Section 1:
Introduction and Overview of the Watershed

Morgan County's Watershed Initiative – Background of Receiving a Section 319 Grant

In July of 2001 The Morgan County Soil and Water Conservation District (SWCD) entered into a contractual agreement with the Indiana Department of Environmental Management (IDEM). The purpose of the agreement was to hire a watershed coordinator, engage the public in water quality prioritization and planning, and develop a watershed management plan based upon research, public input, and public priorities.

The agreement between the SWCD and IDEM was the result of a grant application prepared and submitted by the SWCD under the Section 319 program, a funding program referencing Section 319 of the Clean Water Act and focusing on nonpoint source water pollution. The grant application was screened by IDEM and consolidated with other grant applications submitted by other SWCDs, local governments, and nonprofit organizations. The result was a consolidated package of grant applications submitted by IDEM to the United States Environmental Protection Agency (EPA). Through this submittal, IDEM requested funds for many local watershed projects in Indiana as well as funds to help pay another federal agency, the United States Department of Agriculture Natural Resource Conservation Services (USDA NRCS) to provide technical support to IDEM and to those communities receiving funds to develop plans.

EPA approved the package of grant applications and provided funding to IDEM. IDEM then, in turn prepared the aforementioned contractual agreements with the Morgan County SWCD and other communities that prepared and submitted successful grant applications.

After some public involvement and analysis of the contract, the Morgan County SWCD agreed to enter into the contract with IDEM. The contract called for 24 months of public coordination, research, and plan writing for a 52,438-acre watershed that ultimately drains to the Upper West Fork of the White River in the north central part of Morgan County. The contract became effective in May of 2001.

Between May and September of 2001, the SWCD held the first of 8 quarterly stakeholder meetings (public meetings) required in the contract. Over 50 people attended the first meeting, which was held at Bradford Woods. A great deal of interest was generated at this meeting, and the NRCS representatives (contracted by IDEM) who attended the meeting recommended that four watershed committees be developed at that time. These committees included Education and Outreach, Land Use, Technical, and Steering. The role of the Steering committee was to coordinate and consolidate research and planning efforts of the other three committees. Another recommendation was for each of these committees to hold monthly meetings, in addition to the 8 quarterly stakeholder meetings described in the contract.

In September of 2001, the SWCD chose to hire contract personnel to serve the role of "watershed coordinator". The SWCD entered into a sub-contractual agreement with a professional environmental staffing company, Goode & Associates, Inc., whose specialty is water quality management, policy analysis, and watershed coordination. This subcontract allowed for 20 months (what remained in the initial 24 months) of coordination, meeting facilitation, water quality field sampling, map preparation, and various related coordination and management services. Goode & Associates, Inc. provided a "Coordination Team" (referred to throughout this document) consisting of a land use planner, a biologist/water quality chemist, an agricultural specialist, a local government policy and regulatory specialist, and a Geographical Information Systems (GIS) mapping and database specialist.

This document represents the overall watershed analysis and inventory prepared by the watershed coordination team with consistent input from committee members and the public, and the recommendations for water quality improvement and protection that resulted from such efforts.

Public Participation and a Locally Developed Management Plan:
Public participation played a major role in the analysis and preparation of this document. The Morgan County Watershed Initiative engaged the public over a period of two years to ensure that all aspects of this analysis and planning process were led by the citizens of Morgan County. Some details of this effort are discussed in Section 2 of this document.

With the assistance of the IDEM and the NRCS, an initial meeting among stakeholders (those who live in, work in, or have some particular interest in the watershed) was held in Griffith Hall at Bradford Woods on July 19th 2001. Those who assisted in facilitating this meeting included personnel from the IDEM, NRCS, and Morgan County SWCD. At this meeting several committees were established, including a Land Use Committee, a Technical Committee, an Education and Outreach Committee, and a Steering Committee where the other three committees could coordinate their efforts and collectively develop a plan.

The many participants initially established themselves as the "West Central Morgan County White River Initiative". After a short time however, the participants chose to simplify the name of the effort as simply, the "Morgan County Watershed Initiative." The Initiative established itself as a partnership of citizen stakeholders with the following mission: "*The purpose of the Morgan County Watershed Initiative is to develop a plan to understand our impacts on the West Central Morgan County White River Watershed and to protect and improve water quality*."

In addition to this mission statement, the participants in the first meeting established what they felt at the time to be seventeen "Concerns". These concerns as recorded at the first meeting included:

- Unmanaged growth.
- What streams are impaired? By what and during which season?
- Erosion-county and utility practices and urban development.
- Herbicide spraying-roadsides, utility areas.
- Illegal dumping.
- Farm practices-buffers, herbicides, livestock production and animals in the creek.
- Leaking underground storage tanks.
- Logging practices.
- Runoff from roads and impervious surfaces.
- People in the streams.
- Lack of access to river for recreation.
- Educating residents.
- What is upstream of the river?
- How to consolidate what information is known and how to make it available?
- Failing septic issues, to include treatment capacity and what to connect.
- Riparian vegetation-aquatic habitat improvement and stream bank erosion.
- Failed septics and the impact on drinking water supply.

These seventeen concerns evolved and were fine-tuned and consolidated throughout a watershed coordination and planning process that attempted to involve public input wherever and to the greatest extent possible. Throughout the course of the two-year analysis and planning period, the Initiative held over 50 committee meetings and eight quarterly stakeholder meetings. The eight quarterly stakeholder meetings were heavily advertised for public participation through U.S. mailing and e-mailing invitations, radio announcements, newspaper articles, and flyers posted at public places. While not always publicized, all of the Watershed Initiative committee meetings were also open to public participation.

1.1 Description of the Watershed:

1.1.1 Overview

Morgan County's White River/Lambs Creek watershed falls within the Upper White River West Fork Basin in Central Indiana. The Upper White drains to the White River Basin, which in turn drains to the Wabash River and then to the Ohio River. The Ohio River drains to the Mississippi, which ultimately feeds the Gulf of Mexico. As this chronology of drainage suggests, activities within the Morgan County White River Watershed can play a role, albeit minor, in the overall health of the Mississippi Basin and the Gulf of Mexico.

The area of focus for this watershed plan is the watershed to White River inside Morgan County, Indiana north of the City of Martinsville. This total drainage area encompasses 52,438 acres and is identified by the Hydrologic Unit Code (HUC) No. 05120201-160. Morgan County borders Marion County to the south and is considered a "donut county", experiencing the early effects of suburban population growth and urban sprawl. The watershed is dominated by forest, agriculture, and rural residences. The City of Martinsville, which is Morgan County's largest city and the County Seat, lies in the southernmost point of the watershed and in the center of Morgan County. The watershed is further divided into six subwatersheds, each identified by a unique 14-digit hydrologic unit code. Figure 1.1 provides a map of the watershed. Figure 1.2 shows where the subject watershed falls within the encompassing 8-digit Upper White River West Fork Basin.

1.1.2 Geology and Geographic History

Morgan County's diverse landscape provides a unique look at its natural history. The border separating glaciated northern Indiana from the unglaciated southern portion of Indiana can be observed in the northern reaches of the watershed. Wisconsinan and Illinoian glaciation had the greatest effects on what can be observed today, which is flatter ground in the north and hillier ground in the south. Wisconsinan glaciation terminated near the Martinsville area, in the southern portion of the watershed (central Morgan County). The White River valley drained much of the glacial ice, which flowed southward into the hills of southern Morgan County.

1.1.3 Natural History

Due in part to the diversity of soils in the watershed, which is also a result of glaciation in the area, the entire natural system within the watershed is quite diverse.

Native vegetation in the area is generally broad-leaf deciduous forest. Virtually all old growth hardwoods have been cut at one time or another, leaving newer growth forest and agricultural lands dominating the watershed.

Native wildlife and its evolution is similar to that found throughout the state of Indiana.

1.1.4 Cultural History and Resources

The following information regarding cultural history and resources was compiled by Joanne Raetze Stuttgen, Ph.D. As a resident of Martinsville, Dr. Stuttgen is a stakeholder in the Morgan County White River Watershed, serves on the Martinsville Plan Commission, and has participated on the Land Use Committee for the Watershed Initiative as both a cultural history expert and a residential stakeholder.

Human occupation of the White River Watershed is estimated to have occurred as early as 11,000 years ago. Early Native Americans established settlements and transportation routes through the area, leaving behind a rich and amazing variety of cultural artifacts. (Among the rarest of these found by a local collector are six Clovis points dating from approximately 9,000 BC.) More recent Native peoples were the Miami, Delaware and Shawnee. They, too, left behind evidence of their long occupation. Within the Watershed, the most recently documented site is the Voyles-Bundy Site, located on the east side of SR 39 at White River. Excavated in 1995 by Indiana University, the site is estimated to have been occupied by the Delaware between 800-1200 years ago.

The period of initial occupation by Anglo-American settlers began during the years between Indiana statehood in 1816 and the cession of lands comprising southern Indiana by the Miami Indians in 1818. The first public sales of land in the area that would become Morgan County occurred in 1820. The county itself was organized in 1822. Early platted villages within the Watershed include Martinsville, the Morgan County seat, platted in 1822; Monrovia (1834); Centerton (1854); and Hall (1851-52). The majority of early settlers migrated into southern Indiana from Appalachia, bringing with them cultural traditions of the Upland South: speech and agricultural patterns, foodways, architecture, even political ideology. During this period of initial settlement (1816-1853), pioneers established home sites and communities along White River and its creek tributaries. They felled the native trees—poplar, walnut, white oak, hickory, beech, maple and other varieties—and cleared the land for farms on which were raised corn and livestock, especially hogs. The bluffs were used for grazing.

Pork packing was a major early industry. Flatboats loaded with pork and grain were regularly sent down White River to New Orleans. Other pioneer-era industries dependent on the area's natural resources included saw and gristmills; brick making; and the quarrying of limestone for bridge abutments and building foundations.

Among the most significant historic resources within the watershed remaining from the pioneer era (c1816-1853) are two houses built c1850 and c1860 on the Bradford Estate property in the White River-Centerton Subwatershed; Elm Spring Farm (c1860) in the Lambs Creek-Goose Creek Watershed; the Mt. Pleasant, Stout, Highland, Mt. Zion and Poplar Grove Methodist Episcopal Cemeteries in the Lambs Creek-Patton Lake Subwatershed; and the Hastings and Nutter Cemeteries and Hendricks Farm, located north of Martinsville along Blue Bluff Road, in the White River-Martinsville Subwatershed. The Bradford Estate property and Elm Spring Farm are listed on the National Register of Historic Places.

The completion of the railroad through Martinsville in 1853, and through Mooresville—the largest town in the northern part of Morgan County—in the 1860s, boosted the county's agricultural economy by providing a link to distant markets. Pre-Civil War-era prosperity and an increasing population that demanded more public services and structures—churches, schools, commercial business, professional services—is reflected in a number of significant historic properties that mark the mid-nineteenth-century. These include a number of rural one-room schoolhouses in each subwatershed, as well as fine brick houses and the commercial district in Monrovia.

Due in large part to the coming of the railroads, Morgan County experienced a period of growth and maturity between 1853-1910. No longer solely reliant on fulfilling its own needs, residents turned to outside sources for necessary and desired goods such as building supplies, household goods, farm implements, clothing and machinery. Improved roads were necessary to transport goods such as these from the railroad stations in Martinsville and Mooresville. Several corporate organizations, such as the Monrovia and Hall Gravel Road Company, were organized. Improved roads brought a second generation of bridges, mostly iron trusses that replaced wood covered bridges. An outstanding historic example of a Pratt through truss, County Bridge No. 146, also known as Lamb's Creek Bridge (1893) is found in the Lamb's Creek/Goose Creek Subwatershed. The peculiar plate girder Lake Ditch Bridge (fabricated 1895, placed over Lake Ditch 1926) is found in the Lambs Creek-Patton Lake Subwatershed. Both bridges are on the National Register of Historic Places.

The years between 1853 and 1910 saw a number of families establish large farming enterprises in areas of rich, sandy loam in the White River bottoms and in the northwest portion of the county. This area had been a natural marsh before being drained between 1875-1916 with

the construction of Lake Ditch and a number of smaller ditches.

In the Lambs Creek-Patton Lake Subwatershed, the Hurt family owns hundreds of acres near Hall that are drained by Lake Ditch. In the White River-Centerton Subwatershed, the Milhon family has owned and cultivated the rich river bottom farmland for approximately 100 years. And in the Lamb's Creek-Goose Creek Subwatershed, the land owned by Jim and Ann Lankford has been continually farmed by four generations. These families are exceptions to the norm, however, as most farmers in the Watershed subsisted on significantly less acreage of poorer quality in regards to topography, natural irrigation, soil type (predominantly clay, shale and sand) and natural cover such as trees and other native plants.

Beginning about 1895, Morgan County entered a period of specialized industry dependent on its rich variety and abundance of natural resources. A number of unique businesses found a home in the White River Watershed. In 1888, the Bradford family (of the previously mentioned Bradford Estate, White River-Centerton Subwatershed) discovered a high quality of sand on their property along the banks of Sycamore Creek, mined it and sold it to cast metal mold companies. They acquired over 2,000 acres in the area and built the Bradford Sand Mining Company into a major local business. Nearby in Centerton and Brooklyn, which lie just outside the Watershed, clay and shale were mined and used for the production of brick and tile.

Another one-of-a-kind enterprise, Grassyfork Fisheries, a goldfish hatchery, was located in the White River-Martinsville Subwatershed. Established in 1899 by Eugene Shireman, who capitalized on the area's natural springs and low areas, Grassyfork was by World War II the largest producer of goldfish in the world. The success of Grassyfork encouraged others to enter the fish-raising business. In the Lambs Creek-Goose Creek Subwatershed, for example, local farmer Elmer Fowler raised game fish in 14 pounds on his property for almost 50 years. The Indiana Department of Natural Resources also maintains hatcheries along SR 37 north of Martinsville. A major industry in Martinsville, which lies largely outside the Watershed, was mineral water spa/sanitariums from 1887-1965 (peak years 1900-1930).

A gold mining company operated in the early 1900s along Sycamore Creek in the White River-Highland Creek Subwatershed. It fell to the wayside, but a second venture was again in place during the 1930s and early 1940s. On top of Jake's Butte in the Lambs Creek-Goose Creek Subwatershed, another small mining operation was active in the 1930s. The remnants of quickly-erected miner's cabins and household goods—tin cans, pieces of broken ceramic crocks—can still are found on top of the Butte.

With increased mobility through the use of the Interurban and privately owned motorcars, Morgan County waterways—especially White River—became popular sites for recreation. Private clubs included Rettun Lodge, owned by the Nutter family, and the High Rock Cabin, both located on White River at High Rock. Numerous fishing camps along the sandy banks of the river along the current SR 67, such as Kirkwood and Idle Hours, were available to less prosperous residents. North of Martinsville, the Blue Bluffs Resort was a popular destination for rental cabins, canoes and rowboats, swimming, dancing, picnics and a nearby restaurant specializing in fried chicken.

In 1916, a number of Clay Township residents came together to offer land along Sycamore and Gold Creeks (White River-Highland Creek Subwatershed) to the state for development as a state park. The area was praised for its lush fern glens, canyons filled with cottonwood and quiet nooks of natural beauty. The park was never developed.

Major floods in 1875 and 1913 saw Morgan County's creeks and White River raise to unprecedented levels. The flood of 1913 was a repeat of the earlier tragedy. After nearly 48 hours of continuous rain on March 24-25, 1913, the White River escaped its banks at Centerton and swept into Martinsville. Estimated to be a

mile in width in some places, the swollen river destroyed the rail and Interurban lines, washed out bridges and downed telephone lines. A less devastating flood occurred again in 1930. In hopes of preventing still more disasters, the Army Corps of Engineers constructed the existing levee on the east side of White River north of SR 39 sometime in the mid-1950s.

Another notable federal assistance project within the White River Watershed was the construction of Patton Lake (Lambs Creek-Patton Lake Subwatershed) by the Army Corps of Engineers in the late 1930s. The lake originated as a hand-dug pond held by an earthen berm, both of which were constructed for the use of Morgan County Boy Scouts. Dedication of the new, federally-funded lake was July 4, 1938. Patton Lake—also known as Patton Park—was for many years the premier public recreation area in the Morgan County. Beginning in the early 1960s, the Patton Park/Lake area entered a period of slow decline and neglect that is so evident today.

Also in the 1930s, the Civilian Conservation Corps was involved in selective reforestation in the White River Watershed. A representative example is the planting of pine seedlings at Elm Spring Farm (c1860), located on Goose Creek. The farm was worn out and depleted, the hills grazed bare, when it was lost by the homesteading family during the Depression. The new owners were not farmers and used the property as a private summer retreat, which they shared with local Girl Scouts. With the help of the CCC, they worked to restore and reclaim the land. In recognition of their efforts, Elm Spring Farm was listed on the National Register of Historic Places in 2001.

While Elm Spring Farm was being reclaimed during the 1930s, other significant properties were just being built. The most significant among those remaining from this period is the Goethe Link Observatory (1937) high atop Observatory Hill in the Sycamore Creek Subwatershed, and Foxcliff Estate (1934-1935), a massive Tudor style residence built for Frank Shields, owner of the Barbasol Company. Located in the White River-Martinsville Subwatershed, Shields's house and 800-acre estate was developed into Foxcliff North and South, one of central Indiana's premier golfing residential communities.

From the period of Native American occupation to the present, the White River Watershed is an area rich with significant cultural resources. It is the hope of the professional and community members of the West Central Morgan County White River Watershed Initiative that these resources will continue to be respected, researched, preserved and promoted during the current and any future projects.

SELECTED SOURCES

Anderson, James R. 1947. "White River—Historical Influences Observed in Morgan County." *Indiana Magazine of History*, September 1947, 240-249.

Blanchard, Charles. 1884. *History of Morgan, Monroe and Brown Counties.* Chicago: F. A. Battey.

Hurt, John E. Telephone interview with Joanne Raetz Stuttgen, 18 March 2003.

Morgan County Interim Report. 1993. Indianapolis: Historic Landmarks Foundation of Indiana.

Reynolds, Elmer. Telephone interview with Joanne Raetz Stuttgen, 18 March 2003.

Stuttgen, Joanne Raetz. 1995. *Martinsville: A Pictorial History*. St. Louis: G. Bradley.

Vertical files, Morgan County Public Library, Martinsville.

Figure 1.1

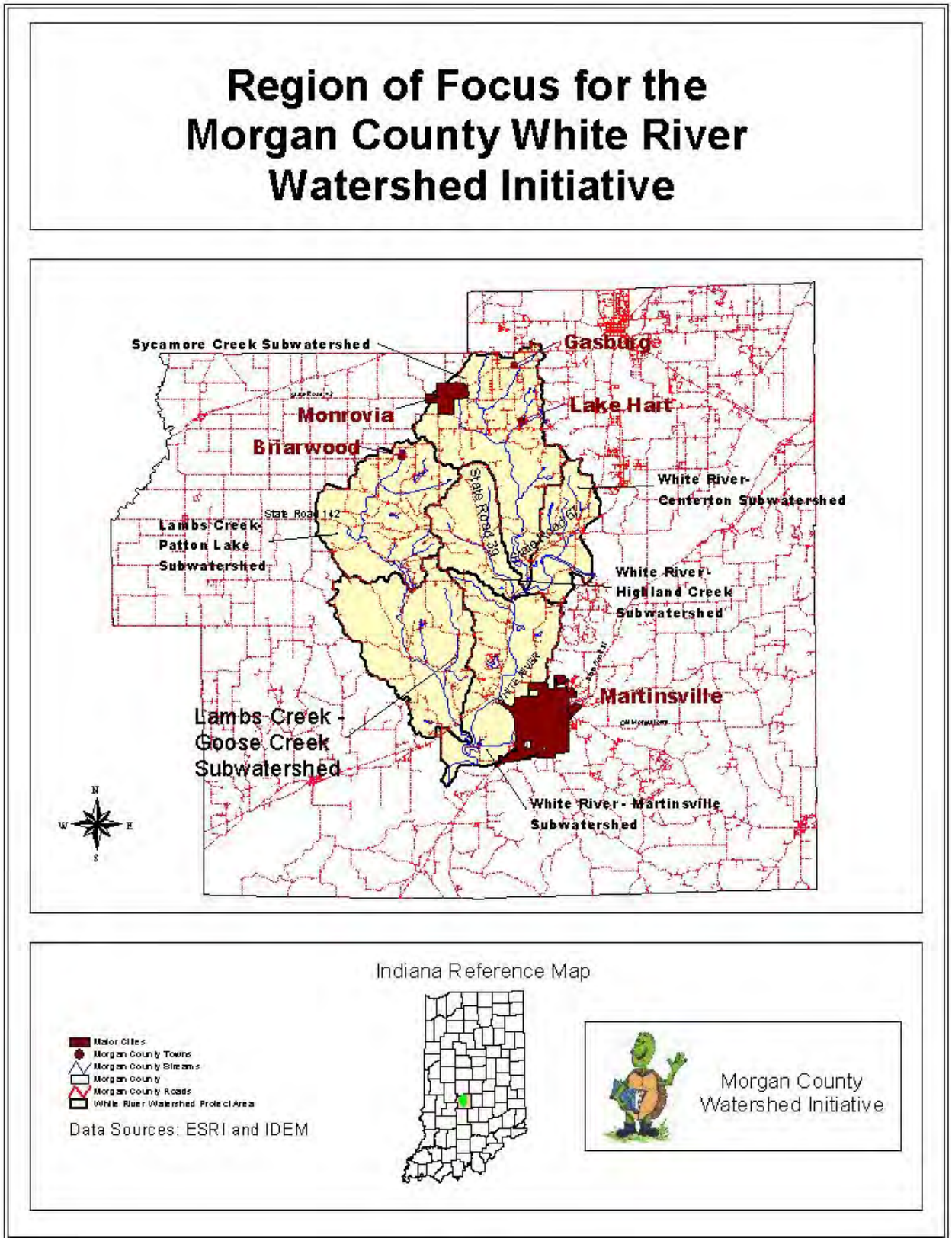
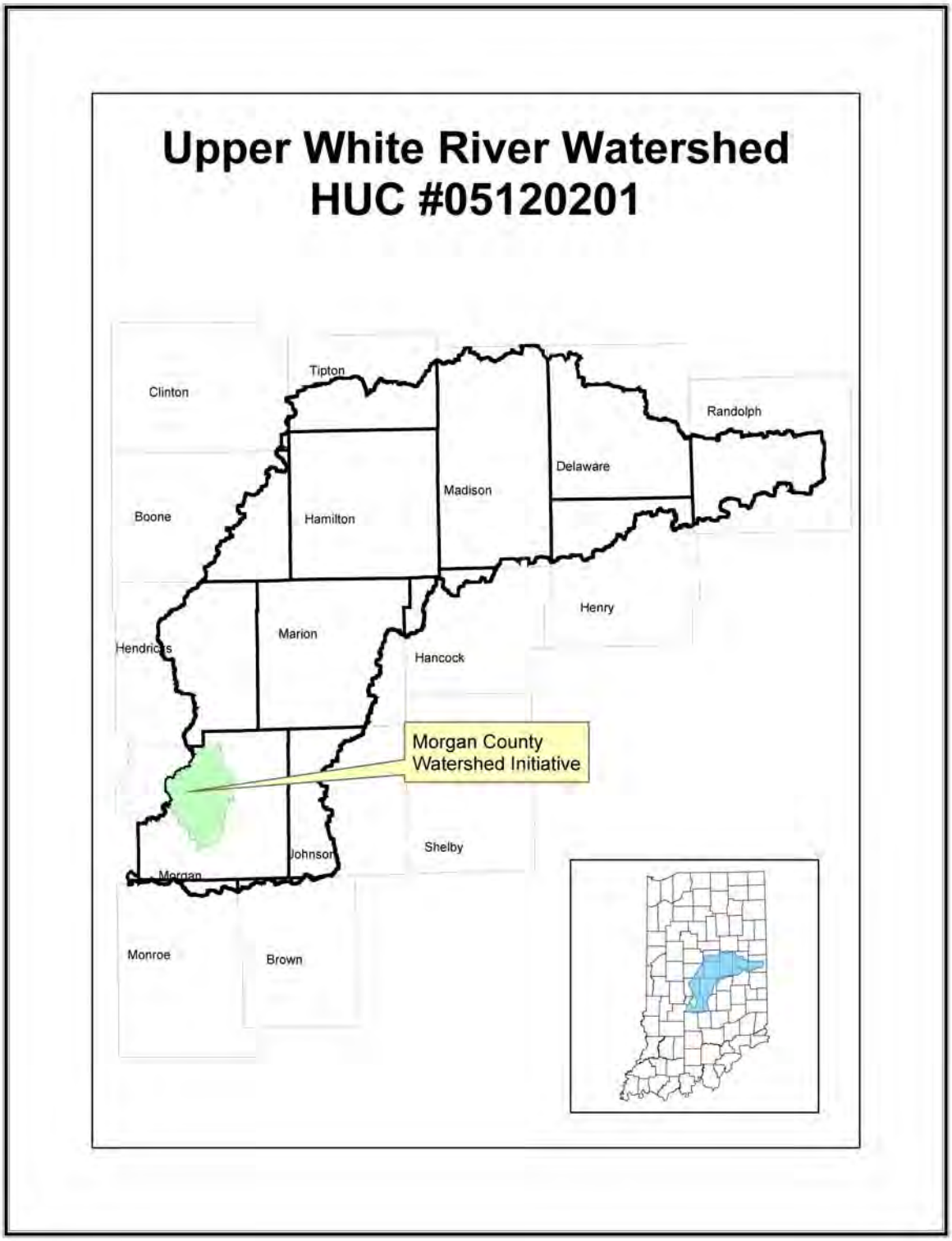


Figure 1.2, Map showing encompassing 8-digit Upper White River West Fork Basin



1.1.5 Current Land Use

The land use in the watershed is made up predominantly of rural residential, agriculture, state-owned land, and small urban communities. Among these land uses, forest canopy is

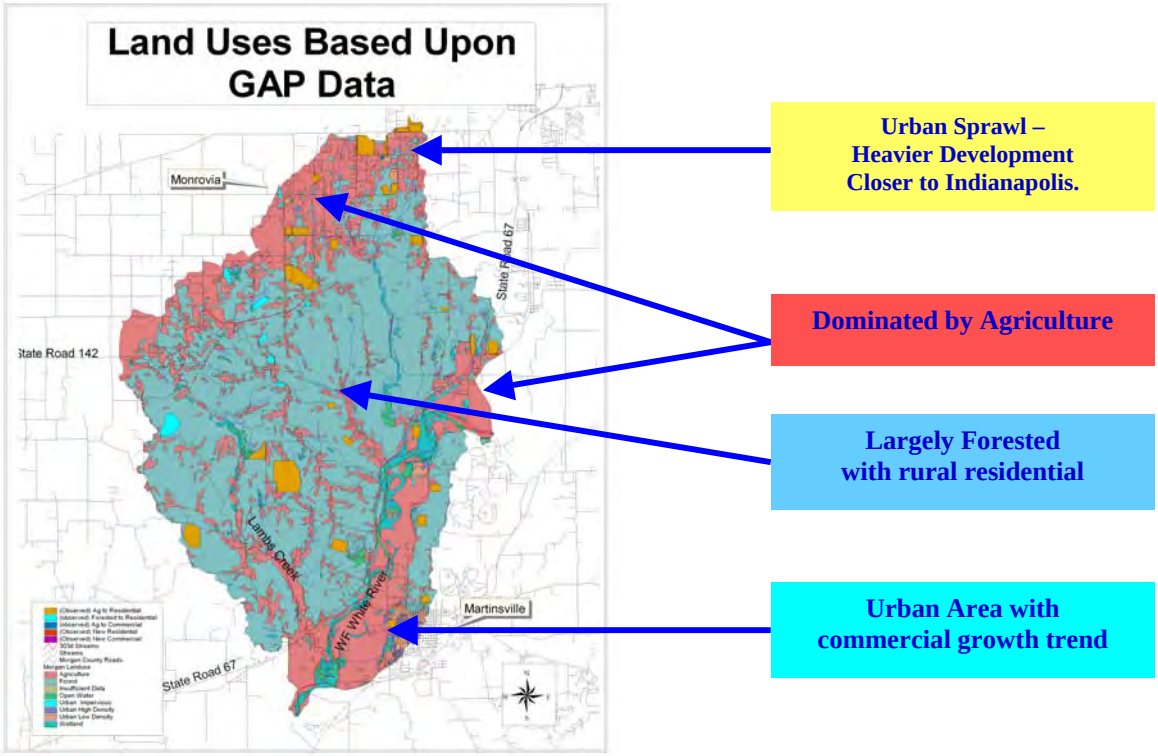
predominant, covering nearly 60% of the watershed.

The northern portion of the watershed is predominantly agricultural lands that are experiencing some suburban development pressure from the Indianapolis area. The Town of Monrovia, with a population of roughly 700 is situated in this area, in the northwestern portion of the watershed. Residential and commercial growth is anticipated to dramatically impact the area around Monrovia over the next several years. Several recent and pending property acquisitions, re-zoning requests, and development proposals point to significant population growth and associated land use change around Monrovia in coming years.

The middle portion of the watershed is predominantly forested lands owned by private residences, Indiana University, and others. The Indiana University Board of Trustees owns Bradford Woods, a 2,575-acre tract made up mostly forested hills and valleys, campgrounds and a small lake. In its current state, Bradford Woods provides extremely valuable wildlife habitat, natural areas, and buffer from pending population growth from the north (Indianapolis/Monrovia) and the south (Martinsville).

The southern portion of the watershed includes the City of Martinsville, with a population of nearly 12,000. Figure 1.3 below provides a very generalized view of the land use in the watershed using GAP (Gap Analysis Program) Data. GAP data is managed by the USGS and identifies various different land uses with the goal of providing resource managers with the ability to make informed land use decisions.

Figure 1.3



According to GAP Project data analysis combined with aerial photography and field observations, the following tables 1.1 and 1.2 describe land uses in the watershed divided into acres and percentages:

Table 1.1 identifies land uses in the watershed by acreage:

Land Use in Acres							
	West Central Morgan County White River Watershed	Sycamore Creek	Lambs Creek-Patton Lake	Lambs Creek-Goose Creek	Highland Creek	White River Centerton	White River Martinsville
Pasture	7,049	2,718	1,270	1,558	542	337	624
Row Crops	10,232	2,218	1,875	996	189	1,319	3,635
*Deciduous Forest***	31,693	6,570	6,254	8,432	4,345	2,184	3,942
Conifer Forest	119	36	27	7	4.3	30	15
Open Water	756	142	95	27	1.0	91	400
Urban High Density	207	14	0	0	0	10	183
Urban Impervious	309	33	44	0	0	105	127
Urban Low Density	567	99	0	0	.5	29	438
Wetland***	1,492	138	104	107	42	395	706
Total Acres	52,438	11,968	9,669	11,127	5,124	4,480	10,070
** Includes mixed forest, shrubland, woodland *** Includes several wetland types							

Table 1.2 identifies land uses in the watershed by percentage

Land Use in Percent							
	West Central Morgan County White River Watershed	Sycamore Creek	Lambs Creek-Patton Lake	Lambs Creek-Goose Creek	Highland Creek	White River Centerton	White River Martinsville
Pasture	13	5.2	2.0	3.0	1.0	0.6	1.2
Row Crops	20	4.2	3.6	2.0	0.4	2.5	7.0
*Deciduous Forest***	60	13.0	12	16.0	8.3	4.0	7.5
Conifer Forest	0.2	0.1	0.05	0.01	0.01	0.05	0.02
Open Water	1.4	3.0	0.2	0.05	0.002	0.17	0.8
Urban High Density	0.4	0.02	0	0	0	0.02	0.3
Urban Impervious	0.6	0.06	0.08	0	0	0.2	0.2
Urban Low Density	1.1	0.2	0	0	0.001	0.05	0.8
Wetland***	3.0	0.3	0.2	0.2	0.1	0.8	1.3
** Includes mixed forest, shrubland, woodland *** Includes several wetland types							

Table 1.3 identifies local activities and conditions with potential for impacting water quality.

Activities or Conditions with *Potential* for Impacting Water Quality
Morgan County White River Watershed (WORKING DRAFT)

Underground Storage Tanks	166
Leaking Underground Storage Tanks	41
NPDES Dischargers (*)	10
Hazardous Waste Generators	72
Hazardous Materials Handlers	5
Septic Systems	Unknown – estimated between 5,000 and 8,000
Failing Septic Systems	Unknown – many reports exist at Health Dept.
Livestock Operations (small/unregulated)	39 (estimated based on field observations)
Drinking Water Intakes from Surface Water	At least 4 public. Private unknown
Auto Salvage Yards	5
Dumping or refuse collection	50 + identified in field
Streambank Erosion Priority Areas	
Other Erosion Problem Areas (Ag/Devel)	
Drainage Complaints	Begin Recording at SWCD
Other Issues/Conditions	
Impervious Surface Area Coverage:	309 acres based upon aerial photos/GAP data

Preserved or protected areas	
Classified Forest Owners	34
Classified Forest Acreage	2,029 acres
Managed/Public Forest Lands	2,343 acres
Total Forest (see Land Use Percent chart) (not necessarily "protected"	31,812 acres
% of total forested land "protected"	Approx. 14.6 %
Old Growth Forest	N/A
New Growth Forest	31,812 acres

1.1.4.2: Agriculture

While agriculture is not the most dominant land use in the watershed, row cropping dominates the northern, flatter lands around Monrovia as well as the floodplains along White River. Small livestock operations are found scattered throughout the watershed. The majority of those operations are cattle. Horses, goats, llama, and pigs are also present. No livestock operations in the watershed meet Indiana's definition of a confined feeding operation.

Agricultural issues are covered in ***Section 5, Row Crop Management Issues*** and in ***Section 6, Livestock Management Issues.***

1.1.4.3 Solid and Hazardous Waste Sites:

There are both regulated hazardous materials handling locations and hazardous waste sites located in the watershed. Both of these are covered in ***Section7, Commercial and Industrial Issues.***

1.1.6 Soils

According to the USGS National Water Quality Assessment Program Report for White River, the watershed is composed of two primary hydrogeomorphic strata, the till plain and the bedrock upland (USGS National Water Quality Assessment Program). The till plain in the upper portion of the watershed is flat to gently rolling and consists of buried pre-Wisconsin till with overlying Wisconsin till at the surface.

Lenses of sand and gravel occur in the loamy till and the drift ranges from 50-400 feet thick. The bedrock uplands make up the southern portion of the watershed and consist of relatively resistant siltsones, sandstones, limestones, and shales. Differential erosion has produced the relatively high relief hill and valley landscape that characterizes the bedrock uplands strata.

Soil types vary significantly within the watershed area. According to the Morgan County Soil Survey, there are five areas within the watershed where general soil types differ. These include:

(1)The northern third of the watershed, which is dominated by deep, nearly level to very seep, well drained to somewhat poorly drained soils on uplands. The two primary soil types in this area are: the Miami Crosby series, characterized as deep, nearly level to very steep, well drained and somewhat poorly drained soils, limited in their susceptibility for soil loss and erosion poorly suited for use as septic absorption fields, that formed in loess and the underlying glacial till on uplands; and the Miami-Fincastel-Xenia series, characterized as deep, nearly level to very steep, well drained to somewhat poorly drained soils, limited in their susceptibility to erosion and soil loss, poorly suited for use as septic absorption fields that formed in loess and the underlying glacial till on uplands.

(2)The upper middle section of the watershed, which includes areas dominated by moderately deep and deep, gently sloping to very steep, well drained soils on uplands. The predominant soils series in this area of the watershed include Hickory-Bedford, Hicorky-Cincinnati-Ava, and Vigo-Ava-Cincinnati

(3)Much of the middle of the watershed is dominated by the upland Berks-Gilpin-Zainesville series, which are moderately deep and deep, gently sloping to very steep, well drained solis that formed in residuum of sandstone and sale or in loes and the underlying residuum of sandstone.

(4)Alford-Grayford, Alford-Hickory, and Parke-Chetwynd-Pik series dominate a portion of the southwestern portion of the watershed near Martinsville. These are mostly deep, nearly level to strongly sloping well drained soils.

(5)Finally, the Wakeland-Banlic-Wilber and Gennessee- Shoals series dominate the areas of the watershed that border White River. These are deep, nearly level, somewhat poorly drained and moderately well drained solids on bottom lands and low terraces.

1.1.7 Topography

Morgan County is described by in the Soil Survey of Morgan County (USDA Soil Conservation Service), Indiana as complex, with a range of relief from 970 feet above sea level to 550 feet above sea level.

The northern portion of the county, which includes the northern portion of the watershed, is nearly level and rolling and has few abrupt changes in elevation. The central and southern parts of the county (roughly the southern two-thirds of the watershed) vary more in elevation and have sharp drops of as much as 250 feet from the ridgetops to the bottom lands.

The White River valley is characterized by broad flat flood plains, which flow from the northeast to the southwest.

1.1.8 Hydrology

1.1.8.1 Streams:

The primary drainage system in the watershed is the White River. The White flows through the eastern portion of the watershed and drains much more area from the west. Tributaries to the White River within the watershed include:

Lambs Creek, which drains a total of 20,798 acres in the western and northwestern portion of the watershed. The Lambs Creek watershed is subdivided into two 14-digit hydrologic unit coded watersheds: Upper Lambs Creek and Patton Lake (HUC) and Lower Lambs Creek and Goose Creek ( ). Several of the smaller tributaries have dams constructed to retain small impoundments. The most significant dam and reservoir is Patton Lake, which divides Upper and Lower Lambs Creek.

Sycamore Creek, which drains a total of 11,969 acres in the north central portion of the watershed.

Highland Creek, which drains a total of 5,129 acres in the eastern portion of the watershed.

White River, which drains a total of 14,543 acres in the eastern and southern portions of the watershed. This section of the White River Watershed is subdivided into two 14-digit hydrologic unit coded watersheds: White River near Centerton (HUC) , which drains a total of 4,470 acres and White River near Martinsville (HUC), which drains a total of 10,073 acres in the southern portion of the watershed

1.1.8.2 Wetlands

What remains of the area's natural wetlands are scattered about the watershed and are represented in both palustrine and riverine systems. Palustrine wetlands typically stand alone from more identifiable bodies of water such as rivers and lakes and are characterized by trees shrubs and a variety of emergent vegetation. Riverine wetlands are typically found along rivers and streams and are characterized by both submergent and emergent vegetation.

1.1.9 Land Ownership

The majority of the property inside the watershed is privately owned. However, a large section (approximately 2500 acres) is owned by the Indiana University Trustees and is known as Bradford Woods and Camp Riley. Many of the privately owned properties around Bradford Woods are 10-30 acres in size. However, several significant landowners (estimated to own 100 acres or more, based on plat map observations) are listed below:

- Weston Paper and Manufacturing Company, which owns several forested acres west of Patton Lake.
- Patton Park Inc., which owns much of the property surrounding Patton Lake in the Lambs Creek Watershed
- Indianapolis Power and Light (AES IPALCO), which owns Pritchard Park and a power plant along White River, both in the White River Centerton Watershed.
- The State Convention of Baptists, which owns nearly 350 acres of forested property in the Highland Creek Watershed.
- The Crone family
- Rhoades Investment Co., Inc.
- Barnard family and farms
- The Milhon family
- The Farr family
- The Cragen family
- The Wagoner family
- The Ruby family

There are at least two conservation clubs in the watershed. These include:

- the Mallory Conservation Club, which owns 266 acres in the Sycamore Creek Watershed
- the Victor Conservation Club, which owns 40 acres.

There are two dedicated preservation/conservation areas in or adjacent to the watershed. These include:

- Central Indiana Land Trust, Inc. (CILTI), which owns a 14-acre tract called Shalom Woods off Observatory Road.
- Nature Conservancy, which owns 31.8 acres in eastern portion of the White River Centerton Watershed

Several subdivisions, commercial parks, and industrial parks can also be found in the watershed, especially in and around the communities of Martinsville and Monrovia.

1.1.10 Rare and Endangered Species

The watershed and proposed project areas are within the range of the federally endangered Indiana bat (Myotis sodalis) and the federally threatened bald eagle (Haliautus leucocephalus).

Bald eagles currently reside in the watershed. In the early 1990's, a nesting pair was established at Bradford Woods in the southern portion of the Sycamore Creek Watershed. Staff at Bradford Woods named the male eagle, "General Patton" and the female, "Rainbow". General Patton also nested with another female in a protected area in the northwestern end of Patton Lake in the Lambs Creek/Patton Lake watershed. The nest at Patton Lake has had successful reproduction. Later in 1997, Another male that the Bradford Woods staff named, "Casanova" took over the nest at Bradford Woods.

The presence of two nesting pairs of bald eagles within this one watershed in Morgan County suggests that the watershed provides both woodland and aquatic habitats necessary these birds at a level of quality that is sufficient for their needs.

Information regarding state endangered species can be obtained from the Indiana Department of Natural Resources.

Public Sanitary Wastewater Treatment Services

Sanitary sewer service and wastewater treatment is provided in City of Martinsville, Bradford Woods, and the Town of Monrovia. Residences outside of the sewered areas in the watershed utilize septic systems for sanitary waste disposal. The Morgan County Health Department has identified four areas of consolidated homes inside the watershed where failing septic systems and associated leachate are known to be a problem. These areas include:

Patton Lake
Lake Hart
Lake Edgewood
Centerton

More detailed discussions regarding septic systems are provided in ***Section 3, Septic Systems and Residential Issues.***

Priority Goals #1-4 for this Watershed Management Plan.

This Watershed Management Plan is divided primarily by land use, in order to provide the reader with readily accessible, pertinent information regarding the type of land use in which the reader is interested.

In most cases, the plan addresses the same topics, questions, and issues in each section in order to be consistent and to provide direct information related to the EPA and IDEM requirements of the contract that supported this plan. Additionally, each section identifies ***objectives*** and recommended ***actions***, which are directly related to the plan section. Each objective and action supports the ***Primary Goals*** of this Watershed Management Plan.

The following are considered primary goals to be achieved through both the development ***and*** implementation of this Watershed Management Plan. Together, these constitute the overall, umbrella goals of this entire effort. Sections within this document will support these Primary Goals. Goals for ***plan development*** are identified as Primary Goals #1-3. The ultimate goal of plan ***implementation*** is Primary Goal #4. This goal will be supported within each section of this plan by Objectives, Management Measures, and Action Plans.

Primary Goal #1:

Identify land use activities in the watershed that affect water quality

Primary Goal #2:

Identify existing water quality problems in the watershed

Primary Goal #3:
Prioritize geographical areas and land use activities in the watershed based upon water quality and land use.

Primary Goal #4:
To the greatest extent possible and with existing and potential resources, improve and protect water quality in the watershed with the intention, where applicable and appropriate, to achieve and maintain state water quality standards.

Basic Facts – The Watershed At a Glance

Watershed Name:	**White River-Lambs Creek**	
Hydrologic Unit Code:	**051120201-160**	
Location:	**North-central Morgan County, Indiana**	
Total Area:	**52,438 acres**	
Townships Affected:	**Green, Clay, Washington, Jefferson, Gregg, Monroe**	
General Land Uses: *(approximate percentage)*	**20 % Row Crops** **13% Pasture** **60% Forested** **2% Urbanized** **3% Wetland** **1.4 % Open Water**	
Six Subwatersheds:	**Upper Lambs Creek & Patton Lake** **Lower Lambs Creek & Goose Creek** **Sycamore Creek** **Highland Creek** **White River Centerton** **White River Martinsville**	**(9,669 acres)** **(11,129 acres)** **(11,969 acres)** **(5,129 acres)** **(4,470 acres)** **(10,073 acres)**

SECTION 2
Education and Outreach Strategy

2.1 IDENTIFYING PROBLEMS

2.1.1 What Was Already Known

What was actually known in the area of water quality education and outreach to the public is difficult to quantify. Based upon the watershed coordination team's observation of water quality education statewide, it could be assumed that the public stakeholders living and working in the watershed were very typical of Indiana residents with regard to their knowledge and understanding of water quality conditions and water quality protection practices. Simply speaking, it was assumed that education about surface and groundwater quality could stand to be dramatically improved in the watershed, as it could be throughout the State of Indiana.

It was already known that at least two bodies of water in the watershed were listed by the state as being "impaired". Impairment was caused in some cases by *E. coli* bacteria. Thorough and proper education of livestock owners as well as septic system owners is often a first step in addressing such issues. The fact that impairments exist for bacteria suggests that education remains an important first step in addressing existing water quality problems in the watershed as well as protecting water bodies from future pollution.

From a more positive perspective, it was also already known that several water quality education programs existed in Morgan County, including, but not limited to: The Morgan County Soil and Water Conservation District's water quality education programs for local students; the District's field programs that are provided at a 32-acre facility called Fallwood; water quality education programs provided at Bradford Woods, which is owned by Indiana University; school curriculum in both Monrovia and Martinsville that focus on water quality; local Master Naturalist and Master Gardner programs; and support from the Riverwatch Program and other Indiana Department of Natural Resources programs. Compared to other counties, these efforts alone are quite remarkable and could serve as models for other counties to follow. On the other hand, it was clear that these programs were in some cases restrictive and in most cases in desperate need of funding for equipment and human resources.

2.1.2 What Was Learned During the Process

The Watershed Initiative maintained an Education and Outreach Committee throughout the two-year study period. Sitting on the committee were professional educators from Bradford Woods, Monrovia schools, and the Soil and Water Conservation District. What was learned and/or confirmed was that there does indeed remain a lack of understanding regarding what the water quality conditions are, how our activities impact water quality, how we can protect water quality, and how we can improve water quality.

Additionally, interaction at 8 publicly-noticed stakeholder meetings, over 50 committee meetings that were open to the public, and one full week of personal interaction with visitors to the Morgan County Fair all confirmed that there is a lack of understanding about water quality concerns in the county and more importantly, a need for educating residents, farmers, industry leaders, community leaders, commercial property owners, forested landowners, and developers about effective ways to protect water quality.

Roughly 60% of the watershed is forested, and the northern reaches are dominated by agricultural land experiencing above average rates of population growth, which can be attributed to urban sprawl from the Indianapolis area. Education is needed now to help forest owners understand the water quality protective value of their forested land; to help planners, politicians, and

developers to understand the impacts of unmanaged growth and increased impervious surfaces; to help farmers and livestock producers better understand appropriate management practices; and to provide general public education to both adults and students about water quality and the resources that require protection in Morgan County. Many of these subject-specific needs are covered in more detail in other sections of the Plan.

The SWCD currently employs a Conservation Educator, Bill Brenneman. Mr. Brenneman works with schools and other entities, providing knowledge about watershed protection. As part of the Watershed Initiative's (prior 319-funded) strategic plan, the Education and Outreach Committee listed Mr. Brenneman's program as an area worth expanding/enhancing. Much of this enhancement would come through grant-funded resources needed by the district to more effectively educate students and adults alike.

2.1.3 Causes or Probable Causes of Impairments or Threats to Water Quality

Indications from the Education and Outreach Committee as well as other stakeholder participation suggest that the ultimate causes of a lack of understanding of water quality issues include the following:

- Education programs are too narrowly targeted to school-aged children, and in some cases only to those children enrolled in certain classes.
- There is a lack of funding needed to:
    - reach a larger audience.
    - purchase equipment to help teach the public about water quality conditions and water quality protection.
    - hire personnel to teach the public about water quality condition .
- There is an inherent lack of interest among the public to learn about or act on water quality issues when there is a perception that such issues do not directly nor immediately affect them in a negative manner. This is often the result of busy lifestyles.
- The amount of coverage of such issues in media sources, such as television, radio, newspaper could be increased.

2.1.4 Sources or Probable Sources of Pollutants or Conditions Causing Water Quality Impairments

Specific sources of pollutants are more directly discussed in other Sections of this Watershed Management Plan. Generally speaking, sources include: failing septic systems; livestock in streams; urban runoff from impervious surface areas; sediment from streambank erosion and cropland erosion; pesticides and herbicides from over-application and runoff from some farms and residential lawns; open dumps; and poor vehicle maintenance.

Public education is a fundamental first step for addressing all of the above water quality management issues. As they continue to develop, education programs should be individually tailored to each of the subject areas and their respective audiences.

2.1.5 Prioritization

From a geographical perspective, the Education and Outreach Committee prioritized the City of Martinsville, the Town of Monrovia, Fallwood Enterprises, and Bradford Woods as primary venues for education programs. Education is needed throughout the watershed; however, the bulk of the watershed population, schools, businesses, and public meeting places are all consolidated in these two municipalities. Outdoor classroom venues have been targeted to continue at Fallwood (east of Martinsville) and at Bradford Woods in the Sycamore Creek subwatershed.

Prioritization by subject matter was addressed among other committees. General water quality education was a priority for the Education and Outreach Committee,

while specific programmatic education such as septic system management and livestock best management practices are addressed in other sections of this document.

2.2 GOALS AND DECISIONS

2.2.1 Goals for Improvement and Protection:

Primary Goal #4 of this Watershed Management Plan, as outlined in Section 1 of this document is, "to the greatest extent possible and with existing and potential resources, improve and protect water quality in the watershed with the intention, where applicable and appropriate, to achieve and maintain state water quality standards." In order to achieve Primary Goal #4 of this Watershed Management Plan, the following objectives related to education and outreach have been established by the Watershed Initiative Education and Outreach Committee:

Objective #2-1:
Increase and link water quality education efforts among Morgan County elementary and high school age students.

Objective #2-2:
Educate adults through newsletters, presentations, river cleanups, events, and other means about the importance of and practices necessary for water quality protection.

Objective #2-3:
Increase public knowledge and awareness of government and private sector programs that are designed to help protect water quality through better agriculture and forest management and protection measures.

Figure 2.1: Public display of Watershed Initiative at Morgan County Fair, 2002.

Figure 2.2: Public information display at one of eight quarterly "Stakeholders Meetings"

Figure 2.3: Local watershed stakeholders participating in educational field studies at Bradford Woods

Figure 2.4: local children visiting Fallwood and learning about watershed management along the "Activity Trail"

2.2.2 Management Measures

In order to help achieve the goals of the Watershed Initiative, a communication source was developed for familiarity and consistency of delivering the messages of water quality education. The source is a mascot, named "Morgan the Turtle".

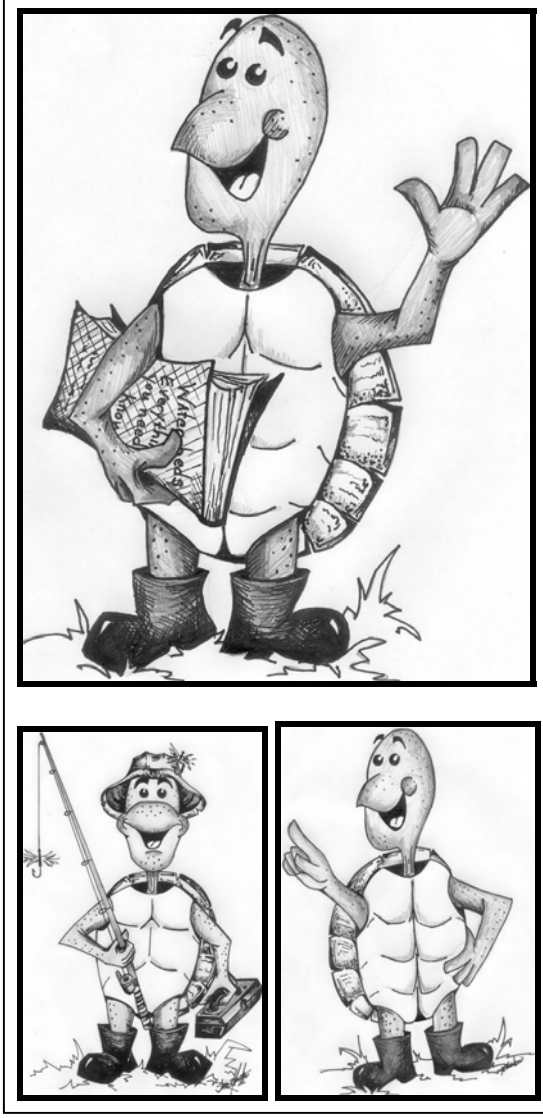
The concept of Morgan the Turtle was created by the Education and Outreach Committee and collectively approved by the Steering Committee and the Soil and Water Conservation District Board of Supervisors.

Artwork for Morgan the Turtle was provided by Tim Martin, while working for a local, participating corporate stakeholder, Pike Lumber Company, Inc.

Morgan the Turtle was "introduced" to the public at a quarterly stakeholders meeting in November 2001. Following that meeting, Morgan was then introduced in December in the Martinsville and Mooresville newspapers with an article explaining Morgan's role in the community and that there would be periodic "Dear Abby" type of reader question and answer columns. A few months after Morgan's introduction, the Education and Outreach Committee produced magnets and tee shirts depicting Morgan the Turtle on the front, and sponsor stakeholders on the back. The tee shirts are sold at public meetings, and revenues from the tee shirt sales are set aside for education projects such as refrigerator magnets, etc.

Morgan the Turtle has been established as Morgan County's voice for water quality education. In addition to its current role, this mascot should be utilized for municipal and county requirements under NPDES Storm Water Phase 2 (Rule 13) for public education and outreach.

Figure 2.3: Various poses of "Morgan the Turtle." Artwork courtesy of Tim Martin



Other measures utilized for achieving public awareness during the initial study timeframe included 8 quarterly public stakeholder meetings, the production and delivery of quarterly newsletters for the Initiative, guest

speaker visits at the local Kiwanis Club and similar associations, and press releases and interviews to the local newspaper. In addition to the newsletters, several newspapers printed periodic articles and public notices on behalf of the Initiative. These articles, along with the newsletters, are included in Appendix A of this document, Public Education and Outreach Record.

2.2.3 Loads or Contributions for the Management Measures

While the ultimate intent of education and outreach efforts is to reduce the pollution load to receiving waters, it is not possible to calculate what reductions will occur as a result of education and outreach. Therefore, no such calculations have been made.

2.2.4 Action Plan

The Education and Outreach Committee developed an Action Plan over the course of several meetings. The action plan was summarized into a simple table, which is included at the end of this section. The action plan has been adopted by the Watershed Initiative Steering Committee and the Morgan County Soil and Water Conservation District Board of Supervisors. Due to the number of detailed, activities listed in the table, only the primary actions that support those activities are provided in this text. However, the table of activities should be considered the "Action Plan".

Action 2-1

Purchase a laptop computer, projector, and associated needs for SWCD and Watershed Initiative watershed education presentations.

Action 2-2

As identified in the Education/Outreach strategic plan, contract with a graphics design firm to design and print a 2004 calendar. The development of the calendar will utilize local photographs of local streams and other natural scenes and water quality educational language produced by the District and the Watershed Education and Outreach Committee.

Action 2-3

Pay a semi-annual user fee to Fallwood Enterprises where over 1000 children will visit and be educated about watershed protection each year. Coordinate and manage educational outings on a to-be-scheduled basis throughout the two year grant cycle. The program has been developed and utilized with great success by the district, but will not be able to continue without funds to support maintenance of the facility.

Action 2-4

Hire a contract employee who will provide specific education services to residents, farmers, forested landowners, and other stakeholders about BMPs and funding programs, etc. This individual will also be the point of contact and assist with coordinating the many detailed activities discussed in the Action Plan at the end of this section.

Action 2-5

Implement a storm drain stenciling or placarding program for any and all storm sewer inlets in the watershed. Local sewer managers should establish new specifications for cast iron storm drain covers and gratings to be molded with permanent waters quality messages, such as "DO NOT DUMP – DRAINS TO STREAM".

2.2.5 Resources

Resources available or needed for achieving education and outreach goals are divided into human resources, facility resources, and funding resources:

2.2.5.1 Human Resources

Currently, the Soil and Water Conservation District staff and voluntary Supervisors are available for participation and direction of the many education and outreach activities. Additionally, the Watershed Initiative Education and Outreach Committee, a strictly voluntary group of stakeholders who have been meeting for 2 years and developed the education and action strategy,

have committed themselves to remain available participants in watershed education and to assist and help direct many of these activities. Most of these committee members are professional educators, and all have indicated a willingness to provide themselves as part of a speakers bureau to help perpetuate the water quality message to the public. Resources purchased by the SWCD for public education, such as computer equipment, will be used by both SWCD staff and Watershed Initiative volunteers for public education and outreach efforts.

2.2.5.2 Facility Resources:
A primary venue for educating local children and other stakeholders is the Fallwood Enterprises facility. Fallwood is currently used by the SWCD several times each year by the District to provide hands-on field experience and on-site instruction about watershed management, water quality, aquatic biology, wetlands, native plants, and general ecology. This 32-acre, outdoor facility has been designed and developed for educational instruction, and is located a few miles east of the SWCD office. In order to continue to provide field education services free to the public, it will become necessary for the SWCD to begin paying semiannual user fees for upkeep, maintenance, and insurance of the facility.

A second field education facility is Bradford Woods. Bradford Woods is owned and operated by the Indiana University Board of Trustees. Throughout the term of this watershed study, Bradford Woods and the facility's environmental educator have provided meeting facilities for the watershed initiative, offered field venues for biological studies, and planned a stream cleanup in collaboration with the Watershed Initiative. Bradford Woods is an excellent venue for environmental education. However, the property is utilized for many other purposes, and fee payments and special arrangements must be made through Indiana University to utilize the property.

Local facilities in the Martinsville and Monrovia area have been available throughout this study and continue to be available for meeting venues and other purposes. These include: the SWCD office; AES/IPALCO Lodge at Pritchard Park; Mapleturn Utilities office; local schools, the County Administration Building; local churches, and other similar venues.

2.2.5.3 Funding Resources
In order to achieve the many goals and objectives of the Education and Outreach component of this Watershed Initiative, the acquisition of funding will be necessary.

Funding will be necessary for equipment, staff, and many overhead costs. Funding resources that will be pursued (see Section 10 for funding for specific actions) will include: Section 319 watershed management funding from US EPA through IDEM; similar programs such as Section 104(b)(3) and Section 205(j) funding; Lake and River Enhancement (LARE); awards from local utilities such as AES and REMCs; and private donations.

2.2.6 Legal Matters:
The nature of education and outreach programs does not necessitate needs for permits such as those associated with construction projects or water discharge practices. However, there are some issues that should be considered and thoroughly addressed with regard to the education and outreach program for the Watershed Initiative.

Most notably of the legal matters is that of liability for safety and the associated need for liability insurance. In the case of all current and proposed education programs (such as the continued use of Fallwood), liability insurance either has been or will be provided wherever necessary and/or required.

2.3 MEASURING PROGRESS

2.3.1 Indicators Selected to Determine Progress

Periodically, the SWCD and/or the participants in the Watershed Initiative will have to measure the progress of education and outreach in a quantifiable manner. To do so, the Initiative will utilize existing resources to:

- Develop surveys for target audiences that allow the educational program provider the ability to track the understanding and appreciation of water quality issues both before and after such programs are provided.
- Periodically survey the general public to ascertain the public's knowledge of water quality conditions and water quality protection practices. Survey results will be compared from each time of survey in order to conclude whether or not a trend toward increased knowledge and awareness has been established.

2.3.2 Re-Evaluation of Plan

The Morgan County Soil and Water Conservation District will be responsible for the regular review and update of this Watershed Management Plan. This Plan should be evaluated on an annual basis to document and celebrate progress; assess effectiveness of efforts; modify activities, if needed, to better target water quality issues; and keep implementation of the Plan on track. The Plan should be revised as needed to better meet the needs of the watershed stakeholders and meet water quality goals.

A summary of the actions proposed for this plan and a detailed list of potential funding sources can be found in Section 10 of this document.

Morgan County Watershed Initiative - Education/Outreach Strategic Plan

Activity	**Target Audience**	**Message**	**Time Commitment High, Med, Low (H, M, L)**	**Costs** H, M, L	**Overall Value/ Effectiveness H, M, L**	**Required by IDEM Contract? Y, N**	**Selected to Do Now, before May 10, 2003**	**Selected to Do in Watershed Action Plan, After May 10, 2003 (Future)**	**Target Activity Date or Completion Date**
Newspaper Articles	General Public – Adult	Update/ informative info	L-M	L	H	YES	YES	YES	**Monthly Ongoing-**
Quarterly Ed. Mailing (Newsletter)	Targeted Mailing List	Updates /Info	M-H	L	L-M	YES	YES	YES	**Quarterly (Newsletters)**
Brochure	General Public-Adults	Introduction & basic info	L	L	H	NO	YES	YES	COMPLETE
Field Days or Workshops on progress/planning	Various Targets – developers	Direct Education	H	H	M	NO	NO	YES	2004
Storm Drain Stenciling Program for entire watershed	Residential /commercial public	Don't Dump in sewer drain	M	M	M	NO	NO	YES (must do watershed-wide if 319 funded	2004
Mascot character	Public – Children	Exposure & Education	H	M	H	NO	YES	YES (add costume)	**ONGOING**
Dear Abbe-type news column	Public – young adult	Specific subject education	M	L	H	NO	YES	YES	**ONGOING**
Educational restaurant place mats	Restaurant patrons – children	General water education	H	H	L	NO	NO	NO	------
Tee Shirts	General Public	Recognition	L	H	H	NO	YES	YES-Continue	**May 2002**

Activity	**Target Audience**	**Message**	**Time Commitment High, Med, Low (H, M, L)**	**Costs H,M,L**	**Overall Value/ Effectiveness H, M, L**	**Required by IDEM Contract? Y, N**	**Selected to Do Now, before May 10, 2003**	**Selected to Do in Watershed Action Plan, After May 10, 2003 (Future)**	**Target Activity Date or Completion Date**
Public Signs, Billboards	General Public	Education	H	H	L	NO	NO	NO	---
Stream Cleanups	Teens through adult	Ownership, appreciation & education	H	L	M	NO	YES	MAYBE (based upon how 2002 effort works)	**Spring 2003**
Web Site	General Public	Exposure & Education	H	H	H	NO (but is in sub-contract)	YES	YES	**Fall 2002**
Trinkets – water bottles (no), bookmarks, magnets, etc.	Household	Exposure & Education	M	M	M	NO	YES	YES	**Summer 2002 (July Fair)**
County Fair	Fairgoers General Public	Exposure & General Education	H	M	L	NO	YES (piggyback w/ SWCD)	?	**Summer 2002 (July Fair)**
School visits – elementary	Children	Education	H	L	H	NO	YES (work with Bill B. @ SWCD)	?	**Fall 2002**
School programs – High School	Teenagers	Education	H	L	M	NO	NO	MAYBE	2003
Science contest Judging	Elementary age children	Education and Initiative	H	L	M	NO	NO (consider special award to existing programs)	NO (Needs to be part of curriculum)	**March 2003 (for award)**

Activity	**Target Audience**	**Message**	**Time Commitment High, Med, Low (H, M, L)**	**Costs** H, M, L	**Overall Value/ Effectiveness H, M, L**	**Required by IDEM Contract? Y, N**	**Selected to Do Now, before May 10, 2003**	**Selected to Do in Watershed Action Plan, After May 10, 2003 (Future)**	**Target Activity Date or Completion Date**
Piggyback events						NO	Keep open – depends on event		
Public Service Announcements	General Public – Adult	Education – subject specific?	L	L	L-M	NO	YES For specific projects	YES	ONGOING Depends upon situation
Shopping Mall displays	Teens, Adults	Exposure & Education	H	H	L	NO	NO	NO	---
Scouts	Use as Tool/vehicle for other efforts	Stream Cleanups, etc.	L	L	H	NO	YES	?	**Summer 2003**
Tours	Teens or Adults	Ownership, exposure, education	M	L	M	NO	NO	MAYBE	2004
Chris Parker's Newsletter (add in articles?)									
Speakers' Bureau / begin targeted presentations	Conservati-on Clubs, Kiwanas, others (Adult)	Exposure and Education	L	H	H	NO	YES	YES	**Summer/Fall 2002**
Calendar	General Public	Exposure and Education	M	H	H	NO	NO	YES	Fall 2003

SECTION 3
Septic Systems and Residential Issues

3.1 IDENTIFYING PROBLEMS

3.1.1 What Was Already Known:

Prior to initiating the watershed planning effort, it was widely known that most Indiana soils, including those found in Morgan County, are not suitable for the long-term utilization of septic systems.

