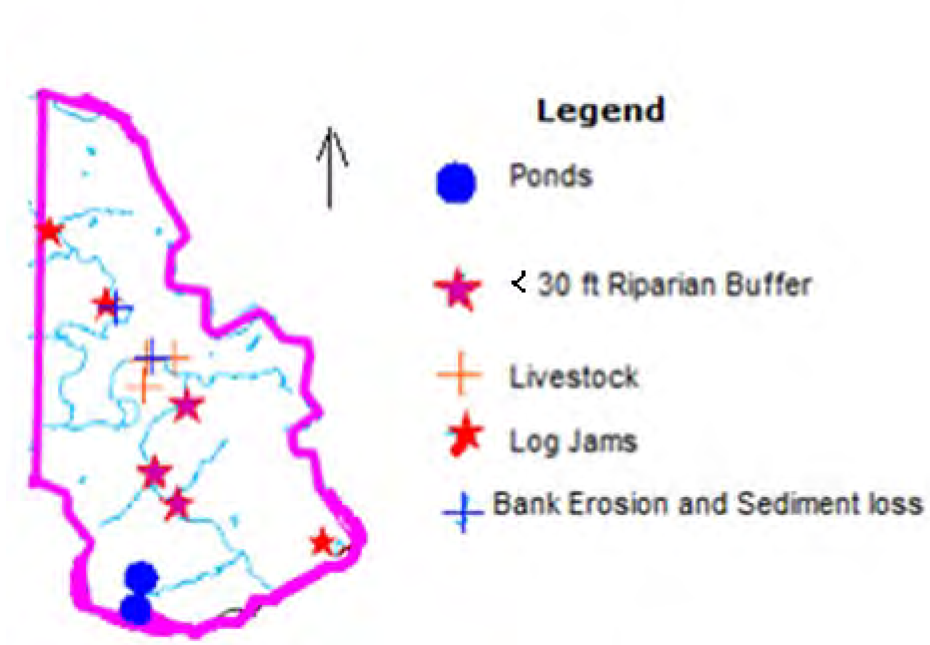


Figure 30: Horseshoe Subwatershed problem areas

The Horseshoe subwatershed was identified for bank erosion, riparian loss, high nitrate, high turbidity readings, high *E. coli*, and log jams. As mentioned above three log jams, two ponds, two bank erosions, two areas of livestock (no direct access), and three areas with lack of riparian buffers were identified within this watershed.

As stated in the tillage section, this subwatershed consists of heavily cropped land-use. The tillage transect identified this subwatershed as having all corn crops conventionally tilled. However, this subwatershed represents the highest no-till cropping of beans within our watershed. **T**he data indicates large amounts of nitrogen were present. High nitrate levels identified during the spring months could be caused by the conventional corn tillage practices. For the entire sampling season the subwatershed is above the target of 1 mg/L. Figure 32 represents the nitrate levels within the subwatershed.

From the visual assessments there were three log jams and three areas of bank erosion. The sampling data collected by the LVRWG indicates high turbidity in the spring during high rain fall. From the visual observations we located areas of severe bank erosion with places that did not have a 30 foot riparian buffer and conventional tillage practices were utilized next to the riverbank. The lack of riparian buffers or buffer strips could be contributing to the high turbidity during the spring months because the protective filtering between field and water source is eroding. The high turbidity readings recorded are a good indication of sediment and erosion loss. As the erosion continues to increase the banks slowly diminish and cause the riparian buffers along the river to diminish. The cause for the erosion occurring is increased velocity of water coming downstream and "beating" the banks causing them to slowly erode into the river.

Chemical testing and Illinois TMDL indicates high levels of *E. coli* present throughout the recreational season in the Little Vermillion River Watershed. Figure 31 indicates high recordings at sampling sites within the entire watershed project area for *E. coli* during the spring sampling season. As previously mentioned, the lack of properly functioning septic systems in this subwatershed leads to pathogenic bacteria entering the water source. Human, livestock, aquatic, and wildlife exposure to such pathogens can cause health concerns.

Within the subwatershed two very large log jams were identified during the surveys. The log jam at the bridge became so large the jam could possibly cause a structural issue to the county highway bridge and the other log jam was cutting the streambank very aggressively. These two log jams have since been dismantled. There has been identification of another log jam beginning to form near sampling Site #1. As log jams become larger, they tend to increase the streambank erosion, by scouring out and around the log jam.

Figure 31: Site #1 & Site #2 *E. coli*

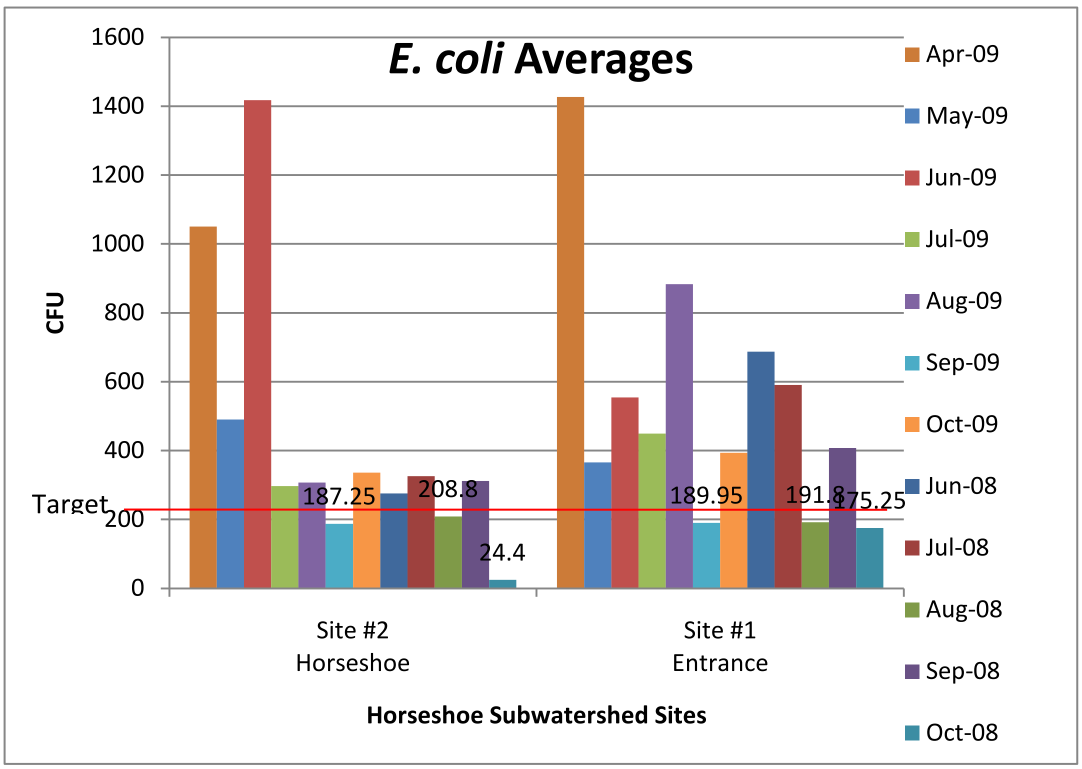
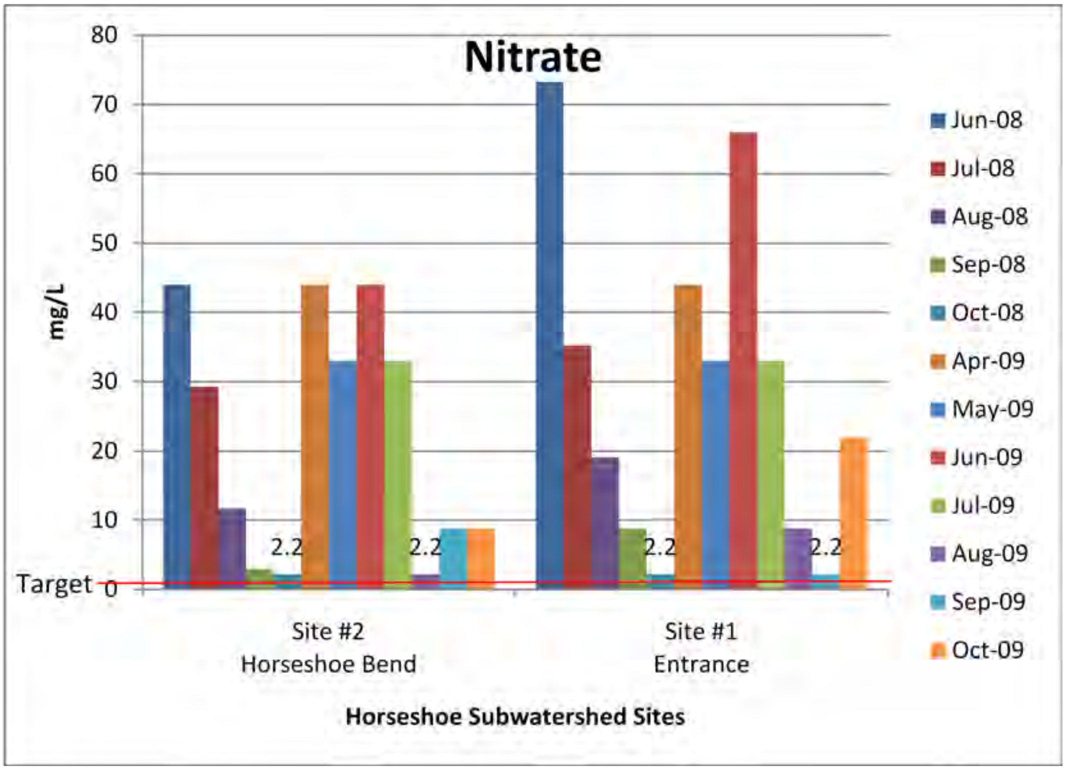


Figure 32: Site #1 & Site #2 Nitrate



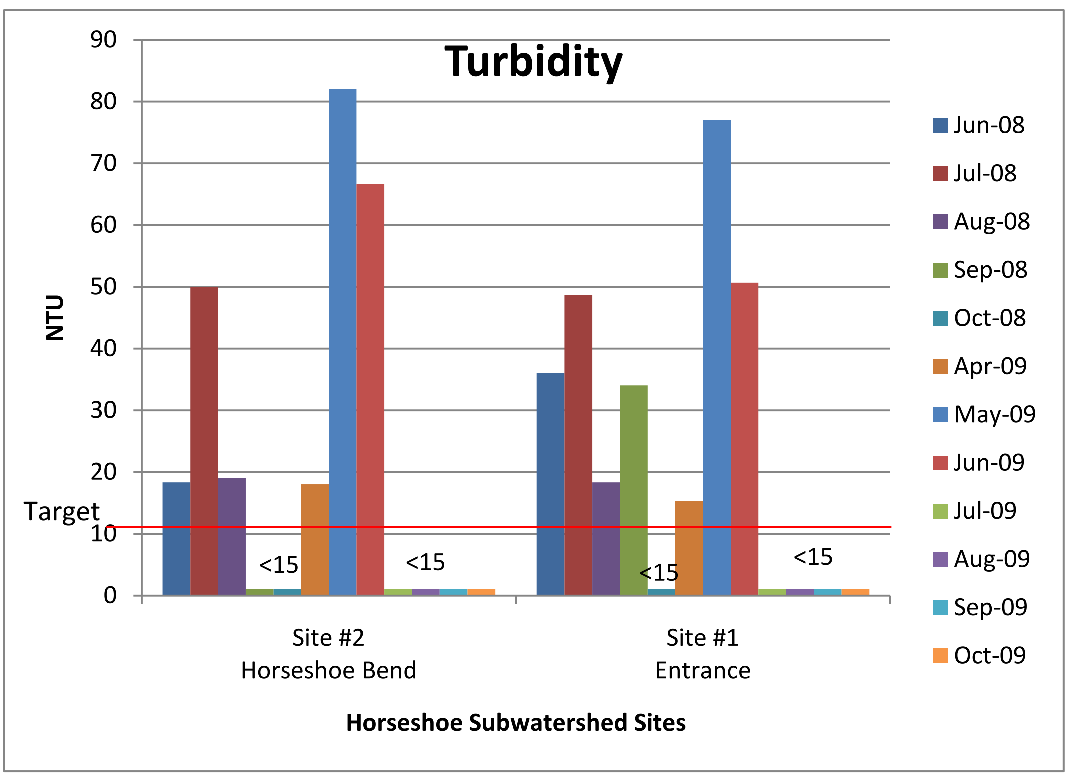


Figure 33: Horseshoe Subwatershed Turbidity Data

Jonathan Creek Subwatershed- 051201081102

Figure 34: Jonathan Creek Subwatershed

This portion of the watershed data indicates we have above our target *E. coli* levels and nitrate levels sampled for the main stem sample site #3 reflects high nitrates present. However, in 2009 when we sampled the tributary the main source of nitrate occurred during the first three months of the spring sampling season. This subwatershed had mostly conventionally tilled corn and did have two fields of no-tilled corn. It also had a substantial amount of no-till beans planted. There were two locations of severe bank erosion within this subwatershed directly next to the stream.

During the flyover and the windshield surveys two locations on Jonathan Creek were identified where livestock were present in the streams. We estimated approximately 75 or more cattle, two sheep, two horses and five or more goats with access to streams. This subwatershed also had significant amounts of *E. coli* present during high flows as indicated in the sampling data. Sampling during the dry season (August and September) in this subwatershed was difficult as the tributary was dry during our sampling. But for the sampling data collected, *E. coli* is present throughout the recreational season in the Little Vermillion River Watershed. The presence of livestock would indicate the probability of livestock manure being spread on fields within the watershed, and livestock having direct access to streams can introduce livestock waste into the water. The added waste can add to the amount of *E. coli* present in our watershed. This subwatershed only had three monthly sampling averages below the target of 235 cfu. The highest *E. coli* occurred in the main stem of 2008 sampling but during the very dry conditions of September 2009 we recorded the highest *E. coli* readings for the 2009 sampling season. This could be due to environmental conditions of low flow and high temperatures present causing the *E. coli* bacteria to grow. These concerns lead to pathogenic bacteria entering the water resource. The health concern is not only for humans but also the livestock, aquatic organisms, and wildlife that are exposed to such pathogens.

Two of the log jams viewed in this watershed are considered small enough not to be causing any significant problems to the tributary streambanks. Small log jams are present and could be dismantled much easier before they block the entire waterway and become a severe problem by causing bank erosion.

