Watershed Diagnostic Study

Loefler and Scott Ditches
Gibson County, Indiana

December, 2009

DAVEY RESOURCE GROUP

A Division of The Davey Tree Expert Company

Watershed Diagnostic Study

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Executive Summary

The Loefler and Scott Ditches Watershed Diagnostic Study is a study of the water quality of the Loefler and Scott Ditches and the factors that influence it. This study was funded by an Indiana Department of Natural Resources (IDNR) Lake and River Enhancement Program grant with a match provided by Gibson County Soil and Water Conservation District (SWCD). Gibson County SWCD retained Davey Resource Group (Davey) and its subcontractor, Empower Results, LLC, to conduct the study. Work began in September, 2008 and concluded in August, 2009 with a final public meeting and publication of this report.

The Loefler and Scott Ditches watershed (watershed study area) is located in the western half of Gibson County, Indiana. It is composed of 2 14-digit HUC watersheds (05120113050030 and 05120113050040) and includes approximately 9,430 hectares (23,300 acres). The watershed study area drains directly to the Wabash River.

Historically, the watershed study area was predominantly bottomland forest with scattered portions of upland forest and possibly prairie. Today, 78 percent of the watershed is cultivated crops, 2 percent is developed, and the remaining balance consists of natural area, pasture, and open water. Weighted averages from 2000 to 2007 tillage transect data indicate that conservation tillage was implemented on approximately 30 percent of all fields. Most of the Scott Ditch watershed portion of the watershed study area has very flat topography and lies within the 100-year floodplain of the Wabash River. A total of 91 percent of soils in this watershed is hydric. The Loefler Ditch watershed is characterized by rolling topography. A total of 44 percent of soils in the Loefler Ditch watershed is hydric and 28 percent are highly erodible.

Data collected as part of this study documented low dissolved oxygen levels as well as high turbidity and total suspended solids concentrations in streams. Ammonia nitrogen levels consistently exceeded Indiana water quality standards at multiple sample sites. Analysis of macroinvertebrate populations indicated that all streams sampled for this parameter are impaired for aquatic life use. Poor quality habitat as indicated by the Qualitative Habitat Evaluation Index (QHEI) influences the macroinvertebrate populations and corresponding analyses.

An analysis of pollutant loads indicated that Subwatersheds 7, 8, and 9 should be emphasized in conservation efforts to reduce nutrient and sediment loads. Watershed modeling was conducted using the Spreadsheet Tool for the Estimation of Pollutant Load (STEPL) program. STEPL estimates significant decreases in nutrient and sediment loads with implementation of conservation tillage.

Protection of the public water supply wellhead and flooding and drainage improvements were discovered to be concerns held by watershed stakeholders. Numerous best management practices (BMPs) and institutional measures are recommended by Davey to address water quality issues and public concerns. Recommended BMPs include conservation tillage, critical area planting, filter strips, grade stabilization structures, grass waterways, nutrient and pest management plans, streambank stabilization, tile riser grass buffers, water and sediment control basins, and wetlands restoration. Other recommended measures include development and implementation of county zoning and a land use ordinance, as well as conducting a petroleum hydrocarbon assessment.

Acknowledgements

This study was made possible by funding from the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement Program and the Gibson County Soil and Water Conservation District (SWCD). Davey Resource Group (Davey) project team members conducted fieldwork, data collection, report writing and mapping, and provided project oversight. The Davey project team consisted of Chad Appleman, Ana Burns, Ken Christensen, Aren Dottenwhy, Alicia Douglass, Jessica Hickey, Deb Sheeler, Kevin Surbella, and Karen Wise. Public meetings and outreach was conducted by Empower Results, LLC staff including Lisa Bihl, Jill Hoffman, and Kelly Levengood.

Individuals who provided project consultation or contributed to this report via personal communication include: Ann Ice from the Gibson County SWCD; Gary Seibert from the Indiana State Department of Agriculture; Angela Sturdevant, Brant Fisher, Katie Smith, Michelle Cain, and Ron Hellmich from IDNR; Michael Stevenson and Orrville Byrns from Gibson County Surveyor's Office; James True from the Gibson County Purdue Extension Service; Chuck Bell, Todd Davis, and Stacey Sobat from the Indiana Department of Environmental Management; Michael Litwin from the U.S. Fish and Wildlife Service; Dennis Simpson, Scott Ditch Commissioners; and Rebecca Sparks from the Duke Energy Gibson Station power plant.

Special thanks are also due to numerous Loefler and Scott Ditches watershed stakeholders including: Keith Armstrong, Gerald Bledsol, Darwin Callis, Eric Callis, Steve Downy, Travis Gogel, Marion Jochim, Ronald Krueger, Clyde Scott, Marla Scott, Phil Scott, Will Scott, and DeWayne Wade.

Introduction

Gibson County Soil and Water Conservation District (SWCD) retained Davey Resource Group (Davey) and its subcontractor, Empower Results, LLC, to conduct a Watershed Diagnostic Study on the Loefler and Scott Ditches watershed (watershed study area). The purpose of a Watershed Diagnostic Study is to describe conditions and trends in a stream and its watershed, identify potential sources of nonpoint source pollution in the watershed, prioritize potential watershed improvement projects, propose direction for future work, and make predictions of success for future work. This Watershed Diagnostic Study for the Loefler and Scott Ditches watershed was funded by an Indiana Department of Natural Resources (IDNR) Lake and River Enhancement Program grant with a match provided by Gibson County SWCD.

The Loefler and Scott Ditches watershed is located in the western half of Gibson County, Indiana (Figure 1). A watershed is the total land area that drains to a particular water body. The U.S. Geological Survey (USGS) has hand-delineated what are known as 8-digit hydrological-unit code (HUC) watershed boundaries based on their topographic maps, sometimes dividing longer streams along their length. The Natural Resources Conservation Service (NRCS) further delineated 11- and 14-digit HUC watersheds within the 8-digit HUC watershed boundaries. The smallest delineated watersheds are assigned 14-digit HUC numbers.

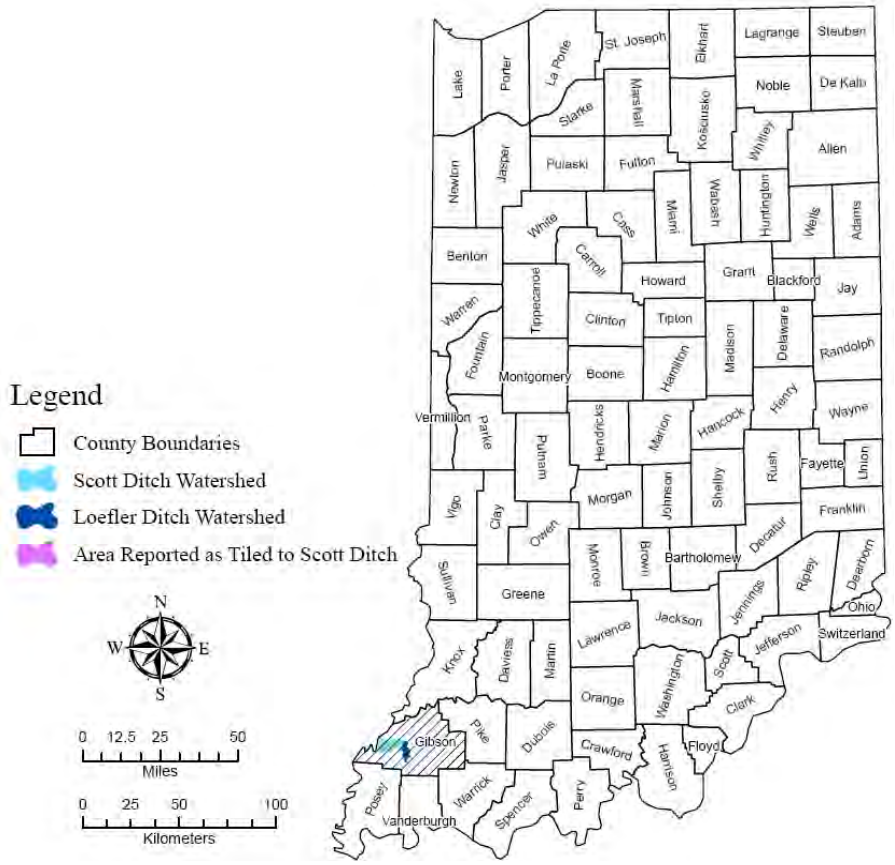


Figure 1. Indiana State Map

The watershed study area contains 2 14-digit HUC watersheds, and an area reported by the landowner to drain to the Scott Ditch via field tiles. The Loefler Ditch watershed (HUC 05120113050030) is located in Union and Montgomery Townships east of the Scott Ditch watershed (HUC 05120113050040) which is located in Montgomery and Wabash Townships (Figure 2). The Loefler Ditch becomes Scott Ditch at State Road (SR) 65, slightly less than halfway along the length of the primary stream in the watershed study area (Figure 3). The Loefler Ditch watershed comprises approximately 2,902 hectares (7,170 acres) of the watershed study area, and the Scott Ditch watershed comprises approximately 6,528 hectares (16,130 acres) of the watershed study area. The watershed study area totals approximately 9,430 hectares (23,300 acres) and drains directly to the Wabash River.

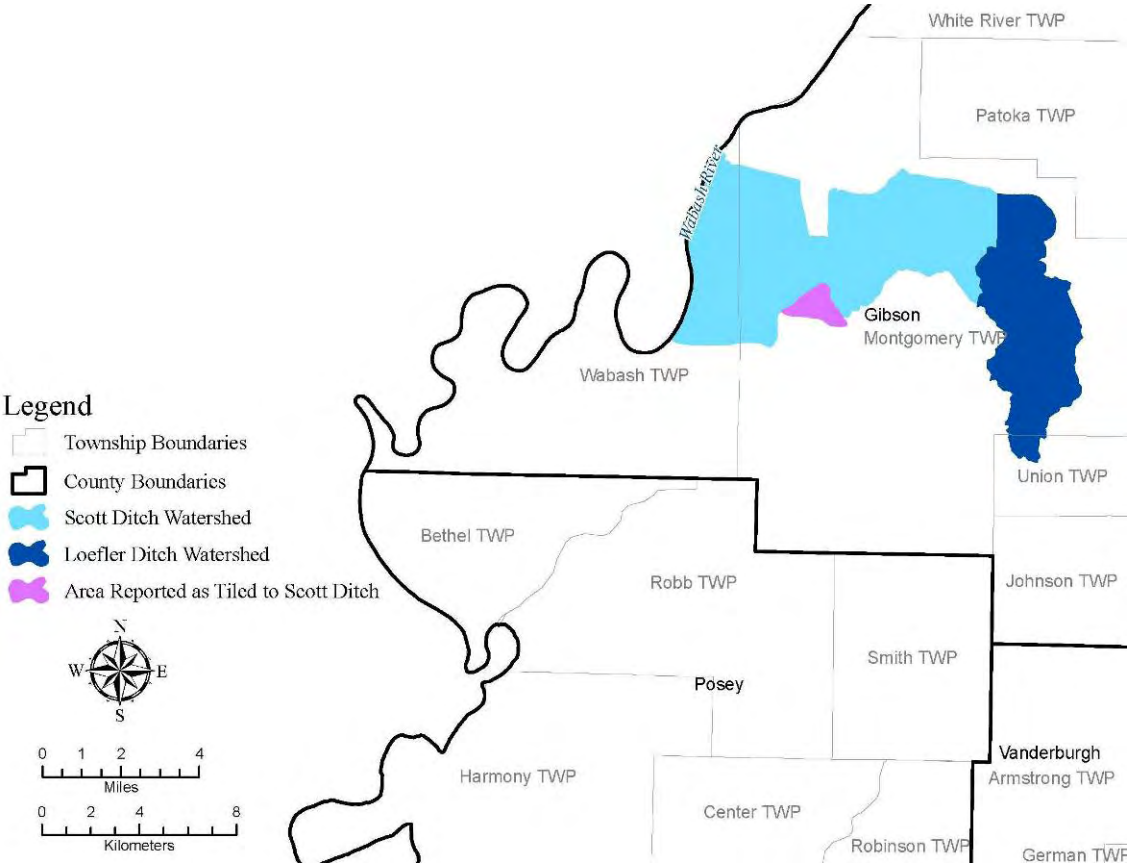


Figure 2. Gibson County Township Map

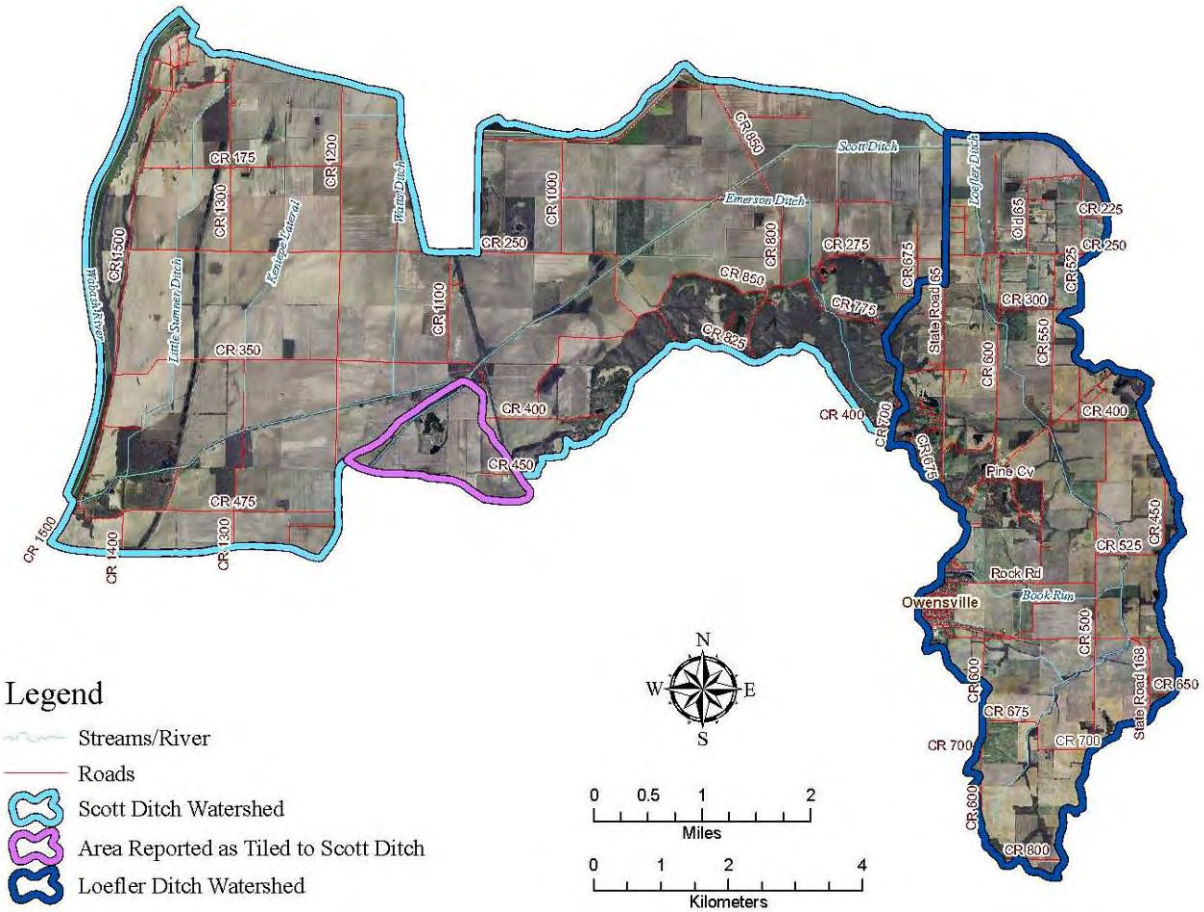


Figure 3. Aerial Photograph Map

Analysis of Secondary Source Data

Data from multiple secondary sources were gathered and analyzed to provide an understanding of the physical setting and general characteristics of the watershed study area. Surface water quality is influenced by multiple factors relating to the setting and characteristics of the watershed study area. Historical water quality related data from the surrounding area provide perspective on how water quality of the Loefler and Scott Ditches watershed influences and compares with other nearby surface waters. The presence of rare, threatened, and endangered species are noted to create awareness of how the watershed study area conditions and activities may influence these species and other life within the study area.

Physical Setting

Geology

The bedrock geology of southwestern Indiana is comprised of the McLeansboro Group of Pennsylvanian age. Shale and sandstone are the predominant components of the group and may consist of more than 90 percent of its composition. Small quantities of siltstone, limestone, clay, and coal may also be present (Thompson, 1998). Depth to Bedrock surface is typically less than 15 meters (50 feet). The McLeansboro Group ranges in thickness from 0 meters (0 feet) where it converges with the Carbondale Group in eastern Gibson County to approximately 213 meters (700 feet) deep on the western edge of the county (Schrader, 2003).

Topography

The topographies of the Loefler and Scott ditches watersheds are distinctly different. In general, the Loefler Ditch watershed is predominantly characterized by rolling topography while the Scott Ditch watershed is nearly flat displaying characteristics of an old lake bed. Significant hill slopes do occur in a relatively small portion of the Scott Ditch watershed located along the southeast boundary of the watershed and northwest of Owensville. Likewise, the old lake bed characteristics of the Scott Ditch watershed do extend east to a small portion of the north end of the Loefler Ditch watershed. Figure 4 depicts the watershed boundaries overlaid on a 7.5-minute U.S. Geological Survey (USGS) topographical map with 6-meter (20-foot) contour lines.

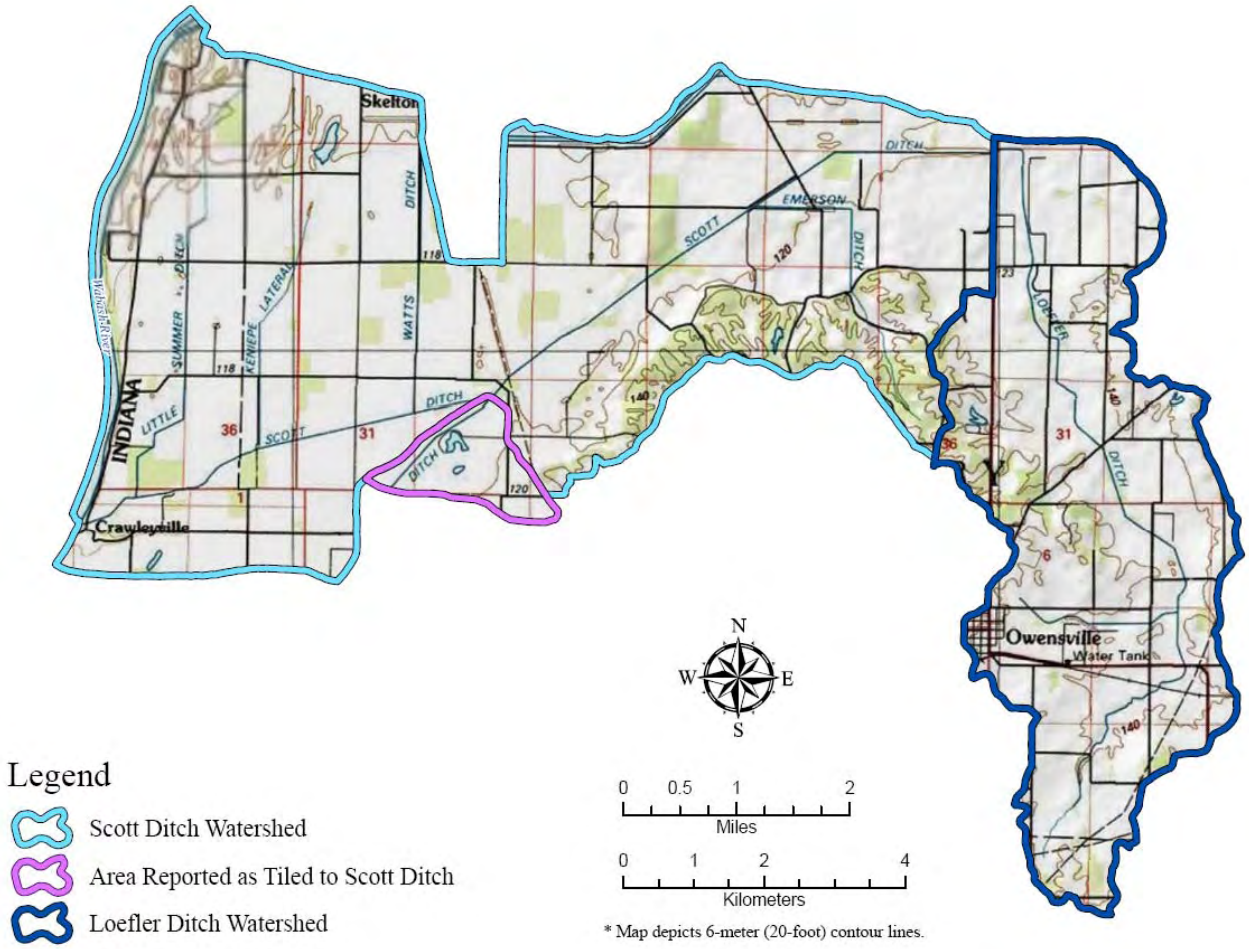


Figure 4. USGS 7.5-Minute Topographical Map

The elevation at the upstream-most point of the Loefler Ditch is approximately 150 meters (495 feet) based on 0.6-meter (2-foot) contour line topographical data from the Gibson County Surveyor's Office (Figure 5). The elevation at the break between the Loefler and Scott Ditch watersheds is approximately 120 meters (395 feet). The elevation at the point where the Scott Ditch debouches into the Wabash River is approximately 117 meters (383 feet). The overall grade change for the entire watershed study area is approximately 1.3 meters per kilometer (6.6 feet per mile). There is approximately 2.4 meters per kilometer (12.8 feet per mile) of fall in the Loefler Ditch watershed, and 0.2 meters per kilometer (1.3 feet per mile) of fall in the Scott Ditch watershed.

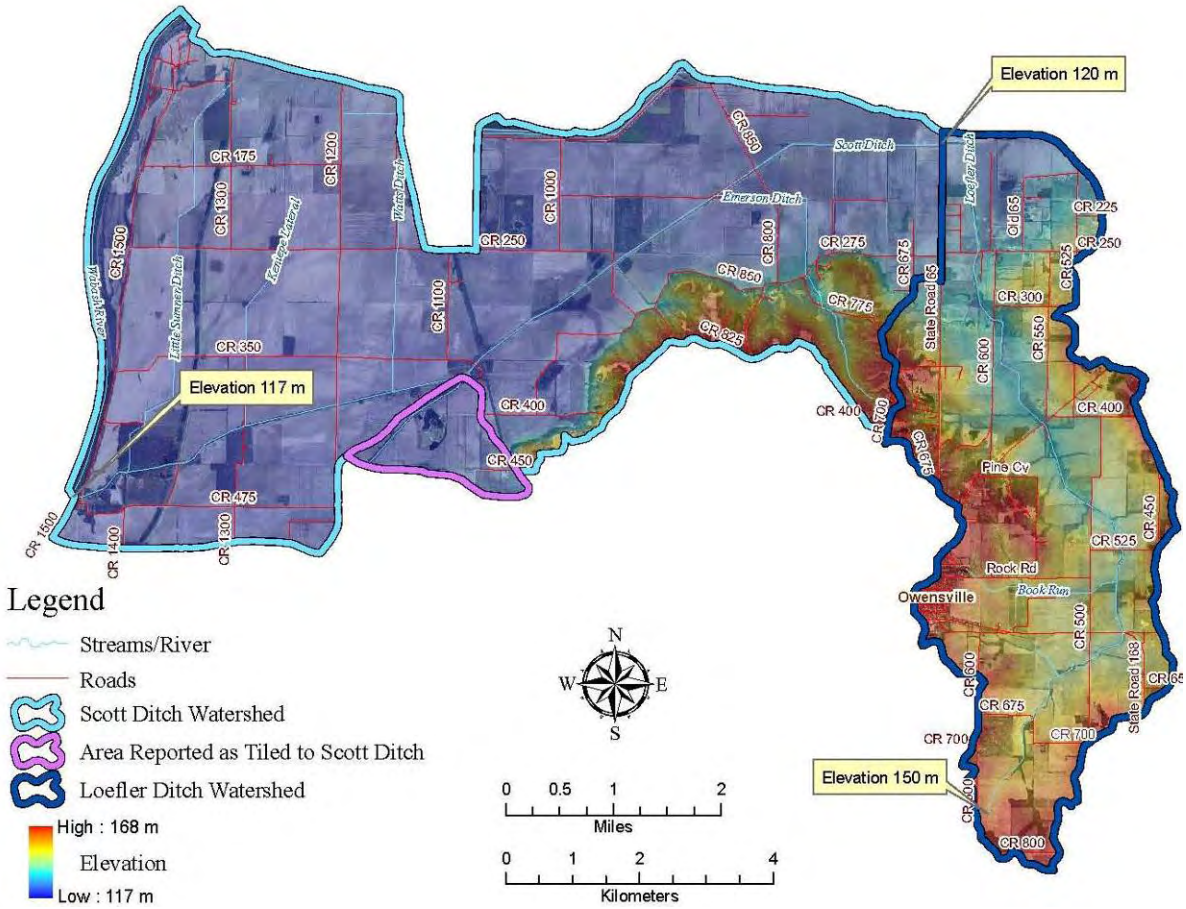


Figure 5. Shaded Relief Elevation Map

Soils

Soils in southwest Indiana formed in lacustrine plains following the retreat of the Illinoian and Wisconsin glaciers (Thornberry, 1950). The Wisconsin glacier plowed soils from northern latitudes burying sandstone, shale, and eolian deposits of the Pennsylvanian age that lie beneath present-day soils. Marginal lakes formed from melt waters of the Illinoian glacier, and tributary valleys served as sluicways for Wisconsin melt waters. Loess deposits are interspersed among lacustrine flats in upland positions.

Two main factors that distinguish two groups of soils occurring in the watershed are parent material from which they were formed and landscape position. The first group includes those soils found in the "hill country", typical of Owensville and most of the Loefler Ditch watershed. Soils in this area were formed as the result of the deposition of windblown Peoria and Farmland loess (Schaetzl and Anderson, 2005). In stark contrast, the parent materials of soils occurring in the nearly level to flat areas typical of the Scott Ditch watershed and most streambeds in the Loefler watershed include lakebed and lacustrine deposits.

Six soil associations occurring in the watershed are listed in Table 1. Soil association data are derived from the State Soil Geographic (STATSGO) database and are available from IndianaMap (IGS, 2008).

Table 1. Soil Associations

Association	Highly Erodible	Hydric	Formation Process	Location
Alford-Sylvan-Ionia	Yes	No	in loess	uplands
Bloomfield-Princeton-Ayreshire	Yes	No	eolian deposits	uplands
Lyles-Patton-Henshaw	No	Yes	in loamy sediments	river terraces
Nolin-Haymond-Petrolia	No	Yes	alluvium	bottomlands
Reeseville-Ragsdale-Uniontown	No	Yes	in silty lacustrine and lakebed deposits	lake plains and lacustrine terraces
Zipp-Vincennes-Evansville	No	Yes	in loamy sediments and lacustrine deposits	river terraces and river bottoms

The variability of topography in the watershed is very pronounced and is the primary factor with the greatest attribution of how erodible soils are in the watershed. As depicted in Figure 6, highly erodible soils are located in the hillslopes and include the Alford-Sylvan-Ionia and Bloomfield-Princeton-Ayreshire associations.

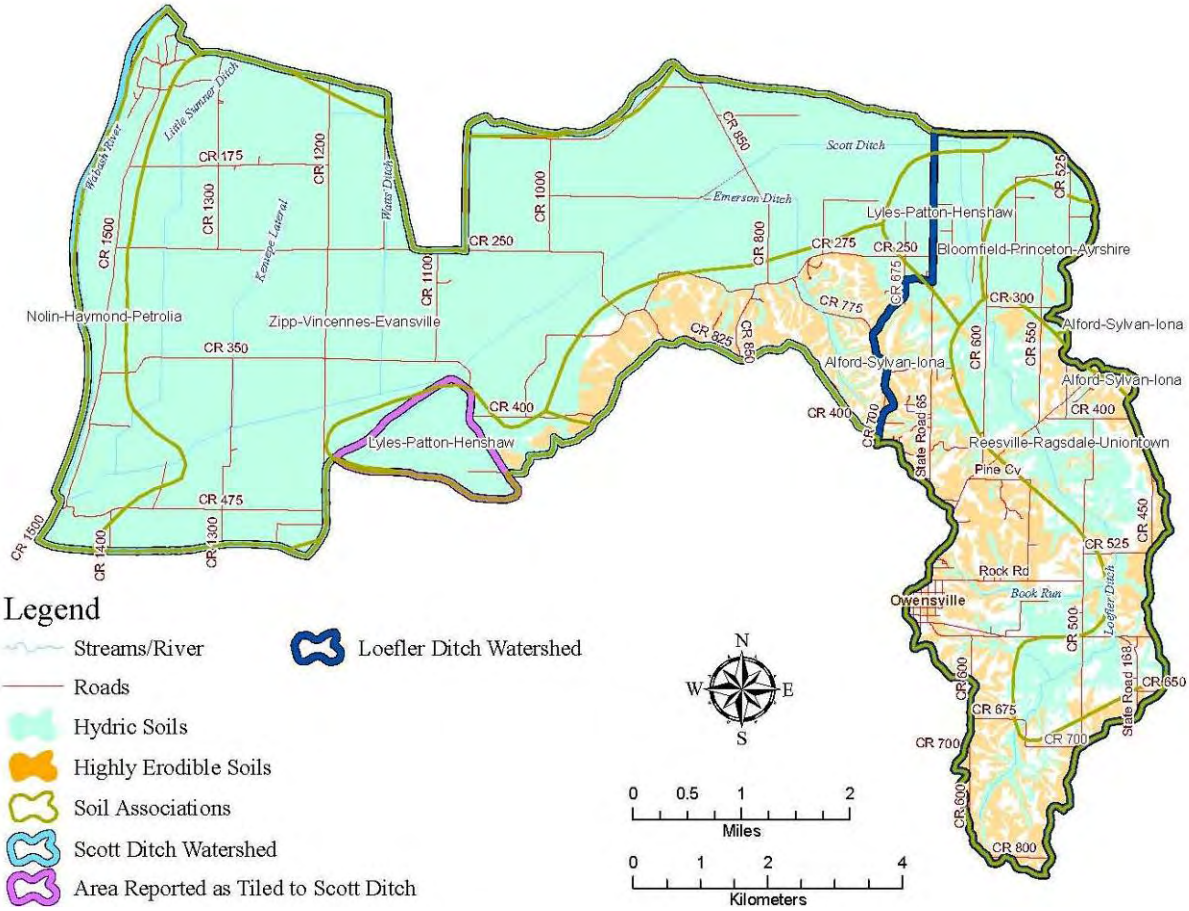


Figure 6. Soils Map

Highly erodible soils were determined to be those having slopes greater than 12 percent or soils with less than a 12 percent slope recorded as either eroded or severely eroded (Soil Survey Staff, 2009). A total of 28 percent of soils in the Loefler Ditch watershed are highly erodible. The most common erodible soil series in the Loefler Ditch watershed include Alford silt loam (AlC3) and Sylvan silt loam (SyC3) which comprise 9 and 8 percent of the soils, respectively. Only 6 percent of soils in the Scott Ditch watershed are highly erodible. Sylvan silt loam (SyF) is the most predominant highly erodible soil series in the Scott Ditch watershed and comprises 4 percent of soils.

Hydric soils are prevalent in both watersheds. Hydric soil series are soils that formed under conditions of saturation, flooding, or ponding for a duration long enough to develop anaerobic conditions in the upper part of the soil column during the growing season (Environmental Laboratory, 1987). A total of 44 percent of soils in the Loefler Ditch watershed are hydric. A total of 91 percent of soils in the Scott Ditch watershed are hydric. The most common hydric soil series in the Loefler Ditch watershed include Maplehill silt loam (Ma), comprising 7 percent of the soils; Bloomfield sand (BlB) and (BlC), comprising 5 and 4 percent of the soils, respectively; Ragsdale silt loam (Ra) and (Rb), comprising 5 and 4 percent of the soils, respectively; and Wakeland silt loam (Wa), comprising 4 percent of soils. The most common hydric soil series in the Scott Ditch watershed include Vincennes loam (Vn), comprising 32 percent of soils; and Zipp silty clay (Zp), comprising 22 percent of soils.

Climate

The climate of the study area is typical to that of Indiana in general. The National Climatic Data Center (NCDC) climate database records an average annual temperatures and precipitation for Indiana. The average annual temperature of Indiana is 10.98 degrees Celsius (51.76 degrees Fahrenheit) for data collected from 1901 to 2000. The data trend toward an average increase in annual temperature of 0.01 degree Celsius (0.03 degree Fahrenheit) per decade from 1895 to 2007 (Figure 7). The average annual precipitation recorded for Indiana from 1901 to 2000 is 101.85 cm (40.10 inches) with an average increase of 1.02 cm (0.40 inch) per decade from 1895 to 2007 (NCDC, 2008).

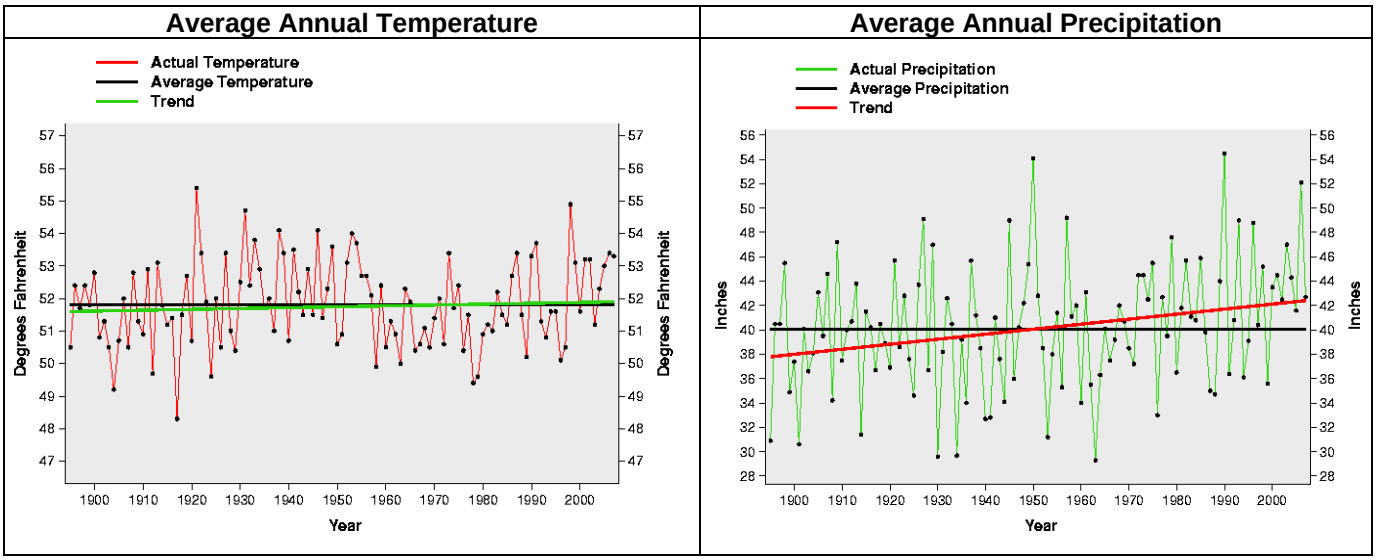


Figure 7. NCDC Climate Data

Hydrology

Drainage

The headwaters of Loefler Ditch begin at County Road 800 South southeast of the town of Owensville. Loefler Ditch is approximately 12.6 kilometers (7.8 miles) in length and flows in a northerly direction before making a 90 degree angle bend to the west just prior to flowing under State Road (SR) 65. At SR 65 Loefler Ditch becomes Scott Ditch. Scott Ditch is approximately 14.5 kilometers (9.0 miles) in length from SR 65 to its confluence with the Wabash River near Crawleyville, Indiana. Multiple tributaries flow to the Loefler and Scott Ditches of which 28.5 kilometers (17.7 miles) are mapped for a total of 55.6 kilometers (34.5 miles) of mapped streams and ditches in the watershed study area.

The Gibson County Drainage Board maintains 329.93 kilometers (205.01 miles) of regulated drains in Gibson County, most of which are open ditches, while 193.60 kilometers (120.30 miles) of drains are maintained by drainage districts (M. Stevenson, personal communication, August 3, 2009). Scott Ditch Board maintains Scott Ditch. Numerous named and unnamed tributaries, private field tiles, eroded gullies, and roadside ditches convey surface water to Loefler and Scott Ditches.

Wetlands

Wetlands are areas where soils are saturated at or near the surface at a frequency and duration long enough to support a dominance of wetlands plants and the development of hydric soils (Environmental Laboratory, 1987). Wetlands serve many functions upon which people and animals depend. Wetlands detain and retain stormwater, thereby attenuating downstream flooding, filter nutrients and sediments from water, help to keep surface water flowing during dry periods, and recharge groundwater aquifers. Many animal species depend on wetlands for food, shelter, and breeding. Plants that are a source of food and the raw materials for many medicines are found in wetlands. Wetlands clearly benefit the pharmaceutical, agriculture, tourism, and recreational industries, to name a few.

Approximately 30 years ago, the U.S. Fish and Wildlife Service (USFWS) began the National Wetlands Inventory (NWI) program to map the extent and status of wetlands. The process entailed examining aerial photographs and other available spatial information, and tracing the locations of wetlands on USGS topographic base maps. Today, the USFWS, in cooperation with the USGS, has converted most NWI paper maps to digital format.

Digital NWI data were downloaded from IndianaMap and overlaid on 2005 aerial imagery to produce Figure 8, in which the locations of wetlands in the Loefler and Scott Ditches watershed are displayed (IGS, 2008). NWI maps represent the locations where wetlands were likely to have occurred at the times maps were produced. Some wetlands depicted in the map may no longer exist and other wetlands may exist that do not appear on the map.

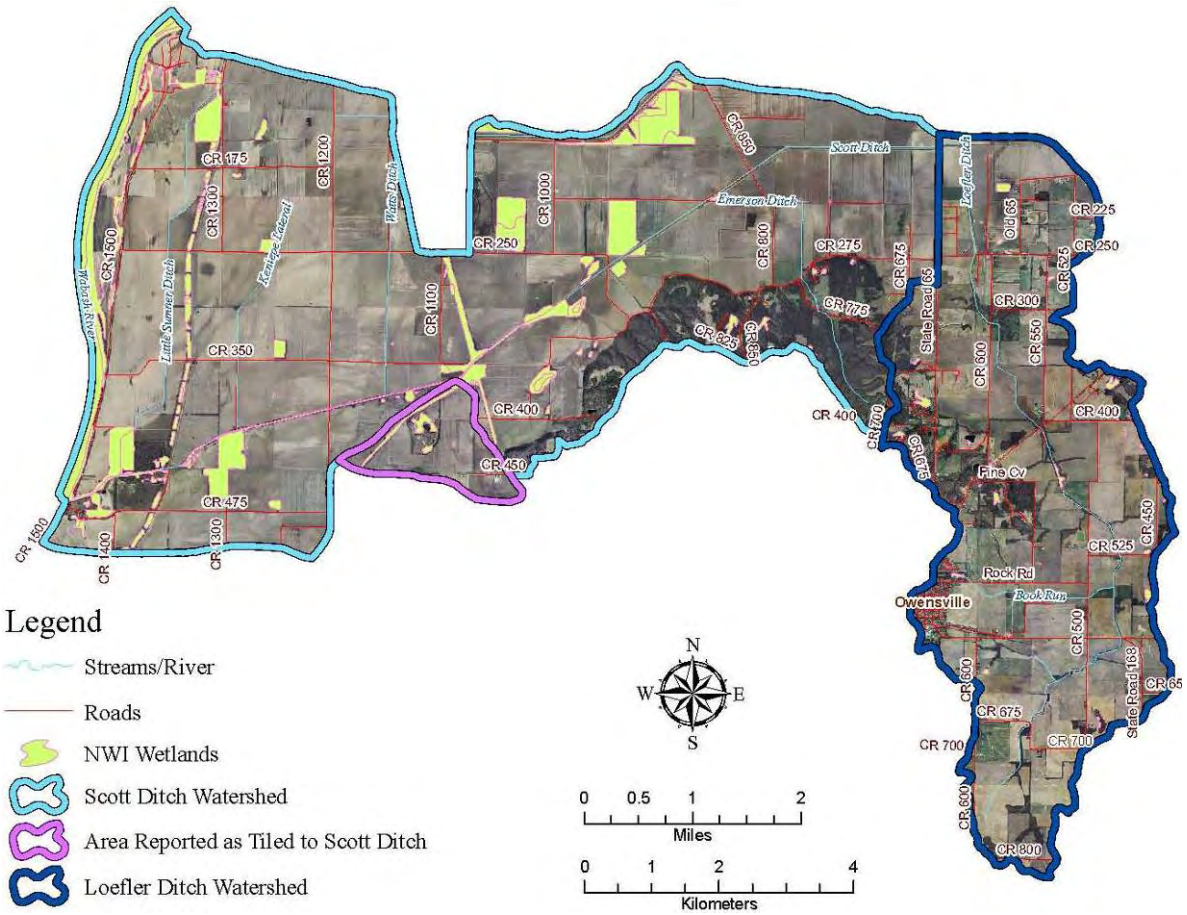


Figure 8. NWI Wetlands Map

According to NWI data, approximately 600 hectares (1,480 acres) of wetlands occur in the watershed study area. Hydric soils are a good indicator of where wetlands may have once existed. Most hydric soils occur in the Scott Ditch watershed where the land is mostly level; however, hydric soils commonly occur in the floodways and flood fringes of Loefler Ditch. Approximately 7,224 hectares (17,851 acres) of hydric soils occur in the Loefler and Scott Ditches watershed. Therefore, it is plausible that approximately 6,625 hectares (16,371 acres) of wetlands in the watershed study area have been converted to non-wetlands through artificial drainage.

Floodplain Management Areas

Floodplains are low-lying areas adjacent to streams and rivers which are prone to recurring flooding. Figure 9 indicates the extent of the Federal Emergency Management Agency (FEMA) 100-year floodplain within the watershed study area. As defined by FEMA, floodplain management is the operation of a community program of corrective and preventative measures for reducing flood damage. These measures take a variety of forms and generally include ordinances governing land use development. Gibson County does not currently have zoning or a land use ordinance.

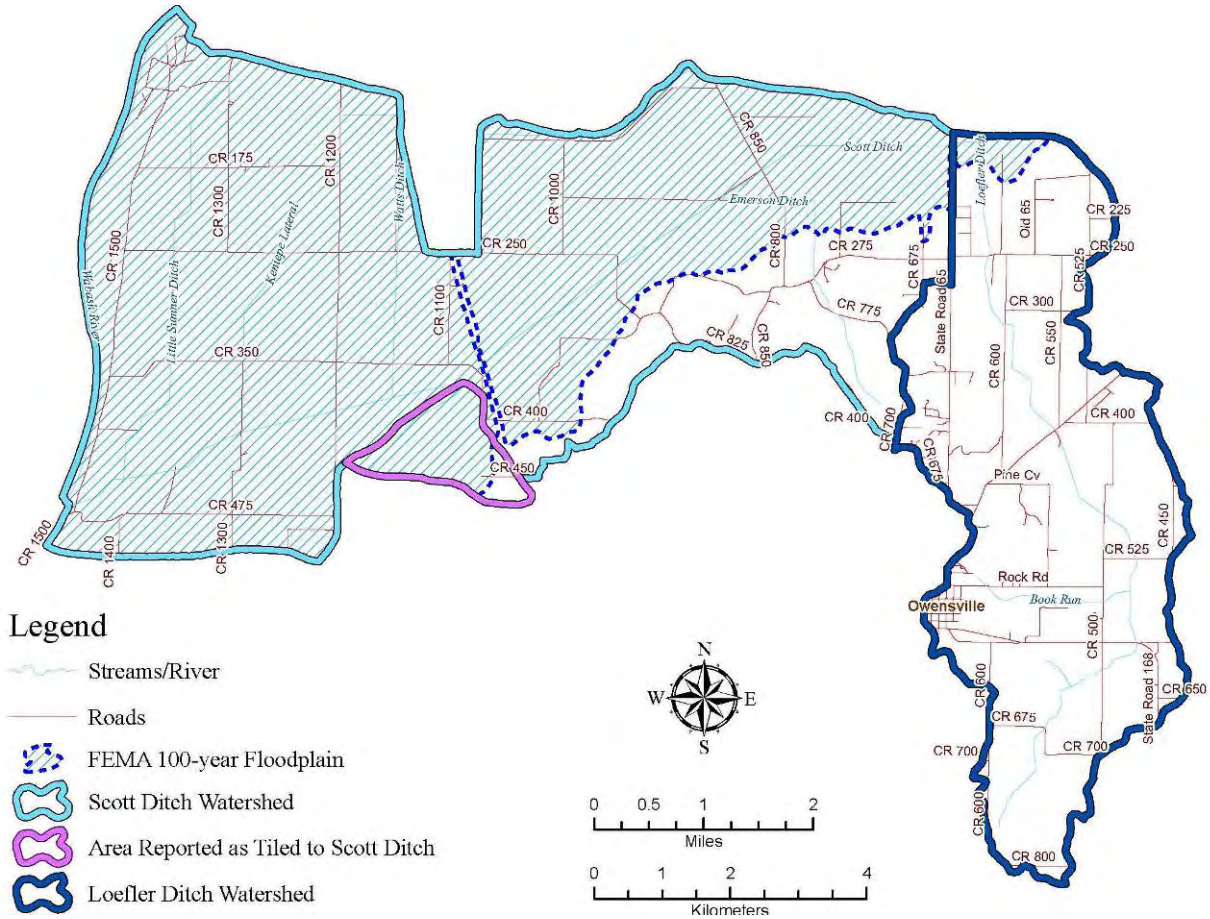


Figure 9. FEMA 100-Year Floodplain Map

The Wabash River is a dynamic, meandering river. In an effort to contain floodwaters of the Wabash River, the U.S. Army Corps of Engineers (USACE) constructed a levee aligned parallel with and located approximately 1.6 kilometers (1 mile) from the east bank of the Wabash River in the 1960s (O. Byrns, personal communication, August 3, 2009). An electric-powered pump system is located just behind the levee on the Scott Ditch approximately 640 meters (2,100 feet) north of County Road 475 South. The pump is maintained by the USACE. County Road 1500 runs north and south parallel to the Wabash River and essentially functions as a levee, as well.

The vegetation cover of the Wabash River floodplains throughout southwest Indiana was primarily bottomland and upland hardwood forest with scattered prairie prior to settlement and conversion to agricultural land (Jackson, 1997). Most of the Wabash River floodplain within the Loefler and Scott Ditches watershed has been converted to and is in active agricultural row crop production. As a result, riparian areas along the Wabash River within the study area are fragmented and consist of woods, many of which contain wetlands.

The floodplain is managed in such a way so as to sustain agricultural row crops. In addition to the levees and pump on Scott Ditch, substantial berms have been constructed along the Scott Ditch to contain floodwaters in the ditch channel when the elevation of the Wabash River prevents water from the Scott Ditch to flow. Some field tile outlets to the Scott Ditch are fitted with flap gates to prevent water from back-flowing into tile systems during high water levels (Photograph 1). Combined, these flood control practices are intended to work as a system to attenuate the intensity and duration of flooding for the primary purpose of reducing the frequency and severity of agricultural losses. There is a minimum of 4 dwellings located in the 100-year floodplain as determined by aerial photointerpretation.

Photograph 1 (10-22-08). This photograph depicts a tile outlet with a flap-gate in the Scott Ditch.

Subwatersheds

A total of 10 subwatersheds were delineated within the Loefler and Scott Ditches watersheds using the watershed delineation tool developed by Choi and Engle (2009). The watershed delineation tool delineates land area draining to a particular set of coordinates based on 7.5-minute USGS topographical map spatial data. Subwatersheds for this study were delineated using the coordinates of each sample point location. A map depicting the subwatershed boundaries and a table listing the hectares and acreage of each subwatershed follows (Figure 10 and Table 2). Knowledge of the extent of land area draining to each sample site location can help land use planners prioritize areas for conservation practice implementation based on water quality data.

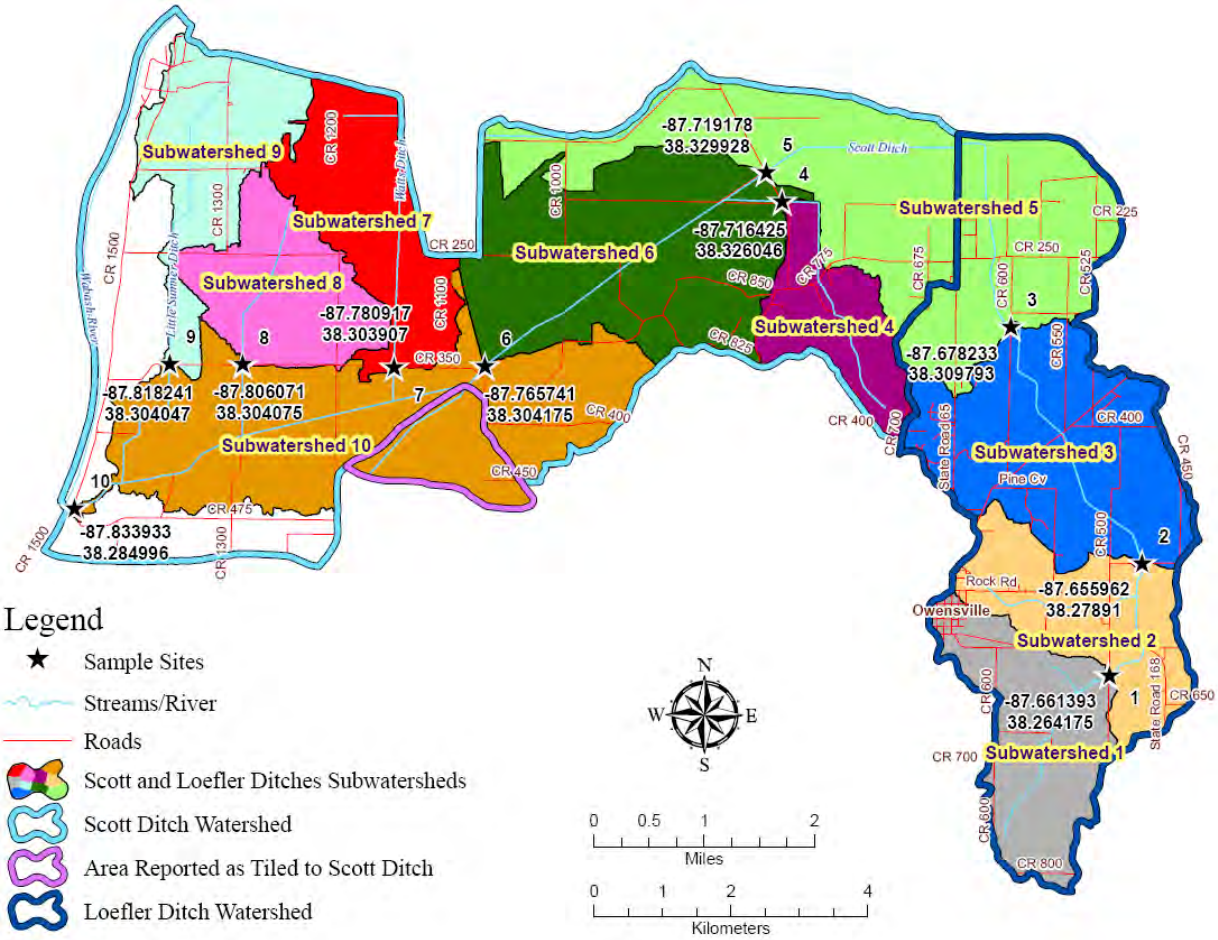


Figure 10. Subwatersheds Map

Table 2. Approximate Size of Subwatersheds

Subwatershed	Hectares	Acres
1	622	1,538
2	570	1,408
3	996	2,460
4	375	927
5	1,688	4,172
6	1,193	2,947
7	603	1,490
8	515	1,271
9	558	1,378
10	1,466	3,622

Land Use

Land Use Categories

Land use data were obtained from the 2001 National Land Cover Database (NLCD) available from IndianaMap (IGS, 2008). These data were originally produced using a combination of Landsat imagery and ancillary data. Figure 11 depicts the distribution of land use types in the study area based on a combination of the 2001 NLCD, aerial photointerpretation, and observations made in the field. Table 3 lists the approximate area of each land use type in the watershed study area.

