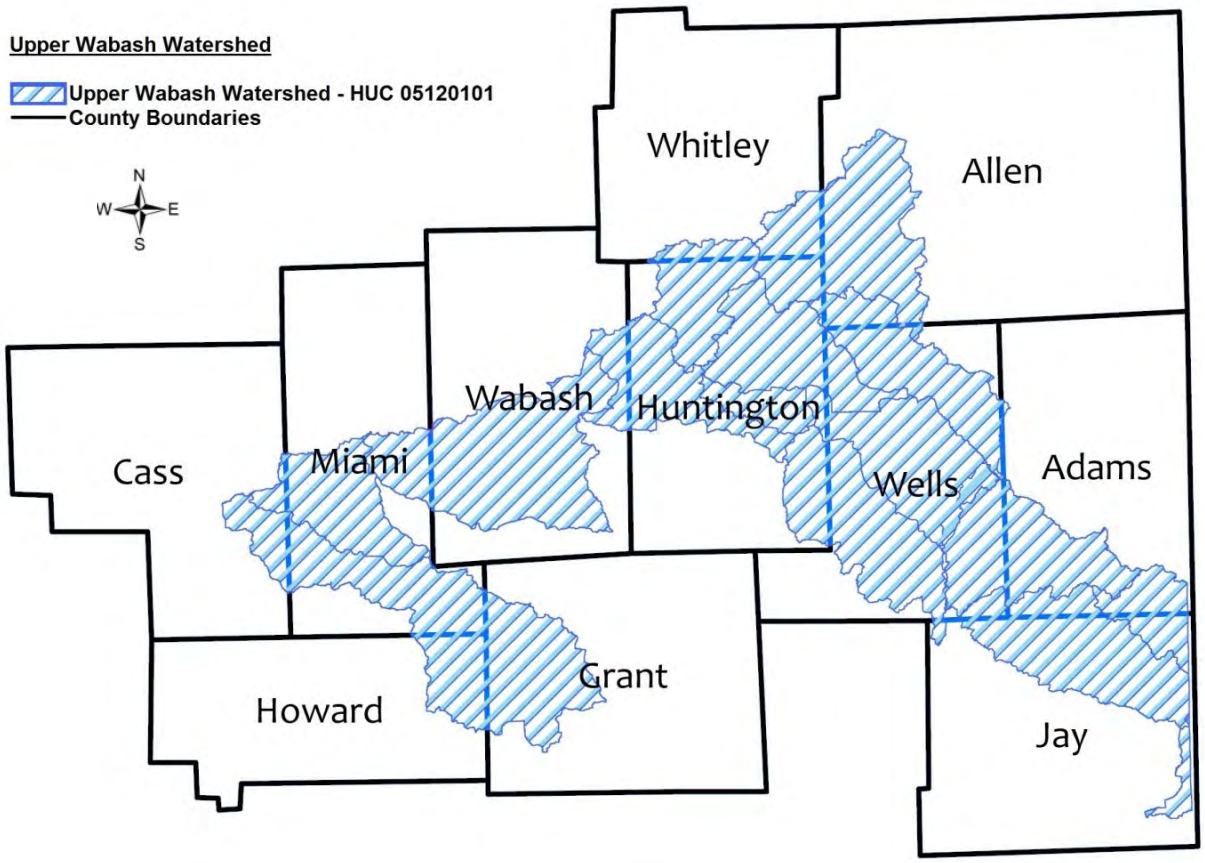
1.0 Community Watershed Initiative

The interest to prepare a Watershed Management Plan (WMP) for the Upper Wabash River basin stems from the known water quality problems in the watershed and the fact that these are common water quality problems facing many other rural watersheds throughout the State.

The Upper Wabash River basin watershed is an 8-digit hydrologic unit code (HUC 05120101) watershed located in northeastern Indiana and western Ohio. The Indiana portion of this watershed encompasses approximately 1,400 square miles in eleven different counties and approximately 750 miles of perennial streams (USEPA 2002a).

Figure 1: Upper Wabash River Basin Watershed, HUC 05120101

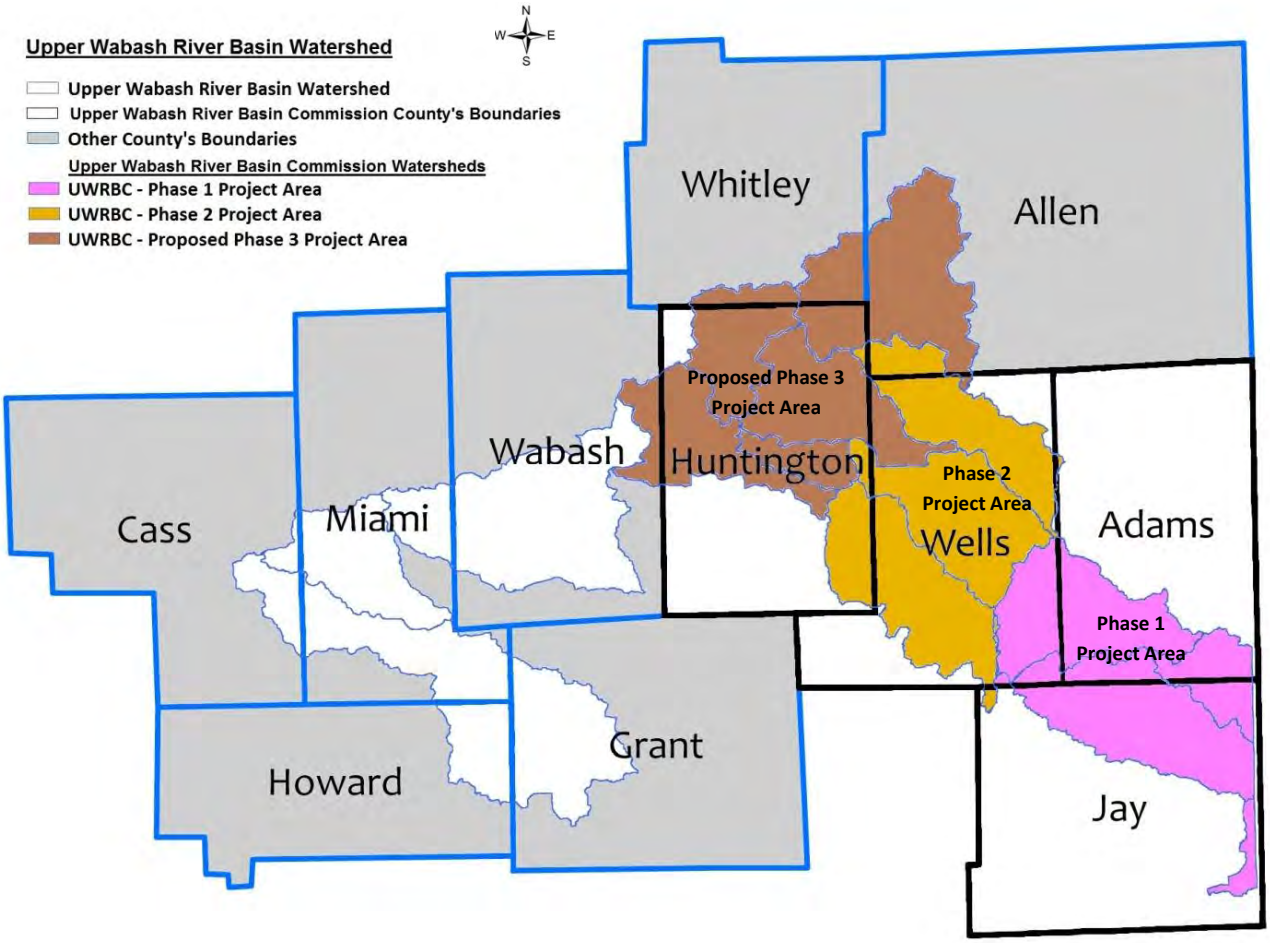


In 2001, Indiana's legislature established the Upper Wabash River Basin Commission (UWRBC) under IC 14-30-4 as a separate municipal entity. The UWRBC was formed at the request of local government officials in Adams, Jay, Wells and Huntington Counties, Indiana to provide an organized structure for mutual cooperation in an effort to address water quantity and quality concerns within the Upper Wabash River basin in the four participating counties (Adams, Jay, Wells and Huntington). The mission of the UWRBC is to provide regional leadership and promotion of flood prevention and control, soil and water conservation, and related resource management through a coordinated and comprehensive planning and implementing approach in which projects of the Commission will not adversely affect landowners within the watershed.

The UWRBC completed a watershed management plan for "Phase 1" of the Upper Wabash River watershed in 2007, then conducted a three-year implementation project of best management practices (BMP's) in the Phase 1 area from 2009-2013. This WMP is for "Phase 2" of the watershed area, and is a continuation of previous efforts to improve water quality in the Upper Wabash River watershed. Upon completion and approval of this plan, the UWRBC will administer a program to install best management practices (BMP's) in the "Phase 2" project area.

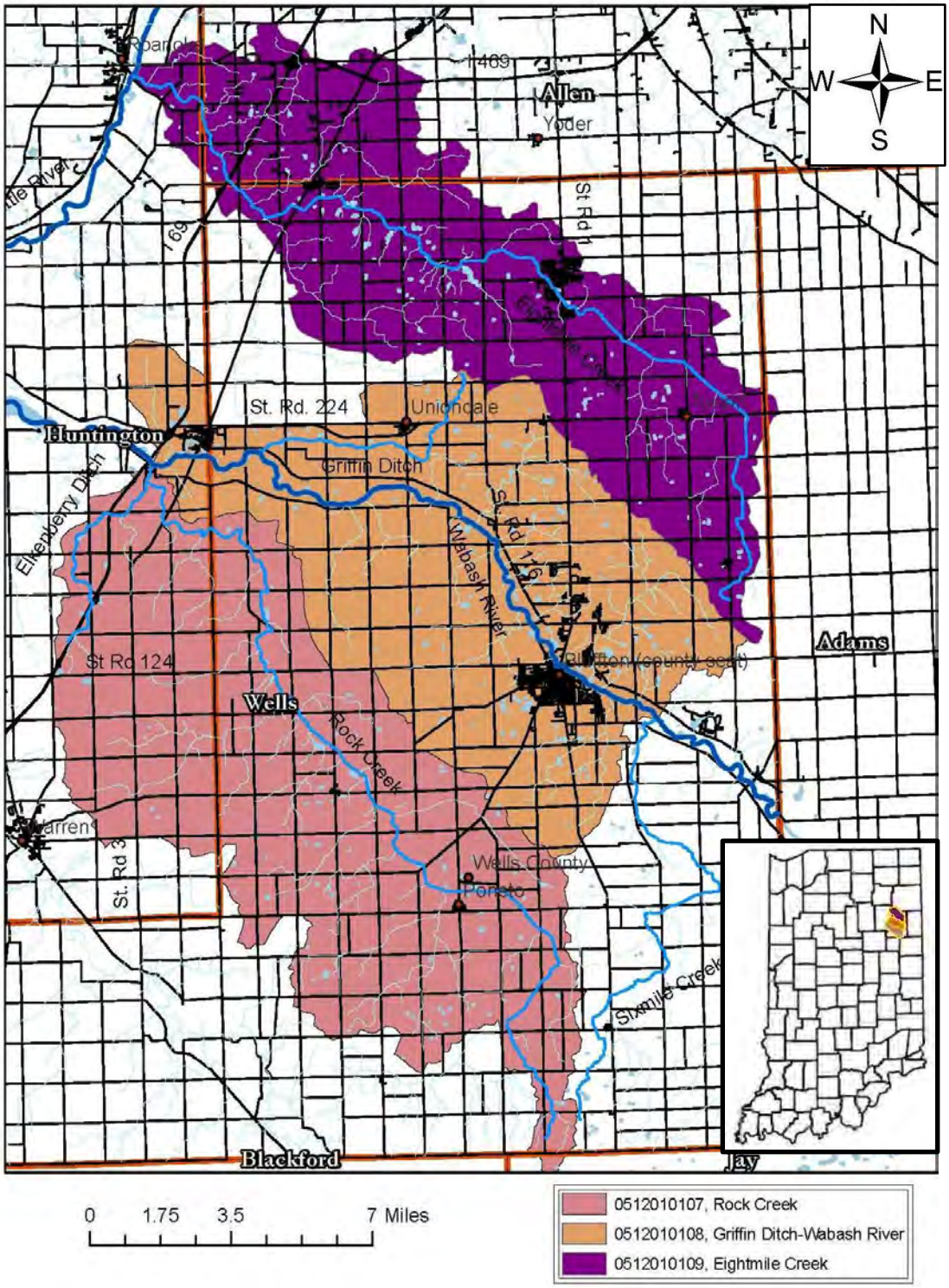
Future projects are anticipated for the "Proposed Phase 3" project area. The UWRBC jurisdiction ends at the Phase 3 project area, but other local watershed groups are interested in working in the downstream subwatersheds in the Upper Wabash River basin area. These coordinated efforts will fulfill local stakeholder desires and long-term vision to complete comprehensive management plans and BMP implementation for the area as a whole and result in watershed protection and restoration throughout the Upper Wabash River basin watersheds.

Figure 2: Upper Wabash River Basin Commission Project Watersheds



"Phase 2" of the UWRBC Project encompasses approximately 176,124 acres and includes the main stem of the Wabash River–Griffin Ditch (HUC: 0512010108), Rock Creek (HUC: 0512010107), and Eight Mile Creek (HUC: 0512010109) subwatersheds (Figure 3), located in Wells, Huntington and Allen counties.

Figure 3: UWRBC Phase 2 Project Area



This WMP is intended to benefit the communities in the watershed by helping to improve the environment through comprehensive water resource planning. This planning effort helps to ensure that current water quality issues are identified and provides a framework for addressing the natural resource concerns in the watershed. It is imperative that the planning process formulates a workable WMP that is sensitive to the values and desires of all members of the community and is developed with the input and support of a diverse cross-section of the community. Input from the farmer, homeowner, government administrator, elected official and others in the community helps to ensure that there is a balanced and equitable distribution of responsibility as well as benefits of clean water in the watershed.

Watershed planning is especially important to help prevent future water resource problems, preserve watershed functions, and ensure future environmental health. Everyone in a watershed is involved in watershed management, even if they are not aware of their contribution or impact. This WMP can provide a better understanding of community values and watershed processes and can provide guidance toward the betterment of watershed management for those who reside in the watershed and community as well as those in adjacent lands.

The watershed faces typical water quality problems, as documented in the Wabash River Total Maximum Daily Load Development Final Report (Wabash TMDL); Rock Creek Conservancy District – Water Monitoring Project; and the Flat Creek, Griffin Ditch, Fleming Ditch, and Somers Creek Watershed Diagnostic Study.

The Wabash River TMDL notes that the primary cause of impairment in the Wabash River is Escherichia coli bacteria (*E. coli*) and nutrients. Excessive nutrients are the likely cause for impaired biotic communities. Excess sediment, habitat degradation, and increased temperatures may also be causes for impaired biotic communities within the Wabash River. Eight Mile Creek and Rock Creek have also been listed as impaired on the Indiana Department of Environmental Management (IDEM) 303(d) list for *E. coli* and impaired biotic communities. Most recent biological monitoring conducted by the Rock Creek Conservancy District shows that the biotic communities are rated poor to fair upstream (Pollution Tolerance Index (PTI) = 4-10) and increases in score (18-25) as the creek approaches the Wabash River main stem at the J.E. Roush Fish and Wildlife area. A PTI score of 23 or greater is considered excellent and scores of 10 or less are considered poor. The Lake and River Enhancement (LARE) study of Flat Creek, Griffin Ditch, Fleming Ditch and Somers Creek concluded that the physical and chemical characteristics of these watersheds were degraded and that the watersheds were net contributors of sediment, nutrients and bacteria to the Wabash River. Additionally, a report in 2000 by the Indiana Department of Natural Resources (Wabash River Fish Study) shows that game fish species are severely limited in the reaches of the Upper Wabash Watershed above the J. E. Roush Lake. The species in greatest abundance, including common carp, are indicators of poor water quality.

Agriculture, the primary land use in the watershed, includes mainly grain and livestock operations. Traditional row crop production pushes tillage to the edge of many stream and ditch banks where sediments, nutrients, and other pollutants can migrate from the agricultural lands to surface waters via runoff, sub-surface tile systems and erosion. County Surveyors increasingly work to reduce re-entry of soil from ditch and stream dredging, but many waterways lack grassed buffers and are void of riparian areas.

The watershed area also encompasses the city of Bluffton (population 9,897), towns of Markle (population 1,095), Uniondale (population 310), Zanesville (population 600), Ossian (population 3,289), and Poneto (population 166); as well as smaller unincorporated communities of Liberty Center, Tocsin, Kingsland and Rockford. In urban communities, the runoff from heavily chemically treated lawns and from asphalt streets and parking lots pollutes the storm water that drains untreated into the waterways. Soils in the smaller communities and rural areas are also limiting or severely limiting for proper septic system function, and these residential areas contribute organic and nutrient pollution.

1.1 Community Leadership

The UWRBC voting members are the three County Commissioners, the County Surveyor, and the chairman of the Soil and Water Conservation Districts (SWCDs) of Adams, Jay, Wells, and Huntington Counties; or their appointed representatives. The UWRBC annually elects officers to serve as the executive committee from among the voting members, which includes a chairperson, vice chairperson, secretary and treasurer, Surveyor representative, and SWCD representative. An administrative secretary is contracted to perform the administrative, secretarial and financial duties.

Current elected officers and executive committee include:

- Ryan Noblitt, Chairperson, representing Adams Co.
- Doug Sundling, Vice Chairperson, representing Wells Co.
- Ed Paxson (2013-present); Ken Brunswick (2002-2013), Secretary, representing Jay Co.
- Jarrod Hahn, Treasurer, representing Wells Co.
- Paul Norr, Surveyor, representing Adams Co.
- Kyle Lund, SWCD, representing Huntington Co.

Table 1-1: UWRBC Voting Members

County	Member	Affiliation
Adams	Doug Bauman	Adams County Commissioner
	Kim Fruechte	Adams County Commissioner
	Ed Coil (thru 2014) Rex Moore (2015)	Adams County Commissioner
	Ryan Noblitt *(Appt. for E. Coil/R. Moore)*	Adams County SWCD
	Paul Norr	Adams County Surveyor
	Vacant *(Randy Roe, SWCD Chairman)*	Adams County SWCD
Huntington	Tom Wall	Huntington County Commissioner
	Leon Hulburt (thru 2014) Rob Miller (2015)	Huntington County Commissioner
	Larry Buzzard	Huntington County Commissioner
	Jay Poe	Huntington County Surveyor
	Kyle Lund, SWCD Chairman	Huntington County SWCD
Jay	*Milo Miller (thru 2014) Douglas Inman (2015)*	Jay County Commissioner
	Bettie Jacobs *(Appt. for M. Miller/D. Inman)*	Jay County SWCD
	Faron Parr	Jay County Commissioner

Jay	Jim Zimmerman	Jay County Commissioner
	Brad Daniels	Jay County Surveyor
	Ed Paxson (2013-present), SWCD Supervisor Ken Brunswick (2002-2013 *SWCD Appt.*)	Jay County SWCD
Wells	*Scott Mossburg (thru 2014)* Tamara Dunmoyer (2015)	Wells County Commissioner
	Doug Sundling *(Appointment for S. Mossburg thru 2014; SWCD Appointment 2015)*	Wells County Landowner
	Kevin Woodward	Wells County Commissioner
	Blake Gerber	Wells County Commissioner
	Jarrod Hahn	Wells County Surveyor
	Wayne Reinhard (*SWCD Appointment thru 2014)*	Wells County SWCD

This project will culminate in a Watershed Management Plan, which represents the earnest efforts of the community to understand, analyze and be an integral part of the solution to improve impaired water quality in the watershed area. The project's focus is to increase stakeholder awareness of water quality issues with the general goal of increasing landowner participation in non-point source pollution reduction efforts over the coming years.

1.2 Steering Committee & Stakeholder Involvement

The UWRBC holds public bi-monthly meetings to plan, discuss, and direct the activities of the Commission. The UWRBC Steering Committee, comprised of UWRBC members and other interested stakeholders, was formed in 2009 to provide oversight to the Phase 1 BMP implementation project. This Steering Committee has continued to meet bi-monthly opposite the UWRBC meetings to provide assistance and oversight to the Watershed Coordinator for this project and to provide input and make recommendations to the UWRBC voting members.

Planning and decision making is a joint venture of the citizens, partners and the UWRBC. Media releases were published and a public WMP kick-off meeting was held to announce the project and solicit input. Stakeholders were invited to join the Steering Committee and encouraged to become involved in the planning process. A total of 23 people participated in the event, and 4 additional citizens contacted the Watershed Coordinator to inquire about the project and provide input to the list of concerns. Stakeholders were invited to provide input throughout the planning process through education and outreach efforts (Appendix B); including newsletters, website announcements, workshops and field days, water quality monitoring activities, and dissemination of information through partner agencies. Stakeholder social indicator data was collected at workshops and field days through the use of surveys and are included in Appendix C.

Partnerships among water resource professionals are also essential to the successful development of the WMP. Therefore personnel from the SWCDs, The Nature Conservancy, Cooperative Extension Service, Indiana State Dept. of Agriculture-Div. of Soil Conservation, Indiana Dept. of Natural Resources-Div. of Fish and Wildlife, and US Dept. of Agriculture-Natural Resources Conservation Service have been included in or invited to participate in the Steering Committee.

Table 1-2: Steering Committee Members

Member	Affiliation
Ryan Noblitt	Adams Co. SWCD/UWRBC member
Doug Sundling	Wells Co. Landowner /UWRBC member
Jarrod Hahn	Wells Co. Surveyor/UWRBC member
Neil Ainslie	Wells Co. Resident
Barbara Elliott	Wells Co. Landowner
Beverly Balish	Wells Co. 8th Grade Biology Teacher
Eric Wenger	Wells Co. Landowner/Agricultural Producer
Makaye Conrad	Wells Co. Landowner/previous member of the Wells Co. Regional Sewer District/Hoosier Riverwatch volunteer
Kelley Barkell	Adams-Wells Co. NRCS District Conservationist/Wells Co. Landowner
Dave Lefforge	ISDA, Div. of Soil Conservation/Wells Co. Landowner
Nick Alles	ISDA, Div. of Soil Conservation/Huntington Co. Resident
Lynne Huffman	Wells Co. SWCD/Wells Co. Landowner
Doug Nusbaum	IDNR, Div. of Fish and Wildlife
Kent Wamsley	The Nature Conservancy

1.3 Stakeholder Concerns

As part of the watershed planning process, an inventory and assessment of the watershed and existing water quality studies relevant to the watershed must be conducted. Examination of the previous data may show that there is sufficient information to determine the condition of water quality, or it may indicate that additional studies need to be completed. In either case, assessing this information will help guide the identification of water quality problems and possible pollution sources in the watershed and direct specifically targeted conservation actions to address each concern.

Citizens living, working, and playing in the watershed can prove to be valuable in the planning process by providing both current and historical insight into the water quality issues in the watershed area. Initial concerns, gathered during the public meetings, as identified by the UWRBC members, Steering Committee and stakeholders are listed in Table 1-3.

Table 1-3: Stakeholder Concerns

Some of the concerns fit in multiple categories, but are listed only once.

Gathered during initial public meetings

Drainage	Log-jams and debris in river and streams
	Encourage 2-stage ditches
	Flooding along the river and streams
Sediment & Nutrients	In-stream and stream bank erosion causing sedimentation
	Agriculture fertilizer (nitrogen and phosphorus) runoff into streams
	Manure management; stockpiling and application practices
	Tillage to the edge of stream banks, no filter strips or riparian area
	Conservation tillage has low adoption rates
	Lack of buffers and filter strips on streams
	Residential runoff from chemically treated lawns (fertilizers and pesticides)
	Construction site (and road construction) erosion causing sedimentation
***E. coli* & Pathogens**	High *E. coli* levels
	Failing septic systems, severely limiting soils, lack of maintenance
	Wastewater treatment in unincorporated communities
	Run-off from asphalt streets and parking lots
Other Concerns	Wetlands drained and forests cleared
	Lack of green space and trails
	Dumping, trash in river and streams

2.0 Watershed Inventory

2.1 Geology and Topography

During the Pleistocene (ice age), Indiana experienced at least three major periods of glaciation, each lasting tens of thousands of years. Each episode of ice advance and retreat affected the landscape. The most recent event, the Wisconsin Glacier, retreated about 13,600 years ago.

The Upper Wabash River watershed is in the Bluffton Till Plain and was one of the last areas of Indiana to be covered by the glacial ice. When the glacier receded, it deposited eroded substrate of various types of sediment, referred to as "drift" over dolomite and limestone bedrock. These deposits left a series of ground moraines which give the landscape a mostly level to moderately sloping appearance, with only a few areas of steep slopes. Of the glacial drift, glacial till is a homogenous, unsorted mixture of particles ranging in size from clay to boulders deposited directly by the ice. Outwash sediments were transported and deposited by the action of the glacial meltwater, and consists of sorted and stratified sand and gravel on flood plains and stream terraces. Lacustrine material, such as clay, silt and very fine sand was deposited in still or shallow ponded glacial meltwater over the majority of the watershed area and was exposed when the glacial waters drained.

This watershed study includes three subwatersheds of the Wabash River Basin. Elevation ranges from 920 feet above sea level in the Rock Creek subwatershed, and 860 feet in the Griffin Ditch-Wabash River subwatershed to about 765 feet above sea level downstream on the Wabash River at the J. E. Roush DNR Fish and Wildlife area in Huntington County. The Eight Mile subwatershed ranges from 860 feet above sea level, to approximately 740 feet downstream where it enters the Little River in Huntington County. The Rock Creek subwatershed slopes northwest through Wells County and slopes mostly north in Huntington County. The Griffin Ditch-Wabash River subwatershed slopes northwest/west through Wells County into Huntington County. The Eight Mile subwatershed slopes northwest through Wells County and a small portion of Allen County before entering Huntington County.

2.2 Hydrology (Drainage Patterns)

The Upper Wabash River Phase 2 project watershed drains over 275 square miles in the Rock Creek, Griffin Ditch-Wabash River, and Eight Mile subwatersheds. The project watersheds cover over 58% of Wells County, 10% of Huntington County, almost 3% of Allen County, and less than 0.3 square miles in both Jay and Adams Counties. There are over 330 miles of streams and ditches within the watershed.

The Rock Creek subwatershed contains 117.10 miles of streams and ditches and 127.91 miles of county tile. The Rock Creek main channel flows for approximately 25 miles in a north/ northwest direction from southern Wells County where it empties into the Wabash River in the J. E. Roush DNR Fish and Wildlife area near Markle, in Huntington County. In the mid 60's to early 70's, the main channel was reconstructed to reduce flooding and provide adequate drainage for agriculture production which is the main use of the stream, as evidenced by the amount of county tile in the watershed. Recreation was also a consideration during the reconstruction, so

habitat areas and fish pools were included in the design, which encourages local residents to use the creek for hunting and fishing.

The Griffin Ditch-Wabash River subwatershed contains 109.90 miles of streams and ditches and 85.94 miles of county tile, and is drained by the Wabash River main stem. The Wabash River flows over 17 miles in a northwest/west direction, from just east of Bluffton, to the J.E. Roush DNR Fish and Wildlife area near Markle, in Huntington County. The Wabash River is listed by the Natural Resources Commission as an Outstanding River. Local stakeholders use the river for drainage, aesthetics, or recreational purposes such as walking trails, fishing, hunting, and canoeing.

The Eight Mile subwatershed contains 103.51 miles of streams and ditches and 82.14 miles of county tile, and the main channel flows for over 27 miles in a northwest direction through Wells and Allen Counties, where it empties into the Little River near Roanoke, in Huntington County. The Eight Mile Creek is used primarily as drainage for agriculture production, and has been channelized and maintained (dredging, clearing vegetation, etc.) as an open drainage ditch. This subwatershed contains five two-stage ditches installed by the Wells Co. Surveyor.

The overall primary use of the streams and ditches in the watershed is for drainage. County legal drains are routinely maintained for this purpose. The open streams and drains are regularly sprayed to reduce and control the growth of woody vegetation; clearing, dredging and/or reconstruction are also used as methods to reduce and remove obstructions. These modifications can result in the destruction of aquatic habitats, loss of riparian areas, and increased potential for erosion and sedimentation. The installation, repair, and replacement of subsurface tile are also used extensively throughout the watershed project area to improve drainage. In fact, there is almost as much county regulated tile as there are open streams and legal drains. Subsurface tile speeds up the amount of water that reaches the streams and ditches in a shorter amount of time. This can lead to increased flow within the stream and increased potential for erosion occurring within the stream channel. Tile inlets can also provide a direct conduit for nutrients, sediments and pathogens to travel to the open stream or river, and result in a decrease in water quality; all concerns identified by local stakeholders.

Wetlands, ponds, and lakes in the watershed area are small and numerous but cover just 1,411 acres, or 0.8% of the watershed area. Wetlands tend to be in wooded areas and landowners generally consider them as a negative. It is an area that cannot be cleared for crop production. Often, these wooded areas are offered as residential building sites. Private ponds and lakes are distributed throughout the watershed area and used for recreation on residential properties.

Table 2-1: Waters of the Upper Wabash River Phase 2 Watershed

Streams and Legal Drains	330.51 miles
County Tile	295.99 miles
Wetlands	695 acres (1,134 wetlands)
Lakes, and Ponds	716 acres (377 waters bodies)

Figure 4: Hydrology of Rock Creek, HUC 0512010107

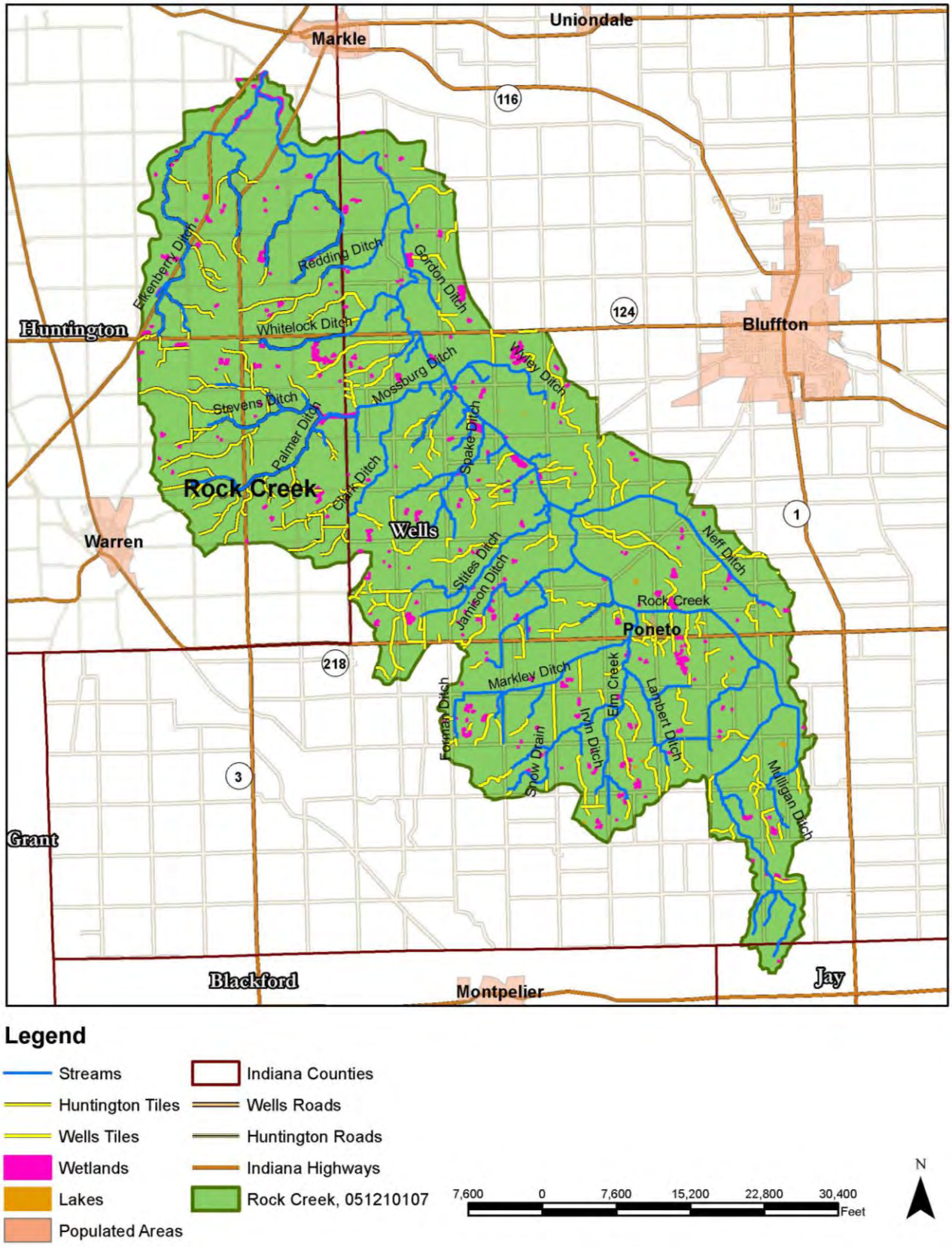


Figure 5: Hydrology of Griffin Ditch-Wabash River, HUC 0512010108

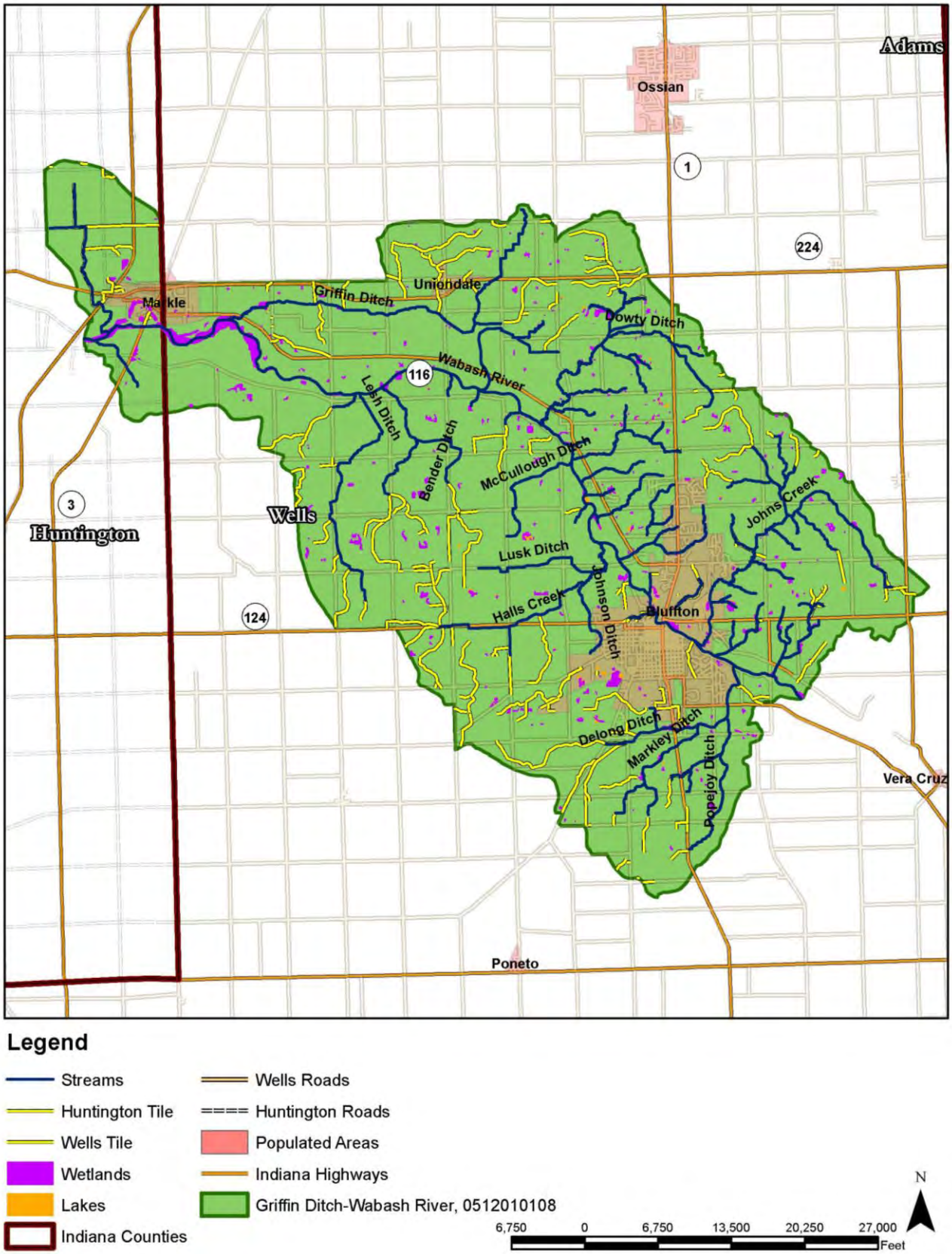
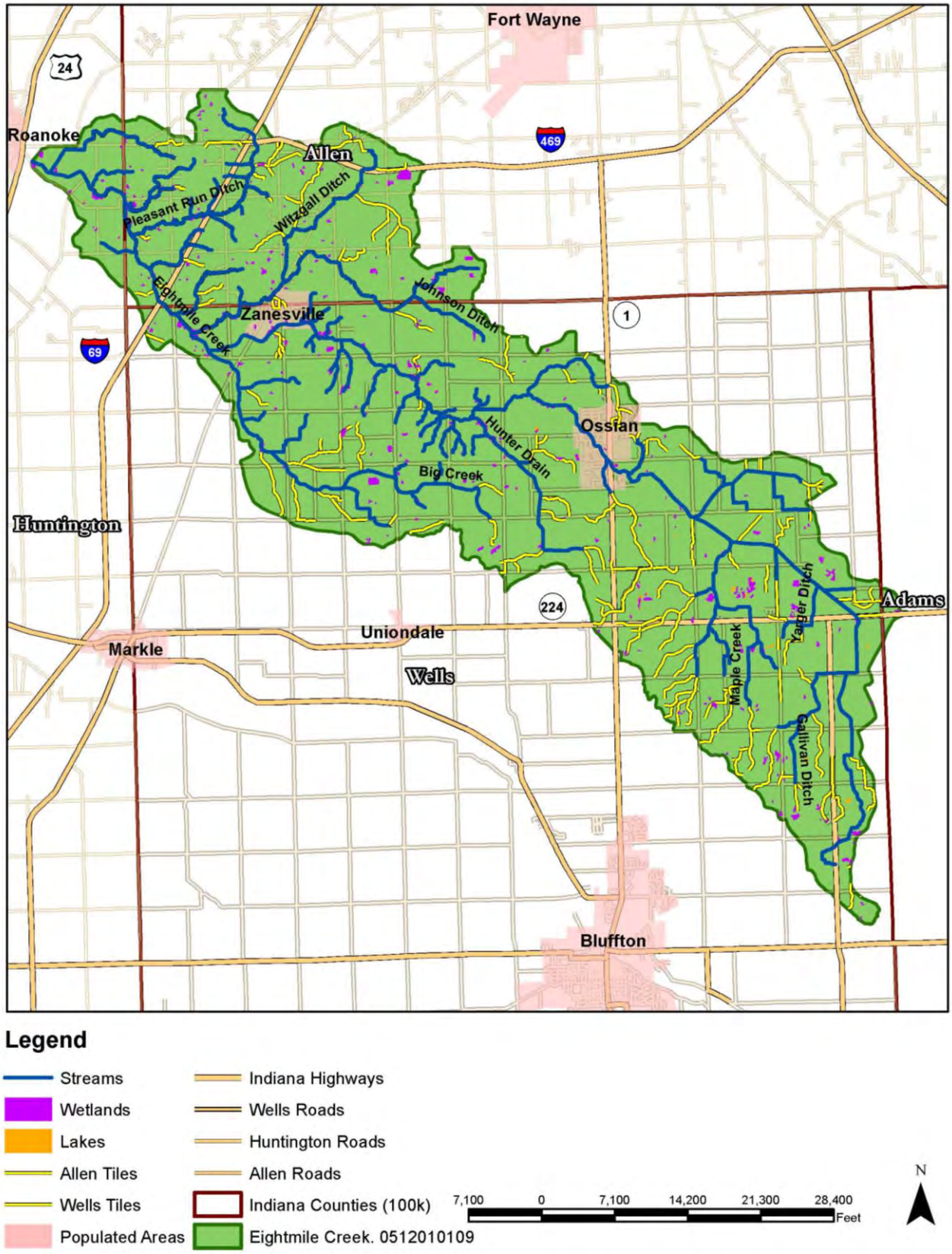


Figure 6: Hydrology of Eight Mile Creek, HUC 0512010109



Impaired Waters - IDEM 303(d) List

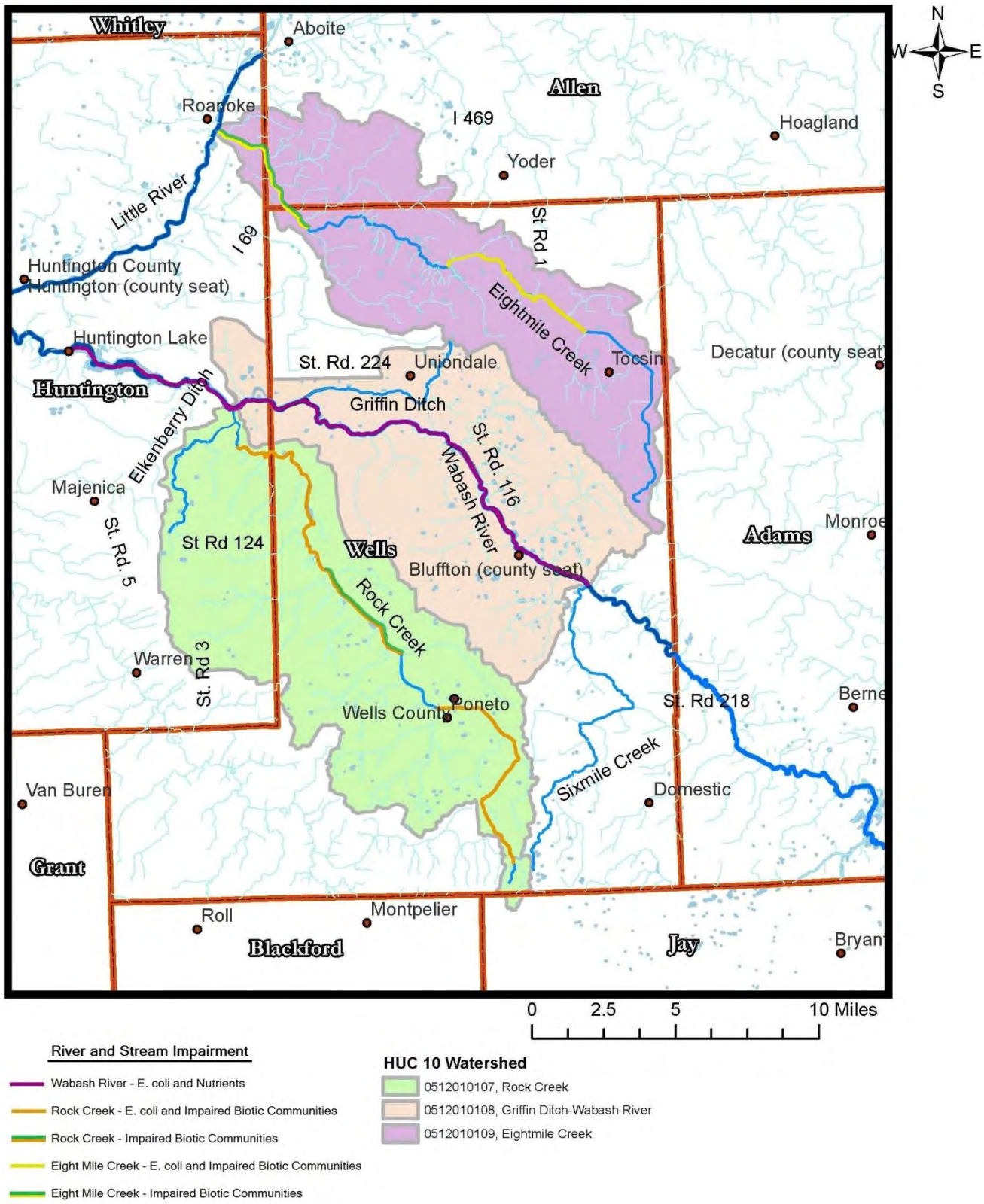
The Indiana Department of Environmental Management (IDEM) Office of Water Quality prepares Indiana's 303(d) List of Impaired Waters every two years as part of the state's Integrated Water Monitoring Assessment Report which is submitted to the US EPA. The 303(d) list identifies where water quality problems exist and the nature of those impairments. Water bodies are included on the list if they do not meet the state's water quality standards.

