1.0 INTRODUCTION

1.1 Mission Statement

The Lilly Creek and Little Duck Creek watershed community is a coalition of existing conservation groups, municipalities, agricultural communities, and concerned citizens dedicated to developing and implementing a successful watershed plan to protect, maintain, and enhance the ecosystems of the Lilly Creek, Pipe Creek, Little Duck Creek, and Big Duck Creeks.

1.2 Watershed Location

The Lilly Creek and Little Duck Creek watersheds include the two 14 digit hydrologic unit code (HUC) watersheds that drain Lilly Creek and Little Duck Creek. The Lilly Creek and Little Duck Creek watersheds encompass all of the two 14 digit watersheds including the Pipe Creek – Lilly Creek watershed (HUC 05120201050060) and the Duck Creek – Little Duck Creek watershed (HUC 05120201060020) within the Upper West Fork White River basin (HUC 05120201). The watersheds include nearly 22,672 acres or 35 square miles. Drainage from the Lilly Creek watershed flows into Lilly and Pipe Creeks, which combine at the downstream edge of the 14-digit watershed. Likewise, the Little Duck Creek watershed contains the entirety of the Little Duck Creek drainage; however, only a portion of the Big Duck Creek drainage is contained within this 14-digit watershed. Water drains from Lilly Creek to Pipe Creek and from Little Duck Creek to Big Duck Creek. Pipe Creek and Big Duck Creek both flow into the West Fork White River near Perkinsville and Strawtown respectively.

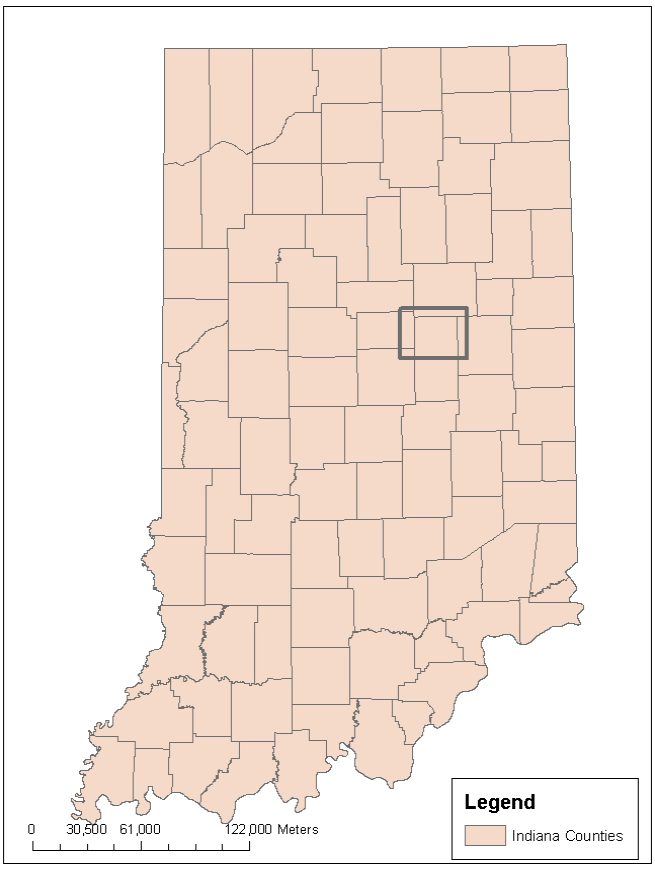

Figure 1 - Location of watersheds within Madison County.

The Lilly Creek and Little Duck Creek watersheds are located in primarily rural areas of Madison County. The City of Elwood (2000 population: 9,737) and the town of Orestes (2000 population: 334) are included in these watersheds. Overall population of both watersheds is approximately 12,278.

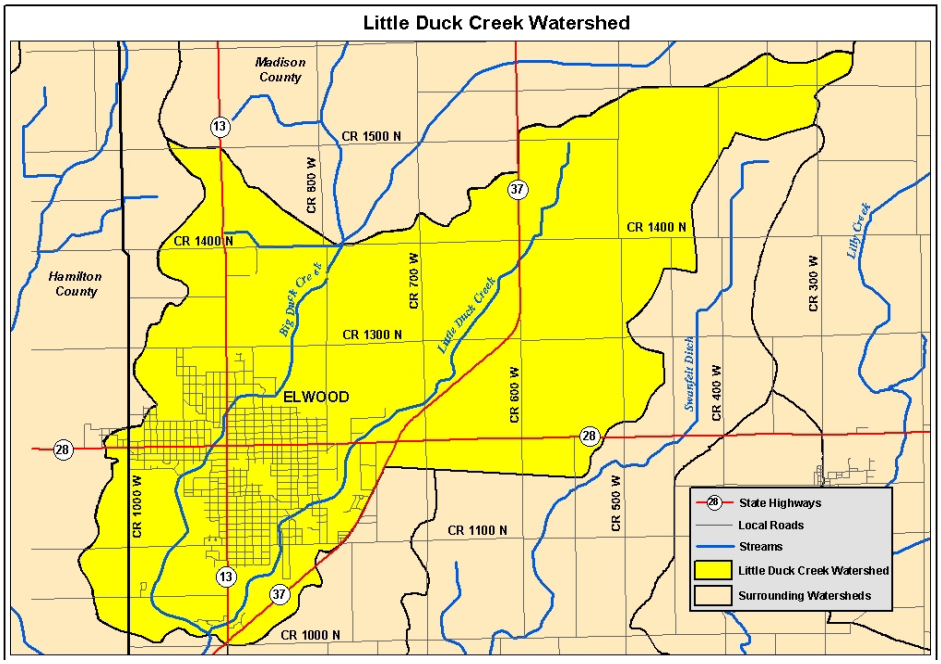

Figure 2 – Little Duck Creek Watershed.

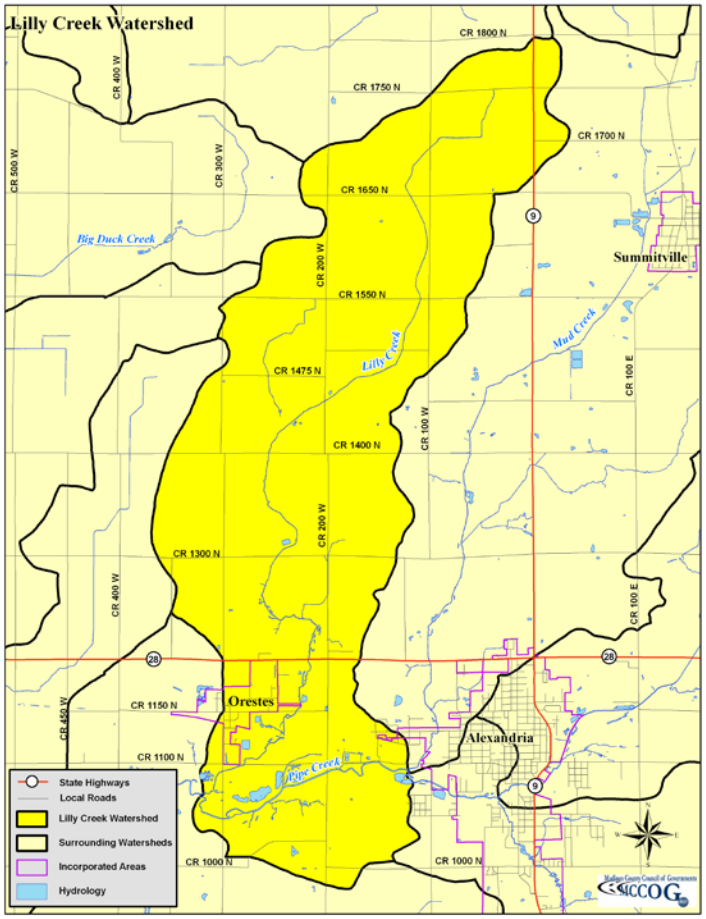

Figure 3 – Lilly Creek Watershed.

This project arose out of a desire by the Madison County Soil & Water Conservation District (SWCD) Board of Supervisors, SWCD staff, and the Swanfelt Watershed Steering Committee to undertake a targeted approach to improving water quality with the help of watershed stakeholders. The Lilly Creek and Little Duck Creek watersheds were chosen based on the following criteria:

- Watershed contains the headwaters of Little Duck Creek and Lilly Creek
- Watershed contains public wellheads
- Watershed contains 303 (d) listed streams
- Watershed is small in size but contains both urban and rural geography

This WMP documents the concerns watershed stakeholders have for the Lilly Creek and Little Duck Creek watersheds and describes the stakeholders' vision for these watersheds. It also outlines the goals, strategies, and action items watershed stakeholders have selected to achieve this vision. The plan concludes with methods for measuring progress toward goals and objectives outlined throughout the plan and time frames for periodic refinement of the plan.

1.3 Watershed Partnerships

To be effective, the preparation of any WMP should include full community participation. Support, direction, and insight from individuals, groups, and/or government agencies within the planning impact areas are essential for successful short-term and long-term watershed management planning and implementation. The Lilly Creek and Little Duck Creek WMP encouraged and provided opportunity for full community participation.

The planning process included meetings of the Steering Committee, public meetings, and availability of draft documents for review. Meeting and activity dates and notes were posted on the Madison County SWCD website. (www.madisonswcd.org)

NAME	AFFILIATION	SUBCOMMITTEE
Garland Antrim	SWCD Board Chairman/Farmer	
Crist Blassaras	SWCD Watershed Coordinator	BMP, Sampling
Greg Bohlander	IN Farm Bureau/Resident	BMP, Sampling
Jerry Bridges	Council of Governments	
Brandon Clidence	County Health Dept.	
Judy DeLury	White River Watchers	Inventory, Outreach, BMP, Editing, Sampling
Tammy Doty	City of Anderson – Urban Forester	
Vickie Griffin	Landowner	
Mary Harless	Resident – Elwood Schools	Outreach, Editing
Dan Ippolito	Anderson University	Inventory, Outreach, Sampling
Angie Martin	RQAW	Inventory, Editing
Glen Murray	Elwood Water Dept.	
Brad Newman	Madison County Surveyor	Inventory, BMP, Sampling
Janelle Parke	SWCD Executive Director	Outreach
Chad Pigg	City of Anderson Engineering	
Bill Savage	Elwood Economic Dev. Dir.	
John Shettle	Town of Orestes	Inventory, Sampling
Mike Shuter	Farmer/Landowner	
Curt Utterback	Resident/Red Gold	
Mike Washburn	Elwood Wastewater Treatment	
Shane Wingler	Red Gold	
Don Zalokar	Phillippe Water	Outreach
Rick Durham	Durham Engineering	
Rob Shumowsky	Council of Governments - GIS	

Table 1 – Steering Committee Members.

The Madison County SWCD was the sponsor for the WMP process. The SWCD applied for an Environmental Protection Agency Section 319 Clean Water Act grant in 2003. The SWCD was awarded the grant and received $96,150. A total of $32,050 was required as in-kind services or cash match.

The SWCD developed a list of key stakeholders for the planning area based on the previous Swanfelt Ditch Steering Committee. Additional members joined the committee based on recommendations and personal acquaintances.

The public was invited to participate in all aspects of this project. Public meetings were held throughout the plan development. Steering committee meetings were also open to the public. The meeting information and updates were sent in the form of press releases to local newspapers, watershed newsletters, targeted mailings, personal conversations, and posting on the Madison County SWCD website. All meetings were held in locations accessible to the public including Anderson Public Library, Elwood Public Library, Elwood YMCA, Orestes Town Hall, and Elwood Municipal Building.

The goal of the first public meeting was to obtain stakeholder input on the watershed, water quality, and land use concerns related to the WMP. Over the course of several months interviews with residents in the area were conducted and surveys were mailed to the residents to develop a sense of community objectives specific to the Lilly Creek & Little Duck Creek watershed. The SWCD conducted a first quarter mail-out survey to assess perceptions about recreation, pollution, water quality, drinking water, and wildlife habitat from the stakeholders. This information is found in Appendix G. An eighth quarter final survey was mailed out to assess stakeholders changes in perception, behavior, meeting participation, and future direction they would like to see taken if implementation money is made available. This information is found in Appendix H.