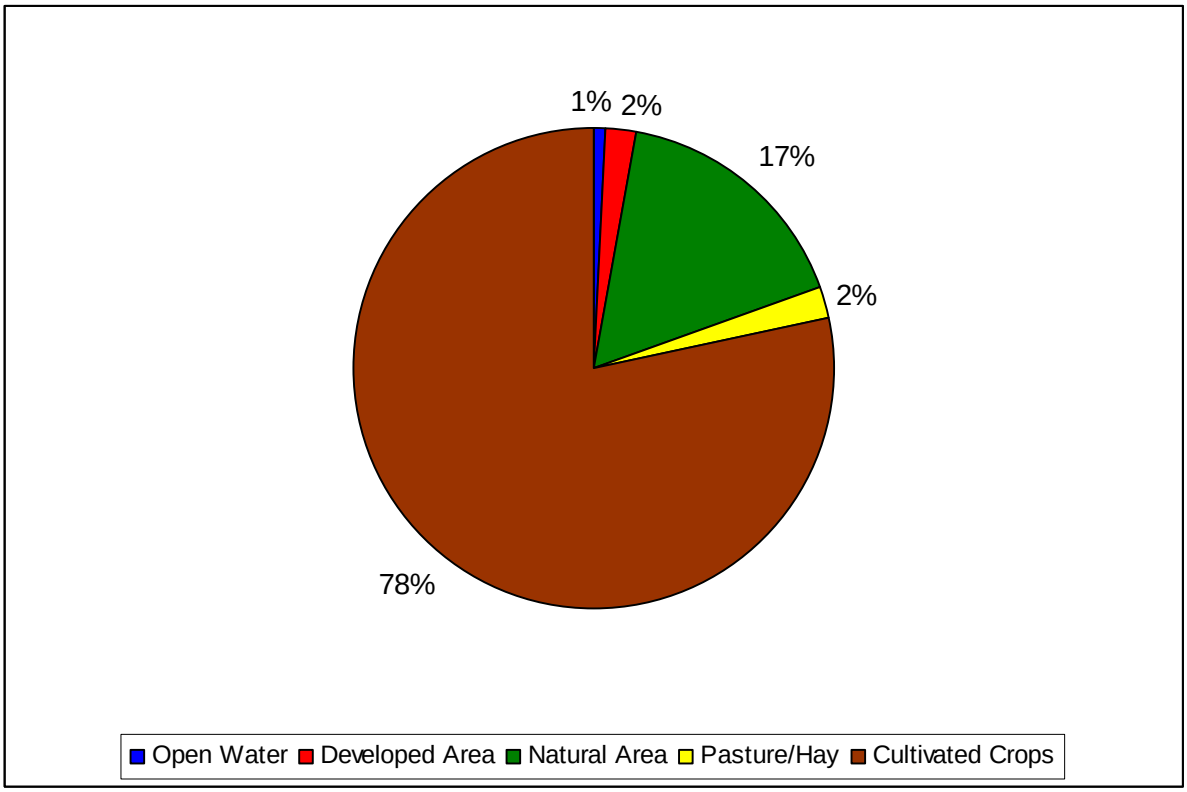


Figure 11. Land Use Percentage Graph

Table 3. Land Use Area

Land Use Type	Area (Hectares)	Area (Acres)
Open water	90	223
Developed area	180	44
Natural area	1,574	3,890
Pasture/hay	189	467
Cultivated crops	7,396	18,275

Agriculture is the predominant land use type in the watershed study with 78 percent of land in the watershed planted in row crops. An additional 2 percent of land is either pasture or hay fields. A total of 17 percent of the watershed is natural area including mature forested areas and wetlands, as well as areas currently being restored to forest and wetlands. Approximately 2 percent of the watershed study area is developed. Developed area includes commercial areas, homes, barns, lawns, and roads. One percent of the study area consists of open water. This number includes a portion of the Wabash River to which the study area as defined by the USGS watershed boundary directly drains.

County land use zoning designations or a land use ordinance do not exist in Gibson County. Consequently, residential, commercial, industrial, and agricultural land use activities can be implemented anywhere within the watershed study area.

Urban

Approximately half of the town of Owensville is within the watershed study area. The eastern half of Owensville is the only urban area in the watershed. The total population of Owensville in 2000 was 1,322 people (U.S. Census Bureau, 2009).

No facilities having a National Pollutant Discharge Elimination System (NPDES) permit or any NPDES permitted outlets are located within the watershed. Three facilities in the part of Owensville within the watershed have or have had leaking underground storage tanks (LUSTs). All LUST incidences were reported in the early 1990s. Record numbers 25127665, 24010918, and 25665130 in Virtual File Cabinet record the LUST incidences as low-priority incidences affecting soil (IDEM, 2009a). It is not suspected that the LUSTs have impacted surface water in the watershed. The locations of the LUSTs are depicted on Figure 12.

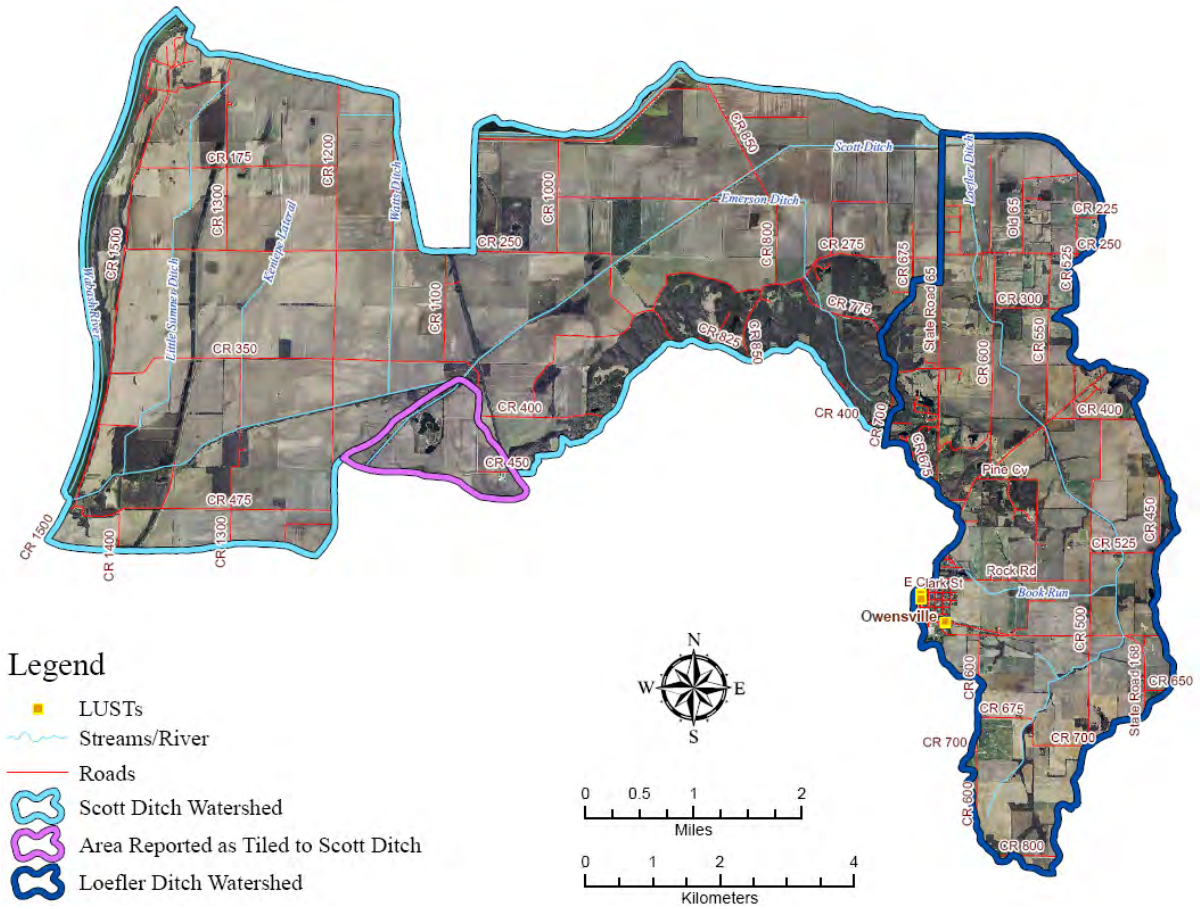


Figure 12. LUST Map

Population and Demographics

Significant increases in population density correlate with an increase in urban development. Urbanization typically results in an increased amount of impervious surface, septic systems, lawn chemicals, and construction erosion all of which create new stresses on water quality within a watershed. Population data were collected by the U.S. Census Bureau and is available at the county and political township levels. The watershed area occurs mostly in Wabash Township and Montgomery Township, while a relatively small portion occurs in Union Township. Wabash Township and Montgomery Township are generally representative of the population demographics of the study area. Approximately two percent of the watershed study area is developed which includes commercial areas, homes, barns, lawns, and roads.

Data from the U.S. Census Bureau indicate that Wabash Township, which is the western portion of the study area, is very sparsely populated and does not appear to be growing. Montgomery Township which contains the town of Owensville has a much higher population density than Wabash Township and appears to have a growing population. However, the population density of Montgomery Township is well below the average population density of Gibson County and the United States as a whole (U.S. Census Bureau, 2009) (Table 4). It is not suspected that water quality is currently being significantly influenced by urbanization activities or development sprawl.

Table 4. Population Density

Geographic Unit	1990 Density (persons per square km)	2000 Density (persons per square km)	20071 Density (persons per square km)
Montgomery Township	13	15	16
Wabash Township	1	<1	<1
Gibson County	25	25	26
United States	27	31	n/a
Geographic Unit	**1990 Density (persons per square mi)**	**2000 Density (persons per square mi)**	**2007[1] Density (persons per square mi)**
Montgomery Township	34	40	41
Wabash Township	2	1	1
Gibson County	65	66	67
United States	70	80	n/a

[1]Population densities for 2007 are U.S. Census Bureau estimates.

Agriculture

Agriculture is the predominant land use in the watershed study area. Approximately 78 percent of the watershed study area is in cultivated crops. An additional 2 percent of land is in pasture or hay.

Indiana Conservation Partnership members regularly conduct surveys of randomly selected farm fields to determine what types of tillage systems are being used in Indiana. Evaluated fields are assigned to one of four tillage categories: conventional tillage, reduced tillage, mulch tillage, and no-till. Conventional tillage refers to a tillage system that leaves 0 to 15 percent residue cover after planting. Reduced tillage refers to a tillage system that leaves 15 to 30 percent residue cover. Mulch tillage refers to any tillage system besides no-till and ridge-till that leaves more than 30 percent residue cover. Any tillage system that leaves 30 percent or greater residue cover is considered conservation tillage. No-till and mulch tillage are both conservation tillage systems (Evans, *et al.*, 2000). It is believed that conservation tillage has more potential than any other agricultural BMP to affect soil erosion, water quality, and long-term productivity of soils in intensive cropping systems (USDA, 2008).

Tillage transect data were provided by the Gibson County SWCD (A. Ice, personal communication, October 10, 2008). From 2000 to 2007, Gibson County averaged 15 percent of corn fields in conservation tillage and 25 percent of corn fields in reduced tillage or conservation tillage. During the same timeframe, an average 48 percent of soybean fields were in conservation tillage and 64 percent were in reduced tillage or conservation tillage. A weighted average for both corn and soybean fields indicated that approximately 30 percent of all fields were in conservation tillage and 42 percent of all fields were in reduced tillage or conservation tillage from 2000 to 2007. The weighted average was calculated from a combination of tillage transect data and county crop acreage data from the Purdue Extension (J. True, personal communication, February 16, 2009). The percent of fields in conservation and reduced tillage has increased since tillage transects studies were first implemented in 1990 (Figures 13 and 14). Gibson County lagged behind state no-till averages in 2000 and 2007, especially with corn production (Evans, *et al*., 2000 and USDA, 2008) (Table 5).

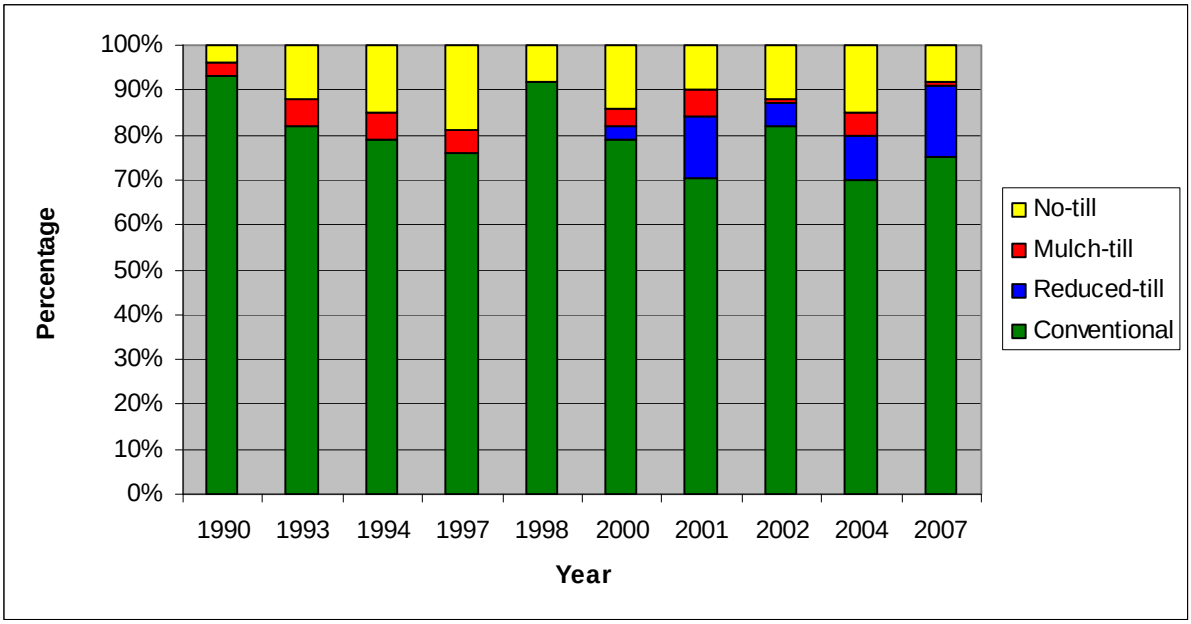


Figure 13. Tillage Systems in Fields Where Corn was the Present Crop

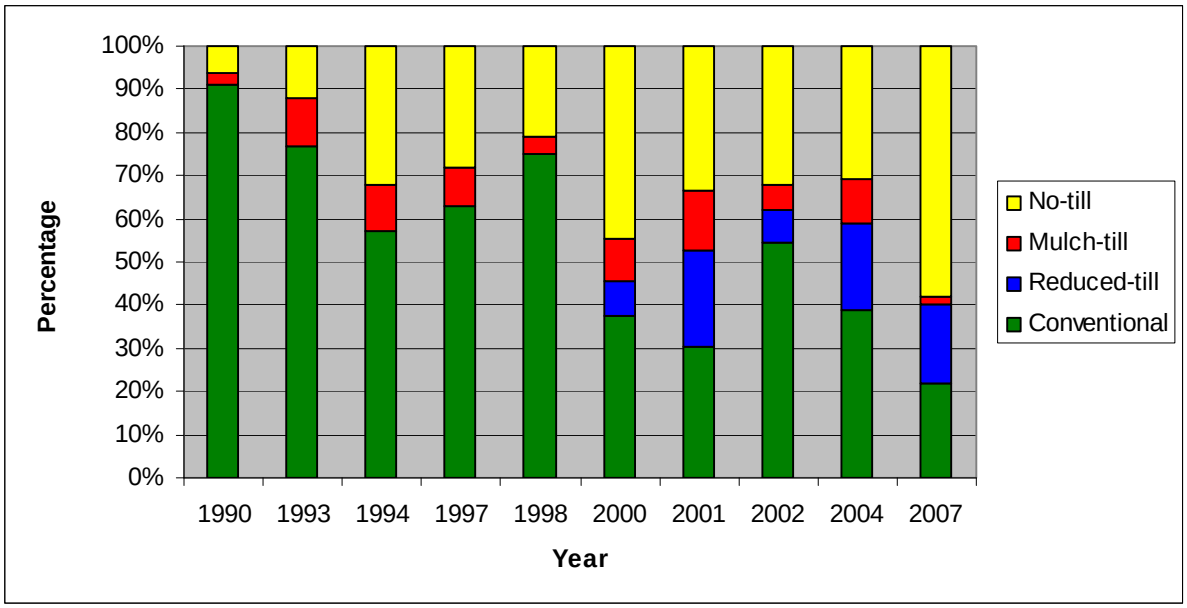


Figure 14. Tillage Systems in Fields where Soybeans was the Present Crop

Table 5. No-Till Percentages

	Percent No-Till Corn	Percent No-Till Soybeans
2000		
Gibson County[1]	14	45
State Average[2]	21	60
2007		
Gibson County[1]	8	58
State Average[3]	27	69

[1] A. Ice, personal communication, October 10, 2008
[2] Evans, *et al*., 2000
[3] USDA, 2008

Existing BMPs

Multiple types of structural BMPs are currently implemented in the watershed. These BMPs include grassed waterways, filter strips, and water and sediment control basins (WASCOBs) (NRCS, 2006).

A grassed waterway is a natural drainageway that has been graded and planted with a sod forming grass to form a shallow vegetated drainageway to prevent gully formation in agricultural fields (Photograph 2). Grassed waterways filter out some sediment and nutrients in surface water flow in addition to reducing gulley erosion (USDA, 2009).

Photograph 2 (10-01-08). This photograph depicts a grassed waterway located on CR 500 West near Owensville, Indiana.

Two grassed waterways were observed during windshield surveys in the Loefler Ditch watershed. One grassed waterway was observed on the south side of County Road (CR) 700 South west of CR 500 West. The second grassed waterway was observed on the west side of CR 500 West south of CR 400 South.

Filter strips are designed to treat surface overland water flow prior to the water reaching an environmentally sensitive area such as a stream by slowing the water velocity and allowing sediment and nutrients to filter out. NRCS technical guidance requires filter strips to be established with select herbaceous species. NRCS guidance requires a minimum flow length through a filter strip to be 6 meters (20 feet) for reducing suspended solids and associated contaminants in overland flow and a minimum of 9 meters (30 feet) to reduce dissolved contaminants in overland flow (NRCS, 2008). It has been estimated that overland flow from 5 percent of cultivated land in the watershed drains through a filter strip prior to entering a stream (A. Ice and G. Seibert, personal communication, March 26, 2009).

Photograph 3 (04-08-09). This photograph depicts three WASCOBs with Hickenbottom riser inlets in the Loefler Ditch watershed. The two WASCOBs in the foreground are distinguished by the darker bands of soil. The third WASCOB is located in the grassed area within the field.

WASCOBs consist of an earthen berm or a combination of a berm and shallow depression constructed across the slope of an agricultural field in order to form a sediment trap and a shallow, quick-draining water detention basin (NRCS, 2006) (Photograph 3). An inlet is installed within the WASCOB connecting it to an underground field tile. Benefits of WASCOBs include a reduction in gully erosion, trapping of sediment, and improving the ability to farm sloping land. On January 29, 2002, 176 WASCOBs were documented in the Loefler Ditch watershed (D. Simpson, personal communication, April 8, 2009). The approximate locations of WASCOBs in the Loefler Ditch watershed are depicted in Figure 15. No WASCOBs were identified in the Scott Ditch watershed by Davey during windshield surveys.

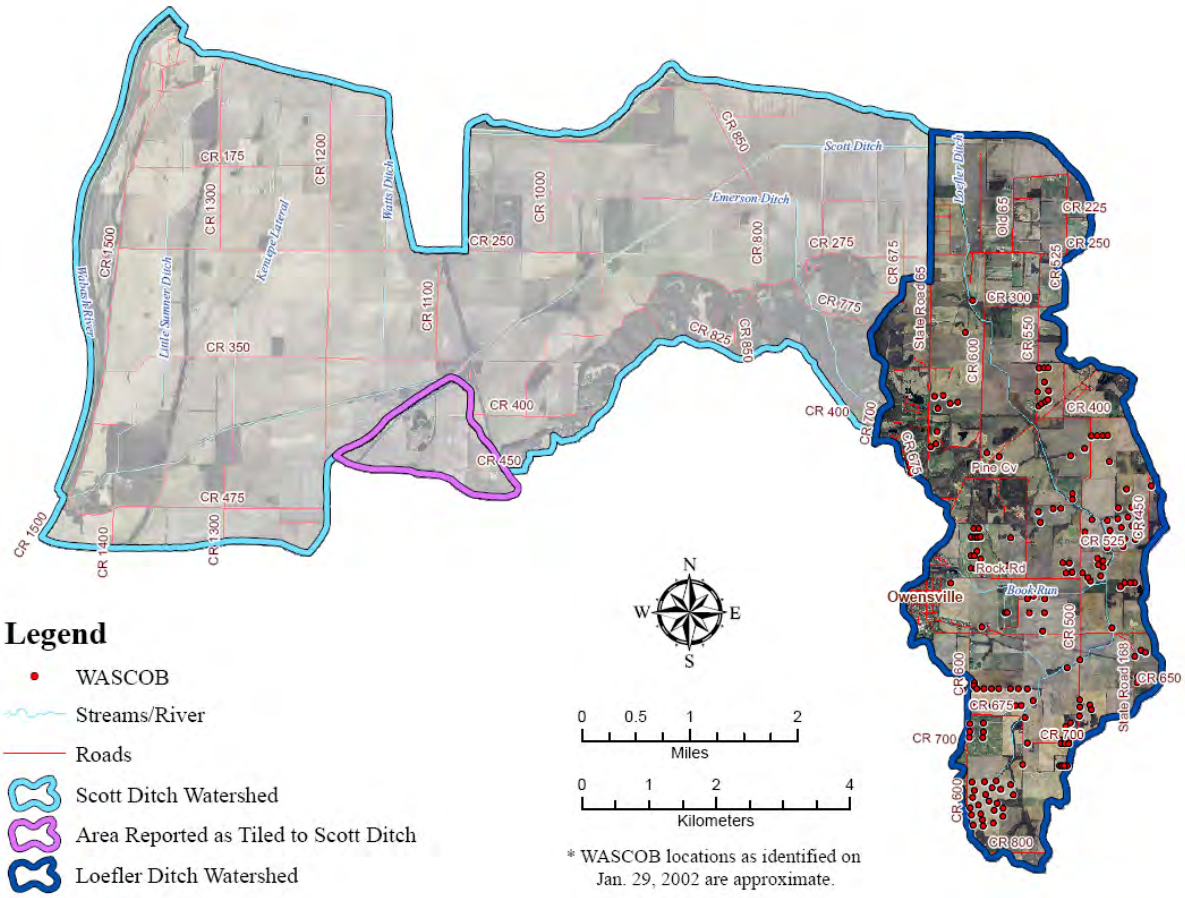


Figure 15. WASCOB Map

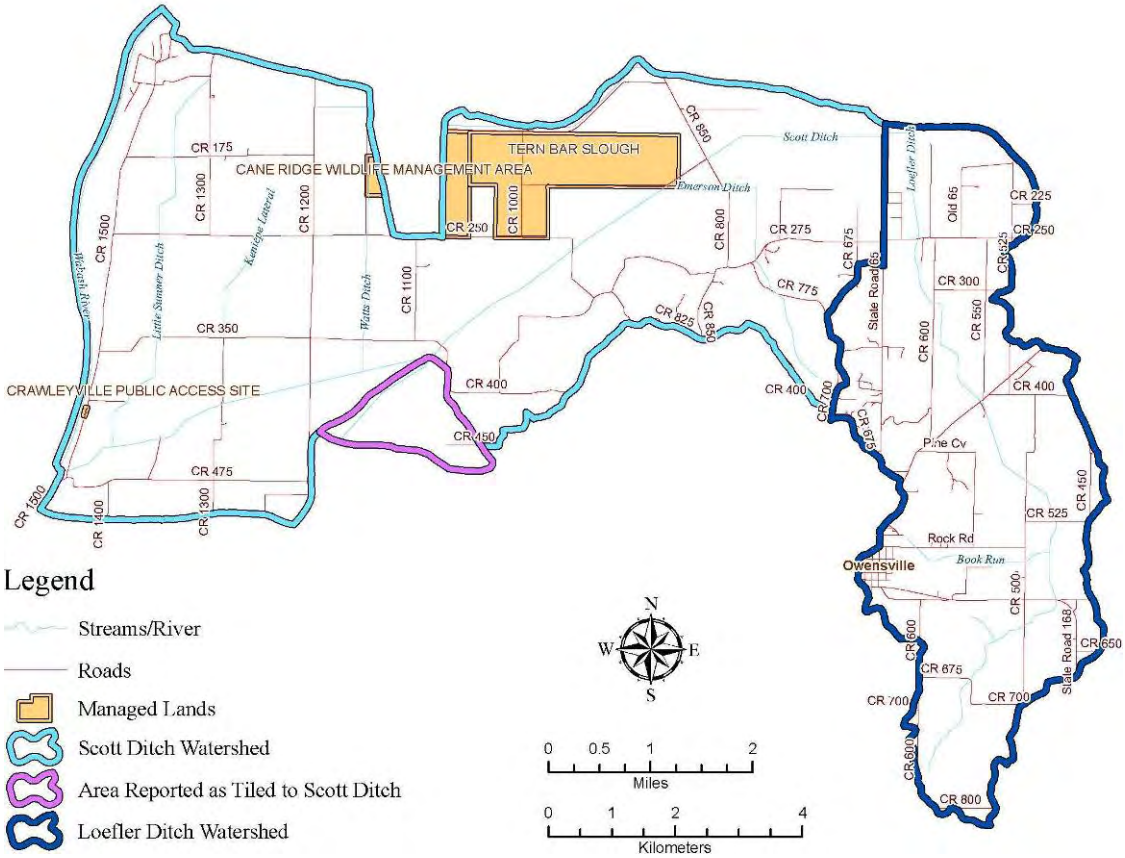


Figure 16. Government Managed Properties Map

Significant Recreational and Natural Areas

Approximately 17 percent of the watershed study area is comprised of natural area including grasslands, shrubby areas, forest, and emergent and forested wetlands. Three government managed properties are present in the study area (Figure 16).

Photograph 4 (02-05-09). This photograph depicts the Cane Ridge Wildlife Management Area.

The Cane Ridge Wildlife Management Area (WMA), a satellite property of the Patoka River National Wildlife Refuge and Management Area, is a Globally Important Bird Area (Photograph 4). It is a 197-hectare (488-acre) property including 73 hectares (180 acres) of reforested bottomland hardwoods, 78 hectares (193 acres) of moist soil wetlands, and 24 hectares (59 acres) of deepwater. The deep water area contains nesting islands that are managed for the federally endangered interior least tern (*Sternula antillarum athalassos*). Trails and observation platforms are available to facilitate wildlife viewing and photography. The property is closed to hunting (USFWS, 2008).

Tern Bar Slough Wildlife Diversity Area (WDA) managed by IDNR is a 340-hectare (840-acre) property east and adjacent to adjacent to Cane Ridge WMA (IDNR, 2006). The property which was formerly in agricultural production was acquired by the state in 2004. It is being managed for bottomland hardwood forest restoration and shallow wetlands including nesting islands surrounded by warm-season grasses for the interior least tern (*Sternula antillarum athalassos*). The property is currently closed for public access to prevent disruption of restoration activities. It is scheduled to open to the public and have managed waterfowl hunting in 2010 (K. Smith, personal communication, December 13, 2008).

The Crawleyville Public Access Site managed by IDNR provides recreational public access to the Wabash River. It is located along County Road 1500 south of County Road 900.

Petroleum Wells

Numerous petroleum wells are located throughout the watershed (Photograph 5). Figure 17 depicts the locations of petroleum test wells known by the Indiana Geological Survey's Petroleum Database Management System (IGS, 2008).

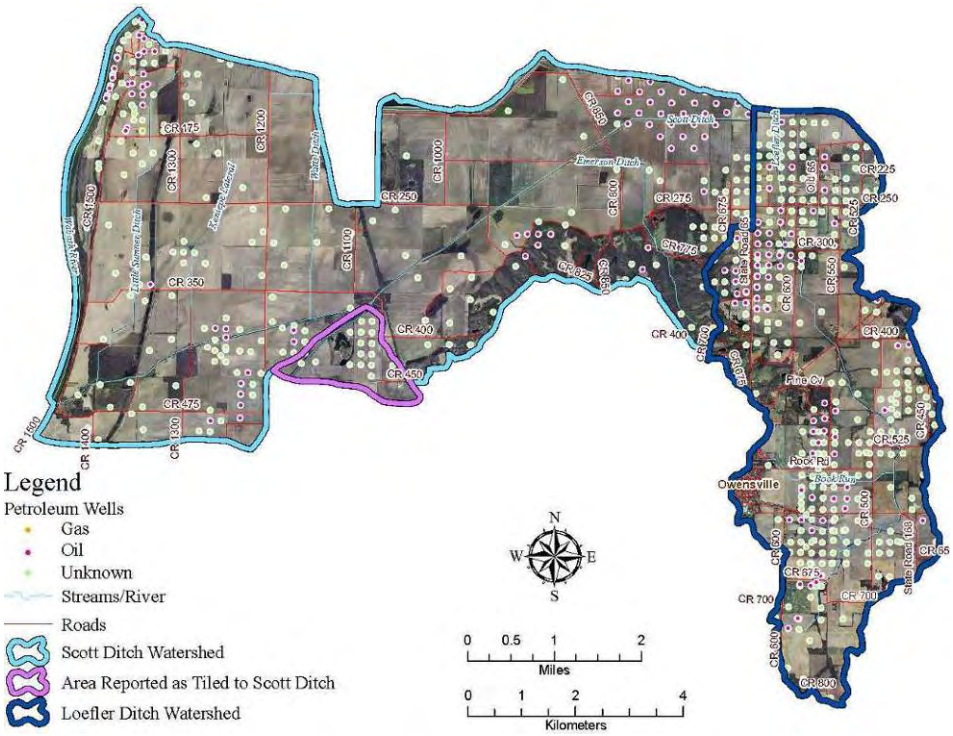


Figure 17. Petroleum Wells Map

The high number of petroleum wells in the watershed raises concerns for groundwater and surface water contamination by petroleum and brine, a byproduct of oil and gas mining. Surface water flow originating from areas of brine contaminated soils may increase the conductivity of the water (Photograph 6). Surface water contamination by either petroleum or brine can be detrimental to aquatic life.

Photograph 5 (02-05-09). This photograph depicts an active petroleum well in the Scott Ditch watershed.

Land Use Summary

Approximately 2 percent of the watershed study area is developed. Developed area includes commercial areas, homes, barns, lawns, and roads. U.S. Census Bureau data do not suggest that water quality is currently being significantly influenced by urbanization activities. Gibson County lacks zoning and a land use ordinance.

Photograph 6 (04-08-09). An area of stressed vegetation resulting from brine contamination of the soil is apparent in the middle of this field.

Agriculture is the predominant land use type in the watershed study area comprising approximately 80 percent of land use including row-crops (78 percent) and pasture/hay fields (2 percent). Statewide tillage transect data suggest that the amount of conservation tillage employed within the study area can be increased. Other BMPs including grassed waterways, filter strips, and WASCOBs are in place in the watershed. Water quality would benefit from increased numbers of some of the aforementioned and other BMPs.

Approximately 17 percent of the watershed is mature natural area or area that is currently being restored to natural area. Two large habitat restorations including Cane Ridge WMA and Tern Bar Slough WDA are present on the north side of the Scott Ditch watershed. Both of these sites contain significant amounts of wetlands restoration. These sites retain surface water, thereby reducing the quantity of water reaching the Scott Ditch and lowering the potential for in-channel erosion associated with high water flows. The wetlands restorations also reduce the amount of sediment and associated nutrients reaching Scott Ditch that once originated from the properties when they were in agricultural production.

A significant number of petroleum wells are located within the watershed increasing the probability of groundwater and surface water contamination by petroleum products and brine. Future water quality studies should conduct tests for these substances.

Historical Water Quality Data

There is no known historical water chemistry or biological studies concentrating specifically on the 14-digit HUC Loefler and Scott Ditches watersheds. IDEM has collected surface water quality data for the broader 8-digit Lower Wabash River watershed.

Historical Water Chemistry Studies

A significant amount of water chemistry data have been collected on the Wabash River (Photograph 7). On June 17, 1999, water chemistry data were collected at the Crawleyville Public Access Site just upstream from the confluence of Scott Ditch with the Wabash River. On the same date, water chemistry data were also collected on the Wabash River near the Interstate 64 crossing just south of the Gibson and Posey County line which is downstream of the Scott Ditch confluence. Table 6 depicts some of the water chemistry parameters tested on the Wabash River that were also tested on the Loefler and Scott Ditches watershed waters as part of this study (C. Bell, personal communication, December 12, 2008). Only one out of five water chemistry parameters indicated poorer water quality downstream than upstream of the Wabash River and Scott Ditch confluence. This suggests, based on limited and older data, that the Loefler and Scott Ditches watershed does not independently have a significant measureable impact on the Wabash River.

Photograph 7 (10-23-08). This photograph of the Wabash River was taken facing north at the Crawleyville Public Access Site.

Table 6. Wabash River Water Chemistry

Sample Location on Wabash River	Ammonia Nitrogen (mg/L)	Nitrate+Nitrite (mg/L)	TKN	Total Phosphorus (mg/L)	TSS (mg/L)
Crawleyville Public Access Site	<0.10	2.8	1.6	0.52	130
Interstate 64	<0.10	3.5	1.4	0.49	<4

Historical Macroinvertebrate Studies

IDEM has developed scoring criteria for a family level macroinvertebrate index of biotic integrity (mIBI). The mIBI consists of 10 metrics designed to assess macroinvertebrate communities' structural, compositional, and functional integrity. These metrics include: Hilsenhoff Biotic Index (HBI); the number of taxa at the family level; the number of individual macroinvertebrates collected; the percentage of the dominant macroinvertebrate family collected; the number of families from the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT Index); the number of individuals from the EPT orders to the total number of individuals; the number of individuals from the EPT orders to the total number of chironomids; the total number of chironomids; and the total number of individuals to the number of squares sorted when subsampling. The mIBI allows IDEM to determine waterways that are impaired for aquatic life use based on the macroinvertebrate community present.

Ranges for each metric are assigned a score of 0, 2, 4, 6, and 8. Scores from each metric are averaged to obtain an overall mIBI score for each sampling site. A mIBI score between 0 and 2 indicates that the site is severely impaired. A score between 2 and 4 indicates moderate impairment. Scores between 4 and 6 and scores between 6 and 8 suggest that sites are slightly impaired and non-impaired, respectively. Any site receiving a score less than 1.4 that was sampled using the Hester-Dendy method and any site scoring less than 2.2 that was sampled using a kick net is designated as impaired for aquatic life use by IDEM (IDEM, 2008a and T. Davis, personal communication, December 5, 2008).

Macroinvertebrate sampling had not been conducted within the study area 14-digit HUC watersheds prior to this study. Such data have been collected in other 14-digit HUC watersheds within the same 8-digit HUC of the study area by the IDEM Water Quality Assessment Branch using the Hester-Dendy method. The Hester-Dendy method involves placing three pieces of artificial substrate in a stream for six weeks, recollecting the artificial substrate, and then analyzing the species that colonized it in a lab. Table 7 lists Hester-Dendy mIBI scoring criteria.

Table 7. Scoring Criteria for the Family Level mIBI – Hester-Dendy[1]

	CLASSIFICATION SCORE				
	0	**2**	**4**	**6**	**8**
Family Level HBI	≥5.93	5.65-5.92	5.38-5.64	5.13-5.37	≤5.12
Number of Taxa	≤5	6	7-8	9	≥10
Number of Individuals	≤107	108-115	116-123	124-132	≥133
Percent Dominant Taxa	≥78.6	67.1-78.5	57.3-67.0	48.9-57.2	≤48.8
EPT Index	≤1	2	3	4	≥5
EPT Count	≤2	3-5	6-14	15-37	≥38
EPT Count to Total Number of Individuals	0	0.01-0.14	0.15-0.24	0.25-0.34	≥0.35
EPT Count to Chironomid Count	≤0.18	0.19-0.40	0.41-0.66	0.67-0.96	≥0.97
Chironomid Count	≥77	51-76	34-50	23-33	≤22
Total Number of Individuals to Number of Squares Sorted	≤7	8-11	12-18	19-30	≥31

[1] Using pentasection and central tendency of the logarithmic transformed data distributions of the 1993-1998 individual Hester-Dendy multiplate samples using 100-organism subsamples

Hester-Dendy mIBI scores from the Higginbotham Ditch at CR 850 South in Gibson County (IDEM Sample ID 961023102) and from Big Creek at State Road 66 in Posey County (IDEM Sample ID 961024103) are displayed in Table 8 (T. Davis, personal communication, December 5, 2008). Higginbotham Ditch and Big Creek are similar ditch systems in a predominantly agricultural area with little to no buffer and are comparable to the ditches in the study area. Higginbotham Ditch is located directly south of Scott Ditch. It scored 5.8 which is an unusually high score for the Hester-Dendy method and this type of stream system. This score indicates that it is only slightly impaired, and suggests that it is possible for a ditch stream system to support a good macroinvertebrate community. Big Creek scored 1.8 indicating that it is severely impaired, but not quite low enough that it is designated impaired for aquatic life use.

Table 8. Historical Macroinvertebrate Studies

	Higginbotham Ditch CR 850 S Gibson County	Big Creek SR 66 Posey County
Metric	Score	Score
Family Level HBI	8	0
Number of Taxa	8	4
Number of Individuals	2	4
Percent Dominant Taxa	8	0
EPT Index	4	2
EPT Count	6	2
EPT Count to Total Number of Individuals	6	2
EPT Count to Chironomid Count	8	0
Chironomid Count	6	0
Total Number of Individuals to Number of Squares Sorted	2	4
Site mIBI Score	5.8	1.8

Historical Fish Community Studies

The IDEM Water Quality Assessment Branch conducted fish community sampling in the Wabash River at the Crawleyville Public Access Site on September 15, 1999. To evaluate fish community assemblages, IDEM uses an Index of Biotic Integrity (IBI) composed of 12 metrics. A waterway is non-supporting for aquatic life use when the fish community sampled receives an IBI score less than 35. The fish community sampled at the Crawleyville Public Access Site had an IBI score of 32 (S. Sobat, personal communication, December 5, 2008). A score of 32 falls within the poor integrity class characterized by a dominance of omnivores and tolerant species with few or no top carnivores and expected species (IDEM, 2007).

Fish community sampling has not been conducted by IDEM in the Loefler or Scott Ditches. Such data have been collect in similar stream systems within the same 8-digit HUC of the watershed study area including Swan Pond Ditch at Carie Road in Knox County, Little Creek at CR 1000 East in Posey County, Big Creek at CR 350 West in Posey County, and an unnamed tributary to Pond Flat Ditch at Mosquito Road in Vanderburgh County. Dominant species recorded in these streams include the blackstripe topminnow (*Fundulus notatus*), central stoneroller (*Campostoma anomalum*), bluntnose minnow (*Pimephales notatus*), spotfin shiner (*Cyprinella spiloptera*), green sunfish (*Lepomis cyanellus*), sand shiner (*Notropis stramineus*), and silverjaw minnow (*Notropis buccatus*) (S. Sobat, personal communication, December 5, 2008). These fish species may also be present in the Loefler and Scott Ditches watershed.

303(d) List

Clean Water Act Sections 305(b) and 303(d) require states to conduct water quality assessments, identify waters that do not or are not expected to meet state water quality standards, and rank these waters based on the severity of pollution and the designated uses of the waters. In accordance with the Clean Water Act, IDEM develops a 303(d) List of Impaired Waters every 2 years from data collected during 305(b) water quality assessments (IDEM, 2008b). The main stem of the Wabash River which the project study area drains to is listed as impaired for mercury in fish tissue and PCBs in fish tissue on the 2008 303(d) List.

In order to achieve compliance with water quality standards, states are also required to develop Total Maximum Daily Loads (TMDLs) for impaired waterways. TMDLs indicate the maximum amount of a pollutant a waterway can receive and still meet water quality standards. The Wabash River Nutrient and Pathogen TMDL Development Final Report dated September 18, 2006 addressed a 2006 303(d) List *E. coli* impairment for the main stem of the Wabash River to which the project study area drains (Tetra Tech, 2006a). This impairment was not part of the 2008 303(d) List.

Rare, Threatened, and Endangered Species

The IDNR Division of Nature Preserves manages the Indiana Natural Heritage Data Center that compiles information on the presence of rare, threatened, and endangered species, high-quality natural communities, and natural areas throughout the state. These data are a collection of observations from many individuals and not the result of comprehensive field surveys. A list of rare, threatened, and endangered species for all of Gibson County from the Indiana Natural Heritage Data Center can be found in Appendix A. Table 9 lists the rare, threatened, and endangered species found within the watershed study area including a portion of the Wabash River (R. Hellmich, personal communication, December 11, 2008). The lack of documented high-quality natural communities and areas does not imply that the project area does not support special plants or animals.

Table 9. Rare, Threatened, and Endangered Species

Common Name	Species Name	Federal Status	State Status	Date Observed	Observation Comments
Plants					
Rose turtlehead	*Chelone obliqua* var. *speciosa*		watch list	09-03-1939	
Water-locust	*Gleditsia aquatica*		endangered	10-10-1938	
Mollusks					
Black sandshell	*Ligumia recta*		monitored	1987	subfossil
Clubshell	*Pleurobema clava*	endangered	endangered	1987	subfossil
Eastern fanshell pearlymussel	*Cyprogenia*	endangered	endangered	1987	subfossil
Fat pocketbook	*Potamilus capax*	endangered	endangered	08-22-2006	live
Pyramid pigtoe	*Pleurobema rubrum*		endangered	1987	subfossil
Tubercled blossom	*Epioblasma torulosa torulosa*	endangered	endangered	1987	subfossil
Fish					
Spottail darter	*Etheostoma squamiceps*		monitored	08-24-2006	
Birds					
Interior least tern	*Sternula antillarum athalassos*	endangered	endangered	08-13-2005	nest site at Cane Ridge WMA
King rail	*Rallus elegans*		endangered		07-31-1983, 06-29-2002
Northern harrier	*Circus cyaneus*		endangered	06-20-2002	
Wilson's phalarope	*Phalaropus tricolor*		special concern	06-30-2002	Cane Ridge WMA
Mammals					
American badger	*Taxidea taxus*		special concern	10-1989	

There is no known state or federally endangered species of fish or mussels in the Loefler or Scott Ditches (B. Fisher, personal communication, November 17, 2008). The fat pocketbook (*Potamilus capax*) mussel was designated as federally endangered in 1976. It is found in large rivers with mud or sand bottoms and slow-flowing water (USFWS, 2008). A reproducing population of this species is present in the Wabash River in Gibson County near the confluence of the Wabash River and Scott Ditch (M. Litwin, personal communication, December 12, 2008).

The interior least tern (*Sterna antillarum athalassos*) was listed as federally endangered in 1985 (Kirsch, 1999). The species nests on sand and gravel bars of large river systems. The Cane Ridge WMA actively manages 2.43 hectares (6 acres) of nesting habitat for the interior least tern and supports the largest nesting colony east of the Mississippi River. The management goal is for Cane Ridge to support 100 nesting adult terns and produce 75 fledglings per year (USFWS, 2008). The interior least tern has also been observed nesting at Tern Bar Slough WDA and the Duke Energy Gibson Station power plant (M. Litwin, personal communication, December 12, 2008).

No current observations of the Indiana bat (*Myotis sodalis*) exist within the project area (M. Litwin, personal communication, December 12, 2008). However, suitable summer habitat does exist. A maternity colony containing more than 100 adults has been documented at the Patoka River National Wildlife Refuge and Management Area approximately 32 kilometers (20 miles) east of the study area. The Indiana bat was listed as a federally endangered species in 1967 under the Endangered Species Conservation Act (USFWS, 2008).

Historical Data Summary

There is a lack of historical water chemistry and biological data available specific to the Loefler and Scott Ditches watersheds. Historical studies available for the Wabash River and the Lower Wabash River watershed which contains the Loefler and Scott Ditches watershed do provide useful information.

One water chemistry study conducted in 1999 for the Wabash River suggests that water received by the river from the Loefler and Scott Ditches watershed does not independently have a significant measureable impact on the Wabash River. Data from the 2006 and 2008 303(d) Lists and associated TMDL do not indicate that water quality parameters examined as part of this study on the Loefler and Scott Ditches watershed are currently an issue of concern in the Wabash River to which the study area drains.

Macroinvertebrate studies on two nearby ditched stream systems similar to those in the watershed study area indicated the range of possible mIBI scores for this type of system. An unusually high score at one sampling site suggests that it is possible for a ditch stream system to support a good macroinvertebrate community.

The interior least tern (*Sterna antillarum athalassos*), a federally listed endangered species, is known to nest at the Cane Ridge WMA wetlands located in the watershed study area.

Analysis of Field Data and Watershed Modeling

Ten sample sites were established within the watershed by IDNR LARE, Gibson County SWCD, Davey, and Empower Results, LLC staff during a field visit on October 1, 2008 (Figure 18). A photograph of each sample site is located in Appendix B.

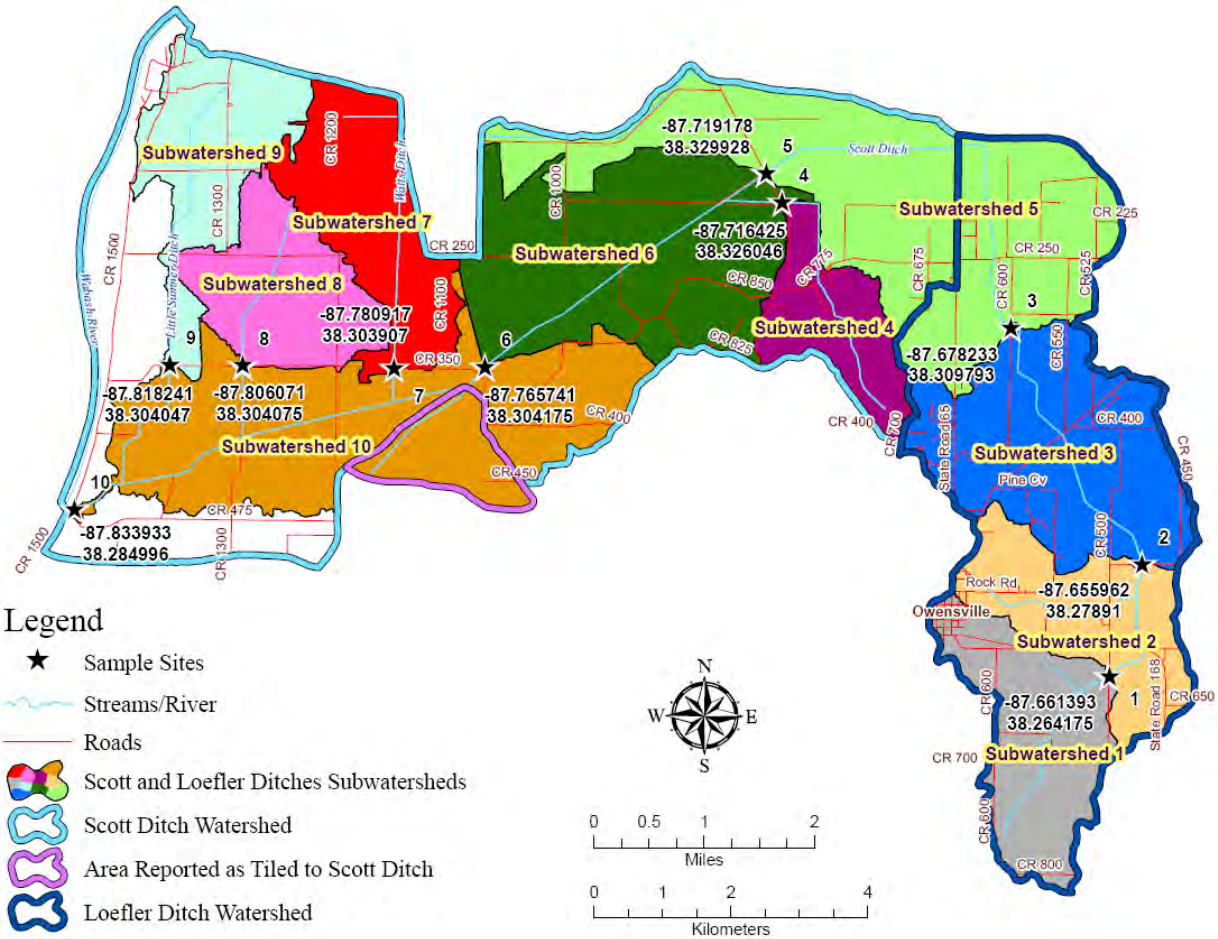


Figure 18. Sample Site Location Map

Sample site locations were selected so as to be able to collect samples along the Loefler and Scott Ditches upstream and downstream of the minor ditches contributing to them. Sample sites on minor ditches flowing into Scott Ditch were selected at the downstream most point of the minor ditches. Locating the sample sites in this manner enabled division of the watershed study area into meaningful subwatersheds. Dividing the watershed study area into subwatersheds can help land use planners prioritize areas for conservation practice implementation based on water quality data. All sample sites were selected along roads for ease of access. Table 10 includes information for each sample site location.