Approximately 52.6 miles of streams in the project area (16%) have been assessed by IDEM. Of those, over 43 miles are on the IDEM 303(d) List Revised (12/28/12) for water quality impairments from nutrients, *E. coli*, and impaired biotic communities (Figure 7). This means that these water bodies do not meet one or more of its designated uses and that the water quality standards or other applicable criteria are not attained.

Table 2-2: Impaired Waters in the Upper Wabash River Phase 2 Watershed 2012 IDEM 303(d) List Revised (12/28/12)

ASSESSMENT UNIT ID (IDEM)	ASSESSMENT UNIT NAME	CAUSE OF IMPAIRMENT
INB0171_01	Rock Creek	E. coli & Impaired Biotic Communities
INB0173_01	Rock Creek	Impaired Biotic Communities
INB0174_01	Rock Creek	E. coli & Impaired Biotic Communities
INB0181_01	Wabash River	E. coli & Nutrients
INB0182_01	Wabash River	E. coli & Nutrients
INB0183_03	Wabash River	E. coli & Nutrients
INB0184_01	Wabash River	E. coli & Nutrients
INB0192_01	Eight Mile Creek	E. coli & Impaired Biotic Communities
INB0194_01	Eight Mile Creek	Impaired Biotic Communities

Figure 7: Upper Wabash River-Phase 2 Watershed Impaired Streams



2.3 Soils

Soils can be grouped and described by looking at the various physical and chemical characteristics. One such characterization is called STATSGO, or State Soil Geographic Database maintained by the United States Department of Agriculture (USDA) – Natural Resources Conservation Service (NRCS).

The soils in the Upper Wabash River Phase 2 project area fall into seven different soil associations. The Blount-Pewamo-Glynwood (IN005) association accounts for 70.78% of the watershed. The Blount-Glynwood-Morley (IN004) association covers 17.25%, the Sawmill-Lawson-Genesee (IN029) association amounts to 6.06% primarily adjoining the major streams, and the Milford-Martinton-Del Rey (IN0523) association is only 4.04% of the watershed. The Sebewa-Gilford-Homer (IN025), Milsdale-New Glarius-Randolph (IN047), and Rensselaer-Darroch-Whitaker (IN003) associations make up the balance of less than 2% of the total watershed area. In general, the soils in the watershed are dominantly glacial till, lacustrine deposits, outwash deposits, alluvium, and organic deposits.

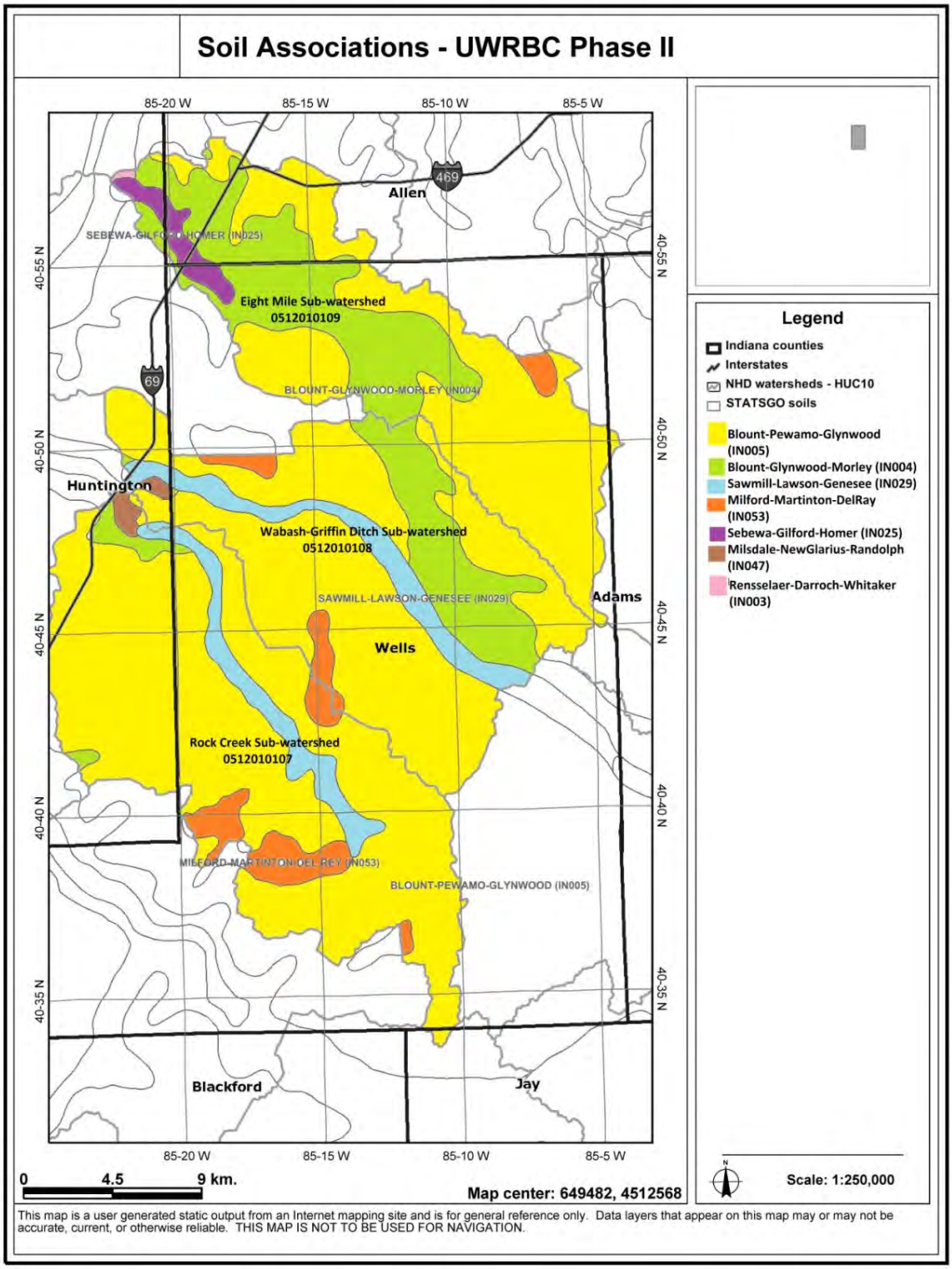
Glacial drift was deposited with minimal water action as the glacial ice melted. The glacial drift is very firm, calcareous silty clay loam and clay loam. Blount, Pewamo, Glynwood, and Morley all formed in glacial till which makes up over 87% of the watershed area. Most areas are used for cultivated crops such as corn, soybeans, small grains, and hay. The Blount and Pewamo soils typically are nearly level to gently sloping with a range of 0 to 4 percent. They are deep to very deep, somewhat poorly drained to very poorly drained, medium textured and moderately fine textured, slowly permeable soils with a well developed subsoil on the lake plains and moraines. Blount soils are on flatter or more convex positions, and Pewamo soils are in depressions or drainage ways. Glynwood and Morley soils formed in thin loess and the underlying clay loam or silty clay loam till. Glynwood and Morley are found on ground and end moraines. They are very deep, moderately well drained and well drained, and have low permeability, with slopes of generally 1 to 18 percent. Potential for surface runoff is low to very high depending on the slope and vegetative cover.

Milford and Del Rey soils formed in lacustrine sediments on the glacial lake plains and are on nearly level low broad summits or in depressions. Lacustrine material was deposited by still or shallow ponded glacial meltwater. Because coarser fragments were deposited as outwash by the moving meltwater, only the finer particles, such as clay, silt and very fine sand remained to settle out. Some areas have a thin mantle of outwash overlying the lacustrine sediments. Lacustrine deposits are typically fine textured, but they have a thin layer of sand. These soils are very deep and somewhat poorly drained to very poorly drained with a seasonal high water table. The Milford soils have a slope of less than 2 percent, and Del Rey soils have a greater slope ranging from 0 to 4 percent.

The Sawmill-Lawson-Genesee association consists of very deep, well drained soils that formed in loamy alluvium on the flood plains. Alluvial material was deposited by floodwaters from streams that were formed by the melting glaciers. These soils are subject to periodic flooding and stream bank erosion. Soils commonly associated with this group include the moderately well drained Eel soils, somewhat poorly drained Shoals soils, and very poorly drained Sloan and

Rensselaer soils that are found in the watershed. They are nearly level, moderately fine and medium textured soils formed in alluvium and outwash material on flood plains and stream terraces.

Figure 8: Soil Associations in the UWRBC Phase 2 Watershed



Highly Erodible Soils

Soil erosion and sedimentation is a concern within the project watershed area. Soil that moves from the landscape to adjacent streams and rivers results in degraded water quality, limited recreational use, and impaired aquatic habitat and health. Soil also carries attached nutrients, pesticides and herbicides to the streams and rivers which can increase plant and algae growth, kill aquatic life, and decrease the water quality.

The USDA Natural Resources Conservation Service (NRCS) uses soil texture and slope to classify soils into groups that are considered highly erodible (HEL), potentially highly erodible (PHEL), and non-erodible. The classification is based on several factors including the average annual rate of erosion by the particular soil, the maximum annual rate of erosion that can occur for the soil type without causing a decline in long-term productivity, steepness and length of the underlying slope.

Highly erodible land (HEL) describes those areas of cropland, hayland or pasture that are potentially exposed to soil erosion by wind or water, and can erode at excessive rates. NRCS has compiled a list of soils which they commonly see in these situations. Lands that are HEL can contribute a significant amount of sediment, nutrients, and chemicals to local waterways, especially if they are row crops and lack appropriate ground cover or other conservation measures. Only 2% (3,742 acres) of the Upper Wabash River Phase 2 watershed area is classified as HEL, but 30% (52,901 acres) of the watershed is classified as PHEL.

With almost one-third of the watershed area (32%) being HEL and PHEL, conservation practices such as conservation tillage and cover crops are recommended. Tillage transects; windshield surveys that collect data on current and past crop use and tillage practices; provide valuable information on trends in cropland use. Based on the 2013 tillage transect, conducted by the USDA NRCS, ISDA, and local SWCD staff; corn and beans were planted by conventional tillage methods on over 66,400 acres (53%) in the project area. Of the total planted acres in the project area 87% of the corn and 22% of the bean crop was planted using conventional tillage. Trends indicate that producers are not adopting conservation tillage for corn production, and in fact have been returning to conventional tillage. No-till (including strip or ridge till), mulch till, and reduced tillage has been widely adopted for bean production at approximately 78%. That trend seems to be holding steady or slowly increasing. Tillage to the edge of stream banks and low adoption rates on conservation tillage has been identified as concerns for contributing sediment and nutrients to the streams.

Highly erodible (HEL) and potentially highly erodible lands (PHEL) are mapped in the following Figures 9 – 11.

Figure 9: Highly Erodible Soils of Rock Creek, HUC 0512010107

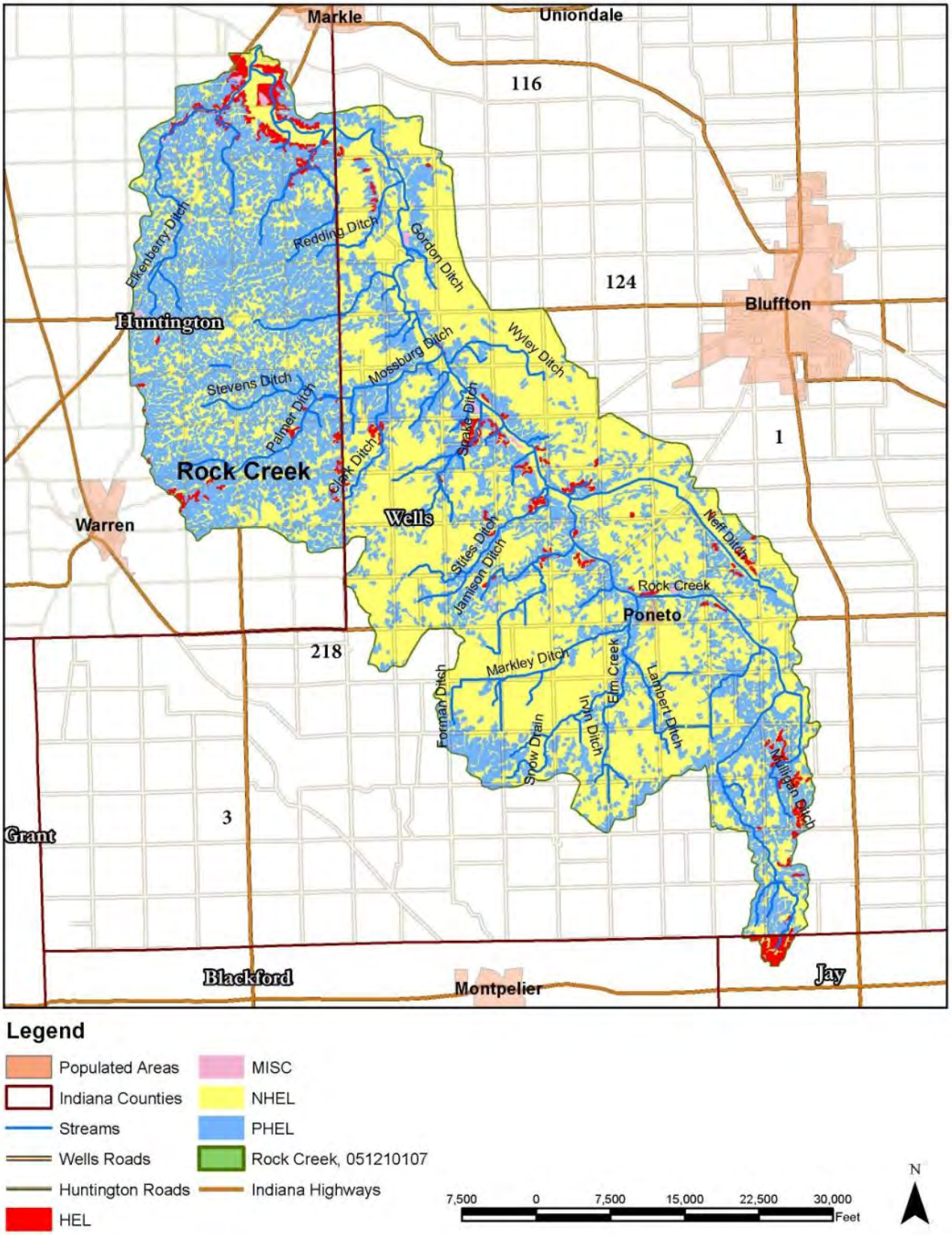


Figure 10: Highly Erodible Soils of Griffin Ditch-Wabash River, HUC 0512010108

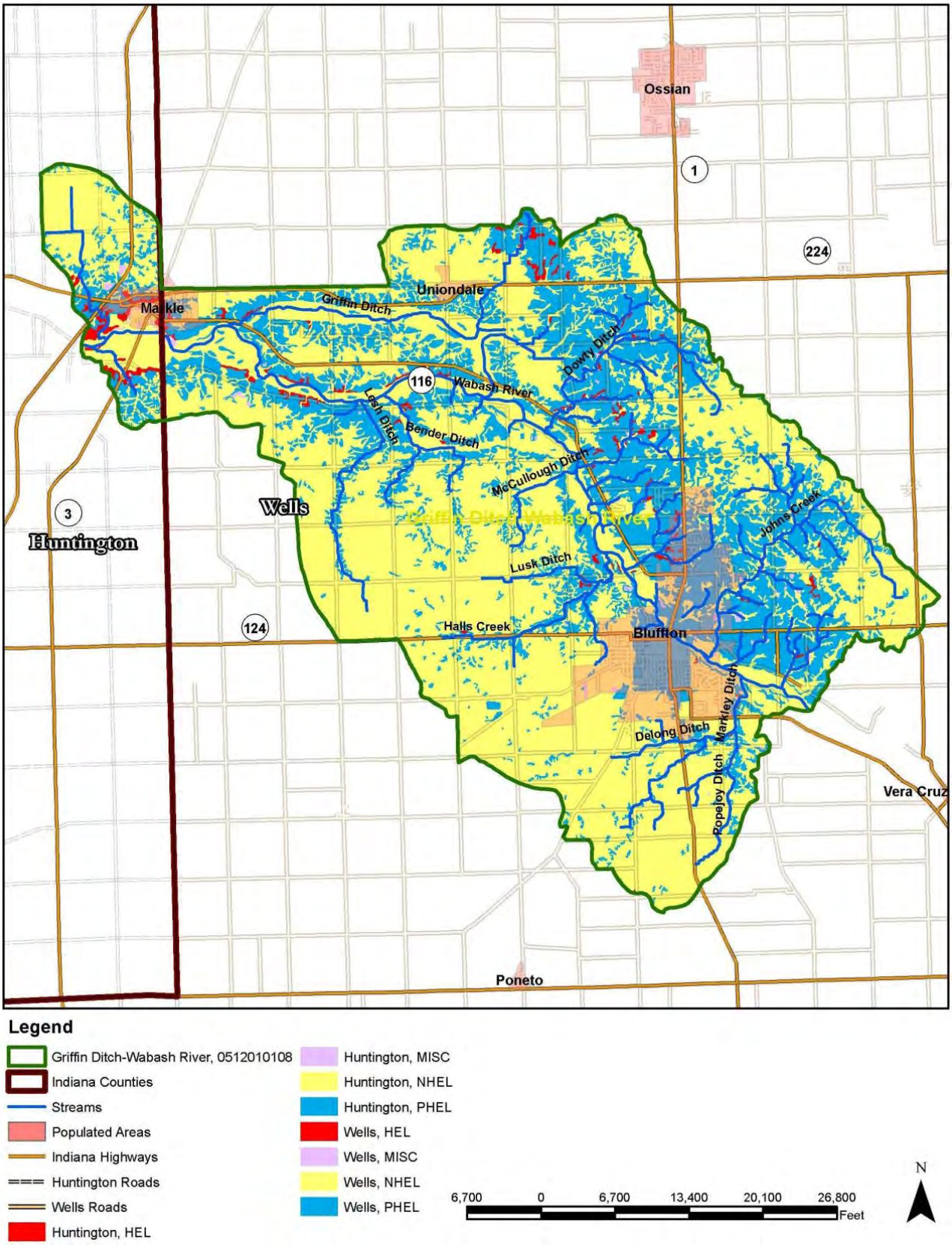
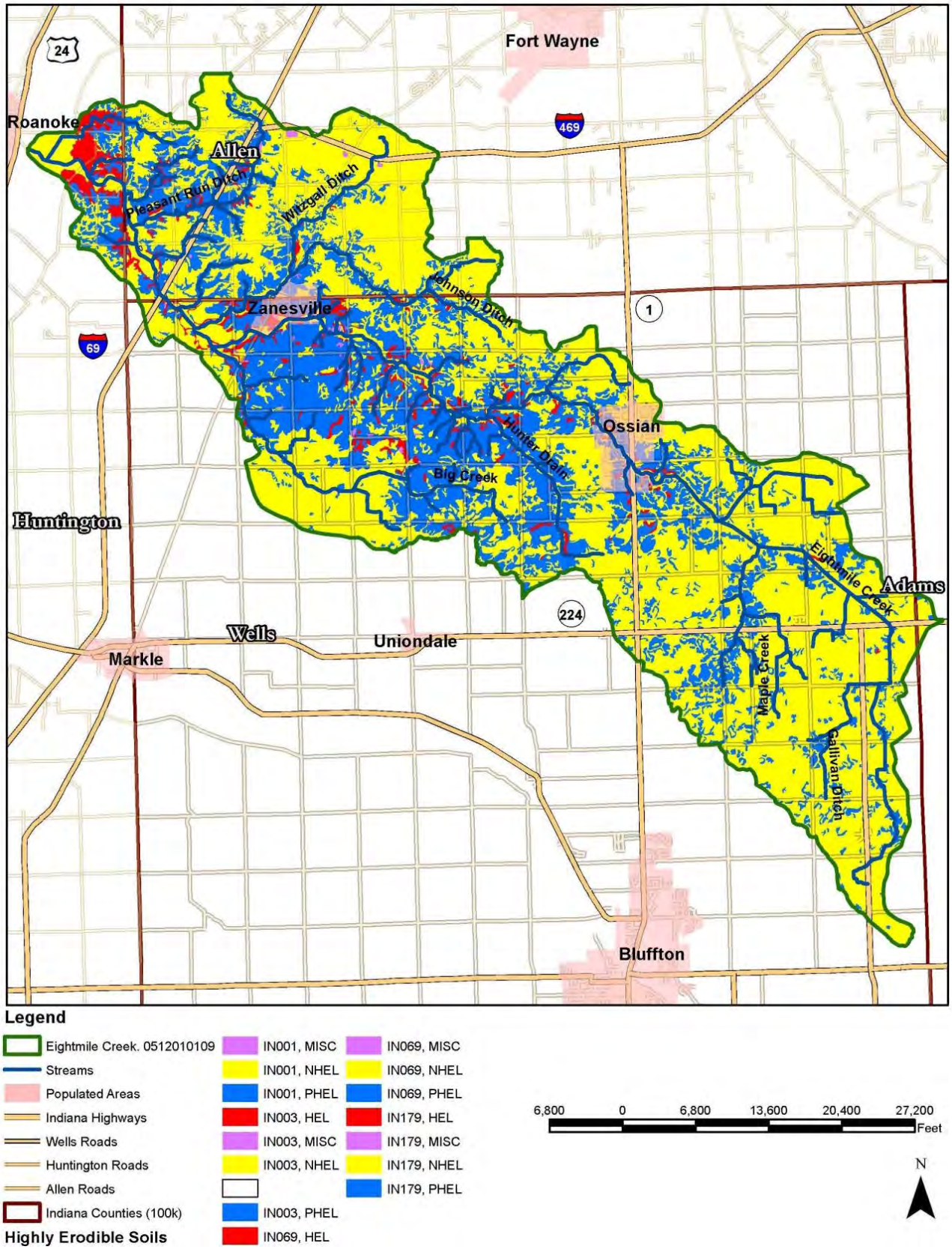


Figure 11: Highly Erodible Soils of Eight Mile, HUC 0512010109



Hydric Soils

Hydric soils are defined by the USDA Natural Resources Conservation Service as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic (low oxygen) conditions in the upper part of the soil layers. These soils, under natural conditions, are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic (water tolerant) vegetation. The presence of hydric soils can indicate areas where a wetland once was or currently is located.

Wetlands are a distinct ecosystem. They are considered to be the most biologically diverse of all ecosystems, serving as home to a wide range of plants and animals. Among the many benefits of wetlands is water purification and flood control. A wetland acts like a natural wastewater treatment plant, removing various pollutants and helping to cycle excess nutrients through the environment. Wetlands close to headwaters of streams are physical barriers that can slow down surface runoff to help prevent sudden, damaging floods downstream and trap sediments.

Over 41% of the watershed (72,564 acres) is classified as hydric soils; however most of these areas have been drained by subsurface tile for crop production. These areas still retain their hydric properties and would be suitable for restoration of wetland habitats which could improve water quality in the project watersheds and address the stakeholder concerns of flooding, and sediment and nutrients in surface water runoff that reaches the streams and river.

Table 2-3: Hydric Soils in the Upper Wabash River Phase 2 Project Area

County	Map Unit Symbol	Soil Name
Allen	Pe	Pewamo silty clay loam
	Wh	Washtenaw silt loam
Huntington	Ms	Millsdale silty clay loam
	Pe	Patton silty clay loam, sandy substratum
	Pg	Pewamo silty clay loam
	Rk	Rensselaer loam
	Ms	Millsdale silty clay loam
	Pe	Patton silty clay loam, sandy substratum
	Pg	Pewamo silty clay loam
Wells	Co	Coesse silt loam
	Mh	Milford silty clay loam
	Mk	Milford silty clay loam, stratified sandy substratum
	Mn	Millgrove clay loam
	Mo	Millsdale silty clay loam
	Pg	Pella silty clay loam, till substratum
	Pk	Pella mucky silty clay loam, sandy substratum
	Pm	Pewamo silty clay loam
	Rr	Rensselaer loam
	Se	Saranac silty clay loam, frequently flooded
	Sv	Sloan silty clay loam, frequently flooded
	Wa	Wallkill silt loam, coprogenous earth substratum, drained
	Wd	Wallkill silt loam, undrained

Figure 12: Hydric Soils of Rock Creek, HUC 0512010107

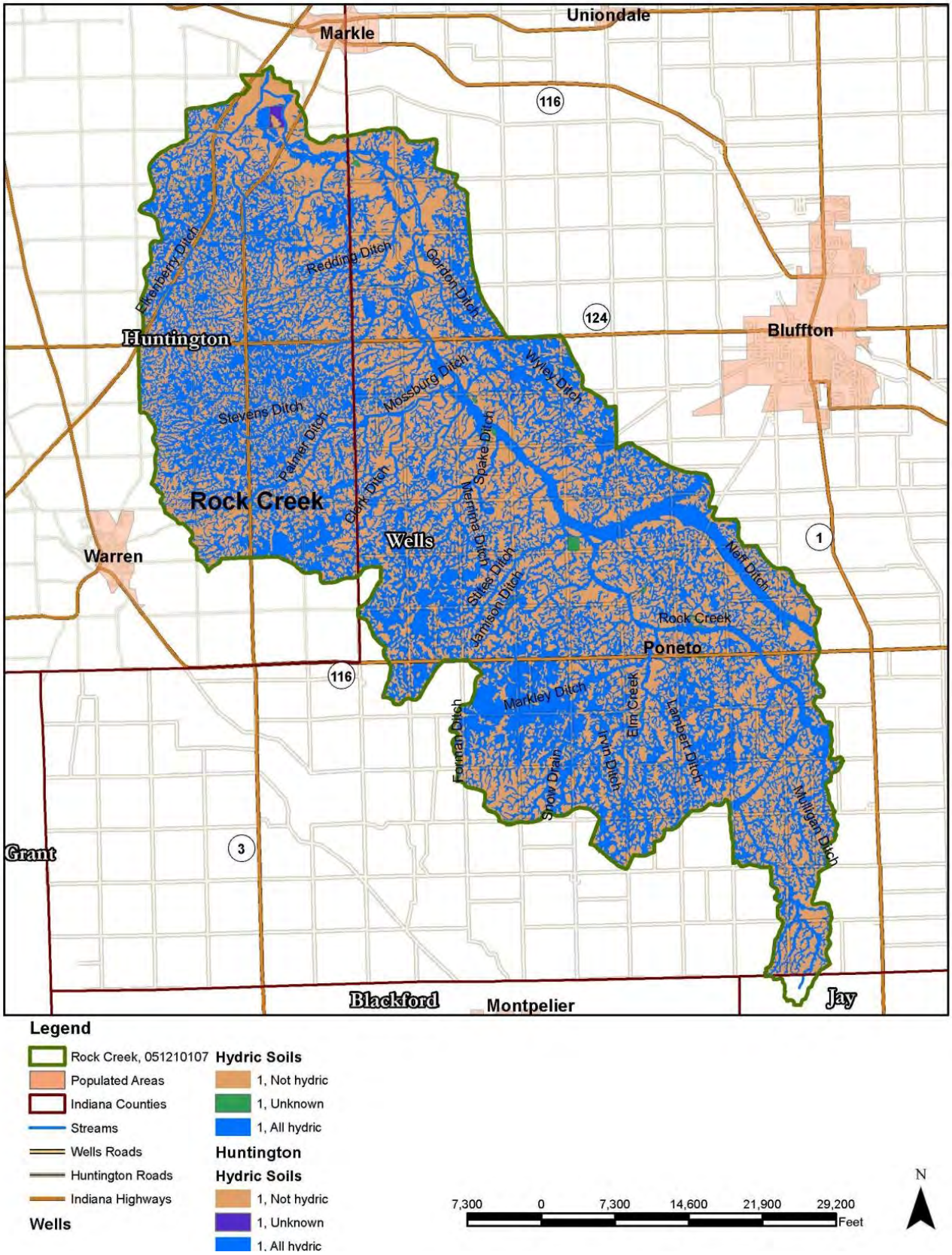


Figure 13: Hydric Soils of Griffin Ditch-Wabash River, HUC 0512010108

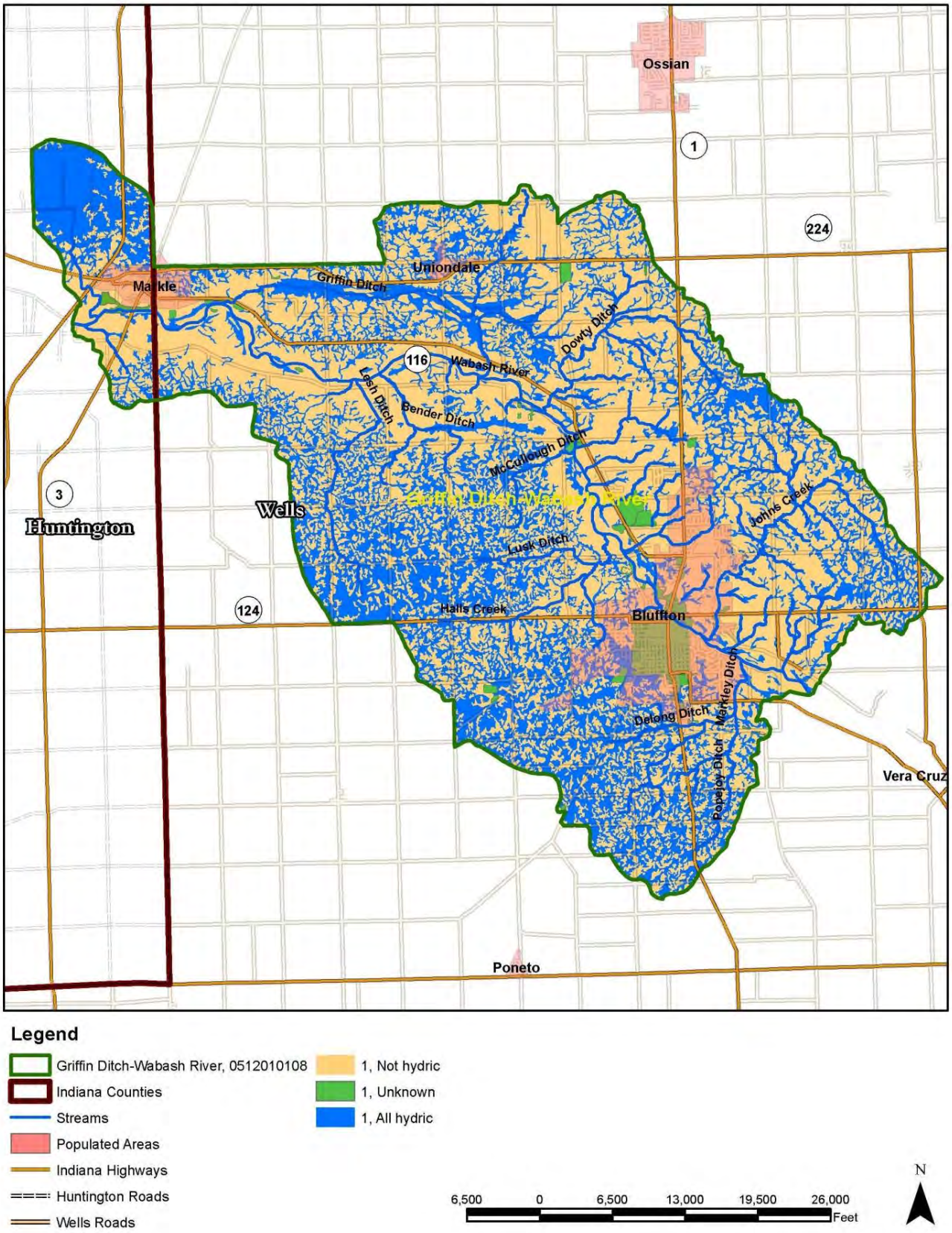
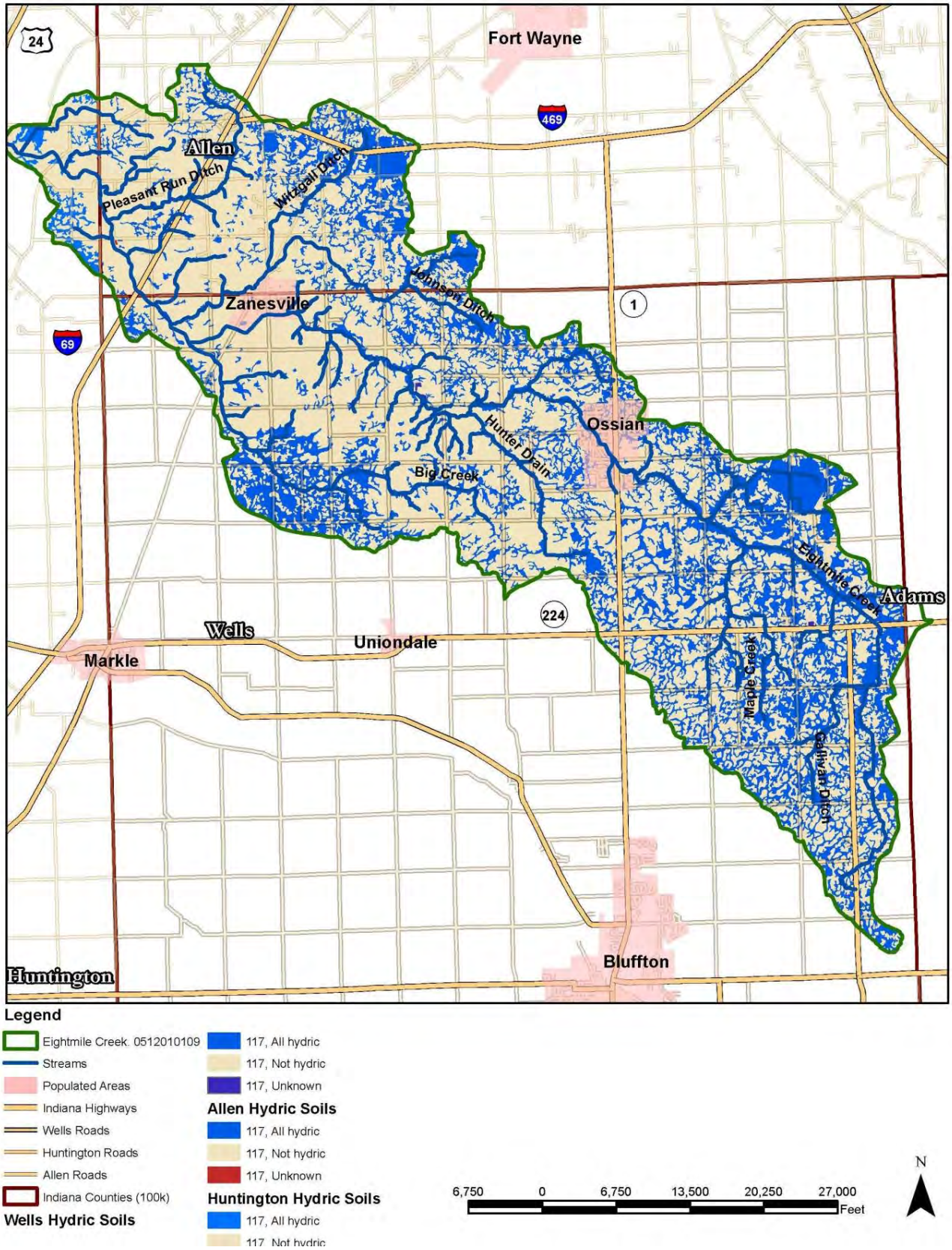


Figure 14: Hydric Soils of Eight Mile Creek, HUC 0512010109



Septic Suitability

Septic systems need well-drained soils to properly treat household wastewater. Nearly all (approximately 99%) of the soils in the Upper Wabash River Phase 2 watershed have severe limitations for supporting on-site wastewater treatment systems (i.e. septic systems) due to being very poorly to somewhat poorly drained and having slow permeability rates or high water tables. Based on visual assessments, GIS maps and estimated populations, there are over 4,000 rural on-site wastewater treatment systems in the project area.

On-site septic systems in the majority of rural homes built prior to 1978 consist of septic tanks connected to a discharge pipe (drainage tile) resulting in the discharge of raw sewage into local waterways. Since that time, many improvements have been implemented to on-site septic systems to reduce the environmental impacts of septic discharges. Currently, health departments require absorption fields with perimeter drains to allow for infiltration and soil cleansing processes. However, these systems require maintenance to ensure proper operation, and many landowners are unaware of the maintenance needs.