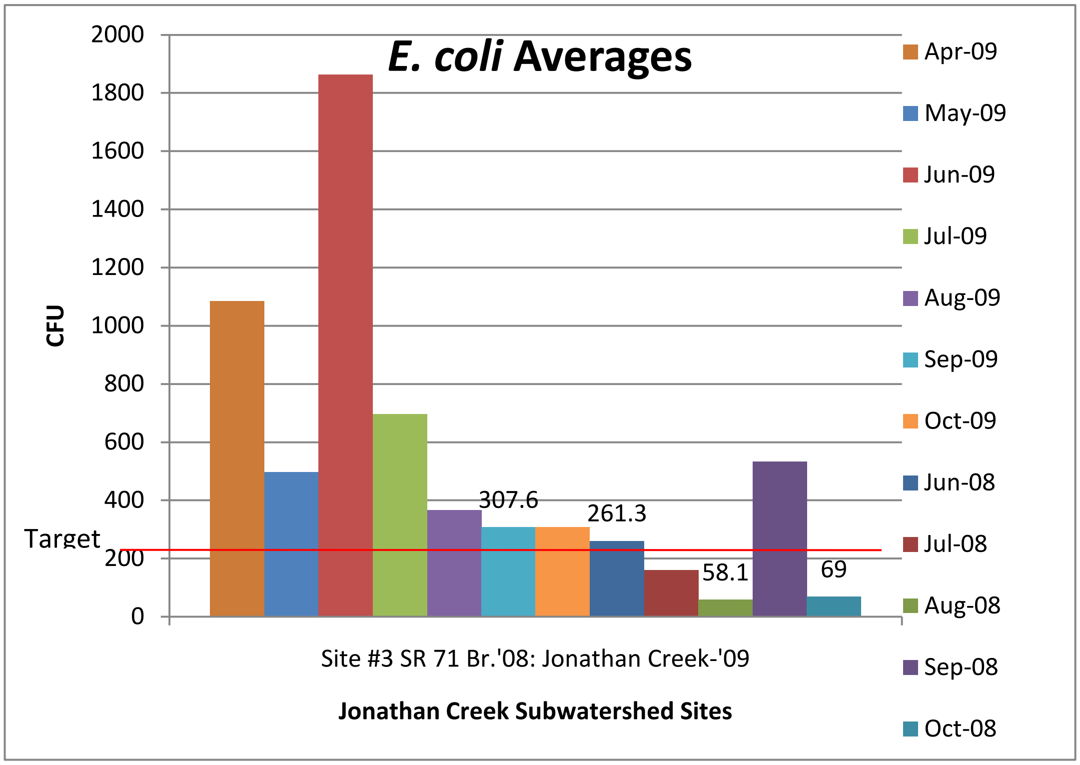


Figure 35: Jonathan Creek Subwatershed *E. coli* Data

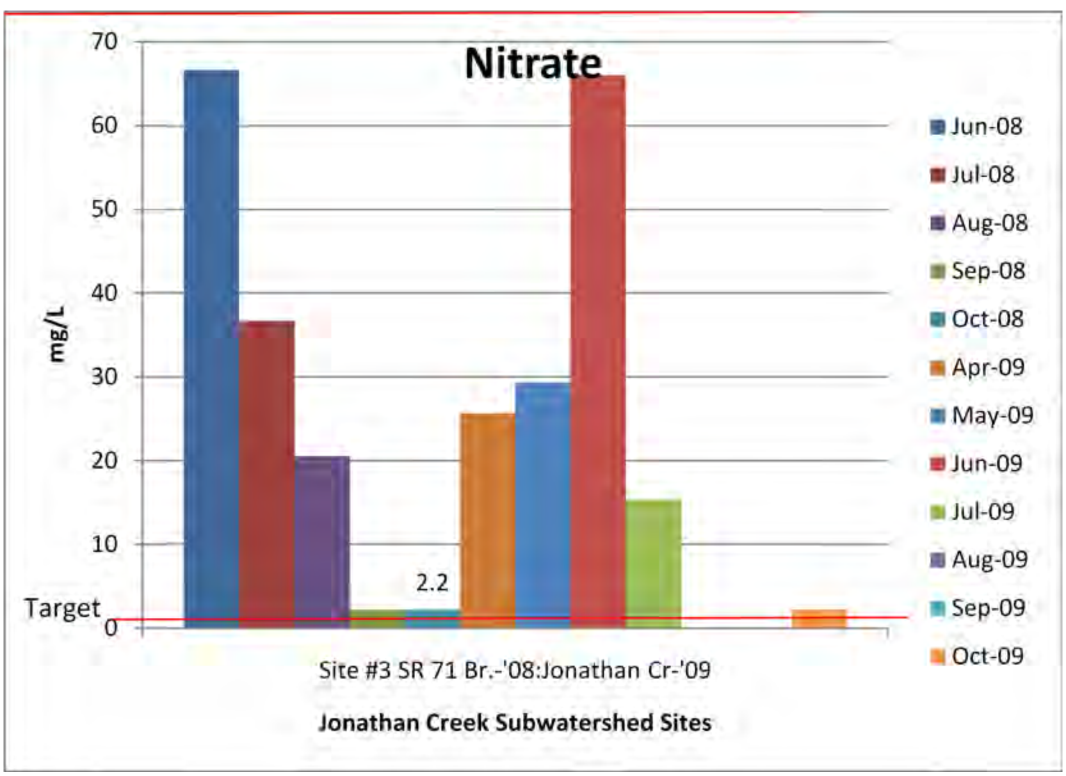


Figure 36: Jonathan Creek Subwatershed Nitrate Data

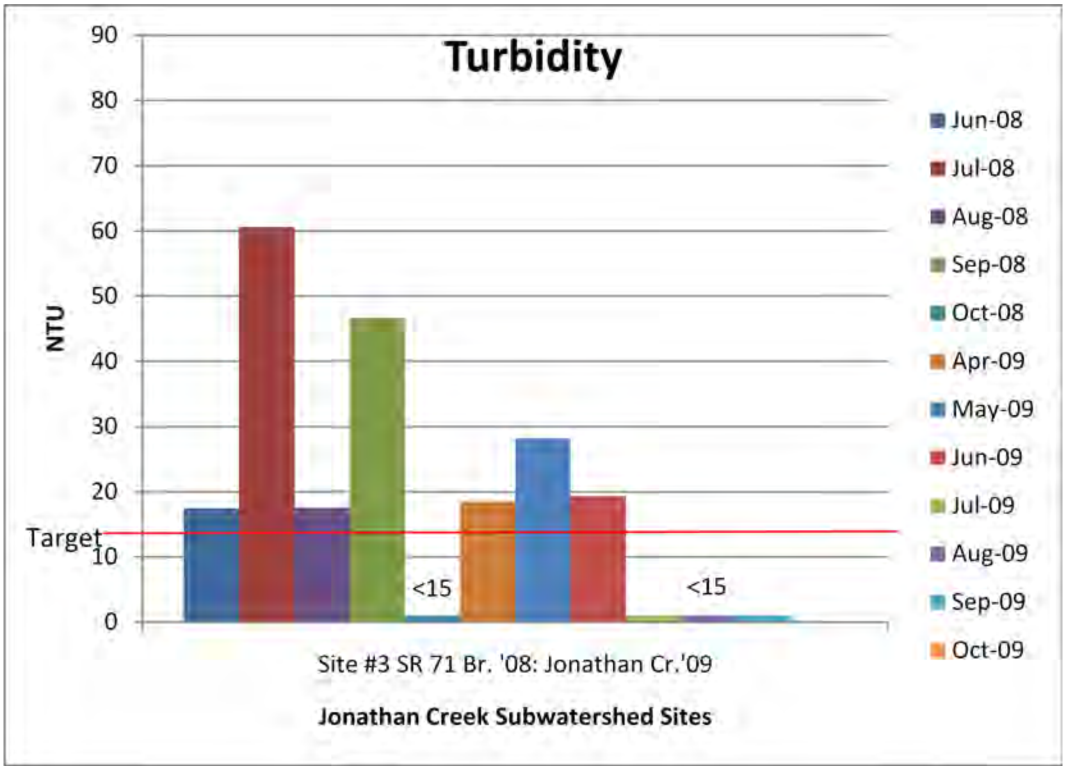


Figure 37: Jonathan Creek Subwatershed Turbidity Data

Newport Watershed- 051201081104

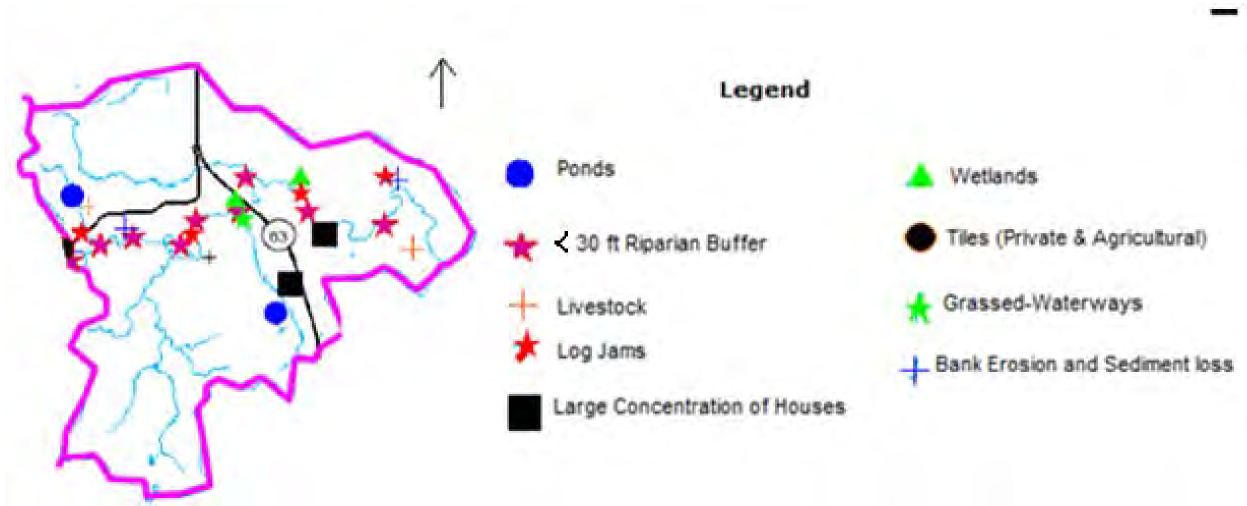


Figure 38: Newport Subwatershed

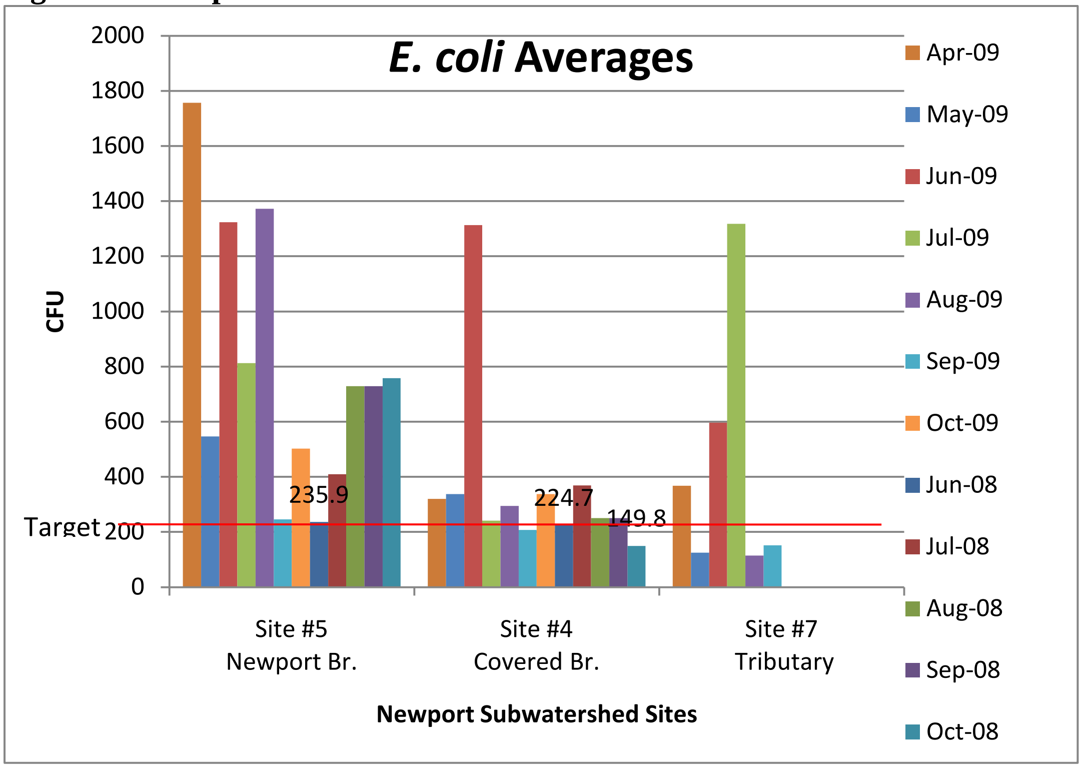
Figure 38 represents the items identified during the windshield survey and flyover. The visual assessment along with the chemical testing concludes there are areas of concern within the Newport subwatershed for streambank erosion and soil loss. As indicated in Figure 41 by turbidity testing the two sample sites on the main stem are very turbid during the high flow season (May-June). The average turbidity is above 70 NTU on sample sites on the Little Vermillion River within this watershed. The 70 NTU is 60.4 NTU greater than our target for the watershed. Nephelometric Turbidity Units (NTU) reflects the amount of sediment within the stream. High sediment affects aquatic organisms' habitat and ability to survive. The tributary sampled in this subwatershed is typically less turbid than the rest of the watershed. From the visual assessments there are three areas of bank erosion, such as seen in photo 2 in Appendix E. Within this subwatershed we have several crop fields and from our tillage transect we determined this portion of the subwatershed had two fields of hay, and one field of wheat, which indicates we do have ground cover on some fields throughout the year. But as noted through visual observations most agricultural fields are heavily corn and bean cropped. The fields are mostly conventionally tilled.

Chemical testing and the Illinois TMDL reflects data indicating high levels of *E. coli* are present throughout the recreational season in the Little Vermillion River Watershed. Out of the top three sampling sites that have the highest *E. coli* levels two of those sites are located within the Newport subwatershed. The following Figure 39 indicates the *E. coli* levels for sampling sites within the subwatershed. Sample Site #5 is where high levels of the pathogen are observed consistently throughout the recreational season. At this testing location the Little Vermillion River navigates a path along the town edge of Newport. It is well-known the town does not have a waste water treatment facility and many of the residents are on private septic systems that may not be up-to-code or straight pipes. "Up-to-code" will be defined as meeting the Indiana code 13-18-4-5 Sec.5 "A person may not: 1.) throw, run, drain, or otherwise dispose into any of the streams or waters of Indiana; or 2.) cause, permit, or suffer to be thrown, run, drained, allowed to seep, or otherwise dispose into waters; any organic or nonorganic matter that causes or contributes to a polluted condition of any waters, as determined by a rule of the board adopted under sections 1 and 3 of this chapter" (IC 13-18-4-5).

There was only one location where livestock (roughly 35 cattle) had direct access to a tributary while the other livestock (roughly 20) observed did not have direct access to a tributary or the river in this subwatershed. With the presence of livestock in the subwatershed, run-off of nutrients from pastures and the increased probability that livestock manure will be spread on fields all increase the potential for the introduction of livestock waste into the water. As previously stated there is a lack of proper septic systems present in the watershed. All these concerns lead to pathogenic bacteria entering the water source. Human, livestock, aquatic, and wildlife exposure to such pathogens can cause health concerns.

Four log jams were viewed in this watershed and were considered small enough not to be causing any significant problems to the river or stream banks at the current time. Small log jams can be prevented or cleared prior to the small log jam becoming large and undercutting or scouring the banks. The prevention of log jams could reduce the loss of the riparian buffers and sediment erosion into our streams.

Figure 39: Newport Subwatershed *E. coli* Data



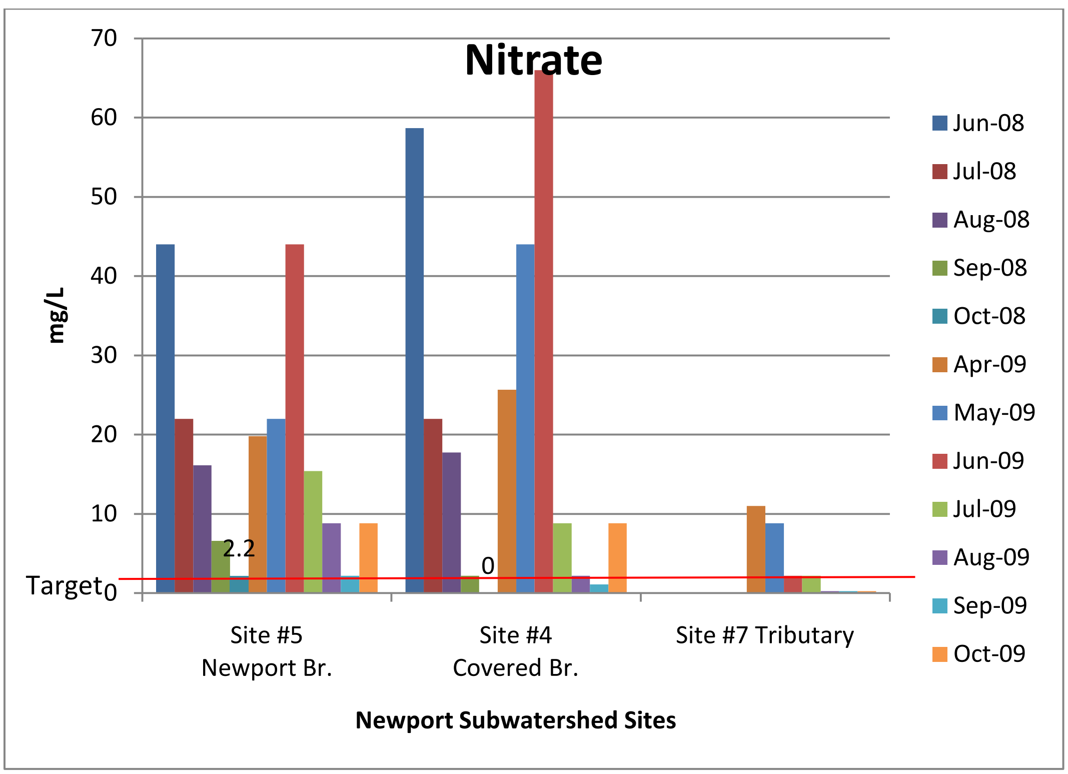


Figure 40: Newport Subwatershed Nitrate Data

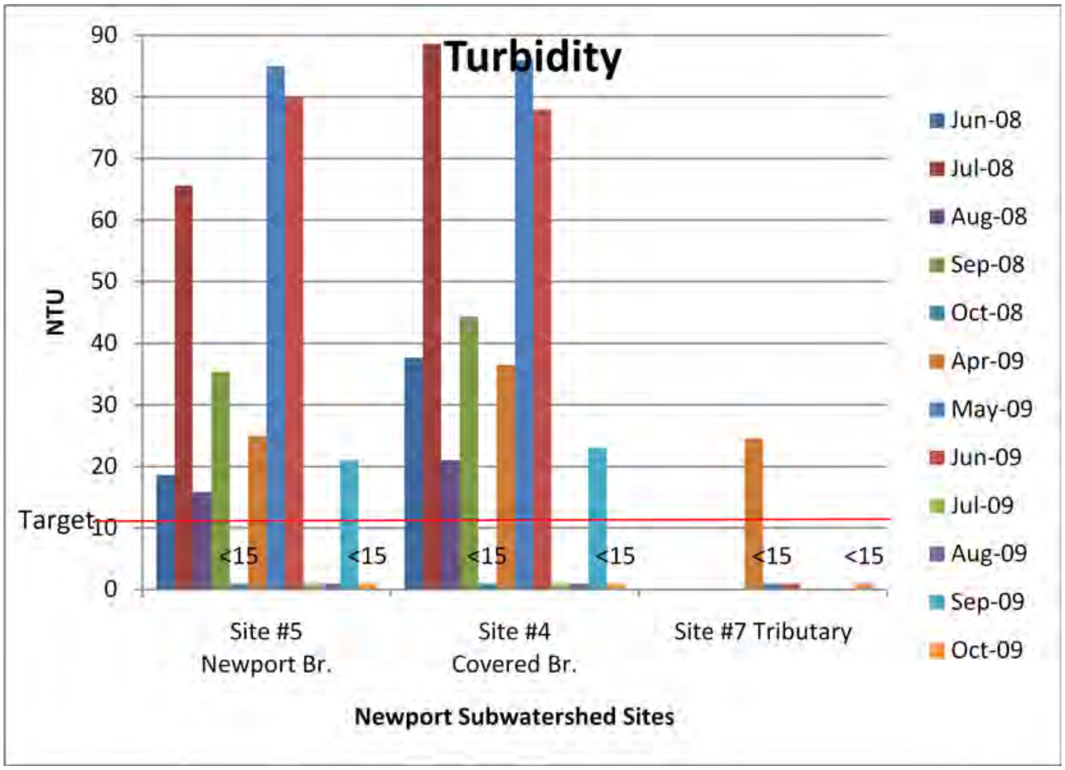


Figure 41: Newport Subwatershed Turbidity Data

Southeast Wabash Subwatershed- 051201081603

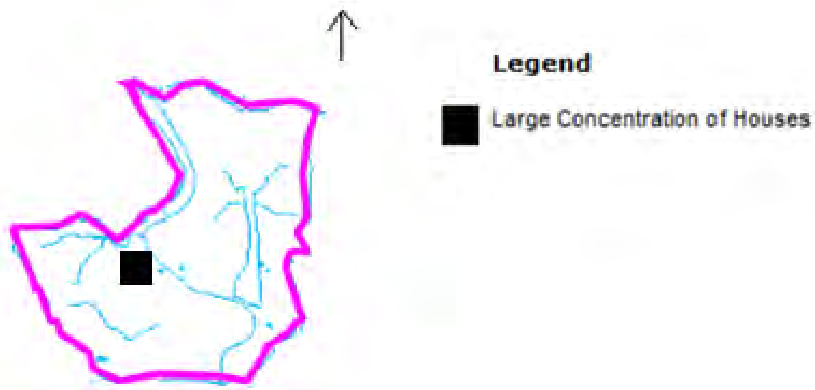


Figure 42: Southeast Subwatershed

Figure 42 represents the Southeast subwatershed. This subwatershed did not have any fields selected for the tillage survey. During our windshield survey the land-use in this watershed is heavily cropped with conventional corn and some no-till soybeans but during our flyover survey most of the floodplains were flooded by the Wabash River. The flooding probably contributes large amounts of sediment into the river since these fields are conventionally tilled. The Wabash TMDL has a positive indication of nutrients and *E. coli* present within this section of the Wabash River that flows through the Southeast Wabash subwatershed.

Upon comparing the 2008 & 2009 data for Site #6, one can easily see this location has high *E. coli* levels. This site runs consistently above the Indiana State Standard of 235 cfu/100 mL. From the data there is indication of *E. coli* upstream therefore *E. coli* is likely entering into the subwatershed. The evidence from the Illinois TMDL and the presence of *E. coli* established by the Indiana TMDL for the Wabash River would assume that *E.* coli passing through this subwatershed. The possibility of *E. coli* contamination through livestock excrement present in pasture land in the floodplains, near this sampling location. However, none of the livestock have direct access to the stream. Even with no direct access there could be contribution of some *E. coli* run-off from the livestock by them being in the flood plain and when the river floods the excrement is washed into the river or by the rain taking livestock excrement as run-off. Figure 43 represents the *E. coli* levels for Site #6. As mentioned in the 2009 data section Site #6 had a very large outlier that, once compared to the 2008 data and the 2009 data there is no strong indication that we should include this sample. We conclude that either our sampling bottle became contaminated or it was a lab error.

The nitrate data in Figure 44 for the Southeast Wabash watershed indicated the levels of nitrate were all above the 1mg/L target. During the sampling of May 2009 the sampling team was unable to collect the nitrate samples. Figure 45 indicates the turbidity for the subwatershed was above the target of 10.4 NTU for majority of 2008. During the 2009 sampling season we had high turbidity for the months of April and June. The turbidity was not sampled for May.