Data were collected at each sample site location relating to the physical and chemical properties of surface water in the Loefler and Scott Ditches watershed.

Table 10. Sample Site Location Information

Sample Point	Ditch Name	Road Crossing	Coordinates	
			Longitude	Latitude
1	Loefler Ditch	County Road 500 West	-87.661393	38.264175
2	Loefler Ditch	County Road 525 South	-87.655962	38.27891
3	Loefler Ditch	County Road 600 West	-87.678233	38.309793
4	Emerson Ditch	County Road 850 West	-87.716425	38.326046
5	Scott Ditch	County Road 850 West	-87.719178	38.329928
6	Scott Ditch	County Road 350 South	-87.765741	38.304175
7	Watts Ditch	County Road 350 South	-87.780917	38.303907
8	Keniepe Lateral	County Road 350 South	-87.806071	38.304075
9	Little Summer Ditch	County Road 350 South	-87.818241	38.304047
10	Scott Ditch	County Road 1500 West	-87.833933	38.284996

Water Quality Assessment

Physical and Chemical Water Quality

Base flow samples were collected at Sample Sites 2, 3, 5, 6, and 10 on October 21-23, 2008 by Davey Biologists Alicia Douglass and Jessica Hickey. Sample Sites 1, 4, 7, 8, and 9 did not have flowing water in October, 2008; thus, base flow samples were collected on June 29, 2009 at these sites by Aren Dottenwhy. No rain events occurred within the watershed study area in the 3 days prior to base flow sampling. Steady rain events occurred within the watershed study area at sporadic times during the 2 days prior to storm flow sampling. Storm flow samples were collected April 7 and 8, 2009 by Alicia Douglass and Aren Dottenwhy (Photograph 8). A storm flow sample was not collected at Sample Site 10 due to high water safety and data quality concerns. Sample Site 10 is located at the point where Scott Ditch enters the Wabash River. The Wabash River backs up into the Scott Ditch during times of high flow making data collection hazardous and skewing water chemistry results.

Photograph 8 (04-08-09). This photograph depicts Davey staff collecting a dissolved oxygen measurement at Sample Site 2.

All samples were collected upstream of road crossings to avoid potential data interference by the road crossing structure. Water chemistry parameters and other physical properties analyzed at each sample site include temperature, pH, onductivity, dissolved oxygen (DO), orthophosphate phosphorus (Ortho-P), total phosphorus (TP), ammonia nitrogen, nitrate + nitrite nitrogen, total Kjeldahl nitrogen (TKN), total suspended solids (TSS), turbidity, and discharge. Measurement of pH, temperature, conductivity, DO, and discharge were conducted in the field by Davey staff. Data from analyses conducted in

the field can be found in Appendix C. All remaining parameters were analyzed by Microbac Laboratories, Inc. (Microbac). Microbac certificate of analysis sheets can be found in Appendix D.

Samples collected for analysis by Microbac were collected in sterile containers provided by the lab and containing preservatives. All samples were placed in a cooler immediately after collection and transported to the lab in Evansville, Indiana for analysis no later than seven hours after collection.

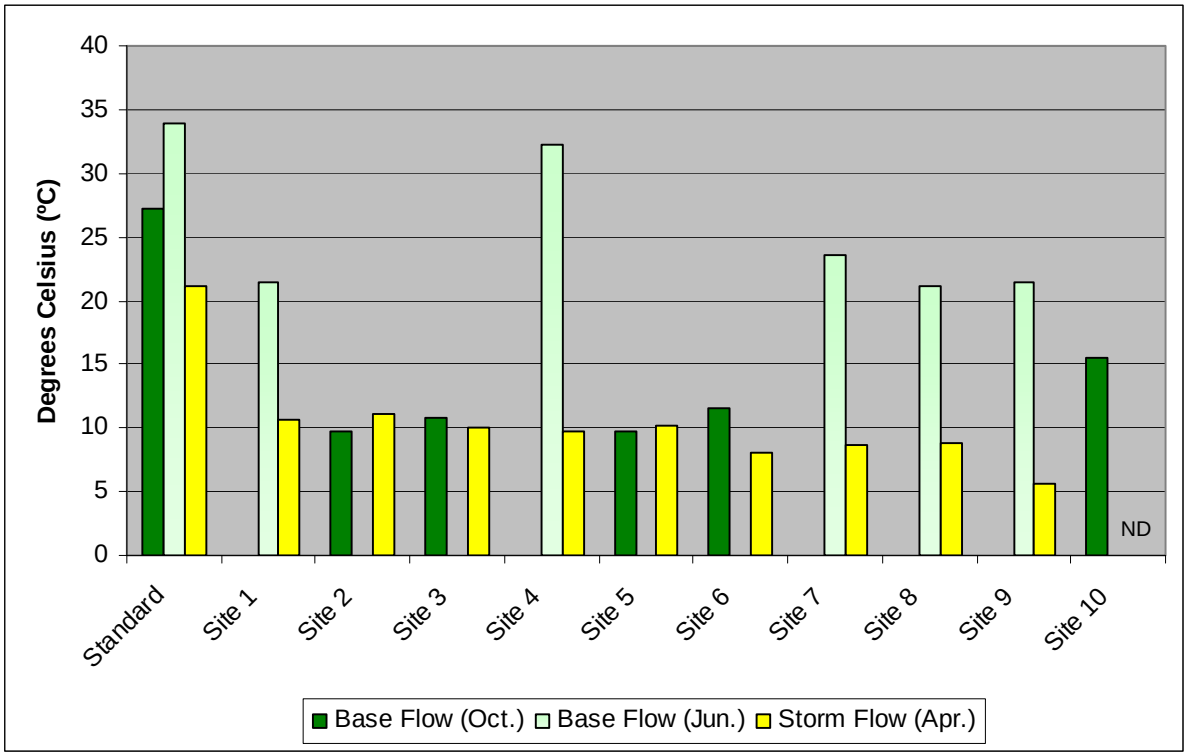
Temperature

Water temperature determines the maximum amount of DO that water can hold. DO is a necessary component for most aquatic life. Many aquatic organisms also require specific temperature ranges for proper metabolic function (IDNR, 2008). Temperature of a stream is influenced by things such as the presence or absence of riparian vegetation, runoff from impervious surfaces, and direct wastewater discharge.

Indiana water quality standards establish temperatures that streams shall not exceed based upon the month of sampling. Base flow samples collected in October shall not exceed 27.2 degrees Celsius (81.0 degrees Fahrenheit). Base flow samples collected in June shall not exceed 33.9 degrees Celsius (93.0 degrees Fahrenheit). Storm flow samples collected in April shall not exceed 22.8 degrees Celsius (73.0 degrees Fahrenheit) (327 IAC 2-1-6[1]).

Water temperature measurements were conducted in the field using the temperature setting on a YSI® EcoSense pH100 instrument. No samples collected as part of this study were in violation of the monthly standard (Figure 19).

[1] Indiana General Assembly. Indiana Administrative Code Database. Available online at <http://www.in.gov/legislative/iac/>. Accessed July 31, 2009.



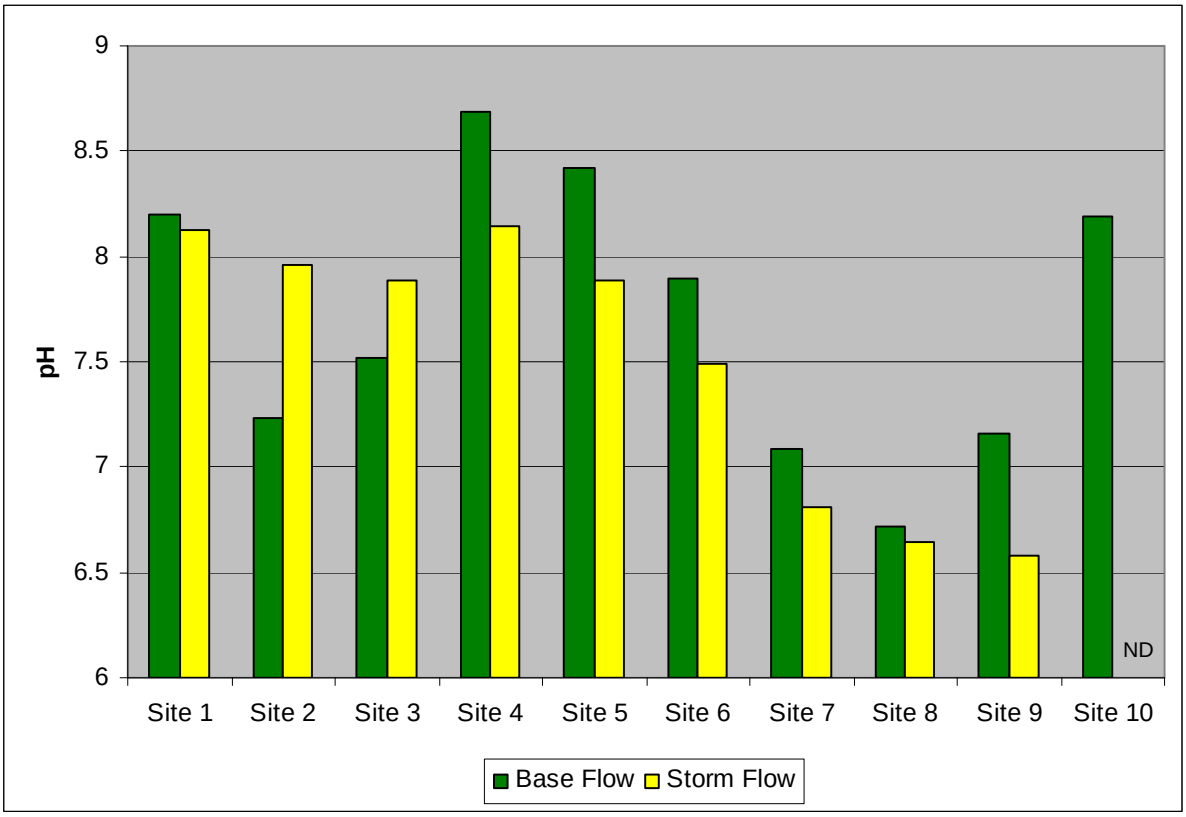
ND = No data collected

Figure 19. Temperature Values

pH

Determination of a pH value is a measure of the acidity or basicity of solution. Many aquatic organisms are sensitive to pH (IDNR, 2008). Indiana water quality standards for aquatic life specify that no pH values shall be below 6.0 or above 9.0 (327 IAC 2-1-6). Many factors influence pH including water temperature, algae blooms, acid rain input, watershed soils and geology, and runoff from mines.

A YSI® EcoSense pH100 instrument was used to collect pH readings in the field. No samples collected as part of this study were in violation of the standard (Figure 20).



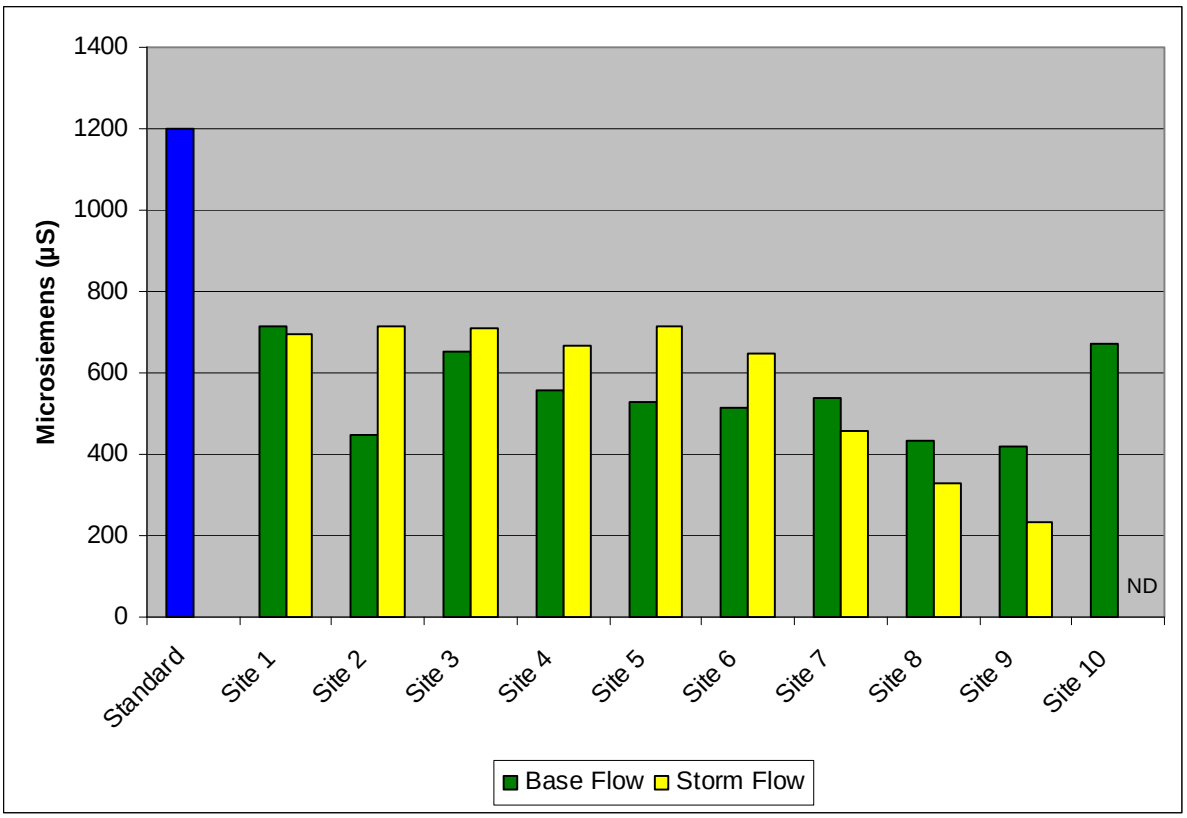
ND = No data collected

Figure 20. pH Values

Specific Conductivity

Indiana water quality standards regulate the concentration of dissolved solids for waters used as a public or industrial water supply. Specific conductivity may be used as a measurement to assess compliance with this standard. Specific conductivity measurements increase with ion concentration. Thus, specific conductivity is an indirect measure of dissolved solids including, but not limited to, chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron. Specific conductivity is influenced by things such as watershed soils and geology, as well as runoff from mines, roads, and agricultural fields. Specific conductivity shall not exceed 1,200 microsiemens (µS) per centimeter at 25 degrees Celsius (327 IAC 2-1-6).

Specific conductivity was measured in the field using a YSI® EcoSense EC300 instrument that compensated measurements to 25 degrees Celsius. No samples collected as part of this study were in violation of the standard for waters used as a public or industrial water supply (Figure 21).



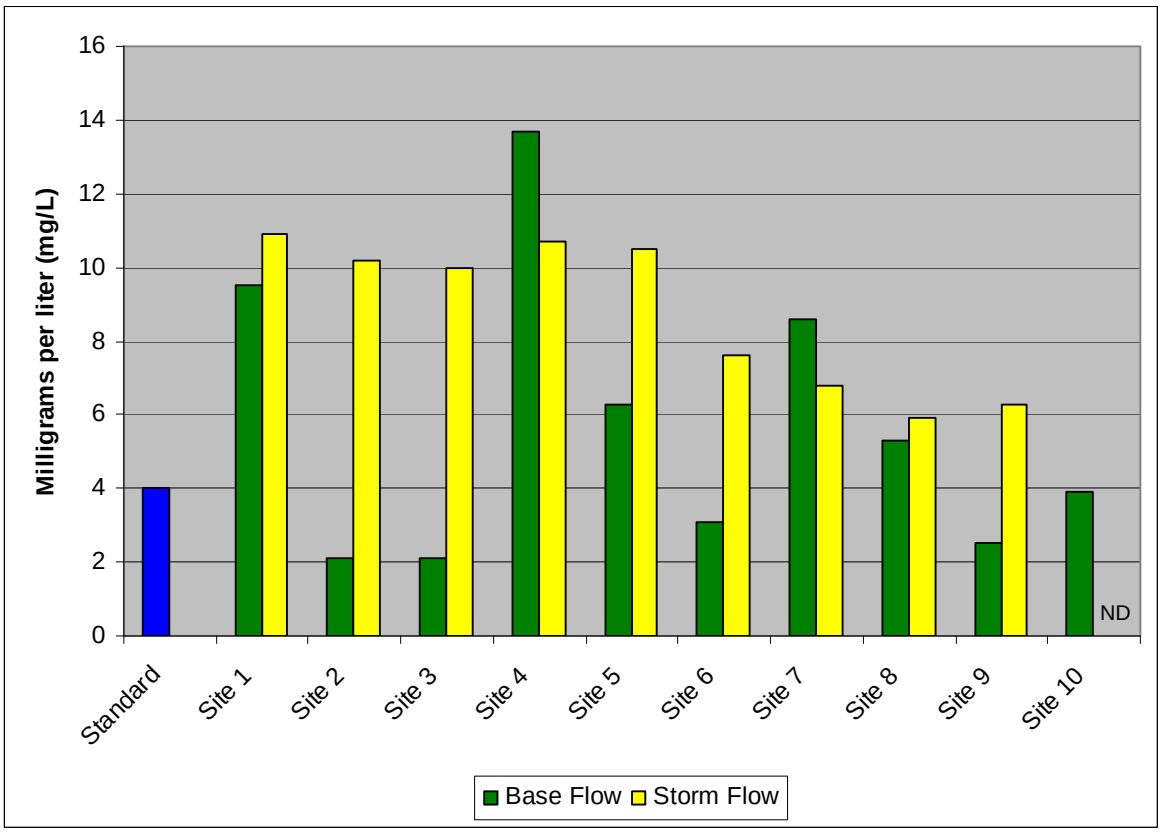
ND = No data collected

Figure 21. Specific Conductivity Values

Dissolved Oxygen

Most aquatic organisms require dissolved oxygen gas in the water for survival. Indiana water quality standards for aquatic life state that DO shall not be less than 4.0 milligrams per liter (mg/L) at any time and shall average at least 5.0 mg per calendar day (327 IAC 2-1-6). DO is influenced by factors such as stream temperature and velocity, as well as by total suspended solids, nutrient, and organic waste concentrations.

DO levels for base flow samples at Sample Sites 2, 3, 6, 9, and 10 were less than the desired water quality standards (Figure 22). DO measurements were collected in the field using a Milwaukee® SM600 Dissolved Oxygen Meter. In general, low DO levels in the watershed study area can be attributed to slow flowing water and lack of riparian cover shading streams. Shading of streams typically reduces water temperature, thereby increasing the DO capacity of the water. And, the faster the water is moving, the greater the degree of aeration occurs. In most instances, the faster moving water from storm flows samples had higher DO concentrations than base flow samples.



ND = No data collected

Figure 22. Dissolved Oxygen Concentrations

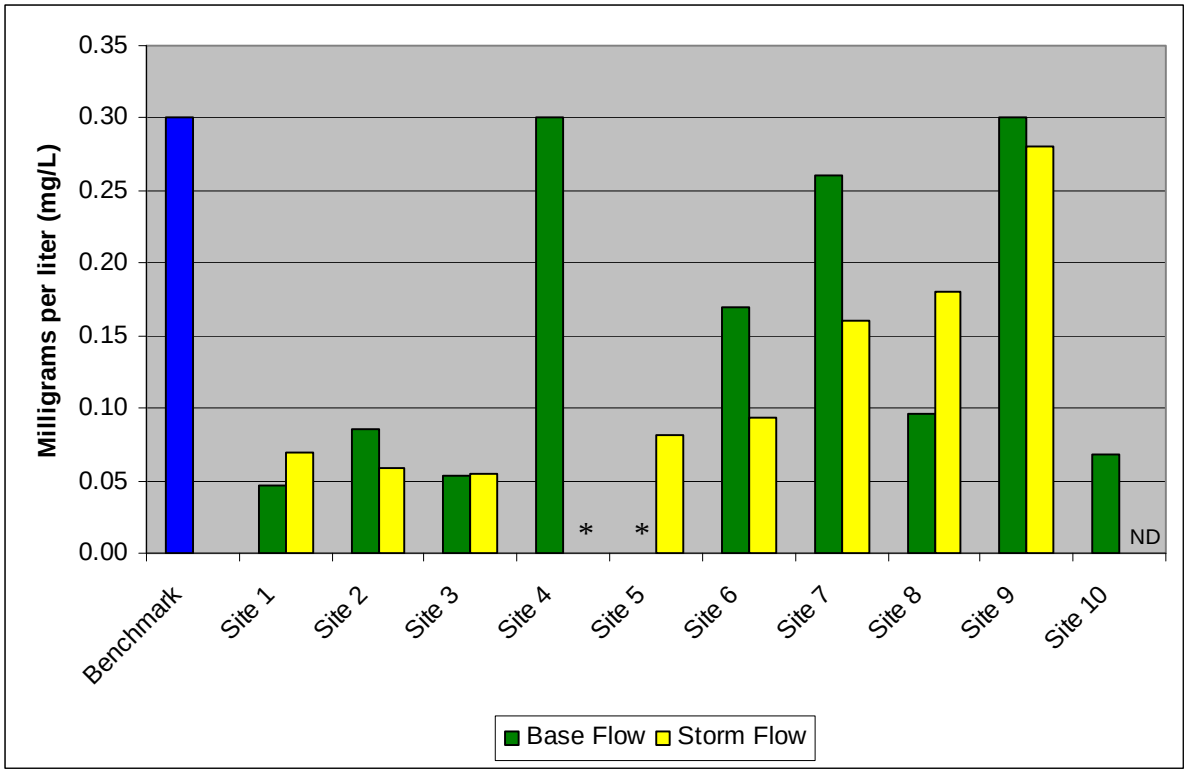
Total Phosphorous

Phosphorus is a naturally occurring nutrient in aquatic systems. Sources of additional phosphorus inputs include organic wastes such as human and animal wastes, fertilizers, detergents, and industry wastes. Phosphorus is necessary for plant growth and is often the limiting growth factor in aquatic systems. Excessive amounts of phosphorus result in algae blooms and eutrophication. In an aquatic system, phosphorus cycles through different forms. Analysis of total phosphate levels indicates the potential for future algal blooms and eutrophication by indicating the amount of phosphate that can convert to orthophosphate and be utilized by plants.

There is not currently an Indiana water quality standard for total phosphorus. The average total phosphorus value for Indiana water bodies is 0.05 mg/L. A benchmark set by IDEM states that one or more measurements of total phosphorus greater than 0.3 mg/L coupled with another impairment on the same date allows the water body to be classified as impaired (IDEM, 2008a). Ohio Environmental Protection Agency (EPA) recommends a maximum total phosphorus concentration of 0.08 mg/L to protect aquatic biotic integrity in warm water habitat (IDEM, 2009b).

No samples collected as part of this study exceeded the IDEM benchmark (Figure 23). The Ohio EPA recommended concentration was exceeded in base flow samples at Sites 2, 4, 6, 7, 8, and 9, as well as in storm flow samples at Sites 5-9. The base flow sample for Site 5 and the storm flow sample for Site 4 were below the detectable lab limit of 0.050 mg/L. Microbac used United States Environmental Protection Agency (USEPA) 365.1[2] methodology for testing the samples.

[2] U.S. Environmental Protection Agency (USEPA), Office of Research and Development, Environmental Monitoring Systems Laboratory. 1993. Method *365.1: Determination of Phosphorus by Semi-Automated Colorimetry*. Cincinnati, Ohio. 17 pp.



* = Concentration below detectable lab limit
ND = No data collected

Figure 23. Total Phosphorus Concentrations

Orthophosphate Phosphorus

Orthophosphates are a form of phosphorus dissolved in water and immediately available for plant uptake. The orthophosphate level is an indicator of the current potential for algae blooms and eutrophication in a water body (IDNR, 2008). There is not a water quality standard for orthophosphates in Indiana at this time.

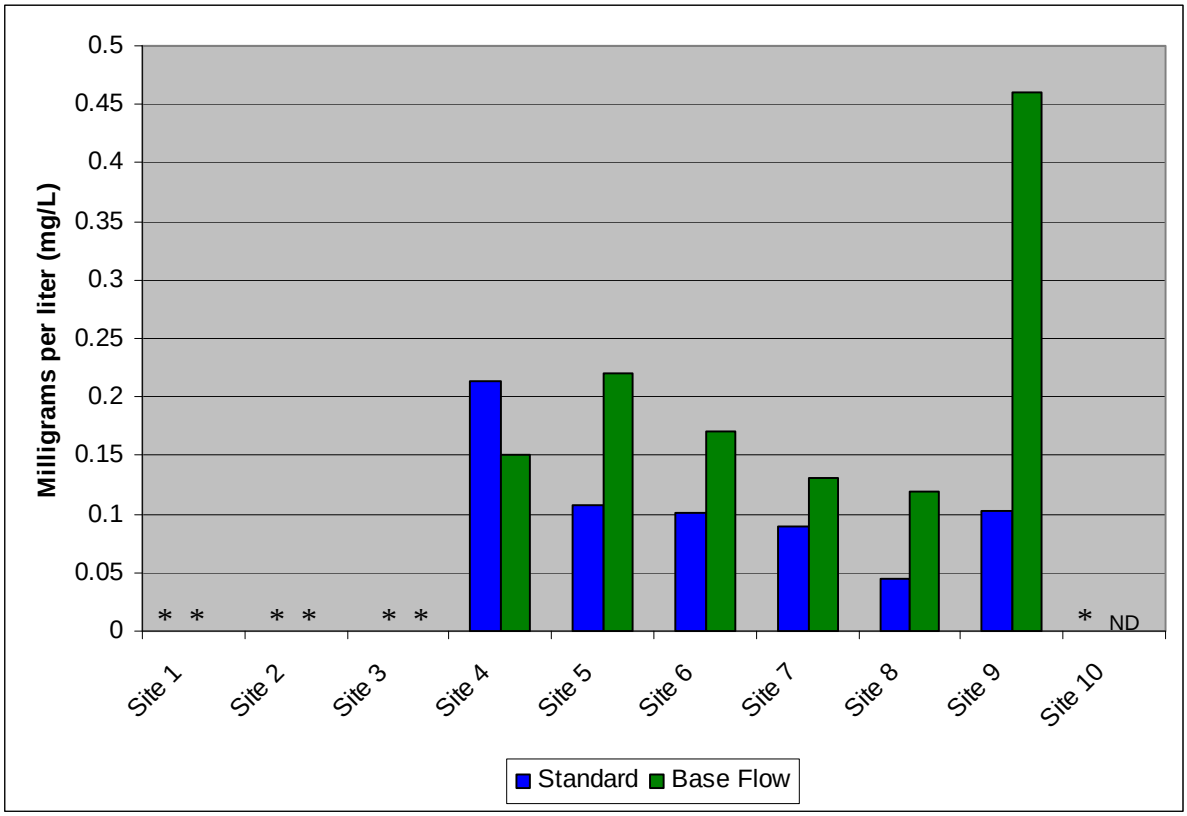
Orthophosphate levels were below detectable lab limits for all samples. They were reported as less than 0.015 milligrams per liter for base flow samples collected in October, 2008, less than 0.068 mg/L and less than 0.07 milligrams per liter for storm flow samples. Microbac used USEPA 300.0[3] methodology for testing the samples.

[3] U.S. Environmental Protection Agency (USEPA), Office of Research and Development, Environmental Monitoring Systems Laboratory. 1993. *Method 300.0: Determination of Inorganic Anions by Ion Chromatography*. Cincinnati, Ohio. 28 pp.

Ammonia Nitrogen

Ammonia (NH_3) is a form of nitrogen soluble in water. Sources of ammonia found in water include decomposing organic matter, human and animal wastes, and fertilizers (IDNR, 2008). Ammonia is known to be toxic and/or carcinogenic, mutagenic, or teratogenic to aquatic organisms, humans, animals and plants. Water quality standards for unionized ammonia concentrations are a function of water pH and temperature. As pH and temperature decrease the standard becomes more stringent (327 IAC 2-1-6).

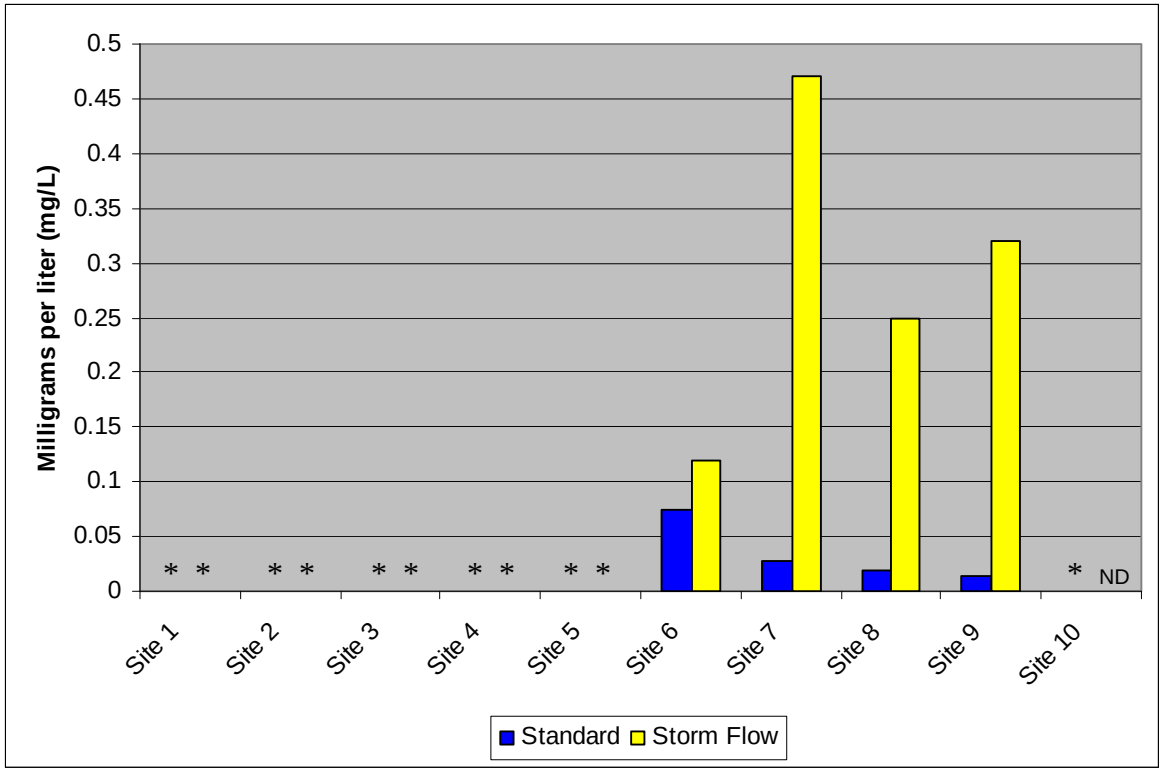
Sample Sites 5-9 exceeded ammonia concentration standards at the time of base flow sampling (Figure 24). Sample Sites 6-9 exceeded standards at the time of storm flow sampling (Figure 25). Ammonia concentrations at all other sample sites for base flow and storm flow samples were below the detectable lab limit of 0.10 mg/L. Microbac used SM 4500-NH3 G[4] methodology for testing the samples. High ammonia levels are most likely attributed to agricultural fertilizers given the high percentage of agricultural land use in the watershed study area.



* = Concentration below detectable lab limit
ND = No data collected

Figure 24. Base Flow Ammonia Nitrogen Concentrations

[4] Standard Methods Committee. 1997. *Standard Methods for the Examination of Water and Wastewater: 4500-NH3 Nitrogen (Ammonia).* Available online at <www.standardmethods.org>. Accessed August 4, 2009.



* = Concentration below detectable lab limit
ND = No data collected

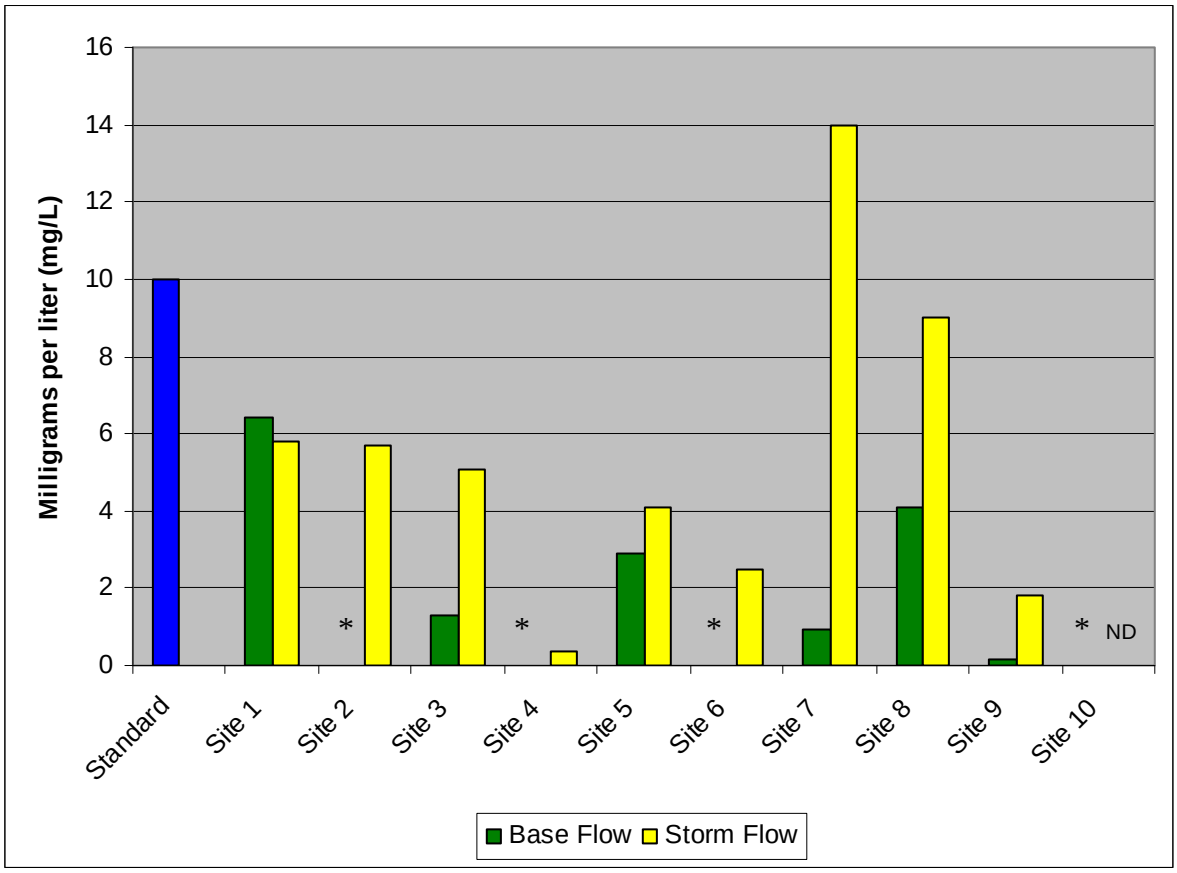
Figure 25. Storm Flow Ammonia Nitrogen Concentrations

Nitrate + Nitrite Nitrogen

Nitrate (NO_3) and nitrite (NO_2) are oxidized inorganic forms of nitrogen that are readily converted between the two forms in nature. Common sources of excess nitrates are human and animal wastes and runoff containing lawn and agricultural fertilizers. Nitrates can lead to increased aquatic plant growth and eutrophication. Elevated levels of nitrates in drinking water can cause severe illness.

There is no current standard for nitrate + nitrite concentrations in surface water not used as a public water supply. Surface water from the Loefler and Scott Ditches watershed is not used as a public water supply. Indiana water quality standards state that nitrate + nitrite levels in surface water are not to exceed a 30-day average of 10 mg/L at a public water supply intake (327 IAC 2-1-6). The average nitrate concentration in Indiana surface water is 12.32 mg/L. Unpolluted waters generally have a nitrate concentration below 4 mg/L (IDNR, 2008).

The storm flow nitrate + nitrite concentration at Sample Site 7 was the only sample that exceeded the public water supply standard and the state average (Figure 26). Due to the lack of livestock and residences in Subwatershed 7, the high nitrate + nitrite concentration is most likely due to inputs from agricultural fertilizer. Sample Sites 2, 4, 6, and 10 base flow samples were below the detectable lab limit of 0.10 mg/L for all samples except the sample from Sample Site 4 which was below the detectable lab limit of 0.11 mg/L. Microbac used USEPA 300.0 methodology for testing the samples



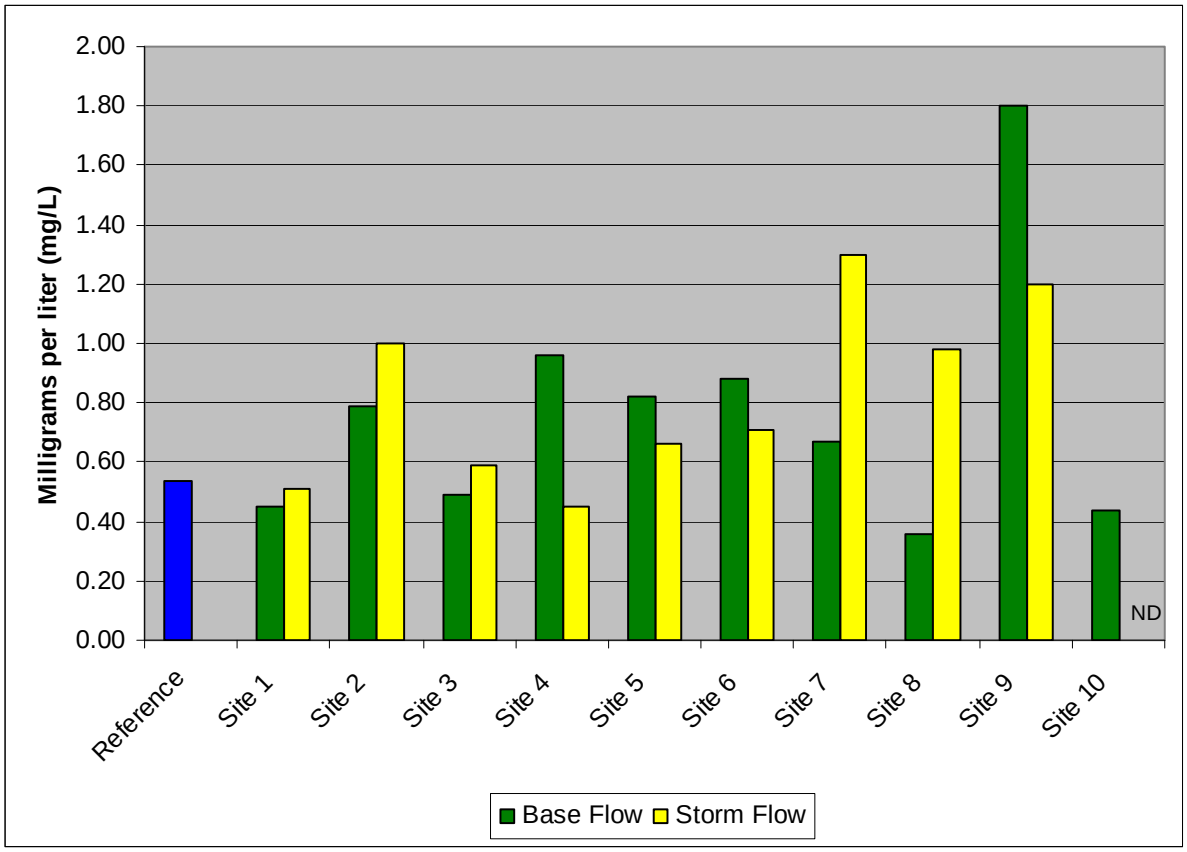
* = Concentration below detectable lab limit
ND = No data collected

Figure 26. Nitrate + Nitrite Concentrations

Total Kjeldahl Nitrogen

Total Kjeldahl nitrogen (TKN) is the sum of all organic nitrogen and ammonia (NH3). Indiana does not have a water quality standard for TKN. The TKN reference condition for USEPA Aggregate Ecoregion IX, Ecoregion 72 is 0.539 milligrams per liter which is based on median TKN concentrations for the top 25th percentile of streams sampled (2000). The top 25th percentile consisted of streams with the lowest concentrations of TKN.

Sample Sites 1, 3, 8, and 10 had TKN concentrations below reference condition at the time of base flow sampling (Figure 27). Sample Sites 1 and 4 had TKN concentrations below reference condition at the time of storm flow sampling. Values below reference condition indicate that these samples fall within the top 25 percent of stream samples having the lowest TKN values in their ecoregion. Microbac used SM 4500-NH3 G methodology for testing the samples.



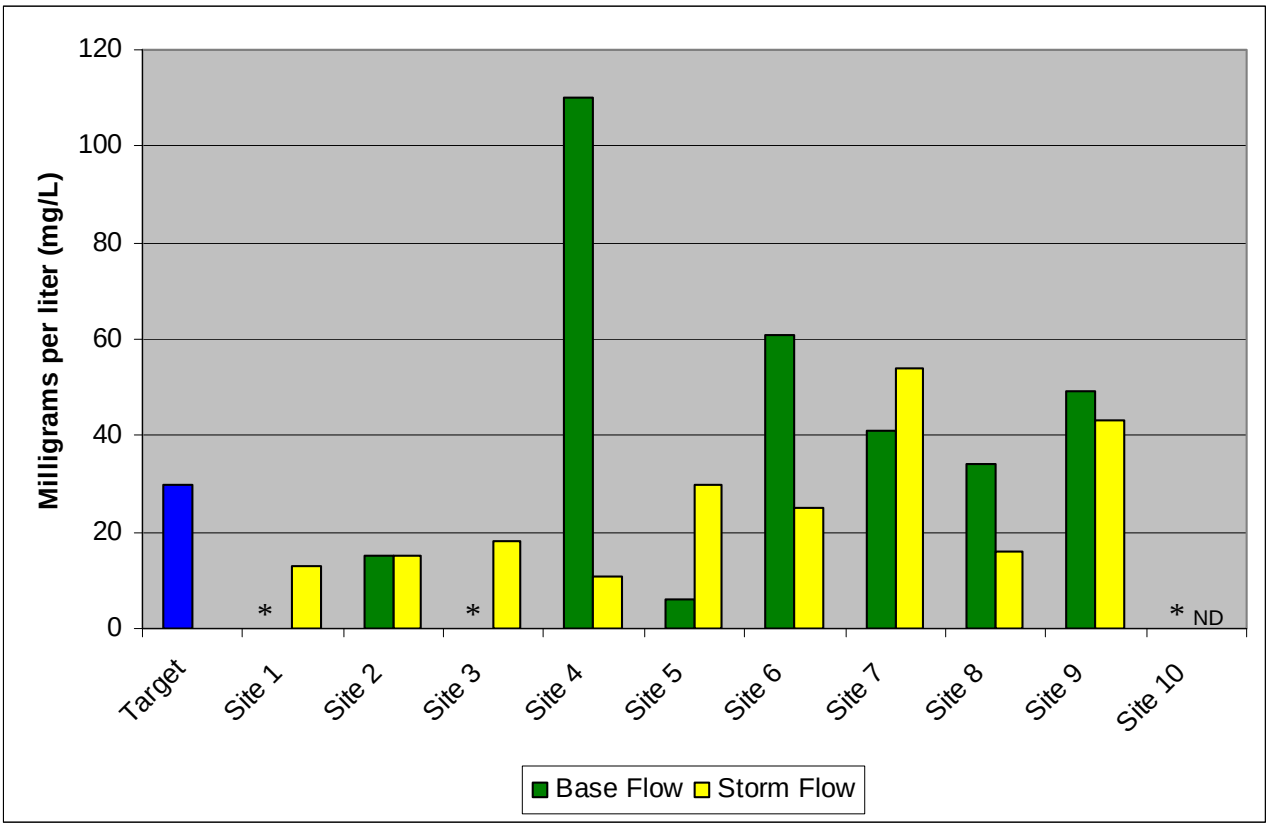
ND = No data collected

Figure 27. TKN Concentrations

Total Suspended Solids

The total suspended solids (TSS) measurement provides the weight of particulate material suspended in a water sample including sediment and other particles such as decaying organic matter. TSS concentrations are influenced by stream velocity. The higher the velocity, the larger and greater number of particles a stream can carry. Suspended particles absorb heat from the sun. A large quantity of suspended particles can result in elevated water temperatures and consequently lower levels of DO. Large quantities of suspended solids can also inhibit sunlight from reaching submerged plants and reduce photosynthesis resulting in less oxygen being released. As the velocity of water slows, TSS settle to the bottom of a stream where they can smother aquatic organisms. Solids suspended in the water column can originate from overland surface flow and streambank erosion. IDEM has established a maximum TSS concentration target of 30.0 mg/L; concentrations from 25.0-80.0 mg/L have been shown to reduce fish populations (IDEM, 2009b).

TSS concentrations exceeded the IDEM target value in base flow samples at Sites 4, 6, 7, 8, and 9 as well as storm flow samples at Sites 7 and 9. Base flow samples collected at Sample Sites 1, 3, and 10 were below the detectable lab limit of less than 5 mg/L (Figure 28). The TSS base flow concentration at Site 4 was much higher than the results from other sites. The high TSS concentration at Site 4 may in part be due to erosion occurring on an area of clear-cut forest upstream of Site 4 and stagnant water skewing the results of the test. Microbac used I-3765-85[5] methodology for testing the samples.



* = Concentration below detectable lab limit

ND = No data collected

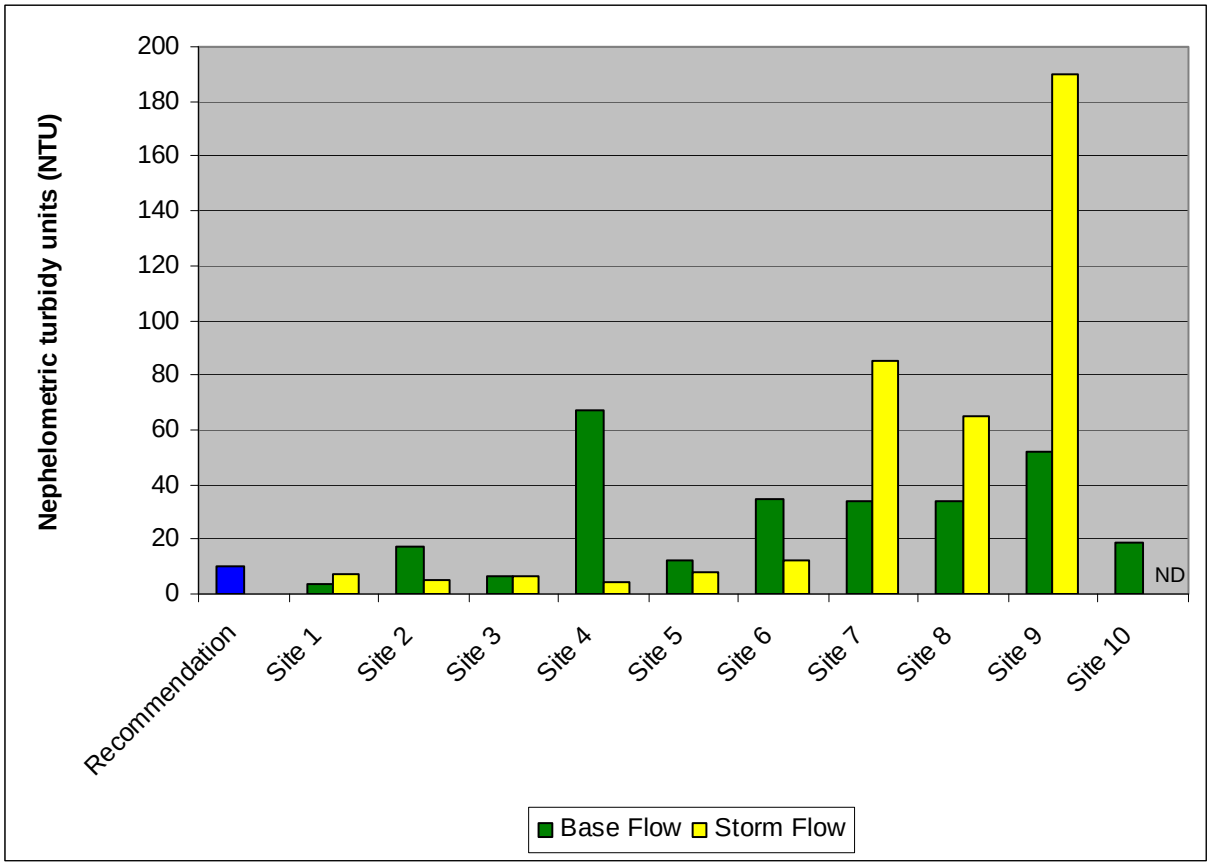
Figure 28. TSS Concentrations

[5] U.S. Geological Survey (USGS). 1989. *Techniques of Water-Resources Investigations of the United States Geological Survey*. Washington D.C. 466 pp.

Turbidity

Turbidity is a measure of clarity of water. Suspended solids in the water column scatter and absorb light reducing the clarity of water and increasing the turbidly value. Unlike a measure of TSS, turbidity measurements do not often include heavier particles that settle out quickly. Turbidity is measured in Nephelometric Turbidity Units (NTU). The average turbidity value for Indiana surface water is 36 NTU (IDNR, 2008). The USEPA recommends a maximum target value of 10.4 NTU (IDEM, 2009b).

Samples from Sites 2 and 4-10 exceeded the USEPA recommended target NTU value at the time of base flow sampling (Figure 29). Erosion is occurring on a previously wooded, clear-cut property upstream of Site 4 which may also increases turbidity values at this site. Sample Sites 6-9 exceeded the recommended value at the time of storm flow sampling. Site 9 storm flow results were more than 18 times higher than the recommend value. The cause for the high turbidity value at Site 9 is uncertain. Given that the TSS concentration for the same sampling event is only moderately high and that Site 9 visually appears to have much more dead plant matter in the ditch than any other site, the high turbidity value may be associated with decaying plant matter and associated microorganisms which do not drastically affect TSS concentrations since they are less dense than sediment particles. Microbac used USEPA 180.1[6] methodology for testing the samples.



ND = No data collected

Figure 29. Turbidity Values

[6] U.S. Environmental Protection Agency (USEPA), Office of Research and Development, Environmental Monitoring Systems Laboratory. 1993 *Method 180.1 Determination of Turbidity by Nephelometry*. Cincinnati, Ohio. 10 pp.