In 2001, it came to the attention of local officials and the public that the McKinney/Paxson Ditch located within the project watershed area had sewage disposal problems with septic systems. Water samples taken from the ditches and analyzed at various times during 1999 and 2000 showed significant elevated counts of *E. coli* bacteria, an indication of improperly treated sewage. A letter of noncompliance was issued by IDEM in 2001. Following a 2009 Recommended Order issued by IDEM, the Wells County Regional Sewer District was formed. More recent collections of water samples and analysis conducted in 2008 and 2011 showed no change in the elevated contamination levels. Local officials and county residents have since been involved in activities to identify actions to be taken to achieve a solution to the pollution problems in the McKinney/Paxson Ditch area. They are looking for solutions that can be used by the Wells County Regional Sewer District across the county. It is believed that in order to overcome these issues, septic systems may require special design, with significant increases in construction costs, and possibly increased maintenance.

Local residents recognize that this is not an isolated issue; potential impacts from wastewater exist in all of the rural unincorporated communities and rural residential clusters in the project watershed that operate without treatment systems and may be discharging raw sewage into local streams and ditches.

Figure 15: Septic System Suitability of Rock Creek, HUC 0512010107

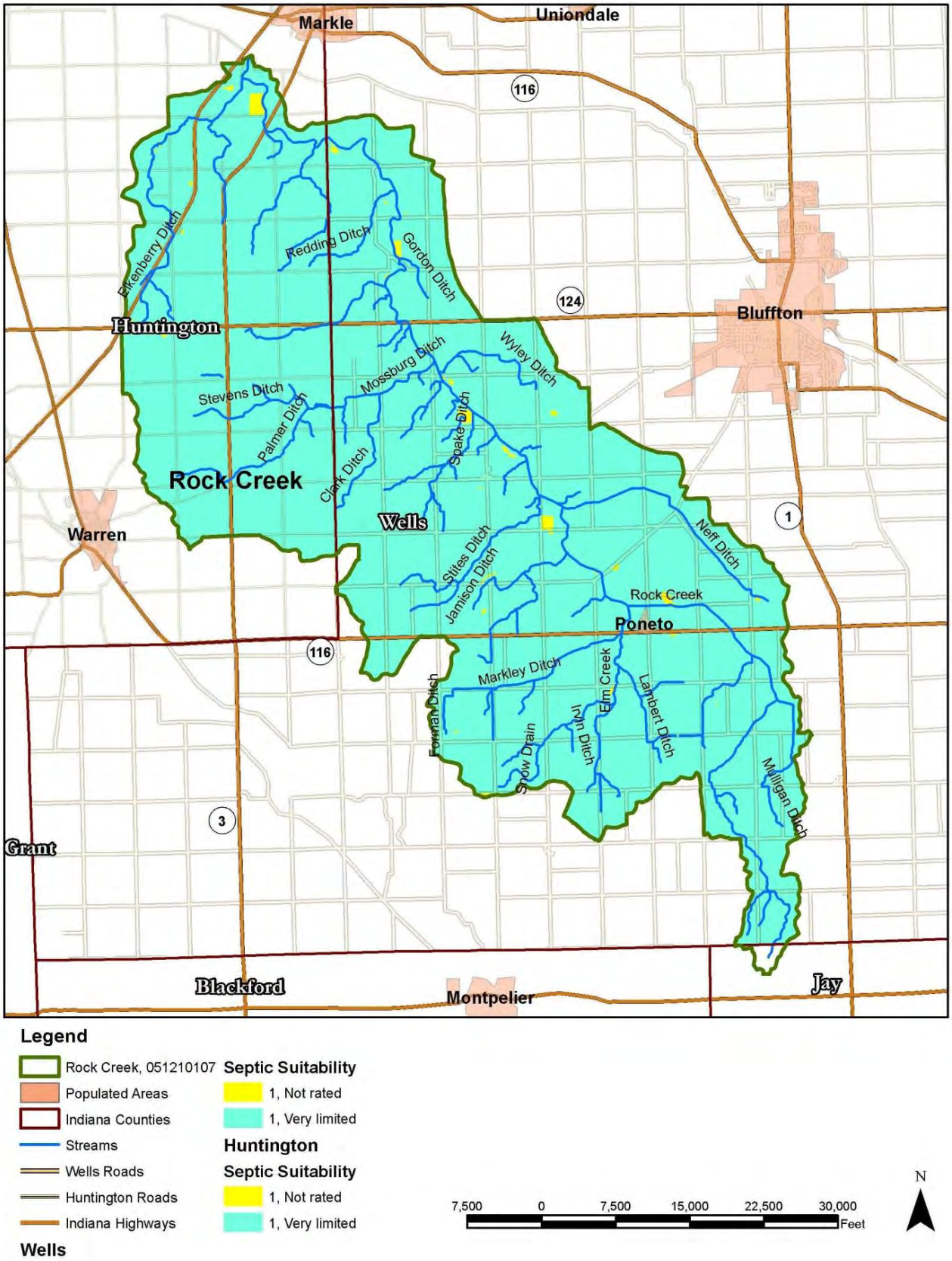


Figure 16: Septic System Suitability of Griffin Ditch-Wabash River, HUC 0512010108

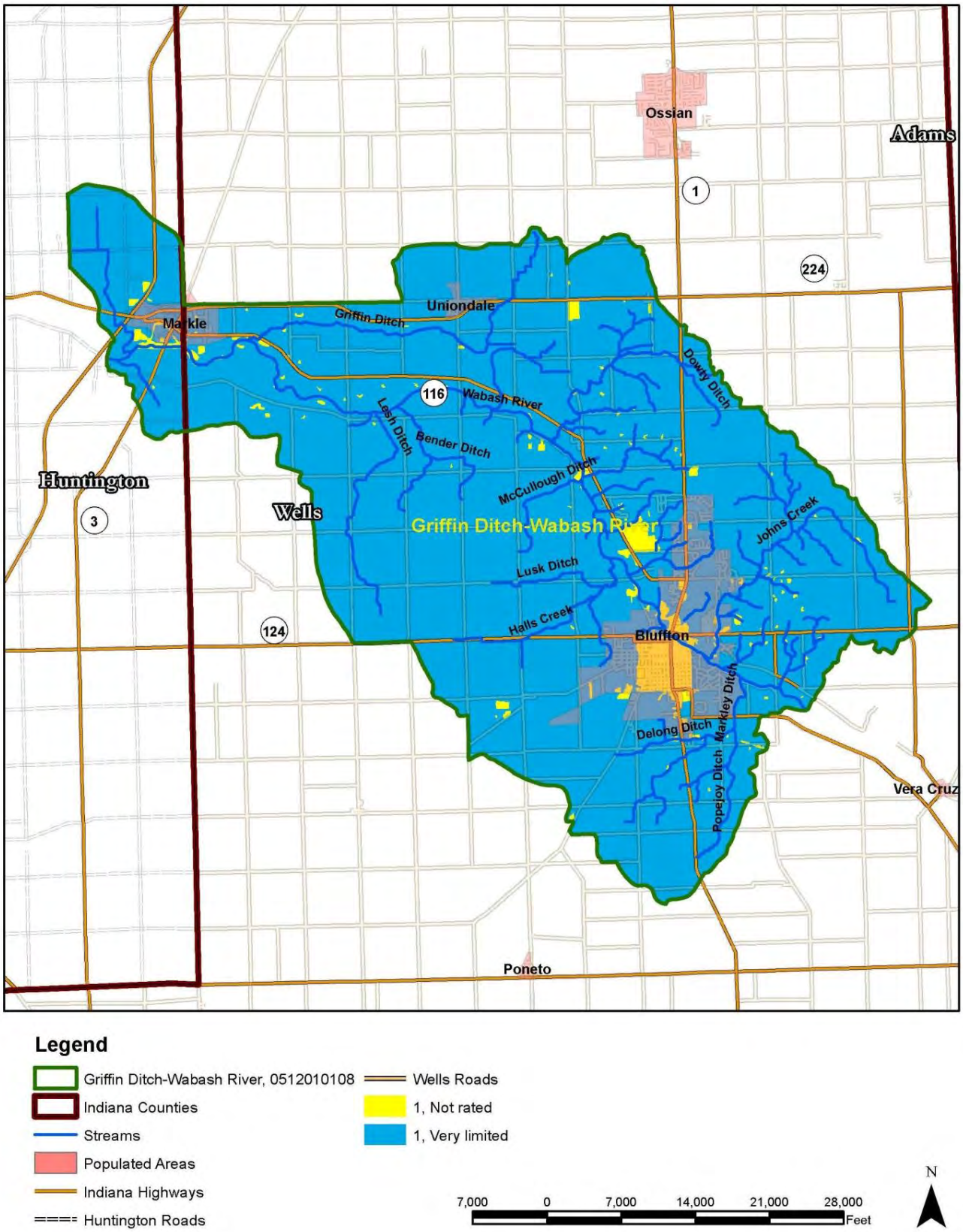
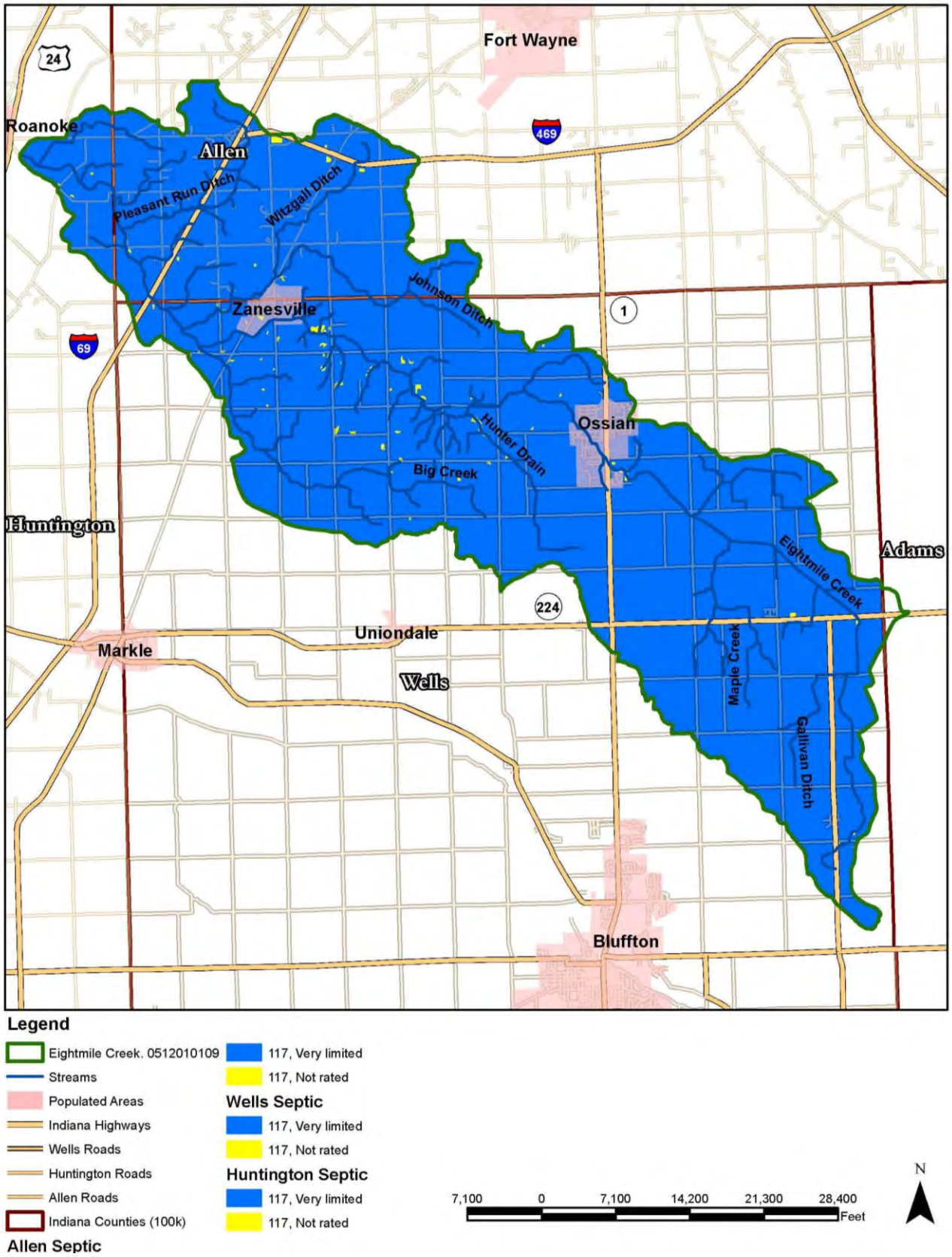


Figure 17: Septic System Suitability of Eight Mile Creek, HUC 0512010108



2.4 Land Use

Prior to settlement in the mid-1800s, much of the Upper Wabash River Basin watershed was covered in wetlands and woods. Land survey notes from the 1830's described the land generally as flat, heavily timbered, and some areas as wetlands. Other areas were recorded as tillable. The upland areas in the watershed were densely covered in sugar maple, oak, hickory, basswood, beech, yellow birch, American elm, ironwood, and red maple. Species such as silver maple, American elm, willow, basswood, sycamore, and ash were more abundant in the river corridors and low-lying marsh areas. The land was cleared by the early settlers as farming became the mainstay of the area.

It is apparent from the land use tables below (Table 2-4 and Table 2-5) that agricultural land uses continue to dominate the landscape with 150,104 acres (85.2%) of the watershed used for farming; and therefore sources associated with agricultural uses (erosion from fields, tile drainage, animal operations, fertilizer applications, failing or illicitly connected on-site septic systems) are likely significant contributors of pollutants to the watershed.

Only 8.36% of the watershed (14,739 acres) has been converted for residential, commercial or industrial land uses and the impervious surface area covers only about 3% of the watershed. Pollution sources associated with urban, suburban, and industrial land use include storm water runoff (lawn fertilizer and pesticides, pet waste, construction site activities, roads and parking lots), centralized and on-site wastewater treatment, combined sewer overflows and sanitary sewer overflows and industrial point-source outlets.

Over the years, the forests, woodlands and wetlands continued to be cleared for additional farming activities, and subsurface drainage was added as a necessity for improved crop production. Today, only 5.62% of the watershed (9,906 acres) is used for forests and woodlands and 659 acres (0.37%) of wetlands remain. Forest and woodland areas can contribute to pollution when wildlife (i.e., deer, raccoons, etc.) is concentrated in these areas and spend time in or around bodies of water.

Table 2-4: Land Use by Subwatershed and Project Area.

Land Use	Rock Creek HUC: 0512010107		Griffin Ditch-Wabash River HUC: 0512010108		Eight Mile Creek HUC: 0512010109		Upper Wabash River Phase 2 Project Area	
	Acres	%	Acres	%	Acres	%	Acres	%
Open Water	**140**	0.21	**380**	0.66	**196**	0.38	**716**	0.41
Developed, Open Space	**3,351**	5.04	**4,151**	7.17	**2,775**	5.37	**10,277**	5.84
Low Intensity Developed	**240**	0.36	**1,847**	3.20	**1,022**	1.98	**3,109**	1.77
Med Intensity Developed	**26**	0.03	**561**	0.97	**262**	0.51	**849**	0.48
High Intensity Developed	**2**	0.01	**394**	0.68	**108**	0.21	**504**	0.28
Deciduous Forest	**2,846**	4.27	**3,564**	6.17	**3,135**	6.07	**9,545**	5.42
Evergreen Forest	**2**	0.01	**36**	0.07	**9**	0.02	**47**	0.03
Shrub/Scrub	**95**	0.14	**127**	0.21	**92**	0.18	**314**	0.18
Grassland/Herbaceous	**346**	0.52	**838**	1.46	**909**	1.76	**2,093**	1.19
Pasture/Hay	**177**	0.27	**525**	0.92	**1,071**	2.07	**1,773**	1.01
Cultivated Crops	**59,354**	88.95	**44,908**	77.79	**41,976**	81.22	**146,238**	83.03
Woody Wetlands	**74**	0.11	**208**	0.36	**81**	0.15	**363**	0.20
Emergent Herbaceous Wetlands	**60**	0.09	**190**	0.32	**46**	0.08	**296**	0.16
TOTALS	**66,713**		**57,729**		**51,680**		**176,124**	

Source: USDA-NRCS State Office, Indianapolis, IN

Table 2-5: Land Use by Groups

Land Use Groups	Rock Creek HUC: 0512010107		Griffin Ditch-Wabash River HUC: 0512010108		Eight Mile Creek HUC: 0512010109		Upper Wabash River Phase 2 Project Area	
	Acres	%	Acres	%	Acres	%	Acres	%
Open Water	**140**	0.21	**380**	0.66	**196**	0.38	**716**	0.41
All Developed Areas	**3,619**	5.42	**6,953**	12.04	**4,167**	8.06	**14,739**	8.36
All Forest/Woodland Types	**2,943**	4.41	**3,727**	6.45	**3,236**	6.26	**9,906**	5.62
Agriculture Uses (Crops, Pasture/Hay, Grasslands)	**59,877**	89.75	**46,271**	80.15	**43,956**	85.05	**150,104**	85.22
All Wetland Types	**134**	0.20	**398**	0.68	**127**	0.24	**659**	0.37
TOTALS	**66,713**		**57,729**		**51,680**		**176,124**	

Figure 18: Land Use of Rock Creek, HUC0512010107

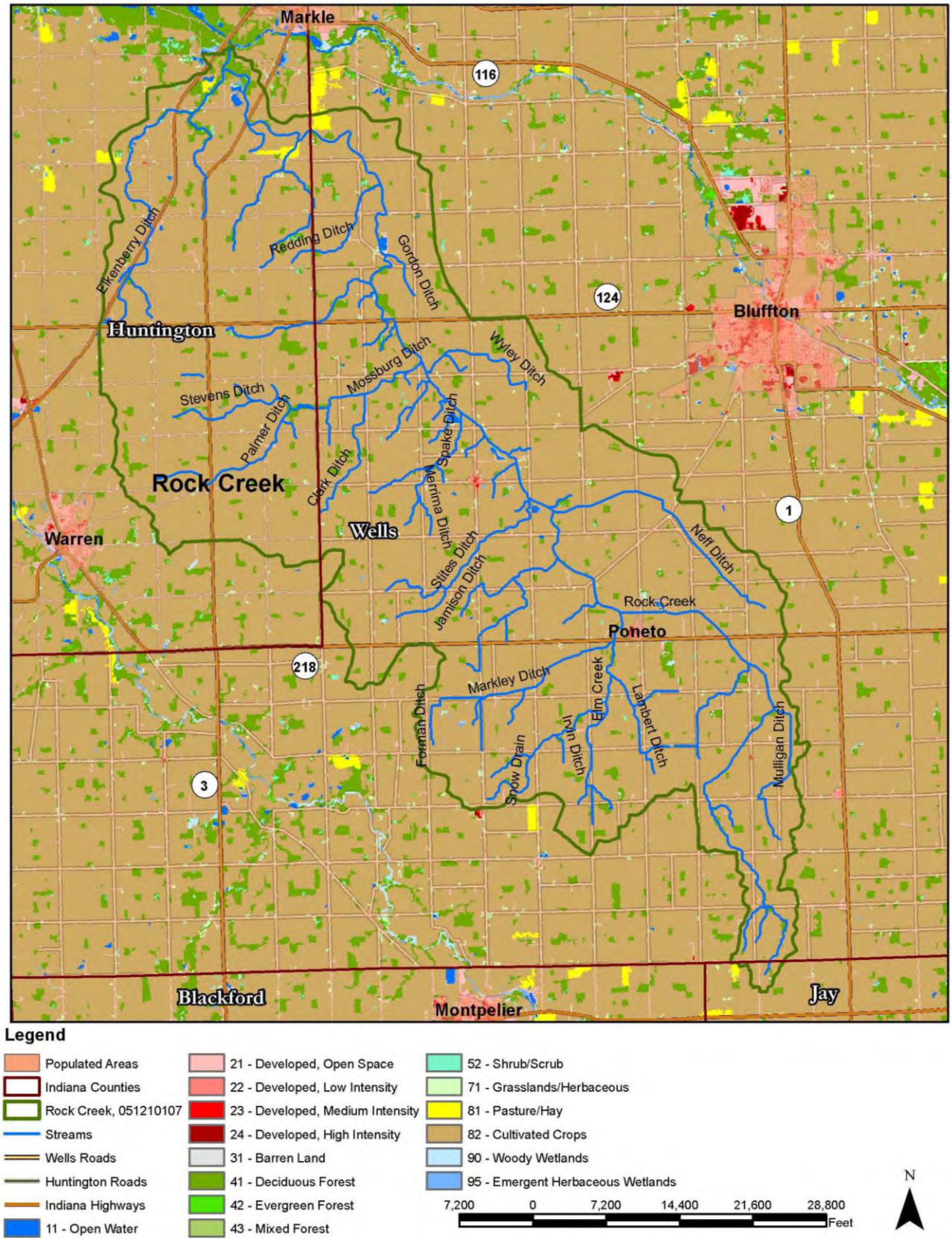


Figure 19: Land Use of Griffin Ditch-Wabash River, HUC0512010108

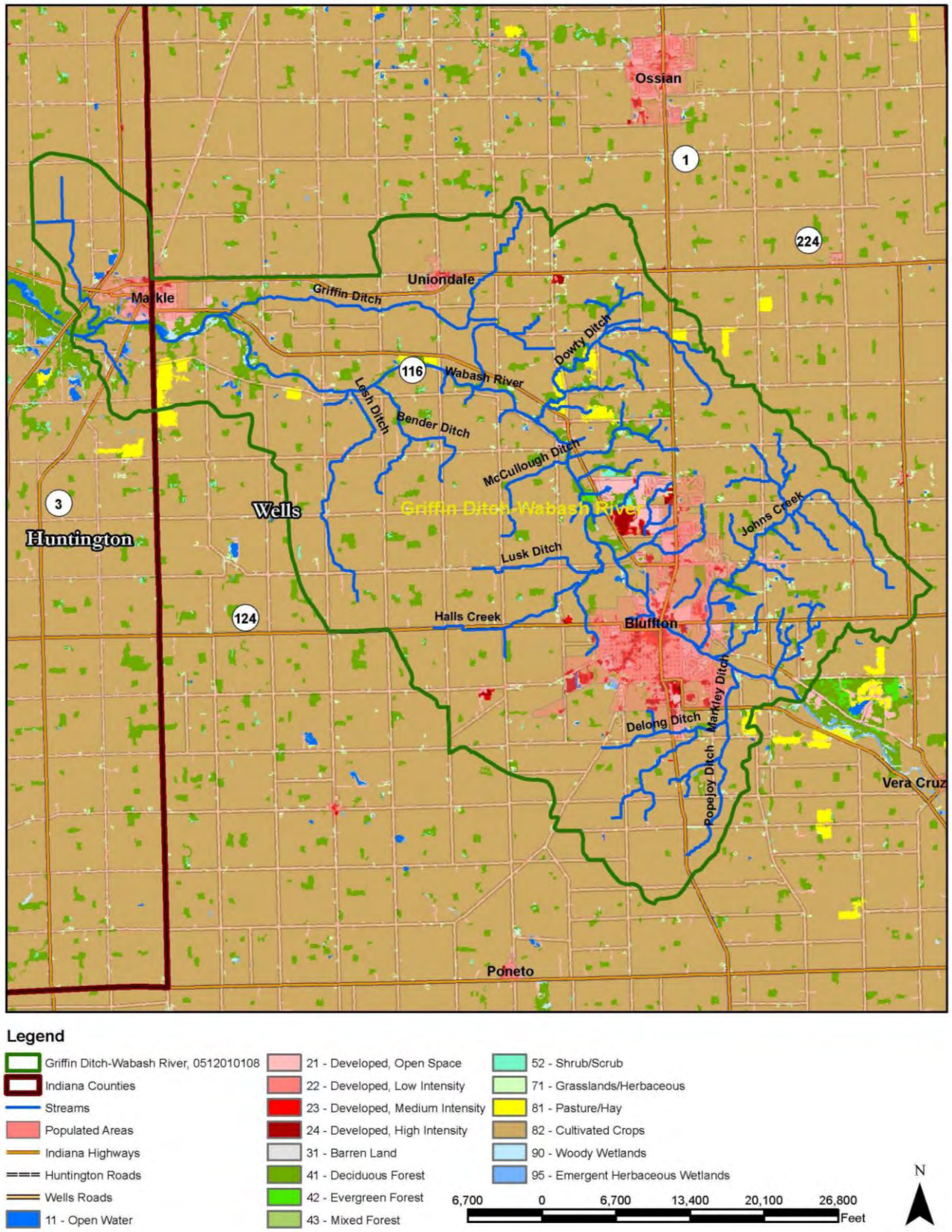
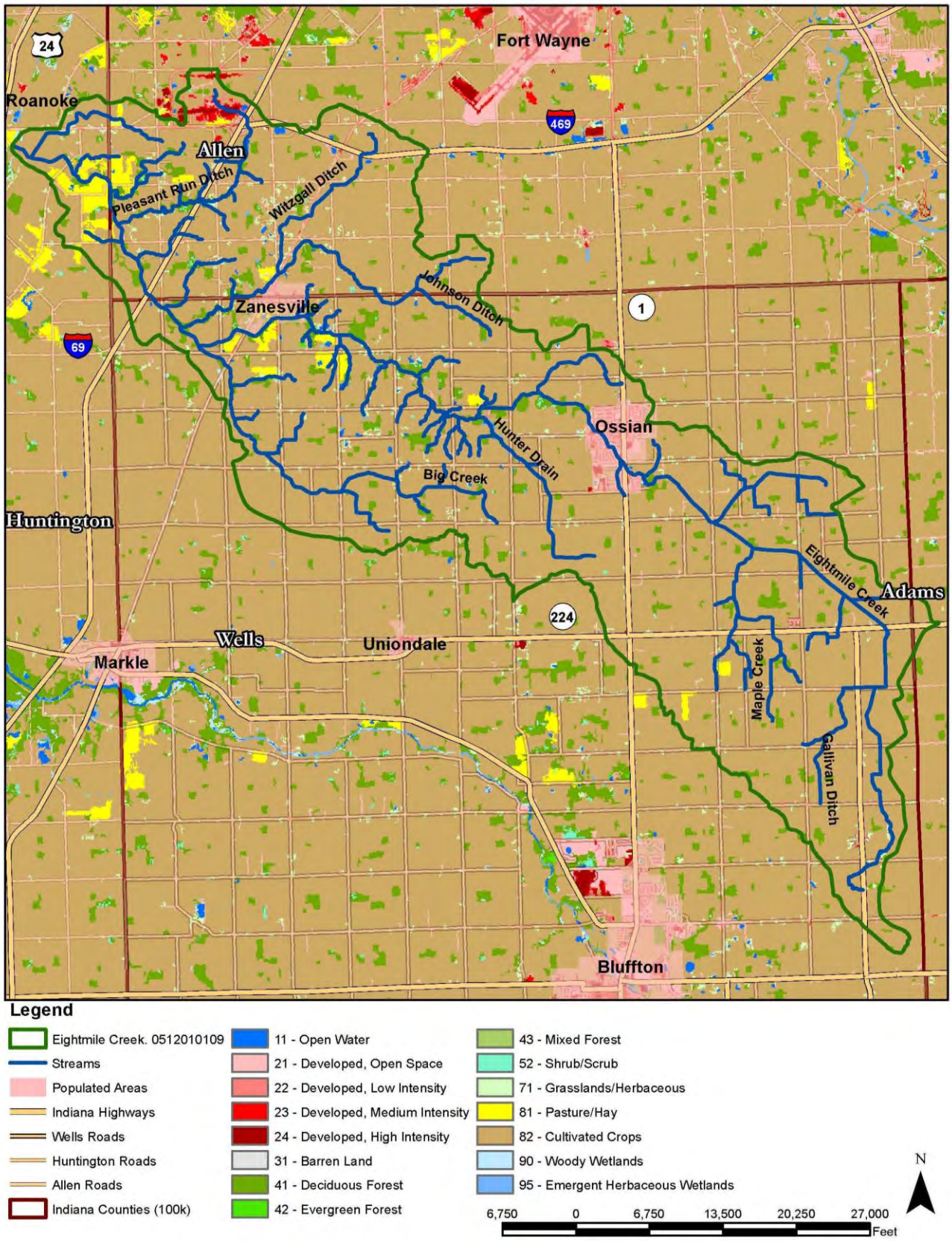


Figure 20: Land Use of Eight Mile Creek, HUC0512010109



Agricultural Uses

Farming continues to be the main enterprise in the watershed area. Corn, soybeans, and small grains are the major cultivated crops in the watershed, totaling 146,238 acres (83%). Grass, hay and pasture land account for an additional 3,866 acres (2.2%) of the agricultural activity.

Prime farmland, as defined by the USDA is the land that is best suited to food, feed, and forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland or other land, but it is not urban or built-up land or water areas. It is either used for food or fiber crops or is available for those purposes. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and results in the least damage to the environment. Approximately 95% of the watershed meets the requirements for "prime farmland if drained" (Figures 27, 28, and 29).

Livestock operations are also included in agricultural uses, with swine operations being the most common, but dairy cattle and poultry and some beef are also raised within the watershed area. A total of 32 sites are considered confined feeding operations (CFO's). Additionally, there are approximately 1,050 "hobby" farms in the project watershed area that include horses, cattle, hogs, sheep, goats, chickens and other small farm animals. Ensuring proper manure management has been listed as a concern by local stakeholders due to the probability that stockpiling and application practices are contributing nutrients to the local streams. (See Figures 24, 25, and 26 for map locations.)

With over 85% of the watershed used for farming and the desire for more productive farmland, the excavation and straightening of streams and installation of subsurface tile has been extensive in the project area. This has altered the water quantity, habitat structure and energy transfer within the streams, and speeds up the amount of surface water that reaches the ditches and streams in a shorter period of time. The increased flow within the stream increases the potential for in-stream erosion. Un-buffered tile inlets also provide a direct conduit for nutrients, sediments and pathogens to travel to the open streams and river resulting in a decrease in water quality. Additionally, as prime farmland is lost to other uses, it puts pressure on marginal lands for crop production that would be better suited for grasslands, woodlands or wetlands areas.

Figure 21: Prime Farmland of Rock Creek, HUC 0512010107

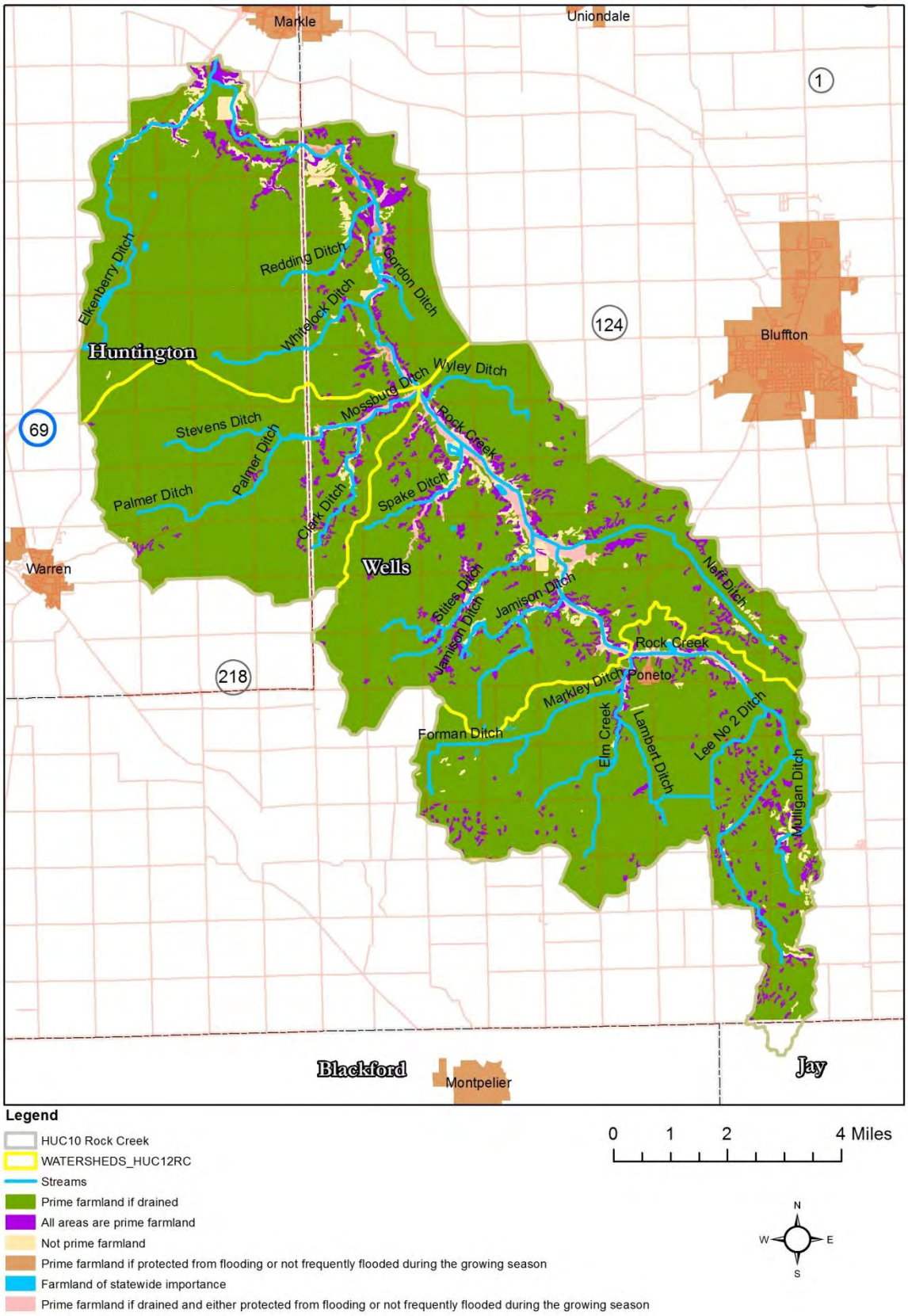


Figure 22: Prime Farmland of Griffin Ditch-Wabash River, HUC 0512010108

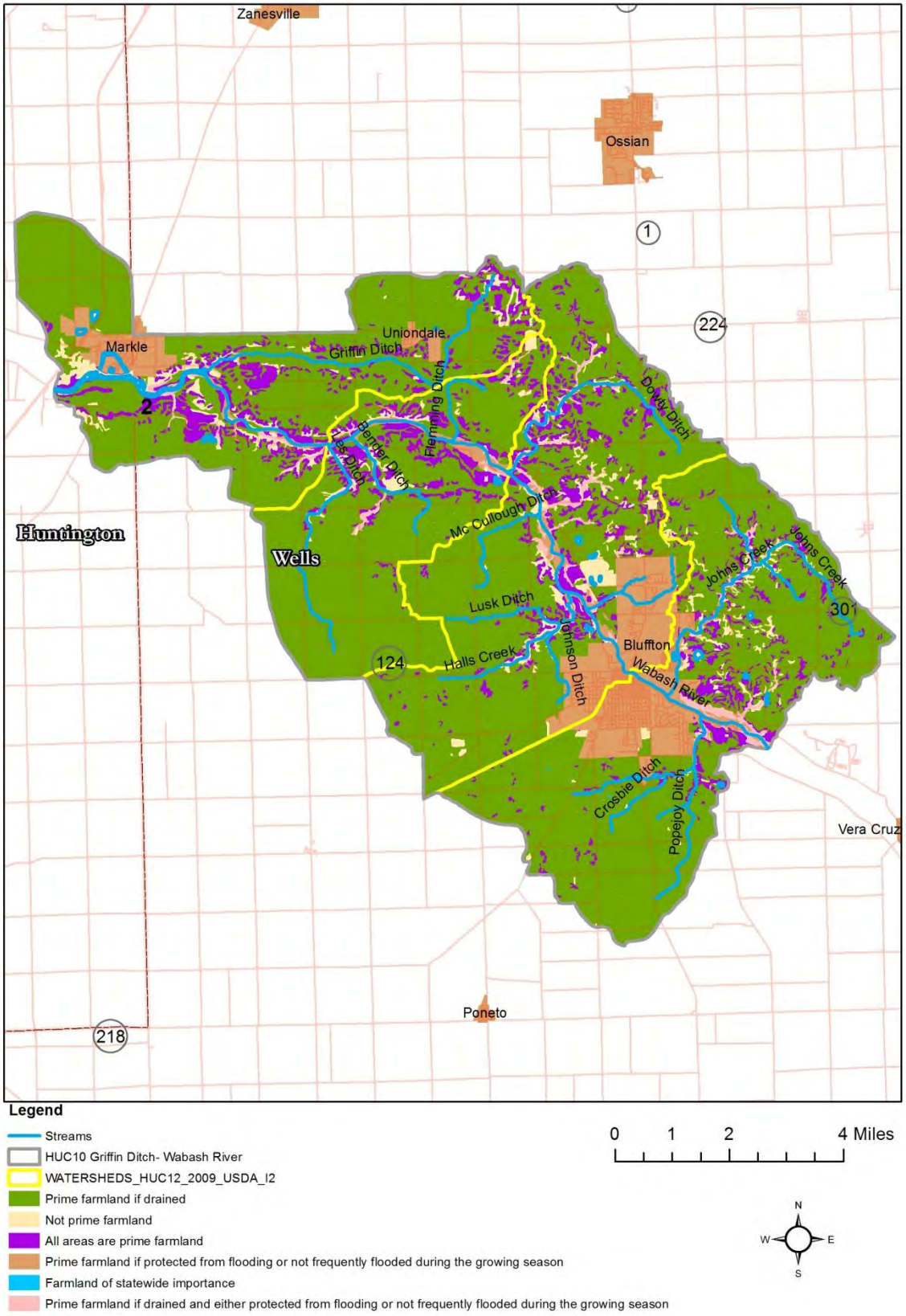


Figure 23: Prime Farmland of Eight Mile Creek, HUC 0512010109

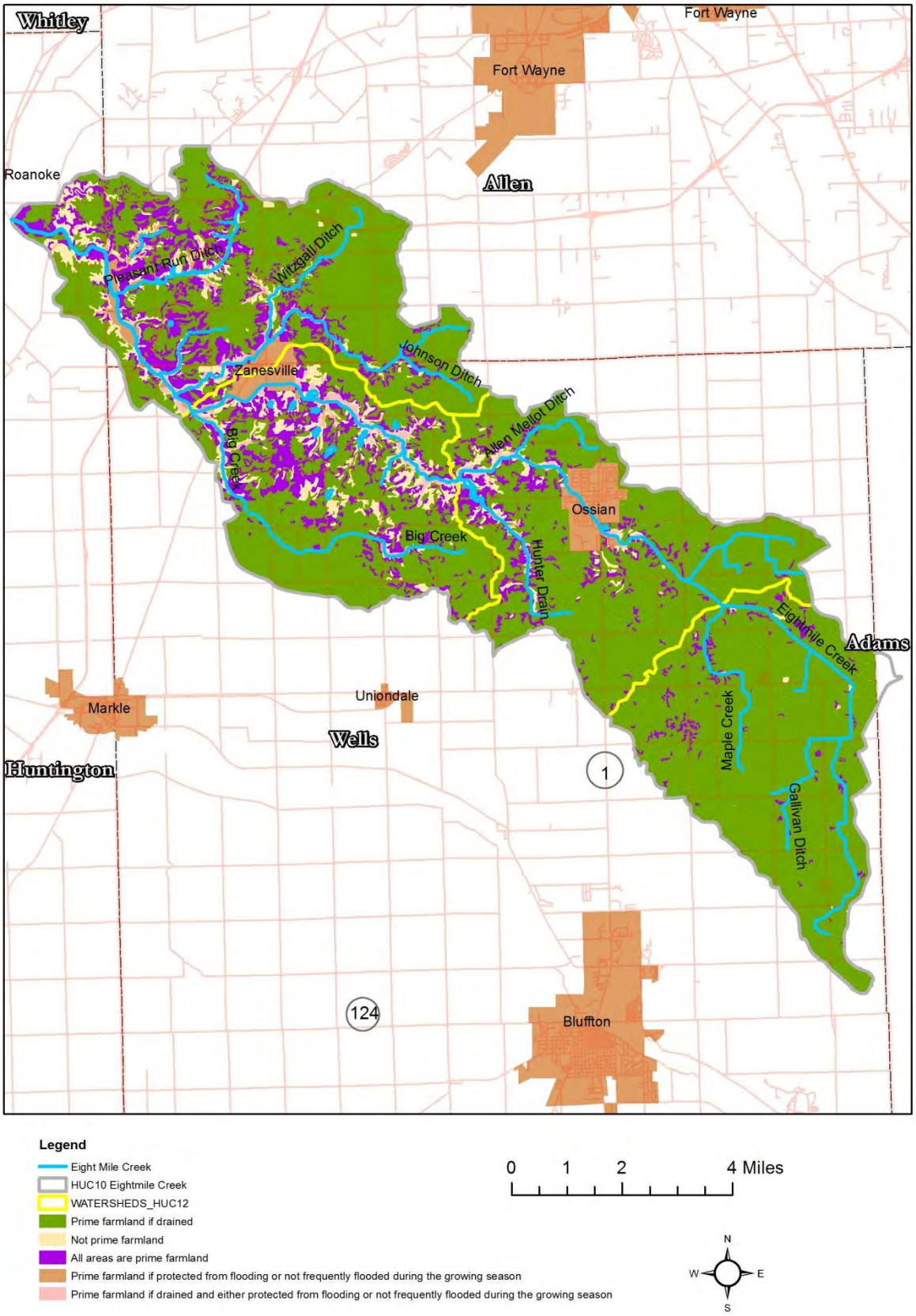


Figure 24: Confined Feeding Operations & Hobby Farms of Rock Creek, HUC 0512010107