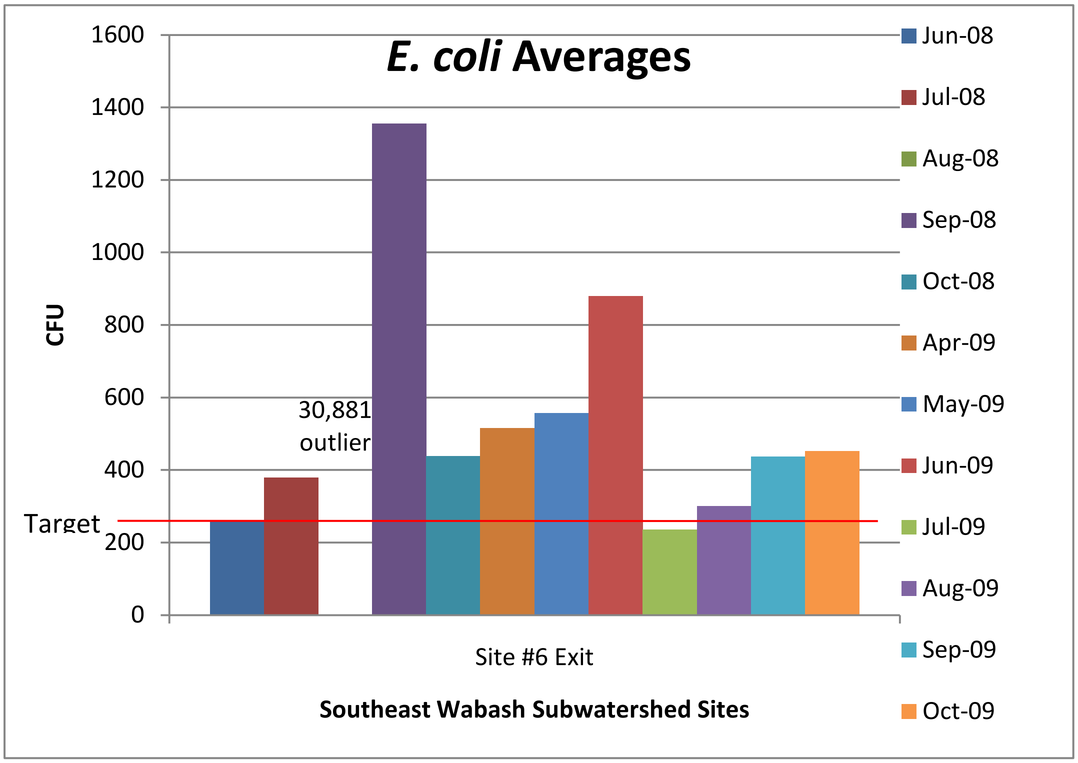


Figure 43: Site #6 *E. coli* Data

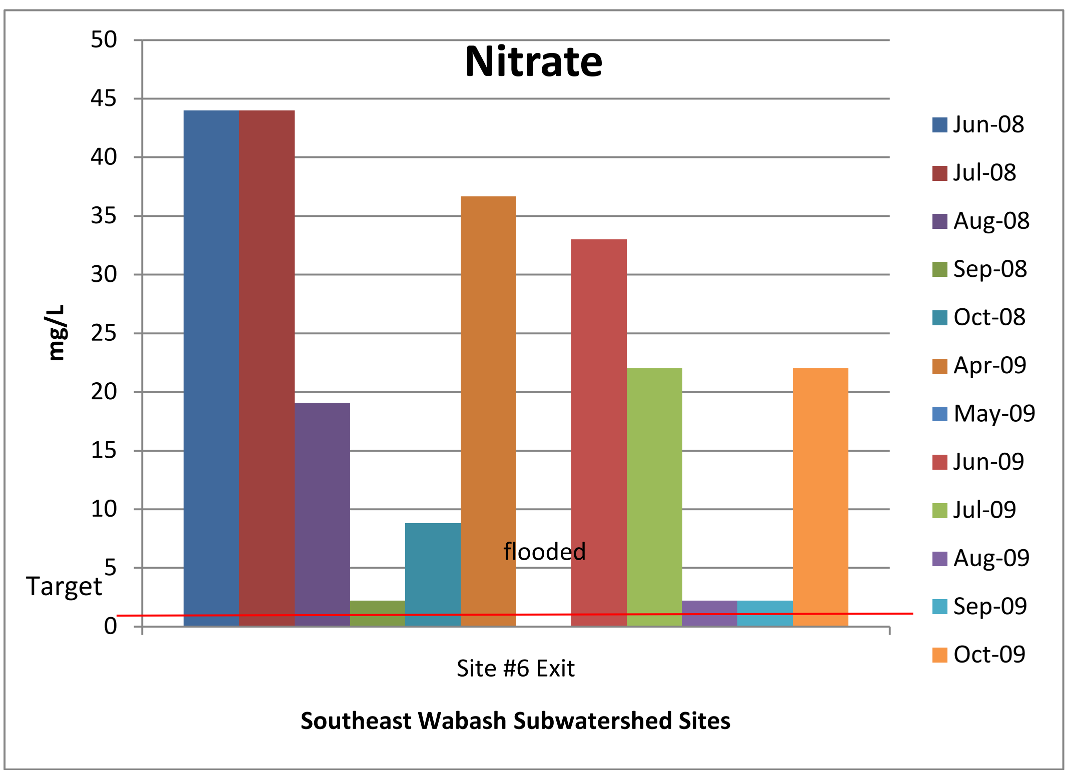


Figure 44: Nitrate Data for Southeast Wabash Subwatershed

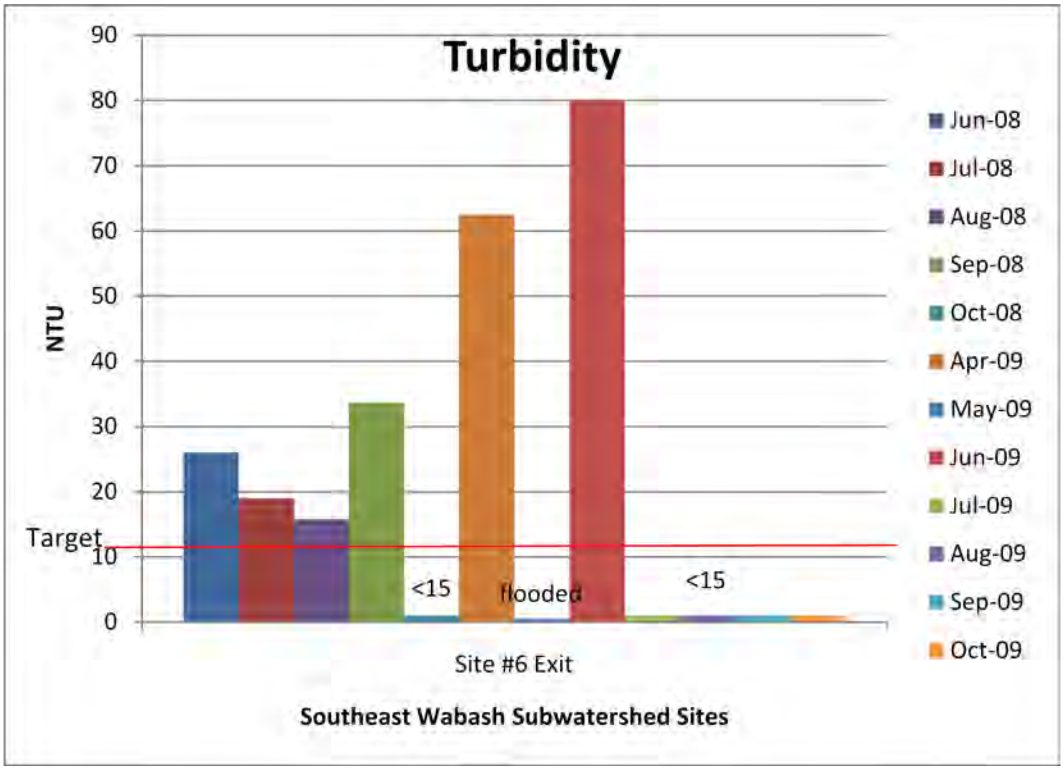


Figure 45: Turbidity for Southeast Wabash Subwatershed

Section V: Development of Problem Statements

The group investigated the benchmark data and existing water quality information to determine the scope of each water quality concern and develop problem statements adequately summarizing the main public concerns within the watershed. The group determined possible causes and sources to the proposed problem. Table 18-22 summarizes the problem, cause, and sources for each concern.

Problem, Cause, and Source Statements

Based on the evidence previously stated within the baseline data, windshield survey and flyover survey the Little Vermillion River Watershed Group adopted the following problem statements:

1.) CONCERN: Erosion and Sediment

PROBLEM: **Erosion of riparian (forest and vegetative) buffers increase the amount of sedimentation within our waterbodies causing the increased turbidity and log jams present within the body of water.**

CAUSE: The loss, encroachment, or destruction of riparian buffers along the stream/river banks causes the more highly erodible soils (HES) in the Jonathan Creek and Horseshoe Bend subwatersheds to be eroded into our streams. Soil erosion can be characterized as the transport of particles that are detached by rainfall, flowing water, or wind. Erosion occurs when land is disturbed and vegetation removed, allowing rain to wash soil particles into the streams and rivers; some erosion is natural. The eroded soil is either re-deposited in the same field or transported from the field in run-off. Sediment released can destroy wildlife and aquatic habitat. Aquatic life affected by the sediment is caused by lower amounts of available DO therefore decreasing aquatic life.

SOURCE: 1.) Farming the banks of ditches, creeks, streams, and rivers can exacerbate erosion as well. The vegetation that grows along these water bodies is necessary to hold soils in place. The erosion of soils into water bodies can impact biotic communities and lead to nutrient overloading.

2.) The direct access livestock have to streams is increasing soil loss along with the riparian loss because they are able to trample the riparian buffers.

3.) Storm events further contribute to the problem by moving more sediment into the waterbodies. Conventionally tilled, unprotected cropland with slopes greater than two percent are the most susceptible to the erosive effects of rainfall and subsequent water movement over its surface.

4.) The erosion of soil within our watershed is believed to be caused a great deal by the conventional tillage practices used within the Little Vermillion Watershed in Illinois and the large number of farm tiles which drain the prairieland directly into the Little Vermilion River.

2.) CONCERN: Log Jams

PROBLEM: **Log jams cause problems by creating structural instability to bridges, the backflow and flooding upstream and riparian loss due to out-washing.**

CAUSE: Log jams are caused by streambank destabilization caused by the lack of riparian buffers due to livestock or conventional tilled fields. From an environmental standpoint, log jams and other woody obstructions in streams are supportive of aquatic life and serve to provide a healthy function in the waterway. But the obstructions divert water flow, which in turn may change the course of a stream, inundating land which was formerly above the bank of the stream.

SOURCE: The high volume of water entering into our watershed from Illinois allows the water to increase at such rapid paces that the banks become scoured and unable to hold the trees into place. Once a log jam is created the diverted flow scours the stream bank, cutting new channels, often increasing erosion causing more trees to become part of the log jam.

3.) CONCERN: *E. coli*

PROBLEM: ***E. coli*** **counts are above the target standard of 235 cfu/100mL and keep surface water in non-attainment of water quality standards causing health risks to humans when using the waters for recreational reasons. The affect of** ***E. coli*** **does negatively impact livestock, aquatic life and wildlife health when water is consumed.**

CAUSE: The lack of education on maintaining or obtaining proper septic systems and the access of livestock increases the amount of *E. coli* present within the watershed.

SOURCE: The Little Vermillion River Watershed Project tests for *E. coli* as indicators of the amount of human and animal waste present in the waterways. The problem exists because of naturally occurring causes (i.e. wildlife), allowing livestock to wade through streams, manure spreading, pasture runoff, improperly functioning or nonexistent septic systems, and the increased amount of fecal coliform introduced into the river by the Georgetown WWTP.

4.) CONCERN: Lack of Education

PROBLEM: **Lack of environmental and conservation education practices is a problem because residents within the watershed do not understand what impacts their actions have on water quality.**

CAUSE: Residents within the watershed tend not to have much knowledge of practices that may be having an impact on the environment. This could stem from the mentality of "it is not broken so why fix it." Some residents have straight pipes for their septic or do not understand proper septic maintenance of septic systems and others dump oil on the ground after changing oil in their vehicle.

SOURCE: The adult and child population needs to be educated on environmental impacts. As mentioned earlier during our annual meeting residents were given our public land survey questionnaire. Twelve out of fifteen people answered "no" to the question "Is properly functioning septic systems a priority?" This gives reason to believe the problem exists because they do not see a direct correlation between the cause and effect. The common mentality is it has been done for generations and they feel they can continue. Therefore, the source of lack of education is not having the basic knowledge of how to dispose of oil and waste, and lack of conservation practices.

5.) CONCERN: Agricultural Nonpoint Source Pollution

PROBLEM: **Agricultural Nonpoint Source Pollution includes *E. coli,* nutrients, chemicals, and sediment. Agricultural Nonpoint Source Pollution is a problem because it contributes *E. coli,* nutrients, chemicals, and sediment into the streams**

that inhibits aquatic life and increases the chemical loads contributed to the water body.

CAUSE: The Agricultural run-off concern is substantiated from existing data establishing the presence of *E. coli*, nitrate, and sediment. The presence of sediment and nutrient within the tributaries and river of the Little Vermillion River Watershed is caused by the heavy use of conventional tillage. Many farmers are still utilizing conventional tillage practices, specifically for corn crops.

SOURCE: 1.) Sediment that leaves cropland, poorly vegetated pastures or feedlots and enters water bodies has a higher pollution potential than from other agricultural land-uses such as well vegetated pastures or hay fields. The topsoil of a crop field is usually richer in nutrients and other chemicals because of past fertilizer and pesticide applications, as well as nutrient cycling and biological activity. When nutrients, fertilizers, or pesticides attach to a soil particle they are more able to be absorbed but also allows those soil particles within fields that have very little protection to run-off into waterways caring the non-point source pollution along.

2.) Reasons for runoff occurring are conventional tillage is in use rather than adopting conservation tillage practices such as not encroaching on waterways, use of grassed waterways, buffer strips, no-till, and the use of new precision agriculture technology.

3.) Also, soils from livestock areas/pastures have high levels of nutrients and pathogens present within the soil. Animal manure contains nutrients and pathogens that will leach from pastures when rained on and contaminate surrounding waterways.

4.) Heavy rainfall during the spring planting season allows soil to erode from farm fields that have no protection or barrier from the rain droplets and the influx of water flowing over the loose soil particles present after the soil has been plowed, cultivated, and planted.

SUMMARY:

In summary the loss of riparian buffers increase the sedimentation due to bank and soil erosion, log jams, lack of education, *E. coli,* and agricultural non-point source pollution impacts the health of the Little Vermillion River Watershed. This is exhibited by increased sedimentation, erosion, increased *E. coli* contamination, decreased in-stream habitat (temperature, contaminants, and sediment) and decreased aesthetic qualities.

Table 18: Erosion and Sediment Summary of Concerns, Causes, Sources, and Problem Statements

<table>
<tr><th>Water Quality Concern</th><th>Cause</th><th>Source</th><th>Problem Statement</th></tr>
<tr><td rowspan="6">Erosion and Sediment</td><td>Occurrence of stream bank erosion</td><td rowspan="2">Inadequate bank cover</td><td rowspan="6">Erosion of riparian (forest and vegetative) buffers increase the amount of sedimentation within our waterbodies causing the increased turbidity and log jams present within the body of water.</td></tr>
<tr><td>Sediment and other pollution entering streams in run-off water.</td></tr>
<tr><td>Occurrence of stream bank erosion</td><td rowspan="2">Inadequate buffers to filter sediment and other pollutants from run-off.</td></tr>
<tr><td>Sediment eroding into the river.</td></tr>
<tr><td rowspan="2">River water rapidly flowing downstream removing vegetation & trees along curves</td><td>Presence of livestock trampling stream banks</td></tr>
<tr><td>Livestock farming in Jonathan Creek Watershed</td></tr>
</table>

Table 19: Log Jam Summary of Concerns, Causes, Sources, and Problem Statements

Water Quality Concern	Cause	Source	Problem Statement
Log Jams	Trees falling into the river and lodging	Inadequate riparian cover along river banks to hold soil particles	Log jams cause problems by creating structural instability to bridges, the backflow and flooding upstream and riparian loss due to out-washing.

Table 20: *E. coli* Summary of Concerns, Causes, Sources, and Problem Statements

Water Quality Concern	**Cause**	**Source**	**Problem Statement**
E. coli contamination	Livestock in streams	Livestock farming practices Locations: Jonathan Creek subwatershed	*E. coli* counts are above the target standard of 235 cfu/100mL and keep surface water in non-attainment of water quality standards causing health risks to humans when using the waters for recreational reasons. The affect of *E. coli* does negatively impact livestock, aquatic life and wildlife health when water is consumed.
	Wildlife	Habitat	
	Presence of human waste causing *E. coli*	Lack of septic system: Newport Courthouse; Georgetown, IL Wastewater Treatment Plant and other local homeowners	
	Georgetown, Illinois Wastewater Treatment Plant	Georgetown STP likely ranges from 2,346 to 1,559,685 million cfu/day	
		combined sewer overflow reported loads ranging from 1,610 to 14,349,200 million cfu/day during high flow events	

Table 21: Lack of Education Summary of Concerns, Causes, Sources, and Problem Statements

Water Quality Concern	Cause	Source	Problem Statement
Lack of Education	Lack of knowledge concerning watershed issues	Residents do not see a direct correlation between the cause and effect of their actions.	Lack of environmental and conservation education practices are a problem because residents within the watershed do not understand what impacts their actions have on water quality.
	Lack of knowledge on conservation and environmentally friendly actions.	Residents not having the basic knowledge of how to dispose of oil and waste, and lack of conservation practices	

Table 22: Agricultural Non-point Source Summary of Concerns, Causes, Sources, and Problem Statements

<table>
<tr><th>Water Quality Concern</th><th>Cause</th><th>Source</th><th>Problem Statement</th></tr>
<tr><td rowspan="3">Agricultural Non-point Source Pollution</td><td rowspan="2">Heavy use of conventional tillage</td><td>Fields with topsoil fully exposed letting nutrients and chemicals run-off into a water source</td><td rowspan="3">Agricultural Nonpoint Source Pollution includes E. coli, nutrients, chemicals, and sediment. Agricultural Nonpoint Source Pollution is a problem because it contributes E. coli, nutrients, chemicals, and sediment into the streams that inhibits aquatic life and increases the chemical loads contributed to the water body.</td></tr>
<tr><td>Heavy rainfall during the spring planting season allows soil to erode from farm fields that have no protection or barrier from the rain droplets and the influx of water flowing over the loose soil particles present after the soil has been plowed, cultivated, and planted.</td></tr>
<tr><td>Soil particles with nutrients and chemicals attached leave cropland and is carried in run-off water into streams</td><td>Lack of conservation tillage adoption such as encroaching on waterways, use of grassed waterways, buffer strips, no-till, and the use of new precision agriculture technology.</td></tr>
</table>

Section VI: Critical Areas Identification and Prioritization

In this section the concerns identified in Section IV were linked to associated parameters tested within the watershed. Habitat quality assessments, visual assessments, and land- use maps were utilized to identify land-uses and associated concerns from Section III within the HUC 12 watersheds.

Critical areas were determined by the overall 12-digit watersheds based on criteria, including the Little Vermillion River Watershed Group chemical and biological test results, windshield survey, flyover survey, land-use, and the Illinois TMDL. Load averages were calculated for each parameter in the 12-digit watershed. In Section IV baseline data indicated the loads calculations based upon:

1. Stream flow at the sample site (CFS)
2. Chemical data collected from sample site

The sites were then assembled into their associated 12-digit watershed. These watersheds were then given a ranking by parameter based upon the following criteria:

1. Indiana State Water Quality Standards or Target Level
2. Land-use present within each watershed
3. Comparative ranking among the 12-digit Little Vermillion River Watershed concerns from stakeholders.

Those watersheds showing recurring or critical levels (higher than state standards/targets) of contamination for a given parameter and have a lot of land-use associated with contamination (i.e. livestock access associated with *E. coli* run-off) within the sub-watershed is identified as high priority. Table 18 reflects the parameter prioritization by sampling site with the watershed association. The ranking was determined from the sampling data reviewed above in the baseline data Section IV. From Table 23 those sites with extreme concentrations of a given parameter were identified with a ranking of high (H). In Table 24 we reflect on our tillage transect data and the land-use described in Section III. Table 25 reflects our observations to our windshield and flyover survey data. Table 26 was established after analyzing our chemical, biological, visual observations, surveys, and land-use. If sampling sites had 4 or high (H) ranking indicated through Tables 23-25 then they also received a "H" ranking for the concerns.

Table 26 the sample sites were grouped within their respective 12-digit HUC sub-watershed to determine critical areas by subwatershed. Critical areas are divided by sub-watershed so that BMP's can best be targeted and implemented in the most critical sections of the watershed. For example if all the sites with a given 12-digit watershed was given a priority ranking "H" for nutrients, agricultural land-use and conventional tillage then this sub-watershed is in need of a specific BMPs to target agricultural non-point source pollution to control the agricultural nutrient run-off.

Table 23: Parameter Prioritization

Sample Sites	12-digit HUC	Parameters								
		Habitat Quality	Macroinvertebrate	Temperature	Dissolved Oxygen	BOD5	pH	Turbidity	E. coli	Nitrogen-NH3
Site #1: State Line	051201081103	L	L	M	M	H	M	H	H	H
Site #2: Horseshoe Br.	051201081103	H	M	M	M	H	M	H	H	H
Site #3: SR 71- 2008	051201081102	H	M	M	M	M	M	H	H	H
Site #3: Jonathan Cr.-2009	051201081102	H	L	M	M	M	M	M	M	M
Site #4: Covered Br.	051201081104	M	M	M	M	M	M	H	H	H
Site #5: Newport Br.	051201081104	M	L	M	M	H	M	H	H	H
Site #6: Exit-South Site	051201081603	H	H	M	M	H	H	H	M	H
Site #7: Tributary - 2009	051201081104	H	L	M	M	M	M	M	L	L
	High	H	chemical samples or biological samples for a given parameter above state standards/targets for the given parameter							
	Moderate	M	chemical samples or biological samples for a given parameter near or at state standards/targets for the given parameter							
	Low	L	samples for a given parameter below state standards/targets for the given parameter							

Table 24: Associated Land-Uses by Site and Watershed

Sample Sites	12-digit HUC	Land-Use				
		Agricultural	Residential	Industrial	Recreational	Forest
Site #1: State Line	051201081103	H	L	L	L	M
Site #2: Horseshoe Br.	051201081103	H	M	L	L	M
Site #3: SR 71- 2008	051201081102	M	L	L	L	H
Site #3: Jonathan Cr.-2009	051201081102	M	L	L	L	H
Site #4: Covered Br.	051201081104	H	M	L	L	H
Site #5: Newport Br.	051201081104	M	H	L	L	L
Site #6: Exit-South Site	051201081603	H	L	L	L	M
Site #7: Tributary - 2009	051201081104	M	M	L	L	M
	High	H	more than 100 acres being used for the listed land-use practices			
	Moderate	M	50-100 acres being used for the listed land-use practices			
	Low	L	50 or less acres being used for the listed land-use practices			

Table 25: Little Vermillion Observations by Sub-watersheds

Watershed Association	12-digit HUC	Visual Observations				
		Log Jams	Bank Erosion	Livestock Access	Field Tiles	Conventional Tillage
Horseshoe Bend	051201081103	M	H	M	M	H
Jonathan Creek	051201081102	H	M	H	M	H
Newport	051201081104	H	H	M	L	M
SE Wabash	051201081603	L	M	L	L	H
	High	H	more than 4 viewed in sub-watershed			
	Moderate	M	2-3 viewed in sub-watershed			
	Low	L	0-1 viewed in sub-watershed			

Table 26: Little Vermillion River Critical Subwatershed by Parameter

Watershed Associations	12-digit HUC	Parameters							
		Habitat Quality	Macroinvertebrate	Dissolved Oxygen	BOD5	pH	Turbidity	E. coli	Nitrogen-NH3
Horseshoe Bend	051201081103	M	M	L	L	L	H	H	H
Jonathan Creek	051201081102	H	M	L	L	L	H	H	H
Newport	051201081104	M	H	L	L	L	H	H	M
SE Wabash	051201081104	M	M	L	L	L	M	M	H
	High	H	4 or more of the baseline data indicated concern (chemical, biological, visual observations, etc.)						
	Moderate	M	2-3 of the baseline data indicated concern (chemical, biological, visual observations, etc.)						
	Low	L	0 -1 of the baseline data indicated concern (chemical, biological, visual observations, etc.)						