1.4 Concerns

The community was continually asked for their watershed quality concerns over the course of the project. This discussion came up at formal meetings as well as during informal conversations. Concerns and suggestions were noted during these discussions and later lumped into general categories. These categories are listed below. Neither the category nor the order is intended to confer any prioritization, and many of the issues are closely interrelated. The community prioritized the concerns later in the process.

1.41 Plan Development, Education, & Outreach

- Public needs to be educated about water quality issues
- Educate community leaders who influence relevant ordinances
- Identify & accentuate farms practicing conservation tillage
- Identify & accentuate eco-friendly lawn care professionals and cleaners

1.42 E-Coli

- Combined Sewer Overflows
- Poorly installed and/or maintained septic systems
- Cattle access to Lilly Creek and both horse and cattle to Little Duck
- Wildlife impact in waterways
- Restricted recreational use (fishing, swimming, boating)
- Need to identify source of E. coli

1.43 Sedimentation

- Stream bank erosion
- Impaired drainage

1.44 Agricultural Practices

- Manure management
- Proper application of pesticides and fertilizers
- Use of conservation practices (no-till, buffer strips, grassed waterways)
- Livestock impact on water quality

1.5 Vision for the Future

As the stakeholders listed concerns regarding the current state of water quality in the Lilly Creek and Little Duck Creek watershed, they also described their vision for the watershed in the future. Several common themes began to surface during the public meetings. Nearly all stakeholders envisioned clean streams that supported multiple uses. Stakeholders unanimously voiced support for a future in which the water was clean and safe for recreation and consumption. Stakeholders also envisioned a future where more individuals have a better understanding of actions they could take to protect water quality. The following vision statement was developed using stakeholder input:

> *Our vision for the Lilly Creek and Little Duck Creek watershed is a healthy ecosystem that supports species diversity, protects water quality, and improves quality of life, flora, and fauna in northern Madison County while maintaining the important social, economic, recreational, agricultural, and drainage uses of the watershed.*

Watershed stakeholders selected goals and strategies that will enable them to make this vision a reality.

2.0 DESCRIPTION OF WATERSHED

2.1 Location

The Lilly Creek & Little Duck Creek watersheds are two 14 digit HUC watersheds that encompass nearly 22,672 acres in northwest Madison County, Indiana (Figure 1). Lilly Creek (05120201050060) is approximately 9,751 acres and Little Duck Creek (05120201060020) contains approximately 12,921 acres. The Lilly & Little Duck Creek watershed consists of 7 streams and/or ditches. Their names and lengths are as follows:

Lilly Creek	10.2 miles
Pipe Creek	3.7 miles
Little Duck Creek	9.4 miles
Big Duck Creek	5.5 miles
Noble Ditch	1.3 miles
Dong Run	0.7 miles
Carver Run	1.8 miles

Table 2 - Streams & Mileage.

2.2 Physical Setting

2.21 Geology

The geology of the watershed is a direct result of the Wisconsinan glacier activity. This gave the Lilly and Little Duck Creek Watershed loamy, high lime, late-Wisconsinan glacial till, glacial outwash and scattered loess overlie Paleozoic carbonates and shale. Its bedrock group is primarily Silurian rocks.

2.22 Soils & Topography

The soils and topography of the Lilly Creek and Little Duck Creek watershed are typical of the Eastern Corn Belt Plains Ecoregion. This region contains glaciated, level to rolling glacial till plain, with end moraines and glacial outwash landforms. Common soil series include Fincastle, Treaty, Cyclone, Xenia, Ockley and Shoals. Common soil types within the watershed consist of Brookston, Crosby, Miami, and Mahalasville. These soils grew Beech forests, oak-sugar maple forests, white oak forests, pin oak swamps, elm-ash swamps grew on nearly level terrain. At present, corn, soybeans, tomatoes, small grains, hay, and livestock are grown agriculturally on these soils. These soils are typified by Brookston – Crosby soil associations. This association is made up of nearly level to gently sloping rises and knobs that are interspersed with level and slightly depressional areas. The Brookston soils are dark colored, very poorly drained and have a silty or clayey surface layer and a dark gray clayey subsoil. They are underlain by grayish-brown to yellowish-brown, calcareous loamy till. The Crosby soils are lighter colored than the Brookston soils and have less clay in the surface layer. They are somewhat poorly drained and have dark yellowish-brown clayey subsoil underlain by yellowish-brown, calcareous loamy till. Both soils typically require artificial drainage for commodity crop production (United States Department of Agriculture, 1969).

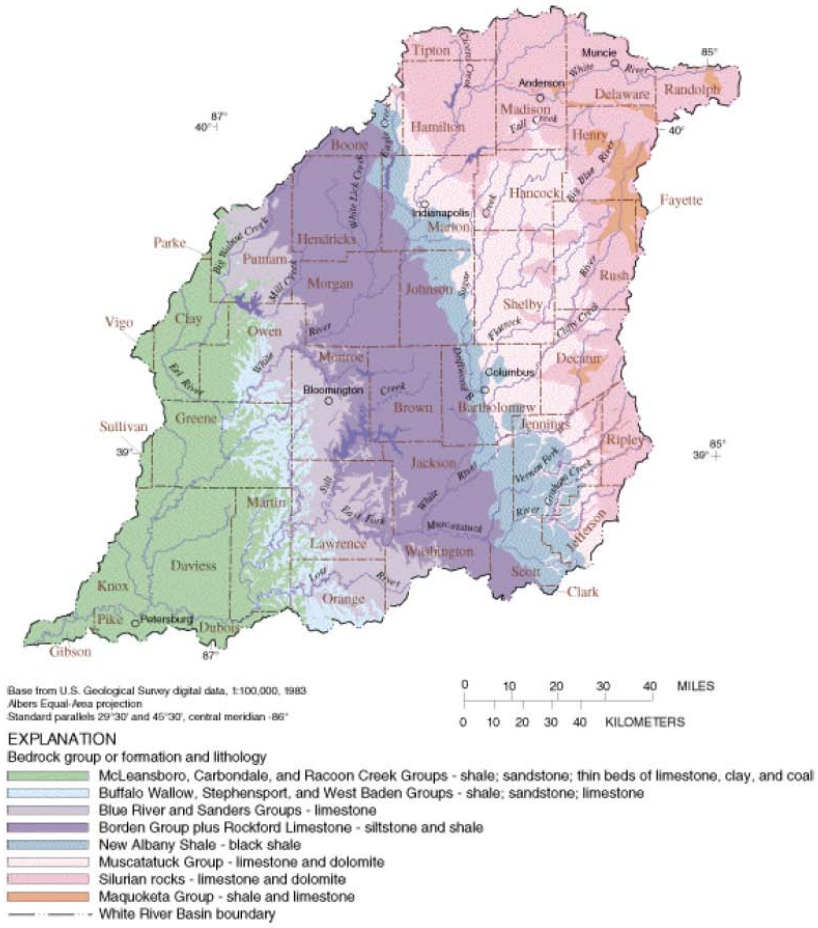

Figure 4 – Bedrock Geology.

2.23 Climate

Madison County, including the Lilly Creek and Little Duck Creek Watershed, has a typical Midwest North American climate. The watershed receives average rainfall amounts of 38 inches. Average low temperature for the watershed is 18.3 ^{o}F. Average high temperature for the watershed is 83.8 ^{o}F. (City-data.com, 2005a).

2.24 Natural History

Before settlement of the area during the early 1800's the entire Lilly Creek and Little Duck Creek watershed was dominated by hardwood forests, streams, and wetlands. At the time of settlement, the new residents cleared most all of the forested areas and began installing subsurface tiles to drain the land for agricultural production. In addition to the

tile installation, the residents also constructed new, open ditches to assist draining areas that were not easily serviced by existing streams and/or areas. Current conditions on the streams include some areas of vegetation and some have little or no vegetation buffering the stream from adjacent land uses.

2.25 Endangered Species

There are nine species of vascular plants, two species of mussels, one species of insect, four species of birds, one species of mammal, and three types of high quality natural areas that are endangered at a federal, state or both the federal and state level. These species mentioned are for the area of Madison County. A complete listing specific to Madison County may be accessed via Indiana Department of Natural Resources, Division of Nature preserves. (Indiana Department of Natural Resources, 1999). No listing of endangered species specific to the Lilly and Little Duck Creek Watershed was found.

2.3 Land Use

In the Lilly Creek watershed the land use is dominated by agricultural production. Agricultural producers plant the majority of the farm acreage to corn and soybeans. However, wheat, alfalfa, and tomatoes are also planted. There are a few small livestock operations in the watershed. A confined animal feeding operation was recently permitted. It is to be located at the intersection of 700W & 1300N and will contain 4000 hogs.

Outside of the urban area of the town of Orestes, the watershed is dotted by small hobby farms, larger full-time farm operations, and rural, residential home plots. Both within the urban and outlying areas, ownership of land is private in nature. Within the watershed, there are no significant public lands or public natural areas that exist.

Of note is the existence of the corporate headquarters for Red Gold, located in the town of Orestes. Red Gold is the nation's largest tomato product supplier outside of California.
According to MCCOG interpolation, the total acreage of the Lilly Creek watershed is 9,751. Of this total acreage, 68% of the Lilly Creek watershed is cropland (approximately 6,652 acres).

Land Use	***Acreage***
Commercial	36.39
Farmsteads	1,276.89
Fields	6,652.62
Heavy Industrial	31.94
High Density Residential	126.29
Institutional	9.38
Light Industrial	50.67
Parks/Open Space	95.44
Single Family Residential	490.69
Wooded	782.98

Table 3 - Lilly Creek Land Use.

Land use in the Little Duck watershed is primarily row crops and the city of Elwood. Within the city of Elwood, land use is primarily Low Intensity Residential. Land uses of Industrial/ Commercial/ Transportation and Urban/ Recreational Grasses are also common within Elwood. The land uses overall for the watershed are below.

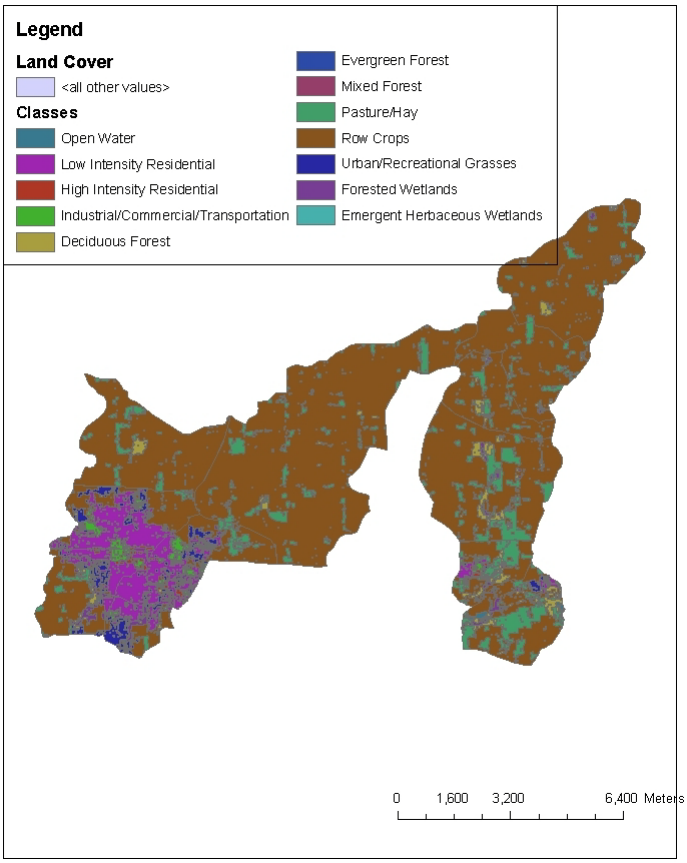

Figure 5 – Land Use.

3.0 BASELINE WATER QUALITY AND WATERSHED CONDITIONS

3.1 Introduction

Data Contained in this section documents current water quality conditions in the Lilly Creek and Little Duck Creek and its tributaries. Understanding the creeks' current conditions will help watershed stakeholders set realistic goals for future water quality conditions. This data will also serve as the benchmark against which future water quality conditions can be compared to measure stakeholder success in achieving their vision for the future of these creeks.