In early 2001, when the SWCD moved forward with meetings among those participating in the Watershed Initiative, community complaints and outside studies had already identified several concerns related to failing septic systems in several neighborhoods and at rural residences throughout the county. A few priority areas were identified inside the subject watershed.

The Morgan County Health Department had been receiving questions and concerns about individually owned septic systems, and complaints from citizens about odor and potential bacteria problems coming from neighboring septic systems were also being received by the Health Department. Individual septic-related complaints came in from a variety of local areas. However, the problem areas (for septic systems) inside the watershed, based upon information provided by the Morgan County Health Department include Patton Lake/Patton Park, Lambs Creek upstream and downstream of Patton Lake, Lake Hart, and Lake Edgewood.

During the watershed study and planning phase, the Morgan County Commissioners were studying and considering several options for a regional sewer district. An early consideration for extending sewers and creating a district was the Patton Lake community. In September 2000, a Preliminary Feasibility Study of Wastewater Management Alternatives for Patton Park, Inc. was prepared by Linda J. Allen, P.E. and submitted to the Indiana Rural Community Assistance Program (RCAP). The report clearly exhibited a need for corrective action to the septic problem, and provided several options. However, due, in part, to potentially high individual costs to citizens, public support and interest was not established for a sewer district, and the geographic area of interest was shifted outside of the watershed.

In August of 2001, the RCAP produced a statewide report on septic priorities in Indiana called the "Findings for the Unsewered Community Database". Over 400 rural communities were scored against one another based upon a criteria rating system that considered such issues as numbers of water bodies impaired by *E coli*, the location if upstream of an impaired water body, average lot size, local income levels, soils, current means of sewage disposal, a recreation/swimming rating, and water supply. Two Morgan County communities, Lake Hart and Patton Park Lake both scored a 78 out of 100 in this rating system, ranking them in the 87th percentile for priority and eligibility for funding programs that are typically facilitated by RCAP.

In addition to the two aforementioned studies, some *E. coli* bacteria problems were already identified by sampling completed by IDEM and the Morgan County Health Departments. Many of the problems identified by the Health Department were concluded to be the direct result of either failing or poorly designed septic systems.

3.1.2 What Was Learned During the Process

As noted in Section 1, which is the Introduction Section of this plan, the City of Martinsville and the Town of Monrovia both provide treatment of wastewater, or household sewage at Publicly Owned Wastewater Treatment (POTW) plants located in the respective municipalities. However, when considering the total population in the watershed (approximately

12,000 estimated households based upon a collective analysis of US Census figures, aerial photography, and plat maps), the number of customers served by the POTW in Monrovia (140) and the number of customers served by the City of Martinsville (4800) (source: Janice Brock, Martinsville Utility Office). The number of customers billed in this case does not equate to numbers of individuals utilizing the system, and only about 50% of Martinsville falls within the subject watershed. Based upon this information, it is estimated that there is a range of persons between 5000 and 8000 that utilize septic systems inside the watershed.

Therefore, it is estimated that between 5000 and 8000 persons in a 52,438 acre watershed must deposit human-generated wastes (feces, food wastes, bathwater, etc.) into something other than a sanitary sewer system, presumably septic systems and, on occasion, illegal direct discharges to local waters.

As a result of information reported by the Morgan County Health Department, the Watershed Initiative's Land Use Committee discussed and prioritized issues related to septic systems early in the planning process. Thereafter, discussions and concerns were voiced about failing septic systems, odor problems, and lack of county funding to address such problems at two of the quarterly public stakeholder meetings.

After 12 months of surface water sampling and monitoring, the coordination team then analyzed the findings related to *E. coli* . It was learned that, as had been the claim and concern from the local stakeholders, *E. coli* counts that exceeded State standards were indeed present at several sampling locations in the watershed, including some locations not listed by the State as impaired. Suspect locations were confirmed to exceed the standards including areas in Lambs Creek, which is listed by the State as being impaired due to the presence of *E. coli*. Local data collection also identified additional locations where *E. coli* exceeded State standards in at least one in ten samples taken. Those locations included sampling locations in the subwatersheds of Sycamore Creek, Dry Fork-Sycamore Creek, Highland Creek, and Lambs Creek both upstream and downstream of Patton Lake (See table 3:1 and sampling results discussed in Appendix B).

After the analysis of data and it's potential relationship to current land uses, preliminary priority areas, as well as potential causes and sources were established by the coordination team. Those areas, causes, and sources were then published on the Soil and Water Conservation District's Internet web site and presented to the Land Use Committee on February 18, 2003. The results of that meeting led to the conclusions and recommendations in this section.

Another residential issue that was learned during the watershed planning process was that private property dump or refuse sites as well as salvage-automobile storage and accumulation is widespread on private properties within the watershed. This situation was also prioritized by the Watershed Initiative committees as a residential issue of priority for water quality protection.

It was learned that the West Central Morgan County Solid Waste Management District holds an annual Tox-Away Day household hazardous waste exchange program in Martinsville. Additionally, waste paint turn-in programs are arranged periodically through a cooperative effort between the Solid Waste Management District and the City.

3.1.3 Causes or Probable Causes of Impairments and Threats

E. coli is a measurable pollutant in the watershed and is one primary reason for the State of Indiana's Department of Environmental Management listing Lambs Creek and White River as impaired on their Section 303(d) list of impaired water bodies.

The presence of such bacteria is not only potentially dangerous to humans, but can also cause decreases in dissolved oxygen in the water column, which in turn can affect the survivability of fish and wildlife.

As is described in detail in Appendix B and summarized for each sampling site location on page B-21, *E. coli* has been identified in elevated concentrations at 6 of the 7 sampling sites, and low dissolved oxygen was also identified at these locations.

While *E. coli* can be considered a cause of water quality impairment in the watershed, the ultimate source of *E. coli* is human and animal feces. *E. coli* lives in the intestinal tract of warm-blooded animals, and can therefore enter surface waters from failing septic systems and areas of congregation of both domestic and wild animals. *E. coli* from livestock such as horses and cattle are specifically discussed in Section 6, *Livestock Management Issues*. The human source of *E. coli* is discussed in this section, as it was the consensus among Watershed Initiative participants that a primary human source of *E. coli* in the watershed is directly related to failing septic systems and/or inappropriately piped waste systems or "strait pipes" that expel sewage directly from homes into surface waters.

A related source of *E. coli* can be that of a failing sewage treatment process or a sewer overflow. Combined sewer overflows, or "CSO's" have not been identified in the watershed. However, bacteria levels exceeding state water quality standards have been identified during stream monitoring in Sycamore Creek at the sampling location downstream of Monrovia schools and the recently constructed Monrovia wastewater treatment plant.

3.1.4 Sources or Probable Sources of Pollutants or Conditions Causing Water Quality Impairments

Impairment #1 – Lambs Creek Bacteria: Current levels of *E. coli* found in Upper and Lower Lambs Creek exceed Indiana's water quality standards (See Appendix B). The following sources of data were utilized to determine this impairment:

- IDEM's 303(d) List of Impaired Waters
- NRCS Unified Watershed Assessment
- Local field sampling data performed as part of this Watershed Management Plan process (see Appendix B).

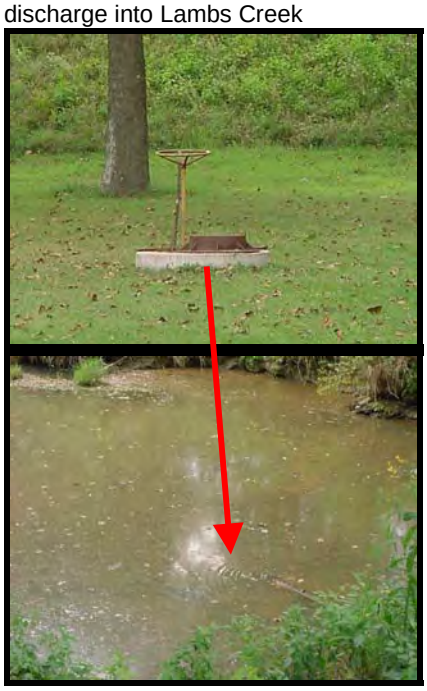
The probable source(s) of this impairment are livestock operations (covered in Section 6), failing septic systems, and direct discharges of sewage from residents to surface waters in areas of Lamb's Creek just before it enters Patton Lake.

The land use of *Upper Lambs Creek* is rural residential in nature with approximately 15 small, unregulated livestock (horse and beef cattle) operations (covered in Section 6). Septic systems are prevelent on and upstream of Patton Lake, which is an impoundement within Lambs Creek. Direct discharge pipes were observed by the coordination team on Upper Lambs Creek prior to it's impoundment at Patton Lake.

Figure 3.1 – homes along Lambs Creek near its entry to Patton Lake. Many have problematic septic systems or direct sewage discharges to the creek.

Data (see Appendix B) suggests that *Lower Lambs Creek,* which is below Patton Lake and drains the Lambs Creek-Goose Creek subwatershed, is impaired by the consistent presence of bacteria and low dissolved oxygen (D.O.), which occur immediately after and as a direct relation to the opening of and discharge from the sediment release valve below Patton Lake dam. The purpose of the valve is to release bottom sediment that accumulates in Patton Lake, with the intention of maintaining some depth to the impoundment. The discharge occurs, on average, about once per month for 8 hours at a time (source: Patton Lake Association). The discharge flows directly into a small ditch/tributary, which in turn flows westward a few hundred feet into Lower Lambs Creek. Surface flow over Patton Lake dam does not appear to have significant bacteria impact, rather, the below dam disharge is the identifiable source. Sampling and analysis suggest that the dissolved oxygen is so low at times, as a result of organic decomposition in the lake sediment, that the *E. coli* bacteria cannot even survive near the discharge point. This can have an enormous negative impact on fish and wildlife.

Figure 3.2 : Patton Lake sediment release and discharge into Lambs Creek



Personal interviews with residents downstream of the lake indicate that when the sediment release valve is opened, at least one half of a mile of Lower Lambs Creek turns black in color, and small fish kills have been observed on numerous occassions. One resident who has lived next to the creek for over 40 years, noted that the quality of fish in this section of stream has gone from gamefish (such as bass and bluegill) to mostly carp and leeches.

Figure 3.3 – Apparent effects from low dissolved oxygen in Lambs Creek below Patton Lake

In conclusion, failing septic systems and illegal strait pipes that pump sewage from homes to surface water are believed to be a significant source of bacteria that collects in Patton Lake. When the lake's sediment control valve is released, pollution from the lake is discharged from the bottom of the south end of the lake through a pipe, and into a feeder ditch to Lower Lambs Creek. This is believed to be a significant source of both *E. coli* bacteria and decomposing lake sediment that is, at times, so anaerobic, that even the bacteria cannot survive.

Impairment # 2 – Upper Sycamore Creek

Field sampling shows *E. coli* bacteria exceeding State water quality standards in Sycamore Creek, at the sampling point downstream of Monrovia (see Appendix B) where there is a wastewater treatment plant, a package treatment plant for Monrovia schools, and a small number of livestock . This location was not previously identified

by the State as impaired for *E. coli* on their Section 303(d) list. Data collection and analysis that were performed as part of this Watershed Management Plan process (see Appendix B) identified this impairment.

The probable cause(s) of this impairment are either one or a combination of the following:

- Inadequate chlorination at the POTW
- Failing treatment system at the school
- Septic systems not clearly identified in field surveys
- Livestock grazing in the area

Figure 3.4 - If not properly operated, the Monrovia Wastewater Treatment Plant could, at times be a source of bacteria in Sycamore Creek; however, operators are well-trained and equipment is new.

Table 3.1 – Indiana E. coli bacteria standard

E. coli - Recreational Use Support (Swimmable)			
Bacteria (cfu = colony forming units.)	No more than one grab sample slightly > 235 cfu/100ml, and geometric mean not exceeded.	No samples in this classification.	One or more grab sample exceeded 235 cfu/100ml, and geometric mean exceeded.

Other Residential Pollutants

In addition to the *E. coli* bacteria, other pollutants are or may be present in the watershed, such as waste oil, antifreeze, and gasoline. The typical cause of such pollutants is automobile wastes, and the typical source is the local private automobile "dump".

Several locations have been observed in the watershed where many apparently unusable automobiles are stored, other materials (i.e., paint, mineral spirits, etc.) were dumped in what appeared to be minor quantities on local properties, and petroleum products from residents who may have historically poured used automobile oil on areas of residential lawns to control weeds or otherwise disposed of the unwanted liquid.

Also observed throughout the watershed were personal garbage dumps, where pollutants of concern might include household hazardous wastes, pesticides, herbicides, and other chemicals.

3.1.5 Prioritization

Priority areas for Septic and residential issues were identified as geographic areas. The location and size of the priority areas have been based upon three primary factors:

(1) The identification of pollutants or poor water quality conditions known to be related to septic systems and residential land uses: *E. coli* is a measurable pollutant of concern and is prioritized in this section for two reasons: first, because its source can be traced to such residential issues as septic systems; and second, because it is the primary reason for listing certain water bodies (Lambs Creek and White River) on the State's Section 303(d) list of impaired water bodies.

(2) The area of land upstream of and surrounding the polluted area that is assumed to be contributing to the pollutant. This assumption is due to known land uses or other factors identified in field observations.

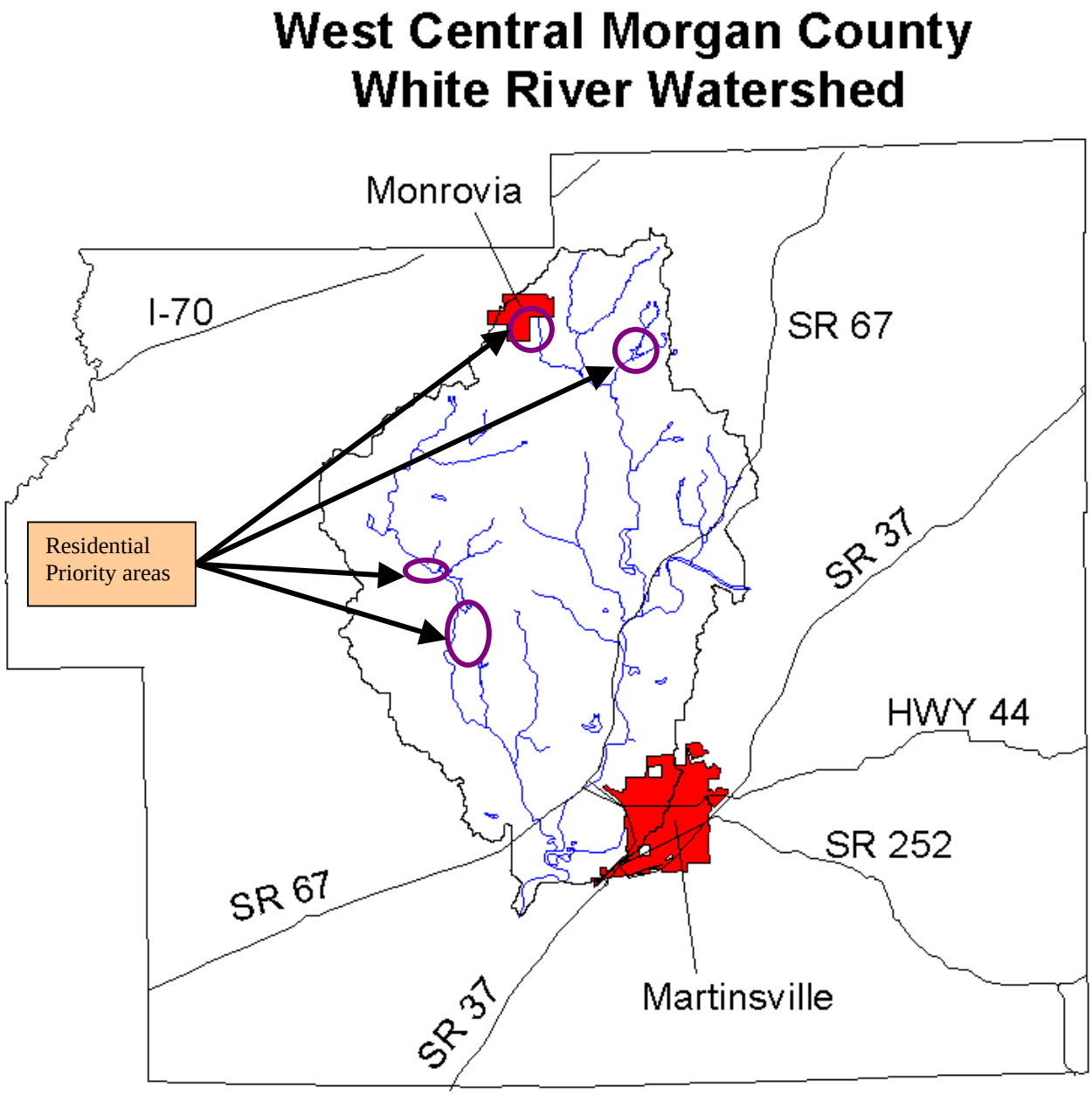
(3) Residential properties where dumps or automobile salvage/storage has been observed.

The map shown as figure 3.4 on the following page identifies the Priority Areas for septic and residential issues in the watershed. Table 3.2 provides some prioritization specifically related to *E. coli.*

Table 3.2 - Area prioritization table for E coli

Sample Site # on map	Location	Number of *E. coli* exceedances in 12 samples	Number of *E coli* exceedances during recreational season (April-October)	Is location in a Section 303(d) listed segment of stream and scheduled for TMDL?	Other extenuating factors related to bacteria – detailed in Appendix	Priority Rank Order for *E. coli*
1	Dry Fork Sycamore Creek at CR 950 North	4	2	No	No	**5**
2	Sycamore Creek at CR 950 North	6	4	No	No	**4**
3	Sycamore Creek at Robb Hill Road	1	1	No	No	**6**
4	Highland Creek at SR 67	4	2	No	No	**5**
5	Lambs Creek upstream of Patton Lake at Upper Patton Road	3	1	YES	No	**3**
6	Lambs Creek downstream of Patton Lake at Lower Patton Road	1	1	YES	YES	**1**
7	Lambs Creek at Old SR 67	6	5	YES	No	**2**

Figure 3.4


West Central Morgan County
White River Watershed
Monrovia
I-70
SR 67
Residential
Priority areas
SR 37
HWY 44
SR 252
SR 67
SR 37
Martinsville

3.2 GOALS AND DECISIONS

3.2.1 Goals for Improvement and Protection:

Primary Goal #4 of this Watershed Management Plan, as outlined in Section 1 of this document is, "to the greatest extent possible and with existing and potential resources, improve and protect water quality in the watershed with the intention, where applicable and appropriate, to achieve and maintain state water quality standards." In order to achieve Primary Goal #4 of this Watershed Management Plan, the following objectives related to septic systems and residential issues have been established:

3.2.2 Action Plan

The Morgan County Soil and Water Conservation District will identify appropriate funding sources to address *E. coli* through a process of elimination in four zones as well as the implementation of public outreach, education, and agency cross-training efforts. This process will include efforts discussed in Section 6 of this Plan.

Objective #3-1:

Within the next 6 years, bring *E. coli* levels within compliance of state water quality standards in Lambs Creek, both north and south of Patton Lake, for 12 months out of the year.

Action 3-1

Zone #1 in figure 3.8 (Upstream of Patton Lake)-The effort to address *E. coli* in this zone is addressed in Section 6, Livestock Management Issues.

Action 3-2

Zone #2 in figure 3.8 (Lambs Creek upstream and adjacent to Patton Lake)- Conduct a feasibility study for a consolidated/clustered septic system to redirect flow from failed septic discharge from approximately fifty (50) homes clustered on small parcels along Lambs Creek just north of and adjacent to Patton Lake. Prepare to pursue additional funds for design and construction pending the outcome of the feasibility study.

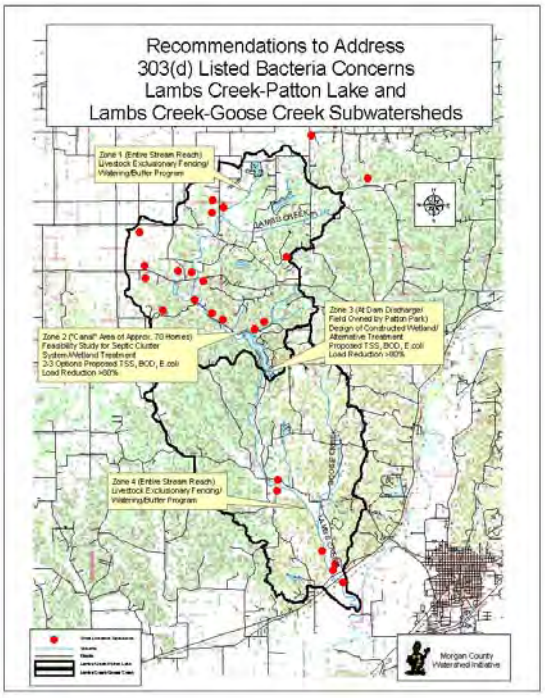
Action 3-3

Zone #3 in figure 3.8 (Downstream of Subsurface Discharge on Patton Lake)- Prepare a feasibility/preliminary engineering study for the construction of subsurface wetlands to treat water purged from the Patton Lake dam into the agricultural field below the dam owned by the Patton Lake Association. Prepare to pursue additional funds for design and construction pending the outcome of the feasibility study.

Action 3-4

Zone #4 in figure 3.8 (Lambs Creek downstream of Patton Lake)- The effort to address *E. coli* in this zone is addressed in Section 6, Livestock Management Issues.

Figure 3.8: Focus Areas and Proposed measures to address *E. coli* in Lambs Creek.



Objective #3-2:

Within the next 5 years, bring *E. coli* levels within compliance of state water quality

standards directly south of Hart Lake for 12 months out of the year.

Action 3-5
Pursue opportunities for regional sewer hookups between Hart Lake residents and the Monrovia wastewater treatment plant via the development of a regional sewer district. Such an action will be examined and led by the County Commissioners with information support and prioritization from the SWCD, the Morgan County Health Department, and partners in the Morgan County Watershed Initiative.

Objective #3-3:
Within the next 2 years, bring *E. coli* levels at the sampling location in Sycamore Creek downstream of the Monrovia Wastewater Treatment Plant and Monrovia Schools schools within compliance of state water quality standards for 12 months out of the year.

Action 3-6
Meet with the WWTP operator as well as with representatives of Monrovia schools in order to ascertain if there is indeed any bypass, failure, or other problem on record during the times of above-standard *E. coli* readings. Investigate with additional sampling if necessary. Balance results and conclusions against the possibility of contamination from any livestock in area. Pursue appropriate corrective action after the actual *E. coli* source is identified.

Objective #3-4:
In localities where it is not likely that state water quality standards for *E. coli* can be met, such as some urban areas, implement management practices and corrective action projects to reduce *E. coli* by 10% per year.

Action 3-7
Implement a community education program that focuses on residential causes and preventative measures for bacteria in municipalities, including septic system maintenance and pet waste cleanup.

Objective #3-5:
Limit the potential of ground and surface water contamination from private, residential property management through the reduction of existing and continuing disposal of refuse, household hazardous wastes, and salvage automobiles, and the improper storage of chemicals.

Action 3-8
Increase knowledge of and agressively promote the household hazardous Waste/Tox-Away programs offered by the regional West Central Solid Waste Management District. Increase participation in the program by 50% over the next five years.

Action 3-9
Develop and implement a public awareness campaign that emphasizes the aesthetics of Morgan County, issues related to property value, and the value and importance of not accumulating refuse, garbage, and scrap material on private properties.

Action 3-10
Adopt and enforce more stringent county and municipal codes that specifically limit or prohibit garbage and refuse collection on private properties. Encourage a county coalition among the commissioners, the County Prosecutor, the County Planning Department, and the County Health Department to ensure that any such existing or proposed codes are consistently enforced.

Action 3-11
Through public awareness campaigns, educate the public about the proper use and storage of residential fertilizers, pesticides, and herbicides in order to avoid overuse and associated runoff as well as improper storage and associated spills.

Objective #3-6
Through watershed teaming (see Section 9) establish cross-training programs and procedures between the SWCD and the County Health Department to collectively understand, identify, and report septic

maintenance problems and illegal dumps.

Action 3-11
Through watershed teaming (see Section 9) cross-train between the Morgan County Health Department, the County Surveyor, and the Morgan County SWCD regarding: proper septic system installation, maintenance and indications of failure; regions of soil type and soil suitability; pending development and new surveys; and other issues related to collective knowledge and notification of potential or existing septic problems.

3.2.3 Loads or Contributions for the Management Measures

As the actions proposed in this section are preliminary studies, the load reductions will be applied in the actual feasibility and preliminary engineering studies. However, it can be noted that experts in the field of alternative treatment methods utilizing constructed wetlands have estimated that bacteria can be reduced by up to 90% and D.O. can be dramatically increased with proper design.

3.2.4 Management Measures:

Several management measures could be implemented in order to achieve the objectives 1-5. One such measure would be, pending the outcome of current state legislation, to establish a Regional Septic Management District in Morgan County. Details regarding this development will be dependent upon the outcome of the 2003 or future legislation.

Another management measure that will be necessary is the continued evaluation of need and solutions related to the establishment of regional sewer districts for areas with septic problems.

A final management measure will involve the development and enforcement of local ordinances that pertain to refuse collection and automobile storage on residential properties.

With respect to specific areas of concern, it is proposed that alternative natural treatment systems be evaluated to address the issue identified as Impairment # 1, at the location just below Patton Lake in Lambs Creek. A preliminary engineering/feasibility study of such a project is proposed. The study would analyze options for, capabilities of, and potential costs of constructed wetlands and retention areas for the water purged from the Patton Lake dam into the agricultural field below the dam, enabling treatment of the water that is purged once per month for 8 hours and usually carries a high bacteria count and an extremely low dissolved oxygen count. The results of the study should allow the District or other entities to determine whether actual design and construction of the alternative treatment system is feasible and appropriate as well as how much it will cost. The District will contract with a design consultant that has expertise in the area of alternative treatment systems, constructed wetlands, and the like.

3.2.5 Resources

Resources available or needed for achieving education and outreach goals are divided into human resources and funding resources:

3.2.5.1 Human Resources

Currently, the Soil and Water Conservation District staff, IDNR staff, NRCS staff, and voluntary Supervisors would likely be available for participation in the regional teaming and cross-training. Additionally, the Watershed Initiative Land Use Committee, a strictly voluntary group of stakeholders who have been meeting for 2 years, have committed themselves to remain available participants in watershed education and to assist and help direct many of these activities. Most of these committee members have indicated a willingness to provide themselves as part of a speakers bureau to help perpetuate the water quality message to the public.

3.2.5.3 Funding Resources

The primary funding necessary to

implement the actions proposed in this section will include engineering services to prepare feasibility studies and ultimately (potentially) design and construction of alternative treatment projects. Funding resources that will be pursued (see Section 10 for funding for specific actions) will include: Section 319 watershed management funding from US EPA through IDEM; similar programs such as Section 104(b)(3) and Section 205(j) funding; local county and city appropriations from Public Works and related budgets; Lake and River Enhancement (LARE); awards from local unitilities; and private donations; The remaining efforts in this section constituted some minor staff scheduling changes, which should not be costly.

3.2.6 Legal Matters:

As part of the feasibility and preliminary engineering studies discussed in this section, the requirements for and likelihood of acquisition of discharge permits for any constructed wetland and/or consolidated septic system will have to be addressed. In addition, the transfer of or easement access of property, specifically that property which is located south of the Patton Lake dam, will have to be coordinated legally and approved by all parties.

3.3 MEASURING PROGRESS

3.3.1 Indicators Selected to Determine Progress

Indicators selected to determine progress with the reduction of *E. coli* in accordance with the four objectives discussed in Section 3.2.1 will be the absence and/or presence of *E. coli* in measured colony forming units per milliliter at the sampling sites identified in Appendix B of this Plan.

The Morgan County Soil and Water Conservation District has already been awarded additional Section 319 funds to continue sampling and monitoring for *E. coli* and other pollutants in the watershed for another 2 years. However, it is proposed that locally implemented water quality sampling and monitoring for *E. coli* continue in the watershed for at least 6 years, in order that progress toward achieving the objectives discussed in Section 3.2.1 is appropriately measured.

3.3.2 Monitoring Indicators

Primary indicators for improvement will be *E. coli*, dissolved oxygen, and if appropriate, periodic observations of macroinvertebrate populations. The continued sampling for *E. coli* following the same sample site locations, timing, and methods will be employed.

3.3.3 Operation and Maintenance

Operation of the education and outreach components of this section will be led by the SWCD with direct involvement of the Education and Outreach Committee.

Operation and maintenance of any constructed wetland or other physical project proposed herein will be discussed in appropriate detail during the feasibility and design phases of such projects.

3.3.4 Re-Evaluation of Plan

The Morgan County Soil and Water Conservation District will be responsible for the regular review and update of this Watershed Management Plan. This Plan should be evaluated on an annual basis to document and celebrate progress; assess effectiveness of efforts; modify activities, if needed, to better target water quality issues; and keep implementation of the Plan on track. The Plan should be revised as needed to better meet the needs of the watershed stakeholders and meet water quality goals.

A summary of the actions proposed for this plan and a detailed list of potential funding sources can be found in Section 10 of this document.

SECTION 4
Forested Land Management

4.1 IDENTIFYING PROBLEMS

4.1.1 What Was Already Known

Generally speaking, forested land does a better job of protecting surface water quality than do most other land conditions and uses. Forested land helps control or avoid erosion in several ways. The leaf canopy in forests help absorb the energy of heavy rain, slowing the erosive effects of direct rain on bare soil. Root structures in the soil also help control erosion from the forest. Leaf litter and decaying wood help build a healthy soil where erosion-controlling plant life and well-balanced nutrients can better serve a healthy ecosystem. Shade provided by trees helps maintain water temperatures necessary for fish habitat.

With regard to forested land-related issues, what was already known was that much of the north-central portion of Morgan County is currently forested.

Approximately 60% of the Lambs Creek/White River watershed in north-central Morgan County is forested. Aerial photographs indicate, and ground observations confirm that there is a tree "canopy" covering over half of the land in the watershed. This area includes such forested properties as: Bradford Woods (owned by the Indiana University Board of Trustees in the Sycamore Creek sub-watershed); sports clubs like the Mallory Conservation Club; properties owned and protected by conservation groups like the Central Indiana Land Trust; conservation areas such as AES/IPALCO's Pritchard Park; and many privately held woodlots scattered throughout the watershed.

We knew that as a general rule, that this healthy forest canopy can have a great deal of protective value to water quality, depending upon its proximity to waterways and coverage in the watershed. Forested land helps protect water quality in many ways, most notably by controlling erosion.

4.1.2 What Was Learned During the Process

During the watershed study and planning process, participating stakeholders learned the following fundamental facts:

(1) Roughly 60%, or 32,000 acres of the watershed is forested.

(2) The majority of soils in the watershed are highly erodible, most typically on the steep, forested slopes.

(3) With the exception of a few areas where *E. coli* bacteria was above water quality standards, most of the chemistry and biological data gathered in the watershed indicated healthy surface water environments in the forested stream segments.

(4) Forested land is an attractive amenity in Morgan County, and many in the development community as well as local homeowners confirmed that the rolling, forested hills that are prevalent in the watershed are indeed an aesthetic resource that increases property values in the area.

(5) Several public and private sector programs do exist to help landowners protect and properly manage their forests, yet many are not well publicized. Several on the Land Use Committee felt that there are still not enough programs currently available to landowners to protect forested lands.

(6) 34 properties totaling 2029 acres in the watershed are enrolled in the Classified Forest Program (source: Chuck Ratts, District Forester).

(7) Education programs that help

teach both children and adults about the water quality protection benefits of forests are lacking in Morgan County.

(8) Logging is very prevalent in Morgan County, and several operations will "cold call" landowners, offering to purchase their timber.

(9) While required in several surrounding states, Best Management Practices for logging and timber management is not required by Indiana State Law. Kentucky, Ohio, Virginia, and West Virginia all have laws that require BMPs for logging operations. If Indiana is to remain unregulated in this regard, then education and market-based encouragement of BMPs will be essential to maintaining the water quality protection value of forests.

(10) While many of the logging operations doing business in Morgan County implement Best Management Practices as part of their operations, there are still several that do not. Lack of BMPs at some logging locations can cause water quality impairments in Morgan County.

4.1.3 Causes or Probable Causes of Impairments and Threats

While virtually the entire county has been timbered at one time or another over the last 150 years, much of the steeply sloped areas of the county have returned to a state of mature forest. No significant parcels in the watershed contain what is considered "old-growth" forest.

The primary reason that the watershed is currently 60% forested is that most agricultural practices are not practical in the vast areas of steep slopes that dominate the watershed. Only the northern portion of the watershed and the White River Valley are flat enough for practical use in cropland or livestock operations. In addition to lack of prime farmland, population and associated development have also had little impact on the forested areas. Until recently, population growth has been slow in the rural areas of the county, leaving the forest canopy generally intact. Finally, many landowners have maintained timber on their property for either aesthetic reasons or because they realize that the topography and soils are not conducive to permanent clearing.

A potential threat to surface water quality in the watershed is the loss of forest canopy. The most probable threats to the existing forest canopy include:

(1) Continued development resulting from population growth and urban sprawl.

(2) Poor or no implementation of BMPs by logging operations .

(3) Disease and/or unnaturally occurring invasive, herbivorous insects.

4.1.4 Sources or Probable Sources of Pollutants or Conditions Causing Water Quality Impairments

Observations and field surveys completed during this watershed study and planning project have concluded that there are very few sources of pollutants or conditions causing water quality impairments in the most forested areas of the watershed. Such sources are usually scattered and include:

(1) Logged areas or areas being logged where BMPs have not been implemented and excessive erosion has caused sedimentation in surface water areas. An example of such a problem is depicted in Figure 4.1. This shows where a ravine draining a portion of the eastern shore of Patton Lake (Lambs Creek) has deposited nearly two feet of soil covering more than an acre in just two years after only 16 acres of upstream logging was poorly managed, resulting in excessive erosion.

(2) Open pastures in the forested areas where livestock have access to the stream. The horse farm in Figure 4.2 shows an open pasture area in an

otherwise forested section of the Lambs Creek watershed.

(3) Open dumps found scattered throughout the watershed on both private and public properties. Chemicals and other potential pollutants have been identified in several of these dumps. Figure 4.3 provides an example of one of many open dumps found in the watershed.

Figure 4.1: Sediment that has filled in a large area of Patton Lake, allegedly the result of upstream logging without implementation of BMPs.

Figure 4.2: The photos below depict a very well maintained horse farm in the Lambs Creek subwatershed, above Patton Lake. This is typical of small "breaks" in the forest canopy.

4.1.5 Prioritization

Prioritization for the protection of forested lands was directed to those areas that:

(1) Currently have forest canopies.
(2) Were identified as having highly erodible soils.
(3) Were likely candidates for forest protection programs (i.e., parcels containing 10 acres or more of contiguous forest).

of how data was used to prioritize forested areas for protection. Figure 4.3 provides an aerial photographic view of the watershed, where trees or forested areas can be identified. Figure 4.4 links forest canopy with highly erodible soils, providing priority areas for forest protection and preservation.

The maps (figures 4.3, 4.4, and 4.5) on the following three pages show the chronology of examining forest canopy to highly erodible areas, to property parcels (the size of which has relevance the qualification for forest preservation programs.

Figure 4.3: 1998 aerial photography

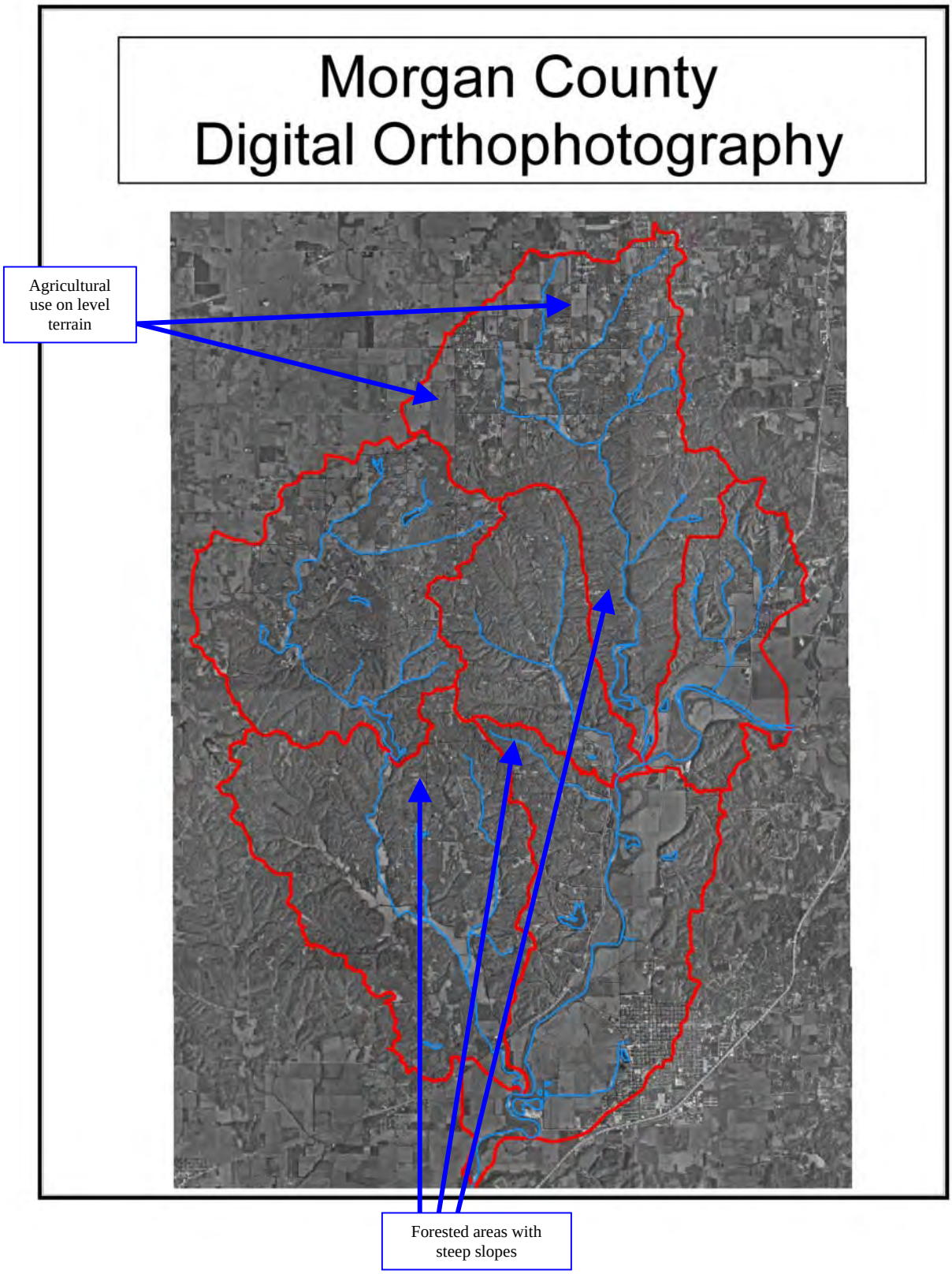


Figure 4.4: Map of highly erodible soils

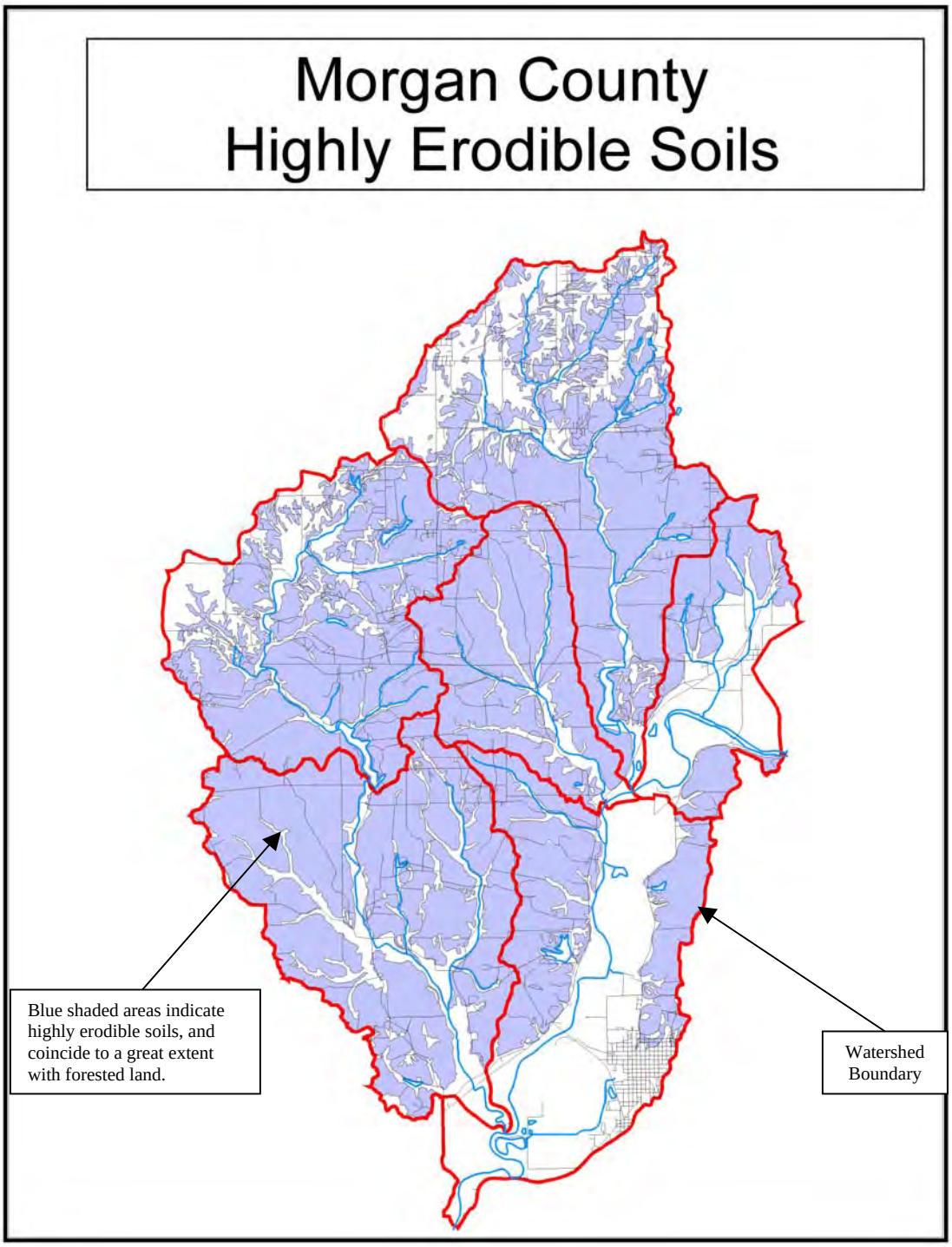


Figure 4.5: Property boundaries in the watershed

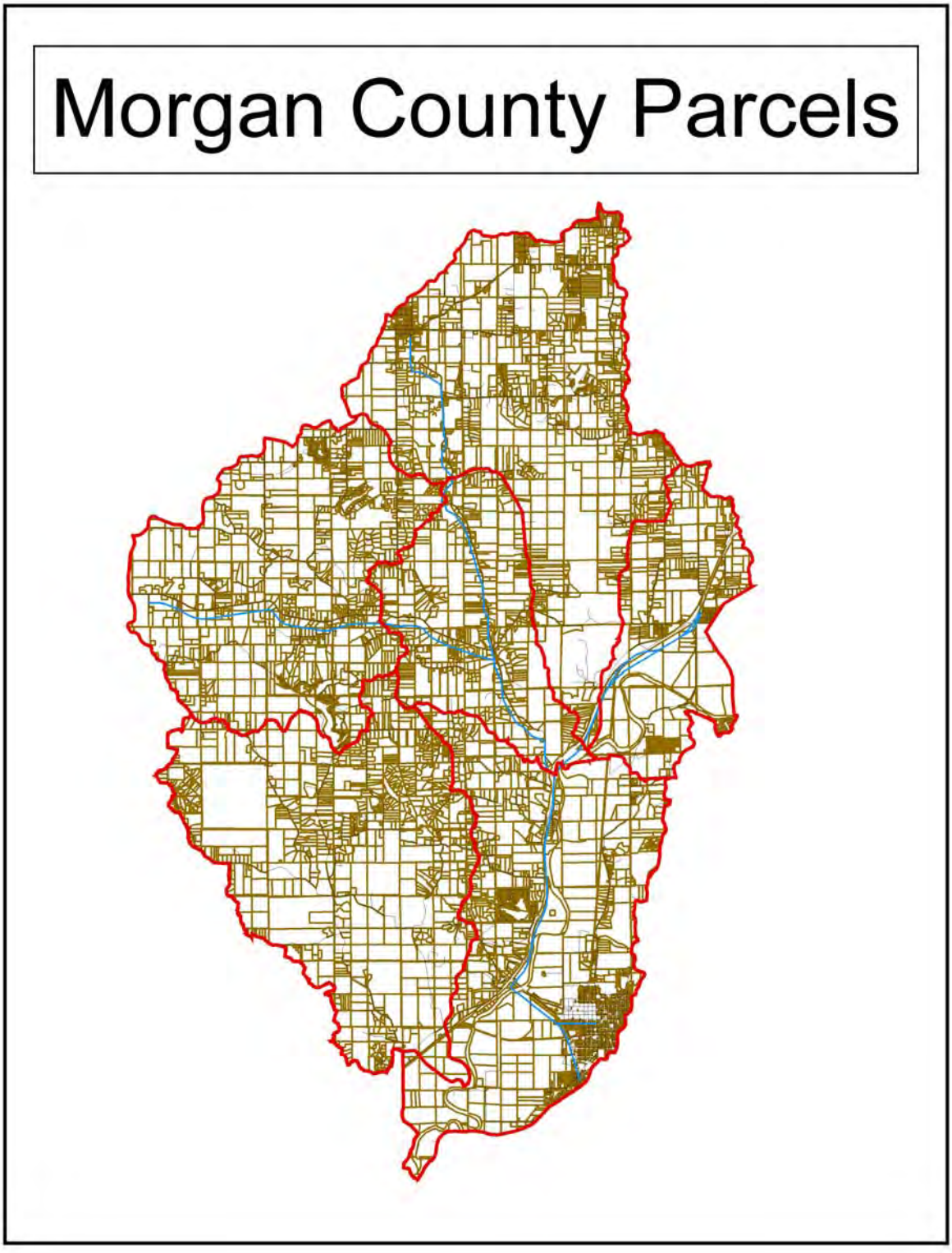
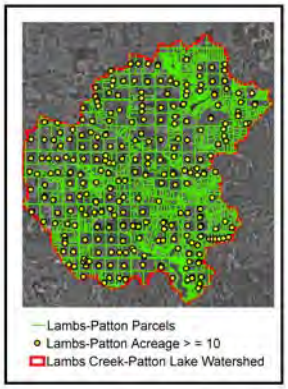
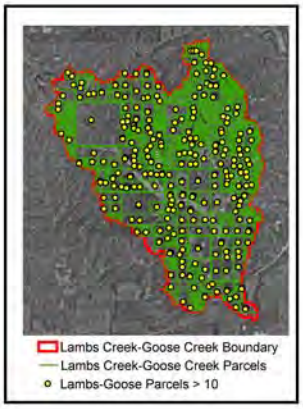
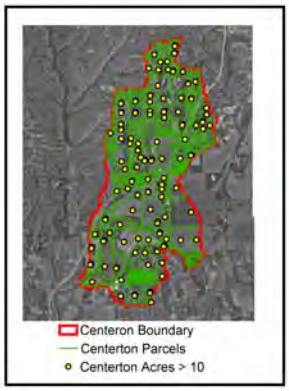
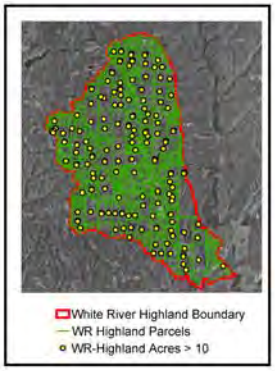


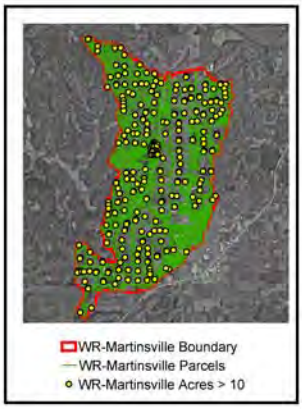
Figure 4.6: Aerial photos of subwatersheds with property boundaries (parcels of 10 acres and above are marked with yellow dot

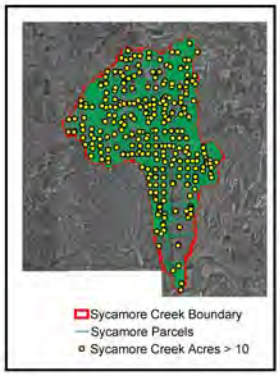












4.2 GOALS AND DECISIONS

4.2.1 Goals for Improvement and Protection

Primary Goal #4 of this Watershed Management Plan, as outlined in Section 1 of this document is, "to the greatest extent possible and with existing and potential resources, improve and protect water quality in the watershed with the intention, where applicable and appropriate, to achieve and maintain state water quality standards."

The Morgan County Watershed Initiative designed and conducted it's 6th quarterly public stakeholder meeting in November of 2002 with a targeted theme of forested land management, forest protection programs, and the relationship between a healthy forest and water quality. The meeting provided a great deal of information with presentations from the watershed coordinator, the State's District Forester, Pike Lumber Company, and the Central Indiana Land Trust.

In order to achieve Primary Goal #4 of this Watershed Management Plan, the following objectives related to forested land management were collectively set by the Land Use Committee shortly after the public stakeholder meeting in November:

Objective #4-1
Achieve, over a ten-year period, no net loss of forest canopy in the watershed.

Objective #4-2
Achieve 100% Implementation of BMPs where logging is occurring in the watershed.

4.2.2 Management Measures

Achieving the goals set by the Watershed Initiative for water quality protection through the protection of forested land will involve ongoing and never-ending processes, policies, and actions. In order to achieve the two goals aimed at protecting water quality through forest protection, the Soil and Water Conservation District will implement several interrelated programs with the help and participation of local businesses, industry, and other government entities.

4.2.3 Loads or Contributions for the Management Measures

Since the primary objectives and actions set forth in this section are ***preventative***, calculating and estimating load reduction is not necessary for this section.

4.2.4 Action Plan

Voluntary measures are recommended for the watershed that can help maintain a 60% forest coverage. These actions include:

Zoning Considerations: Politically speaking, it would be extremely challenging to pass any regulatory measure in Morgan County that would have enforceable authority to control private land and timber harvesting and/or clearing for development or agriculture. However, it is proposed that the SWCD and the Watershed Initiative work directly with the County Planning Department to revisit and re-define "critical areas" in the County's next Comprehensive Land Use Plan. Critical area delineation should consider the value of forest canopy in relation to water quality protection, especially in areas where rare or endangered species have been identified in the receiving stream.

Landowner Education: Increase education to landowners with regard to the water quality value of their forests and programs that are available to help them protect their forested land. To achieve this objective, the Soil and Water Conservation District will pursue grant funding in order to hire part-time staff person to conduct the following activities:

Actions to support Objective # 4-1

Action 4-1
The SWCD will hire a contract employee who will heavily "market" forest protection and management programs such as the

Classified Forest Program and agricultural programs such as CRP, etc. throughout the watershed but specifically targeted to priority areas identified in the watershed plan, based upon soils, property ownership, tree canopy, etc.

Action 4-2
Through the contract employee, provide technical assistance to landowners, farmers, and forest owners regarding forestry and agricultural conservation best management practices.

Action 4-3
Through the contract employee, provide guidance to landowners, farmers, and forest owners regarding public and private conservation programs such as IDEM/EPA cost-share programs (Section 319), USDA cost-share programs (EQIP, CRP, etc.), IDNR conservation programs (CFP, CWP, etc.), and private programs such as the Nature Conservancy, the Central Indiana Land Trust, etc.

Action 4-4
Implement an Incentive-Based, Voluntary Mitigation Program: Develop consistent criteria for and implement a program through the local Planning Department with assistance from the SWCD, where public appreciation (through signage, proclamations, etc.) are implemented where the planting of 1:1 or higher ratio of trees lost is implemented by development and land use change.

Action 4-5
Promote, assist where possible, and publicly support corporate stewardship programs such as the AES/IPALCO challenge, which involved the planting of 6000 trees.

Action 4-6
Initiate tree sales and/or tree giveaways through the SWCD and its watershed partners.

Action 4-7
Promote the concept of cluster development in new subdivisions where average lot size requirements are met through a combination of densely populated areas among preserved green space within a subdivision.

Actions Necessary to Achieve Objective #4-2

Action 4-8
Establish, and implement Market-Based Incentive Programs for those who implement BMPs: The SWCD and its partners in the Watershed Initiative will work with the State Implementation Committee of the Indiana Forest Industry Council to expand the number timber and chip buyers in Morgan County (and surrounding areas) that require Sustainable Forestry Initiative Logger Training. An initial step to reach this objective will be to identify all buyers in Morgan County and work as a partner with the State Implementation Committee in targeting those in the watershed to adopt such timber buying policies.

Action 4-9
Enhance forestry education: The SWCD will work with and help promote the Indiana Forest Industry Council's Sustainable Forestry Initiative Logger Training and assist with arrangements for such training when possible. Additionally, the IDNR periodically provides educational workshops for forestry methods that help protect the environment. The SWCD will help promote and assist with these programs where appropriate.

Action 4-10
Develop and utilize Public Honor Incentives: It is recommended that the Morgan County Commissioners establish an award to provide annually to a timbering operation that practices BMPs. The SWCD, its watershed partners, and the IDNR will all assist with the development of criteria for this award.

Figure 4.7 (courtesy of Pike Lumber Company, Inc.) – Use of this temporary bridge BMP protects streams and stream banks during logging operations

Figure 4-8: Proper construction and use of a logging road using appropriate BMPs.

4.2.5 Resources

Funding will be necessary for equipment, staff, and many overhead costs. Funding resources that will be pursued (see Section 10 for funding for specific actions) will include: Section 319 watershed management funding from US EPA through IDEM; similar programs such as Section 104(b)(3) and Section 205(j) funding; Lake and River Enhancement (LARE); and private donations.

4.2.6 Legal Matters:

At this time, the hope is that the voluntary implementation of BMPs while logging can increase to the level to meet the objectives of this plan. It is hoped that through the education and incentive programs discussed herein, that this will occur. Legal matters are therefore not of concern at this time.

4.3 MEASURING PROGRESS

4.3.1 Indicators Selected to Determine Progress

The forestry professionals who participated with the Land Use Committee and helped set the "no net loss" goal, agree that there is no practical means to accurately measure the progress of this goal. The indicators selected and listed below will not provide scientifically sound or accurate conclusions, however they will help the SWCD and its partners monitor the goal of no net loss of forest canopy.

(1) Review aerial photographs and satellite imagery on an annual basis to provide a general measure of forest canopy coverage in the watershed and whether the percentage of canopy has increased or decreased. Maintain and publish records of observations.

(2) Maintain records of development where net tree loss occurs, maintain records of all mitigation planting actions that occur, and compare the two on an annual basis.

(3) Maintain visual observations where logging has occurred to ensure that the natural and/or managed regeneration of tree growth is occurring within one year of cutting. Maintain record and aerial photography as appropriate.

(4) As is the focus of this entire watershed management plan, maintaining and improving water quality will be the ultimate

indicator of overall improved water quality, which is the ultimate purpose of the protection and maintenance of the forest canopy in this case. Therefore, water quality monitoring will continue through Section 319 and other funding mechanisms. This monitoring will help the SWCD judge whether or not we are maintaining and/or improving water quality. It's relationship to the forest protection effort will however, be difficult to specifically identify and confirm.

4.3.2 Monitoring Indicators

Indicators of success will include percentages of forest canopy observed on aerial photography as well as records maintained showing mitigation through tree planting where land use change has occurred. Water quality monitoring will also serve as an overall indicator of the progress of reaching the ultimate goal of water quality protection and improvement.

4.3.3 Re-Evaluation of Plan

The Morgan County SWCD will be responsible for the regular review and update of this Watershed Management Plan. This Plan should be evaluated in partnership with the IDNR District Forester, and the private timber management community on a regular basis to document and celebrate progress; assess the effectiveness of efforts; and to modify the action items, if needed. A summary of the actions proposed for development, planning, and zoning can be found in Chapter 10.

SECTION 5
Row Crop Management Issues

5.1 IDENTIFYING PROBLEMS

5.1.1 What Was Already Known:

Before members of the Watershed Initiative began researching agricultural issues in the watershed, it was generally known that row crops, primarily corn and soybeans, are less prevalent in the Morgan County White River watershed when compared to other areas of Morgan County. This fact is primarily due to the steep slopes that dominate the landscape in the watershed. The row crop acres that do exist in the watershed, as depicted in Figure 5-1, are concentrated in three primary areas:

1.) the White River bottoms
2.) the Lambs Creek, Sycamore Creek, and Highland Creek bottoms
3.) the northwestern boundary of the watershed, near Monrovia, which is flat to gently rolling.

The local SWCD, NRCS and IDNR staff members were aware that agricultural conservation practices are not widely adopted throughout the watershed. They realized that a watershed plan was necessary to identify and prioritize the conservation needs and develop a strategy to increase the utilization of agricultural best management practices such as:

- conservation tillage
- conservation buffers
- nutrient management
- pesticide management

The local SWCD, NRCS, and IDNR staff were also aware of the fact that many of the agricultural acres in the northwest portion of the watershed, near Monrovia, are decreasing annually due to the level of development occurring in the area. With the anticipation of selling land that is increasing in value, many landowners in areas experiencing urban sprawl are reluctant to commit the time or money to implement conservation practices.

5.1.2 What Was Learned During the Process

The watershed coordination team, with the assistance of the Land Use and Technical Committees, conducted an agricultural assessment of the watershed. The assessment included the utilization of existing and current water quality data, available GIS data, field surveys, personal conversations with local agricultural professionals, and review of Indiana agricultural statistics, and other available agricultural data. The purpose of the assessment was to identify the impact that row crop production has on water quality, the current conservation trends in the watershed, and the particular conservation practices necessary to mitigate any water quality pollution that may be occurring as a result of certain agricultural practices. This information is discussed throughout this section.

Through various conversations with farmers at the Morgan County Fair, several public stakeholder meetings, and most notably, the Agricultural Stakeholder Meeting conducted on February 5, 2003, the following information was also learned:

1.) Local farmers are not completely aware of their options when it comes to conservation practices and available conservation programs.
2.) Local farmers are concerned that increased participation in voluntary conservation programs may potentially lead to more regulation.
3.) Local farmers are receptive and willing to participate in conservation programs but feel they need more information on the requirements associated with participating in such activities.
4.) Local farmers need the assurance that long-term support for such programs will be available.

5.1.2.1 Water Quality

To assess water quality in the Morgan County White River watershed, the coordination team relied on two sources of water quality data:

Table 5.1: Land Use in Acres

Land Use in Acres							
	West Central Morgan County White River Watershed	Sycamore Creek	Lambs Creek-Patton Lake	Lambs Creek-Goose Creek	Highland Creek	White River Centerton	White River Martinsville
Pasture	7,049	2,718	1,270	1,558	542	337	624
Row Crops	10,232	2,218	1,875	996	189	1,319	3,635
*Deciduous Forest***	31,693	6,570	6,254	8,432	4,345	2,184	3,942
Conifer Forest	119	36	27	7	4.3	30	15
Open Water	756	142	95	27	1.0	91	400
Urban High Density	207	14	0	0	0	10	183
Urban Impervious	309	33	44	0	0	105	127
Urban Low Density	567	99	0	0	.5	29	438
Wetland* **	1,492	138	104	107	42	395	706
Total Acres	52,438	11,968	9,669	11,127	5,124	4,480	10,070
** Includes mixed forest, shrubland, woodland *** Includes several wetland types							

1.) water quality data collected and analyzed by the IDEM, the primary agency involved in surface water quality monitoring and assessment in the State of Indiana.
2.) water quality data collected by the watershed coordination team throughout the planning phase of this project.

Data collection identified periodic spikes of phosphorus and nitrogen in the northern portions (where there is a greater concentration of agricultural land) of the Sycamore Creek subwatershed.

Also, field data shows high nitrogen and phosphorous levels in the lower portion of Lambs Creek.

Specific testing for pesticides or herbicides was not completed as part of this project. Water quality data can be found in detail in Appendix B of this document. A summary of conclusions from data is provided on page B-21.

5.1.2.2 Land Use

Utilizing GAP Data, it was determined that approximately 20% or 10,487 acres of the Morgan County White River watershed are utilized for row crop production (See Table 5-1). As mentioned above, the majority of those acres lie within the creek and river bottoms and in the northwest portion of the watershed (see Figure 5-1) and the White River floodplain.

5.1.2.3 Highly Erodible Lands (HEL)

It was also learned that approximately 6,264 acres (61%) of the row crop acres within the watershed are comprised of soils considered to be highly erodible lands (HEL). There are nineteen (19) different soil series found in the watershed that are considered, according to the Morgan County soil survey, to be highly erodible (see Table 5-2). The majority of the HEL acres involved in row crop production are located in the northwestern portion of the watershed (see Figure 5-2).