Critical Watersheds by Parameter

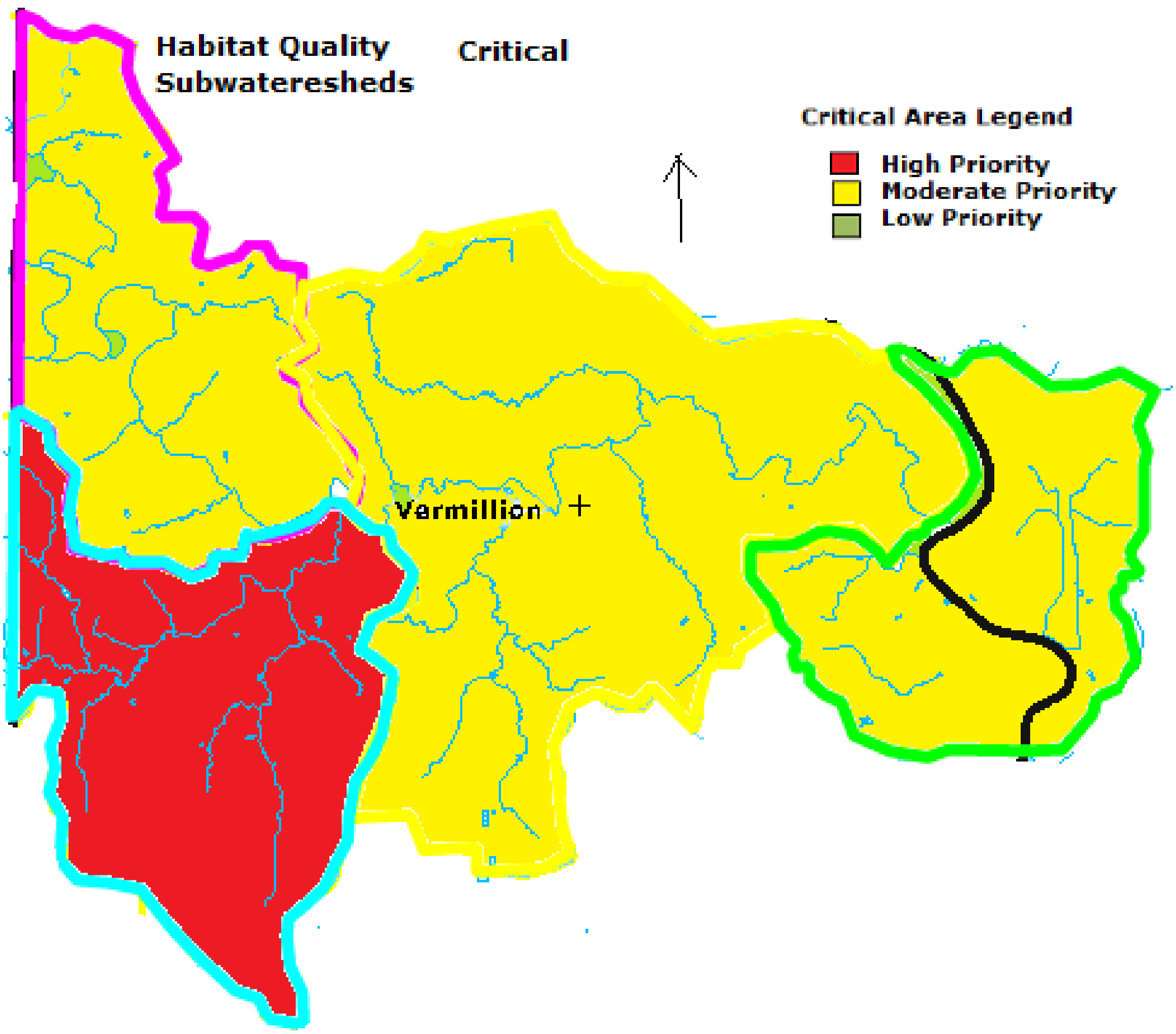
In determining critical areas we looked at 2007 Inventory data, governmental data, and our current sampling data and visual assessments. All the background information needed to be reviewed as the current sampling data did not reveal direct locations within the Little Vermillion River Watershed that was the contributing source for critical areas. Most of our water is delivered from upstream areas within Illinois. As we realize from the Illinois TMDL we have quite a large quantity of pollution contamination coming from upstream. Therefore, we looked at all the data collectively to combine the information into the four above tables, (Tables 23-26). These tables allowed the group to distinguish where critical areas are present within the sub-watersheds according to the parameters in accordance with the concerns of the LVRWG. The entire watershed cannot be labeled as critical for a parameter. Therefore, when looking at the data a determination of causes need to be reviewed in the subwatersheds for implementation of BMPs. After each given parameter the subwatersheds are identified and the reasons behind the priority rating. Figures 46-51 represent the critical watersheds by the given parameter.

a. **Habitat Quality-**

i. Jonathan Creek Subwatershed

1. As indicated by the above table this subwatershed would be considered a high priority for habitat quality. As the biological data revealed this subwatershed had a poor habitat quality. However, the section of stream sampled had one pool of water that did have pollution intolerant macroinvertebrates. This subwatershed has the Jonathan Creek tributary which is an intermittent stream and that was the reason for the poor habitat rating. The DO levels prior to the biological sampling were above the LVRWG target.

Figure 46: Habitat Quality Critical Subwatersheds



b. **Macroinvertebrate-**

i. Newport Subwatershed

1. Indicated by the biological data this subwatershed is critical for macroinvertebrates. According to the data collected the number for pollution intolerant species identified was low. This could be caused by the high readings of nitrates and *E. coli* collected within this subwatershed.

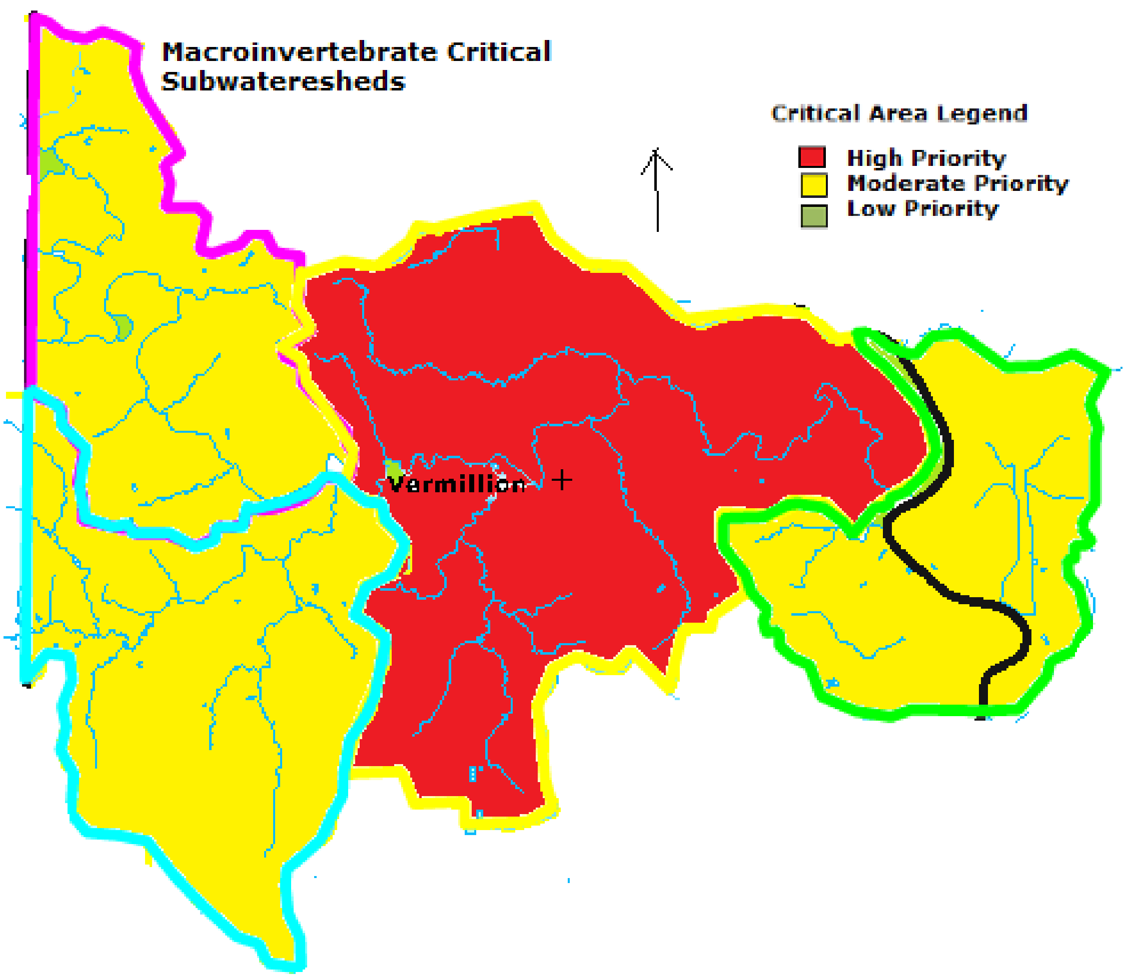


Figure 47: Macroinvertebrate Critical Subwatersheds

c. **DO-** The target for the Little Vermillion River Watershed is 4 mg/L -7 mg/L.

a. The subwatersheds sampling sites were within the target range for the sampling sites. No subwatersheds are indicated as being critical for DO levels.

d. **BOD_5-** The target for the Little Vermillion River Watershed is 1.5 mg/L.

a. The subwatersheds sampling sites were within the target range for the sampling sites. No subwatersheds are indicated as being critical for BOD_5 levels.

e. **pH-** The target for the Little Vermillion River Watershed is between 6-9.

a. The subwatersheds sampling sites were within the target range for the sampling sites. No subwatersheds are indicated as being critical for pH levels.

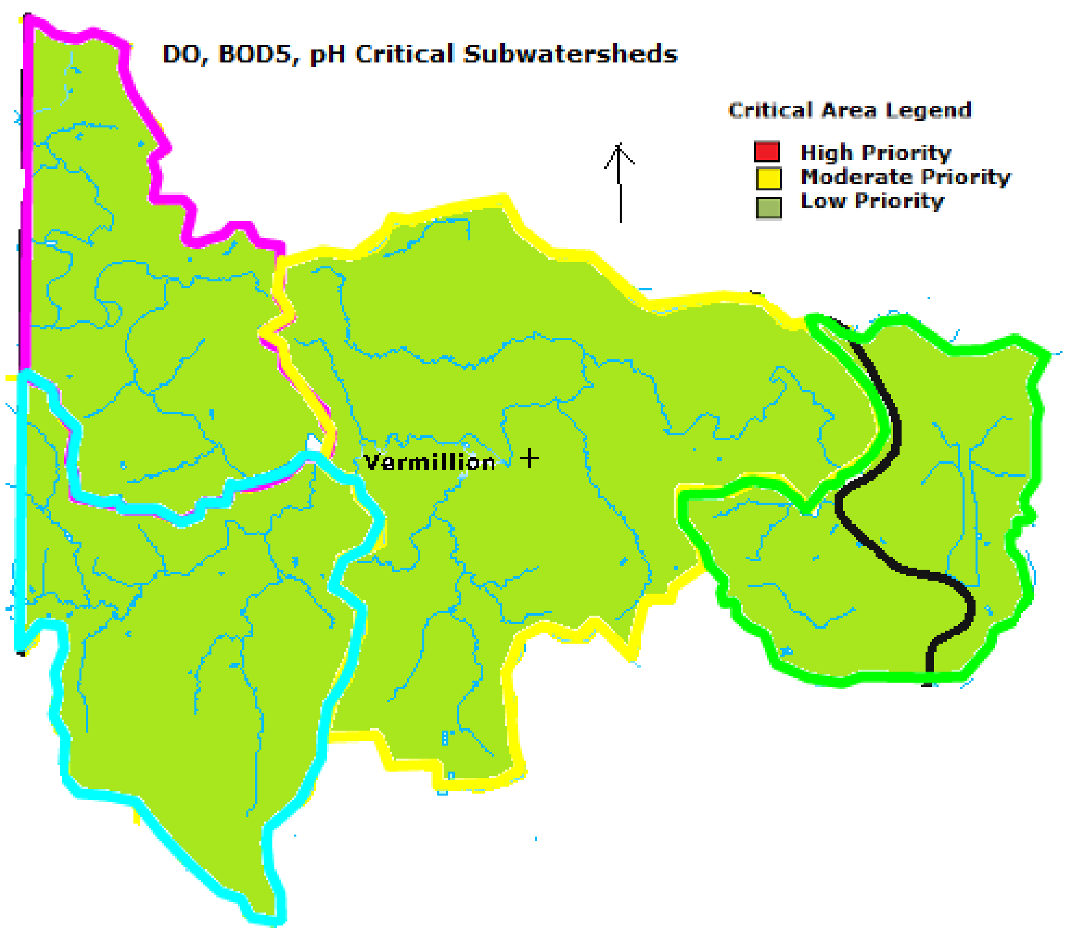


Figure 48: DO, BOD_5, pH Critical Subwatersheds

f. ***E. coli*-** The target for the Little Vermillion River Watershed is 235 cfu/100mL. The entire watershed has *E. coli* contamination. The *E. coli* levels could be contributed by the LVRWG concerns for the watershed such as agricultural non-point source pollution, livestock access, or bank and sediment erosion.

i. Horseshoe Bend Subwatershed

1. Site #1, Horseshoe subwatershed which indicates *E. coli* in the Little Vermillion River Watershed and supports the Illinois TMDL, which as stated earlier, lists the river for *E. coli* impairments. To reduce the *E. coli* count the group will need to work with Illinois to try to reduce high loads of *E. coli* entering into the State of Indiana.

ii. Newport subwatershed

1. Had high *E. coli* levels within this subwatershed Site #5 consistently has higher *E. coli* readings throughout the entire sampling seasons. From the background inventory data and visual assessments collected this subwatershed has large concentrations of houses present and one location where livestock had direct access to a tributary. From the data there is indication that properly functioning septic systems do not exist. The most effective BMP for managing loads from septic systems is regular maintenance. BMPs for preventing livestock from having direct access to streambanks would also help lower *E. coli* counts in the watershed.

iii. Jonathan Creek subwatershed

1. Had high *E. coli* levels and within this subwatershed visual observations revealed the largest quantities of livestock having direct access to the stream banks. This subwatershed would benefit from BMPs that would prevent the access of livestock to stream banks.

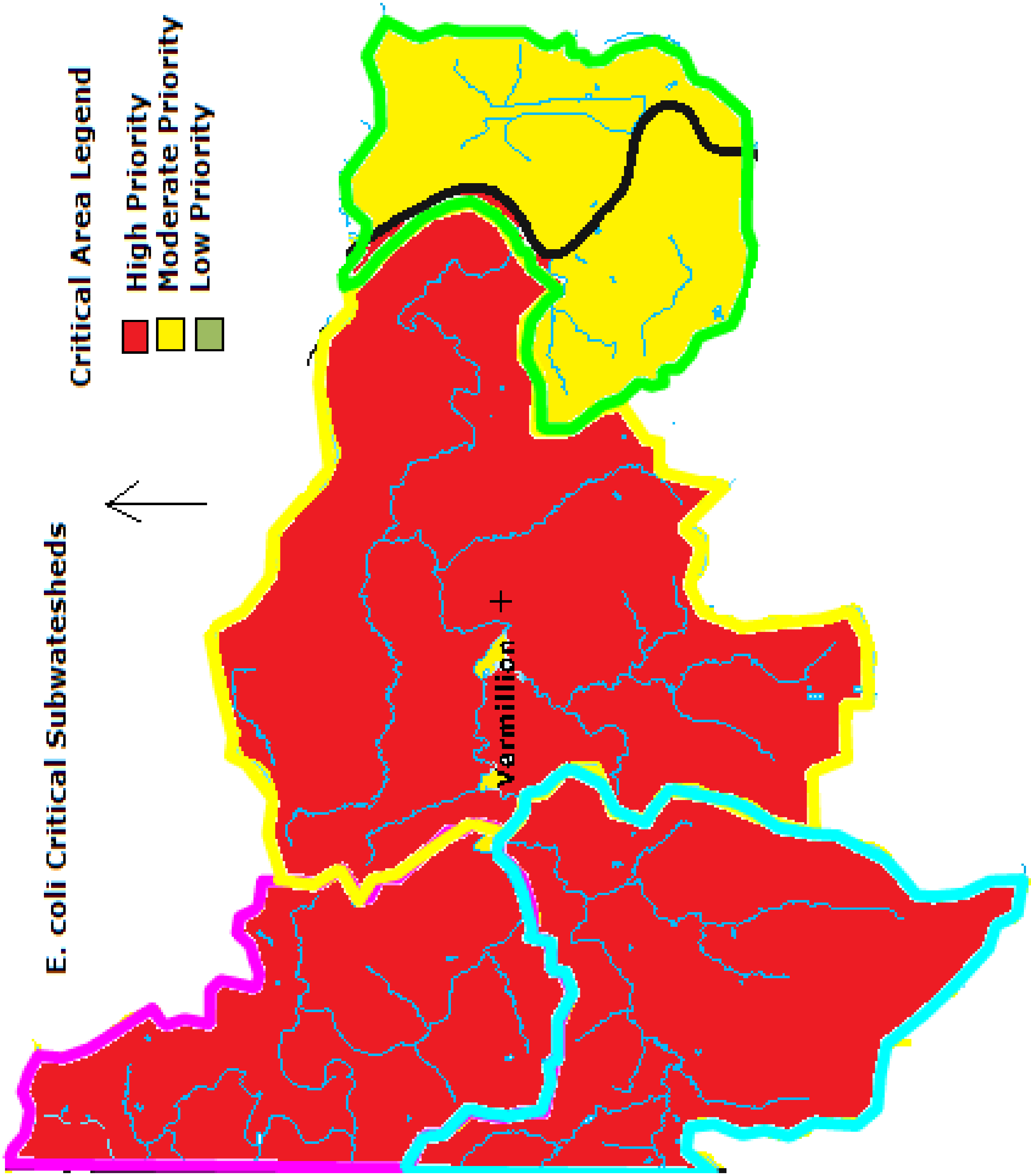


Figure 49: *E. coli* Critical Subwatersheds

g. **Nitrates-** the target rate for the Little Vermillion River Watershed is < 1 mg/L. The nitrate levels could be contributed by the LVRWG concerns for the watershed such as agricultural non-point source pollution, livestock access, or bank and sediment erosion.

i. Nitrates are a problem within the watershed. Every subwatershed is above the target during the sampling the spring season. Higher amounts of rain occur during April through June and this is when the highest recordings of nitrate occur within the watersheds. The Newport Watershed is a moderate priority.

ii. Horseshoe Bend subwatershed

1. As the transect data, inventory and visual assessments revealed a great deal of conventional tillage. The conventional tillage practices are allowing the crop fields to be exposed to the weather and when it rains and the water and soil particles run-off into the streams we are getting increased nitrogen levels.

iii. Southeast subwatershed

1. As the transect data, inventory and visual assessments revealed a great deal of conventional tillage. The conventional tillage practices are allowing the crop fields to be exposed to the weather and when it rains and the water and soil particles run-off into the streams we are getting increased nitrogen levels.

iv. Jonathan Creek subwatershed

1. Experiences large amounts of nitrate levels during the spring months. This could be due to the conventional tillage practices,

although the more likely cause is this subwatershed had the largest amount of livestock with direct access to the streams which could be contributing the nitrogen into the streams

