Flatrock Creek/Auglaize River Watershed Management Plan 2022

Planning for Five HUC 12 Subwatersheds: Wildcat Creek (041000071205); Headwaters Flatrock Creek (041000071201); Bohnke Ditch (041000071203); Hoffman Creek (041000071202); Brown Ditch (041000071204)

Prepared by the Allen County Soil & Water Conservation District and the Flatrock/Auglaize Steering Committee

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1.0 Introduction

1.1 Flatrock/Auglaize Watershed Project Initiation

Since the mid-1990's, Harmful Algal Blooms (HABs) have been on the rise in the western basin of Lake Erie. They are composed of cyanobacteria that produce the liver toxin microcystin which poses a risk to human and wildlife health. The blooms have led to frequent public health warnings, beach closures, and fish consumption advisories. In 2014, the city of Toledo, Ohio was forced to shut down their water supply for three days due to elevated microcystin levels at their drinking water intake in Lake Erie.

Figure 1.1 Photo of Lake Erie algae bloom courtesy of the National Oceanic and Atmospheric Administration, 2014

Extensive research by academia and private organizations has revealed that the main contributor to HABs is elevated nutrient loading from watersheds that drain to the lake. Of these watersheds, the Maumee River watershed is the largest. The Maumee watershed covers 8,316 square miles or 4.2 million acres and drains all or part of eighteen Ohio counties, two Michigan counties, and five Indiana counties. It originates in Fort Wayne, Indiana where the St. Joseph and St. Marys rivers converge. It has three major tributaries: the Auglaize, Tiffin and Blanchard rivers.

Water quality in the Maumee River at Waterville, Ohio, is monitored by the National Center for Water Quality Research at Heidelberg University. Their research indicates that the flow of phosphorus loading into the lake is largely dependent on precipitation and the timing of fertilizer applications on farm fields throughout the watershed. Research and modeling indicate that a 40% reduction in the river phosphorus level is needed to minimize HABs to a safe level.

The Allen and Adams County Soil and Water Conservation Districts, along with the Paulding and Van Wert Ohio Soil and Water Conservation Districts have been concerned about water quality in the Auglaize River watershed for many years. Considering that all other Indiana Western Lake Erie Basin watersheds have Watershed Management Plans, the focus shifted to the Flatrock/Auglaize watershed in 2018. The Allen County Soil & Water Conservation District applied to the Indiana Department of Environmental Management for a 205j grant to develop a Watershed Management Plan. The two-year project was awarded in November of 2019.

1.2 Watershed Steering Committee

The planning effort was led by a Steering Committee composed of technical advisors and local stakeholders who are most knowledgeable of the needs of the watershed. To begin the process of bringing this diverse group together, the Allen County Soil & Water Conservation District held the first Steering Committee meeting in conjunction with a public meeting on Jan. 14, 2020 at the Fort Wayne Farm Show. A second Steering Committee/public meeting was held on Feb. 24, 2020 in the heart of the project area at the Town Hall in Monroeville, IN. The committee, along with its technical advisors represented all major stakeholders in the watershed.

Table 1.1 Steering Committee	
Members	**Affiliation**
Dale Anderson	Farmer
Mark Anderson	Farmer
Lindsey Bluhm	Indiana State Department of Agriculture
Tim Bomba	USDA, Natural Resources Conservation Service
Pat Brames	Farmer
Jeremy Freimuth	Allen County Surveyor's Office
Matt Fuelling	Ebberts Field Seeds, Agribusiness
Ron Funk	Farmer
Brent Hoffman	Hoffman Bulldozing & Farm Services, Inc.
Matt Jarrett	Allen County Surveyor's Office
Greg Kneubuhler	G&K Concepts, Agribusiness
Brad Kohlhagen	Adams County Purdue Extension Service
Greg Lake	Allen County Soil & Water Conservation District
Austin Miller	Farmer
Tom Miller	Allen County Soil & Water Conservation District
John Nidlinger	Farmer
Larry Oberley	Town of Monroeville
Seth Owens	VanWert County Soil & Water Conservation District
Sharon Partridge	Allen County Soil & Water Conservation District
Leslie Robertson	Farmer
Troy Robertson	Farmer
Ron Roy	Ag Plus, Agribusiness
Barry Scherer	Adams County Regional Sewer District
Nathan Scherer	Adams County Health Department
Stephanie Singer	The Nature Conservancy
Scott Thompson	Allen County Soil & Water Conservation District
Courtney Taylor	Allen County Soil & Water Conservation District
Kristi Todd	Indiana Department of Environmental Management
Eugene Trabel	Farmer
Patrick Troyer	Paulding County Soil & Water Conservation Service
Sandy Voglewede	Adams County Soil & Water Conservation Service
Mike Werling	Allen County Soil & Water Conservation District
James Wolff	Allen County Purdue Extension Service

1.3 Stakeholder Concerns

At the public/Steering Committee meetings, participants were asked to identify their concerns regarding land use and water quality in the project area. Table 1.2 is a list of the concerns expressed.

Table 1.2 Stakeholder Concerns	
Concerns	**Relevance**
Flooding	Corn and soybean fodder washing from fields plugging ditches. Unresolved issue of a limestone shelf in the Flatrock Creek downstream of the Indiana/Ohio state line that holds back water.
Log Jams	Log jams in Ohio hold back water in the Flatrock Creek and cause flooding.
Rural Legal Drains	Lack of coordination between Indiana and Ohio drainage authorities contributes to flooding problems.
Stream/Ditch Bank Erosion	Prevalent throughout the watershed especially in areas where stream/ditch banks are subject to flooding.
Illegal Dumping into Ditches	Concrete containing metals, construction waste, hazardous wastes, trash.
Need for more Water Quality Research	Two sub-watersheds have their headwaters in Ohio and the contribution to poor water quality from the Ohio area is unknown.
Lack of Water Quality Education/Outreach	Residents unaware of resource concerns. No materials/activities to specifically address the project area.
High *E. coli* Levels	Historic water quality data collected at the Indiana/Ohio state line from the Flatrock Creek (sample site # 401) identifies 34% of *E.coli* samples exceeding the water quality limit.
High Turbidity Levels	Historic water quality data collected at the Indiana/Ohio state line from the Flatrock Creek (sample site # 401) identifies 100% of Turbidity samples exceeding the water quality limit.
High Phosphorus Levels	Historic water quality data collected at the Indiana/Ohio state line from the Flatrock Creek (sample site # 401) identifies 79% of Total Phosphorus samples exceeding the water quality limit.
Faulty or Absent Septic Systems	Failing or absent septic systems. Older homes or businesses where the on-site waste disposal system is inadequate, compromised or totally absent.
Excessive Nutrients entering Streams/Ditches	Runoff from farmland and residential/commercial properties where organic and/or inorganic fertilizer has been applied. Direct livestock access to streams/ditches.
Excessive Sediment in Water Column	Unbuffered runoff from farmland and residential/commercial areas. Eroding stream/ditch banks.
Lack of Buffer Strips	Unbuffered streams/ditches. Eroding stream/ditch banks.
Lack of Residue/Cover on Ag Fields	Only 10% of fields are in no-till/cover crops.
Unbuffered Tile Field Inlets	Tile field inlets provide a direct conduit for sediment and other pollutants to flow directly into streams/ditches.
Barnyard Runoff	Stormwater picks up pollutants from barnyards and carries them to streams/ditches.
Stream/Ditches Listed as Impaired by IDEM	303d listed segments for nutrients and impaired biotic communities.
Drained Wetlands	Lack of wetlands near streams that filter runoff.

2.0 Watershed Inventory

2.1 Description of the Watershed

The Flatrock Creek/Auglaize River watershed management plan project area is the western-most portion of the greater Auglaize River watershed. It is located in the southeast corner of Allen County, Indiana, the northeast corner of Adams County, Indiana, the southwest corner of Paulding County, Ohio and the northwest corner of Van Wert County, Ohio. It is represented by 5 Hydrologic Unit Code (HUC)-12 subwatersheds. (Table 2.1 and Figures 2.1 and 2.2)

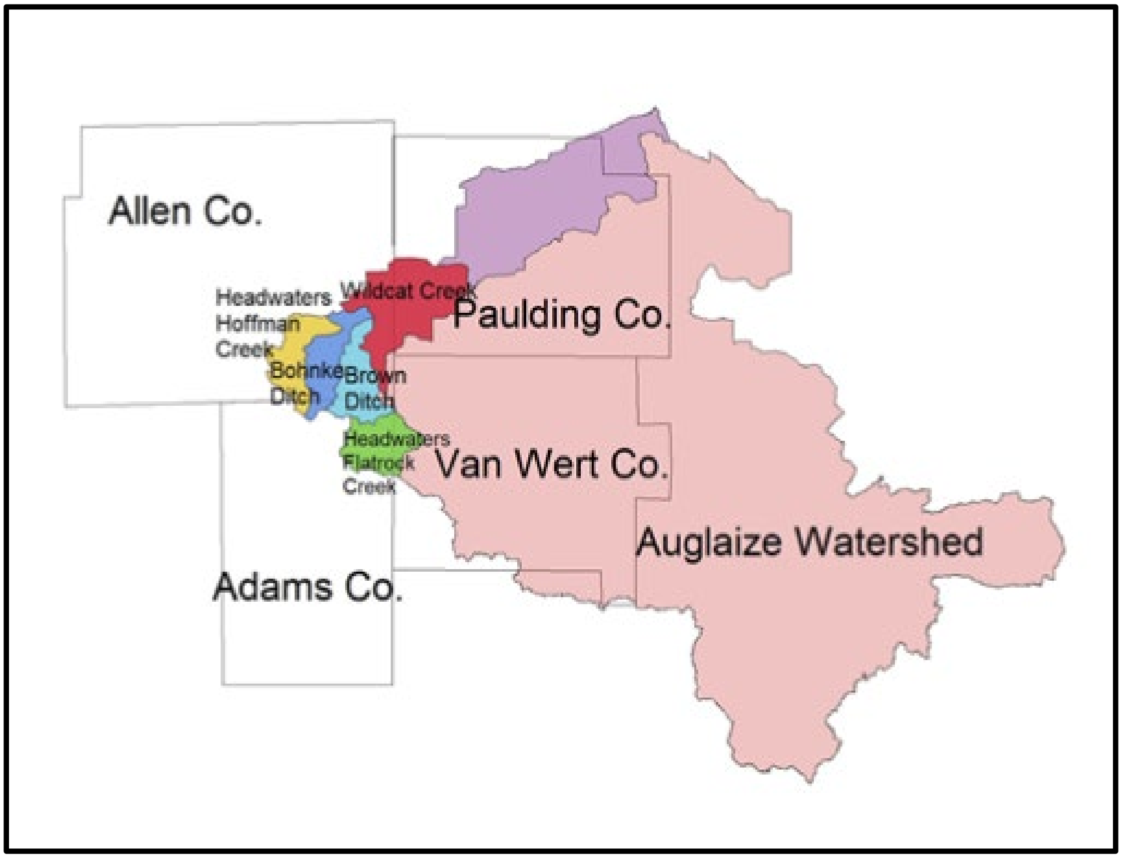

Figure 2.1 Flatrock Creek/Auglaize River Watershed Management Plan Project Area within the greater Auglaize River watershed

Table 2.1 Subwatersheds		
Subwatershed Name	HUC	Approximate Acres
Wildcat Creek	041000071205	35,697
Headwaters Flatrock Creek	041000071201	15,700
Bohnke Ditch	041000071203	14,694
Hoffman Creek	041000071202	14,887
Brown Ditch	041000071204	15,602
Total		96,580

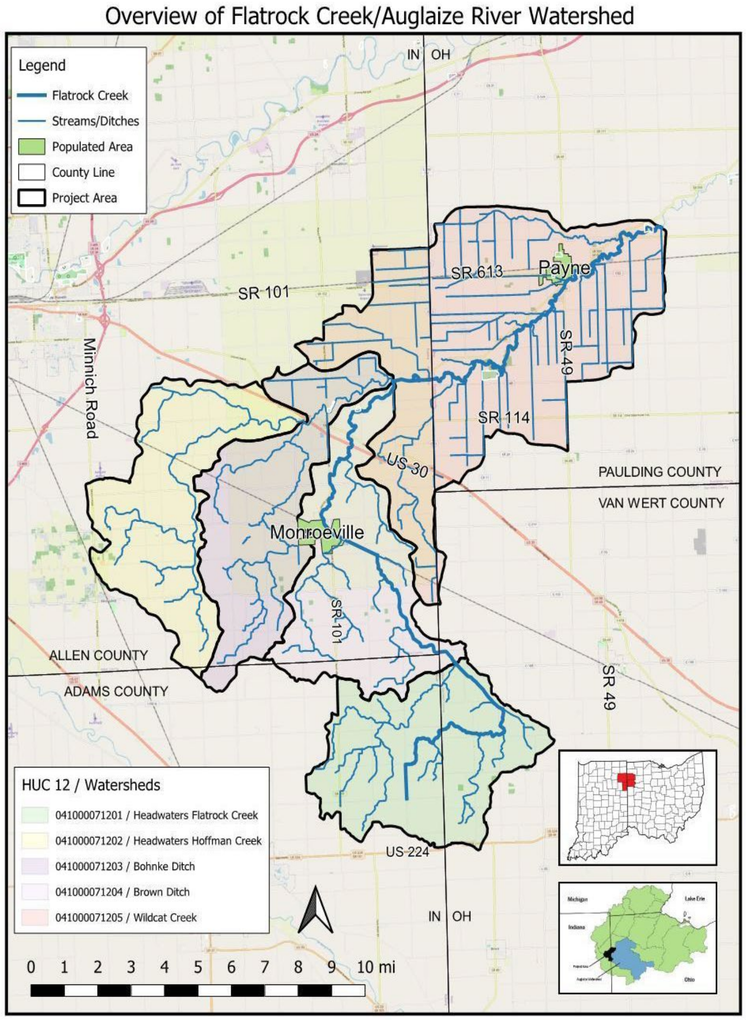

Figure 2.2 Flatrock Creek/Auglaize River Watershed Management Plan Project Area

There are approximately 289 miles of streams in the project area. Flatrock Creek proper is a 57.2-mile-long stream, originating in Adams County, Indiana. It flows easterly to Van Wert County, Ohio, then turns near Wolfcale, Ohio to flow northwest to Monroeville, Indiana. In Monroeville, Flatrock Creek flows northeast and crosses the Indiana/Ohio State line into Paulding County, Ohio. Flatrock Creek continues to flow northeast to meet the Auglaize River approximately 10 miles southwest of Defiance, Ohio. The streams and ditches are primarily used as a function of the agricultural drainage system.