3.2 Existing Data

3.21 United States Geological Survey

"The mission of the U.S. Geological Survey (USGS) is to assess the quantity and quality of the earth resources of the Nation and to provide information that will assist resource managers and policymakers at Federal, State, and local levels in making sound decisions. Assessment of water-quality conditions and trends is an important part of this overall mission. The long term goals of the National Water Quality Assessment Program (NAWQA) are to describe the status and trends in the quality of a large, representative part of the Nation's surface- and ground-water resources, and to provide a sound, scientific understanding of the primary factors affecting the quality of these resources. The White River Basin in Indiana is one of many large river basins being studied throughout the United States."

The NAWQA report specifically points out that within agricultural areas of the White River basin, nutrient concentrations, ammonia, pesticides, and herbicide concentrations were present and exceeded water quality targets. They also mention that land use, differing types of agricultural practices and seasonal changes in nutrient uptake and runoff from varying levels of precipitation affect the quantity of the pollutants that are found through their water quality monitoring in the White River Basin.
The report also states that ammonia and nitrites levels were 2 times and 5 times greater, respectively, in an agricultural watershed affected by farm animals.

3.22 IDEM

State and regional reports provide benchmarks for water quality in Indiana lakes and streams by identifying how the watershed fits into the overall state and regional picture. A variety of sources were reviewed to assist in establishing baseline water quality conditions in the waterbodies of the Lilly Creek & Little Duck Creek watershed. Every two years, the United States Environmental Protection Agency (USEPA) requires the state to submit an Indiana Water Quality 305(b) report on the status of waters in the state. The current and historical Indiana Water Quality 305(b) reports were studied (IDEM, 1989-1990; IDEM, 1992-1993; IDEM, 1995-1996; IDEM, 2002; IDEM, 2004; and IDEM, 2006). Additionally, the USEPA requires that Indiana submit a Section 303(d) List of Impaired Water Bodies for Indiana, which is named after enabling legislation in the federal Clean Water Act. This list provides a listing of waters that do not or are not expected to meet applicable water quality standards. This list was examined to determine if any portion of the Lilly Creek & Little Duck Creek watershed was listed as impaired.

In the Indiana Water Quality 305(b) reports for the years 1989-1990, 1992-1993, and 1995-1996, Lilly Creek & Little Duck Creek were assessed and given a rating of fully supporting of aquatic life (IDEM, 1991; IDEM, 1994; and IDEM, 1997). In 1998, Duck Creek in Elwood to Little Duck Creek and Pipe Creek were placed on the 303(d) list for E. coli. Pipe Creek was also cited for impaired biotic communities in 1998. In 2004, the Little Duck Creek Basin and Big Duck Creek were placed on the 303(d) list for E. coli. Pipe Creek was also cited for fish consumption for PCBs and mercury. The 2006 303(d) lists Pipe Creek, Little Duck Creek Basin, Duck Creek from Elwood to Little Duck

Creek, and Big Duck Creek for E. coli. Pipe Creek is still listed as a fish consumption advisory for PCBs and mercury. Duck Creek and Pipe Creek have a draft TMDL report on file at IDEM. A TMDL (Total Maximum Daily Load), established under section 303(d) of the federal Clean Water Act, is a calculation of the maximum amount of pollutant that a waterbody can receive and still meet water quality standards, and allocates pollutant loadings among point and non-point sources. No segments of these watersheds are listed as impaired for aquatic life on the 2006 303d list.

3.23 Madison County Tillage Transect

The Tillage Transect is generally completed every two years by Indiana Conservation Partnership employees stationed in Madison County (SWCD, ISDA, & NRCS). The purpose is to give a summary of trends associated with the adoption of no-till and/or conservation tillage with relation to crop residue and soil loss within Madison County. The surveys are completed each spring after crops have emerged but while the soil residue conditions are still visible. Data is recorded and compiled statewide by most all counties and viewed on a state level as well.

The Madison County Tillage Transect from the spring of 2004 showed that 81% of the corn crop is conventional till, with the remaining 11% and 8% being no-till and mulch till. The soybean crop showed that 16% was conventional till, 68% was no-till, and 16% mulch till. Madison County ranked 62nd out of 89 counties surveyed in percent of corn planted using a no-till system. No-till corn acreage has decreased from 14% in 2000 to 11% in 2004. Madison County ranked 5th out of 89 counties in 2000 by planting 83% of its soybeans utilizing no-till. Soybean no-till has decreased from 83% to 68% in 4 years. A tillage transect was conducted in May of 2007, but the state has not released the results.

3.24 US Fish & Wildlife Service Study

In 2002, Thomas Simon conducted an assessment of the fish assemblages of major tributaries of the West Fork White River at 77 stream reaches from Indianapolis to Muncie, Indiana. The survey was conducted in the fish kill zone to document the species present including basic biological data. In addition, habitat and water quality was assessed during two time periods between July and October 2002. Characteristics of the fish assemblage of each tributary were compared to habitat, ammonia, and nitrate concentrations measured during the fall sampling period. Big Duck Creek study sites were #42, #43, and #45. Little Duck Creek study sites were #46 and #47. Pipe Creeks study site was #54. Lilly Creek study sites were #55 and #56. Six of these sample sites were also utilized in our chemical and biological assessments. (This study can be accessed at: http://www.in.gov/idem/your_environment/wrcac/index.html)

Overall results indicate that nitrate levels are acutely (10mg/L) to chronically (12mg/L) toxic and further investigation is needed. Ohio-EPA has established a nitrate target for TMDL's at 1.5mg/L. The habitat assessment shows that the majority of fish species are pollution tolerant. Channelization, removal of riparian corridors, sedimentation, and loss of in stream cover were cited as primary reasons for the loss of habitat quality. (Simon, 2004)

3.25 JFNew Watershed Stream Sampling

To supplement the base of existing data, JFNew completed water chemistry sampling and physical habitat assessments at 12 locations within the Lilly Creek & Little Duck Creek watershed. Three sampling sites were located on Big Duck Creek with an additional three sampling sites on Little Duck Creek. Five sampling sites were located on Lilly Creek and one sampling site on Pipe Creek at the road crossing closest to its convergence with Lilly Creek.

2005	2006
8/3 – base flow	5/9 – base flow
9/6 – base flow	6/15 –base flow
9/26 – storm flow	7/12 – storm flow
10/19 – base flow	8/2 – base flow

Table 4 – JFNew Sampling Schedule.

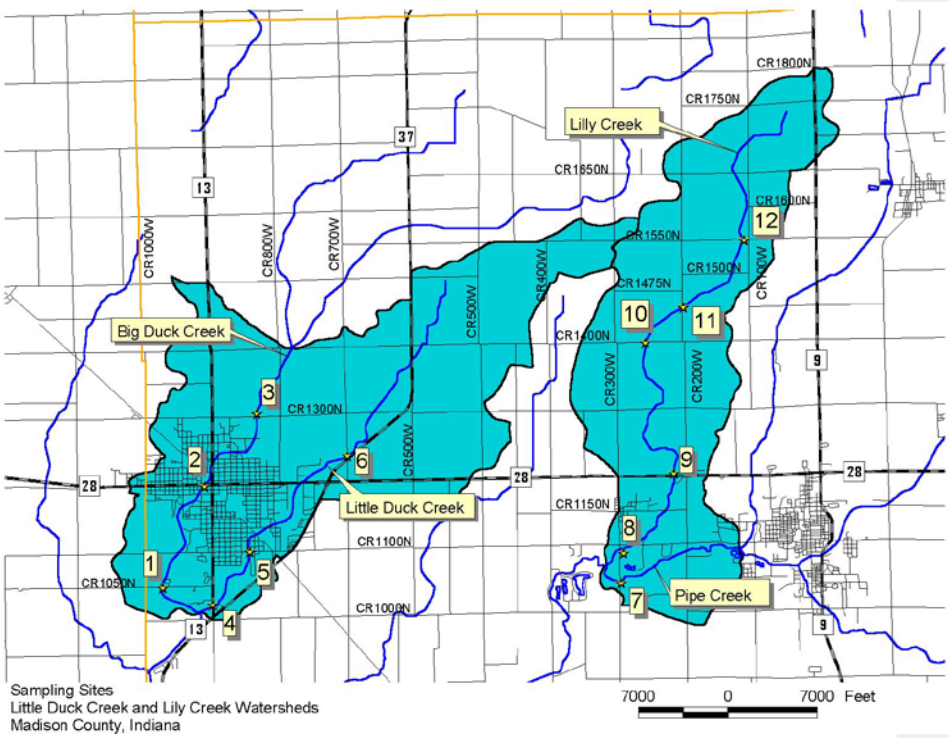

Figure 6 – Sampling Sites.

3.251 Water Quality Parameters

JFNew measured various chemical parameters over a two year period. Descriptions of the parameters measured are listed below.

Temperature

Temperature can determine the form, solubility, and toxicity of a broad range of aqueous compounds. Likewise, water temperature regulates the species composition and activity of life associated with the aquatic environment. As essentially all aquatic organisms are cold-blooded, the temperature of the water regulates their metabolism and ability to survive and reproduce effectively (USEPA, 1976). The Indiana Administrative Code (IAC) (327 IAC 2-1-6) sets maximum temperature limits to protect aquatic life for Indiana streams. For example, temperatures during the months of June and July should not exceed 90°F by more than 3°F. The code also states that the "maximum temperature rise at any time or place…shall not exceed 5°F in streams…"

Dissolved Oxygen (DO)

DO is the dissolved gaseous form of oxygen. It is essential for respiration of fish and other aquatic organisms. Fish require a DO concentration of at least three to five mg/l of DO. Cold water fish such as trout generally require higher concentrations of DO than warm water fish such as bass or bluegill. The IAC sets minimum DO concentrations at five mg/l for warm water fish. DO enters water by diffusion from the atmosphere and as a byproduct of photosynthesis from algae and plants. Excessive algae growth can over-saturate (greater than 100 percent saturation) the water with DO. Waterbodies with large populations of algae and macrophytes often exhibit supersaturation due to the high levels of photosynthesis. Dissolved oxygen is consumed by respiration of aquatic organisms, such as fish, and during bacterial decomposition of plant and animal matter.

Conductivity

Conductivity is a measure of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions: on their total concentration, mobility, and valence (APHA, 1998). In lower flow conditions, conductivity is higher than it is following a storm because the water moves more slowly across or through ion containing soils and substrates during base flow. Carbonates and other charged particles (ions) dissolve into the slow-moving water, thereby increasing conductivity levels.

pH

The pH of stream water describes the concentration of acidic ions (specifically H+) present in the water. The pH also determines the form, solubility, and toxicity of a wide range of other aqueous compounds. The IAC establishes a range of six to nine pH units for the protection of aquatic life.

Turbidity

Turbidity (measured in Nephelometric Turbidity Units or NTUs) is a measure of water coloration and particles suspended in the water itself. It is generally related to suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton, and other microscopic organisms. According to the Hoosier Riverwatch, the

average turbidity of an Indiana stream is 11 NTU with a typical range of 4.5-17.5 NTU (White, unpublished data). Turbidity measurements 〉20 NTU have been found to cause undesirable changes in aquatic life (Walker, 1978). The USEPA developed recommended water quality criteria as part of the work to establish numeric criteria for nutrients on an ecoregional basis. Recommended turbidity concentrations for the Central Corn Belt Plains, in which the Lilly Creek and Little Duck Creek watersheds lie are 9.89 NTUs (USEPA, 2000).