Table 5.2: Highly Erodible Lands (HEL)
in the Morgan County White River Watershed

Symbol	Soil Series	Tolerable Soil Loss (Tons/Year)
AfC2	Alford	5
AvB	Ava	4
BeB	Bedford	4
BeC2	Bedford	4
BfG	Berks	3
ChF	Chetwynd	5
CnC2	Cincinnati	4
CnC3	Cincinnati	2
CnD2	Cincinnati	4
CnD3	Cincinnati	2
EsC2	Elkinsville	5
FxC2	Fox	4
GpC	Gilpin	3
GpD	Gilpin	3
GpE	Gilpin	3
GrC	Grayford	5
GrD2	Grayford	5
HkF	Hickory	5
MbD2	Markland	3
MbE	Markland	3
MnB2	Miami	4
MnC2	Miami	4
MnD2	Miami	4
MnE	Miami	4
MnF	Miami	4
MoC3	Miami	3
MoD3	Miami	3
PkC2	Parke	5
PkD	Parke	5
PnB	Pekin	4
PrD	Princeton	5
PrE	Princeton	5
WcG	Weikert	1
WfC	Wellson	4
ZaB	Zanesville	4
ZaC	Zanesville	4

Figure 5.1: Watershed-Subwatershed Gap Data

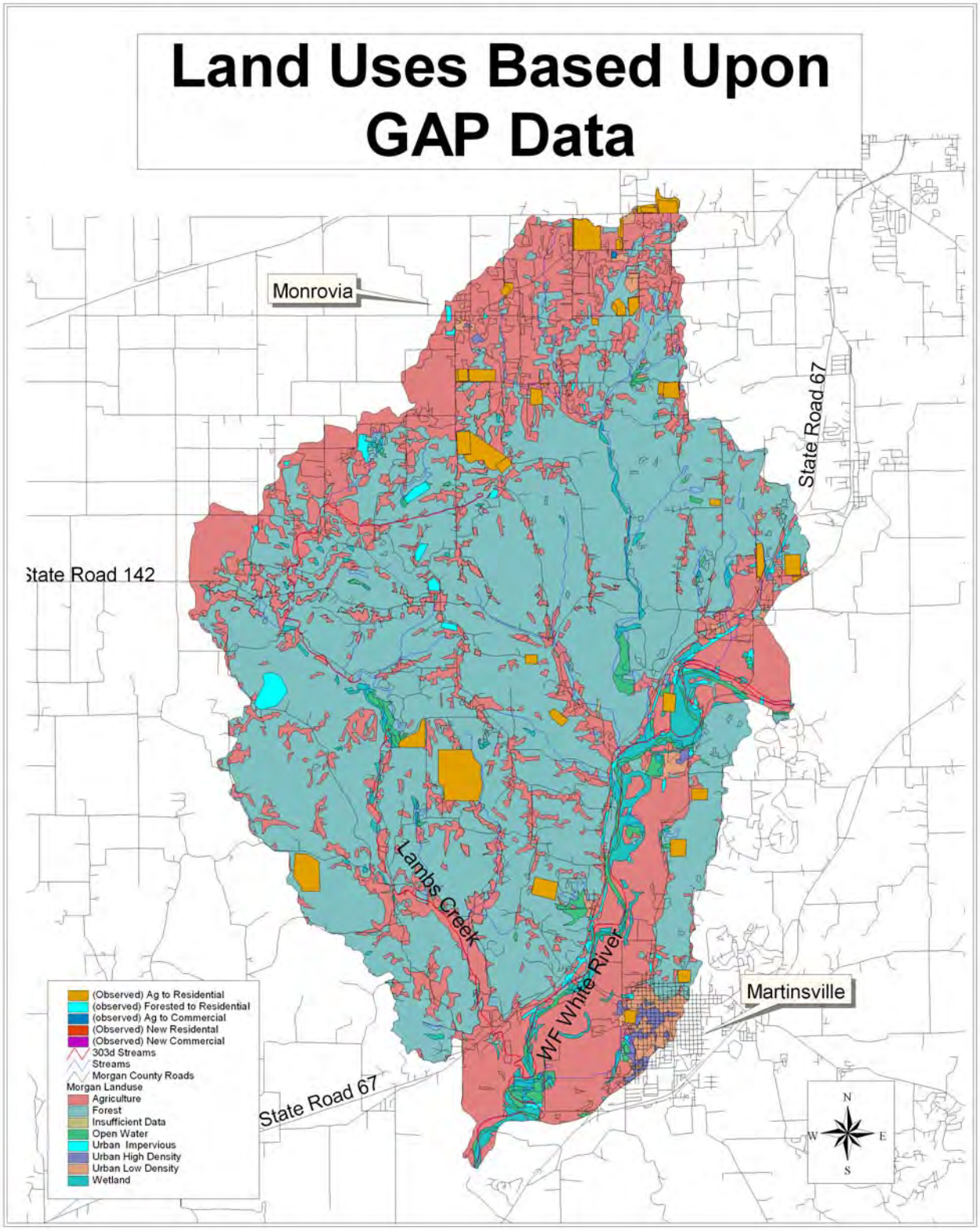
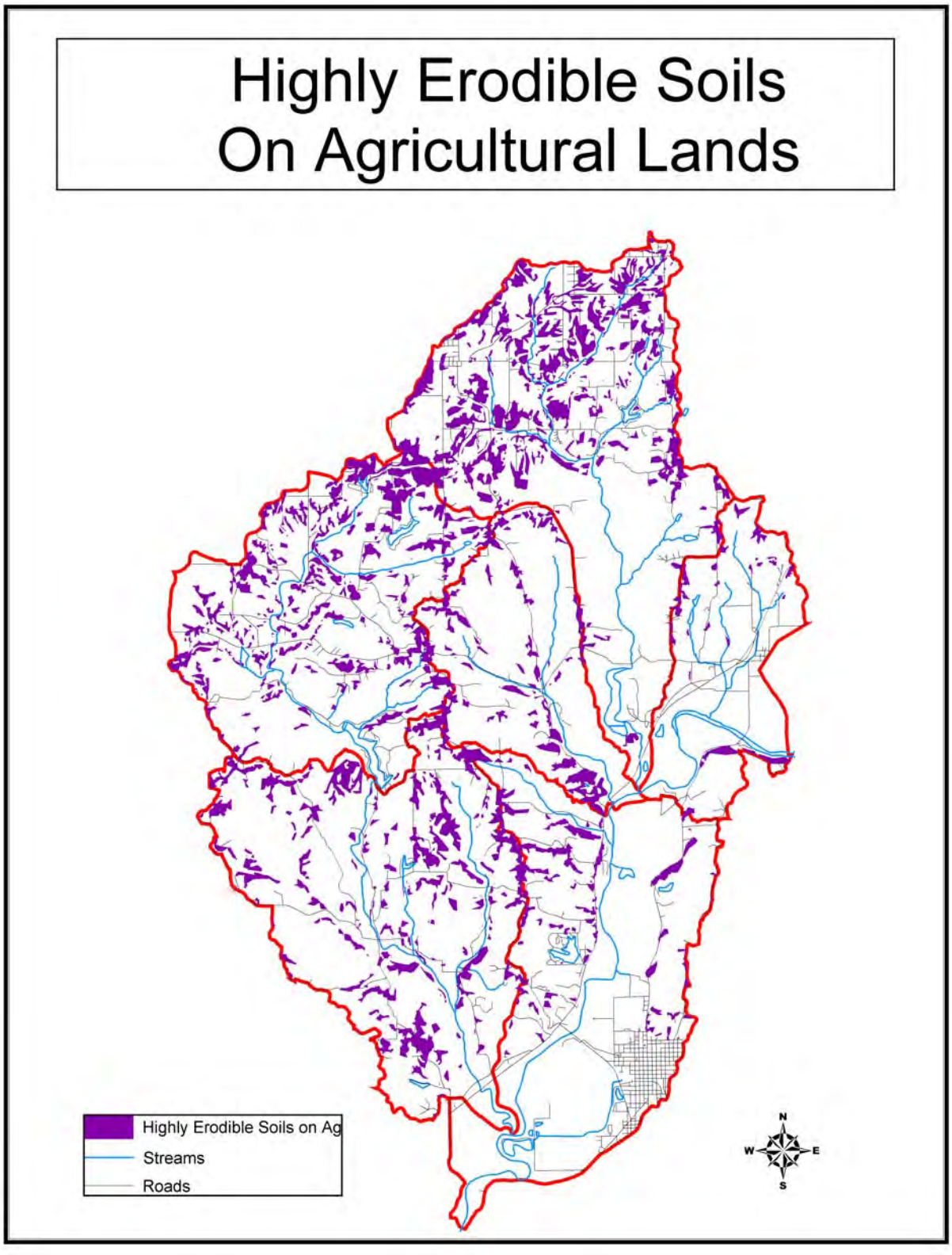


Figure 5.2: Highly Erodible Soils on Agricultural Lands



5.1.3 Causes or Probable Causes of Impairments and Threats to Water Quality

Despite the small percentage of land involved in row crop production, some agricultural practices were identified as a possible cause or threat of impairment (see Section 1) to the White River watershed.

Generally speaking, agriculture has been identified as one of the major contributors of nonpoint source pollution in rural landscapes around the United States. In 1997, the National Water Quality Inventory (NWQI), sponsored by the United States Environmental Protection Agency (US EPA), reported that agricultural nonpoint source (NPS) pollution is the leading source of water quality impacts to surveyed rivers and lakes, the third largest source of impairments to surveyed estuaries, and a major contributor to ground water contamination and wetlands degradation. (EPA, 1997).

Probable NPS pollutants stemming from agriculture in the White River watershed include nutrients, pesticides, and sediment (see Table 5-3). Such pollutants can migrate from agricultural lands to surface and groundwater through processes including surface runoff, erosion, infiltration and drainage tile outlet. It is important to note, however, that pesticides and fertilizers can pose a threat to surface and ground water quality not only during the application phase, but during the transport, handling, and storage phases as well. Also, these pollutants are not specific to agriculture and can originate from urban, commercial, and industrial lands.

Table 5.3: NPS and Row Crop Production

Pollutants	Agriculture Sources
Nutrients	commercial fertilizers and manure
Pesticides	herbicides, insecticides, fungicides
Sediment	sheet, rill, gully, and stream bank erosion

5..1.3.1 Nutrients

Nutrients such as phosphorus (P) and nitrogen (N) in the form of commercial fertilizers, manure, sludge, legumes, and crop residues are applied to enhance crop production. In small amounts, N and P are beneficial to aquatic life, however, too much P and N can stimulate the occurrence of algal blooms and excessive plant growth in receiving waters. Algal blooms and excessive plant growth often reduce the dissolved oxygen content of surface waters through plant respiration and decomposition of dead algae and other plants. This situation can be accelerated in hot weather and low flow conditions because of the reduced capacity of the water to retain dissolved oxygen. Since fish and aquatic insects need the oxygen that is dissolved in water to live, and when decaying algae uses up that oxygen, fish kills can result.

Figure 5.3: Ammonia/Nitrogen Application

5..1.3.2 Pesticides

Pesticides include a broad array of chemicals used to control plant growth (herbicides), insects (insecticides), and fungi (fungicides). These chemicals have the potential to enter and contaminate water through direct application, runoff, wind transport, and atmospheric deposition. They can kill fish and wildlife, contaminate food and drinking water sources, and destroy the habitat that animals use for protective cover.

While some pesticides undergo biological degradation by soil and water bacteria, others are very resistant to degradation.

Such non-biodegradable compounds may become "fixed" or bound to clay particles and organic matter in the soil, making them less available. However, many pesticides are not permanently fixed by the soil. Instead, they collect on plant surfaces and enter the food chain, eventually accumulating in wildlife such as fish and birds. Many pesticides have been found to negatively affect both humans and wildlife by damaging the nervous, endocrine, and reproductive systems or causing cancer (Kormondy 1996).

Figure 5-4: Pesticide Application

5.1.3.3 Erosion and Sedimentation

Sedimentation occurs when wind or water runoff carries soil particles from an area, such as a farm field or stream bank, and transports them to a water body, such as a stream or lake. Excessive sedimentation clouds the water, which reduces the amount of sunlight reaching aquatic plants; covers fish spawning areas and food supplies; and clogs the gills of fish. In addition, other pollutants like phosphorus, pathogens, and heavy metals are often attached to the soil particles and wind up in the water bodies with the sediment.

Figure 5-5: Sheet Erosion

5.1.4 Sources or Probable Sources of Pollutants or Conditions Causing Water Quality Impairments

The sources or probable sources of pollutants or conditions causing water quality impairments or potentially causing water quality impairments include:

- sheet, rill, gully, and stream bank erosion from agricultural fields and streambanks;
- fertilizer and manure application, runoff, and infiltration from agricultural fields, storage barns, mixing pads, etc.;
- pesticide application, runoff, and infiltration from agricultural fields, storage barns, and mixing pads, etc.

5.2 GOALS AND DECISIONS

Solutions for addressing Sources or Probable Source of Pollutants

The identified sources of pollution stemming from row crop production are not specific to the White River watershed or Morgan County. These issues arise with all farming operation around the nation. A remedy to minimize the pollution risks associated with row crop production is through proper management of soils, nutrients, and pesticides. According to agricultural experts, including local SWCD, NRCS, and IDNR staff, as well as national organizations such as the Conservation Tillage Information Center (CTIC), the adoption of a Core 4 program can alleviate the impacts of row crop production. The Core 4 include:

1. conservation tillage
2. conservation buffers
3. nutrient management
4. pesticide management

Conservation Tillage

As defined by the Conservation Tillage Information Center (CTIC), conservation tillage is any tillage and planting system that covers 30 percent or more of the soil surface with crop residue, after planting, to reduce soil erosion by water and wind.

Figure 5.6: Conservation Tillage

No-till, the ultimate form of conservation tillage, is defined by CTIC as the ideal tillage practice to reduce soil erosion by water and wind. In a no-till system, soil is left undisturbed from harvest to planting. Planting or drilling is accomplished using disc openers, coulter(s), row cleaners, in-row chisels or roto-tillers. Weed control is accomplished primarily with crop protection products. Cultivation may be used for emergency weed control.

Benefits of Conservation Tillage

According to the CTIC, there are numerous economic and environmental benefits that conservation tillage offers that conventional tillage systems can't match. The top ten benefits, as identified by the CTIC, are as follows:

1.) Reduces labor, saves time
As little as one trip for planting compared to two or more tillage operations means fewer hours on a tractor and fewer labor hours to pay ... or more acres to farm. For instance, on 500 acres the time savings can be as much as 225 hours per year. That's almost four 60-hour weeks.

2.) Saves fuel
Save an average 3.5 gallons an acre or 1,750 gallons on a 500-acre farm.

3.) Reduces machinery wear
Fewer trips save an estimated $5 per acre on machinery wear and maintenance costs—a $2,500 savings on a 500-acre farm.

4.) Improves soil tilth
A continuous no-till system increases soil particle aggregation (small soil clumps) making it easier for plants to establish roots. Improved soil tilth also can minimize compaction. Of course, reducing trips across the field also reduces compaction.

5.) Increases organic matter
The latest research shows the more soil is tilled, the more carbon is released to the air and the less carbon is available to build organic matter for future crops. In fact, carbon accounts for about half of organic matter.

6.) Traps soil moisture to improve water availability
Keeping crop residue on the surface traps water in the soil by providing shade. The shade reduces water evaporation. In addition, residue acts as tiny dams slowing runoff and increasing the opportunity for water to soak into the soil. Another way infiltration increases is by the channels (macropores) created by earthworms and old plant roots. In fact, continuous no-till can result in as much as two additional inches of water available to plants in late summer.

7.) Reduces soil erosion
Crop residues on the soil surface reduce erosion by water and wind. Depending on the amount of residues present, soil erosion can be reduced by up to 90% compared to an unprotected, intensively tilled field.

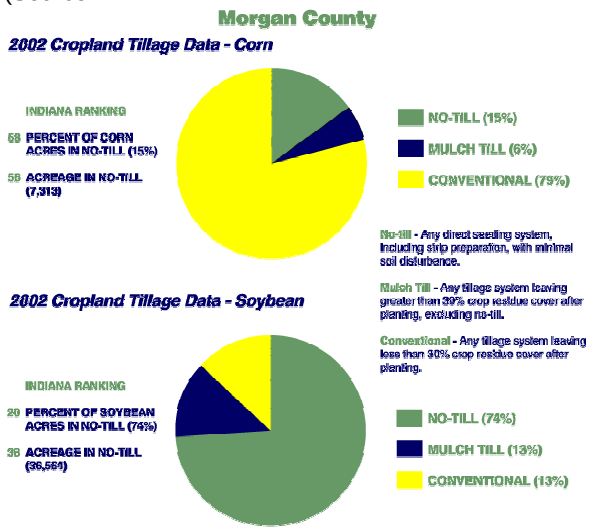
8.) Improves water quality
Crop residue helps hold soil along with associated nutrients (particularly phosphorous) and pesticides on the field to reduce runoff into surface water. In fact, residue can cut herbicide runoff rates in half. Additionally, microbes that live in carbon-rich soils quickly degrade pesticides and utilize

nutrients to protect groundwater quality.

9.) Increases wildlife
Crop residues provide shelter and food for wildlife, such as game birds and small animals.

10.) Improves air quality
Crop residue left on the surface improves air quality because it: Reduces wind erosion, thus it reduces the amount of dust in the air; Reduces fossil fuel emissions from tractors by making fewer trips across the field; and Reduces the release of carbon dioxide into the atmosphere by tying up more carbon in organic matter.

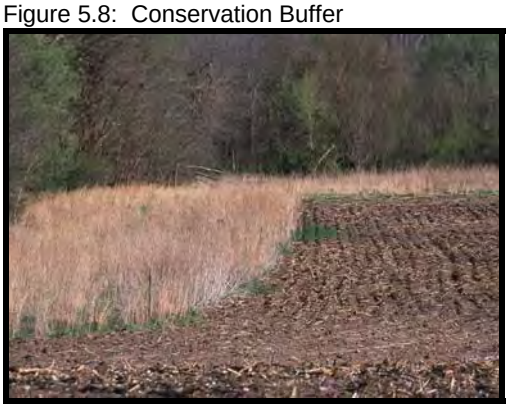
Figure 5.7: Morgan County Tillage Data (Source:



Conservation Buffers

Conservation buffers are small areas or strips of land in permanent vegetation, designed to slow water runoff, provide shelter and stabilize riparian areas. Strategically placed buffer strips in the agricultural landscape can effectively mitigate the movement of sediment, nutrients, and pesticides within farm fields and from farm fields. Buffers include: contour buffer strips, field borders, filter strips, grassed waterways, living snow fences, riparian buffers, shelterbelts/windbreaks, (grass, shrubs and trees), and wetlands. The small amount of land taken out of production helps producers meet environmental and economic goals.

Figure 5.8: Conservation Buffer



Benefits of Conservation Buffers

The economic and environmental benefits of conservation buffers, as identified by the CTIC, are as follows**:**

- Reduce up to 80% of sediment from runoff.
- Reduces 40% (on average) of phosphorous from runoff.
- Removes a significant amount of nitrate from runoff.
- Reduces up to 60% of pathogens removed from runoff.
- Provides a source of food, nesting cover and shelter for wildlife.
- Improves fish habitat.
- Reduces wind erosion.
- Slows water runoff.
- Reduces downstream flooding.
- Stabilizes streambanks.
- Establish natural vegetation.
- Adds visual aesthetics to the landscape.
- Protects soil in vulnerable areas.

Riparian Buffer Width Requirements

According to the Natural Resource Conservation Service (NRCS), riparian buffer width depends on both the character and the needs of the site. Below are the ideal buffer widths for addressing a variety of issues according to the NRCS.

Stabilize eroding banks - On smaller streams and lakes, good erosion control may require only the width of the bank to be covered

with shrubs and trees. Extending buffer vegetation beyond the bank is necessary where more active bank erosion is occurring.

Filter sediment and sediment-attached contaminants from runoff - For slopes less than 15%, most sediment settling occurs within a 25-30 ft (8-9.25 m) wide buffer of grass. Greater width may be required for shrub and tree vegetation, on steeper slopes, or where sediment loads are particularly high.

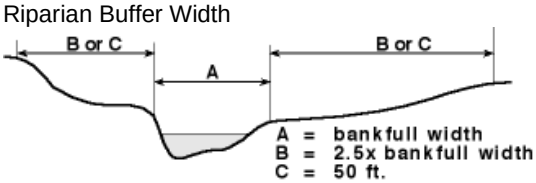
Filter soluble nutrients and pesticides from runoff - Width up to 100 ft (30 m) or more may be necessary on steeper slopes and less-permeable soils to obtain sufficient capacity for infiltration of runoff, and vegetation and microbial uptake of nutrients and pesticides.

Provide shade, shelter, and food for aquatic organisms - Warm water fisheries may require only very narrow buffers, except where shade and temperature control is needed to discourage algae blooms. Width up to 100 ft (30 m) in trees may be needed for adequate shade and water temperature control for cold-water fisheries in warmer climates.

Wildlife habitat - Width required is highly dependent upon desired species. For example, Nebraska NRCS Standards call for a minimum of 45 ft (14 m) of grass to promote upland game birds. Generally, larger animals have greater minimum width requirements, particularly interior forest species. Narrower width may be acceptable where a travel corridor is desired for connecting larger areas of habitat.

NRCS recognizes that it is not always feasible, for numerous reasons, to construct buffer strips as wide as what is suggested in the above paragraphs. For this reason, the NRCS has developed a minimum standard for assessing the buffering needs of a stream. The standard is based on a dimension equal to two and one-half times the bankfull channel width or 50 feet, whichever is less (See Figure 5-9). This distance is measured away from the bankfull channel to arrive at the standard buffer width.

Figure 5.9: NRCS Formula for Establishing Riparian Buffer Width

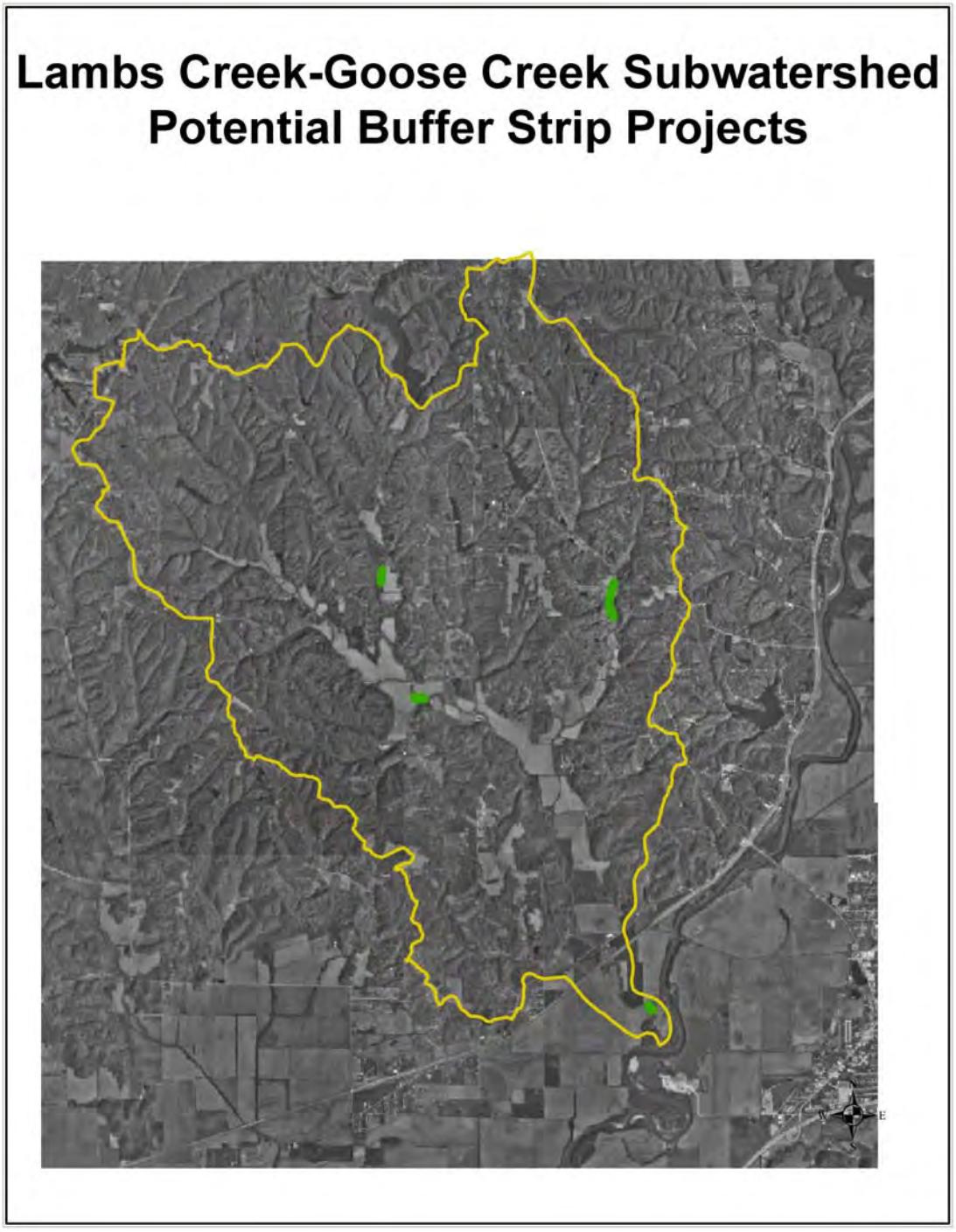


Riparian Buffers in the White River Watershed

The watershed coordination team identified areas adjacent to the White River and its tributaries that, based upon visual assessment of 1998 aerial photography, do not have a vegetated buffer that satisfies the formula in Figure 5-9 (See Figures 5-10 thru 5-15).

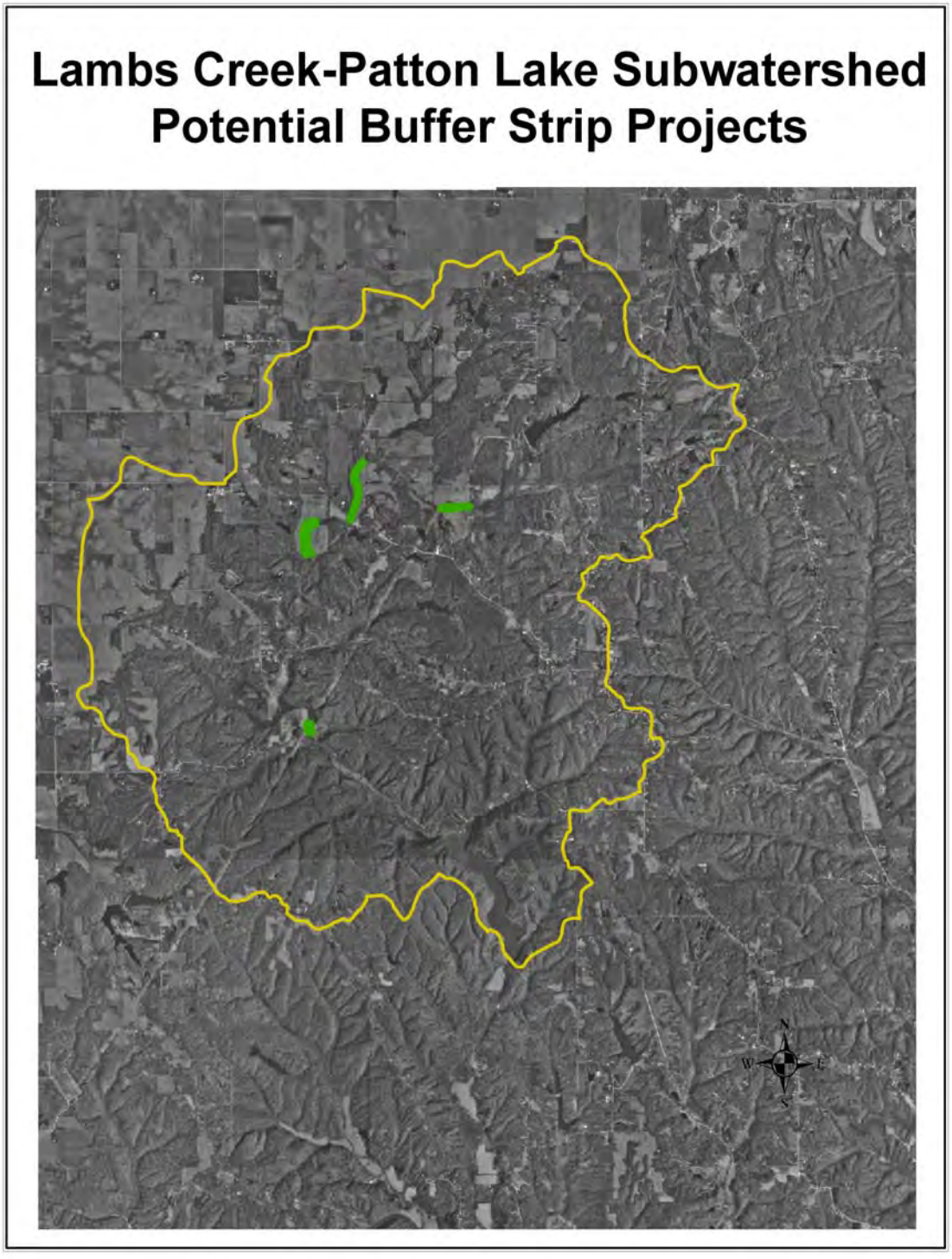
The coordination team recognizes that this information comes with a margin of error due to the scale and the date of the photos. The coordination team feels that this assessment is a good start but recommends actual “ground truthing” by conservation professionals to establish the true needs of the sites identified.

Figure 5.10: Potential Buffer Strip Projects in the Lambs Creek-Goose Creek Subwatershed



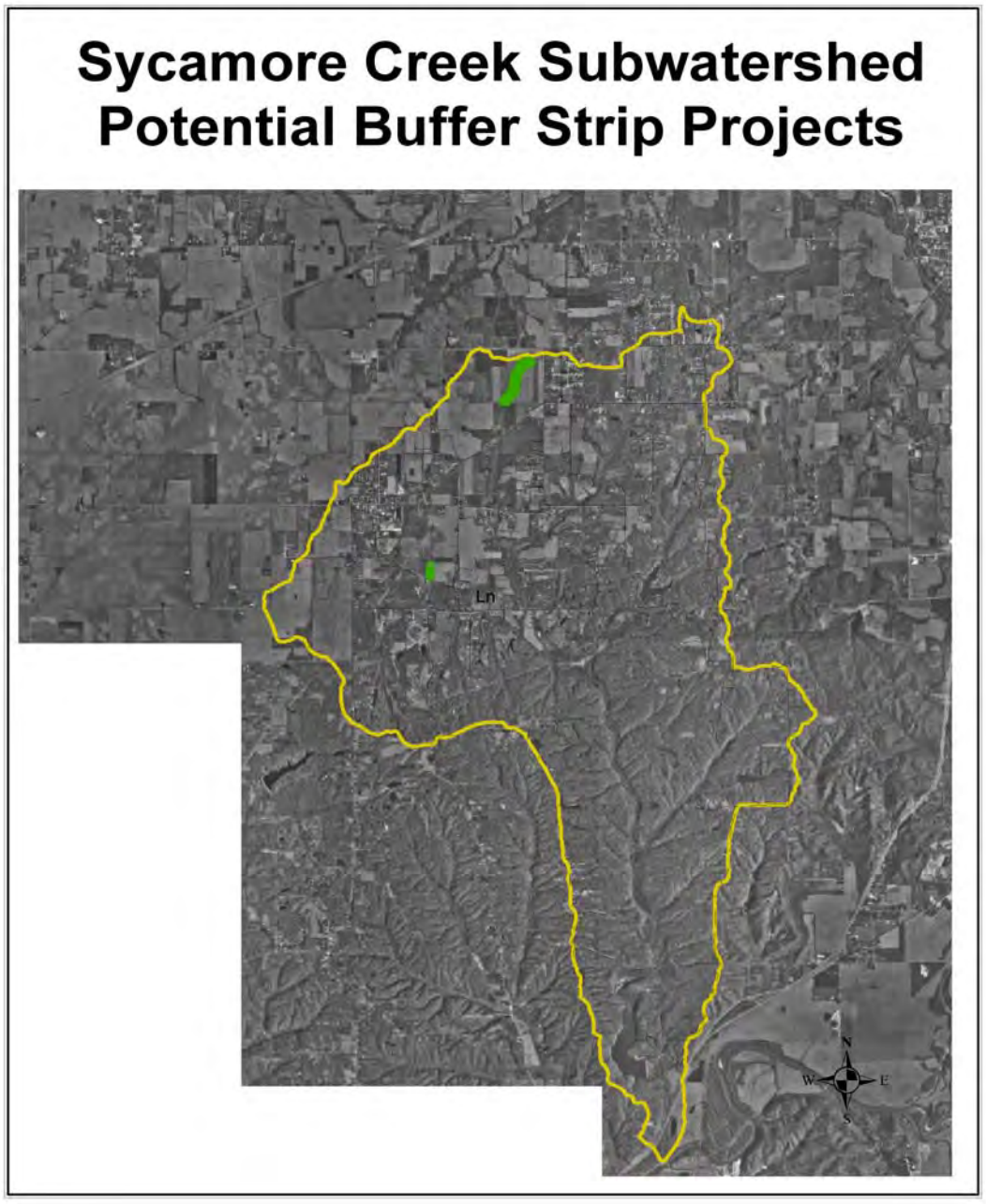
Areas shaded in green indicate areas without adequate buffers. Most, but not all areas lack buffers on both sides of the stream, resulting in 2 segments for each (most) shaded area. Seven (7) segments were identified in the Lambs Creek-Goose Creek totaling 2,789 feet (.52 miles).

Figure 5.11: Potential Buffer Strip Projects in the Lambs Creek-Patton Lake



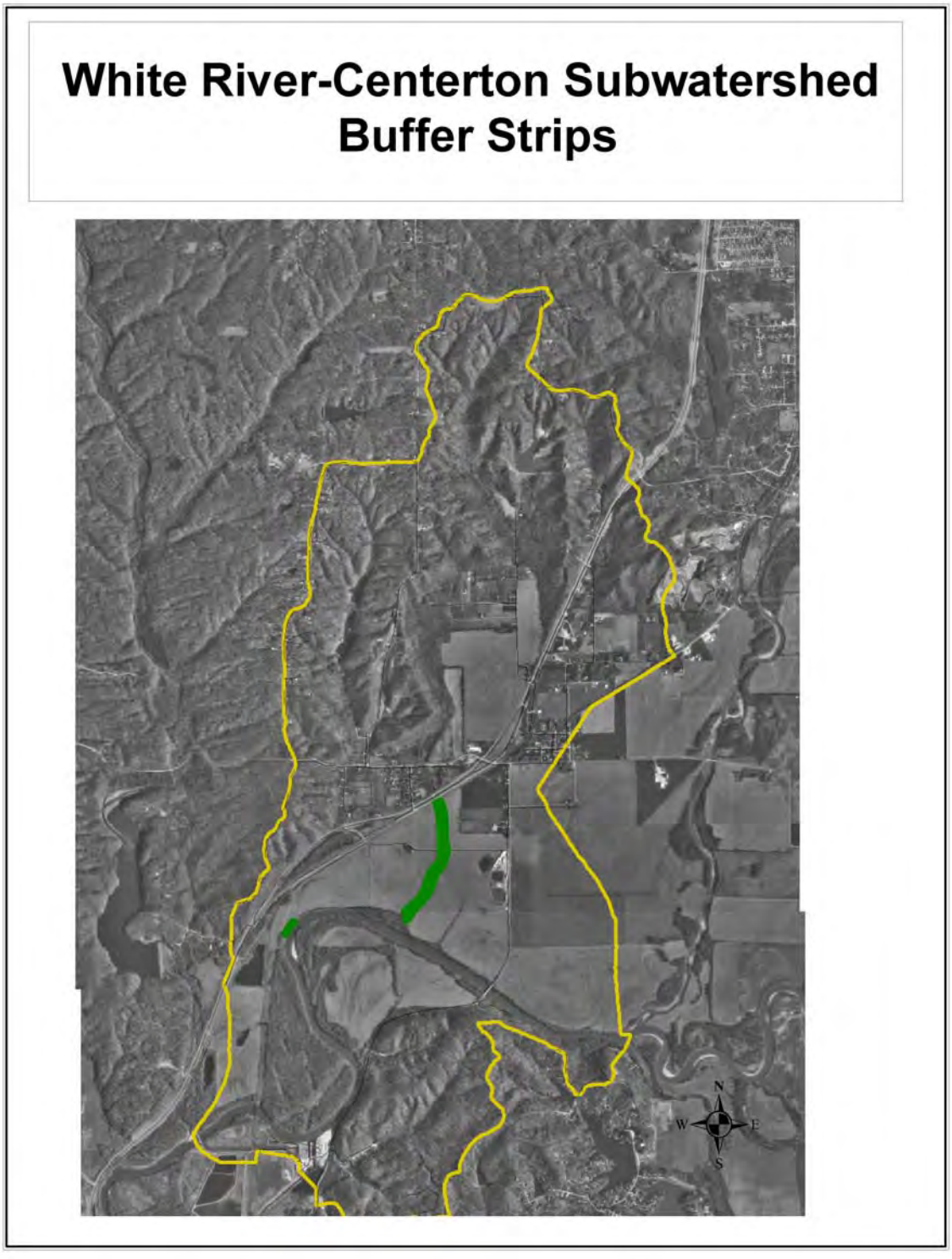
Areas shaded in green indicate areas without adequate buffers. Most, but not all areas lack buffers on both sides of the stream, resulting in 2 segments for each (most) shaded area. Eight (8) segments were identified in the Lambs Creek-Patton Lake subwatershed totaling 6,895 linear feet (1.3 miles).

Figure 5.12: Potential Buffer Strip Projects in the Sycamore Creek



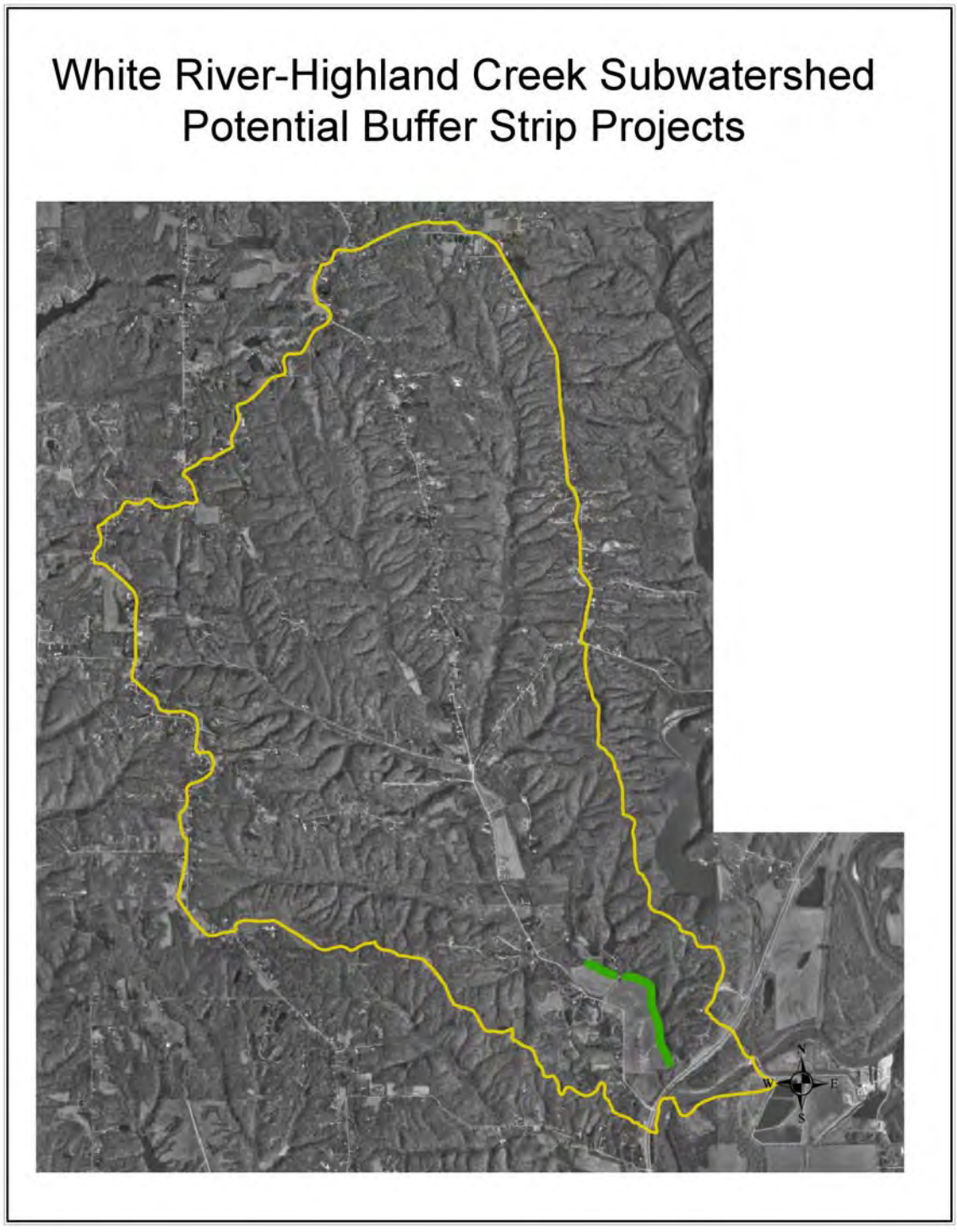
Areas shaded in green indicate areas without adequate buffers. Most, but not all areas lack buffers on both sides of the stream, resulting in 2 segments for each (most) shaded area. Three (3) segments were identified in the Sycamore Creek subwatershed totaling 5,804 linear feet (1.1 miles).

Figure 5.13: Potential Buffer Strip Projects in the Lambs Creek-Goose Creek



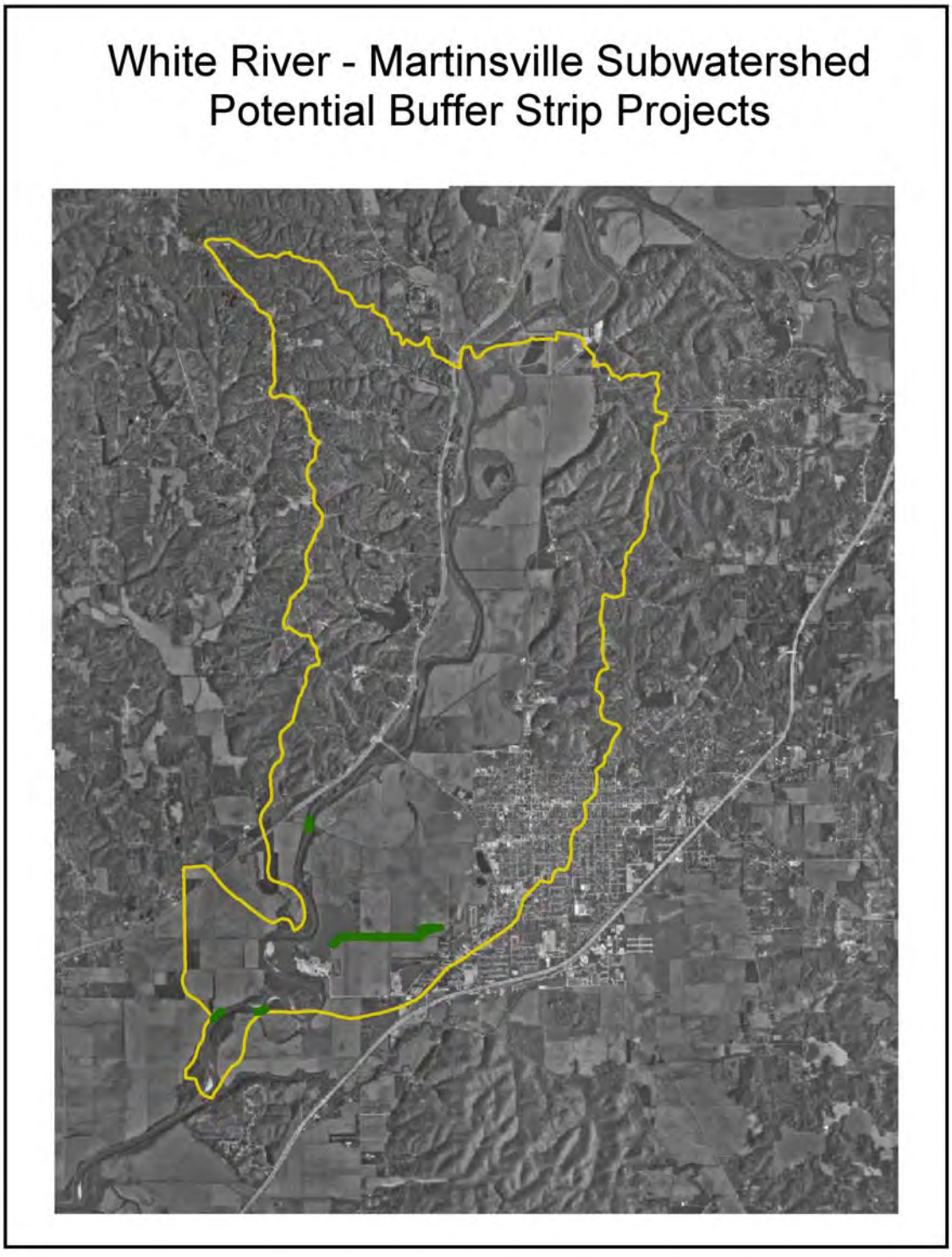
Areas shaded in green indicate areas without adequate buffers. Most, but not all areas lack buffers on both sides of the stream, resulting in 2 segments for each (most) shaded area. Three (3) segments were identified in the White River-Centerton subwatershed totaling 7,300 linear feet (1.4 miles).

Figure 5.14: Potential Buffer Strip Projects in the Highland Creek Subwatershed



Areas shaded in green indicate areas without adequate buffers. Most, but not all areas lack buffers on both sides of the stream, resulting in 2 segments for each (most) shaded area. Two (2) segments were identified in the Lambs Creek-Patton Lake subwatershed totaling 2910 linear feet (.6 miles).

Figure 5.15: Potential Buffer Strip Projects in the White River-Martinsville



Areas shaded in green indicate areas without adequate buffers. Most, but not all areas lack buffers on both sides of the stream, resulting in 2 segments for each (most) shaded area. Six (6) segments were identified in the Lambs Creek-Patton Lake subwatershed totaling 6,822 linear feet (1.3 miles).

Nutrient Management

Nutrient management is another important component to a sound on-farm management system to minimize the impacts that fertilizers have on water quality. According to CTIC there are ten fundamental components of a Crop Nutrient Management Plan. Each component is critical to helping a farmer analyze each field and improve nutrient efficiency for the crops grown. The following components derive from CTIC web site.

1. Field map. For improved planning purposes, field maps should include general reference points such as streams, residences, wellheads, number of acres, soil types, etc.

2. Soil test. Soil tests should be conducted on a consistent schedule to analyze the true nutrient needs of individual fields. Figure 5-16 shows a farmer testing his soils and referencing his sample points utilizing a Global Positioning System (GPS).

3. Crop sequence. The crops grown and the management practices utilized in the past should all be considered when making nutrient management related decisions.

4. Estimated yield. Historic yields are important in developing yield estimates for next year. Accurate yield estimates can dramatically improve nutrient use efficiency.

5. Sources and forms. The sources and forms of available nutrients can vary from farm-to-farm and even field-to-field (manure, legumes, etc.).

6. Sensitive areas. The physical characteristics of the field should be considered when developing a nutrient management plan. One should pay considerable attention to whether or not there are conditions present that could increase or decrease the risk of nutrient loading to water bodies (streams, lakes, drainage ditches, sandy soils, wellheads, buffer strips)

7. Recommended rates. Given everything noted in points 1-6, recommended rates involve the proper amount and location of applied fertilizer.

8. Recommended timing. There are numerous variables involved with the proper timing of fertilizer application (temperature, moisture, tillage practice, whether or not a starter fertilizer will be used, etc.) Taking all variables into consideration will provide a benefit to your nutrient management program.

9. Recommended methods. There are different methods upon which to apply fertilizer and manure. Slope, rainfall patterns, soil type, crop rotation many other factors affect which method is best for optimizing nutrient efficiency. These things should all be considered on a field by field basis.

10. Annual review and update. By keeping good notes throughout the season and annually reviewing the nutrient program can provide great benefit to an operation. Documenting the weather patterns, crop diseases, yields, what fertilizer was applied and how much fertilizer was applied can help a farmer understand how his/her soils respond under different conditions.

Figure 5-16: Soil Testing Utilizing GPS

Pest and Weed Management

As defined by the CTIC, pest management is a comprehensive approach to fine tuning on-farm management of harmful weeds and

pests including management strategies that allow for better control, with minimum risk to the environment. Resistant plants, cultural controls, soil amendments, beneficial insects, natural enemies, barriers, physical treatments, behavioral disruptants, biological and conventional pesticides are some of these management strategies.

Figure 5.17: Pest Scouting

Economic and Environmental Benefits of Pesticide Management

Weed and pest management results in fewer herbicide and any other applications, at reduced rates, using the safest and most effective formulations. This minimizes risk associated with the application including accidents, drift, and any potential toxic effects on non-target species. Scouting helps avoid unexpected pest outbreaks, which can cause heavy losses if not caught and treated.

By using mechanical cultivation, pesticides, fertilizers and tillage only when necessary, growers protect the environment, by reducing sediment, and polluted runoff from entering our lakes, streams and rivers. Utilizing scouting and selecting the appropriate control for the weed or pest identified, supports the biological integrity of all life on earth.

5.2.1 Prioritization

Taking all of the above information into consideration, the technical and land use committees developed the following priorities for row crop management.

1. Farms not currently utilizing conservation tillage, conservation buffers, nutrient management and pest management
2. Farms containing highly erodible soils (see Figure 5-2)
3. Areas within the watershed that have been identified as having water quality impairments associated with row crop production (see Appendix B).
4. Stream corridors identified by the watershed coordination team as not having sufficient vegetated buffers (see Figures 5-x-5-z)

5.2.2 Goals for Improvement and Protection

Primary Goal #4 of this Watershed Management Plan, as outlined in Section 1 of this document, is "to the greatest extent possible and with existing and potential resources, improve and protect water quality in the watershed with the intention, where applicable and appropriate, to achieve and maintain state water quality standards." In order to achieve Primary Goal #4 of this Watershed Management Plan, the following objectives related to row crop issues have been established:

Objective #5-1: By 2006, attempt interaction with 100% of the row crop producers in the watershed to stress the economic and environmental benefits of adopting conservation practices such as conservation tillage, conservation buffers, nutrient management and pest management as well as other conservation practices and to provide the necessary technical and financial assistance to implement those practices.

Objective #5-2: By 2006, increase conservation tillage by 10% throughout the watershed.

- Soybean Acres—87% to 97% by 2006 (512 acres)

- Corn Acres—21% to 31% by 2006 (562 acres)

Objective #5-3: By 2006, install buffers along 30% of the stream corridors identified as lacking buffers (9,756 feet of the 32,520 identified)

Management Measures:
Achieving the goals set by the Watershed Initiative for water quality protection through agricultural conservation practices will involve ongoing and never-ending processes, programs, and actions. In order to achieve the three (3) objectives at protecting water quality through agricultural conservation, the Soil and Water Conservation District will implement several interrelated programs.

- Heavily "market" best management practices and cost-share programs such as the Conservation Reserve Program (CRP), Environmental Quality Incentive Program (EQIP), IDEM Section 319 cost-share dollars, throughout the watershed but specifically targeted to priority areas identified in the Prioritization section of this plan.
- Provide technical and financial assistance to landowners and farmers regarding agricultural best management practices and the funds available for such practices

5.2.3 Loads or Contributions for the Management Measures

The IDEM's Load Reduction Workbook was utilized to calculate/estimate the pollutant load reductions associated with achieving Objectives 5-2 and 5-3. The Load Reduction Workbook uses the "Pollutants Controlled Calculation and Documentation for Section 319 Watershed Training Manual (Michigan Department of Environmental Quality, June 1999) to provide a gross estimate of sediment and nutrient load reductions associated with the implementation of agricultural conservation practices. This workbook uses many simplifying assumptions to provide a general ESTIMATE of pollutant load reductions (IDEM, 2003).

- Estimated Load Reductions for Objective 5-2 are as follows:

Sediment Load Reduction: 413 ton/year
Phosphorus Load Reduction: 693 lbs/year
Nitrogen Load Reduction: 1383 lbs/year

- Estimated Load Reductions for Objective 5-3 are as follows:

Sediment Load Reduction: 18 tons/year
Phosphorus Load Reduction: 53 lbs/year
Nitrogen Load Reduction: 98 lbs/year

5.2.4 Action Plan

Actions Necessary to Achieve Objectives #1, #2, and #3:

Action 5-1: Hire an individual at the SWCD to "market" conservation programs to farmers within the watershed.

Action 5-2: Through the hired individual, contact and interact with 100% of the farmers within the watershed regarding the economic and water quality benefits that stem from proper management of fertilizers, pesticides, and soils.

Action 5-3: Provide technical assistance to landowners and farmers regarding agricultural conservation best management practices.

Action 5-4: Provide guidance to landowners and farmers regarding public and private conservation programs such as IDEM/EPA cost-share programs (Section 319), USDA cost-share programs (EQIP, CRP, etc.), etc.

Action 5-5: Organize and conduct a series of field days and workshops for local landowners and farmers covering topics such as conservation tillage, conservation

buffers, nutrient management, pest management, farm*a*syst, etc.

5.2.5 Resources
The Morgan County SWCD, IDNR, and NRCS staff members have been identified as the key resources to improve agricultural practices within the Morgan County White River watershed. Together, these agencies will work together to educate landowners and farmers of the economic and environmental benefits of implementing conservation practices upon agricultural lands. These agencies will also be responsible for providing technical and financial assistance to landowners and producers to support the implementation of best management practices.

5.2.6 Legal Matters:
Legal matters are not applicable to this section.

5.3 MEASURING PROGRESS

In order to measure the progress of the actions outlined in this section, the SWCD will have to do the following:

- Document all interaction with local farmers
- Document the attendance at field days and workshops
- Utilizing GIS, document the location and other specifics of projects implemented as a result of this project.
- If applicable, load reductions will be calculated for individual projects implemented within the watershed utilizing the IDEM's Load Reduction Workbook.

5.3.1 Indicators Selected to Determine Progress
Indicators selected to determine the progress with plan implementation include:

- Conservation practices implemented or installed.
- Public surveys.
- Attendance at conferences, workshops, and field days.
- Overall water quality improvements.
- Farmers and landowners reached through outreach efforts.
- Pollutant load reductions reached through the implementation of conservation practices.

5.3.2 Monitoring Indicators
Indicators of success will include a series of activities:

- Documenting, in GIS, the implementation of best management practices funded and implemented through USDA, IDNR, and IDEM cost-share funds.
- Utilizing the IDEM's Load Reduction Workbook (where applicable) for best management practices implemented to estimate sediment and nutrient load reductions.
- Documenting the number of participants at agricultural field days and workshops.
- Documenting frequency and number of producers reached through outreach efforts.
- Conducting surveys among local farmers to obtain their level of knowledge of and willingness to participate in conservation activities.
- Water quality improvements.

5.3.3 Operation and Maintenance
The landowners who participate in government cost-share programs are ultimately responsible for the operation and maintenance of practices installed with those funds. IDEM and USDA programs typically require that the landowner sign a 10-15 year maintenance agreement with their cost-share application.

5.3.4 Re-Evaluation of Plan
The SWCD will be responsible for the re-evaluation of this plan. Such activities will occur on an annual basis to evaluate the progress and determine if any changes are necessary to the strategies originally devised.

SECTION 6
Livestock Management Issues

6.1 IDENTIFYING PROBLEMS

6.1.1 What Was Already Known:

At the beginning of this watershed study, it was already known that small cattle and horse operations are fairly common throughout the watershed and that many of these facilities provide animals with direct access to the creeks as a source of drinking water and relief from the hot and humid Indiana summers (see Figure 6-1)

Figure 6.1. Cattle access to local waterways. Photo courtesy of Morgan County Soil and Water Conservation District

It was also common knowledge that livestock herds, if not managed properly, can have a negative impact on the physical, chemical, and biological conditions of surface water as well as quality of groundwater supplies.

Commonly accepted concerns associated with livestock activities include:

1.) elevated bacteria (*E. Coli*) resulting from direct deposit of manure or runoff from feed lots, pastures, and stream banks.
2.) elevated nutrient loading, primarily nitrogen (N) and phosphorus (P), associated with manure, which can lead to algal blooms and significant reductions in dissolved oxygen levels, which are crucial to aquatic organisms.
3.) reduction in cover, biomass, and the productivity of herbaceous and woody vegetation along stream banks, which exposes bare ground, compacts soil, reduces shading of the stream, and leads to an increase in erosion and sedimentation
4.) elevated nitrate and bacteria levels in groundwater supplies

As is described in detail in Appendix B and summarized for each sampling site location on page B-21, *E. coli* has been identified in elevated concentrations at 6 of the 7 sampling sites, and low dissolved oxygen was also identified at these locations.

Data collection also identified periodic spikes of phosphorus and nitrogen in the northern portions (where there is a greater concentration of agricultural land) of the Sycamore Creek subwatershed and southern portions of Lambs Creek.

The Morgan County Health Department staff, through their water quality monitoring program, had already identified livestock as a likely source of *E. Coli* within the watershed. Their findings, as well as the IDEM's and the Watershed Initiative's, findings are discussed in more detail in Appendix B.

6.1.2 What Was Learned During the Process

Windshield surveys conducted by members of the Land Use Committee in 2002 indicated that the livestock populations, originally thought to be scattered throughout the watershed, are concentrated primarily within the Upper and Lower Lambs Creek subwatersheds and the Sycamore Creek subwatershed.

Through various conversations with farmers at the 2002 Morgan County Fair, several public stakeholder meetings, and most notably, the Agricultural Stakeholder Meeting conducted on February 5, 2003, the following information was also learned:

1.) Local farmers are not completely aware of their options when it comes to conservation practices and available conservation programs.
2.) Local farmers are concerned that increased participation in voluntary conservation programs may potentially lead to more regulation.
3.) Local farmers are receptive and willing to participate in conservation programs but feel that they need more information on the requirements associated with participating in such activities.
4.) Local farmers need the assurance that long-term support for such programs will be available.

6.1.2.1 Water Quality

In order to assess the impact livestock populations have on water quality in the Morgan County White River watershed, the coordination team relied on two primary sources of water quality data:

1.) water quality data collected and analyzed by the IDEM, the primary agency involved in surface water quality monitoring and assessment in the State of Indiana.
2.) water quality data collected by the watershed coordination team throughout the planning phase of this project.

Based upon field observations and the collection and analysis of water quality data, the coordination team concluded that several locations within the Morgan County White River Watershed do not meet Indiana's standards for bacteria (*E. Coli*) and that livestock facilities are a contributing factor to this problem.

6.1.3 Causes or Probable Causes of Impairments and Threats

Livestock, in the beginning of this project, was initially identified as a possible cause of bacterial contamination to the White River watershed. This anticipated conclusion, as mentioned in Section 5, agriculture, including row crop and livestock production, has been identified as one of the major contributors of nonpoint source pollution in rural landscapes around the United States.

In 1997, the National Water Quality Inventory (NWQI), sponsored by the United States Environmental Protection Agency (US EPA), reported that agricultural nonpoint source (NPS) pollution is the leading source of water quality impacts to surveyed rivers and lakes, the third largest source of impairments to surveyed estuaries, and a major contributor to ground water contamination and wetlands degradation.

6.1.4 Sources or Probable Sources of Pollutants or Conditions Causing Water Quality Impairments

Probable NPS pollutants associated with livestock in the White River watershed include nutrients, sediment, and bacteria from poorly managed livestock facilities (See Table 6-1). Such pollutants can migrate from feedlots, stream banks, and streambeds to surface and ground water through processes including surface runoff, erosion, and infiltration. In some cases, nutrients and bacteria are directly deposited to the stream through animal defecation. It is important to note that these sources are not specific to the White River watershed or Morgan County. These issues arise with livestock operations around the nation.

Table 6.1 Nonpoint Source Pollution and Livestock Production

Pollutants	Sources Associated with Livestock
Nutrients	Manure (runoff, leaching, direct deposit)
Bacteria	Manure (runoff, leaching, direct deposit)
Sediment	Pasture and streambank erosion due to over grazing and tromping of soil

6.1.5 Prioritization

Figures 6-2 thru 6-4 identify the known livestock facilities that exist within the project area which are limited to the Lambs Creek and Sycamore Creek watersheds. These locations are based upon field observations made by Watershed Initiative volunteers.