2.2 Geology, Topography, Soils, Hydrology, Wetlands

Geology/Topography

Northeast Indiana and Northwest Ohio's landscape consisted of rolling hills and valleys accompanied by streams and lakes until the Wisconsin glaciation that occurred over 14,000 years ago. Three episodes or lobes: Huron-Erie, Saginaw, and Erie lobe, together made up the Wisconsin glaciation. The Huron-Erie lobe traveled east to west and deposited subsurface bedrock fragments known as the "Trafalgar Formation'' which is composed of Ordovician limestone, Silurian dolomite, Devonian limestone and Devonian black shale. The most relevant and recent event, the Erie lobe, created the Largo Formation which advanced across clay-rich lakes resulting in the clay-rich composition we see today in the landscape. The main parent material of the Largo formation are fine-grained tills which aid to protect the aquifers in the area. The movement of these massive ice sheets resulted in a homogenous landscape that flattened the hills, filled in preexisting streams, and formed lakes (ex: Great Lakes). Rocks, sand, and minerals were deposited across the terrain as this glacier melted. The predominant bedrock of the project area consists of black shale, shale, dolomite and limestone. Karsts features are not exposed at the surface and are buried. (Figure 2.3)

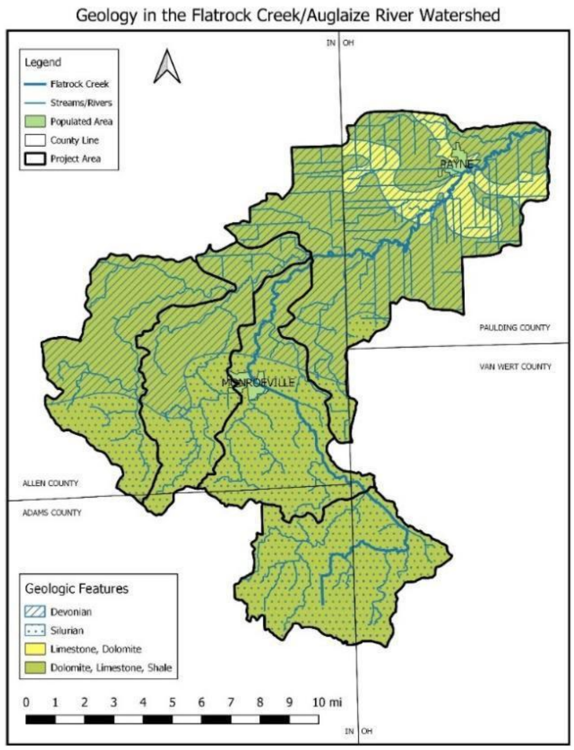

Figure 2.3 Geologic Features in the Flatrock Creek/Auglaize River Watershed

The topography of the area is relatively homogenous. The average elevation is between 700 and 760 feet above sea level. There are very few areas where the slope of the land exceeds 2%. Such flat conditions present considerable challenges for the current primary land use, agriculture. This topic will be discussed further throughout the watershed management plan. The project area lies within the Clayey High Lime Till Plain Ecoregion.

Soils

The watershed is made up of numerous soil types representing wide-ranging characteristics. The characteristics studied for the watershed planning purposes are: drainage, erodibility, and septic system suitability.

Soil Drainage and Wetlands

According to the National Soil Survey, a “hydrologic group” is a group of soil types having similar runoff potential under similar storm and cover conditions. The runoff potential is influenced by the rate of infiltration. An inventory of the hydrologic soil groups was conducted to determine how the soils are affecting stormwater runoff. Soil groups with low infiltration rates have greater potential to carry pollutants to surface waters. (Table 2.2)

Table 2.2 Soils of the Flatrock/Auglaize Watershed			
Hydrologic Group	Group Characteristics	Acres in Watershed	Percentage
A	High infiltration rate, low runoff potential when thoroughly wet. Very deep, well drained to excessively drained. Sands or gravelly sands. High rate of water transmission.	0	0
B	Moderate infiltration rate, moderate runoff potential when thoroughly wet. Moderately deep and well drained. Moderately fine to coarse particle size. Moderate rate of water transmission.	1,001	1
C	Slow infiltration rate, moderately high runoff potential when thoroughly wet. Has a layer that impedes downward movement of water. Moderately fine to fine particle size. Slow rate of water transmission.	27,520	29
D	Very slow infiltration rate, high runoff potential when thoroughly wet. Has permanent high-water table, claypan or clay layer at or near the surface. Clayey soil that has high shrink-swell potential. Very slow rate of water transmission.	67,929	70
Not Rated	No group rating	130	0.10
Totals		96,580	100

Nearly 100% of the soil types in the watershed have a slow to very slow infiltration rate and limiting layers that impede the downward movement of water. These characteristics lead to increased stormwater runoff during rain events and surface water ponding.

Soils that are saturated or inundated with water for extended periods of time are classified as hydric. Figure 2.4 shows the extent of hydric soils in the project area. Approximately 94,816 acres, or 98% of the Flatrock Creek watershed soil types are classified as hydric.

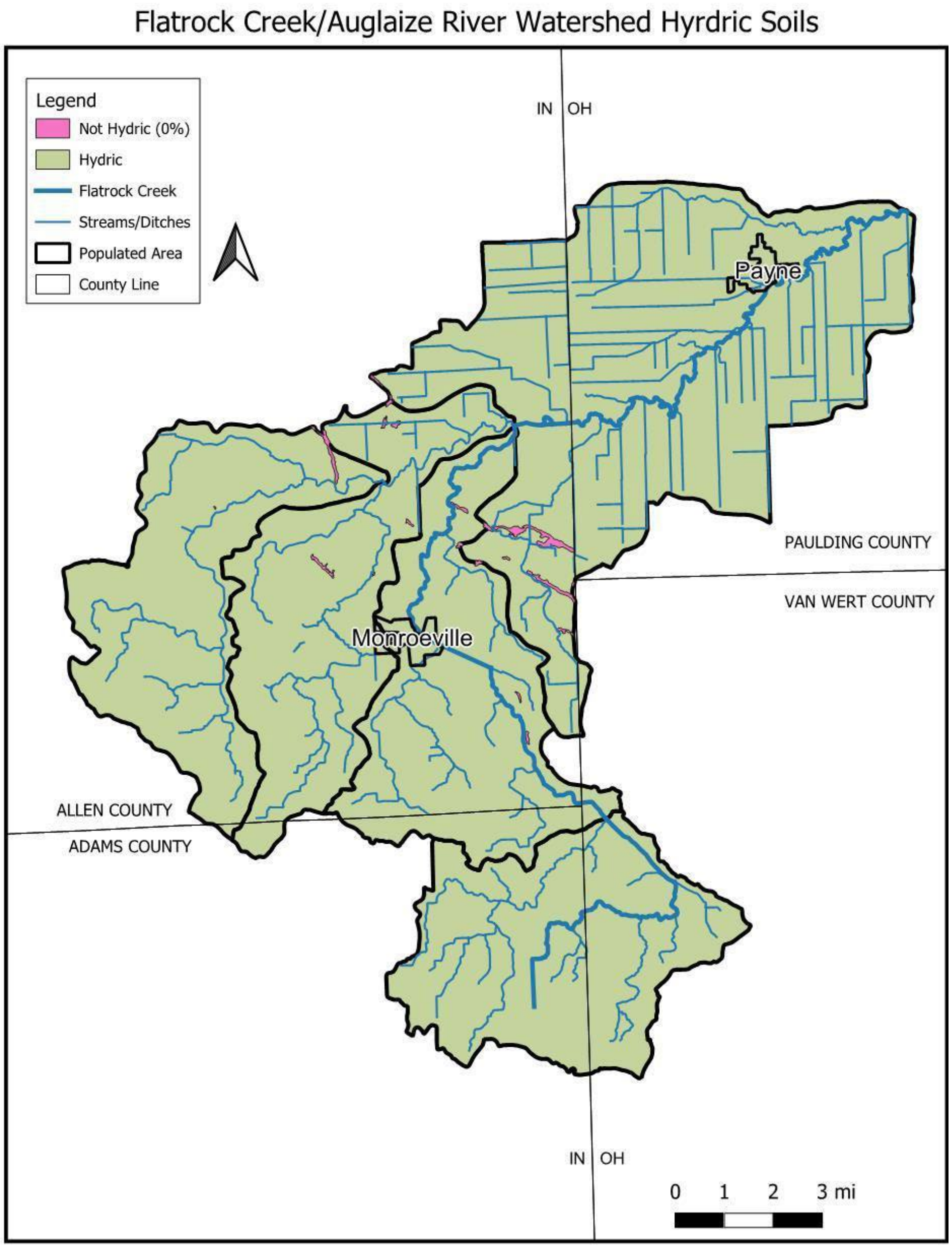

Figure 2.4 Hydric Soils of the Flatrock Creek Watershed

Hydromodification

Extensive hydrologic modifications have been made to the natural drainage system. Manmade ditches are common in all of the subwatersheds. Construction began in the early 1800s to drain the Black Swamp and allow agricultural access to the land. Along with the ditches, extensive underground tile drainage systems have been installed in crop fields. In most areas, the ditches and main-line tiles are managed by local county drainage boards. Field drainage tiles are maintained privately. There are no natural or manmade dams or lakes in the project area. Figure 2.5 shows the hydrologic features.

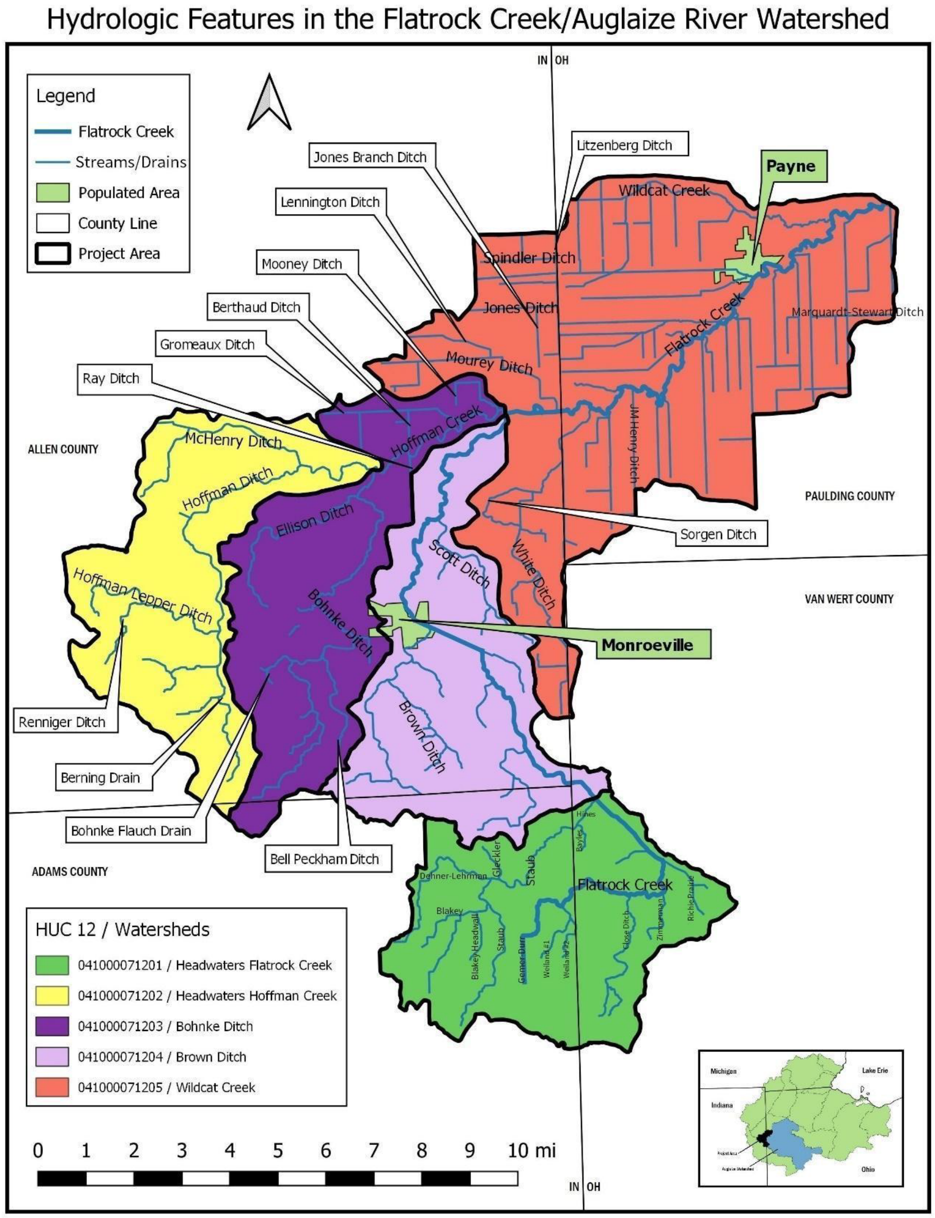

Figure 2.5 Hydrologic Features in the Flatrock watershed

Wetlands

The project area is wholly within the Great Black Swamp. This area was a glacially fed wetland in northwest Ohio, sections of lower Michigan, and northeast Indiana that existed from the end of the Wisconsin glaciation until the late 19th century. The Great Black Swamp was composed of extensive swamps and marshes with some higher, drier ground interspersed. It occupied what was formerly the southwestern part of proglacial Lake Maumee, a Holocene precursor to Lake Erie. The area was about 25 miles wide (north to south) and 100 miles long, covering an estimated 1,500 square miles. (Figure 2.6)