Nitrogen

Nitrogen is an essential plant nutrient found in fertilizers, human and animal wastes, yard waste, and the air. About 80 percent of the air we breathe is nitrogen gas. Nitrogen gas diffuses into water where it can be "fixed", or converted by blue-green algae to ammonia for their use. Nitrogen can also enter lakes and streams as inorganic nitrogen and ammonia. Because of this, there is an abundant supply of available nitrogen to aquatic systems. The two common forms of nitrogen are:

- *Nitrate-nitrogen*

Nitrate is an oxidized form of dissolved nitrogen that is converted to ammonia by algae. It is found in streams and runoff when dissolved oxygen is present, usually in the surface waters. Ammonia applied to farmland is rapidly oxidized or converted to nitrate and usually enters surface and groundwater as nitrate. The Ohio EPA (1999) found that the median nitrate-nitrogen concentration in wadeable streams classified as modified warm water habitat (MWH) was 1.6 mg/l. MWH was defined as: the aquatic life use assigned to streams that have irretrievable, extensive, man-induced modification that precludes attainment of the warm water habitat use designation; such stream are characterized by species that are tolerant of poor chemical quality (fluctuating dissolved oxygen) and habitat conditions (siltation, habitat amplification) that often occur in modified streams (Ohio EPA, 1999). The target or concentration breakpoint we used for load reduction calculations was 1.5mg/L.

- *Ammonia-nitrogen*

Ammonia-nitrogen is a form of dissolved nitrogen that is the preferred form for algae use. Bacteria produce ammonia as they decompose dead plant and animal matter. Ammonia is the reduced form of nitrogen and is found in water where dissolved oxygen is lacking. Important sources of ammonia include fertilizers and animal manure. Both temperature and pH govern the toxicity of ammonia for aquatic life. According to the IAC, maximum ionized ammonia concentrations for the study streams should not exceed approximately 1.94 to 7.12 mg/l, depending on the water's pH and temperature. The target or concentration breakpoint we used for load reduction calculations was 0.5mg/L.

Phosphorus

Phosphorus is an essential plant nutrient and the one that most often controls aquatic plant (algae and macrophyte) growth. It is found in fertilizers, human and animal wastes, and yard waste. There are few natural sources of phosphorus to streams other than that which is attached to soil particles; there is no atmospheric (vapor) form of phosphorus. For this reason, phosphorus is often a limiting nutrient in aquatic systems. This means

that the relative scarcity of phosphorus may limit the ultimate growth and production of algae and rooted aquatic plants. Management efforts often focus on reducing phosphorus inputs to receiving waterways because: (a) it can be managed and (b) reducing phosphorus can reduce algae production. The target or concentration breakpoint we used for load reduction calculations was 0.17mg/L. This is the same breakpoint used for the Wabash River Nutrient and Pathogen TMDL.

Total Suspended Solids (TSS)
A TSS measurement quantifies all particles suspended in stream water. Closely related to turbidity, this parameter quantifies sediment particles and other solid compounds typically found in stream water. In general, the concentration of suspended solids is greater during high flow events due to increased overland flow. The increased overland flow erodes and carries more soil and other particulates to the stream. The state of Indiana does not have a TSS standard. In general, TSS concentrations greater than 80 mg/l have been found to be harmful to aquatic life (Waters, 1995). The target or concentration breakpoint we used for load reduction calculations was 50mg/L. This is the same breakpoint used for the Wabash River Nutrient and Pathogen TMDL.

E. coli Bacteria
E. coli is one member of a group of bacteria that comprises the fecal coliform bacteria and is used as an indicator organism to identify the potential presence of pathogenic organisms in a water sample. Pathogenic organisms can present a threat to human health by causing a variety of serious diseases, including infectious hepatitis, typhoid, gastroenteritis, and other gastrointestinal illnesses. E. coli can come from the feces of any warm-blooded animal. Wildlife, livestock, and/or domestic animal defecation, manure fertilizers, previously contaminated sediments, and failing or improperly sited septic systems are common sources of the bacteria. The IAC sets the maximum standard at 235 colonies/100 ml in any one sample within a 30 day period.

Macroinvertebrates
The benthic community at each sample site was evaluated using two biological indices: the Hilsenhoff Family Level Biotic Index (HBI) (Hilsenhoff, 1988) and IDEM's macroinvertebrate Index of Biotic Integrity (mIBI) (IDEM, unpublished). The HBI uses the macroinvertebrate community to assess the level of organic pollution in a stream. The HBI is based on the premise that different families of aquatic insects possess different tolerance levels to organic pollution. Hilsenhoff assigned each aquatic insect family a tolerance value from 1 to 9; those families with lower tolerances to organic pollution were assigned lower values, while families that were more tolerant to organic pollution were assigned higher values. The HBI is calculated by multiplying the number of organisms from each family collected at a given site by the family tolerance value, summing these products, and dividing by the total number of organisms in the sample:

$$HBI = \frac{\sum_i x_i t_i}{n}$$

where x_i is the number of species in a given family, t_i is the tolerance values of that family, and n is the total number of organisms in the sample. Benthic communities dominated by organisms that are tolerant of organic pollution will exhibit higher HBI scores compared to benthic communities dominated by intolerant organisms. Table 5 correlates the HBI score with the level of organic pollution.

Hilsenhoff Family Level Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

Table 5 - Water quality correlation to Hilsenhoff Biotic Index score.

IDEM's mIBI is a multi-metric index designed to provide a complete assessment of a creek's biological integrity. Karr and Dudley (1981) define biological integrity as "the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the best natural habitats within a region". It is likely that this definition of biological integrity is what IDEM means by biological integrity as well. The mIBI consists of ten metrics which measure the species richness, evenness, composition, and density of the benthic community at a given site. The metrics include family-level HBI (Hilsenhoff's FBI), number of taxa, number of individuals, percent dominant taxa, EPT Index, EPT count, EPT count to total number of individuals, EPT count to chironomid count, chironomid count, and total number of individuals to number of squares sorted. (EPT stands for the Ephemeroptera, Plecoptera, and Trichoptera orders.) A classification score of 0, 2, 4, 6, or 8 is assigned to specific ranges for metric values. For example, if the benthic community being assessed supports nine different families, that community would receive a classification score of 2 for the "Number of Taxa" metric. The mIBI is calculated by averaging the classification scores for the ten metrics. mIBI scores of 0-2 indicate the sampling site is severely impaired; scores of 2-4 indicate the site is moderately impaired; scores of 4-6 indicate the site is slightly impaired; and scores of 6-8 indicate that the site is non-impaired.

JFNew collected six sets of water chemistry samples during normal or baseline conditions and two sets of water chemistry samples during a period of more than one inch of rain in a 24-hour period. Benthic macroinvertebrates were assessed twice a year in early and late summer along with each stream's physical habitat. To ensure comparability to data collected previously by IDEM, JFNew followed similar stream sampling protocols. The stream sampling and the appropriate quality assurance/quality control procedures are referenced in the project's Quality Assurance Project Plan (QAPP). Appendix A contains the project QAPP and Appendix E contains tables of the results of field sampling performed at twelve sample sites by JFNew.

In addition to water sampling, a Qualitative Habitat Evaluation Index (QHEI) was assessed for these sties. Photos taken for the QHEI are located in Appendix F and QHEI data sheets are provided in Appendix B. This assessment quantifies six metrics: substrate, instream cover, channel morphology, riparian zone and bank erosion, pool/glide quality and riffle/run quality, and gradient. Numbers are assigned based on these metrics for a final QHEI score. IDEM considers scores above 64 to be fully supporting of a balanced warm water community, while scores below 51 are considered to be non-supporting for the stream's aquatic life use designation.

3.252 Water Quality Sampling Results

Temperature
Water temperature varied with season. In general, there was no consistent difference between water temperatures in Little Duck Creek and Lilly Creek. Sites located in the lower portion of the watershed typically exhibited slightly lower water temperatures compared to sites located in the upper watershed during all sampling events. The cooler water temperatures in the lower watershed may be the result of greater groundwater influence on the streams but is likely due to larger portions of canopy cover in the lower portion of the watershed compared to streams and sties in the upper portion of the watershed.

DO
DO in all streams exceeded the Indiana state minimum warmwater standard of 5 mg/l at all sites in the Little Duck Creek watershed indicating that oxygen was sufficient to support aquatic life. Low DO levels in headwaters of Lilly Creek (Sites 10 to 12) limit the use of these ditches by fish as refuges. Lilly Creek at CR 1400N and CR 1550N possessed DO concentrations below the state minimum standard. Lilly Creek at CR 1550N contained a dissolved oxygen concentration as low as 0.71 mg/l. All other sites possessed sufficient dissolved oxygen to support warmwater biotic communities.

All of the sampling sites, with the exception of the two headwater sites within Little Duck and Big Duck Creeks, possessed saturation levels (84-95%) within the typical range for streams the size of Little Duck and Lilly Creeks. However, Big Duck Creek at CR 1050N (Site 1), Little Duck Creek at South P Street, and the sites along the length of Lilly Creek routinely exhibited dissolved oxygen saturation levels less than 60%. All three headwater sites along Lilly Creek (Sites 10 to 12) contained less than 30% dissolved oxygen during the August 2006 assessment.

Within Lilly Creek (Sites 10-12), the low dissolved oxygen saturation accompanied high (relative to other sites in the watershed) BOD concentrations. Decomposition processes likely played a role in lowering the DO content of the water at these three sites.

Conductivity
Conductivity concentrations generally fell within acceptable ranges. However, conductivity levels measured in some of the watershed streams are of concern. Big Duck

Creek at CR 1050N exceeded the state standard during three of the four sampling events in 2005 and one of the four sampling events in 2006. Within the Lilly Creek watershed, Lilly Creek at CR 300W and Pipe Creek both exceeded the state standard for conductivity. Lilly Creek exceeded the standard during all four of the sampling events in 2005.

pH
In general, pH values fell within acceptable ranges as determined by the Indiana Administrative Code for the protection of aquatic biota. The pH measurements for stream sites in both the Little Duck Creek and Lilly Creek watersheds fell within the state standards of 6 and 9.

Turbidity
Streams in both the Duck Creek and Lilly Creek watersheds possessed elevated turbidity levels. Recommended turbidity concentrations for the Central Corn Belt Plains, in which the Lilly Creek and Little Duck Creek watershed lies are 9.89 NTUs (USEPA, 2000). All sites exceeded USEPA recommended nutrient criteria turbidity levels at least once during the 2005 sampling events. The highest turbidity was recorded at most sites during the August 2005 storm event. In 2006, none of the Big Duck Creek sampling sites exhibited turbidity levels above the recommended criteria, while the Little Duck Creek at CR 1100N and 700W sampling sites both possessed turbidity levels in excess of the recommended criteria at least once during the 2006 sampling events.

Lilly Creek watershed sites recorded greater numbers of exceedances than Little Duck Creek watershed sites especially during 2006. Pipe Creek exceeded the recommended criteria during five of the eight sampling events. This is not surprising based on the large watershed draining to Pipe Creek at its sampling location.

Nitrate-Nitrogen
Nitrate-nitrogen concentrations during base and storm flow conditions were elevated throughout the watersheds. Pipe Creek possessed nitrate-nitrogen concentrations in excess of the Indiana state drinking water standard during two of the four 2005 sampling events. In 2006, all of the sites within the Little Duck Creek watershed exceeded the state standard during the June base flow sampling event as did Lilly Creek at CR 1550N. Additionally, all sites exceeded the USEPA recommended criteria for nitrate-nitrogen, while many sites exceeded the concentrations at which the Ohio EPA determined that biotic impairment occurs.

Ammonia-Nitrogen
Ammonia-nitrogen concentrations were elevated at all sites during the eight sampling events. However, only one site (Lilly Creek at SR 28; September 2005) exceeded the Indiana state standard for drinking water during all of the sampling events which is 1mg/L. Little Duck Creek watershed streams typically possessed lower ammonia-nitrogen concentrations than those present in Lilly Creek watershed streams.

Phosphorus
Under both base and storm flow conditions, total phosphorus concentrations were generally high in the Little Duck Creek and Lilly Creek watersheds. At all of these sampling sites total phosphorus concentrations exceeded the Ohio EPA's numeric total phosphorus criteria set to protect aquatic life. (Indiana does not have numeric nutrient criteria). The high total phosphorus concentrations and resultant productivity in these tributaries may be altering the tributaries' biotic community structure and impairing aquatic life in the tributaries. The habitat assessment and the four macroinvertebrate samplings support this concern.