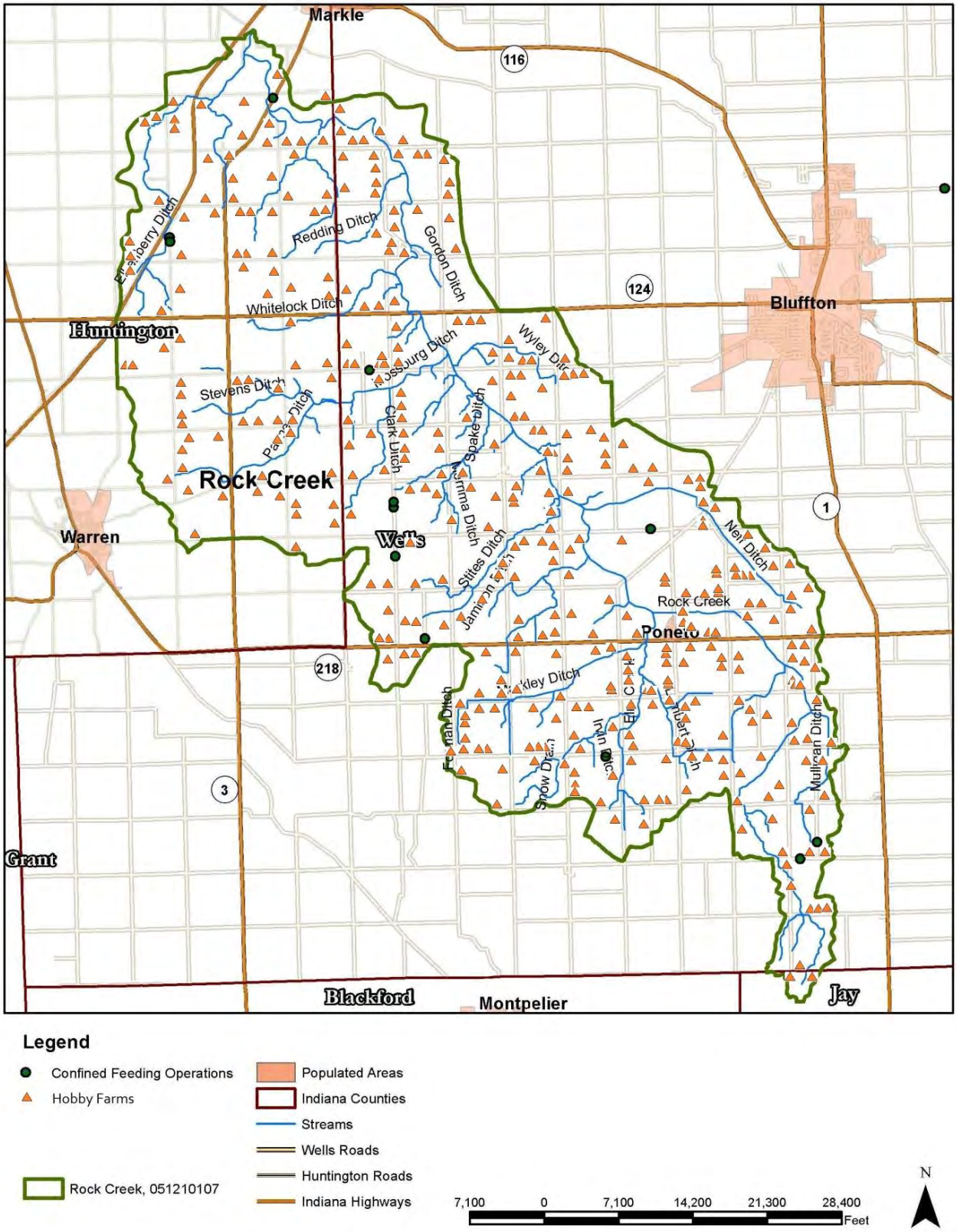


Figure 25: Confined Feeding Operations & Hobby Farms of Griffin Ditch-Wabash River, HUC 0512010108

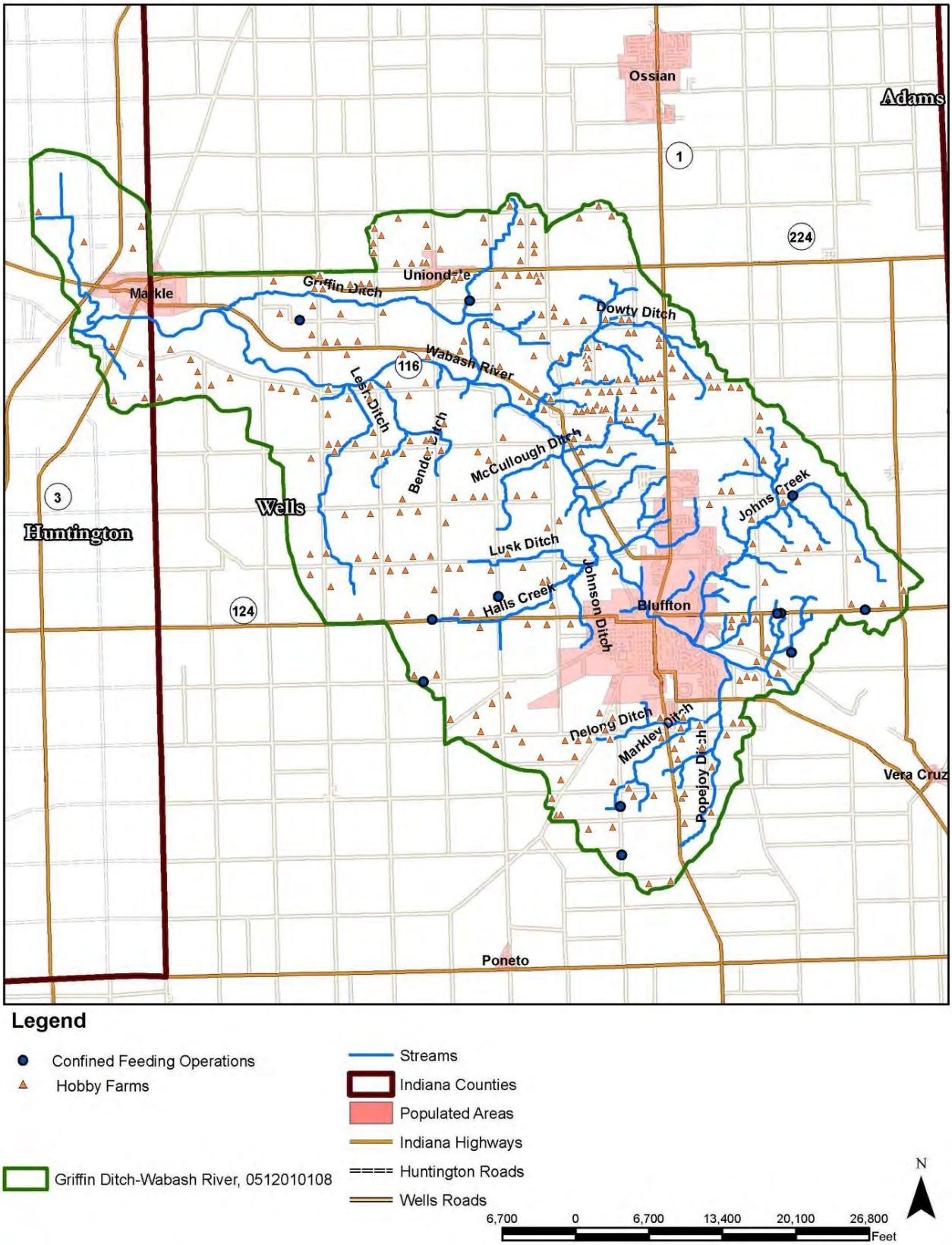


Figure 26: Confined Feeding Operations & Hobby Farms of Eight Mile Creek, HUC 0512010109

Urban Land Uses

The developed areas in the project area total only 14,739 acres, or 8.36% of the project watershed. The majority of the developed lands is within the City of Bluffton and towns of Ossian, Markle, Zanesville, Uniondale, and Poneto and includes single and multi-family housing, parks, golf courses, businesses, and industry. An area of high intensity development in the rural landscape is located in Allen County adjoining the I-69/I-469 interchange. This area contains large industrial sites, such as General Motors and Vera Bradley, as well as smaller industries that serve them. Construction in this area is generally on large parcels of ground in anticipation of future development.

Even though the amount of impervious surface in the watershed appears low, most of the development is along the Wabash River and the major streams (Rock Creek and Eight Mile). According to the Center for Watershed Protection's, '*Watershed Protection Techniques',* there is a direct relationship between the amount of impervious surface in a watershed and the quality and quantity of water found within that drainage area. Development surrounding the streams has the potential to produce significant impacts on the water quality of those streams. Stakeholders identified residential runoff from chemically treated lawns, construction site erosion causing sedimentation, runoff from streets and parking lots, and lack of green space as concerns relating to urban development.

National Pollution Discharge Elimination System (NPDES) Facilities

Other potential impacts to water quality exist in these urban communities due to the operation of facilities which treat wastewater and are permitted to discharge the treated effluent to local waterways. These facilities are regulated by the National Pollution Discharge Elimination System (NPDES) permits, and range from municipal sewer treatment plants (STP) to industrial waste dischargers.

The City of Bluffton, town of Ossian, and town of Markle operate traditional municipal waste water treatment plants (WWTP). The town of Zanesville is connected to a municipal sewer treatment system that is operated outside the watershed. The city of Bluffton municipal STP reported 11 sewer overflow/bypass discharges from 2011–2013. Of those incidents, three were discharges to the Wabash River while the remaining events were discharges to public and private lands. The town of Markle WWTP reported a bypass discharge of 0.5 million gallons/day from their equalization basins directly to the Wabash River in 2013 and two overflows in 2014. The town of Ossian WWTP reported four sewer discharges in 2013 to the Eight Mile Creek.

The town of Uniondale and town of Poneto have wetland sewer treatment systems. Uniondale's wetland system discharges to the Griffin Ditch, a tributary of the Wabash River; and Poneto's wetland system discharges to the Rock Creek. Both of these wetland waste water treatment systems had compliance issues in 2014. The town of Uniondale exceeded the discharge permit limit for *E. coli* on one occasion due to possible equipment malfunctions, and has regularly been above the discharge levels for Phosphorus. An inspection at the Poneto wetland treatment system in the spring of 2014 revealed an overflow at that site. Due to the reported sewer overflow/bypass discharges, stakeholders remain concerned that these facilities add sewage, nutrients and bacteria into the streams.

Other NPDES sites in the watershed include two closed landfills, two active stone quarries, a number of industrial waste sites, open dumps and remediation sites. The landfills are located along the Rock Creek and Eight Mile creek. These sites are closed landfills and they are continuously monitored, however concern still exists with area residents that due to their locations they may be contributing contaminants to the streams. The stone quarries are located in the Rock Creek and Wabash-Griffin Ditch watersheds. One is adjacent to and discharges directly into the Rock Creek and the second one discharges into a tributary of the Wabash River. Even though these sites have NPDES permits, stakeholders are concerned that contaminants from the operations pose a risk to water quality of the nearby streams and landscape changes increase runoff and stream flow resulting in increased erosion. Table 2-6 details the NPDES facilities, industrial waste sites, clean-up sites, open dumps and landfills that are mapped on Figures 27 - 29.

Table 2-6: NPDES Facilities

Map ID	Permit Number	Facility Name & Flow (if applicable)	Activity Description	Discharges To
RC 01	0000064	Rockford Wells	Clean up Site	Rock Creek
RC 02	ING490112	Rock Creek Materials LLC	Stone Quarry	Rock Creek
RC 03	200209054	IN DOT Plumtree	Clean up Site	Rock Creek via Mossburg Ditch
RC 04	90-02	South Wells County Landfill	Closed Landfill	Rock Creek
RC 05	IN0059048	Poneto Municipal STP 0.024 Mil Gal/Day	Sewage Treatment	Rock Creek
WG 01	199711027	Hott	Clean up Site	Wabash River
WG 02	IND005456173	Wayne Metal Products Co. Inc.	Industrial Waste	Markle Waste Water Treatment Plant - Wabash River
WG 03	199803220	All Seasons Industries Inc.	Clean up Site	Wabash River
WG 04	IN0023736	Markle WWTP 0.45 Mil Gal/Day	Municipal WWTP	Wabash River
WG 05	IN0051098	Uniondale WWTP 0.0223 Mil Gal/Day	Municipal WWTP	Wabash River via Griffin Ditch
WG 06	ING490017	IMI Bluffton Plant	Stone Quarry	Wabash River
WG 07	IN0022411	Bluffton Municipal STP 6.0 Mil Gal/Day	Municipal Sewage Treatment	Wabash River
WG 08	4080510	Red Cross	Brownfield Site	Wabash River
WG 09	IND984875740	Crown Unlimited Inc.	Industrial Waste	Wabash River
WG 10	IND984897520	Crown Unlimited	Industrial Waste	Wabash River
WG 11	IND005080965	Sterling Casting Corp	Industrial Waste	Wabash River
WG 12	INP000277	Alexin LLC 0.076 Mil Gal/Day	NPDES facility	Bluffton Municipal STP - Wabash River
WG 13	IND985085745	Main Cleaners	Industrial Waste	Wabash River
WG 14	201119674	The Main Cleaners	Clean up Site	Wabash River

Map ID	Permit Number	Facility Name & Flow (if applicable)	Activity Description	Discharges To
WG 15	IND985091545	OK Modern Cleaners	Industrial Waste	Wabash River
WG 16	IN0036668 - Terminated	Sterling Casting Corp	Gray & Ductile Iron Foundries	Wabash River
WG 17	IND984897694	Hires Auto Parts	Industrial Waste	Wabash River
WG 17	IND984919316	Ten Kwik Minutes Inc. Bluffton	Industrial Waste	Wabash River
WG 17	IND984876193	Hiday Motors Inc.	Industrial Waste	Wabash River
WG 18	IND984875872	Reimschisel Ford Inc.	Industrial Waste	Wabash River
WG 19	IND984887786	CVS Pharmacy	Industrial Waste	Wabash River
WG 20	IND982608796	Biberstine Tire Inc.	Industrial Waste	Wabash River
WG 21	4070307	Bluffton Motor Works LLC	Brownfield Site	Wabash River
WG 22	IND061574869	Franklin Electric Co. Inc.	Industrial Waste	Bluffton Municipal STP – Wabash River
WG 23	IN0033294 - Terminated	Bluffton Sewage Treatment Plant	Municipal Sewage Treatment	Wabash River
WG 24	IN0004596	Bluffton Public Water Supply 0.07 Mil Gal/Day	Water Supply Treatment	Wabash River
WG 25		Bluffton Public Water Supply	Water Supply Treatment	Wabash River
WG 26	200705003	Marengwer Trailer Park	Clean up Site	Wabash River
EM 01	IND982211013	Fort Wayne Fleet Equipment Co.	Industrial Waste	Eight Mile
EM 02	IND115304594	General Motors Co. Fort Wayne Assembly	Industrial Waste	Eight Mile
EM 03	IND065545949	D&D Body Shop	Industrial Waste	Eight Mile
EM 04	20000530A	Bailey Open Dump	Open Dump	Eight Mile
EM 05	IND984886697	Energy Control, Inc.	Industrial Waste	Eight Mile
EM 06	IN0004294 - Terminated	Ossian Canning Co.	Canning Facility	Eight Mile
EM 07	IN0020745	Town of Ossian WWTP 0.9 Mil Gal/Day	Municipal WWTP	Eight Mile
EM 08	IN0001334275	JRP Machine Products	Industrial Waste	Eight Mile
EM 09	INP000278 - Terminated	Dawn Food Products 0.004 Mil Gal/Day	Food Preparations	Ossian POTW - Eight Mile
EM 10	IND115304768	Johnson Controls, Inc.	Industrial Waste	Eight Mile
EM 11	000008797880	Stripease	Industrial Waste	Eight Mile
EM 12	90-01	North Wells Landfill	Closed Landfill	Eight Mile

Figure 27: NPDES Facilities of Rock Creek, HUC 0512010107

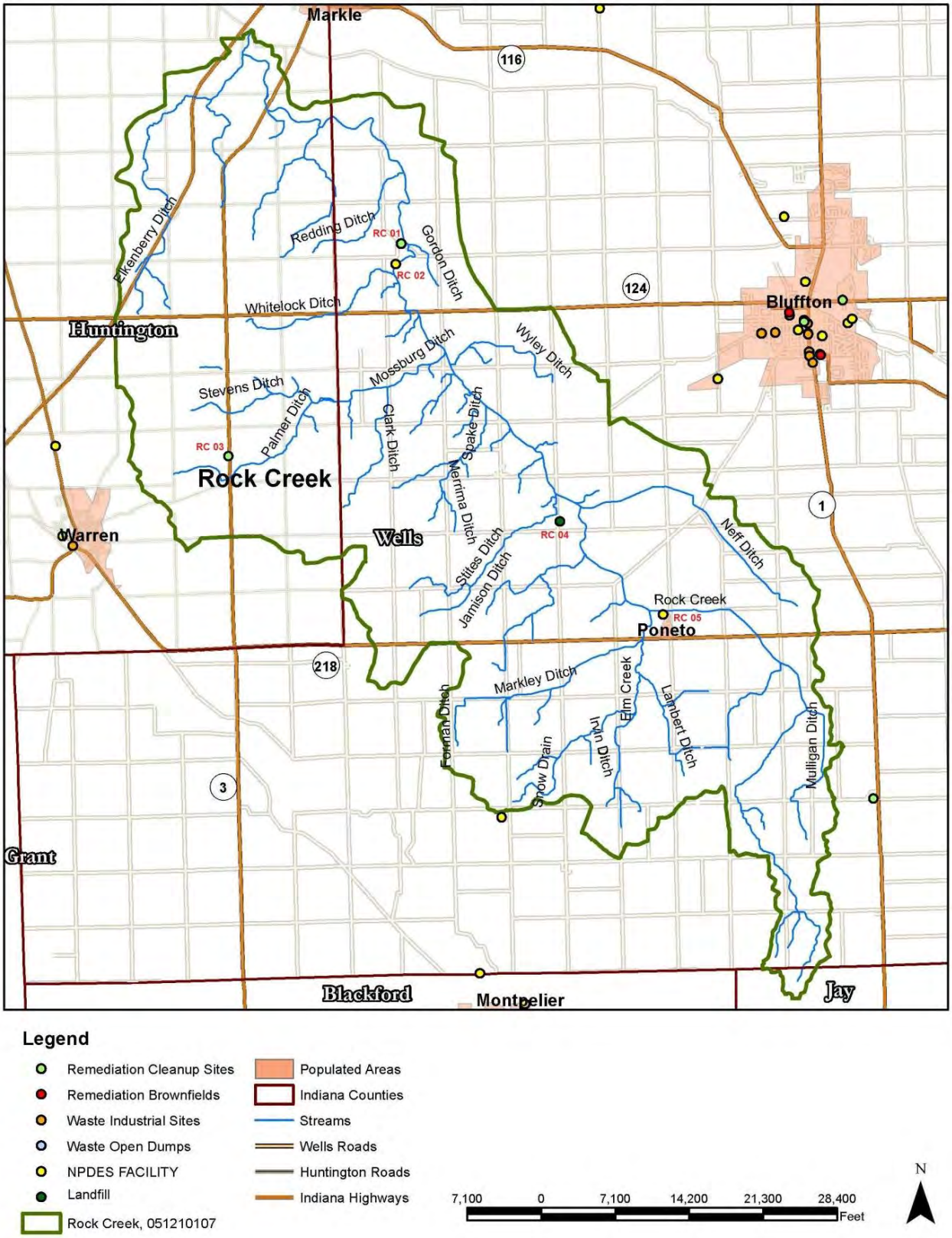


Figure 28: NPDES Facilities of Griffin Ditch-Wabash River, HUC 0512010108

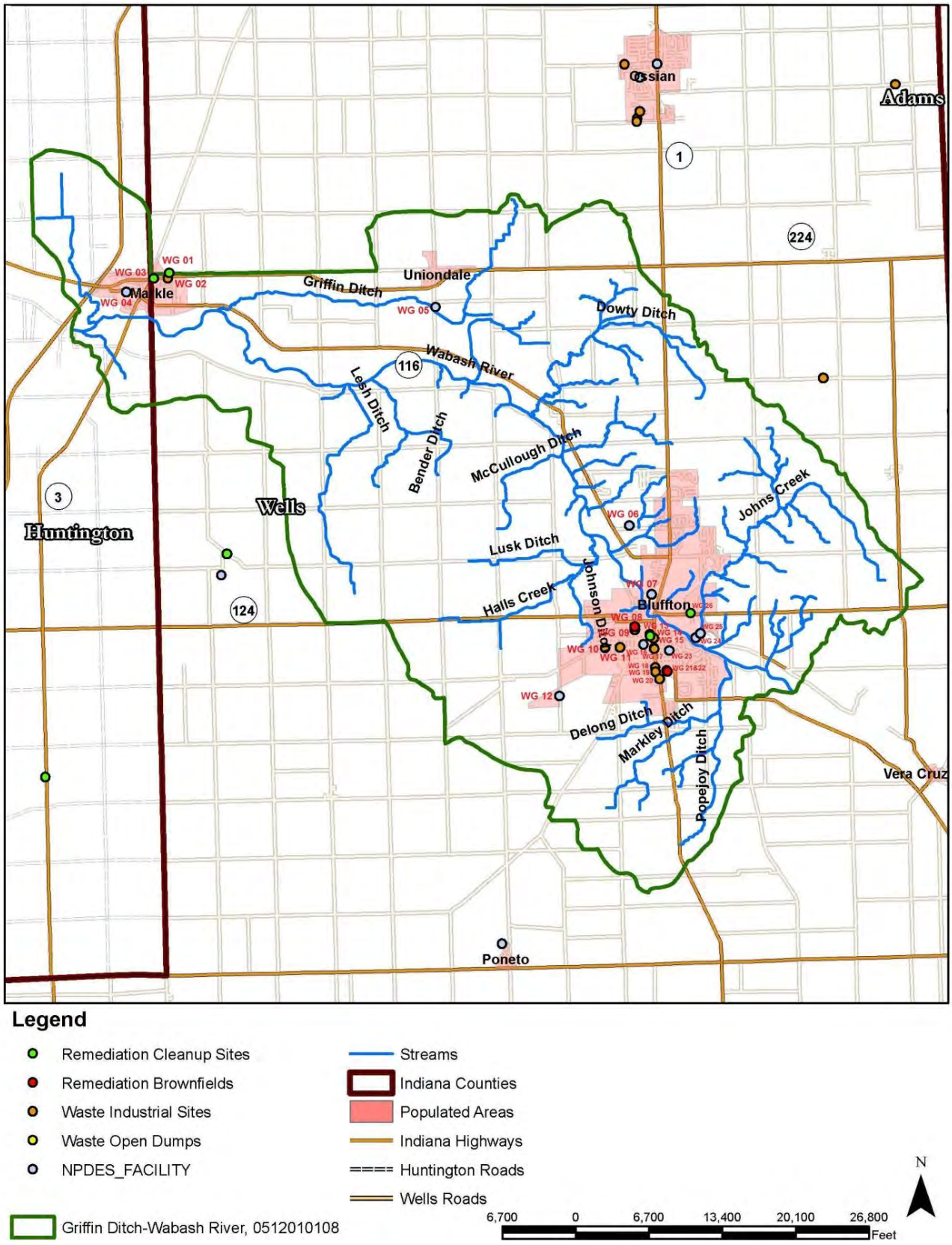
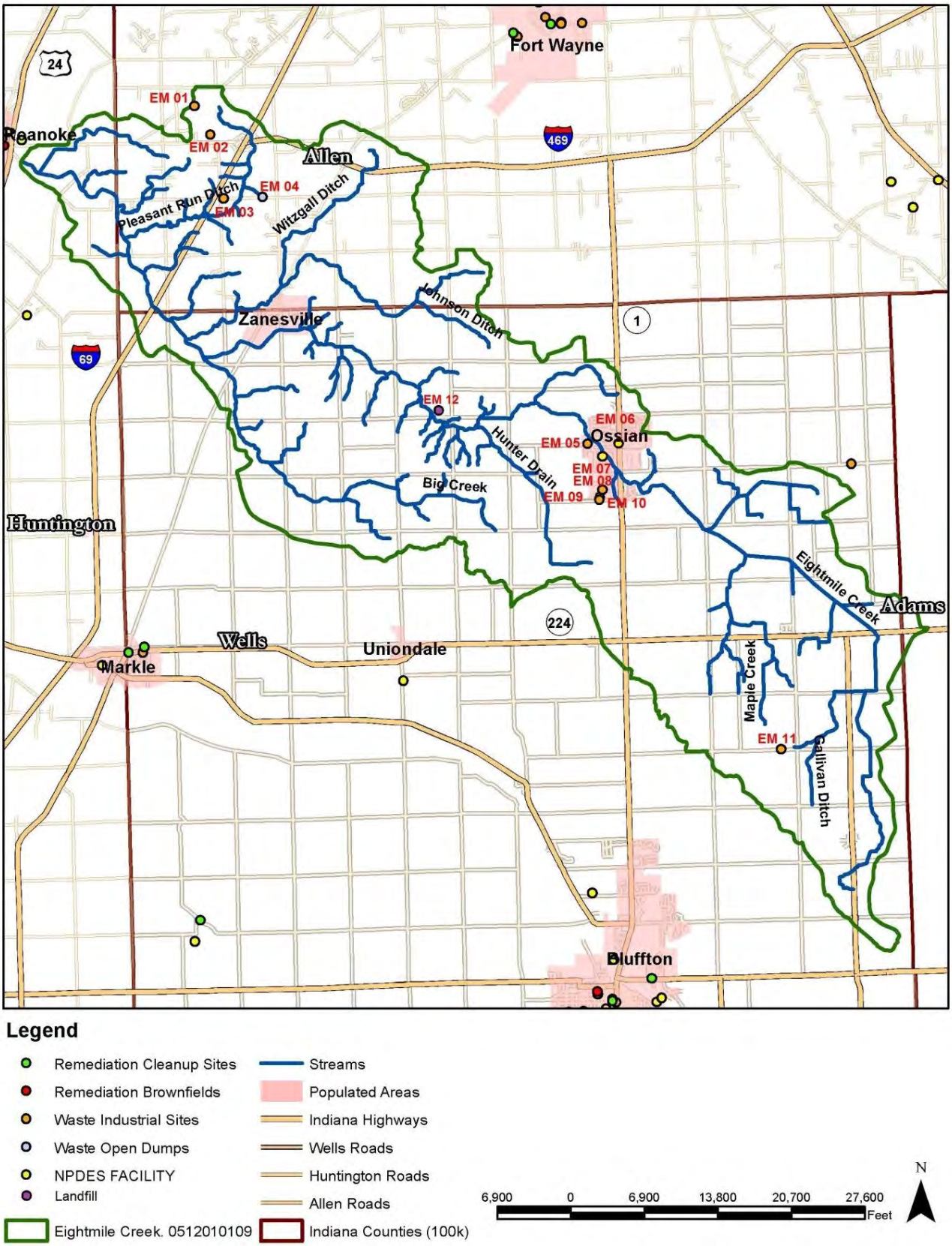


Figure 29: NPDES Facilities of Eight Mile Creek, HUC 0512010109



Other Land Uses

Forests, woodlands and wetlands in the project area account for around 6% of the watershed (10,565 acres). The forest land base is highly fragmented due to agriculture and development; and the majority of wetlands are located in the woodland areas that have not been cleared for crop production or in the floodplains adjacent to the streams and river. Healthy woodlands and wetlands perform valuable water quality-related functions by filtering water and trapping sediments and pollutants from surface runoff and retain sediment during flooding events. These systems offer green space, improve water quality, and buffer the streams or river from adjacent land uses. The lack of forested riparian areas and stream buffers increases the potential for sediment and nutrients to reach the river and streams. Additionally, wildlife habitat is decreased, which can result in a decline in the diversity of the wildlife throughout the watershed.

There are a few recreational and/or protected areas in the watershed; Acres Along the Wabash and the Hammer Nature Preserve (Anna Brand Hammer) owned by Acres Land Trust, the City of Bluffton Wetland area, and the J.E. Roush Nature Preserve managed by the Indiana Department of Natural Resources.

Stakeholder Concerns by Land Use

The list of stakeholder concerns gathered during initial meetings has been evaluated and compared to the major land uses in the watershed where they most commonly occur. This comparison will aid in identifying goals to improve water quality in the watershed.

Table 2-7: Stakeholder Concerns by Land Use

Stakeholder Concern	Agriculture & Livestock	Rural	Urban
Log jams and debris in the river and streams.	X	X	X
Encourage 2-stage ditches.	X	X	X
Flooding along the river and streams.	X	X	X
In-stream and stream bank erosion causing sedimentation.	X	X	X
Agriculture fertilizer (nitrogen and phosphorus) runoff into streams.	X		
Manure management; stockpiling and application practices.	X		
Tillage to the edge of stream banks, no filter strips or riparian area.	X		
Conservation tillage has low adoption rates.	X		
Lack of buffers and filter strips on streams.	X	X	X
Residential runoff from chemically treated lawns (fertilizers and pesticides).		X	X
Construction Site (and road construction) erosion causing sedimentation.		X	X
High *E. coli* levels.	X	X	X
Failing septic systems, severely limiting soils, lack of maintenance.		X	X
Wastewater treatment in unincorporated communities.		X	
Runoff from asphalt streets and parking lots.			X
Wetland drained and forests cleared.	X	X	X
Lack of green space and trails.			X
Dumping, trash in river and streams.		X	X

2.5 Rare, Threatened and Endangered Plants and Animals

The loss of habitat from human activities; such as streamside deforestation, removal of fence rows, loss of grass lands, conversion of forested land for agriculture development, pesticide use, stream flow alterations, and siltation all contribute to a species being listed as rare, threatened and endangered. Stakeholders have identified the removal of forest and wetlands, and the lack of riparian areas, buffers and filter strips as concerns in the project area; all of which can contribute to a species listing.

According to the Indiana Department of Natural Resources Division of Nature Preserves there are a number of endangered, threatened and rare plants and animals that have been identified in Wells, Allen and Huntington Counties and could be within the watershed area, however a detailed field study was not conducted to verify their actual presence.

A number of mussels have been observed in the Wabash River, Rock Creek and Eight Mile Creek waterways, but a field study by experts will need to be conducted to identify the species. Great Blue Herons are abundant in project area and roost near the local streams. Bald Eagles which are listed as threatened and of special concern have been seen migrating from the J.E. Roush Fish and Wildlife Area upstream along the Wabash River corridor to Bluffton.

Table 2-8: Endangered, Threatened and Rare Species List for Allen, Huntington, and Wells Counties

County	Species Name	Common Name	Fed	State	GRank	SRank
	Mollusk: Bivalvia (Mussels)					
Allen	Epioblasma obliquata perobliqua	White Cat's Paw Pearlymussel	LE	SE	G1T1	SX
Allen, Huntington, Wells	Epioblasma torulosa rangiana	Northern Riffleshell	LE	SE	G2T2	SX
Huntington, Wells	Epioblasma triquetra	Snuffbox	LE	SE	G3	S1
Allen, Huntington	Lampsilis fasciola	Wavyrayed Lampmussel		SSC	G5	S3
Allen, Huntington	Ligumia recta	Black Sandshell			G5	S2
Allen, Huntington	Obovaria subrotunda	Round Hickorynut		SSC	G4	S1
Allen, Huntington, Wells	Pleurobema clava	Clubshell	LE	SE	G2	S1
Allen, Huntington, Wells	Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Allen, Huntington, Wells	Quadrula cylindrica cylindrica	Rabbitsfoot	C	SE	G3G4T 3	S1
Allen, Huntington, Wells	Toxolasma lividus	Purple Lilliput		SSC	G3	S2
Allen, Huntington	Villosa fabalis	Rayed Bean	LE	SSC	G2	S1
	Insect: Odonata (Dragonflies & Damselflies)					
Wells	Macromia wabashensis	Wabash River Cruiser		SE	G1G3Q	S1
Allen	Tachopteryx thoreyi	Gray Petaltail		SR	G4	S2S3
	Fish					
Allen, Huntington	Moxostoma valenciennesi	Greater Redhorse		SE	G4	S2
Allen	Percina evides	Gilt Darter		SE	G4	S1
	Amphibian					
Allen	Ambystoma laterale	Blue-spotted Salamander		SSC	G5	S2
Allen	Hemidactylium scutatum	Four-toed Salamander		SSC	G5	S2
Allen, Wells	Rana pipiens	Northern Leopard Frog		SSC	G5	S2
	Reptile					
Allen	Clemmys guttata	Spotted Turtle		SE	G5	S2
Allen, Wells	Clonophis kirtlandii	Kirtland's Snake		SE	G2	S2
Allen	Emydoidea blandingii	Blanding's Turtle		SE	G4	S2
Wells	Nerodia erythrogaster neglecta	Copperbelly Water Snake	PS:LT	SE	G5T3	S2
Allen, Wells	Sistrurus catenatus catenatus	Eastern Massasauga	C	SE	G3G4 T3T4Q	S2

County	Species Name	Common Name	Fed	State	GRank	SRank
	Bird					
Allen, Huntington, Wells	Ardea herodias	Great Blue Heron			G5	S4B
Allen	Asio flammeus	Short-eared Owl		SE	G5	S2
Allen, Wells	Bartramia longicauda	Upland Sandpiper		SE	G5	S3B
Allen, Huntington	Buteo lineatus	Red-shouldered Hawk		SSC	G5	S3
Allen	Buteo platypterus	Broad-winged Hawk	No Status	SSC	G5	S3B
Allen	Certhia americana	Brown Creeper			G5	S2B
Allen	Circus cyaneus	Northern Harrier		SE	G5	S2
Huntington	Cistothorus palustris	Marsh Wren		SE	G5	S3B
Allen	Dendroica cerulea	Cerulean Warbler		SE	G4	S3B
Allen	Falco peregrinus	Peregrine Falcon	No Status	SE	G4	S2B
Allen, Huntington	Haliaeetus leucocephalus	Bald Eagle	LT, PDL	SSC	G5	S2
Allen, Huntington	Ixobrychus exilis	Least Bittern		SE	G5	S3B
Allen	Lanius ludovicianus	Loggerhead Shrike	No Status	SE	G4	S3B
Allen	Nyctanassa violacea	Yellow-crowned Night-heron		SE	G5	S2B
Allen, Huntington	Nycticorax nycticorax	Black-crowned Night-heron		SE	G5	S1B
Huntington	Phalacrocorax auritus	Double-crested Cormorant		SX	G5	SHB
Allen	Phalaropus tricolor	Wilson's Phalarope		SSC	G5	SHB
Huntington	Rallus limicola	Virginia Rail		SE	G5	S3B
Allen, Huntington	Sturnella neglecta	Western Meadowlark		SSC	G5	S2B
Allen	Tyto alba	Barn Owl		SE	G5	S2
Allen, Huntington	Wilsonia citrina	Hooded Warbler		SSC	G5	S3B
	Mammal					
Huntington	Mustela nivalis	Least Weasel		SSC	G5	S2?
Huntington, Wells	Myotis sodalis	Indiana Bat or Social Myotis	LE	SE	G2	S1
Allen, Huntington	Taxidea taxus	American Badger		SSC	G5	S2
	Vascular Plant					
Allen, Wells	Andromeda glaucophylla	Bog Rosemary		SR	G5	S2
Wells	Arethusa bulbosa	Swamp pink		SX	G4	SX
Allen, Wells	Armoracia aquatica	Lake Cress		SE	G4?	S1
Wells	Carex arctata	Black Sedge		SE	G5?	S1
Wells	Carex echinata	Little Prickly Sedge		SE	G5	S1
Wells	Carex limosa	Mud Sedge		SE	G5	S1
Allen	Chelone obliqua var. speciosa	Rose Turtlehead		WL	G4T3	S3
Allen	Circaea alpina	Small Enchanter's Nightshade		SX	G5	SX
Allen, Huntington	Coeloglossum viride var. virescens	Long-bract Green Orchis		ST	G5T5	S2
Wells	Crataegus kelloggii	Kellogg Hawthorn		SE	G3?	S1
Allen	Crataegus succulenta	Fleshy Hawthorn		SR	G5	S2
Wells	Eriophorum gracile	Slender Cotton-grass		ST	G5	S2
Allen, Wells	Euphorbia obtusata	Bluntleaf Spurge		SE	G5	S1
Huntington, Wells	Fragaria vesca var. americana	Woodland Strawberry		SE	G5T5	S1
Huntington	Juglans cinerea	Butternut		WL	G4	S3
Allen	Phlox ovata	Mountain Phlox		SE	G4	S1
	Vascular Plant (Cont.)					
Huntington	Pinus strobus	Eastern White Pine		SR	G5	S2
Wells	Plantago cordata	Heart-leaved Plantain		SE	G4	S1
Wells	Platanthera orbiculata	Large Roundleaf Orchid		SX	G5	SX
Allen	Platanthera psycodes	Small Purple-fringe Orchis		SR	G5	S2
Allen, Wells	Poa alsodes	Grove Meadow Grass		SR	G4G5	S2
Allen	Scutellaria parvula var. parvula	Small Skullcap		SX	G4T4	SX
Allen	Spiranthes lucida	Shining Ladies'-tresses		SR	G5	S2
Allen	Spiranthes magnicamporum	Great Plains Ladies'-tresses		SE	G4	S1
Huntington	Viburnum molle	Softleaf Arrow-wood		SR	G5	S2
Wells	Viburnum opulus var. americanum	Highbush-cranberry		SE	G5T5	S1
Wells	Xyris difformis	Carolina Yellow-eyed Grass		ST	G5	S2

County	Species Name	Common Name	Fed	State	GRank	SRank
	High Quality Natural Community					
Huntington, Wells	Forest - flatwoods central till plain	Central Till Plain Flatwoods		SG	G3	S2
Allen	Forest - floodplain mesic	Mesic Floodplain Forest		SG	G3?	S1
Allen, Wells	Forest - floodplain wet-mesic	Wet-mesic Floodplain Forest		SG	G3?	S3
Allen	Forest – upland dry	Dry Upland Forest		SG	G4	S4
Allen	Forest – upland dry – mesic	Dry-mesic Upland Forest		SG	G4	S4
Huntington, Wells	Forest-upland mesic	Mesic Upland Forest		SG	G3?	S3
Allen	Lake – pond	Pond		SG	GNR	SNR
Allen	Prairie – dry-mesic	Dry-mesic Prairie		SG	G3	S2
Allen	Wetland – marsh	Marsh		SG	GU	S4
Allen	Wetland – swamp forest	Forested Swamp		SG	G2?	S2
Allen	Wetland – swamp shrub	Shrub Swamp		SG	GU	S2
	Other					
Allen	Geomorphic - Nonglacial Erosional Feature - Water Fall and Cascade	Water Fall and Cascade			GNR	SNR

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; S4 = 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

2.6 Local Planning Efforts

This WMP is a holistic approach to watershed management and brings together various planning efforts to provide a guiding document for the protection and management of our natural resources, and identifies opportunities for developing partnerships through the various strategies incorporated into this plan throughout the entire UWRBC Phase 2 watershed area.

Comprehensive Plans

The Upper Wabash River Phase 2 watershed covers portions of Wells, Huntington, and Allen counties, and less than 200 acres each in Jay and Adams counties. Each county has held planning efforts to guide future development and growth. The plans were developed separately from one another, using different methods to determine objectives, goals and aspirations and were specifically focused towards local zoning and planning efforts in the individual counties.