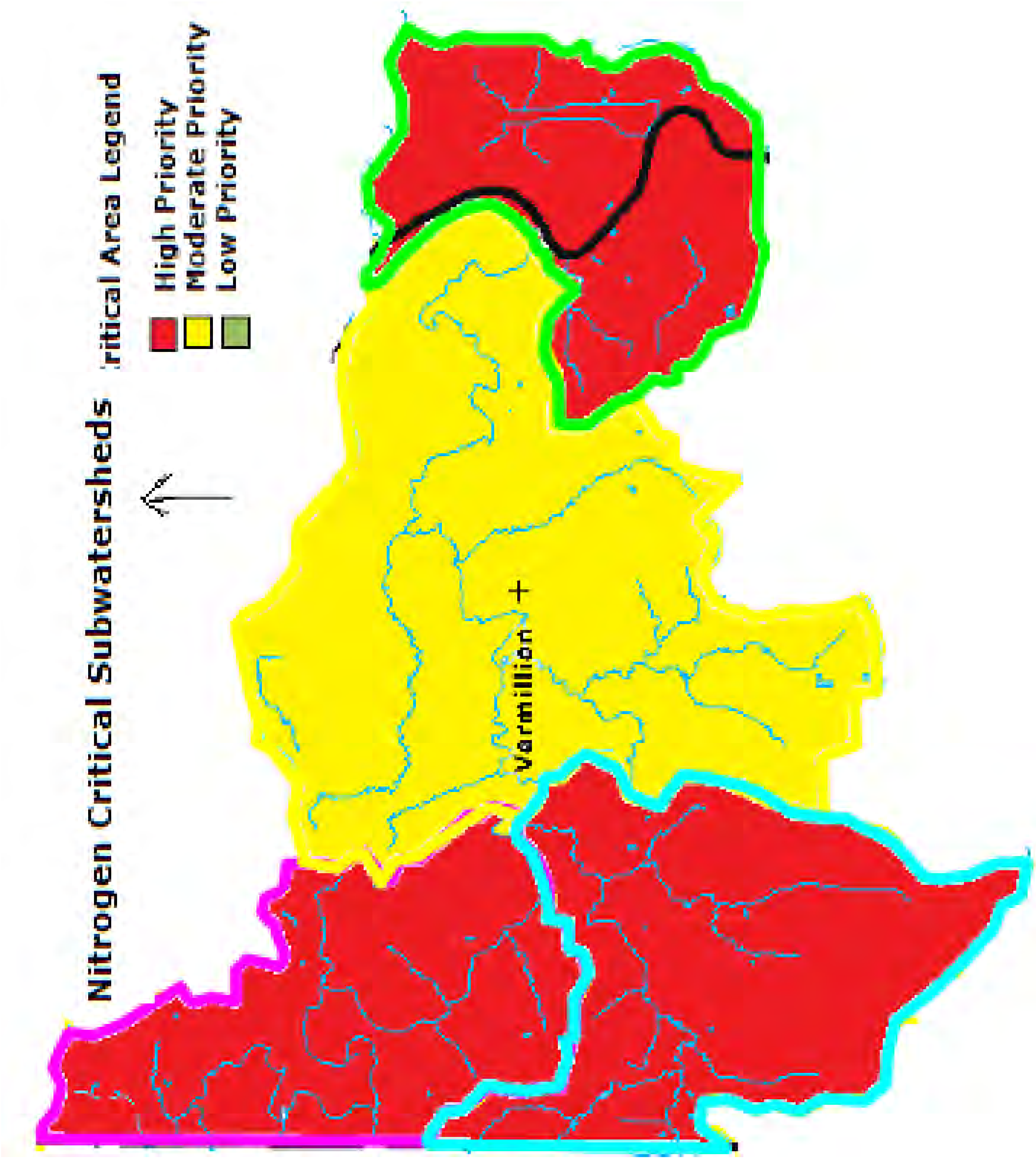


Figure 50: Nitrogen Critical Subwatersheds

h. **Turbidity**- the target rate of TSS is <30 mg/L or Turbidity < 10.4 NTU. The turbidity levels could be contributed by the LVRWG concerns for the watershed such as agricultural non-point source pollution, livestock access, log jams, or bank and sediment erosion.

   i. The watershed had a moderate reading of turbidity throughout the entire sampling season. However, during the spring months when rainfall is increased the turbidity readings are well above the target.

   ii. Newport subwatershed

      1. As indicated earlier in the visual observations we identified in the Newport watershed three locations of bank and sediment erosion. Bank and sediment erosion would benefit from BMPs that limit livestock access and help slow the run-off of sediment.
      2. Newport subwatershed had the most small log jams present within the watershed area. Preventing these log jams from becoming large would help prevent further damage to the stream banks and lesson the amount of sediment eroding into the streams.
      3. Newport subwatershed had the greatest number, nine, of less than 30 feet of riparian buffers. Riparian buffers help filter the nutrients before entering into the water source.

   iii. Jonathan Creek subwatershed

      1. Had two locations where severe bank erosion was located. These locations were caused due to the livestock destruction.

iv. Horseshoe subwatershed

1. Had two locations where severe bank erosion was located. These locations were caused due to the livestock destruction.
2. Horseshoe subwatershed tended to have the largest visual log jams present causing damage to the surrounding area. Log jams would benefit from BMPs that aid in bank stabilization.
3. Horseshoe Bend subwatershed had three locations were there was less than 30 foot of riparian buffers. Riparian buffers would benefit from BMPs that aid in slowing, absorbing, and filtering the water before the water enters into the waterbody.

v. Southeast Wabash subwatershed

1. Turbidity readings were high during the spring months. The high amount of sediment erosion during the spring could be due to the conventional tillage practices used in the floodplain of the watershed and each of the above subwatersheds upstream. This subwatershed is a moderate priority for turbidity.

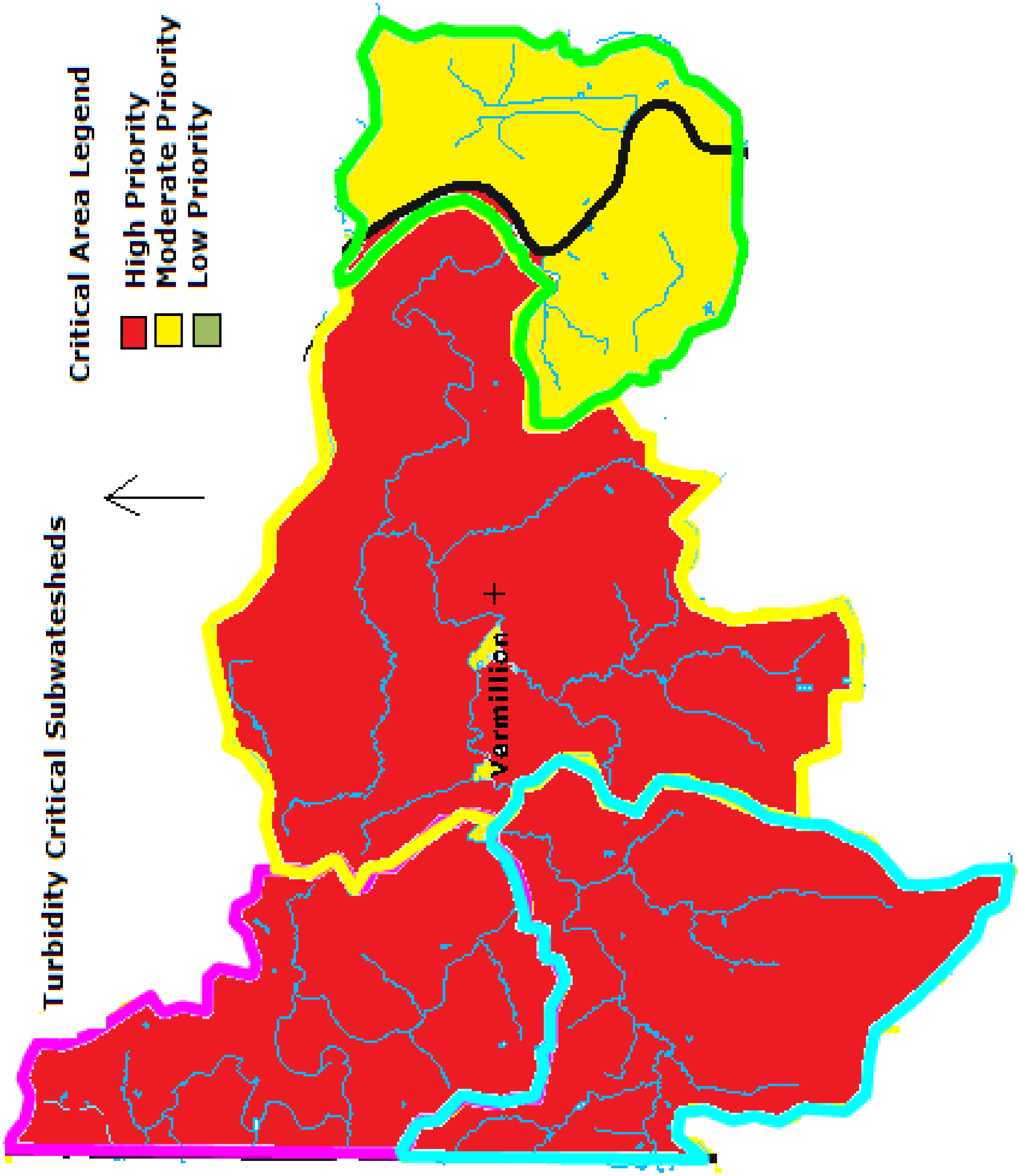


Figure 51: Turbidity Critical Subwatersheds

Section VII: Goal Statements

Based on the problem statements listed in Section V and the critical areas listed in Section VI, the Little Vermillion River Watershed Group, considered alternatives and developed eleven main goals to address water quality issues in the Little Vermillion River Watershed:

<u>1.) Bank and Land Loss Goals</u>

Bank and land loss will be targeted to areas that currently do not have adequate buffers, located predominately in the flood zones of the watershed.

I. Implement bank restoration projects to repair damaged riparian banks.

II. Reduce sediment load to the water body by 20% of the current estimated load of 28 tons/year over the next 10 years by increasing the use of conservation tillage practices, precision agriculture technology, buffer strips, and grassed waterways.

III. Increase conservation tillage practices by 50% over the next ten years.

<u>2.) Log Jam Goals</u>

Log jams goals will be targeted to areas were riverbank erosion is the primary cause of trees to be entering into the streambed.

IV. Decrease the number of extreme log jams by 5% or one log jam per year in the next 5 years through the decrease of river bank erosion by bank stabilization or by removing small log jams before they become severe.

<u>3.) *E. coli* Goals</u>

E. coli goals will be targeted to those areas of the watershed which are urbanized and those areas with livestock.

V. Reduce the concentration of *E. coli* by working with Illinois to reduce the introduction, decreasing the amount of livestock with access to streams within the Little Vermillion

River Watershed water bodies, so water within the streams meets the standards for *E. coli* within 25 years.

4.) Lack of Education Goals

Lack of education goals will be targeted to those areas that are highly urbanized and watersheds where straight pipes were located, livestock have access to streams, and no-till practices are not being utilized.

VI. Promote water-friendly behaviors such as using less yard fertilizers and proper maintenance of septic systems among residents and county officials.

VII. Establish an open line of communication through media outreach to community members and directly communicating with residents about watershed education, outreach, and continued sampling data results.

5.) Agricultural Non-point Source Pollution Goals

Agricultural non-point source pollution goal efforts will be directed to the existing agricultural land within the watershed and will be specifically targeted to farm land not likely to undergo land-use change in the next five years.

VIII. By the fall of 2015, riparian buffer zones identified during the visual assessments will have an established buffer in place along those sections of the river or stream.

IX. Increase the awareness and education of not applying nitrogen in the fall on the ground that lies within the river's floodplains.

X. Educate and promote the increased participation in conservation programs through 319 cost-share, Farm Bill programs, and other efforts.

XI. Reduce the nutrient load reaching the Little Vermillion River and tributaries by 25% of the current estimated load of 173,537.52 lbs/year over the next 10 years by increasing the use of conservation tillage practices, precision agriculture technology, buffer strips, and grassed waterways.

Section VIII: Plan for Implementation and Evaluation

This section of the watershed management plan is to outline the implementation, possible best management practices (BMPs) for the watershed and an evaluation process for determining BMPs that can be implemented into subwatersheds.

Implementation

Based on Section VI critical area determination the LVRWG will announce the BMP cost-share to local stakeholders by a public meeting and media sources. Those landowners with land in critical areas will be notified by a personal letter addressing BMPs preferred for their location and an application. Once applications are received they will be reviewed on first come first serve basis.

Best Management Practices (BMPs)

Generally, a set of BMPs will be developed for individual sites as properties are enrolled into the Little Vermillion River Watershed Groups programs. Because each site is unique, each mix of BMPs will be unique to that subwatershed or location. The LVRWG has decided to use the following BMPs to target critical areas in the subwatershed as mentioned above in Section VI. These BMPs will help target our goals of reducing log jams, educating citizens, decreasing the agricultural nonpoint source pollution, and reducing the amount of *E. coli* present within the entire Little Vermillion River Watershed.

A) Agricultural BMPs

Agricultural BMPs may be subdivided by agronomic/cropping BMPs and livestock BMPs. The basis for most of the BMP standards can be found in the NRCS Field Office Technical Guide (FOTG).

Agronomic / Cropping BMPs

a. Cover Crops (340)
b. Drainage Water Management- (two-stage ditch) (582)
c. Grassed Waterways / Ephemeral Stream Protection (412)
d. Mulching / Residue Management (484)
e. No-Till (329)
f. Nutrient Management (590)
g. Pesticide Management (595)
h. Precision Agriculture Technology

Livestock BMPs

a. Access Control (472)
b. Livestock Exclusion Fence (382)
c. Prescribed Grazing (528)
d. Alternative Watering
e. Heavy Use Area Protection

Conservation BMPs

a. Wetland Wildlife Habitat Management (644)
b. Field Boarder- (386)

B.) Riparian BMPs

a. Mitigation Clearinghouse-
    a. This site (http://idemmaps.idem.in.gov/apps/MitigationVolunteer/) provides a conduit for State employees, environmental consultants, and the public to share

information regarding potential mitigation sites for wetlands, streams, lakes or other water features.

b. Filter Strips / Buffers (Including Habitat Development) (393)
c. Forested Riparian Area (391)
d. Tree Planting- (612)
e. Streambank and Shoreline Protection (580)
f. Streambank Stabilization –(584)
g. Wetland Restoration / Preservation – (657, 659)

C.) Residential Waste Disposal

a. Septic System Inspection and Maintenance
b. Alternative septic systems
c. Installation of municipal waste water treatment plants

Once we established our critical areas in Section VI and the reasons as to why they are considered critical we then needed to look at the above NRCS practices to determine probable BMPs for our watershed. Table 27-31 represents the critical areas by subwatershed with BMPs that could be used to improve water quality.

Load Reductions Expected for each BMP

The following Table 27 -30 represents the BMPs expected load reductions for the critical areas of the subwatersheds. The reductions were calculated using the STEPL modeling system. *E. coli* load reductions are unable to be easily modeled. The BMPs known to reduce *E. coli* levels are listed and the pollutant loads reductions are listed.

****Reductions modeled by STEPL.***

Table 27: Targeted BMPs and Expected Load Reductions for Horseshoe Bend Subwatershed

Critical Area	Reason for critical labeling	BMP or Measure	Estimated Load Reduction for single BMP*
Horseshoe Bend	*E. coli*	Septic System Maintenance workshops	N/A
		Filter Strips	325.6 lbs N/yr 125.3 lbs P/yr 239.4 tons sediment/yr
		Streambank Stabilization	7,411.9 lbs N/yr 2,782.8 lbs P/yr 980.5 tons sediment /yr
	High turbidity	Cover Crops and No-till cropping (modeled as reduced tillage)	1,003.2 tons sediment/yr
		Field Buffers	904.4 tons sediment/yr
		Tree Planting	262.1
		No-till & cover crop workshop	N/A
		Precision Agriculture Technology	N/A
		Removal of log jams	N/A
		No-till & Cover Crop Planting (modeled as reduced tillage)	6,227.5 lbs Nitrogen/yr
	High nitrogen loads	Drainage water management	N/A
		Filter strips/Riparian Buffers	6,854.2 N/yr
		Wetland Restoration	N/A
		Precision Agriculture Technology	N/A

Table 28: Targeted BMPs and Expected Load Reductions for Jonathan Creek Subwatershed

Critical Area	Reason for critical labeling	BMP or Measure	Estimated Load Reduction for single BMP*
Jonathan Creek	*E. coli*	Access control/Alternative Watering (modeled as runoff mgnt system)	8341.3 lbs N 1951.7 lbs P 897.9 tons sediment/yr
		Septic System Maintenance workshops	N/A
		Filter Strips	7,675.3 lbs N/yr 1,951.7 lbs P/yr 897.9 tons sediment/yr
	High turbidity	Streambank Stabilization	897.9 tons sediment/yr
		Log Jam Removal	N/A
		Cover Crops and No-till cropping (modeled as reduced tillage)	805.3 tons sediment /yr
		Field Buffers	805.3 tons sediment/yr
		Tree Planting	919.3 tons sediment/yr
	High nitrogen loads	No-till & cover crop workshop	N/A
		No-till & Cover Crop Planting (modeled as reduced tillage)	11,920.1lbs N/yr
		Drainage water management	N/A
		Streambank Stabilization and fencing	8,409.9 lbs/ N
		Filter Strips	7,675.3 lbs N/yr

Table 29: Targeted BMPs and Expected Load Reductions for Newport Subwatershed

Critical Area	Reason for critical labeling	BMP or Measure	Estimated Load Reduction for single BMP*
Newport	*E. coli*	Access control/Alternative Watering (modeled as runoff mngt system)	4.7 lbs N/yr 1.8 lbs P/yr 3.4 tons sediment/yr
		Septic System Maintenance workshops	N/A
		Filter Strips	4.7 lbs N/yr 1.8 lbs P/yr 3.4 tons sediment/yr
	Macroinvertebrate	Streambank Stabilization	19,752.7 lbs N/yr 1,841.8 tons sediment/yr
		Cover Crops and No-till cropping (modeled as reduced tillage)	16,157.5lbs N/yr 1,628.2 tons sediment/yr
	High turbidity	Forested Riparian Area	
		Cover Crops and No-till cropping (modeled as reduced tillage)	1,628.2 tons sediment/yr
		Filter Strips	159.2 tons sediment/yr
		Tree Planting	35.5 tons sediment/yr
		No-till & cover crop workshop	N/A
		Drainage water management	N/A
		Filter strips/Riparian Buffers	18155.8 lbs N/yr
		Streambank Stabilization and Fencing	19,752.7 lbs N/yr
		Wetland Restoration	N/A
		Precision Agriculture	N/A

Table 30: Targeted BMPs and Expected Load Reductions for Southeast Wabash Subwatershed

Critical Area	Reason for critical labeling	BMP or Measure	Estimated Load Reduction for single BMP*
SE Wabash	High nitrogen loads	No-till & cover crop workshop	N/A
		No-till & Cover Crop Planting (modeled as reduced tillage)	3,103.5 lbs N/yr
		Drainage water management	N/A
		Filter strips/Riparian Buffers	3,433 lbs N/yr
		Precision Agriculture Technology	N/A

Section X: Action Register

In section X the LVRWG developed a list of list of objectives, action items, target audiences, responsible parties, tentative schedules, and potential indicators to measure progress for the eleven goals listed in Section VIII. The objectives, action items, organizational capacity, cost for BMP and evaluation for each goal are in the following Tables 31-35. Organizational capacity is broken into three different categories; responsible parties (RP), those responsible for completing the tasks, possible partners (PP) those who will assist in completing or aiding in the action items and technical help (TH) those that could aid in giving advice on a given topic.

Bank and Land Loss Problem Statements

Erosion of riparian (forest and vegetative) buffers increase the amount of sedimentation within our waterbodies causing the increased turbidity and log jams present within the body of water.

Table 31: Bank and Land Loss Goals and Objectives

I. ***Goal I*: Implement bank restoration projects to repair damaged riparian banks.**

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Costs	Evaluation
Continue to locate and monitor bank loss and implementation of bank restoration progress	Conduct annual visual field assessments	SWCD; Little Vermillion River Watershed Group	RP: LVRWG, SWCD	Present to 2 years	¼ of full time staff= $10,000	A continual visual assessment identifying the specific critical areas with implementation and reduction of bank loss.
	Continually map the identified areas using all data sources					
	Educate & install bank restoration projects	Landowners			$22.00 per linear foot	Number of areas restored
						Amount of sediment reduced

II. *Goal II:* **Reduce sediment load to the water body by 20% of the current estimated load of 28 tons/year over the next 10 years by increasing the use of conservation tillage practices, precision agriculture technology, buffer strips, and grassed waterways**.

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Cost	Evaluation
Restrict the access of livestock to streams- livestock exclusion.	Educate operators about the affect livestock have on water quality	Agricultural landowners/ operators	RP: LVRWG PP:SWCD	Have 50% of current livestock denied access to the river in 5 years with re-vegetation along streambank	$500.00 per workshop	Number of attendees at informational workshops on livestock
					$1.60 per foot for fencing	50% of fencing around streams is installed
	SWCD to assist landowners in establishing fencing around streams to prevent livestock access				$1.80 per square foot for seeding	

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Cost	Evaluation
Implement grassed waterways along and in crop fields.	Educate operators of the importance and benefits of grassed waterways on water quality.	Agricultural landowners/ operators	RP: LVRWG PP:SWCD, NRCS	Host educational workshops yearly.	$500.00 per workshop	Number of attendees at informational workshops on livestock
	SWCD to assist landowners in establishing grassed waterways.			Have 50% of un-grassed waterways established in 5 years.	$1.80 per square foot for seeding	50% of grassed waterways is installed
Increase the riparian buffers along those areas that have less than 30 foot of riparian buffer.	SWCD to assist landowners in establishing riparian buffers	Agricultural landowners/ operators	RP: LVRWG PP:SWCD, NRCS	In 5 years have 50% of the current < 30 foot riparian buffers re-vegetated.	$6.00 per tree planted	50 % of riparian buffers installed.

III. **Goal III: Increase conservation tillage practices by 50% over the next ten years.**

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Cost	Evaluation
Promote existing educational and incentive programs for conservation tillage	Inform operators about USDA programs through mailings	Agricultural landowners/ operators	RP: SWCD; LVRWG	By year 1 of implementation have an educational workshop detailing possible incentive plans	$0.44 per letter	Survey evaluation of how beneficial workshops are.
	Host informational meetings about existing incentive programs				$500.00 each	Number of program attendees

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Cost	Evaluation
Create a cost-share program encouraging conservation tillage	Develop criteria for cost-share program	Agricultural landowners/ operators	RP: LVRWG TH & PP:SWCD	Development 2009-2010	1/5 of full time staff= $8,000	Number of projects funded through cost-share Estimated amount of soil reduction through BMP implementation erosion/sediment
	Promote cost-share program			2010		
	Implement the cost-share program			Summer and Fall 2010 and Spring and Summer 2011		

Log Jam Problem Statement

Log jams cause problems structural instability to bridges, the backflow and flooding upstream and riparian loss due to out-washing.