Total Suspended Solids (TSS)
Streams throughout the Little Duck Creek and Lilly Creek watersheds possessed elevated total suspended solids concentrations on several occasions after rain events; however, none of the samples exceeded the level determined by Waters (1998) to be deleterious for aquatic life.

E. coli
E. coli concentrations exceeded the Indiana state standard for state waters at least once at every sampling site during each sampling season (2005 and 2006). Little Duck Creek at SR 13 and Lilly Creek at CR 1550N exceeded the state standard during all eight sampling events, while Pipe Creek at CR 300W and Big Duck Creek at CR 1050N exceeded the state standard during seven of the eight sampling events. Only Big Duck Creek at CR 1300N exceeded the state standard during less than half of the sampling events. All the samples collected under storm flow conditions were in excess of the state standard. Storm flow E. coli concentrations were of special concern in Big Duck Creek at CR 1050N where E. coli concentrations measured 141,360 colonies/100mL and 241,920 colonies/100mL during the 2005 and 2006 storm sampling events, respectively. Throughout the two watersheds, E. coli concentrations in excess of the standard measured 1.1 to 1030 times the state standard. High E. coli concentrations suggest the presence of other pathogens. These other pathogens may impair the tributaries biota and limit human use of the creeks.

Site #	Stream	Location	Exceeds State Standard* **		Doesn't exceed std, but value of concern*	
			2005	2006	2005	2006
1	Big Duck Creek	CR 1050 N.	--	1	3	3
2	Big Duck Creek	SR 13	--	1	1	2
3	Big Duck Creek	CR 1300 N.	--	1	1	2
4	Little Duck Creek	SR 13	--	1	2	2
5	Little Duck Creek	CR 1100 N.	--	1	2	2
6	Little Duck Creek	CR 700 W.	--	1	2	2
7	Pipe Creek	CR 300 W.	2	--	2	3
8	Lilly Creek	CR 300 W.	--	--	1	3
9	Lilly Creek	SR 28	--	--	1	4
10	Lilly Creek	CR 1400 N.	--	--	1	3
11	Lilly Creek	CR 200 W.	--	--	1	3
12	Lilly Creek	CR 1550 N.	--	1	2	2

* The number represents the number of times that the site exceeded the standard.
** IAC standard < 10 mg/L; Ohio EPA state 2 mg/L = impaired biotic communities; Ohio EPA recommended criteria < 1 mg/L. USEPA recommended criteria < 0.63 mg/L.

Table 6 - Water quality standard summary of stream nitrate concentrations sampled during 2005 and 2006 in the Duck Creek and Lilly Creek watersheds.

Site #	Stream	Location	Exceeds USEPA recommended nutrient criteria* **	
			2005	2006
1	Big Duck Creek	CR 1050 N.	4	3
2	Big Duck Creek	SR 13	2	1
3	Big Duck Creek	CR 1300 N.	--	1
4	Little Duck Creek	SR 13	3	2
5	Little Duck Creek	CR 1100 N.	3	2
6	Little Duck Creek	CR 700 W.	2	1
7	Pipe Creek	CR 300 W.	3	4
8	Lilly Creek	CR 300 W.	3	3
9	Lilly Creek	SR 28	--	3
10	Lilly Creek	CR 1400 N.	--	3
11	Lilly Creek	CR 200 W.	1	3
12	Lilly Creek	CR 1550 N.	2	3

* The number represents the number of times that the site exceeded the standard.
** USEPA recommended nutrient criteria, Dodd et al. (1998) level at which eutrophication

occurs, and the Ohio EPA recommended level < 0.075mg/L.

Table 7 - Water quality standard summary of stream total phosphorus concentrations sampled during 2005 and 2006 in the Duck Creek and Lilly Creek watersheds.

Site #	Stream	Location	Exceeds State Standards* **	
			2005	2006
1	Big Duck Creek	CR 1050 N	4	3
2	Big Duck Creek	South B Street	1	3
3	Big Duck Creek	CR 1300 N	1	2
4	Little Duck Creek	SR 13	4	4
5	Little Duck Creek	CR 1100 N	2	4
6	Little Duck Creek	CR 700 N	3	2
7	Pipe Creek	CR 300 W	3	4
8	Lilly Creek	CR 300 W	2	3
9	Lilly Creek	SR 28	2	4
10	Lilly Creek	CR 1400 N	2	4
11	Lilly Creek	CR 200 W	2	3
12	Lilly Creek	CR 1550 N	4	4

* The number represents the number of times that the site exceeded the standard.
** IAC standards = <235 colonies/100 ml in any one sample in 30 days

Table 8 - Water quality standard summary of stream E. coli concentrations sampled during 2005 and 2006 in the Duck Creek and Lilly Creek watersheds.

Macroinvertebrates

The results of the macroinvertebrate survey assist with directing watershed management decisions. On average, Big Duck Creek at CR 1050N (Site 1), Little Duck Creek at SR13 (Site 4), and Pipe Creek at CR 300W (Site 7) possessed the highest quality macroinvertebrate community average scores of 3.06, 3.00, and 3.31, respectively. All of these average scores rate as moderately impaired. Big Duck Creek at CR 1050N (Site 1) possessed the highest calculated score (4.5) during the initial assessment (August 2005) while Lilly Creek at CR 300W (Site 8) possessed the lowest calculated score (1.0) during the October 2005 assessment. All of the watershed streams contained communities dominated by moderate to very tolerant species.

Macroinvertebrate communities in only three of the stream reaches during a total of five assessments rated as slightly impaired. These ratings occurred in Big Duck Creek at CR 1050N (Site 1) during the August and October 2005 assessments, in Little Duck Creek at SR 13 (site 4) during August 2005 and May 2006 assessments, and in Pipe Creek at CR 300W (Site 7) during the October 2005 assessment. All other sites rated as moderately or severely impaired during the four assessments. Although these streams' scores differ slightly from assessment to assessment, streams typically fell into the same biotic integrity class. Karr and Chu (1999) indicate that differences between scores *within* an

integrity class are not statistically significant; these differences within integrity classes often reflect the large variability associated with sampling natural biological communities rather than true differences in community quality.

3.3 Watershed Tours

Watershed tours were conducted in order to record observations of potential water quality impacts. Various members of the steering committee took part in the watershed tours. The tours were conducted at different times of the year. Additionally, the group viewed aerial photography and pictometry to determine where vegetative buffers were needed.

In general, there were lots of field tiles flowing into the creeks. A large amount of heavily tilled land was also noted. At three sites, livestock and horses had direct access to the creek. Most bridges had pipes on the roadway that directly dropped down to the creek. Litter was a problem primarily in urban areas, although trash was common throughout the creeks. Storm drains were not marked and were heavily clogged with debris.

3.4 Watershed Interviews

In order to gauge general perceptions of water quality issues in the Lilly Creek & Little Duck Creek watershed, the SWCD conducted interviews as well as mailed initial surveys to stakeholders who live and/or work in the area. Information gathered during the interview process was considered during the decision-making process of this WMP.

Results of the initial survey are summarized in Appendix G. The general consensus of the public survey was that poor drainage (19%) and flooding (13%) were issues of concern. Stakeholders also cited restricted recreational use (67%) as a concern. Many stakeholders mentioned foul odors in the creeks, especially after heavy rain events. The City of Elwood's 14 Combined Sewer Overflows were specifically referenced. 19% of stakeholders surveyed were concerned about pollutants from agricultural runoff. A final survey was conducted and that information can be found in Appendix H. The general consensus of the final survey showed that (67%) of the respondents were more aware of water quality issues that before this project began and (97%) said they would modify their behavior if it would lead to improved water quality.

3.5 Water Quality Concerns

Water quality conditions were generally poor throughout the Little Duck Creek and Lilly Creek watersheds. With respect to water chemistry, nutrient concentrations were higher than the Ohio EPA's standards to protect aquatic life (Indiana does not possess numeric nutrient criteria). Additionally, high conductivity levels and low dissolved oxygen concentrations were of concern throughout the two watersheds. *E. coli* concentrations exceeded the state standard at sites throughout both watersheds during all four sampling events. Habitat scores were generally poor throughout the two watersheds. QHEI scores ranged from 33 (Little Duck Creek at CR 700W, Big Duck Creek at SR 13, Lilly Creek at CR 1550N) to 54 (Big Duck Creek at CR 1050N and Lilly Creek at CR 300W). mIBI scores reflected the poor habitat and water quality conditions present throughout the watersheds. Scores ranged from low of 1 (Little Duck Creek at South P Street) to a high

of 4.5 (Big Duck Creek at CR 1050N). These scores suggest that stream reaches throughout both the Little Duck Creek and Lilly Creek watersheds are not capable of fully supporting their aquatic life use designation. These results do not correspond with the IDEM 2006 303d list. However, because of our sampling results this management plan will address that concern.

3.6 Results Analysis

In order to interpret the sampling results and set water quality goals for the implementation of this WMP, the data had to be converted into a useable format. Therefore, the concentrations calculated in the lab were converted into loading rates. For example, phosphorus, nitrate, and total suspended solid concentrations were converted into kg/day of total load into the watershed system. Appendix D shows the loading rates of the various water quality parameters that were measured in the sampling series.

For the purpose of this watershed plan and setting load reduction goals, annual load was calculated for sediment and nutrient concentrations measured during JFNew's sampling events.

The final calculations for target loads, reductions needed, average reductions needed/site, average current loads, average target loads, and average % reductions/site are found in Appendix I using the target breakpoints listed in the above sections.

4.0 CLARIFYING OUR PROBLEMS

4.1 Linking Concerns to Existing Data

Throughout the planning process, watershed stakeholders were invited to share their concerns for the Lilly Creek and Little Duck Creek watershed. All of the stakeholders' concerns identified during the planning process were detailed in the Concerns Section of the Introduction (Section 1.4). The watershed coordinator developed a group of broad categories to utilize within the planning process to develop problem statements, identify priority areas, and set goals for watershed and water quality improvement. The process of developing problem statements began with an investigation of stakeholder concerns and data collected during the watershed inventory process.

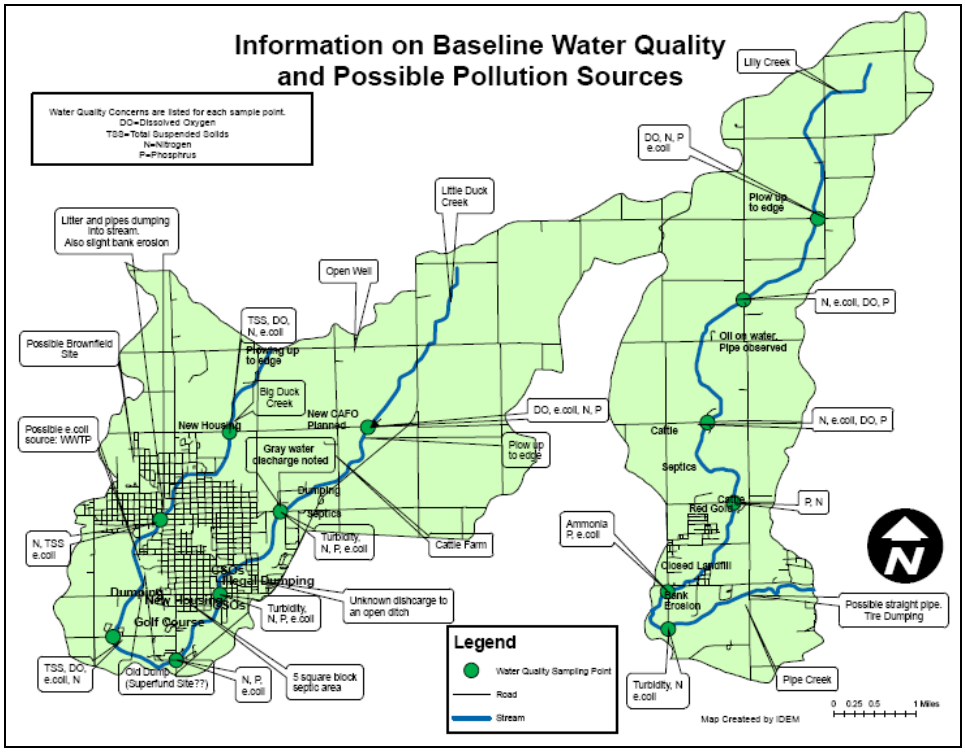

Figure 7 - Baseline Water Quality & Possible Pollution Sources.