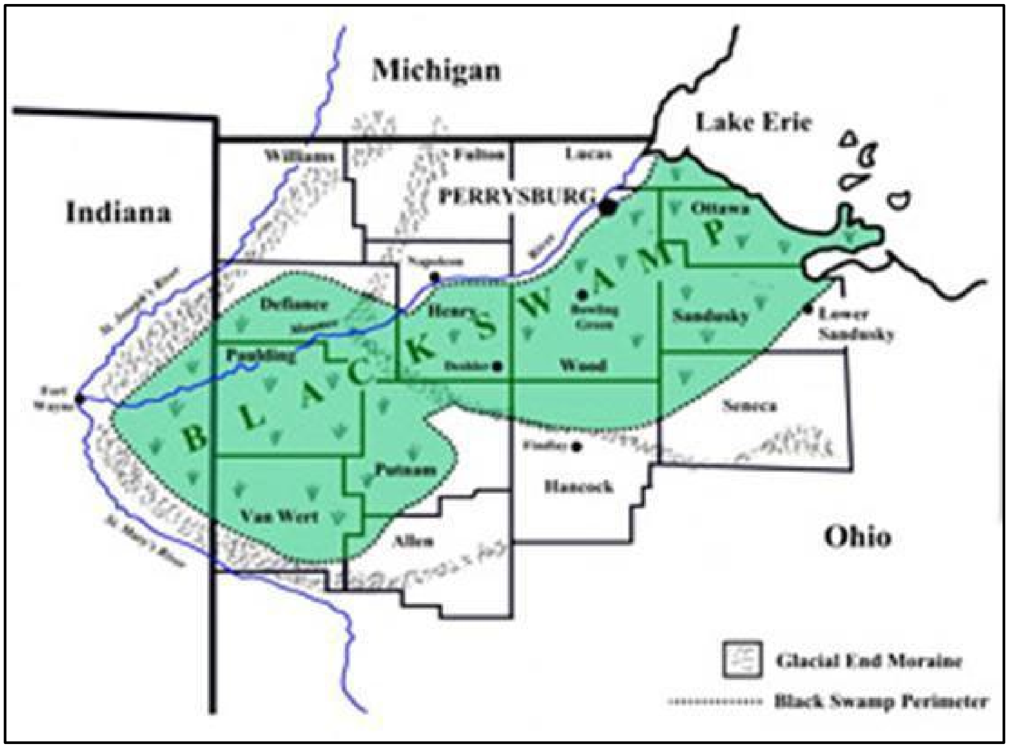

Figure 2.6 The general extent of the Great Black Swamp before the 19th century (Map source unknown)

The Great Black Swamp was gradually drained and settled in the second half of the 19th century. It is now highly productive farmland.

The extent of wetlands remaining in the project area can be seen in Figure 2.7. According to the National Wetland Inventory, there are 2,007 acres of wetlands comprising 2% of the project area. This number varies from the acreage reported in the Land Use section, based upon the National Land Cover Database values. The average accuracy between the two databases across select NLCD land classifications was reported to be 27% by Handley and Wells in 2009, which could account for the discrepancy between the estimated wetland values. Estimated current wetland coverage throughout the project area is likely between the range estimated by these two databases (0.51 to 2%). When compared with historical coverage, this is very low. The existing wetlands are not used by the public in any known way.

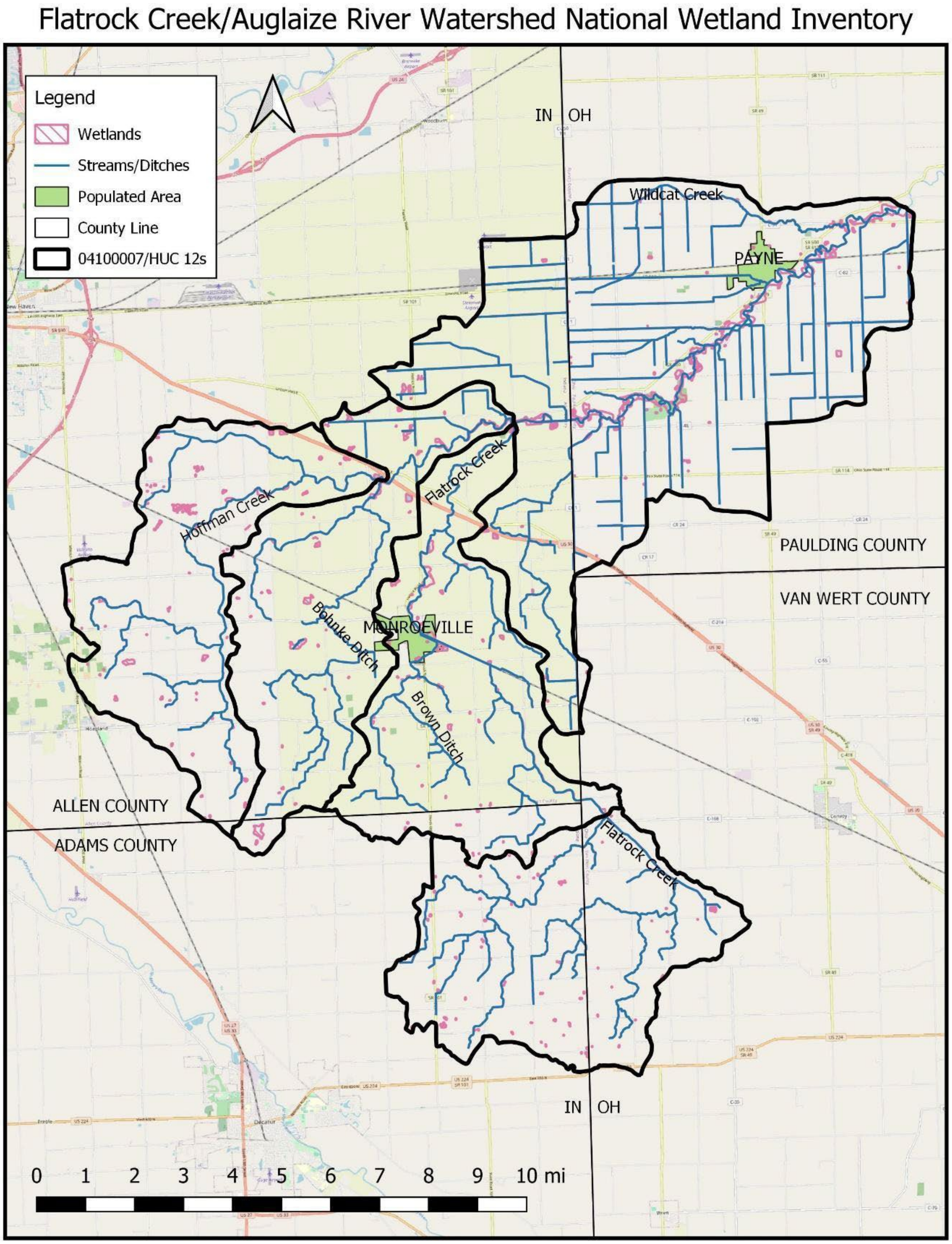

Figure 2.7 Present Day NWI wetlands in the Flatrock watershed.

Flooding

Flooding issues within the watershed were identified as a major area of concern by Steering Committee members. It can cause economic hardship, property damage, degraded water quality, and destruction of wildlife habitat. Steering Committee members report that agriculture is the primary land use affected by flood waters and impacts are greater in Indiana vs Ohio.

Conditions along Flatrock Creek in Paulding County, Ohio were investigated to determine their contribution to flooding in Indiana. Travis McGarvey, Paulding County engineer advised that:

- The water level in the Flatrock Creek is controlled by the Auglaize River.
- There is a railroad bridge outside of Payne, OH that is undersized but not to the extent that it obstructs substantial flows.
- There is only 0.5% grade in the channel through Paulding County.
- Out-of-bank flow occurs in a 10-year storm.
- The floodplain in Paulding County is over 500 feet wide in places and flood water makes its way around obstructions such as log jams.
- One-on-one conversations with landowners along the Flatrock Creek in Paulding County reveal that they are not supportive of the county removing log jams.
- Some landowners in Paulding County take it upon themselves to remove log jams on their land.
- Citizens near the Village of Payne in Ohio petitioned the SWCD and County Engineer's office in early 2000 and again in 2010 to have retention areas built along Flatrock Creek. Both requests were denied due to expense (over $1,000,000.00), low-cost benefit, environmental impacts, and access issues.
- If a major project was done that increased the size of Flatrock Creek in an attempt to keep flood water in the channel, the Town of Paulding would be harmed.
- Corn and soybean fodder washing from farm fields plugs ditches and culverts causing localized flooding.

The Steering Committee determined that more information about flooding was needed so they asked Rodney Renkenberger, Executive Director of the Maumee River Basin Commission, to study the issues and provide comments. Rodney presented his findings at the July 2021 Steering Committee meeting. A summary of his report follows.

Flatrock Creek Floodplain Analysis

Flatrock Creek, as its name implies, is a very flat drainage conveyance system, with a channel bottom elevation of 680.0 NAVD88 at the Flatrock Creek / Auglaize River overflow channel and a channel bottom of 746.0 NAVD88 at the IN/OH State Line Road bridge located 35.18 stream miles upstream of Flatrock Creek / Auglaize River overflow channel. The resulting gradient is only 0.04%. As a result of the extreme flat gradient, Flatrock Creek's ability to provide adequate drainage to upstream Indiana communities during high-frequency storm events is very susceptible to stream obstructions such as log jams. Although opponents to any maintenance activities in the Ohio portion of Flatrock Creek may use the argument that such log jams and obstructions do not cause any additional flooding, such argument only holds true for low frequency flood events (2%, 1%, and 0.20% Annual Chance Flood Events). Moving forward, it will be extremely important for the “narrative” to focus on high frequency flooding events and the impacts log jams and obstructions have on agricultural damages. High frequency flood events (5-yr, 10-yr, and 20-yr Frequency Floods a/k/a 20%, 10%, and 5% Annual Chance Flood Events respectively) generally do not create “bank-full conditions” therefore any obstruction located in a stream will cause water to be backed up and cause an adverse impact, particularly to agricultural drainage. In contrast, low frequency flood events generally result in bank-full conditions throughout the watershed and excess floodwaters flow through the wide floodplain corridor and don’t cause any additional adverse impact to upstream properties.

Flood Risk areas are shown in Figure 2.8.

Having heard from two local floodplain management experts, the Steering Committee determined that further dialogue regarding flooding issues needs to occur. Additionally, the Steering Committee felt that further review of existing flood profile data needed to be reviewed and additional studies may be warranted.

Understanding that flooding in the Auglaize-Flatrock watershed is a long-standing complex issue with multiple governmental entities involved, the Steering Committee encouraged that dialogue begin between federal, state, and local officials. They also encourage conversations with the general public regarding potential solutions to the flooding problems.