Discharge

Three velocity measurements were taken at each sample site at the time water chemistry samples were collected. Velocity measurements were taken using a Marsh-McBirney Flow-Mate™ model 2000 portable velocity meter. The cross-sectional area of the stream at each sample site was estimated by measuring the stream width and depths of water in the stream channel. Three depth and velocity measurements were taken at evenly spaced intervals on the same plane across the width of the channel. Depth and velocity measurements were collected in the same locations. The amount of discharge for each stream was determined by multiplying cross-sectional area of the stream by the velocity of the water flowing through it.

Discharge was significantly higher at the time of storm flow sampling than base flow sampling for all sample sites (Table 11). The rate of flow at the time of base flow sampling events was very low at all sample sites. A negative base flow discharge rate at Sample Site 4 indicates that the water was most likely stagnant. Storm flow discharge data were not collected at Sample Site 10 due to high water safety concerns resulting from Wabash River floodwaters backing up in Scott Ditch at this site.

Table 11. Discharge Rates

Site	Discharge (cubic m/s)		Discharge (cubic ft/sec.)	
	Base Flow	Storm Flow	Base Flow	Storm Flow
1	0.0025	0.0784	0.09	2.77
2	0.0159	0.1263	0.56	4.46
3	0.0130	0.3356	0.46	11.85
4	-0.0003	0.0263	-0.01	0.93
5	0.0203	0.6020	0.72	21.26
6	0.0048	0.9463	0.17	33.42
7	0.0017	0.1147	0.06	4.05
8	0.0181	0.3466	0.64	12.24
9	0.0006	0.0498	0.02	1.76
10	0.0340	n/a	1.20	n/a

Pollutant Loads

The sum total of nutrients and other particles carried by a stream is a factor of concentration and discharge and is referred to as a load.

The highest TSS load, the second highest nitrate + nitrite and TKN loads, and the third highest total phosphorus load were recorded at Site 5. Subwatershed 5 encompasses more acreage by far than any other subwatershed. And, the second highest recorded storm flow discharge rate of the watershed study area was recorded at Site 5. The highest TKN load, and the second highest phosphorus and TSS loads, were recorded at Site 6. The highest recorded storm flow discharge rate was recorded at Site 6. Subwatershed 6 is the third largest subwatershed in the watershed study area. It makes sense that the some of the highest loads in the watershed study area were recorded at Sites 5 and 6 (Figures 30-33). These sites are the downstream most sample locations on the Scott Ditch where storm flow discharge was determined. It is logical to assume that storm flow loads at Site 10 downstream of Sites 5 and 6 would also be high. Storm flow discharge data were not collected at Site 10 due to safety concerns associated with high Wabash River waters.

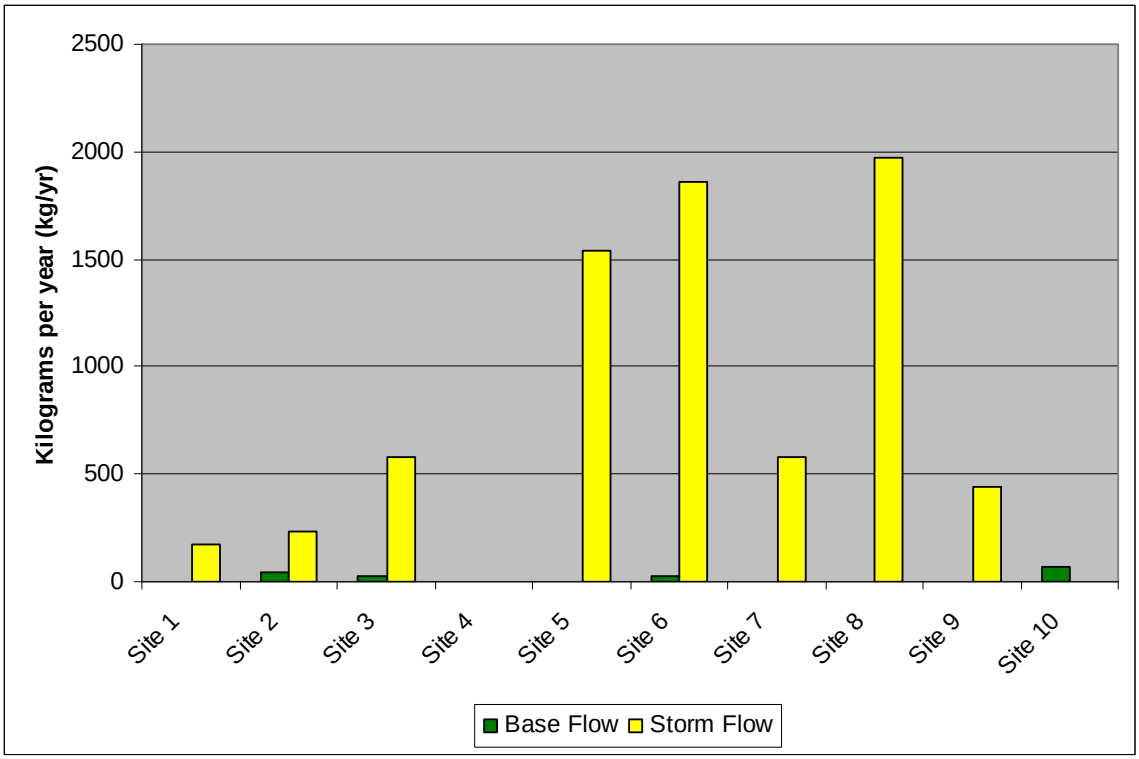


Figure 30. Total Phosphorus Loads

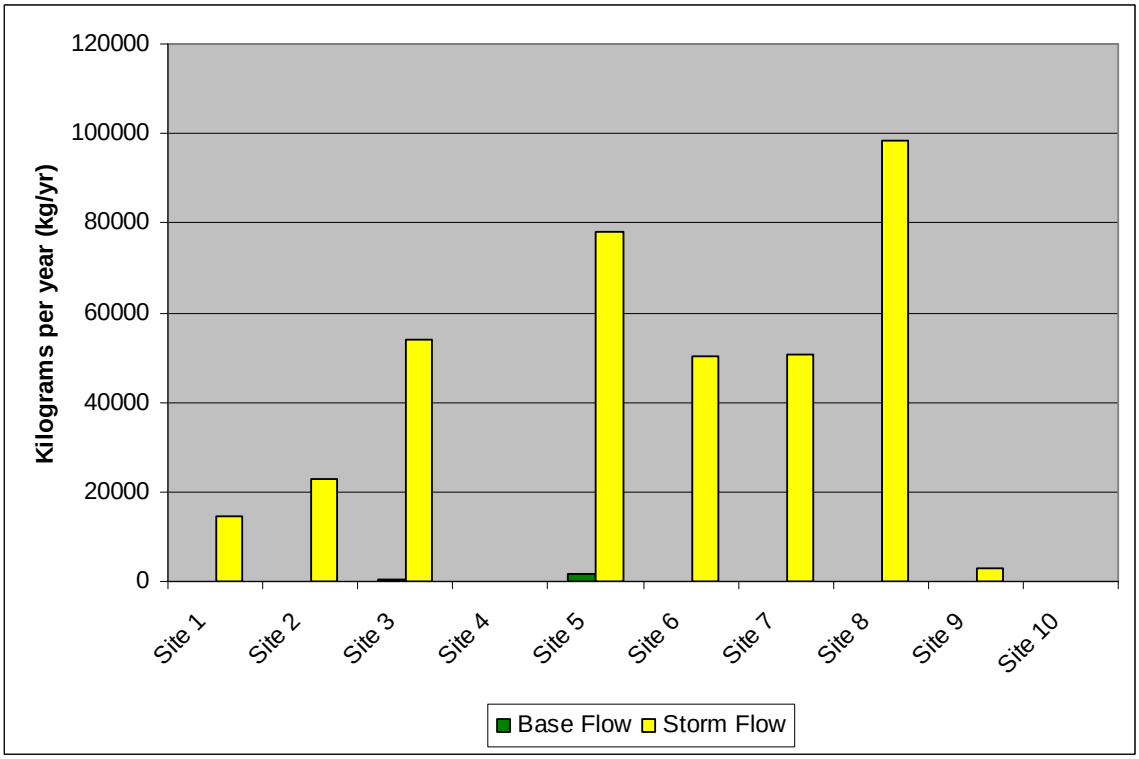


Figure 31. Total Nitrate + Nitrite Nitrogen Loads

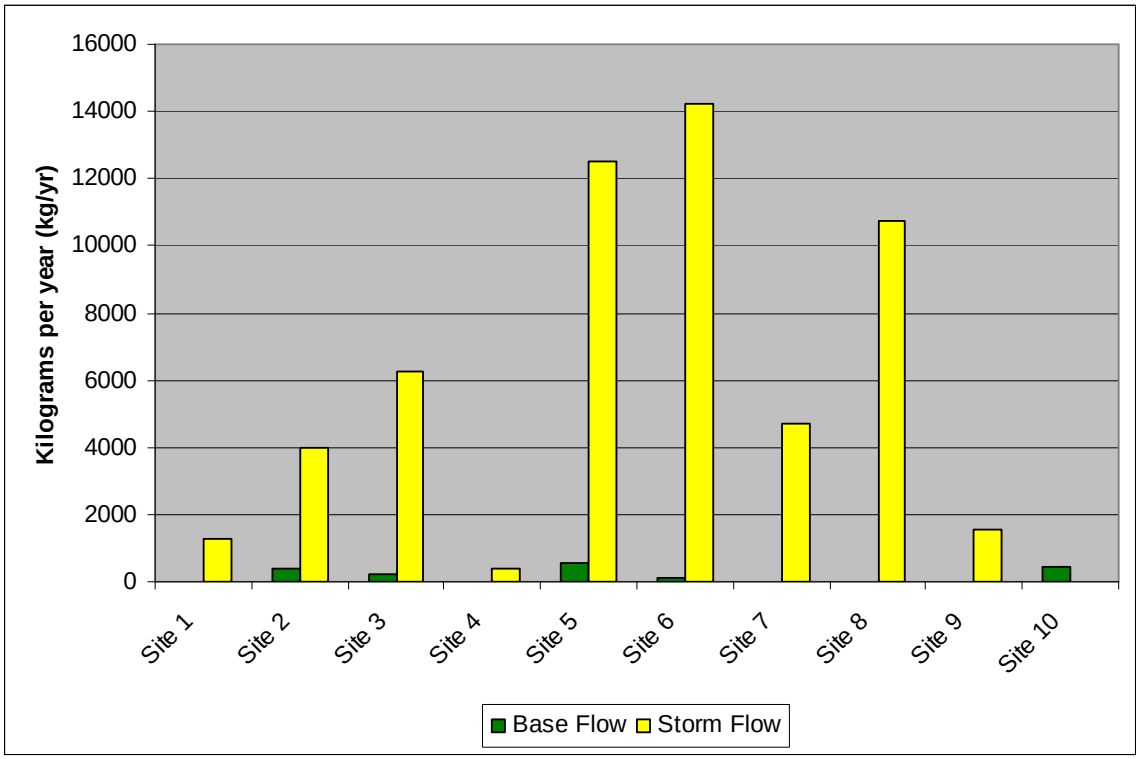


Figure 32. TKN Loads

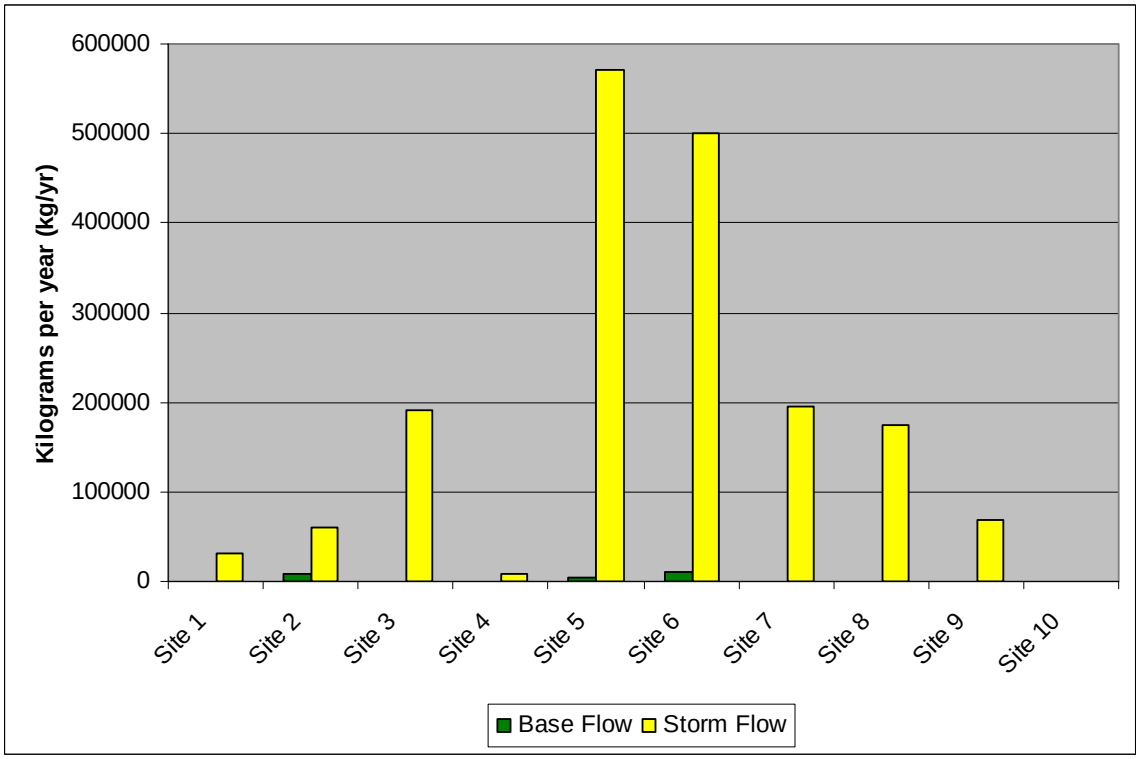


Figure 33. TSS Loads

The highest total phosphorus and nitrate + nitrite loads were recorded at Site 8. Site 8 has the third highest recorded storm flow discharge in the watershed study area. However, Subwatershed 8 has the second smallest subwatershed acreage. In general, the pollutant loads recorded at Sites 7, 8, and 9 are high compared with other subwatersheds receiving runoff from larger acreages such as Sites 2 and 3 (Table 12). These data suggest that conservation efforts designed to reduce nutrient and TSS loads should be concentrated in Subwatersheds 7, 8, and 9.

Table 12. Storm Flow Discharge, Pollutant Loads, and Acreages Draining to Sample Sites

Site/ Subwatershed	Subwatershed Hectares	Total Hectares Draining to Site	Discharge (cubic m/sec)	Phosphorus Load (kg/yr)	Nitrate + Nitrite Load (kg/yr)	TKN Load (kg/yr)	TSS Load (kg/yr)
1	622.22	622.22	0.0784	170.80	14,356.84	1,262.41	32,179.13
2	569.66	1,191.88	0.1263	235.10	22,717.52	3,985.53	59,782.95
3	995.59	2,187.47	0.3356	582.39	54,005.72	6,247.72	190,608.41
4	375.24	375.24	0.0263	n/a	290.87	373.98	9,141.70
5	1,688.49	3,875.96	0.6020	1 538.88	77,892.98	12,538.87	569,948.64
6	1,192.52	5,443.71	0.9463	1 863.18	50,087.21	14,224.77	500,872.08
7	603.17	603.17	0.1147	579.09	50,668.06	4,704.89	195,433.94
8	514.54	514.54	0.3466	1 969.78	98,440.8	10,719.11	175,005.88
9	557.50	557.50	0.0498	440.40	2,830.98	1,887.32	67,628.90
10	1,465.75	8,354.77	n/a	n/a	n/a	n/a	n/a
Site/ Subwatershed	**Subwatershed Acres**	**Total Acres Draining to Site**	**Discharge (cubic ft/sec)**	**Phosphorus Load (lbs/yr)**	**Nitrate + Nitrite Load (lbs/yr)**	**TKN Load (lbs/yr)**	**TSS Load (tons/yr)**
1	1,537.53	1,537.53	2.77	376.55	31,651.22	2,783.09	35.47
2	1,407.66	2,945.19	4.46	518.30	50,083.00	8,786.43	65.90
3	2,460.16	5,405.35	11.85	1,283.96	119,060.97	13,773.68	210.11
4	927.23	927.23	0.93	n/a	641.26	824.52	10.08
5	4,172.35	9,577.70	21.26	3,392.66	171,722.91	27,643.26	628.25
6	2,946.78	13,451.71	33.42	4,107.61	110,422.24	31,359.99	552.11
7	1,490.47	1,490.47	4.05	1,276.68	111,702.89	10,372.42	215.43
8	1,271.45	1,271.45	12.24	4,342.62	217,022.59	23,631.33	192.91
9	1,377.61	1,377.61	1.76	970.91	6,241.22	3,397.95	74.55
10	3,053.84	20,645.08	n/a	n/a	n/a	n/a	n/a

Biological Water Quality Assessment

E. coli

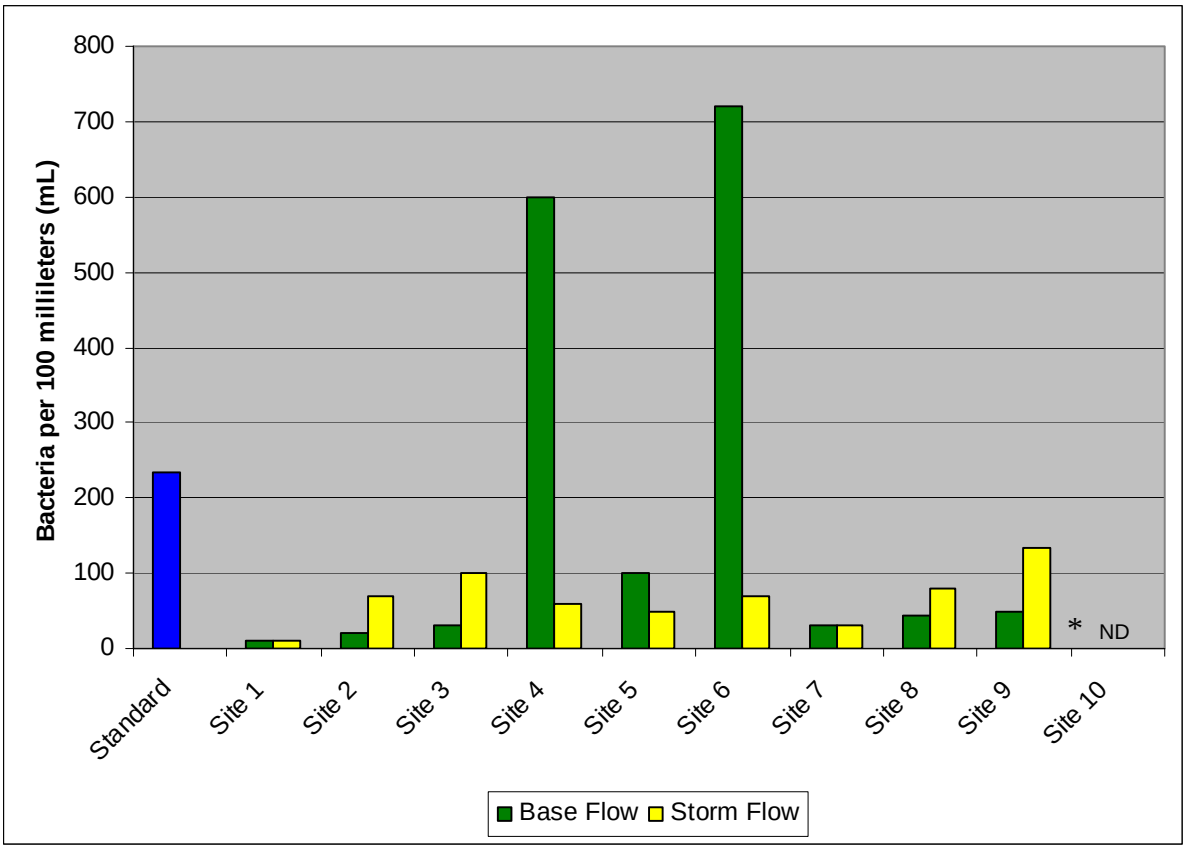
Escherichia coli (*E. coli*) bacteria are found in the lower intestine and feces of warm-blooded animals. Some strains of *E. coli* can cause illness when they enter the body through the mouth, nose, eyes, ears, or cuts in the skin. The presence of *E. coli* in water is a good indicator of fecal contamination and the presence of other bacteria harmful to human health. Typical sources of *E. coli* in water are combined sewer overflows, malfunctioning septic systems, and livestock manure. Indiana water quality standards state that for full body contact recreational use, *E. coli* concentrations shall not exceed 235 colony-forming units (CFU) per 100 milliliters of water in any 1 sample in a 30-day period.(327 IAC 2-1-6). The average *E. coli* concentration of surface water in Indiana is 645 CFU per 100 milliliters (IDNR, 2008).

E. coli samples were collected at the same time and by the same Davey staff as the physical and chemical water quality parameters. Microbac used SM 9213D methodology to test the samples.

All sample sites had *E. coli* concentrations less than the state standard for base flow and storm flow sampling events with the exception of base flow samples from Sample Sites 4 and 6.

Sample Sites 4 and 6 had respective *E. coli* concentrations of 600 and 720 CFU per 100 milliliters (Figure 34). A small quantity of cattle and a few septic systems are near Emerson Ditch in Subwatershed 4. *E. coli* may have originated from these sources or wildlife fecal contamination. The storm flow sample collected at Site 4 had an *E. coli* concentration of 60 CFU per 100 mL which is significantly less than the base flow sample and the standard.

There is no evidence of potential sources of contamination from outfalls, livestock, or septic systems in the vicinity of Site 6. The storm flow sample taken at the same location had an *E. coli* concentration of 70 CFU per 100 mL, which is far less than the base flow sample and the standard. Wildlife fecal contamination coupled with slow moving water is the most probable explanation for the elevated base flow *E. coli* concentration at this sample site.



* = Concentration below detectable lab limit
ND = No data collected

Figure 34. E. coli Concentrations

Macroinvertebrates

Benthic macroinvertebrates were sampled at all sample sites determined to have sufficient habitat and water levels to support a macroinvertebrate community. Specifically, macroinvertebrate sample sites were Site 2, Site 3, Site 5, and Site 10. Sampling occurred October 21-23, 2008 by Davey Biologists Jessica Hickey and Alicia Douglass. Macroinvertebrates were collected in accordance with the Rapid Bioassessment Protocol multi-habitat approach due to the minimal presence of cobble habitat (Barbour, *et al.*, 1999). A 100-organism subsample was taken in accordance with IDEM's subsampling protocol (T. Davis, personal communication, December 10, 2008). All specimens collected were identified to the family level. Identifications are based on Merritt and Cummins (1996) and Voshell (2002).

HBI

Organic and nutrient stream pollution can be evaluated using a family level macroinvertebrate biotic index developed by Hilsenhoff (HBI). Macroinvertebrate families are assigned a number from 0 to 10 based on tolerance to organic pollution. A 0 is assigned to families most intolerant to organic pollution and a 10 to families most tolerant to organic pollution (Hilsenhoff, 1988). In accordance with IDEM standard practices, in this study Hilsenhoff tolerance values were supplemented with values from Bode (1988). Families not assigned a tolerance value by either Hilsenhoff or Bode were excluded from the HBI (T. Davis, personal communication, December 10, 2008). HBI scores are determined by multiplying the total number of individuals for each family by the family tolerance values. The sum of all products for a site is divided by the total number of individuals to determine the HBI score. Table 13 correlates the HBI score with water quality and the likely degree of organic pollution.

Table 13. Interpretation of HBI Scores

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

HBI scores for all sites ranged from 7.40 to 8.46 indicating that water quality is very poor and severe organic pollution is likely. The 100-organism macroinvertebrate subsamples collected at each site are displayed in Tables 14-17. These tables list the macroinvertebrate families identified, the HBI tolerance value for each family, the number of individuals collected per family, and the site HBI score.

Table 14. Sample Site 2 HBI

Family	Quantity	Tolerance Value
Baetidae	2	4
Chironomidae[1]	20	7
Coenagrionidae	55	9
Haliplidae[2]	2	n/a
Libellulidae	23	9
Physidae	2	8
Pyralidae	1	5
HBI Total Macroinvertebrates	**103**	
HBI Score	**8.46**	

[1] Both red and non-red chironomids were observed in the field. Hilsenhoff (1988) assigned tolerance values of 8 and 6, respectively, to blood red chironomids and all other colors including pink. Official counts were conducted in the laboratory with preserved specimens making color determination uncertain; consequently an average tolerance value of 7 was assigned to all chironomids.

[2] Families that were not assigned a tolerance value by Hilsenhoff (1988) or Bode (1988) were excluded from the HBI score calculation.

Table 15. Sample Site 3 HBI

Family	Quantity	Tolerance Value
Asellidae	12	8
Baetidae	11	4
Branchiobdellidae[2]	9	n/a
Chironomidae[1]	20	7
Coenagrionidae	21	9
Corixidae[2]	19	n/a
Culicidae[2]	2	n/a
Haliplidae[2]	1	n/a
Libellulidae	4	9
Physidae	4	8
HBI Total Macroinvertebrates	**72**	
HBI Score	**7.46**	

[1] Both red and non-red chironomids were observed in the field. Hilsenhoff (1988) assigned tolerance values of 8 and 6, respectively, to blood red chironomids and all other colors including pink. Official counts were conducted in the laboratory with preserved specimens making color determination uncertain; consequently an average tolerance value of 7 was assigned to all chironomids..

[2] Families that were not assigned a tolerance value by Hilsenhoff (1988) or Bode (1988) were excluded from the HBI score calculation.

Table 16. Sample Site 5 HBI

Family	Quantity	Tolerance Value
Chironomidae[1]	2	7
Coenagrionidae	39	9
Corixidae[2]	36	n/a
Dytiscidae[2]	1	n/a
Gomphidae	5	1
Haliplidae[2]	11	n/a
Libellulidae	2	9
Physidae	5	8
Tipulidae	1	3
HBI Total Macroinvertebrates	**54**	
HBI Score	**7.98**	

[1] Both red and non-red chironomids were observed in the field. Hilsenhoff (1988) assigned tolerance values of 8 and 6, respectively, to blood red chironomids and all other colors including pink. Official counts were conducted in the laboratory with preserved specimens making color determination uncertain; consequently an average tolerance value of 7 was assigned to all chironomids.

[2] Families that were not assigned a tolerance value by Hilsenhoff (1988) or Bode (1988) were excluded from the HBI score calculation.

Table 17. Sample Site 10 HBI

Family	Quantity	Tolerance Value
Bipaliidae	3	4
Branchiobdellidae[2]	11	n/a
Chironomidae[1]	27	7
Coenagrionidae	13	9
Corixidae[2]	9	n/a
Culicidae[2]	1	n/a
Dytiscidae[2]	2	n/a
Gyrinidae[2]	2	n/a
Haliplidae[2]	1	n/a
Hirundinidae[2]	1	n/a
Libellulidae	1	9
Simuliidae	1	6
HBI Total Macroinvertebrates	**45**	
HBI Score	**7.40**	

[1] Both red and non-red chironomids were observed in the field. Hilsenhoff (1988) assigned tolerance values of 8 and 6, respectively, to blood red chironomids and all other colors including pink. Official counts were conducted in the laboratory with preserved specimens making color determination uncertain; consequently an average tolerance value of 7 was assigned to all chironomids.

[2] Families that were not assigned a tolerance value by Hilsenhoff (1988) or Bode (1988) were excluded from the HBI score calculation.

mIBI

IDEM's mIBI for riffle kick samples was used to evaluate the macroinvertebrate community (T. Davis, personal communication, October 13, 2008). Using mIBI a score is determined for each site in 10 different metrics. The average of all 10 metric scores is the mIBI score for a site. The 10 mIBI metrics include the family level HBI score, the number of taxa collected, the number of individuals collected, the percent of the dominant taxa, the EPT index, the EPT organism count, the EPT count to the total number of individuals collected, the EPT count to the chironomid count, the total chironomid count, and the total number of individuals for the number of squares sorted when subsampling. The EPT index is a measure of taxa richness within the orders Ephemeroptera, Plecoptera, and Odonata, orders containing families less tolerant of pollution (Mandaville, 2002). Chironomids are organisms belonging to the taxonomic family Chironomidae.

Table 18 depicts mIBI scoring criteria using the riffle kick method. A mIBI score between 0 and 2 indicates that the site is severely impaired. A score between 2 and 4 indicates moderate impairment. Scores between 4 and 6 and scores between 6 and 8 suggest that the site is slightly impaired and non-impaired, respectively. Any site receiving a score less than 2.2 is designated as impaired for aquatic life use by IDEM (IDEM, 2008a).

Table 18. Scoring Criteria for the Family Level mIBI – Riffle Kick Samples[1]

	CLASSIFICATION SCORE				
	0	**2**	**4**	**6**	**8**
Family Level HBI	≥5.63	5.06-5.62	4.55-5.05	4.09-4.54	<4.08
Number of Taxa	<7	8-10	11-14	15-17	>18
Number of Individuals	<79	80-129	130-212	213-349	>350
Percent Dominant Taxa	>61.6	43.9-61.5	31.2-43.8	22.2-31.1	<22.1
EPT Index	<2	3	4-5	6-7	>8
EPT Count	<19	20-42	43-91	92-194	>195
EPT Count to Total Number of Individuals	<0.13	0.14-0.29	0.30-0.46	0.47-0.68	>0.69
EPT Count to Chironomid Count	<0.88	0.89-2.55	2.56-5.70	5.71-11.65	>11.66
Chironomid Count	>147	55-146	20-54	7-19	<6
Total Number of Individuals to Number of Squares Sorted	<29	30-71	72-171	172-409	>410

[1] Calibrated from transformed data distribution of the 1990-1995 100-organism subsamples

All sites have mIBI scores indicating that they are severely impaired and classified as impaired for aquatic life use (Table 19). Total mIBI scores for all sites range from a minimum of 1.00 to a maximum of 2.00. Big Creek in Posey County, a similar regional stream in the same 8-digit HUC watershed, was determined by IDEM to have a similar mIBI score of 1.80. Although the result obtained at Big Creek is not directly comparable to the results from the watershed study area sites due to different sampling and scoring methodologies.

All sites in the watershed study area achieved mIBI metric scores of 0 for HBI, the EPT index, EPT count, EPT count to total number of individuals, EPT count to chironomid count, and number of individuals to the number of squares sorted. HBI scores indicated the likelihood of severe organic pollution at the sample sites. This coincides with low scores for the EPT index.

Table 19. Metric Scores for the Family Level mIBI – Riffle Kick Samples

	Site 2		Site 3		Site 5		Site 10	
Metric	**Data**	**Score**	**Data**	**Score**	**Data**	**Score**	**Data**	**Score**
Family Level HBI	8.46	0	7.46	0	7.98	0	7.4	0
Number of Taxa	8	2	11	4	11	4	12	4
Number of Individuals	105	2	103	2	102	2	72	0
Percent Dominant Taxa	52.4	2	20.4	8	38.2	4	37.5	4
EPT Index	1	0	1	0	0	0	0	0
EPT Count	5	0	15	0	0	0	0	0
EPT Count to Total Number of Individuals	0.05	0	0.15	2	0	0	0	0
EPT Count to Chironomid Count	0.25	0	0.75	0	0	0	0	0
Chironomid Count	20	4	20	4	2	8	27	4
Number of Individuals to Number of Squares Sorted	1.8	0	1.9	0	4.1	0	1.1	0
Site mIBI Score	**1.00**		**2.00**		**1.80**		**1.20**	

An even distribution among the EPT taxa and chironomids indicates a community in good biotic condition, whereas a community disproportionately high in chironomids may indicate environmental stress. Chironomids are typically more tolerant of pollution (Mandaville, 2002). The EPT to the chironomid count was disproportionate for Sites 2, 5, and 10. Site 3 ranked higher in this metric.

The percent dominant taxa metric indicates the family level community balance. Communities dominated by few families indicated that the community is under environmental stress (Mandaville, 2002). Site 3 achieved a high score in this metric while Sites 5 and 10 scored moderately. Site 2 had a large number of individuals in the Coenagrionidae family, consequently scoring lower in this metric.

Sites 3, 5, and 10 have a number of taxa metric score of 4. This metric coupled with the percent dominant taxa metric indicate that the macroinvertebrate communities at these three sites are moderately diverse and balanced. Site 2 is less diverse and has a less balanced community than the other sample sites. This may be attributed to the fact that it is the furthest upstream sample point in the watershed at which macroinvertebrates were sampled.

All sites scored relatively low for the total number of individuals. It was unnecessary to subsample organisms collected at Site 10 since the total collected was below the 100-organism subsample threshold. The low number of organisms at Site 10 is most likely influenced by several factors. These factors include possible influences of the roadway bridge on habitat, water depth, and past flooding. Because water was too deep for macroinvertebrate sampling upstream of the bridge, sampling was conducted beneath the bridge and immediately downstream of the bridge. Collecting macroinvertebrates beneath and downstream of bridges is not recommended in the Rapid Bioassessment Protocol (Barbour, *et al*., 1999). Additionally, Site 10 is very close to the Wabash River. Wabash River flooding that occurred in Spring, 2008 may have negatively influenced macroinvertebrate populations by washing away habitat and individual organisms. Consequently, the total mIBI score for Site 10 may be distorted.

Fish

Data related to the fish community present in the Loefler and Scott Ditches watershed were not collected as part of this study. It is important to note that the watershed study area does support a fish community. Multiple fish of an unidentified species were observed at Site 5. A rainbow darter (*Etheostoma caeruleum*) was caught in the macroinvertebrate kick seine at Site 10.

Exotic and Nuisance Species

No exotic or nuisance species were identified as a having a significant negative effect on water quality in the watershed study area.

Habitat Evaluation

The Qualitative Habitat Evaluation Index (QHEI) is a six metric index used to evaluate the physical habitat of a waterway. A QHEI analysis was conducted at all sample sites October 21-23, 2008 by Jessica Hickey and Alicia Douglass. QHEI takes into account substrate, in-stream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle/run quality, and the waterway gradient. The maximum QHEI score is 100 (Ohio EPA, 2006). IDEM has determined that a total QHEI score less than 51 indicates poor quality habitat. QHEI scores are evaluated to determine if poor quality habitat is a contributing stressor on aquatic biotic communities (IDEM, 2008a).

All study area sampling sites had QHEI scores indicating that habitat quality is poor (Figure 35). Site 3 ranked well for in-stream cover, pool/glide and riffle/run quality, and gradient (Photograph 3, Appendix B). Sites 1, 2, and 4 also ranked well for gradient. In all other instances, each sample site ranked 50 percent or less in all other metrics. Such results are as to be expected for maintained ditch waterways. Table 20 lists QHEI scores for each sample site by metric. QHEI data sheets can be found in Appendix E.

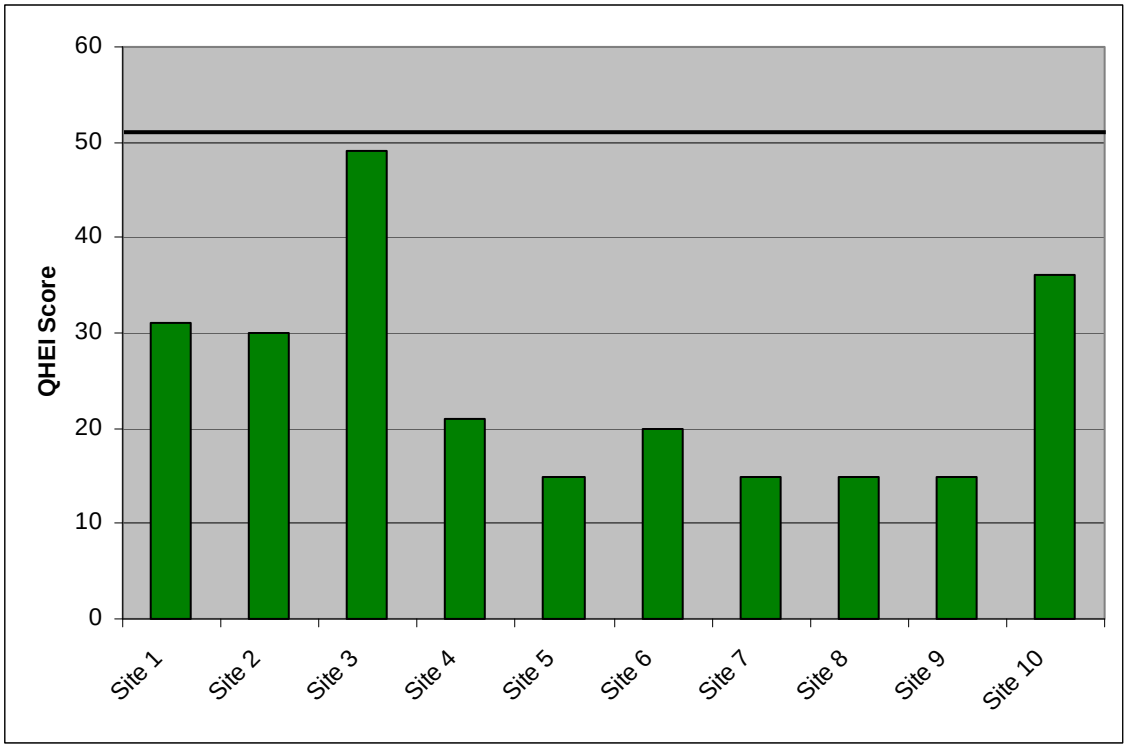


Figure 35. Sample Site QHEI Scores

Table 20. Sample Site QHEI Scores per Metric

Metric	Substrate	In-stream Cover	Channel Morphology	Bank Erosion & Riparian Zone	Pool/Glide & Riffle/Run Quality	Gradient	Total
Maximum Score	20	20	20	10	20	10	100
Site 1	6	4	10	3.75	-1	8	30.75
Site 2	5	4	7	2.5	3	8	29.5
Site 3	5.5	14	10	5	8	6	48.5
Site 4	7	2	4	3	-1	6	21
Site 5	0	3	4	3	3	2	15
Site 6	0	5	6	5	2	2	20
Site 7	3	2	4	3	-1	4	15
Site 8	3	2	4	3	-1	4	15
Site 9	3	2	4	3	-1	4	15
Site 10	2	12	9	3	8	2	36

Table 21 lists QHEI general score ranges assigned by Ohio EPA. Based on this interpretation 7 out of 10 sample sites have very poor quality habitat. A total of 2 sample sites have poor quality habitat, and 1 site has fair quality habitat.

Table 21. QHEI Score Ranges Assigned by Ohio EPA

Habitat Rating	QHEI Score Range	
	Headwaters	Larger Streams
Excellent	≥ 70	≥ 75
Good	55-69	60-74
Fair	43-54	45-59
Poor	30-42	30-44
Very Poor	< 30	< 30

Water Quality Summary

Water sample results indicate that *E. coli* contamination, water temperature, pH, dissolved solids in the form of specific conductivity, and phosphorus levels are not of high concern. Since phosphorus is often the limiting nutrient factor in aquatic systems for plant growth, low orthophosphate and total phosphorus levels indicate the potential for algae blooms and corresponding eutrophication is low.

Five sites had base flow DO concentrations below the desired state water quality standards. Low DO concentrations are negatively influenced by high nutrient and organic waste levels. Nutrient test results suggest that low DO concentrations in the watershed study area are also likely influenced by sluggish water velocity and lack of a riparian zone shading the stream at some of the sites. Base flow stream velocity was very low at all sites resulting in a watershed study area maximum discharge of 0.034 cubic meter (1.20 cubic feet) per second, which was recorded at Site 10.

Macroinvertebrate HBI scores suggest that all sites where macroinvertebrates were sampled have very poor water quality and that severe organic pollution is likely. In HBI, the degree of organic pollution is indirectly determined by the number of organisms tolerant of low DO levels. As previously discussed, DO levels are sometimes influenced by factors other than organic pollution.

Scores from mIBI are indicative of environmental stress and classify all macroinvertebrate sampled streams as impaired for aquatic life use. QHEI scores indicate that all streams in the watershed study area have poor quality habitat. Poor quality habitat likely heavily influences macroinvertebrate populations. Based on water chemistry results, it is reasoned that poor quality habitat coupled with low DO levels resulting from sluggish water velocity and lack of a riparian zone have a greater influence on macroinvertebrate populations than organic pollution and high nutrient levels.

Ammonia nitrogen was the only nutrient sampled for that consistently exceeds water quality standards at multiple sites including Sites 5-9 at the time of base flow sampling and Sites 6-9 at the time of storm flow sampling. Agricultural fertilizer is the most probable source of this nutrient. Davey recommends that watershed stakeholders strive to reduce ammonia nitrogen levels in the Scott Ditch watershed by 50-75 percent. Turbidity values exceeded target levels in base flow samples at Sites 2 and 4-10 as well as in storm flow samples at Sites 6-9. TSS concentrations exceeded the water quality target in base flow samples from Sites 4 and 6-9 as well as in storm flow samples from Sites 7 and 9. High turbidity and TSS values suggest streams in these locations are carrying large quantities of sediment. In general, nutrient and TSS loads are the highest per acreage draining to the sample sites for Subwatersheds 7-9.

QHEI analysis and aerial photointerpretation indicate that there is little to no riparian zones or filter strips adjacent to streams in these subwatersheds. Davey recommends that watershed stakeholders strive to achieve TSS concentrations at or below the 30.0 mg/L target concentration established by IDEM.

Subwatersheds 7-9 should be emphasized in conservation efforts to reduce nutrient and TSS loads.

Watershed Modeling

Nutrient and Sediment Loads

The Spreadsheet Tool for the Estimation of Pollutant Load (STEPL) Region 5 Load Estimation Model Version 4.0 was selected to model sediment and nutrient loads from predicted sources of nonpoint source pollution from different land use types in the Loefler and Scott Ditches watershed. STEPL was designed for the Grants Reporting and Tracking System of the U.S. Environmental Protection Agency by Tetra Tech, Inc. from a model previously developed by IDEM. STEPL uses algorithms to calculate relative nutrient and sediment loads and resulting load reductions associated with implementation of certain BMPs (Tetra Tech, 2006b).

Load reductions are determined by first estimating gross erosion within the watershed, and then the amount of sediment and associated nutrients that reach surface water. Gross erosion is determined through the Revised Universal Soil Loss Equation (RUSLE), the Gully Erosion Equation (GEE), and the Channel Erosion Equation. Estimated sediment delivery to surface waters and the associated nutrient contents are estimated using equations and values derived from scientific literature. Pollutant and sediment load reductions are computed using known BMP efficiencies for certain practices. Nutrient reductions are assumed to come from reduction in sediment-borne nutrients. Dissolved nutrients are not included.

The program considers acreages of urban, cropland, pasture, feedlot, and forest land use types. For this particular watershed model, the STEPL program also took into consideration the numbers and types of farm animals in the watershed, septic system numbers and failure rate data, national weather service rainfall data, and observed streambank and gully erosion instances.

Land cover type for each subwatershed was determined from the 2001 National Land Cover Database (NLCD) and observations made in the field. Approximately 78 percent of the watershed study area is cropland, 2 percent is urban, and the balance is various types of natural areas. Numbers of farm animals, septic systems, and instances of streambank erosion were derived from field observations and aerial photointerpretation.

BMPs known to currently exist in the watershed taken into consideration by the STEPL program include filter strips and reduced tillage (including reduced tillage, mulch tillage, and no-till). A total of 42 percent of fields in Gibson County practiced reduced tillage or a more conservative tillage practice from 2000-2007 as was determined from calculations of tillage transect data provided by the Gibson County SWCD (A. Ice, personal communication, October 10, 2008). It was assumed that the Loefler and Scott Ditches watershed is typical of the County. It was also assumed that the percentage of the number of fields on which reduced tillage or a more conservative tillage form is practiced is equivalent to the percentage of acres on which these same practices occur. Overland flow from an estimated 5 percent of cultivated land in the watershed study drains through a filter strip prior to entering surface water (A. Ice and G. Seibert, personal communication, March 26, 2009). It was assumed that conservation tillage is practiced on fields having filter strips. Based on these data and assumptions, STEPL calculated baseline annual nutrient and sediment loads for all subwatersheds.

For all subwatersheds, STEPL estimates that 89.7 percent of total phosphorus loads, 80.8 percent of total nitrogen loads, and 95.1 percent of sediment loads are derived from cropland (Figures 36-38). Pasture and Grasslands are estimated to contribute 8.0 percent of total phosphorus loads, 17.7 percent of total nitrogen loads, and 4.4 percent of sediment loads, making this land use category the second largest nutrient and sediment contributor. Urban areas are estimated to contribute 0.4 percent of total phosphorus load, 0.6 percent of the total nitrogen load, and 0.2 percent of the sediment load. Septic systems are estimated to contribute 0.2 percent to total phosphorus loads, 0.1 percent to total nitrogen loads, and less than the 0.0 percent detectable limit to sediment loads. Streambanks are estimated to contribute less than the 0.0 percent detectable limit to nutrient and sediment loads.

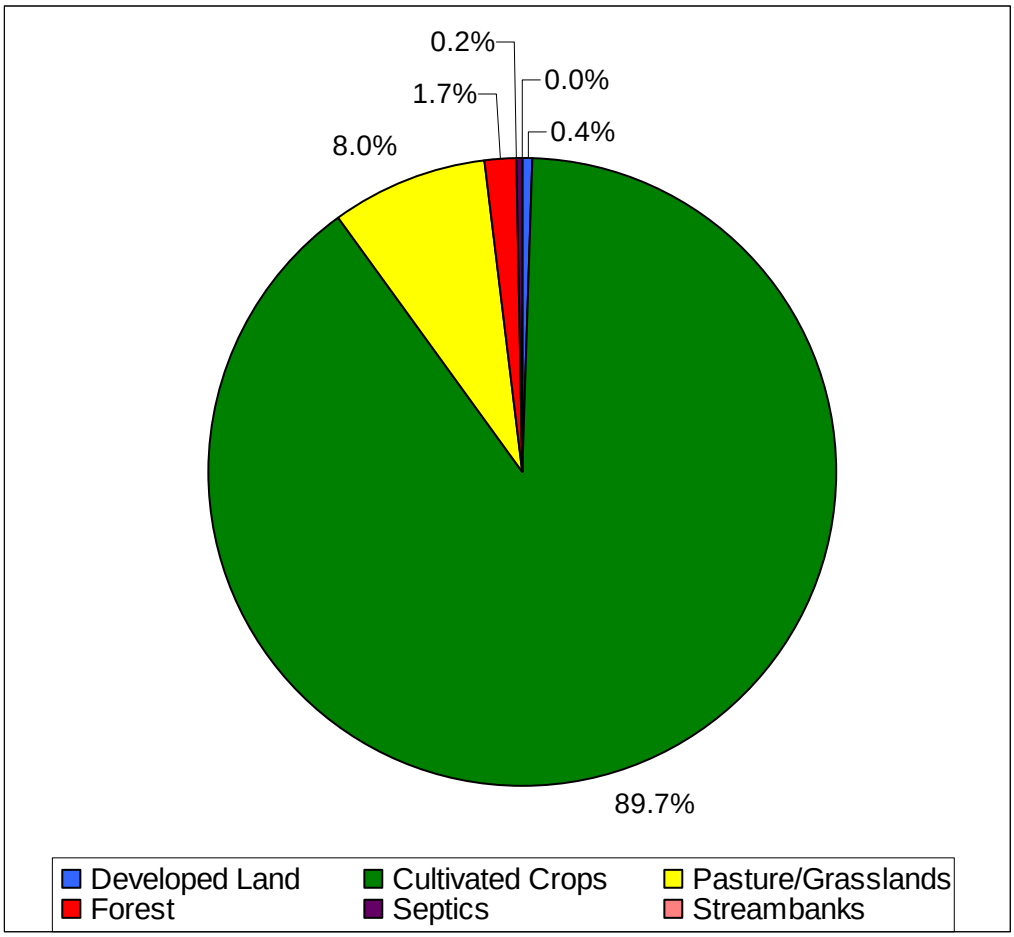


Figure 36. STEPL Generated Total Phosphorus Loads

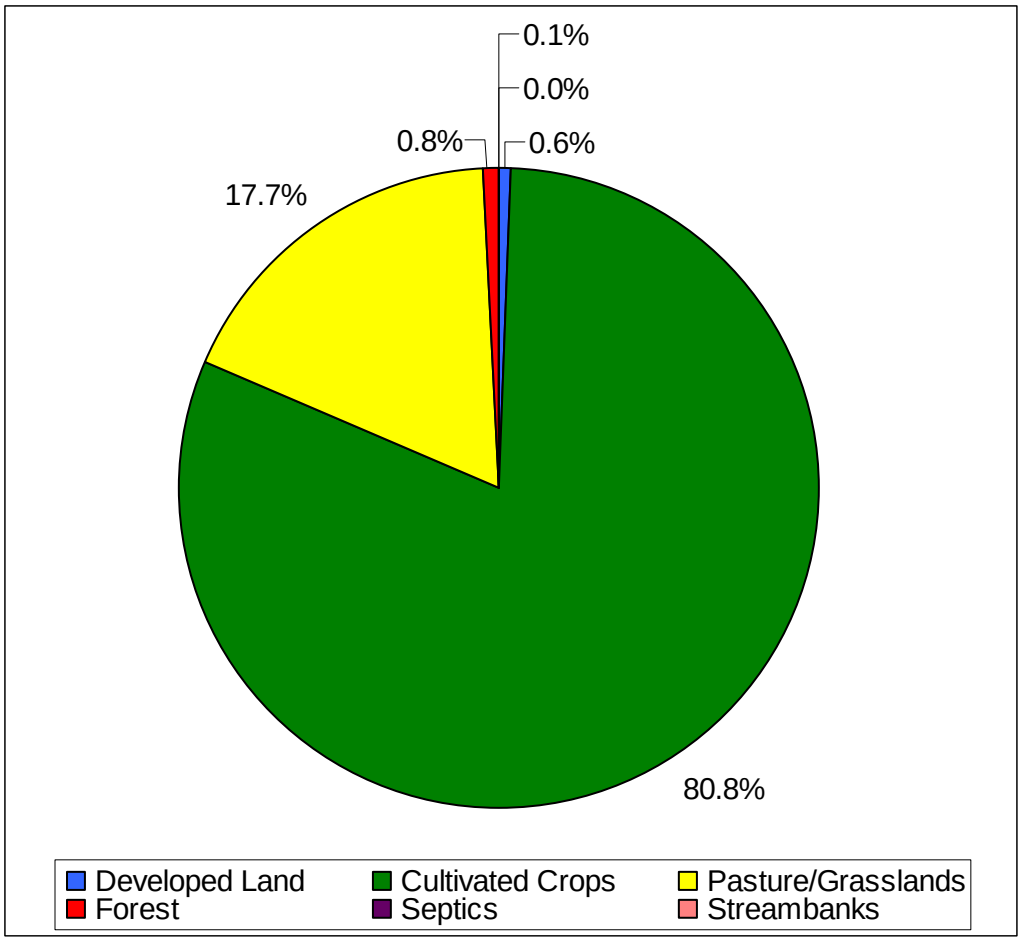


Figure 37. STEPL Generated Total Nitrogen Loads

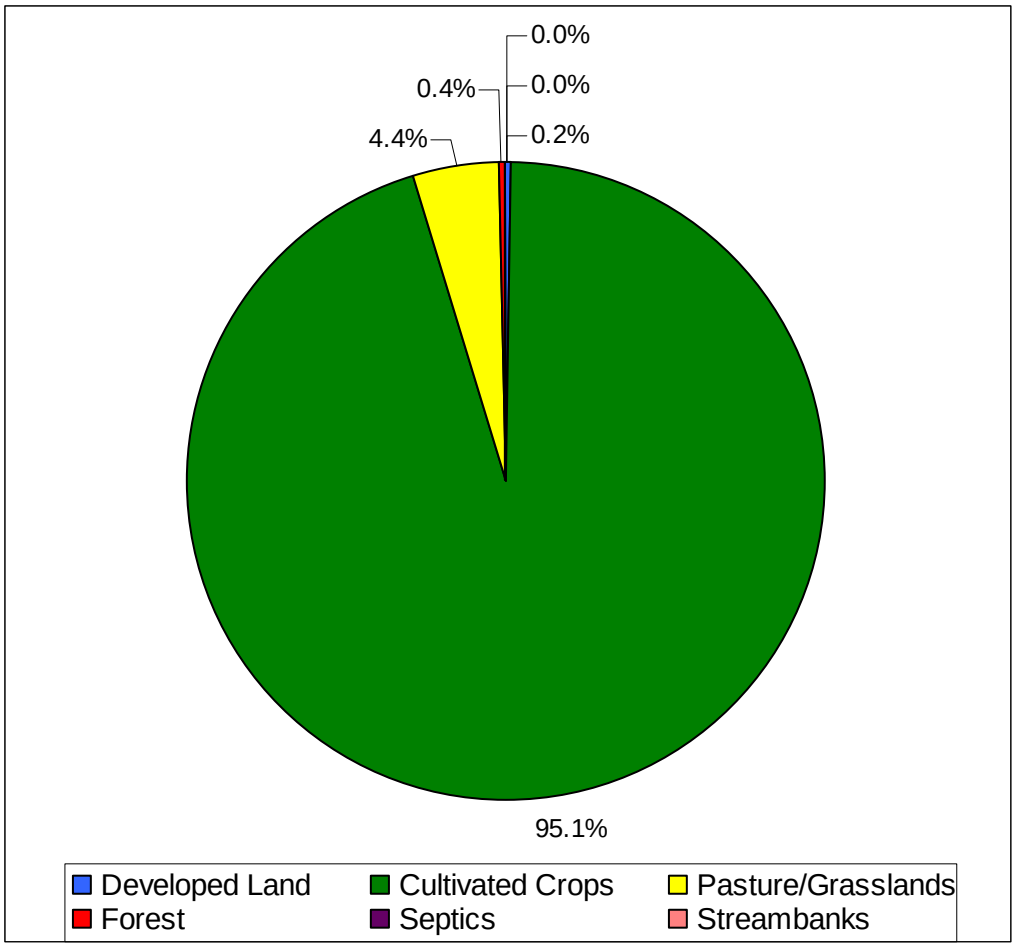


Figure 38. STEPL Generated Sediment Loads

STEPL was used to estimate theoretical percent reductions in nutrient and sediment loads that will occur with an increased percentage of cropland runoff acreage draining through filter strips and an increased percentage in the number of cropland acreages on which reduced or conservation tillage is implemented. Current watershed study area conditions assume that 5 percent of cropland acres drain through a filter strip and that reduced or conservation tillage is implemented on 42 percent of cropland acres.