4.11 Developing Problem Statements

Problem statement development occurred throughout the planning process in an effort to tie watershed stakeholders' concerns with existing data and develop a clear pathway for future work in the Lilly Creek and Little Duck Creek watershed. Once the problem statements were approved, the stakeholders were surveyed and asked to rank the problem statements in order from most important to least important. The problem statements below are presented in order of importance.

Problem Statement 1:

Pathogen levels in the watershed regularly exceed the state standard of 235 colonies/100mL, and often exceed safety standards for partial human contact with the water (1,000 colonies/100mL)

Stressor:	E. coli
Potential Sources:	Failing septic systems Agricultural fields where manure surface application are used Livestock and horse access to creeks-three sites

Natural wildlife, waterfowl, and pets
City of Elwood's 14 combined sewer overflows – Big Duck Creek

Problem Statement 2:
Sediment carried through the watershed is degrading and filling creeks and limiting their use for drainage, wildlife habitat, recreational, and aesthetic purposes.

Stressor: Silt/Sediment
Potential Sources: Lack of soil conservation practices in agricultural fields
Livestock and horse access to streams
Bank erosion
Construction activities

Problem Statement 3:
Elevated nitrate levels, documented in historic and recent water quality sampling, are negatively affecting the quality of downstream surface waters.

Stressor: Nutrients
Potential Sources: Soil Erosion
Agricultural fertilizers (both manure & synthetic)
Residential lawn fertilizers
Livestock and horse access to streams
Industrial waste
Household waste

Problem Statement 4:
Elevated phosphorus levels, documented in historic and recent water quality sampling, are negatively affecting the quality of downstream surface waters.

Stressor: Nutrients
Potential Sources: Soil Erosion
Agricultural fertilizers (both manure & synthetic)
Residential lawn fertilizers
Livestock and horse access to streams
Industrial waste
Household waste

Problem Statement 5:
Residents in the watershed are not knowledgeable about their daily impact on the watershed and how it impacts to water quality

Stressor: Lack of public education
Potential Sources: Improper or no septic maintenance
Residential lawn care – application of fertilizers and herbicides
Improper disposal of pet waste
Storm sewer recognition

4.12 Linking Problem Statements to Concerns

The following reflects the stakeholders' concerns and identifies the corresponding problem statement.

Concerns	*Problem Statement #*
Public needs to be educated about water quality issues	1,2,3,4
Educate community leaders who influence relevant ordinances	1,2,3,4
Identify and accentuate farms practicing conservation tillage	1,2,3,4
Identify and accentuate eco-friendly lawn care professionals and cleaners	4
Database management	4
Combined sewer overflows	1,3
Poorly installed and/or maintained septic systems	1,4
Livestock impact in creeks	1,2,3
Wildlife impact in creeks	1,2,3
Restricted recreational use (fishing, swimming, boating)	1,2,3,4
Need to identify source of e. coli	1,2,3
Stream bank erosion	1,2,3
Impaired drainage	2
Manure management	1,2,3
Proper application of pesticides and fertilizers	1,3,4
Use of agricultural conservation practices	1,2,3,4

Table 9 – Linking Problem Statements to Concerns.

5.0 CRITICAL AREAS

Taking into consideration all of the data collected throughout the planning process, the following critical areas were developed.

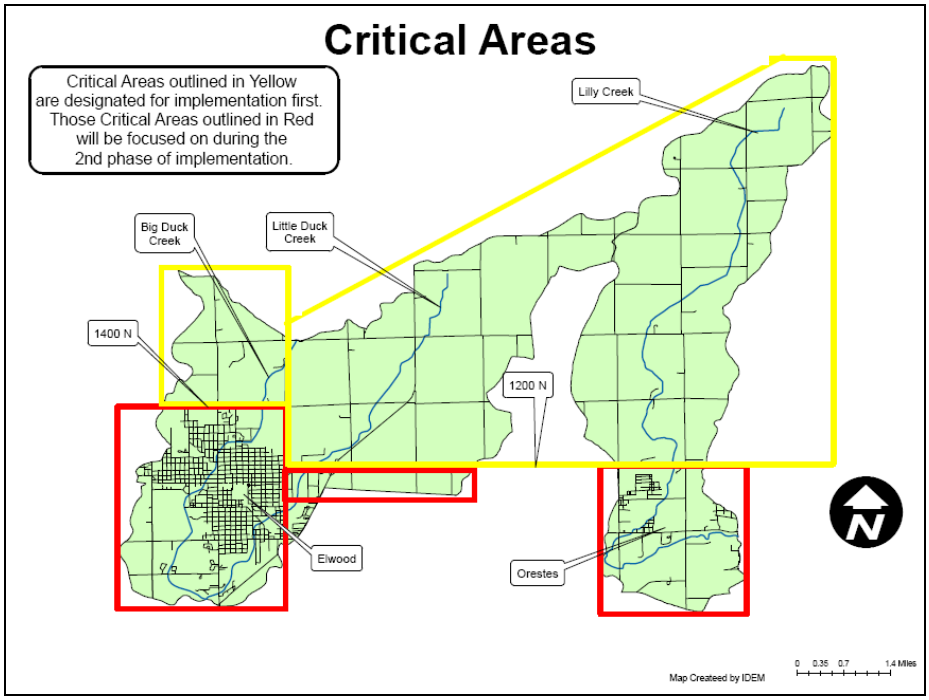

Figure 8 – Critical Areas – Agriculture and Urban

Critical Area #1

Agricultural areas that are conventionally tilled and/or lacking buffers

Through the planning process it was determined that inadequate levels of conservation tillage or no-till practices are occurring and there are large stream segments lacking buffers. (See Figures 10 and 11 below) The figures illustrate the locations of areas with adequate buffers. They also point out areas of concern or where riparian buffer areas can be improved. This can cause erosion and surface runoff of nutrients, chemicals, and sediment. All six sample sites in the agricultural areas had Qualitative Habitat Evaluation Index (QHEI) scores considered to be non-supporting for the stream's aquatic life use designation. These results do not correspond with the IDEM 2006 303d list. Due to the results of the chemical and biological assessments along with the location of headwaters the following is critical area #1. The following critical areas are prioritized for when implementation monies become available.

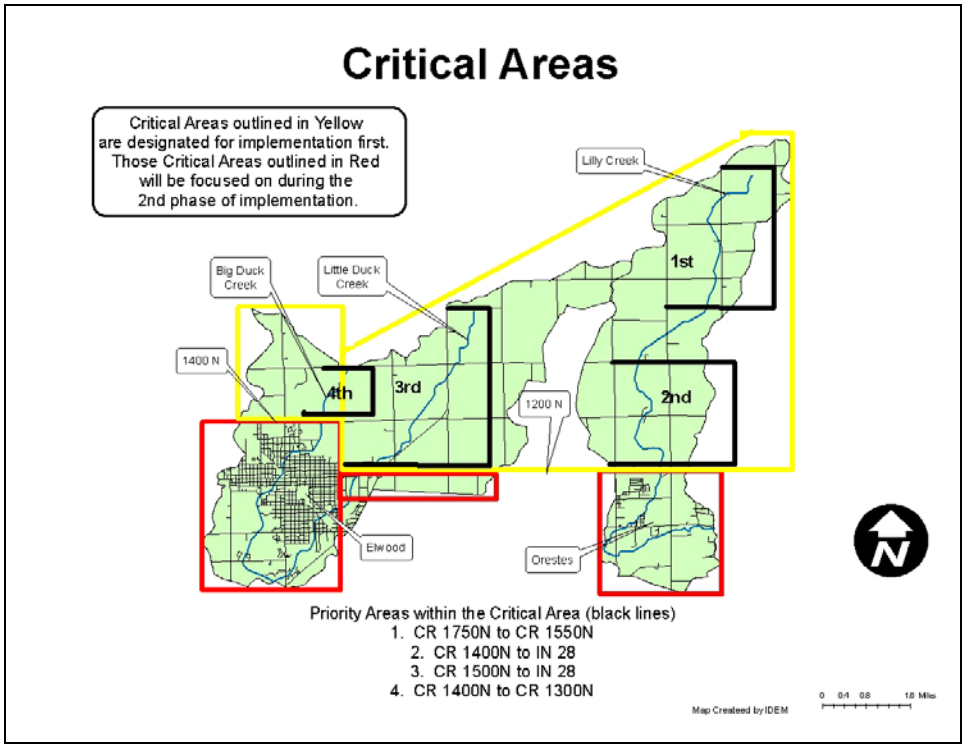

Figure 9 – Critical Areas by priority

Lilly Creek: CR 1750N to 1200N (5.5 miles)

1. **CR1550N** to **CR1750N** is the first priority area on Lilly Creek needing BMP's. This **headwater** area is lacking adequate buffers and there is heavy muck/silt deposition that is extensive. Channelization, canopy removal, and one of the lowest QHEI scores affects this stream segment. This area needs nitrate and E. coli reductions.

2. **CR1400N** to **SR28 (CR1200N)** is the second priority area on Lilly Creek needing BMP's. This area has the highest E. coli reductions needed and cattle have access to the stream at SR28. There are also five ten-apartment buildings on septic fields located west of Lilly Creek on CR1400N that house migrant workers. This area is lacking adequate buffers and there is heavy muck/silt deposition that is extensive. Channelization, canopy removal, and low QHEI scores affect this stream segment. Nitrates need to be reduced and this was the only area needing a TSS (total suspended solid) load reduction.

Little Duck: CR 1500N to 1200N (3 miles)

3. **CR700W** heading north-east to **CR1500N** is the third priority area needing BMP's. This **headwater** area is lacking adequate buffers and there is heavy muck/silt deposition that is extensive. Channelization, canopy removal, and a low QHEI score effect this stream segment. This area needs nitrate and E. coli reductions. Horses have access on the west side where Little Duck Creek goes under IN37 just south of CR1400N. During a windshield survey it was noted that surface applied manure was present on the east side of CR700W west of the creek. Cattle also have access on the west side where the creek passes under 700W just north of IN37.

Big Duck: CR 1400N to 1300N (1 mile)

4. **CR1300N to CR1400N** is the fourth priority area needing attention BMP's. This area is lacking adequate buffers and there is heavy muck/silt deposition that is extensive. Channelization, canopy removal, and one of the lowest QHEI scores affects this stream segment. This area needs nitrate and E. coli reductions.