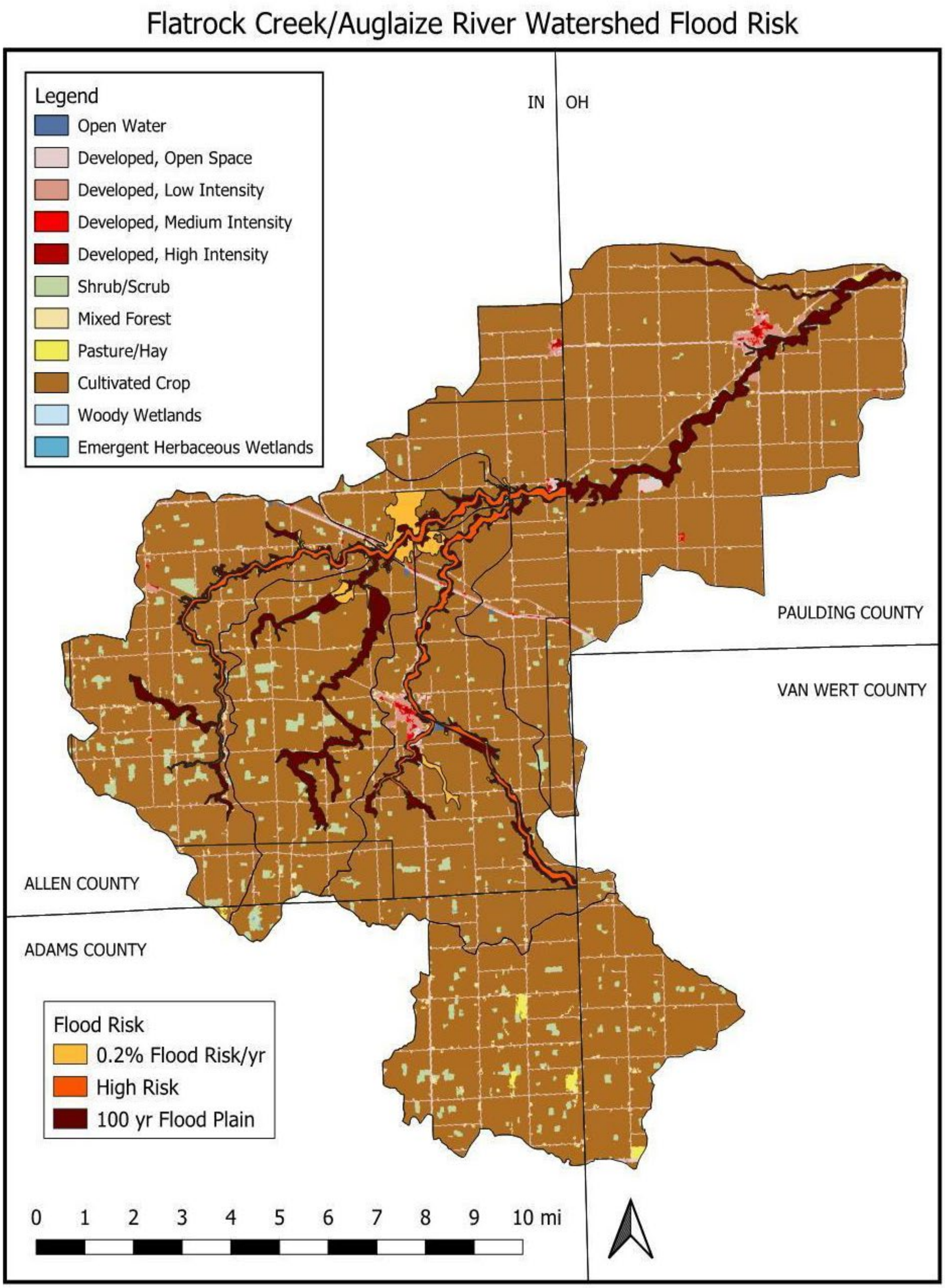

Figure 2.8 Flood Risk Areas in the Flatrock Creek watershed

Soil Erodibility

Natural Resources Conservation Service soil scientists and soil conservationists determine if a soil, or soil map unit, is highly erodible (HEL), potentially highly erodible (PHEL), or non-highly erodible (NHEL) due to sheet and rill erosion. This determination is done by using the Universal Soil Loss Equation (USLE). The USLE relates the effects of rainfall, soil characteristics, and slope to the soil's tolerable sheet and rill erosion rate. A highly erodible soil has a maximum potential for erosion that equals or exceeds eight times the tolerable erosion rate. The classification of potentially highly erodible is used when factors for determining the USLE have not been assigned. A soil map unit is non-highly erodible when the calculated erosion index for both wind and water erosion is less than 8.

Excessive erosion from HEL and PHEL soils can negatively impact the health of watersheds. Erosion increases sedimentation of streambeds which impacts the quality of habitat for fish and other organisms. It also impacts water quality as water flows over land and enters streams as runoff. It carries pollutants and nutrients that are attached to soil particles.

The inventory of highly erodible and potentially highly erodible soils in the project area reveals that 486.2 acres, or 0.50% of the lands within the project area are classified as highly erodible. Potentially highly erodible lands cover 2,592.83 acres, or 2.68% of the project area. (Figure 2.9). The remaining acres in the watershed are classified as non-highly erodible lands. Because the percentage of highly erodible soils is so low, gully erosion is uncommon. Sheet and rill erosion are common in areas where there is little to no plant residue protecting the soil.

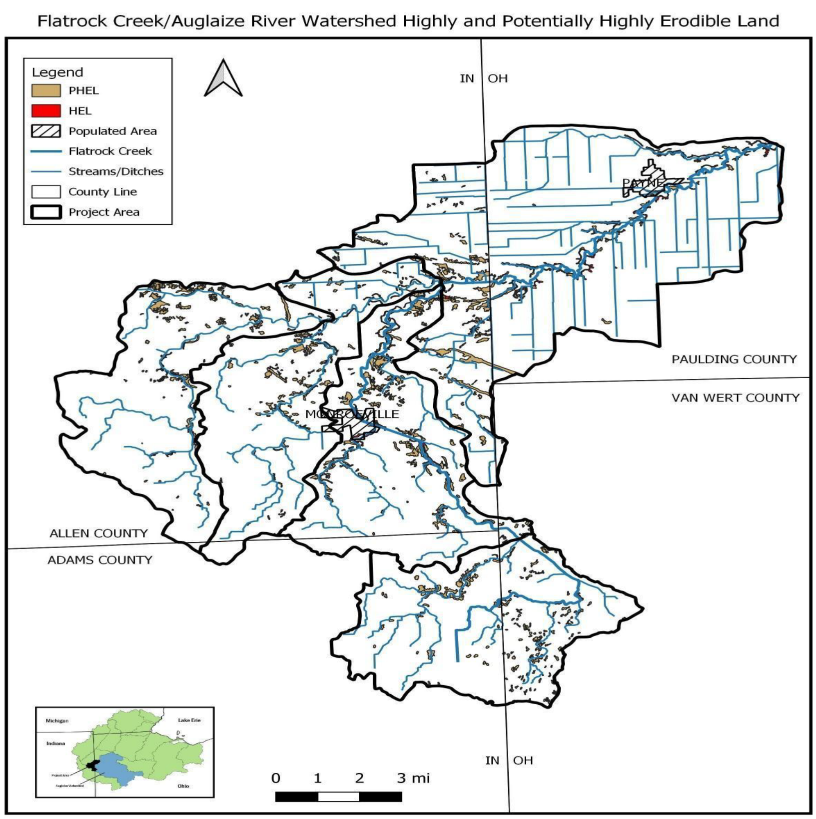

Figure 2.9 Highly erodible soils in the Flatrock Creek watershed

Sewered and Unsewered Areas

The vast majority of the watershed is rural with no sewer service with the exception of the sewered communities of Monroeville, IN and Payne, OH. There are eight unsewered small communities in the watershed. These are Wolfcale in Ohio, and Dixon, Boston Center, Maples, Tillman, Zulu, Townley, and Edgerton in Indiana. (Figure 2.10)

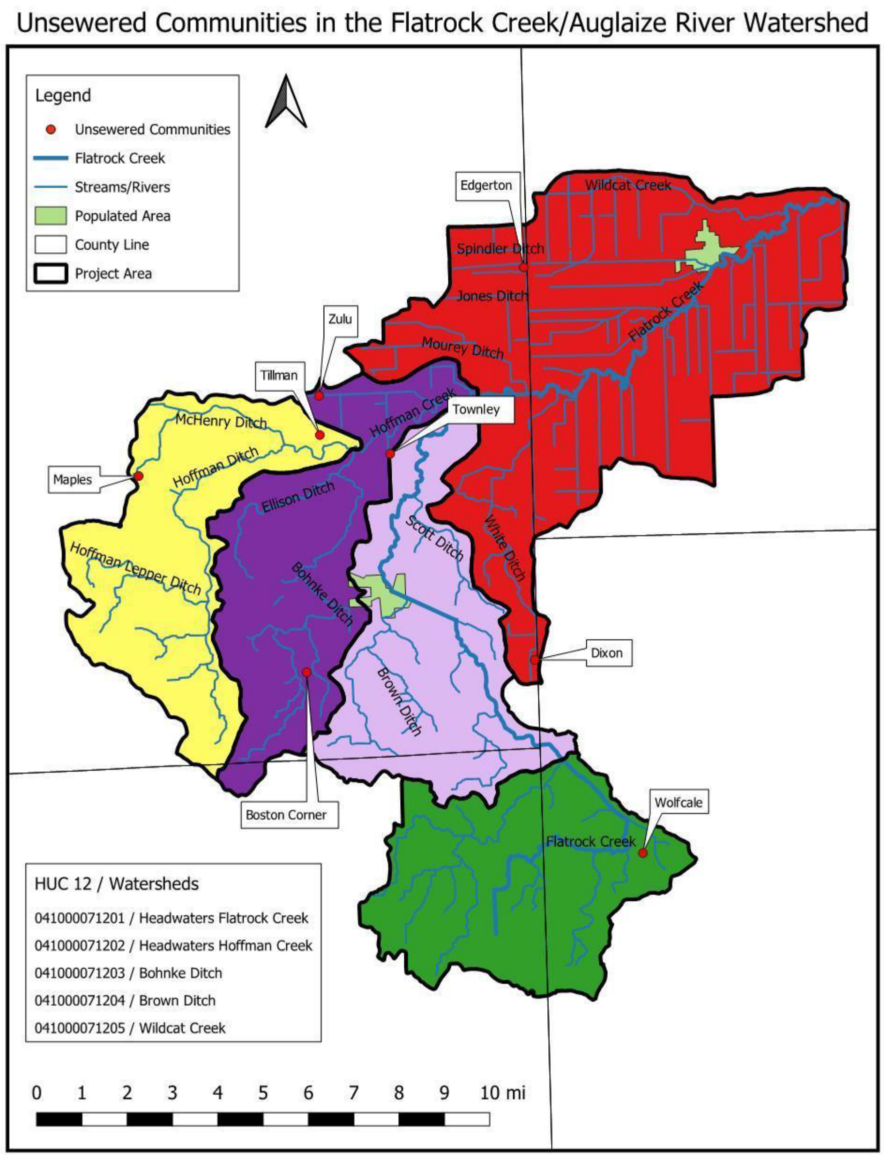

Figure 2.10 Unsewered Communities in the Flatrock Watershed

The majority of watershed residents rely on septic systems for waste treatment. The degree of limitation for the disposal of sewage effluent from septic tanks is based on soil properties that affect leach fields and their capacity to absorb effluent. These properties include permeability, depth to bedrock, slope, natural drainage, depth to the water table, and flood hazards.

In the county Soil Surveys, soils are classified for their ability to function as septic disposal fields. The classifications are: Suitable for Septics; Somewhat Limited - possible contamination of water sources; and Very Limited - likely contamination of water sources. Figure 2.11 shows the extent of these characteristics in the Flatrock Creek watershed. 99.7% (96,305 acres) of the Flatrock watershed is considered “very limited” in terms of soil suitability for septic systems. The remaining 0.03% (275 acres) are classified as “somewhat suitable”. No “suitable” acres for septic use were found.