Figure 6.2 Livestock Facilities within the Sycamore Creek Subwatershed

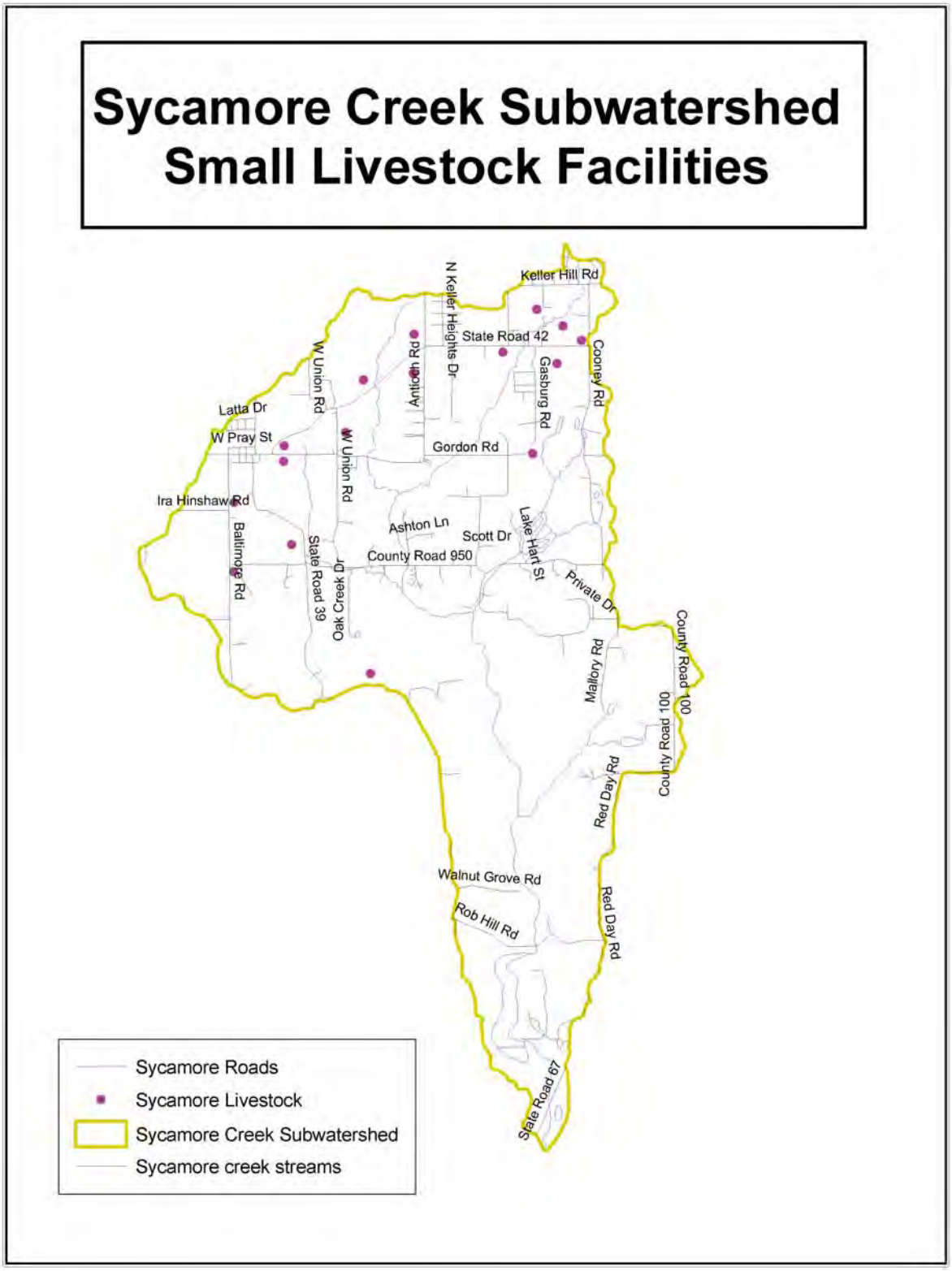


Figure 6.3 Livestock Facilities within the Lambs Creek-Patton Lake Subwatershed

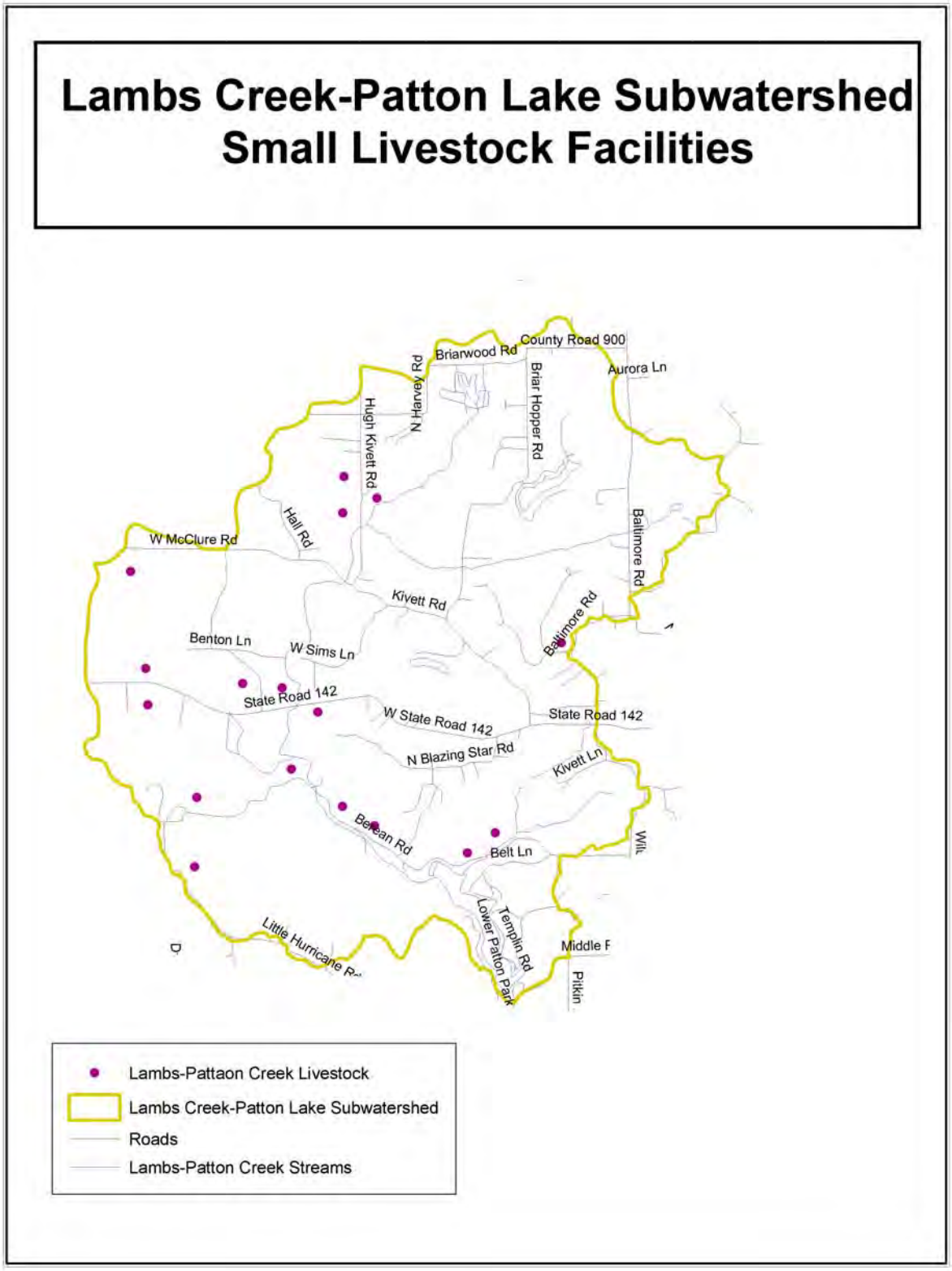
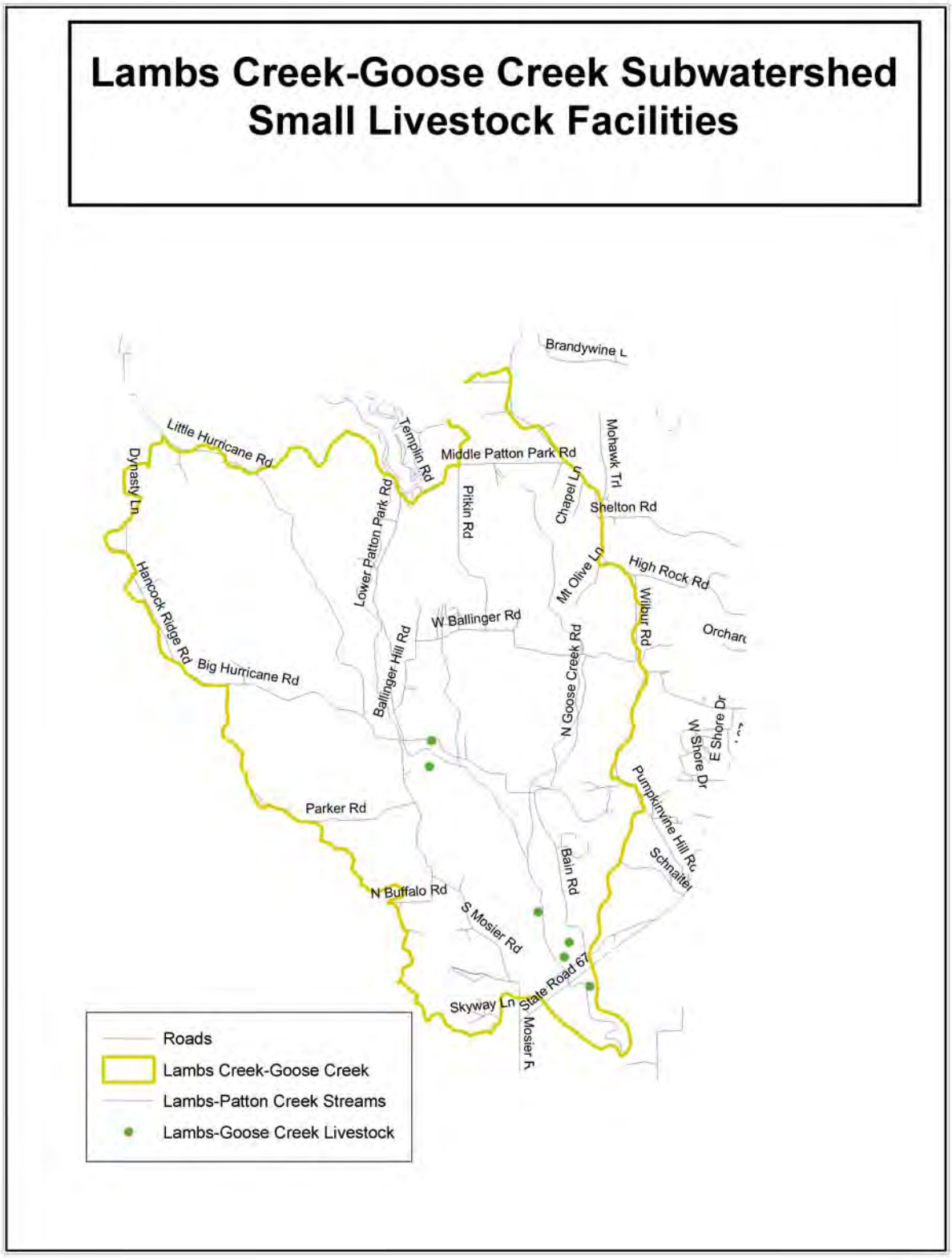


Figure 6.4 Livestock Facilities within the Lambs Creek-Goose Creek Subwatershed



In order to prioritize efforts to address *E. Coli* associated with livestock, it was decided that all of the livestock facilities within the Lambs Creek and Sycamore Creek watersheds should be considered Priority Areas due to the fact that these streams are either on Indiana's 303d list or have been identified as having E. Coli levels that exceed Indiana's water quality standards (see Figure 6-5).

Figure 6.5: Area prioritization table for E coli

Sample Site # on map	Location	Number of *E. coli* exceedances in 12 samples	Number of E coli exceedances during recreational season (April-October)	Is location in a Section 303(d) listed segment of stream and scheduled for TMDL?	Other extenuating factors related to bacteria – detailed in Appendix I	Priority Rank Order for E coli
1	Dry Fork Sycamore Creek at CR 950 North	4	2	No	No	**5**
**2	Sycamore Creek at CR 950 North	6	4	No	No	**4**
3	Sycamore Creek at Robb Hill Road	1	1	No	No	**6**
4	Highland Creek at SR 67	4	2	No	No	**5**
**5	Lambs Creek upstream of Patton Lake at Upper Patton Road	3	1	YES	No	**3**
**6	Lambs Creek downstream of Patton Lake at Lower Patton Road	1	1	YES	YES	**1**
**7	Lambs Creek at Old SR 67	6	5	YES	No	**2**

****Indicates Priority Areas: Sampling Points 2,5,6,7**

6.2 GOALS AND DECISIONS

Primary GOAL #4 of this Watershed Management Plan, as outlined in Section 1 of this document, "to the greatest extent possible and with existing and potential resources, improve and protect water quality in the watershed with the intention, where applicable and appropriate, to achieve and maintain state water quality standards. In order to achieve Primary Goal #4 of this Watershed Management Plan, the following objectives related to livestock issues in the Morgan County White River watershed have been established:

Objective #6-1:
Within the next 6 years, bring E. Coli levels within compliance of state water quality standards in Lambs Creek, both north and south of Patton Lake, and Sycamore Creek south of Hart Lake for 12 months out of the year.

Objective #6-2:
By 2006, attempt interaction with 100% of livestock producers within the watershed to address water quality issues.

Objective #6-3:
Implement a cost-share program to fence cattle from streams, install vegetated buffers between pasturelands and streams, and provide alternative water sources for livestock facilities. The overall goal is to exclude 15% of the livestock from the surface waters of the watershed over the next 5 years.

6.2.2 Management Measures:

Achieving the goals and objectives set by the Watershed Initiative for water quality protection through livestock management practices will involve ongoing and never-ending processes, programs, and actions. In order to achieve the objectives aimed at protecting water quality through livestock management, the Soil and Water Conservation District will implement several interrelated programs.

- Heavily "marketing" best management practices and cost-share programs such as the Conservation Reserve Program (CRP), Environmental Quality Incentive Program (EQIP), IDEM Section 319 cost-share dollars, throughout the watershed but specifically targeted to priority areas identified in the Prioritization section above.
- Provide technical and financial assistance to livestock producers regarding livestock related best management.

6.2.3 Loads or Contributions for the Management Measures

Utilizing the IDEM's Load Reduction Workbook and Purdue's Assessment Tool/Watershed Inventory Making and making broad assumptions and generalizations, local NRCS staff and the Coordination Team estimated that by achieving Objective #6-3, the following pollutant load reductions would result:

Sediment Load Reduction: 1236 tons/yr.
Phosphorus Load Reduction: 1528 lbs/yr
Nitrogen Load Reduction: 2964 lbs/yr.

Additionally, reductions of direct load from manure are estimated to be 150 lbs/day for nitrogen and 121.87 lbs/day of phosphorus.

As the pollutant source (manure) is the same, simultaneous E coli reductions are anticipated to directly correspond with the nitrogen and phosphorous reductions.

6.2.4 Action Plan

In October of 2002, The Morgan County Soil and Water Conservation District

applied to the Indiana Department of Environmental Management for Section 319 Grant funds to help livestock owners voluntarily address water. The initial request was for "Early Stage 2 Implementation, which focuses primarily on Lambs Creek. The plan of action will be to first target those livestock owners whose animals have access to any waterway within the watershed. As funds become available, those livestock owners will be approached, educated about the impacts their animals may have on water quality, and offered the opportunity to participate in voluntary cost share program that will provide the following:

- Personnel to visit livestock facilities and discuss the many different available cost-share programs and provide technical assistance
- Exclusionary fencing from the stream(s)
- Alternative watering systems for animals that have been excluded from their water source.
- Vegetated buffer plantings where needed between the exclusionary fencing and the stream(s).

Actions Necessary to Achieve Objectives #6-1 and #6-2:
To achieve this objective, the Soil and Water Conservation District will utilize the grant funds mentioned above to:

Action 6-1
Hire contract personnel who will prioritize those areas where livestock have been identified and water quality is a concern, arrange visits to those properties, and offer technical and financial assistance to livestock producers regarding exclusionary fencing and other livestock best management practices

Action 6-2
Provide guidance to landowners and farmers regarding public and private conservation programs such as IDEM/EPA cost-share programs (Section 319), USDA cost-share programs (EQIP, CRP, etc.), etc.

- Organize and conduct livestock related field days, pasture walks and workshops

Actions Necessary to Achieve Objective #6-3:
Visit and interact with livestock producers who grant their livestock access to the streams and market the available cost-share dollars available to:

- Fence cattle from the streams
- Construct alternative water sources (nose pumps, gravity pumps, electric pumps, etc.)
- Develop buffer strips between pastureland and the stream

6.2.5 Resources
In accordance with assigned responsibilities and subject expertise, the Morgan County SWCD and NRCS staff members have been identified as the key resources to improve livestock practices within the Morgan County White River watershed. Together, these agencies will work together to educate landowners and livestock producers of the economic and environmental benefits of implementing conservation practices on pasture lands. These agencies will also be responsible for providing technical and financial assistance to landowners and producers to support the implementation of best management practices.

6.2.6 Legal Matters:
Legal matters do not apply to this section

6.3 MEASURING PROGRESS
Indicators of success will include a series of activities:

- Documenting, in GIS, the best management practices funded and implemented through USDA, IDNR, and IDEM cost-share funds
- Utilizing the IDEM's Load Reduction Workbook (where applicable) for best management practices implemented to estimate

sediment and nutrient load reductions
- Documenting the number of participants at agricultural field days and workshops.
- Documenting frequency and number of producers reached through outreach efforts.
- Conducting surveys among local farmers to assess their level of knowledge of and willingness to participate in conservation activities.

6.3.1 Monitoring Indicators

Indicators of success will include a series of activities:

- Documenting, in GIS, the implementation of best management practices funded and implemented through USDA, IDNR, and IDEM cost-share funds
- Utilizing the IDEM's Load Reduction Workbook (where applicable) for best management practices implemented to estimate sediment and nutrient load reductions
- Documenting the number of participants at agricultural field days and workshops.
- Documenting frequency and number of producers reached through outreach efforts.
- Conducting surveys among local farmers to assess their level of knowledge of and willingness to participate in conservation activities.

6.3.3 Operation and Maintenance

Ultimately the farmer or the landowner will be responsible for the operation and maintenance of any best management practices implemented with government dollars. The SWCD, NRCS, FSA, and IDEM require a 10-15 year maintenance agreement for practices installed with government dollars, depending upon the financial program utilized.

6.3.4 Re-Evaluation of Plan

The SWCD will be responsible for the re-evaluation of this plan. Such activities will occur on an annual basis to evaluate the progress and determine if any changes are necessary to the strategies originally devised.

SECTION 7
Commercial and Industrial Issues

7.1 IDENTIFYING PROBLEMS

The research for and development of this Watershed Management Plan were funded by a grant under Section 319 of the Clean Water Act. This federal program, which is administered by the State, is focused on nonpoint source pollution and the associated planning and projects necessary to correct problems associated with nonpoint source pollution.

While all issues involving both point source pollution and nonpoint source pollution should be addressed collectively in a true watershed approach, the funding and overall scope of this Watershed Plan were focused on nonpoint source pollution issues in unregulated geographical areas and at unregulated locations. Therefore, regulated entities such as certain industries, municipalities, and wastewater treatment plants, are not covered in-depth in this Plan. Additionally, the water quality sampling effort was not designed to identify the myriad of potential pollutants (chemicals, fuels, etc.) that could be associated with certain industries.

With this limitation considered, this section attempts to briefly discuss issues related to industry and commercial issues without becoming too involved with the requirements of existing state permits and pending regulatory programs. The intent is to allow for some exposure to these issues and ensure the consideration of such issues in the encompassing watershed planning process.

7.1.1 What Was Already Known

What was actually known with regard to commercial and industrial issues is that: (1) Commercial development and industrial growth is helpful to the local economy, and (2) both facility site design and activities associated with commercial and industrial impacts can, if not well-managed or properly designed, have detrimental impacts on water quality.

It was also understood that Morgan County and the City of Martinsville had, in recent years seen an above average rate of development and land use change from agricultural and other open land to both commercial and industrial use.

Figure 7.2: Example of recent industry development in Morgan County. Such development is indicative of a healthy economy.

Since many industries are permitted to discharge process wastewaters into municipal sanitary sewer systems, wastewater treatment plants are discussed briefly in this Section. Specifically, industrial dischargers are, under certain conditions, permitted to the sanitary sewer system if they comply with what is called "industrial pretreatment."

Discharges from industrial activities as well as site design for commercial land use are regulated by the state, however review of the individual permits, inspection reports, design, and other information related to such facilities was beyond the scope of this Watershed Management Plan.

7.1.2 What Was Learned During the Process

Over the course of the watershed study, some interesting facts related to industry and commercial issues were learned:

(1) New water quality problems specifically related to industry in this subject area were not identified since the type of data

that was collected by the coordination team is generally not the type of data that would indicate problems related to industrial processes. In addition, as discussed in Section 1 and Appendix B of this Plan, sample locations were focused on the tributaries where industry is much less prevalent.

(2) **Monrovia Wastewater**: The Town of Monrovia's new Wastewater Treatment plant had only recently been constructed. Its discharge is in the Sycamore Creek Watershed. Surface water samples were taken downstream of this location, and details of location, process, and findings are discussed in Appendix B of this Plan. The plant serves 140 residents.

(3) **Martinsville Wastewater**: The discharge from the Martinsville Wastewater treatment plant is directly into the White River, southwest of Martinsville in the very southern reaches of the subject watershed. Sampling by the watershed coordination team did not sample below this point, since the sampling focused on tributaries to White River.

(4) **Hazardous Materials**: According to the Community Right to Know database, there are 5 operations in the watershed that involve the handling hazardous materials. These locations are shown in figure 7.2. These facilities are required to provide the local emergency response authority (LEPC and fire department) of the type and quantity of chemicals they use.

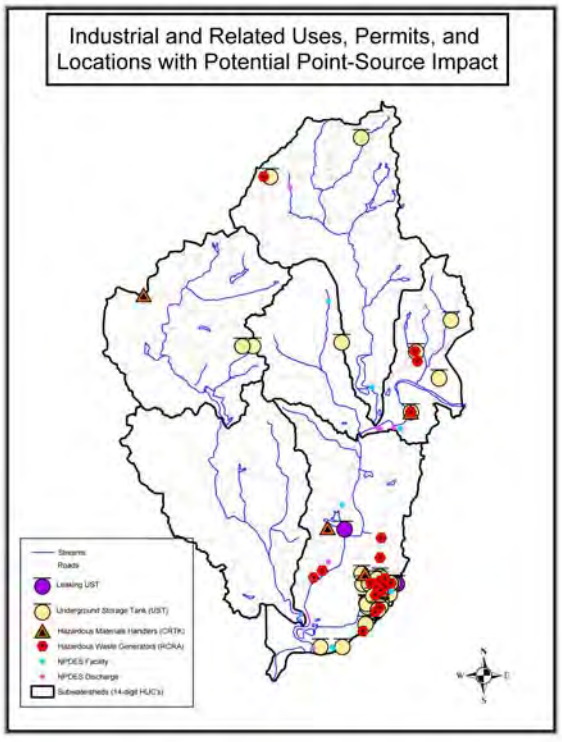
(5) **Hazardous Waste**: According to the Resource Conservation and Recovery Act database, there are 72 operations in the watershed that generate and/or store hazardous waste. These locations are also shown in figure 7.2.

(6) **Storage Tanks**: There are 166 underground storage tanks (USTs) registered with IDEM in the watershed. Of these 166 tanks, 41 are on record as leaking underground storage tanks (LUSTs). Most tanks store petroleum products. In addition to those tanks registered with the state and listed on the UST and LUST databases found at IDEM, there are likely other USTs and LUSTs located in the watershed that were never registered with the state.

(7) **Commercial Development:** Land use change from agriculture and other open lands to industrial and commercial use is continuing at what appears to be an increasing rate. Large parking areas for restaurants, auto dealers, "strip centers", and other retail use are appearing in areas most evident around Martinsville and Monrovia.

(8) **I-69**: Indiana's Governor announced in early 2003 that the new Interstate 69 extension south of Indianapolis to Evansville will follow much of S.R. 37 through Martinsville, but will also involve new terrain and expansion in many locations very near the watershed in Morgan County. This project is expected to drive an increased rate of growth and development including industry and commercial land uses in the area.

Figure 7.2:



7.1.2.1 Water Quality

As previously mentioned, the field sampling and monitoring program was not designed to specifically identify problems related to industrial discharges. The sampling *of E. coli* bacteria was one potential indicator of problems related to incomplete sewage treatment prior to wastewater treatment plant discharge. However, the presence of *E. coli* could also be caused by leaking septic systems, wildlife, and livestock facilities.

7.1.3 Causes or Probable Causes of Impairments or Threats to Water Quality

There are many potential causes of impairments to water quality in this subject watershed. Most notably, the *E. coli* bacteria has been identified by both IDEM and the coordination team sampling results, as an impairment and/or threat in the tributaries. Additionally, mercury, PCBs, and heavy sediment loads have all been identified by IDEM in surface waters within the watershed.

7.1.3.1 Industrial Causes

Pollutants identified in surface waters, such as petroleum byproducts and other chemicals can be harmful to both humans and wildlife. Often these pollutants exist in the water or sediment because of historical, and occasionally current industrial discharges that are either poorly managed or not permitted by the State. Since the Clean Water Act of 1972, most of these industrial pollutants from point source discharges have been addressed through permitting and enforcement. However, there remains a legacy of such pollution, such as Polychlorinated Bipheonols (PCBs) or mercury found in streambed sediments. Both of these pollutants are found in the White River, according to State water quality data and the Section 303(d) list of impaired waters. Industrial discharges, leaking underground storage tanks (LUSTs), and chemical spills are typical causes. Much of this pollution is likely to have traveled downstream from the industry-heavy City of Indianapolis. Other probable causes are (or were at one time) located in the Martinsville area.

7.1.3.2 Commercial Development

Rapid and unmanaged commercial development poses two primary risks to water quality. They are: soil sediment entering streams caused by erosion from poorly managed construction and development (usually temporary); and increased pollution runoff of petroleum products (motor oil and gasoline), antifreeze, zinc from rooftops, and other typical waste products that accumulate on concrete, asphalt, and rooftops (long-term). The cause of the latter of the two risks is the increase of impervious surface area from what was once farmland, forested land, or other unpaved property. Impervious surfaces allow for the collection of chemicals from such sources as automobiles, increase surface water runoff directly to surface waters, and reduce the groundwater recharge necessary for adequate groundwater supplies.

7.1.4 Sources or Probable Sources of Pollutants or Conditions Causing Water Quality Impairments

Historical industrial discharges, unpermitted or poorly managed current discharges, leaking underground storage tanks, spills, and poorly planned development are the primary sources of the pollutants described in this section. Specific sources and their locations are not discussed in this Plan.

7.1.5 Prioritization

From a geographical perspective, the Land Use Committee prioritized the developing areas around the City of Martinsville and the Town of Monrovia. These locations are the most likely to experience growth and development in the coming 5 to 10 years. This is due to their proximity to Indianapolis and it's associated population expansion as well as the proposed I-69 corridor extension.

7.2 GOALS AND DECISIONS

7.2.1 Goals for Improvement and Protection:

Primary Goal #4 of this Watershed Management Plan, as outlined in Section 1 of this document is, "to the greatest extent possible and with existing and potential resources, improve and protect water quality in the watershed with the intention, where applicable and appropriate, to achieve and maintain state water quality standards." In order to achieve Primary Goal #4 of this Watershed Management Plan, the following objectives related to commercial and industrial issues have been established by the Watershed Initiative:

Objective #7-1

Reduce the likelyhood of petroleum and chemical spills, increase the preparedness for spills, and respond with knowledge and full understanding of sources of spills of chemicals and other petroleum products into surface waters.

Action 7-1

Through watershed teaming, discussed in Section 9 of this Plan, ensure consistent interaction and information sharing between the LEPC, all local fire departments, the SWCD, and County Health Department regarding the locations and types of hazardous materials and hazardous waste operations dicussed in this Section. The proximity to local waters, water resource sensitivity, soil types, and slopes should be understood and maintained by both parties.

Action 7-2

Ensure that appropriate Spill Prevention Control and Countermeasure Plans (SPCCP) are avialable at all facilities that handle hazardous materials and petroleum products. Ensure through inspection and educational processes, that employees at those facilities are trained to implement the SPCCP.

Action 7-3

For facilities that are not regulated per their industrial classification to maintain an SPCCP, ensure through the consituent requirements of Storm Water Phase 2 (see Section 9), all other facilities are trained and understand their potential for impact on surface waters in the event of a spill or release of chemicals.

Action 7-4

Upon acquisition and establishment of GIS in the county (see Sections 8 and 9), ensure that all locations where hazardous materials and wastes are kept are located and displayed in GIS. Up-to-date lists of materials (i.e., Material Safety Data Sheets) and typical waste streams should be linked to the geographical location to ensure regional, upstream and downstream knowledge in the event that indications of a pollutant are found in surface waters (i.e., evidence of a spill or fish kill).

Objective #7-2

Through watershed teaming (see Section 9) establish cross-training programs and procedures between local agencies to expand the understanding and inspection capabilities between local agencies whose activities involve water quality protection.

Action 7-5

Cross-train between the SWCD and the Martinsville and Monrovia wastewaster pretreatment coordinators so that there is a comprehensvie understanding among both regarding:

- Chemicals used in certain industries and how they are treated prior to final discharge both to and from the treatement plant.
- Sensitivity of waters and soils downtream of the industries using chemicals (in the case of a spill) and downstream of the treatment plants in the event of a bypass or an unauthorized pollutant discharge to the plant (similar to the City of Anderson/Guide Corporation discharge event that resulted in a large fish kill in White River in 1999).

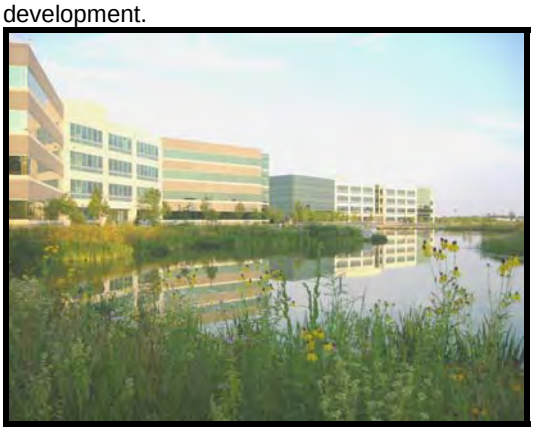
Action 7-6
Cross train between the SWCD, the LEPC, local drinking water utilities, the Morgan County Health Department, and the local fire departments regarding spill response capabilities, priorities, and processes. The SWCD should provide information regarding sensitive areas, soils, slopes, and already impaired areas of surface waters. Through this process, the local water utilities should help educate all parties about wellfield protection areas, and other geographical issues of public health concerns. This will provide opportunties for the fire department to enhance their spill response priorities.

Objective #7-3
Ensure that the increasing land use change in the watershed from farmland and forested land to commercial areas with impervious surfaces results in minimal impact to water quality.

Action 7-7
As is proposed in Section 8 of this document, *Development, Planning and Zoning*, the County Development Department should be encouraged to utilize the Long Term Hydrologic Impact Assessment (LTHIA) software, available from Purdue University. The development department can then run screening scenarios of proposed land use and zoning changes. Results of the LTHIA screening should be turned over to the SWCD prior to any Zoning Board decisions. The SWCD will have the opportunity to recommend mitigation measures to the Zoning Board for any anticipated water quality impacts. It will be necessary to acquire and begin consistent use of GIS software (see Sections 8 and 9) in order to utilize LTHIA.

7.2.2 Management Measures
In order to accomplish the objectives and initiate the actions discussed in this Section, it will first be necessary to design and implement an intergovernmental teaming process, such as the watershed teaming process described in Section 9. The opportunities to share information, co-educate, and cross-train will result.

Figure 7.2: An example of a commercial complex where natural features were integrated with proper storm water management. This commercial site design by Ratio Architects and JF New provides many natural features to minimize the impacts of commercial development.



7.2.3 Loads or Contributions for the Management Measures
While the ultimate intent of this section is to reduce the pollution load to receiving waters, it is not realistically possible to calculate what reductions will occur as a result of the actions proposed in this section. Therefore, no such calculations have been made. However, with regard to *Action 7-7*, the potential pollutant load contribution of each proposed land use change can be calculated for individual proposed land use changes. This would occur on a site-by-site basis.

7.2.5 Resources
Resources available or needed for achieving goals and objectives discussed in this section are divided into human resources, and funding resources:

7.2.5.1 Human Resources
Currently, the Soil and Water Conservation District staff, IDNR staff, NRCS staff, and voluntary Supervisors would likely be available for participation in the regional teaming and cross-training. Additionally, the Watershed Initiative Land Use Committee, a strictly voluntary group of

stakeholders who have been meeting for 2 years, have committed themselves to remain available participants in watershed education and to assist and help direct many of these activities. Most of these committee members have indicated a willingness to provide themselves as part of a speakers bureau to help perpetuate the water quality message to the public.

7.2.5.2 Funding Resources

The primary funding necessary to implement the actions of this Section will include those costs necessary for the acquisition of GIS (which serves and supports many actions in this Plan). The remaining efforts in this Section constituted some minor staff scheduling changes, which should not be costly.

Sources of funding will be necessary for software, equipment, and minor overhead costs. Funding resources that will be pursued (see Section 10 for funding for specific actions) will include: Section 319 watershed management funding from US EPA through IDEM; similar programs such as Section 104(b)(3) and Section 205(j) funding; local county and city appropriations Public Works and related budgets; Lake and River Enhancement (LARE); and private donations.

7.2.6 Legal Matters:

Legal matters related to this section are more appropriately addressed directly between the regulated (i.e., permit holders) and the regulator (i.e., IDEM). As discussed in this Section 9 and Appendix C of this Plan, Wasteload Allocations necessary to meet TMDL limitations will be addressed through legal discharge permitting methods.

7.3 MEASURING PROGRESS

7.3.1 Indicators Selected to Determine Progress

Periodically, the SWCD and/or the participants in the Watershed Initiative will have to measure the progress of the actions proposed in this section by making record of each of the actions, such as cross training, and re-visiting the value and success of the program will be necessary.

Indicators of success will included:

- Increased knowledge between departments regarding spill response, sensitive areas, and pretreatment inspection processes.
- Better preparation for spills.
- Fewer spills based upon records available at IDEM and local LEPC.
- More thorough evaluation of property design for land use change, with a reduction in the rate of increase of impervious surface areas.

7.3.2 Re-Evaluation of Plan

The Morgan County Soil and Water Conservation District will be responsible for the regular review and update of this Watershed Management Plan. This Plan should be evaluated on an annual basis to document and celebrate progress; assess effectiveness of efforts; modify activities, if needed, to better target water quality issues; and keep implementation of the Plan on track. The Plan should be revised as needed to better meet the needs of the watershed stakeholders and meet water quality goals.

A summary of the actions proposed for this plan and a detailed list of potential funding sources can be found in Section 10 of this Plan.

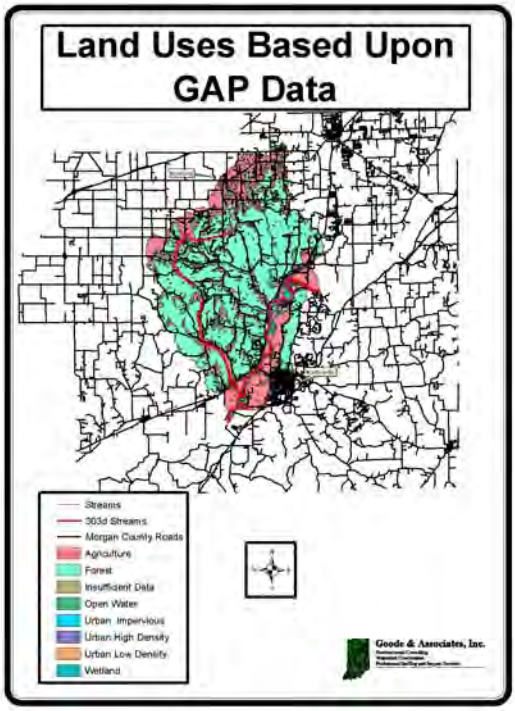
SECTION 8
Development, Planning, and Zoning

8.1 IDENTIFYING PROBLEMS

8.1.1 What Was Already Known

Land use within the entire White River Watershed is predominantly deciduous forest including mixed forest, shrubland, and woodland species.

Figure 8.1: GAP land use map of watershed with subwatershed boundaries



According to the most recent GAP data, deciduous forest comprise 60% or 31,693 acres followed by agriculture row crops at 20% (10,232 acres) and pasture at 13% (7,049). The GAP data classifies only a small percentage, 2.1% (1083 acres) of land in the White River Wateshed as urban low density, urban high density, and urban impervious (Table 8-1)(USGS, 1997). The White River Martinsville and White River Centerton subwatersheds contain the greatest amount of urban land uses – 748 acres and 144 acres respectively. The City of Martinsville and SR 67 are located in these subwatershed. These numbers are likely to increase as the City of Indianapolis continues to grow and influence land use change in Morgan County.

There are two urban centers in the White River Watershed: Martinsville and Monrovia. Both are only partially located in the watershed. The Town of Monrovia is located along SR 42 just south of the I-70 interchange at the northwest corner of the watershed and the City of Martinsville is just east of SR 67 at the southeastern edge of the White River Watershed.

Figure 8.2: Simple location map of county, watershed, communities and roads

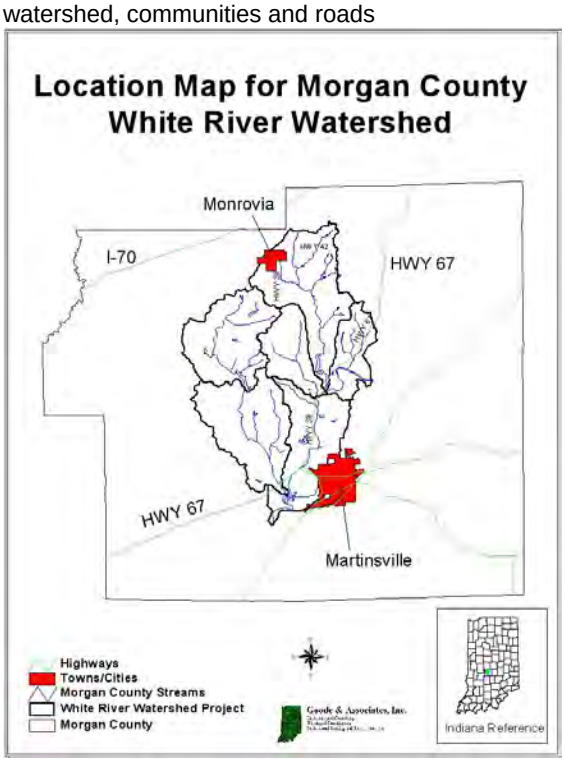


Table 8-1 GAP Data Land Use Classifications

Land Use Classification							
	White River	*Sycamore Creek*	*Lambs Creek-Patton Lake*	*Lambs Creek-Goose Creek*	*Highland Creek*	*White River Centerton*	*White River Martinsville*
Pasture	7,059 Ac. (13%)	2,718 Ac. (5.2%)	1,270 Ac. (2%)	1,558 Ac. (3.0%)	542 Ac. (1.0%)	337 Ac. (0.6%)	624 Ac. (1.2%)
Row Crops	10,232 Ac. (20%)	2,218 Ac. (4.2%)	1,875 Ac. (3.6%)	996 Ac. (2.0%)	189 Ac. (0.4%)	1,319 Ac. (2.5%)	3,635 Ac. (7%)
*Deciduous Forest***	31,693 Ac. (60%)	6,57 Ac. (13%)	6,254 Ac. (12%)	8,432 Ac. (16%)	4,345 Ac. (8.3%)	2,184 Ac. (4.0%)	3,942 Ac. (7.5%)
Conifer Forest	119 Ac. (0.2%)	36 Ac. (0.1%)	27 Ac. (0.05%)	7 Ac. (0.01%)	4.3 Ac. (0.01%)	30 Ac. (0.05%)	15 Ac. (0.02%)
Open Water	756 Ac. (1.4%)	142 Ac. (3%)	95 Ac. (0.2%)	27 Ac. (0.05%)	1.0 Ac. (0.002%)	91 Ac. (0.17%)	400 Ac. (0.8%)
Urban High Density	207 Ac. (0.4%)	14 Ac. (0.02%)	0 Ac. (0%)	0 Ac. (0%)	0 Ac. (0%)	10 Ac. (0.02%)	183 Ac. (0.3%)
Urban Impervious	309 Ac. (2.1%)	33 Ac. (0.06%)	44 Ac. (0.08%)	0 Ac. (0%)	0 Ac. (0%)	105 Ac. (0.2%)	127 Ac. (0.2%)
Urban Low Density	567 Ac. (1.1%)	99 Ac. (0.2%)	0 Ac. (0%)	0 Ac. (0%)	0.5 Ac. (0.001%)	29 Ac. (0.05%)	438 Ac. (0.8%)
*Wetland****	1,492 Ac. (3%)	138 Ac. (0.3%)	104 Ac. (0.2%)	107 Ac. (0.2%)	42 Ac. (0.1%)	395 Ac. (0.8%)	706 Ac. (1.3%)
Total Acres	52,438 Ac. (100%)	11,968 Ac. (100%)	9,669 Ac. (100%)	11,127 Ac. (100%)	5,124 Ac. (100%)	4,480 Ac. (100%)	10,070 Ac. (100%)

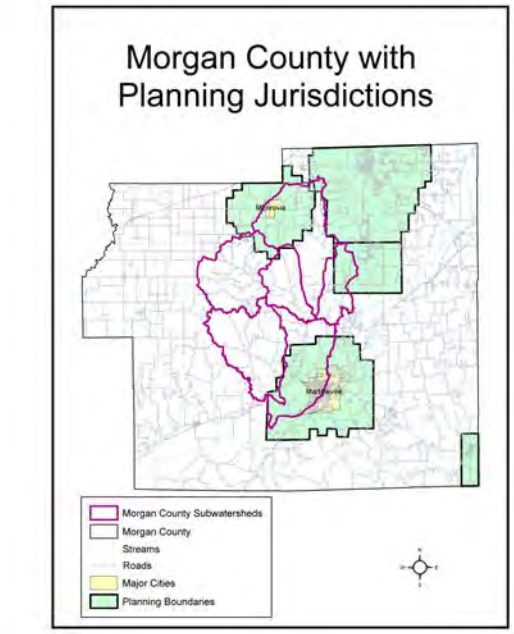
** Includes mixed forest, shrubland, woodland
*** Includes several wetland types

(USGS, 1997)

The City of Martinsville is the countyseat for Morgan County. According to the 2000 Census, the City of Martinsville is the largest community in Morgan County with 11,698 people or 17.5% of the County's population. The Town of Monrovia is the 6th largest community in the County with 628 people (US Census, 2000). Both Martinsville and Monrovia are within 30 miles or less of downtown Indianapolis and have, as a result, become popular bedroom communities for Indianapolis' workforce.

There are three planning organizations in the White River Watershed: Morgan County, Martinsville, and Monrovia. Each planning organization has a Plan Commission, Planning Director, and planning staff which deal with development, planning, and zoning issues within their planning jurisdiction.

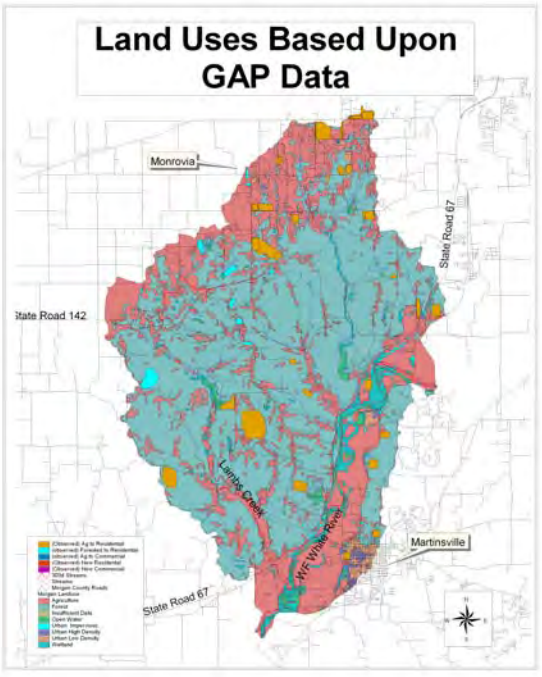
Figure 8-3 map of Morgan County and planning jurisdictions.



8.1.2 What Was Learned During the Process

In the fall of 2000, 10 volunteers from Morgan County conducted a windshield survey of the White River Watershed. The purpose of this windshield survey was to identify visible changes in land use from the most recent GAP data. The volunteers observed changes in land use from agriculture to residential; forest to residential; new residential; and new commercial.

Figure 8.4: map of observed land use changes (in orange) since between 1998 and 2001



The subwatersheds that appeared to have the greatest change in land use were Sycamore Creek, White River Centerton, and White River Martinsville. These subwatersheds are closest to the City of Indianapolis, SR 67, and the City of Martinsville. Approximately 95% of the land use change occurring according to the volunteers is residential development. These developments include large tract subdivisions, single-family clustered developments, and large lot or estate-type developments.

8.1.3 Causes or Probable Causes of Impairments and Threats

There is a strong relationship between land use and water quality. What occurs on the land ultimately affects the water and in turn, the health, safety, and well being of the community. As far as water quality is concerned, there are two types of land uses: those that benefit water quality and those that impair water quality. Land uses such as natural or vegetated areas have a positive impact on water quality. These areas allow stormwater to slowly soak into the ground, naturally filtering pollutants and sediments before draining to nearby streams. Other land uses can have a negative impact on water quality. Impervious areas such as rooftops, driveways, streets, parking lots, etc. prevent rain from naturally infiltrating into the soil and as a result cause rapid discharge of unfiltered water into receiving streams.

According to the data collected during the development of this Watershed Management Plan, the causes or probable causes of impairments and threats to water quality are failing septic systems, development in natural areas and on prime agricultural land, and livestock management. With respect to addressing these water quality concerns through development, planning, and zoning, stronger language and enforcement, where applicable, could be added to the Comprehensive Plan, Zoning Ordinance, and Subdivision Control Ordinance to address water quality concerns without affecting an individual's right to develop their land.

8.1.4 Sources or Probable Sources of Pollutants or Conditions Causing Water Quality Impairments

As mentioned in the previous section, there is a strong relationship between land use and water quality. Sources or probable sources of pollutants or conditions causing water quality impairments as it relates to development, planning, and zoning include:

1) Unchecked and unregulated growth and development as a result of insufficient language to protect water quality in planning and zoning documents.
2) Sediment runoff from construction sites without adequate erosion and sediment control best management practices (BMPs).
3) Encroachment from development into natural areas including riparian areas, streams, lakes, and wetlands.
4) Pollutants carried by stormwater from impervious areas such as parking lots, roads, drives, and rooftops draining directly into waterways without any filtration.
5) Insufficient state resources to enforce erosion control requirements (i.e., Rule 5) due to disproportionate relationship between available staff numbers and the rapid rate of local land use change.

8.1.5 Prioritization

The following are priorities for addressing water quality concerns through development, planning, and zoning as part of this watershed planning effort:

1) Education for developers, planners, and decisions-makers of how land use planning directly impacts water quality. Changing attitudes and behaviors about water quality is important to the long-term success of this Watershed Management Plan.
2) Improved enforcement of erosion and sediment control BMPs to reduce the amount of sediment entering nearby waterways. This is especially important on the highly erodible soils in Morgan County.
3) Establish setbacks and buffers for riparian corridors, floodplains, waterways, and wetlands. Undeveloped lands adjacent to natural areas will naturally trap and filter harmful sediments and pollutants before entering receiving waterbodies.
4) Encourage development to occur in proximity to established infrastructure and services in existing communities. Limit large, multiple home developments in remote rural and natural areas where available infrastructure and services do not exist.

8.2 GOALS AND DECISIONS

8.2.1 Goal for Improvement and Protection

Primary Goal #4 of this Watershed Management Plan, as outlined in Section 1 of this document is, "to the greatest extent possible and with existing and potential resources, improve and protect water quality in the watershed with the intention, where applicable and appropriate, to achieve and maintain state water quality standards." In order to achieve this goal, the following objectives related to development, planning, and zoning have been established:

Objective #8-1:
Guide growth and development in Morgan County so that it enhances and improves water quality.

Objective #8-2:
Consider the impact of land use on water quality in all planning and zoning decisions.

8.2.2 Management Measures:

This section of the Watershed Management Plan addresses development, planning, and zoning issues and how those relate to water quality. As stated earlier, there is a strong relationship between land use and water quality. There are typically two or three documents that drive development, planning, and zoning in a community. These include the Comprehensive Plan, Zoning Ordinance and Subdivision Control Ordinance.

The Comprehensive Plan defines policies on a wide-range of topics and dictates how a community should grow, change, or look in the future. The policies crafted in the Comprehensive Plan become the foundation of the Zoning Ordinance and Subdivision Control Ordinance which in turn determine how land should be used and divided.

Morgan County has had an interesting history with development, planning, and zoning practices. In 1994, the County Commissioners adopted an updated Comprehesive Plan and Zoning Ordinance. Prior to 1994, the Comprehensive Plan and Zoning Ordinance were from 1956 and had been ammended numerous times to meet the changing needs of the community. Both the 1994 Comprehensive Plan and Zoning Ordinance were implemented until 1997 when the County Commissioners decided to discontinue the use of regulated planning and zoning practices in Morgan County. Planning and zoning practices were reinstated in 2001 following four years of haphazard and unregulated development throughout the county.

As a positive step to reinstate planning and zoning, the current Comprehensive Plan for Morgan County identifies only the basic planning needs for the community. The Plan outlines general guidelines for residential, commercial/industrial, and agricultural land use as well as recreation and community appearance. These general guidelines do include some language, albeit limited, regarding the protection and improvement of natural resources – including water quality. The Plan Director does plan to lead the community through a more detailed Comprehensive Planning process following the completion of this Watershed Management Plan and an Economic Development Plan for Morgan County.

The Morgan County Zoning Ordinance does not contain a section that specifically addresses drainage or stormwater management. The Ordinance does include a floodplain district, which requires the first floor of structures to be two feet above the high water mark.

The current Comprehensive Plan and Zoning Ordinance for the City of Martinsville were adopted in 1994 and 2001 respectfully. The second of fourteen goals listed in the Comprehensive Plan identifies protecting and preserving the natural resources in the city including wetlands, woodlands, floodplains, drainage ways, wildlife habitats, and steep slopes. As stated in the Plan, the City of Martinsville desires to protect its valuable resources and continually raise its quality of life in the wake of furture development. However, the Plan lacks specific language of how to protect and preserve the natural resources in the city.

In addition to the City of Martinsville's Zoning Ordinance, the city has adopted and enforces separate ordinances for Erosion Control, Drainage (stormwater), and Flood Hazard Areas. These separate ordinances do specifically address water quality and quantity issues.

The Town of Monrovia was incorporated in 1995. Planning and zoning were officially implemented in February 1997. Monrovia adopted a Comprehensive Plan unique to their community needs however has adopted and implements some aspects of Morgan County's zoning ordinance. The planning department is very small and depends on the support of the Morgan County planning staff. The Town was able to maintain planning and zoning practices in the community through the four years that Morgan County abolished its planning department.

The "Natural Environment, Natural Resources" section of the Town of Monrovia's Comprehensive Plan identifies quality of water supply, preservation of natural resources, and soil erosion as major issues. Objectives and policies to specifically improve or enhance water quality include 1) expand monitoring activities on septic systems, sewage treatment plants, quality and design of storm and street drainage systems and identify significant point discharges. 2) preservation of rivers, creeks, ponds, and wetlands. 3) encourage large lot development in sensitive areas or land with poor suitablility for development. 4) use of appropriate erosion

control measures on all development sites and the use of special structures on drainage channels with steep slopes to reduce the velocity of stormwater runoff.

8.2.3 Loads or Contributions for the Management Measures

Although there is a growing body of research to illustrate the relationship of land use and water quality, quantifying the benefit is not as well developed as it is with other programs such as filter strips or conservation tillage. As a result, load reductions or contributions for the management measures are not available.

8.2.4 Action Plan

The following action plan items were prepared as a result of review of the current planning documents, conversations with the Planning Directors, and the issues discussed during public meetings and individual committee meetings.

Action 8-1

Conduct annual workshops and/or seminars and have fact sheets readily available for developers, planners, and decision-makers as a reminder of how land use directly impacts water quality.

Action 8-2

Update the current Comprehensive Plan, Zoning Ordinance, and Subdivision Control Ordinance for Morgan County, the City of Martinsville, and the Town of Monrovia to address water quality issues including: stormwater and drainage requirements; floodplain management; wetland protection; riparian corridor protection; tree conservation; setbacks and buffer protection; overlay zoning districts; service area boundaries; treatment of septic and sewer; limits for imperviousness; conservation design; and flexible development standards to protect natural or enhance resources

Action 8-3

Prepare a countywide Greenways Plan as a means to inventory and map the existing condition of the riparian corridors, floodplains, and waterways with recommendations for improvement and protection.

Action 8-4

Morgan County and the Town of Monrovia should adopt a stormwater or drainage ordinance that specifically addresses water quality as well as quantity concerns through development controls. This could be a stand-alone document or incorporated into the Zoning Ordinance and Subdivision Control document as it is in the City of Martinsville.

Action 8-5

Minimize soil erosion and sediment in waterways with better construction management and practices including: education for developers and decision-makers; regular inspection of construction sites; enforce fines for construction violations; proper installation and maintenance of erosion and sediment controls; tree preservation; temporary seeding and mulching; and stabilization and vegetation of streambanks.

Action 8-6

Improve water quality through effective storage and treatment of urban, suburban, and rural stormwater runoff including: on-site stormwater treatment; constructed wetlands; detention and retention ponds; infiltration basins and trenches; vegetated filter strips and swales; and stream buffers.

Action 8-7

Determine land uses for development, agriculture, wetlands, flood storage, and forest cover based on soil suitability. Use Geographic Information Systems (GIS) and updated soil information to establish the zoning and land use maps.

Action 8-8

Determine the short-term and long-term impacts of land use change through Purdue's SedSpec and L-THIA (Long-Term Hydrological Impact Assessment) programs to identify: runoff rates; erosion problems;

BMP effectiveness; and impacts of past and proposed development.

8.2.5 Resources

The following resources will be needed in order for the successful implementation of the Goals, Objectives, and Action Plan items listed in this Watershed Management Plan. These include:

- Support from Planning Director(s), Plan Commission(s), and general public.
- List of definitions, suggested language, and model ordinances.
- List of BMPs (Best Management Practices).
- Cooperation of contractors, developers, and landowners.
- Enforcement from local and state government (Planning, Health Department, SWCD, IDNR, IDEM).
- Support from decision-makers and community leaders.
- Funds and personnel to create "Development Handbook" for decision-makers, developers, and landowners (see HHRCD "Indiana Development Guide" for good reference).
- GIS layers including soils, drainage, parcel layers.
- Permission to use SedSpec and L-THIA from Purdue University.

8.2.6 Legal Matters:

Before implementation of the Goals, Objectives, and Action Plan items identified in this Watershed Management Plan, the Plan Commission, and Town Council, City Council, or County Commissioners must approve and adopt any changes or updates to the Comprehensive Plan, Zoning Ordinance, and Subdivision Control Ordinance. Such updates will need the full support of the general public in order to be successfully implemented. It is also important that scheduled inspections/reviews are conducted and fines are enforced when the rules are violated.

8.3 MEASURING PROGRESS

8.3.1 Indicators Selected to Determine Progress

Indicators are important to determine whether or not progress is being made. The following indicators may be used to determine the successful implementation of this Watershed Management Plan. These include:

1. The inclusion of a water quality section in the next update of the Comprehensive Plan complete with goals, objectives, and strategies.
2. Protection and buffering of natural areas to improve water quality.
3. The adoption and enforcement of a stormwater or drainage ordinance by Morgan County and the Town of Monrovia.
4. The completion of a countywide Greenways Plan that inventories and makes recommendations for improvement to the riparian corridors, floodplains, and waterways in the county.
5. Implementation and enforcement of erosion and sediment control techniques during construction.
6. Improved treatment of stormwater from urban, suburban, and rural runoff.
7. Land development patterns based on soil suitability.
8. GIS modeling to determine short and long-term impacts of development on water quality.

8.3.2 Monitoring Indicators

Indicators should be monitored by the Planning Director(s) and Plan Commission(s). Indicators used to measure progress such as the updates to the Comprehensive Plan, Zoning Ordinance, and Subdivision Control Ordinance should be straight forward providing sufficient time is given for adequate public participation and support. However, others such as establishing a GIS database to map soils and model development impacts will take much longer than others to implement.

8.3.3 Operation and Maintenance

The planning staff, Planning Director, and Plan Commission for Morgan County, the City of Martinsville, and the Town of Monrovia are each responsible for the operation and maintenance of the recommendations made in this Watershed Management Plan. Support of the SWCD and its Watershed Initiative partners, IDNR, and IDEM staff may be needed for guidance and enforcement.

8.3.4 Re-Evaluation of Plan

The Morgan County SWCD, in partnership with the Planning Director from Morgan County, the City of Martinsville, and the Town of Monrovia will be responsible for the regular review and update of this Watershed Management Plan. This Plan should be evaluated on a regular basis to document and celebrate progress; assess the effectiveness of efforts; and to modify the action items, if needed. A summary of the actions proposed for development, planning, and zoning can be found in Chapter 10.

SECTION 9
Local Government Management and Policies

9.1 IDENTIFYING PROBLEMS

9.1.1 What Was Already Known:

Problems identified in Morgan County that are associated with local government policy are divided into three general areas: planning and zoning, regulation, and coordinated management.

9.1.1.1 Planning and Zoning

With respect to local policies, it was well known that Morgan County had only recently re-established zoning requirements. While the vast majority of Indiana counties were making use of some type of land use planning and zoning, (prior) leadership in the county had done away with most land use and zoning requirements.

For the period between February of 1997 and March of 2001, Morgan County was the only county in the rapidly growing, nine-county, Indianapolis Metropolitan Statistical Area in central Indiana (this includes the region of seven "donut counties" that surround and directly border the consolidated city of Indianapolis/Marion County) where there was no land use planning or zoning. The result of the abandonment of land use management policies in Morgan County during this four-year period included unrestricted land use change, poorly planned development, and little or no attention paid to the potential environmental impacts of land use and land use change.

With the exception of some land clearing processes associated with a few local developments, the lack of zoning policy during this four-year period did not significantly affect the subject watershed. Most of the poorly planned and unregulated land use change occurred north and east of the subject watershed. In March of 2001, the new Morgan County Commissioners re-established zoning, and a new Director of Planning was hired to re-visit and re-develop a comprehensive land use plan. Planning and zoning issues are fundamental and significant with regard to water quality protection. For this reason, an entire section of this Plan is dedicated to this issue. **Planning and Zoning issues are discussed in more detail in Section 8** of this Watershed Management Plan.

9.1.1.2 Regulation

Details regarding state and federal water quality regulatory policies are discussed in some detail in Appendix C of this Plan, Water Quality Regulatory Information. However, it should be pointed out that local water quality regulation is not prevalent in Indiana, and most policies, permits, rules, regulations, and enforcement are the responsibility of the state. The ability to regulate at the local government level is to a great extent, governed by state policies and authorities.

In Morgan County, as in all other local Indiana communities, there is an inherent lack local regulation and policy that would otherwise be most appropriately suited to the needs of the local community. With regard to water quality, such needs might include the desires of the local community, the realistic ability for a local community to actually achieve statewide water quality standards, and all issues related to such desires and capabilities that are unique to a ***local*** community such as: financial strength, industry, population, total impervious surface area, soils, forest canopy, cropland, recreational areas, existing and desired uses of water bodies, topography, weather patterns, and local priorities.

At the beginning of this study, it was known that the most current water quality regulatory program that will affect Morgan County is the assortment of Storm Water Phase 2 requirements under the National Pollutant Discharge Elimination System (NPDES). In Indiana, this has been

established and is commonly known as "Rule 13". While Rule 13 will indeed allow for local regulation of certain entities, it also ***requires*** such regulation, with a minimum set of requirements that are, as mentioned earlier, set by the state.

The inclusion of Storm Water Phase 2 management practices will be discussed in this section as they are related and extremely relevant to the management of this watershed. As mentioned, the details of the actual intent and requirements of Storm Water Phase 2 are discussed in Appendix C, with other water quality regulatory policies.

9.1.1.3 Coordinated Management

The issue of proper inter-governmental coordination (or lack thereof) is not a data-supported, technical issue or a tangible, identifiable water quality problem. This is a human and program management issue, of which some might initially have difficulty seeing the importance or relevance to a watershed management plan. On the contrary, the Watershed Coordination Team understands this issue to be a fundamental, overriding challenge that must be overcome if any "tangible" corrective actions are to be effective at improving and protecting water quality in the long term. While data-supported, local problem-solving corrective actions are the intent for the Section 319 Program (the funding source for this Plan), such projects will, over time, be fruitless without programmatic change in water quality management at the local and state levels.

At the beginning of this watershed study, it was known that, like virtually every other local government in Indiana, all issues that impact water quality were not being addressed collectively among a variety of departments and agencies.

Throughout Indiana, local governments operate parochially with respect to local city, town, and county departmental management. What was known and understood in Morgan County was that the responsibility of analysis of water quality, water quality protection, and the management of land use that affects water quality fell under several different authorities. Indications at the beginning of the watershed study were that there was likely some gap in communication among local and state agencies that deal with water quality, land use management, and related policies. Government coordination and communication gaps needed to be analyzed.

9.1.2 What Was Learned During the Process

Too often in government, "the right hand does not know what the left hand is doing". No state or large city government is completely immune to this rule. While, in the area of water quality management, redundancy and inefficiency are not uncommon at the state and federal level, Morgan County and the municipalities it encompasses is also functioning with a few ***local*** coordination and communication gaps that exist naturally, due to the size and complexity of a growing county government.

During the time of this watershed study and the preparation of this Watershed Management Plan, a commonly referred-to issue in the national media was that of "homeland security", an issue that provided the Watershed Initiative with a clear and understandable analogy regarding governmental collaboration. Specifically, pundits and critics alike pointed out that many of the federal and local organizations that dealt with overlapping security issues (i.e., the CIA, FBI, INS, Coast Guard, and local law enforcement agencies to name a few) were not communicating, sharing information, or integrating their goals, objectives and processes. Critics pointed out that much of this was due to an institutional evolution of top-heavy bureaucracy, turf, and competition for funding among agencies. Most politicians from all parties agreed that lack of intergovernmental cooperation was a costly

and wasteful problem at the federal level. The Watershed Initiative soon concluded that such challenges were not limited to the federal government or national security issues, but common among all levels of state and local governments as well.

Typically, the larger and more complex an organization or group of organizations becomes, the more opportunities evolve for communication and management to become fragmented. This is especially true when different agencies and organizations, which are not related to one another, are working on similar subject matter and in similar geographic areas. This holds especially true in the areas of water resource management in Indiana. One unfortunate result of this complex web of activities is information and management gaps, resulting in inefficiencies.

Lack of communication is both a driving force behind the need for implementation of an integrated, coordinated, watershed management approach as well as an obstacle and delay for making such an approach work. The agencies that support state and local government efforts are often unaware of what sister departments or agencies are doing. While more often perception than reality, there is occasionally a "turf" issue, where an agency or local department is hesitant to share information or work with other agencies or departments for fear that such coordination might affect job security or require the sharing of credit for a commendable or high-profile project. Most of the lack of coordination however is innocent and is simply due to the shear size and workload of individual agencies or departments. Regardless, with multiple government agencies, and/or departments often dealing with similar issues and performing similar functions, coordination is essential to the success of their endeavors.

The watershed coordination team's analysis of state and local efforts toward water quality management concluded that Morgan County is quite similar to every other county in Indiana with regard to water quality management structure. It was observed that indeed, several local, state, and federal government entities that function within the watershed function independently from one another and with little or no communication or integrated planning between agencies.

One ***exception*** to this is the formalized interaction between Morgan County Soil and Water Conservation Service and three other agencies, the IDNR, the IDEM, and the USDA Natural Resources Conservation Service. Through a physical coexistence in the SWCD Office and an integrated management process, these 4 agencies do maintain a fair amount of communication, information sharing, and mutual assistance.