Table 32: Log Jam Goals and Objectives

Goal IV: **Decrease the number of extreme log jams by 5% or one log jam per year in the next 5 years through the decrease of river bank erosion by bank stabilization or by removing small log jams before they become severe.**

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Cost	Evaluation
Remove small log jams before they become severe	Continue to locate and remove log jams	Landowners	RP: LVRWG & landowners PP:SWCD TH: IDNR	Present to 5 years.	Dependent on size	Fewer severe log jams being identified on an annual bases
Implement bank restoration/stabilization methods	Research and implement best bank stabilization methods	Landowners	RP: LVRWG PP: SWCD TH: NRCS	Present to 5 years. Have 5 acres of trees planted and have areas of instability stabilized by re-vegetation	$50 to $300 per tree $1.80 per sq ft. for seeding	Zero log jams compromising the structure of bridges
	Educate landowners on restoration/ stabilization methods		RP: LVRWG PP: SWCD, Purdue Extension		$500 per workshop	Number of attendees at workshops

***E. coli* Problem Statement**

E. coli counts are above the target standard of 235 cfu/100mL and keep surface water in non-attainment of water quality standards causing health risks to humans when using the waters for recreational reasons. The affect of *E. coli* does negatively impact livestock, aquatic life and wildlife health when water is consumed.

Table 33: *E. coli* Goal and Objectives

***Goal V:* Reduce the concentration of *E. coli* by working with Illinois to reduce the introduction, decreasing the amount of livestock with access to streams within the Little Vermillion River Watershed water bodies, so water within the streams meets the standards for *E. coli* within 25 years.**

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Cost	Evaluation
Restrict livestock access to streams	SWCD to assist landowners in establishing fencing around streams to prevent livestock access	Livestock producers	RP: LVRWG PP: SWCD TH: NRCS	Have 50% of current livestock denied access to the river in 5 years and have the streambank re-vegetated	$1.60 per foot for fencing $1.80 per square foot for seeding	installed fencing adjacent to 50% of all identified waterways to which livestock access has been identified
	SWCD assisting with EQIP				1/5 of full time staff= $8,000	Number of landowners participating in EQIP, 319, and other incentive and cost-share programs

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Cost	Evaluation
Educate residents with improper function septic systems.	Host educational workshops for homeowners regarding proper maintenance of septic systems	Residents	RP: LVRWG PP: SWCD, Purdue Extension TH: ISDA	Present to 5 years. (ongoing)	$500.00 per workshop	Number of people attending educational workshops
	Provide educational pamphlets with septic system maintenance information				$0.10 per copy	Number of people picking up pamphlets

Lack of Education Problem Statement
Lack of environmental and conservation education practices are a problem because residents within the watershed do not understand what impacts their actions have on water quality.

Table 34: Lack of Education Goals and Objectives

I. ***Goal VI:*** **Promote water-friendly behaviors such as using less yard fertilizers and proper maintenance on septic systems among residents and county officials.**

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Cost	Evaluation
To encourage local officials to implement water-friendly ordinances into the county plan.	Monitor governmental agenda, upcoming decisions or legislation having a potential impact on water quality.	City/County Councils (local government); Drainage board; County Commissioners; County Surveyor	RP: LVRWG PP: SWCD	Present to 5 years. (ongoing)	Volunteer based	Number of ordinances put into the county plan
	Identify and organize local experts who are willing to provide technical information to decision-makers when such information is needed				Dependent on number of experts	The number of issues where technical support was needed for discussion.

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Costs	Evaluation
Encourage local residents to participate in Hoosier River Watch (HRW) training and do their own monitoring.	Provide technical support when residents are monitoring	Local residents of the Little Vermillion River Watershed	RP: LVRWG PP: SWCD, IDNR TH: IDNR Education center	Present to 5 years (ongoing)	¼ of full time staff= $10,000	Number of people asking for technical support/or number of people recording monitoring data
	Provide county wide HRW training days annually				1/5 of full time staff= $8,000	Number of people trained
	Emphasize the relationship between the monitoring data results and the actions of poor water-friendly behaviors can have on water-quality through workshops					Number of people attending workshops

II. ***Goal VII:*** **Establish an open line of communication through media outreach to community members and directly communicating with residents about watershed education, outreach, and continued sampling data results.**

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Costs	Evaluation
Publicize the current conditions of the Little Vermillion River by informing locals of the existing conditions	Publish data in annual newsletters to local stakeholders	Local Residence of the Little Vermillion River Watershed Area.	RP: LVRWG, County SWCD TH: Daily Clintonian, Cayuga Herald	Annually On-going	$500.00 each	Less pollution being found along and in the river and streams
						Number of quarterly articles published in the papers about events, education material or sampling data
	Submit press releases to local media containing existing data.				Free	People contacting the SWCD office for more information on data.

Agricultural Problem Statement:
Agricultural Nonpoint Source Pollution includes *E. coli*, nutrients, chemicals, and sediment. Agricultural Nonpoint Source Pollution is a problem because it contributes *E. coli*, nutrients, chemicals, and sediment into the streams that inhibits aquatic life and increases the chemical loads contributed to the water body.

Table 35: Agricultural Goals and Objectives

IV. ***Goal VII:*** **By the fall of 2015, riparian buffer zones identified during the visual assessments will have an established buffer in place along those sections of the river or stream.**

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Costs	Evaluation
Implement riparian buffers along the Little Vermillion River	Increase riparian buffers at locations identified during the visual assessment	Landowners	RP: LVRWG PP: SWCD TH: NRCS, IDNR	Present to 5 years.	$190.00 per acre for filter strips $500.00 per acre for riparian buffers	30 stream miles of riparian buffer or filter strips installed in 2 years

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Costs	Evaluation
Market existing programs (CRP, EQIP, WRP, WHIP,etc) to agricultural producers	Marketing will focus on opportunities for cost-share of buffer installation.	Landowners	RP: LVRWG PP: SWCD, TH:NRCS, IDNR	Present to 10 years	¼ full time staff = $10,000	Number of acres participating in programs
Reconstruct wetlands	Find mitigation money to reconstruct a new wetland	Farmers; landowners; homeowners	RP: LVRWG PP:SWCD, IDNR	Present to 5 years	1/5th full time staff =$8,000	number of wetlands replaced
					1,000 to $2,000 per acre for reconstruction	the size of the wetlands in acres over time

V. ***Goal XI:* Increase the awareness and education of not applying nitrogen in the fall on the ground that lies within the river's floodplains.**

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Costs	Evaluation
Implement cover crops on 1,000 acres	Develop educational workshops	Agricultural landowners/ operators	RP: LVRWG PP: SWCD TH: CCSI	Implement 50 acres a year	$500.00 each	Number of people attending workshops
	Educate operators on cost-share incentives				¼ full time staff time =$10,000	Number of acres in cover crops
					$14.00 per acre	
Conduct educational programs related to nitrogen application and plant up-take	Develop an educational workshop	Agricultural landowners/ operators	RP: LVRWG PP: SWCD, Purdue Extension TH: CCSI	Annually during the SWCD field day (on-going)	$500.00 each	Number of people attending workshops
	Obtain an expert to speak on nitrogen application				Dependent on experts requirement	Number of people contacting the office for more information

VI. *Goal X*: **Educate and promote the increased participation in conservation programs through 319 cost-share, Farm Bill programs, and other efforts.**

Objective	Action Items	Target Audience	Organizational Capacity	Schedule	Costs	Evaluation
Market existing programs (CRP, EQIP, WRP, WHIP,etc) to agricultural producers	Marketing will focus on opportunities for these programs	Landowners / operators	RP: LVRWG PP: SWCD, TH: NRCS, IDNR	Present to 10 years	¼ full time staff = $10,000	Number of acres participating in programs
Increase the use of conservation systems (cover crop, no-till, GPS, GIS, Precision Agriculture, etc.)	Host educational workshops with experts on the operation and benefits of this technology	Farmers/ Operators	RP: LVRWG PP: SWCD, Ceres Solutions TH: John Deere, Case New Holland	Present to 10 years	$500.00 each	Number of people attending workshops

VII. ***Goal XI:*** Reduce the nutrient load reaching the Little Vermillion River and tributaries by 25% of the current estimated load of 173,537.52 lbs/year over the next 10 years by increasing the use of conservation tillage practices, precision agriculture technology, buffer strips, and grassed waterways.

Objective	Action Items	Target Audience	Responsible Party	Schedule	Costs	Evaluation
Promote existing educational and incentive programs for conservation tillage	Inform operators about USDA programs through mailings	Agricultural landowners/ operators	RP:LVRWG PP:SWCD	On-going	$0.44 per letter	Number of program applicants
	Hold informational meetings about existing incentive programs				$500.00 each	Number of people at meetings
Encourage the use of BMPs and conduct education and outreach programs	Secure personnel to promote agricultural outreach	Agricultural landowners/ operators	RP: LVRWG, SWCD	Begin Fall of 2010	$30,000-$40,000	Marketing consultant hired to promote cost-share BMPs.
	Create educational materials and programs		RP: LVRWG, SWCD		¼ full time staff = $10,000	Number of people attending educational programs

Evaluation

Measuring progress

Implementation of soil and water conservation practices comes at a cost. The evaluation of these activities and their effectiveness in improving the water quality in the Little Vermillion River Watershed is important.

By using monitoring data the trends in water quality can determine direct and indirect effects of water quality improvements for recreational use and aesthetic value from the BMPs implemented. The watershed can be measured by monitoring the following factors: chemical, physical, and biological conditions in the river and tributaries.

In addition to monitoring water quality, other indicators may be used to measure the success of implementing soil and water conservation practices. These may include:

• Awareness and adoption of conservation practices by landowners.

• Community collaboration and stakeholder participation rates.

• Economic impacts such as property values and agricultural productivity.

All monitoring efforts must take into consideration the use of protocols and sampling sites that are the same as the prior data collection will aid in facilitating the detection of long-term trends.

Indicators of water quality improvement can include measurements to determine long-term large-scale trends in water quality and use. Specific monitoring regimes would also be designed in association with implementation of particular conservation goals and actions.

As Tables 31-35 indicates a variety of methods that will be used to evaluate the effectiveness of the tasks at meeting the goals and objectives. The following summarizes some of the evaluation techniques recommended.

The first evaluation tool will be ongoing water quality monitoring. Currently, water quality monitoring has been taking place on the Little Vermillion River and tributaries to establish baseline data. Continued physical, chemical, and biological monitoring will show water quality trends over time. (See Section IV for reference on the parameters monitored). The results should improve or stay the same if management techniques are effective in reducing nonpoint source pollution. The approximate cost for this type of ongoing monitoring would be $15,000 per year.

Volunteer monitoring can also be used as an evaluation tool to supplement the professional water quality monitoring. The Little Vermillion River Watershed Group provides Hoosier Riverwatch training annually to interested groups and individuals. Volunteers typically monitor macroinvertebrate communities and are trained to perform visual monitoring of turbidity, chemical parameters (nitrogen, orthophosphate, DO, and BOD), and other visual observations that can indicate nonpoint source pollution like excessive plant growth. Additional monitoring locations that correspond with implementation sites could be added in order to determine fish habitat and macroinvertebrate improvements from the installation of best management practices at those sites if adequate volunteers are obtained.

Photographic or visual evidence can be used at BMP installation sites to document improvement. In these areas, the benefits of streambank stabilization, buffer strips, etc. will be documented using before and after pictures.

The number of BMP sites can be documented as an evaluation tool. For instance, the number of BMP sites that are implemented through grant funding can be recorded. These sites can be used for demonstration value to encourage others to participate in the installation of BMPs. Any additional BMPs installed by individuals can be counted and used as an indicator of program success.

Before and after surveys at workshops and field days will also be a good evaluation tool.

These surveys can evaluate whether or not the workshop was effective in raising awareness of water quality issues and if the information provided was enough to encourage participants to change their behaviors.

Future of WMP Activity

The Little Vermillion River watershed management plan is not intended to be an inactive document. It will be reviewed on an annual basis to:

- Review and Update Concerns, Sources, and Critical Areas
- Create Annual Work Plans
- Target potential funding sources
- Document Progress

The review and adaptation process may be scheduled to coincide with grant funding cycles, planning processes of major community organizations, and planning processes for local government agencies.

This plan may be adapted or blended with other watershed management plans to effect larger-scale change and capitalize on shared resources.

The ultimate goal of this watershed management plan is to assess the water quality of the Little Vermillion River Watershed and promote, protect, and enhance watershed health for the benefit of the residents.

Section IX: References and Appendices

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Appendix A. Advisory Group Participants

Sherry Baird-Whetstone	Vermillion County SWCD, Watershed Coordinator
Tom Knapke	Duke Energy, Environmentalist
Tyler Martin	Vermillion County SWCD, Conservation Technician
Charla Peery	Landowner
Lewis Peery	Landowner
Mary Kay Sungail	Resident/Landowner
Joseph Sungail	Resident/Landowner
Danny Wesch	Farmer/Resident/Landowner

Appendix B. Chemical Monitoring Data

IDEM Sampling Data

General Chemistry

HUC to 14	Sample Date	Sample Number	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Coliforms (Total) (MPN/100mL)	Cyanide (Total) (mg/L)	E_Coli (MPN/100mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+ Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
5120108140040	6/16/2009 14:30	AA56896	218	16.5	< 10		< 0.005		326	0.07	12.1	0.165	23.7 (fDJ)	369	1.67 (fDJ)	1.96	444	64
5120108140040	7/28/2009 12:30	AA58992	230	20.6	< 10		< 0.005		296	< 0.05	6.57	< 0.1	31.5	385	1.22	2.2	486	6.5
5120108140040	9/22/2009 15:00	AA59550	242	24.8	12.9		< 0.005		325	< 0.05	1.84	< 0.1	40.5	361 (fDJ)	0.635	2.93 (QJ)	347 (fDJ)	< 5
5120108140060	6/16/2009 11:50	AA56911	206	15.6	< 10		< 0.005		313	0.049 (UJ)	11.4	0.171	23.2	368	0.897 (fDJ	2.11	514	77.5
5120108140060	7/28/2009 10:30	AA58993	224	19.1	< 10		< 0.005		310	0.031 (UJ)	6.29	< 0.1	31.2	385	2.08	1.88	479	6.5
5120108140060	9/22/2009 10:00	AA59549	266	22.6	12.5		< 0.005		332	< 0.05	1.19	< 0.1	40.9	284 (fDJ)	0.778	2.63 (QJ)	286 (fDJ)	5
5120108140040	6/16/2009 13:20	AA56895	214	17	< 10		< 0.005		328	0.098	12.2	0.209	23.5 (fDJ)	378	0.701 (fDJ	2.04	439	53
5120108140040	7/28/2009 14:30	AA58991	246	21.3	< 10		< 0.005		293	< 0.05	6.73	< 0.1	31.3	390	0.798	2.24	482	10
5120108140040	9/22/2009 13:10	AA59551	242	27.3	13.2		< 0.005		330	0.032 (UJ)	2.36	0.155	38.8	373 (fDJ)	0.937	3.11 (QJ)	411 (fDJ)	5.5
5120108140040	6/1/2009 13:15	AA56934				> 2419.6		248.1										
5120108140040	6/8/2009 12:45	AA56954				> 2419.6		260.3										
5120108140040	6/15/2009 12:36	AA56974				> 2419.6		920.8										
5120108140040	6/22/2009 12:35	AA56994				> 2419.6		2419.6										
5120108140040	6/29/2009 16:00	AA57014				> 2419.6		387.3										
5120108140060	6/1/2009 14:15	AA56937				> 2419.6		108.1										
5120108140060	6/8/2009 13:35	AA56957				> 2419.6		178.5										
5120108140060	6/15/2009 13:35	AA56978				> 2419.6		816.4										
5120108140060	6/22/2009 14:00	AA56997				> 24196		3448										
5120108140060	6/29/2009 15:30	AA57018				> 2419.6		307.6										
5120108140040	6/1/2009 13:36	AA56944				> 2419.6		248.1										
5120108140040	6/8/2009 13:00	AA56963				> 2419.6		290.9										
5120108140040	6/15/2009 13:00	AA56984				> 2419.6		1046.2										
5120108140040	6/22/2009 13:25	AA57003				> 24196		4611										
5120108140040	6/29/2009 16:25	AA57024				> 2419.6		435.2										

Metals

4	Sample Date	Sample Number	Aluminum (Total) (ug/L)	Antimony (Total) (ug/L)	Arsenic (Total) (ug/L)	Cadmium (Total) (ug/L)	Calcium (ug/L)	Chromium (Total) (ug/L)	Copper (Total) (ug/L)	Lead (Total) (ug/L)	Magnesium (ug/L)	Nickel (Total) (ug/L)	Selenium (Total) (ug/L)	Zinc (Total) (ug/L)
.08140040	6/16/2009 14:30	AA56896	1650 (QJ)	< 1	< 5	< 1	79500	< 2	< 3	< 2	31000	2.46	< 5	< 12
.08140040	7/28/2009 12:30	AA58992	162	< 1	< 5	< 1	68600	< 2	< 3	< 2	30400	< 4	< 5	< 10
.08140040	9/22/2009 15:00	AA59550	83.7	< 1	< 5	< 1	71600	< 2	< 3	< 2	35500	< 4	< 5	< 10
.08140060	6/16/2009 11:50	AA56911	955 (QJ)	< 1	< 5	< 1	76600	< 2	< 3	< 2	29600	< 4.5	< 5	< 11
.08140060	7/28/2009 10:30	AA58993	171	< 1	< 5	< 1	70100	< 2	< 3	< 2	32700	< 4	< 5	< 10
.08140060	9/22/2009 10:00	AA59549	196	< 1	< 5	< 1	75200	< 2	< 3	< 2	35000	< 5	< 5	< 10
.08140040	6/16/2009 13:20	AA56895	1480 (QJ)	< 1	< 5	< 1	79600	< 2	< 3	< 2	31300	< 4	< 5	< 10
.08140040	7/28/2009 14:30	AA58991	170	< 1	< 5	< 1	67700	< 2	< 3	< 2	30100	< 4	< 5	< 10
.08140040	9/22/2009 13:10	AA59551	227	< 1	< 5	< 1	73400	< 2	< 3	< 2	35500	< 5	< 5	< 10

Field Data

HUC to 14	Sample Date	Sample Time	Sample Number	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)
5120108140040	6/16/2009	14:30	AA56896	8.48	18.36	92.7	8.16	583	77.6
5120108140040	7/28/2009	12:30	AA58992	8.7	23.38	104.6	8.22	603	12.3
5120108140040	9/22/2009	15:00	AA59550	8.46	21.82	99.3	8.26	604	7.3
5120108140060	6/16/2009	11:50	AA56911	8.12	19.14	90.2	8.15	568	92.4
5120108140060	7/28/2009	10:30	AA58993	7.59	22.89	90.7	8.05	597	8.6
5120108140060	9/22/2009	10:00	AA59549	6.94	19.99	78.7	7.92	607	14.1
5120108140040	6/16/2009	13:20	AA56895	8.56	18.06	93.1	8.12	582	69.7
5120108140040	7/28/2009	14:30	AA58991	11.43	25.6	143	8.38	594	13
5120108140040	9/22/2009	13:10	AA59551	7.3	20.49	83.3	8.13	614	12.7

Fish Sampling

ventI	MPLENUMB	MMONNA	FISHCOUN	DEFORMIT	INEROSIO	LESION	TUMOR	LTIANOMA	LSite	StreamNam
09 55 0	AA57909	redfin shiner	4	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	longnose gar	1	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	silver redhorse	2	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	shorthead redhorse	1	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	yellow bullhead	1	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	highfin carpsuck er	2	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	smallmou th bass	5	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	white sucker	1	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	longear sunfish	51	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	rock bass	9	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	black redhorse	26	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	northern hog sucker	5	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	largemout h bass	1	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	bluegill	2	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	bigeye chub	1	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	sand shiner	3	0	0	0	0	0	WLV140-0009	Little Vermilion River
09 55 0	AA57909	greenside darter	2	0	0	0	0	0	WLV140-0009	Little Vermilion River

EventID	MPLENUMB	MMONNA	FISHCOUNT	DEFORMITY	INEROSIO	LESION	TUMOR	LTIANOMA	LSite	StreamName
09554	AA57913	bluntnose minnow	49	0	0	0	0	0	WLV140-0010	Little Vermilion River
09554	AA57913	sand shiner	24	0	0	0	0	0	WLV140-0010	Little Vermilion River
09554	AA57913	spotfin shiner	39	0	0	0	0	0	WLV140-0010	Little Vermilion River

Data Qualifiers and Flags for General Chemistries, and Metals

B: This parameter was found in field (fB) or lab blank (B). Whether the result is accepted, estimated, or rejected will be based upon the level of contamination listed below.

1) If the result of the sample is greater than the method reporting limit (MRL) but less than five times the blank contamination, then the result will be rejected.
2) If the result of the sample is between five and ten times the blank contamination, then the result will be estimated
3) If the result of the sample is less than the reporting limit or greater than ten times the blank contamination, the result will be accepted.