In relation to the UWRBC Phase 2 watershed, the comprehensive plans were reviewed to take into consideration how local communities are intending to manage land use and water resources. This information can serve as indicators of future threats to water quality. Several goals included in the comprehensive plans support the concerns expressed by local stakeholders in the development of this WMP. These goals include: access to public sanitary sewers or alternative methods of sewage treatment in rural residential development; promotion of conservation, open spaces, development buffers and riparian areas along streams and rivers; conserve and restore forestland, wetlands and natural areas; and promoting the use of 2-stage ditches and storm water detention/retention areas.

Wells County: Wells County developed their first Comprehensive Plan in 1970. It was updated in 1993, and in again in 2013. The current Comprehensive Plan is for a period of 10 years, and became effective January 1, 2014.

The plan identifies the need to protect productive farm ground, limit rural residential uses to areas that can be served by public sanitary sewers, limit objectionable land uses, and promote storm water detention, conservation, trails and open spaces. The plan also includes strategies to promote community clean-up programs and water testing of the river and streams.

Table 2-9: Natural Resource Strategies from the Wells County Comprehensive Plan

STATEMENT OF OBJECTIVES FOR THE FUTURE DEVELOPMENT OF THE JURISDICTION:
Rural Residential Development: Rural residential development is the use of property outside of the incorporated limits of the County's City and Towns for the purpose of low density housing. The following areas within the County are affected by this topic: All property zoned S-1, A-R or A-1 within Wells County *Action points need to be considered to help the County reach its goals and aspirations regarding this topic:* • *Review rural residential zoning districts to verify whether they promote denser development near public sanitary systems* • *Verify that the ordinance does not cause any unnecessary removal of productive farm ground* • *Review how the A-1 residential densities and sell-off requirements impact rural development to reduce its residential densities* • *Review the applicability of developing rural residential uses only where public sanitary sewer can be accessed, or review alternative methods of sewage treatment that would alleviate the need*
Confined Animal Feeding Operations (CAFO): CAFOs are as defined by 327 I.A.C. 5-4-3, a lot or facility, other than an aquatic animal production facility, that exceeds a certain number, as established by state law, of individual animals and where (1) those animals have been, are, or will be stabled or confined and fed or maintained for a total of at least forty-five (45) days in any twelve (12) month period and (2) crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over at least fifty percent (50%) of the lot or facility. For the purposes of this plan, this definition will also include both onsite and satellite manure storage facilities. The following areas within the County are affected by this topic: Areas located in the vicinity of existing CAFO operations and areas in and around the A-1 zoning district *Action points need to be considered to help the County reach its goals and aspirations regarding this topic:* • *Remember when reviewing the CAFO section of the zoning ordinance, do not stray away too far from the current rules* • *Continually review new technologies to promote using proven odor reduction techniques within the plan* • *Continually stay up-to-date on the Indiana Department of Environmental Management, Indiana State Chemists, and the United States Environmental Protection Agency's rules regarding ground water protection, surface water protection, and manure application* • *Review the need for minimal acreage requirements regarding CAFOs while keeping action point 1 in mind* • *Continually stay up-to-date on the Indiana Code rules regarding water rights*
Housing Subdivisions: A housing subdivision is any residential development that would require a Major Subdivision approval as required by the County ordinances. The following areas within the County are affected by this topic: All property zoned A-R, S-1, R-1, R-2, R-3, M-1 and M-2 within Wells County *Action points need to be considered to help the County reach its goals and aspirations regarding this topic:* • *Review the ordinances to verify that housing subdivisions are being promoted directly around the incorporated City and Towns where sanitary sewer service is readily accessible*

Wells County's Discouraged Land Uses: Some land uses should be discouraged in Wells County based on their negative attributes. The following areas within the County are affected by this topic: all areas within Wells County
Action points need to be considered to help the County reach its goals and aspirations regarding this topic:

- *Review the requirements for landfills to verify adequacy*
- *Review the requirements for commercial scale wind development to verify adequacy*
- *Review the requirements for all electric production facilities to verify adequacy*
- *Determine what types of land uses may have objectionable attributes and verify whether or not the ordinance should prohibit such uses, or whether the ordinance requirements governing such uses are adequate, or should be amended*
- *Review the County's setbacks to verify that they successfully alleviate the objectionable attributes of these uses*
- *Review possible non-setback related solutions that have been proven successful in alleviating the objectionable attributes*
- *Review what types of approval processes are adequate for these uses (i.e. development plans, special exceptions, overlay zones)*

Oil and Gas Exploration and Extraction: This is the exploration and extraction of hydrocarbon deposits beneath the earth's surface, such as oil and natural gas. The following areas within the County are affected by this topic: The southern portion of Wells County
Action points need to be considered to help the County reach its goals and aspirations regarding this topic:

- *Continually stay up-to-date on the Indiana Department of Natural Resources requirements for oil and gas exploration and extraction*
- *Review the County's ordinances to verify whether or not requirements should exist regarding this use and in which zoning districts it should be permitted*

Floodplain: Floodplain means the channel proper and the areas adjoining any wetland, lake, or watercourse which have been or hereafter may be covered by the regulatory flood. The floodplain includes both the floodway and the fringe districts. The following areas within the County are affected by this topic: Any area designated by the National Floodplain Insurance Rate Map as having a one percent or greater chance of flooding in a given year
Action points need to be considered to help the County reach its goals and aspirations regarding this topic:

- *Protect the County's residences from the effects of flood damages*
- *Find a balance between private land rights and necessary flood plain regulations*
- *Utilize flood prone areas for recreational uses that are not negatively impacted by flooding*
- *Start with the state and federal government's regulations to participate in the national flood insurance program*
- *Upgrade floodplain maps to make determinations easier at a local level and encourage more accurate mapping when feasible*
- *Strongly discourage development in the mapped floodplain*
- *Promote conservation and open spaces' uses such as parks and trails in flood prone areas*
- *Review regulations and zoning maps to verify that these policies are being promoted*

County Appeal: County appeal is the ability for it to attract and arouse interest of those moving to and residing within it. The following areas within the County are affected by this topic: All areas within Wells County
Action points need to be considered to help the County reach its goals and aspirations regarding this topic:

- *Promote the creation of community clean-up groups*
- *Create water testing protocols for the County's rivers and streams*
- *The County should stay aware of the different pollution rules as set forth by the State of Indiana and the federal government*
- *Create programs to help clean up and utilize the Wabash River*
- *Protect existing and promote future conservation areas*

A STATEMENT OF POLICY FOR THE LAND USE DEVELOPMENT OF THE JURISDICTION:

Overview of Zoning Principles
The following zoning principles should be taken into account when the County is making land use decisions

- *Areas that need to be preserved should be zoned Conservation (C-1), therefore not providing developers with a false sense of development opportunity*
- *Urban residential should only be used in areas that have immediate access to a public sanitary sewer system*
- *Rural residential should only be used in areas that have a reasonable potential for obtaining access to a public sanitary system*

A STATEMENT OF POLICY FOR THE DEVELOPMENT OF PUBLIC WAYS, PUBLIC PLACES, PUBLIC LANDS, PUBLIC STRUCTURES AND PUBLIC UTILITIES:
Community Transportation • *Continue the Bluffton Trail System to connect pedestrian destinations* • *Review the feasibility of continuing the Wabash River Trail System to Markle and Vera Cruz*
Community Sanitary Sewer Service • *Improve the County's sewer capacities in areas with a high potential for growth* • *Reduce the infiltration and inflow of storm water into the County's sanitary sewers to improve line and plant capacities* • *Promote private sanitary sewer system upgrades that reduce the amount of pollution entering the County's waterways* • *Promote the use of the Wells County Regional Sewer District to help determine the best route to treat the rural sewage issues within the County* • *Promote the separation of the County's sanitary sewer and storm water*
Community Storm Water Service • *Promote the improvement of the County's storm drainage facilities* • *Promote the use of two-stage open ditches in the County* • *Promote the separation of the County sanitary sewer and storm water systems* • *Promote storm water detention/retention and ditch widening at new development sites* • *Promote regional detention basins* • *Review new technology options for storm water detention*
Community Recreation • *Preserve and maintain the County's parks and recreational areas* • *Promote community service activities to help preserve and maintain the County's parks and recreational areas, including youth leadership*

Huntington County: In April 2000, Huntington County began its process of updating its Comprehensive Plan. The plan was completed in 2001 and contains long range goals, objectives and strategies that will guide future decision-making efforts.

This plan emphasizes objectives to protect the quality and quantity of water in Huntington County's streams, rivers and reservoirs. Specific strategies include the conservation of natural areas, protecting forestlands, wetlands, prairies and farm ground, creating open space and connecting communities through trail development, and directing development to those areas that have the infrastructure to support it.

Table 2-10: Natural Resource Strategies from the Huntington County Comprehensive Plan

Goal Statement - Environment: Promote an ecologically sound community through the protection and enhancement of environmental resources, balancing the value of human, plant, and animal life forms and their need to coexist together, while continuing to recognize, protect and enhance to the fullest extent possible, those natural systems and the intricacies of their interrelationships, which support our way of life in Huntington County.	
Objectives	**Strategies**
• Protect the quality and quantity of water in Huntington County's streams, rivers, and reservoirs. • Conserve natural areas such as forestland, wetlands and prairies. • Protect and enhance the character of the natural environment present in Huntington County. • Protect and enhance the streams and riverbanks throughout the county. • Minimize conflicts between growth and the natural environment. • Protect and preserve natural drainage areas and the 100-year floodplain. • Reserve open space for future development of parks and recreation amenities and to provide habitats for plants and animals.	• Establish development buffers around waterways that run throughout Huntington County. • Establish a Huntington County Land Trust program to protect forestlands, wetlands, prairies and valuable farm ground. • Use cluster development techniques for new developments to create pockets of open space. • Limit development and uses within the 100-year flood zone. • Limit development and uses within the 500-year flood zone. • Expand DNR's involvement throughout the county. • Create education experience (K-12) with respect to environmental issues. • Encourage conscientious landowners.
Goal Statement – Parks and Recreation: Develop, maintain and promote recreational opportunities and/or facilities to meet the current and future needs of Huntington County; preserve green spaces between towns by development of a forest preserve system that is countywide.	
Objectives	**Strategies**
• Protect parklands and recreational areas from undesirable, conflicting and potentially hazardous land uses and developments. • Ensure a mix of sizes and locations of public parks and open spaces to provide opportunities for passive and active recreation. • Interconnect the parks, recreation land, public natural areas and public facilities with a network of trails suitable for pedestrians and bicyclists.	• Develop trails from Huntington to the towns in the County (Andrews, Roanoke, Warren, Mt. Etna and Markle). • Develop trails connecting smaller towns to one another. • Develop trails connecting to other communities and counties. • Expand reservoir programs.
Goal Statement – Alternative Transportation: To provide a safe, appropriate and when possible, an aesthetic transportation network for alternative modes of transportation throughout Huntington County.	
Objectives	**Strategies**
• Encourage alternative transportation linkages to schools, parks, and other public resources.	• Trail systems to connect communities and amenities. • Make improvements to water access for boating purposes.

Goal Statement – Community Facilities: Provide responsive, high quality, effective and efficient public facilities and services for the current and future citizens of Huntington County.	
Objectives	**Strategies**
• Recognize change and add, change or consolidate services when appropriate. • Recognize what types of facilities work locally and which work regionally and act upon these appropriately.	• Ensure adequate water and sewage system quality and availability for all existing and future developments within Huntington County. • Ensure adequate solid waste disposal, management, and availability for all existing and future developments within Huntington County.
Goal Statement – Growth Management: Manage and direct growth and development in Huntington County by encouraging compact urban form within the corporate limits of each municipality; discouraging sprawl; and preserving the integrity of prime agricultural land while maintaining the highest "quality of life" for current and future residents.	
Objectives	**Strategies**
• Preserve and enhance the farming industry throughout Huntington County by discouraging urban sprawl and spot zoning. • Develop green spaces/buffers between development zones.	• Establishing a Transfer of Development Rights (TDR) program for the county to help preserve farmland and open space while combating sprawl. • Create a Huntington County Land Trust program. • Make necessary revisions to the storm water control ordinances. • Set up an overlay district for confined feeding areas. • Increasing minimum lot size of agriculturally zoned lands. • Take a more proactive stance towards urbanization and preservation of lands throughout Huntington County.
Goal Statement – Land Use: Encourage orderly and responsible development of land in order to promote the health, safety and welfare of residents within Huntington County, while promoting opportunities for community growth and development that results in enhanced quality of life that leads to diverse housing, economic vitality and enhanced recreation and that nurtures environmental integrity.	
Objectives	**Strategies**
• Allow residential, commercial, industrial, farming, parks, and open space to occur in areas planned for such uses and restrict the same uses from occurring where they are not planned. • Protect prime agricultural land from unrelated development. • Require that uses of land are sensitive to adjacent environmental features. • Strongly discourage incompatible and conflicting land uses from being adjacent or in close proximity to one another.	• Follow existing Land Use Patterns to accommodate additional residential development without compromising the county's agricultural land base. • Smart Growth – direct growth to those areas that already have the infrastructure to support it. • Limit development on areas not suitable for future development.

Allen County: Allen County's current Comprehensive Plan was adopted in 2007. The new plan brought about an integrated approach to planning and development to create a community that makes more efficient and coordinated use of resources.

This plan is largely focused on continued residential growth, but takes into consideration natural features of significant value and environmentally sensitive land. Objectives and strategies include protection of agricultural lands, woodlands, wetlands, wildlife habitats and conservation areas; as well as supporting and collaborating on the development of watershed management plans to address surface water contamination. This plan includes protection for endangered species, which is not specifically addressed in the other county comprehensive plans.

Table 2-11: Natural Resource Strategies from the Allen County Comprehensive Plan

Goal - Land Use: Carefully planned, sustainable growth and efficient use of land resources through coordinated and quality development, revitalization and redevelopment which leads to improved community well-being.	
Objectives	**Strategies**
• Encourage carefully planned growth by utilizing the conceptual development map as part of the community's land use decision-making process. • Use land resources more efficiently by encouraging new development within the Conceptual Development Map growth areas which are adjacent to existing development. • Use land resources efficiently by encouraging new development, revitalization and redevelopment in areas already served by infrastructure. • Discourage unplanned growth in areas not currently served by public municipal or private corporate sanitary sewer facilities. • Encourage sustainable growth by conserving natural features and environmentally sensitive land with significant value. • Maintain the quality of agricultural operations by minimizing urban, suburban and rural conflicts.	• Significant utility, service area, and infrastructure expansions should be encouraged inside the Conceptual Development Map growth areas. • Endorse improvements to and extensions of infrastructure in areas adjacent to existing development. • Support new development, revitalization and redevelopment in areas currently served by adequate existing public municipal or private corporate sanitary sewer and water facilities. • Develop and adopt Plan Commission policies to address development in unincorporated communities not currently served by public municipal or private corporate sanitary sewer facilities. • Define "significant value" in terms of natural features and environmentally sensitive land. • Encourage development proposals that are sensitive to preserve or reserve areas. • Identify and implement additional floodplain- and watershed-management tools, and update existing floodplain- and watershed-management tools as needed. • Inform and educate the public and appropriate community stakeholders about sustainable development alternatives that conserve natural features and preserve environmentally sensitive land. • Collaborate with nongovernmental entities and organizations to acquire and/or protect significant natural and environmentally sensitive land. • Encourage discussion on the value of exclusive agricultural-zoning districts. • Identify the full range of tools available to promote the continued viability of prime agricultural land and existing agricultural operations. • Encourage the continuation of agricultural uses by protecting agricultural areas from incompatible land uses.
Goal – Housing and Neighborhoods: Neighborhoods that are stable and diverse, providing a wide range of housing options, linking residents to a variety of land uses which meet the needs of the community.	
Objectives	**Strategies**
• Provide connectivity.	• Promote and plan for greenways, bikeways, and trails within new and existing developments.

Goal – Transportation: An integrated transportation system that ensures accessibility, safe and efficient movement and connectivity through all parts of the county and region; and accommodates a range of transportation choices such as public transit and paratransit, high-speed rail, pedestrian, bicycle, vehicular and horse-drawn.	
Objectives	**Strategies**
• Improve vehicular transportation throughout the region while accounting for air quality standards and noise mitigation.	• Ensure that environmental oversight complies with state and federal standards in transportation improvement projects.
Goal – Environmental Stewardship: A healthy, sustainable, and enjoyable environment with clean air and water, greenways and open spaces for residents, habitats for wildlife, protection from flooding, utilization of rivers, protection of other environmental assets (farmland, woodlands and wetlands), and promotion of a strong ethic among residents and businesses to control pollution and support environmental stewardship efforts.	
Objectives	**Strategies**
• Ensure the conservation of significant land resources, including but not limited to agricultural lands, woodlands and wetlands. • Protect wildlife habitats and limit invasive species. • Preserve and improve the quality of groundwater and surface water resources. • Protect the natural and built environment through comprehensive floodplain management initiatives. • Encourage Brownfield redevelopment.	• Coordinate and combine existing maps and inventories of agricultural, woodland and wetland areas. Identify areas of contiguous prime soil, significant agricultural heritage and prime lands for targeted conservation efforts. • Continue stewardship efforts and identify areas for possible expansion of contiguous forested and natural areas (such as the Little Wabash River Corridor and other environmentally significant areas). • Investigate the value of adopting local wetland protection ordinances and regulations. • Pursue wetlands restoration initiatives. • Consider zoning and subdivision standards to protect natural features and environmentally sensitive land. • Collaborate with federal and state agencies and not-for-profit organizations in the protection of endangered species. • Work with local organizations to protect natural habitat areas, particularly along linear riparian corridors and around critical aquatic communities. • Support and collaborate in the establishment of watershed management plans that recommends actions to address major sources of surface water contamination. • Using the No Adverse Impact principle as a guide, develop a program to map floodplains, track impacts of floods and enhance green infrastructure in floodplains. • Consider tools, such as overlay districts along river basins and streams to encourage the expansion of riparian buffers and enhance public access to waterfronts. • Develop an inventory of Brownfields. • Set priorities for Brownfield redevelopment in the region. • Secure resources to assist with assessment, remediation and redevelopment of brownfields.

Goal – Community Identity and Appearance: An attractive, vibrant community with a positive image and physical appearance in its rural areas, small towns, neighborhoods and downtowns that celebrates its heritage, diversity and waterways through ongoing quality development, historic preservation and neighborhood revitalization.	
Objectives	**Strategies**
• Renew, protect and enhance the rivers and other significant waterways that define the region. • Preserve rural agricultural landscapes.	• Collaborate with an array of community partners to improve water quality and enhance rivers, streams, corridors and watershed areas. • Encourage the preservation of prime agricultural areas that are distinguished by high crop yields and large contiguous blocks of land. • Encourage the preservation of agricultural uses and structures by protecting agricultural areas from incompatible land uses. • Develop and adopt updated regulations that place limits on metes and bounds tract property sales and development. • Maintain and enhance heritage corridors.
Goal – Community Facilities: Quality facilities that promote recreation and cultural enjoyment, ensure public health and safety, provide educational opportunities, and encourage tourism and investment; collectively building a thriving, accessible and welcoming community for all ages and backgrounds.	
Objectives	**Strategies**
• Sustain and improve high-quality parks and recreational opportunities throughout the county.	• Encourage parkland and open space conservation. • Encourage usable open space for new development.
Goal – Utilities: Safe and abundant drinking water and regionalization of interests for improving regional water quality – such as reduction of failed septic systems and improved performance from sanitary sewers and stormwater facilities – that is expandable to meet demands and support community plans for growth.	
Objectives	**Strategies**
• Ensure cooperative decision making and uniform standards for protecting water quality throughout the region. • Improve and expand sanitary sewer systems within the Conceptual Development Map areas. • Work with the Department of Health and other agencies to protect and enhance drinking water systems. • Enhance stormwater management and drainage systems.	• Consider a collaborative water quality partnership among local governments, stakeholders and utility providers. • Encourage improvement to existing sewer systems to resolve sewer overflows. • Provide direction for the exploration of alternative sewage-processing methods. • Discourage development on conventional septic systems. • Discourage on-site wastewater package treatment facilities. • Expand and enhance initiatives to protect the St. Joseph, Wabash and Maumee River watersheds. • Work with local groups to educate the public about practices to protect groundwater and river water in order to maintain drinking-water quality. • Consider a partnership to coordinate stormwater management on a countywide basis. • Ensure uniform standards for stormwater management and drainage systems.

MS4 Areas and Rule 5

The UWRBC Phase 2 watershed area in Wells and Huntington Counties does not fall under the Municipal Separate Storm Sewer System (MS4) regulation; however, Allen County, in its entirety, is regulated as a MS4 area. The land in this project that is located in Allen County is not considered to be a priority for planning and/or enforcement for the MS4 due to the land use being mostly agricultural or industrial. The industrial sites, such as the General Motors plant, Vera Bradley plant, and Truck Bed Liner plant as well as other commercial and residential construction are regulated under the Allen County Erosion Control Ordinance. The Allen

County Erosion Control Ordinance requires any new construction site to implement BMPs to meet an 80% total suspended sediment removal rate post construction.

The Wells and Huntington County Soil and Water Conservation Districts (SWCDs) have plan review authority for 327 IAC 15-5, commonly referred to as Rule 5 (storm water run-off associated with construction activity), which is a regulation designed to reduce pollutants, principally sediment, that are a result of soil erosion and other activities associated with construction and/or land disturbing activities on projects of 1 acre or more. The SWCDs actively review the storm water pollution prevention plans, make site visits, and suggest best management practices to reduce the threat that runoff could pose to local water quality throughout the counties. The Allen County Erosion Control Ordinance is used to regulate property in Allen County, similar to Rule 5.

Regional Sewer District Plans

The Wells County Regional Sewer District, which includes all unincorporated areas of Wells County, was formed in 2009 following a Recommended Order that was issued by IDEM due to sewage disposal issues that were discovered in the McKinney/Paxson Ditch. The McKinney/Paxson Ditch is a subwatershed of the Wabash–Griffin Ditch watershed in this project area. A sewer district plan was submitted to IDEM in 2011, and was found to be deficient. The plan was revised and resubmitted in March 2012. This plan anticipated that a project to achieve collection, treatment and disposal of sewage to solve the pollution problem in the McKinney/Paxson ditches would be approved by June 2012. Following development of the cost estimates, rate study, and meeting with possible funding agencies, it was determined that the project was not feasible. The Wells County Regional Sewer District continues to work with IDEM to find cost-effective solutions to this problem, and has focused its efforts on investigating possible experimental on-site treatment systems versus trying to construct a treatment facility for the affected area. The Wells County Regional Sewer District will be tasked to address other unincorporated areas in the future.

Watershed Management Plans

Watershed Diagnostic Study: Flat Creek, Griffin Ditch, Fleming Ditch and Somers Creek
(www.in.gov/dnr/fishwild/files/fw-FlatCrk__GriffenDitch_FlemingDitch_WtrshdDiag-WellsCo-April2002.pdf.)
In 2000, a Watershed Diagnostic Study was conducted by J.F. New and Associates on the Flat Creek, Griffin Ditch, Fleming Ditch and Somers Creek subwatersheds (Figure 30) in Wells and Huntington Counties. The study was sponsored by the Wells County Soil & Water Conservation District and funded through the IDNR Lake and River Enhancement (LARE) program.

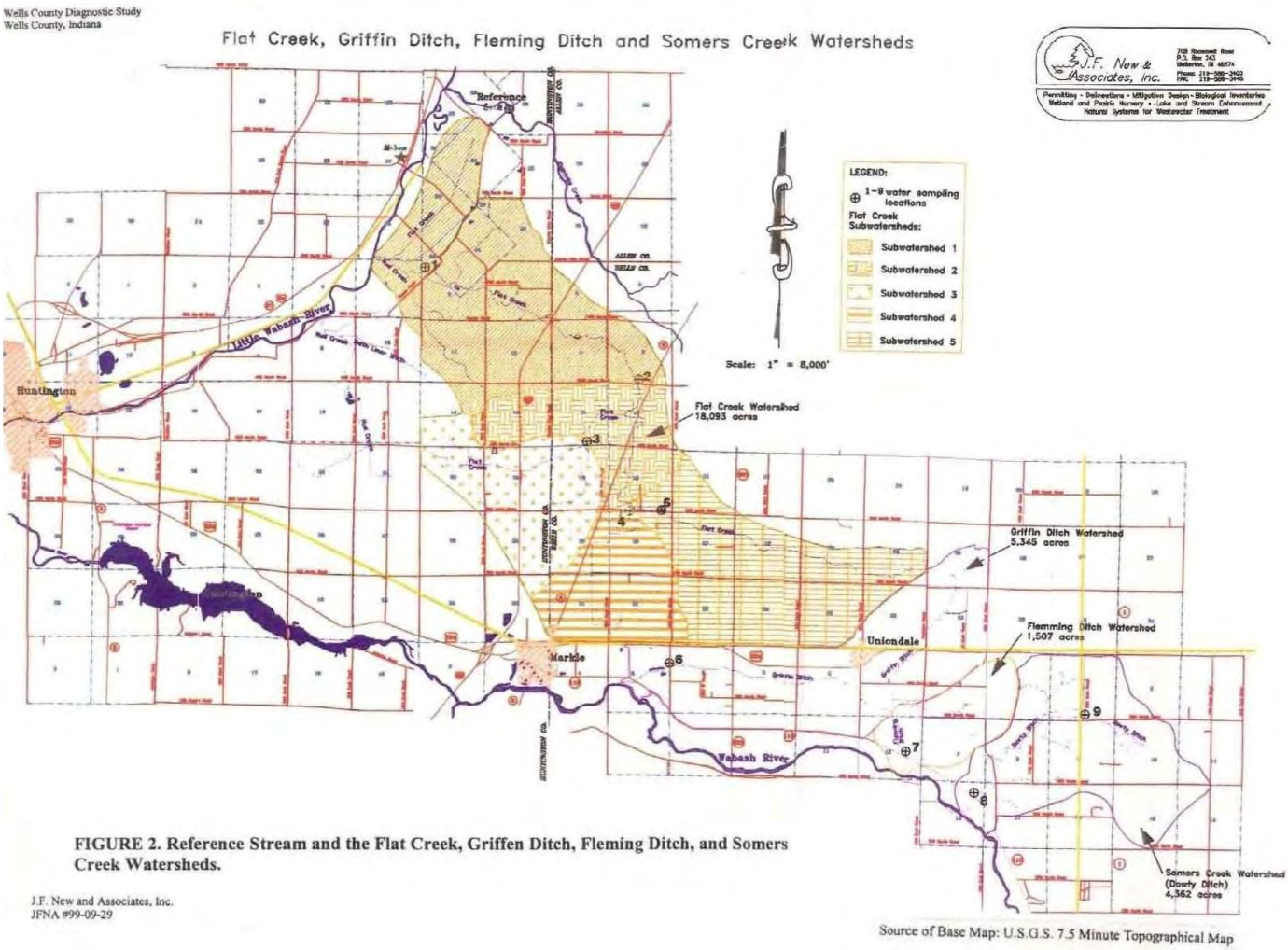
Areas of concern listed in the study include farming near the edge of streams and stream bank erosion due to artificial channelization and lack of filter strips or riparian areas. Additionally the study noted that concentrations of rural development with on-site septic systems have definite implications for nutrient and bacterial loading to the waterways.

The study recommended implementing several best management practices such as conservation tillage, drainage management plans to protect natural resources, innovative riparian management systems, wetland restoration and shallow water pond construction, fencing, grassed swales, storm water treatment, and creating additional water storage capacity where possible. The study

also states that the ditches would benefit from in-stream structures such as rock chutes, drop structures and grade control structures to slow streambed and stream bank erosion. Areas where highly erodible land borders the ditches were listed as priority sites for these practices.

Following the LARE study, the Wells Co. SWCD actively promoted the use of USDA technical and financial assistance programs and Clean Water Indiana grant funds to implement best management practices in the watershed study area in an effort to reduce nonpoint source pollution. As a result of their outreach activities since 2001, conservation tillage, wetland restoration, cover crops, filter strips and grass waterways, and a restored wetland have been installed in the watershed area; however, additional practices are still needed.

Figure 30: LARE Watershed Diagnostic Study Map
Flat Creek, Griffin Ditch, Fleming Ditch, and Somers Creek

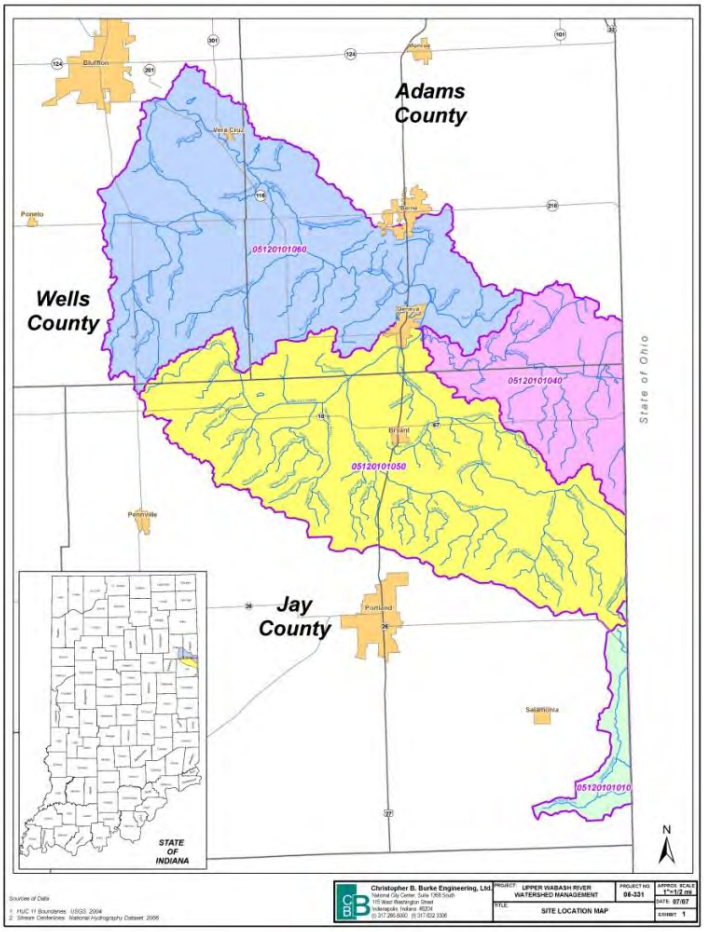


Wabash River (Upper) WMP 5-74
http://www.in.gov/idem/nps/3187.htm
The Upper Wabash River Basin Commission received an IDEM 205(j) grant in 2005 and hired Christopher Burke Engineering, Ltd. to develop the watershed management plan for the Upper Wabash River Phase 1 project area that begins at the Ohio/Indiana state line and ends just east of the current project area. The planning process was completed in 2007.

The plan identifies several potential pollutant sources that are contributing sediment, nutrients, pathogens and bacteria to the watershed. The pollutant sources listed include: stream bank erosion and in-stream obstructions, areas prone to flooding, unbuffered stream reaches, conventional tilled farms, highly erodible lands, subsurface drainage systems, livestock in streams, failing septic systems, and storm water runoff from impervious areas.

Goals for improving water quality in the project area were identified by the stakeholders, and subsequently, an IDEM Section 319 grant funded the implementation of best management practices and education efforts from 2009-2013 by the Upper Wabash River Basin Commission. The Upper Wabash River Basin Commission continues to partner with the Soil and Water Conservation Districts in the Phase 1 project area to monitor water quality and promote best management practices in the watersheds.

Figure 31: UWRBC Phase I Project Area



Other Reports

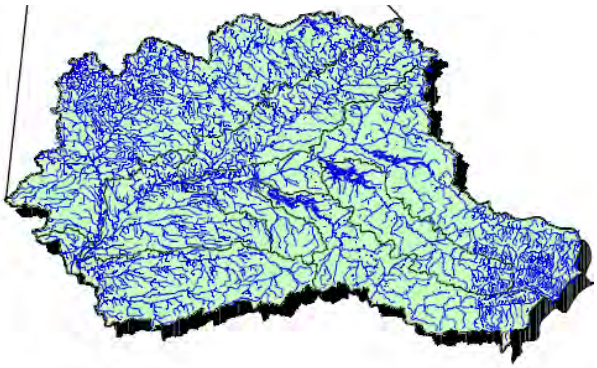
Since 1999, the Rock Creek Conservancy District has been performing low level water quality testing for nutrients, *E. coli*, chemical and biological parameters, and habitat assessments. The program has changed several times throughout the years, as funding allowed, but has mainly been conducted using Indiana Hoosier Riverwatch methods. The main focus of this monitoring has been for the education of the landowners within the District and to have a benchmark for identifying changes in the water quality of the Rock Creek.

Other watershed studies have been developed for state agencies for the entire Upper Wabash River Basin, but none of them are specific to the Upper Wabash River Phase 2 project area. The various reports provide an overall strategy for addressing pollutants in the basin as a whole, but do not dictate management activities for individual stream segments or tributary watersheds. Several of the studies recommend targeting and prioritizing activities at the 12-digit HUC watershed level.

The Rapid Watershed Assessment Upper Wabash Watershed (2009) report sites excessive amounts of sediments, nutrients, and bacteria as resource concerns in the entire Upper Wabash 8-digit HUC 05120101 watershed that begins in northeast Ohio and continues west into 10 northeastern Indiana counties, which includes the UWRBC Phase 2 project area. The Wabash River TMDL (2006) details sources of pollution for the entire 475 miles of river in Indiana to the confluence with the Ohio River. The TMDL states that nonpoint source pollution in the watershed results from agricultural practices, land application of manure, and urban and rural run-off; as well as point source pollution from straight pipe discharges of home sewage treatment systems and combined sewer overflow outlets. The Watershed Restoration Action Strategy for the Upper Wabash Watershed (2002) identifies and discusses the same concerns as the other reports, again on the 8-digit HUC watershed scale, which is much too large to make local decisions. However, many of the concerns listed in these reports have also been identified by the UWRBC members, steering committee members, and stakeholders in the Phase 2 project area.

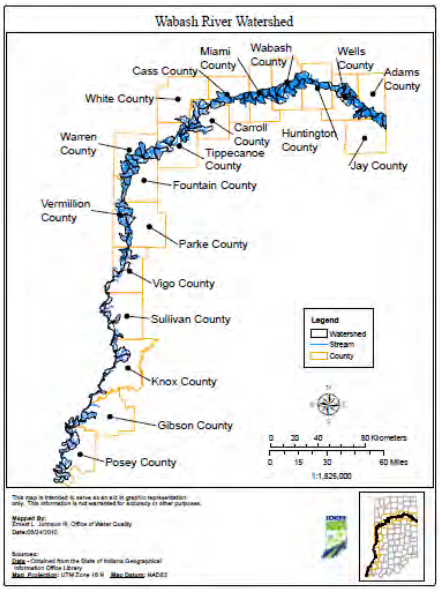
Figure 32: Other Reports Project Areas

Upper Wabash River Basin Fourteen Digit Hydrologic Unit Mileages (1999) *and* 1998 Upper Wabash River Basin Sampling Sites and Stream Standard Violations (2000)



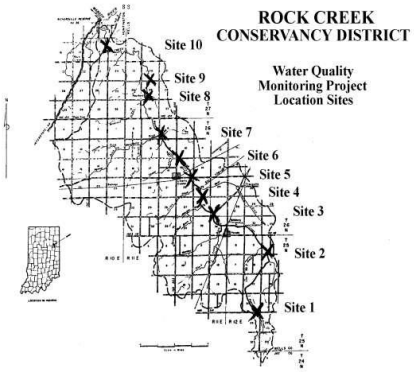
An Assessment of Pesticides in the Upper Wabash River Basin (2001)

Watershed Restoration Action Strategy for the Upper Wabash Watershed (2002)



Wabash River TMDL (2006)

Rapid Watershed Assessment Upper Wabash Watershed (2009)



Rock Creek Conservancy District Water Quality Monitoring Project (1999-present)

2.7 Watershed Summary

Agriculture is the primary land use in the Upper Wabash River Phase 2 watershed area. The nearly flat landscape and highly productive soils account for row crops being the largest agricultural commodity. Both surface and subsurface drainage is used to increase the potential for crop production, but also speeds up the delivery of storm water to the receiving streams and provides a direct conduit for sediment, fertilizer, and chemical runoff. Conventional tillage is used throughout the watershed which can also contribute to sediment and nutrients entering the streams, however there is interest in transitioning to reduced tillage methods and using conservation practices such as cover crops to minimize the loss of soil and nutrients from the agricultural lands. Regular maintenance of open ditches and conversion of riparian areas and woodlands to row crops result in losses of areas that would normally provide benefits for water quality improvement, flood protection, and wildlife habitat.

Confined feeding operations (CFO's) are prevalent in the watershed, as well as smaller livestock operations and "hobby" farms. Almost all of the CFO's are located adjacent to or within one mile of a stream. Manure storage and land application can contribute nutrients and pathogens to local waterways. In the past, local CFOs have had storage lagoons that have overtopped and drained into field tile resulting in fish kills in local waterways. Land application of manure prior to wet weather events has also been a cause of impairment. On at least two occasions, manure was spilled onto roads and into side ditches during transport which then drained to and directly impacted local streams and water quality.

The watershed contains rural residential development and a number of small rural communities. Soils throughout the project area are unsuitable for individual on-site septic systems, and the unincorporated communities do not provide wastewater treatment. Many of the older septic systems are considered "direct connect" and even newer updated systems such as those in the McKinney/Paxson drainage area fail due to soil limitations and lack of maintenance resulting in wastewater discharges that impact water quality.

Urbanized areas within the watershed present different threats to water quality due to urban residential, suburban residential, commercial and industrial uses. Storm water runoff from these concentrated areas of rooftops, lawns, streets and roads, and parking lots all contribute to surface waters reaching the river and streams untreated and at a faster rate than under less developed conditions. Construction sites for urban housing and industrial parks tend to be larger and also have a greater chance of contributing sediment. Generally speaking, residents in urbanized areas often fail to recognize the combined impact of their actions and how it will affect the environmental resources as a whole.

3.0 Environmental and Water Quality Data

3.1 Historical Water Quality Information

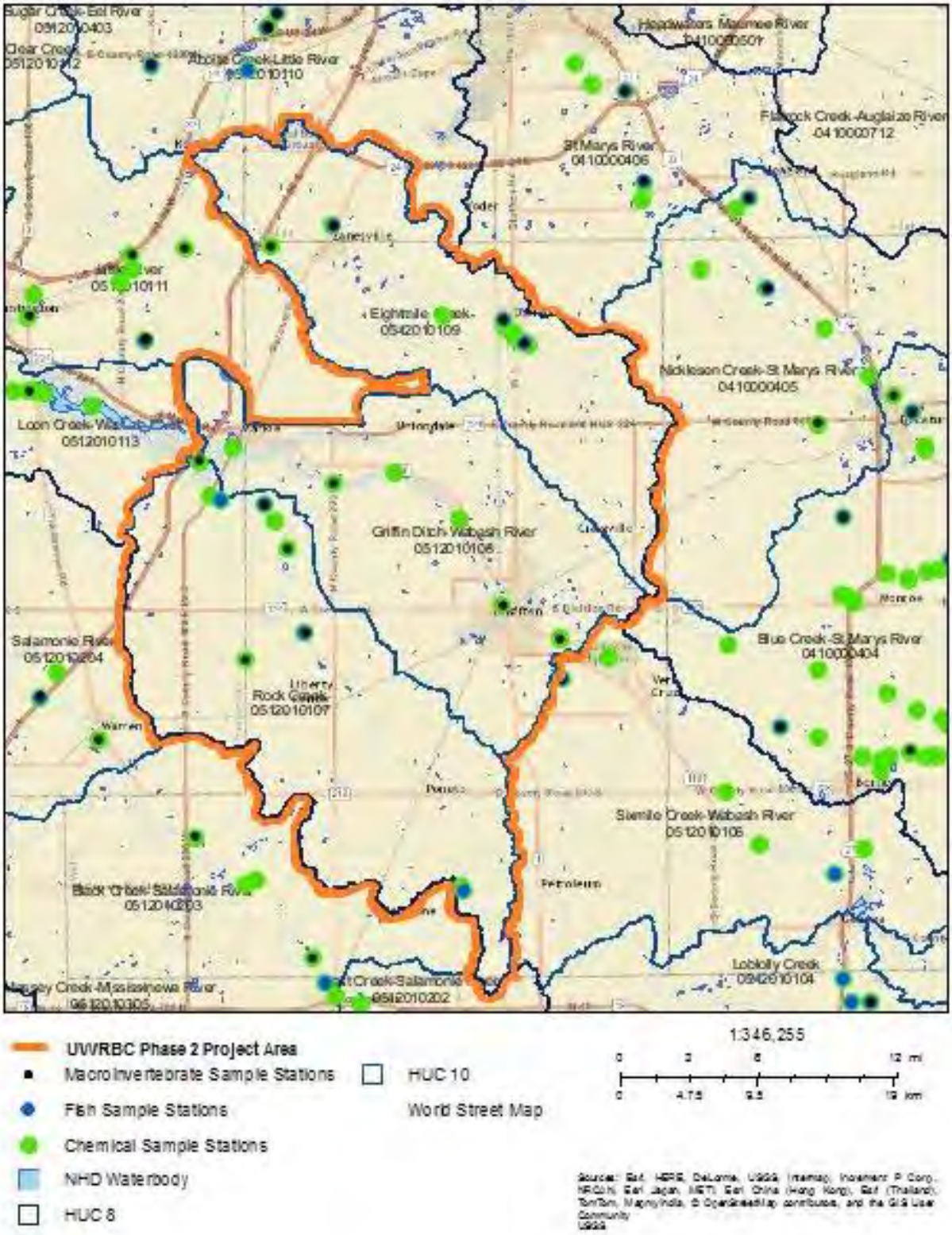
A variety of reports have been developed that contain historical water quality data for the Upper Wabash River Basin watershed area. Water quality monitoring data is also available from various sources; including IDEM, US EPA, and the US Geological Survey, as well as local studies and volunteer monitoring groups.