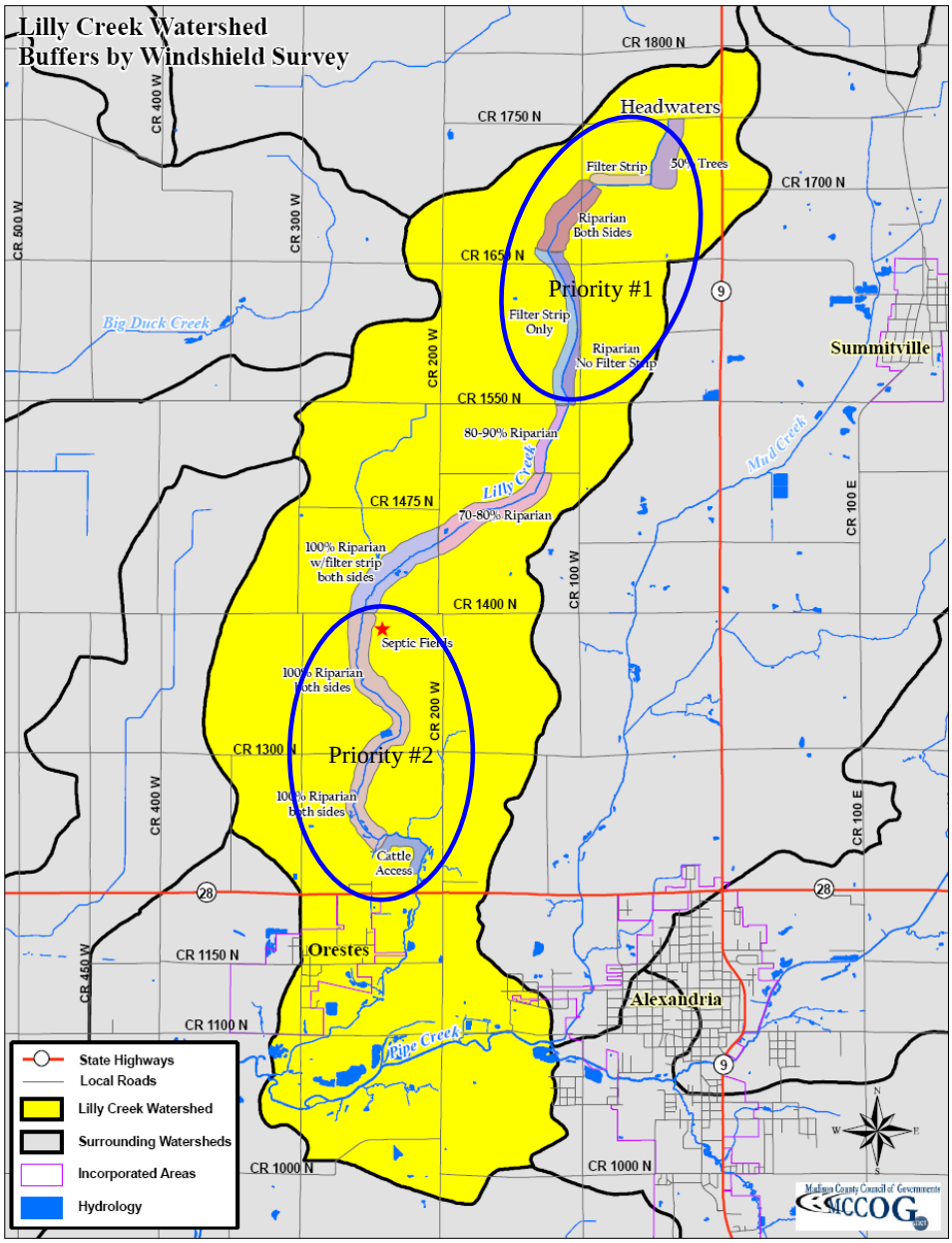

Figure 10 – Lilly Creek Buffers

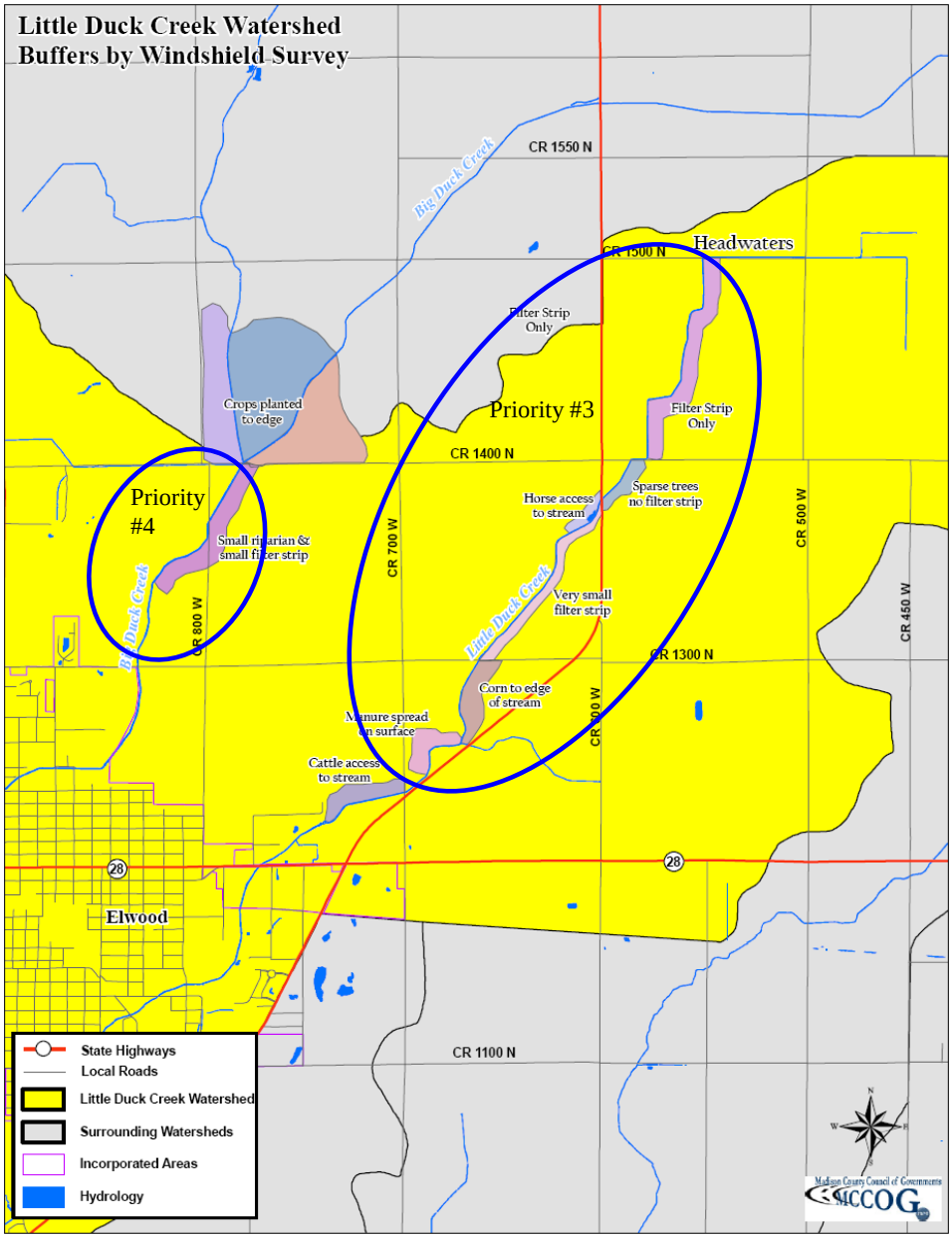

Figure 11 - Little Duck Buffers

Critical Area #2
Urbanized areas (specifically the Town of Orestes and the City of Elwood)
Throughout the planning process E. coli was cited as a major issue of concern. The chemical assessments show extremely high levels of E. coli at sampling site #1 (CR 1050N). The City of Elwood has 14 combined sewer overflows. Storm sewers shorten the transport of storm water runoff and can increase the quantity of sediment and other pollutants in the streams. Four of the seven sample sites in the urban areas had Qualitative Habitat Evaluation Index (QHEI) scores considered to be non-supporting for the stream's aquatic life use designation. These results do not correspond with IDEM 2006 303d list. The stream segments in the urban areas all need to have trash and debris removed. Citizens need to be educated about proper disposal of pet wastes, petroleum products, paints, and proper use of yard fertilizers and herbicides. Citizens need to be aware of what urban BMP practices they can utilize to reduce runoff from their residential sites.

Critical area # 2 is the following locations:

Lilly Creek: CR 1200N to 1050N (1.5 miles)
Little Duck: CR 1200N to 1025N (1.75 miles)
Big Duck: CR 1300N to 1025N (2.75 miles)

These three stream segments have the highest QHEI scores at the farthest reach from the headwaters. This may be due to increased flow rates. Five of the sixth highest E. coli reductions needed occurred in these urban stream segments. Big Duck Creek at CR1050N is below the Elwood Waste Water Treatment Plant and recorded the highest E. coli reduction needed at 99.72%. Little Duck Creek at SR13 was second at 98.90%.

6.0 SETTING GOALS

6.1 Potential Goals and Techniques

To address the problem statements, goals were developed and techniques identified for accomplishing the goals. Initial goals were derived from the stakeholder concerns and resulting problem statements. During the July, 2006 stakeholder meeting, steering committee members reviewed and refined the potential goals, and then prioritized them according to the problem statements to which they applied. The potential goals and techniques listed below were developed.

Potential Goal 1
Reduce the concentrations of E. coli in the watershed to meet the state standard of 235 colonies/100mL by 2030.

Potential Techniques:
- Determine specific sources of E. coli
- Replace failing septic systems and encourage routine maintenance
- Restrict livestock and horse access to creeks in Lilly and Little Duck creeks

- Promote conservation practices to agricultural and residential stakeholders
- City of Elwood reduces 14 CSO's as funding becomes available

Potential Goal 2
Reduce the sediment load during storm events to Lilly Creek & Little Duck Creek watershed by 25% over the next ten years.

Potential Techniques:
- Promote conservation tillage
- Riparian buffers, filter strips, grassed waterways
- Enforcement of erosion control ordinances
- Restrict horse and cattle access to streams
- Place the watershed on a regulated drain maintenance program

Potential Goal 3
Reduce the nitrate loads in Lilly Creek & Little Duck Creek watershed by 15% over the next five years.

Potential Techniques:
- Promote conservation tillage
- Riparian buffers, filter strips, grassed waterways
- Restrict horse and cattle access to streams
- Replace failing septic systems and encourage routine maintenance
- Proper residential lawn care and storm sewer awareness
- Manure management practices program

Potential Goal 4
Reduce the phosphorus loads in Lilly Creek & Little Duck Creek watershed by 15% over the next five years.

Potential Techniques:
- Promote conservation tillage
- Riparian buffers, filter strips, grassed waterways
- Restrict horse and cattle access to streams
- Replace failing septic systems and encourage routine maintenance
- Proper residential lawn care and storm sewer awareness
- Manure management practices program

Potential Goal 5
Increase stakeholder participation in implementation of the Lilly Creek & Little Duck Creek WMP.

Potential Techniques:
- Outreach (newsletters, press releases, SWCD website)
- Coordination with local community groups or units of local government

- Public education (field days, BMP tours)
- Promote other governmental agency conservation programs (CREP, CRP, EQIP, Hoosier Heartland RC&D)

6.2 Final Goals and Objectives

The following goals and action plan are a result of several public and steering committee meetings. The plan is designed to address critical area # 1 during the first five years of the cost-share implementation phase. The urban component of the implementation cost-share program focusing on critical area #2 will occur during years 5 through 10 and involve another funding source.

To achieve these goals the Farm Service Agency, Indiana State Department of Agriculture and Natural Resources Conservation Service will assist the Madison County Soil & Water Conservation District in the execution of a cost-share program marketing agricultural BMPs. The agricultural BMPs could include but are not limited to conservation tillage, riparian buffers, filter strips, grassed waterways, field borders, and livestock exclusion fencing. The primary focus will be to develop and implement a cost-share program for equipment modifications for no-till and reduced till. Estimated costs of equipment modifications are $500 - $600 per planter row. The steering committee strives to convert 1/3 of the cropland to no-till within five years and 2/3 of the cropland within 10 years. One third of the cropland changing from conventional tillage to conservation tillage practices will allow for target sedimentation, nitrate and phosphorus load reductions to be achieved. Another goal of the steering committee is to have 30 acres of filter strips installed within 10 years. The estimated cost per acre of filter strip is $65-150.

The sedimentation reductions found below in Table 10 and Table 12 were calculated using the USLE (Universal Soil Loss Equation) for cropland with less than 3% slope. 30% residue was used for the conservation tillage calculations. The actual reductions in sedimentation and nutrients will be greater because some of the ground is strip-tilled which leaves at least an 85% residue cover.

The nutrient reductions found in Table 11 and Table 12 were calculated using IDEM's Region V model. The data generated for Tables 10 through 12 are located at the Madison County SWCD.