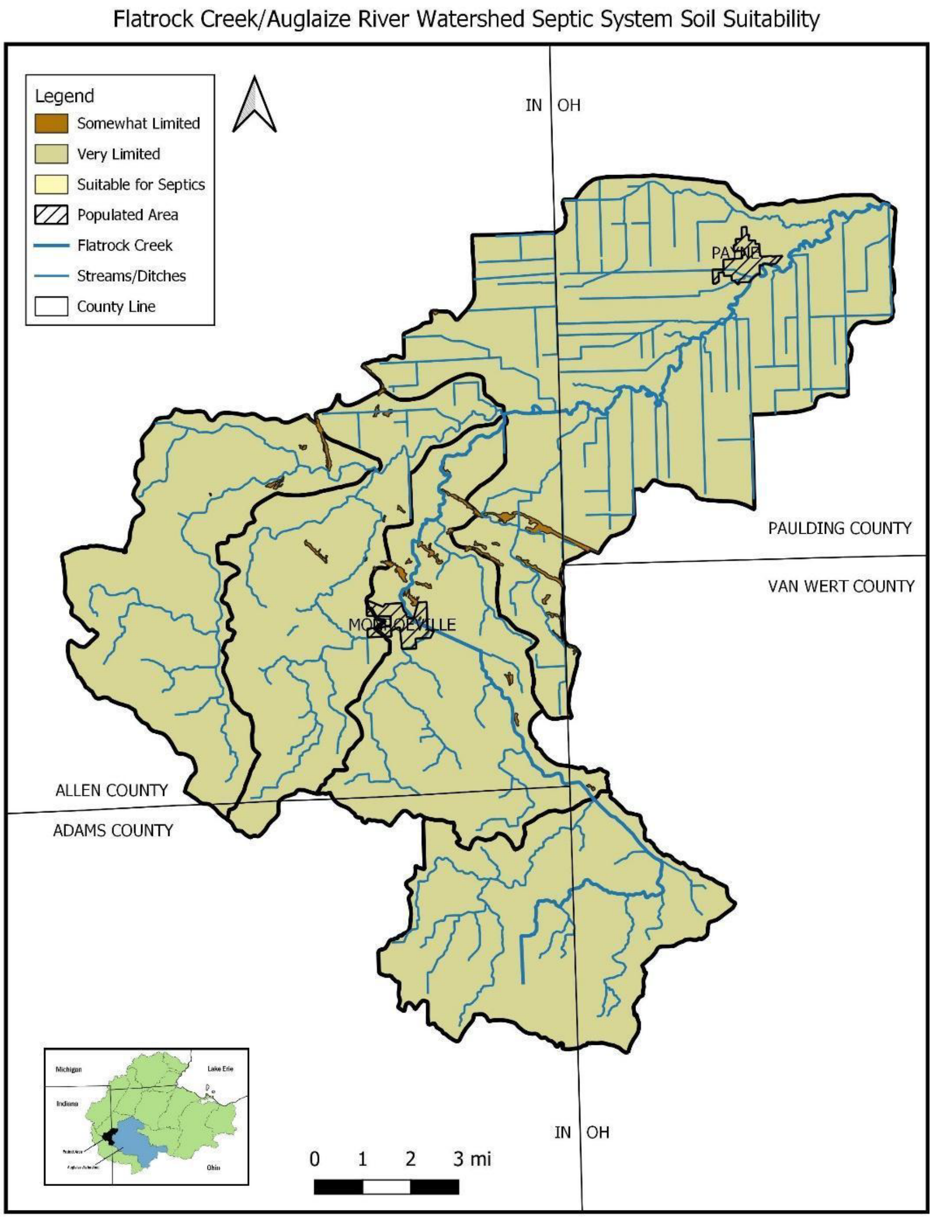

Figure 2.11 Septic System Soil Suitability

Personal interviews with Board of Health representatives in each county represented in the Flatrock watershed document the percentage of on-site waste disposal systems that have failed or are in disrepair as follows: Allen over 60%; Adams 40%; Paulding 50 - 60%; Van Wert at least 50%.

Lots of household products like fertilizers, soaps, and detergents contain phosphorus and nitrogen. These products can result in nutrient pollution if a septic system fails and effluent discharges into surface water. When there are too many nutrients in surface water, they act as fertilizers which lead to a heightened growth of bacteria and algae in the water. This rapid growth of algae can reduce the quality of water, kill some aquatic life, and introduce toxins in the water. Algal blooms in lakes and streams can be toxic to both humans and animals. Furthermore, the nutrients have an individual impact on the quality of water.
Phosphorus: Unabsorbed phosphorus travels into groundwater and ends up in other water bodies like lakes and rivers. Freshwater bodies are very vulnerable to phosphorus pollution.
Nitrogen: Nitrogen that finds its way into the water table will eventually flow into surface water bodies. This can cause health problems to humans. For instance, infants are very susceptible to water that has too many nitrates leading to a medical condition referred to as "blue baby".
Bacteria: Contaminants like Escheri Coli and Salmonella can cause various communicable diseases.

2.3 Land Use

Land use in the project area directly affects water quality. The predominant land use, agriculture, if not properly managed, contributes to increased turbidity, suspended solids, phosphorus, nitrogen, and *E.coli* levels in surface water. Low-density residential areas that are unsewered can contribute to elevated *E.coli* and nutrient levels in surface water. High-density areas, cities, and towns contribute to elevated nutrient loads in surface water where runoff contains lawn fertilizers and pet waste. Impermeable surfaces such as buildings and roads lead to increased stormwater volume runoff. Since agriculture is the dominant land use, fertilizer (commercial and manure) is considered a critical issue and has been addressed in subsequent chapters. (Figure 2.12 and Table 2.3)

Table 2.3 Land Use in the Flatrock Watershed

Land Use	Total Acres	% of Watershed
Open Water	72	0.07
Developed, Open Space	5,159	5.34
Low-Density Residential	939	0.97
High-Density Residential	167	0.17
Commercial/Industrial	52	0.05
Deciduous Forest	2,923	3.03
Grassland Herbaceous	938	0.97
Pasture/Hay	217	0.23
Cropland	85,630	88.66
Woody Wetlands	442	0.46
Emergent Wetlands	41	0.05

Table 2.3 Land Use in the Flatrock Watershed		
Land Use	Total Acres	% of Watershed
Total	96,580	100

Landuse in the Flatrock Creek/Auglaize River Watershed

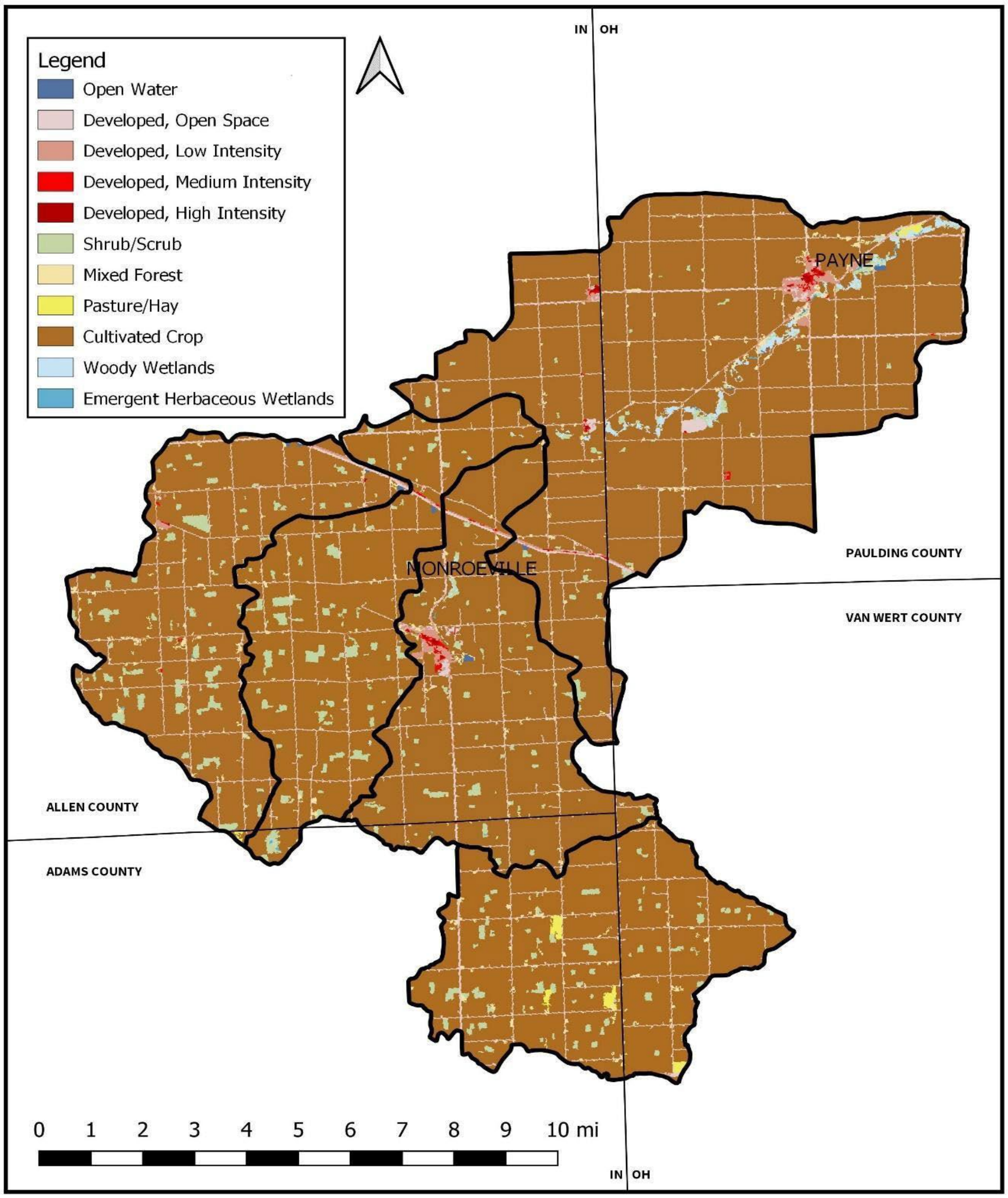

Figure 2.12 Land Use in the Project Area

Section Three of the Watershed Management Plan provides a more in depth look at land use in the watershed by HUC 12 subwatersheds.

Parks and Protected Lands

Parks and protected lands in the watershed are privately and publicly held. In total, 270 acres are listed in the United States Geological Survey's Protected Areas Database. (Table 2.4; Figure 2.13)

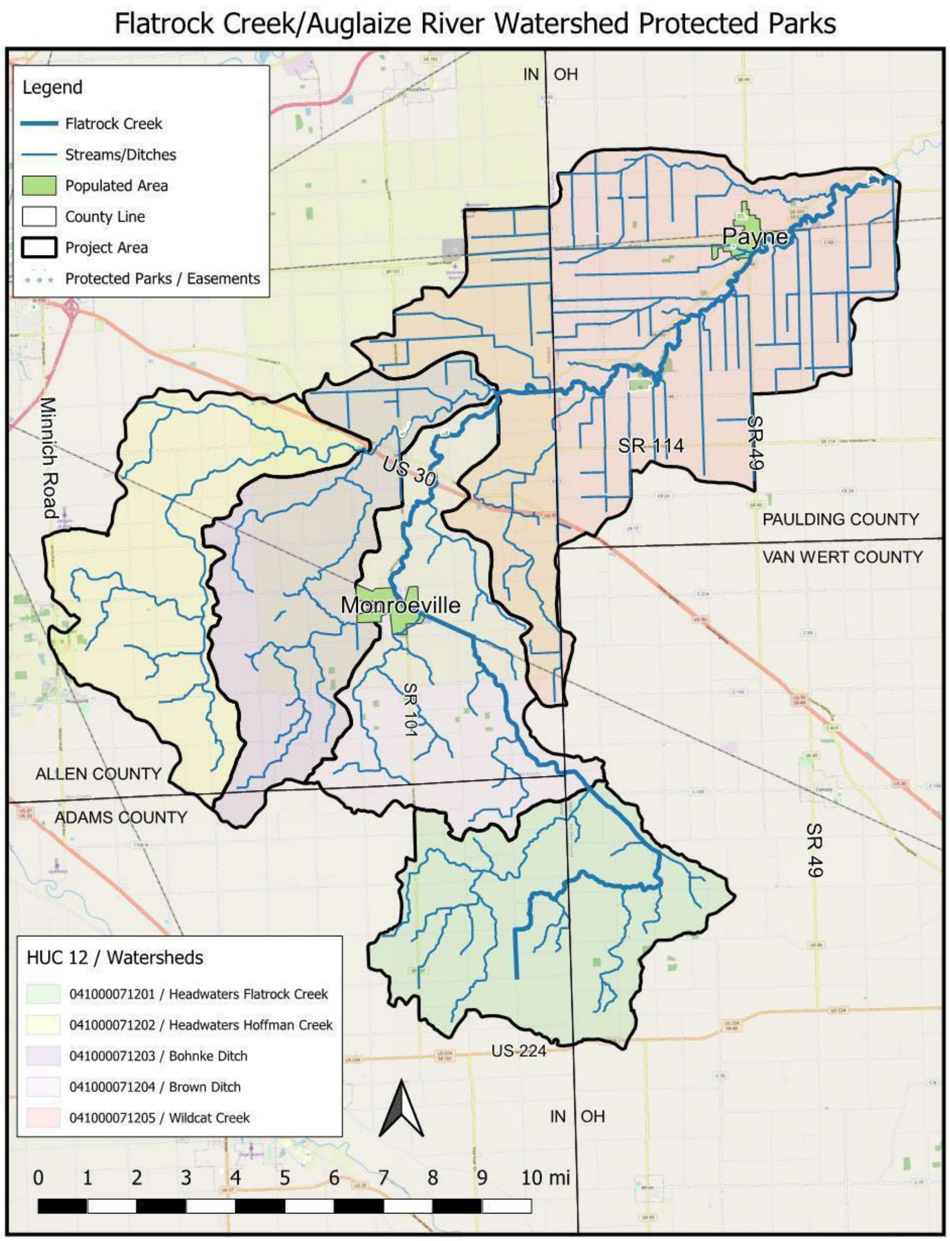

Figure 2.13 Protected Parks

Table 2.4 Parks and Protected Lands		
Name	Acreage	Description
Payne Community Park	16	Village of Payne park; baseball diamonds and recreational fields; fishing pond; playground; rental facilities
Pleasant Valley Golf Course	177	Paulding County. Nine-hole public golf course
Monroeville Community Park	22	Monroeville, IN. Baseball diamonds; tennis courts; rental facilities; playground; fishing
Private	32	Paulding County, Wetland Reserve Program
Private	11	Allen County, Conservation Easement
Private	12	Allen County, Conservation Easement

Tillage Transect

In June of 2020 and March and June of 2021, a windshield survey tillage transect was completed to collect information on tillage practices and crops planted from 297 points across the Flatrock Creek watershed. Data gathered from the survey is used to track cropland use and conservation cropping systems. To conduct the transect, staff members drove every east-west and north-south road in the watershed recording cropland data at designated points/sites along the route. The transect is considered "representative" since only crop fields that can be seen from the road are a part of the transect inventory. (Tables 2.5-2.7)

Tillage system definitions

No-till farming is an agricultural technique for growing crops or pasture without disturbing the soil through tillage. No-till farming decreases the amount of soil erosion tillage causes. Other benefits include an increase in the amount of water infiltration, soil retention of organic matter, and nutrient cycling. Using no-till increases the amount and variety of life in and on the soil. Typically, no-tillage systems require the use of very large amounts of herbicides to control weeds.