IDEM monitors the rivers, streams and lakes in Indiana to comply with federal regulations to develop reports to summarize the status of Indiana's waters. According to *Indiana's 2014 Integrated Water Monitoring and Assessment Report,* 71% of the waters sampled in the Upper Wabash River basin do not meet the criteria to support aquatic life use, and 87% does not meet the criteria for recreational use. Based on the data that IDEM has collected in the Upper Wabash River Phase 2 project area, the Wabash River main stem and segments of the Rock Creek, Elkenberry Ditch, and Eight Mile totaling over 43 miles of river or streams are included on Indiana's 303(d) List of Impaired Waters. The impairments to the river and streams include *E. coli*, impaired biotic communities, nutrients, and PCBs and Mercury in fish tissue.

The Wabash River Watershed Total Maximum Daily Load (TMDL) report that was completed for IDEM in 2006 also lists the Wabash River main stem as impaired for *E. coli* and nutrients. A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. The report stated that due to the size of the watershed, more detailed implementation plans would need to be developed and tailored to individual tributary watersheds. Additional monitoring was also recommended to further refine the estimate of nutrient loads. Based on a comprehensive review of the available water quality data at that time, it was determined that TMDLs would be developed for *E. coli*, nitrate and phosphorus for the Upper Wabash River watershed, which includes the project area. The TMDLs that were established were: a reduction in *E. coli* from nonpoint sources by up to 95% of the existing loads; and a reduction in total phosphorus from nonpoint sources of 12-23% of the existing loads. Existing nitrate levels required no reductions to meet water quality standards. It was noted that by reducing the pollutants in the streams and river the biological communities should improve and no longer be impaired.

The Indiana Water Quality Atlas is an online, interactive mapping application that can be used for watershed management and water quality analysis. Sampling locations and water quality results from IDEM's Assessment Information Management System (AIMS) includes periodic macroinvertebrate, chemical and fish data from 1991 through 2008 as part of their probabilistic monitoring program (Figure 33). This information will be discussed in the subwatershed section that follows. IDEM will return to the watershed in 2015 to collect additional data.

Figure 33: IDEM Water Quality Monitoring Locations



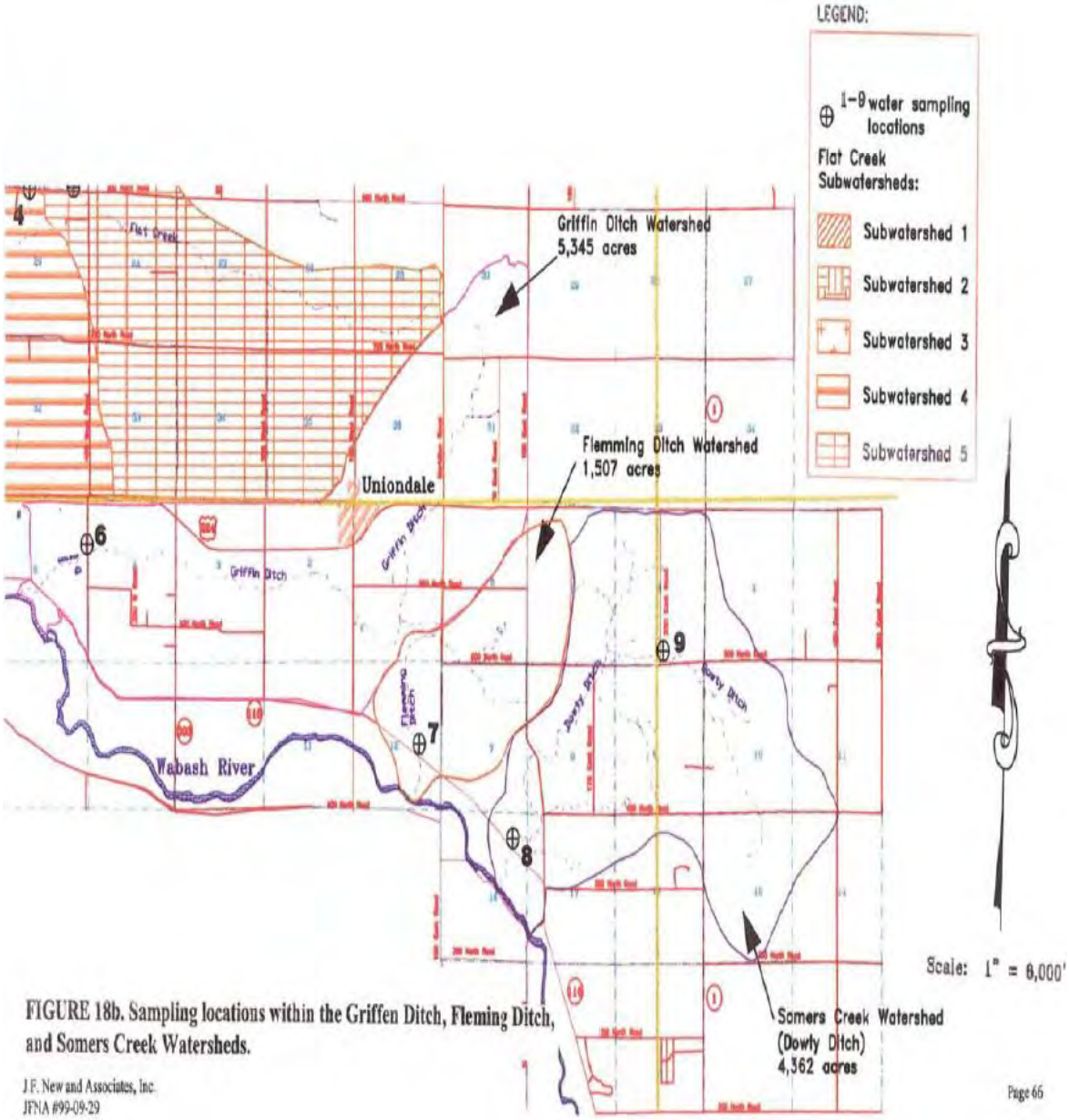
The US EPA website includes a variety of watershed assessment summaries, monitoring data, and compliance reports from state, federal and local agencies, universities, dischargers, and volunteers. The majority of this data is also available through IDEM. EPA's "Surf Your Watershed" webpage provides links to citizen-based groups, impaired waters, and the STORET data warehouse for water quality monitoring data. The "My WATERS Mapper" is an interactive map that displays snapshots of EPA Office of Water program data. It includes information on water quality assessments, and NPDES permits, and other water-related map layers.

According to NPDES facility reports obtained through the US EPA Enforcement and Compliance History Online (ECHO) website, several industrial facilities with NPDES permits are listed as contributing pollutants. The Bluffton, Ossian, Uniondale and Markle wastewater treatment plants have all had recent sanitary sewer and combined sewer overflow incidents that directly impact the watershed streams by contributing significant amounts of sediment, nutrients and pathogens into the local waterways.

The US Geological Survey (USGS) operates an extensive network of stream gauging stations throughout the United States. In Indiana, these stations provide a variety of information for over 200 sites. The USGS National Water Information System (NWIS) provides for the long-term storage of this water data. The USGS NWIS lists three stream gauges on the Wabash River within the UWRBC Phase 2 project area. USGS site #03322958 near Bluffton, at CR450E has recently been discontinued. This site previously recorded gage height and discharge measurements which were compared to the UWRBC monitoring measurements and used to estimate stream flow in the project area when high waters prevented the collection of flow data. USGS site #03323000 at the Main Street Bridge in Bluffton was in service from 1930-1971, and put back in service in April 2015. This site currently only measures gage height and precipitation. There is an abundance of historical monitoring data for this station which provides insight into the condition of the river over past decades. The other stream gauge station, USGS site #404919085204901 is located at the Markle Pumping Station. This information is not available online but can be obtained through the USGS state office.

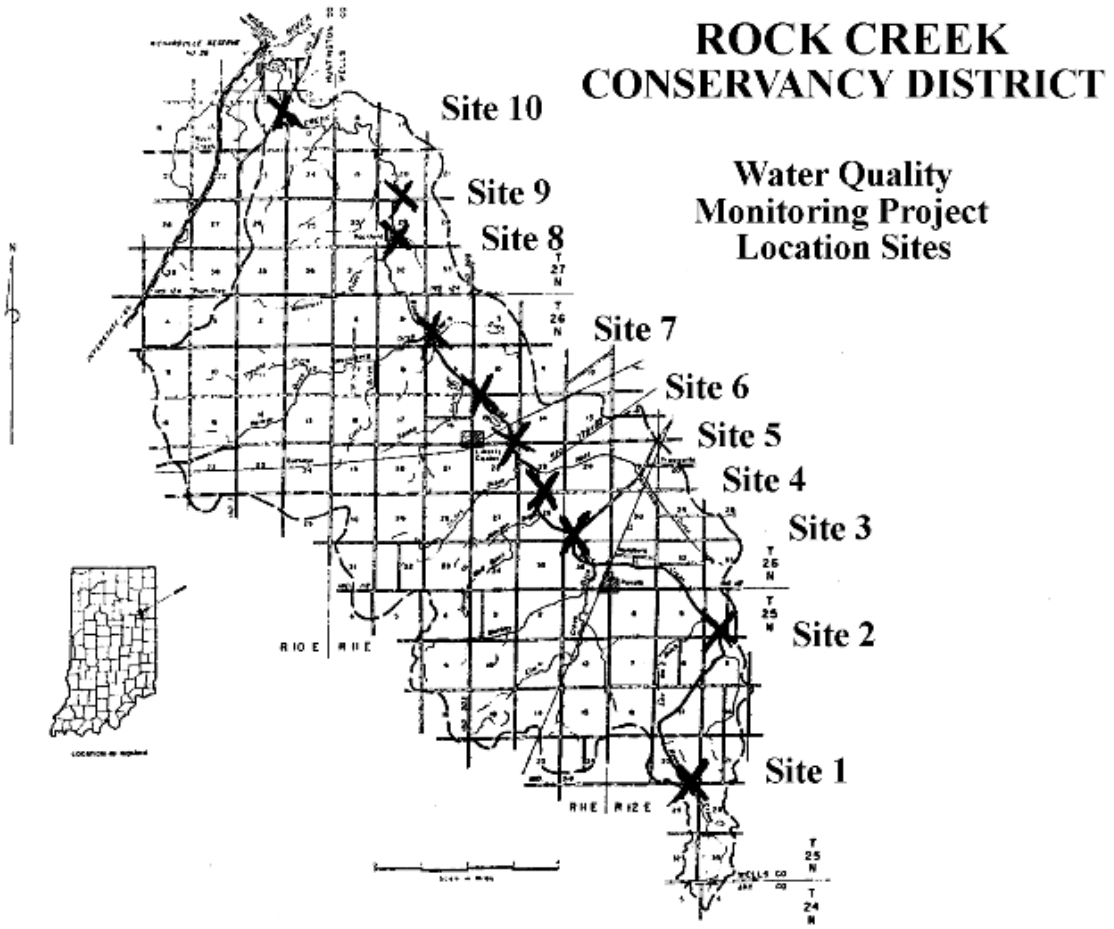
In 2002, a Lake and River Enhancement (LARE) Diagnostic Study was completed on the Flat Creek, Griffin Ditch, Flemming Ditch, and Somers Creek (also known as Dowty Ditch) subwatersheds. The Griffin Ditch, Flemming Ditch and Somers Creek are included in this watershed management plan project area. In general, the LARE study noted that the physical and chemical characteristics of these streams indicate a high degree of degradation. Multiple parameters violated Indiana state standards for both human and aquatic biota health. High loading rates of dissolved nutrients relative to flows, and sediment loading rates during runoff events were both listed as concerns. The habitat evaluations fell below the level conducive to the existence of warm water faunas, and the macroinvertebrate communities were of low diversity and composed predominantly of highly tolerant taxa or species.

Figure 34: LARE Diagnostic Study – Water Quality Monitoring Locations in Griffin and Flemming Ditches, and Somers Creek Watersheds – Sites 6-9



The Rock Creek Conservancy District (RCCD) began collecting water quality information on the Rock Creek channel in 1999. The RCCD sampled for herbicides, phosphorus, nitrogen, *E. coli* and total coliforms. The results did not indicate a large influx of agricultural herbicides into the creek; however, *E. coli*, total coliforms and phosphorus did exceed the maximum contaminant level, as determined by the state, on several sampling events over the years. In general, nitrogen generally exceeded the maximum contaminant level during the spring and early summer planting season. In 2002, Hoosier Riverwatch biological and habitat monitoring was added to the program to further evaluate the health of the stream. Due to limited funding, the chemical monitoring was discontinued in 2005, but the biological, habitat and stream flow data continued to be collected through 2012. Overall, macroinvertebrate pollution tolerance indexes (PTI) indicate that the Rock Creek has a poor – fair rating at the upper end of the creek, and as the stream flows towards the Wabash River it improves to fair – good, with a few sites gaining an excellent rating on occasion. Habitat evaluations using the Citizens Qualitative Habitat Evaluation Index (CQHEI) generally show the same trend, with low scores at the upper end of the creek, improving as the stream flows towards the Wabash River, but not reaching the benchmark score of 60, which you would expect from a stream that is considered by the stakeholders to be primarily for agricultural drainage.

Figure 35: Rock Creek Conservancy District Water Quality Monitoring Locations



3.2 Habitat and Biological Information

The biological and habitat studies conducted by the various groups indicate that the ditches and streams in the project area are degraded. The primary sources of impairments have been identified as sediment, nutrients, and bacteria. Since agriculture is the dominant land use within the watershed, activities associated with agricultural activities (i.e. sheet/rill erosion from fields, tile drainage, fertilizer applications, confined feeding operations, and on-site wastewater systems) are likely significant sources causing impairment to the water bodies. Municipal and industrial discharges and urban storm water runoff (including construction activities, lawn fertilizer, and pet waste) are also believed to be contributing sources.

The lack of wetlands, riparian areas, buffers and filter strips, and drainage maintenance activities increase the rate in which surface water runoff reaches the streams and river and also point to stream bank and in-stream erosion and degradation of quality habitat and biological communities. The addition of phosphorus and nitrogen to the local streams and Wabash River often causes excessive algal growth and further compromises the stream conditions for the biological communities and aquatic life. Filter strips have been promoted locally by the Soil and Water Conservation Districts and County Surveyors, and were observed during the windshield survey. The areas with filter strips generally appeared to have stable stream banks, but in-stream siltation and erosion was still noted.

Between 2002 and 2009, the City of Bluffton reforested approximately 150 acres of the Wabash River floodplain with Oak-Hickory and Maple-Beech forest habitats and a mixture of native grasses and wildflowers. Additional natural habitat riparian areas in the project area include two properties owned and managed by Acres Land Trust, Inc. The Anna Brand Hammer Nature Preserve in the Eight Mile subwatershed contains approximately 20 acres of mixed hardwood forest in the midst of fields with a small intermittent stream that provides homes for salamanders and wildlife. The 86 acre Acres Along the Wabash Nature Preserve in the Wabash River-Griffin Ditch subwatershed includes natural forests and native grass plantings. The J. E. Roush Fish and Wildlife area in the Wabash River-Griffin Ditch subwatershed on the Wabash River also provides over 2,700 acres of diverse forest, wetland, and native habitat area. These areas promote diverse aquatic communities and host a variety of wildlife, as well as benefit water quality by providing buffer zones to filter pollutants.

3.3 Watershed Surveys

In addition to the historical water quality data, other data inventories were collected using both desktop and windshield survey methods to help identify potential sources of pollutants in the Upper Wabash River Phase 2 project area.

The desktop survey included collecting information through Geographic Information Systems (GIS) from a variety of on-line sources, including IndianaMap, USDA's Web Soil Survey, and the Allen, Huntington and Wells County GIS websites, to name a few. This led to specific sources of information such as IDEMs Office of Land Quality, where various land uses are regulated by National Pollution Discharge Elimination System (NPDES) permits for activities

such as agricultural and solid waste, auto salvage, concentrated feeding operations, hazardous waste, industrial waste, and underground storage tanks.

This was followed by researching available reports such as Rapid Watershed Assessments (RWA) and tillage transect information from the USDA-Natural Resource Conservation Service (NRCS) and Indiana State Department of Agriculture-Division of Soil Conservation (ISDA-DSC) respectively, to gather existing natural resource data, such as soils, land use, wetlands and tillage trends to identify possible areas where conservation practices may already exist. The county GIS websites were also used to estimate areas that would benefit from the implementation of conservation practices.

Windshield surveys were conducted to confirm the conditions on the land by driving throughout the watershed and visually assessing the local land use and documenting the findings using photographs, and field sheets. This information was then compiled and used to support or alleviate the stakeholder concerns gathered during the initial public meetings. This information is discussed more specifically within each subwatershed.

Table 3-1: Summary of Windshield Survey Observations.

Windshield Observations	
Drainage	• Log-jams and debris in the Wabash River (1 site), Rock Creek (2 sites) and Eight Mile Creek (2 sites). • Five 2-stage ditches are located in the Moser Ditch-Eight Mile Creek subwatershed, two are located in the Johns Creek-Wabash River subwatershed, and one is located in the Dowty Ditch-Wabash River subwatershed.
Sediment & Nutrients	• The presence of silt bars, sloughing creek banks and areas of active erosion (including sheet, rill, gully and bank erosion) observed in all watersheds. (Wabash River/Griffin Ditch – 14 sites; Rock Creek – 25 sites; Eight Mile – 9 sites). • Lack of buffer/filter strips (Wabash River-Griffin Ditch – 35 miles; Rock Creek – 48 miles; Eight Mile Creek – 38 miles), tillage to the edge of streams, and conventional tillage (66,405 acres) in all watersheds. • 32 CFOs and smaller hobby farms (1,062) in all watersheds. • Animals have direct access to waterways in Elkenberry-Rock Creek subwatershed (1 site) and Dowty Ditch-Wabash River subwatershed (1 site). • Manure transport lines observed near Rock Creek in the Stites Ditch subwatershed (2 sites).
E. coli & Pathogens	• Rural homes in the watersheds with septic systems (estimated 4,000) • Wastewater treatment facility discharges from Bluffton, Markle and Uniondale to the Wabash River (6 occurrences), from Poneto to the Rock Creek (1 occurrence), and from Ossian to the Eight Mile Creek (4 occurrences). • Concentrated impervious areas in populated areas (approx. 3 %).
Other Concerns	• Two sites were observed where woodlands were being cleared. • Few green spaces in the rural areas in all watersheds. • On three separate occasions trash and household furniture was dumped in or along the Wabash River.

Photos of Watershed Areas

Photo 1: 2-stage Ditch on Eight Mile Creek CR 1000 N – CR 100 E (WQM site 2).

Photo 2: Wooded riparian area being cleared on Rock Creek CR 600 W, north of CR 300 N.

Photo 3: Bank sloughing on Wabash River in IDNR Fish & Wildlife area (WQM site 12).

Photo 4: Bank sloughing on Rock Creek in IDNR Fish & Wildlife area (WQM site 10).

3.4 Project Water Quality Monitoring, Targets and Data

The primary goal of conducting water quality monitoring for this project was to collect current baseline data which identifies the chemical, biological and physical conditions of the Rock Creek, Eight Mile Creek, and Wabash River and compare it to the historical data to evaluate changes in the water quality. This allowed for evaluation of aggregate water quality, while also identifying contributions of non-point source pollution from individual catchments within the watershed. It was used to determine non-point source pollution problems and possible causes or sources. This data also serves as a benchmark for comparison to future water quality data. A secondary goal was to educate the public about non-point source pollution issues and assist stakeholders in identifying critical areas within the watershed that were prioritized for future best management practice implementation.

The study was designed to be a year-long, monthly sampling program at 15 sites (Table 3-2 and Figure 35). The sites were distributed between the Rock Creek, Wabash River and Eight Mile Creek subwatersheds. It was anticipated that there would be times that some sites would not be accessible due to high water or other hazards; therefore a standard of completeness was set to sample a minimum of 12 of the 15 sites during each of the 12 monthly sampling events.

The water quality assessment included water chemistry, flow, biological (macroinvertebrate counts) and habitat evaluations. Chemistry and flow were monitored monthly, and biology and habitat sampling was conducted during a single event between July and October. Volunteer monitoring using Hoosier Riverwatch methods was also conducted at three designated sample sites (#2, #7, and #13) at least once each year during the project duration.

Chemistry measurements for dissolved oxygen (DO), temperature, pH, and turbidity were taken in the field with a Hach® Hydrolab Quanta multi-parameter sonde. Grab samples were collected and taken to Meadow-Wood Laboratory Services for total phosphorus and nitrate-nitrite testing; and *E. coli* samples were plated in the field and taken to the laboratory for incubation and analysis. A Hach® OTT MF Pro electromagnetic flow meter was used for flow measurements. Hoosier Riverwatch monitoring parameters included temperature, DO, pH, Nitrate-Nitrite, orthophosphate, and turbidity. Biological sampling (macroinvertebrate counts) used the macroinvertebrate Pollution Tolerance Index (PTI) ratings, and the Citizens Qualitative Habitat Evaluation Index (CQHEI) was used for the habitat evaluations, both Hoosier Riverwatch volunteer monitoring methods.

Pictures of the monitoring sites are included in Appendix F.

Table 3-2: UWRBC Phase 2 Water Quality Monitoring Locations

SITE NUMBER	LATITUDE/ UTM EAST	LONGITUDE/ UTM NORTH	WATER SEGMENT	ROADWAY	SITE COMMENTS
1	40.951829944 638944.42	-85.349130621 4534721.92	Eight Mile	Mayne Rd, NE of Station Rd, Roanoke, Huntington Co.	Steep banks, downed trees, housing, dairy within 1 mile
2 *HR site	40.887734117 651306.69	-85.203991178 4527847.18	Eight Mile	CR 100 E & CR 1000 N, near Ossian, Wells Co.	2-stage ditch, grass lands, dumping concrete on banks
3	40.859139506 656809.80	-85.13947349 4524786.31	Eight Mile	CR 800 N, west of CR 450 E, near Ossian, Wells Co.	Rip rap on bottom, buffer w/ row crops, silted
4	40.815413464 661821.27	-85.081277937 4520037.91	Eight Mile	CR 500 N, east of SR 301, Wells Co.	Man-made changes, silting, grass banks
5	40.728426157 657336.02	-85.136889182 4510279.90	Wabash River	CR 450 E, at White Bridge east of Bluffton, Wells Co.	Dairy farm within 1 mile; septic issues in McKinney/ Paxson Ditch
6	40.757136019 653225.95	-85.184775917 4513382.34	Wabash River	CR 100 N, at Gerber Bridge, SR 116 and Oak St. Ext., Wells Co.	Steep banks, downed trees, row crop
7 *HR site	40.788304126 651559.79	-85.203673923 4516809.57	Wabash River	Rose Rd, north of CR 300 N, Wells Co.	Bedrock sheets, tires, trash, debris in river
8	40.820563138 641843.30	-85.318016745 4520199.37	Wabash River	CR 500 W, at IDNR F&W area, south of SR 116, Wells Co.	Wide and deep, impoundment area for flood waters
9	40.816460699 638216.79	-85.361119341 4519675.06	Wabash River	North of CR 100 S at IDNR F&W area, Huntington Co.	Large boulders, rock, rapid area, very natural site
10	40.814927481 638009.98	-85.363609102 4519500.93	Rock Creek	East CR 100 S dead end at IDNR F&W area, Huntington Co.	Bedrock, large snail bed downstream from site
11	40.807323921 637905.35	-85.366133898 4518750.96	Elkenberry Ditch	Division Rd, dead end at IDNR F&W area, Huntington Co.	Bedrock, normally very shallow and narrow, natural habitat area
12	40.818272028 637987.24	-85.363796521 4519871.93	Wabash River	Division Rd, under I-69, at IDNR F&W area, Huntington Co.	Large boulders, back water, stream bank erosion, downed trees
13 *HR site	40.7709157 642715.43	-85.308936127 4514702.61	Rock Creek	CR 200 N, east of CR 500 W, Wells Co.	Large rock, stable banks, buffer w/row crops
14	40.714427708 645333.94	-85.279366951 4508480.30	Rock Creek	CR 300 W, north of CR 200 S, Wells Co.	Steep banks, siltation, buffer w/row crop
15	40.683498485 647875.22	-85.250091478 4505095.67	Rock Creek	CR 400 S, east of CR 200 W, Wells Co.	Steep banks, silt bar, buffer w/row crop, foam in water
*HR site: denotes the Hoosier Riverwatch volunteer monitoring locations.					

Historical data is available for the following sites:
Site 5 – USGS #03322958 Stream Gauge and AIMS stations #7983 (WUW070-0012) and #5821 (WUW070-0004); Site 7 – AIMS station #4445 (WUW070-0003); Site 10 – AIMS station #5851 (WUW080-0005); Site 13 – AIMS station #5835 (WUW080-0004) and Rock Creek Conservancy District site #9; Site 15 – Rock Creek Conservancy District site #4.

Figure 36: Upper Wabash River Phase 2 Project Water Quality Monitoring Locations

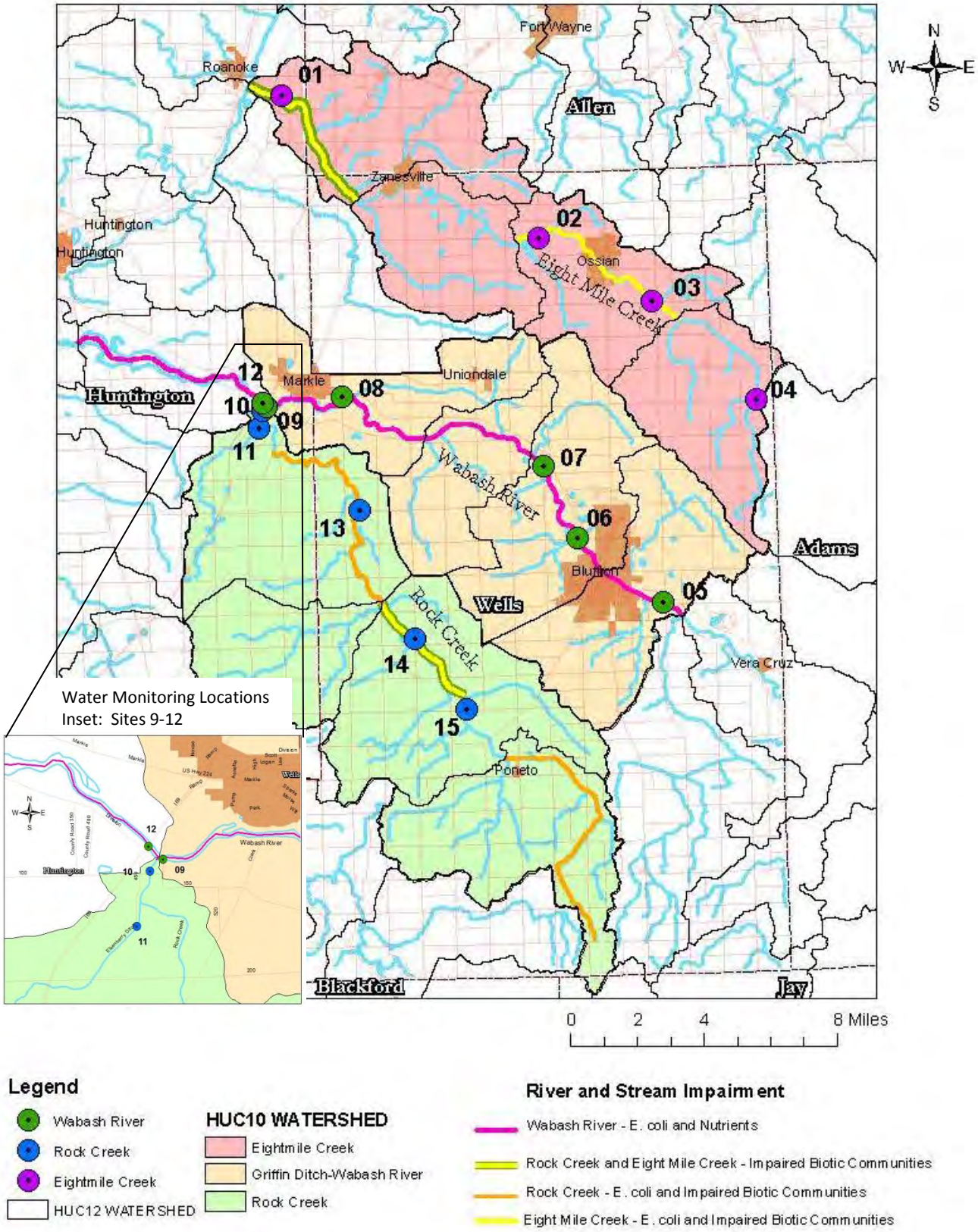
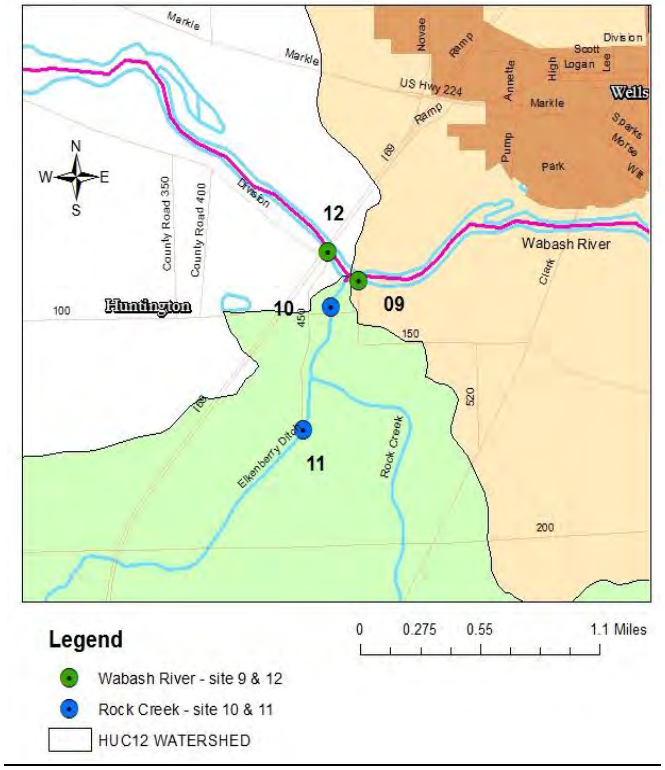


Figure 37: Upper Wabash River Phase 2 Project - WQM Locations Map Inset Sites 9-12



Sites 1-4: Eight Mile Creek Monitoring

Site 1: Eight Mile Creek at Mayne Road, Huntington County, Pleasant Run Ditch subwatershed HUC 051201010904. This monitoring site also includes the Big Creek subwatershed HUC 051202020903 drainage area. When monitoring began in 2013, site 1 had a forested riparian area on both sides of the ditch with small to medium rock bottom with minimal smothering. In the fall of 2014, the Huntington County Surveyor performed ditch clearing and maintenance which removed all vegetation on one side of the ditch. The previous rocky bottom was then mostly sandy and silted.

Site 2: Eight Mile Creek at CR 100 E and CR 1000 N, Wells County, Moser Lake subwatershed HUC 051201010902. This site has a two-stage ditch on one side and a narrow riparian area on the other, stable vegetated banks and minimal smothering. The Town of Ossian waste water treatment plant NPDES discharge pipe is located approximately 1 mile up-stream.

Site 3: Eight Mile Creek at CR 800 N west of CR 450 E, Wells County, Moser Lake subwatershed HUC 051201010902. Located adjacent to row crop fields, the ditch bottom is very fine, smothered and silted. It has a combination of stable and eroding banks, and no stream shading. Filter strips are present at this site.

Site 4: Eight Mile Creek at CR 500 N east of SR 301, Wells County, Maple Creek subwatershed HUC 051201010901. Similar to site 3; site 4 is located adjacent to row cops with narrow filter strips. It is channelized with a combination of steep stable and eroding banks, smothered, and silted with no stream shading. Riffle/run areas are not present at this site.

Sites 5-9, and 12: Wabash River Monitoring

Site 5: Wabash River at the White Bridge on CR 450 E east of Bluffton, Wells County, Johns Creek subwatershed HUC 051201010801. This is the upstream monitoring site on the Wabash River in the project area, and represents the pollutants coming into the project area from the upstream Wabash River Basin watershed. The river substrate is mostly large rock and boulders that are smothered and silted. There are many man-made changes. The riparian area consists of a wide forest/wetland area on one side and a road, grass, greenway trail and park on the other. The site includes a combination of stable and eroding banks, a variety of fish cover, and areas of riffles and runs.

Site 6: Wabash River at the Gerber Bridge on CR 100 N west of SR 116, Wells County, Dowty Ditch subwatershed HUC 051201010802. Downstream from the City of Bluffton and the Bluffton municipal wastewater treatment plant, site 6 has a mostly medium rock bottom that is smothered and silted. The clay banks are steep, eroded, and slippery making it difficult to access the site. Row crops are located beyond a wide riparian area. There are no riffles or runs.

Site 7: Wabash River at Rose Road north of CR 300 N, Wells County, Dowty Ditch subwatershed HUC 051201010802. This site is primarily bedrock with boulders and smaller coarse rock that is smothered and silted. There are a few man-made changes, a wide riparian area on one side; trees, a gravel road and row crops on the other. It has a combination of stable and eroding banks, large riffle and run areas, a variety of fish cover, and is partly shaded. There are numerous downed trees and logs in this area and it is a popular fishing location.

Site 8: Wabash River at CR 500 W south of SR 116 at the Indiana Department of Natural Resources J.E. Roush Lake Fish and Wildlife area east of Markle, Wells County, Griffin Ditch subwatershed HUC 051201010804, and includes the Bender Ditch subwatershed HUC 051201010803 drainage area. This site is an impoundment area for flood waters of Roush Lake. It is too deep and wide to perform stream flow monitoring, so the flow was estimated. Biological assessments could not be completed at this site. This site is also prone to flooding and therefore chemical monitoring was conducted only when the site was accessible. There is a levee and sluice gate just downstream from this site that holds flood waters back from the Town of Markle.

Site 9: Wabash River located in the J.E. Roush Lake Fish and Wildlife area north of CR 100 S at the dead end access road, Huntington County, Griffin Ditch subwatershed HUC 051201010804. This Wabash River site is mostly natural with forested riparian areas, various fish cover, and pools, riffles and runs. Boulders and large rocks make up the substrate of the river and the banks are stable and well vegetated.

Site 12: Wabash River on Division Road in the J.E. Roush Lake Fish and Wildlife area; just east of the I-69 Interstate bridges, Huntington County, Loon Creek subwatershed HUC 051201011301 but is used as an indicator for the Wabash River and Rock Creek subwatersheds. Boulders and large rocks are smothered and silted, but there is an abundance of fish habitat and riffle and runs at this site. The banks are a combination of stable and eroding and there is a shallow backwater area with nearly no flow during dry periods. There are man-made changes at this site including the access road and the I-69 Interstate bridges that cross the Wabash River.

During spring snow melts and wet weather events, flooding in the area prevents access to the site and the flow is too great to safely conduct monitoring.

Sites 10, 11, 13-15: Rock Creek Monitoring

Site 10: Rock Creek at CR 100 S in the J.E. Roush Lake Fish and Wildlife area, Huntington County, Elkenberry Ditch subwatershed HUC 051201010704. The creek bottom is mostly smothered and silted bedrock, boulders, and small to medium coarse rock. There are few man-made changes with a wide forested riparian area, various types of fish cover and riffles and runs. Bedrock outcrops are observed in several areas along the stream bank. A snail bed is located downstream, near the mouth of the Rock Creek where it enters the Wabash River. At times of heavy snow melt and rain events this site is not accessible due to flooding

Site 11: Elkenberry Ditch at the dead end of Division Road in the J.E. Roush Lake Fish and Wildlife area, Huntington County, Elkenberry Ditch subwatershed HUC 051201010704. This tributary stream to the Rock Creek is small in comparison to the other sites in the area. It has a bedrock substrate that is smothered and silted with some fish cover areas. It is heavily forested and the pools, riffles and runs are shallow and slow during most of the year. An access road to other areas of the DNR property crosses through the stream over the bedrock at the monitoring site. At times of heavy snow melt and rain events this site is not accessible due to flooding.

Site 13: Rock Creek at CR 200 N, Wells County, Elkenberry Ditch subwatershed HUC 051201010704 and includes the Mossburg Ditch subwatershed HUC 051201010702 drainage area. This site is comparable to most of the lower section (north of SR 124) of the Rock Creek. It has grass buffers along row crops on both banks, mostly large rock on the substrate with some silting, a few areas of fish cover, fish pools, runs and riffles, and little or no stream shading. The banks are generally stable and well vegetated with a few areas of erosion and bank sloughing. The small rural community of Rockford and an active stone quarry is located 1 mile upstream from this monitoring site.

Site 14: Rock Creek at CR 300 W, north of CR 200 S, Wells County, Stites Ditch subwatershed HUC 051201010703. This site on the Rock Creek has a tree line on one bank and grass buffer along row crops on the other. There is a large surface water inlet pipe near the monitoring location. The banks are relatively steep and in-stream erosion at or below the flow line is an issue. Initially, it was thought that this would be a good site to monitor as it is downstream from the rural community of Liberty Center, but due to the amount of sediment in the stream, it is difficult to move within the stream to collect the data, therefore the majority of testing has been chemical data using suspended equipment and grab samples.

Site 15: Rock Creek at CR 400 S, Wells County, Stites Ditch subwatershed HUC 051201010703. This site has a medium rock substrate that is smothered and silted. The riparian area consists of a narrow line of trees along row crops on one side and grass buffer along row crops on the other. There are a few areas of fish cover, undercut banks and is partly shaded. Pool areas and slow riffle and run areas are present. A large dairy CFO is located within 1.5 miles of the monitoring site, and adjoining fields are used for manure applications.

Table 3-3: Subwatershed Acres by Water Monitoring Sites

12-digit HUC Subwatershed Name	12-digit HUC	12-digit HUC Acres	Monitoring Site Subwatershed Acres	Monitoring Site % of Subwatershed	Monitoring Site Number
Eight Mile Creek Monitoring Sites: Total Drainage Area = 51,692 acres					
Pleasant Run	051201010904	15,437	14,345	93%	1
Big Creek	051201010903	11,414	11,414	100%	
Moser Lake	051201010902	12,421	3,419	28%	
			6,259	50%	2
			2,743	22%	3
Maple Creek	051201010901	12,420	8,064	65%	
			4,356	35%	4
Wabash River Monitoring Sites: Total Drainage Area in Phase 2 Project Area = 57,743 acres					
Johns Creek	051201010801	16,413	1,212	7%	5
			15,201	93%	6
Dowty Ditch	051201010802	17,250	1,349	8%	
			11,016	64%	7
			4,885	28%	8
Bender Ditch	051201010803	10,257	10,257	100%	
Griffin Ditch	051201010804	13,823	8,591	62%	
			5,232	38%	9
			53	0.38%	12
Elkenberry Ditch	051201010704	18,666	37	0.06%	
Rock Creek Monitoring Sites: Total Drainage Area = 66,731					
Elkenberry Ditch	051201010704	18,666	7,194	39%	10
			6,173	33%	11
			5,299	28%	13
Mossburg Ditch	051201010702	10,839	10,839	100%	
Stites Ditch	051201010703	20,459	6,582	32%	
			10,268	50%	14
			3,609	18%	15
Rock Creek Headwaters	051201010701	16,767	16,767	100%	

Chemistry

Aquatic chemistry is complex and is influenced by many interrelated factors. Dissolved oxygen in water is essential to the health of streams and rivers. Much of the dissolved oxygen in water comes from the oxygen in the air. Dissolved oxygen can indicate how well the water can support aquatic plant and animal life, or indicate the level of pollution in the water. Generally a higher oxygen level indicates better water quality. Rapid decomposition of organic materials, including dead algae, shoreline vegetation, manure or wastewater decreases dissolved oxygen.