Aside from the organizational integration at the SWCD Office, observations support the conclusion that, like virtually every other county in Indiana, interdepartmental communication and integrated management could stand to be improved. It is typical of a growing local government to experience "departmental segregation", and it is challenging for local leadership to actually integrate departments to the extent that the general public may perceive them to already be. What the public usually perceives to be one local government body, staff and elected officials often see as a group of "agencies" whose budgets, management, goals, and objectives are all different from one another. What the general public does not typically realize, is that Indiana Code dictates, to a certain extent, the process of departmentalization of municipal and county governments and the process by which those departments are established, managed, and budgeted. This should not suggest however, that the public's perception of the collective county government "working as one" and their desire to see efficient, integrated management in government is illogical.

To address these logical public desires, this section describes the recommendation of "blending" departmental staff beyond periodic department head meetings and

project routing forms. This integrated management model is based on the use of watershed regions, where information sharing and the early coordination of plans can be very beneficial to the county government and the municipalities that exist therein. The model will also help prepare the local community to better manage Total Maximum Daily Loads (TMDLs) and the approach of the federal Watershed Rule, now under development.

A combination of the coordination team's experience working with local governments, observations, informal meetings, and other interaction with various city, town, and county staff during the period of the watershed study supported the development of a collective profile of organizational structure, staff responsibilities, and an understanding of the people and programs dealing with water resource management, programs that affect water resources (such as development and land use change), and the level of interdepartmental coordination that exists among those entities. The following questions were assessed by the coordination team as part of the local government policy analysis and associated with the watershed study. The answers to these questions have helped to identify areas needing improvement.

(1) How are various county agencies and city departments within the county communicating and coordinating efforts that impact water quality?

(2) Are there dislocations or gaps in communication among county (and municipal) staff whose actions impact water quality?

(3) Are actions being taken that are redundant or do not consider the actions of the other departments or agencies whose actions impact water quality?

(4) How can County government prepare, through its management processes, for the State's implementation of Total Maximum Daily loads on streams within Morgan County that are currently listed on the 303(d) list of impaired waterbodies.

(5) How can the County work toward integrating various permit requirements and master plans associated with storm water, development, TMDLs, etc.?

(6) How can water quality be incorporated as one (of the many) criteria used in decision making (zoning, infrastructure, ordinances, etc)?

(7) How can the County evaluate the performance of infrastructure improvement designed to protect water quality?

9.1.2.1 Identifying the Affecting Entities

Many federal, state, and local authorities share the responsibility of evaluating, regulating, enforcing, managing, or otherwise impacting water resources and public health across the nation. Collaboration and information sharing among these organizations through an integrated teaming process could greatly enhance the cost-effectiveness of water quality management.

9.1.2.1.1 Federal Agencies

The following federal agencies are directly involved with water quality protection and/or management in one form or another:

The U.S. Department of Interior

- U.S. Geological Survey
- U.S. Fish and Wildlife Service

The U.S. Department of Agriculture

- Natural Resources Conservation Service

The U.S. Environmental Protection Agency

The U.S. Army Corps of Engineers

9.1.2.1.2 State Agencies

The following state agencies are directly involved with water quality protection and/or management in one form or another. Since these agencies are more directly involved in local community issues in Indiana, their responsibilities are briefly discussed:

The Indiana Department of Environmental Management (IDEM):
The Indiana Department of Environmental Management's Office of Water Quality (OWQ) implements and enforces the Clean Water Act. With oversight from U.S. EPA Region V office in Chicago, Illinois, IDEM's OWQ Wastewater Permitting Branch maintains responsibility for Indiana's NPDES permit program and for issuing, modifying, revoking and reissuing, terminating, denying, monitoring, and enforcing permits for the discharge of pollutants from point sources and imposing and enforcing pretreatment requirements. The Permitting Branch issues NPDES permits to wastewater dischargers in Indiana to regulate compliance with the Clean Water Act. It also issues construction permits for facilities needing to construct, install or modify any water pollution treatment control facility or sanitary sewer.

IDEM's jurisdiction includes all the "waters of the state" of Indiana, which is defined as "accumulations of water, surface and underground, natural and artificial, public and private, or parts thereof, which are wholly or partially within, flow through, or border upon this state". However, the term does not include any private pond, or any pond, reservoir, or facility built for reduction or control of pollution or cooling of water prior to discharge unless the discharge therefrom causes or threatens to cause water pollution.

The Indiana Department of Natural Resources:
The State Department of Natural Resources, Division of Water, is charged by the State of Indiana to maintain, regulate, collect data from, and evaluate Indiana's surface and ground water resources. The Division of Water is compromised of 17 sections divided between three branches: Engineering, Planning, and Regulation. The Division issues permits for: (1) alteration of the bed or shoreline of a public freshwater lake; (2) construction or reconstruction of any ditch or drain having a bottom depth lower than the normal water level of a freshwater lake of 10 acres or more and within ½ mile of the lake; (3) construction within the floodway of any river or stream; (4) placing, filling, or erecting a permanent structure in; water withdrawal from; or material extraction from; a navigable waterway; (5) extraction of mineral resources from or under the bed of a navigable waterway; and (6) construction of an access channel.

The State Department of Natural Resources, Division of Reclamation, is responsible for implementing the federal Surface Mining Control and Reclamation Act (SCMRA). The Division of Reclamation issues permits to coal mining companies, which allows them to mine coal in Indiana. The Division of Reclamation works closely with the IDEM to protect the waters of the state through the issuance and enforcement of construction permits and NPDES permits involving coal mining activities. The Division of Reclamation has primary responsibility for the compliance and enforcement of all coal mining and wastewater permits.

The Indiana State Department of Health:
The State Department of Health is responsible for training and providing technical assistance to county health departments regarding residential septic systems. In addition, the Department also is responsible for issuing construction permits to all commercial on-site non-discharging sewage disposal systems.

9.1.2.1.3 Local Government Operations in Morgan County
Water Quality and Quantity issues were identified as being directly related to or affected by the following local departments and/or agencies. These local county government agencies deal directly, on a day-to-day basis with these many related issues:
Morgan County Soil and Water Conservation District (SWCD)

The Morgan County Soil & Water Conservation District (SWCD) is responsible for assisting the land users and residents of Morgan County in the protection and improvement of the environment. Working in partnership with other governmental agencies such as the Indiana Department of Natural Resources (IDNR), Natural Resources Conservation Service (NRCS), and Farm Services Agency (FSA), the SWCD aids in the development of basic resources in Morgan County, placing emphasis on the protection of prime agricultural land and other priority resources such as water quality.

Morgan County Board of Health

The Morgan County Board of Health is dedicated to protecting the health and wellness of county citizens and safeguarding the environment for use by county citizens. Among other things, the board of health is charged with issuing permits for residential septic systems. Ensuring that septic systems are properly installed, serviced, and maintained is crucial to the quality of local water resources. Excess nutrients and bacteria associated with discharges from septic systems can be stressful to aquatic organisms and can potentially cause health problems to people using local water bodies for recreational purposes.

Morgan County Surveyor

The Morgan County Surveyors office is responsible for recording all section corners throughout the county. The Surveyor is also charged with reconstruction and maintenance of legal drains/ditches; issuing drainage related permits; and calculating drainage assessments. All regulated drains have a direct impact on water quality, as they are the main conveyance by which rain and storm water make their way into local rivers and streams. Therefore, it is important that these drains be regulated in a way that considers the potential impacts to water quality in the permitting process.

Morgan County Highway Department

The Morgan County Highway Department oversees the construction and management of bridges and roads within the county's jurisdiction, and oversee certain ditch maintenance and driveway permits. Storm water runoff associated with impervious surfaces such as bridges and roads can have significant impacts on local water quality. Pollution associated with this runoff includes road salt/snow melting agents, automobile wastes, sediment, general litter and other sources. It is important for bridges, roads, and ditches to be managed in a way that considers the impacts that these sources of pollution can have on water quality.

Morgan County Department of Planning

Morgan County Department of Planning is charged with land use planning and zoning throughout the county's jurisdiction. The department of planning has the ability to limit the impact that construction and development have on water quality. Increased development and changes in land use can increase the amounts of storm water runoff, which can increase erosion and loadings of manmade pollutants into local waterways. The Department of Planning has the ability to target and prioritize growth and development in a way that allows for protection and consideration of water quality issues in the planning process.

9.1.2.1.4 City and Town Departments

Water Quality and Quantity issues were identified as being directly related to or affected the following city and town departments:

City of Martinsville Public Works
City of Martinsville Engineering Department
City of Martinsville Planning Department
City of Martinsville Parks Department
City of Martinsville Fire Department
Monrovia Town Engineer
Monrovia Planning Department

9.1.2.1.5 Non-Government Local Water-Focused Organizations

In additional to the complex web of governmental organizations, several conservation, sports, and environmental activist organizations also exist and that are active in the subject watershed. These include, but are not limited to:

- The Mallory Conservation Club
- The Hoosier Environmental Council
- The Central Indiana Land Trust
- The Indiana Nature Conservancy
- The Sierra Club-Heartlands Chapter
- Citizens Action Coalition
- Improving Kids Environment

9.1.2.1.6 Local Programs and Plans Currently Underway

The items listed below are just a few of the planning documents that are or soon will be under development or that already exist within Morgan County. Many of these projects are required by law. Some are extremely detailed, time consuming, and expensive. There is a great deal of potential for integration of these individual plans and associated documents:

- Morgan County Comprehensive Land Use Plan
- Martinsville Comprehensive Land Use Plan
- Monrovia Comprehensive Land Use Plan
- Storm Water Phase 2 Notice(s) of Intent, Characterization Report(s), and Storm Water Management Plan(s) for at least four regulated urbanized areas.
- Wellfield Protection Plans
- Operations Plans for wastewater treatment plants
- Watershed Management Plan(s)
- Agriculture and conservation plans and strategies of the SWCD.

All of the issues of focus in the above-listed plans should be developed with direct and consistent consideration of one another and looked at collectively and holistically from a watershed perspective.

9.2 GOALS AND DECISIONS

Primary Goal #4 of this Watershed Management Plan, as outlined in Section 1 of this document is, "to the greatest extent possible and with existing and potential resources, improve and protect water quality in the watershed with the intention, where applicable and appropriate, to achieve and maintain state water quality standards." In order to achieve Primary Goal #4 of this Watershed Management Plan, the following objectives related to efficient local governmental operations an integration of overlapping regulatory programs have been established by the Watershed Initiative.

In order to support this goal, the recommendations included in this section will be to enhance such activities and to make them more meaningful, efficient, and effective. What is proposed in this section is to some extent a new way of thinking and a policy-driven approach to water quality management that should result in an inclusive environment for multiple departments, governments, and agencies. The approach will also help prepare the local community to better manage TMDLs.

Objective #9-1

Acquisition and Thorough Implementation of a Countywide Geographical Information System (GIS)

The success of the proposed teaming process (see Objective 9-3) will depend in part on the consistent availability of up to date GIS information that is easily accessible by local government staff and ultimately the public. GIS provides an invaluable tool for integrated evaluation of everything from areas with water quality impairments, to proposed developments and capital infrastructure improvement projects.

Recommended layers/themes for immediate use in GIS (for watershed management)

- Hydrologic Unit Codes (available via the Internet) delineated watersheds
- Current land use
- Zoning
- Aerial photography

- Streets, Roads, and related infrastructure
- Proposed or planned improvements to infrastructure
- Legal ditches, streams, lakes, and other bodies of water
- Proposed re-zoning applications and proposed development sites
- Drainage Complaints
- Water Quality monitoring results.
- Water Quality Bibliographic Information
- Professional, Public Agency, and Public Official Contacts list
- Other

It is further recommended that the county examine other local government GIS programs throughout an appropriate shared region, such as the Indianapolis MSA or the Upper White River Watershed. Upon examination, it is recommended that the county choose a GIS software that is commonly used and therefore compatible with surrounding community data, so that such data is to be shared regionally at a future date.

Objective 9-3

Establish Watershed Management Areas

Watersheds have been delineated throughout the nation and are identified through a cataloging process utilizing **Hydrologic Unit Codes** (HUC) in a hierarchical scheme. These codes were developed by the United States Geological Survey and apply to watersheds of similar sizes nationwide. HUC codes are utilized by federal and state agencies as a common language that uniquely describes a unique watershed by region, subregion, accounting unit, and subunit. For example, starting at the eight (8) digit HUC watershed level, smaller watersheds within an 8-digit region are uniquely designated and identified by adding digits, in units of 3, to the end of the larger HUC. These designations are typically used to produce increasingly smaller 11 or 14 digit watershed HUCs. For a spatial perspective, there are 42 eight-digit watersheds within Indiana and roughly 2,211 8-digit watersheds across the United States.

These 8-digit regions are then subdivided again and identified by an 11-digit code (the 8-digit code plus 3). One more subdivision of the 11 digit regions provides a similar 14-digit identification code). These regions will have more and more significance with development of policies related to TMDLs, wetland mitigation, NPDES permits, etc.

The map in figure 9-1 shows the watersheds delineated at the "11-digit" level in Morgan County. The watershed of focus for this watershed plan is highlighted in blue.

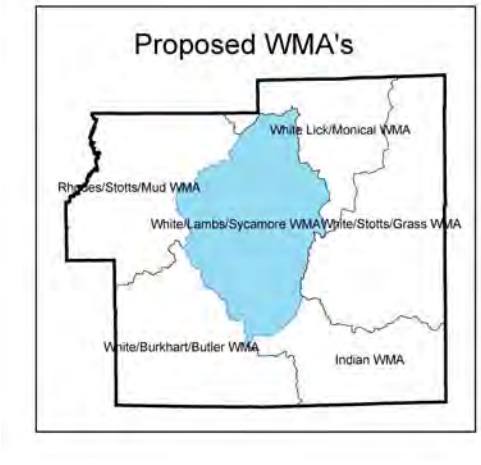
It is recommended that six management regions be permanently established as a fundamental first step in developing a thorough and consistent watershed management and staff integration program in Morgan County. These regions are discussed below and are illustrated on the map (following page). The regions have been derived from prior watershed delineation work and should be integrated into the County's Geographical Information System, once established.

Action 9-1

- Establish the 6 primary Watershed Management Areas (mapped) as permanent integrated watershed agency teaming regions, also known as Watershed Management Areas (WMA).
- ***Description of 6 Proposed Management Regions (Watershed Management Areas)***
  Six Watershed Management Areas (WMAs) are proposed for staff regional focus and interaction amongst County staff. These WMAs are:
- White/Lambs/Sycamore WMA (HUC 05120201160)
- Rhodes/Stotts/Mud WMA (HUC 05120203060)

- White Lick/Monical WMA (HUC 05120201150)
- White/Stotts/Grass WMA (HUC 05120201140)
- White/Burkhart/Butler WMA (HUC 05120201180)
- Indian WMA (HUC 05120201170)

Figure 9.1: Proposed Watershed Management Areas for consistent, regionalized agency communication



Objective #9-2
Organizational/Staff Regionalization Based on WMAs

Action 9-2

- Identify key staff from each local county, city, and town agency who will focus in a designated WMA.

Action 9-3

- Initiate consistent teaming among county, city, and town team members through a monthly meeting and early planning/coordinating process.

Action 9-4

- As part of the teaming process discussed earlier in this section, data, proposed projects, and other relevant information should be updated consistently in a database format that can be queried, by watershed, into the GIS system. Watershed-queried capital improvement project lists should be regularly reviewed and analyzed for water quality impacts and for potential synchronization with other departmental projects.

  In addition to the capital improvement project lists, private development projects will also be needed in watershed queried data.

Objective #9-3
Integrate Water Quality with the Comprehensive Plan for Morgan County

Morgan County has had an interesting history with development, planning, and zoning practices. In 1994, the County Commissioners adopted an updated Comprehesive Plan and Zoning Ordinance. Prior to 1994, the Comprehensive Plan and Zoning Ordinance were from 1956 and had been ammended numerous times to meet the changing needs of the community. Both the 1994 Comprehensive Plan and Zoning Ordinance were implemented until 1997 when the County Commissioners decided to discontinue the use of regulated planning and zoning practices in Morgan County. Planning and zoning practices were reinstated in 2001 following four years of haphazard and unregulated development throughout the county.

While the current plan and policy is much better than no policy at all, it should be expanded to a process that will consider long-term, water quality related priorities, policies, and participation of all stakeholders. A new Director of Planning was hired to ensure the appropriate development and public input of a comprehensive plan and to ensure that proper land use and planning is applied in Morgan County. More details of this recent history of planning and zoning are provided in Section 8 of this Watershed Management Plan.

"Growth" in Morgan County, especially if properly managed and coordinated, is good for the citizens and businesses in Morgan County. There is no suggestion in this Watershed Management Plan that economic growth and development are not good for the prosperity of the citizens of this county. However, the consideration of water quality and quantity should be a prioritized in the growth planning process. Surveys clearly suggest that when given a choice, people would much prefer to reside in a community that has clean water and limited flood potential rather than a community with poor water quality or flooding issues.

Land use is a major factor with regard to water quality. A comprehensive plan deals specifically with land use among its other areas of focus. With increased development and a new focus on the watershed approach in Morgan County, Section 8 of this Plan generally proposes that updates to the comprehensive plan incorporate water quality and quantity issues as highly prioritized considerations with regard to how development will occur. Such a policies can be implemented without hindering growth and development. However, additional thought, creativity, and some concessions will be necessary in order to protect water quality while prospering in terms of growth. The teaming process proposed in this Section should allow for more consistent flow of water quality related information to those directly involved in the comprehensive planning process.

Objective #9-4

Integrate Storm water ("Phase 2") Planning with Watershed Efforts

As part of the 1987 amendments to the federal Clean Water Act (CWA), Congress added Section 402(p) to the CWA to address the water quality impacts of storm water discharges from industrial facilities and large to medium municipal separate storm sewer systems (MS4s). Large to medium MS4s were defined as communities serving populations of 100,000 or more and are regulated by the Environmental Protection Agency (EPA) under the National Pollutant Discharge Elimination System's (NPDES) Storm Water Phase I Program.

In addition to these amendments, Congress directed the EPA to issue further regulations to identify and regulate additional storm water discharges that were considered to be contributing to national water quality impairments. On December 8, 1999, the EPA issued new regulations that expanded the NPDES Storm Water Program to include discharges from small MS4s in "urbanized areas" serving populations of less than 100,000 and storm water discharges from construction activities that disturb more than one acre of land. These regulations are referred to as Phase II of the Storm Water NPDES Program.

The State of Indiana, specifically the Indiana Department of Environmental Management (IDEM), is responsible for implementation of Phase II of the NPDES Storm Water Program. Indiana's Phase II Storm Water Rule was adopted as 327 IAC 15-13 on March 12, 2003. This rule is commonly known as "Rule 13" and contains the requirements for Indiana's statewide general permit for storm water discharges. The rule applies to regulated municipal separate sewer systems, or MS4s. Regulated storm water conveyance systems include roads with drains, municipal streets, catch basins, curbs, gutters, storm drains, piping, channels, ditches, tunnels and conduits. After appropriate signatures are applied, Rule 13 is anticipated to become effective in July of 2003 and will require designated MS4s to submit permit applications within 90 days of the effective date of the rule.

The IDEM has currently **designated four (4) MS4 entities in Morgan County as meeting the "urbanized area" criteria for coverage by Phase II of the NPDES Storm Water Program. Those designated entities inside the watershed are as follows:**

- **Morgan County**
- **Martinsville**

- **Mooresville**
- **Brooklyn**

In order to more efficiently and cost-effectively address Storm water Phase 2 requirements, which include, (1) Completion of the Notice of Intent (NOI) and initial permit application, (2) Development of the Storm Water Quality Management Plan (SWQMP) and supporting minimum control measures (MCMs), and (3) Completion of Monthly and/or Annual reporting requirements, it is recommended that the planning, management, and oversight of Storm Water Phase 2 in Morgan County ensure the following:

Action 9-5

- Consider and utilize all findings, data, educational programs, and public input already developed and included in this Watershed Management Plan in the Storm Water Management Program.

Action 9-6

- Integrate, wherever possible, Storm water Phase 2 programs between Morgan County and the municipalities of Martinsville, Mooresville, and Monrovia.

Action 9-7

- Through Watershed Teaming (see Action 9-3), ensure the consistent communication with and integration among programs and local agencies discussed in this Plan Section.

Simply stated, the County and the three affected municipalities can significantly reduce program costs if these three recommended actions are implemented. On the other hand, ignoring these suggestions can and will cause duplication of effort and redundant actions that will unnecessarily burden Morgan County taxpayers. Using an integrated watershed management approach will allow the local government entities to leverage resources both regionally and programmatically.

Objective 9-5

Implement Watershed Planning

This Watershed Management Plan is the first EPA grant-funded plan administered under the Section 319 Program for Morgan County. It is the intention of the Soil and Water Conservation District to continue developing new watershed plans in different areas of the county. Section 319 and other sources of funding for such planning will be pursued by the District.

"Watershed" has become a very common term in the areas of local government, environmental management, and permitting. While the definition may seem obvious, there have evolved many different ideas about what it really means to take a watershed approach to water resource management strategies, and at what level of management the term most effectively applies.

In order to adequately apply the concept and to gain the most benefit from such a management approach, it is essential that potential "watershed partners" begin to share a common perspective about watershed coordination. Thereafter, appropriate and common goals can be collectively set by those partners.

A typical definition of the watershed approach describes a coordinated means of management based on a region that is defined by natural hydrology. The resource becomes the focal point, and managers are able to gain a more complete understanding of overall conditions in an area and the stressors, which affect those conditions. The approach can lead to greater public awareness and a more logical and holistic means of addressing (and avoiding) water pollution. There are a variety of different definitions, and Morgan County can even form it's own unique definition based on its goals and priorities. However, the bottom line remains constant that since water quality, like air quality, is a regional issue, we need to coordinate, communicate, prioritize, and act on a regional basis

whenever possible. Such an approach is logical and it helps to efficiently reach common goals. Such coordination can be interdepartmental within the County on a "subwatershed basis" or on an inter-governmental and interagency basis region-wide as is intent of the Upper White River Watershed Alliance, Inc., a fifteen-county watershed region that encompasses much of western Morgan County.

In order to truly be effective in water quality and quantity management, all factors of potential impact in a watershed must be considered. Prioritizing watersheds for one issue such as combined sewer overflow (CSO) improvements or drainage is only attacking one piece of a complex puzzle. Other factors should also be considered during such prioritization so that the entire water-quality issue can be solved more comprehensively in prioritized target areas. Otherwise, significant amounts of money are invested in correcting only one of many causes of the overall symptoms (degraded water quality). If other (pollution) factors go unaddressed, then water quality goals may not be effectively or efficiently reached, and public funds may be ineffectively spent.

If watershed coordination is to be truly "locally-led", then Morgan County and all other stakeholders throughout the region must have an opportunity to work cooperatively from the municipal, county, district, agricultural, and citizen-group levels now, and should avoid waiting to place the burden of coordination on the state at a future time.

An inclusive watershed approach is very challenging for a regulated community like Morgan County to implement. Due to the timing and processes developed for state and federal permitting requirements, communities have historically been forced to attack the individual symptom or end result of one type of pollution problem rather than holistically attacking all of the independent and interrelated causes of the pollution. Watershed planning, which should be an overall, first tier management process for all water quality improvement and protection actions, is too often an afterthought to these parochially-planned projects.

Many current and developing regulations and policies place a great deal of emphasis on watershed coordination. Both the NPDES Storm Water Phase 2 requirements as well as implementation of Total Maximum Daily Loads will create an environment that fosters, if not demands coordinated management among communities that share a watershed. Communities that embark upon watershed coordination now will be much better prepared to deal with existing and future regulations and policies.

The Morgan County Watershed Initiative has determined that, while challenging, there is real value in incorporating and implementing a watershed approach to its planning processes and its environmental management programs. It is anticipated that, if appropriately implemented and supported, results will include both cost savings through avoidance of duplicative efforts, as well as thorough and permanent water quality improvements.

Objective 9-6

Anticipate and plan for Implementation of Total Maximum Daily Loads (TMDLs)

Finally, the development and implementation of TMDLs in Morgan County will be led by IDEM with the involvement and input from the public stakeholders.

In cases where permits and effluent limitations are unable to protect a stream's ability to meet state water quality standards, IDEM and the US EPA are required to list streams that demonstrate water quality impairments, that are not the result of a compliance issue, under the provisions of the Clean Water Act. Streams identified on

this list are required to undergo the Total Maximum Daily Load (TMDL) Process.

By definition, a Total Maximum Daily Load (TMDL) is the maximum amount of any given pollutant that a waterbody can absorb without violating water quality standards for designated uses, such as drinking water, aquatic life, and recreation. TMDL is also used to describe the process used for bringing a body of water back into compliance with water quality standards. This process involves assessing and/or measuring the probable sources of water quality problems in a water body and setting Waste Load Allocations (WLAs) for point source discharges and specific requirements and/or best management practices for non-point sources of pollutants that will bring the water body into compliance with water quality standards.

TMDLs are a requirement of Section 303(d) of the Clean Water Act that requires states to identify the waters within their boundaries that do not meet water quality standards. The list must identify the pollutant(s) or factor(s) responsible for the listing of each water body. States must then rank the waters on the list taking into account the severity of pollution and the designated uses of the waters. These rankings are used to set priorities for achieving water quality standards. Each State is required to review the 303(d) list, make changes as necessary, and submit the list to the U.S. Environmental Protection Agency (EPA) for approval in even-numbered years. Once a body of water is added to a State 303(d) list, a TMDL for that water body is calculated to meet water quality objectives.

States are directed by EPA to provide water quality data and watershed characterization and prioritization on a two-year cycle. Currently, Indiana's 305(b) reporting cycle is the (5-year rotational) vehicle by which IDEM provides information to EPA. This cycle focuses on the 5 primary basin regions in Indiana and pays specific attention to the aforementioned 8-digit watershed regions.

The State must submit the 303(d) list of impaired waters to EPA every two years. Typically, only the portion of the 303(d) list that has had monitoring completed in conjunction with the 5-year reporting cycle will have been updated. In other words, portions of the 303(d) list of impaired waters are updated every two years, while other (regional) portions are not. In the case of Morgan County, the latest 303(d) listing for 2002 included the region encompassing Morgan County, and new listings of stream segments were added to this list for being impaired since the initiation of the this Plan.

TMDLs can and most likely will have an impact on municipal and development and operations. As a result of the waste load allocations (WLAs) calculated for a TMDL, additional pollution discharge limits could be applied to a community's wastewater treatment plant or to local industries, requiring additional treatment or possibly new technology. Additionally, a community may be required to control and treat storm water runoff from their streets and parking lots. Even local farmers may be asked to use alternative methods in their operations to prevent fertilizers and pesticides from reaching rivers.

Once TMDLs are set, states will enforce them through permits and through management plans designed to prevent or limit runoff. Permits will include the pollutant limits and a schedule for compliance. In the meantime, States will continue to evaluate the waters in question and will modify the permits when appropriate.

Within Morgan County, the following streams have been listed on IDEM's 303(d) list:

- Lambs Creek, listed for for *E. coli* (in the watershed)
- White River, listed for *E. coli,* Cyanide, Mercury, and PCBs (in the watershed)
- North Prong Stotts Creek headwaters, listed for impaired

biotic communities (outside of watershed)
- White Lick Creek, listed for fish consumption advisory, mercury, and PCBs (outside of watershed)

This means that the TMDL issue will become an immediate management concern that, due to the timing of implementation on some streams, will become intertwined with the storm water phase 2 program.

Ironically, TMDLs are scheduled to be developed and implemented in 2003 for the two streams in the watershed on which this Plan focuses, which are Lambs Creek and White River. It is therefore logical and highly recommended that the TMDL process in Morgan County include the following actions:

Action 9-8
- Consider and utilize of all findings, data, and public input already prepared in this Watershed Management Plan.

Action 9-9
- Integrate and consider any and all agricultural BMP funding programs proposed in this Plan.

Action 9-10
- Integrate TMDL efforts with any and all NPDES permit programs, including Storm Water Phase 2.

Action 9-11
- Integrate, wherever possible, of Storm water Phase 2 programs between the City of Martinsville and Morgan County.

Action 9-12
- Ensure, through Watershed Teaming, the consistent communication with and integration among other programs and local agencies discussed in this Plan Section.

Action 9-13
- Complete a Use Attainability Analysis (UAA).

While an expensive endeavor to undertake locally, a UAA is a fundamental step that enables to the County to clearly understand the financial implications of meeting water quality standards and establish realistic water quality goals. Those goals are based upon historical, capable, and desired "uses" of certain water bodies. Once achievable goals have been approved by the state, then the planning and prioritization process involved in watershed planning can address and prioritize realistic, achievable goals. A community that completes and achieves state approval of a UAA, can be better prepared for the state's implementation of Total Maximum Daily Loads.

Objective #9-7
Implement Water Quality Considerations in County and City Operations
City and County operations, such as those that those related to road and bridge construction, snow removal, vehicle washing, ditch maintenance, flood management, and debris removal from streams should all begin to consider potential water quality impacts of those operations and identify alternative solutions where water quality may suffer. A cost benefit analysis should be consistently applied to the following activities and potential alternative methods that reach the same goal:
- Snow melting agents
- Vehicle washing

9.2.3 Loads or Contributions for the Management Measures
Load calculations for the management measures are not applicable to the recommendations in this section.

9.3 MEASURING PROGRESS

9.3.1 Indicators Selected to Determine Progress
A watershed is a region that is to some extent contained. This can be very beneficial to the water resource manager

because, unless outside factors are affecting drainage, a watershed or drainage basin can be evaluated independently of other watersheds.

Just as a watershed offers the capability to limit the geographical search for one pollutant, the performance of pollution removal and pollution prevention projects can be better evaluated by containing and examining data within segregated tributary watersheds. It is much easier to evaluate the effectiveness of a CSO removal project or storm water filtration action inside a given watershed.

Improved Water Quality
Field sampling and water quality data analysis within each subwatershed will provide a means by which progress can be measured. Improved water quality will be achieved through ongoing and proposed programs and projects regardless of whether or not management is better integrated. However, the level of efficiency and the pace at which water quality improvement can be achieved can be enhanced through integrated management while overall costs are reduced.

Improved Communication and Coordination
If implemented properly, the watershed approach can dramatically increase and improve communication among stakeholders and coordination among those whose actions affect the watershed. Gaps in communication and coordination among city departments result in inefficiency and therefore increased costs to the municipality.

During initial interviews of County staff, and regional organizations, several communication gaps were identified by the coordination team. The mere fact that a few key stakeholders that deal with water quality issues every day were invited but did not even participate in the watershed study is a clear indication that there is room in County (and municipal) government for improved communication and coordination.

In addition to the local county/city coordination regional coordination could also be improved by local participation in the regional (8-digit HUC) Upper White River Watershed Alliance, Inc. Information about this organization can be reviewed at www.whiteriveralliance.org.

Increased Knowledge of a Targeted Region
Just as a police officer gets to "know his beat", those who focus in a subwatershed region (see Section 2 recommendations on "teaming") gain a better knowledge of a watershed when focused upon that watershed as his or her region. Personnel have an opportunity to take ownership and pride in a given region for which they are responsible, as their work can be compared to the work of their colleagues in other watersheds regions.

Maximum utilization of Limited Resources
The County and local municipalities alike currently function with lean staff numbers, and the public typically demands local government to do more with less. The watershed approach as described in this report allows for coordinated focus among such limited personnel resources in order to avoid duplicative efforts, and to promote cooperation when working toward common goals. Because it eliminates redundancy and encourages coordinated efforts, it increases cost effectiveness.

Economic Value of the Resource
From an economic perspective, the White River and its tributaries can serve as a valuable resource to Morgan County. Future opportunities for new greenways, public access points, boat ramps, and fishing venues could provide character for the County, as well as popular venues for the ever-increasing thirst for outdoor recreation.

However, the riverside locations of these attractions can lose much of their appeal if their locations provide unpleasant odors, unsightly views of solid wastes, explicit signage, or even the knowledge or

impression that the water is unclean and unsafe.

Research of livability indices (such as Money Magazine's annual "Best Places to Live" feature) suggests that clean water ranks unexpectedly high on the list of concerns for relocation of residence. It is logical to assume that industries that are concerned about quality of life issues for their employees and that are looking to relocate to Morgan County could consider the issue of clean water. When selling the attractiveness of the County or local municipalities, inclusion of available water-related recreation is a plus.

SECTION 10
Consolidated Recommendations and Potential Funding Sources – A "Living" Work Plan

- Actions in this work plan are changeable at any time due to issues such as funding limitations, priority shifts, new or previously undiscovered priorities, etc.
- Following this table is a list of several additional **funding *sources*** that the SWCD and the Watershed Initiative can peruse and consider as alternative funding sources for specific actions.

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
2-1	Support public education needs through purchase/use of laptop computer and projector by SWCD education staff and Watershed Initiative volunteers.	Objective #2-1: Increase and link water quality education efforts among Morgan County elementary and high school age students. *Objective* #2-2: Educate adults through newsletters, presentations, river cleanups, events, and other means about the importance of and practices necessary for water quality protection.	July 2003	July 2003	$6,000.00	CWA Section 319 Grants	Due Oct 1 to IDEM each yr.; 25% local match	Y	N
2-2	Contract with design firm to develop and print a professional 2004 calendar using local water photos and conservation info.	Objective #2-2: Educate adults through newsletters, presentations, river cleanups, events, and other means about the importance of and practices necessary for water quality protection.	Sept. 2003	Nov. 2003	$2,000.00	CWA Section 319 Grants	Submitted Oct 2003. 25% match req.	Y	N
2-3	Ensure semi-annual fee is paid to Fallwood Enterprises. SWCD staff will continue to develop and guide field education programs.	Objective #2-1: Increase and link water quality education efforts among Morgan County elementary and high school age students.	July 2003	July 2005	$6,000.00 *($1,500.00 semi-annual fees)*	CWA Section 319 Grants	Submitted Oct 2003. 25% match req.	Y	N
2-4	Hire a contract employee to provide specific education services and to market conservation grant programs to residents, farmers and forestland	Objective #2-3: Increase public knowledge and awareness of government and private sector programs that are designed to help	August 2003	July 2005	$40,000.00 *20K Per year plus match*	CWA Section 319 Grants	Submitted Oct 2003. 25% match req.	Y	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	owners.	protect water quality through better agriculture and forest management and protection measures.							
2-5	Implement storm drain marking program watershed –wide	Objective #2-2: Educate adults through newsletters, presentations, river cleanups, events, and other means about the importance of and practices necessary for water quality protection.	June 2004	August 2004	$10,000.00	CWA Section 319 funds	October 1, 2003 for Section 319	N	N
3-1	*Zone #1 upstream of Patton Lake:* The effort to address *E. coli* in this zone is addressed in Section 6, Livestock Management Issues.	Objective #3-1: Within the next 6 years, bring *E. coli* levels within compliance of state water quality standards in Lambs Creek, both north and south of Patton Lake, for 12 months out of the year.	See Section 6 recommendations	See Section 6 recommendations	See Section 6 recommendations	See Section 6 recommendations	See Section 6 recommendations	N	N
3-2	*Zone #2 in figure 3.8 (Lambs Creek upstream and adjacent to Patton Lake)*- Conduct a feasibility study for a consolidated/clustered septic system to redirect flow from failed septic discharge from approximately fifty (50) homes clustered on small parcels along Lambs Creek just north of and adjacent to Patton Lake. Prepare to pursue additional funds for design and construction pending the outcome of the feasibility study.	Objective #3-1: Within the next 6 years, bring *E. coli* levels within compliance of state water quality standards in Lambs Creek, both north and south of Patton Lake, for 12 months out of the year.	Sept 2004	Dec. 2004	$15,000.00	LARE Possibly 319	October 1, 2003 for 319	N	N
3-3	*Zone #3 in figure 3.8 (Downstream of Subsurface Discharge on Patton Lake)*- Prepare a feasibility/preliminary engineering study for the construction of subsurface	Objective #3-1: Within the next 6 years, bring *E. coli* levels within compliance of state water quality standards in Lambs Creek, both north and south of Patton Lake, for 12	Sept 2004	Dec. 2004	$15,000.00	LARE Possibly 319	October 1, 2003 for 319	N	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	wetlands to treat water purged from the Patton Lake dam into the agricultural field below the dam owned by the Patton Lake Association. Prepare to pursue additional funds for design and construction pending the outcome of the feasibility study.	months out of the year.							
3-4	*Zone #4 in figure 3.8 (Lambs Creek downstream of Patton Lake)*- The effort to address *E. coli* in this zone is addressed in Section 6, Livestock Management Issues.	Objective #3-1: Within the next 6 years, bring *E. coli* levels within compliance of state water quality standards in Lambs Creek, both north and south of Patton Lake, for 12 months out of the year.	See Section 6 recommendations	See Section 6 recommendations	See Section 6 recommendations	See Section 6 recommendations	See Section 6 recommendations	N	N
3-5	Pursue opportunities for regional sewer hookups between Hart Lake residents and the Monrovia wastewater treatment plant via the development of a regional sewer district. Such an action will be examined and led by the County Commissioners with information support and prioritization from the SWCD, its Watershed Initiative Partners, and the Morgan County Health Department.	Objective #3-2: Within next 5 years, bring E. coli levels within compliance of state water quality standards directly south of Hart Lake for 12 months out of the year.	July 2003	Unknown	Not Studied. Addressed by County Commiss.	State Revolving Loan Fund	To be determined	N	N
3-6	Meet with the WWTP operator as well as with representatives of Monrovia schools in order to ascertain if there is indeed any bypass, failure, or other problem on record during the times of above-standard *E. coli* readings. Investigate with additional sampling if necessary. Balance results and conclusions against the possibility of contamination	Objective #3-3: Within the next 2 years, bring *E. coli* levels at the sampling location in Sycamore Creek, downstream of the Monrovia Wastewater Treatment Plant and Monrovia Schools, within compliance of state water quality standards for 12 months out of the year.	May 2003	May 2005	Unknown	If costs-possibly state revolving loan funds	To be determined	N	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	from any livestock in area. Pursue appropriate corrective action after the actual *E. coli* source is identified.								
3-7	Implement a community education program that focuses on residential causes and preventative measures for bacteria in municipalities, including septic system maintenance and pet waste cleanup. (SWCD staff and contract hire)	Objective #3-4: In localities where it is not likely that state water quality standards for E. coli can me met, such as some urban areas, implement management practices and corrective action projects to reduce *E. coli* by 10% per year.	August 2003	Ongoing	Incurred by other Actions and existing programs	CWA Section 319 funds	Submitted Oct 2003. 25% match req.	Y	N
3-8	Increase knowledge of and aggressively promote the household hazardous Waste/Tox-Away programs offered by the regional West Central Solid Waste Management District. Increase participation in the program by 50% over the next five years. (SWMD with assist from SWCD staff, contract hire)	Objective #3-5: Limit the potential of ground and surface water contamination from private, residential property management through reduction of existing and continuing disposal of refuse, household chemicals, and salvage automobiles, and the improper storage of chemicals.	July 2003	July 2008	Incurred by other Actions and existing programs	Solid Waste Management District		Y	N
3-9	(Through contract employee) develop and implement a public awareness campaign that emphasizes the aesthetics of Morgan County, issues related to property value, and the value and importance of not accumulating refuse, garbage, and scrap material on private properties.	Objective #3-5: Limit the potential of ground and surface water contamination from private, residential property management through reduction of existing and continuing disposal of refuse, household chemicals, and salvage automobiles, and the improper storage of chemicals.	August 2003	July 2005	Costs incurred in Actions 2-4 and 2-1	CWA Section 319	Submitted Oct 2003. 25% match req.	Y	N
3-10	Adopt and enforce more stringent county and municipal codes that specifically limit or prohibit garbage and refuse collection on private properties. Encourage a county coalition among the	Objective #3-5: Limit the potential of ground and surface water contamination from private, residential property management through reduction of existing and continuing	October 2003	October 2004	Undefined costs of ongoing policy-making	N/A	N/A	N/A	N/A

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	commissioner, the County Prosecutor, the County Planning Department, and the County Health Department to ensure that any such existing or proposed codes are consistently enforced.	disposal of refuse, household chemicals, and salvage automobiles, and the improper storage of chemicals.							
3-11	Through public awareness campaigns, educate the public about the proper use and storage of residential fertilizers, pesticides, and herbicides in order to avoid overuse and associated runoff as well as improper storage and associated spills. (Purdue Extension should lead, with help from contact hire)	Objective #3-5: Limit the potential of ground and surface water contamination from private, residential property management through reduction of existing and continuing disposal of refuse, household chemicals, and salvage automobiles, and the improper storage of chemicals.	July 2003	Ongoing	Incurred by other Actions and existing programs	N/A	N/A	N/A	N/A
3-12	Through watershed teaming (see Section 9) cross-train between the Morgan County Health Department, the County Surveyor, and the Morgan County SWCD regarding: proper septic system installation, maintenance and indications of failure; regions of soil type and soil suitability; pending development and new surveys; and other issues related to collective knowledge and notification of potential or existing septic problems.	Objective #3-6: Through watershed teaming (see Section 9) establish cross-training programs and procedures between the SWCD and the County Health Department to collectively understand, identify, and report septic maintenance problems and illegal dumps.	May 2004	Ongoing	$50,000.00 for design and initial facilitation of process	County and City funds budgeted for professional services for Public Works, Utilities, etc.	Plan for and request appropriations in next local budget cycle(s)	N	N
4-1	Hire a contract employee to market forested land management programs. Part-time contract hire will serve several functions described in this Action Plan.	Objective *#4-1:* Achieve, over a ten-year period, no net loss of forest canopy in the watershed.	August 2003	July 2005	Cost shown in Action 2-4	CWA Section 319	Submitted Oct 2003. 25% match req.	Y	N
4-2	Through the contract employee, provide tech assistance regarding BMPs to forestland owners and farmers.	Objective *#4-1:* Achieve, over a ten-year period, no net loss of forest canopy in the watershed.	August 2003	July 2005	Cost shown in Action 2-4	CWA Section 319	Submitted Oct 2003. 25% match req.	Y	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
4-3	Through the contract employee, provide guidance to forestland owners regarding private and public sector funding, grants, and cost share programs.	Objective *#4-1:* Achieve, over a ten-year period, no net loss of forest canopy in the watershed.	August 2003	July 2005	Cost shown in Action 2-4	CWA Section 319	Submitted Oct 2003. 25% match req.	Y	N
4-4	Implement an Incentive-based, voluntary mitigation program for developers to plant 1:1 tree replacement.	Objective *#4-1:* Achieve, over a ten-year period, no net loss of forest canopy in the watershed.	October 2003	October 2013	$50,000.00 over 10 yrs	Local budgets, LARE	Some costs incurred within existing programs	N	N
4-5	Promote, assist, and publicly support corporate forest steward programs (SWCD Board of Supervisors)	Objective *#4-1:* Achieve, over a ten-year period, no net loss of forest canopy in the watershed.	October 2003	October 2013	$50,000.00 over 10 yrs	Private utility grants		N	N
4-6	Initiate SWCD tree sales (SWCD Supervisors and staff)	Objective *#4-1:* Achieve, over a ten-year period, no net loss of forest canopy in the watershed.	April 2003	Ongoing	Net Revenue	N/A	N/A	N/A	N/A
4-7	Promote concept of cluster development in new subdivisions (County Planning Dept.)	Objective *#4-1:* Achieve, over a ten-year period, no net loss of forest canopy in the watershed.	October 2003	October 2013	N/A	N/A	N/A	N/A	N/A
4-8	Establish and implement a market-based incentive program for loggers who implement BMPs	Objective *#4-2:* Achieve 100% Implementation of BMPs where logging is occurring in the watershed.	July 2003	Ongoing	To be determined	To be determined		N	N
4-9	(Contract employee) Promote the Indiana Forest Industry Council's Sustainable Forestry Initiative Logger Training and assist with arranging such training when possible.	Objective *#4-2:* Achieve 100% Implementation of BMPs where logging is occurring in the watershed.	August 2003	July 2005	Cost shown in Action 2-4	CWA Section 319 funds	Submitted Oct 2003. 25% match req.	Y	N
4-10	Develop and utilize public honor incentives/awards for forestry BMPs (SWCD Board of Supervisors and contract employee)	Objective *#4-2:* Achieve 100% Implementation of BMPs where logging is occurring in the watershed.	July 2003	Ongoing	Cost shown in Action 2-4	CWA Section 319 funds	Submitted Oct 2003. 25% match req.	Y	N
5-1	Hire a contract employee to aggressively market conservation programs and funding options to farmers in priority areas within	Objective #5-1, 5-2, & 5-3: 100% interaction 10%conservation tillage increase	August 2003	July 2005	Cost shown in Action 2-4	CWA Section 319 funds	Submitted Oct 2003. 25% match req.	Y	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	the watershed	Buffers along 30% of unbuffered areas							
5-2	Through the hired individual (see 5-1), contact and interact with 100% of the farmers within the watershed regarding the economic and water quality benefits that stem from proper management of fertilizers, pesticides, and soils.	Objective #5-1, 5-2, & 5-3: 100% interaction 10%conservation tillage increase Buffers along 30% of unbuffered areas	August 2003	July 2005	Cost shown in Action 2-4	CWA Section 319 Grant	Submitted Oct 2003. 25% match req.	Y	N
5-3	Provide technical assistance to landowners and farmers regarding agricultural conservation best management practices (SWCD staff, DNR, NRCS and Contract hire)	Objective #5-1, 5-2, & 5-3: 100% interaction 10%conservation tillage increase Buffers along 30% of unbuffered areas	August 2003	July 2005	Cost shown in Action 2-4	CWA 319 for contract employee USDA-DNR Staff costs covered	Submitted Oct 2003. 25% match req.	Y	N
5-4	Provide guidance to landowners and farmers regarding public and private conservation programs such as IDEM/EPA cost share programs (Section 319), USDA cost-share programs (EQIP, CRP, etc.), and others. Contract hire.	Objective #5-1, 5-2, & 5-3: 100% interaction 10%conservation tillage increase Buffers along 30% of unbuffered areas	August 2003	July 2005	Cost shown in Action 2-4	CWA 319 funds	Submitted Oct 2003. 25% match req.	Y	N
5-5	Organize and conduct a series of field days and workshops for local landowners and farmers covering topics such as conservation tillage, conservation buffers, nutrient management, pest management, farm*a*syst, etc. (SWCD staff, DNR, NRCS, and Contract hire)	Objective #5-1, 5-2, & 5-3: 100% interaction 10%conservation tillage increase Buffers along 30% of unbuffered areas	August 2003	July 2005	$2,000.00 & staff/overhead costs covered in Action 2-1 with help from volunteers	Local funding With CWA Section 319 funding	(319) Submitted Oct 2003. 25% match req.	Y	N
6-1	Hire a contract employee who will utilize prioritized areas in the WMA, arrange visits to those livestock producers to offer technical and financial assistance	Objective #6-1:Within the next 6 years, bring E. coli levels within compliance of state water quality standards in Lambs Creek, both north and	August 2003	July 2009	Cost shown in Action 2-4	CWA Section 319 funds	Submitted Oct 2003. 25% match req.	Y	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	regarding exclusionary fencing and other livestock BMPs.	south of Patton Lake, and Sycamore Creek south of Hart Lake for 12 months out of the year. Objective #6-2: by 2006 attempt interaction with 100% of livestock producers within the watershed to address any and all water quality issues associated with their facility.							
6-2	Organize and conduct livestock related field days, pasture walks, and workshops. Provide guidance to landowners regarding public and private conservation funding and cost share programs	Objective #6-1:Within the next 6 years, bring E. coli levels within compliance of state water quality standards in Lambs Creek, both north and south of Patton Lake, and Dry Fork of Sycamore Creek south of Hart Lake for 12 months out of the year. Objective #6-2: by 2006 attempt interaction with 100% of livestock producers within the watershed to address any and all water quality issues associated with their facility.	August 2003	July 2009	$2,000.00 staff and overhead costs covered in Action 2-1 and with volunteer assistance	CWA Section 319 funds EQIP County SWCD budget Optional private donations	Submitted Oct 2003. 25% match req. NRCS directs Annual County budget reqs. Program dependent	Y (319)	N
6-3	Implement program to fence cattle from streams at priority areas where voluntary participation is available. (Led by Contract hire with guidance and assistance from NRCS, IDNR staff)	Objective #6-3: Implement a cost-share program to fence cattle from streams, install vegetated buffers between pasturelands and streams, and provide alternative water sources for livestock facilities. The overall goal is to exclude 15% of the livestock from the surface waters of the watershed.	July 2003	July 2006	$30,000.00	Section 319 Cost Share dollars EQIP for additional funding	25% match (can be in-kind). Watershed Plan approved. Submitted Oct. 2002 for summer 2003 funding.	Y	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
7-1	Through watershed teaming (see Section 9) ensure the interaction and information sharing between LEPC and EMA, all local fire departments, the SWCD, and County Health Dept. Regarding the locations and types of hazardous materials and hazardous waste operations in the watershed, local soils, slopes, and resource sensitivity.	Object #7-1:Reduce the likelyhood of petroleum and chemical spills, increase the preparedness for spills, and respond with knowledge and full understanding of sources of spills of chemicals and other petroleum products into surface waters.	Ongoing for LEPC Role; May 2004 for Watershed Teaming	Ongoing	See Action 3-12	County and City funds budgeted for professional services for Public Works, Utilities, etc.	Plan for and request appropriations in next local budget cycle(s)	N	N
7-2	Support the LEPC mission by helping to ensure that appropriate Spill Prevention Control and Countermeasure Plans (SPCCP) are avialable at all appropriate facilities that handle hazardous materials and petroleum products. Ensure through inspection and educational processes, that employees at those facilities are trained to implement the SPCCP.	Objective #7-1: Reduce the likelyhood of petroleum and chemical spills, increase the preparedness for spills, and respond with knowledge and full understanding of sources of spills of chemicals and other petroleum products into surface waters.	Ongoing	Ongoing	N/A	N/A	N/A	N/A	N/A
7-3	For facilities that are not regulated per their industrial classification to maintain an SPCCP, ensure through the consituent requirements of Storm Water Phase 2 (see Section 9), all other facilities are trained and understand their potential for impact on surface waters in the event of a spill or release of chemicals.	Objective #7-1: Reduce the likelyhood of petroleum and chemical spills, increase the preparedness for spills, and respond with knowledge and full understanding of sources of spills of chemicals and other petroleum products into surface waters.	May 2004 for Watershed Teaming aspect	Ongoing	Cost incurred and covered in Action 3-12	County and City funds budgeted for professional services for Public Works, Utilities, etc.	Plan for and request appropriations in next local budget cycle(s)	N	N
7-4	Upon acquisition and establishment of GIS in the county (see Sections 8 and 9), ensure that all locations where hazardous materials and wastes are kept are located and displayed	Objective #7-1: Reduce the likelyhood of petroleum and chemical spills, increase the preparedness for spills, and respond with knowledge and full understanding of sources of	May 2004	Ongoing	$10,000.00	Local funds	Plan for and request appropriations in next local budget cycle(s)	N	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	in GIS. Up-to-date lists of materials (i.e., Material Safety Data Sheets) and typical waste streams should be linked to the geographical location to ensure regional, upstream and downstream knowledge in the event that indications of a pollutant are found in surface waters (i.e., evidence of a spill or fish kill).	spills of chemicals and other petroleum products into surface waters.							
7-5	Cross-train between the SWCD and the Martinsville and Monrovia wastewaster pretreatment coordinators so that there is a comprehensvie understanding among both regarding: ❑ Chemicals used in certain industries and how they are treated prior to final discharge both to and from the treatement plant. ❑ Sensitivity of waters and soils downtream of the industries using chemicals (in the case of a spill) and downstream of the treatment plants in the event of a bypass or an unauthorized pollutant discharge to the plant (similar to the City of Anderson/Guide Corporation discharge event that resulted in a large fish kill in White River in 1999).	Objective #7-2: Through watershed teaming (see Section 9) establish cross-training programs and procedures between local agencies to expand the understanding and inspection capabilities between local agencies whose activities involve water quality protection.	May 2004	Ongoing	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
7-6	Cross train between the SWCD, the Morgan County Health Department, local drinking water	Objective #7-2: Through watershed teaming (see Section 9) establish	May 2004	Ongoing	Cost incurred and covered in Action 3-	County and municipal	Plan for and request appropriations in	N	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	utitlies, and the local fire departments regarding spill response capabilities, priorities, and processes. The SWCD should provide information regarding sensitive areas, soils, slopes, and already impaired areas of surface waters. The water utilities will help educate all parties about wellfield protection areas, and other geographical issues of public health concerns. This will provide opportunties for the fire department to enhance their spill response priorities.	cross-training programs and procedures between local agencies to expand the understanding and inspection capabilities between local agencies whose activities involve water quality protection.			12		next local budget cycle(s)		
7-7	As is proposed in Section 8 of this document, *Development, Planning and Zoning*, the County Development Department should utilize the Long Term Hydrologic Impact Assessment (LTHIA) software, available from Purdue University. The development department will run screening scenarios of proposed land use and zoning changes. Results of the LTHIA screening will be turned over to the SWCD prior to any Zoning Board decisions. The SWCD will have the opportunity to recommend mitigation measures to the Zoning Board for any anticipated water quality impacts. It will be necessary to acquire and begin consistent use of GIS software (see Sections 8 and 9) in order to utilize LTHIA.	Objective #7-3: Ensure that the increasing land use change in the watershed from farmland and forested land to commercial areas with impervious surfaces results in minimal impact to water quality.	August 2004	Ongoing	Costs incurred and covered in Action 8-8	CWA Section 319 funds	October 1 of 2003 for 2004 funding	N	N
8-1	Conduct annual workshops and/or seminars and have fact sheets	Objective #8-1: Guide growth and development in Morgan	To be determined	To be determined	$2,000.00	CWA Section 319			

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	readily available for developers, planners, and decision makers as a reminder of how land use directly impacts water quality	County so that it enhances and improves water quality. Objective #8-2:Consider the impact of land use on water quality in all planning and zoning decisions.	by Planning Department	by Planning Department					
8-2	Update the current Comprehensive Plan, Zoning Ordinance, and Subdivision Control Ordinance for Morgan County, the City of Martinsville, and the Town of Monrovia to address water quality issues including: stormwater and drainage requirements; floodplain management; wetland protection; riparian corridor protection; tree preservation; setbacks and buffer protection; overlay zoning districts; service area boundaries; treatment of septic and sewer; limits for imperviousness; conservation design; and flexible development standards to protect natural or enhance resources .	Objective #8-1: Guide growth and development in Morgan County so that it enhances and improves water quality. Objective #8-2:Consider the impact of land use on water quality in all planning and zoning decisions.	2003	2004	Incurred in Planning Department budget	County	To be determined	To be determined	To be determined
8-3	Prepare a countywide Greenways Plan as a means to inventory and map the existing condition of the riparian corridors, floodplains, and waterways with recommendations for improvement and protection.	Objective #8-1: Guide growth and development in Morgan County so that it enhances and improves water quality. Objective #8-2: Consider the impact of land use on water quality in all planning and zoning decisions.	2005	2005	$50,000.00 - $80,000.00	Local funds LARE (?)		N	N
8-4	Morgan County and the Town of Monrovia should adopt a stormwater or drainage ordinance that specifically addresses water	Objective #8-1: Guide growth and development in Morgan County so that it enhances and improves water quality.	December 2003	May 2004	$5,000.00	Local funds	Next budget cycle	N	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	quality as well as quantity concerns through development controls. This could be a stand-alone document or incorporated into the Zoning Ordinance and Subdivision Control document as it is in the City of Martinsville.	Objective #8-2: Consider the impact of land use on water quality in all planning and zoning decisions.							
8-5	Minimize soil erosion and sediment in waterways with better construction management and practices including: education for developers and decision-makers; regular inspection of construction sites; enforce fines for construction violations; proper installation and maintenance of erosion and sediment controls; tree preservation; temporary seeding and mulching; and stabilization and vegetation of streambanks	Objective #8-1: Guide growth and development in Morgan County so that it enhances and improves water quality. Objective #8-2: Consider the impact of land use on water quality in all planning and zoning decisions.	Ongoing	Ongoing	Incurred by local staffing budgets		To be determined	To be determined	To be determined
8-6	Improve water quality through effective storage and treatment of urban, suburban, and rural stormwater runoff including: on-site stormwater treatment; constructed wetlands; detention and retention ponds; infiltration basins and trenches; vegetated filter strips and swales; and stream buffers.	Objective #8-1: Guide growth and development in Morgan County so that it enhances and improves water quality. Objective #8-2: Consider the impact of land use on water quality in all planning and zoning decisions.	Ongoing	Ongoing	Project dependent		To be determined	To be determined	To be determined
8-7	Determine land uses for development, agriculture, wetlands, flood storage, and forest cover based on soil suitability. Use Geographic Information Systems (GIS) and updated soil information to establish the	Objective #8-1: Guide growth and development in Morgan County so that it enhances and improves water quality. Objective #8-2: Consider the impact of land use on water	2005	2005	$10,000.00	Local budge	Pending GIS funding and staff availability	To be determined	To be determined

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	zoning and land use maps.	quality in all planning and zoning decisions.							
8-8	Determine the short-term and long-term impacts of land use change through Purdue's SedSpec and L-THIA (Long-Term Hydrological Impact Assessment) programs to identify: runoff rates; erosion problems; BMP effectiveness; and impacts of past and proposed development.	Objective #8-1: Guide growth and development in Morgan County so that it enhances and improves water quality. Objective #8-2: Consider the impact of land use on water quality in all planning and zoning decisions.	July 2004	Ongoing	$30,000.00 for initial data production	CWA Section 319 funds	October 1, 2003 deadline	N	N
9-1	Establish the 6 primary Watershed Management Areas (mapped) as permanent integrated watershed agency teaming regions, also known as Watershed Management Areas (WMA).	Objective #9-1: Acquisition and Thorough Implementation of a Countywide Geographical Information System (GIS	January 2004	February 2004	$30,000.00 - $60,000.00 for software licenses, training.	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-2	Identify key staff from each local county, city, and town agency who will focus in a designated WMA.	Objective #9-2: Organizational/Staff Regionalization Based on WMAs	March 2004	May 2004	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-3	Initiate consistent teaming among county, city, and town team members through a monthly meeting and early planning/coordinating process.	Objective #9-2: Organizational/Staff Regionalization Based on WMAs	May 2004	Ongoing	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-4	As part of the teaming process discussed earlier in this section, data, proposed projects, and other relevant information should be updated consistently in a database format that can be queried, by watershed, into the GIS system. Watershed-queried capital improvement project lists should be regularly reviewed and analyzed for water quality impacts and for potential	Objective #9-2: Organizational/Staff Regionalization Based on WMAs	May 2004	Ongoing	Local overhead costs incurred by local staff	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
	synchronization with other departmental projects.								
9-5		Objective #9-3: Integrate Water Quality with the Comprehensive Plan for Morgan County	2003/2004	Periodic updates per local needs	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-6	Consider and utilize all findings, data, educational programs, and public input already developed and included in this Watershed Management Plan in the Storm Water Management Program.	Objective #9-4: Integrate Storm water ("Phase 2") Planning with Watershed Efforts	August 2003	October 2003	(future) Costs incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-7	Integrate, wherever possible, Storm water Phase 2 programs between Morgan County and the municipalities of Martinsville, Mooresville, and Monrovia.	Objective #9-4: Integrate Storm water ("Phase 2") Planning with Watershed Efforts	September 2003	Ongoing	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-8	Through Watershed Teaming (see Action 9-3), ensure the consistent communication with and integration among programs and local agencies discussed in this Plan Section.	Objective #9-4: Integrate Storm water ("Phase 2") Planning with Watershed Efforts	May 2004	Ongoing	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-9	Consider and utilize of all findings, data, and public input already prepared in this Watershed Management Plan.	Objective #9-6: Anticipate and plan for Implementation of Total Maximum Daily Loads (TMDLs)	July 2003	Ongoing	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-10	Integrate and consider any and all agricultural BMP funding programs proposed in this Plan.	Objective #9-6: Anticipate and plan for Implementation of Total Maximum Daily Loads (TMDLs)	May 2004	Ongoing	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-11	Integrate TMDL efforts with any and all NPDES permit programs, including Storm Water Phase 2.	Objective #9-6: Anticipate and plan for Implementation of Total Maximum Daily Loads (TMDLs)	May 2004	Ongoing	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N

Action Number	Action Plan for SWCD with Support from Watershed Initiative Partners	Objective that Action Supports	Proposed Start Date	Proposed Completion Date	Cost	Potential Funding Source(s)	Funding Source Requirements, Deadlines, etc.	Funding Acquired Y/N	Action Complete Y/N
9-12	Integrate, wherever possible, of Storm water Phase 2 programs between the City of Martinsville and Morgan County.	Objective #9-6: Anticipate and plan for Implementation of Total Maximum Daily Loads (TMDLs)	August 2003	Ongoing	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-13	Ensure, through Watershed Teaming, the consistent communication with and integration among other programs and local agencies discussed in this Plan Section.	Objective #9-6: Anticipate and plan for Implementation of Total Maximum Daily Loads (TMDLs)	May 2004	Ongoing	Cost incurred and covered in Action 3-12	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N
9-14	Complete a Use Attainability Analysis (UAA).	Objective #9-6: Anticipate and plan for Implementation of Total Maximum Daily Loads (TMDLs)	May 2004	December 2004	$60,000.00-$140,000.00	County and municipal	Plan for and request appropriations in next local budget cycle(s)	N	N

OPTIONAL FUNDING SOURCES:

Non Point Source Implementation Grants (319)
Administered: EPA/IDEM
Summary: Projects to control nonpoint source pollution are eligible. Funds can be used for TMDL development and implementation, watershed management plans, education programs and more.
Eligibility: Non-profit groups, universities, municipalities, etc.
How Much: Twenty Five percent match with a maximum award of $112,500.
Application Deadline: October 1
Web Pages/Links: http://www.in.gov/idem/water/planbr/wsm/index.html

State Revolving Fund Program
Administered: EPA/IDEM
Summary: Low interest loans designed to assist communities with wastewater and drinking water needs. Projects include traditional wastewater treatment methods as well as nonpoint source management programs.
Eligibility: Cities, towns, regional sewer districts.
How Much: Fixed low interest loans (20yr) are provided to recipients (80% Federal : 20% State)
Deadlines: February 22
Web Pages/Links: http://www.in.gov/idem/water/fasb/srflp.html

Water Quality Cooperative Agreements (104 (b)(3))
Administered: EPA
Summary: Funding for programs developing, implementing, and demonstrating new concepts or requirements that will improve the effectiveness of NPDES programs (CSO and Stormwater).
Eligibility: Non-profit organizations
How Much: There is a 5% in-kind or cash match required for 104(b)(3).
Application Deadline: End of January
Web Pages/Links: http://www.in.gov/idem/water/planbr/wsm/Section104b3_main.html
http://aspe.os.dhhs.gov/cfda/p66463.htm