D: The Relative Present Difference (RPD) for this parameter was above the acceptable control limits. The parameter will be considered estimated below:

1. **Field Duplicates (fD)**:
   a. The RPD is not calculated and no flags are assigned if either of the following is true:
      1. Both samples values are less than MRL.
      2. The Sample or Duplicate value is less than the MRL, and the other value is less than or equal to 5/3 times the MRL.
   b. All analytical results for this parameter will be flagged "**fDJ**" and estimated if either of the following are true:
      1. The RPD is greater than the IDEM control range for field duplicates (RPDMax).
      2. The Sample or Duplicate value is less than the MRL, and the other value exceeds 5/3 times the MRL.
2. **Lab Duplicates**
   a. If the RPD is between 20% and 40% then the samples in the batch will be estimated.
   b. If the RPD exceeds 40% then the samples in the batch will be rejected.

H: The analysis for this parameter was performed out of the holding time. The results will be estimated or rejected on the basis listed below:

1) If the analysis was performed between the holding time and 1½ times the holding time the result will be estimated.
2) If the analysis was performed outside the 1½ times the holding time window the result will be rejected.

U: The result of the parameter is above the Method Detection Limit (MDL) but below the reporting limit and will be estimated.

R: Rejected Results for causes identified

Q: One or more of the QC checks or criteria are out of control ***or*** one or more of the MS/MSD results are outside control limits due to matrix spike recovery problem

J: If one or more of the QC checks or criteria are out of control, the results will be estimated. For a parameter, if both the MS and the MSD were outside the 80% to 120% range and were not rerun, a 'J' flag will be used to indicate the results as Estimated values (only the sample used for the spike). However, the following exceptions would apply for not using the "J" Flag.

1. If **only one** of the Matrix Spikes was outside the % recoveries criteria (80% - 120%) and RPD, but the **three QC checks**, listed below, for the parameter were within specification, then the result will not be 'J' flagged.

2. If the RPD was outside the criteria of 0 to 20% and **only one or none** of the Matrix spike sample was outside the 80% to 120% range, but the three QC checks for the parameters were within specifications as listed below then the result will not be 'J' flagged.

QC Checks for 'J' Flag

1. The Continuing Calibration Standard's recovery was within the (90-110%) range.
2. Contamination was not found above the parameter's reporting limit, and
3. The Laboratory QC Check Standards' recoveries were within the 80% to120% range.

2008 Existing Data

8-Apr-08	Site #6- Exit	Site #5- Newport Bridge	Site #4- Covered Bridge	Site #3- SR 71 Bridge	Site #2- Horseshoe Bridge	Site #1- State Line- Entrance
DO-mg/L	6		6.2			6
DO- %Saturation	60%		63%			62%
BOD-mg/L	unknown		unknown			unknown
pH	7.3		6.8			8
Temp change	unknown		unknown			unknown
Orthophosphate	0.1		0.1			0.1
Nitrate-mg/L or ppm	43.12		42.5			44
Nitrite-mg/L or ppm	0		0			0
Transparency-cm	>60		>60			>60
Turbidity-NTU	<15		<15			<15
Flow- cfs	87.05		97.9			240.3
E.Coli	261.3		224.7			686.7

24-Jun-08	Site #6- Exit	Site #5- Newport Bridge	Site #4- Covered Bridge	Site #3- SR 71 Bridge	Site #2- Horseshoe Bridge	Site #1- State Line-
DO-mg/L	8	5.66	5.66	6	8	8
DO- %Saturation	88%	62%	62%	66%	96%	92%
BOD-mg/L	6	4.66	4.66	5	3	5
pH	7.66	8.17	8.66	7.83	8.33	8.16
Temp change	0	-0.5	0.5	-0.5	3	0
Nitrate-mg/L or ppm	44	44	58.65	66.64	44	73.3
Nitrite-mg/L or ppm	0	0	0	0	0	0
Transparency-cm	26.8	41.5	21.43	44	41.33	22.2
Turbidity-NTU	26	18.66	37.66	17.51	18.33	36
Flow- cfs	87.05	174.9	97.9	69.06	74.49	240.3
E.Coli	261.3	235.9	224.7	261.3	275.5	686.7
23-Jul-08						
DO-mg/L	6	5.66	8	6.67	6.33	5.66
DO- %Saturation	66%	62%	88%	0%	0%	62%
BOD-mg/L	0.67	0.66	0.67		1	
pH	7.75	8.5	8.17	7.33	8.16	8
Temp change	0	1	0	2	0	0
Nitrate-mg/L or ppm	44	22	22	36.7	29.3	35.2
Nitrite-mg/L or ppm	0	0	0	0	0	0
Transparency-cm	31	11.33	5.33	12	14.76	15.67
Turbidity-NTU	19	65.6	88.6	60.6	50	48.7
Flow- cfs	153.17	335	106.7	123.11	245.4	545.89
E.Coli-July 16	519.4	547.5	488.4	>900	Unavail.	816.4
E. coli-July 29	238.2	272.3	248.9	160.7	325.5	365.4
Monthly *E. coli* avg.	378.8	409.9	368.65	160.7	325.5	590.9

18-Aug-08						
DO-mg/L	8	8	5	6	11.33	8
DO- %Saturation	89%	89%	57%	68%	131%	93%
BOD-mg/L	2.67	2.34	0	1	5.33	1.34
pH	7.5	7.66	7.5	7.5	8.16	8
Temp change	0	-1	0	0	-1	0
Nitrate-mg/L or ppm	19.052	16.13	17.76	20.53	11.7	19.1
Nitrite-mg/L or ppm	0	0	0	0	0	0
Transparency-cm	57.8	56.7	31.66	46	35.33	19.02
Turbidity-NTU	15.79	15.9	21	17.57	19	18.33
Flow- cfs	8.58	5.045	15.04	24.31	5.41	41.33
E.Coli Aug. 14th	461.1	686.7	209.8	68.3	198.9	191.8
E. coli- Aug. 26th	60,301	770.1	290.9	47.9	218.7	lab failure
Monthly *E. coli* avg.	30,881.05	728.4	250.35	58.1	208.8	191.8
15-Sep-08						
DO-mg/L	7	6.33	6.66	6.66	9.33	7.66
DO- %Saturation	75%	69.5%	70%	70%	100%	84%
BOD-mg/L	0.67	0.33	0.66	1	2.33	2
pH	6.83	7.33	6.5	8.5	6.5	8.5
Temp change	-1	0.5	0	-0.5	-1	0
Nitrate-mg/L or ppm	2.2	6.6	2.2	2.2	3	8.8
Nitrite-mg/L or ppm	0	0	0	0	0	0
Transparency-cm	23	22.33	16.66	16.33	>60	23
Turbidity-NTU	33.66	35.33	44.33	46.66	<15	34
Flow- cfs	26.88	39.9	149.29	19.11	31.27	351.68
E. coli - 9/9/08	2,419.20	2,419.20	770.1	866.4	387.3	613.1
E. coli - 9/23/08	290.9	866.4	410.6	201.4	235.9	201.4
Avg. *E. coli*	1355.05	1642.8	590.35	533.9	311.6	407.25
20-Oct-08						
DO-mg/L	10.66	9.33	8.66	8.66	11.66	11.33
DO- %Saturation	94%	85%	79%	79%	108%	108%
BOD-mg/L	2	1.73	1.66	2	3.33	3
pH	7.66	7.66	7	7.5	6.5	8
Temp change	-1	0	0	-1	-1	0
Nitrate-mg/L or ppm	8.8	2.2		2.2	2.2	2.2
Nitrite-mg/L or ppm	0	0		0	0	0
Transparency-cm	>60	>60	>60	>60	>60	>60
Turbidity-NTU	<15	<15	<15	<15	<15	<15
Flow- cfs	14.82	4.04	20.61	5.12	4.59	10.75
E. coli- 10/14/08	387.3	1203.3	206.3	63.1	16.4	172
E. coli - 10/28/08	488.4	313	93.3	74.9	32.4	178.5
Avg. *E. coli*	437.85	758.15	149.8	69	24.4	175.25

2009 SAMPLE AVERAGES FOR CHEMICAL MONITORING

20-Apr-09	Site #6- Exit	Site #5- Newport Bridge	Site #7 Tributary	Site #4- Covered Bridge	Site #3- Jonathan Creek	Site #2- Horseshoe Bridge	Site #1- State Line Bridge
DO-mg/L	8	8.33	8	7.66	8.33	6.66	7.66
DO- %Saturation	73%	76%	69%	70%	72%	61%	70%
BOD-mg/L	1	0.33	0	0.66	0.33	none	0.66
pH	8	8.16	7.66	7.33	8.16	8	7.66
Temp change	0	2	-2	2	-2	0	0
orthophosphate	0	0	0	0	0	0	0
Nitrate-mg/L or ppm	36.65	19.8	11	25.65	25.66	44	44
Nitrite-mg/L or ppm	0	0	0	0	0	0	0
Transparency-cm	39	27	27.33	21.66	33	34	42
Turbidity-NTU	62.5	25	24.6	36.5	18.5	18	15.33
Flow- cfs	160.7	2068	20.6	97.9	85.79	2094.2	240.3
E.Coli-4/14/09	261.3	275.5	547.5	410.6	618.4	1553.1	866.4
E.Coli-4/28/09	686.2	365.4	2419.2	325.5	1553.1	547.5	1986.3
Monthly *E. coli* avg.	515.5	320.45	1757.1	368.05	1085.75	1050.3	1426.35
May-09							
DO-mg/L		10	6.33	5.66	8.66	7.66	8.66
DO- %Saturation		98%	61%	52%	80%	66%	84%
BOD-mg/L		4	0.66	0.66	2.33	7.66	1.66
pH		7	7.33	6.33	7.33	8.16	8.16
Temp change		2	-1	0	3	-5	0
Nitrate-mg/L or ppm		22	8.8	44	29.3	33	33
Nitrite-mg/L or ppm		0	0	0	0	0	0
Transparency-cm		6.33	>60	6	26.33	7.33	8.33
Turbidity-NTU		85	<15	86	28.2	82	77
Flow- cfs		2202.15	11.84	1732.8	87.2	2324.7	16724.2
orthophosphate		0	0	0	0	0	0
E.Coli-5/12/09	501.2	727	2	187.2	224.7	331.4	243.6
E. coli-5/26/09	613.1	365.4	248.9	488.4	770.1	648.8	488.4
Monthly *E. coli* avg.	557.15	546.2	125.45	337.8	497.4	490.1	366

15-Jun-09	Site #6- Exit	Site #5- Newport Bridge	Site #7 Tributary	Site #4- Covered Bridge	Site #3- Jonathan Creek	Site #2- Horseshoe Bridge	Site #1- State Line Bridge
DO-mg/L	7.33	7	7.66	6.66	7.66	7.33	7
BOD-mg/L	2.67	1	2.66	0.66	3.16	2.22	1
pH	7	8	8	7	8.5	6.5	7
Temp change	0	1	0	-1	0	0	0
Nitrate-mg/L or ppm	33	44	2.2	66	66	44	66
Nitrite-mg/L or ppm	0	0	0	0	0	0	0
Transparency-cm	7	7	>60	8	30.66	11	14
Turbidity-NTU	80	80	<15	78	19.33	66.6	50.66
Flow- cfs	973	1855	0.2259	1359.9	153.5	433.75	9201.9
orthophosphate	0	0	0	0	0	0	0
E.Coli-June 9	344.8	228.2	866.4	206.3	1046.2	214.2	187.2
E. coli-June 23	1413.6	2419.2	325.5	2419.2	816.4	1203.3	920.8
Monthly *E. coli* avg.	879.2	1323.7	595.95	1312.75	1862.6	1417.5	554
28-Jul-09							
DO-mg/L	9.66	8.66	8.11	7	9	10.66	9.33
DO- %Saturation	111%	104%	91%	84%	105%	132%	115%
BOD-mg/L	4.66	6.33	2.78	2	2	2.66	2.33
pH	8	7.5	8	7.5	8	8.5	9
Temp change	-2	4	0	-1	0	0	0
Nitrate-mg/L or ppm	22	15.4	2.2	8.8	15.4	33	33
Nitrite-mg/L or ppm	0	0	0	0	0	0	0
Transparency-cm	>60	>60	>60	>60	>60	>60	>60
Turbidity-NTU	<15	<15	<15	<15	<15	<15	<15
Flow- cfs	50.75	26.79	0.1429	33.2	5.032	100.27	75.19
orthophosphate	0	0	0	0	0	0	0
E.Coli July 14th	275.5	325.5	648.8	387.3	816.4	365.4	410.6
E. coli- July 28th	195	1299.7	1986.3	95.9	579.4	228.2	488.4
Monthly *E. coli* avg.	235.30	812.6	1317.55	241.6	697.9	296.8	449.5
17-Aug-09							
DO-mg/L	7.33	8	3	7.66	4	8	9.33
DO- %Saturation	88%	96.0%	35.0%	92.0%	46.5%	98.7%	112.0%
BOD-mg/L	2.67	3	-2	1.33	-1.66	3	2
pH	8.5	8	7.5	8	8	8.5	8
Temp change	0	2	2	-2	3	1	0
orthophosphate	0	0	0	0	0	0	0.133
Nitrate-mg/L or ppm	2.2	8.8	0	2.2	0	2.2	8.8
Nitrite-mg/L or ppm	0	0	0	0	0	0	0
Transparency-cm	>60	44		49.66	>60	>60	>60
Turbidity-NTU	<15	21		23	<15	<15	<15
Flow- cfs			0				
E. coli - 8/11/08	325.50	325.50	117.20	224.70	186.00	248.10	214.2
E. coli - 8/25/08	275.5	2419.2	111.9	365.4	547.5	365.4	1553.1
Avg. *E. coli*	300.5	1372.35	114.55	295.05	366.75	306.75	883.65

21-Sep-09	Site #6- Exit	Site #5- Newport Bridge	Site #7 Tributary	Site #4- Covered Bridge	Site #3- Jonathan Creek	Site #2- Horseshoe Bridge	Site #1- State Line Bridge
DO-mg/L	7.66	7		9		6.33	11
DO- %Saturation	82%	75%		99%		70%	121%
BOD-mg/L	3.33	2		4.34		1.33	6.67
pH	9	8.5		8		9	8
Temp change	0	1		0		0	0
orthophosphate	0	0		0		0.1	0.1
Nitrate-mg/L or ppm	2.2	2.2		1.1		8.8	2.2
Nitrite-mg/L or ppm	0	0		0		0	0
Transparency-cm	>60	>60		>60		>60	>60
Turbidity-NTU	<15	<15		<15		<15	<15
Flow- cfs	5.51	9.9	0	3.1	0	32.15	67.9
E. coli- 9/08/09	325.5	166.4	151.5	101.4	307.6	195.6	178.5
E. coli -09/22/09	547.5	325.5	Dry	313	Dry	178.9	201.4
Avg. *E. coli*	436.5	245.95	151.5	207.2	307.6	187.25	189.95
19-Oct-09							
DO-mg/L	10.66	9	4	11	7	11	9
DO- %Saturation	94%	80%	38%	97%	62%	97%	82%
BOD-mg/L							
pH	7.5	7	7	7.5	7	7.5	7
Temp change	0	-3	3	0	0	0	0
orthophosphate	0	0	0	0	0	0	0
Nitrate-mg/L or ppm	22	8.8	0	8.8	2.2	8.8	22
Nitrite-mg/L or ppm	0	0	0	0	0	0	0
Transparency-cm	>60	>60	>60	>60	>60	>60	>60
Turbidity-NTU	<15	<15	<15	<15	<15	<15	<15
Flow- cfs	5.2	151.66			8.75	85.54	
E. coli- 10/13/09	613.1	618.4	111.9	488.4	224.7	435.2	461.1
E. coli -10/27/09							
Avg. *E. coli*	580.3	471.95	111.9	400.7	307.6	307.05	331.25

2008 Existing Loads

24-Jun-08	Site #6-South	Site #5-Newport Bridge	Site #4-Covered Bridge	Site #3-SR 71 Bridge	Site #2-Horseshoe Bridge	Site #1-State Line-
DO-mg/L/cfs	696.40	989.93	554.11	414.36	595.92	1922.40
Nitrate-ppm/cfs	3830.20	7695.6	5741.83	4602.15	3277.56	17613.99
Nitrite-ppm /cfs	0	0	0	0	0	0
E.Coli-June 16- cfu/cfs	22746.17	41258.91	21998.13	18045.38	20522	165014
23-Jul-08						
DO-mg/L/cfs	919.02	1896.1	853.6	821.14	1553.38	3089.73
Nitrate-ppm/cfs	6739.48	7370	2347.4	4518.13	7190.22	19215.33
Nitrite-ppm/cfs	0	0	0	0	0	0
E.Coli-July 16	79556.50	183412.5	52112.28			445664.6
E. coli-July 29	36485.09	91220.5	26557.63	19783.78	79877.70	199468.2
Monthly *E. coli* avg. cfu/cfs	58020.80	137316.5	39334.96	19783.78	79877.7	322566.4
18-Aug-08						
DO-mg/L/cfs	68.64	40.36	75.2	145.86	61.29	330.64
Nitrate-ppm/cfs	163.46	81.37	267.11	499.08	63.29	789.40
Nitrite-ppm/cfs	0	0	0	0	0	0
E.Coli Aug. 14th	3956.23	3464.40	3155.33	1660.37	1076.04	7927.09
E. coli- Aug. 26th	517382.6	3885.15	4375.13	1164.44	1183.16	
Monthly *E. coli* avg.-cfu/cfs	264959.4	3674.77	3765.26	1412.41	1129.61	7927.09
15-Sep-08						
DO-mg/L/cfs	188.16	252.56	994.27	127.27	291.74	2693.86
Nitrate-ppm/cfs	59.13	263.34	328.43	42.04	93.81	3094.78
Nitrite-ppm/cfs	0	0	0	0	0	0
E. coli – 9/9/08	65028.10	96526.08	114968.2	16556.9	12110.87	215615
E. coli – 9/23/08	7819.39	34569.36	61298.47	3848.75	7376.59	70828.35
Avg. *E. coli*- cfu/cfs	36423.74	65547.72	88133.35	10202.83	9743.73	143221.7
20-Oct-08						
DO-mg/L/cfs	157.98	37.69	178.48	44.33	53.51	121.79
Nitrate-ppm/cfs	130.41	8.88	0	11.26	10.09	23.65
Nitrite-ppm/cfs	0	0	0	0	0	0
E. coli- 10/14/08	5739.78	4861.33	4251.84	323.07	75.27	1849
E. coli - 10/28/08	7238.08	1264.52	1922.91	383.48	148.71	1918.87
Avg. *E. coli*-cfu/cfs	6488.93	3062.92	3087.37	353.28	111.99	1883.93

2009 Existing Loads

20-Apr-09	Site #6- Exit	Site #5- Newport Bridge	Site #7 Tributary	Site #4- Covered Bridge	Site #3- Jonathan Creek	Site #2- Horseshoe Bridge	Site #1- State Line
DO-mg/L	1285.6	17226.4	164.8	749.914	714.630	13947.3	1840.69
orthophosphate	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Nitrate-mg/L or ppm	*5889.65*	*40946.4*	*226.6*	*2511.13*	*2201.37*	*92144.8*	*10573.2*
Nitrite-mg/L or ppm	*0*	*0*	*0*	*0*	*0*	*0*	*0*
E. coli- 4/14- cfu/cfs	41990.91	569734	11278.5	40197.74	53052.54	3252502	208195.9
E. coli-4/28-cfu/cfs	110272.34	755647.2	49835.52	31866.45	133240.4	1146575	477307.9
E. coli- Avg.	82840.85	51496.32	36196.26	7581.83	93146.49	90105.24	342751.9
May 15, 2009	Flooded						
DO-mg/L/cfs	0	22021.5	74.9472	9807.64	755.152	17807.2	144831.
Nitrate-ppm/cfs	0	48447.3	104.192	76243.2	2554.96	76715.1	551898.
Nitrite-ppm /cfs	0	0	0	0	0	0	0
E. coli-5/12- cfu/cfs	0	1600963	23.68	324380.2	19593.84	770405.6	4074015
E. coli- 5/26-cfu/cfs	0	804665.6	2946.976	846299.5	67152.72	1508265	8168099
Avg. *E. coli*-cfu/cfs	0	1202814	1485.328	585339.8	43373.28	1139335	6121057
15-Jun-09							
DO-mg/L/cfs	7132.09	12985	1.73039	9056.93	1175.81	3179.38	64413.3
Nitrate-ppm/cfs	32109	81620	0.49698	89753.4	10131	19085	607325.
Nitrite-ppm/cfs	0	0	0	0	0	0	0
orthophosphate	0	0	0	0	0	0	0
E. coli-June 9	335490.	423311	195.719	280547.	160591.	92909.2	1722596
E. coli-June 23	1375433	4487616	73.5304	3289870	125317	521931	8473110
Monthly *E. coli* avg. cfu/cfs	855461	2455464	134.625	1785209	285909	614840	5097853
28-Jul-09							
DO-mg/L/cfs	490.245	232.001		232.4	45.288	1068.87	701.522
Nitrate-ppm/cfs	1116.5	412.566	0.31438	292.16	77.4928	3308.91	2481.27
Nitrite-ppm/cfs	0	0	0	0	0	0	0
orthophosphate	0	0	0	0	0	0	0
E. coli July 14th	13981.6	8720.14	92.7135	12858.3	4108.12	36638.6	30873.0
E. coli- July 28th	9901.32	34818.9		3183.88	2915.54	22881.6	
Monthly *E. coli* avg.- cfu/cfs	11941.4	21769.5		8021.12	3511.83	29760.1	33797.91