Water temperature has a direct influence on other water quality factors such as dissolved oxygen, growth of bacteria or algae and even on the survival of some aquatic species. Colder water can hold more dissolved oxygen, where as warmer water with lower oxygen levels weaken fish and aquatic insects making them more susceptible to illness and disease. The rate of plant and algal growth increases with warmer temperatures, leading to increased plant death and decomposition. Temperature also effect metabolic rates of the aquatic animals. Loss of shading by trees, runoff

from roads and parking lots, and discharges from municipal wastewater and industrial sources can all affect the temperature of local waterways.

The pH level, the measure of whether the water is acidic or basic, is important because aquatic organisms are sensitive to pH, especially during reproduction. Additionally, changes in pH can make some pollutants more toxic to fish and aquatic insects. Many natural processes affect pH, such as plant photo-synthesis which can raise the pH, however due to the limestone geology in the area; most surface waters in Indiana have a relatively basic pH.

Turbidity is the relative clarity of the water. Turbid water is cloudy and is caused by suspended matter including clay, silt, organic and inorganic material, and algae. Turbidity can cause higher water temperatures, thus lowering the dissolved oxygen levels, and the suspended particles can clog gills of fish and invertebrates and smother their habitat. Soil erosion and runoff from agricultural fields, lawns, parking lots, construction sites, or the stream bank itself leads to turbid waters.

Nitrogen is found in all living things, and occurs in water as nitrate, nitrite and ammonia. Nitrates are essential for plant growth, and are the main ingredient in fertilizers. Due to its high solubility and weak retention by soil; nitrates are very mobile in soil and has a high potential to migrate. It does not volatilize in water; therefore, nitrate/nitrite is likely to remain until it is consumed by plants or other organisms. Sewage is the #1 source of nitrates in Indiana's surface waters, but it also comes from animal feed lots, manure from farm fields, or the over application of fertilizers on agricultural lands, golf courses and lawns.

Phosphorus is also essential to plant and animal life, and is naturally present in the environment. The presence of phosphorus in itself is not the problem, but the addition of excessive amounts can lead to excessive plant and algal growth. Unlike nitrogen and other nutrients, once phosphorus is in an aquatic system, it remains there unless physically removed. Phosphorus occurs naturally in soil, and sediments from soil erosion and runoff are a significant source of phosphorus. Additional sources can come from manure, over-fertilized fields, storm drains, parking lot and road runoff, construction sites, wastewater and septic tank effluent, or even waterfowl.

Fecal coliform bacteria are naturally present in the digestive tract of warm-blooded animals and are found in the feces of humans, pets, livestock, wildlife and waterfowl. It is rare or absent in unpolluted waters. *E. coli* is the specific species of fecal coliform bacteria used to evaluate the presence of fecal contamination and the potential presence of other pathogens that could cause human illnesses. Sources of *E.coli* and fecal coliform in water is typically due to sewer overflows, poorly or non-functioning septic systems, pet waste, wildlife, livestock or manure runoff from fields.

Habitat and Flow

A natural steam and rivers meander as they flow to release the energy of the water in the most even or uniform manner, often referred to "as the path of least resistance". These meandering streams and rivers provide a variety of habitat for plants and animals. Pools, riffles, undercut banks and snags all provide different types of habitat. The more types of habitat present, the

greater the potential for a greater diversity of plants and animals. Areas adjacent to stream channels, referred to as "riparian areas" provide bank support and stabilization, erosion and flood control, water quality protection, wildlife habitat and scenic beauty. The habitat is evaluated by recording and scoring the type and condition of the stream bottom, the cover or hiding places for fish and aquatic organisms, the stream shape and human alterations, the riparian area, the depth and velocity, and the pools, riffles or runs present in the stream.

Habitat ratings can range from a score of 0-100. Streams that have moderate to extensive man-made modifications would generally be classified as modified warm water habitats, and have lower scores ranging from 0-49. These modified habitats could include channelized, treeless ditches with silt and muck substrates, eroding banks, with little depth and poor flow rate. Streams that score from 50-60 can generally support biological communities, but depending on which habitat features are lacking may fall short of attaining the warm water habitat classification. Streams that have enough positive habitat features available to attain the warm water habitat classification score from 61-69 on the habitat evaluation; and generally include good depth and flow, a varied substrate, riffles and pools, and trees and shrubs. Exceptional warm water habitat would be those streams that score above 70, and would include variable depth, good flow, riffles and pools, good substrates, stable banks, forest canopy and a quality riparian area.

Stream flow is important because it influences the physical, chemical and biological characteristics of the streams and river. High flow or discharge rates (the volume of water flowing in the stream per second) may indicate recent rain or snowmelt events leading to sediments and nutrients being carried to the stream or river. Low flow or discharge rates may indicate drought conditions which can cause pollutants to be in higher concentrations in the stream or river and indicate that the pollutant entered the stream or river without the aid of runoff.

Biology - Macroinvertebrates

Benthic macroinvertebrates are aquatic invertebrates that live in the bottom parts of our waters. They make good indicators of the health of our streams and rivers because they live in the water for all or most of their life. They often live more than one year, have limited mobility and stay in areas suitable for their survival. They are easy to collect and identify and differ in their tolerance to the amounts and types of pollution. Pollution-sensitive organisms are more susceptible to the effects of physical or chemical changes in the water, therefore the presence of pollution-sensitive organisms act as indicators of the absence of pollutants. Impairments to the biotic communities can be caused by lack of habitat, water pollution or a combination of both.

Water Quality Target Levels

Table 3-4 lists the water quality parameters and target levels used to assess the water quality throughout the Upper Wabash River Phase 2 project. Water quality targets for each parameter were selected based on applicable Indiana Administrative Code, the Wabash River Watershed TMDL, and other standards accepted by IDEM.

Table 3-4: Water Quality Parameters and Target Levels in the Upper Wabash River Phase 2 Project Watershed.

Parameter	Target Level	Source
Dissolved Oxygen (DO)	Min.: >4.0 mg/L Max.: <12.0 mg/L and 100% saturation	Indiana Administrative Code (327 IAC 2-1-6)
pH	Min.: 6 units Max.: 9 units	Indiana Administrative Code (327 IAC 2-1-6)
Temperature	Dependent on time of year and whether stream is designated as a cold water fishery. Expected range: 0°C (32° F) in winter months to 32.2° C (90° F) in summer months	Indiana Administrative Code (327 IAC 2-1-6)
Turbidity	Max.: 25.0 NTU	Minnesota TMDL criteria for protection of fish/ macroinvertebrate health
E. coli	Max.: 235 cfu/100 mL in a single sample	Indiana Administrative Code (327 IAC 2-1.5-8)
Total Phosphorus	Max.: 0.3 mg/L	Wabash River Watershed TMDL/ IDEM draft TMDL Target
Nitrate (NO3)	Max.: 10 mg/L	Indiana Administrative Code (327 IAC 2-1-6)
Nitrite (NO2)	Max.: 1 mg/L	Indiana Administrative Code (327 IAC 2-1-6)
Total Nitrogen	Max. 10 mg/L	Indiana Administrative Code (327 IAC 2-1-6)
Temperature Change	Max.: <2.8° C (5° F)	Indiana Administrative Code (327 IAC 2-1-6)
Ortho-Phosphate	Max: 0.05 mg/L	Hoosier Riverwatch – Indiana average
Macroinvertebrate Index of Biotic Integrity	Min.: >10 Pollution Tolerance Index rating	Hoosier Riverwatch
Citizen's Qualitative Habitat Evaluation Index	Min.: >60 CQHEI score	Hoosier Riverwatch – developed by Ohio EPA

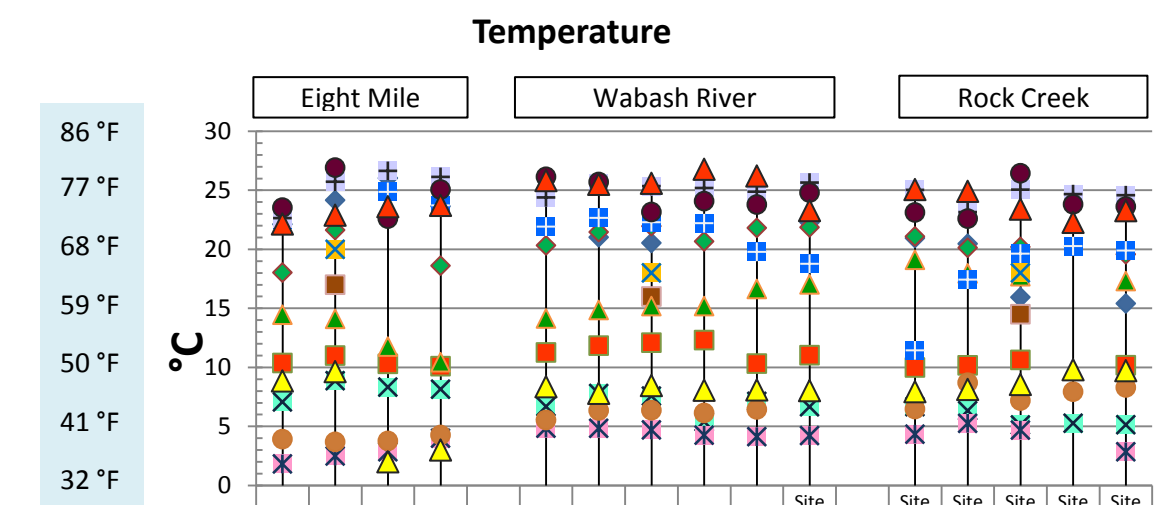
Upper Wabash Watershed Phase 2 Water Quality Data (2013-2014)

Monthly water quality monitoring began in September 2013 and continued through the end of November 2013. Monitoring was delayed due to heavy rains and flood-level waters followed by several significant snow events, sub-zero temperatures, and thick ice sheets that had formed on the streams and river. Regular monthly monitoring resumed as weather allowed beginning in March 2014. The monitoring schedule was amended to allow for a 14-21 day interval between sampling events in order make up the missed months of monitoring and still meet the requirement of 12 monitoring events from September 2013 – November 2014. Hoosier Riverwatch volunteer monitoring was also conducted at three sites (#2, #7, and #13) in October 2013 and September 2014. One site in each of the three subwatersheds was selected to encourage stakeholder participation across the watershed area. Figures 38 through 50 display the results of the data collected throughout the project and the data is also included in Appendix G.

Temperature

Figure 38 illustrates the water temperature at each site at the time of each sampling event. Overall, temperatures measured nearly the same in all three subwatersheds with seasonal changes creating a wide range of temperatures throughout the yearly monitoring period. Temperatures in Eight Mile Creek range from 1.82°C to 26.92°C. The Wabash River temperatures range from 4.22°C to 26.78°C, and the Rock Creek temperatures range from 2.85°C to 26.44°C. Temperatures recorded at the individual sites during a sampling event only varied by 2.32°C – 8.67°C, except for two occasions. For the 9/12/13-9/15/13 event, the temperature at Rock Creek sites 13 and 15 were as much as 10.62°C lower than the highest temperature recorded for the event at site 5 on the Wabash River. During the 6/13/14-6/15/14 event, the temperature at Rock Creek site 10 was 14.32°C lower than the highest temperature recorded for the event at 25.76°C at site 2 on the Eight Mile Creek. Some of the variances can be attributed to the fact that the testing occurred throughout each day over a 2-3 day period. Sites that were sampled in the early part of the day would naturally have a lower temperature than sites that were mid-day and later in the day.

Figure 38: Temperature Monitoring Data Chart

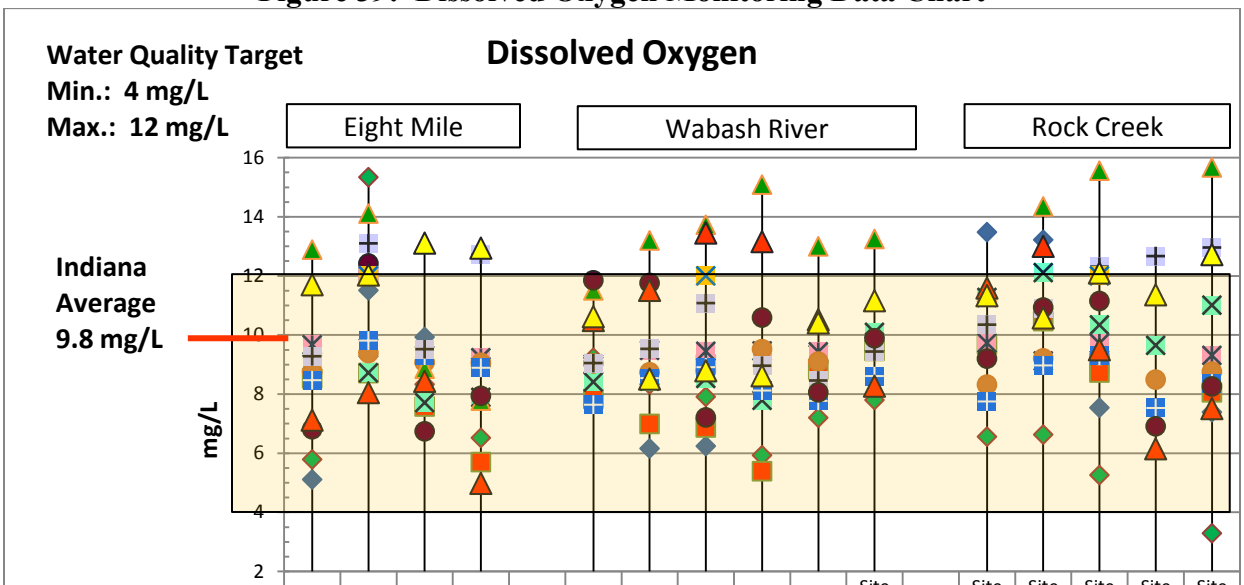


	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	22.12	24.16	26.03	23.64		25.12	21.02	20.54			22.28		20.95	20.47	15.94		15.41
10/3/13 - 10/6/13	18.03	21.63	22.93	18.61		20.33	21.46	21.96	20.67	21.81	21.86		21.09	20.13	20.2		19.58
HRW Volunteer - 10/12/13		17						16							14.5		
11/1/13 - 11/3/13	10.37	11	10.3	10.1		11.26	11.84	12.09	12.31	10.32	11.03		9.99	10.17	10.63		10.18
11/21/13 - 11/23/13	7.07	8.87	8.33	8.15		6.68	7.79	7.57	5.4	7.12	6.66		6.67	6.33	5.12	5.27	5.14
3/15/2014	1.82	2.49	2.85	4		4.85	4.84	4.7	4.26	4.13	4.22		4.34	5.26	4.69		2.85
4/5/2014	3.92	3.69	3.77	4.27		5.54	6.35	6.37	6.14	6.44			6.47	8.7	7.19	7.94	8.3
4/25/14 - 4/26/14	14.46	14.11	11.76	10.44		14.14	14.86	15.19	15.19	16.64	17.03		19.11	17.96	17.72		17.31
6/13/14 - 6/15/14	22.54	25.76	24.86	23.72		21.92	22.66	22.29	22.21	19.78	18.77		11.44	17.43	19.63	20.27	19.89
7/11/14 - 7/13/14	22.64	25.72	26.64	26.13		24.39	25.53	25.35	25.19	24.88	25.65		25.03	23.15	25.05	24.67	24.58
8/4/14 - 8/5/14	23.53	26.92	22.6	25.06		26.14	25.7	23.16	24.08	23.79	24.8		23.12	22.6	26.44	23.81	23.62
8/28/14 - 8/31/14	22.14	22.89	23.61	23.72		25.82	25.5	25.59	26.78	26.21	23.28		25.06	24.91	23.4	22.28	23.27
HRW Volunteer - 9/23/14		20						18							18		
11/1/14 - 11/16/14	8.85	9.64	2	3		8.36	7.8	8.46	8.06	8.09	8.03		7.94	8.13	8.55	9.8	9.72

Dissolved Oxygen

Dissolved oxygen concentrations varied with seasonal changes. The 4/25/14-4/26/14 sampling was conducted approximately three weeks after a large rain event and significant spring warming and resulted in 10 of the 14 sites (71%) being greater than the water quality target of 12.0 mg/L. Based on the water temperatures, the increase in the levels may be due to an increase in plant growth and photosynthesis. On one occasion (10/3/13-10/6/13 sample), the level of dissolved oxygen at site 15 on Rock Creek fell below the water quality standard of 4.0 mg/L. Overall, Rock Creek had 12 samples out of 57 (21%) that measured greater than the target during four sampling events; and Eight Mile Creek had 9 samples out of 50 (18%) during five events that were greater than the target. The Wabash River had 7 samples out of 71 (9.8%) over the target only during two sampling events. It should be noted that concentrations greater than 12.0 mg/L can occur naturally due to really cold water temperatures.

Figure 39: Dissolved Oxygen Monitoring Data Chart

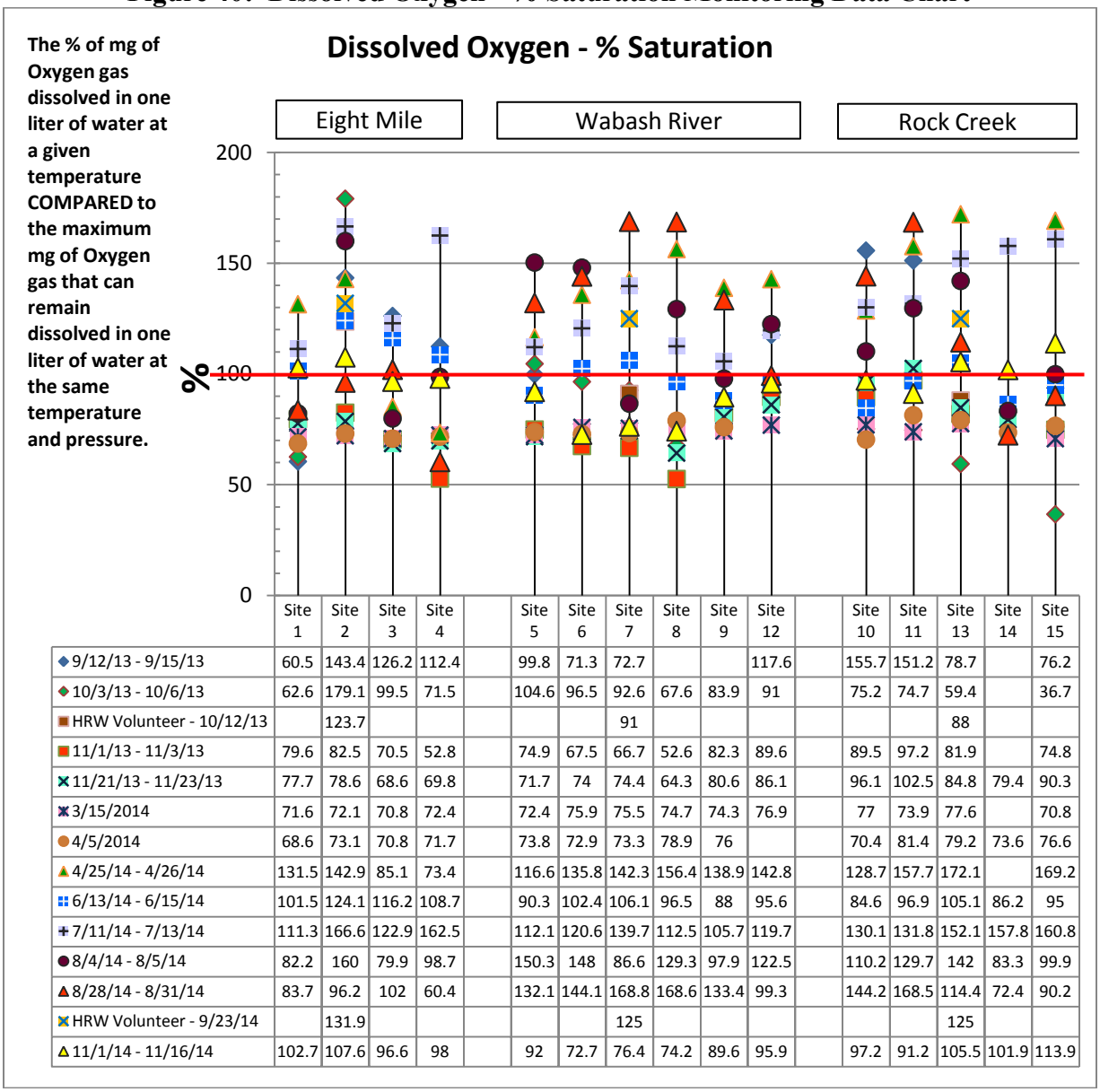


	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	5.11	11.51	9.93	9.21		7.97	6.16	6.24			9.91		13.48	13.22	7.54		7.39
10/3/13 - 10/6/13	5.79	15.34	8.33	6.52		9.23	8.33	7.91	5.93	7.2	7.8		6.56	6.63	5.26		3.29
HRW Volunteer - 10/12/13		12						9							9		
11/1/13 - 11/3/13	8.53	8.71	7.58	5.7		7.84	6.99	6.87	5.39	8.83	9.46		9.68	10.47	8.73		8.06
11/21/13 - 11/23/13	9.01	8.72	7.71	7.89		8.41	8.44	8.53	7.79	9.34	10.09		11.27	12.11	10.34	9.65	11.01
3/15/2014	9.67	9.56	9.31	9.23		9.02	9.48	9.45	9.46	9.43	9.75		9.73	9.12	9.72		9.31
4/5/2014	8.76	9.39	9.08	9.06		9.04	8.74	8.79	9.52	9.1			8.32	9.21	9.3	8.49	8.76
4/25/14 - 4/26/14	12.89	14.11	8.86	7.78		11.51	13.2	13.73	15.09	13	13.25		11.45	14.35	15.56		15.67
6/13/14 - 6/15/14	8.47	9.81	9.3	8.89		7.64	8.54	8.91	8.12	7.77	8.61		7.75	8.97	9.3	7.53	8.36
7/11/14 - 7/13/14	9.28	13.1	9.52	12.72		9.05	9.53	11.08	8.96	8.46	9.44		10.35	10.9	12.31	12.67	12.96
8/4/14 - 8/5/14	6.81	12.42	6.74	7.94		11.85	11.76	7.21	10.59	8.06	9.89		9.2	10.93	11.15	6.91	8.26
8/28/14 - 8/31/14	7.12	8.05	8.43	4.98		10.49	11.51	13.45	13.16	10.52	8.27		11.59	13	9.5	6.15	7.51
HRW Volunteer - 9/23/14		12						12							12		
11/1/14 - 11/16/14	11.7	12.03	13.11	12.94		10.62	8.51	8.79	8.62	10.41	11.16		11.33	10.58	12.1	11.36	12.72

Dissolved Oxygen - % Saturation

In general, 97.71% of the samples resulted in levels of 60% saturation or more. Only 4 samples fell below that level in October and November 2013; one each on Eight Mile Creek (site 4 at 52.8%) and Wabash River (site 8 at 52.6%), and two on Rock Creek (site 13 at 59.4% and site 15 at 36.7%). Besides having low percent saturation, water can become supersaturated, holding more than 100% of the oxygen it would hold under normal conditions. This occurred during monitoring events in the late spring, summer and fall. All 15 samples on the 7/11/14 – 7/13/14 sampling event exceeded 100% saturation. The Wabash River had 26 samples out of 71 (36.6%) resulting in over 100% saturation, followed by Rock Creek with 23 samples out of 57 (40.3%) and Eight Mile Creek with 20 samples out of 50 (40%).

Figure 40: Dissolved Oxygen - % Saturation Monitoring Data Chart

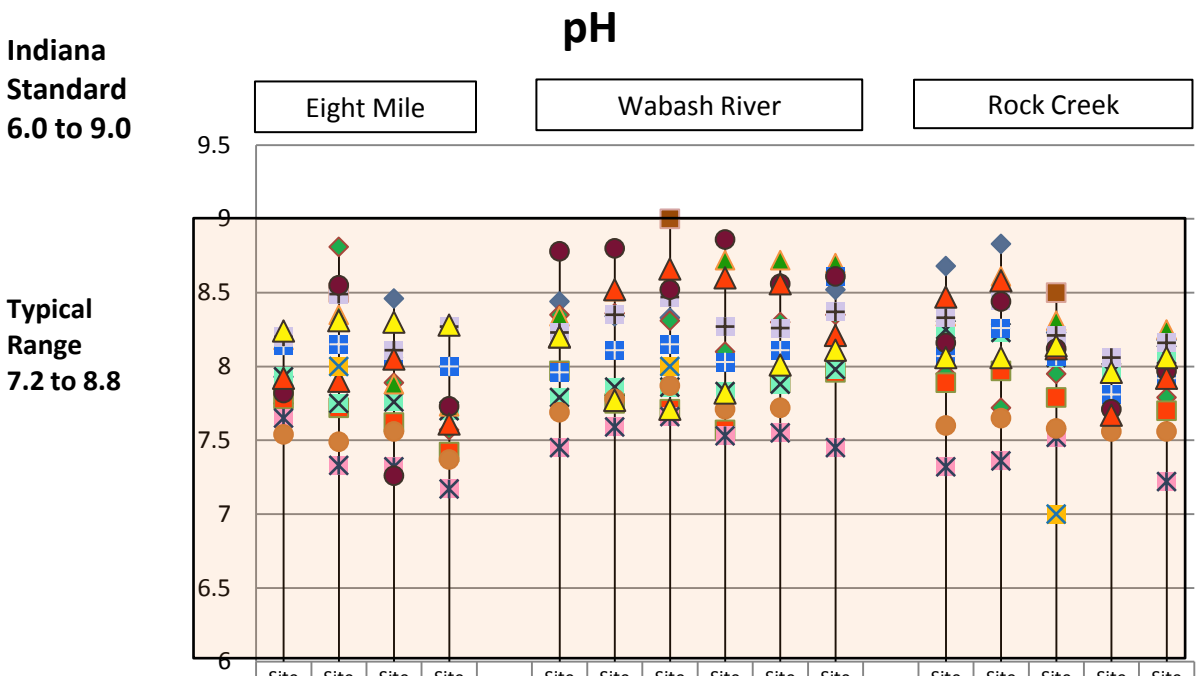


	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	60.5	143.4	126.2	112.4		99.8	71.3	72.7			117.6		155.7	151.2	78.7		76.2
10/3/13 - 10/6/13	62.6	179.1	99.5	71.5		104.6	96.5	92.6	67.6	83.9	91		75.2	74.7	59.4		36.7
HRW Volunteer - 10/12/13		123.7						91							88		
11/1/13 - 11/3/13	79.6	82.5	70.5	52.8		74.9	67.5	66.7	52.6	82.3	89.6		89.5	97.2	81.9		74.8
11/21/13 - 11/23/13	77.7	78.6	68.6	69.8		71.7	74	74.4	64.3	80.6	86.1		96.1	102.5	84.8	79.4	90.3
3/15/2014	71.6	72.1	70.8	72.4		72.4	75.9	75.5	74.7	74.3	76.9		77	73.9	77.6		70.8
4/5/2014	68.6	73.1	70.8	71.7		73.8	72.9	73.3	78.9	76			70.4	81.4	79.2	73.6	76.6
4/25/14 - 4/26/14	131.5	142.9	85.1	73.4		116.6	135.8	142.3	156.4	138.9	142.8		128.7	157.7	172.1		169.2
6/13/14 - 6/15/14	101.5	124.1	116.2	108.7		90.3	102.4	106.1	96.5	88	95.6		84.6	96.9	105.1	86.2	95
7/11/14 - 7/13/14	111.3	166.6	122.9	162.5		112.1	120.6	139.7	112.5	105.7	119.7		130.1	131.8	152.1	157.8	160.8
8/4/14 - 8/5/14	82.2	160	79.9	98.7		150.3	148	86.6	129.3	97.9	122.5		110.2	129.7	142	83.3	99.9
8/28/14 - 8/31/14	83.7	96.2	102	60.4		132.1	144.1	168.8	168.6	133.4	99.3		144.2	168.5	114.4	72.4	90.2
HRW Volunteer - 9/23/14		131.9						125							125		
11/1/14 - 11/16/14	102.7	107.6	96.6	98		92	72.7	76.4	74.2	89.6	95.9		97.2	91.2	105.5	101.9	113.9

pH

The pH at all sites was within the acceptable range throughout the monitoring period, which is expected, due to the limestone that is present in the soil and bottom of the streams and river. The Eight Mile Creek results varied between 7.17–8.81 units, the Wabash River results varied between 7.45–8.86 units, and the Rock Creek varied between 7.22–8.83 units. The Hoosier Riverwatch (HRW) test results of 7 and 9 are a result of the limitations on the monitoring method detection limits.

Figure 41: pH Monitoring Data Chart

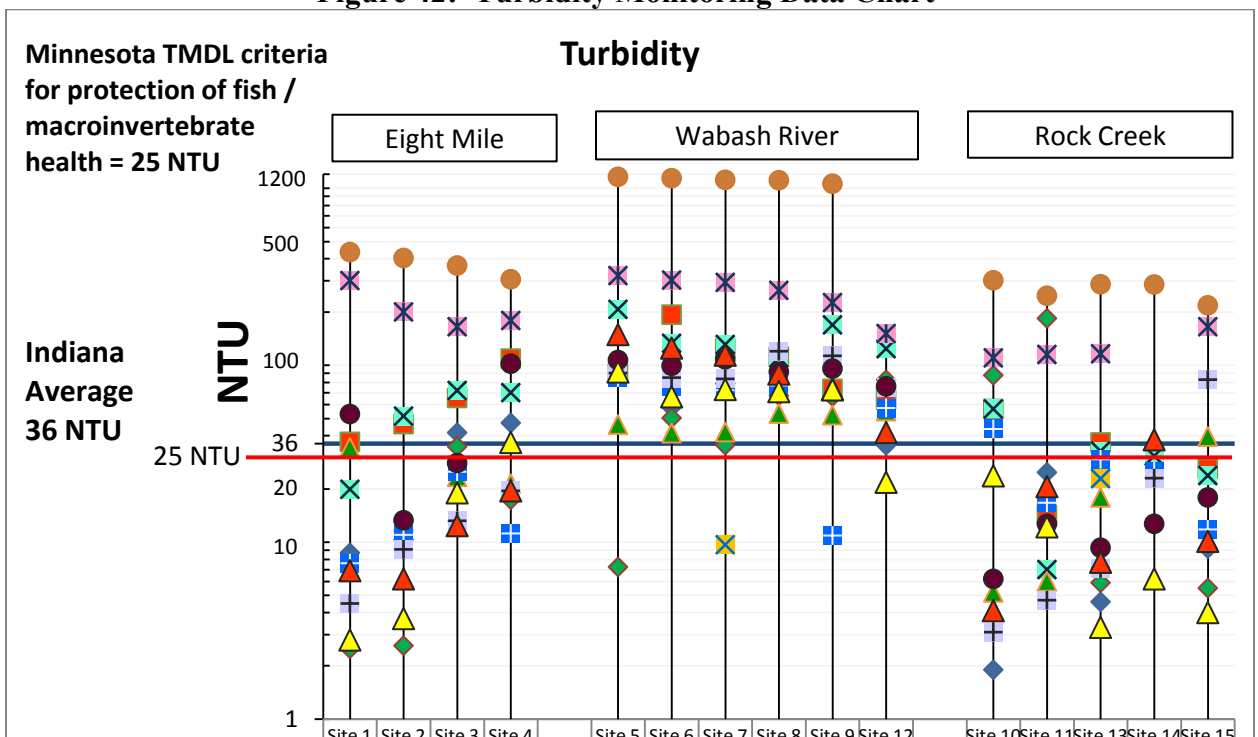


	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	7.93	8.53	8.46	8		8.44	8.34	8.33			8.52		8.68	8.83	8.23		8.18
10/3/13 - 10/6/13	7.75	8.81	7.89	7.57		8.35	8.36	8.31	8.1	8.3	8.35		7.95	7.72	7.95		7.79
HRW Volunteer - 10/12/13		8.5						9							8.5		
11/1/13 - 11/3/13	7.78	7.72	7.62	7.42		7.97	7.75	7.71	7.57	7.89	7.96		7.89	7.97	7.79		7.7
11/21/13 - 11/23/13	7.93	7.75	7.76	7.7		7.79	7.86	7.86	7.83	7.88	7.98		8.25	8.23	8.06	7.96	8.08
3/15/2014	7.65	7.33	7.32	7.17		7.45	7.59	7.66	7.53	7.55	7.45		7.32	7.36	7.52		7.22
4/5/2014	7.54	7.49	7.56	7.37		7.69	7.78	7.87	7.71	7.72			7.6	7.65	7.58	7.56	7.56
4/25/14 - 4/26/14	8.18	8.35	7.88	7.73		8.34	8.51	8.58	8.72	8.72	8.7		8.34	8.61	8.31		8.25
6/13/14 - 6/15/14	8.14	8.15	8.06	8		7.96	8.11	8.15	8.03	8.11	8.61		8.07	8.26	8.07	7.81	7.92
7/11/14 - 7/13/14	8.2	8.49	8.11	8.27		8.23	8.35	8.47	8.27	8.26	8.37		8.33	8.45	8.21	8.06	8.16
8/4/14 - 8/5/14	7.82	8.55	7.26	7.73		8.78	8.8	8.52	8.86	8.56	8.61		8.16	8.44	8.12	7.71	7.97
8/28/14 - 8/31/14	7.92	7.9	8.05	7.61		8.2	8.52	8.66	8.6	8.56	8.21		8.47	8.58	8.12	7.67	7.92
HRW Volunteer - 9/23/14		8						8							7		
11/1/14 - 11/16/14	8.24	8.31	8.3	8.28		8.2	7.77	7.71	7.82	8.01	8.11		8.06	8.06	8.14	7.96	8.06

Turbidity

Turbid water can be the result of soil erosion, urban runoff, algal blooms and bottom sediment disturbance and has a direct relationship to the flow in the stream or river. During the monitoring period, the Eight Mile Creek turbidity concentrations exceeded the 25.0 NTU target in 23 of the 49 (46.9%) samples, and peaked at 436 NTUs, which is over 17 times the target level. The Wabash River exceeded the target 97.1% of the time, with only 2 samples out of 70 that was under the target level. The peak on the Wabash River occurred during spring snow and ice melt and was 1161 NTUs, or more than 46 times the target level. The Rock Creek turbidity concentrations exceeded the target 41% of the time with 23 out of 56 samples over 25.0 NTUs. The Rock Creek peak was at 302 NTUs, or over 12 times the target. On two sampling events (3/15/14 and 4/5/14) all of the sites were over the target level of 25 NTUs.

Figure 42: Turbidity Monitoring Data Chart

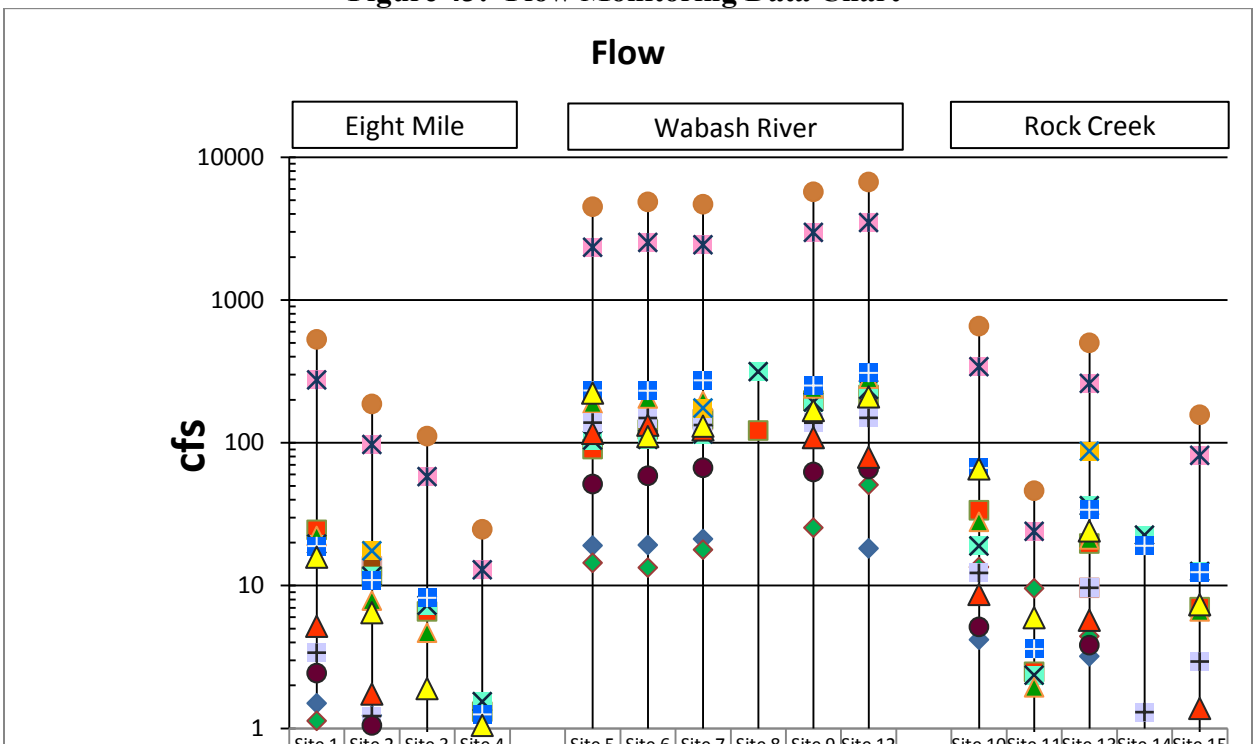


	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	8.7	10.3	41.6	47.2		99.9	57.8	78.8			35.3		1.9	24.8	4.6		9.2
10/3/13 - 10/6/13	2.5	2.6	34.7	17.4		7.24	50.3	35.4	67.3	66.5	82.7		87.8	184	5.9		5.5
HRW Volunteer - 10/12/13																	
11/1/13 - 11/3/13	36.9	46.5	65.3	109		90.38	193	125	112	73.5	64		56.6	14.3	36.6		26
11/21/13 - 11/23/13	19.9	51.6	72	70		207	133	131	110	169	124		56.6	7	32.7	30.7	23.8
3/5/2014	301	200	165	179		321	303	294	265	226	151		110	115	116		165
4/5/2014	436	404	366	306		1161	1141	1116	1111	1062			302	247	287	286	218
4/25/14 - 4/26/14	34.3	13.1	23.4	21.4		46.2	41.3	41.9	53.3	52.2	55.1		5.2	6	17.9		39.5
6/13/14 - 6/15/14	7.6	11	25	11.2		85.2	75.5	72.2	76.9	10.9	57.3		43.6	16.7	29.4	25.1	11.8
7/11/14 - 7/13/14	4.5	9.1	13.2	19.5		90.2	85.1	83.7	120	113	74.5		3.1	4.7	7.1	23	82.9
8/4/14 - 8/5/14	53	13.3	28	102		107	99.3	108	91.8	95.7	76		6.2	12.7	9.3	12.7	17.9
8/28/14 - 8/31/14	6.9	6.2	12.4	19.5		149	125	114	89.2	72.9	41.7		4.1	20.6	7.7	37.9	10.1
HRW Volunteer - 9/23/14		0						9.67							22.87		
11/1/14 - 11/16/14	2.8	3.7	19	36.6		91.6	66.3	72.9	70.9	72.6	21.8		23.7	12.2	3.3	6.2	4

Flow

Flow varies based on seasons, rain and snow events, and dry periods; and can influence the chemical tests, as well as in-stream habitat and biology. Flow is used to calculate average concentrations of pollutants as well as estimated pollutant loads in a stream or river and the resulting reductions that are needed to reach water quality targets so that the stream or river will attain its intended use. Figure 43 below details the actual in stream flow readings or estimates based off of USGS gauges.