Table 10 - Plan for Best Management Practices Implementation Sedimentation Reduction Table

Priority Ranking	Creek	Location of BMP	Best Management Practice	Number of Acres	Sediment Reduction in tons/year	Responsible Party
1	Lilly	CR1550N to CR1750N	Conservation Tillage	1,280	4,736	SWCD
2	Lilly	SR 28 to CR1400N	Conservation Tillage	1,280	4,736	SWCD
3	Little Duck	CR700W to CR1500N	Conservation Tillage	1,920	7,104	SWCD
4	Big Duck	CR1300N to CR1400N	Conservation Tillage	640	2,368	SWCD
TOTALS				5,120	18,944	

Formatted: Font: Not Bold

Implementation will start during the first quarter and continue throughout the contract time period until the implementation monies are exhausted. All BMP's will be ranked and implemented by proximity to the waterway and with regard to the load reductions that can be attained. The Madison County SWCD will be the responsible party for all conservation tillage rankings and equipment modifications. The NRCS, ISDA, Hoosier Heartland RC & D, and CREP will be the responsible parties for the installation of filter strips, riparian wildlife habitat areas, and grassed waterways.

Table 11 - Nutrient Reduction Table

Priority Ranking	Creek	Location of BMP	Best Management Practice	Number of Acres	Nitrogen Reduction pounds/year	Phosphorus Reduction pounds/year
1	Lilly	CR1550N to CR1750N	Conservation Tillage	1,280	5,133	2,568
2	Lilly	SR 28 to CR1400N	Conservation Tillage	1,280	5,133	2,568
3	Little Duck	CR700W to CR1500N	Conservation Tillage	1,920	7,394	3,699
4	Big Duck	CR1300N to CR1400N	Conservation Tillage	640	2,751	1,376
TOTALS				5,120	17,872	8,944

Table 12 – Long Range Estimated Load Reductions in Critical Areas 1-4 Combined

Year	Post BMP-years	Sediment Reduction-Tons	Nitrogen Reduction-Tons	Phosphorus Reduction-Tons
2010	2	37,888	35,744	17,888
2015	7	132,608	125,104	62,608
2020	12	227,328	214,464	107,328
2025	17	322,048	303,824	152,048

Once implemented, this watershed management plan will exceed the goals for sediment, nitrogen, and phosphorus reductions by the year 2015. The E. coli loads will be reduced due to conservation tillage practices and other best management practices listed in this plan. The

In focusing on critical area # 2, cooperation from the town and city officials will be needed. The Orestes town council president serves as the steering committee president and the mayor of Elwood has also been involved throughout the planning process as well as other city of Elwood employees. Storm drains prevent flooding of roads and neighborhoods by carrying rain and snowmelt away from streets and sidewalks. Unlike water from our taps and tub, water flowing into storm drains is not treated. Storm drains connect directly into our streams. Trash, pet waste, motor oil, paint, and other materials dump or wash into storm drains into Lilly, Little Duck, and Big Duck Creeks. Markers on each storm drain will remind the citizens to keep storm drains and our streams clean. The Cattails Country Club in Elwood could help by installing buffer strips along the southern edge of the property close to Big Duck Creek.

The following are the prioritized goals and respective action plans for the Lilly Creek & Little Duck Creek watershed.

Goal 1: The watershed group aspires to reduce E. coli to the state standard of 235 colonies/100mL by 2030 and educate stakeholders on BMPs available to reduce pathogenic contamination of the Lilly Creek & Little Duck Creek watershed.

Implementation Items:

- Elwood reduces the current 14 CSO's as funding becomes available.
- Develop and distribute residential flyers to help with individual lot reductions in stormwater run off.
- Develop and distribute a summary of BMPs available to reduce the risk of pathogenic contamination of waterbodies in the Lilly Creek and Little Duck Creek watershed. The list should include management techniques to address contamination from all potential sources. In addition, the list should be written to target a non-technical audience.
- Conduct a conservation tillage marketing program.
- Develop and implement a cost-share program for Best Management Practices (BMPs). BMPs could include but are not limited to conservation tillage, riparian

buffers, filter strips, grassed waterways, field borders, and horse and livestock exclusion fencing.

Education Items: Education will take place during the first two years.

- Mail septic system repair and maintenance brochures to residents of the watershed
- Conduct a tour of city sewage treatment plant.
- Conduct a field day to educate the public on agricultural BMPs.
- Develop and distribute nonpoint source pollution education newsletters and press releases.
- Maintain watershed website and advertise it at outreach events.
- Conduct a conservation tillage marketing program.

Goal 2: By the year 2015, reduce the nitrate load during storm events to Lilly Creek and Little Duck Creek watersheds by 15%.

Implementation Items:

- Develop and implement a cost-share program for Best Management Practices (BMPs). BMPs could include but are not limited to conservation tillage, riparian buffers, filter strips, grassed waterways, field borders, and livestock exclusion fencing.

Education Items:

- Conduct a field day to educate the public on agricultural BMPs.
- Develop and distribute nonpoint source pollution education newsletters and press releases.
- Maintain watershed website and advertise it at outreach events.

Goal 3: By the year 2015, reduce the phosphorus loads to Lilly Creek and Little Duck Creek watersheds by 15%

Implementation Items:

Conduct a conservation tillage marketing program.

- Develop and implement a cost-share program for Best Management Practices (BMPs). BMPs could include but are not limited to conservation tillage, riparian buffers, filter strips, grassed waterways, field borders, and livestock exclusion fencing.

Education Items:

- Conduct a field day to educate the public on agricultural BMPs.
- Develop and distribute nonpoint source pollution education newsletters and press releases.
- Maintain watershed website and advertise it at outreach events.

Goal 4: Increase stakeholder participation in implementation of the Lilly Creek and Little Duck Creek WMP.

Implementation Items:

- Promote other governmental agency conservation programs (CREP, CRP, EQIP, Hoosier Heartland RC&D)
- Coordinate with local community groups or units of local government to conduct creek clean-ups, label storm drains, promote soil & water conservation 4H projects, etc.
- Utilize city, county, and state politicians to leverage involvement.
- Conduct a conservation tillage marketing program.

Education Items:

- Develop and distribute nonpoint source pollution education newsletters and press releases.
- Maintain watershed website and advertise it at outreach events.

7.0 MEASURING SUCCESS

Measuring the success at achieving the stakeholders' goals and assessing the progress towards realizing their vision for the Lilly Creek and Little Duck Creek watershed is an important component of this plan. Success will be measured by the following:

- Reversing the negative trend for no-till corn and beans in Madison County utilizing the 2007 & 2009 Madison County Tillage Transect. We would like to increase no-till corn by 10% by the 2009 Tillage Transect.
- Increase public attendance at conservation tillage field days, BMP tours, public meetings, steering committee meetings, creek clean-ups, etc.
- Counting the number of new CRP, CREP, EQIP, etc. applications.
- Geolocating newly installed BMPs.
- Improvement of chemical and biological assessments as determined by future testing.
- Reduction in sediment and nutrient loading as determined by future testing.
- Pre and post implementation surveys to stakeholders.

8.0 CONCLUSION

The successful implementation of the WMP in the Lilly Creek and Little Duck Creek watersheds will have allowed producers to participate in a cost-share program that directly benefits all stakeholders by improving water quality. Conservation tillage in this 35 mile square headwater area is the single best management practice that can help reduce E. coli, sedimentation, nitrates, and phosphorus. This practice used in combination with riparian buffers, filter strips, grassed waterways, with horse and cattle exclusion fencing will help improve the water quality of these streams while also improving wildlife habitat and recreation opportunities. This watershed management plan will exceed the goals for nitrogen, and phosphorus reductions by the year 2105. With the expected implementation to begin in 2008, the initial outcome is expected to take us to at or over our goals for the first critical area. Further improvements to be implemented in a subsequent phase to address the second downstream critical priority area.

9.0 REFERENCES CITED

APHA-AWWA-WPCF, 1998. Standard Methods for the Examination of Water and Wastewater. 15th edition, APHA, Washington, USA.

City-data.com, 2005a. Anderson, Indiana. Accessed August 29, 2005 from http://www.city-data.com/city/Anderson-Indiana.html

Correll, D.L., 1998. The Role of Phosphorus in the Eutrophication of Receiving Waters: A Review. J. Environ. Qual. 27:261-266.

Hilsenhoff, W.L., 1988. Rapid field assessment of organic pollution with a family-level biotic index. Journal of North American Benthological Society. 7(1):65-68.

Hoosier Riverwatch Training Manual, 2004.

Indiana Department of Environmental Management (IDEM), 1998. Indiana Water Quality Report. Annual Report: IDEM/34/02/002/1998.

Indiana Department of Environmental Management (IDEM), 2006. Indiana Water Quality 305(b) Reports. http://www.in.gov/idem/owm/planbr/wqs/quality.html. Accessed July, 15 2006.

Indiana Department of Environmental Management (IDEM), 2006. Section 303(d) List of Impaired Water Bodies for Indiana. http://www.in.gov/idem/owm/planbr/wqs/303d.html. Accessed July 15, 2006.

Indiana Department of Natural Resources, 1999. Endangered, threatened and rare species documented from Madison County, Indiana. http://www.state.in.us/dnr/naturepr/species/madison.pdf Accessed September 20, 2005.

Karr, J.R. and D.R. Dudley, 1981. Ecological perspective on water quality goals. Environmental Management. 5:55-68.

Karr, J.R. and E.W. Chu, 1999. Restoring life in running waters. Island Press, Washington D.C.

McCafferty, W.P., 1981. Aquatic Entomology. Jones and Bartlett Publishers, Sudbury, Massachusetts p.447.

Ohio Environmental Protection Act (OEPA), 1999.

Simon, Thomas, 2004. Assessing the Fish Communities and Habitat Quality of the Upper White River Tributaries from Indianapolis to Muncie, Indiana. US Fish & Wildlife Service, Bloomington, IN.

U.S. EPA, 1976. Quality criteria for water. EPA-440/9-76-023 or PB-263943. National Technical Information Service, Springfield, VA.

U.S. EPA, 2000. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health. EPA-822-B-00-004. Office of Science and Technology Office of Water U.S. Environmental Protection Agency. Washington D.C.

U.S. Department of Agriculture, 1967. Soil Survey Madison County Indiana. Washington D.C.

Walker, R.G., 1978. Deep-water Sandstone Facies and Ancient Submarine fans: Models for Exploration for Stratigraphic Traps. American Association of Petroleum Geologists Bulletin 62:932-966.

Waters, TE., 1995. Sediment in Streams: Sources, Biological Effects and Control. American Fisheries Society: Bethesda, MD

Special Thanks for Support, Leadership, and Technical Assistance

I would like to thank the stakeholders who live in the Lilly and Little Duck watersheds for their participation in this project.

I would like to thank the Madison County Soil and Water Conservation District and their Supervisors for sponsoring this 319 grant. I would like to acknowledge Laura Fribley, who was the Watershed Coordinator for the first year. Janelle Parke provided assistance with the production of the watershed newsletters and coordination of the steering committee meetings. Shannon Adams provided administrative assistance.

The Steering Committee and the sub-committees provided invaluable assistance throughout this entire project.

Sara Peel from JF New provided technical assistance with the QAPP, QHEI, and all of the biological and chemical assessments.

The Madison County surveyor, Brad Newman served as a steering committee member and also helped with aerial pictometry assessment of stream buffers.

The Madison County Council of Governments provided assistance with the generation of the watershed maps. Thanks to Trent Pell and Rob Shumowski.

The Indiana State Department of Agriculture (ISDA) provided technical planning for conservation practices installed through the Conservation Reserve Enhancement Program (CREP). Thanks to Doug Walker.

The Natural Resources Conservation Services (NRCS) also provided technical assistance. Thanks to Mike Hughes and Told Herrli who were the District Conservationists.

Judy Delury is an Associate Supervisor at the Madison County SWCD and a steering committee member. Judy assisted Brad Newman in gathering buffer information from aerial pictometry and completed all of the GIS requirements for this project.

Trinka Mount from the Ohio-EPA-TMDL section helped with establishing nutrient targets and provided reference materials.

The following people from the Indiana Department of Environmental Management (IDEM) helped during this two and a half year process: Bonny Elifritz, Sky Schelle, Pam Brown, Tim Kroeker, Joanna Land, Kathleen Hagan, Steve West, Nathan Rice, and Ernie Johnson.

Mayor Merrill Taylor and Bill Savage provided assistance from the City of Elwood.

John Shettle provided assistance from the Town of Orestes.

Thank you for all of your help in making this watershed management plan.

Crist Blassaras-Watershed Coordinator