Mulch-till uses chisel plows, field cultivators, disks, sweeps, or blades to till the soil before planting. The tillage does not invert the soil but leaves it rough and cloddy. Various chisel points or sweeps attached to the shanks affect the amount of residue cover left on the soil surface.

Conventional tillage is often characterized by deeper tillage tools, such as disk-rippers and chisel plows. These tools can mix large amounts of soil, bury heavy residue, or break compacted layers. The soil surface will then be further tilled using a harrow to provide a seedbed devoid of clods.

A tillage transect was conducted by project staff in June 2020 to represent after planting and again two more times in 2021. The first was in March of 2021 to represent before planting season, and again in June to represent what was observed after the 2021 planting season was done.

Admittedly, using data on crop rotation and tillage patterns over a short two-year window should be viewed as preliminary when drawing any conclusions regarding cropping and tillage pattern changes. That being said, a few observations that can be drawn from the preliminary data include:

1. A two-crop rotation of corn and soybeans is dominant throughout the watershed.
2. A limited amount of small grains, such as wheat, is produced in the watershed. An even smaller amount of hay or pasture exists.
3. Intensive or conventional tillage dominates the tillage systems used. However, no-till is identified on over one-third of the cropland acres. Close review of the Transect data shows that the predominance of no-till is used when soybeans are being planted into the previous year's corn crop residue.
4. A relatively new trend of employing a tillage system known as vertical tillage is increasing throughout the watershed. Typically, this practice is included in the mulch till category.
5. When asked, many farmers indicate they feel some form of tillage is needed in this watershed due to soil type and drainage.

Table 2.5 2020 Spring Flatrock Watershed Tillage Transect (June 2020, after planting)		
Crop Type	# of Relevant Fields	Percentage
Soybeans	148	50%
Corn	127	42%
Wheat	15	5%
Hay	7	2%
		100%
Tillage System	# of Relevant Fields	Percentage
No-Till	112	38%
Mulch Till	27	9%
Conventional	151	51%
Other	7	2%
		100%

Table 2.6 2021 Winter Flatrock Watershed Tillage Transect (March 2021, before plant)		
Crop Type	# of Relevant Fields	Percentage
Soybeans	146	49%
Corn	129	44%
Wheat	15	5%
Hay	7	2%
		100%
Tillage System	# of Relevant Fields	Percentage
No-Till	109	37%
Mulch Till	93	31%
Conventional	53	18%
Other	42	14%
		100%
2021 Spring Flatrock Watershed Tillage Transect (June 2021, after planting)		
Crop Type	# of Relevant Fields	Percentage
Soybeans	153	52%
Corn	114	38%
Wheat	22	7%
Hay	7	2%
Fallow	1	<1%
		100%
Tillage System	# of Relevant Fields	Percentage
No-Till	109	37%
Mulch Till	53	18%
Conventional	110	37%
Other	25	8%
		100%

Table 2.7 Comparison of the 2020 and 2021 Flatrock Watershed Spring Tillage Transect Data-After Planting										
Crop Type	Soybean Fields		Corn Fields		Wheat Fields		Hay Fields		Total Fields	Unit
Year	2020	2021	2020	2021	2020	2021	2020	2021		Percentage
No-Till	88	85	8	12	15	11	0	1	220	37%
Mulch Till	19	33	8	8	0	11	0	0	79	13%
Conventional	22	28	100	83	0	0	0	1	234	40%
Other	19	7	11	11	0	0	7	5	60	10%

Windshield Survey

A Windshield Survey was conducted by project staff in June 2020. The survey team traveled all roads throughout the project area to identify resource concerns and attributes to help characterize the watershed. The primary resource concerns (log jams, bank erosion, flooding, and unbuffered tile inlets) were those identified by the Steering Committee. The results are presented in Table 2.8.

Table 2.8 2020 Windshield Survey Results					
County	Total # Points	Log Jams	Bank Erosion	Flooding	Unbuffered Inlets
Allen	180	1	77	3	117
Adams	130	0	3	0	182
Paulding	27	4	5	1	4
Van Wert	21	0	1	0	15
Total	358	5	86	4	318

The windshield survey will be discussed in further detail, at the sub-watershed level, in Section Three of the WMP.

Buffer Strip Inventory

Steering Committee members identified the lack of buffer strips along streams and ditches as a concern, particularly in agricultural areas. Land disturbing activities that occur immediately adjacent to banks can result in unstable, eroding banks. The possibility of pollutants washing off the land also increases.

A desktop buffer strip inventory was completed for the entire project area using Google Earth 3D. For each subwatershed, reviewers began downstream and worked their way up the mainstem and tributaries noting the condition of the riparian corridor as it relates to adequate vegetation serving as a buffer strip. “Adequate” was determined to be 20 feet of width or greater. Adequate buffer strips have the potential to stabilize banks and intercept nutrients and sediment in surface water runoff. Figure 2.14 represents the inventory for the entire project area. A comprehensive evaluation of the buffer strip inventory results is presented in Section Three on a subwatershed basis.

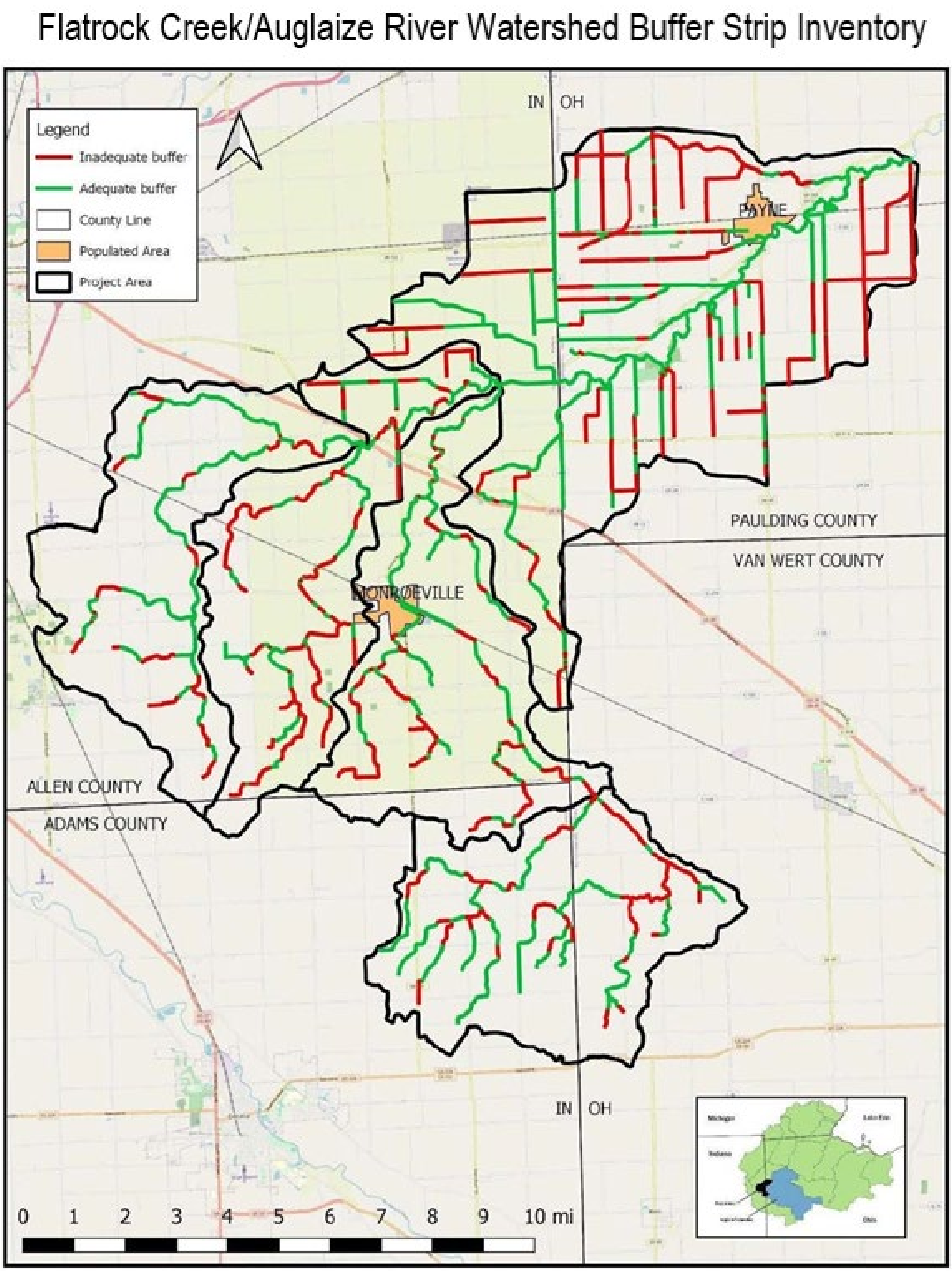

Figure 2.14 Project Area Buffer Strip Inventory, looking upstream

Bank Erosion Inventory

Stream and ditch bank erosion was identified as a concern by the Steering Committee. Land use changes in runoff hydrology, channel straightening, and flood impacts lead to conditions in which banks become unstable. This leads to a net source of sediment into a stream channel, exceeding its natural balance. In fact, sediment from bank erosion under these conditions has been cited as one of the leading sources of fine sediment and nutrients (attached to soil particles) entering streams in the U.S. (EPA 2009).

A desktop inventory of eroded stream and ditch banks was conducted alongside the buffer strip inventory using Google Earth 3D. Areas where reviewers could see bank erosion were noted on maps. In the project area; 46.3 miles of streams have bank erosion on both sides, 10.3 miles have bank erosion on the left side when looking downstream, 15 miles of streams have bank erosion on the right side when looking downstream, and 217 miles of streams do not exhibit signs of bank erosion. Figure 2.15 represents this information in percentages of the total and Figure 2.16 provides a visual representation of the inventory.

The results of the bank erosion inventory will be discussed in Section Three on a subwatershed basis.