Wetlands Protection Development Grants Program
Administered: EPA
Summary: Provides financial assistance to support wetlands programs/projects or augmentation and enhancement of existing programs.
Eligibility: States, Local Governments
How Much: 1999 grants ranged from $20,000 - +$594,000. Federal non-federal cost share is 75% - 25%.
Application Deadline: December 14
Web Pages/Links: http://www.epa.gov/r5water/wshednps/pdf/r5wetlandgrants2002_info.pdf
http://www.epa.gov/owow/wetlands/2002grant/

Environmental Education Program
Administered: EPA
Summary: To support environmental education programs and projects.
Eligibility: Non-profit organizations
Application Deadlines: Mid to late November
How Much: $25,000, or less. Federal non-federal cost share of 75%-25%.
Web Pages/Links: http://www.epa.gov/Region5/enved/grants.html

Section 205(j) Water Quality Management Planning Program
Administered: IDEM
Summary: Grants are for water quality projects such as, studies of non-point source pollution impacts, nonagricultural NPS mapping, and the development and implementation of watershed management projects.
Eligibility: Available to municipalities, counties, conservation districts, drainage districts, and other public organizations. For-profit entities, non-profit organizations, private associations, and individuals are NOT eligible for this funding.
Application Deadline: January 31
How Much: Funds can be requested for up to $100,000 and no match is required.
Web Pages/Links: http://www.in.gov/idem/water/planbr/wsm/205jgeninfo.pdf
http://www.in.gov/idem/water/planbr/wsm/Section205j_main.html

Environmental Quality Incentives Program
Administered: USDA/NRCS
Summary: Funding for projects to treat identified soil, water and related natural resource concerns on eligible land. Technical, financial and educational support are available. Half of which is targeted towards livestock related concerns and half of it toward general conservation.
Eligibility: Non-federal landowners engaged in livestock operations or agricultural productions.
How Much: Up to $10,000 per person per year and up to $50,000 over the length of a contract. Federal cost share support of up to 75%.
Application Deadline:
Web Pages/Links: http://www.nrcs.usda.gov/programs/eqip/

Conservation Reserve Program
Administered: USDA/ Indiana Farm Service Agency
Summary: Funding for projects to control soil erosion. The goal of the program is to give farmers incentives to convert highly erodible land or other sensitive areas into vegetative cover such as native grasses, trees, and riparian buffers.
Eligibility: Agricultural land owners
How Much: Annual rental payments for the term of a multi year contract of up to $50,000 per fiscal year. Funds are also available for up to 50% of cost of establishing vegetative cover.
Application Deadline: Continual sing up period
Web Pages/Links: http://www.fsa.usda.gov/dafp/cepd/crp.htm

Wetland Reserve Program
Administered: USDA/NRCS
Summary: Program provides technical and financial assistance to land owners restoring marginal agricultural land to wetland. Easements range from 10-30 years. Landowners retain ownership.
Eligibility: Land owners who have owned their land for at least 12 months.
How Much: NRCS easement and restoration payments range from 75% - 100%
Application Deadline: Applications are always accepted.
Web pages and Links: http://www.nhq.nrcs.usda.gov/PROGRAMS/wrp/

Wildlife Habitat Incentive Program
Administered: USDA/NRCS
Summary: Cost share and technical assistance to develop and improve wildlife habitat on private land.
Eligibility: Private landowners who are agricultural producers are eligible
How Much: 75% Federal Cost Share
Application Deadline: Continual Sign Up
Web Pages/Links: http://www.nhq.nrcs.usda.gov/PROGRAMS/whip/

Conservation Security Program
Administered: USDA/NRCS
Summary: Provides incentive payments for maintaining and increasing farm and ranch stewardship practices on working lands. The program promotes conservation and improvements to soil, water, and air quality.
Eligibility: Participation in the program stipulates that land practices must achieve resource and environmental benefits. Removal of land from production is not required.
How Much: 75% federal reimbursement on conservation practice chosen, with potential for additional assistance.
Application Deadline:
Web Pages/Links: http://www.extension.iastate.edu/Publications/FM1872B.pdf

Emergency Watershed Protection Program
Administered: **USDA/NRCS**
Summary: **The program is set up to respond to natural disaster induced emergencies. The project must be economically and environmentally justifiable.**
Eligibility: **Any land on floodplains that has been impaired within the last 12 months is eligible for funding, but landowners must be represented by a project sponsor, who must be a public agency.**
How Much: **NRCS may bear up to 75 percent of the construction cost of emergency measures. The remaining 25percent must come from local sources and can be in the form of cash or in-kind services.**
Application Deadline: **All applications must be submitted within 10 days of the disaster for exigency situations and within 60 days of the disaster for nonexigency situations**
Web Pages/Links: http://www.nrcs.usda.gov/programs/ewp/ewp.html

SARE Producer Grant Program
Administered: USDA
Summary: Grants for farm projects such as erosion and runoff control that are economically viable, environmentally sound, and socially responsible.
Eligibility: States and non-profit organizations.
Application Deadline: Mid July
How Much: Awards range from $2,000 - $15,000
Web Pages/Links: http://www.sare.org/ncrsare/prod.htm

Soil and Water Conservation Assistance
Administered: USDA/NRCS
Summary: Cost share program available to farmers and ranchers addressing threats to soil, water, and related natural resources, including, grazing land, wetlands, and wildlife habitat.
Eligibility: Land owners and operators not in EQIP/WRP/CRP priority areas
How Much: The federal cost share will cover up to 75 percent of the cost of an eligible practice.
Application Deadline: Continual sign up
Web Pages/Links: http://www.nrcs.usda.gov.programs/swca/swca.info.html

Resource Conservation and Development Program
Summary: Technical assistance is available for the planning and installation of approved projects specified in RC&D area plans, for land conservation, water management, community development, and environmental enhancement projects.
Eligibility: Land must be in RC&D area.
How Much: Cost share of up to 25% of the total cost of a project, not to exceed $50,000
Application Deadline: Continual sign up
Web Pages/Links: http://www.nrcs.usda.gov/programs/swca/

Forest Legacy Program
Administered: USDA Forest Service
Summary: Designed to encourage the protection of privately owned forest lands. The program encourages and supports acquisition of conservation easements. Landowners are required to prepare a multiple resource management plan for the land as part of the conservation easement acquisition.
Eligibility: Private forest landowners
How Much: Federal government may fund up to 75% of program costs, with at least 25% coming from private, state or local sources.
Application Deadline: January 31, for priority but applications are accepted anytime.
Web Pages/Links: http://www.fs.fed.us/spf/coop/flp.htm

Forest Land Enhancement Program
Administered: USDA/NRCS
Summary: The program provides cost-share support for non-industrial private forest landowners to help them develop and implement Forest Stewardship Plans.
Eligibility: Non-industrial private forest land owners
How Much: Landowners are reimbursed for up to 75% of approved expenses, with a maximum of $10,000 per year per landowner. In exchange, the landowner agrees to maintain and protect FLEP funded practices for a minimum of 10 years.
Web Pages/Links: http://www.pinchot.org/pic/farmbill/CScompare.htm and http://www.usda.gov/farmbill/forestry_fb.html

North American Wetlands Conservation Act Grants
Administered: U.S Fish and Wildlife Service
Summary: Provides matching grants to private or public organizations or to individuals who have developed partnerships to carry out wetlands conservation projects including acquisition, enhancement, and restoration in the United States, Canada, and Mexico.
Eligibility: Public or private, profit or non-profit agencies.
How Much: Cost share must be at a 1:1 federal to non-federal ratio.
Application Deadline: March 23 and July 6
Web Page/Links: http://northamerican.fws.gov/NAWCA/grants.htm
http://www.nws.usace.army.mil/pm/cw/planning.cfm

Partners for Fish and Wildlife Program
Administered: U.S. Fish and Wildlife Service
Summary: Provides financial and technical assistance to private landowners through voluntary cooperative agreements. Priority projects include restoration of degraded wetlands, streams, and riparian areas.
Eligibility: Private landowners
How Much: Dollar for dollar federal to non-federal match.
Web Pages/Links: http://partners.fws.gov/pdfs/partnersfs.pdf

Planning Assistance to States Program
Administered: U.S. Army Corps of Engineers
Summary: Funding assistance for preparation of comprehensive plans for development, utilization, and conservation of water and related land resources. Recent projects include water quality and conservation projects.
Eligibility: Non Federal entities
How Much: One to one federal to non-federal cost share, with annual allotments per state not to exceed $500,000 per year.
Application Deadline: No deadline
Web Pages and Links: http://www.cfda.gov/public/viewprog.asp?progid=250

Project Modifications for Improvement of the Environment
Administered: U.S. Army Corps of Engineers
Summary: Used to restore habitat and improve habitat that has been impacted by existing Corps projects.
Eligibility: States and non-governmental groups
How Much: 75% - 25% federal non-federal cost share.
Application Deadlines: Continual sign up
Web Pages and Links: http://www.swg.usace.army.mil/pe-p/projmod.asp

Aquatic Ecosystems Restoration
Administered: U.S. Army Corps of Engineers
Summary: Funds can be used for restoration and protection of aquatic habitat and water quality in lakes, rivers, and streams without any connection to existing Corps projects.
Eligibility: State and non-governmental groups.
How Much: 65% 35% federal non-federal cost share.
Application Deadline: Submit request for study at any time.
Web Pages and Links: http://www.mvp.usace.army.mil/enviro_protection/aqua_eco_rstor/

Lake and River Enhancement Program
Administered: Indiana DNR
Summary: Funding to reduce inflow of sediments and nutrients into lakes and rivers. Eligible projects include water quality monitoring and watershed projects.
Eligibility: Local entities, land planners, and development organizations.
How Much: Financial assistance of up to $100,000 is available. Program also provides up to 80% cost share of approved watershed land treatment practices.
Application Deadline:
Web Pages and Links: http://www.in.gov/dnr/soilcons/pdfs/lare.pdf and http://www.in.gov/dnr/soilcons

Urban Forest Conservation Grants
Administered: Indiana DNR
Summary: Projects that help to improve and protect trees and associated resources in urban areas.
Eligibility: Municipalities, non-profit organizations
How Much: One to one matches ranging from $2,000 to $20,000
Web Pages and Links: http://www.state.in.us./dnr/outdoor/planning/scorp/dnrresourcemanual.pdf

Hometown Indiana Grant Program
Administered: DNR
Summary: Provides grants for acquisition and or development of recreation sites and facilities, historic preservation and forestry.
Eligibility: Municipal corporations with a five year park and recreation master plan.
How Much: One to one state match of funds ranging from $10,000 - $200,000.
Web Pages and Links: http://www.in.gov/dnr/outdoor/grants/hometown.html

Classified Wildlife Habitat Program
Administered: Indiana DNR
Summary: Incentive program to foster private wildlife habitat management through tax reduction and technical assistance. Landowners need 15 or more acres of habitat to be eligible.
Eligibility: Private landowners with at least 15 acres of land.
How Much: Tax reductions
Application Deadlines:
Web Pages and Links: http://www.ai.org/dnr/fishwild/about/habitat.htm

Classified Forest Program
Administered: DNR
Summary: Program allows landowners to set aside at least 10 acres of land as forest. In return owners receive property tax breaks, forestry literature, and technical assistance.
Eligibility: Private landowners with 10 acres of land.
How Much: Lands are eligible for Assessments at $1.00 an acre. Property taxes are then paid based on that assessment.
Application Deadline:
Web Pages/Links: http://www.state.in.us/dnr/forestry/privateland/clasfor.htm

Classified Wind Break Act
Administered: U.S Fish and Wildlife
Summary: Establishment of windbreaks at least 450 feet long adjacent to tillable land.
Eligibility:
How Much:
Application Deadlines:
Web Pages and Links:

Nisource Environmental Challenge Fund
Administered: NiSource
Summary: Funding for projects designed to preserve, protect, or enhance the environment in areas served by NiSource or a subsidiary.
Eligibility: Non-profit and grassroots organizations and other community groups.
How Much: Awards are usually between $500 and $5000. Funding available for up to 80% of a projects cost.
Application Deadline:
Web Pages/Links: http://www.nisource.com/enviro/ecf.asp

IPL Golden Eagle Environmental Grant
Administered: Indianapolis Power & Light
Summary: Provide funds for projects that will preserve, protect, enhance or restore environmental and biological resources throughout the state.
Eligibility: Municipalities, states, non-for profits, etc.
How Much: Grants will not exceed $10,000.
Application Deadline:
Web Pages/Links: http://www.ipalco.com/ABOUTIPALCO/Environment/Golden_Eagle/Golden_Eagle_Application.html

Watershed Assistance Grants
Administered: EPA and the River Network
Summary: Program is designed support the growth and sustainability of local watershed partnerships in the United States. For the purpose of this program, a "watershed partnership" is defined as an inclusive, enduring, diverse, community-based group organized to identify and resolve watershed problems and issues.
Eligibility: Watershed partnerships.
How Much: Awards ranging from $1,000 - $3,100
Web Pages/Links: http://www.rivernetwork.org/howwecanhelp/howwag_2002cri.cfm

Re-Grants
Administered: CS Mott Foundation
Summary: This Program is designed to help staff members, board members, and volunteers develop skills important to their duties with river and watershed organizations. Funding is used to cover travel expenses and/or registration fees for selective river training opportunities.
Eligibility: Non Profit organizations, watershed staffs, volunteers in the Great Lakes Basin.
How Much: $300-$500
Web pages/links: http://www.rivernetwork.org/howwecanhelp/howregrant.cfm

Hoosier Riverwatch Water Quality Monitoring Equipment
Administered: Hoosier Riverwatch
Summary: Grant provides equipment for participating in the statewide volunteer stream-monitoring program.
Eligibility: Schools, government agencies, non-profit organizations
How Much: Up to $500 worth of water quality testing equipment.
Application Deadline: March 15
Web Pages/Links: http://www.state.in.us/dnr/soilcons/riverwatch/

Core Four Alliance Grants
Summary: Grants are provided to alliances throughout the country implementing programs that will advance the Core 4 Conservation Campaign to realize better soil, cleaner water, greater profits for agriculture, and a brighter future for all of us.
Eligibility: Alliances promoting Core 4 Campaign.
How much: Up to $2500 with a dollar for dollar match from non-federal funds.
Web Pages/Links: http://www.ctic.purdue.edu/Tammy/Application.pdf

General Challenge Grant
Administered: National Fish and Wildlife Federation
Summary: Funding for projects that address priority actions promoting fish, wildlife, plants and the habitats on which they depend.
Eligibility: Federal, tribal, state, local governments, education institutions, non-profit, and conservation organizations.
How Much: $10,000 - $150,000. The match is 1:1 federal to non-federal.
Web Pages/Links: http://www.nfwf.org/programs/guidelines.htm

Bring Back the Natives
Administered: National Fish and Wildlife Foundation
Summary: Program provides funds to restore damaged or degraded riverine habitats and their native aquatic species through watershed restoration and improved land management.
Eligibility: Local governments, states, and non-profit organizations.
How Much: Non federal to federal matching is 2:1.
We Pages/Links: http://www.nfwf.org
http://www.epa.gov/owow/watershed/wacademy/fund/natives.html

Appendix A

Public Involvement and Outreach Record

Including copies of:

- Brochure
- Sample Newsletters
- Sample Newspaper Articles
- Other related public outreach efforts

Available in Hard Copy Only

WATERSHED BIOASSESSMENT REPORT

WEST CENTRAL MORGAN COUNTY WATERSHED

Lambs Creek
Sycamore Creek
Highland Creek

April and October 2002

Study Conducted By:

Commonwealth Biomonitoring
8061 Windham Lake Drive
Indianapolis, Indiana 46214

(317) 297- 7713

TABLE OF CONTENTS

EXECUTIVE SUMMARY

A rapid bioassessment of the benthic macroinvertebrate communities of four tributaries of the West Fork of White River in Morgan County, Indiana was conducted in April and October 2002. The purpose of the assessment was to document the biological condition of the streams as part of a watershed management program sponsored by the Morgan County Soil and Water Conservation District.

The study showed that 9 of the 10 sites examined on the four streams were impacted, as compared to values from "reference" streams in the same ecoregion. One site, Sycamore Creek at Robb Hill Road, had habitat and a biological community among the best in Indiana.

Although lower aquatic habitat values contributed to biological impacts at some of the other sites (especially an unnamed tributary near Centerton), degraded water quality appeared to be a problem as well. Causes of water quality degradation, as indicated by biological indicators, probably included low dissolved oxygen concentrations (3 sites) and excessive nutrient concentrations (1 site). The sites identified as having the most degraded water quality were all downstream from impoundments. Occasional release of nutrient-rich, anoxic water from these impoundments may be contributing to the problem. Excessive sediment inputs did not appear to be a problem at any site.

Recommendations to improve conditions in the watershed include (1) determining if dam outlet structures on impoundments in the watershed can be modified to allow discharge from surface waters rather than bottom waters, (2) protecting streams from channelization and excessive stream bank tree removal, and (3) continuing to provide high quality wastewater treatment, including nutrient removal, at the Monrovia Wastewater Treatment Plant.

INTRODUCTION

A 319 nonpoint source grant was awarded to the Morgan County Soil and Water Conservation District to assess water quality in several tributaries of the West Fork of White River. One of the streams (Lambs Creek) is on the Indiana Department of Environmental Management's list of "impaired waterbodies" [1]. An important component of the grant was to conduct a series of bioassessments in these streams. Bioassessments are recognized as a valuable tool in identifying water quality problems and helping diagnose their causes [2]. Certain animals are sensitive to different types of stresses. Comparison of the numbers and kinds of animals present can give important clues about the presence of toxic substances, excessive sedimentation, excessive nutrient inputs, or low dissolved oxygen concentrations.

This project was designed to characterize the biological and physical (aquatic habitat) integrity of the streams in West Central Morgan County. Questions to be answered include:

What is the overall ecological health of these watersheds?

Are unhealthy streams affected primarily by degraded water quality or by degraded habitat?

Are dissolved oxygen, pH, temperature, and conductivity within normal ranges for aquatic life?

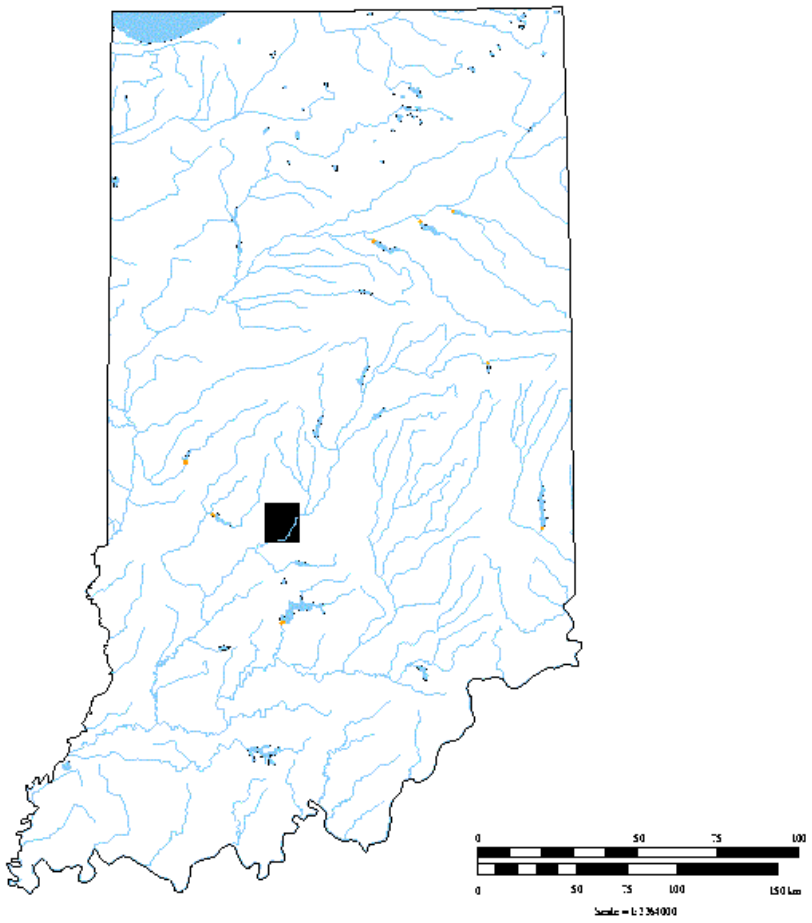
What can be done to make the identified problems better?

Local Setting

The streams in this watershed (Fig. 1) lie in the "Eastern Corn Belt Plain" ecoregion of the Central U.S. This area is composed of a glacial till plain manteled in many places with loess. Stream valleys are generally shallow with narrow valley floors. Constructed ditches and channelized streams are common because much of the ecoregion has poorly drained soils. The natural vegetation consists of a mosaic of bluestem prairie and oak/hickory forest. However, a great majority of the land in this ecoregion is used for agriculture, primarily for corn and soybeans [3].

On a more local level, all of these streams originate in a unique area of glacial outwash at the southernmost end of the last glaciation [5]. Steep slopes on siltstone and shale bedrock have prevented widespread agricultural use and kept most of the watershed in a forested condition.

Figure 1.

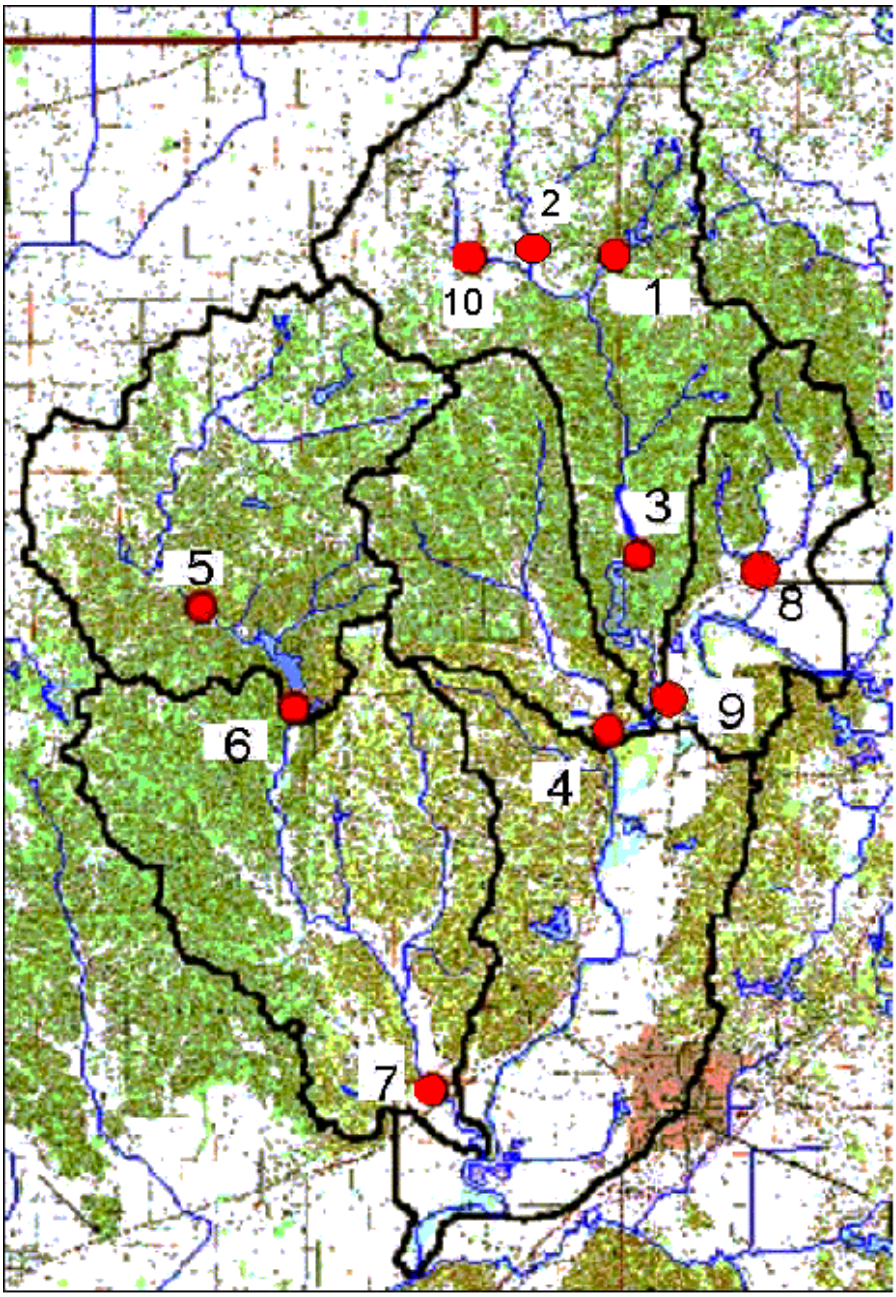


The Present Study

To document the biological integrity of the watershed, nine sites were chosen for study (Fig. 2). A tenth site was added in October 2002, when site 9 became too dry to support a benthic community. Site locations were as follows:

	Stream	Latitude	Longitude
Site 1	Dry Fork of Sycamore Creek below Lake Hart	39.33.658	86.26.441
Site 2	Sycamore Creek CR 950 N	39.33.845	86.27.239
Site 3	Sycamore Creek Robb Hill Road	39.30.792	86.25.923
Site 4	Sycamore Creek State Road 67	39.29.491	86.25.784
Site 5	Highland Creek State Road 67	39.29.634	86.26.840
Site 6	Lambs Creek Upstream from Patton Lake	39.30.526	86.31.696
Site 7	Lambs Creek Downstream from Patton Lake	39.29.021	86.30.363
Site 8	Lambs Creek State Road 67	39.25.286	86.28.449
Site 9	Unnamed tributary near Centerton	39.30.472	86.24.352
Site 10	Unnamed tributary near Monrovia		

Fig. 2. Location of Study Sites



METHODS

AQUATIC COMMUNITY

Because they are considered to be more sensitive to local conditions and respond relatively rapidly to change, benthic (bottom-dwelling) organisms were chosen to document the biological condition of the streams. The U.S. Environmental Protection Agency (EPA) has recently developed a "rapid bioassessment" protocol [4] which has been shown to produce highly reproducible results that accurately reflect changes in water quality. We used a modification of this protocol developed by Ohio EPA [8]. The bioassessment technique relies upon comparison of the aquatic community to a "reference" condition (streams of similar size in the same geographic area which are least impacted by human changes in the watershed). The reference condition for macroinvertebrates in the Eastern Corn Belt Ecoregion were determined by Ohio EPA [8].

Habitat Evaluation

The aquatic habitat at each study site was evaluated according to the method described by Ohio EPA [8]. This method's results assigns values to various habitat parameters (e.g. substrate quality, riparian vegetation, channel morphology, etc.) and results in a numerical score for each site. Higher scores indicate higher aquatic habitat value. The maximum value for habitat using this assessment technique is 100.

Sample Collection

Macroinvertebrate samples in this study were collected by dipnet in riffle areas where current speed approached 30 cm/sec. All samples were preserved in the field with 70% ethanol.

Laboratory Analysis

In the laboratory, a 100 organism subsample was prepared from each site by evenly distributing the animals collected in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample.

Each animal was identified to the lowest practical taxon (usually genus or species). As each new taxon was identified, a representative specimen was

preserved as a "voucher." All voucher specimens will ultimately be deposited in the Purdue University Department of Entomology collection.

Data Analysis

Following identification of the animals in the sample, ten "metrics" are calculated for each site. These metrics are based on knowledge about the sensitivity of each species to changes in environmental conditions and how the benthic communities of unimpacted ("reference") streams are usually organized. For example, mayflies and caddisflies are aquatic insects which are known to be more sensitive than most other benthic animals to degradation of environmental conditions. A larger proportion of these animals in a sample receives a higher score. The sum of all ten metrics provides an individual "biotic score" for each site.

The metrics used in this study were adapted from Ohio EPA [8]. Because Ohio EPA uses a larger sample size in its macroinvertebrate protocol, some of the metrics were modified to more closely correspond to a 100 organism sample. In addition, since a separate qualitative sample was not taken, the U.S. EPA metric "% Dominant Taxon" was substituted for the "EPT Qualitative Taxa" metric used in Ohio. The following scoring values were used in this study:

SCORING VALUES FOR METRICS
Adapted from Ohio EPA and U.S. EPA RBA Protocol III.

	6 points	4 points	2 points	0 points
# of Genera	>20	14 - 20	7 - 13	<7
# Mayfly Taxa	> 6	4 - 6	2 - 4	<2
# Caddisfly Taxa	> 4	3 - 4	1 - 2	0
# Diptera Taxa	>12	8 - 12	4 - 7	<4
% Tanytarsini	>25	11 - 25	1 - 10	0
% Mayflies	>25	11 - 25	1 - 10	0
% Caddisflies	>20	11 - 19	1 - 10	0
% Tolerant Species	0-10	11 - 20	21 - 30	>30
% non-Tanytarsids & non-insects	<25	25 - 45	46 - 65	>65
% Dominant Taxon	<20	21-29	30-39	>40

Because the index scores for macroinvertebrates and habitat result in different maximum values, they are difficult to relate to each other. Therefore, both indices were eventually converted to a normalized score of 0 to 100 using the following formula:

Normalized Score = Actual Score / Maximum Possible Score x 100

RESULTS

Water Chemistry

Table 1 shows a summary of all the water chemistry data collected at the 10 sites examined at least once in this study:

Table 1. Water Chemistry

	Dissolved Oxygen (mg/l)		pH SU		Temp. Deg. C		Cond. uS	
	Apr.	Oct.	Apr.	Oct.	Apr.	Oct.	Apr.	Oct.
Site 1	9.5	7.3	8.3	7.8	22.8	25.8	260	450
Site 2	10.6	10.0	8.3	8.3	23.2	22.1	360	430
Site 3	10.6	10.0	8.6	8,0	22.8	21.1	240	360
Site 4	9.3	6.3	7.5	8.0	20.1	21.7	110	310
Site 5	11.7	7.6	8.8	7.8	23.2	20.2	210	270
Site 6	9.3	6.4	8.3	7.7	20.5	20.8	190	290
Site 7	9.8	3.8	8.1	7.4	22.3	20.1	180	230
Site 8	10.2	8.2	8.8	8.1	24.2	20.2	170	290
Site 9	9.5		8.3		22.7		250	
Site 10		9.2		8.2		21.0		510

Dissolved oxygen, pH, and water temperature fell within ranges tolerable to most forms of aquatic life. Site 7 (Lambs Creek downstream from Patton Lake) had a dissolved oxygen concentration below the Indiana water quality standard (4 mg/l) during October.

Aquatic Habitat Analysis

When the EPA habitat scoring technique was used, the following aquatic habitat values were obtained for each site in the study:

Table 2. Aquatic Habitat

		Score
Site 1	Dry Fork Cr. below Hart Lake	55
Site 2	Sycamore Creek upstream	68
Site 3	Sycamore Creek middle	80
Site 4	Sycamore Creek downstream	76
Site 5	Highland Creek	65
Site 6	Lambs Creek upstream	74
Site 7	Lambs Creek below Patton Lk	79
Site 8	Lambs Creek downstream	69
Site 9	unnamed trib. near Centerton	39
Site 10	unnamed trib. near Monrovia	67

Table 3.
Summary of IBI "Normalized"Scores

		4/02 Score	!0/02 Score	Mean Score	Rank
Site 1	Dry Fork Cr. Below Hart Lake	37	dry	37	8
Site 2	Sycamore Creek upstream	43	50	47	5
Site 3	Sycamore Creek middle	73	70	72	1
Site 4	Sycamore Creek downstream	23	40	32	9
Site 5	Highland Creek	37	57	47	4
Site 6	Lambs Creek upstream	50	67	59	2
Site 7	Lambs Creek below Patton Lake	27	50	39	6
Site 8	Lambs Creek downstream	33	40	37	7
Site 9	Unnamed tributary near Centerton	23	dry	23	10
Site 10	Unnamed tributary near Monrovia		50	50	3

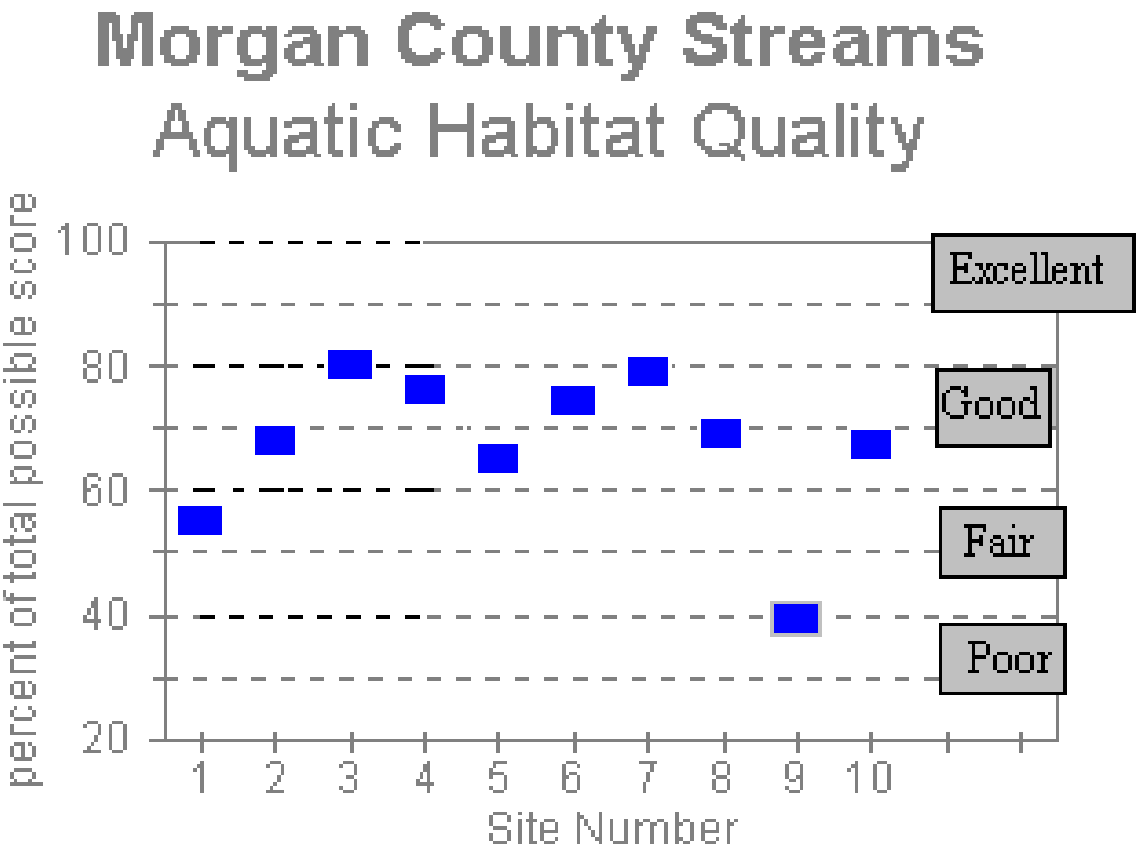
Quality assurance duplicate samples collected at site 3 during April resulted in identical "normalized" IBI scores (73). This indicates that the bioassessment technique was producing reliable, reproducible results during the study period.

DISCUSSION

Aquatic Habitat

Aquatic habitat index values ranged from 39 to 80 at the 10 study sites. According to this scoring scheme, most sites in the watershed have generally "good" aquatic habitat. One site was "excellent," seven were "good," one was "fair," and one was "poor." The site with poor aquatic habitat (the unnamed tributary near Centerton) was artificially channelized, had no shading canopy, and dried up during late summer. None of the other sites had artificially altered channels. Unchannelized headwater streams are rather rare in Indiana.

Figure 3.

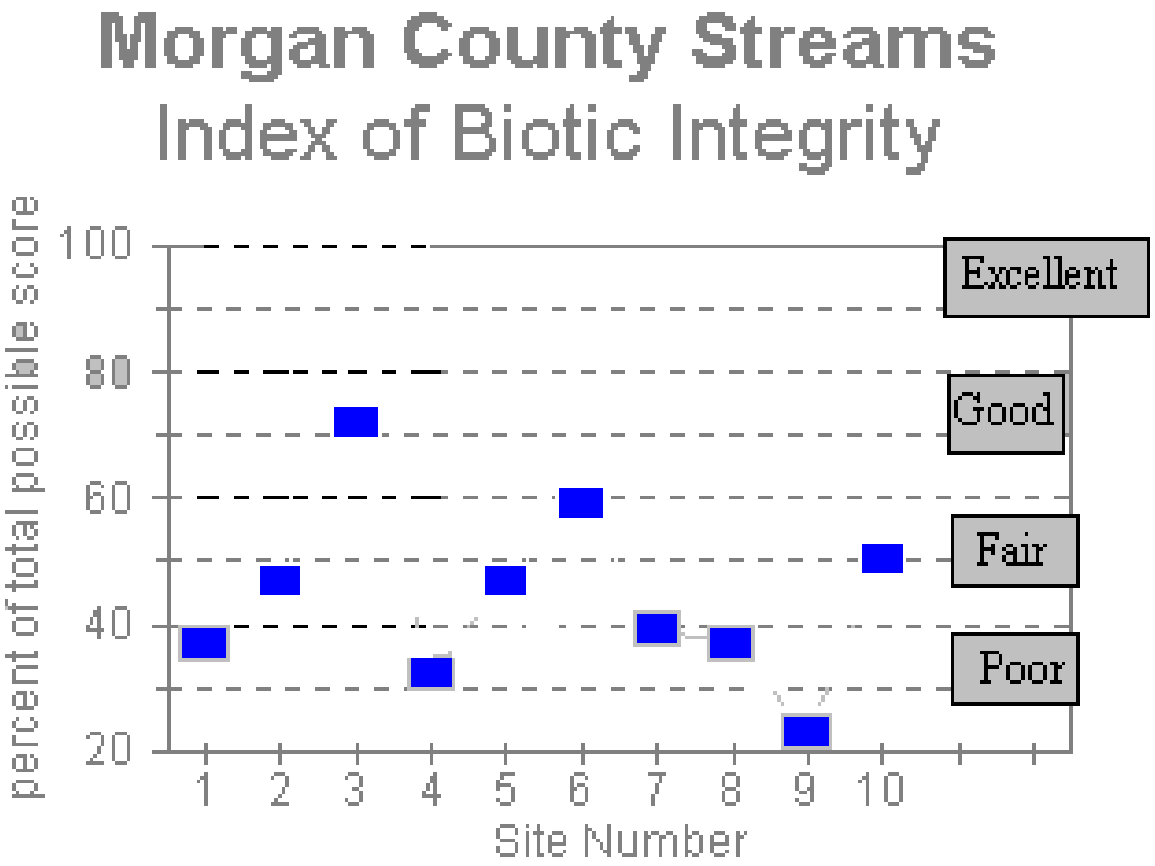


Macroinvertebrate Communities

A total of 49 macroinvertebrate genera were collected at the 10 study sites. The most commonly collected species were riffle beetles (*Stenelmis crenata*), caddisflies (*Cheumatopsyche* spp.), mayflies (*Isonychia sicca* and *Stenonema vicarium*), and midge larvae. Stoneflies were also common during the April sampling period.

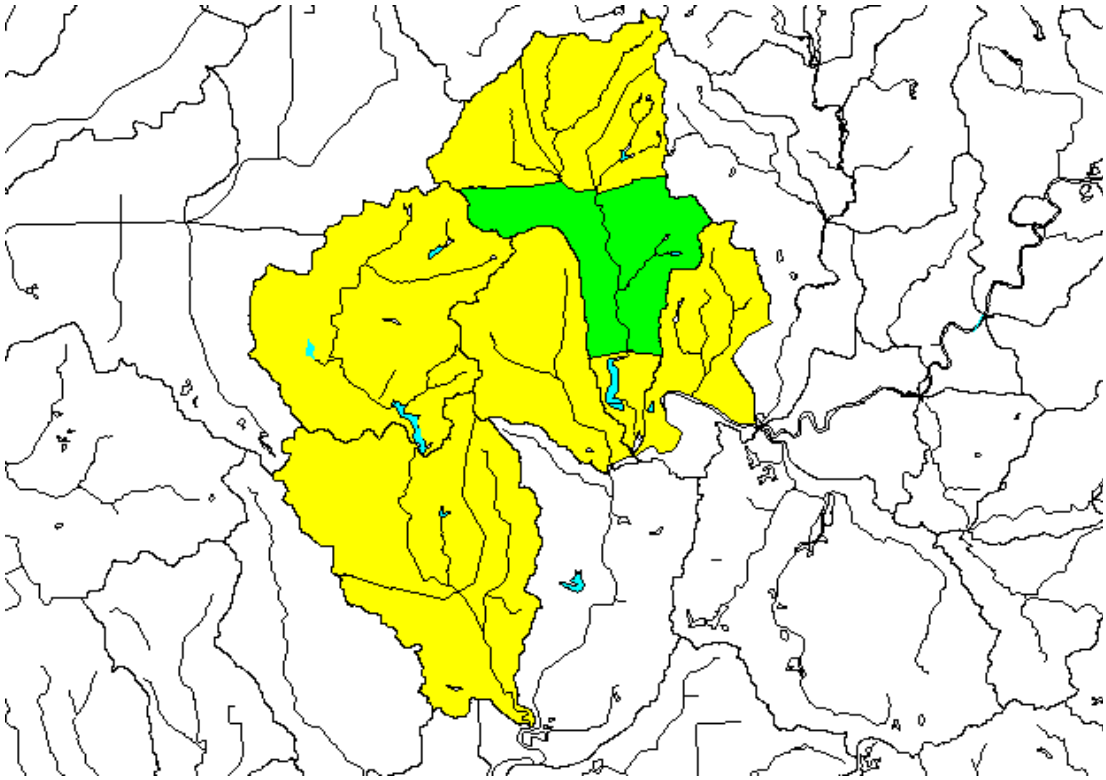
The normalized biotic index scores ranged from 23 to 73 on a scale of 0 to 100. For the yearly mean, two sites fell in the "good" category, four sites were "fair," while four sites had "poor" biotic integrity. It is interesting to note that the IBI scores at many sites were significantly higher during October than during the earlier April sampling period (Table 3). This indicates that water quality conditions generally improved as the year progressed. Sites 4, 5 and 7 showed the biggest improvements during this time.

Figure 4
Only one of the ten study sites (site 3 on Sycamore Creek at Robb Hill Road)



had no aquatic habitat or biological impairment. The watershed represented by this site is shown in green in Fig. 5. This site qualifies as a "regional reference site," having habitat and an aquatic community among the best in Indiana.

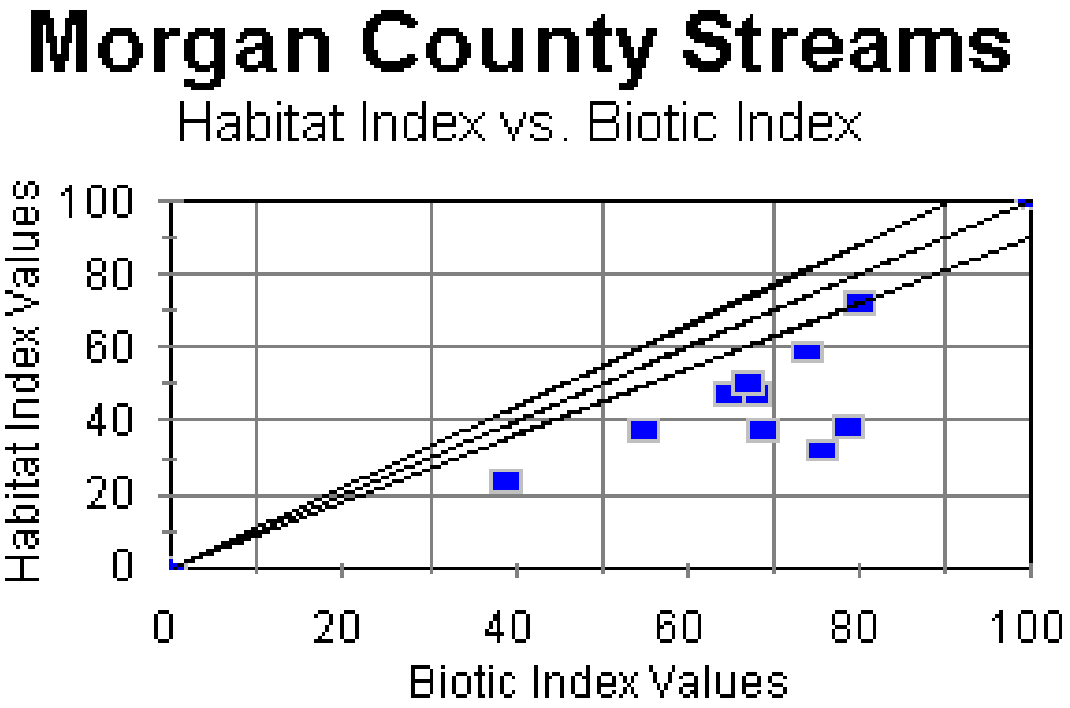
Fig. 5



Diagnosis

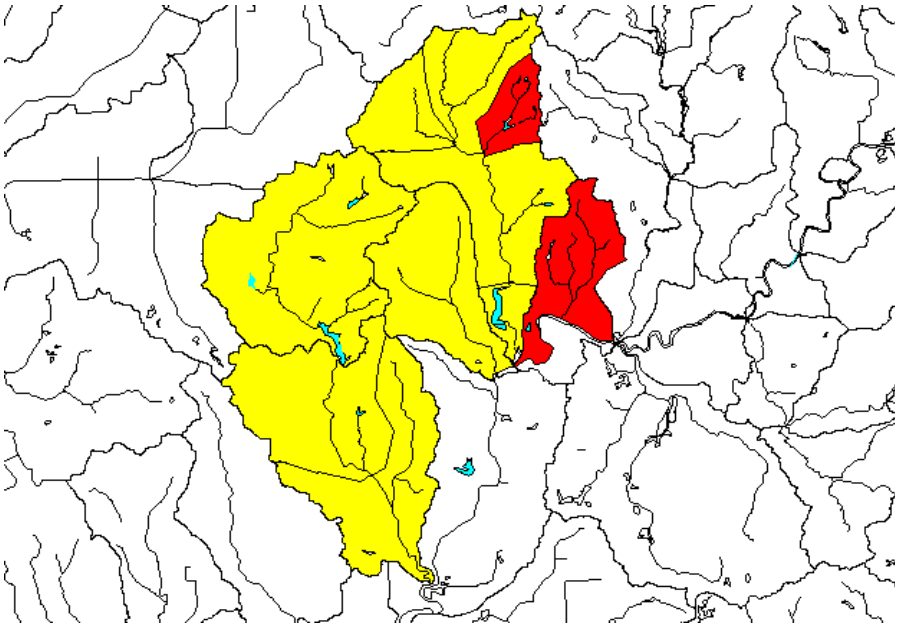
The remaining nine sites exhibited some degree of impairment. One of the most useful aspects of biological monitoring is the ability to use information on the way aquatic animals respond to different types of stress to diagnose a problem. For example, degraded biotic integrity can often be directly related to degraded habitat. Macroinvertebrates cannot thrive where habitat is lacking. When the two values are graphed in relation to each other, they form a straight line [4]. A measurement error of plus or minus 10% can be added to the graph to give a range in which biotic integrity degradation is explained simply by a lack of adequate habitat. When values fall outside this range, however, water quality problems are suspected. A comparison of biotic integrity to habitat is shown in Fig. 6. This figure suggests that nine of the ten study sites had degraded water quality in at least one sampling period.

Figure 6



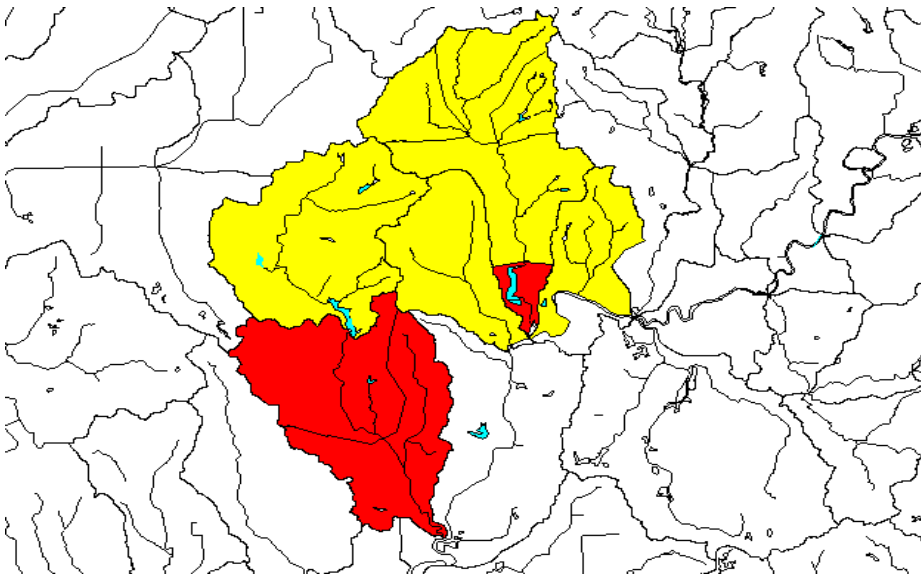
Aquatic life will not thrive were habitat is unsuitable. The watersheds with the lowest aquatic habitat values are shown in Figure 7.

Figure 7.



Three watersheds had biotic index values which were at least 30 points lower than available habitat would allow. These areas, shown in Figure 8, had the most degraded water quality. They include the lower end of Sycamore Creek and the lower end of Lamb's Creek. Both sites are downstream from impoundments.

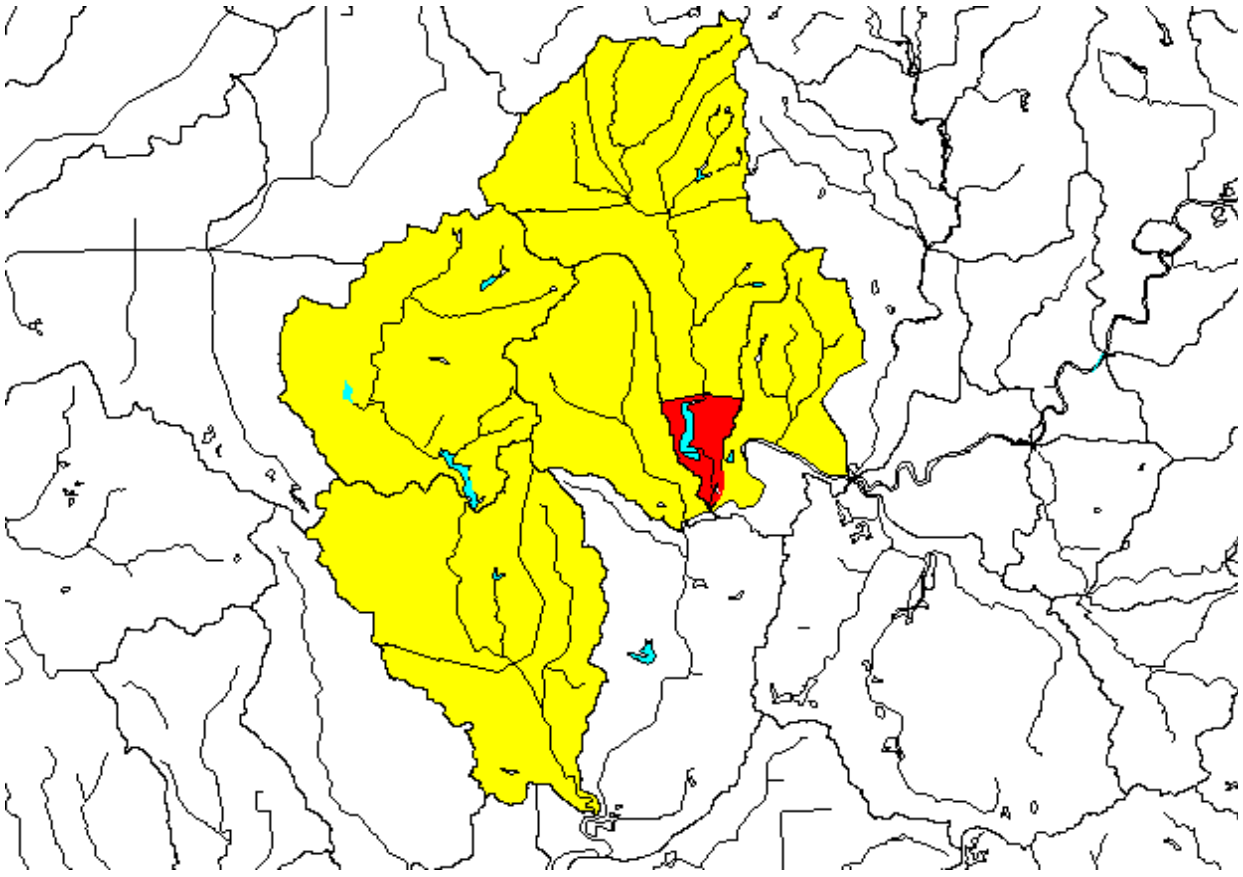
Figure 8



An examination of those metrics showing the lowest values may provide an important clue about causes of biological impairment. No sites were dominated by species known to be tolerant to high amounts of sediment deposition. Instead, sediment-intolerant species were common in most areas. Excessive sediment inputs do not appear to be a problem in these watersheds.

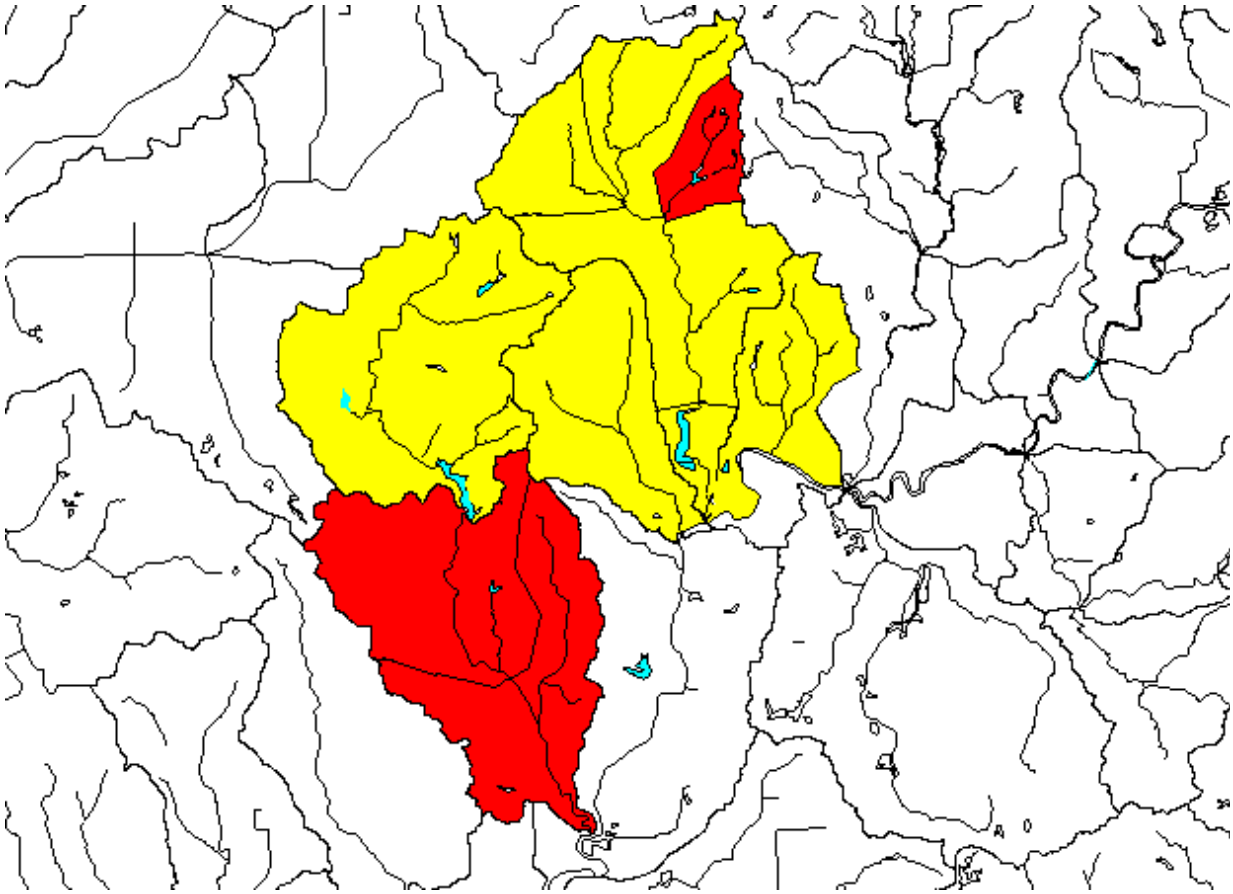
Excessive nutrient inputs are often indicated by a dominance of animals which eat algae ("scrapers"). Dominance by riffle beetles and snails are especially good indicators of this type of impairment [4]. Sites dominated by scrapers and potentially impaired by nutrients are shown in Figure 9.

Figure 9



Low dissolved oxygen concentrations can often be determined by examining the Hilsenhoff Biotic Index for a particular site. This index, which ranges between 0 and 10, is especially suitable for the diagnosis of sewage-related pollution [6]. Sites with values greater than 7 frequently have dissolved oxygen concentrations below 4 mg/l. Watersheds which may be affected by low dissolved oxygen are shown in Figure 10.