STEPL was used to model percent reductions in nutrient and sediment loads assuming the percent of cropland draining through filter strips increases from 5 percent to 10 percent, 15 percent, and 20 percent. STEPL predicts a 2.1 percent, 1.8 percent, and 1.5 percent reduction in total phosphorus, total nitrogen, and sediment loads, respectively, if the percent of cropland in all subwatersheds draining through filter strips is increased to 20 percent (Table 22).

Table 22. Filter Strip Estimated Pollutant Load Reductions

Pollutants Reduced	Percent of Cropland Acres Draining through a Filter Strip Increased from 5 Percent		
	10	15	20
All Subwatersheds	Pollutant Percent Reduction		
Phosphorus	0.7	1.4	2.1
Nitrogen	0.6	1.2	1.8
Sediment	0.6	1.0	1.5

Expected percent reduction in nutrient and sediment loads resulting from increasing the percent of cropland draining on which reduced or conservation tillage is practiced from 42 percent to 50 percent, 60 percent, 70 percent, 80 percent, and 90 percent was modeled for the sum total of all subwatershed acreages and each subwatershed individually. STEPL predicts a 36.3 percent, 32.7 percent, and 50.2 percent reduction in total phosphorus, total nitrogen, and sediment loads, respectively, if the percent of cropland on which reduced or conservation tillage is practiced increased to 90 percent (Table 23).

STEPL-generated pollutant load reductions suggest that an increase from 42 percent to 50 percent of land on which reduced or conservation tillage is practiced will result in over 3 times the average pollutant reduction than a 15 percent increase in the amount of cropland draining through filter strips.

Figure 39 depicts subwatersheds that will have the greatest, moderate, and least amounts of potential pollutant reductions resulting from increasing reduced or conservation tillage to 50 percent according to the STEPL model. The STEPL model bases percent reduction on the percentage of land in cultivated crops in each subwatershed. In reality, the actual percent pollutant reductions received from implementing increased conservation tillage in Subwatersheds 5, 6, and 10 may be lower than the model predicts due to decreased surface flow reaching Scott Ditch as a result of substantial berms constructed adjacent to the ditch to contain floodwaters in the channel.

Table 23. Reduced or Conservation Tillage Estimated Pollutant Load Reductions

Pollutants Reduced per Subwatershed	Percent of Field Area with Reduced or Conservation Tillage Increased from 42 Percent				
	50	60	70	80	90
All Subwatersheds	Pollutant Percent Reduction				
Phosphorus	6.1	13.6	21.2	28.8	36.3
Nitrogen	5.5	12.3	19.1	25.9	32.7
Sediment	8.4	18.8	29.3	39.7	50.2
Subwatershed 1	Pollutant Percent Reduction				
Phosphorus	6.1	13.7	21.3	28.9	36.5
Nitrogen	5.5	12.3	19.2	26	32.9
Sediment	8.4	26.2	29.3	39.8	50.3
Subwatershed 2	Pollutant Percent Reduction				
Phosphorus	6.6	14.8	23.1	31.3	39.6
Nitrogen	6.5	14.6	22.8	30.9	39.0
Sediment	8.7	19.6	30.5	41.5	52.4
Subwatershed 3	Pollutant Percent Reduction				
Phosphorus	5.7	12.9	20.0	27.2	34.3
Nitrogen	4.9	11.0	17.1	23.3	29.4
Sediment	8.1	18.3	28.5	38.7	48.8
Subwatershed 4	Pollutant Percent Reduction				
Phosphorus	3.6	8.2	12.7	17.2	21.8
Nitrogen	2.8	6.2	9.7	13.1	16.6
Sediment	6.6	14.9	23.2	31.5	39.8
Subwatershed 5	Pollutant Percent Reduction				
Phosphorus	5.9	13.3	20.7	28.0	35.4
Nitrogen	5.1	11.4	17.8	24.1	30.5
Sediment	8.2	18.5	28.8	39.1	49.3
Subwatershed 6	Pollutant Percent Reduction				
Phosphorus	5.5	12.4	19.2	26.1	32.9
Nitrogen	4.5	10.2	15.8	21.5	27.1
Sediment	8.0	17.9	27.8	37.8	47.7
Subwatershed 7	Pollutant Percent Reduction				
Phosphorus	6.5	14.6	22.7	30.8	39.0
Nitrogen	6.2	13.9	21.6	29.3	37.0
Sediment	8.6	19.4	30.2	41.0	51.7
Subwatershed 8	Pollutant Percent Reduction				
Phosphorus	6.6	14.8	23.0	31.2	39.4
Nitrogen	6.4	14.2	22.4	30.3	38.3
Sediment	8.7	19.6	30.4	41.3	52.1
Subwatershed 9	Pollutant Percent Reduction				
Phosphorus	6.4	14.5	22.5	30.5	38.6
Nitrogen	6.1	13.8	21.5	29.2	36.8
Sediment	8.6	19.4	30.1	40.9	51.6
Subwatershed 10	Pollutant Percent Reduction				
Phosphorus	6.4	14.4	22.4	30.3	38.3
Nitrogen	6.2	14.0	21.7	29.5	37.3
Sediment	8.6	19.4	30.2	40.9	51.7

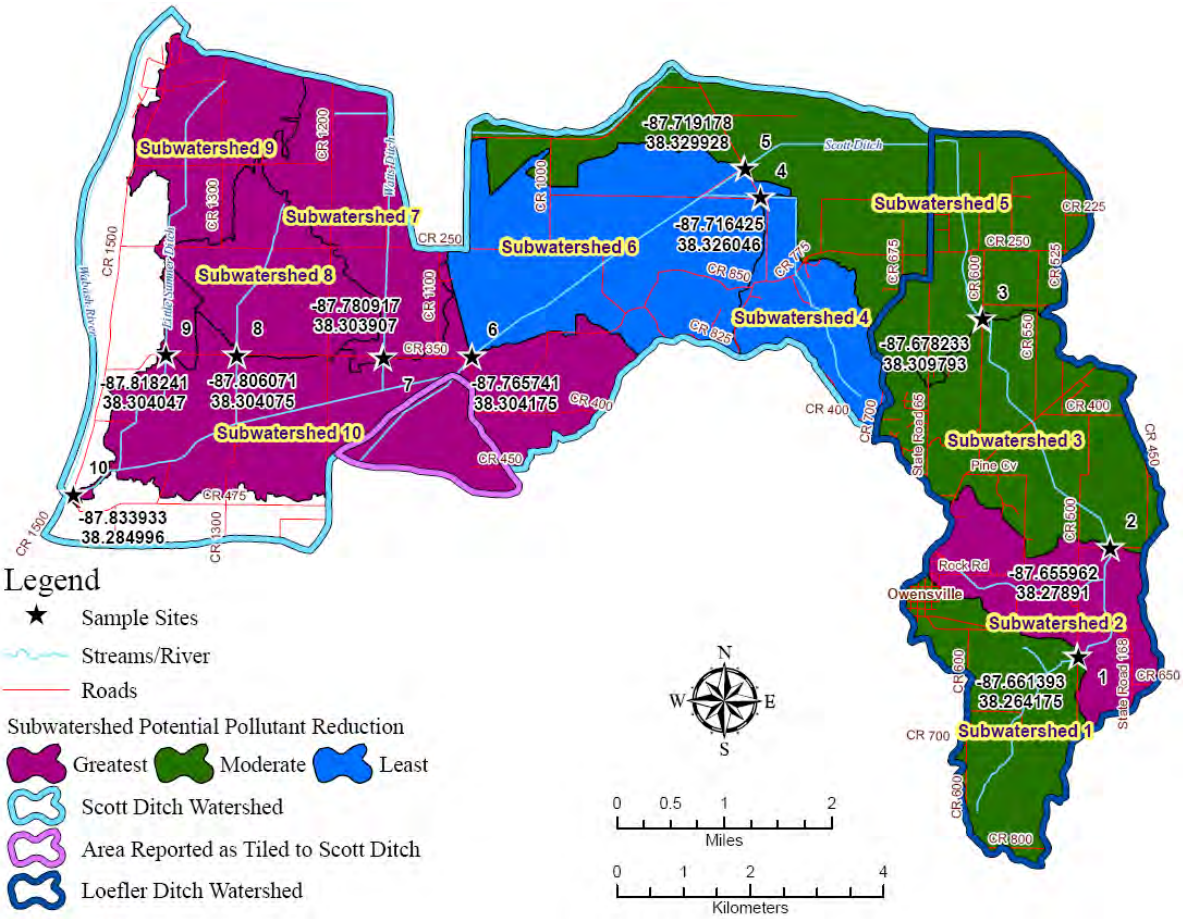


Figure 39. Classification of Potential Pollutant Reduction per Subwatershed as a Result of Increasing Reduced and Conservation Tillage

Characterization of Watershed Issues

Issues Characterized from Secondary Source Data

The Loefler Ditch watershed is characterized by gently rolling topography and highly erodible soils. In contrast, the Scott Ditch watershed is nearly flat with a change in elevation of only 0.2 meters per kilometer (1.3 feet per mile) on the Scott Ditch. Most of the Scott Ditch watershed is within the 100-year floodplain of the Wabash River and is characterized by hydric soil series. Water velocity throughout the entire watershed study area is slow.

Agriculture is the predominant land use classification in the Loefler and Scott Ditches watershed. The watershed is intensely managed for row crop production through dredged and channelized waterways and an extensive system of underground tiles in some locations. The Scott Ditch debouches into the Wabash River near Crawleyville, Indiana. While one water chemistry study conducted in the Wabash River suggests that water received by the river from the Loefler and Scott Ditches watershed does not independently have a significant measurable impact on the River, the Loefler and Scott Ditches watershed is undoubtedly contributing to the river's nutrient and sediment loads.

Issues Characterized from Field Data and Observations

DO levels were less than the desired state water quality standard at five sites at the time of base flow sampling. Low DO levels are primarily attributed to a combination of high TSS concentrations, low stream velocity, and lack of a riparian zone shading most streams. Low DO levels and lack of instream habitat have negatively affected macroinvertebrate populations.

Ammonia nitrogen was the only nutrient tested that consistently exceeds water quality standards at multiple sites in the Scott Ditch watershed at the time of base flow and storm flow sampling. Turbidity values and TSS concentrations were consistently above target values. In general, nutrient and TSS loading is the highest per acre draining to the sample sites for Subwatersheds 7, 8, and 9. QHEI analysis and aerial photointerpretation indicate that there is little to no riparian zones or filter strips adjacent to streams in these subwatersheds.

Issues Characterized from Public Outreach

The first watershed public meeting was held on February 5, 2009 at the Owensville Community Center (Photograph 9). Watershed landowners were notified of the meeting in advance by mail. A record of the public meeting can be found in Appendix F. A total of 21 people, including 4 people from the Davey team, were present at the meeting.

Concerns presented by the public at the meeting included:

- Cost-share funds for implementation of BMPs
- Flooding and funding for drainage improvements in the Scott Ditch watershed
- Increasing urban runoff
- Water pumping and drainage modifications created by the Duke Energy Gibson Station power plant
- Lack of county zoning, and protection of the public water supply

Photograph 9 (02-05-09). Watershed public meetings were held at the Owensville Community Center.

- A property managed by Gibson County Coal, LLC located in the vicinity of the Owensville public water supply wellhead:
    - Past and current lack of effective erosion control measures
    - The extent of a future stormwater management plan
    - Coal mining practices if mining activities are conducted on this property in the future

A representative from Duke Energy stated there is no transfer of water from the Duke Energy Gibson Station power plant property to the Scott Ditch watershed beyond the natural flow of water resulting from precipitation events. Any construction that has occurred on the south side of the power plant's property has resulted in water being directed back to the plant's cooling pond located outside of the Loefler and Scott Ditches watershed boundary (R. Sparks, personal communication, April 4, 2009).

Summary of All Key Issues

Many of the aforementioned watershed issues are intimately intertwined. Table 24 provides a summary of the most prevailing key issues in the Loefler and Scott Ditches watershed, the cause or source of the issues, and potential solutions.

Table 24. Summary of Watershed Issues

Key Issue	Cause/Source	Potential Solution
Low DO	Slow water velocity and lack of riparian shading	Plant riparian vegetation and protect streams from sources of organic pollution that will further exacerbate low DO concentrations
High turbidity	Lack of filter strips or riparian zones adjacent to streambanks, minimal conservation tillage, and lack of erosion control measures on clear-cut wooded property	Install filter strips adjacent to streams, implement conservation tillage, implement other BMPs, and enforce all Rule 5 and 6 stormwater regulations
High ammonia nitrogen	Minimal conservation tillage to preserve topsoil on cultivated fields, lack of filter strips or riparian zones to filter sediment and associated nutrients, and application of more nitrogen fertilizer than is necessary	Implement conservation tillage, install filter strips adjacent to streams, implement other BMPs, test soil samples to determine the amount of fertilizer necessary, and prevent overfertilization
Poor quality of instream habitat	High sedimentation resulting from lack of filter strips or riparian zones adjacent to streambanks and minimal conservation tillage; lack of in-stream habitat associated with dredging and channelization	Install filter strips and plant riparian vegetation adjacent to streams as well as implement conservation tillage to reduce sedimentation and, consequently, reduce the frequency of dredging
Flooding and drainage improvements in the Scott Ditch watershed	Most of the Scott Ditch watershed is within the 100-year floodplain of the Wabash River and has very flat topography; sediment entering the streams from agricultural and urban sources as well as development projects further exacerbates drainage problems.	Prevent as much sediment as possible from entering the streams by using filter strips, conservation tillage, and other BMPs; enforce all Rule 5 and Rule 6 stormwater regulations; promote Low Impact Development (LID) practices for all new development
Protection of the public water supply	Lack of a county zoning ordinance may result in development occurring in areas that negatively impact surface and groundwater in the watershed study area	Develop and implement a county zoning ordinance that restricts certain types of development from occurring within the vicinity of the Owensville public water supply wellhead

Watershed Management Recommendations

Structural and Institutional Recommendations

A total of 11 BMPs have been selected to address the key issues identified as a result of this study and presented in Table 25. These practices should result in a demonstrable improvement in water quality and habitat conditions in the watershed if implemented. It is important to note that no single practice will address all principle issues; rather, it will be necessary to implement a combination of most, if not all, practices described in order to achieve the highest level of results.

Each BMP selected falls under one of the following categories as indicated in Table 25. Structural BMPs are tangible practices that are constructed. Institutional BMPs are policies, procedures, rules, regulations, and ordinances. An institutional measure, such as county zoning classifications and a land use ordinance that restricts certain types of development in environmentally sensitive areas, will help protect the environmental integrity of the watershed study area and help it better adapt to changes over time. The priority or importance of implementing each BMP is provided. It is recommended that implementation of high priority BMPs are the primary focus in the next few years followed by medium priority and then low priority BMPs.

Table 25. Summary of Recommended BMPs

BMP	Type	Priority
Conservation Tillage	Structural	High
Critical Area Planting	Structural	High
Filter Strips	Structural	High
Grade Stabilization Structures	Structural	Medium
Grass Waterways	Structural	Medium
Indiana Rule 5 and Rule 6 Compliance	Institutional	Medium
Nutrient and Pest Management Plans	Institutional	High
Petroleum Hydrocarbon Assessments	Institutional	Low
Streambank Stabilization	Structural	Medium
Tile Riser Grass Buffers	Structural	High
Water and Sediment Control Basins	Structural	Medium
Wetlands Restoration	Structural	Medium
Zoning and Land Use Ordinances	Institutional	High

As watershed conditions and public opinions change over time, the priority indicated for each BMP will change. Further, implementation of some BMPs may no longer be as important or may no longer be needed at all. As policies change and technologies improve, new BMPs may later be identified that should be implemented.

The appropriateness of implementing any one BMP will be affected by landowner participation, implementation costs, and the overall expected water quality benefits given specific site conditions on which the BMP is implemented. Voluntary landowner participation will likely increase as landowners are further educated about watershed and water quality issues as well as cost-share programs and incentive payments that are available to offset costs associated with BMP implementation. Demonstrations and presentations by landowners who have successfully implemented BMPs in the watershed study area may also further encourage additional landowners to participate. Benefits received by farmers from implementing BMPs should be a primary focus.

A map indicating some of the better locations to implement a few particular types of BMPs including wetlands restoration, filter strips, streambank stabilization, and other erosion control measures is presented in Figure 40. Water chemistry data suggests that conservation efforts designed to reduce nutrient and TSS loads should be concentrated in Subwatersheds 7, 8, and 9.

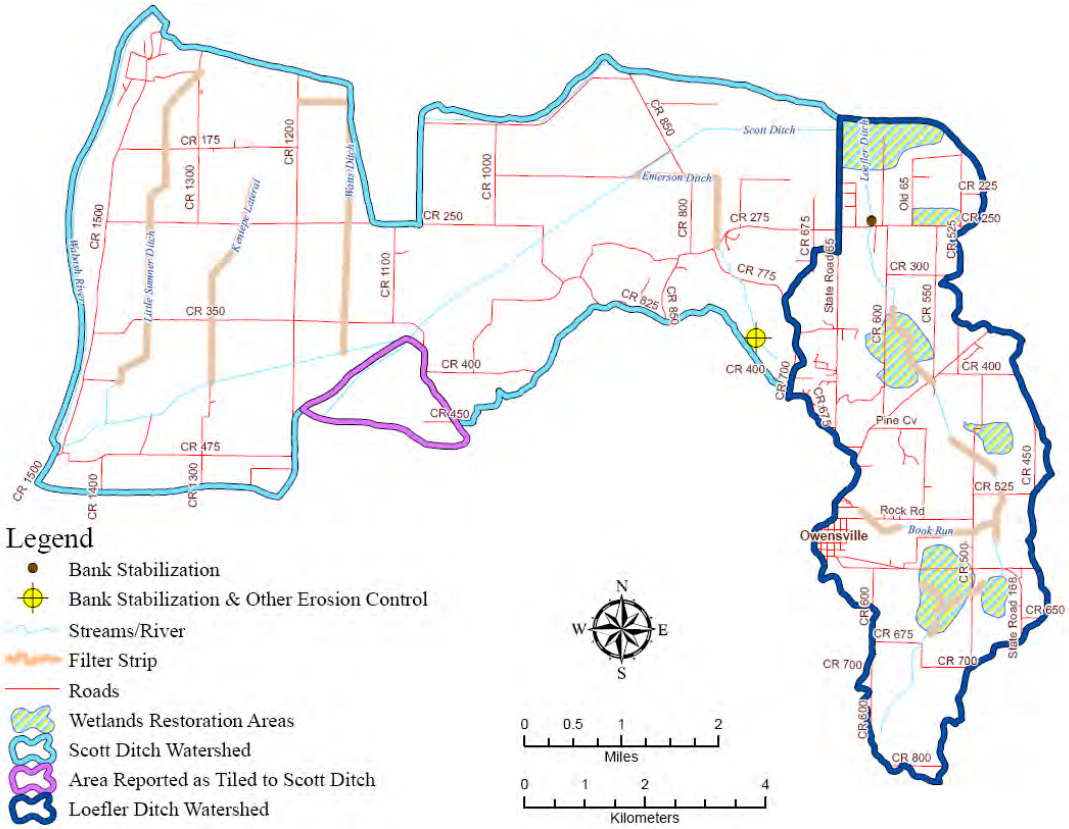


Figure 40. BMP Implementation Map

Conservation Tillage

Conservation tillage includes tillage practices that leave 30 percent or more of crop residue on the soil surface following planting. STEPL watershed modeling indicates that increased implementation of reduced and conservation tillage will dramatically reduce nutrient and sediment loads in the watershed study area. STEPL watershed modeling also predicts that increasing the percentage of reduced and conservation tillage in Subwatersheds 2, 7, 8, 9, and 10 will provide the greatest percent reduction in nutrient and sediment loads. In reality, the actual percent pollutant reductions received from implementing increased conservation tillage in Subwatershed 10 may be lower than the model predicts and efforts to increase this practice should be prioritized in Subwatersheds 2, 7, 8, and 9.

No-till is the conservation tillage type that allows for the least amount of soil erosion. Tillage transect data indicates that the percentage of corn fields on which no-till in Gibson County was practiced in 2007 was 21 percent less than the state average and 11 percent less than the state average for soybean fields. In order to increase the weighted average of conservation tillage in the watershed study area two-fold, it will be necessary to implement conservation tillage on an additional 2,020 hectares (5,000 acres) of cultivated land, which should include approximately 1,620 hectares (4,000 acres) in no-till. Cost-share programs for implementation of no-till are listed in Table 27.

Critical Area Planting

Highly erodible or critically eroding areas should be planted with vegetation to reduce the amount of sediment and nutrients reaching waterways from these areas. One critically eroding area was identified in the watershed study area (Photograph 10). It is located north of CR 825 and west of CR 700 West in Subwatershed 4. The condition of this area should be assessed and a stabilization plan implemented. It is uncertain how many acres are currently critically eroding, but it is anticipated to be less than 40 hectares (100 acres).

Photograph 10 (04-09-09). Highly erodible and critically eroding soils should be stabilized with vegetation.

Filter Strips

Filter strips are narrow bands sod-forming grasses, legumes, and forbs planted adjacent to a water edge that retard the transport of sediment, nutrients, and pesticides to a waterbody. Filter strips are relatively inexpensive to install and maintain and offer substantial water quality benefits. There are locations in the watershed study area where filter strips have been installed; however, there are numerous areas remaining where filter strips would be advantageous. These areas are shown in Figure 40 and total approximately 23,500 linear meters (77,000 linear feet). Subwatersheds 2, 7, 8, and 9 have the greatest need for filter strip installation. Several cost-share programs that help farmers establish filter strips along streams are listed in Table 27.

Grade Stabilization Structures

A grade stabilization structure can be a dam or embankment built across a gully or grass waterway that drops water to a lower elevation while protecting the soil from gully erosion or scouring. Structures are typically either a drop spillway or a small dam and basin with a pipe outlet. Grade stabilization structures constructed in Loefler Ditch or its tributaries may serve to reduce channel bottom and streambank erosion; however, this study does not specify the exact locations in the watershed where these devices might prove helpful. It is anticipated that installation of one to two structures would be sufficient.

Grass Waterways

Grass waterways are drainage swales in farm fields constructed where gully erosion is a recurring problem. Generally, construction involves minor grading to form a trapezoidal or parabolic channel followed by seeding with a sod-forming grass. Stream headwaters are the most practicable places for grass waterway installation. A few areas in the watershed that may benefit from grass waterway installation and were identified through aerial photointerpretation include fields south of CR 700 South and east of CR 500 West, a field east of CR 500 West and south of Rock Road, and fields located on both sides of CR 600 West south of CR 300 South and north of Owensville-Princeton Pike. It may be possible to install approximately 2,400 linear meters (7,800 linear feet) of grass waterway in these locations.

Indiana Rule 5 and Rule 6 Compliance

Land develop activities commonly involve the clearing of vegetation followed by land moving and excavation activities. When such activities are conducted and bare soil is exposed, the natural forces of wind and water can cause the transport of small amounts to hundreds of tons of soil and sediment from construction sites to lakes, streams, rivers, wetlands, and other environmentally sensitive areas. In addition to sediment, other pollutants such as oils and greases and a variety of chemicals can be discharged from construction sites, as well.

Indiana Administrative Code 327 IAC 15-5, commonly known as “Rule 5”, affects construction projects that result in the disturbance of 0.40 hectare (1 acre) of land or more. Types of construction projects affected by Rule 5 include roads, residential housing, commercial, industrial, and municipal projects.

Indiana Administrative Code 327 IAC 15-6, commonly known as “Rule 6”, applies to stormwater discharge that has been exposed to manufacturing and processing activities, raw materials, or intermediate product storage areas at an industrial facility.

At the time of this study, there was essentially no land disturbing activities associated with development being conducted in the watershed. One priority area needing erosion control plantings was identified in the hill slopes of the Scott Ditch watershed (Figure 40). Information was revealed during the first public outreach meeting that a mining company had begun land clearing activities in preparation for a mining activity. The project ceased but exposed soil remains unstabilized. The condition of this area should be assessed and a stabilization plan implemented.

Nutrient and Pest Management Plans

A Nutrient and Pest Management Plan (NPMP) is a tool that helps agricultural producers identify the best timing and adequate amounts of fertilizers to apply for a particular crop in order to maximize yields and minimize nutrient runoff. NPMPs should take into consideration all sources of potential nutrients for a field such as commercial fertilizers, animal manure and other organic by-products, irrigation water, and naturally occurring soil nutrients. NPMPs can help minimize costs that would be incurred by agricultural producers by preventing an over application of fertilizer. Application of insecticides and herbicides should also be evaluated as part of a pest management plan.

Development of NPMPs should be prioritized within the Owensville public water supply well head to help prevent unnecessary nutrient and chemical applications to the soil surface that may move through the soil column and eventually reach a public water supply well. NPMPs should be developed on a minimum of 130 hectares (320 acres) to encompass the portion of the well field within the area having a 10-year pollutant travel time to the public water supply wells.

Petroleum Contamination Assessment

During the first public outreach meeting and in other personal communications with stakeholders, concern was raised regarding past contamination of surface waters by petroleum products associated with petroleum wells in the watershed. This concern was also tied to the wellhead protection area in the watershed.

The scope of this study did not include sampling surface water or groundwater for petroleum hydrocarbons. IDEM should be consulted should any group wish to begin a monitoring program for petroleum hydrocarbons in surface and/or groundwater.

Photograph 11 (04-09-09). The area of eroding streambank on the Loefler Ditch depicted in this photograph is approximately 20 feet tall and 50 feet wide. It is located immediately north of CR 250 South.

Streambank Stabilization

Areas of streambank erosion and instability were noted during windshield surveys of the watershed study area (Figure 40). One area of bank erosion was noted on the Loefler Ditch north of CR 250 South in Subwatershed 5 (Photograph 11). The eroding area is approximately 6 meters (20 feet) tall and 15 meters (50 feet) wide. Erosion in this location began as a result of bank instability created by heavy equipment accidently dropping within the ditch channel during dredging activities. Figure 41 depicts a typical cross-sectional drawing for streambank stabilization measures that can be implemented in this location.

Streambank instability was also observed in a clear-cut area in Subwatershed 4 on the same site as critically eroding soils north of CR 825 and west of CR 700 West. Bank stabilization measures should be implemented in this location on both sides of the stream. The length of unstable streambanks in this location is uncertain, but is estimated to be at least a 200 linear meters (660 linear feet).

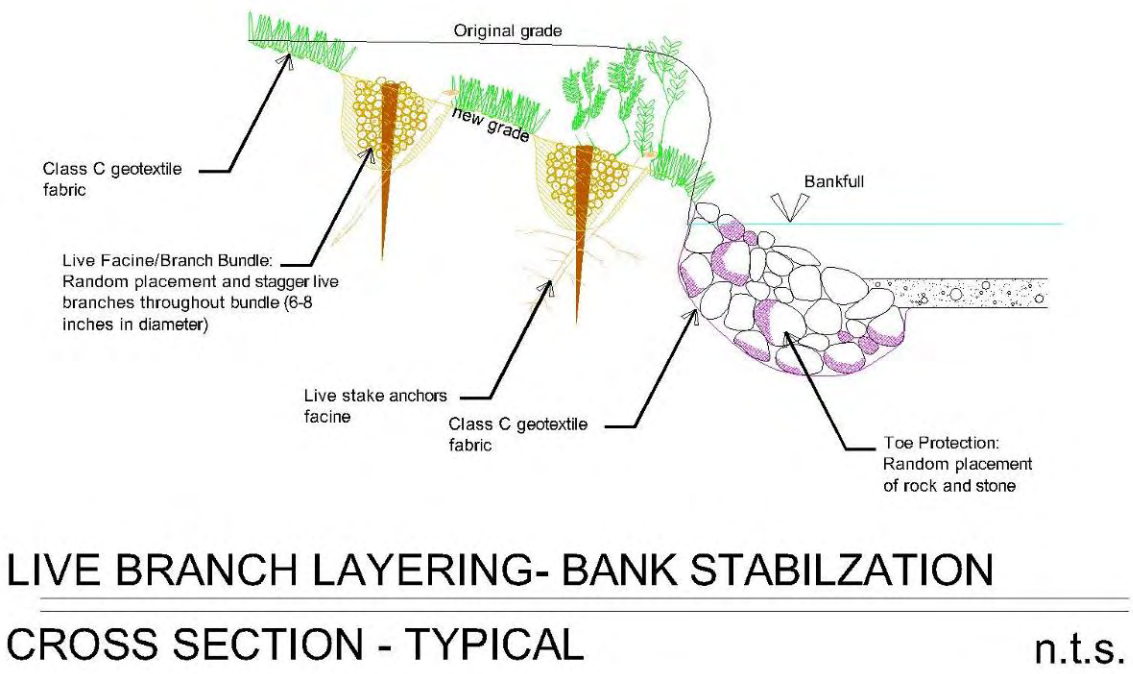


Figure 41. Typical Streambank Stabilization Cross-Section

Tile Riser Grass Buffers

Numerous tile inlet risers associated with WASCOBs are present in the Loefler Ditch watershed, specifically in Subwatersheds 1, 2, and 3. Crops are planted and tilling is conducted immediately next to many of these inlet risers. Without vegetation, such as grasses, surrounding the inlet, "first flush" stormwater laden with high levels of pollutants are discharged to the tile system and the stream that the tile system discharges to. A total of 176 WASCOBs were recorded in the watershed study area in 2002. It is estimated that approximately 100 of the riser inlets associated with the WASCOBs could benefit from installation of a tile riser grass buffer.

Water and Sediment Control Basins (WASCOBs)

WASCOBs consist of an earthen berm or a combination of a berm and shallow depression constructed across the slope of an agricultural field to trap water and sediment running off cropland upslope of the structure. WASCOBs reduce gully erosion by controlling flow within the drainage area. Water is usually released slowly via infiltration or a riser inlet connected to a subsurface drainage tile. WASCOBs can be effective in reducing sedimentation of nearby waters when grass buffers are maintained around tile inlets to filter water prior to it reaching a subsurface drainage tile. Designers of WASCOBs should specify a grass seed mixture in the WASCOB and inform farmers to maintain the vegetation.

The Gibson County SWCD has been a staunch advocate of WASCOBs, and a substantial number of WASCOBs are established in Loefler Ditch watershed. It is estimated that no more than 20 additional WASCOBs are needed.

Wetlands Restoration

Wetlands restoration involves returning wetlands hydrology and vegetation to an area that was historically a wetlands, but was drained or tiled for agricultural purposes. A few natural wetlands functions include nutrient and sediment filtration, nutrient uptake, floodwater retention, and wildlife habitat. Wetlands restoration can likely be implemented in all most all areas of the watershed study area having hydric soils (Figure 6). Wetlands restoration on large areas of hydric soil in the Loefler Ditch watershed will provide more benefits for each restoration dollar invested by retaining floodwaters before they reach the Scott Ditch watershed in addition to filtering nutrients and sediment from surface flow (Figure 40). The nearly flat topography of the Scott Ditch watershed results in slow drainage rates from the ditches resulting in high water levels accumulating within the ditch channels. Preventing some floodwaters from reaching the Scott Ditch will allow agricultural fields in the Scott Ditch watershed to drain for a longer period of time before high ditch waters prevent further drainage. Figure 40 depicts approximately 375 hectares (930 acres) of potential wetlands restoration areas. Restoring a minimum of 20 hectares (50 acres) of wetlands in the Loefler Ditch watershed is a worthwhile goal.

Zoning and Land Use Ordinance

Implementation of county zoning and a land use ordinance is strongly recommended for Gibson County. Zoning and an accompanying land use ordinance will encourage orderly development and promote appropriate uses for land within the county. A land use ordinance should consider measures that protect public health, natural resources, and agriculturally productive land within the county.

Other Recommendations

Photograph 12 (02-05-09). The four white well houses in this photograph contain wells that are part of the Owensville public water supply system.

The town of Owensville public water supply is pumped from an underground aquifer by four wells located northwest of the intersection of CR 675 West and CR 275 South (Photograph 12). Protecting the public water supply from contamination includes preventing possible contaminants from entering the well field. A well field is the surface and subsurface area through which contaminants are likely to move through and reach a well. A well field map has been delineated for the Owensville wells. The map includes 1-, 5-, and 10-year pollutant travel time boundaries. The 1-year pollutant travel time boundary extends in approximately a 30-meter (100-foot) radius from the wells forming the bottom of a teardrop-shaped area. The 10-year boundary forms the tip of the teardrop in an area east of SR 65, approximately 2.4 kilometers (1.5 miles) southeast of the intersection of CR 675 West and CR 275 South.

The Owensville well field is a conservation priority area. Aerial photointerpretation suggests that land use within the well field consists primarily of cultivated land and a few residential properties. Plans should be developed to identify and address potential contaminant sources within the well field.

Public Response to Recommendations

A second and final public meeting was held on August 13, 2009 at the Owensville Community Center. A total of 11 members of the public were present at the meeting, as were representatives from IDNR, the Gibson County SWCD, the Scott Ditch Board, the local electric utility, and the project team. The meeting included a hands-on educational activity on nutrient cycling followed by a presentation of the study's findings and recommendations. Water quality data were reviewed and compared to state water quality standards. Public discussion and questions centered on nutrient management, especially nitrogen application. Input was taken on various recommendation and solutions presented in the draft report and visible on the display map.

Local landowners were given an opportunity to sign up for a consultation with an agricultural specialist and/or express their interest in installing a recommended practice. Two landowners completed the interest form/survey. Both landowners expressed an interest in filter strips and streambank stabilization. In addition, one landowner also noted potential interest in no-till equipment modification and nutrient management planning. The Gibson County SWCD, together with its conservation partners, NRCS and the Indiana State Department of Agriculture (ISDA), will approach the interested landowners.

A record of the public meeting can be found in Appendix F. A public information handout made available at the public meeting is located in Appendix G. Landowners can continue to be informed about watershed issues through the Gibson County SWCD newsletter and website.

Summary of Recommendation Goals

Education about watershed and water quality issues should be emphasized to encourage voluntary landowner implementation of BMPs. It is recommended that concentrated efforts be made to encourage implementation of high priority BMPs in the next few years. High priority BMPs include conservation tillage, critical area planting, filter strips, NPMPs, tile riser grass buffers, and development of county zoning and a land use ordinance. Efforts to increase conservation tillage should be made throughout the entire watershed study area. Conservation tillage should especially be prioritized in Subwatersheds 2, 7, 8, and 9. Installation of filter strips should also be prioritized in the same aforementioned subwatersheds. A critical area in need of planting for erosion control is located in Subwatershed 4. High priority should be placed on the development of NPMPs for cultivated land in the public water supply well head. Tile riser grass buffers should be installed in Subwatersheds 1, 2, and 3 around many riser inlets associated with WASCOBs where farming practices are occurring directly adjacent to the risers. County zoning and a land use ordinance should be implemented to encourage orderly development and promote appropriate uses for land within the county in a manner that safeguards water quality.

Promotional emphasis should be shifted to implementation of medium priority BMPs once significant progress has been made toward implementation of high priority BMPs. Medium priority BMPs include grade stabilization structures, grass waterways, local inspection for Indiana Rule 5 and 6 compliance, streambank stabilization, WASCOBs, and wetlands restoration.

Davey recommends that a petroleum contamination assessment be conducted in the watershed study area as soon as resources to conduct the assessment become available. Table 26 establishes some specific BMP goals to strive for to improve water quality in the watershed study area in the coming decades.

Table 26. BMP Implementation Goals

BMP	Implementation Goal	
Conservation Tillage (No-Till)	1,620 hectares	4,000 acres
Critical Area Planting	40 hectares	100 acres
Filter Strips	23,500 linear meters	77,000 linear feet
Grade Stabilization Structures	2 structures	
Grass Waterways	2,400 linear meters	7,800 linear feet
Nutrient Pest Management Plans	130 hectares	320 acres
Streambank Stabilization	215 linear meters	710 linear feet
Tile Riser Grass Buffers	100 grass buffers	
Water and Sediment Control Basins	20 basins	
Wetlands Restoration	20 hectares	50 acres

Watershed Management Resources

Potential Future Funding

Funding for Common BMPs

Several well-known cost-share programs are offered by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), the Indiana State Department of Agriculture (ISDA), the Indiana Department of Natural Resources Lake and River Enhancement Program (LARE), and other less well-known programs that could be used to financially support the implementation of common BMPs recommended in this report.

The NRCS offers its Conservation Reserve Program (CRP), which provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement. CRP is administered by the Farm Service Agency, with NRCS providing technical land eligibility determinations, conservation planning, and practice implementation. The CRP reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost-sharing is provided to establish the vegetative cover practices.

The NRCS Environmental Quality Incentives Program (EQIP) is a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.

The Wetlands Reserve Program (WRP) authorized under the Farm Bill provides financial incentives to restore, protect, and enhance wetlands in exchange for retiring marginal land from agricultural production. Eligible land includes but is not limited to wetlands farmed under natural conditions, prior converted cropland, farmed wetland pasture, and lands adjacent to protected wetlands. Another program administered by the NRCS that may provide cost-share for wetlands development is the Wildlife Habitat Incentive Program (WHIP). Eligible land includes private agricultural land including cropland, grassland, pasture, and other land determined by NRCS to be suitable for fish and wildlife habitat development.

Persons interested in the CRP, EQIP, WRP, or WHIP program should contact the Gibson County Soil and Water Conservation District or the NRCS District Conservationist. Contact information is provided in the Institutional Resources section of this report.

The ISDA Division of Soil Conservation administers the Clean Water Indiana (CWI) fund under direction of the State Soil Conservation Board. CWI provides financial assistance to SWCDs, conservation groups, and land occupiers to implement conservation practices for reducing nonpoint source water pollution. Funds are available for education, technical assistance, training, and cost-share programs. Cost-share programs can provide funds to encourage land occupiers to implement conservation practices to reduce nutrient, pesticide, and sediment runoff as well as implementing nutrient management programs including fencing for intensive grazing systems, purchasing nutrient management equipment, voluntary environmental audits, and similar expenditures (IC 14-32-8). SWCDS must apply for funds, and priority will be given to applications with at least a 50 percent match. Contact information is provided in the Institutional Resources section of this report.

The IDNR LARE program provides cost-share funds or incentive payments to implement many of the recommended structural BMPs. Organizations interested in sponsoring a Watershed Land Treatment project for landowners must contact LARE project managers by November 1st of each year to discuss potential projects. Grant applications are due January 15th of each year. Contact information is provided in the Institutional Resources section of this report.

A summary of BMP costs and funding sources is depicted in Table 27.

Table 27. Summary of BMP Funding Sources

BMP	Popular Cost-Share & Incentive Payment Programs for Select Practices			
	CRP	EQIP	LARE	WRP, WHIP
Conservation Tillage (No-Till)	No	Yes	Yes	No
Critical Area Planting	No	No	Yes[1]	No
Filter Strips	Yes	Yes	Yes[1]	No
Grade Stabilization Structures	No	Yes	Yes	No
Grass Waterways	Yes	Yes	Yes	No
Nutrient Pest Management Plans	No	Yes	Yes	No
Streambank Stabilization	No	No	Yes	No
Tile Riser Grass Buffers	Yes	Yes	Yes[1]	Yes
Water and Sediment Control Basins	No	Yes	Yes	No
Wetlands Restoration	No	No	Yes	Yes

[1] Incentive payment

The LARE program provides an 80 percent cost-share for the actual cost of BMP installation with a maximum cost-share amount available for each practice. The maximum LARE cost-share available for each recommended BMP is listed in Table 28. LARE incentive payments are eligible to be combined with funds from other non-state programs. The 80 percent LARE cost-share limit does not apply to incentive payments.

Table 28. LARE Cost-Share and Incentive Payment Maximums

BMP	Maximum LARE Cost-Share
Conservation Tillage (No-Till)	$12 per acre; 300-acre maximum
Critical Area Planting[1]	$400 per acre
Filter Strips[1]	$650 per acre
Grade Stabilization Structures	$6,000 per structure
Grass Waterways	$6.00 per linear foot
Nutrient Pest Management Plans	$8 per acre; 300-acre maximum
Streambank Stabilization	$50 per foot
Tile Riser Grass Buffers[1]	$250 per tile riser
Water and Sediment Control Basins	$1,700 per basin
Wetlands Restoration	$400 per acre

[1] LARE incentive payments can be combined with funds from other non-state sources.

Funding for Special BMPs

Some BMPs recommended this report are less common or will require significant financial resources, time, and cooperation to implement. Of the BMPs discussed, these include conducting assessments of surface water for petroleum hydrocarbon content, developing an educational and compliance program to support Indiana Rule 5 and Rule 6 compliance, and development of a local land planning ordinance.

The Land Use Team of the Purdue University Cooperative Extension Service offers programs to assist local leaders in developing local land use plans. Their *Local Decision Maker* is a comprehensive, 4-phase planning tool that helps leaders inventory and analyze local resources, build visions and objectives, develop strategies to meet objectives, and implement plans. The tool takes into account economic, social, and natural resources. This tool may be a starting point to help local leaders build a land use ordinance and local stormwater pollution prevention program.

IDEM Section 319 Funding

The Federal Clean Water Act Section 319(h) provides funding for various types of projects that work to reduce nonpoint source water pollution. Application for Section 319 funds is made through the Indiana Department of Environmental Management. Funds may be used to conduct assessments, develop and implement Total Maximum Daily Limits (TMDL) and watershed management plans, provide technical assistance, demonstrate new technology, and provide education and outreach. Organizations eligible for funding include nonprofit organizations; universities; and local, state, and federal government agencies. A 40 percent (non-federal) in-kind or cash match of the total project cost must be provided. Section 319 funds could be used to demonstrate new technology that could potentially address principle issues discussed in this report. A Section 319 approved Watershed Management Plan must exist in order to obtain funds for project implementation.

The size of the Loefler and Scott Ditches watershed may be too small to utilize Section 319 funding to develop a watershed management plan. In order to secure Section 319 funding, it is necessary to have a significant amount of public participation and hold monthly steering committee meetings throughout the duration of a funded project. Steering committees should consist of a diverse group of watershed stakeholders. The small size of the watershed study area and low population density may make public participation requirements difficult to achieve. A larger watershed area should be considered should an organization wish to pursue Section 319 funding.

Institutional Resources

A large variety of established institutional resources and other potential institutional resources exist in the watershed to aid in water quality improvement efforts. Davey recommends that potential institutional resources such as local 4-H clubs, the Oakland City Lions Club, Boy Scout troops, potential science clubs at local high schools, and landowners who attended the public meetings be made aware of the opportunity to serve as Hoosier Riverwatch volunteers. Already established institutional resources range from local government offices, state and federal agency personnel/programs, and non-profit conservation organizations. The following sub-sections outline some of the various roles, resources, and contact information for established institutional resources.

Local and County Government Offices

Soil & Water Conservation Districts

Indiana's Soil and Water Conservation Districts (SWCDs) were established by the Indiana Conservation Act (IC 14-32). SWCDs are chartered, legal subdivisions of State Government whose territories are aligned with county boundaries. SWCDs develop and implement conservation programs based on a set of resource priorities, and channel resources from all levels of government into action at the local/county level. Indiana's 92 SWCDs are each governed by a board of supervisors, consisting of three elected supervisors, who own or rent more than 10 acres of land in the district, and two appointed supervisors who maintain their permanent residence in the district.

Gibson County Soil and Water Conservation District
Ann Ice
229 South 2nd Avenue
Princeton, Indiana 47670
812-385-5033, ext. 3

Surveyors & Drainage Boards

County surveyors and drainage boards play a critical role in the implementation of streamside BMPs, as well as potential restoration efforts that may involve the manipulation of current above- or belowground drainage infrastructure.

The Indiana Drainage Code of 1965 sets forth the authority to create a Drainage Board in each County. The Drainage Board consists of either the County Commissioners or a citizen board with one Commissioner as a member. The County Surveyor sits on the Board as an Ex-Officio Member. This position is a non-voting position, and the County Surveyor serves as a technical advisor to the Board. The Drainage Board has the authority to construct, maintain, reconstruct, or vacate a regulated drain. They may also create new regulated drains if so petitioned by landowners. The Board is in charge of maintaining drains by putting the drain back to its original specifications by dredging, repair tile, clearing, removing obstructions, or other work necessary to keep the drain in proper working order. The County surveyors are often the best contact for drainage projects or concerns, or to coordinate with the Drainage Boards.

Gibson County Surveyor
Michael Stevenson
101 North Main Street
Princeton, Indiana 47670
812-385-4853
mstevenson@gibsoncounty-in.gov

The drainage board meets the first Tuesday of the month following the Commissioners meeting at 8:30 a.m. (drainage board is tentatively set for 9:30 a.m.). They meet in the North Annex at 225 North Hart Street, Princeton.

Many of the streams and ditches in the watershed are official "regulated drains" and are, therefore, under the authority of the drainage boards and surveyors. Any project proposed along these waterways should be coordinated with the appropriate County Surveyor.

Purdue University Cooperative Extension Service

The Purdue University Cooperative Extension Service provides information from agricultural and natural resources scientific research in a format useable to the general public for the purpose of improving lives and livelihoods.

Gibson County Purdue University Cooperative Extension Service

Agriculture and Natural Resources Educator
Courthouse Annex South, Room 35
800 South Prince Street
Princeton, Indiana 47670
812-385-3491

The Purdue University Land Use Team has developed a program called Local Decision Maker designed to help Indiana communities make informed and integrated land use and economic development decisions. Because a land use ordinance does not exist for Gibson County or Owensville, the Local Decision Maker program may be a logical tool to explore, as the program is comprehensive and considers many recent and "smart-growth" land use programs that have been developed across the United States. Further information can be obtained from Robert McCormick at 765-494-3627 or from the website of the Local Decision maker program at http://ldm.agriculture.purdue.edu/.

Scott Ditch Board

Scott Ditch has its own board of ditch commissioners. These commissioners are appointed by the County Commissioners for a three-year revolving term. The ditch commissioners are in charge of all maintenance and operation of the specified ditch system. Any projects affecting Scott Ditch go through the ditch commissioners and not the Drainage Board. The Scott Ditch Board has three members. They are:

Darwin Callis: 812-729-7469

Marion Jochim: 812-729-7310

Dennis Simpson: 812-729-7390

Health Departments

The Gibson County Health Department does not conduct regular water quality monitoring. They do inspect new septic systems and septic system repairs. Training for septic systems installers has been held in the past, but no training is currently available. The health department is aware of a number of areas that have older or failing systems that are of concern. For more information contact:

Benjamin Dye
800 South Prince Street
Princeton, Indiana 47670
812-385-3831

State Government Offices and Programs

Indiana Department of Natural Resources & Indiana Department of Environmental Management

The Indiana Department of Natural Resources (IDNR) and the Indiana Department of Environmental Management (IDEM) have a variety of programs and staff dedicated to water quality assessments and watershed planning initiatives. The most relevant contacts at these agencies to assist local leaders in water quality planning efforts are listed below. While there are countless specialists at these agencies, the staff listed below should be able to guide local questions to appropriate personnel.