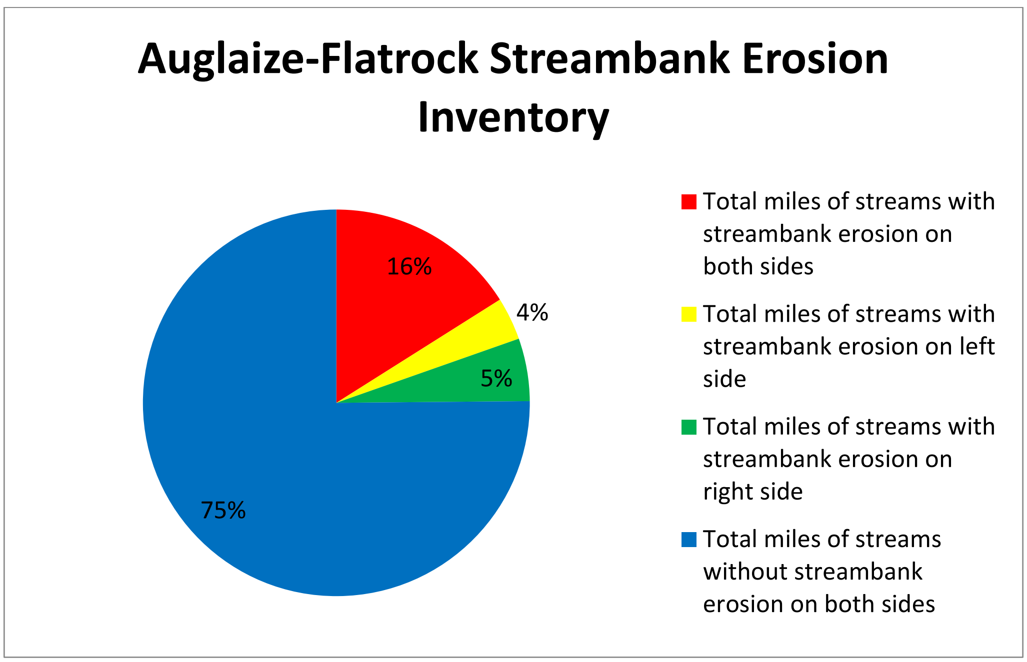

Figure 2.15 Project Area Bank Erosion Inventory, looking upstream

Bank Erosion Inventory

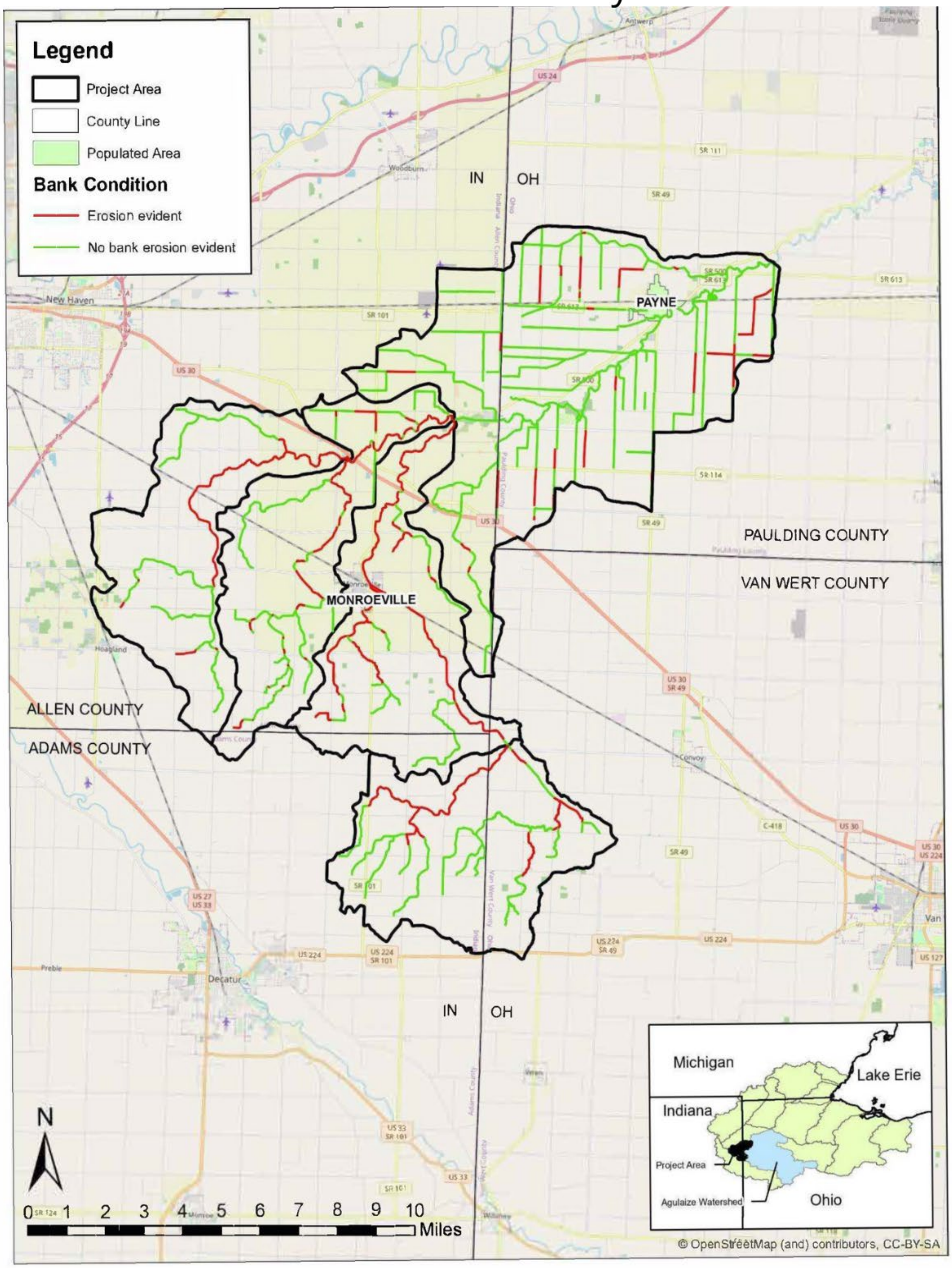

Figure 2.16 Project Area Bank Erosion Inventory, looking upstream

Livestock Inventory

The proper management, disposal, and land application of livestock manure was identified as a concern by the Steering Committee. The specific components in animal waste which can cause water quality problems are: nitrogen, phosphorus, and bacteria. Livestock may also compact riparian area soils and destabilize stream banks. These impacts from livestock in turn decrease infiltration rates and increase runoff, sedimentation, and bank sloughing.

In order to assess the impact of livestock, an estimate of the number of animals existing in the project area was obtained from the USDA Census of Agriculture (2019). (Table 2.9)

Table 2.9 Estimated Animal Numbers and Manure Outputs		
Livestock Type	Animal Units	Manure Produced (tons/year)
Chickens, Broilers	3,065	425.1
Chickens, Layers	79,176	4,768.4
Cows, Beef	316	3,806.2
Cows, Dairy	1,637	56,464.2
Horses	951	10,496.8
Pigs/Hogs/Swine	16,426	59,355.4
Sheep	381	525.7
Turkeys	32	4.6

Animal facilities were observed and counted during the Windshield Survey in June 2020. The number of facilities by type are: cattle – five; horse – four; turkey – one; dairy – three; swine – eight; unknown – eight.

Concentrated Animal Feeding Operations and Confined Feeding Operations

Very large Concentrated Animal Feeding Operations (CAFOs) are regulated under a federal National Pollutant Discharge Elimination System (NPDES) permit issued by IDEM in Indiana and OEPA in Ohio. Confined Feeding Operations (CFO) and Confined Animal Feeding Facilities (CAFF) are defined as facilities where animals are kept and raised in confined situations where the following conditions are met:

- Animals have been, are, or will be stabled or confined and fed for a total of 45 days or more in any 12-month period
- The number of animals present meets the requirements for the state permitting action

IDEM regulates CFOs. In Ohio, CAFFs are regulated by the Ohio Department of Agriculture (ODA). There is one CAFF in the Ohio portion of the project, two CFOs in the Indiana portion, and one CAFO in the Indiana portion. (Table 2.10, Figure 2.17)

Table 2.10 Watershed CFOs, CAFFs, and CAFOs			
Name	Subwatershed	Type	Animal Raised
Rosswurm Swine Farm	Wildcat Creek-Flatrock Creek	CAFF	Swine
State Line Pork, Incorporated	Wildcat Creek-Flatrock Creek	CAFO	Swine
Taylor Farms	Bohnke Ditch HUC-12	CFO	Swine
Delane Dairy farm, Incorporated	Bohnke Ditch HUC-12	CFO	Dairy Cattle

Feeding Operations

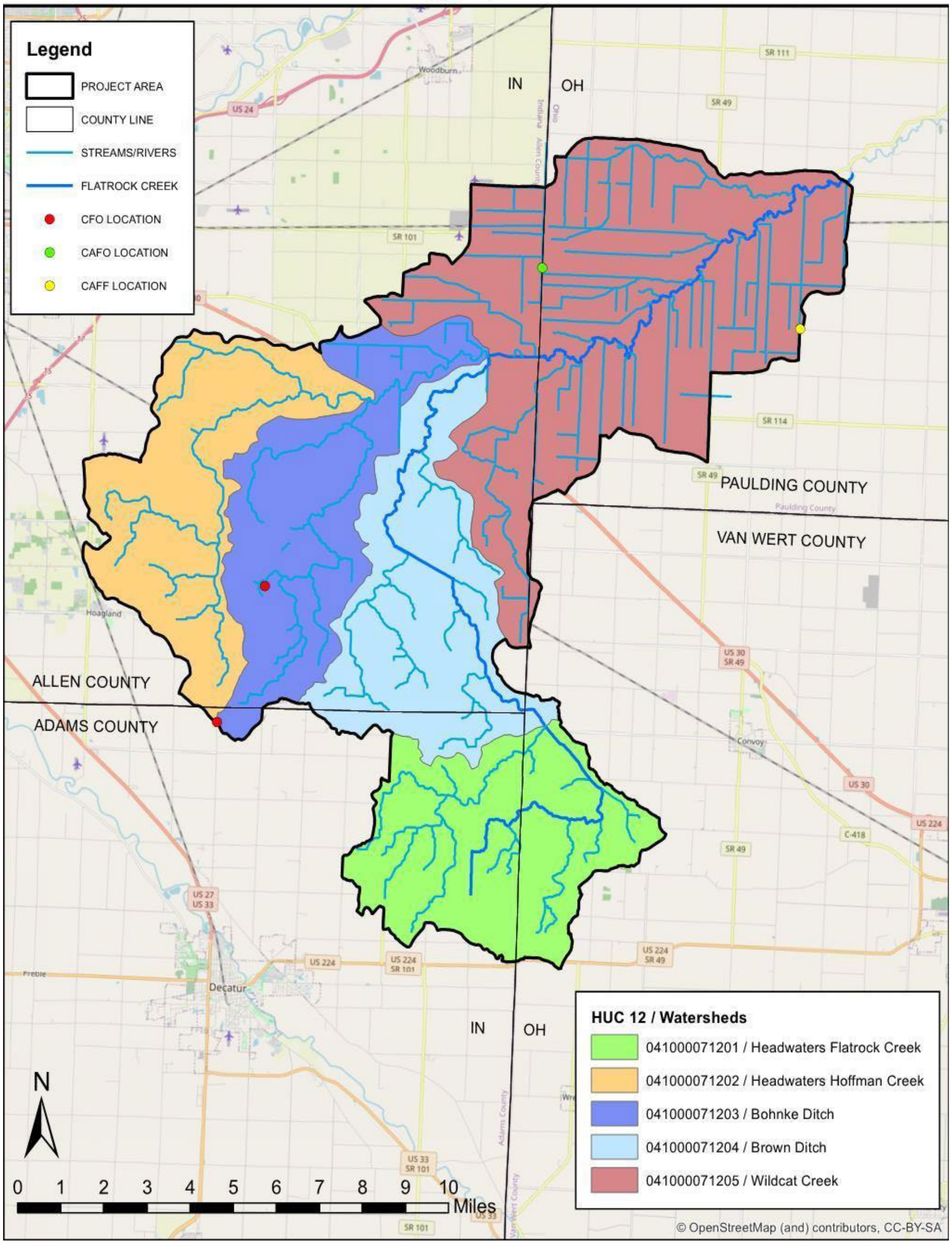

Figure 2.17 Confined Feeding Operations

National Pollution Discharge Elimination System

The Clean Water Act prohibits facilities from discharging pollutants through a "point source" into waters of the United States unless they have a National Pollution Discharge Elimination System (NPDES) permit. The permit contains limits on what can be discharged, monitoring requirements, and other provisions to ensure that the discharge does not impact water quality or people's health. The permit translates general requirements of the Clean Water Act into specific provisions tailored to the operations at each facility.

As of July 2020, there were 11 NPDES facilities in the project area. Of these, only the Monroeville and Village of Payne Wastewater Treatment Plants (WWTP) have recorded non-compliance issues The Monroeville WWTP non-compliance issues were for “failure to maintain records” and “late or missing discharge monitoring reports”. The Village of Payne WWTP non-compliance issues were for “failure to submit discharge monitoring reports” and “effluent monthly average limit exceedances.” Table 2.11 provides details for each facility. Figure 2.18 is a map of the facility locations.

Table 2.11 NPDES Facilities in Project Area (Source: EPA’s Enforcement and Compliance History database-(-https://catalog.data.gov/dataset/epa-enforcement-and-compliance-history-online)

Permit Name	Permit Number	County	Street Address	City	State	State Water Body	Quarters with Noncompliance (3 years)	Formal Enforcement Actions (5 years)
Monroeville WWTP	IN0000906	Allen	200 UTILITY DR	MONROEVILLE	IN	Flatrock Creek	9	0
Monmouth-Roe Acres & Rivare (Bobo) Service Areas - Contract "A"	INR10L397	Allen	N PIQUA RD & CR 850 N	DECATUR	IN	Flatrock Creek	0	0
Sampson Road	INR10L736	Allen	7200-8900 SAMPSON RD	MONROEVILLE	IN	Flatrock Creek	0	0
Allen Station Phase 2 Expansion Project	INR10L890	Allen	COUNTYWIDE	MONROEVILLE	IN	Flatrock Creek	0	0
Bradtmueller Farm	INR10P073	Allen	12102 E ROHRBACH RD	FORT WAYNE	IN	Flatrock Creek	0	0
Flatrock Road	INRA01403	Allen	FLATROCK RD & GROTRIAN RD	MONROEVILLE	IN	Flatrock Creek	0	0
Whittern Road	INRA01406	Allen	14900-16400 WHITTERN RD	MONROEVILLE	IN	Flatrock Creek	0	0

Permit Name	Permit Number	County	Street Address	City	State	State Water Body	Quarters with Noncompliance (3 years)	Formal Enforcement Actions (5 years)
Allen County Bridge 298	INRA01829	Allen	TERNET RD & ELLISON DITCH	MONROEVILLE	IN	Flatrock Creek	0	0
Monroeville Community Park	INRA02533	Allen	421 MONROE ST	MONROEVILLE	IN	Flatrock Creek	0	0
Don Gerardot, Town of Monroeville	INRA04011	Allen	MONROEVILLE RD & S WASHINGTON ST	MONROEVILLE	IN	Flatrock Creek	0	0
Village of Payne Waste Water Treatment Plant	11000982317	Paulding	211 N. Laura St.	Payne	OH	Flatrock Creek	8	0

Potential Point Source/Pollution Sites in the Flatrock Creek/Auglaize River Watershed