	Site #6	Site #5	Site #7	Site #4	Site #3	Site #2	Site #1
17-Aug-09			DRY		DRY		
DO-mg/L/cfs	273.848	143.52	0	96.516	0	184	3480.09
Nitrate-ppm/cfs	82.192	157.872	0	27.72	0	50.6	3282.4
Nitrite-ppm/cfs	0	0	0	0	0	0	0
E. coli - 9/9/08	12160.6	5839.47	0	2831.22	0	5706.3	79896.6
E. coli - 9/23/08	10292.6	43400.4	0	4604.04	0	8404.2	579306.
Avg. *E. coli*- cfu/cfs	11226.6	24619.9	0	3717.63	0	7055.25	329601
21-Sep-09							
DO-mg/L/cfs	42.2066	69.3	dry	27.9	0	203.5095	746.9
orthophosphate	0	0	0	0	0	3.215	6.79
Nitrate-ppm/cfs	12.122	21.78	0	3.41	0	282.92	149.38
Nitrite-ppm/cfs	0	0		0	0	0	0
E. coli - 9/08/09	1793.505	1647.36	0	314.34	0	6288.54	12120.15
E. coli - 9/22/09	3016.725	3222.45	0	970.3	0	5751.635	13675.06
Avg. *E. coli*-cfu/cfs	2405.115	2434.905	0	642.32	0	6020.088	12897.61
19-Oct-09							
DO-mg/L/cfs	55.432	1364.94	no flow	680.9	61.25	940.94	6608.7
orthophosphate	0	0	0	0	0	0	0
Nitrate-ppm/cfs	114.4	1334.608	no flow	544.72	19.25	752.752	16154.6
Nitrite-ppm/cfs	0	0		0	0	0	0
E. coli - 10/13-cfu/cfs	3188.12	93786.54	no flow	30231.96	1966.125	37227.01	338585.7
E. coli - 10/27-cfu/cfs	1512.68	58737.92	no flow	11513.4	2691.5	20178.89	239014.7
Avg. *E. coli*-cfu/cfs	2350.4	76262.23	no flow	20872.68	2691.5	28702.95	288800.2

Chemical Monitoring Work Sheet

Date		Air Temp °C
Time	Stream Name and Site ID	Water Temp °C
		Lat °N
		Long °W

Current Weather ☐ Clear/Sunny ☐ Overcast ☐ Showers ☐ Rain (Steady) ☐ Storm (Heavy)

Worst Weather in Past 48 hrs ☐ Clear/Sunny ☐ Overcast ☐ Showers ☐ Rain (Steady) ☐ Storm (Heavy)

	Units	Sample 1	Sample 2	Sample 3	Average
Dissolved Oxygen (DO)	% Saturation				
	mg/L				
Avg DO (original)	mg/L				
− DO after 5 days		−	−	−	−
BOD 5-day (difference)					
E. Coli Bacteria *(purple/blue-violet colonies)*	colonies/ 100 mL				
General Coliforms *(pink/magenta colonies)*	colonies/ 100 mL				
pH	units				
Temp at Your Site	°C				
− Upstream (1 mi) Temp		−	−	−	−
Temperature Change					
Orthophosphate	mg/L				
Total Phosphate *(add acid and boil for 30 min)*	mg/L				
Nitrate (NO_3) *(after multiply by 4.4)*	mg/L				
Nitrite (NO_2) *(after multiply by 3.3)*	mg/L				
Transparency *(from Tube)*	cm				
Turbidity *(from chart – use in database entry)*	NTU				
Ammonia Nitrogen	mg/L				
Other ______________					
Other ______________					
Other ______________					
Other ______________					

Appendix C: Biological Monitoring Data

September 23-24, 2008 DATA FOR BIOLOGICAL MONITORING

PT GROUP1	Site #6- Exit	Site #5- Newport Bridge	Site #4- Covered Bridge	Site #3- SR 71 Bridge	Site #2- Horseshoe Bend	Site #1- State Line- Entrance
Stonefly Nymph	0	1	2	0	0	2
Mayfly Nymph	0	1	4	13	4	14
Caddis Fly Nymph	0	37	1	2	0	2
Dobsonfly Nymph	1	0	0	0	0	0
Riffle Beetle	0	0	0	5	0	0
Water Penny	0	0	0	0	0	0
Right-Handed Snail	0	0	0	0	0	0
# of Taxa	1	3	3	3	1	3
Factors x 4	4	12	12	12	4	12
PT GROUP2						
Damselfly Nymph	0	0	0	0	0	2
Dragonfly Nymph	0	0	0	0	0	0
Sowbug	0	0	3	2	0	4
Scud	0	0	0	0	0	0
Crane Fly Larvae	0	0	0	0	0	0
Clams/Mussels	0	0	0	0	0	0
Crayfish	1	1	0	0	0	4
# of Taxa	1	1	1	1	0	3
Factors x 3	3	3	3	3	0	9
PT Group 3						
Midges	0	0	0	0	0	1
Black Fly Larvae	0	0	0	0	0	0
Planaria	0	0	0	0	0	0
Leech	0	0	0	0	0	0
# of Taxa	0	0	0	0	0	1
Factors x 2	0	0	0	0	0	2
PT Group 4						
Left-handed Snail	0	0	0	1	0	1
Aquatic Worms	0	2	1	0	0	0
Blood Midge	0	0	0	0	0	0
Rat-tailed Maggot	0	0	0	0	0	0
# of Taxa	0	1	1	1	0	1
Factors x 1	0	1	1	1	0	1
Pollution Tolerance Index Rating	**7**	**16**	**16**	**16**	**4**	**24**
	Poor	Fair	Fair	Fair	Poor	Excellent

PT GROUP1	Site #6- Exit	Site #5- Newport Bridge	Site #4- Covered Bridge	Site #3- Jonathan Creek	Site #2- Horseshoe Bridge	Site #1- State Line Bridge	Site #7- Tributary
Stonefly Nymph	3	1	1	1	10	0	0
Mayfly Nymph	0	0	0	0	0	0	0
Caddis Fly Nymph	0	25	3	1	4	1	0
Dobsonfly Nymph	1	0	0	0	0	0	0
Riffle Beetle	1	0	0	15	0	0	0
Water Penny	0	0	0	0	0	0	0
Right-Handed Snail	0	0	0	1	0	1	0
# of Taxa	3	2	2	4	2	2	0
Factors x 4	12	8	8	16	8	8	0
PT GROUP2							
Damselfly Nymph	0	0	2	1	0	0	0
Dragonfly Nymph	0	1	0	1	1	0	0
Sowbug	0	0	0	0	0	0	0
Scud	0	0	0	0	0	0	0
Crane Fly Larvae	1	0	0	0	0	0	0
Clams/Mussels	0	0	0	0	0	0	0
Crayfish	0	0	0	0	0	1	0
# of Taxa	1	1	1	2	1	1	0
Factors x 3	3	3	3	6	3	3	0
PT Group 3							
Midges	0	0	0	0	0	0	0
Black Fly Larvae	0	0	0	0	0	0	0
Planaria	0	0	0	0	0	0	0
Leech	0	0	0	0	0	0	0
# of Taxa	0	0	0	0	0	0	0
Factors x 2	0	0	0	0	0	0	0
PT Group 4							
Left-handed Snail	0	0	0	0	0	0	0
Aquatic Worms	0	0	0	0	0	0	0
Blood Midge	0	0	0	0	0	0	0
Rat-tailed Maggot	0	0	0	0	0	0	0
# of Taxa	0	1	0	0	0	0	0
Factors x 1	0	1	0	0	0	0	0
Pollution Tolerance Index Rating	**15**	**12**	**11**	**22**	**11**	**11**	**0**
	Fair	Fair	Fair	Fair	Fair	Fair	Poor

BIOLOGICAL MONITORING DATA SHEET

Date ____/____/____ (MM DD YY)   Begin Time _____:_____ (am/pm)   # Adults ________________
End Time _____:_____ (am/pm)   # Students ________________

Certified Monitors' Names ________________________________   Volunteer ID ____________

Organization Name ____

Watershed Name ________________________________   Watershed # _ _ _ _ _ _ _ _ _ _ _

Stream/River Name ________________________________   Site ID ____________
(Please do not abbreviate.)   (Above ID numbers are required.)

Check Methods Used

- ☐ Kick Seine Net (3 times)
- ☐ D-Net (20 jabs or scoops)

Check Habitats Sampled

- ☐ Riffles
- ☐ Undercut Banks
- ☐ Sediment
- ☐ Leaf Packs
- ☐ Snags/Vegetation
- ☐ Other

POLLUTION TOLERANCE INDEX (PTI)

PT GROUP 1 *Intolerant*		PT GROUP 2 *Moderately Intolerant*		PT GROUP 3 *Fairly Tolerant*		PT GROUP 4 *Very Tolerant*	
Stonefly Nymph	____	Damselfly Nymph	____	Midges	____	Left-Handed Snail	____
Mayfly Nymph	____	Dragonfly Nymph	____	Black Fly Larvae	____	Aquatic Worms	____
Caddis Fly Larvae	____	Sowbug	____	Planaria	____	Blood Midge	____
Dobsonfly Larvae	____	Scud	____	Leech	____	Rat-tailed Maggot	____
Riffle Beetle	____	Crane Fly Larvae	____				
Water Penny	____	Clams/Mussels	____				
Right-Handed Snail	____	Crayfish	____				
# Of TAXA	____	# Of TAXA	____	# Of TAXA	____	# Of TAXA	____
Weighting Factors: (x 4)	____	(x 3)	____	(x 2)	____	(x 1)	____

23 or More	Excellent
17 - 22	Good
11 - 16	Fair
10 or Less	Poor

POLLUTION TOLERANCE INDEX RATING ☐
(Add the final index values for each group.)

Other Biological Indicators

☐ Native Mussels   ☐ Zebra Mussels   ☐ Rusty Crayfish   ☐ Aquatic Plants   ______ % Algae Cover   ______ Diversity Index

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Appendix D: Tillage and Land-use Survey

Please answer the following sections of questions as they pertain to you. All individual responses will be confidential. Only group summarizations will be released.

1. Township(s) property lies within: ____

Section 1: Property Owner/Homeowner

1.) What is the approximate number of acres on your property in
   a. Forest ________________
   b. Crop ________________
   c. Pasture ________________
   d. Residential ________________

2.) Do you have a problem with erosion control on your property? _______________

3.) Is properly functioning septic systems a priority? _____________
   **** If so attend the "Toilet to Tap, Where Does All the Poo GO?" Workshop on February 28th at the Vermillion County Courthouse Auditorium at 1PM.****

4.) Are there many impervious surfaces present on your land?(i.e. black top drive, several buildings, large amounts of cement, etc) ___________
   a. Approximately ________ percent is impervious surfaces on my land.

5.) Do you maintain a garden? If yes check the one that applies
   a. ______ Organic (no chemical fertilizers , pesticides, or herbicides)
   b. ______ Traditional (chemical fertilizers, pesticides, or herbicides used)

6.) What other types of workshops would you be interested in attending?
   ____
   ____

Section 2: Producer/Farmer

When answering , please think of conservation tillage as including no-till, ridge till, reduced tillage, mulch till, or any practice which <u>leaves at least 30%</u> crop residue.

1.) How many acres of land are you cultivating for crops this year (excluding permanent pasture)?
   __________ Acres of cropland for 2009

2.) At any time in the past, have you used conservation tillage?
   a. __________ No, I do not know much about conservation tillage
   b. __________ No, I looked into conservation tillage, but decided against it
   c. __________ Yes, I tried it but quit after _____ years
   d. __________ Yes, I tried it and still use it after _______ years

3.) Of your cropland, what percentage is under conservation tillage, leaving 30% crop residue or more?
   _________ Percent cropland under conservation tillage

4.) *If applicable:* I started using conservation tillage because: (**check all that apply**)
   a. ____ Required by government policy
   b. ____ Other farmers had success
   c. ____ Saved time and fuel
   d. ____ Lowered production costs

e. _____ Reduced soil erosion
f. _____ Increased yield per acre
g. _____ Other _________________________

5.) *If applicable:* I do not use conservation tillage because: (**check all that apply**)

a. _____ Equipment is not suitable
b. _____ My landowner or operator is against it
c. _____ Couldn't control weeds
d. _____ Poor stands
e. _____ Expense
f. _____Increased time
g. _____ Increased production costs
h. _____ Reduced yield per acre
i. _____ Other ___________________________

6.) Do you use new technology in your farming process? _______________

- If you answered yes please list those technologies

a. ____
b. ____
c. ____
d. ____

Appendix E. Photos of Windshield Survey and Flyover

Photo 10: Severe bank erosion identified in Jonathan Creek watershed on Jonathan Creek.

Photo 11: Severe bank erosion identified in Newport watershed on the Little Vermillion River.

Photo 12: Livestock Pasture in Jonathan Creek Watershed

Photo 13: Bank erosion identified in northeast section of Newport watershed along the Little Vermillion River.

Photo 14: Wabash River flooding the bottoms of the SE Wabash watershed.

Photo: 15: Small log jam beginning to form in the Newport watershed in the Little Vermillion River.

Appendix F: Windshield & Flyover Survey Sheet

SITE ID	PICTURE #	GPS (way pt)	Field Drainage tiles vs. Non-Ag. Pipes	Erosion Y/N	Trash			Riparian Cover				Riparian Buffer			Impervious Surfaces Y/N describe	Grass Buffers Y/N	Livestock present Y/N
					None	Litter	Dump	Trees	Grass	Crops	Poor	0-5ft	5-30ft	30 + ft			
Grube		#1	N	N	X			X	X	X			X		N	Pasture on W	12 cattle not kept out of ditch waterway
100 E	321, 322, 323	#2	N	N	X			X	X				X		Drive to east of creek	Lawns on both sides	N
Covered Bridge Rd.	324, 325, 236, 327, 328	#3	N	Some	X			X		X			X		Road is blacktop		N
Covered Bridge Site	329	#4	N	N		X		X	X	X			X		Road is blacktop	Yes, steep banks	N

SITE ID	PICTURE #	GPS (way pt)	Field Drainage tiles vs. Non-Ag. Pipes	Erosion Y/N	Trash			Riparian Cover				Riparian Buffer			Impervious Surfaces Y/N describe	Grass Buffers Y/N	Livestock present Y/N
					None	Litter	Dump	Trees	Grass	Crops	Poor	0-5ft	5-30ft	30 + ft			
SR 71 Dam		#5	Y	Y		X		X				X				Dam stops water before entering LV	
SR 71 Site	330, 331, 332	#6	Non-AG South Side of bridge	Y		X		X	X	X			X		SR 71 and county roads are blacktop	Yes on one side no on other	N
Sungail Site	333, 334	#7	N	N	X			X	X				X		Drive to east of creek	Y	Some fenced off of river
Co. RD 275	335, 336	#8	N- not along the river but in watershed				X								Salvage yard		N
Site #1		#9		Yes, along bank		X		X	X	X			X		Road is blacktop	Yes, to south and NE	N
Co Rd. 225		#10		Y	X			X	X	X					N	Yes, with gully erosion	N

SITE ID	PICTURE #	GPS (way pt)	Field Drainage tiles vs. Non-Ag. Pipes	Erosion Y/N	Trash			Riparian Cover				Riparian Buffer			Impervious Surfaces Y/N describe	Grass Buffers Y/N	Livestock present Y/N
					None	Litter	Dump	Trees	Grass	Crops	Poor	0-5ft	5-30ft	30 + ft			
CO.RD. 300	337, 338	#11		Y	X				X				X		N	somewhat	several cattle not kept out stream
CoRD. Jonathan Creek	339	#12	N	Y			X	X	X			X - N	X-S			Y	Y-by stream
CO.RD 200	340, 341, 342, 343	#13	Y	y	X					X		X			Road is blacktop		Y-goats on SE side
Cr 200 by SR 71	343	#14	N	Y		Concrete		X	X				X		Road is blacktop	Yes, steep banks	Y, sheep present
CR 200 towards Depot	344, 345, 346	#15	Y-non-ag	Y	X			X	X				X		Y-road is blacktop	Y	Yes-goats & pony

SITE ID	PICTURE #	GPS (way pt)	Field Drainage tiles vs. Non-Ag. Pipes	Erosion Y/N	Trash			Riparian Cover				Riparian Buffer			Impervious Surfaces Y/N describe	Grass Buffers Y/N	Livestock present Y/N
					None	Litter	Dump	Trees	Grass	Crops	Poor	0-5ft	5-30ft	30 + ft			
Baseline Rd	347, 348, 349	#16	Y	Y	X			X		X			X		N	Yes, some	N
Newport Bridge		#17	Yes-Non-Ag	Y-minor		X		X					X		Yes road	N	N

Appendix G: 2007 Inventory Data Report

First Test Summary (June 13-14)

The results of the first test did not indicate any large variations from Indiana averages. However, there was some variance across the samples. Turbidity was the factor that varied the most, with large increases at the state line and at the mouth of the river. This could indicate increased erosion and sediment control issues in those areas. Jonathon Creek was found to be exceptionally clear. pH held relatively constant, staying between the 8.5 to 9 range. Dissolved oxygen levels held constant at 7 ppm until reaching the covered bridge, at which point it jumped to 9 ppm, up to 10 ppm at bridge 120, and then back down to 8 ppm at the mouth of the river. One could draw the conclusion that there is less algal growth taking place in that area, or that the water simply churns more in this area. Biochemical Oxygen Demand is another factor that increases at bridge 120. All the other samples were in the 2 to 2.5 ppm range. At bridge 120, Biochemical Oxygen Demand is 5.5 ppm. The Indiana average is 1.5 ppm. However, it is not unusual for it to range between 0 and 6.3 ppm. This puts the sample just above the "Fairly clean with some organic waste" category. A high BOD level can be caused by municipal wastewater and septic tank effluent that has not been completely treated, or eutrophication in conjunction with hot weather. Further testing will help confirm if this is a problem.

Macroinvertebrate Inventory

Macroinvertebrates are a good indicator of water quality. While chemical data is just a snapshot in time, biological data is more long-term. Macroinvertebrates are not very mobile and often spend their entire lives in one portion of a stream. Some species are more tolerant to pollution than others; this makes them good indicators of long-term stream health. Bridge 120 was an area of concern because it is located at the town of Newport. Based on the macroinvertebrates found at the bridge, the site received a rating well above the "Excellent" category (*PTI* of 34). The sampling at Bridge 120 was done by hand, using dip nets. We were able to collect good data at two other sites using artificial substrates. Based on the diversity of macroinvertebrate life found on the Grube's property near the point at which the Little Vermillion empties into the Wabash, the river received a pollution tolerance index rating of 26. This places it into the "Excellent" category as well. This is encouraging, due to the high turbidity level at that site. One could argue that the high turbidity level actually helps macroinvertebrate life thrive, due to the fact that the water is not as clear, making it less suited for their natural predators such as larger fish. Bridge 70 is located in the area known as the "horseshoe bend". The artificial substrate collected at Bridge 70 received a score of 17, placing it in the "Good" category. Sampling with dip nets might allow for a better sample collection and could potentially yield a higher score in the "Excellent" category.

Second (Chemical) Test Summary (July 27-28)

The second round of testing was consistent with the first round. Turbidity varied across the river from one end to the other as before, but much more dramatically. During the first round of testing, for example, turbidity near the Wabash River was 53 NTU. The second round of testing showed a value of 92 NTU for turbidity at this location. A considerable amount of rain had fallen since the first test, and this would probably contribute to an increase of sediment in the water. Other chemical data was consistent with the first testing run. An *E. coli* test was also performed using the microbiology lab at Lafayette Home Hospital.

***E. coli* test**

The *E. coli* test was performed at three sites along the river. These sites were Bridge 76, along State Road 71, and the Newport town bridge, BR120 (Ref: LVRWG Site #5). The results were analyzed by the microbiology lab at Home Hospital. All three samples came back with platelet counts of "greater than 200 per 100 mL". The Indiana average is 645 colonies/100 mL. The state water quality standard for total body contact recreation is 235 colonies/100mL. The EPA has determined that *E. coli* counts above 235 colonies/100mL indicate that more than 8 out of 1,000 people who come in contact with the water will become sick. Forty-one percent of Indiana stream miles do not support primary contact due to high *E. coli* bacteria levels according to the IDEM Integrated Water Quality Monitoring and Assessment Report.   In all likelihood, these samples were more than 235, so it is safe to say that the river is not fit for total body contact recreation (swimming). This *E. coli* contamination could be attributed to several factors. These include poor septic systems and runoff from agricultural feedlots. These results are not surprising, as the river is listed as impaired due to high *E. coli* concentrations in the Illinois portion of the watershed. This was only a preliminary test to identify possible concerns. Future testing at these sites and possibly some more sites along the river could help pinpoint some of the sources of *E. coli* contamination.