Indiana Department of Natural Resources
Division of Fish & Wildlife – Lake & River Enhancement Program (LARE)
Angela Sturdevant, Biologist
402 West Washington Street, Room W273
Indianapolis, Indiana 46204
317-234-4906

Indiana Department of Environmental Management
Office of Water Quality
Bonny Elifritz, Watershed Specialist
100 North Senate Avenue
Indianapolis, IN 46206
317-234-3405

The IDNR Division of Fish and Wildlife, Wildlife Diversity Section also manages Tern Bar Slough Wildlife Diversity Area. The property is 339.94 hectares (840 acres) and is adjacent to Cane Ridge Wildlife Management Area, a U.S. Fish and Wildlife Service property. Tern Bar Slough provides habitat for many state and endangered species, including the interior least tern, as well as many other birds and waterfowl. The area provides two nesting islands for the interior least tern.

For more information about Tern Bar Slough Wildlife Diversity Area, contact:

Indiana Department of Natural Resources
Division of Fish & Wildlife – Wildlife Diversity Section
Katie Smith, Section Chief
402 West Washington Street, Room W273
Indianapolis, Indiana 46204
317-232-8160
kgsmith@dnr.in.gov

Indiana State Department of Agriculture (ISDA)

The Division of Soil Conservation belongs to the Indiana Conservation Partnership; however, it is situated in the Indiana State Department of Agriculture (ISDA). As part of the Partnership, ISDA provides technical, educational, and financial assistance to citizens to solve erosion and sediment-related problems occurring on the land or impacting public waters. The Division of Soil Conservation is divided into Conservation Implementation Teams (CIT) that cover specific counties. These teams can deliver advice to landowners regarding best management practices, assist with engineering design, and secure/coordinate associated project permits and cost-share amounts.

CIT Leader for Gibson County is:

Gary Seibert
229 South 2nd Avenue, Suite 3
Princeton, Indiana 47670
812-385-5033, ext. 3

Clean Water Indiana (CWI) is administered through ISDA. CWI provides funds to implement conservation practices that reduce nonpoint source water pollution. Information regarding CWI fund applications can be directed to the ISDA Grants Coordinator:

Amy Eizinger
317-234-5263
aeizinger@isda.in.gov

Federal Government Offices and Programs

Natural Resources Conservation Service (NRCS)

The NRCS is a Federal agency that works with landowners and managers to conserve their soil, water, and other natural resources. NRCS employees provide technical assistance based on a customer's specific needs in such areas as animal husbandry and clean water, ecological sciences, engineering, resource economics, and social sciences. They also provide financial assistance for many conservation activities. The NRCS programs are all voluntary participation programs.

Gibson County District Conservationist
Travis Gogel
229 South 2nd Avenue, Suite 3
Princeton, Indiana 47670
812-385-5033, ext. 107

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) owns and manages Cane Ridge Wildlife Management Area. The 197.49-hectare (488-acre) wildlife area was dedicated in 2006 as a home for waterfowl and other birds near the 1,214.06-hectare (3,000-acre) Duke Energy Gibson Station power plant cooling lake. Cane Ridge Wildlife Management Area is overseen by the Patoka River National Wildlife Refuge. Cane Ridge Wildlife Management Area is a Globally Important Bird Area as it is home to the endangered interior least tern.

For more information on Cane Ridge Wildlife Management Area or Patoka River National Wildlife Refuge, contact:

Bill McCoy
P.O. Box 217
510 1/2 West Morton Street
Oakland City, Indiana 47660
812-749-3199
bill_mccoy@fws.gov

Local Non-Profit Organizations

Four Rivers RC&D Council

The Four Rivers Resource Conservation and Development Council is a nonprofit organization dedicated to improving the quality of life in southwest Indiana. The Four Rivers RC&D serves Daviess, Dubois, Gibson, Greene, Knox, Martin, Pike, Posey, Vanderburg, and Warrick Counties. The RC&D works to address natural resource needs and cultivate opportunities in economic, environmental, and social areas. The primary natural resource focus is on air, water, land, woods, plants, and wildlife. The combined efforts of the community and volunteers look to achieve four primary goals:

1. Promote Better Woodland Management
2. Balance Rural and Urban Land Use Needs
3. Develop Partnerships to Address Water Quality and Quantity
4. Increase Community Involvement in Natural Concerns

The Four Rivers RC&D Council can be contacted at:

Four Rivers RC&D Area, Inc.
112 South Lakeview Drive
Petersburg, Indiana 47567
812-354-6120, ext. 5
rivers4@sigecom.net

Conclusion

The Loefler and Scott Ditches Watershed Diagnostic Study is a study of the water quality of the Loefler and Scott Ditches and the factors that influence it. Agriculture is the predominant land use classification in the Loefler and Scott Ditches watershed. The watershed study area is intensely managed for row crop production through dredged and channelized waterways and an extensive system of underground tiles in some locations.

Data collected as part of this study documented low dissolved oxygen levels as well as high turbidity and TSS concentrations in streams. Ammonia nitrogen levels consistently exceeded Indiana water quality standards at multiple sample sites. Analysis of macroinvertebrate populations indicated that all streams sampled for this parameter are impaired for aquatic life use. Poor quality habitat as indicated by QHEI influences the macroinvertebrate populations and corresponding analyses.

An analysis of pollutant loads indicated that Subwatersheds 7, 8, and 9 should be emphasized in conservation efforts to reduce nutrient and sediment loads. Watershed modeling was conducted using the STEPL program. STEPL estimates significant decreases in nutrient and sediment loads with implementation of conservation tillage.

Davey specifically recommends that watershed stakeholders strive to achieve TSS concentrations at or below the 30.0 mg/L target concentration established by IDEM. Ammonia nitrogen levels should be reduced 50-75 percent in the Scott Ditch watershed.

Protection of the public water supply wellhead and flooding and drainage improvements were discovered to be concerns held by watershed stakeholders.

Numerous BMPs and institutional measures are recommended by Davey to address water quality issues and public concerns. Recommended BMPs include conservation tillage, critical area planting, filter strips, grade stabilization structures, grass waterways, NPMPs, streambank stabilization, tile riser grass buffers, WASCOBs, and wetlands restoration. Other recommended measures include development and implementation of county zoning and a land use ordinance, as well as conducting a petroleum hydrocarbon assessment

A large variety of institutional resources exist in the watershed to help educate the public as well as provide technical guidance and funding for BMP implementation. Institutional resources available include Gibson County SWCD, Gibson County Surveyor, Scott Ditch Board, Gibson County Health Department, Purdue Cooperative Extension Service, IDNR Division of Fish and Wildlife LARE Program and Wildlife Diversity Section, IDEM Office of Water Quality, ISDA Division of Soil Conservation, NRCS, USFWS, and Four Rivers RC&D Council.

Federal programs that provide a cost-share or incentive payment for recommended BMPs are CRP, EQIP, WRP, and WHIP administered by the NRCS. Funds may also be available through Section 319 administered by IDEM providing an approved watershed management plan is in place, CWI administered by ISDA, and the LARE program administered by IDNR.

The Land Use Team of the Purdue University Cooperative Extension Service offers programs to assist local leaders in developing local land use plans. This tool may be a starting point to help local leaders build a land use ordinance and local stormwater pollution prevention program.

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Appendix A
Gibson County Rare, Threatened, and Endangered Species

Indiana County Endangered, Threatened and Rare Species List

County: Gibson

Species Name	Common Name	FED	STATE	GRANK	SRANK
Crustacean: Malacostraca					
Orconectes indianensis	Indiana Crayfish		SR	G2G3	S2
Mollusk: Bivalvia (Mussels)					
Cumberlandia monodonta	Spectaclecase	C	SX	G2G3	SX
Cyprogenia stegaria	Eastern Fanshell Pearlymussel	LE	SE	G1	S1
Epioblasma flexuosa	Leafshell		SX	GX	SX
Epioblasma propinqua	Tennessee Riffleshell		SX	GX	SX
Epioblasma torulosa torulosa	Tubercled Blossom	LE	SE	G2TX	SH
Fusconaia subrotunda	Longsolid		SE	G3	S1
Lampsilis ovata	Pocketbook			G5	S2
Lampsilis teres	Yellow Sandshell			G5	S2
Ligumia recta	Black Sandshell			G5	S2
Obovaria retusa	Ring Pink	LE	SX	G1	SX
Obovaria subrotunda	Round Hickorynut		SSC	G4	S2
Plethobasus cooperianus	Orangefoot Pimpleback	LE	SE	G1	S1
Plethobasus cyphyus	Sheepnose	C	SE	G3	S1
Pleurobema clava	Clubshell	LE	SE	G2	S1
Pleurobema cordatum	Ohio Pigtoe		SSC	G3	S2
Pleurobema pyramidatum	Pyramid Pigtoe		SE	G2	S1
Potamilus capax	Fat Pocketbook	LE	SE	G1	S1
Quadrula cylindrica cylindrica	Rabbitsfoot		SE	G3T3	S1
Insect: Ephemeroptera (Mayflies)					
Homoeoneuria ammophila	A Sand-filtering Mayfly		SE	G4	S1
Pseudiron centralis	A Mayfly		SE	G5	S1
Insect: Lepidoptera (Butterflies & Moths)					
Euphyes dukesi	Scarce Swamp Skipper		ST	G3	S1S2
Fish					
Cycleptus elongatus	Blue Sucker			G3G4	S2
Etheostoma histrio	Harlequin Darter			G5	S1
Etheostoma squamiceps	Spottail Darter			G4G5	S1
Reptile					
Kinosternon subrubrum	Eastern Mud Turtle		SE	G5	S2
Nerodia erythrogaster neglecta	Copperbelly Water Snake	PS:LT	SE	G5T2T3	S2
Opheodrys aestivus	Rough Green Snake		SSC	G5	S3
Pseudemys concinna hieroglyphica	Hieroglyphic River Cooter		SE	G5T4	S1
Bird					
Ammodramus henslowii	Henslow's Sparrow		SE	G4	S3B
Ardea herodias	Great Blue Heron			G5	S4B
Botaurus lentiginosus	American Bittern		SE	G4	S2B
Buteo lineatus	Red-shouldered Hawk		SSC	G5	S3
Circus cyaneus	Northern Harrier		SE	G5	S2
Cistothorus platensis	Sedge Wren		SE	G5	S3B
Falco peregrinus	Peregrine Falcon	No Status	SE	G4	S2B
Haliaeetus leucocephalus	Bald Eagle	LT,PDL	SE	G5	S2
Ixobrychus exilis	Least Bittern		SE	G5	S3B
Nyctanassa violacea	Yellow-crowned Night-heron		SE	G5	S2B
Phalaropus tricolor	Wilson's Phalarope		SX	G5	SHB
Rallus elegans	King Rail		SE	G4	S1B
Sterna antillarum athalassos	Interior Least Tern	LE	SE	G4T2Q	S1B
Thryomanes bewickii	Bewick's Wren			G5	S1B
Tyto alba	Barn Owl		SE	G5	S2
Mammal					
Lutra canadensis	Northern River Otter			G5	S2
Mustela nivalis	Least Weasel		SSC	G5	S2?

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

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

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

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

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

Indiana County Endangered, Threatened and Rare Species List

County: Gibson

Species Name	Common Name	FED	STATE	GRANK	SRANK
Myotis sodalis	Indiana Bat or Social Myotis	LE	SE	G2	S1
Sylvilagus aquaticus	Swamp Rabbit		SE	G5	S1
Taxidea taxus	American Badger			G5	S2
Vascular Plant					
Acalypha deamii	Mercury		SR	G4?	S2
Armoracia aquatica	Lake Cress		SE	G4?	S1
Azolla caroliniana	Carolina Mosquito-fern		ST	G5	S2
Calycocarpum lyonii	Cup-seed		ST	G5	S2
Carex socialis	Social Sedge		SR	G4	S2
Carex straminea	Straw Sedge		ST	G5	S2
Catalpa speciosa	Northern Catalpa		SR	G4?	S2
Chelone obliqua var. speciosa	Rose Turtlehead		WL	G4T3	S3
Clematis pitcheri	Pitcher Leather-flower		SR	G4G5	S2
Crataegus grandis	Grand Hawthorn		SE	G3G5Q	S1
Crataegus viridis	Green Hawthorn		ST	G5	S2
Cyperus pseudovegetus	Green Flatsedge		SR	G5	S2
Didiplis diandra	Water-purslane		SE	G5	S2
Diodia virginiana	Buttonweed		WL	G5	S2
Gleditsia aquatica	Water-locust		SE	G5	S1
Hibiscus moscheutos ssp. lasiocarpos	Hairy-fruited Hibiscus		SE	G5T4	S1
Iresine rhizomatosa	Eastern Bloodleaf		SR	G5	S2
Juglans cinerea	Butternut		WL	G3G4	S3
Linum striatum	Ridged Yellow Flax		WL	G5	S3
Ludwigia decurrens	Primrose Willow		WL	G5	S2
Orobanche ludoviciana	Louisiana Broomrape		SE	G5	S2
Platanthera flava var. flava	Southern Rein Orchid		SE	G4T4?Q	S1
Potamogeton pusillus	Slender Pondweed		WL	G5	S2
Sparganium androcladum	Branching Bur-reed		ST	G4G5	S2
Strophostyles leiosperma	Slick-seed Wild-bean		ST	G5	S2
Styrax americanus	American Snowbell		WL	G5	S3
Taxodium distichum	Bald Cypress		ST	G5	S2
Trachelospermum difforme	Climbing Dogbane		SR	G4G5	S2
Vitis palmata	Catbird Grape		SR	G4	S2
High Quality Natural Community					
Forest - floodplain wet-mesic	Wet-mesic Floodplain Forest		SG	G3?	S3
Forest - upland dry-mesic	Dry-mesic Upland Forest		SG	G4	S4
Forest - upland mesic	Mesic Upland Forest		SG	G3?	S3
Wetland - swamp shrub	Shrub Swamp		SG	GU	S2

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

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

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

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

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

Appendix B
Sample Site Photographs

Photograph 1 (04-07-09). This photograph of Site 1 was taken facing west (upstream) from CR 500 West.

Photograph 2 (04-08-09). This photograph of Site 2 was taken facing south (upstream) from CR 525 South.

Photograph 3 (04-08-09). This photograph of Site 3 was taken facing east (upstream) from CR 600 West.

Photograph 4 (04-07-09). This photograph of Site 4 was taken facing east (upstream) from CR 850 West.

Photograph 5 (04-07-09). This photograph of Site 5 was taken facing northeast (upstream) from CR 850 West.

Photograph 6 (04-07-09). This photograph of Site 6 was taken facing northeast (upstream) from a point along the streambank just northeast of a railroad bridge crossing the stream which is northeast of CR 350 South.

Photograph 7 (04-07-09). This photograph of Site 7 was taken facing north (upstream) from CR 350 South.

Photograph 8 (04-07-09). This photograph of Site 8 was taken facing north (upstream) from CR 350 South.

Photograph 9 (04-07-09). This photograph of Site 9 was taken facing north (upstream) from CR 350 South.

Photograph 10 (10-01-08). This photograph of Site 10 was taken facing east (upstream) from CR 1500 West.

Appendix C
Field Conducted Analyses Data

Water Temperature, pH, Specific Conductivity, and Dissolved Oxygen Field Data

Site	Sample Type	Date	Time	Air Temp. (ºC)	Water Temp. (ºC)	pH	Specific Conductivity (µS)	Dissolved Oxygen (mg/L)	Data Collectors[1]	Weather
1	base flow	06-29-09	12:16	25.3	21.4	8.20	712	9.5	ALD	clear
1	storm flow	04-07-09	13:15	9.8	10.6	8.13	694	10.9	ALD, ARD	overcast
2	base flow	10-22-08	9:00	8	9.7	7.23	447.5	2.1	ARD, JH	overcast
2	storm flow	04-08-09	10:20	11.1	7.5	7.96	715.5	10.2	ALD, ARD	clear
3	base flow	10-22-08	10:00	11	10.8	7.52	653.8	2.1	ARD, JH	clear
3	storm flow	04-08-09	9:30	10.0	7.0	7.89	710.1	10.0	ALD, ARD	clear
4	base flow	06-29-09	11:09	25.8	32.3	8.69	557	13.7	ALD	clear
4	storm flow	04-07-09	12:05	7.6	9.8	8.44	667.4	10.7	ALD, ARD	clear
5	base flow	10-22-08	10:45	13	9.8	8.42	528.0	6.3	ARD, JH	clear
5	storm flow	04-07-09	12:30	11.1	10.2	7.89	715	10.5	ALD, ARD	overcast
6	base flow	10-22-08	11:45	15	11.5	7.90	515.0	3.1	ARD, JH	clear
6	storm flow	04-07-09	10:55	11.6	8.1	7.49	646.4	7.6	ALD, ARD	clear
7	base flow	06-29-09	10:10	26.9	23.5	7.09	540	8.6	ALD	clear
7	storm flow	04-07-09	10:20	6.1	8.7	6.81	459.5	6.8	ALD, ARD	clear
8	base flow	06-29-09	9:28	26.0	21.2	6.72	435.6	5.3	ALD	clear
8	storm flow	04-07-09	9:20	4.7	8.8	6.64	328.1	5.9	ALD, ARD	clear
9	base flow	06-29-09	8:14	21.3	21.5	7.16	418.2	2.5	ALD	clear
9	storm flow	04-07-09	8:20	4.6	5.6	6.58	235.3	6.3	ALD, ARD	clear
10	base flow	10-22-08	14:30	17	15.5	8.19	673	3.9	ARD, JH	clear

[1] Aren Dottenwhy (ALD), Alicia Douglass (ARD), Jessica Hickey (JH)

Base Flow Stream Width and Water Velocity Measurements

Site	Date	Time	Total Stream Width (ft.)	Stream Segment	Stream Depth (ft.)	Velocity (ft./sec.)	Data Collectors[1]
1	06-29-09	12:16	10.5	1	0.20	0.01	ALD
				2	0.25	0.03	
				3	0.50	0.03	
2	10-22-08	9:00	14	1	1.00	0.03	ARD, JH
				2	1.00	0.05	
				3	1.30	0.03	
3	10-22-08	10:00	24	1	1.30	0	ARD, JH
				2	0.90	0.03	
				3	1.00	0.03	
4	06-29-09	11:09	5.4	1	0.20	-0.01	ALD
				2	0.20	-0.01	
				3	0.15	-0.01	
5	10-22-08	10:45	13.5	1	0.20	0.02	ARD, JH
				2	0.40	0.07	
				3	0.80	0.16	
6	10-22-08	11:45	15	1	0.50	0.02	ARD, JH
				2	0.80	0.03	
				3	0.50	0	
7	06-29-09	10:10	9.2	1	0.75	0.01	ALD
				2	1.35	0.01	
				3	0.90	0	
8	06-29-09	9:28	10.4	1	0.60	0.07	ALD
				2	0.60	0.17	
				3	0.60	0.07	
9	06-29-09	8:14	10.5	1	0.60	0	ALD
				2	0.50	0.01	
				3	0.60	0	
10	10-22-08	14:30	23.5	1	0.70	0.06	ARD, JH
				2	1.20	0.07	
				3	0.90	0.03	

[1] Aren Dottenwhy (ALD), Alicia Douglass (ARD), Jessica Hickey (JH)

Storm Flow Stream Width and Water Velocity Measurements

Site	Date	Time	Total Stream Width (ft.)	Stream Segment	Stream Depth (ft.)	Velocity (ft./sec.)	Data Collectors[1]
1	04-07-09	13:15	12.3	1	0.80	0.22	ALD, ARD
				2	1.30	0.35	
				3	0.90	0.05	
2	04-08-09	10:20	17.1	1	2.20	01.6	ALD, ARD
				2	2.25	0.07	
				3	2.10	0.13	
3	04-08-09	9:30	27.5	1	0.90	0.40	ALD, ARD
				2	0.95	0.44	
				3	1.05	0.49	
4	04-07-09	12:05	12.6	1	0.70	0.02	ALD, ARD
				2	0.95	0.21	
				3	0.75	0.01	
5	04-07-09	12:30	18.5	1	1.50	1.35	ALD, ARD
				2	0.90	1.18	
				3	0.60	0.60	
6	04-07-09	10:55	26.3	1	2.50	0.66	ALD, ARD
				2	2.50	0.53	
				3	1.25	0.67	
7	04-07-09	10:20	12.3	1	2.00	0.12	ALD, ARD
				2	2.10	0.19	
				3	1.20	0.29	
8	04-07-09	9:20	14.1	1	2.20	0.49	ALD, ARD
				2	1.90	0.43	
				3	2.15	0.33	
9	04-07-09	8:20	13.0	1	1.15	0.14	ALD, ARD
				2	1.15	0.10	
				3	1.00	0.13	

[1] Aren Dottenwhy (ALD), Alicia Douglass (ARD), Jessica Hickey (JH)

Appendix D
Microbac Laboratories, Inc. Analyses Sheets

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Microbac Laboratories, Inc.

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ELECTRONIC CERTIFICATE OF ANALYSIS

REVISED

0810-01533

DAVEY RESOURCE GROUP (DRG)
ALICIA DOUGLASS
3846 NEW VISION DRIVE
FORTWAYNE, IN 46845

Date Reported	11/03/2008
Date Due	10/31/2008
Date Received	10/22/2008
Date Sampled	10/22/2008
Invoice No.	36027
Customer #	1539
Customer P.O.	CREDIT CARD

SURFACE WATER PROJECT SAMPLE#2

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech
Sample: 001 **#2**								Date & Time Sampled: 10/22/2008 @ 9:00			
SOLIDS, TOTAL SUSPENDED			15	MG/L			I-3765-85	5	10/23/08	14:00	JMJ
PHOSPHORUS, TOTAL			0.086	MG/L			EPA 365.1	0.01	10/29/08	20:09	JPM
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.015	MG/L			EPA 300.0	0.05	10/23/08	22:07	JPM
NITROGEN, AMMONIA		UJ	<0.10	MG/L			SM 4500-NH3 G	0.25	10/28/08	15:47	AFB
NITROGEN, TOTAL KJELDAHL			0.79	MG/L			SM 4500-NH3 G	0.4	10/29/08	17:18	AFB
NITROGEN, NITRATE + NITRITE		UJ	<0.10	MG/L			EPA 300.0	0.26	10/23/08	21:07	JPM
TURBIDITY			17	NTU			EPA 180.1	1.0	10/23/08	11:40	JRV
E. COLI			20	PER 100ML			SM 9213D		10/22/08	16:59	KDS
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		10/27/08	14:00	CMA

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0810-01533

DAVEY RESOURCE GROUP (DRG)
ALICIA DOUGLASS
SURFACE WATER PROJECT SAMPLE#2

Date Reported 11/03/2008
Date Received 10/22/2008
Date Sampled 10/22/2008

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech

QUALIFIER DEFINITIONS:

AR Results reported on an as received basis.
B1 Analyte value in the method blank above control limit.
B2 Analyte value in the method blank is between the method detection limit and the reporting detection limit.
B3 BOD blank is over specifications . The reported result may be biased high.
BOD1 BOD result estimated due to insufficient oxygen depletion.
BOD2 BOD result estimated due to insufficient oxygen residual.
BOD3 BOD result estimated due to inconsistent oxygen depletion
C1 Continuing calibration verification (CCV) above upper control limit, analyte(s) not detected.
CU Customer specified reporting limit
CE Conclusion Entry
CG Confluent Growth.
DI Surrogate recoveries out of compliance due to sample dilution.
DW Results reported on a dry weight basis.
E1 Elevated reporting or detection limit(s) due to sample matrix interference and sample dilution.
E2 Elevated reporting or detection limit(s) due to high analyte concentration and sample dilution.
E3 Elevated reporting or detection limit(s) due to insufficient sample volume
ES Estimated microbiological count
E4 Elevated reporting or detection limit(s) due to low level calibration variance
F1 Test Method Epa 1010 Not Valid For Solid Samples. Samples Analyzed By A Modified 1010 Method.
F2 No Flash Observed; Test Flame Is Being Extinguished By Sample At The Reported Temperature.
F3 The result is estimated, as the sample can not by sufficiently cooled below the expected flashpoint.
H1 Sample received outside of holding time for these analytes.
H2 Analyte was prepared and/or analyzed outside of the analytical method holding time.
J1 The analyte was positively identified; analyte was detected between the reporting limit and method detection limit and the result is an estimated value.
J2 The analyte was positively identified;the result is above the quantitation range and is an estimated value.
L1 Lab control sample (LCS) recovery below lower control limit, all other batch QC acceptable.
L2 Lab control sample (LCS) recovery above upper control limit, all other batch QC acceptable.
L3 Lab control sample (LCS) recovery above upper control limit, analyte not detected.
M1 Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased High.
M2 Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased Low.
M3 Matrix Spike Recovery Outside Control Limits Due To Analyte Concentration. Matrix Spike Evaluation not applicable when sample concentration is >= 4X Spike Concentration.
MC Miscellaneous (see conclusion statement)
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification." Any associated quantitation is an estimate based on industry standard practices.
ND Not detected at or below the reporting limit (or method detection limit, if listed).
NJ The analysis indicates the presence of an analyte that has been "tentatively identified" and is an estimated value.
OOC The above value is over the client provided or regulatory specification for this parameter
P1 Sample received was improperly preserved for these analytes.
P2 Sample pH greater than method limit of 2.
R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. the presence or absence of the analyte cannot be verified.
TNC Colonies too numerous to count
R1 Relative percent difference (RPD) of matrix spike duplicates outside of control limit.
R2 Relative percent difference (RPD) of LCS duplicates outside of control limit.
R3 Relative percent difference (RPD) of sample duplicates outside of control limit.
S1 One or more surrogates outside control limits, no target analytes detected.
S2 One or more surrogates outside control limits due to matrix interference.
S3 One or more surrogates outside control limits. the data was accepted based on the valid recovery of remaining surrogate(s).
SUB Analysis subcontracted.
SUM This total is the sum of several values, some which are less that their respective reporting limits. The total is an estimate.
UJ Analyte was not detected above the reporting limit, however, the reporting limit is approximate & may or may not represent the actual limit of quantitation necessary to accurately & precisely measure the analyte in the sample.
V Analyte concentration estimated due to sample matrix interference and/or high analyte concentration interference.

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0810-01536

DAVEY RESOURCE GROUP (DRG)
ALICIA DOUGLASS
3846 NEW VISION DRIVE
FORTWAYNE, IN 46845

Date Reported	11/03/2008
Date Due	10/31/2008
Date Received	10/22/2008
Date Sampled	10/22/2008
Invoice No.	36028
Customer #	1539
Customer P.O.	CREDIT CARD

SURFACE WATER PROJECT SAMPLE#3

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech
Sample: 001 **#3**							Date & Time Sampled: 10/22/2008 @ 10:00				
SOLIDS, TOTAL SUSPENDED			<5	MG/L			I-3765-85	5	10/23/08	14:00	JMJ
PHOSPHORUS, TOTAL			0.054	MG/L			EPA 365.1	0.01	10/29/08	20:10	JPM
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.015	MG/L			EPA 300.0	0.05	10/23/08	21:21	JPM
NITROGEN, AMMONIA		UJ	<0.10	MG/L			SM 4500-NH3 G	0.25	10/28/08	15:49	AFB
NITROGEN, TOTAL KJELDAHL			0.49	MG/L			SM 4500-NH3 G	0.4	10/29/08	17:20	AFB
NITROGEN, NITRATE + NITRITE			1.3	MG/L			EPA 300.0	0.26	10/23/08	21:21	JPM
TURBIDITY			6.6	NTU			EPA 180.1	1.0	10/23/08	11:40	JRV
E. COLI			30	PER 100ML			SM 9213D		10/22/08	17:04	KDS
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		10/27/08	14:00	CMA

CE - CERTIFICATE OF ANALYSIS WAS REVISED TO CORRECT THE RL OF SEVERAL ANALYTES PER THE CLIENTS REQUEST AND PERMIT SPECIFICATIONS. RRR 11/4/2008

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0810-01536

DAVEY RESOURCE GROUP (DRG)		Date Reported	11/03/2008
ALICIA DOUGLASS		Date Received	10/22/2008
SURFACE WATER PROJECT SAMPLE#3		Date Sampled	10/22/2008

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech

QUALIFIER DEFINITIONS:

AR Results reported on an as received basis.
B1 Analyte value in the method blank above control limit.
B2 Analyte value in the method blank is between the method detection limit and the reporting detection limit.
B3 BOD blank is over specifications . The reported result may be biased high.
BOD1 BOD result estimated due to insufficient oxygen depletion.
BOD2 BOD result estimated due to insufficient oxygen residual.
BOD3 BOD result estimated due to inconsistent oxygen depletion
C1 Continuing calibration verification (CCV) above upper control limit; analyte(s) not detected.
CU Customer specified reporting limit
CE Conclusion Entry
CG Confluent Growth
DI Surrogate recoveries out of compliance due to sample dilution.
DW Results reported on a dry weight basis.
E1 Elevated reporting or detection limit(s) due to sample matrix interference and sample dilution.
E2 Elevated reporting or detection limit(s) due to high analyte concentration and sample dilution.
E3 Elevated reporting or detection limit(s) due to insufficient sample volume
ES Estimated microbiological count
E4 Elevated reporting or detection limit(s) due to low level calibration variance
F1 Test Method Epa 1010 Not Valid For Solid Samples. Samples Analyzed By A Modified 1010 Method.
F2 No Flash Observed; Test Flame Is Being Extinguished By Sample At The Reported Temperature.
F3 The result is estimated, as the sample can not by sufficiently cooled below the expected flashpoint.
H1 Sample received outside of holding time for these analytes.
H2 Analyte was prepared and/or analyzed outside of the analytical method holding time.
J1 The analyte was positively identified; analyte was detected between the reporting limit and method detection limit and the result is an estimated value.
J2 The analyte was positively identified;the result is above the quantitation range and is an estimated value.
L1 Lab control sample (LCS) recovery below lower control limit, all other batch QC acceptable.
L2 Lab control sample (LCS) recovery above upper control limit, all other batch QC acceptable.
L3 Lab control sample (LCS) recovery above upper control limit, analyte not detected.
M1 Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased High.
M2 Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased Low.
M3 Matrix Spike Recovery Outside Control Limits Due To Analyte Concentration. Matrix Spike Evaluation not applicable when sample concentration is >= 4X Spike Concentration.
MC Miscellaneous (see conclusion statement)
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification." Any associated quantitation is an estimate based on industry standard practices.
ND Not detected at or below the reporting limit (or method detection limit, if listed).
NJ The analysis indicates the presence of an analyte that has been "tentatively identified" and is an estimated value.
OOC The above value is over the client provided or regulatory specification for this parameter
P1 Sample received was improperly preserved for these analytes.
P2 Sample pH greater than method limit of 2.
R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. the presence or absence of the analyte cannot be verified.
TNC Colonies too numerous to count
R1 Relative percent difference (RPD) of matrix spike duplicates outside of control limit.
R2 Relative percent difference (RPD) of LCS duplicates outside of control limit.
R3 Relative percent difference (RPD) of sample duplicates outside of control limit.
S1 One or more surrogates outside control limits, no target analytes detected.
S2 One or more surrogates outside control limits due to matrix interference.
S3 One or more surrogates outside control limits. the data was accepted based on the valid recovery of remaining surrogate(s).
SUB Analysis subcontracted.
SUM This total is the sum of several values, some which are less that their respective reporting limits. The total is an estimate.
UJ Analyte was not detected above the reporting limit, however, the reporting limit is approximate & may or may not represent the actual limit of quantitation necessary to accurately & precisely measure the analyte in the sample.
V Analyte concentration estimated due to sample matrix interference and/or high analyte concentration interference.

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0810-01538

DAVEY RESOURCE GROUP (DRG)
ALICIA DOUGLASS
3846 NEW VISION DRIVE
FORTWAYNE, IN 46845

Date Reported	11/03/2008
Date Due	10/31/2008
Date Received	10/22/2008
Date Sampled	10/22/2008
Invoice No.	36029
Customer #	1539
Customer P.O.	CREDIT CARD

SURFACE WATER PROJECT SAMPLE#5

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech
Sample: 001 **#5**								Date & Time Sampled: 10/22/2008 @ 10:45			
SOLIDS, TOTAL SUSPENDED			6	MG/L			I-3765-85	5	10/23/08	14:00	JMJ
PHOSPHORUS, TOTAL			<0.050	MG/L			EPA 365.1	0.01	10/29/08	20:12	JPM
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.015	MG/L			EPA 300.0	0.05	10/23/08	21:34	JPM
NITROGEN, AMMONIA		J1	0.22	MG/L			SM 4500-NH3 G	0.25	10/28/08	15:55	AFB
NITROGEN, TOTAL KJELDAHL			0.82	MG/L			SM 4500-NH3 G	0.4	10/29/08	17:23	AFB
NITROGEN, NITRATE + NITRITE			2.9	MG/L			EPA 300.0	0.26	10/23/08	21:34	JPM
TURBIDITY			12	NTU			EPA 180.1	1.0	10/23/08	11:40	JRV
E. COLI			100	PER 100ML			SM 9213D		10/22/08	17:10	KDS
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		10/27/08	14:00	CMA

CE - CERTIFICATE OF ANALYSIS WAS REVISED TO CORRECT THE RL OF SEVERAL ANALYTES PER THE CLIENTS REQUEST AND PERMIT SPECIFICATIONS. RRR 11/4/2008

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0810-01538

DAVEY RESOURCE GROUP (DRG)
ALICIA DOUGLASS
SURFACE WATER PROJECT SAMPLE#5

Date Reported	**11/03/2008**
Date Received	**10/22/2008**
Date Sampled	**10/22/2008**

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech

QUALIFIER DEFINITIONS:

AR Results reported on an as received basis.
B1 Analyte value in the method blank above control limit.
B2 Analyte value in the method blank is between the method detection limit and the reporting detection limit.
B3 BOD blank is over specifications . The reported result may be biased high.
BOD1 BOD result estimated due to insufficient oxygen depletion.
BOD2 BOD result estimated due to insufficient oxygen residual.
BOD3 BOD result estimated due to inconsistent oxygen depletion
CI Continuing calibration verification (CCV) above upper control limit, analyte(s) not detected.
CU Customer specified reporting limit
CE Conclusion Entry
CG Confluent Growth
DI Surrogate recoveries out of compliance due to sample dilution.
DW Results reported on a dry weight basis.
E1 Elevated reporting or detection limit(s) due to sample matrix interference and sample dilution.
E2 Elevated reporting or detection limit(s) due to high analyte concentration and sample dilution.
E3 Elevated reporting or detection limit(s) due to insufficient sample volume
ES Estimated microbiological count
E4 Elevated reporting or detection limit(s) due to low level calibration variance
F1 Test Method Epa 1010 Not Valid For Solid Samples. Samples Analyzed By A Modified 1010 Method.
F2 No Flash Observed; Test Flame Is Being Extinguished By Sample At The Reported Temperature.
F3 The result is estimated, as the sample can not by sufficiently cooled below the expected flashpoint.
H1 Sample received outside of holding time for these analytes.
H2 Analyte was prepared and/or analyzed outside of the analytical method holding time.
J1 The analyte was positively identified; analyte was detected between the reporting limit and method detection limit and the result is an estimated value.
J2 The analyte was positively identified;the result is above the quantitation range and is an estimated value.
L1 Lab control sample (LCS) recovery below lower control limit, all other batch QC acceptable.
L2 Lab control sample (LCS) recovery above upper control limit, all other batch QC acceptable.
L3 Lab control sample (LCS) recovery above upper control limit, analyte not detected.
M1 Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased High.
M2 Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased Low.
M3 Matrix Spike Recovery Outside Control Limits Due To Analyte Concentration. Matrix Spike Evaluation not applicable when sample concentration is >= 4X Spike Concentration.
MC Miscellaneous (see conclusion statement)
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification." Any associated quantitation is an estimate based on industry standard practices.
ND Not detected at or below the reporting limit (or method detection limit, if listed).
NJ The analysis indicates the presence of an analyte that has been "tentatively identified" and is an estimated value.
OOC The above value is over the client provided or regulatory specification for this parameter.
P1 Sample received was improperly preserved for these analytes.
P2 Sample pH greater than method limit of 2.
R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. the presence or absence of the analyte cannot be verified.
TNC Colonies too numerous to count
R1 Relative percent difference (RPD) of matrix spike duplicates outside of control limit.
R2 Relative percent difference (RPD) of LCS duplicates outside of control limit.
R3 Relative percent difference (RPD) of sample duplicates outside of control limit.
S1 One or more surrogates outside control limits, no target analytes detected.
S2 One or more surrogates outside control limits due to matrix interference.
S3 One or more surrogates outside control limits. the data was accepted based on the valid recovery of remaining surrogate(s).
SUB Analysis subcontracted.
SUM This total is the sum of several values, some which are less that their respective reporting limits. The total is an estimate.
UJ Analyte was not detected above the reporting limit, however, the reporting limit is approximate & may or may not represent the actual limit of quantitation necessary to accurately & precisely measure the analyte in the sample.
V Analyte concentration estimated due to sample matrix interference and/or high analyte concentration interference.

Microbac Laboratories, Inc.

KENTUCKY TESTING LABORATORY DIVISION
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Member ACIL

Chemical, Biological, Physical, Molecular, and Toxicological Services

ELECTRONIC CERTIFICATE OF ANALYSIS

REVISED

0810-01539

DAVEY RESOURCE GROUP (DRG)
ALICIA DOUGLASS
3846 NEW VISION DRIVE
FORTWAYNE, IN 46845

Date Reported	11/03/2008
Date Due	10/31/2008
Date Received	10/22/2008
Date Sampled	10/22/2008
Invoice No.	36030
Customer #	1539
Customer P.O.	CREDIT CARD

SURFACE WATER PROJECT SAMPLE#6

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech
Sample: 001 **#6**								Date & Time Sampled: 10/22/2008 @ 11:45			
SOLIDS, TOTAL SUSPENDED			61	MG/L			I-3765-85	5	10/23/08	14:00	JMJ
PHOSPHORUS, TOTAL			0.17	MG/L			EPA 365.1	0.01	10/29/08	20:13	JPM
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.015	MG/L			EPA 300.0	0.05	10/23/08	21:47	JPM
NITROGEN, AMMONIA		J1	0.17	MG/L			SM 4500-NH3 G	0.25	10/28/08	15:57	AFB
NITROGEN, TOTAL KJELDAHL			0.88	MG/L			SM 4500-NH3 G	0.4	10/29/08	17:25	AFB
NITROGEN, NITRATE + NITRITE		UJ	<0.10	MG/L			EPA 300.0	0.26	10/23/08	21:47	JPM
TURBIDITY			35	NTU			EPA 180.1	1.0	10/23/08	11:40	JRV
E. COLI			720	PER 100ML			SM 9213D		10/22/08	17:17	KDS
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		10/27/08	14:00	CMA

CE - CERTIFICATE OF ANALYSIS WAS REVISED TO CORRECT THE RL OF SEVERAL ANALYTES PER THE CLIENTS REQUEST AND PERMIT SPECIFICATIONS. RRR 11/4/2008

UNLESS OTHERWISE NOTED, SAMPLES RESULTS ARE REPORTED ON AN AS RECEIVED BASIS

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: R. Clifton

MICROBAC LABORATORIES, INC.

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ELECTRONIC CERTIFICATE OF ANALYSIS

REVISED

0810-01539

DAVEY RESOURCE GROUP (DRG)
ALICIA DOUGLASS
SURFACE WATER PROJECT SAMPLE#6

Date Reported	**11/03/2008**
Date Received	**10/22/2008**
Date Sampled	**10/22/2008**

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech

QUALIFIER DEFINITIONS:

AR Results reported on an as received basis.
B1 Analyte value in the method blank above control limit.
B2 Analyte value in the method blank is between the method detection limit and the reporting detection limit.
B3 BOD blank is over specifications . The reported result may be biased high.
BOD1 BOD result estimated due to insufficient oxygen depletion.
BOD2 BOD result estimated due to insufficient oxygen residual.
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C1 Continuing calibration verification (CCV) above upper control limit, analyte(s) not detected.
CU Customer specified reporting limit
CE Conclusion Entry
CG Confluent Growth
DI Surrogate recoveries out of compliance due to sample dilution.
DW Results reported on a dry weight basis.
E1 Elevated reporting or detection limit(s) due to sample matrix interference and sample dilution.
E2 Elevated reporting or detection limit(s) due to high analyte concentration and sample dilution.
E3 Elevated reporting or detection limit(s) due to insufficient sample volume
ES Estimated microbiological count
E4 Elevated reporting or detection limit(s) due to low level calibration variance
F1 Test Method Epa 1010 Not Valid For Solid Samples. Samples Analyzed By A Modified 1010 Method.
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MC Miscellaneous (see conclusion statement)
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P1 Sample received was improperly preserved for these analytes.
P2 Sample pH greater than method limit of 2.
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R2 Relative percent difference (RPD) of LCS duplicates outside of control limit.
R3 Relative percent difference (RPD) of sample duplicates outside of control limit.
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S2 One or more surrogates outside control limits due to matrix interference.
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Chemical, Biological, Physical, Molecular, and Toxicological Services

ELECTRONIC CERTIFICATE OF ANALYSIS

REVISED

0810-01541

DAVEY RESOURCE GROUP (DRG)
ALICIA DOUGLASS
3846 NEW VISION DRIVE
FORTWAYNE, IN 46845

Date Reported	11/03/2008
Date Due	10/31/2008
Date Received	10/22/2008
Date Sampled	10/22/2008
Invoice No.	36031
Customer #	1539
Customer P.O.	CREDIT CARD

SURFACE WTR PROJECT SAMPLE#10

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech
Sample: 001 **#10**							Date & Time Sampled:		10/22/2008	@ 14:30	
SOLIDS, TOTAL SUSPENDED			<5	MG/L			I-3765-85	5	10/23/08	14:00	JMJ
PHOSPHORUS, TOTAL			0.068	MG/L			EPA 365.1	0.01	10/29/08	20:16	JPM
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.015	MG/L			EPA 300.0	0.05	10/23/08	22:00	JPM
NITROGEN, AMMONIA		J1	<0.1	MG/L			SM 4500-NH3 G	0.25	10/28/08	15:59	AFB
NITROGEN, TOTAL KJELDAHL			0.44	MG/L			SM 4500-NH3 G	0.4	10/29/08	17:27	AFB
NITROGEN, NITRATE + NITRITE		UJ	<0.1	MG/L			EPA 300.0	0.26	10/23/08	22:00	JPM
TURBIDITY			19	NTU			EPA 180.1	1.0	10/23/08	11:40	JRV
E. COLI			<10	PER 100ML			SM 9213D		10/22/08	17:24	KDS
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		10/27/08	14:00	CMA

CE - CERTIFICATE OF ANALYSIS WAS REVISED TO INPUT THE OMITTED ORTHO-P RESULTS. RRR 11/3/2008

CE - CERTIFICATE OF ANALYSIS WAS REVISED TO CORRECT THE RL OF SEVERAL ANALYTES PER THE CLIENTS REQUEST AND PERMIT SPECIFICATIONS. RRR 11/3/2008

UNLESS OTHERWISE NOTED, SAMPLES RESULTS ARE REPORTED ON AN AS RECEIVED BASIS

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: R. Clifton

MICROBAC LABORATORIES, INC.

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ELECTRONIC CERTIFICATE OF ANALYSIS

REVISED

0810-01541

DAVEY RESOURCE GROUP (DRG)		Date Reported	11/03/2008
ALICIA DOUGLASS		Date Received	10/22/2008
SURFACE WTR PROJECT SAMPLE#10		Date Sampled	10/22/2008

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech

QUALIFIER DEFINITIONS:

AR Results reported on an as received basis.
B1 Analyte value in the method blank above control limit.
B2 Analyte value in the method blank is between the method detection limit and the reporting detection limit.
B3 BOD blank is over specifications . The reported result may be biased high.
BOD1 BOD result estimated due to insufficient oxygen depletion.
BOD2 BOD result estimated due to insufficient oxygen residual.
BOD3 BOD result estimated due to inconsistent oxygen depletion
C1 Continuing calibration verification (CCV) above upper control limit, analyte(s) not detected.
CU Customer specified reporting limit
CE Conclusion Entry
CG Confluent Growth
DI Surrogate recoveries out of compliance due to sample dilution.
DW Results reported on a dry weight basis.
E1 Elevated reporting or detection limit(s) due to sample matrix interference and sample dilution.
E2 Elevated reporting or detection limit(s) due to high analyte concentration and sample dilution.
E3 Elevated reporting or detection limit(s) due to insufficient sample volume
ES Estimated microbiological count
E4 Elevated reporting or detection limit(s) due to low level calibration variance
F1 Test Method Epa 1010 Not Valid For Solid Samples. Samples Analyzed By A Modified 1010 Method.
F2 No Flash Observed; Test Flame Is Being Extinguished By Sample At The Reported Temperature.
F3 The result is estimated, as the sample can not by sufficiently cooled below the expected flashpoint.
H1 Sample received outside of holding time for these analytes.
H2 Analyte was prepared and/or analyzed outside of the analytical method holding time.
J1 The analyte was positively identified; analyte was detected between the reporting limit and method detection limit and the result is an estimated value.
J2 The analyte was positively identified;the result is above the quantitation range and is an estimated value.
L1 Lab control sample (LCS) recovery below lower control limit, all other batch QC acceptable.
L2 Lab control sample (LCS) recovery above upper control limit, all other batch QC acceptable.
L3 Lab control sample (LCS) recovery above upper control limit, analyte not detected.
M1 Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased High.
M2 Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased Low.
M3 Matrix Spike Recovery Outside Control Limits Due To Analyte Concentration. Matrix Spike Evaluation not applicable when sample concentration is >= 4X Spike Concentration.
MC Miscellaneous (see conclusion statement)
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification." Any associated quantitation is an estimate based on industry standard practices.
ND Not detected at or below the reporting limit (or method detection limit, if listed).
NJ The analysis indicates the presence of an analyte that has been "tentatively identified" and is an estimated value.
OOC The above value is over the client provided or regulatory specification for this parameter
P1 Sample received was improperly preserved for these analytes.
P2 Sample pH greater than method limit of 2.
R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. the presence or absence of the analyte cannot be verified.
TNC Colonies too numerous to count
R1 Relative percent difference (RPD) of matrix spike duplicates outside of control limit.
R2 Relative percent difference (RPD) of LCS duplicates outside of control limit.
R3 Relative percent difference (RPD) of sample duplicates outside of control limit.
S1 One or more surrogates outside control limits, no target analytes detected.
S2 One or more surrogates outside control limits due to matrix interference.
S3 One or more surrogates outside control limits. the data was accepted based on the valid recovery of remaining surrogate(s).
SUB Analysis subcontracted.
SUM This total is the sum of several values, some which are less that their respective reporting limits. The total is an estimate.
UJ Analyte was not detected above the reporting limit, however, the reporting limit is approximate & may or may not represent the actual limit of quantitation necessary to accurately & precisely measure the analyte in the sample.
V Analyte concentration estimated due to sample matrix interference and/or high analyte concentration interference.