Figure 10



RECOMMENDATIONS

1. **The sites impaired most by low water quality were downstream from impoundments (Patton Lake and Bradford Woods Lake). The way water is released from impoundments can adversely affect stream quality. For example, if anoxic water high in nutrients is released from the bottom of a stratified lake to a low-flow stream, aquatic life in the stream will be exposed to stressful conditions. Most pollution-sensitive forms will not be capable of living there. In such situations, it would be more beneficial to stream quality if water was released from the surface of the lake. It would be worthwhile to investigate the possibility of changing the dam outlet structures to allow this.**

2. **The Monrovia Wastewater Treatment Plant, which discharges to a tributary of Sycamore Creek upstream from site 10, does not appear to adversely affect water quality to any large degree at the present time. Good nutrient control, including phosphorus removal to less than 1 mg/l, would help prevent excessive eutrophication of Bradford Woods Lake.**

3. **Investigate the possibility of enhancing aquatic habitat in the unnamed tributary near Centerton (site 9). This would include reducing the degree of channelization and planting trees along the stream banks.**

4. **Continue to protect the good aquatic habitat of the remaining streams. Discourage channelization, prevent wholesale tree removal near stream banks, and encourage land use practices which do not add excessive silt to the stream.**

LITERATURE CITED

1. **Indiana Department of Environmental Management. 2002. Indiana 303(d) List for 2002. Office of Water Management, Indianapolis IN.**

2. **Karr, J.R. et al., 1986. Assessing biological integrity in running waters: a method and its rationale. Illinois Natural History Survey Special Publication 5, 28 pp.**

3. **Omernik, J.M. and A.L. Gallant. 1988. Ecoregions of the Upper Midwest States. U.S. EPA Environmental Research Laboratory, Corvallis, OR. EPA/600/3-88/037.**

4. **Plafkin. J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers. U.S. EPA Office of Water, Washington, D.C. EPA/444/4-89-001.**

5. **Schneider, A.F., 1966. Physiography of Indiana. In: Natural Features of Indiana. Indiana Academy of Science, Indianapolis, IN**

6. **Hilsenhoff, W.L., 1987. An improved biotic index of organic stream pollution. Great Lakes Entomologist 20:31-39.**

7. **Simon, T.P. and R. Dufour. 1997. Development of Index of Biotic Integrity expectations for the ecoregions of Indiana. V. Eastern Corn Belt Plain. U.S. Environmental Protection Agency, Region V, Environmental Services Division, Chicago, IL. EPA 905/9-96/00**

8. **Ohio EPA. 1987. Biological criteria for the protection of aquatic life: Vol. II. Users manual for biological field assessment of Ohio surface waters. Div. of Water Quality Monitoring and Assessment, Columbus, OH.**

Rapid Bioassessment Results - Macroinvertebrates

Morgan County Benthos - April 2002	DryFk1	Syc2	Syc 3	Syc4	HldCr5	Lam6	Lam7	Lam8	Trib9	
Chironomidae	68	23	16	25	56	34	65	70	42	
Tipulidae										
Tipula spp.	2		1		1				1	
Hesperoconopa spp.						3	1			
Hexatoma spp.						5			12	
Simuliidae	1	6		3	3	9		6		
Ephemeroptera										
Stenonema vicarium			11	21		2	7		2	
Stenonema femoratum			10				6	2		
Stenacron interpunctatum			2							
Heptagenia sp.				2						
Caenis amica			2							
Isonychia sicca			11			3				
Baetis amplus	1	2						8		
Baetis brunneicolor	2									
Attenella attenuata					1					
Trichoptera										
Cheumatopsyche spp			11		1		1	2		
Certatopsyche bifida			5							
Hydropsyche betteni		1		1						6
Pycnopsyche sp.			1		1					
Rhyacophila spp.	6	15	2			2				
Plecoptera										
Isoperla nana			3		3	1				
Isoperla confusa						5		1		
Isoperla duplicata								1		
Allocapnia sp.						1				
Hydroperla fugitans					23					
Amphinemura venosa	4	41	9	2	5	5	2	2		
Perlesta placida							1			
Megaloptera										
Corydalus cornutus			1							
Odonata										
Gomphus sp.			1							
Coleoptera										
Stenelmis crenata	6		1	68	3	13			8	
Stenelmis sexlineata								20		
Macronychus glabratus					1			4		
Psephenus herricki			1			12				
Gastropoda										
Physella gyrina									14	
Fossaria modicella									3	
Oligochaeta (Tubificidae)									1	
Hirudinea		1								
Amphipoda										
Hyalella azteca	4		1				2	2		
Isopoda										
Lirceus spp.	4	2							13	
Caecidotea spp.							2			
Total	100	100	100	100	100	100	100	100	100	

Morgan County Benthos - October 2002

	DryFk1	Syc2	Syc 3	Syc4	HldCr5	Lam6	Lam7	Lam8	Trib9	Mon10
Chironomidae			18	14	24	10	35	42		7
Tipulidae										
Tipula spp.		6	1		12	4	6	6		2
Antocha spp.						3				1
Simuliidae				1		3				
Ephemeroptera										
Stenonema vicarium			24	23		12			1	1
Stenonema femoratum		1	11		19	29	5			1
Stenacron interpunctatum		1	1				4	1		
Caenis amica		1			4	2	8			
Tricorythodes spp.			1	1						
Isonychia sicca		51	2		8					
Baetis flavistriga		2		1						
Baetis brunneicolor				1						
Trichoptera										
Cheumatopsyche spp		6	28	1	11	12	4	1		57
Certatopsyche bifida										
Hydropsyche betteni				1		1	11	1	3	26
Chimarra obscura		3	4							2
Megaloptera										
Corydalus cornutus		1		2		1				
Odonata								1		
Boyeria vinosa					1					
Calopteryx spp.			1				4			
Ischnura spp.							2			
Progomphus spp.								1		
Coleoptera										
Stenelmis crenata				2		1				
Stenelmis sexlineata					2				3	
Stenelmis larvae			3	74	3	8	19			2
Dubiraphia larvae			1							
Optioservus spp.		2				1	1	2		
Psephenus herricki		2			3	14				
Berosus spp.								3		
Gastropoda										
Physella gyrina			3		1		1			
Ferrissia spp.							7	6		
Pelecypoda										
Corbicula fluminea				1				29		
Oligochaeta										
Lumbriculidae							1			
Hirudinea								1		
Decapoda										
Orconectes spp.					1	1				
Amphipoda										
Hyalella azteca							1			
Isopoda										
Caecidotea spp.			2							1
Lirceus spp.								1		
Total	NO FLOW	100	100	100	100	100	100	100	DRY	100

Data Analysis for Macroinvertebrates - 4/02

METRICS

	Site # 1	2	3	4	5
# of Genera	12	7	19	5	12
Mayfly Taxa	2	2	5	1	2
Caddisfly Taxa	2	1	5	0	2
Diptera Taxa	4	4	4	4	6
% Tanytarsini	1	1	0	0	0
% Mayflies	3	13	46	2	3
% Caddisflies	7	15	20	0	2
% Tolerant Species	1	0	0	0	0
% non-Tanytarsid midges & non-insects	77	25	17	25	56
% Dominant Taxon	34	41	21	68	23

SCORING

	Site # 1	2	3	4	5
# of Genera	2	2	4	0	2
# Mayfly Taxa	2	2	4	0	2
# Caddisfly Taxa	2	0	6	0	2
# Diptera Taxa	2	2	2	2	2
% Tanytarsini	2	2	0	0	0
% Mayflies	2	4	6	2	2
% Caddisflies	2	4	6	0	0
% Tolerant Species	6	6	6	6	6
% non-Tanytarsid midges & non-insects	0	4	6	4	2
% Dominant Taxon	2	0	4	0	4
SCORE	**22**	**26**	**44**	**14**	**22**
STANDARDIZED SCORE	**37**	**43**	**73**	**23**	**37**

Data Analysis for Macroinvertebrates - 4/02

METRICS

	Site # 6	7	8	9	3-d
# of Genera	13	9	11	9	18
Mayfly Taxa	2	1	3	0	3
Caddisfly Taxa	1	1	1	1	4
Diptera Taxa	8	4	4	6	4
% Tanytarsini	0	0	0	2	1
% Mayflies	10	6	12	0	49
% Caddisflies	2	1	2	6	26
% Tolerant Species	0	2	0	28	0
% non-Tanytarsid midges & non-insects	34	69	72	73	11
% Dominant Taxon	17	32	35	21	29

SCORING

	Site # 6	7	8	9	3-d
# of Genera	2	2	2	2	4
# Mayfly Taxa	2	0	2	0	2
# Caddisfly Taxa	0	0	0	0	4
# Diptera Taxa	4	2	2	2	2
% Tanytarsini	0	0	0	2	2
% Mayflies	4	2	4	0	6
% Caddisflies	2	2	2	2	6
% Tolerant Species	6	6	6	2	6
% non-Tanytarsid midges & non-insects	4	0	0	0	6
% Dominant Taxon	6	2	2	4	4
SCORE	**30**	**16**	**20**	**14**	**44**
STANDARDIZED SCORE	**50**	**27**	**33**	**23**	**73**

Data Analysis for Macroinvertebrates - 10/02

METRICS

	Site # 1	2	3	4	5
# of Genera		12	15	11	13
Mayfly Taxa		6	5	3	3
Caddisfly Taxa		2	3	1	2
Diptera Taxa		2	4	4	4
% Tanytarsini		1	0	0	0
% Mayflies		80	38	3	43
% Caddisflies		9	33	1	12
% Tolerant Species		0	5	0	1
% non-Tanytarsid midges & non-insects		0	23	15	26
% Dominant Taxon		51	28	74	19

SCORING

	Site # 1	2	3	4	5
# of Genera		2	4	2	2
# Mayfly Taxa		4	4	2	2
# Caddisfly Taxa		2	4	2	2
# Diptera Taxa		0	2	2	2
% Tanytarsini		2	0	0	0
% Mayflies		6	6	2	6
% Caddisflies		2	6	2	4
% Tolerant Species		6	6	6	6
% non-Tanytarsid midges & non-insects		6	6	6	4
% Dominant Taxon		0	4	0	6
SCORE		30	42	24	34
STANDARDIZED SCORE	NO FLOW	50	70	40	57

Data Analysis for Macroinvertebrates - 10/02

METRICS

	Site # 6	7	8	9	10
# of Genera	14	16	14		10
Mayfly Taxa	2	3	2		2
Caddisfly Taxa	2	2	2		3
Diptera Taxa	8	4	4		6
% Tanytarsini	0	0	0		0
% Mayflies	31	17	2		2
% Caddisflies	23	5	4		83
% Tolerant Species	0	10	7		1
% non-Tanytarsid midges & non-insects	11	46	77		8
% Dominant Taxon	29	19	29		57

SCORING

	Site # 6	7	8	9	10
# of Genera	4	4	4		2
# Mayfly Taxa	2	2	2		2
# Caddisfly Taxa	2	2	2		4
# Diptera Taxa	4	2	2		2
% Tanytarsini	0	0	0		0
% Mayflies	6	4	2		2
% Caddisflies	6	2	2		6
% Tolerant Species	6	6	6		6
% non-Tanytarsid midges & non-insects	6	2	0		6
% Dominant Taxon	4	6	4		0
SCORE	40	30	24		30
STANDARDIZED SCORE	67	50	40		50

DRY

Habitat Evaluation Breakdown

	Site Number									
	1	2	3	4	5	6	7	8	9	10
SUBSTRATE	12	12	12	12	8	12	12	10	6	12
COVER	6	8	8	9	8	8	9	8	5	8
CHANNEL	13	13	12	13	13	13	14	12	7	12
RIPARIAN	8	13	18	18	12	14	17	12	5	12
POOL/RIFFLE	2	10	12	12	10	11	11	12	2	11
GRADIENT	8	6	10	4	8	8	8	6	8	6
DRAINAGE AREA	6	6	8	8	6	8	8	9	6	6
TOTAL	55	68	80	76	65	74	79	69	39	67

The sites with the two lowest habitat scores (1 and 9) became nearly or completely dry during the October 2002 sampling period.

BIOASSESSMENT SUMMARY

Lambs, Sycamore, and Highland Creeks Morgan County, Indiana

Purpose

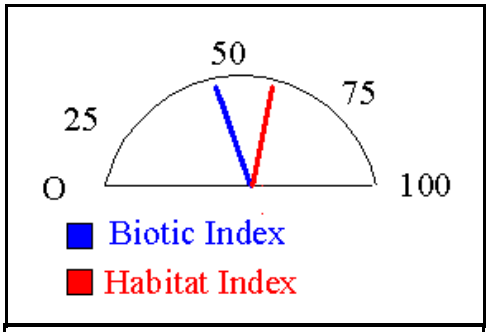
To measure the ecological integrity of Lambs, Sycamore and Highland Creeks in Morgan County, Indiana. A bioassessment technique was employed. Bioassessment uses knowledge of the biology of stream-dwelling animals to measure stream health.

Watershed Characteristics

The watershed is primarily forested. Residential use is rapidly increasing.

Results

Water quality and habitat are among the best in Indiana at one site. Other sites are affected by degraded water quality or habitat. Water quality problems include excessive nutrients and low dissolved oxygen.



Watershed Gauge
A score of 100 is our goal

Recommendations

Sites downstream from lakes have the most severe water quality impacts. Work with lakes associations to re-design dams to release surface water. Protect stream channels and stream bank vegetation.

Commonwealth Biomonitoring, Inc.
8061 Windham Lake Drive
Indianapolis, IN 46214
317-297-7713
www.biomonitor.com

Date: April and October 2002

Appendix B: Water Quality Data Collection Explanation and Results

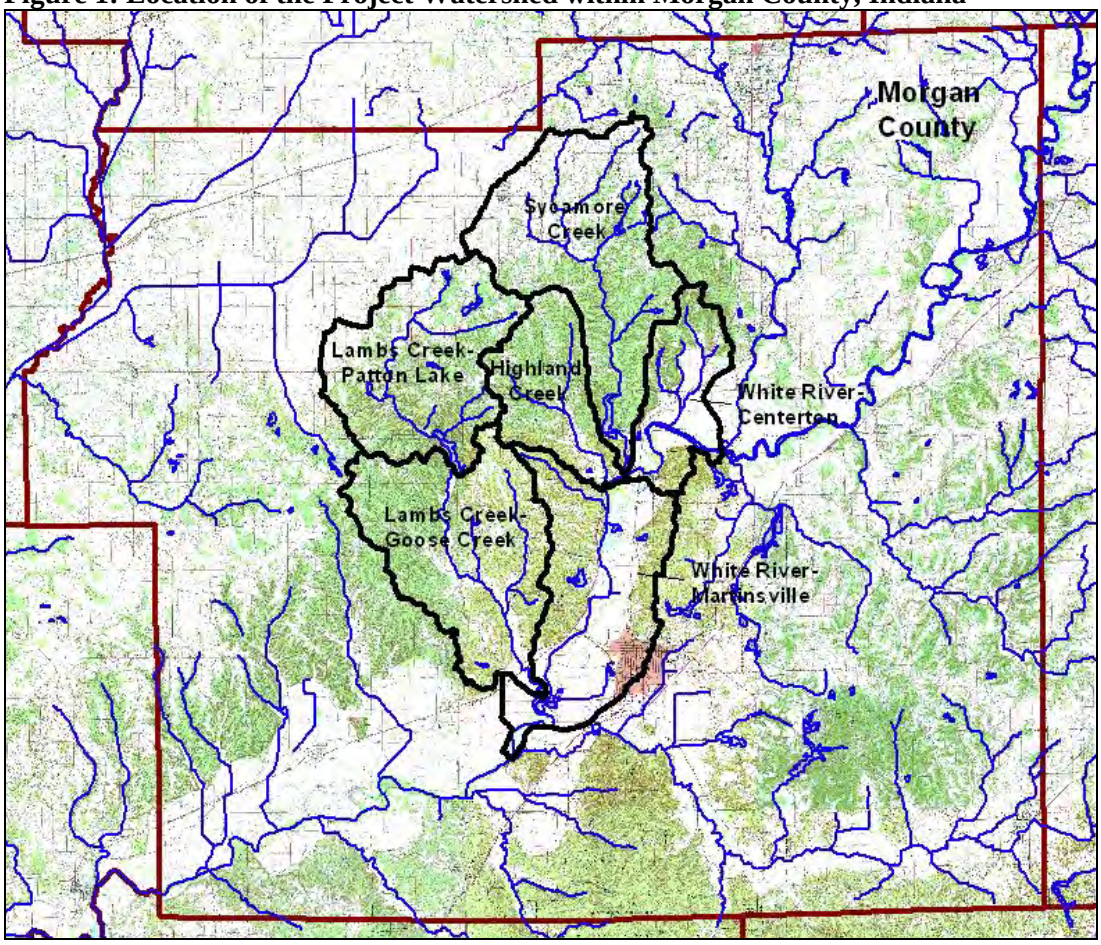
Morgan County Watershed Initiative - Water Quality Assessment Project

Project Description

The West Central Morgan County White River Watershed (HUC 05120201160), a watershed within the larger West Fork White River Basin (HUC 05120201), is located completely within Morgan County, Indiana (**Figure 1**). Drainage from the three major tributaries within this 11-digit HUC watershed (Lambs Creek, Sycamore Creek and Highland Creek) discharges directly into the West Fork of the White River.

Like many waterbodies in the White River Basin, streams within this Morgan County watershed have suffered from the impact of both agriculture and urbanization. Although land uses predominately consist of deciduous forest, future growth and development in and around the Cities of Martinsville, Mooresville and Monrovia, as well as along the SR 67 corridor could potentially increase pollutant loads and storm water runoff volumes in the watershed. Concerns identified in IDEM's 2000 Unified Watershed Assessment regarding the density of septic systems and the 1998 303(d) listings for Lamb's Creek (*E. coli*.) were perceived to be indicative of problems with failing septic systems, agriculture, and wildlife within the watershed. Several of these suspected problems could be exacerbated with increased development pressures.

Figure 1: Location of the Project Watershed within Morgan County, Indiana



In an effort to better identify pollutant problems and to prioritize areas for pollutant reduction or mitigation efforts, the Morgan County Watershed Initiative (MCWI) contracted with Goode & Associates, Inc. to conduct a water quality monitoring program as described in this document. Monitoring results were used to assist in identifying broad, watershed-wide water quality problems and in developing this watershed management plan.

Project Objectives

The goal of the project was to document the physical, biological and chemical conditions of the watershed from which a watershed management plan could be developed. Data collected by the project was used to make broad management decisions on a watershed scale. More specifically, data collected by the study was compared to concentration based water quality standards to identify "hot spots" in the watershed where water quality standards are not being met; to suggest appropriate Best Management Practices (BMPs) to curb current ecological degradation in the watershed; and to guide future development in the watershed while maintaining its ecological health. The data collected during this study will also serve as baseline data to track changes in conditions of the watershed. Additionally, the data may be used as baseline data to track the success of any restoration efforts undertaken as a result of the management plan.

Project goals were accomplished by:

- Documenting the physical conditions of the watershed such as land use, soils, and stream habitat.
- Collecting and analyzing water quality and biological data.
- Developing a watershed management plan that addresses any water quality impairments identified via project monitoring.

To achieve the goal of evaluating and ranking "hot spots" in the watershed relative to one another and thus assisting the prioritization of management efforts, emphasis was placed on maintaining standard procedures at each water quality sampling station. Consistencies in protocol ensured sampling stations could be compared to one another, enabling the Project Manager to determine which sites were most degraded relative to others in the watershed.

Project Monitoring Sites

Water chemistry monitoring sites were selected to achieve a representation of each major tributary within the watershed; however, sites were not located within sub-watersheds that were primarily representative of the main stem of the White River. It was determined that the IDEM Water Assessment Branch maintains a fixed monitoring station on the White River within the watershed that is monitored on a monthly basis. In addition, samples collected from IDEM's Fixed Station Program are analyzed by the same laboratory that was used for this project (Indiana State Department of Health Laboratory). As a result, the main stem of the White River is adequately monitored and the data is of a public nature such that the information should be available, comparable, and usable for this project.

Preliminary selection for chemical monitoring sites was based on map analysis. This analysis consisted of locating major tributaries that also have access points (road crossings). This approach attempts to establish sampling stations in various subwatersheds to determine which streams are contributing the most pollutants. The sampling stations that were selected based on map analysis were then field checked by the Project Manager for verification of site accessibility. Following the field inspection, 9 sampling stations were selected.

Sampling stations were presented to the technical sub-committee of the MCWI's steering committee. Input from the sub-

committee and Project Manager narrowed the potential locations to seven sites. The locations of these sites are shown in **Figure 2**. Narrative descriptions of these sites are included in **Table 1**. Landowners at these sampling stations were contacted to obtain permission to conduct sampling in those areas.

Figure 2: Chemical Monitoring Sites

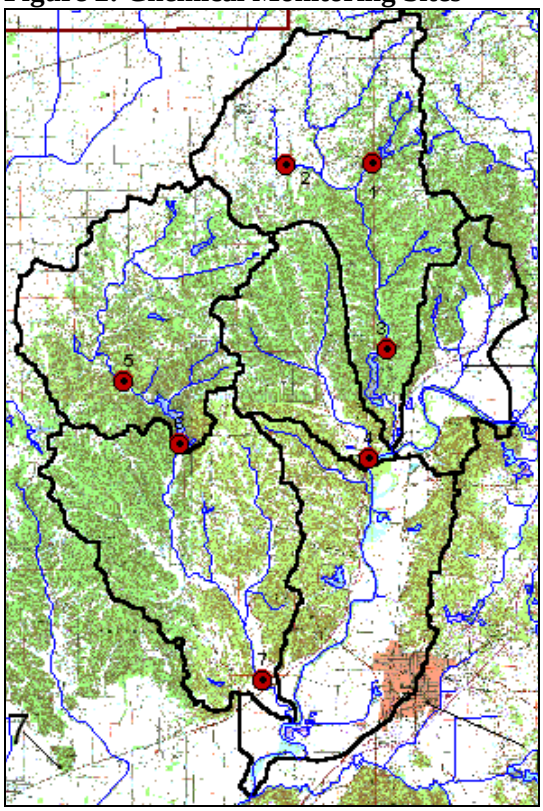


Table 1: Narrative Description of Chemical Monitoring Sites

Site #:	Waterbody Name	Location
Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North
Site 2	Sycamore Creek	CR 950 North
Site 3	Sycamore Creek	Robb Hill Road
Site 4	Highland Creek	SR 67
Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road
Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road
Site 7	Lambs Creek	SR 67

Water quality parameters sampled include pH, temperature, dissolved oxygen, turbidity, specific conductance, *E. coli*, total kjeldahl nitrogen (TKN), total phosphorous, and total organic carbon (TOC). PH, temperature, and dissolved oxygen were analyzed in the field with field equipment. Indiana State Board of Health Laboratory in Indianapolis, Indiana analyzed the remaining parameters at their laboratory.

Sampling Design

Chemical monitoring was conducted on a monthly basis throughout the course of the study. This timing allowed the data to be consistent and comparable with the IDEM's fixed station data being collected within the watershed. Collection of water quality data under this design provided an overview of water quality in the watershed under varying conditions and was sufficient for accomplishing the goals of the water quality monitoring program outlined in the project objectives. The water quality sampling schedule was flexible to prevent sampling during inappropriate weather or when equipment was not working.

Although the MCWI contracted with Goode & Associates to conduct water quality monitoring on a monthly basis from January 2002 through March 2003, the timeline for development of the watershed plan required that an evaluation of the data occur prior to full completion of the monitoring contract. Consequently, all observations discussed in this report reflect one year of water quality monitoring data collected from January 2002 through January 2003 (Samples were

not collected in June 2002 due to logistical problems).

Goode & Associates collected water quality samples from the sampling sites in the Morgan County watershed on a monthly basis during the study period. Samples were typically collected on the last Wednesday of every month, where feasible, however, this schedule was altered on several occasions to accommodate logistical problems. These monitoring dates are listed in **Table 2**.

Table 2: Chemical Monitoring Dates/ Streamflow Conditions

Monitoring Date	Streamflow Condition
January 23, 2002	Dry
February 27, 2002	Wet
March 27, 2002	Wet
April 30, 2002	Wet
May 30, 2002	Wet
July 31, 2002	Dry
August 28, 2002	Dry
September 30, 2002	Wet
October 30, 2002	Wet
November 26, 2002	Dry
December 30, 2002	Dry
January 31, 2003	Dry

As a result of the consistent monthly monitoring regime, chemical monitoring data collected for this project is considered to be representative of the variety of stream flow conditions experienced in the watershed during the study period, including both dry and wet weather events. Stream flow conditions during any given sampling event are determined by comparing the measured stream flow at a nearby USGS stream discharge monitoring station to the median daily streamflow for the period of record. The following two USGS gauging stations were used to evaluate streamflow conditions:

- USGS 03353800 – White Lick Creek at Mooresville, Indiana
- USGS 03354000 – White River near Centerton, Indiana

Graphs illustrating the daily mean (average) discharges for these USGS gauging stations during the project period are depicted in **Figures 3 and 4**.

The sampling crew collected water at each site in sterile, pre-preserved sample containers, where applicable, supplied by the Morgan County Health Department. Samples were delivered to the Indiana State Department of Health (ISDH) where laboratory analysis was conducted in accordance with the Quality Assurance Project Plan (QAPP) developed for this project (ARN: A305-1-00-216). The QAPP is available on file at the Indiana Department of Environmental Management.

Figure 3: Mean daily discharge for White Lick Creek at Mooresville, Indiana (January 2002 – March 2003)

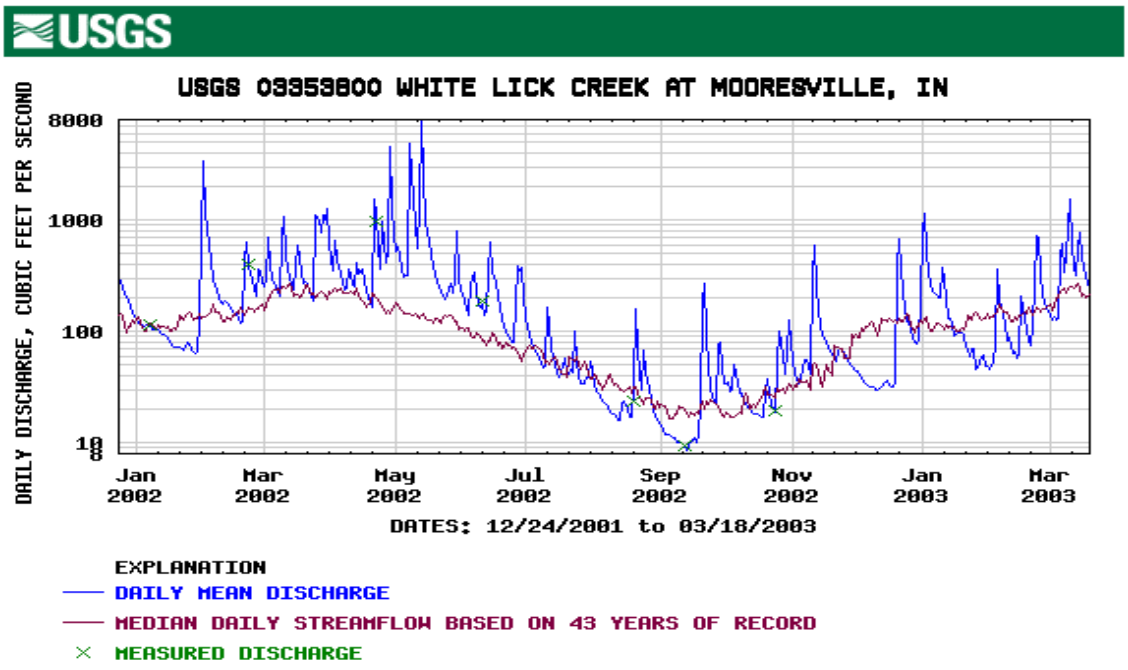
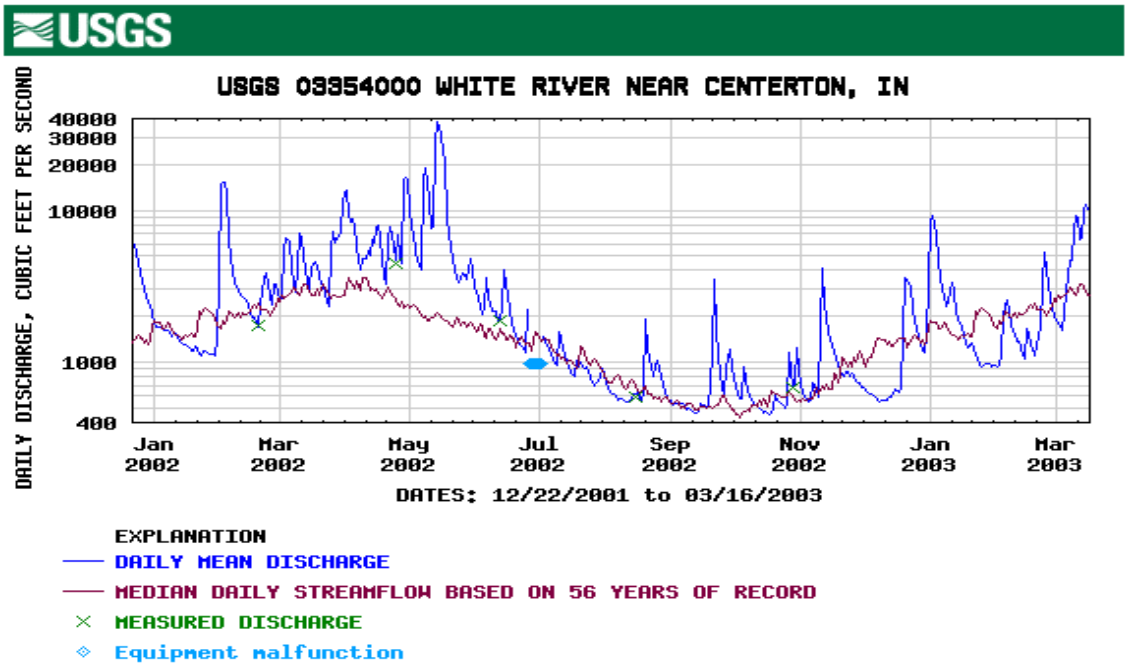


Figure 3: Mean daily discharge for White River near Centerton, Indiana (January 2002 – March 2003)



Water Quality Monitoring Results

Introduction

In most cases, water quality monitoring projects are initiated to document the present condition of a given lake, river, or stream with the expressed intent of understanding how those conditions are positively or negatively affecting the designated uses of the waterbody, i.e. swimming, fishing, or boating. Once an understanding of the waterbody's condition is realized, monitoring results can then be interpreted to help water resource managers better understand the causes and sources of these conditions so that they can make decisions regarding the proper management of the waterbody. By either maintaining, implementing, or mitigating land use practices that are having an impact on water quality, water resource managers have the ability to modify the factors contributing to the conditions of the waterbody.

Although very limited in size, scope and budget, the water quality monitoring completed for this project provides some insights regarding the existing conditions of several small watersheds in the west central portion of Morgan County, Indiana. The purposes of this report is to discuss the water quality monitoring results collected for this project, and when appropriate, discuss the causes and sources of the conditions of the streams within these watersheds.

Evaluating Water Quality Pollutants

A number of substances including bacteria, nutrients, oxygen demanding wastes, metals, and toxic substances, cause water pollution. Causes of pollution refer to the substances that enter surface waters that result in water quality degradation and impairment. Sources of these pollution causing substances are divided into two broad categories: point sources and nonpoint sources (IDEM, 2002). Point and nonpoint sources of pollution are described as follows:

Point sources of pollution refer to discharges that enter surface waters through a pipe, ditch or other well defined point of discharge. The term applies to wastewater and storm water discharges from a variety of sources. Wastewater point source discharges include municipal (city, town, and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems that may serve schools, commercial offices, residential subdivisions and individual homes. Storm water point source discharges include storm water discharges associated with industrial activities and storm water discharges from municipal separate storm sewer (MS4s) systems for municipalities that meet the requirements of 327 IAC 15-13.

The primary pollutants associated with point source discharges are bacteria, oxygen demanding wastes, nutrients, sediment, color and toxic substances including chlorine, ammonia and metals. Point source dischargers in Indiana must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state. Discharge permits are issued under the NPDES program (See Appendix A), which is delegated to Indiana by the US Environmental Protection Agency (EPA).

Nonpoint sources of pollution refer to discharges of runoff that enter surface waters from storm water runoff, contaminated ground water, snowmelt or atmospheric deposition. There are many types of land use activities that can serve as sources of nonpoint source pollution including land development, construction, mining operations, crop production, animal feeding lots, timber harvesting, failing septic systems, landfills, roads and paved areas, and wildlife.

Sediment and nutrients are major pollution causing substances associated with nonpoint source pollution. Others pollutants can

include *E. coli* bacteria, heavy metals, pesticides, oil and grease, and any other substance that may be washed off the ground or removed from the atmosphere and carried into surface waters. Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur at random depending on rainfall events.

Types of Pollution

Causes of pollution refer to the substances that enter surface waters from point and nonpoint sources and result in water quality degradation and impairment. Major causes of water quality impairment include *E. coli* bacteria, biochemical oxygen demand (BOD), nutrients, and toxicants (such as polychlorinated biphenyls [PCBs] and ammonia). The following discussion provides a general overview of causes of impairment and the activities that may lead to their introduction into surface waters (IDEM, 2002).

Bacteria

E.coli bacteria are associated with the intestinal tract of warm-blooded animals. Although not a pollutant in itself, *E.coli* is widely used as an indicator of sewage pollution, which may harbor additional waterborne disease causing (pathogenic) bacteria, protozoa, and viruses. *E.coli* is also used as an indicator because it is easier and less costly to monitor and detect than the actual pathogenic organisms, such as *Giardia*, *Cryptosporidium*, and *Shigella*, which require special sampling protocols and very sophisticated laboratory techniques. The presence of these waterborne disease-causing organisms can cause outbreaks of diseases, such as typhoid fever, dysentery, cholera, and cryptosporidiosis.

Water quality standards (WQS) for *E.coli* bacteria have been established in order to ensure safe use of waters for drinking water and recreation. 327 IAC 2-1-6 Section 6(d) states that *E.coli* bacteria, using membrane filter count (MF), shall not exceed 125 per 100 milliliters as a geometric mean based on not less than five samples equally spaced over a 30 day period nor exceed 235 per 100 milliliters in any one sample in a 30 day period.

E.coli bacteria may enter surface waters from nonpoint source runoff from failing septic systems, straight pipe discharges from septic tanks, livestock, domestic pets, and wildlife. In addition, *E.coli* can also come from improperly treated discharges of domestic wastewater. Common sources of *E.coli* bacteria include leaking or failing septic systems, direct septic discharge, leaking sewer lines or pump station overflows, runoff from livestock operations, urban storm water and wildlife. *E.coli* bacteria in treatment plant effluent are controlled through disinfection methods including chlorination, ozonation or ultraviolet light radiation.

E.coli monitoring by the IDEM in the Lambs Creek watershed identified several locations where the WQS for *E.coli* was violated during 1996. Lamb's Creek is listed as impaired by *E.coli* on the 2002 Indiana 303(d) list. These stream segments are scheduled for TMDL development from 2003-2005.

In addition to the IDEM's monitoring data, water quality monitoring conducted for this project confirmed the presence of ongoing *E.coli* violations at several locations on Lamb's Creek. Violations of the *E.coli* water quality standard were also detected at monitoring sites on Sycamore Creek and Highland Creek (see **Graph 1**).

Monitoring locations were prioritized according to the level of impairment, which was judged by the percentage of exceeedances of the *E.coli* water quality standard at each site (**Table 3**). In most cases, the percentage method of prioritizing sites is appropriate for identifying stream segments with the most need for mitigation; however, this ranking is independent of the results from other parameters.

Graph 1: *E.coli* Sampling Results, 2002 - 2003

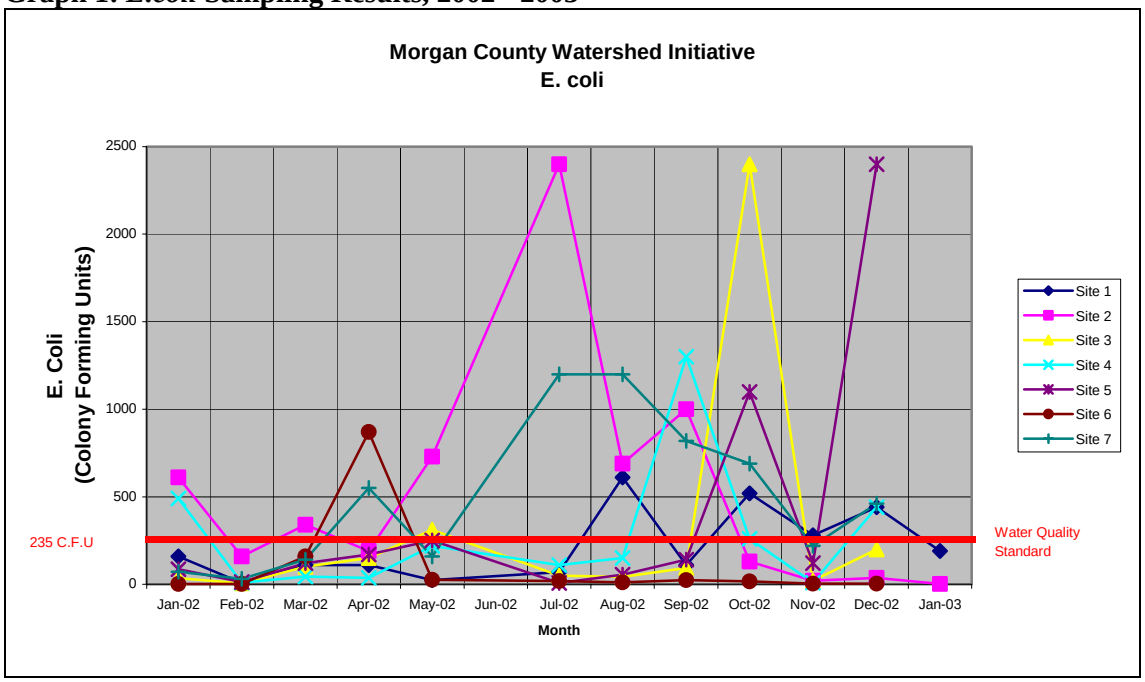


Table 3. E.coli Monitoring Results (Average and Median) in Colony Forming Units (CFUs); Percentage of Samples Exceeding Water Quality Standards (WQS) of 235 CFU; Priority Ranking of Sites (1 = Least Impaired, 6 = Most Impaired)

Site #	Average CFU	Median CFU	% of Samples Exceeding WQS	*Priority Ranking
Site # 1	219.08	135	33%	**3**
Site # 2	525.67	265	50%	**5**
Site # 3	309.55	93	18%	**2**
Site # 4	279.27	150	33%	**4**
Site # 5	405.45	120	27%	**3**
Site # 6	95.33	14.5	9%	**1**
Site # 7	504	460	55%	**6**

Site 2 (Sycamore Creek downstream of Monrovia) and Site 7 (Lower Lamb's Creek) would be considered the most impacted sites for *E.coli* within the project area. Site 1 (Sycamore Creek below Hart Lake), Site 4 (Highland Creek) and Site 5 (Lamb's Creek upstream of Patton Lake) also experienced frequent periods of impairment from *E.coli*. Site 3 (Sycamore Creek) and Site 6 (Lamb's Creek downstream of Patton Lake) had minor problems with *E.coli*.

The sources of E.coli at Site 2 likely originate from the Town of Monrovia from either domestic wildlife, failing septic systems, or inadequate wastewater treatment at Monrovia Middle School or the municipal wastewater treatment plant. Monitoring conducted for this project was not of sufficient detail to distinguish between these potential sources.

The sources of E.coli at Site 7 likely originate from cattle livestock operations immediately upstream of the monitoring site

and/or failing septic systems as far upstream as Patton Lake.

The sources of E.coli at Site 1 are most likely associated with native wildlife and/or failing septic systems.

The sources of *E.coli* present Site 4 and Site 5 were not readily apparent; however, both sites had stream habitat conditions that were observed to be somewhat degraded or stagnant due to the presence of several beaver dams within the monitored stream reach, possibly suggesting wildlife contributions of *E.coli*. Land use observations indicate that the drainage area upstream of Site 4 consists of small bottomland farms practicing row crop agriculture within the subwatershed that could support small quantities of livestock and/or failing septic systems that may also be contributing to the *E.coli* violations observed at this site.

Oxygen Consuming Wastes

Since maintaining sufficient levels of dissolved oxygen in a waterbody is critical to the survival of most forms of aquatic life, evaluating oxygen-consuming wastes in a river or stream is central to diagnosing the health of a river system or watershed. Pollutants associated with oxygen consuming wastes are typically composed of either decomposing organic matter or chemicals that bind with available instream oxygen to reduce the available concentrations of dissolved oxygen in the water column. Organic causes of oxygen consuming wastes are measured as biochemical oxygen demand (BOD) and chemical causes of oxygen consuming wastes are measured as chemical oxygen demand (COD); however, the concentration of dissolved oxygen in a waterbody is used as a common indicator of the general health of an aquatic ecosystem.

327 IAC Section 6 (b)(3) states that concentrations of dissolved oxygen shall average at least five milligrams per liter per calendar day and shall not be less than four milligrams per liter at any time. Dissolved oxygen concentrations are affected by a number of factors. Physical conditions, such as lower water temperatures generally allow for retention of higher dissolved oxygen (DO) concentrations. In addition, higher dissolved oxygen concentrations can be naturally or artificially produced by turbulent actions, such as by instream riffles or by the cascading effect of a waterbody spilling over a dam, which inject air into surface waters. Low dissolved oxygen levels tend to occur more often in warmer, slow moving waters. In general, the lowest dissolved oxygen concentrations occur during the warmest summer months and particularly during periods of low stream flow.

Violations of the water quality standard for dissolved oxygen were detected at monitoring sites on Highland Creek and Lamb's Creek (see **Graph 2**).

As illustrated in **Table 4**, monitoring locations were prioritized according to the level of impairment, which was judged by the percentage of exceedances of the dissolved oxygen water quality standard at each site. For sites without violations, rankings are based on which sites maintained the highest average dissolved oxygen results. Note: This ranking is independent of the results from other parameters.

Monitoring results indicate that Site 4 (Highland Creek) and Site #6 (Lambs Creek downstream of Patton Lake) experienced the lowest dissolved oxygen levels of the seven sampling locations.

Graph 2: Dissolved Oxygen (DO) Results, 2002 – 2003

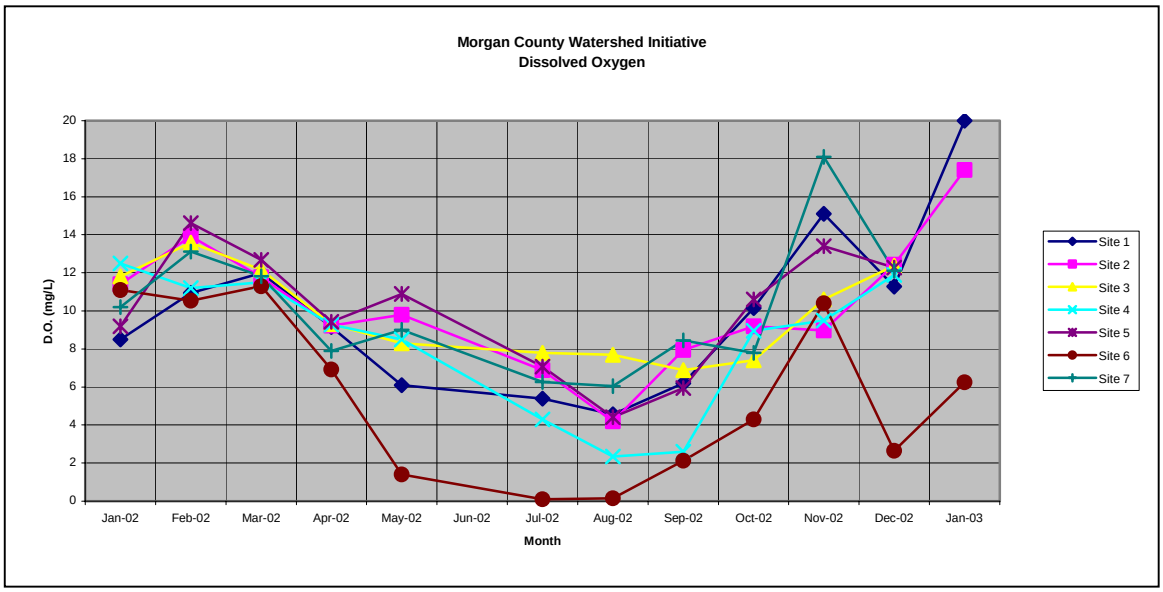


Table 4. Dissolved Oxygen Monitoring Results (Average and Median) in Milligrams per Liter (Mg/L); Percentage of Samples Exceeding Water Quality Standards (WQS) of 4 Mg/L; Priority Ranking of Sites (1 = Least Impaired, 6 = Most Impaired)

Site #	Average Mg/L	Median Mg/L	% of Samples Exceeding WQS	*Priority Ranking
Site # 1	10.0	9.7	0%	**3**
Site # 2	10.6	9.5	0%	**1**
Site # 3	9.8	9.3	0%	**4**
Site # 4	8.4	9.3	18%	**5**
Site # 5	10.1	10.6	0%	**2**
Site # 6	5.7	5.3	42%	**6**
Site # 7	10.1	9.0	0%	**2**

The causes of low dissolved oxygen at Site 4 were likely due to the degraded stream habitat conditions and stagnant water from the presence of several beaver dams within the monitored stream reach. Failing septic systems within the subwatershed may also be contributing organic waste to the stream that can bind oxygen as it decays.

An additional cause of low dissolved oxygen concentrations during the warmer months of the year may be diurnal fluctuations of oxygen in the water column due to conditions of nutrient enrichment. Monitoring detected the presence of elevated concentrations of nutrients (phosphorus and TKN) in sufficient quantities to support an overabundance of algae growth within the stream. Although the process of photosynthesis in the algae produces a large volume of oxygen during periods of daylight, respiration by algae during the nighttime hours absorbs more oxygen than the water column can maintain, resulting in times when dissolved oxygen concentrations are significantly reduced or depleted. This situation can be intensified in hot weather and low flow conditions due to the reduced capacity of water to retain dissolved oxygen.

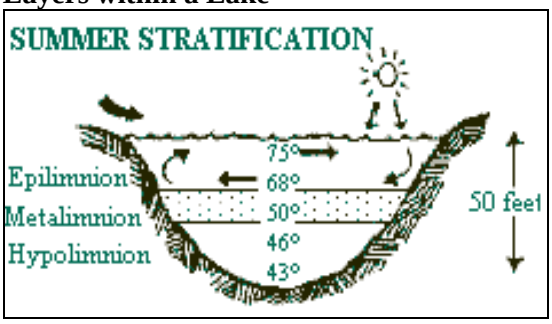
The cause of low dissolved oxygen at Site 6 is due to the anoxic (lacking oxygen) condition of the discharge from the bottom of Patton Lake. Water quality in a lake can be affected by how much of the water mixes. Lake depth, size, and shape all are factors that influence mixing and the stratification process. Since water density peaks at 39 Degrees Fahrenheit, water at that temperature is the heaviest and will move to the bottom of the lake. Any water above or below this temperature will be lighter and move up in the water column. Density variations due to temperature differences can prevent warm and cold water from mixing.

In early spring when ice melts, the temperature and density of the water in the lake will be relatively the same from top to bottom. This allows all of the water to mix together, where the cold water from the bottom will move towards the surface, and the warmer surface water is mixed downward. Nutrients that were in the bottom sediments are brought up in the water column, and the cold water is replenished with oxygen. In the process the water becomes uniform in nearly all respects, including temperature, density, dissolved oxygen content, and nutrients. This phenomenon is referred to as the spring overturn. Later in the spring, the water nearest the surface warms and loses density. This leads to distinct temperature layers in the lake. This layering effect is called stratification. The cooler temperature of the discharge from Patton Lake at Site 6 is illustrated in **Graph 3**.

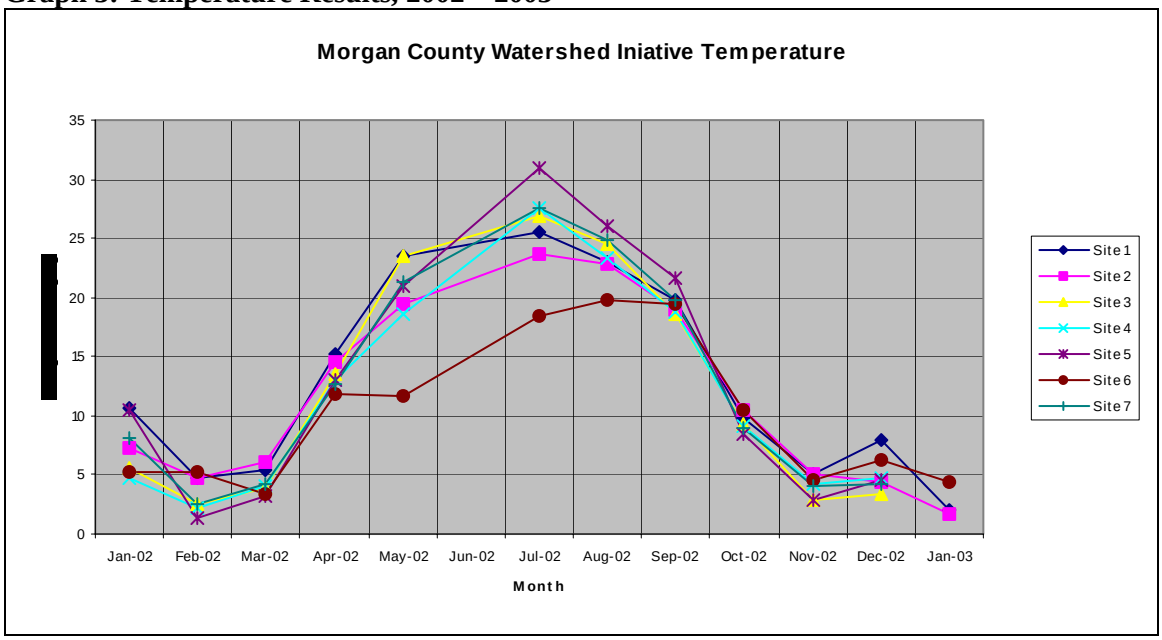
There are three layers in a stratified lake: the epilimnion, metalimnion, and hypolimnion (see **Figure 4**). The epilimnion is the layer nearest the surface, and also the warmest layer. The middle layer is called the metalimnion. The metalimnion contains the thermocline, which is the depth at which the water stops mixing, and a sharp temperature decline results. The metalimnion is the transition zone between the warm surface waters that mix, and the unmixed cold water of the bottom layer, or hypolimnion.

In stratification, the hypolimnion traps nutrients released from bottom sediments from being mixed throughout the lake. Eventually, as the lake has been stratified for long enough, all of the oxygen in the hypolimnion gets used up in respiration by small organisms, plants, or fish. This condition is called anoxia (oxygen depletion). Eutrophic lakes are particularly susceptible to oxygen depletion (anoxia) in the hypolimnion.

Figure 4: Example of Stratification Layers within a Lake



Graph 3: Temperature Results, 2002 – 2003



Toxic Substances

327 IAC 2-1-9(45) identifies toxic substances as substances that are or may become harmful to plant or animal life, or to food chains when present in sufficient concentrations or combinations. Toxic substances include those pollutants identified as toxic under Section 307 (a)(1) of the Clean Water Act. Indiana's standards for individual toxic substances are listed in 327 IAC 2-1-6. Toxic substances frequently encountered include chlorine, ammonia, organic pollutants, heavy metals, and pH. These substances can be toxic to aquatic organisms and their effects may be evident immediately or may only be manifested after long-term exposure or accumulation in living tissue (IDEM, 2002).

Whole effluent toxicity testing is required for major NPDES dischargers (discharge over 1 million gallons per day or population greater than 10,000). This test shows if the effluent from a treatment plant is toxic, but it does not identify the specific cause of toxicity. If the effluent is found to be toxic, further testing is done to determine the specific cause. Other testing, or monitoring, done to detect a toxicity problem includes fish tissue analyses, chemical water quality sampling, and biological monitoring.

Polychlorinated biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) were first created in 1881 and subsequently began to be commercially manufactured around 1929 (Bunce, 1994). Because of their fire-resistant and insulating properties, PCBs were widely used in transformers, capacitors, and in hydraulic and heat transfer systems. In addition, PCBs were used in products such as plasticizers, rubber, ink, and wax. In 1966, PCBs were first detected in wildlife, and were soon found to be ubiquitous in the environment (Bunce, 1994). PCBs entered the environment through unregulated disposal of products such as waste oils, transformers, capacitors, sealants, paints, and carbonless copy paper. In 1977, production of PCBs in North America was halted. Subsequently, PCB contamination present in our surface waters and environment today is the result of historical waste disposal practices (IDEM, 2002).

Although there are no waterbodies within the project watershed specifically listed for PCB contamination, there is a statewide fish consumption advisory for carp greater than 15 inches in length.

Nutrients

The term "nutrients" primarily refers to the two major plant macronutrients, phosphorus and nitrogen. These nutrients are common components of fertilizers, animal and human wastes, vegetation, and some industrial processes. Nutrients in surface waters come from both point and nonpoint sources. Nutrients are beneficial to aquatic life in small amounts. However, in over abundance and under certain conditions, they can stimulate the occurrence of algal blooms and excessive plant growth in quiet waters or low flow conditions. Algae blooms and excessive plant growth often reduce the dissolved oxygen content of surface waters through plant respiration and the decomposition of dead algae and other plants (IDEM, 2002).

Phosphorus

Nonpoint source discharges are the major sources of phosphorus in most watersheds. Phosphorus can be present as organic matter (living or dead organisms and excreted organic material) and can be either dissolved or suspended in the water column. Phosphorus may also occur in inorganic compounds released from various minerals, fertilizers or detergents that may also be either dissolved or suspended in the water column. Phosphorus is the primary nutrient associated with production of algae and macrophytes (rooted aquatic plants) in waterbodies, as it is generally the nutrient in shortest supply in aquatic systems (Phillips et al, 2000).

Elevated phosphorus concentrations are a cause of pollution in the project watershed. In the absence of a specific surface water quality standard for phosphorus, results from 2002 monitoring project were compared to the results of a statistically based study of the West Fork White River Basin study completed by the IDEM in 1998. The "*1996 Probabilistic Monitoring Program Assessment of the West Fork White River and the Patoka River Basins*" was a probabilistic monitoring study that consisted of a one-time sampling of 27 randomly chosen sites within the West Fork White River watershed designed to gain an understanding of ambient water quality during low flow conditions in the basin. The data from this study were statistically evaluated to create a classification metric based on quartile ranges (IDEM, 1998). The classifications were high, upper ambient, ambient, lower ambient, and low and summary statistics were developed appropriate for establishing metrics for each eight digit HUC watershed within the basin, as well as for the compiled dataset from all seven eight digit HUC watersheds.

In order to best evaluate the phosphorus data collected during this monitoring project, 2002 monitoring results were compared to the summary statistics and classification metrics from the IDEM's 1996 study. An evaluation of the 1996 study's summary statistics indicated that the average concentration of phosphorus for samples collected in the West Fork White River watershed was 0.23 mg/L, while the median concentration of phosphorus was 0.14 mg/L. Concentrations of phosphorus exceeding 0.20 mg/L were considered to be significantly elevated, while concentrations of phosphorus exceeding 0.26 mg/L were considered to be "high".

A comparison of project monitoring results to the mean and median values observed in 1996 reveals that two stream reaches, Site 1 (Sycamore Creek downstream of Hart Lake) and Site 6 (Lamb's Creek downstream of Patton Lake), had monitoring results that exceeded the "high" classification metric from the IDEM's 1996 study (see **Graph 4**).

The sources of phosphorus at both Site 1 and Site 6 seem to be tied to the presence of man-made lakes or impoundments in each of the subwatersheds. Phosphorus is mainly

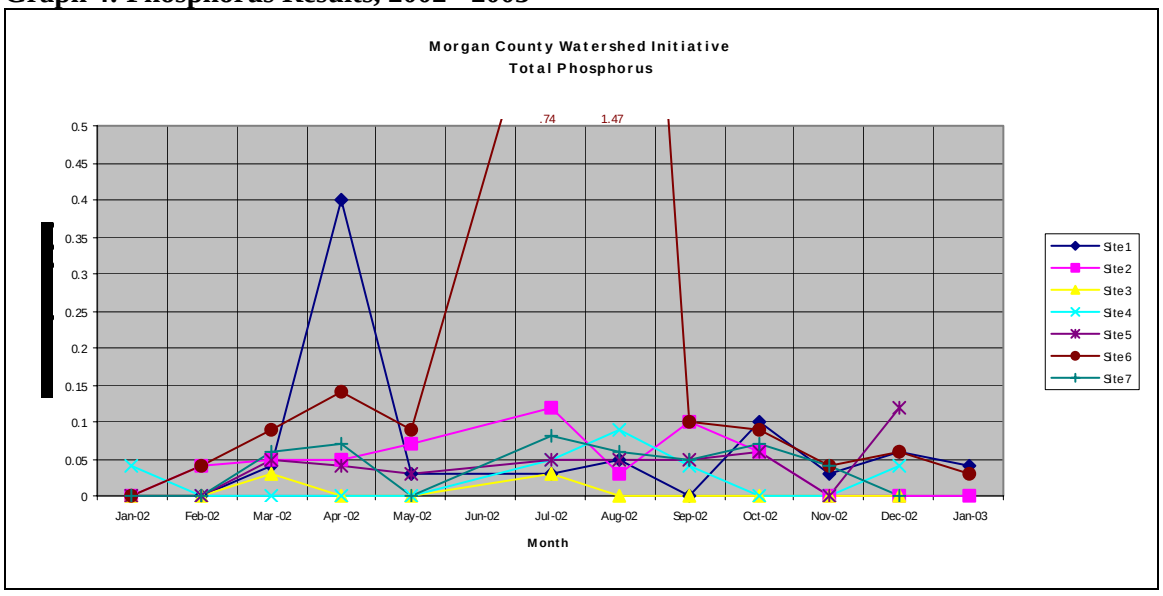
introduced to lakes through human activities. Farmland runoff, lawn fertilizers, soil erosion due to construction, sewage from failing septic systems, animal waste, and detergents all account for excess phosphorus entering a lake system. Once phosphorus enters a lake, it may take a long time until it moves out of the lake system. Phosphorus migration depends on the retention time of the lake. Usually after a heavy rainfall, a eutrophic lake will exhibit an algae bloom due to increased phosphorus amount in the lake due to the above reasons.

Phosphorus is by far the most important nutrient in most lakes. Elevated concentrations of phosphorus can promote excessive aquatic plant growth. Phosphorus is rapidly recycled and changes from dissolved to particulate form easily as illustrated in **Figure 5**. Dissolved phosphorus can be used by phytoplankton (floating algae) and macrophytes to grow. Also, once living organisms within a lake die (plants and animals), they sink to the bottom and their phosphorus again becomes unavailable.

In deep stratified lakes there is a limited replenishment of phosphate in surface waters and the quantity of "available" phosphorus in late winter may determine the level of phytoplankton growth that can develop in the summer. Intensive algal growth in spring usually depletes phosphate to levels in the surface waters. Hence, phytoplankton growth during the summer usually occurs shortly after inputs of phosphorus from storm water runoff. Direct sediment resupply is also important during the summer.

Rooted aquatic plants often obtain large quantities of phosphorus from the sediments and can release large amounts into the water. When phosphate levels are low in surface waters, phytoplankton excrete extracellular enzymes called *alkaline phosphatases*, which have the ability to free phosphate bound to organic molecules. Since phosphate is readily adsorbed by soil particles and does not move easily with groundwater, high inflows of total phosphorus are typically due to re-suspension of phosphorus bearing sediments during spring and winter turnovers.

Graph 4: Phosphorus Results, 2002 - 2003

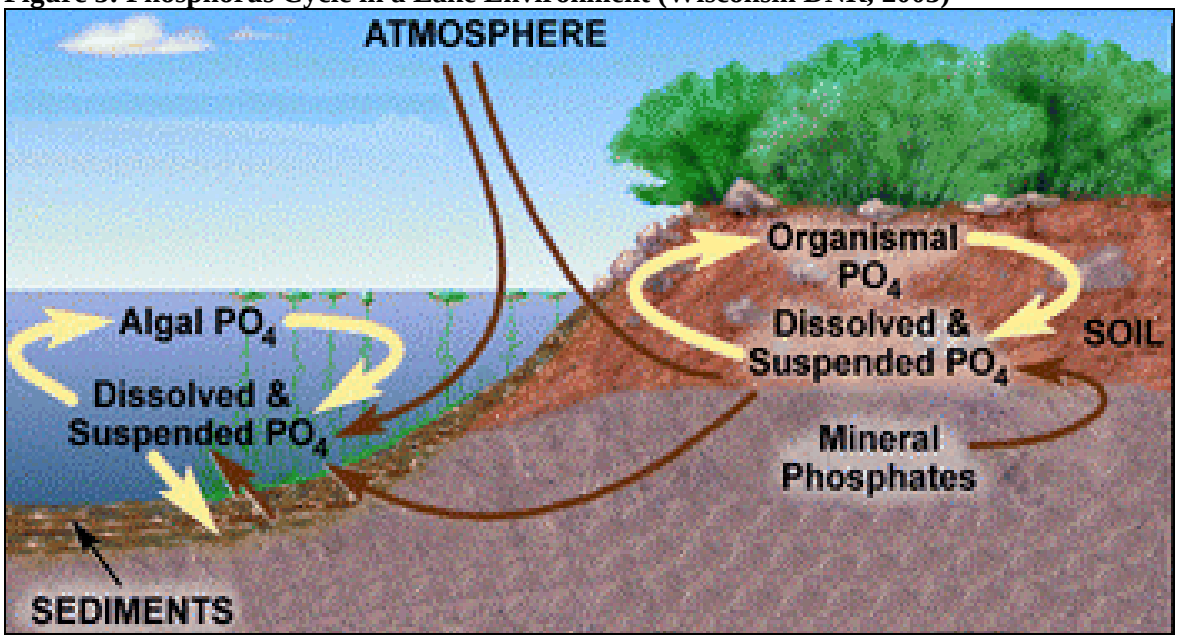


As illustrated in **Table 5**, monitoring locations were prioritized according to the level of phosphorus impairment, which was judged by the percentage of exeeedances of the "High" classification metric as compared to the IDEM's 1996 study of the West Fork White River. For sites without exceedances of the high classification, rankings are based on which sites maintained the average phosphorus results. Note: This ranking is independent of the results from other parameters.

Table 5. Phosphorus Monitoring Results (Average and Median) in Milligrams per Liter (Mg/L); Percentage of Samples Exceeding the IDEM's 1996 "High" Classification Metric; Priority Ranking of Sites (1 = Least Impaired, 6 = Most Impaired)

Site #	Average Mg/L	Median Mg/L	% of Samples Exceeding "High"	*Priority Ranking
Site # 1	0.07	0.04	8%	**5**
Site # 2	0.06	0.05	0%	**4**
Site # 3	0.03	0.03	0%	**1**
Site # 4	0.04	0.03	0%	**2**
Site # 5	0.05	0.05	0%	**3**
Site # 6	0.24	0.09	17%	**6**
Site # 7	0.05	0.05	0%	**3**

Figure 5: Phosphorus Cycle in a Lake Environment (Wisconsin DNR, 2003)



Nitrogen (Total Kjeldahl Nitrogen – TKN)

Point source dischargers, such as wastewater treatment plants, can be a significant source of nitrogen in surface waters; however, nonpoint source discharges of untreated septic effluent, decaying organisms, and bacterial decomposition of animal waste from improper disposal or storm water runoff can also contribute to the concentrations of nitrogen in a waterbody.

Elevated TKN concentrations are a cause of pollution in the project watershed. In the absence of a specific surface water quality standard for TKN, monitoring results collected during this project were also compared to the summary statistics and classification metrics from the IDEM's 1996 West Fork White River study. An evaluation of the 1996 study's summary statistics indicated that the average concentration of TKN for samples collected in the West Fork White River watershed was 0.85 mg/L, while the median concentration of TKN was 0.74 mg/L. Concentrations of TKN exceeding 0.91 mg/L were considered to be significantly elevated, while concentrations of TKN exceeding 1.2 mg/L were considered to be "high".

A comparison of project monitoring results to the mean and median values observed in 1996 reveals that three stream reaches, Site 2 (Sycamore Creek downstream of Monrovia), Site 6 (Lamb's Creek downstream of Patton Lake) and Site (Lower Lamb's Creek), had monitoring results that exceeded the "high" classification metric from the IDEM's 1996 study (see **Graph 5**).

As illustrated in **Table 6**, monitoring locations were prioritized according to the level of TKN impairment, which was judged by the percentage of exceeedances of the "High" classification metric as compared to the IDEM's 1996 study of the West Fork White River. For sites without exceedances of the high classification, rankings are based on which sites maintained the lowest average TKN results. Note: This ranking is independent of the results from other parameters.

Graph 5: Total Kjeldahl Nitrogen (TKN) Monitoring Results, 2002 - 2003

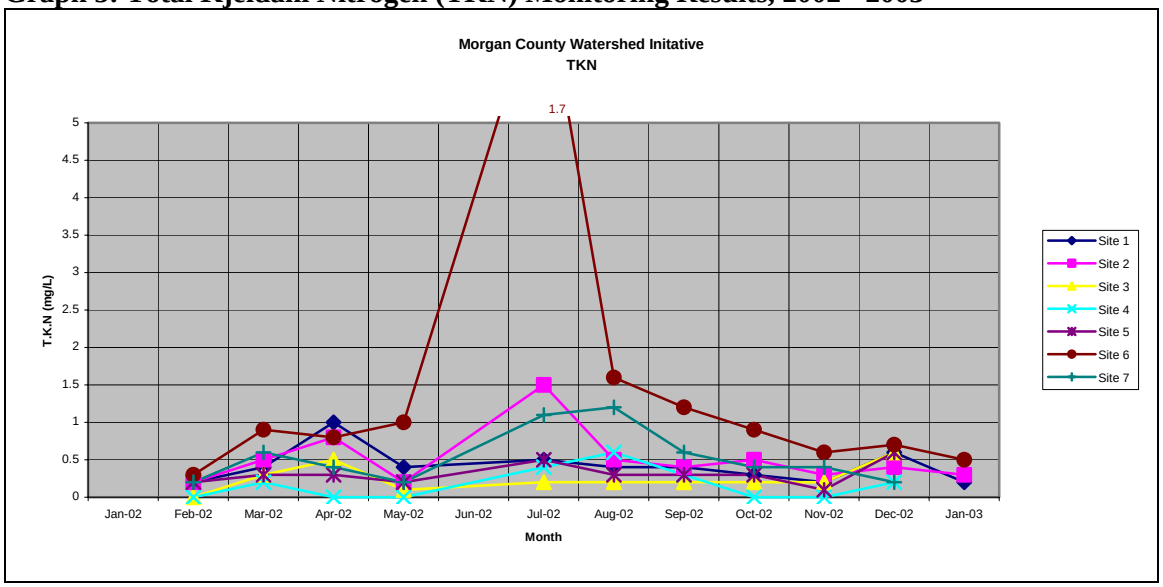


Table 6. TKN Monitoring Results (Average and Median) in Milligrams per Liter (Mg/L); Percentage of Samples Exceeding the IDEM's 1996 "High" Classification Metric; Priority Ranking of Sites (1 = Least Impaired, 7 = Most Impaired)

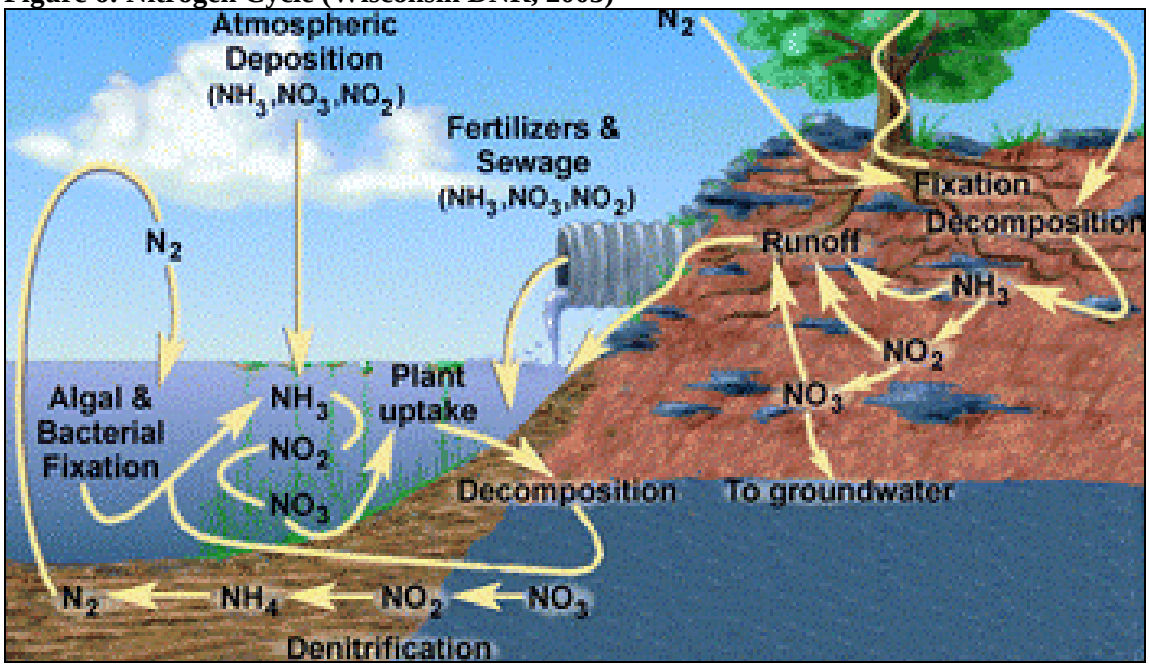
Site #	Average Mg/L	Median Mg/L	% of Samples Exceeding "High"	*Priority Ranking
Site # 1	0.42	0.4	0%	**4**
Site # 2	0.49	0.4	8%	**5**
Site # 3	0.26	0.2	0%	**2**
Site # 4	0.22	0.15	0%	**1**
Site # 5	0.32	0.3	0%	**3**
Site # 6	1.43	0.9	25%	**7**
Site # 7	0.53	0.4	9%	**6**

The sources of TKN at Site 2 likely originate from the Town of Monrovia from either domestic wildlife, failing septic systems, or inadequate wastewater treatment at Monrovia Middle School or the municipal wastewater treatment plant. Monitoring conducted for this project was not of sufficient detail to distinguish between these potential sources.