Figure 43: Flow Monitoring Data Chart

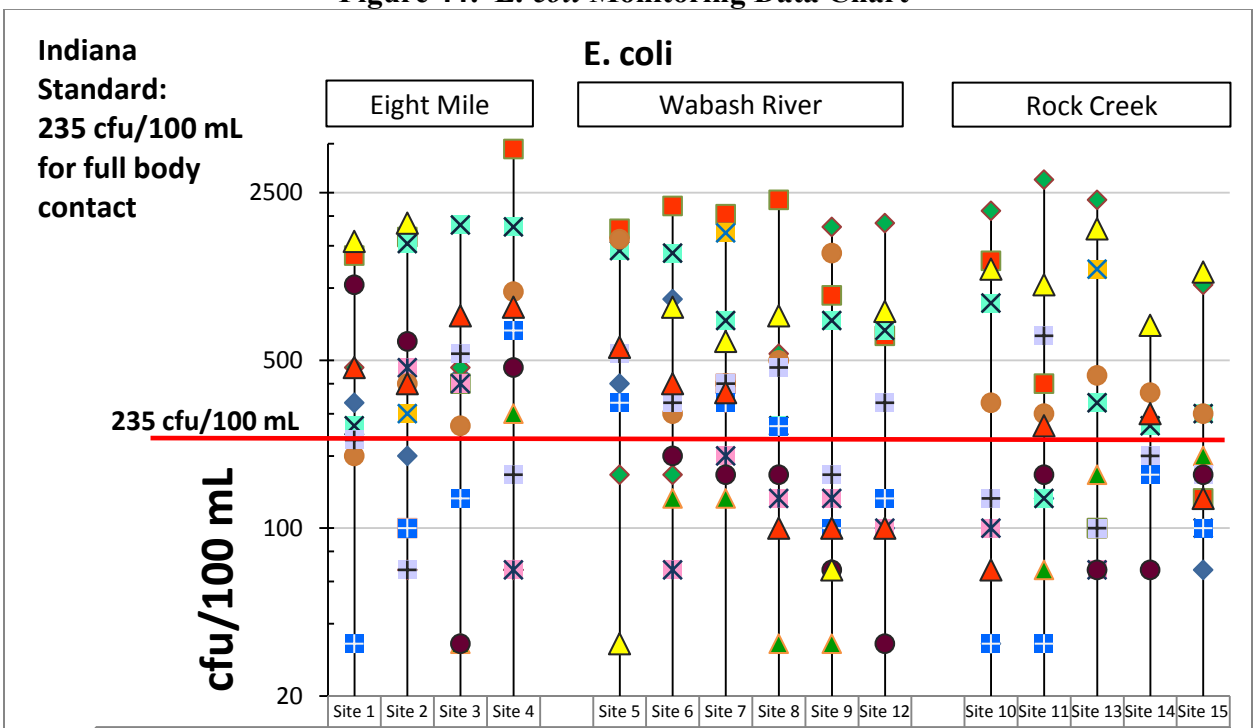


	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	1.5	1.23	0.07			19.08	19.24	21.22			18.23		4.18	0	3.2		0.93
10/3/13 - 10/6/13	1.13	0.51	0.71	0		14.44	13.37	17.84		25.45	50.79		13.49	9.57	4.42		0.75
HRW Volunteer - 10/12/13		13.67						143.8							9.66		
11/1/13 - 11/3/13	24.55	11.59	6.6	1.31		90.38	124	147	121.9	197.8	216.4		33.7	2.49	19.71		7.06
11/21/13 - 11/23/13	19.54	11.61	7.28	1.54		104.4	105.7	115.2	314.9	192.8	236.2		18.94	2.36	36.26	22.59	12.56
3/15/14 EST - Bridge Pull	275.6	97.3	57.94	12.9		2340	2529	2435		2975	3486		341.3	24	260.7		81.7
4/5/2014 EST - Bridge Pull	530	187.2	111.4	24.8		4500	4864	4683		5722	6705		656.4	46.2	501.4		157.2
4/25/14 - 4/26/14	22.26	7.86	4.68	1.04		189	204.3	196.7		240.3	281.6		27.97	1.94	21.06		6.6
6/13/14 - 6/15/14	18.91	10.93	8.21	1.253		232.3	231.5	273.7		251.7	308.6		66.64	3.6	33.96	19	12.41
7/11/14 - 7/13/14	3.39	1.22	0.68	0.17		138.4	149.1	133.1		138.2	149.5		12.27	0.41	9.65	1.3	2.94
8/4/14 - 8/5/14	2.44	1.05	0.31	-0.14		51.44	58.75	66.85		62.48	65.48		5.14	0.19	3.83		0.88
8/28/14 - 8/31/14	5.19	1.74	0.38	-0.1		116.4	132.8	123.1		108.7	79.25		8.67	0.49	5.72		1.38
HRW Volunteer - 9/23/14		17.52						175.2							87.37		
11/1/14 - 11/16/14	15.82	6.46	1.9	1.05		222.9	110.5	130.7		168.2	209.6		65.6	5.96	24.15		7.35

E. coli

It is not unusual for *E. coli* concentrations in the Eight Mile Creek, Wabash River and Rock Creek to exceed the state water quality standard for total body contact of 235 cfu/100 mL. During the monitoring period, Eight Mile Creek exceeded the target 60% of the time (30 out of 50 samples). The Wabash River exceeded the target 59.15% of the time (42 out of 71 samples), and Rock Creek exceeded the target 44.8% of the time (26 out of 58 samples). On three sampling events (11/1/13-11/3/13, 11/21/13-11/23/13 and 4/5/14) all but one site was over the target level (14 sites out of 15, and 13 sites out of 14). Not only were results over the target, 30 of the 179 samples (16.75%) were over 1,000 cfu/100 mL, indicating direct *E. coli* sources and inputs such as livestock or manure runoff from land application on fields and failed or illicitly discharging septic systems. The lowest number of sites testing over the target occurred on 3/15/14, 4/25/14-4/26/14, and 8/4/14-8/5/14; with 2 sites out of 14, 1 site out of 14, and 3 sites out of 15, respectively, being over the target.

Figure 44: *E. coli* Monitoring Data Chart

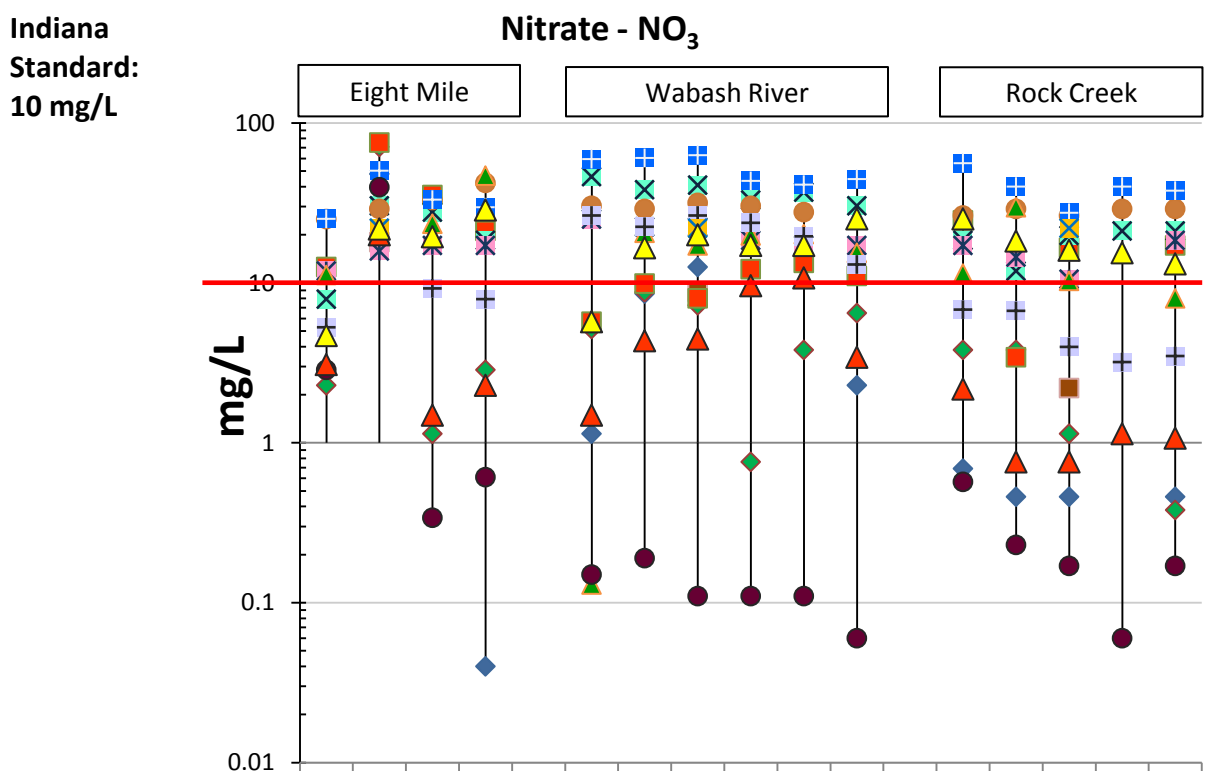


	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	333	200	433	67		400	900	367			100		33	133	67		67
10/3/13 - 10/6/13	467	67	467	67		167	167	333	533	1800	1867		2100	2833	2333		1033
HRW Volunteer - 10/12/13		100						400							100		
11/1/13 - 11/3/13	1367	1633	400	3800		1767	2200	2033	2333	933	633		1300	400	100		133
11/21/13 - 11/23/13	267	1533	1833	1800		1433	1400	733	267	733	667		867	133	333	267	300
3/15/2014	0	466	400	67		0	67	200	133	133	100		100	0	67		100
4/5/2014	200	400	267	967		1600	300	400	500	1400			333	300	433	367	300
4/25/14 - 4/26/14	0	0	33	300		0	133	133	33	33	0		0	67	167		200
6/13/14 - 6/15/14	33	100	133	666		333	333	333	266	100	133		33	33	100	167	100
7/11/14 - 7/13/14	233	67	533	167		533	333	400	467	167	333		133	633	100	200	167
8/4/14 - 8/5/14	1033	600	33	467		0	200	167	167	67	33		0	167	67	67	167
8/28/14 - 8/31/14	467	400	767	833		567	400	367	100	100	100		67	267	0	300	133
HRW Volunteer - 9/23/14		300						1700							1200		
11/1/14 - 11/16/14	1566	1866	0	0		33	833	600	767	67	800		1200	1033	1766	700	1167

Nitrate (NO_3)

Nitrate levels can vary greatly throughout the year based on land use. Site 2 on the Eight Mile Creek exceeded the target for drinking water of 10 mg/L on all testing events with an annual average concentration of 34.48 mg/L. There were four testing events (in the months of August, September and October) where only one or two sites out of the 15 sampled exceeded the target. Overall, 108 samples out of 178 total (61.3%) exceeded the target, indicating an abundance of nitrate in the watershed. On three monitoring events (3/15/14, 4/5/14, and 6/13/14) the target was exceeded at all sites. Nitrate concentrations in general are higher during late fall, spring and early summer at times of agricultural activity (harvest, manure application, and planting) and at times of heavy rainfall.

Figure 45: Nitrate – NO_3 Monitoring Data Chart

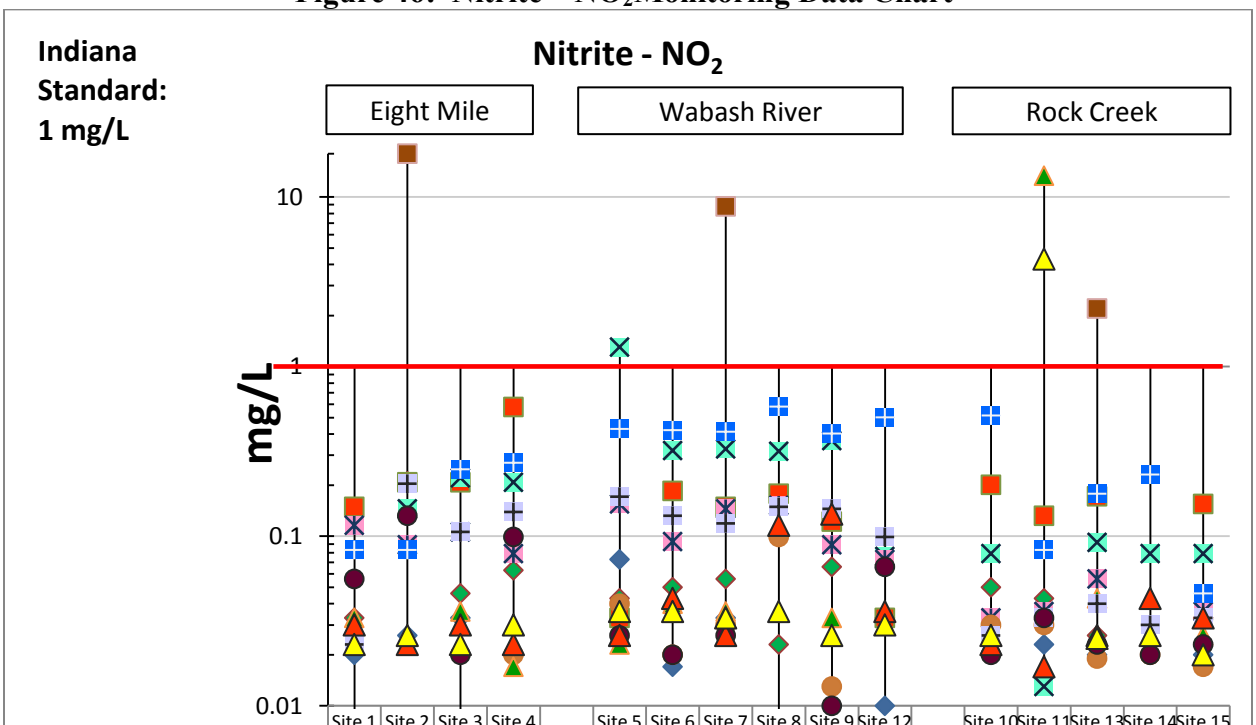


	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	0	48.05	0	0.04		1.14	8.58	12.58			2.29		0.69	0.46	0.46		0.46
10/3/13 - 10/6/13	2.29	70.93	1.14	2.86		5.15	8.77	7.25	0.76	3.81	6.48		3.81	3.81	1.14		0.38
HRW Volunteer - 10/12/13		18						8.8							2.2		
11/1/13 - 11/3/13	12.58	75.5	35.46	21.16		5.72	9.91	8.01	12.2	13.35	11.06		24.6	3.43	16.59		17.16
11/21/13 - 11/23/13	7.92	30.36	27.72	18.48		46.2	38.28	40.92	33	36.96	30.36		18.48	11.88	19.8	21.12	21.12
3/15/2014	11.88	15.84	17.16	17.16		25.08	22.44	22.44	18.48	17.16	17.16		17.16	14.52	10.56		18.48
4/5/2014	25.08	29.04	33	42.24		30.36	29.04	31.68	30.36	27.72			26.4	29.04	26.4	29.04	29.04
4/25/14 - 4/26/14	11.21	20.02	23.45	46.9		0.13	20.59	17.16	19.83	20.21	15.44		11.44	29.74	10.3		8.01
6/13/14 - 6/15/14	25.17	50.34	33.18	29.74		59.49	60.47	62.92	43.47	41.18	44.62		56.06	40.04	27.46	40.04	37.75
7/11/14 - 7/13/14	5.28	21.12	9.24	7.92		26.4	22.44	26.4	23.76	19.56	13.04		6.81	6.69	3.98	3.2	3.49
8/4/14 - 8/5/14	2.86	39.69	0.34	0.61		0.15	0.19	0.11	0.11	0.11	0.06		0.57	0.23	0.17	0.06	0.17
8/28/14 - 8/31/14	3.09	20.02	1.49	2.29		1.49	4.35	4.46	9.61	10.75	3.43		2.17	0.76	0.76	1.14	1.07
HRW Volunteer - 9/23/14		22						22							22		
11/1/14 - 11/16/14	4.69	21.74	19.45	28.6		5.72	16.59	20.02	17.16	17.16	25.17		25.17	18.3	16.02	15.44	13.16

Nitrite (NO_2)

Only six samples exceeded the Nitrite target of 1 mg/L, and three of those were using the Hoosier Riverwatch testing method on 10/12/13 at the one HRW site in each subwatershed. The Wabash River site 5 was over the target on one occasion, and the Rock Creek-Elkenberry Ditch site 11 is the only other anomaly, with two testing events that measured significantly higher than the other test sites.

Figure 46: Nitrite – NO_2Monitoring Data Chart

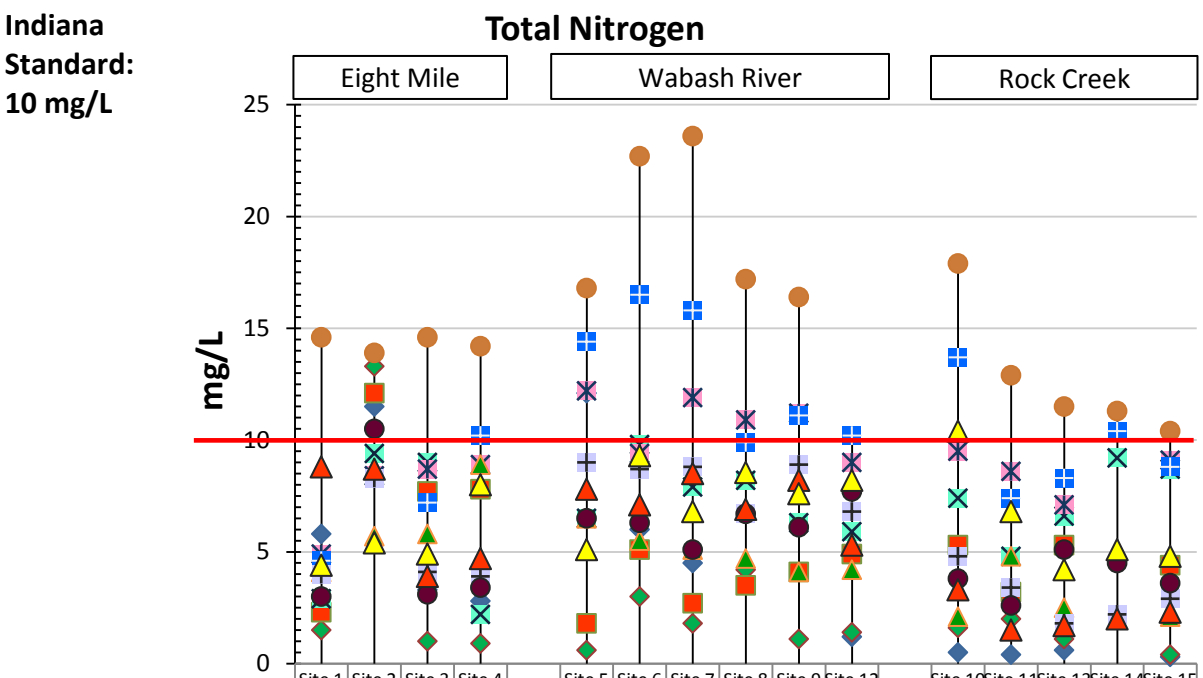


	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	0.02	0.026	0.033	0.02		0.073	0.017	0.033			0.01		0.02	0.023	0.02		0.02
10/3/13 - 10/6/13	0.033	0.211	0.046	0.063		0.043	0.05	0.056	0.023	0.066	0.033		0.05	0.043	0.026		0.033
HRW Volunteer - 10/12/13		18						8.8							2.2		
11/1/13 - 11/3/13	0.149	0.208	0.208	0.578		0.033	0.185	0.149	0.178	0.122	0.033		0.201	0.132	0.172		0.155
11/21/13 - 11/23/13	0.003	0.145	0.221	0.208		1.304	0.32	0.327	0.317	0.366	0.076		0.079	0.013	0.092	0.079	0.079
3/15/2014	0.116	0.089	0.106	0.079		0.155	0.093	0.145	0.152	0.089	0.073		0.033	0.036	0.056		0.036
4/5/2014	0.007	0	0.003	0.02		0.04	0.02	0.03	0.099	0.013			0.03	0.03	0.019	0.02	0.017
4/25/14 - 4/26/14	0.033	0.026	0.036	0.017		0.023	0.04	0.036	0.036	0.033	0.03		0.026	13.35	0.043		0.026
6/13/14 - 6/15/14	0.083	0.083	0.248	0.271		0.429	0.422	0.413	0.581	0.403	0.502		0.515	0.083	0.178	0.231	0.046
7/11/14 - 7/13/14	0.023	0.204	0.106	0.139		0.171	0.132	0.119	0.149	0.145	0.099		0.026	0.033	0.04	0.03	0.033
8/4/14 - 8/5/14	0.056	0.132	0.02	0.099		0.026	0.02	0.026	0.007	0.01	0.066		0.02	0.033	0.023	0.02	0.023
8/28/14 - 8/31/14	0.03	0.023	0.03	0.023		0.026	0.043	0.026	0.116	0.135	0.036		0.023	0.017	0.026	0.043	0.033
HRW Volunteer - 9/23/14		0						0							0		
11/1/14 - 11/16/14	0.023	0.026	0.023	0.03		0.036	0.036	0.033	0.036	0.026	0.03		0.026	4.307	0.025	0.026	0.02

Total Nitrogen

A total of 172 Total Nitrogen samples were collected throughout the monitoring period. Of those, 32 samples (18.6%) exceeded the water quality target of 10 mg/L. The Eight Mile Creek subwatershed had nine exceedances out of 48 samples (18.75%). The Wabash River monitoring sites exceeded the target in 15 samples out of 71 (21%), and the Rock Creek subwatershed had eight exceedances out of 55 samples (14.5%). All sampling sites exceeded the target on one occasion (4/15/14), which was during a time of snow and ice melt with high flows and saturated soil conditions. The 6/13/14-6/15/14 sampling event resulted in eight of the 15 sites exceeding the target, which was also under moist conditions, indicating that nutrients are being flushed into the streams and rivers throughout the subwatersheds. Site 2 in the Eight Mile Creek subwatershed had the most exceedances with five out of 12 samples (41.6%), followed by site 5 on the Wabash River with four out of 12 samples (33.3%) exceeding the target. Also of concern is that the results on the Wabash River were 1.5–2 times higher than the target for more than 50% of the exceedances.

Figure 47: Total Nitrogen Monitoring Data Chart

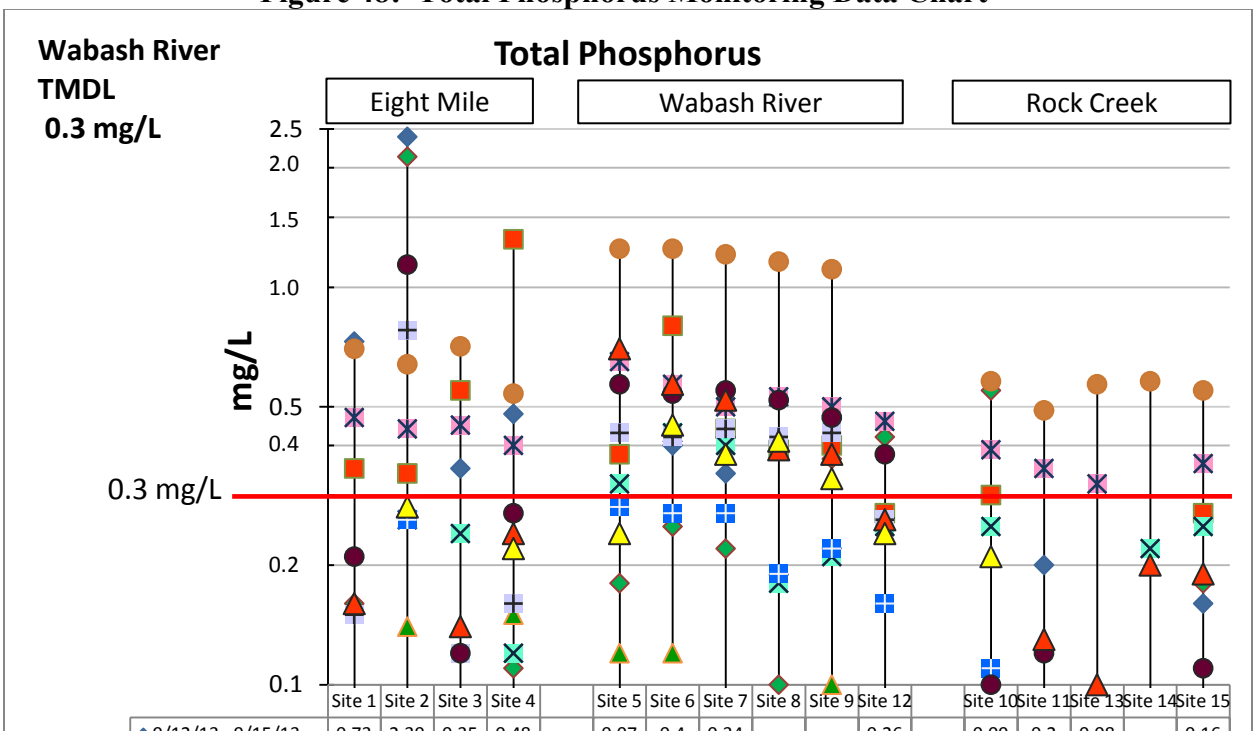


	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	5.8	11.5	3.3	2.8		12.1	6	4.5			1.2		0.5	0.4	0.6		0.3
10/3/13 - 10/6/13	1.5	13.3	1	0.9		0.6	3	1.8	4.2	1.1	1.4		1.6	2	1.1		0.4
11/1/13 - 11/3/13	2.3	12.1	7.7	7.8		1.8	5.1	2.7	3.5	4.1	4.9		5.3	3.2	5.3		4.4
11/21/13 - 11/23/13	2.9	9.4	9	2.2		6.5	9.8	7.9	8.2	6.3	5.9		7.4	4.8	6.6	9.2	8.7
3/15/2014	4.9	8.4	8.7	8.9		12.2	9.4	11.9	10.9	11.2	9		9.5	8.6	7.1		9.1
4/5/2014	14.6	13.9	14.6	14.2		16.8	22.7	23.6	17.2	16.4			17.9	12.9	11.5	11.3	10.4
4/25/14 - 4/26/14	4.1	5.7	5.8	8.9		6.5	5.5	5.1	4.7	4.1	4.2		2.1	4.8	2.5		2.1
6/13/14 - 6/15/14	4.6	8.3	7.2	10.2		14.4	16.5	15.8	9.9	11.1	10.2		13.7	7.4	8.3	10.4	8.8
7/11/14 - 7/13/14	4	8.3	4.1	3.9		9	8.7	8.8	6.7	8.9	6.8		4.8	3.4	1.8	2.2	2.9
8/4/14 - 8/5/14	3	10.5	3.1	3.4		6.5	6.3	5.1	6.7	6.1	7.7		3.8	2.6	5.1	4.5	3.6
8/28/14 - 8/31/14	8.8	8.7	3.9	4.7		7.8	7.1	8.5	6.9	8.2	5.3		3.3	1.5	1.7	2	2.3
11/1/14 -11/16/14	4.4	5.4	4.9	8		5.1	9.3	6.8	8.55	7.6	8.2		10.4	6.8	4.2	5.1	4.8

Total Phosphorus

The water quality target 0.3 mg/L for Total Phosphorus was exceeded in 72 samples out of the 172 that were collected (41.8%). The Eight Mile Creek subwatershed had 19 exceedances out of 48 samples (39.5%), with site 2 accounting for just over a third of the exceedances (7 out of 19 samples). Site 2 also had the highest levels of Total Phosphorus on four monitoring events, being as much as eight times the target level. The Wabash River subwatershed had 41 exceedances out of 69 monitoring samples (59.4%), with site 7 exceeding the target in nine out of 12 samples (75%). Monitoring results on the Wabash River subwatershed were as much as four times the target level. The Rock Creek subwatershed exceeded the target in 12 out of 55 samples (21.8%). All samples exceeded the target on two occasions, 3/15/14 and 4/5/14, both during times of high flow events when soil and stream bank erosion or in-stream sedimentation would be more likely to occur. There were two instances where all samples were under the target, occurring on 4/25/14-4/26/14 and 6/13/14-6/15/14.

Figure 48: Total Phosphorus Monitoring Data Chart



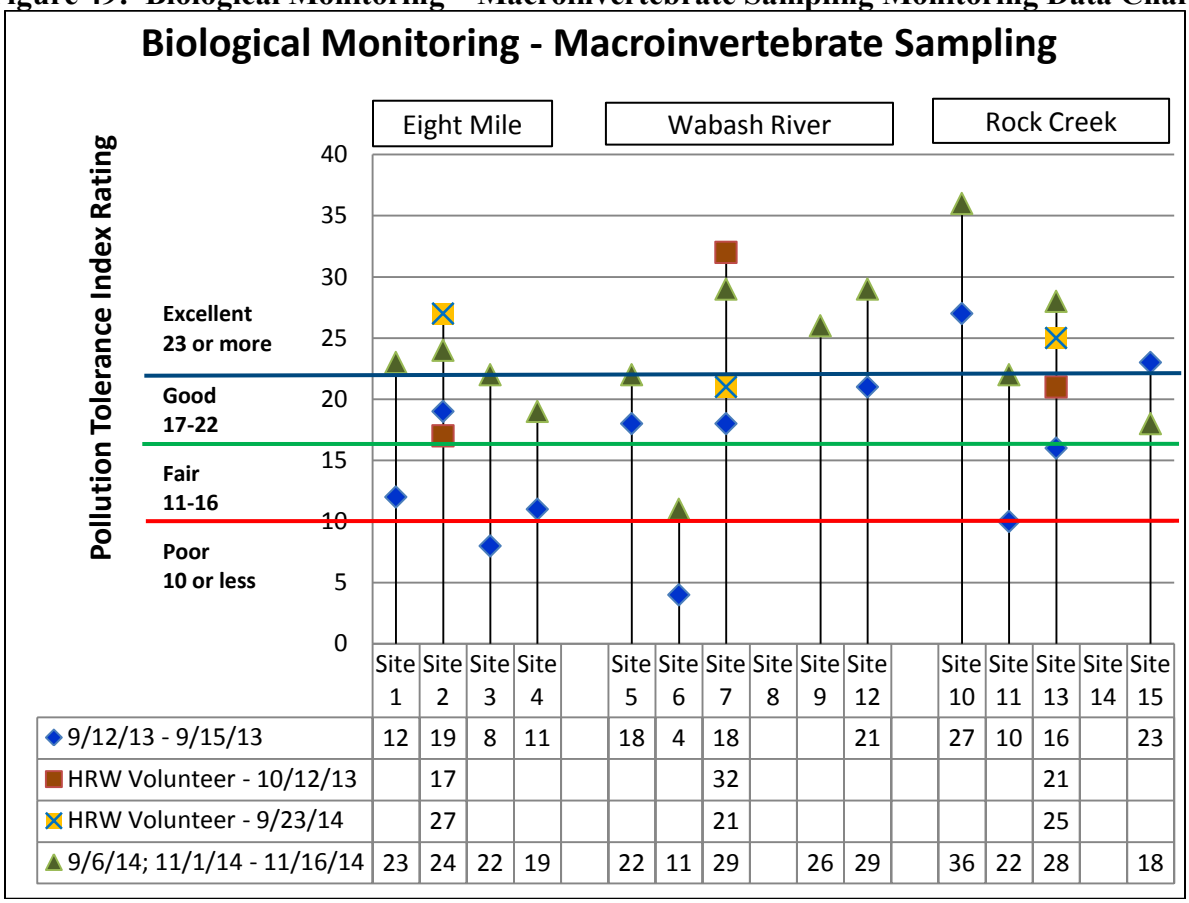
	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
9/12/13 - 9/15/13	0.73	2.39	0.35	0.48		0.07	0.4	0.34			0.26		0.09	0.2	0.08		0.16
10/3/13 - 10/6/13	0.16	2.13	0.08	0.11		0.18	0.25	0.22	0.1	0.37	0.42		0.55	0.49	0.05		0.18
11/1/13 - 11/3/13	0.35	0.34	0.55	1.32		0.38	0.8	0.44	0.39	0.4	0.27		0.3	0.04	0.05		0.27
11/21/13 - 11/23/13	0.08	0.26	0.24	0.12		0.32	0.43	0.4	0.18	0.21	0.25		0.25	0.01	0.08	0.22	0.25
3/15/2014	0.47	0.44	0.45	0.4		0.65	0.57	0.5	0.53	0.5	0.46		0.39	0.35	0.32		0.36
4/5/2014	0.7	0.64	0.71	0.54		1.25	1.25	1.21	1.16	1.11			0.58	0.49	0.57	0.58	0.55
4/25/14 - 4/26/14	0.03	0.14	0.05	0.15		0.12	0.12	0.08	0.07	0.1	0.03		0.02	0.04	0.03		0.03
6/13/14 - 6/15/14	0.15	0.26	0.09	0.06		0.28	0.27	0.27	0.19	0.22	0.16		0.11	0.05	0.06	0.08	0.06
7/11/14 - 7/13/14	0.15	0.78	0.12	0.16		0.43	0.42	0.44	0.42	0.43	0.26		0.05	0.06	0.05	0.08	0.07
8/4/14 - 8/5/14	0.21	1.14	0.12	0.27		0.57	0.54	0.55	0.52	0.47	0.38		0.1	0.12	0.09	0.07	0.11
8/28/14 - 8/31/14	0.16	0.08	0.14	0.24		0.7	0.57	0.52	0.39	0.38	0.26		0.08	0.13	0.1	0.2	0.19
11/1/14 - 11/16/14	0.09	0.28	0.09	0.22		0.24	0.45	0.38	0.41	0.33	0.24		0.21	0.06	0.07	0.04	0.08

Biological Monitoring – Macroinvertebrate Sampling

Macroinvertebrate sampling occurred once per year at a minimum of 12 sites and once per year at the three Hoosier Riverwatch monitoring sites. Site 8 on the Wabash River is an impoundment area that is part of the J. E. Roush DNR Fish & Wildlife area. This site is too deep to conduct biological monitoring. The Rock Creek site 14 is heavily silted. Staff would sink into the silted substrate while trying to complete monitoring activities, so it was determined that for safety reasons biological monitoring would not be completed at this site. Biological monitoring was not conducted on site 9 on the Wabash River in 2013 due to time constraints.

The 2014 ratings were higher than the 2013 ratings at all sites except for site 15 on the Rock Creek. The three sites that were rated as poor in 2013 (Eight Mile site 3, Wabash River site 6, and Rock Creek site 11) were now rated as fair and good in 2014. Site 2 on the Eight Mile Creek is a 2-stage ditch location, and this site was rated good and excellent in 2013 and 2014, respectively. Site 10 on the Rock Creek rated excellent during both years. This site is very natural, with a snail bed just downstream from the monitoring location. Additionally, the Wabash River sites 7, 9 and 12 are mostly natural sites with diverse populations of macroinvertebrates. In general, a total of 31 collections were completed at the sites, with 23 samplings rating as good or excellent (74.1%). Each of the monitoring site ratings were also averaged for both years, and a total of 9 sites out of 13 rated as good or excellent (69%).

Figure 49: Biological Monitoring – Macroinvertebrate Sampling Monitoring Data Chart



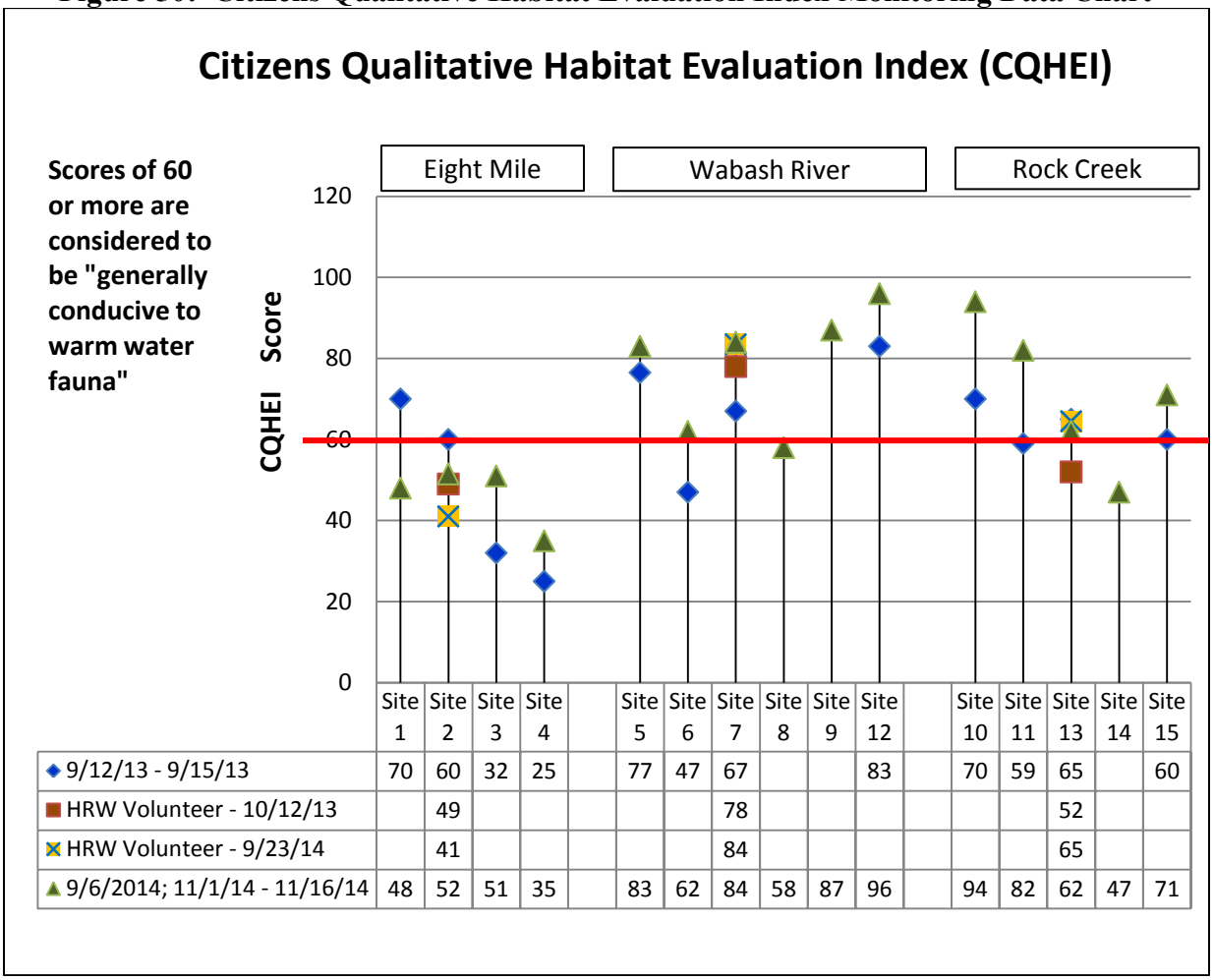
	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
◆ 9/12/13 - 9/15/13	12	19	8	11		18	4	18			21		27	10	16		23
■ HRW Volunteer - 10/12/13		17						32							21		
✕ HRW Volunteer - 9/23/14		27						21							25		
▲ 9/6/14; 11/1/14 - 11/16/14	23	24	22	19		22	11	29		26	29		36	22	28		18

Habitat

The habitat varies widely between the tributary streams and the Wabash River. The Citizens Qualitative Habitat Evaluation Index (CQHEI) was used to measure the quality of the habitat at the monitoring sites. A score of 60 was used as the habitat quality target. Our monitoring protocol required that monitoring be completed at a minimum of 12 sites each year. In general, the habitat CQHEI index score improved at all but two sites from 2013 to 2014.

Eight Mile Creek sites 1 and 2 meet or exceeded the target in 2013, but fell below the target in 2014. Ditch maintenance and clearing activities at site 1, and substrate smothering and an increase in bank erosion at site 2 accounts for the decrease. The Wabash River and Rock Creek sites 10 and 11 in the DNR Fish & Wildlife area have the most diverse habitat and natural areas which increases the index scores. The Wabash River site 6 is downstream from the City of Bluffton and has a smothered and silted substrate, minimal riparian area, and many man-made changes accounting for the lower score. Overall, a total of 33 evaluations were made at the 15 monitoring sites, and a total of 20 evaluations met or exceeded the target (60%). Additionally, when averaging the scores at each site over the two-year period, 53% of the sites (8 out of 15) met or exceeded the target, which in this case is a positive outcome.

Figure 50: Citizens Qualitative Habitat Evaluation Index Monitoring Data Chart



	Site 1	Site 2	Site 3	Site 4		Site 5	Site 6	Site 7	Site 8	Site 9	Site 12		Site 10	Site 11	Site 13	Site 14	Site 15
◆ 9/12/13 - 9/15/13	70	60	32	25		77	47	67			83		70	59	65		60
■ HRW Volunteer - 10/12/13		49						78							52		
✕ HRW Volunteer - 9/23/14		41						84							65		
▲ 9/6/2014; 11/1/14 - 11/16/14	48	52	51	35		83	62	84	58	87	96		94	82	62	47	71