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Lexington 859.276.3506 • Paducah 270.898.3637 • Evansville 812.464.9000

Chemical, Biological, Physical, Molecular, and Toxicological Services

CERTIFICATE OF ANALYSIS

REVISED

0904-00629

DAVEY RESOURCE GROUP
ALICIA DOUGLASS
3846 NEW VISION DR.
FORT WAYNE, IN 46845

SURFACE WATER

Date Reported	04/21/2009
Date Due	04/17/2009
Date Received	04/08/2009
Date Sampled	04/08/2009
Invoice No.	46437
Customer #	1539
Customer P.O.	CREDIT CARD

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech
Sample: 001 SURFACE WATER #2								Date & Time Sampled: 04/08/2009 @ 10:20			
E. COLI			70	PER 100ML			SM 9213D		04/08/09	14:55	KSH
SOLIDS, TOTAL SUSPENDED			15	MG/L			I-3765-85	5	04/13/09	16:00	KRE
PHOSPHORUS, TOTAL			0.059	MG/L			EPA 365.1	0.01	04/13/09	16:27	LER
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.07	MG/L			EPA 300.0	0.05	04/10/09	22:11	JPM
NITROGEN, AMMONIA		UJ	<0.1	MG/L			SM 4500-NH3 G	0.25	04/16/09	13:14	MRR
NITROGEN, TOTAL KJELDAHL			1.0	MG/L			SM 4500-NH3 G	0.4	04/20/09	12:55	LER
NITROGEN, NITRATE + NITRITE			5.7	MG/L			EPA 300.0	1.3	04/10/09	21:00	JPM
TURBIDITY			4.7	NTU			EPA 180.1	1.0	04/09/09	14:00	VAS
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		04/14/09	12:00	CMA
Sample: 002 SURFACE WATER #3								Date & Time Sampled: 04/08/2009 @ 9:30			
E. COLI			100	PER 100ML			SM 9213D		04/08/09	14:55	KSH
SOLIDS, TOTAL SUSPENDED			18	MG/L			I-3765-85	5	04/13/09	16:00	KRE
PHOSPHORUS, TOTAL			0.055	MG/L			EPA 365.1	0.01	04/13/09	16:28	LER
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.07	MG/L			EPA 300.0	0.05	04/10/09	22:53	JPM
NITROGEN, AMMONIA		UJ	<0.1	MG/L			SM 4500-NH3 G	0.25	04/16/09	13:16	MRR
NITROGEN, TOTAL KJELDAHL			0.59	MG/L			SM 4500-NH3 G	0.4	04/20/09	12:57	LER
NITROGEN, NITRATE + NITRITE			5.1	MG/L			EPA 300.0	1.3	04/10/09	21:15	JPM
TURBIDITY			6.7	NTU			EPA 180.1	1.0	04/09/09	14:00	VAS
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		04/14/09	12:00	CMA

REVISED TO REPORT LOWER LIMITS FOR AMMONIA, ORTHOPHOSPHATE AND NITRITE + NITRATE. DIC 4/30/2009

UNLESS OTHERWISE NOTED, SAMPLES RESULTS ARE REPORTED ON AN AS RECEIVED BASIS

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: R. Clifton

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Chemical, Biological, Physical, Molecular, and Toxicological Services

CERTIFICATE OF ANALYSIS

REVISED

0904-00629

DAVEY RESOURCE GROUP
ALICIA DOUGLASS
SURFACE WATER

Date Reported	**04/21/2009**
Date Received	**04/08/2009**
Date Sampled	**04/08/2009**

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech

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Chemical, Biological, Physical, Molecular, and Toxicological Services

CERTIFICATE OF ANALYSIS

REVISED

0904-00473

DAVEY RESOURCE GROUP
ALICIA DOUGLAS
3846 NEW VISION DRIVE
FT WAYNE, IN 46845

SURFACE WATER

Date Reported	04/22/2009
Date Due	04/16/2009
Date Received	04/07/2009
Date Sampled	04/07/2009
Invoice No.	46558
Customer #	1539
Customer P.O.	CREDIT CARD

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech
Sample: 001 SURFACE WATER SAMPLE 1								Date & Time Sampled: 04/07/2009 @ 13:15			
SOLIDS, TOTAL SUSPENDED			13	MG/L			I-3765-85	5	04/10/09	14:00	KRE
PHOSPHORUS, TOTAL			0.069	MG/L			EPA 365.1	0.01	04/13/09	15:54	LER
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.07	MG/L			EPA 300.0	0.16	04/09/09	21:45	JPM
NITROGEN, TOTAL KJELDAHL			0.51	MG/L			SM 4500-NH3 G	0.4	04/14/09	13:34	JPM
TURBIDITY			7.3	NTU			EPA 180.1	1.0	04/08/09	15:44	VAS
NITROGEN, AMMONIA		UJ	<0.1	MG/L			SM 4500-NH3 G	0.25	04/13/09	18:54	MRR
NITROGEN, NITRATE + NITRITE		J2	5.8	MG/L			EPA 300.0	0.03	04/09/09	21:45	JPM
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		04/09/09	12:00	CMA
E. COLI			10	PER 100ML			SM 9213D		04/08/09	15:15	KSH
Sample: 002 SURFACE WATER SAMPLE 4								Date & Time Sampled: 04/07/2009 @ 12:05			
SOLIDS, TOTAL SUSPENDED			11	MG/L			I-3765-85	5	04/10/09	14:00	KRE
PHOSPHORUS, TOTAL			<0.050	MG/L			EPA 365.1	0.01	04/13/09	15:56	LER
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.07	MG/L			EPA 300.0	0.16	04/09/09	21:59	JPM
NITROGEN, TOTAL KJELDAHL			0.45	MG/L			SM 4500-NH3 G	0.4	04/14/09	13:36	JPM
TURBIDITY			4.0	NTU			EPA 180.1	1.0	04/08/09	15:44	VAS
NITROGEN, AMMONIA		UJ	<0.1	MG/L			SM 4500-NH3 G	0.25	04/13/09	18:56	MRR
NITROGEN, NITRATE + NITRITE		UJ	0.35	MG/L			EPA 300.0	0.03	04/09/09	21:45	JPM
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		04/09/09	12:00	CMA
E. COLI			60	PER 100ML			SM 9213D		04/08/09	15:15	KSH
Sample: 003 SURFACE WATER SAMPLE 5								Date & Time Sampled: 04/07/2009 @ 12:30			
SOLIDS, TOTAL SUSPENDED			30	MG/L			I-3765-85	5	04/10/09	14:00	KRE
PHOSPHORUS, TOTAL			0.081	MG/L			EPA 365.1	0.01	04/13/09	15:57	LER
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.07	MG/L			EPA 300.0	0.16	04/09/09	22:41	JPM
NITROGEN, TOTAL KJELDAHL			0.66	MG/L			SM 4500-NH3 G	0.4	04/14/09	13:38	JPM
TURBIDITY			8.1	NTU			EPA 180.1	1.0	04/08/09	15:44	VAS
NITROGEN, AMMONIA		UJ	<0.1	MG/L			SM 4500-NH3 G	0.25	04/13/09	18:58	MRR
NITROGEN, NITRATE + NITRITE			4.1	MG/L			EPA 300.0	0.03	04/09/09	22:41	JPM
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		04/09/09	12:00	CMA
E. COLI			50	PER 100ML			SM 9213D		04/08/09	15:15	KSH

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Chemical, Biological, Physical, Molecular, and Toxicological Services

CERTIFICATE OF ANALYSIS

REVISED

0904-00473

DAVEY RESOURCE GROUP
ALICIA DOUGLAS
SURFACE WATER

Date Reported 04/22/2009
Date Received 04/07/2009
Date Sampled 04/07/2009

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech
Sample: 004 SURFACE WATER SAMPLE 6								Date & Time Sampled: 04/07/2009 @ 10:55			
SOLIDS, TOTAL SUSPENDED			25	MG/L			I-3765-85	5	04/10/09	14:00	KRE
PHOSPHORUS, TOTAL			0.093	MG/L			EPA 365.1	0.01	04/13/09	15:58	LER
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.07	MG/L			EPA 300.0	0.16	04/09/09	22:56	JPM
NITROGEN, TOTAL KJELDAHL			0.71	MG/L			SM 4500-NH3 G	0.4	04/14/09	13:40	JPM
TURBIDITY			12	NTU			EPA 180.1	1.0	04/08/09	15:44	VAS
NITROGEN, AMMONIA		J1	0.12	MG/L			SM 4500-NH3 G	0.25	04/13/09	19:00	MRR
NITROGEN, NITRATE + NITRITE			2.5	MG/L			EPA 300.0	0.03	04/09/09	22:56	JPM
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		04/09/09	12:00	CMA
E. COLI			70	PER 100ML			SM 9213D		04/08/09	15:15	KSH
Sample: 005 SURFACE WATER SAMPLE 7								Date & Time Sampled: 04/07/2009 @ 10:20			
SOLIDS, TOTAL SUSPENDED			54	MG/L			I-3765-85	5	04/10/09	14:00	KRE
PHOSPHORUS, TOTAL			0.16	MG/L			EPA 365.1	0.01	04/13/09	15:59	LER
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.07	MG/L			EPA 300.0	0.16	04/09/09	23:10	JPM
NITROGEN, TOTAL KJELDAHL			1.3	MG/L			SM 4500-NH3 G	0.4	04/14/09	13:42	JPM
TURBIDITY			85	NTU			EPA 180.1	1.0	04/08/09	15:44	VAS
NITROGEN, AMMONIA			0.47	MG/L			SM 4500-NH3 G	0.25	04/13/09	19:02	MRR
NITROGEN, NITRATE + NITRITE			14	MG/L			EPA 300.0	0.03	04/13/09	20:33	JPM
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		04/09/09	12:00	CMA
E. COLI			30	PER 100ML			SM 9213D		04/08/09	15:15	KSH
Sample: 006 SURFACE WATER SAMPLE 8								Date & Time Sampled: 04/07/2009 @ 9:20			
SOLIDS, TOTAL SUSPENDED			16	MG/L			I-3765-85	5	04/10/09	14:00	KRE
PHOSPHORUS, TOTAL			0.18	MG/L			EPA 365.1	0.01	04/13/09	16:01	LER
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.07	MG/L			EPA 300.0	0.16	04/10/09	0:06	JPM
NITROGEN, TOTAL KJELDAHL			0.98	MG/L			SM 4500-NH3 G	0.4	04/14/09	13:48	JPM
TURBIDITY			65	NTU			EPA 180.1	1.0	04/08/09	15:44	VAS
NITROGEN, AMMONIA		UJ	0.25	MG/L			SM 4500-NH3 G	0.25	04/13/09	19:08	MRR
NITROGEN, NITRATE + NITRITE			9.0	MG/L			EPA 300.0	0.03	04/10/09	0:06	JPM
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		04/09/09	12:00	CMA
E. COLI			80	PER 100ML			SM 9213D		04/08/09	15:15	KSH
Sample: 007 SURFACE WATER SAMPLE 9								Date & Time Sampled: 04/07/2009 @ 8:20			
SOLIDS, TOTAL SUSPENDED			43	MG/L			I-3765-85	5	04/10/09	14:00	KRE
PHOSPHORUS, TOTAL			0.28	MG/L			EPA 365.1	0.01	04/13/09	16:02	LER

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Chemical, Biological, Physical, Molecular, and Toxicological Services

CERTIFICATE OF ANALYSIS

REVISED

0904-00473

DAVEY RESOURCE GROUP
ALICIA DOUGLAS
SURFACE WATER

Date Reported 04/22/2009
Date Received 04/07/2009
Date Sampled 04/07/2009

Sample: 007 **SURFACE WATER SAMPLE 9** Date & Time Sampled: 04/07/2009 @ 8:20

.....continued

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.07	MG/L			EPA 300.0	0.16	04/10/09	0:20	JPM
NITROGEN, TOTAL KJELDAHL			1.2	MG/L			SM 4500-NH3 G	0.4	04/14/09	13:50	JPM
TURBIDITY		L1	190	NTU			EPA 180.1	1.0	04/08/09	15:44	VAS
NITROGEN, AMMONIA			0.32	MG/L			SM 4500-NH3 G	0.25	04/13/09	19:10	MRR
NITROGEN, NITRATE + NITRITE			1.8	MG/L			EPA 300.0	0.03	04/10/09	0:20	JPM
DATE DIGESTED TKN - MICRO			COMPLETED	---			SM 4500-Norg C		04/09/09	12:00	CMA
E. COLI			135	PER 100ML			SM 9213D		04/08/09	15:15	KSH

REVISED TO REPORT LOWER LIMITS FOR AMMONIA, ORTHOPHOSPHATE AND NITRITE + NITRATE. DIC 4/30/2009

UNLESS OTHERWISE NOTED, SAMPLES RESULTS ARE REPORTED ON AN AS RECEIVED BASIS

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: R. Clifton

MICROBAC LABORATORIES, INC.

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact Sean Hyde, the Managing Director at 502.962.6400. You may also contact both Trevor Boyce, President and Robert Morgan, Chief Operating Officer at president@microbac.com.

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0904-00473

DAVEY RESOURCE GROUP
ALICIA DOUGLAS
SURFACE WATER

Date Reported	04/22/2009
Date Received	04/07/2009
Date Sampled	04/07/2009

Analysis	Out of Spec	Qualif	Result	Unit	Min	Max	Method	Std Limit	Date	Time	Tech

QUALIFIER DEFINITIONS:

AR	Results reported on an as received basis.
B1	Analyte value in the method blank above control limit.
B2	Analyte value in the method blank is between the method detection limit and the reporting detection limit.
B3	BOD blank is over specifications . The reported result may be biased high.
BOD1	BOD result estimated due to insufficient oxygen depletion.
BOD2	BOD result estimated due to insufficient oxygen residual.
BOD3	BOD result estimated due to inconsistent oxygen depletion
C1	Continuing calibration verification (CCV) above upper control limit, analyte(s) not detected.
CU	Customer specified reporting limit
CE	Conclusion Entry
CG	Confluent Growth
DI	Surrogate recoveries out of compliance due to sample dilution.
DW	Results reported on a dry weight basis.
E1	Elevated reporting or detection limit(s) due to sample matrix interference and sample dilution.
E2	Elevated reporting or detection limit(s) due to high analyte concentration and sample dilution.
E3	Elevated reporting or detection limit(s) due to insufficient sample volume
ES	Estimated microbiological count
E4	Elevated reporting or detection limit(s) due to low level calibration variance
F1	Test Method Epa 1010 Not Valid For Solid Samples. Samples Analyzed By A Modified 1010 Method.
F2	No Flash Observed; Test Flame Is Being Extinguished By Sample At The Reported Temperature.
F3	The result is estimated, as the sample can not by sufficiently cooled below the expected flashpoint.
H1	Sample received outside of holding time for these analytes.
H2	Analyte was prepared and/or analyzed outside of the analytical method holding time.
J1	The analyte was positively identified; analyte was detected between the reporting limit and method detection limit and the result is an estimated value.
J2	The analyte was positively identified;the result is above the quantitation range and is an estimated value.
L1	Lab control sample (LCS) recovery below lower control limit, all other batch QC acceptable.
L2	Lab control sample (LCS) recovery above upper control limit, all other batch QC acceptable.
L3	Lab control sample (LCS) recovery above upper control limit, analyte not detected.
M1	Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased High.
M2	Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased Low.
M3	Matrix Spike Recovery Outside Control Limits Due To Analyte Concentration. Matrix Spike Evaluation not applicable when sample concentration is >= 4X Spike Concentration.
MC	Miscellaneous (see conclusion statement)
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification." Any associated quantitation is an estimate based on industry standard practices.
ND	Not detected at or below the reporting limit (or method detection limit, if listed).
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and is an estimated value.
OOC	The above value is over the client provided or regulatory specification for this parameter
P1	Sample received was improperly preserved for these analytes.
P2	Sample pH greater than method limit of 2.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. the presence or absence of the analyte cannot be verified.
TNC	Colonies too numerous to count
R1	Relative percent difference (RPD) of matrix spike duplicates outside of control limit.
R2	Relative percent difference (RPD) of LCS duplicates outside of control limit.
R3	Relative percent difference (RPD) of sample duplicates outside of control limit.
S1	One or more surrogates outside control limits, no target analytes detected.
S2	One or more surrogates outside control limits due to matrix interference.
S3	One or more surrogates outside control limits. the data was accepted based on the valid recovery of remaining surrogate(s).
SUM	This total is the sum of several values, some which are less that their respective reporting limits. The total is an estimate.
SUB	Analysis subcontracted.
UJ	Analyte was not detected above the reporting limit, however, the reporting limit is approximate & may or may not represent the actual limit of quantitation necessary to accurately & precisely measure the analyte in the sample.
V	Analyte concentration estimated due to sample matrix interference and/or high analyte concentration interference.

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Chemical, Biological, Physical, Molecular, and Toxicological Services

CERTIFICATE OF ANALYSIS

0906-02037

DAVEY RESOURCE GROUP
ALICIA DOUGLASS
3846 NEW VISION DRIVE
FORT WAYNE, IN 46845

Date Reported	07/13/2009
Date Due	07/08/2009
Date Received	06/29/2009
Date Sampled	06/29/2009
Invoice No.	52008
Customer #	1138
Customer P.O.	CREDIT CARD

SURFACE WATER

Analysis	Out of Spec	Qualif	Result	Unit	MDL	Method	Std Limit	Date	Time	Tech
Sample: 001 SURFACE WATER SAMPLE #1							Date & Time Sampled: 06/29/2009 @ 12:16			
E. COLI			10	PER 100ML	1	SM 9213D		06/29/09	15:57	PSF
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.068	MG/L	0.068	EPA 300.0	0.16	06/30/09	20:13	JPM
PHOSPHORUS, TOTAL			0.047	MG/L	0.0078	EPA 365.1	0.010	07/02/09	11:40	LER
NITROGEN, AMMONIA		UJ B2	<0.090	MG/L	0.090	SM 4500-NH3 G	0.25	07/07/09	20:31	JPM
NITROGEN, NITRATE + NITRITE		J2	6.4	MG/L	0.019	EPA 300.0	0.03	06/30/09	20:13	JPM
NITROGEN, TOTAL KJELDAHL		B2	0.45	MG/L	0.14	SM 4500-NH3 G	0.40	07/07/09	13:32	JPM
SOLIDS, TOTAL SUSPENDED			<5	MG/L	3.6	I-3765-85	5	07/01/09	13:00	BGG
TURBIDITY			3.9	NTU	0.24	EPA 180.1	1.0	06/30/09	13:55	JRV
DATE DIGESTED TKN - MICRO			COMPLETED	---		SM 4500-Norg C		07/01/09	17:00	VAS
Sample: 002 SURFACE WATER SAMPLE #4							Date & Time Sampled: 06/29/2009 @ 11:09			
E. COLI			600	PER 100ML	1	SM 9213D		06/29/09	15:57	PSF
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.068	MG/L	0.068	EPA 300.0	0.16	06/30/09	20:55	JPM
PHOSPHORUS, TOTAL			0.30	MG/L	0.0078	EPA 365.1	0.010	07/02/09	11:41	LER
NITROGEN, AMMONIA		J1 B2	0.15	MG/L	0.090	SM 4500-NH3 G	0.25	07/07/09	20:38	JPM
NITROGEN, NITRATE + NITRITE			<0.11	MG/L	0.019	EPA 300.0	0.03	06/30/09	20:55	JPM
NITROGEN, TOTAL KJELDAHL			0.96	MG/L	0.14	SM 4500-NH3 G	0.40	07/10/09	15:15	MRR
SOLIDS, TOTAL SUSPENDED			110	MG/L	3.6	I-3765-85	5	07/01/09	13:00	BGG
TURBIDITY			67	NTU	0.24	EPA 180.1	1.0	06/30/09	13:55	JRV
DATE DIGESTED TKN - MICRO			COMPLETED	---		SM 4500-Norg C		07/01/09	17:00	VAS
Sample: 003 SURFACE WATER SAMPLE #7							Date & Time Sampled: 06/29/2009 @ 10:10			
E. COLI			30	PER 100ML	1	SM 9213D		06/29/09	15:57	PSF
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.068	MG/L	0.068	EPA 300.0	0.16	06/30/09	21:09	JPM
PHOSPHORUS, TOTAL			0.26	MG/L	0.0078	EPA 365.1	0.010	07/02/09	11:43	LER
NITROGEN, AMMONIA		J1 B2	0.13	MG/L	0.090	SM 4500-NH3 G	0.25	07/07/09	20:40	JPM
NITROGEN, NITRATE + NITRITE			0.94	MG/L	0.019	EPA 300.0	0.03	06/30/09	21:09	JPM
NITROGEN, TOTAL KJELDAHL		B2	0.67	MG/L	0.14	SM 4500-NH3 G	0.40	07/07/09	13:38	JPM
SOLIDS, TOTAL SUSPENDED			41	MG/L	3.6	I-3765-85	5	07/01/09	13:00	BGG
TURBIDITY			34	NTU	0.24	EPA 180.1	1.0	06/30/09	13:55	JRV

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0906-02037

DAVEY RESOURCE GROUP
ALICIA DOUGLASS
SURFACE WATER

Date Reported 07/13/2009
Date Received 06/29/2009
Date Sampled 06/29/2009

Analysis	Out of Spec	Qualif	Result	Unit	MDL	Method	Std Limit	Date	Time	Tech
Sample: 003 **SURFACE WATER SAMPLE #7** .....continued							Date & Time Sampled: 06/29/2009 @ 10:10			
DATE DIGESTED TKN - MICRO			COMPLETED	---		SM 4500-Norg C		07/01/09	17:00	VAS
Sample: 004 **SURFACE WATER SAMPLE #8**							Date & Time Sampled: 06/29/2009 @ 9:28			
E. COLI			45	PER 100ML	1	SM 9213D		06/29/09	15:57	PSF
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.068	MG/L	0.068	EPA 300.0	0.16	06/30/09	21:23	JPM
PHOSPHORUS, TOTAL			0.096	MG/L	0.0078	EPA 365.1	0.010	07/02/09	11:44	LER
NITROGEN, AMMONIA		J1 B2	0.12	MG/L	0.090	SM 4500-NH3 G	0.25	07/07/09	20:42	JPM
NITROGEN, NITRATE + NITRITE			4.1	MG/L	0.019	EPA 300.0	0.03	06/30/09	21:23	JPM
NITROGEN, TOTAL KJELDAHL		J1 B2	0.36	MG/L	0.14	SM 4500-NH3 G	0.40	07/07/09	13:39	JPM
SOLIDS, TOTAL SUSPENDED			34	MG/L	3.6	I-3765-85	5	07/01/09	13:00	BGG
TURBIDITY			34	NTU	0.24	EPA 180.1	1.0	06/30/09	13:55	JRV
DATE DIGESTED TKN - MICRO			COMPLETED	---		SM 4500-Norg C		07/01/09	17:00	VAS
Sample: 005 **SURFACE WATER SAMPLE #9**							Date & Time Sampled: 06/29/2009 @ 8:14			
E. COLI			50	PER 100ML	1	SM 9213D		06/29/09	15:57	PSF
PHOSPHORUS, ORTHOPHOSPHATE		UJ	<0.068	MG/L	0.068	EPA 300.0	0.16	06/30/09	21:37	JPM
PHOSPHORUS, TOTAL			0.30	MG/L	0.0078	EPA 365.1	0.010	07/02/09	11:48	LER
NITROGEN, AMMONIA		B2	0.46	MG/L	0.090	SM 4500-NH3 G	0.25	07/07/09	20:44	JPM
NITROGEN, NITRATE + NITRITE			0.13	MG/L	0.019	EPA 300.0	0.03	06/30/09	21:37	JPM
NITROGEN, TOTAL KJELDAHL			1.8	MG/L	0.14	SM 4500-NH3 G	0.40	07/07/09	13:41	JPM
SOLIDS, TOTAL SUSPENDED			49	MG/L	3.6	I-3765-85	5	07/01/09	13:00	BGG
TURBIDITY			52	NTU	0.24	EPA 180.1	1.0	06/30/09	13:55	JRV
DATE DIGESTED TKN - MICRO			COMPLETED	---		SM 4500-Norg C		07/01/09	17:00	VAS

UNLESS OTHERWISE NOTED, SOIL AND SLUDGE SAMPLES RESULTS ARE REPORTED ON AN AS DRY-WEIGHT BASIS

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: R. Clifton

MICROBAC LABORATORIES, INC.

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Chemical, Biological, Physical, Molecular, and Toxicological Services

CERTIFICATE OF ANALYSIS

0906-02037

DAVEY RESOURCE GROUP
ALICIA DOUGLASS
SURFACE WATER

Date Reported	07/13/2009
Date Received	06/29/2009
Date Sampled	06/29/2009

Analysis	Out of Spec	Qualif	Result	Unit	MDL	Method	Std Limit	Date	Time	Tech

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Date Reported	07/13/2009
Date Received	06/29/2009
Date Sampled	06/29/2009

Analysis	Out of Spec	Qualif	Result	Unit	MDL	Method	Std Limit	Date	Time	Tech

QUALIFIER DEFINITIONS:

AR	Results reported on an as received basis.
B1	Analyte value in the method blank above control limit.
B2	Analyte value in the method blank is between the method detection limit and the reporting detection limit.
B3	BOD blank is over specifications . The reported result may be biased high.
BOD1	BOD result estimated due to insufficient oxygen depletion.
BOD2	BOD result estimated due to insufficient oxygen residual.
BOD3	BOD result estimated due to inconsistent oxygen depletion
C1	Continuing calibration verification (CCV) above upper control limit, analyte(s) not detected.
CU	Customer specified reporting limit
CE	Conclusion Entry
CG	Confluent Growth
DI	Surrogate recoveries out of compliance due to sample dilution.
DW	Results reported on a dry weight basis.
E1	Elevated reporting or detection limit(s) due to sample matrix interference and sample dilution.
E2	Elevated reporting or detection limit(s) due to high analyte concentration and sample dilution.
E3	Elevated reporting or detection limit(s) due to insufficient sample volume
ES	Estimated microbiological count
E4	Elevated reporting or detection limit(s) due to low level calibration variance
F1	Test Method Epa 1010 Not Valid For Solid Samples. Samples Analyzed By A Modified 1010 Method.
F2	No Flash Observed; Test Flame Is Being Extinguished By Sample At The Reported Temperature.
F3	The result is estimated, as the sample can not by sufficiently cooled below the expected flashpoint.
H1	Sample received outside of holding time for these analytes.
H2	Analyte was prepared and/or analyzed outside of the analytical method holding time.
J1	The analyte was positively identified; analyte was detected between the reporting limit and method detection limit and the result is an estimated value.
J2	The analyte was positively identified;the result is above the quantitation range and is an estimated value.
L1	Lab control sample (LCS) recovery below lower control limit, all other batch QC acceptable.
L2	Lab control sample (LCS) recovery above upper control limit, all other batch QC acceptable.
L3	Lab control sample (LCS) recovery above upper control limit, analyte not detected.
M1	Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased High.
M2	Matrix Spike Recovery Outside Control Limits Due To Sample Matrix Interference, Biased Low.
M3	Matrix Spike Recovery Outside Control Limits Due To Analyte Concentration. Matrix Spike Evaluation not applicable when sample concentration is >= 4X Spike Concentration.
MC	Miscellaneous (see conclusion statement)
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification." Any associated quantitation is an estimate based on industry standard practices.
ND	Not detected at or below the reporting limit (or method detection limit, if listed).
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and is an estimated value.
OOC	The above value is over the client provided or regulatory specification for this parameter
P1	Sample received was improperly preserved for these analytes.
P2	Sample pH greater than method limit of 2.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. the presence or absence of the analyte cannot be verified.
TNC	Colonies too numerous to count
R1	Relative percent difference (RPD) of matrix spike duplicates outside of control limit.
R2	Relative percent difference (RPD) of LCS duplicates outside of control limit.
R3	Relative percent difference (RPD) of sample duplicates outside of control limit.
S1	One or more surrogates outside control limits, no target analytes detected.
S2	One or more surrogates outside control limits due to matrix interference.
S3	One or more surrogates outside control limits. the data was accepted based on the valid recovery of remaining surrogate(s).
SUM	This total is the sum of several values, some which are less than their respective reporting limits. The total is an estimate.
SUB	Analysis subcontracted.
UJ	Analyte was not detected above the reporting limit, however, the reporting limit is approximate & may or may not represent the actual limit of quantitation necessary to accurately & precisely measure the analyte in the sample.
V	Analyte concentration estimated due to sample matrix interference and/or high analyte concentration interference.

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Appendix E
QHEI Data Sheets

Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 30.75

Stream & Location: Loeffler Ditch at CR 500 **RM:** ___.___ **Date:** 10/23/08

Site 1 **Scorers Full Name & Affiliation:** Jessica Hickey, Alicia Douglass; DRG

River Code: ___-___-___ **STORET #:** _____ **Lat./Long.:** (NAD 83 - decimal °) 38.2642 / 87.6614 Office verified location ☒

1] SUBSTRATE

Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐ ☐ BLDR /SLABS [10]			☐ ☐ HARDPAN [4]	✓	
☐ ☐ BOULDER [9]			☐ ☐ DETRITUS [3]		
☐ ☐ COBBLE [8]	✓		☐ ☐ MUCK [2]		
☐ ☐ GRAVEL [7]			☒ ☐ SILT [2]		
☒ ☐ SAND [6]			☐ ☐ ARTIFICIAL [0]	✓	
☐ ☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY	
☐ LIMESTONE [1]	SILT: ☐ HEAVY [-2]	
☐ TILLS [1]	☒ MODERATE [-1]	
☒ WETLANDS [0]	☐ NORMAL [0]	
☒ HARDPAN [0]	☐ FREE [1]	
☐ SANDSTONE [0]	EMBEDDEDNESS: ☐ EXTENSIVE [-2]	
☐ RIP/RAP [0]	☒ MODERATE [-1]	
☐ LACUSTURINE [0]	☐ NORMAL [0]	
☐ SHALE [-1]	☐ NONE [1]	
☐ COAL FINES [-2]		

Comments

Substrate: 6 (Maximum 20)

2] INSTREAM COVER

Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

___ UNDERCUT BANKS [1]	___ POOLS > 70cm [2]	___ OXBOWS, BACKWATERS [1]
1 OVERHANGING VEGETATION [1]	___ ROOTWADS [1]	___ AQUATIC MACROPHYTES [1]
___ SHALLOWS (IN SLOW WATER) [1]	___ BOULDERS [1]	___ LOGS OR WOODY DEBRIS [1]
___ ROOTMATS [1]		

AMOUNT — Check ONE (Or 2 & average)

☐ EXTENSIVE >75% [11]
☐ MODERATE 25-75% [7]
☒ SPARSE 5-<25% [3]
☐ NEARLY ABSENT <5% [1]

Comments

Cover: 4 (Maximum 20)

3] CHANNEL MORPHOLOGY

Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☒ MODERATE [2]
☒ LOW [2]	☒ FAIR [3]	☒ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel: 10 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE

Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☒ ☒ NONE / LITTLE [3]	☐ ☐ WIDE > 50m [4]	☐ ☐ FOREST, SWAMP [3]	☐ ☐ CONSERVATION TILLAGE [1]
☐ ☐ MODERATE [2]	☐ ☐ MODERATE 10-50m [3]	☐ ☐ SHRUB OR OLD FIELD [2]	☐ ☐ URBAN OR INDUSTRIAL [0]
☐ ☐ HEAVY / SEVERE [1]	☐ ☐ NARROW 5-10m [2]	☐ ☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐ ☐ MINING / CONSTRUCTION [0]
	☒ ☒ VERY NARROW < 5m [1]	☐ ☐ FENCED PASTURE [1]	
	☐ ☒ NONE [0]	☒ ☒ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 3.75 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY
Check ONE (ONLY!)	Check ONE (Or 2 & average)	Check ALL that apply
☐ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1] ☐ SLOW [1]
☐ 0.7-<1m [4]	☒ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1] ☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1] ☒ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☐ MODERATE [1] ☐ EDDIES [1]
☒ < 0.2m [0]		Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current: -1 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run: 0 (Maximum 8)

6] GRADIENT

(14.7 ft/mi) ☐ VERY LOW - LOW [2-4] ☒ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (<9.2 mi²)

%POOL: ( ) %GLIDE: ( )
%RUN: ( ) %RIFFLE: ( )

Gradient: 8 (Maximum 10)

Site 1

A] SAMPLED REACH

Check ALL that apply

METHOD
- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE (1st -sample pass- 2nd)
- ☐ HIGH ☐
- ☐ UP ☐
- ☒ NORMAL ☐
- ☐ LOW ☐
- ☐ DRY ☐

DISTANCE
- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY (1st --sample pass-- 2nd)
- ☐ < 20 cm ☐
- ☐ 20-<40 cm ☐
- ☐ 40-70 cm ☐
- ☐ > 70 cm/ CTB ☐
- ☐ SECCHI DEPTH ☐

1st _____ cm
2nd _____ cm

CANOPY
- ☐ > 85%- OPEN
- ☒ 65%-<85%
- ☐ 30%-<65%
- ☐ 10%-<30%
- ☐ <10%- CLOSED

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Reach is relatively typical of stream.
The stream is dry, but doesn't appear to have been dry long.
Stream reach sampled just upstream of bridge.

B] AESTHETICS
- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☒ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

C] RECREATION

	AREA	DEPTH
POOL:	☐ >100ft²	☐ >3ft

D] MAINTENANCE

Circle some & *COMMENT*

PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

E] ISSUES

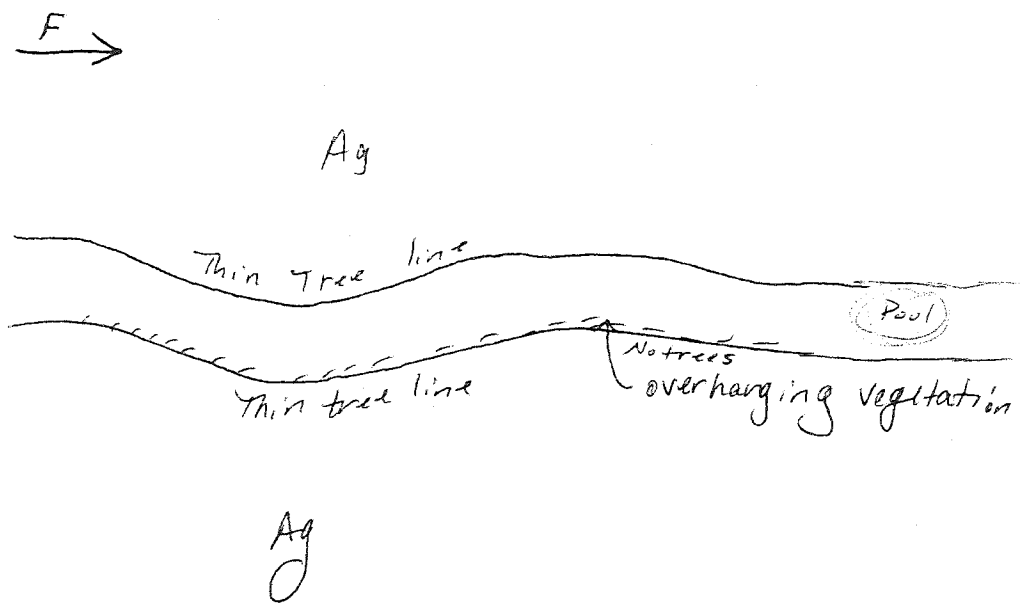
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_2O / TILE / H_2O TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS

- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 29.5

Stream & Location: Loefler Ditch at CR 525 **RM:** ___ **Date:** 10 / 21 / 08

Site 2 **Scorers Full Name & Affiliation:** Jessica Hickey, Alicia Douglass, DRG

River Code: ___-___-___ **STORET #:** _____ **Lat./ Long.:** (NAD 83 - decimal °) 38.2789 / 87.6560 Office verified location ☒

1] SUBSTRATE

Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]	✓	
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]	✓		☐☐ MUCK [2]		
☐☐ GRAVEL [7]	✓		☐☒ SILT [2]		
☒☐ SAND [6]			☐☐ ARTIFICIAL [0]	✓	
☐☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Comments

Check ONE (Or 2 & average)

ORIGIN
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☒ WETLANDS [0]
- ☒ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTURINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☒ HEAVY [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☐ EXTENSIVE [-2]
- ☒ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate: 5 (Maximum 20)

2] INSTREAM COVER

Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

- ___ UNDERCUT BANKS [1]
- 1 OVERHANGING VEGETATION [1]
- 1 SHALLOWS (IN SLOW WATER) [1]
- ___ ROOTMATS [1]
- ___ POOLS > 70cm [2]
- ___ ROOTWADS [1]
- ___ BOULDERS [1]
- ___ OXBOWS, BACKWATERS [1]
- 1 AQUATIC MACROPHYTES [1]
- ___ LOGS OR WOODY DEBRIS [1]

AMOUNT

Check ONE (Or 2 & average)
- ☐ EXTENSIVE >75% [11]
- ☐ MODERATE 25-75% [7]
- ☐ SPARSE 5-<25% [3]
- ☒ NEARLY ABSENT <5% [1]

Comments

Cover: 4 (Maximum 20)

3] CHANNEL MORPHOLOGY

Check ONE in each category (Or 2 & average)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☒ LOW [2]
- ☐ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☒ POOR [1]

CHANNELIZATION
- ☐ NONE [6]
- ☐ RECOVERED [4]
- ☒ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☐ MODERATE [2]
- ☒ LOW [1]

Comments

Channel: 7 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE

Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L / R)
- ☒☐ NONE / LITTLE [3]
- ☒☒ MODERATE [2]
- ☐☒ HEAVY / SEVERE [1]

RIPARIAN WIDTH (L / R)
- ☐☐ WIDE > 50m [4]
- ☐☐ MODERATE 10-50m [3]
- ☐☐ NARROW 5-10m [2]
- ☒☐ VERY NARROW < 5m [1]
- ☐☒ NONE [0]

FLOOD PLAIN QUALITY (L / R)
- ☐☐ FOREST, SWAMP [3]
- ☐☐ SHRUB OR OLD FIELD [2]
- ☐☐ RESIDENTIAL, PARK, NEW FIELD [1]
- ☐☐ FENCED PASTURE [1]
- ☒☒ OPEN PASTURE, ROWCROP [0]
- ☐☐ CONSERVATION TILLAGE [1]
- ☐☐ URBAN OR INDUSTRIAL [0]
- ☐☐ MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 7.5 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH

Check ONE (ONLY!)
- ☐ > 1m [6]
- ☐ 0.7-<1m [4]
- ☐ 0.4-<0.7m [2]
- ☒ 0.2-<0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH

Check ONE (Or 2 & average)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☒ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY

Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☐ FAST [1]
- ☐ MODERATE [1]
- ☒ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current: 3 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5-10cm [1]
- ☐ BEST AREAS < 5cm [metric=0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ☐ MAXIMUM < 50cm [1]

RIFFLE / RUN SUBSTRATE
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
- ☐ NONE [2]
- ☐ LOW [1]
- ☐ MODERATE [0]
- ☐ EXTENSIVE [-1]

Comments

Riffle / Run: 0 (Maximum 8)

6] GRADIENT

(10.6 ft/mi)

DRAINAGE AREA (29.2 mi²)

- ☐ VERY LOW - LOW [2-4]
- ☒ MODERATE [6-10]
- ☐ HIGH - VERY HIGH [10-6]

%POOL: 5 %GLIDE: 95

%RUN: ___ %RIFFLE: ___

Gradient: 8 (Maximum 10)

Site 2

A] SAMPLED REACH
Check ALL that apply

METHOD
- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE (1st -sample pass- 2nd)
- ☐ HIGH ☐
- ☐ UP ☐
- ☒ NORMAL ☐
- ☐ LOW ☐
- ☐ DRY ☐

DISTANCE
- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY (1st --sample pass-- 2nd)
- ☐ < 20 cm ☐
- ☐ 20-<40 cm ☐
- ☐ 40-70 cm ☐
- ☐ > 70 cm/ CTB ☐
- ☐ SECCHI DEPTH ☐

1st _____ cm
2nd _____ cm

CANOPY
- Yes ☒ > 85% - OPEN
- ☐ 55%-<85%
- ☐ 30%-<55%
- No ☒ 10%-<30%
- ☐ <10% - CLOSED

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Reach is typical.
Minnows observed

Stream reach sampled approximately 100 m upstream of bridge

B] AESTHETICS
- ☒ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☐ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☒ CSOs/SSOs/OUTFALLS

C] RECREATION
POOL: ☐ >100ft² (AREA) ☐ >3ft (DEPTH)

D] MAINTENANCE
Circle some & COMMENT

PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

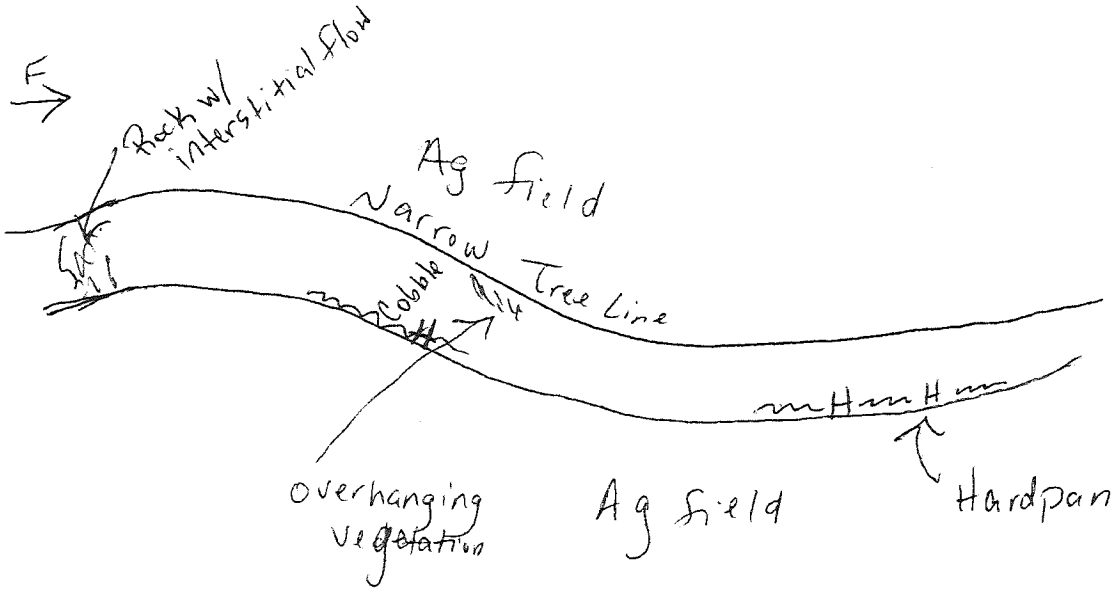
Ag field

E] ISSUES
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS
- x̄ width
- x̄ depth
- max. depth
- x̄ bankfull width
- bankfull x̄ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 48.5

Stream & Location: Loeffler Ditch at CR 600 **RM:** ___ **Date:** 10 / 21 / 08

Site 3 **Scorers Full Name & Affiliation:** Jessica Hickey, Alicia Douglass, DRG

River Code: ___-___-___ **STORET #:** _____ **Lat./Long.:** 38.3098 / 87.6782 (NAD 83 - decimal °) Office verified location ☒

1] SUBSTRATE

Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]	✓	
☐☐ COBBLE [8]			☐☐ MUCK [2]	✓	
☐☒ GRAVEL [7]			☒☐ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]	✓	
☐☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☐ LIMESTONE [1]	☒ HEAVY [-2]
☐ TILLS [1]	☐ MODERATE [-1]
☒ WETLANDS [0]	☐ NORMAL [0]
☐ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	☒ EXTENSIVE [-2]
☐ RIP/RAP [0]	☒ MODERATE [-1]
☐ LACUSTURINE [0]	☐ NORMAL [0]
☐ SHALE [-1]	☐ NONE [1]
☐ COAL FINES [-2]	

SILT / EMBEDDEDNESS

Comments

Substrate: 55 (Maximum 20)

2] INSTREAM COVER

Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

___ UNDERCUT BANKS [1]	2 POOLS > 70cm [2]	___ OXBOWS, BACKWATERS [1]	AMOUNT (Check ONE (Or 2 & average))
2 OVERHANGING VEGETATION [1]	1 ROOTWADS [1]	2 AQUATIC MACROPHYTES [1]	☐ EXTENSIVE >75% [11]
___ SHALLOWS (IN SLOW WATER) [1]	___ BOULDERS [1]	3 LOGS OR WOODY DEBRIS [1]	☒ MODERATE 25-75% [7]
1 ROOTMATS [1]			☐ SPARSE 5-<25% [3]
			☐ NEARLY ABSENT <5% [1]

Comments

Cover: 14 (Maximum 20)

3] CHANNEL MORPHOLOGY

Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☒ MODERATE [3]	☐ GOOD [5]	☒ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☒ FAIR [3]	☐ RECOVERING [3]	☒ LOW [1]
☐ NONE [1]	☒ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel: 10 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE

Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☒☐ NONE / LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☒ MODERATE [2]	☐☒ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☒☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☐☐ NONE [0]	☒☒ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 5 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH (Check ONE (ONLY!))	CHANNEL WIDTH (Check ONE (Or 2 & average))	CURRENT VELOCITY (Check ALL that apply)	
☒ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1]	☒ SLOW [1]
☐ 0.7-<1m [4]	☒ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1]	☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1]	☐ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☐ MODERATE [1]	☐ EDDIES [1]
☐ < 0.2m [0]			

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current: 8 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run: 0 (Maximum 8)

6] GRADIENT

(6.1 ft/mi) ☐ VERY LOW - LOW [2-4] ☒ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (292 mi²)

%POOL: 5 %GLIDE: 95 %RUN: ___ %RIFFLE: ___

Gradient: 6 (Maximum 10)

Site 3

A] SAMPLED REACH
Check ALL that apply

METHOD
- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE (1st -sample pass- 2nd)
- ☐ HIGH ☐
- ☐ UP ☐
- ☐ NORMAL ☐
- ☐ LOW ☐
- ☐ DRY ☐

DISTANCE
- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY (1st --sample pass-- 2nd)
- ☐ < 20 cm ☐
- ☐ 20-<40 cm ☐
- ☐ 40-70 cm ☐
- ☐ > 70 cm/ CTB ☐
- ☐ SECCHI DEPTH ☐

1st _____ cm
2nd _____ cm

CANOPY
- ☐ > 85%- OPEN
- ☐ 55%-<85%
- ☐ 30%-<55%
- ☒ 10%-<30%
- ☐ <10%-CLOSED

Comment RE: Reach consistency/ Is reach typical of steam?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

Reach is fairly typical; more riparian ~~area~~ buffer than other areas. Minnows observed.

Nearby gas well, smell of gas prevalent, rusty pipes observed on bank, Stream reach sampled approximately 100m upstream of bridge.

Circle some & COMMENT

B] AESTHETICS
- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☒ FOAM / SCUM
- ☒ OIL SHEEN
- ☒ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

C] RECREATION AREA DEPTH
POOL: ☐ >100ft² ☐ >3ft

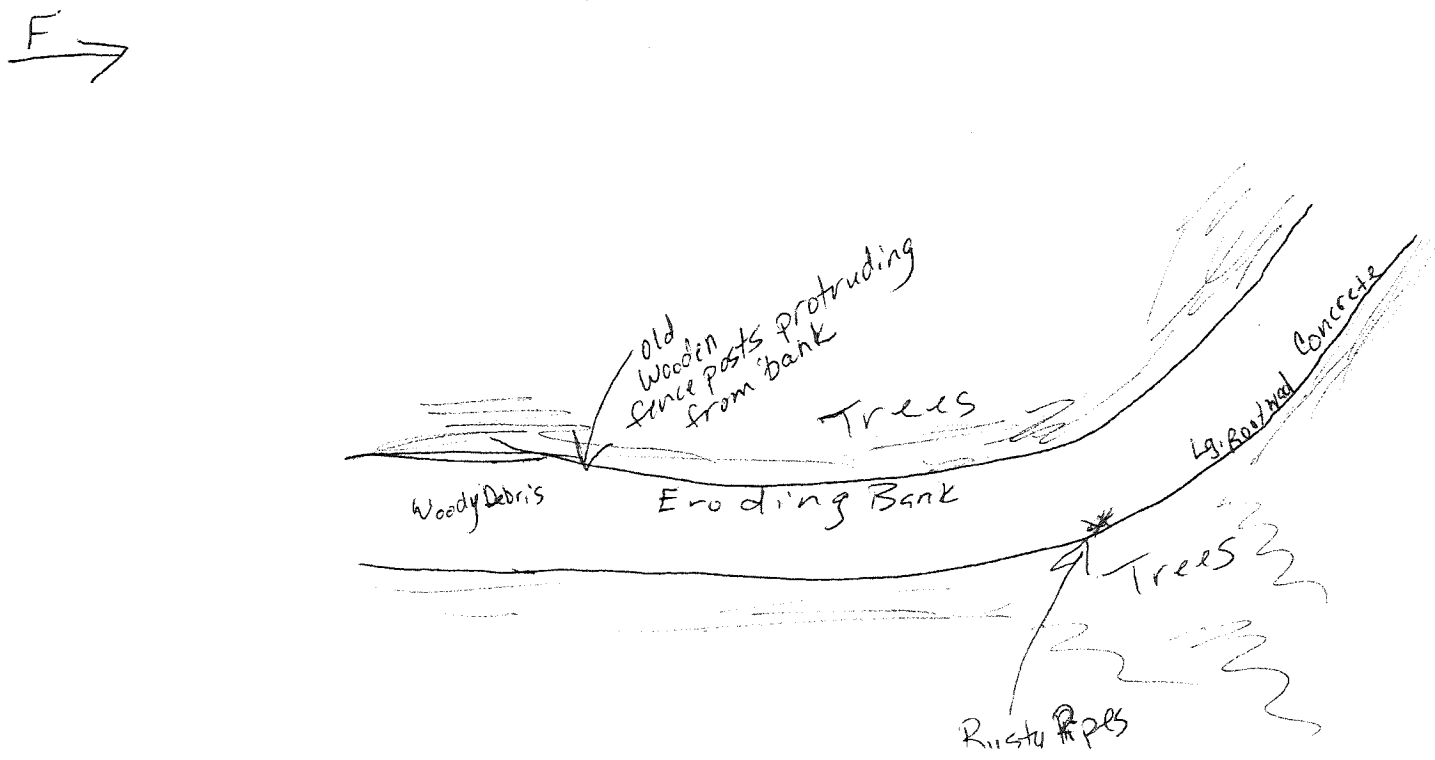
D] MAINTENANCE
PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

E] ISSUES
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS
- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Ohio EPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 21

Stream & Location: Site 4 **RM:** ___ **Date:** 10/21/08

Scorers Full Name & Affiliation: Alicia Douglass, Jessica Hickey, DRG

River Code: __-__-__ **STORET #:** _____ **Lat./Long.:** 38.3260 / 81.7164 (NAD 83 - decimal °) **Office verified location** ☒

1] SUBSTRATE

Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☒☒ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☐☐ MUCK [2]		
☐☐ GRAVEL [7]			☐☐ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]	✓	
☐☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☐ LIMESTONE [1]	☐ HEAVY [-2]
☐ TILLS [1]	☐ MODERATE [-1]
☒ WETLANDS [0]	☒ NORMAL [0]
☒ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	SILT — EMBEDDEDNESS
☐ RIP/RAP [0]	☐ EXTENSIVE [-2]
☐ LACUSTURINE [0]	☒ MODERATE [-1]
☐ SHALE [-1]	☐ NORMAL [0]
☐ COAL FINES [-2]	☐ NONE [1]

Comments

Substrate 7 (Maximum 20)

2] INSTREAM COVER

Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

___ UNDERCUT BANKS [1]	___ POOLS > 70cm [2]	___ OXBOWS, BACKWATERS [1]
3 OVERHANGING VEGETATION [1]	___ ROOTWADS [1]	___ AQUATIC MACROPHYTES [1]
___ SHALLOWS (IN SLOW WATER) [1]	___ BOULDERS [1]	___ LOGS OR WOODY DEBRIS [1]
___ ROOTMATS [1]		

AMOUNT Check ONE (Or 2 & average)

- ☐ EXTENSIVE >75% [11]
- ☐ MODERATE 25-75% [7]
- ☐ SPARSE 5-<25% [3]
- ☒ NEARLY ABSENT <5% [1]

Comments

Cover 2 (Maximum 20)

3] CHANNEL MORPHOLOGY

Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☒ LOW [1]
☒ NONE [1]	☒ POOR [1]	☒ RECENT OR NO RECOVERY [1]	

Comments

Channel 4 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE

Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☒☒ NONE / LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☒☒ NONE [0]	☒☒ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian 3 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH (Check ONE (ONLY!))	CHANNEL WIDTH (Check ONE (Or 2 & average))	CURRENT VELOCITY (Check ALL that apply)	
☐ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1]	☐ SLOW [1]
☐ 0.7-<1m [4]	☒ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1]	☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1]	☒ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☐ MODERATE [1]	☐ EDDIES [1]
☒ < 0.2m [0]			

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current -1 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run 0 (Maximum 8)

6] GRADIENT

(9.8 ft/mi) ☐ VERY LOW - LOW [2-4] ☒ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (<9.2 mi²)

%POOL: ( ) %GLIDE: ( )
%RUN: ( ) %RIFFLE: ( )

Gradient 6 (Maximum 10)

Site 4

A] SAMPLED REACH
Check ALL that apply

METHOD
- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE (1st -sample pass- 2nd)
- ☐ HIGH ☐
- ☐ UP ☐
- ☐ NORMAL ☐
- ☐ LOW ☐
- ☒ DRY ☐

DISTANCE
- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY (1st --sample pass-- 2nd)
- ☐ < 20 cm ☐
- ☐ 20-<40 cm ☐
- ☐ 40-70 cm ☐
- ☐ > 70 cm/ CTB ☐
- ☐ SECCHI DEPTH ☐

CANOPY
- ☒ >85%- OPEN
- ☐ 55%-<85%
- ☐ 30%-<55%
- ☐ 10%-<30%
- ☐ <10%- CLOSED

1st pass _____ cm
2nd _____ cm

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream reach is typial.
Channel is very dry & heavily vegetated.
Streambed is cracked

B] AESTHETICS
- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☒ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

C] RECREATION AREA DEPTH
POOL: ☐ >100ft² ☐ >3ft

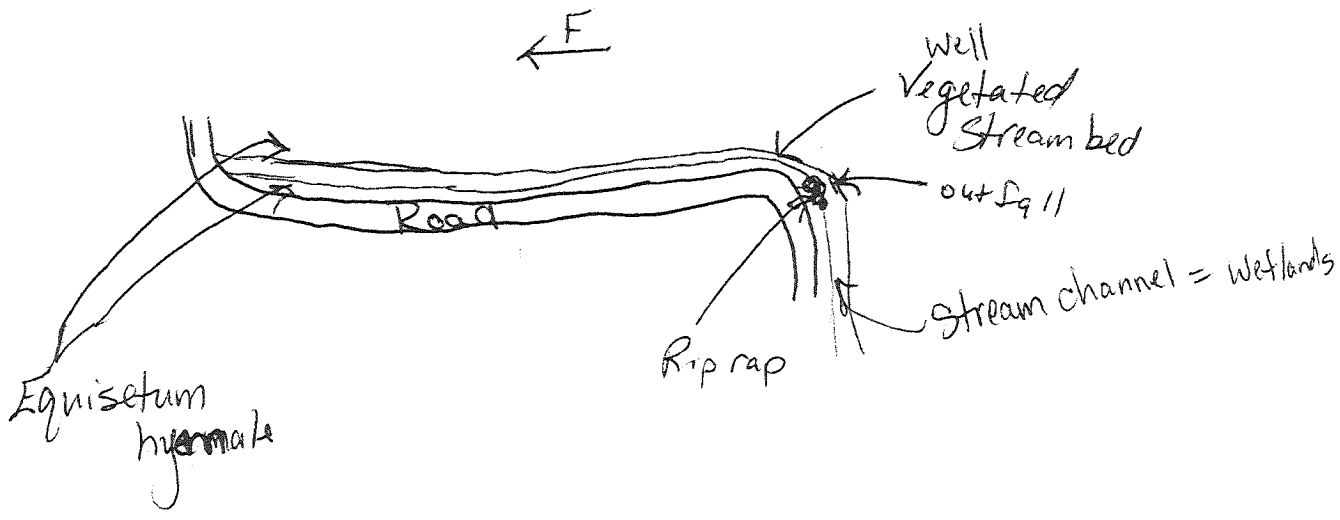
D] MAINTENANCE Circle some & *COMMENT*
PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

E] ISSUES
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS
- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Ohio EPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 15

Stream & Location: Scott Ditch at CR 850 **RM:** ___ **Date:** 10/21/08

Site 5

Scorers Full Name & Affiliation: Jessica Hickey, Alicia Douglass, DRG

River Code: ___-___-___ **STORET #:** _____ **Lat./Long.:** 38.3299 / 87.7192 (NAD 83 - decimal °) Office verified location ☒

1] SUBSTRATE

Check *ONLY* Two substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☐☐ MUCK [2]		
☐☐ GRAVEL [7]			☒☒ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Check ONE (*Or 2 & average*)

ORIGIN	QUALITY
☐ LIMESTONE [1]	☒ HEAVY [-2]
☐ TILLS [1]	☐ MODERATE [-1]
☒ WETLANDS [0]	☐ NORMAL [0]
☐ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	☒ EXTENSIVE [-2]
☐ RIP/RAP [0]	☐ MODERATE [-1]
☐ LACUSTURINE [0]	☐ NORMAL [0]
☐ SHALE [-1]	☐ NONE [1]
☐ COAL FINES [-2]	

SILT — EMBEDDEDNESS

Comments

Substrate: 0 (Maximum 20)

2] INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

___ UNDERCUT BANKS [1]	___ POOLS > 70cm [2]	___ OXBOWS, BACKWATERS [1]
1 OVERHANGING VEGETATION [1]	___ ROOTWADS [1]	1 AQUATIC MACROPHYTES [1]
___ SHALLOWS (IN SLOW WATER) [1]	___ BOULDERS [1]	___ LOGS OR WOODY DEBRIS [1]
___ ROOTMATS [1]		

AMOUNT Check ONE (*Or 2 & average*)

☐ EXTENSIVE >75% [11]
☐ MODERATE 25-75% [7]
☐ SPARSE 5-<25% [3]
☒ NEARLY ABSENT <5% [1]

Comments

Cover: 3 (Maximum 20)

3] CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☒ LOW [1]
☒ NONE [1]	☒ POOR [1]	☒ RECENT OR NO RECOVERY [1]	

Comments

Channel: 4 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☒☒ NONE / LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☒☒ NONE [0]	☒☒ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 3 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY
Check **ONE** (*ONLY!*)	Check ONE (*Or 2 & average*)	Check ALL that apply
☐ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1]
☐ 0.7-<1m [4]	☒ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1]
☒ 0.2-<0.4m [1]		☐ MODERATE [1]
☐ < 0.2m [0]		☒ SLOW [1]
		☐ INTERSTITIAL [-1]
		☐ INTERMITTENT [-2]
		☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current: 3 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (*Or 2 & average*). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run: 0 (Maximum 8)

6] GRADIENT

(0.8 ft/mi) ☒ VERY LOW - LOW [2-4]
☐ MODERATE [6-10]
☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (79.2, <35 mi²)

%POOL: ___ %GLIDE: 100
%RUN: ___ %RIFFLE: ___

Gradient: 2 (Maximum 10)

Site 5

A] SAMPLED REACH

Check ALL that apply

METHOD

- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE

1st -sample pass- 2nd

- ☐ HIGH ☐
- ☐ UP ☐
- ☒ NORMAL ☐
- ☐ LOW ☐
- ☐ DRY ☐

DISTANCE

- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY

1st --sample pass-- 2nd

- ☐ < 20 cm ☐
- ☐ 20-<40 cm ☐
- ☐ 40-70 cm ☐
- ☐ > 70 cm/ CTB ☐
- ☐ SECCHI DEPTH ☐

1st _____ cm
2nd _____ cm

CANOPY

- ☒ > 85%- OPEN
- ☐ 65%-<85%
- ☐ 30%-<65%
- ☐ 10%-<30%
- ☐ <10%- CLOSED

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream reach is typical.
Large minnows observed

Stream reach sampled is approximately 100 m upstream of bridge.