The sources of TKN at Sites 6 and 7 are most likely tied to the eutrophic nature of Patton Lake. Addition observations of the below average concentrations (as compared to the IDEM's 1996 study) of TKN entering Patton Lake at Site 5 suggest that the cause of this eutrophication is likely the land uses immediately surrounding the lake. In eutrophic lakes, anoxia results in increased levels of nitrogen with increasing depth in the hypolimnion. When the hypolimnion of a eutrophic lake becomes anoxic (lacking any oxygen), bacterial nitrification of ammonia ceases and nitrogen in the form of ammonium ion (NH4+) concentrations increase (Wisconsin DNR, 2003).

Denitrification only occurs at low oxygen levels, and is typically restricted to sediments, although it also occurs in the deoxygenated hypolimnia of some lakes. In eutrophic lakes that are stratified, concentrations of N2 may decline in the epilimnion because of reduced solubility as temperatures rise and increase in the hypolimnion from denitrification of nitrate (NO3) to nitrite (NO2) to inorganic nitrogen (N2). Nitrite (NO2) rarely accumulates except in the metalimnion and hypolimnion of eutrophic lakes (see **Figure 6**). Concentrations of nitrite in lakes are usually very low unless organic pollution is high (Wisconsin DNR, 2003).

Figure 6: Nitrogen Cycle (Wisconsin DNR, 2003)



Organic Carbon

Organic contaminants can enter waterways during periods of storm water runoff from many sources including insecticides, herbicides, agricultural chemicals and natural organic substances. Domestic wastewaters from improperly operated wastewater treatment facilities or failing septic systems also contribute organic contaminants in various amounts.

Total Organic Carbon (TOC) measurements are indicative of the number of carbon-containing compounds in a waterbody. The larger the organic carbon content, the more oxygen is consumed. A high organic content means an increase in the growth of microorganisms that contribute to the depletion of oxygen supplies. Elevated concentration of TOC can create unfavorable conditions for aquatic life, such as the depletion of oxygen and the presence of toxic substances.

In eutrophic lakes, the loading of organic matter to the hypolimnion and sediments increases the consumption of dissolved oxygen. As a result, the oxygen content of the hypolimnion of stratified lakes is reduced progressively during the period of summer stratification at the deepest portion of the lake where a lower volume of water is exposed to the intensive oxygen consuming processes of decomposition at the surface of the lake sediments.

Steep watersheds tend to have less organic content in their soils and therefore contribute lower TOC concentrations from storm water runoff. In the project watershed, the primarily steep, forested nature topography suggests that sources of TOC are more likely to originate from human activities than from naturally occurring sources.

Elevated TOC concentrations are a cause of pollution in the project watershed. In the absence of a specific surface water quality standard for TOC, monitoring results collected during this monitoring project were also compared to the summary statistics and classification metrics from the IDEM's 1996 West Fork White River study. An evaluation of the 1996 study's summary

statistics indicated that the average concentration of TKN for samples collected in the West Fork White River watershed was 4.08 mg/L, while the median concentration of TKN was 3.8 mg/L. Concentrations of TKN exceeding 4.4 mg/L were considered to be significantly elevated, while concentrations of phosphorus exceeding 4.8 mg/L were considered to be "high".

A comparison of project monitoring results to the mean and median values observed in 1996 reveals that three stream reaches, Site 1 (Sycamore Creek downstream of Hart Lake), Site 4 (Highland Creek), Site 6 (Lamb's Creek downstream of Patton Lake) and Site 7 (Lower Lamb's Creek), had monitoring results that exceeded the "high" classification metric from the IDEM's 1996 study (see **Graph 6**).

As illustrated in **Table 7**, monitoring locations were prioritized according to the level of TOC impairment, which was judged by the percentage of exceeedances of the "High" classification metric as compared to the IDEM's 1996 study of the West Fork White River. For sites without exceedances of the high classification, rankings are based on which sites maintained the lowest average TOC results. Note: This ranking is independent of the results from other parameters.

Graph 6: Total Organic Carbon (T.O.C) Monitoring Results, 2002 - 2003

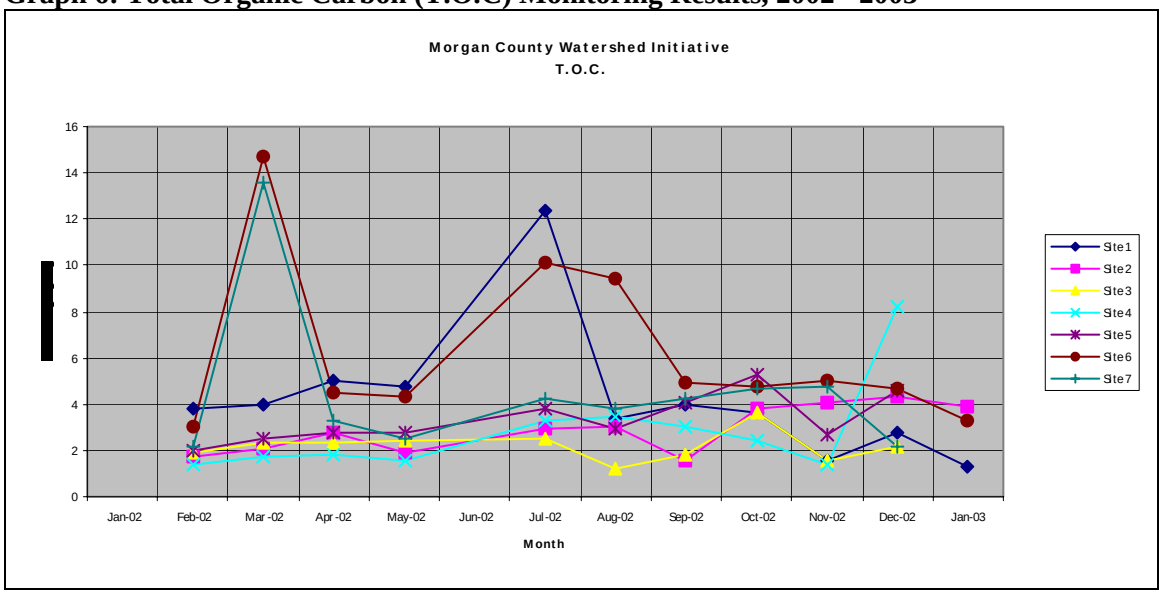


Table 7. TOC Monitoring Results (Average and Median) in Milligrams per Liter (Mg/L); Percentage of Samples Exceeding the IDEM's 1996 "High" Classification Metric; Priority Ranking of Sites (1 = Least Impaired, 7 = Most Impaired)

Site #	Average Mg/L	Median Mg/L	% of Samples Exceeding "High"	*Priority Ranking
Site # 1	4.18	3.7	9%	**4**
Site # 2	2.64	2.45	0%	**2**
Site # 3	2.13	2.2	0%	**1**
Site # 4	2.68	1.8	10%	**5**
Site # 5	3.22	2.8	0%	**3**
Site # 6	5.98	4.75	36%	**7**
Site # 7	4.34	3.8	10%	**6**

Water Quality Summaries by Subwatershed

Sycamore Creek Subwatershed (Sites 1, 2 and 3)
The upper portions of the Sycamore Creek subwatershed, represented by Site 1 (downstream of Hart Lake) and Site 2 (downstream of Monrovia), is moderately impacted by various pollutants or display conditions that indicate the presence of water quality pollutants. Chemical monitoring within the subwatershed identified:

- elevated concentrations of *E.coli* bacteria at both Sites 1 and 2
- low concentrations of dissolved oxygen at both Sites 1 and 2
- periodic spikes of phosphorus at Site 1
- periodic spikes of nitrogen as both Sites 1 and 2
- elevated concentrations of organic carbon at Site 1
- elevated concentrations of specific conductance at Sites 1
- Bioassessment scores indicated the presence of poor quality macroinvertebrate communities at Site 1 and fair quality macroinvertebrate communities at Site 2.

The lower portion of Sycamore Creek, represented by Site 3 (Robb Hill Road), is slightly impacted by pollutants or pollution. Chemical monitoring within the subwatershed identified:

- elevated concentrations of E.coli, but only during wet weather
- above average dissolved oxygen concentrations throughout the year
- below average concentrations of phosphorus
- below average concentrations of nitrogen
- below average concentrations of organic carbon
- average concentrations of specific conductance
- Bioassessment scores indicated the presence of good quality macroinvertebrate communities at Site 3. This site qualifies as a "regional reference site," having habitat and an aquatic community among the best in Indiana..

Increase in the quality of the water quality monitoring results at Site 3 are indicative of the Sycamore Creek's natural ability to dilute, absorb and degrade water quality pollutants. Addressing the upstream sources of pollutants in the watershed should prove to further increase water and the quality of resident macroinvertebrate communities.

Highland Creek Subwatershed (Site 4)
The Highland Creek subwatershed, represented by Site 4 is moderately impacted by various pollutants or display conditions that indicate the presence of water quality pollutants. Chemical monitoring within the subwatershed identified:

- elevated concentrations of *E.coli* bacteria
- low concentrations of dissolved oxygen
- slightly elevated concentrations of phosphorus
- average concentrations of nitrogen
- periodic spikes in concentrations of organic carbon
- below average concentrations of specific conductance at Sites 1
- Bioassessment scores indicated the presence of poor quality macroinvertebrate communities.

A more thorough assessment of the Highland Creek subwatershed would be necessary to specifically diagnose the causes and sources of pollutants identified by this study. An evaluation of land uses within the subwatershed suggest that poor stream habitat (due to beaver dams), wildlife, livestock, and failing septic systems to be potential sources of pollution.

Lamb's Creek Subwatershed (Sites 5,6 and 7)

The upper portions of the Lamb's Creek subwatershed, represented by Site 5 (Lamb's Creek upstream of Patton Lake) is slightly impacted by various pollutants or display conditions that indicate the presence of water quality pollutants. Chemical monitoring within the subwatershed identified:

- elevated concentrations of *E.coli* bacteria
- low concentrations of dissolved oxygen during the warm weather months
- below average concentrations of phosphorus
- below average concentrations of nitrogen
- below average concentrations of organic carbon at Site 1
- below average concentrations of specific conductance at Sites 1
- Bioassessment scores indicated the presence of fair quality macroinvertebrate communities.

The lower portion of Lamb's Creek, represented by Sites 6 (Lamb's Creek downstream of Patton Lake) and Site 7 (Lower Lamb's Creek), is moderately impacted by pollutants or pollution. Chemical monitoring within the subwatershed identified:

- elevated concentrations of E.coli at both sites, particularly Site 7
- very low dissolved oxygen concentrations at Site 6
- high concentrations of phosphorus at Site 6
- high concentrations of nitrogen at both sites
- High concentrations of organic carbon at both sites
- average concentrations of specific conductance at both sites
- Bioassessment scores indicated the presence of fair quality macroinvertebrate communities at Site 6 and poor quality macroinvertebrate communities at Site 7.

The above average water quality observed at Site 5 upstream of Patton Lake juxtaposed with the generally poor water quality observations at Sites 6 and 7 suggest that the sources of pollutants and pollution present in the lower portions of the Lamb's creek watershed are due to land use activities immediately surrounding and downstream of Patton Lake. The presence of failing septic systems and additional pollutant contributions from storm water runoff containing wildlife and domestic animal wastes are the likely causes of the eutrophication that is negatively impacting Patton Lake.

Although many of the water quality problems observed at Site 7 are due upstream sources of pollution, primarily from Patton Lake, downstream land uses are also contributing to the water quality impairments observed at this site. Wildlife, livestock, failing septic systems and erosion are probable contributors to the pollutant loads documented at this site.

All data evaluated for this report are included in **Table 8: Morgan County Monitoring Project – Raw Data.**

Table 8: Morgan County Monitoring Project – Raw Data

Sample Date	Site ID	Waterbody Name	Location	Sample ID	Samp. Coll	D.O. (mg/L)	Temp. (C)	pH	Cond	Weather	TSS	Turbidity	T. Phos	T.O.C.	T.K.N.	E.coli
1/23/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	123021	sdh	8.5	10.6	7.6	*	4-18-1-2	4	1.69	0.03	3.5	**	160
2/27/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	227021	sdh	10.94	4.8	8.2	416	9-27-0-1	4	3.2	0.03	3.8	0.2	7
3/27/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	327021	sdh	11.98	5.4	8.5	412	2-27-0-2	13	9.2	0.04	4	0.4	110
4/30/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	430021	slm	9.15	15.2	8.4	360	3-27-1-4	12	13	0.4	5	1	110
5/30/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	530021	slm	6.1	23.5	8.6	354	1-27-0-4	4	2.7	0.03	4.8	0.4	23
7/31/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	731021	wma	5.38	25.6	8.2	407	1-27-0-5	4	1.4	0.03	12.4	0.5	69
8/28/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	828021	zdb	4.57	23	8	490	2-18-0-5	30	6.7	0.05	3.4	0.4	610
9/30/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	930021	zdb	6.2	19.8	8	430	3-27-1-4	6	2.3	0.03	4	0.4	110
10/30/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	1030021	wma	10.15	9.8	8.3	770	4-00-2-2	4	1.6	0.1	3.6	0.3	520
11/26/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	1126021	zdb	15.1	5	8.5	732	4-00-1-2	4	1.5	0.03	1.6	0.2	280
12/30/2002	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	1230021	zdb	11.28	8	8.2	595		9	10	0.06	2.8	0.6	440
1/31/2003	Site 1	Dry Fork of Sycamore Creek (d/s of Hart Lake)	CR 950 North	131031	zdb	20	2.1	10.8	708	4-27-0-2	4	1.2	0.04	1.3	0.2	190
1/23/2002	Site 2	Sycamore Creek	CR 950 North	123022	sdh	11.4	7.3	8	*	4-18-3-2	4	1.35	<0.03	1.1	**	610
2/27/2002	Site 2	Sycamore Creek	CR 950 North	227022	sdh	13.93	4.7	7.6	617	9-18-1-1	4	1.83	0.04	1.7	0.2	160
3/27/2002	Site 2	Sycamore Creek	CR 950 North	327022	sdh	11.76	6.1	8.4	571	2-27-0-2	11	6.5	0.05	2.1	0.5	340
4/30/2002	Site 2	Sycamore Creek	CR 950 North	430022	slm	9.22	14.6	8.6	593	2-27-1-4	10	4.6	0.05	2.8	0.8	190

5/30/2002	Site 2	Sycamore Creek	CR 950 North	530022	slm	9.8	19.4	8.7	672	1-27-0-4	4	4	0.07	1.9	0.2	730
7/31/2002	Site 2	Sycamore Creek	CR 950 North	731022	wma	6.88	23.6	8.4	761	1-27-0-5	13	5.7	0.12	2.9	1.5	2400
8/28/2002	Site 2	Sycamore Creek	CR 950 North	828022	zdb	7.95	21.5	8.2	776	2-18-0-5	8	4.1	0.09	1.5	0.3	690
9/30/2002	Site 2	Sycamore Creek	CR 950 North	930022	zdb	7.95	19	8.1	750	3-27-1-4	38	11	0.1	1.6	0.4	1000
10/30/2002	Site 2	Sycamore Creek	CR 950 North	1030022	wma	9.2	10.5	8.3	392	4-00-2-2	4	1.5	0.06	3.8	0.5	130
11/26/2002	Site 2	Sycamore Creek	CR 950 North	1126022	zdb	8.98	5	8.4	435	9-00-2-1	5	1.8	0.03	4.1	0.3	21
12/30/2002	Site 2	Sycamore Creek	CR 950 North	1230022	zdb	12.43	4.4	8.4	415	4-09-0-3	4	2.6	0.03	4.3	0.4	36
1/31/2003	Site 2	Sycamore Creek	CR 950 North	131032	zdb	17.41	1.7	6.9	445	4-27-0-1	5	1.3	0.03	3.9	0.3	1
1/23/2002	Site 3	Sycamore Creek	Robb Hill Road	123023	sdh	11.8	5.5	8.2	*	4-18-1-2	4	1.02	0.03	1.6	**	34
2/27/2002	Site 3	Sycamore Creek	Robb Hill Road	227023	sdh	13.59	2.5	8.5	429	9-18-1-1	4	1.3	0.03	1.9	0.1	6
3/27/2002	Site 3	Sycamore Creek	Robb Hill Road	327023	sdh	12.16	3.9	8.6	395	2-27-0-2	10	9	0.03	2.3	0.3	100
4/30/2002	Site 3	Sycamore Creek	Robb Hill Road	430023	slm	9.31	13.5	8.5	408	3-27-1-4	7	3.8	0.03	2.3	0.5	150
5/30/2002	Site 3	Sycamore Creek	Robb Hill Road	530023	slm	8.3	23.5	8.9	449	1-00-1-4	4	1.6	0.03	2.4	0.1	310
7/31/2002	Site 3	Sycamore Creek	Robb Hill Road	731023	wma	7.8	26.9	8.5	571	1-27-0-5	7	2.9	0.03	2.5	0.2	49
8/28/2002	Site 3	Sycamore Creek	Robb Hill Road	828023	zdb	7.7	24.5	8	541	3-18-1-5	5	2.5	0.03	1.2	0.2	42
9/30/2002	Site 3	Sycamore Creek	Robb Hill Road	930023	zdb	6.89	18.6	8	545	3-27-0-4	4	0.81	0.03	1.8	0.2	93
10/30/2002	Site 3	Sycamore Creek	Robb Hill Road	1030023	wma	7.4	9.3	8.3	511	4-00-2-2	4	2.7	0.03	3.6	0.2	2400

11/26/2002	Site3	Sycamore Creek	Robb Hill Road	1126023	zdb	10.6	2.9	8.4	585	4-09-2-3	4	1.1	0.03	1.6	0.2	21
12/30/2002	Site 3	Sycamore Creek	Robb Hill Road	1230023	zdb	12.38	3.4	8.5	526	4-09-0-3	4	2.4	0.03	2.2	0.6	200
1/31/2003	Site 3	Sycamore Creek	Robb Hill Road	131033	zdb	Frozen										
1/23/2002	Site 4	Highland Creek	SR 67	123024	sdh	12.5	4.7	8	*	4-18-1-2	7	6.9	0.04	1.2	**	490
2/27/2002	Site 4	Highland Creek	SR 67	227024	sdh	11.2	2.2	8.4	194	9-27-1-1	4	3.15	0.03	1.4	0.1	10
3/27/2002	Site 4	Highland Creek	SR 67	327024	sdh	11.5	4	8.3	180	2-27-0-2	15	9.2	0.03	1.7	0.2	44
4/30/2002	Site 4	Highland Creek	SR 39	430024d	slm	9.27	13.1	7.9	166	1-27-1-4	23	15	0.03	1.8	0.1	38
5/30/2002	Site 4	Highland Creek	SR 39	530024	slm	8.5	18.6	8.4	207	1-00-0-4	4	2.7	0.03	1.6	0.1	220
7/31/2002	Site 4	Highland Creek	SR 39	731024	wma	4.3	27.5	8	375	1-27-1-5	25	17	0.05	3.3	0.4	110
8/28/2002	Site 4	Highland Creek	SR 39	828024	zdb	2.34	23.4	7.7	398	3-18-1-5	24	20	0.09	3.5	0.6	150
9/30/2002	Site 4	Highland Creek	SR 39	930024	zdb	2.6	18.7	7.1	384	3-27-1-4	17	12	0.04	3	0.3	1300
10/30/2002	Site 4	Highland Creek	SR 39	1030024	wma	8.95	9.2	8.1	317	4-00-2-2	4	3	0.03	2.4	0.1	260
11/26/2002	Site 4	Highland Creek	SR 39	1126024	zdb	9.5	4.3	8.4	294	4-00-1-2	6	3.1	0.03	1.4	0.1	10
12/30/2002	Site 4	Highland Creek	SR 39	1230024	zdb	11.88	4.7	8.4	291	4-09-0-3	18	15	0.04	8.2	0.2	440
1/31/2003	Site 4	Highland Creek	SR 39	131034	zdb	Frozen										
1/23/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	123025	sdh	9.2	10.5	8.2	*	5-18-0-2	4	3.8	0.03	1.8	**	86
2/27/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	227025	sdh	14.62	1.4	7.9	382	9-00-1-1	5	3.16	0.03	2	0.2	13
3/27/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	327025	sdh	12.67	3.2	8.4	361	2-27-0-2	19	15	0.05	2.6	0.4	120
4/30/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	430025	slm	9.42	13	7.6	369	1-27-2-3	14	9	0.04	2.8	0.3	170
5/30/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	530025	slm	10.9	20.9	9.1	395	1-00-0-4	4	4	0.03	2.8	0.2	250

7/31/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	731025	wma	7.07	30.9	8.5	409	1-27-0-5	25	17	0.05	3.8	0.5	7
8/28/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	828025	zdb	4.41	26.1	8	439	3-18-1-5	17	11	0.05	2.9	0.3	54
9/30/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	930025	zdb	5.95	21.6	8.1	448	1-27-1-4	11	5.2	0.05	4.1	0.3	140
10/30/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	1030025	wma	10.6	8.4	8.1	438	4-00-2-2	8	14	0.06	5.3	0.3	1100
11/26/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	1126025	zdb	13.4	2.8	8.4	504	4-00-0-2	11	3.1	0.03	2.7	0.1	120
12/30/2002	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	1230025	zdb	12.27	4.5	8.4	430	4-27-1-3	32	19	0.12	4.6	0.6	2400
1/31/2003	Site 5	Lambs Creek (u/s Patton Lake)	Upper Patton Lake Road	131035	zdb	Frozen										
1/23/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	123026	sdh	11.1	5.2	7.8	*	4-18-1-2	5	4.1	0.03	3.2	**	1
2/27/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	227026	sdh	11.61	5.3	8.2	319	9-00-1-1	13	13.2	0.04	2.9	0.5	1
3/27/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	327026	sdh	11.3	3.3	8.4	301	2-27-0-2	35	36	0.09	14.7	0.9	160
4/30/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	430026	slm	6.92	11.83	8.1	252	1-27-2-3	64	58	0.14	4.5	0.8	870

5/30/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	530026	slm	1.4	11.6	8.6	307	3-00-0-4	138	11	0.09	4.3	1	25
7/31/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	731026	wma	0.1	18.5	7.5	367	1-27-0-5	38	52	0.74	10.1	7	18
8/28/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	828026	zdb	0.15	19.8	7.2	412	4-18-0-5	64	120	1.47	9.4	1.6	11
9/30/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	930026	zdb	2.12	19.4	7.8	306	2-27-1-4	29	23	0.1	4.9	1.2	24
10/30/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	1030026	wma	4.3	10.5	7.9	353	4-00-2-2	35	27	0.09	4.8	0.9	17
11/26/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	1126026	zdb	10.4	4.5	8.3	326	4-00-1-2	12	7.7	0.04	5	0.6	4
12/30/2002	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	1230026	zdb	2.65	6.3	8.5	406	4-27-1-3	8	12	0.06	4.7	0.7	12
1/31/2003	Site 6	Lambs Creek (d/s Patton Lake)	Lower Patton Lake Road	131036	zdb	6.25	4.4	10.8	438	4-27-0-2	6	3.7	0.03	3.3	0.5	1
1/23/2002	Site 7	Lambs Creek	SR 67	37496	sdh	10.2	8.2	8	*	4-18-1-2	6	5.1	0.03	2.2	**	72
2/27/2002	Site 7	Lambs Creek	SR 67	227027	sdh	13.11	2.5	8.2	268	9-18-2-1	7	6.72	0.03	2.2	0.2	32
3/27/2002	Site 7	Lambs Creek	SR 67	327027	sdh	11.82	4.2	8.8	255	1-27-1-1	42	26	0.06	13.6	0.6	140
4/30/2002	Site 7	Lambs Creek	SR 67	430027	slm	7.9	12.6	8.9	244	1-27-2-3	35	30	0.07	3.3	0.4	550
5/30/2002	Site 7	Lambs Creek	SR 67	530027	slm	9	21.3	8.6	297	3-00-1-4	4	2.7	0.03	2.5	0.2	160
7/31/2002	Site 7	Lambs Creek	SR 67	731027	wma	6.27	27.5	8.2	369	1-27-1-5	22	14	0.08	4.2	1.1	1200
8/28/2002	Site 7	Lambs Creek	SR 67	828027	zdb	6.05	24.9	8.2	461	3-18-0-5	13	11	0.06	3.8	1.2	1200
9/30/2002	Site 7	Lambs Creek	SR 67	930027	zdb	8.45	19.8	8.1	366	1-27-0-5	9	6.1	0.05	4.2	0.6	820
10/30/2002	Site 7	Lambs Creek	SR 67	1030027	wma	7.8	9	8.3	349	4-00-2-2	7	6.5	0.07	4.7	0.4	690
11/26/2002	Site 7	Lambs Creek	SR 67	1126027	zdb	18.1	4.1	8.4	341	4-00-1-2	10	6.1	0.04	4.8	0.4	220

12/30/2002	Site 7	Lambs Creek	SR 67	1230027	zdb	12.1	4.3	8.9	366	4-09-1-3	4	3.8	0.03	2.2	0.2	460
1/31/2003	Site 7	Lambs Creek	SR 67	131037	zdb	Frozen										

APPENDIX C:
Water Quality Regulatory Information

Understanding Designated Uses, Water Quality Standards, Basin Assessments, and Problem Pollutants

In order to identify water quality problems in the west central White River watershed in Morgan County, Indiana, stakeholders in the watershed planning process felt that readers of this plan needed to understand the basis for measuring or quantifying water quality problems. Consequently, this section of the watershed plan provides a technically detailed discussion of how water quality standards, the measures of quality in rivers, streams, and lakes, are developed and used to protect water quality. This section of the plan will also briefly discuss the programs actively monitoring water quality within the watershed and explain the process used to assess the quality of surface waters in the watershed.

Understanding Designated Uses and Water Quality Standards

Rivers, streams, and lakes have naturally occurring plants, animals, and microorganisms that break down, or consume, water quality contaminants. This process, in conjunction with the rate and volume of stream flow, oxygen levels, temperature, and other naturally occurring conditions dictates the rate at which streams are able to breakdown and absorb contaminants. Historically, many waterbodies have received more contaminants than they could naturally absorb. Waterbodies that received more contaminants than they can absorb are considered to be polluted.

In order to prevent waterbodies from becoming polluted and to implement protections for already contaminated waterbodies, in 1972, Congress established the Clean Water Act and the National Pollutant Discharge Elimination System (NPDES) to regulate the discharges of pollutants into lakes, rivers, and streams from industrial and municipal wastewater treatment plants, and other direct sources of pollution. The NPDES Program uses water quality standards and discharge limitations to restrict the introduction of contaminants that would exceed a waterbody's ability to naturally absorb and consume pollutants.

In order to determine appropriate discharge limitations for a NPDES regulated facility, the State of Indiana first established designated uses and water quality standards to support those uses for the waters of the State. Indiana's current designated uses for surface waters are described in **Table 3-1**.

A water quality standard is the combination of a designated use (i.e. swimmable or fishable) and a narrative or numeric water quality criterion designed to protect that use (i.e. an ammonia discharge limit of 3.0mg/L or an E. coli discharge limit of 125 cfu/100ml). Designated uses and resulting water quality standards form the foundation for the NPDES program to control the amount of pollutants being discharged into the rivers, streams, and lakes of Indiana.

In Indiana, effluent limitations are implemented through NPDES permit conditions established by the Indiana Department of Environmental Management (IDEM). Effluent limitations are designed to limit the quantities, discharge rates, and concentrations of pollutants that are discharged, from "point sources" of pollution. These limitations represent the minimum effluent quality or quantity that must be achieved prior to discharge of a treated wastewater into a waterbody (river, stream, or lake). The NPDES permits issued by the IDEM contain specific effluent limits designed to meet the State's water quality standards.

Table 3-1: Surface Water Use Designations and Classifications

The following uses are designated by the Indiana Water Pollution Control Board (327 IAC 2-1-3):

- Surface waters of the state are designated for full-body contact recreation during the recreational season (April through October).
- All waters, except limited use waters, will be capable of supporting a well-balanced, warm water aquatic community.
- All waters, which are used for public or industrial water supply, must meet the standards for those uses at the point where water is withdrawn.
- All waters, which are used for agricultural purposes, must meet minimum surface water quality standards.
- All waters in which naturally poor physical characteristics (including lack of sufficient flow), naturally poor or reversible man-induced conditions, which came into existence prior to January 1, 1983, and having been established by use attainability analysis, public comment period, and hearing may qualify to be classified for limited use and must be evaluated for restoration and upgrading at each triennial review of this rule.
- All waters, which provide unusual aquatic habitat, which are an integral feature of an area of exceptional natural beauty or character, or which support unique assemblages of aquatic organisms may be classified for exceptional use.
- All waters of the state, at all times and at all places, including the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges:
    - that will settle to form putrescent or otherwise objectionable deposits,
    - that are in amounts sufficient to be unsightly or deleterious,
    - that produce color, visible oil sheen, odor, or other conditions in such degree as to create a nuisance,
    - which are in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill aquatic life, other animals, plants, or humans, or
    - which are in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly, or otherwise impair designated uses.

The 305(b) Process – Assessing Indiana's Watersheds

In order to assess the effectiveness of a State's water quality standards, effluent limitations, and NPDES permitting program, Section 305(b) of the Clean Water Act (CWA) requires each State to develop a program to monitor the quality of its waters and prepare a report describing their quality. This process of monitoring and assessment produces an evaluation of the degree to which each waterbody supports a State's designated uses and water quality standards. Each waterbody assessed is rated as supportive, partially supportive, or not supportive of it's designated uses. **Table 3-2** illustrates the criteria used by the IDEM for assessing a waterbody's ability to support its designated uses.

TABLE 3-2: CRITERIA FOR EVALUATING DESIGNATED USE SUPPORT*

Parameter	Fully Supporting	Partially Supporting	Not Supporting
Aquatic Life Use Support			
Toxic Pollutants	Metals were evaluated on a site-by-site basis and judged according to magnitude of exceedance and the number of times exceedances occurred.		
Conventional Inorganic Pollutants	There were very few water quality violations, almost all of which were due to natural conditions.		
Benthic aquatic macroinvertebrate Index of Biotic Integrity (mIBI)	mIBI $\geq$ 4.	mIBI < 4 and $\geq$ 2.	mIBI < 2.
Qualitative habitat use evaluation (QHEI)	QHEI $\geq$ 64.	QHEI < 64 and $\geq$ 51.	QHEI < 51.
Fish community (fIBI) (Lower White River only)	IBI $\geq$ 44.	IBI < 44 and $\geq$ 22	IBI < 22.
Sediment (PAHs = polynuclear aromatic hydrocarbons. AVS/SEM = acid volatile sulfide/ simultaneously extracted metals.)	All PAHs $\leq$ 75th percentile. All AVS/SEMs $\leq$ 75th percentile. All other parameters $\leq$ 95th percentile.	PAHs or AVS/SEMs > 75th percentile. (Includes Grand Calumet River and Indiana Harbor Canal sediment results, and so is a conservative number.)	Parameters > 95thpercentile as derived from IDEM Sediment Contaminants Database.
Indiana Trophic State Index (lakes only)	Nutrients, dissolved oxygen, turbidity, algal growth, and sometimes pH were evaluated on a lake-by-lake basis. Each parameter judged according to magnitude.		
Fish Consumption			
Fish tissue	No specific Advisory*	Limited Group 2 - 4 Advisory*	Group 5 Advisory*
* Indiana Fish Consumption Advisory, 1997, includes a state wide advisory for carp consumption. This was not included in individual waterbody reports because it obscures the magnitude of impairment caused by other parameters.			
Recreational Use Support (Swimmable)			
Bacteria (cfu = colony forming units.)	No more than one grab sample slightly > 235 cfu/100ml, and geometric mean not exceeded.	No samples in this classification.	One or more grab sample exceeded 235 cfu/100ml, and geometric mean exceeded.

***From Indiana Water Quality Report for 1998**

Participants in the 305(b) Process
In Indiana, the primary agencies involved in collecting, analyzing, and assessing surface water quality data for the state's 305(b) report are as follows:

1. **Indiana Department of Environmental Management (IDEM), Office of Water Quality, Assessment Branch – River Basin Monitoring Program**
   The Water Quality Assessment Branch of the Office of Water Quality (OWQ) is responsible for assessing the quality of water in Indiana's lakes, rivers and streams for the state's 305(b) Report. In 1995, in response to the growing demand for more and better water quality data, the IDEM Water Assessment Branch developed a Surface Water Quality Monitoring Strategy. The strategy was designed to direct the efforts of the Assessment Branch in the light of increased workloads, as well as new 305(b) reporting guidelines to states from the Environmental Protection Agency (EPA).

   IDEM's monitoring strategy was crafted to provide technical data and information to support the 305(b) report, the NPDES permitting program, and the annual Fish Consumption Advisory. As a result, the Assessment Branch operates on a rotating basin approach that is designed to sample, analyze, and assess one of the state's five (5) major river basins each year and to provide a statewide assessment every 5 years.

   River Basin Monitoring Cycle
   The five-year rotating river basin monitoring cycle began in 1996 and continues to be the basis for Indiana's Surface Water Quality Monitoring Strategy. The state of Indiana has been divided geographically into five major hydrological groupings or sampling units for the purpose of sampling, analysis and assessment. The five-year monitoring cycle listed below indicates the timeframes by which the IDEM plans to complete surface water quality surveys throughout the state.

Major River Basin	Sampling Year(s)
• West Fork White River and Patoka River Basins	1996, 2001
• East Fork White River and Whitewater River Basins	1997, 2002
• Upper Wabash River Basin	1998, 2003
• Lower Wabash River and Kankakee River Basins	1999, 2004
• Great Lakes and Ohio River Basins	2000, 2005

IDEM Assessment Branch Monitoring Programs
The Assessment Branch is composed of two sections that work together to collect data and assess the quality in Indiana's surface waters via the 305(b) report. These sections are as follows:

- **The Surveys Section** is responsible for collecting chemical and physical water quality data, assessing the quality of Indiana's river and streams, and determining the effect of approximately 1,800 permitted point sources on the rivers and streams of Indiana. The Surveys Section provides data for models, 305(b) water quality reports and wasteload allocations for NPDES permitting purposes, as well as an assessment of non-point sources. The OWQ biological and surface water monitoring programs identify stream reaches, watersheds or segments where physical, chemical and/or biological quality has been or would be impaired by either point or nonpoint sources. This information is used to help allocate

waste loads equitably among various pollutant sources in a way that would ensure that water quality standards are met along stream reaches in each of the nearly 100 stream segments in Indiana.

- **The Biological Studies Section (BSS)** is responsible for determining the biological integrity of aquatic communities in Indiana lakes, rivers and streams. They do this through a variety of field, laboratory, and cooperative studies that involve several different forms of aquatic life as well as surface water and sediment chemistry, physical and habitat information. These data are used to determine compliance with the existing narrative biological criteria in the Indiana water quality standards, and form the basis for new specific numerical biological criteria. Additionally, the data determine the extent of ecological harm and recovery, and make correlations to physical and/or chemical impairments that may occur.

  The BSS conducts fish tissue and sediment sampling to assess the level and extent of contamination by toxic and bioaccumulating substances whose concentrations in other environmental media are often too low to be easily measured with routine sampling and laboratory procedures. The fish tissue monitoring program provides the majority of data used to make decisions for Indiana's fish consumption advisories. In addition these data are also used for wildlife health risk assessments for fish-eating birds and mammals, and to provide the information needed to develop models to assess changes in Indiana ecosystems that affect aquatic life and human health.

  The BSS also oversees lake monitoring efforts conducted under contract by staff and students of the Indiana University School of Public and Environmental Affairs, as well as by a group of trained volunteer monitors. Both programs include the monitoring of physical, chemical and/or biological parameters useful in assessing the impacts of nutrients in Indiana lakes and reservoirs.

2. **The Indiana Department of Natural Resources (IDNR) - Division of Fish and Wildlife**
   The IDNR Division of Fish and Wildlife maintains a network of fishery biologists that conduct research throughout the state to assess and manage fishery populations in Indiana's rivers, streams and lakes. The IDNR biologists routinely conduct macroinvertebrate sampling, electrofishing, netting surveys, and creel surveys to evaluate the status of local fisheries. The IDNR works cooperatively with the IDEM Biological Studies Section to assess the State's fisheries populations and to provide data to the Indiana State Board of Health to be used in the annual Fish Consumption Advisory.

The 303(d) List - Impaired Streams and Problem Pollutants

As a result of the waterbody assessments performed in the 305(b) process, a number of the rivers, streams, and lakes within the state are determined to be only partially supportive or non-supportive of each waterbody's designated uses. Section 303(d) of the CWA requires that waters not meeting or not expected to meet water quality standards after the implementation of regulatory controls (NPDES permits) to be compiled and listed as "impaired waters" by the IDEM. In other words, impaired waters are considered to be those waterbodies that don't meet the state's water quality standards for one or more designated uses.

Total Maximum Daily Loads (TMDL)

Based on Indiana's 2002 303(d) list, the streams listed have been identified as having impairing pollutants by the IDEM. Streams identified on the state's 303(d) list are also required to undergo a planning process

designed to reduce the amount of the pollutant(s) coming from both point and nonpoint sources of pollution. This process is called Total Maximum Daily Loads (TMDL).

The IDEM defines a TMDL as "a process that leads to the quantification of the amount of a specific pollutant discharged into a waterbody that can be assimilated and still meet the water quality standards (designated uses)." This is achieved by specifying the amount of pollutant reductions necessary from point and non-point sources in order to meet the water quality standard set for an impairing pollutant. EPA is responsible for ensuring that TMDLs are completed by States and for approving completed TMDLs.

IDEM's TMDL Strategy

Under the TMDL approach, states establish priorities and schedules for TMDL development. When TMDL development occurs, IDEM via the TMDL process determines the required reductions in pollutant loads or other actions needed to meet water quality goals. This process promotes a watershed approach driven by local needs and directed by the State's list of priority waterbodies. The overall goal in establishing the TMDL is to implement the pollutant reductions necessary from point and nonpoint sources of pollution that are necessary for a waterbody to meet water quality standards.

IDEM's Office of Water Quality has reorganized its work activities around a five-year rotating basin schedule. The waters of the state have been grouped geographically into major river basins, and water quality data and other information will be collected and analyzed from each basin, or group of basins, once every five years. The schedule for implementing the TMDL Strategy is proposed to follow this rotating basin plan to the extent possible. Supplemental data collection (i.e. collection during a year other than the one prescribed in the IDEM's Surface Water Quality Monitoring Strategy) may also be required to complete the TMDL process.

IDEM's TMDL Strategy discusses activities to be accomplished in three phases. Phase One involves planning, sampling and data collection and will take place the first year. Phase Two involves TMDL development (water quality modeling) and will occur in the second year. Phase Three is the TMDL implementation period and is expected to occur during the third year; however, it is expected that some phases, especially the implementation of a TMDL, may take more than one year to fully accomplish.

The TMDL goals that are chosen in conjunction with watershed stakeholders during Phase Two will be used to develop a plan to implement the TMDL. During this process, stakeholder participation will be essential. IDEM's Basin Coordinator, in conjunction with the stakeholder groups, will develop a plan to implement the TMDL. Once the draft plan has been finalized through comments from stakeholder groups and IDEM, the plan becomes a "final draft" and is open to public review.

Regulatory Agency Responsibilities

Currently, most major sources of pollutants are regulated and enforced under by Federal and/ or State agencies. In Indiana, the Indiana Department of Environmental Management (IDEM) has been delegated authority by the United States Environmental Protection Agency (U.S. EPA) to regulate sources of pollution via the National Pollutant Discharge Elimination System (NPDES) Program. In addition to federal and state regulations, many communities also initiate additional local water quality protections through implementation of local zoning and ordinance controls. Persons interested in local initiatives to protect water quality can find more information on these efforts by contacting their county health department or municipal department of public works. In addition to IDEM, the Indiana Department of Natural Resources and the Morgan County Soil and Water Conservation District also provide inspection and regulatory authority over the erosion control requirements.

Regulatory Agencies and Responsibilities in Indiana:

Many federal, state, and local authorities share the responsibility of regulating, enforcing, and or managing water quality programs that protect water resources and public health across the nation. In Indiana, these agencies include:

Department of Interior:

- U.S. Geological Survey (USGS)
- U.S. Fish and Wildlife Service (USFWS)

Department of Agriculture:

- Natural Resources Conservation Service (NRCS)
- Farm Services Agency (FSA)

U.S. Environmental Protection Agency:

- Office of Water

U.S. Army Corps of Engineers:

- Section 404 Program: Dredge/fill Permits

The Indiana Department of Natural Resources (IDNR):

The State Department of Natural Resources, Division of Water, is charged by the State of Indiana to maintain, regulate, collect data from, and evaluate Indiana's surface and ground water resources. The Division of Water is compromised of 17 sections divided between three branches: Engineering, Planning, and Regulation. The Division issues permits for: (1) alteration of the bed or shoreline of a public freshwater lake; (2) construction or reconstruction of any ditch or drain having a bottom depth lower than the normal water level of a freshwater lake of 10 acres or more and within ½ mile of the lake; (3) construction within the floodway of any river or stream; (4) placing, filling, or erecting a permanent structure in; water withdrawal from; or material extraction from; a navigable waterway; (5) extraction of mineral resources from or under the bed of a navigable waterway; and (6) construction of an access channel.

The State Department of Natural Resources, Division of Reclamation, is responsible for implementing the federal Surface Mining Control and Reclamation Act (SCMRA). The Division of Reclamation issues permits to coal mining companies, which allows them to mine coal in Indiana. The Division of Reclamation works closely with the IDEM to protect the waters of the state through the issuance and enforcement of construction permits and NPDES permits involving coal mining activities. The Division of Reclamation has primary responsibility for the compliance and enforcement of all coal mining and wastewater permits.

The Indiana Department of Environmental Management (IDEM):

The Indiana Department of Environmental Management's Office of Water Management

(OWM) implements and enforces the Clean Water Act. With oversight from U.S. EPA Region V office in Chicago, Illinois, IDEM's Office of Water Management (OWM) Wastewater Permitting Branch maintains responsibility for Indiana's NPDES permit program and for issuing, modifying, revoking and reissuing, terminating, denying, monitoring, and enforcing permits for the discharge of pollutants from point sources and imposing and enforcing pretreatment requirements. The Permitting Branch issues NPDES permits to wastewater dischargers in Indiana to regulate compliance with the Clean Water Act. It also issues construction permits for facilities needing to construct, install or modify any water pollution treatment control facility or sanitary sewer.

IDEM's jurisdiction includes all the "waters of the state" of Indiana, which is defined as "accumulations of water, surface and underground, natural and artificial, public and private, or parts thereof, which are wholly or partially within, flow through, or border upon this state". However, the term does not include any private pond, or any pond, reservoir, or facility built for reduction or control of pollution or cooling of water prior to discharge unless the discharge causes or threatens to cause water pollution.

The State Department of Health (ISDH):
The State Department of Health is responsible for training and providing technical assistance to county health departments regarding residential septic systems. In addition, the Department also is responsible for issuing construction permits to all commercial on-site non-discharging sewage disposal systems.

Morgan County Health Department (MCHD):
Health Departments are responsible for issuing residential septic permits. Some counties also may require a county-issued construction permit for commercial on-site non-discharging sewage disposal systems.

Regulatory Programs

Regulations governing water quality pollutants are usually differentiated based on where the pollutants are generated; usually referred to as either point or nonpoint source pollutants. Point sources (PS) have a known discharge point, such as industrial facility discharges or municipal sewage treatment plant outfall pipes**.** Nonpoint sources (NPS) of pollution are generated by rainfall or melting snow moving over and through the ground. As the runoff moves, it picks up and carries pollutants from streets, parking lots, and construction sites and deposits them into lakes, rivers, wetlands, and underground sources of drinking water.

Generally, both point and nonpoint sources of pollution are regulated by authorized agencies under four main programmatic areas; Wastewater, Wet Weather (CSOs and Stormwater), Drinking Water, and Total Daily Maximum Loads. This section will discuss the various regulations governing the point and nonpoint source regulations that are driving the need for increased communication and coordination on water quality issues.

Wastewater Programs: National Pollutant Discharge Elimination System (NPDES) Program

As a result of the 1972 Clean Water Act, point source wastewater dischargers are required to have a National Pollutant Discharge Elimination System (NPDES) permit that establishes pollution limits, and specifies monitoring and reporting requirements. NPDES permits regulate sanitary and industrial wastes that are collected in sewers and treated at municipal wastewater treatment plants that discharge into wastewater collection systems or discharge directly into receiving waters.

The United States Environmental Protection Agency (US EPA) and the Indiana Department of Environmental Management (IDEM) Office of Water Management (OWM) Wastewater Permits Branch can issue two different types of NPDES permits:

- **General Permits,** or permits-by-rule, are issued for specific types of discharges such as storm water runoff from construction sites, non-contact cooling water, or stone quarry discharges. The activities covered under each specific type of general permit are very similar in nature; therefore, each such activity is regulated under the rules of a general permit.
- **Individual Permits** are site-specific and issued to dischargers on a case-by-case basis. The issuance process provides opportunity for public input or appeal. The applications for individual permits are of varying degrees of complexity, and can require extensive narrative explanations of planned treatment activities.

The following individual permit types are processed and issued by the US EPA and the IDEM OWM in the State of Indiana:

Publicly Owned Treatment Works (POTW) Permits

Sources that discharge or intend to discharge wastewater containing pollutants, or treated wastewater that could potentially contain pollutants, from a point source into any streams, lakes, ponds, or other waters of Indiana and the United States must have an NPDES wastewater permit. A NPDES discharge permit also serves as an operating permit, under which the owner/operator generates and/or collects wastewater for discharge.

Permits are required for facilities that treat and disinfect municipal wastewater prior to discharge to any waters of the State. Two types of permits are issued:

- Major Discharge = discharges more than one (1) million gallons per day.

- Minor Discharge = discharges less than one (1) million gallons per day.

  Since enactment of the 1972 Federal Water Pollution Control Act, all POTWs are required to provide secondary treatment, at a minimum. A primary component of secondary treatment is the reduction of biochemical oxygen demand (BOD) and chemical oxygen demand (COD), which can deplete dissolved oxygen and kill fish and other aquatic life in waterbodies. Secondary treatment can also reduce ammonia, and some facilities also must remove phosphorus. In addition, secondary treatment may reduce concentrations of some heavy metals. Finally, the wastewater is required to be disinfected during the recreational season (April 1to October 31) to reduce disease-causing microorganisms prior to discharge.

Industrial Wastewater Pretreatment Permit (IWPP)

Industrial Wastewater Pretreatment Permits are for industrial process wastewater that is treated to remove contaminants prior to discharge into a municipal wastewater collection system. Treatment is similar to that associated with NPDES industrial permits, but the effluent is discharged into a municipal sewer rather than directly into a stream or other body of water. As a result, this wastewater receives further treatment at the municipal POTW prior to being discharged to "waters of the state".

Currently 45 Indiana municipalities, including the City of Fort Wayne, have EPA-delegated pretreatment programs in place, under which they regulate industrial discharges to their municipal wastewater collection systems. In addition, IDEM issues IWPP to industries in those towns and cities that do not have a local pretreatment program in place.

Concentrated Animal Feeding and Aquaculture Operation Permits (CAFO)

Concentrated animal feeding operations are point sources subject to the NPDES permit program. However, the need for such a permit is conditioned on an on-site inspection, which determines that a permit is required, based on either;

- Number of animals, per category, housed at a facility,
- Whether pollutants from the facility are discharged into the "waters of the state" through a man-made ditch or flushing system, or
- If pollutants are discharged directly into the waters of the State which originate outside the facility, but pass over, across, or through the facility.

Otherwise, the disposal of wastes generated at such a facility are regulated as a solid waste under a Confined Feeding Approval administered by the IDEM Office of Solid and Hazardous Waste (OSHWM) Land Use Branch. Aquaculture, or concentrated aquatic animal production facilities, as defined in the U.S. Code Federal of Regulations at 40 CFR 122.24 also are point sources subject to NPDES permit requirements. However, as with concentrated animal feeding operations, the need for such a permit is conditioned on an on-site inspection which determines whether a permit is required, based on:

1. the location and quality of the receiving waters,
2. whether the facility is a significant contributor of pollution to the "waters of the state", or
3. if the holding, feeding and production capacities of the facility, are such that it is determined that the facility does not need an NPDES permit because;
   a) The aquatic animals are raised in a structure that discharges less than thirty (30) days per year, and
   b) Produces less than 20,000 lbs. of cold water, or

100,000 lbs. of warm water aquatic animals per year.

Discharges into aquaculture projects, as defined in 40 CFR 122.25 also are subject to the NPDES permit program. However, this applies only to those operations that feature the confinement of aquatic animals within the waters of the State, or of the United States.

Wet Weather Programs:
In addition to point source NPDES permits, NPDES permits are also required for certain nonpoint sources (NPS) of pollution, such as Municipal Separate Stormwater Systems (MS4s), storm water runoff from various categories of industrial facilities, and runoff from construction sites. Nonpoint source NPDES permits require permitees to develop storm water management plans and education programs necessary to protect water quality.

Combined Sewer Overflow (CSO) Requirements
Prior to implementation of the of the Federal Water Pollution Control Act or the Clean Water Act, many cities and towns in Indiana and across the nation constructed combined sewer systems rather than separate sanitary and storm sewer systems. At the time, these systems were a cost-effective means of providing sewer service and improved drainage via a wastewater collection system that conveys sanitary wastewater and storm water through the same pipe.

Combined sewer systems were designed to carry wastewater flow during dry weather conditions and as much storm water flow as possible during wet weather events. Whenever the maximum capacity of these CSSs is exceeded, the excess flow is discharged directly into adjacent streams through overflow structures. While these overflows were intended to prevent excess flow from backing up in the collection system or overwhelming the wastewater treatment plant, Combined Sewer Overflows (CSO) result in the discharge untreated wastewater directly into river, streams, and lakes.

In Indiana, one hundred and eight (108) municipalities, including the City of Fort Wayne, have combined sewer systems with a total of over nine hundred (900) CSO outfalls. These CSO outfalls are point source discharges that are subject to NPDES permit requirements. As a result, the CSO requirements established in the Indiana CSO strategy are incorporated into individual municipal wastewater treatment plant NPDES permits (both major and minor permits) for CSO communities in Indiana.

In May 1996, the IDEM finalized its strategy for bringing CSO communities into compliance by the year 2005. This strategy is composed of a two (2) phase plan.

Phase I requires CSO communities to demonstrate implementation of minimum technology-based control plans, including the following:

- Proper operation and regular maintenance of sewers and POTW.
- Maximum use of the collection system for storage.
- Review and modification of pretreatment programs.
- Maximization of flow to the POTW for treatment.
- Prohibition of CSO discharges during dry weather.
- Control of solid and floatable materials in CSO discharge.
- Pollution prevention programs.
- Public notification of CSO occurrences and impacts.
- Review and revise sewer use ordinances to prevent additional CSOs and promote future designs to help minimize the impact of wet weather events
- Establish a Stream Reach Characterization and Evaluation protocol for assessing CSS and CSO discharges, and reporting on the impact

of both CSOs and the efficacy of CSO controls on receiving streams

Phase II requires CSO communities to establish a Long Term Control Plan (LTCP) with Water Quality Based Effluent Limits (WQBELs). The plan should have affordable and enforceable WQBEL goals with control alternatives developed with public participation. Phase II plans could require implementation schedules of 10 to 15 years. The goal of Phase II is to reduce overflow events to 4, or fewer, per year, or to capture 85 percent of all flows, system-wide.

Stormwater Phase I and II NPDES Permits (Rule 13)

In response to a desire for more comprehensive NPDES requirements for discharges of storm water, in 1987 Congress amended the CWA to require the Environmental Protection Agency (EPA) to establish phased NPDES requirements for storm water discharges. To implement these requirements, on November 16, 1990, EPA published the initial permit application requirements for certain categories of storm water discharges associated with industrial activity and for discharges from municipal separate storm sewer systems (MS4s).

The Phase I program addressed sources of storm water runoff that had the greatest potential to negatively impact water quality. Under Phase I, EPA required NPDES permit coverage for storm water discharges from:

- "Medium" and "large" municipal separate storm sewer systems located in incorporated places or counties with populations of 100,000 or more; and
- Eleven categories of industrial activity, one of which is construction activity that disturbs five or more acres of land.

Even with implementation of Storm Water Phase I requirements, pollutants in storm water discharges continued to remain a significant source of environmental impacts to surface waters as documented in the "National Water Quality Inventory, 1994 Report to Congress". This report provided a general assessment of water quality based on biennial reports submitted by the States under Section 305(b) of the Clean Water Act. The report indicated that storm water discharges from a variety of sources including separate storm sewers, construction activities, waste disposal, and resource extraction activities were major causes of water quality impairment.

As a result of ongoing concerns regarding the water quality impacts of storm water runoff, on January 9, 1998, the EPA proposed the development of NPDES storm water regulations for Phase II of the NPDES Storm Water Program. The Phase II regulations established an application process for all Phase II storm water discharges, which include all discharges composed entirely of storm water, except those specifically classified as Phase I dischargers. Such discharges include storm water from small municipal separate storm sewer systems, commercial sites, and institutional facilities. The Final Rule for Phase II of the NPDES Storm Water Program was published in the Federal Register on December 8, 1999.

The State of Indiana, specifically the IDEM, is responsible for implementation of Phase II of the NPDES Storm Water Program. Consequently, the IDEM has developed a new storm water general permit rule (327 IAC 15-13) in order to comply with Federal storm water program mandates. Regulated conveyance systems include roads with drains, municipal streets, catch basins, curbs, gutters, storm drains, piping, channels, ditches, tunnels and conduits.

Indiana's final Phase II Storm Water Rule was adopted as 327 IAC 15-13 on March 12, 2003. This rule is commonly known as "Rule 13" and contains the requirements for Indiana's statewide general permit for storm water discharges.

Storm Water Runoff Associated with Industrial Activity (Rule 6)
Discharges of runoff which have intermingled with non-storm waters or come into contact with certain wastes, discharges from certain facilities subject to federal storm water effluent limitations guidelines, or discharges into receiving streams and waters listed as Outstanding State Resource Waters or as Exceptional Use Streams (Other Runoff Associated with a Industrial Activity is eligible for a general, Rule 6, NPDES Storm Water Runoff Permit).

Drinking Water:
In 1996, amendments to the Safe Drinking Water Act placed a new focus on protecting drinking water by requiring States to implement Source Water Assessment and Protection (SWAP) programs to identify potential threats and implement protection efforts in areas serving as sources of drinking water. As a result of these source water protection requirements, local water utilities within the Maumee River Basin are in various stages of implementing Source Water Assessment and Wellhead Protection (WHP) Programs to protect against drinking water contamination.

Source Water Assessment Programs (SWAPs)
In 1997, Indiana began implementing Source Water Assessment Programs (SWAPs) to assess areas of potential threats and initiate protection efforts in areas that serve as sources of drinking water. Source water is untreated water from streams, rivers, lakes, or underground aquifers, which is used to supply private wells and public drinking water. While some treatment is usually necessary, ensuring that source water is protected from contamination can reduce the costs of treatment and risks to public health.

Protection of drinking water at the source can be successful in providing public health protection and reducing the treatment challenge for public water suppliers. Source water quality can be threatened by many everyday activities and land uses, ranging from industrial wastes to the chemicals applied to suburban lawns. The land area that impacts a wellfied is called an aquifer recharge or wellhead protection area and the land area that impacts both surface water and groundwater quality is termed the watershed.

In February of 1999, State Source Water Assessment Programs (SWAP) were required to be submitted to EPA describing their plan to implement a program to analyze existing and potential threats to the quality of the public drinking water throughout the state. To fulfill the intent of the Source Water Assessment Program, Indiana required drinking water utilities using groundwater to implement Wellhead Protection Programs (see below) and utilities using surface water intakes to monitor and report on the following contaminants:

- Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
- Inorganic contaminants, such as salts and metals, which can occur naturally or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.
- Pesticides and herbicides, which may come from a variety of sources such as agriculture,

stormwater runoff, and residential uses.
- Organic chemical contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.
- Radioactive contaminants, which can be naturally occurring or be the result of oil and gas production and mining activities.

Utilities are also required to develop an Annual Water Quality or Consumer Confidence Report in order to provide consumers with information about the quality of their drinking water.

The IDEM will provide the following four source water assessment elements for utilities that use surface water:
- Delineating (or mapping) the source water assessment areas (watersheds),
- Conducting an inventory of potential sources of contamination in the delineated area,
- Determining the susceptibility of the water supply to those contamination sources, and
- Releasing the results of the determinations to the public.

The Underground Injection Control (UIC) Program also works closely with the with State SWAPs and local governments to oversee underground injection of waste (Class I-V Wells) in order to prevent contamination of drinking water resources.

Wellhead Protection Program
Wellhead protection refers to a state-mandated program requiring public water suppliers who provide drinking water from groundwater sources to plan and implement a program to protect groundwater near their wells. More specifically, a "wellhead protection area" must be established either by a "delineation" (typically done by a geologist) or, in cases where the system's pumping capacity is less than 100,000 gallons per day, a 3000 foot radius can be drawn around each wellhead. For the larger systems that require the delineation, the boundaries are based primarily on one-year and five-year "time of travel" of groundwater as well as the actual physical boundaries and degree of confinement of the aquifer.

Upon establishment of the wellhead protection area(s), the public water supplier must then embark on a process which involves: the establishment of a Local Planning Team; the preparation of a Wellhead Protection Plan; and the implementation of that Plan. There are 7 primary requirements for the initial draft plan submittal to the State. These plan requirements include: planning team member information; delineation of wellhead protection area and associated technical information; a potential pollution source inventory; a management strategy with implementation timetable; a contingency plan; a description of public participation; and a description of a proposed public education program.

Plans including the requirements mentioned above were to be completed and submitted to IDEM by the following dates:

For public water suppliers serving a population of more than 50,000:	March 2000
For public water suppliers serving a population of 3,300-50,000:	March 2001
For public water suppliers serving a population of less than 3,300:	March 2002

Total Maximum Daily Load (TMDL) Program

In cases where permits and effluents limitations are unable to protect a streams ability to meet state water quality standards, IDEM and the US EPA are required to list streams that demonstrate water quality impairments, that are not the result of a compliance issue, under the provisions of the Clean Water Act. Streams identified on this list are required to undergo the Total Maximum Daily Load (TMDL) Process.

By definition, a Total Maximum Daily Load (TMDL) is the maximum amount of any given pollutant that a waterbody can absorb without violating water quality standards for designated uses, such as drinking water, aquatic life, and recreation. TMDL is also used to describe the process used for bringing a body of water back into compliance with water quality standards. This process involves assessing and/or measuring the probable sources of water quality problems in a water body and setting Waste Load Allocations (WLAs) for point source discharges and specific requirements and/or best management practices for non-point sources of pollutants that will bring the water body into compliance with water quality standards.

TMDLs are a requirement of Section 303(d) of the Clean Water Act that requires states to identify the waters within their boundaries that do not meet water quality standards. The list must identify the pollutant(s) or factor(s) responsible for the listing of each water body. States must then rank the waters on the list taking into account the severity of pollution and the designated uses of the waters. These rankings are used to set priorities for achieving water quality standards. Each State is required to review the 303(d) list, make changes as necessary, and submit the list to the U.S. Environmental Protection Agency (EPA) for approval in even-numbered years. Once a body of water is added to a State 303(d) list, a TMDL for that water body is calculated to meet water quality objectives.

TMDLs can and most likely will have an impact on municipal growth and development, operations, and quite possibly its economy. As a result of the waste load allocations (WLAs) calculated for a TMDL, additional pollution discharge limits could be applied to a community's wastewater treatment plant or to local industries, requiring additional treatment or possibly new technology. Additionally, a community may be required to control and treat stormwater runoff from their streets and parking lots. Even local farmers may be asked to use alternative methods in their operations to prevent fertilizers and pesticides from reaching rivers.

Once TMDLs are set, States will enforce them through permits and through management plans designed to prevent or limit runoff. Permits will include the pollutant limits and a schedule for compliance. In the meantime, States will continue to evaluate the waters in question and will modify the permits when appropriate.