B] AESTHETICS

- ☒ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☒ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☒ FOAM / SCUM
- ☐ OIL SHEEN
- ☐ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

C] RECREATION

AREA DEPTH

POOL: ☐ >100ft² ☐ >3ft

D] MAINTENANCE

Circle some & COMMENT

PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

E] ISSUES

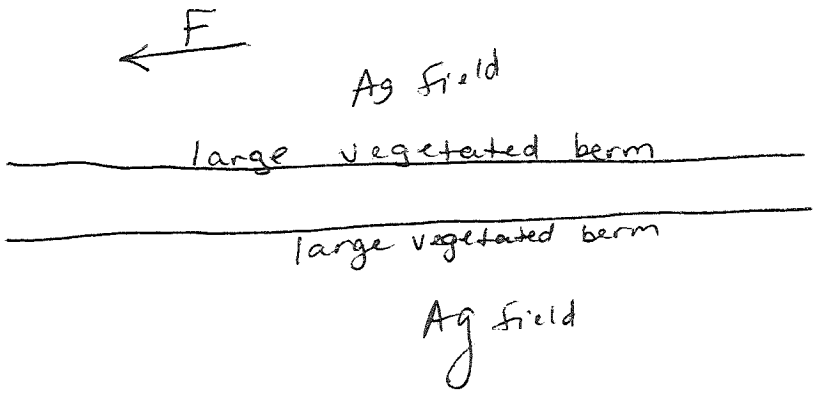
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_2O / TILE / H_2O TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS

$\bar{x}$ width
$\bar{x}$ depth
max. depth
$\bar{x}$ bankfull width
bankfull $\bar{x}$ depth
W/D ratio
bankfull max. depth
floodprone x^2 width
entrench. ratio

Legacy Tree:

Stream Drawing:



Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 20

Stream & Location: Scott Ditch at CR 350 **RM:** ___ **Date:** 10 / 22 / 08

Site 10 **Scorers Full Name & Affiliation:** Jessica Hickey, Alicia Douglass, DRG

River Code: ___-___-___ **STORET #:** _____ **Lat./Long.:** (NAD 83 - decimal °) 38.3042 / 87.7657 Office verified location ☑

1] SUBSTRATE

Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☑☐ MUCK [2]		
☐☐ GRAVEL [7]	✓		☒☐ SILT [2]		
☐☐ SAND [6]	✓		☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☐ LIMESTONE [1]	SILT: ☑ HEAVY [-2] ☐ MODERATE [-1] ☐ NORMAL [0] ☐ FREE [1]
☐ TILLS [1]	EMBEDDEDNESS: ☑ EXTENSIVE [-2] ☐ MODERATE [-1] ☐ NORMAL [0] ☐ NONE [1]
☑ WETLANDS [0]	
☐ HARDPAN [0]	
☐ SANDSTONE [0]	
☐ RIP/RAP [0]	
☐ LACUSTURINE [0]	
☐ SHALE [-1]	
☐ COAL FINES [-2]	

Comments

Substrate: 0 (Maximum 20)

2] INSTREAM COVER

Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

___ UNDERCUT BANKS [1]	___ POOLS > 70cm [2]	___ OXBOWS, BACKWATERS [1]
1 OVERHANGING VEGETATION [1]	___ ROOTWADS [1]	___ AQUATIC MACROPHYTES [1]
___ SHALLOWS (IN SLOW WATER) [1]	___ BOULDERS [1]	1 LOGS OR WOODY DEBRIS [1]
___ ROOTMATS [1]		

AMOUNT Check ONE (Or 2 & average)

☐ EXTENSIVE >75% [11]
☐ MODERATE 25-75% [7]
☑ SPARSE 5-<25% [3]
☐ NEARLY ABSENT <5% [1]

Comments

Cover: 5 (Maximum 20)

3] CHANNEL MORPHOLOGY

Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☑ RECOVERING [3]	☑ LOW [1]
☑ NONE [1]	☑ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel: 6 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE

Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☑☑ NONE / LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☒ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☑☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☐☐ NONE [0]	☑☑ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 5 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY
Check ONE (ONLY!)	Check ONE (Or 2 & average)	Check ALL that apply
☐ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1] ☑ SLOW [1]
☐ 0.7-<1m [4]	☑ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1] ☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1] ☐ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☐ MODERATE [1] ☐ EDDIES [1]
☑ < 0.2m [0]		

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current: 2 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run: 0 (Maximum 8)

6] GRADIENT

(0.8 ft/mi) ☑ VERY LOW - LOW [2-4]
☐ MODERATE [6-10]
☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (39.2, 435 mi²)

%POOL: ___ %GLIDE: 100
%RUN: ___ %RIFFLE: ___

Gradient: 2 (Maximum 10)

Site 6

A] SAMPLED REACH
Check ALL that apply

METHOD
- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE (1st -sample pass- 2nd)
- ☐ HIGH ☐
- ☐ UP ☐
- ☒ NORMAL ☐
- ☐ LOW ☐
- ☐ DRY ☐

DISTANCE
- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY (1st --sample pass-- 2nd)
- ☐ < 20 cm ☐
- ☐ 20-<40 cm ☐
- ☐ 40-70 cm ☐
- ☐ > 70 cm/ CTB ☐
- ☐ SECCHI DEPTH ☐

CANOPY
- ☐ > 85%- OPEN
- ☐ 55%-<85%
- ☒ 30%-<55%
- ☐ 10%-<30%
- ☐ <10%- CLOSED

pass 1st _____ cm
2nd _____ cm

Comment RE: *Reach consistency/* Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream reach is fairly typical.
Juvenile frogs, minnows, & numerous dead & live muscles observed
Gravel beneath silt lager.

Stream Reach sampled approximately 200m upstream of bridge due to alterations created by train bridge.

B] AESTHETICS
- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☒ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☐ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

C] RECREATION
POOL: AREA ☐ >100ft² DEPTH ☐ >3ft

D] MAINTENANCE
Circle some & *COMMENT*

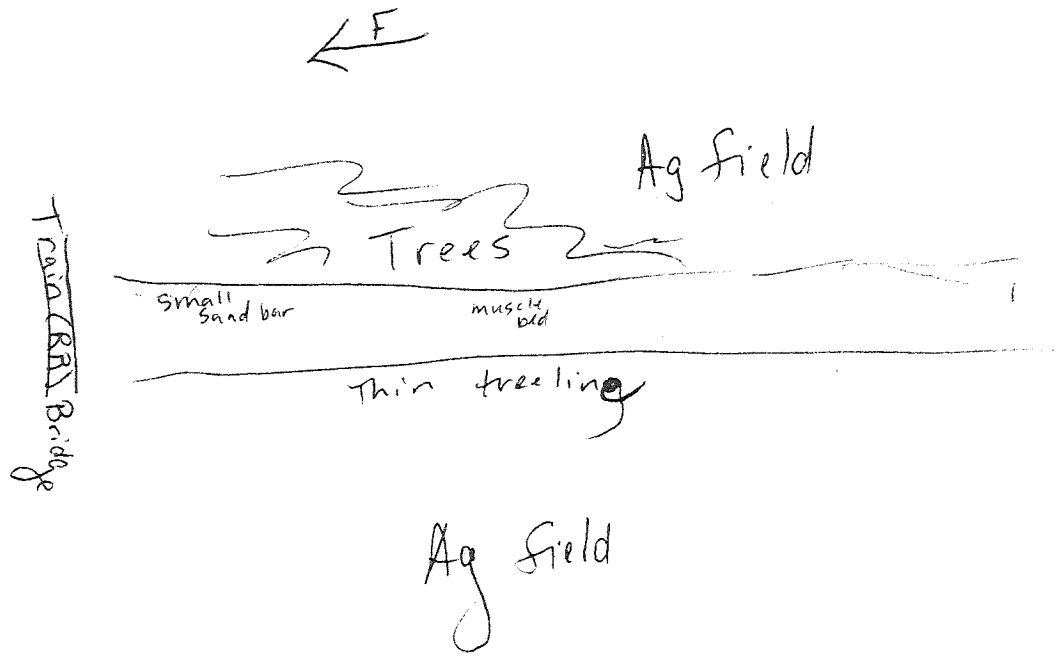
PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

E] ISSUES
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_2O / TILE / H_2O TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS
- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 15

Stream & Location: Site 7 **RM:** ___ **Date:** 10/22/08

Scorers Full Name & Affiliation: Jessica Hickey, Alicia Douglass, DBG

River Code: ___-___-___ **STORET #:** _____ **Lat./Long.:** (NAD 83 - decimal °) 38.3039 / 81.7809 Office verified location ☐

1] SUBSTRATE

Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☐☐ MUCK [2]		
☐☐ GRAVEL [7]			☒☒ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☐ LIMESTONE [1]	SILT: ☐ HEAVY [-2] ☒ MODERATE [-1] ☐ NORMAL [0] ☐ FREE [1]
☐ TILLS [1]	EMBEDDEDNESS: ☐ EXTENSIVE [-2] ☐ MODERATE [-1] ☒ NORMAL [0] ☐ NONE [1]
☒ WETLANDS [0]	
☐ HARDPAN [0]	
☐ SANDSTONE [0]	
☐ RIP/RAP [0]	
☐ LACUSTURINE [0]	
☐ SHALE [-1]	
☐ COAL FINES [-2]	

Comments

Substrate 3 (Maximum 20)

2] INSTREAM COVER

Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

___ UNDERCUT BANKS [1]	___ POOLS > 70cm [2]	___ OXBOWS, BACKWATERS [1]
1 OVERHANGING VEGETATION [1]	___ ROOTWADS [1]	___ AQUATIC MACROPHYTES [1]
___ SHALLOWS (IN SLOW WATER) [1]	___ BOULDERS [1]	___ LOGS OR WOODY DEBRIS [1]
___ ROOTMATS [1]		

AMOUNT Check ONE (Or 2 & average)

☐ EXTENSIVE >75% [11]
☐ MODERATE 25-75% [7]
☐ SPARSE 5-<25% [3]
☒ NEARLY ABSENT <5% [1]

Comments

Cover 2 (Maximum 20)

3] CHANNEL MORPHOLOGY

Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☒ LOW [1]
☒ NONE [1]	☒ POOR [1]	☒ RECENT OR NO RECOVERY [1]	

Comments

Channel 4 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE

Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☒☒ NONE / LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☒☒ NONE [0]	☒☒ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian 3 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY
Check ONE (ONLY!)	Check ONE (Or 2 & average)	Check ALL that apply
☐ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1] ☐ SLOW [1]
☐ 0.7-<1m [4]	☒ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1] ☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1] ☒ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☐ MODERATE [1] ☐ EDDIES [1]
☒ < 0.2m [0]		Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current -1 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run 0 (Maximum 8)

6] GRADIENT

GRADIENT (1.6 ft/mi) ☒ VERY LOW - LOW [2-4] ☐ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (29.2 mi²)

%POOL: ( ) %GLIDE: ( )
%RUN: ( ) %RIFFLE: ( )

Gradient 4 (Maximum 10)

Site 7

A] SAMPLED REACH

Check ALL that apply

METHOD

- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE

1st -sample pass- 2nd

- ☐ HIGH ☐
- ☐ UP ☐
- ☐ NORMAL ☐
- ☐ LOW ☐
- ☒ DRY ☐

DISTANCE

- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY

1st --sample pass-- 2nd

- ☐ < 20 cm ☐
- ☐ 20-<40 cm ☐
- ☐ 40-70 cm ☐
- ☐ > 70 cm/ CTB ☐
- ☐ SECCHI DEPTH ☐

CANOPY

- ☒ > 85%- OPEN
- ☐ 55%-<85%
- ☐ 30%-<55%
- ☐ 10%-<30%
- ☐ <10%- CLOSED

1st pass _____ cm

2nd _____ cm

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream reach is typical.
Stream has been dry for long time & is well vegetated.
Stream reach sampled is immediately upstream of bridge.

B] AESTHETICS

- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☐ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☒ CSOs/SSOs/OUTFALLS

C] RECREATION

POOL: AREA ☐ >100ft² DEPTH ☐ >3ft

D] MAINTENANCE

Circle some & *COMMENT*

PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

E] ISSUES

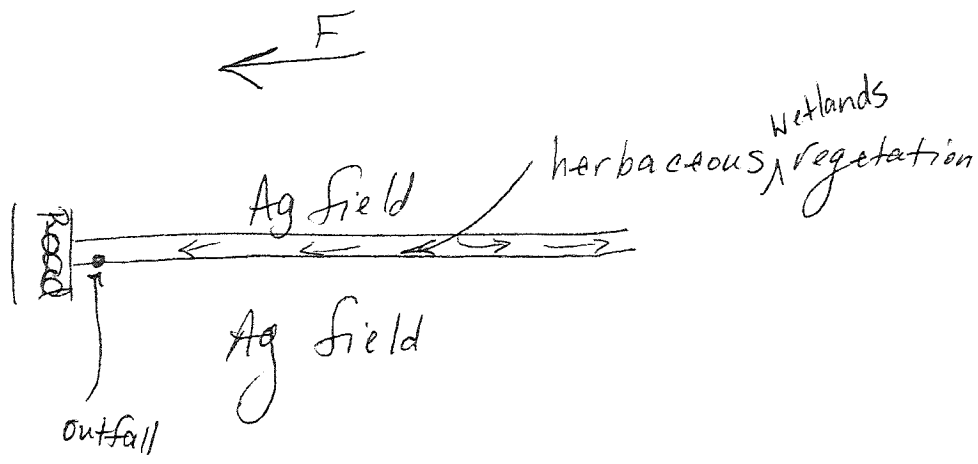
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS

- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Ohio EPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 15

Stream & Location: Site 8 **RM:** ___ **Date:** 10/22/08

Scorers Full Name & Affiliation: Jessica Hickey, Alicia Douglass, DRG

River Code: ___-___-___ **STORET #:** _____ **Lat./Long.:** (NAD 83 - decimal °) 38.3041 / 87.8861 **Office verified location** ☒

1] SUBSTRATE
Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☐☐ MUCK [2]		
☐☐ GRAVEL [7]			☒☒ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☐ LIMESTONE [1]	☐ HEAVY [-2]
☐ TILLS [1]	☒ MODERATE [-1]
☒ WETLANDS [0]	☐ NORMAL [0]
☐ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	☐ EXTENSIVE [-2]
☐ RIP/RAP [0]	☐ MODERATE [-1]
☐ LACUSTURINE [0]	☒ NORMAL [0]
☐ SHALE [-1]	☐ NONE [1]
☐ COAL FINES [-2]	

SILT

EMBEDDEDNESS

Comments

Substrate 3 (Maximum 20)

2] INSTREAM COVER
Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

___ UNDERCUT BANKS [1]	___ POOLS > 70cm [2]	___ OXBOWS, BACKWATERS [1]
1 OVERHANGING VEGETATION [1]	___ ROOTWADS [1]	___ AQUATIC MACROPHYTES [1]
___ SHALLOWS (IN SLOW WATER) [1]	___ BOULDERS [1]	___ LOGS OR WOODY DEBRIS [1]
___ ROOTMATS [1]		

AMOUNT Check ONE (Or 2 & average)
- ☐ EXTENSIVE >75% [11]
- ☐ MODERATE 25-75% [7]
- ☐ SPARSE 5-<25% [3]
- ☒ NEARLY ABSENT <5% [1]

Comments

Cover 2 (Maximum 20)

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☒ LOW [1]
☒ NONE [1]	☒ POOR [1]	☒ RECENT OR NO RECOVERY [1]	

Comments

Channel 4 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☒☒ NONE / LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☒☒ NONE [0]	☒☒ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian 3 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH (Check ONE (ONLY!))	CHANNEL WIDTH (Check ONE (Or 2 & average))	CURRENT VELOCITY (Check ALL that apply)	
☐ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1]	☐ SLOW [1]
☐ 0.7-<1m [4]	☒ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1]	☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1]	☒ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☐ MODERATE [1]	☐ EDDIES [1]
☒ < 0.2m [0]		Indicate for reach - pools and riffles.	

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current -1 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run 0 (Maximum 8)

6] GRADIENT (1.3 ft/mi)
DRAINAGE AREA (29.2 mi²)

- ☒ VERY LOW - LOW [2-4]
- ☐ MODERATE [6-10]
- ☐ HIGH - VERY HIGH [10-6]

%POOL: ___ %GLIDE: ___ %RUN: ___ %RIFFLE: ___

Gradient 4 (Maximum 10)

Site 8

A] SAMPLED REACH

Check ALL that apply

METHOD
- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE (1st -sample pass- 2nd)
- ☐ HIGH ☐
- ☐ UP ☐
- ☐ NORMAL ☐
- ☐ LOW ☐
- ☒ DRY ☐

DISTANCE
- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY (1st --sample pass-- 2nd)
- ☐ < 20 cm ☐
- ☐ 20-<40 cm ☐
- ☐ 40-70 cm ☐
- ☐ > 70 cm/ CTB ☐
- ☐ SECCHI DEPTH ☐

1st pass _____ cm
2nd _____ cm

CANOPY
- ☒ > 85%- OPEN
- ☐ 55%-<85%
- ☐ 30%-<55%
- ☐ 10%-<30%
- ☐ <10%- CLOSED

Comment RE: Reach consistency/ Is reach typical of steam?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

Stream reach is typical.
Stream has been dry a long time, and soil is cracked.
Channel is well vegetated with herbaceous wetlands species.

Stream reach sampled is immediately upstream of road.

Circle some & COMMENT

B] AESTHETICS
- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☐ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

C] RECREATION

POOL: AREA ☐ >100ft² DEPTH ☐ >3ft

D] MAINTENANCE

PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

E] ISSUES

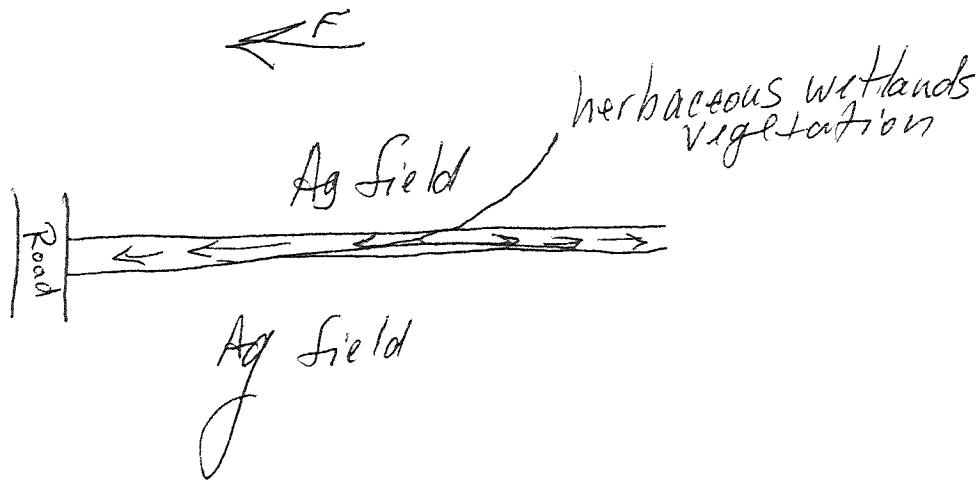
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS

- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 15

Stream & Location: Site 9 **RM:** ___.___ **Date:** 10 / 22 / 08

Scorers Full Name & Affiliation: Jessica Hickey, Alicia Douglass, DRG

River Code: ___-___-___ **STORET #:** _____ **Lat./ Long.:** (NAD 83 - decimal °) 38.3040 / 87.8182 Office verified location ☒

1] SUBSTRATE

Check *ONLY* Two substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES		POOL	RIFFLE	OTHER TYPES		POOL	RIFFLE
☐	☐ BLDR /SLABS [10]			☐	☐ HARDPAN [4]		
☐	☐ BOULDER [9]			☐	☐ DETRITUS [3]		
☐	☐ COBBLE [8]			☐	☐ MUCK [2]		
☐	☐ GRAVEL [7]			☒	☒ SILT [2]		
☐	☐ SAND [6]			☐	☐ ARTIFICIAL [0]	1	
☐	☐ BEDROCK [5]						

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Check ONE (*Or 2 & average*)

ORIGIN	QUALITY
☐ LIMESTONE [1]	SILT: ☐ HEAVY [-2]
☐ TILLS [1]	☒ MODERATE [-1]
☒ WETLANDS [0]	☐ NORMAL [0]
☐ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	EMBEDDEDNESS: ☐ EXTENSIVE [-2]
☐ RIP/RAP [0]	☐ MODERATE [-1]
☐ LACUSTURINE [0]	☒ NORMAL [0]
☐ SHALE [-1]	☐ NONE [1]
☐ COAL FINES [-2]	

Comments

Substrate 3 (Maximum 20)

2] INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

___ UNDERCUT BANKS [1]	___ POOLS > 70cm [2]	___ OXBOWS, BACKWATERS [1]
1 OVERHANGING VEGETATION [1]	___ ROOTWADS [1]	___ AQUATIC MACROPHYTES [1]
___ SHALLOWS (IN SLOW WATER) [1]	___ BOULDERS [1]	___ LOGS OR WOODY DEBRIS [1]
___ ROOTMATS [1]		

AMOUNT Check ONE (*Or 2 & average*)

☐ EXTENSIVE >75% [11]
☐ MODERATE 25-75% [7]
☐ SPARSE 5-<25% [3]
☒ NEARLY ABSENT <5% [1]

Comments

Cover 2 (Maximum 20)

3] CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☒ LOW [1]
☒ NONE [1]	☒ POOR [1]	☒ RECENT OR NO RECOVERY [1]	

Comments

Channel 4 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☒ ☒ NONE / LITTLE [3]	☐ ☐ WIDE > 50m [4]	☐ ☐ FOREST, SWAMP [3]	☐ ☐ CONSERVATION TILLAGE [1]
☐ ☐ MODERATE [2]	☐ ☐ MODERATE 10-50m [3]	☐ ☐ SHRUB OR OLD FIELD [2]	☐ ☐ URBAN OR INDUSTRIAL [0]
☐ ☐ HEAVY / SEVERE [1]	☐ ☐ NARROW 5-10m [2]	☐ ☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐ ☐ MINING / CONSTRUCTION [0]
	☐ ☐ VERY NARROW < 5m [1]	☐ ☐ FENCED PASTURE [1]	
	☒ ☒ NONE [0]	☒ ☒ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian 3 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY
Check **ONE** (*ONLY!*)	Check ONE (*Or 2 & average*)	Check ALL that apply
☐ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1] ☐ SLOW [1]
☐ 0.7-<1m [4]	☒ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1] ☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1] ☒ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☐ MODERATE [1] ☐ EDDIES [1]
☒ < 0.2m [0]		*Indicate for reach - pools and riffles.*

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current -1 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (*Or 2 & average*). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run 0 (Maximum 8)

6] GRADIENT

(2.4 ft/mi) ☒ VERY LOW - LOW [2-4]
☐ MODERATE [6-10]
☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (29.2 mi²)

%POOL: ___ %GLIDE: ___
%RUN: ___ %RIFFLE: ___

Gradient 4 (Maximum 10)

Site 9

A] SAMPLED REACH

Check ALL that apply

METHOD
- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE (1st -sample pass- 2nd)
- ☐ HIGH ☐
- ☐ UP ☐
- ☐ NORMAL ☐
- ☐ LOW ☐
- ☒ DRY ☐

DISTANCE
- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY (1st --sample pass-- 2nd)
- ☐ < 20 cm ☐
- ☐ 20-<40 cm ☐
- ☐ 40-70 cm ☐
- ☐ > 70 cm/ CTB ☐
- ☐ SECCHI DEPTH ☐

1st _____ cm
2nd _____ cm

CANOPY
- ☒ > 85%- OPEN
- ☐ 55%-<85%
- ☐ 30%-<55%
- ☐ 10%-<30%
- ☐ <10%- CLOSED

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream reach is typical
Stream has been dry for long time
The channel is well vegetated with herbaceous wetlands vegetation

B] AESTHETICS
- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☐ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

C] RECREATION

POOL: AREA ☐ >100ft² DEPTH ☐ >3ft

D] MAINTENANCE

Circle some & *COMMENT*

PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

E] ISSUES

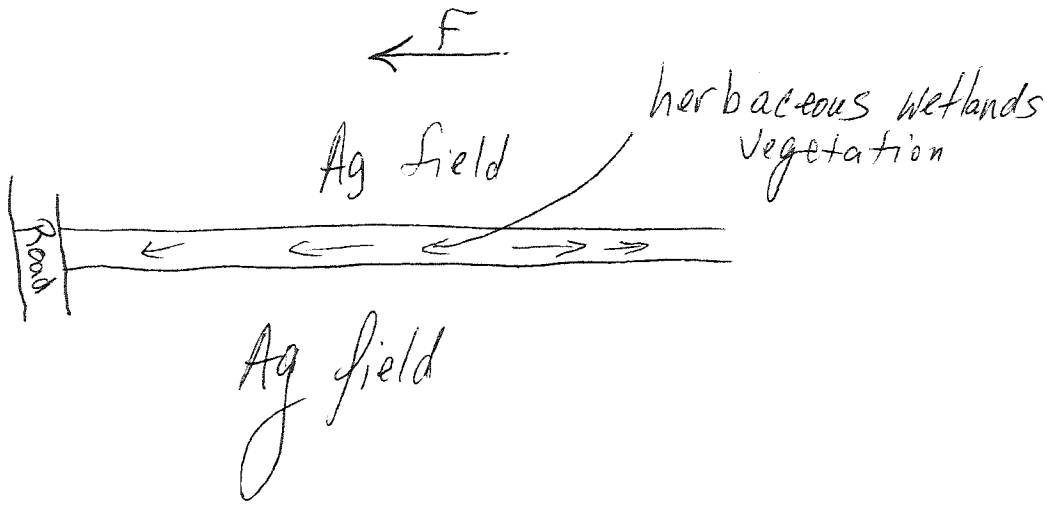
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS

- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 36

Stream & Location: Scott Ditch at CR 1500 **RM:** ___ **Date:** 10 / 22 / 08

Site 1D **Scorers Full Name & Affiliation:** Jessica Hickey, Alicia Douglass; DRG

River Code: ___-___-___ **STORET #:** _____ **Lat./ Long.:** 38.2850 / 87.8329 (NAD 83 - decimal °) Office verified location ☒

1] SUBSTRATE

Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]	✓	
☐☐ BOULDER [9]	✓		☐☐ DETRITUS [3]		
☐☐ COBBLE [8]	✓		☒☐ MUCK [2]		
☐☐ GRAVEL [7]			☒☐ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]	✓	
☐☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☐ LIMESTONE [1]	☐ HEAVY [-2]
☐ TILLS [1]	☒ MODERATE [-1]
☒ WETLANDS [0]	☐ NORMAL [0]
☒ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	☐ EXTENSIVE [-2]
☐ RIP/RAP [0]	☒ MODERATE [-1]
☐ LACUSTURINE [0]	☐ NORMAL [0]
☐ SHALE [-1]	☐ NONE [1]
☐ COAL FINES [-2]	

SILT

EMBEDDEDNESS

Comments

Substrate: 2 (Maximum 20)

2] INSTREAM COVER

Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

___ UNDERCUT BANKS [1]	2 POOLS > 70cm [2]	___ OXBOWS, BACKWATERS [1]
___ OVERHANGING VEGETATION [1]	___ ROOTWADS [1]	___ AQUATIC MACROPHYTES [1]
___ SHALLOWS (IN SLOW WATER) [1]	1 BOULDERS [1]	3 LOGS OR WOODY DEBRIS [1]
2 ROOTMATS [1]		

AMOUNT Check ONE (Or 2 & average)

☐ EXTENSIVE >75% [11]
☒ MODERATE 25-75% [7]
☐ SPARSE 5-<25% [3]
☐ NEARLY ABSENT <5% [1]

Comments

Cover: 12 (Maximum 20)

3] CHANNEL MORPHOLOGY

Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☒ LOW [2]	☒ FAIR [3]	☒ RECOVERING [3]	☒ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel: 9 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE

Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☐☐ NONE / LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☒☒ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☒☒ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☐☐ NONE [0]	☒☒ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 3 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!)

☒ 1m [6]
☐ 0.7-<1m [4]
☐ 0.4-<0.7m [2]
☐ 0.2-<0.4m [1]
☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average)

☐ POOL WIDTH > RIFFLE WIDTH [2]
☒ POOL WIDTH = RIFFLE WIDTH [1]
☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply

☐ TORRENTIAL [-1]	☒ SLOW [1]
☐ VERY FAST [1]	☐ INTERSTITIAL [-1]
☐ FAST [1]	☐ INTERMITTENT [-2]
☐ MODERATE [1]	☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current: 8 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run: 0 (Maximum 8)

6] GRADIENT

(0.8 ft/mi) ☒ VERY LOW - LOW [2-4]
☐ MODERATE [6-10]
☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (355 mi²)

%POOL: 10 %GLIDE: 90
%RUN: ___ %RIFFLE: ___

Gradient: 2 (Maximum 10)

Site 10

A] SAMPLED REACH

Check ALL that apply

METHOD
- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE (1st -sample pass- 2nd)
- ☐ HIGH ☐
- ☐ UP ☐
- ☑ NORMAL ☐
- ☐ LOW ☐
- ☐ DRY ☐

DISTANCE
- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY (1st --sample pass-- 2nd)
- ☐ < 20 cm ☐
- ☐ 20-<40 cm ☐
- ☐ 40-70 cm ☐
- ☐ > 70 cm/ CTB ☐
- ☐ SECCHI DEPTH ☐

1st _____ cm
2nd _____ cm

CANOPY
- ☐ > 85%- OPEN
- ☐ 55%-<85%
- ☑ 30%-<55%
- ☐ 10%-<30%
- ☐ <10%- CLOSED

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream reach is typical.
Very deep pools present
Rainbow darter identified

Stream reach sampled is approximately 100 m upstream of bridge

B] AESTHETICS
- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☐ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

C] RECREATION

POOL: AREA ☐ >100ft² DEPTH ☐ >3ft

D] MAINTENANCE

Circle some & *COMMENT*

PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

E] ISSUES

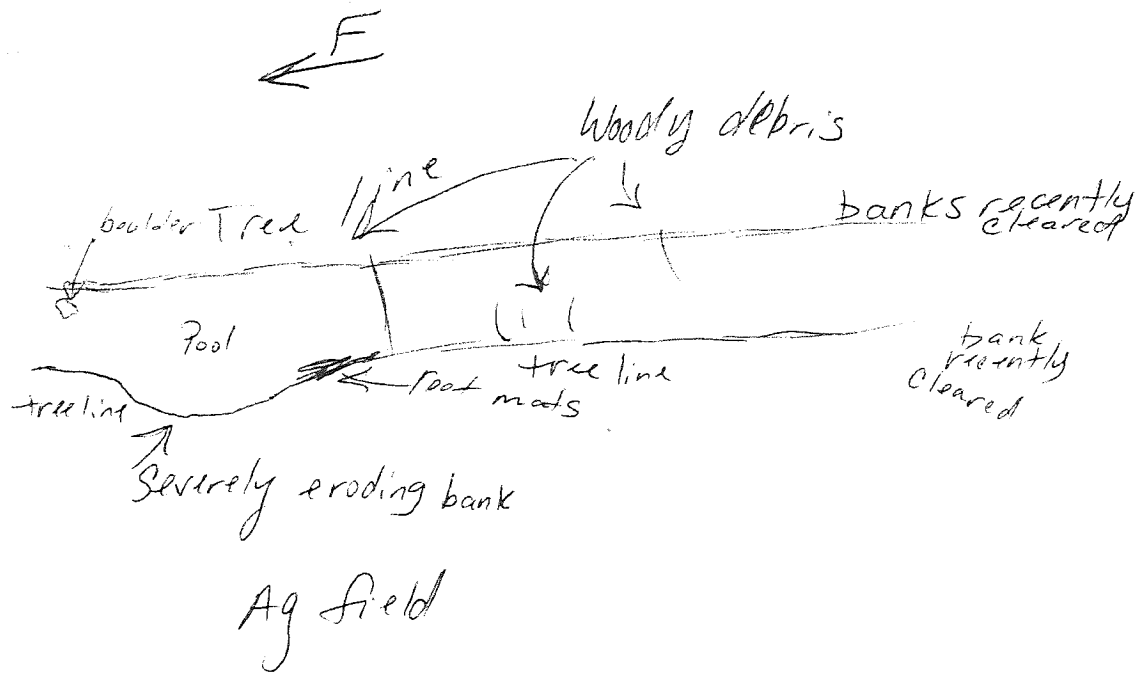
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS

$\bar{x}$ width
$\bar{x}$ depth
max. depth
$\bar{x}$ bankfull width
bankfull $\bar{x}$ depth
W/D ratio
bankfull max. depth
floodprone x^2 width
entrench. ratio

Legacy Tree:

Stream Drawing:



Appendix F
Public Meeting Records

Scott & Loelfer Ditch Watershed Study
Public Meeting
February 5th, 2009
Owensville Community Center
6:00 – 7:30 p.m.

Record of meeting

A. Concerns collected on flip charts:
   i. More money for WASCOB
   ii. Urban runoff is increasing
   iii. Timing of the conservation practice (how long land needs to be 'tied-up' is a concern)
   iv. Size of practice (no interest or payment for small practices via NRCS)
   v. Meter the water (so much fall in Loefler Ditch, need to slow before it gets to flat ground)
   vi. Drainage of flat ground is poor
   vii. Ditch maintenance needed (no funds)
   viii. Duke pumping/Drainage Changes
   ix. Offline wetland opportunities
   x. Coal mining practices
   xi. Protection of drinking water

B. Comments questions collected:
   i. Question asked by public: What is the difference between petroleum and oil wells?
   ii. Question asked by public: What/where is gas mined and shown in the maps?
   iii. Question asked by public: What's been done about recreational pollution impacts?
   iv. Question asked by public: What can be done about septic system problems?
   v. Question asked by public: Is there money for dredging?
   vi. Question asked by public: Is it possible to pay for offline/overflow flood protection in filter strips areas?
   vii. One audience member indicated that the watershed boundary maps were incorrect.
   viii. Ronald Krueger approached staff to indicate that he was interested in filter strips on his property.
   ix. Concern about uncontrolled runoff from current mining operation and its discharge to Scott Ditch.
   x. Absolutely no zoning in the county so no protection from mining or other activities near well head area.

C. Questions concerns collected from anonymous survey
   i. Find a way to hold water back so we don't have to dig out sediment. Not just in filter strips but allowing it to get off slowly into flat land.
   ii. We tend to look to the deep pockets for solutions; probably use of fertilizers per acre are higher on yards and golf courses. Back to back tax pollution standards will be coming for state?
   iii. Flooding need WASCOBs in hill ground to help control flooding; much needed dredging

D. Survey results summarized – 10 surveys collected in total

i. I would be more likely go to public meeting if there was a specific educational program planned.
   - 2

ii. I would be more likely to go on a week day evening.
   - 8

iii. I would like the meetings to include post-meeting watershed tours of relevant concerns or areas of interest.
   - 2

iv. I just want the meetings to cover the basics of what was discovered or developed via a short presentation.
   - 1

v. I won't go to a meeting that is longer than 1.5 hours no matter what is offered.
   - 2

vi. The Owensville Community Center is a good meeting location.
   - 9

vii. Educational topics they would like to know more about:
   - Sources of water pollution - 4
   - Water quality science - 2
   - Fishery health and management - 2
   - Flooding - 4
   - Confined feeding operations - 0
   - E. coli and other health risks - 3
   - Stream erosion - 4
   - Wetland or floodplain science - 1
   - Water quality regulation - 4
   - Exotic or endangered species - 2
   - Septic system maintenance - 5
   - County land use planning - 3
   - Conservation programs - 2
   - Agricultural practices - 3
   - Urban stormwater - 0
   - Things home owners can do to help - 2
   - Other: 0

Scott & Loelfer Ditch Watershed Study
Public Meeting
August 13th, 2009
Owensville Community Center
6:00 – 7:30 p.m.

Record of Meeting

A. The meeting began with introductions of the project team and audience members. There were roughly 20 people in attendance, the majority of which were local farmers. Some state and federal agency staff were also present, including IDNR and NRCS. Initial presentation slides reminded the group of water quality pollutants found during the Scott Ditch Watershed sampling (i.e, sediment, E. coli, and nutrients).

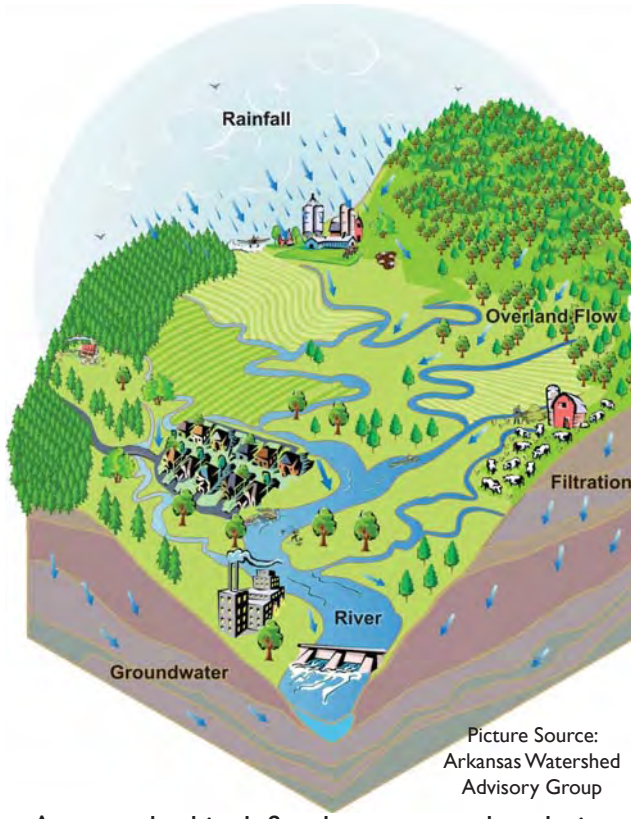
B. Audience members participated in a hands-on water quality activity. The activity mimicked the phosphorus and nitrogen cycles through the use of activity stations. Participants and team members then discussed the role of these nutrients in water quality and where within the environment these nutrients linger. Some discussion of national water quality impacts associated with these nutrients also ensued.

C. Watershed study finding and recommendations were presented via Powerpoint slides. Slides showed which sample locations and associated subwatersheds had higher loads than others. Recommendations for best management practices (BMPs) proposed in each subwatershed were also presented.

D. An open public question and answer period allowed for local input about the proposed BMP locations. Participants were then given a handout that asked about their individual interest in participating in conservation programs and installing various types of BMPs. These forms were collected and given to Gibson County SWCD staff.

Appendix G
Public Information Handout

Watershed Basics

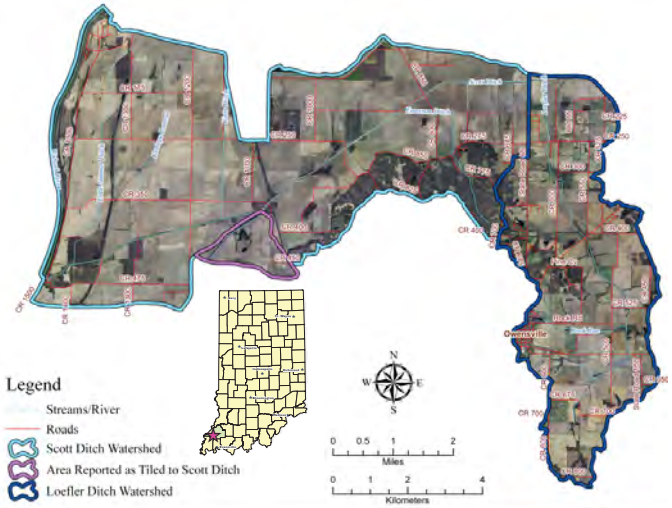


Picture Source: Arkansas Watershed Advisory Group

A watershed is defined as an area that drains to a common point. That common point may be a lake, an outlet to a river, or any point within a river system.

DID YOU KNOW?

• Cane Ridge Wildlife Management Area (USFWS Property) and Tern Bar Slough (IDNR Property) are both located in the watershed and recognized as Globally Important Bird Areas.



Other important conservation professionals:

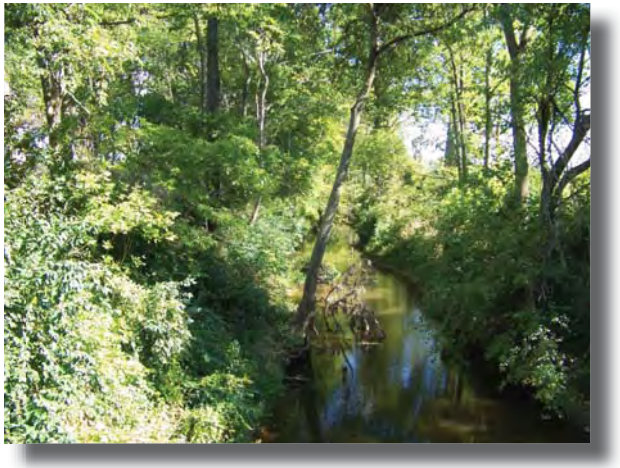
IDNR Lake and River Enhancement
317-233-1484
lare@dnr.in.gov
www.in.gov/dnr/fishwild/2364.htm

Cane Ridge Wildlife Management Area
(Patoka River National Wildlife Refuge)
812-749-3199

Tern Bar Slough Wildlife Diversity Area
(IDNR Div. of Fish & Wildlife – Wildlife Diversity Section)
317-232-8160

This brochure was produced with funding from the IDNR LARE program and the Gibson County SWCD.

The watershed study was completed by Davey Resource Group and Empower Results.



Things YOU Can Do To Keep Our Watershed Healthy

Fence livestock out of streams and ditches and set up alternative watering sources.

Conserve and reuse water wisely.

Properly dispose of toxic chemicals at local Tox-Away Days.

Create a habitat that is unfavorable to geese. Plant native species that grow taller than 12 inches along pond edges. Do not feed the geese!

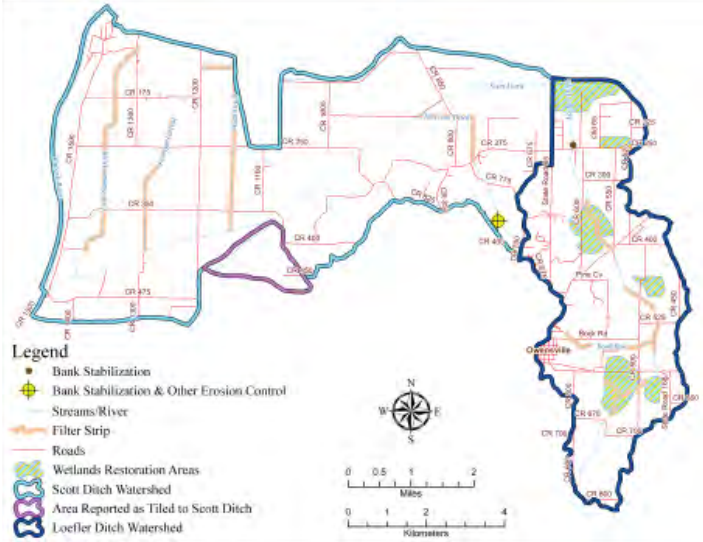
Switch to conservation tillage practices. Conservation tillage can reduce soil erosion by up to 90%. It also reduces nutrient and pesticide movement.

Add vegetative filter strips along ditches or streams instead of farming or mowing right up to the edge. Filter strips remove pollutants like sediment, bacteria, and chemicals and help to stabilize eroding banks.

CONCERNS IN THE WATERSHED

- Ammonia Nitrogen Levels
- Turbidity
- Dissolved Oxygen Levels
- Aquatic Insect Populations
- Stream Habitat Quality

BEST MANAGEMENT PRACTICE (BMP) IMPLEMENTATION RECOMMENDATIONS



We have funds to help get conservation on your property!

There are a variety of sources of funds available to help you improve local water quality. Contact the Gibson County SWCD at 812-385-5033 ext. 3.

Funds are available for: filter strips, grassed waterways, wildlife plantings, streambank erosion, wetland restoration, conservation tillage, no-till equipment modification, pasture fencing, alternative water supplies, and other practices.

POLLUTANTS

Where do they come from?

Most pollutants come from human activity. Below are 3 sources of water pollution.

Agriculture

Practices used for crop and livestock production may introduce nutrients, pathogens, pesticides, and sediment in to streams and watercourses within the watershed.

Land Development

Bare soil is often exposed during construction leading to an increase in erosion. Also during land development, many pervious surfaces are converted to impervious surfaces, such as sidewaks and parking lots. Runoff from these surfaces may contain increased amounts of oils, greases, nutrients, and pesticides.

Septic Systems

When a septic system fails, excess nutrients, and pathogens can be released directly into streams and tributaries.