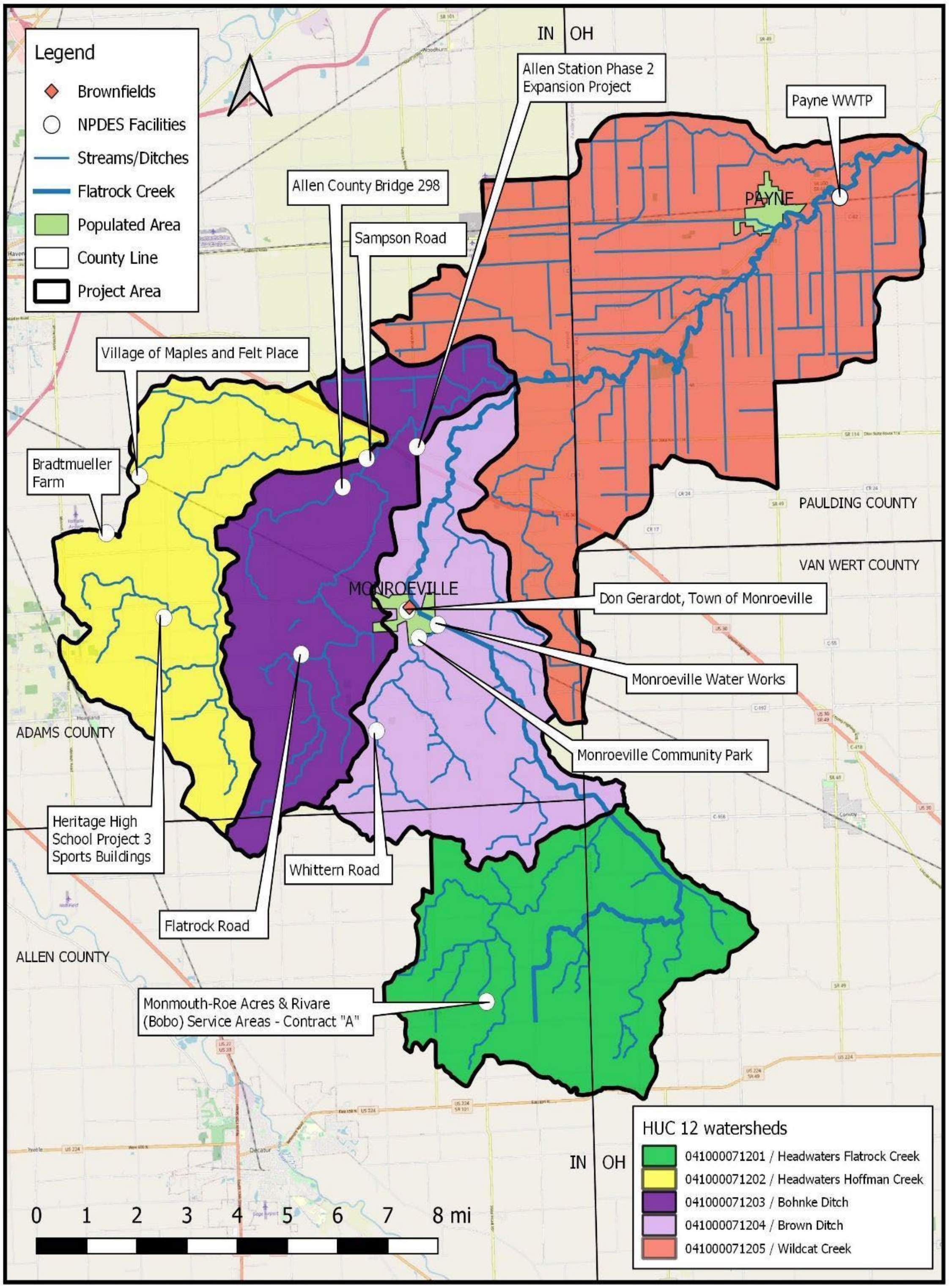

Figure 2.18 NPDES Facilities in the project area

Combined Sewer Overflows

Monroeville and Village of Payne wastewater treatment plants have occasional combined sewer overflows. Under normal conditions, wastewater is transported to a sewage treatment plant for treatment in a pipe system typically located under roads. When rainwater and snowmelt get added into the system, the volume of wastewater can sometimes exceed the capacity of the system or treatment plant. When this occurs, untreated stormwater and wastewater discharge directly to Flatrock Creek. Both communities are in the process of upgrading their systems to reduce the number of CSOs that occur each year.

Underground Storage Tanks

An underground storage tank (UST) system is a tank and any underground piping connected to the tank that has at least 10 percent of its combined volume underground. The IDEM and OEPA regulate UST systems that store petroleum or certain hazardous substances and assign a disposition of “open,” “closed,” or “other” to every site.

- Systems classified as “open” and “active” have Leaking Underground Storage Tanks (LUST) where site characterization or corrective action is underway.
- “Open/Discontinued” sites are still active and meet one or more of the following criteria:
    - The site has been referred to another agency.
    - The owner cannot be located, and the site is a low priority based on site information and potential threats to human health and the environment.
- “Closed” sites are characterized by Conditional or Unconditional Closure status based on whether or not further action is required.

In total, seven USTs and seven LUSTs are within the project area. Locations of USTs and LUSTs are provided in Figure 2.19. Both the Bohnke Ditch HUC-12 and Headwaters Flatrock Creek HUC-12 are absent from UST systems. Brown Ditch contains seven, five of which are leaking. The Wildcat Creek HUC-12 contains four (one leaking), and Headwaters Hoffman Ditch HUC-12 contains three (one leaking).

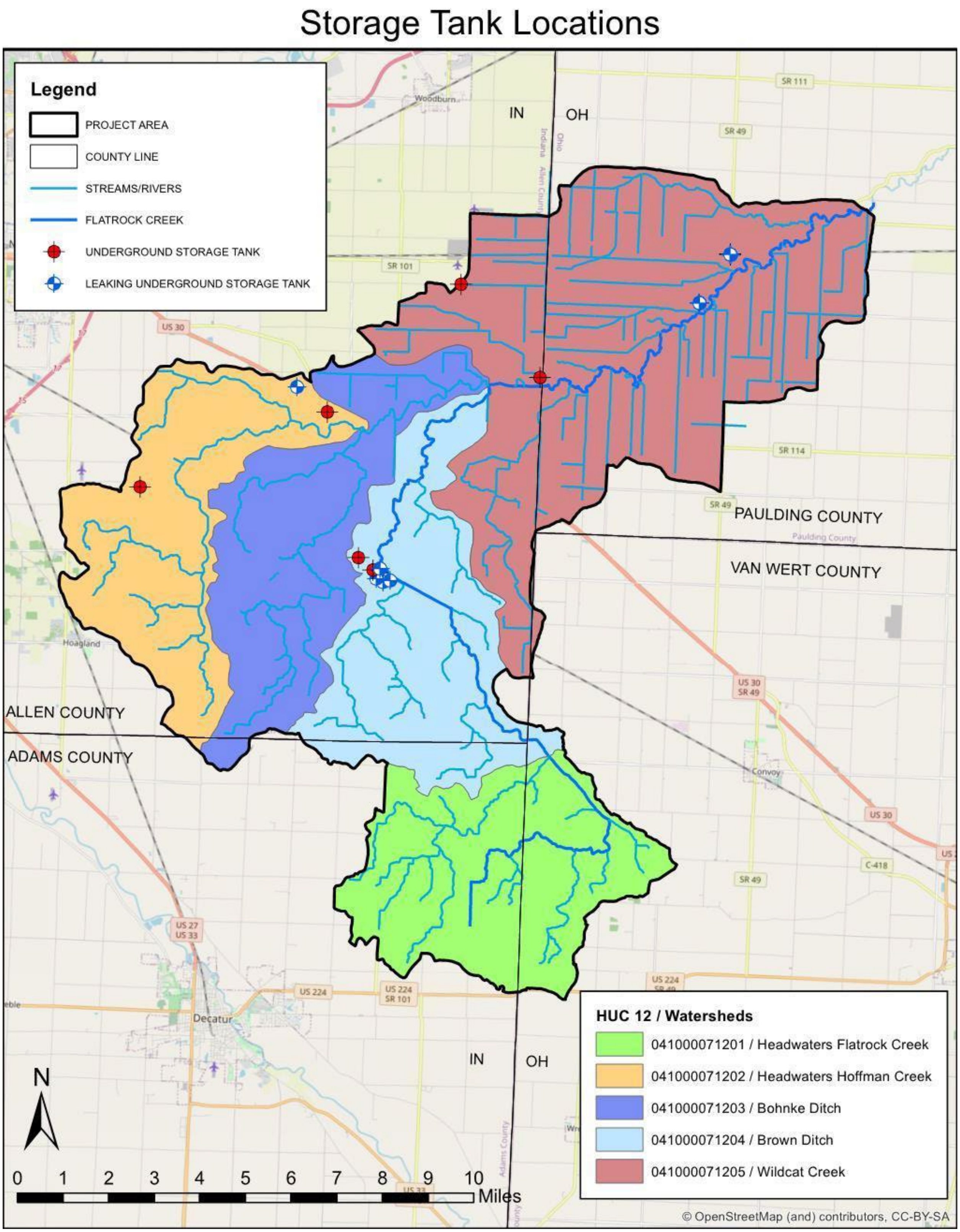

Figure 2.19 Underground Storage Tanks

Brownfields and Superfund Sites

There are no Superfund sites in the project area.

There is one Brownfield site in the project area. It is known as Jerry Parker Marathon (4110701) at 209 Main Street, Monroeville, IN. It is listed as “inactive.”

2.4 Other Planning Efforts

Other planning efforts relevant to the protection of water quality in the Flatrock/Auglaize watershed were researched. The content of these studies was reviewed and considered in the development of this WMP. A summary of each plan follows.

Stormwater Quality Management Plans

The federal Clean Water Act requires that stormwater discharge from larger urbanized areas be permitted under the National Pollutant Discharge Elimination (NPDES) system program. Allen County, Indiana falls under this program, however, only the areas in the county that are considered “urbanized” are included in this program. There aren’t any areas in the WMP project area that meet the urbanized designation. However, IDEM can apply NPDES rules to runoff and sedimentation from construction sites that have over an acre of disturbance. This has not been identified as a concern for the watershed due to the lack of development, construction, and sprawl.

Wellhead Protection Plans

IDEM’s Groundwater Section administers the Wellhead Protection Program in Indiana. In Ohio, it is administered by OEPA’s Source Water Assessment and Protection program. Wellhead Protection Plans are a tool for communities to use in protecting their community public water systems. The Safe Drinking Water Act mandates a wellhead protection program for each well or wellfield providing groundwater to a community public water system. There are two wellhead protection areas located in the Flatrock Creek watershed. They are for the Village of Payne (OH6300712) in Paulding County, Ohio serving approximately 1594 people and Monroeville Water Works (5202008) in Allen County, Indiana serving approximately 1400 people. Both plans are on a five-year renewal cycle. The mandatory updates must include information on the delineated area including potential pollution sources.

Indiana Domestic Action Plan

https://www.in.gov/isda/divisions/soil-conservation/western-lake-erie-basin/indianas-great-lakes-water-quality-agreement-glwqa-domestic-action-plan-dap-for-the-western-lake-erie-basin-wleb/

Indiana’s Great Lakes Water Quality Agreement (GLWQA) Domestic Action Plan (DAP) to reduce phosphorus to the Western Lake Erie Basin (WLEB) is the product of a dedicated Advisory Committee comprised of representatives from different stakeholder sectors and led by the Indiana Department of Environmental Management (IDEM). Founded on the principle of adaptive management, the DAP is a dynamic document acknowledging that phosphorus loading and nutrient pollution is a very complex problem. The issue is caused by point and nonpoint sources across all sectors requiring a multi-dimensional solution.

The focus of Indiana’s DAP is the 40% reduction of total phosphorus and dissolved reactive phosphorus in the Maumee River. This nutrient drives hazardous algal blooms (HABs) in the WLEB and contributes to central basin hypoxia. Indiana’s goal is to meet the spring-time flow weighted mean concentration

(FWMC) targets of 0.23 mg/L and 0.05 mg/L for total phosphorus (TP) and dissolved reactive phosphorus (DRP) respectively. The measuring points are the Maumee River and Flatrock Creek as they flow across the border into Ohio.

Allen County water quality sampling site 401 (see location map on page 50) represents Flatrock Creek's load contribution as it flows into Ohio. Load calculations and FWMC were calculated using results from the USGS LOADEST model. The seasonal TP FWMC is 0.41 mg/L which is above the target concentration. Statistics were not available for DRP.

Relevant DAP recommended actions to reduce nutrient loading:

- Work with county surveyors and drainage boards to encourage ecological maintenance of regulated and unregulated drains to reduce hydrological modification and maintenance needs.
- Reduce nutrient and sediment loading through implementation of conservation practices.
- Continue existing and create new opportunities for cost-share programs that address resource concerns.
- Conduct urban and agricultural education and outreach programs to bring about behavioral changes.
- Reduce and repair streambank erosion.
- Reduce nutrient loading from failed septic systems.
- Develop a response process for reports of manure mishandling and runoff from unregulated livestock operations or land application.

Ohio Domestic Action Plan

https://www.lakeerie.ohio.gov/Portals/0/Ohio%20DAP

The governors of Ohio and Michigan and the premier of Ontario committed to a goal of reducing phosphorus loadings in Lake Erie by 40% through the signing of the Lake Erie Collaborative Agreement (Collaborative), first in 2015 and again in 2019. The Collaborative was the precursor to the Ohio Domestic Action Plan (DAP). Ohio's DAP will advance efforts toward the proposed nutrient reduction targets put forth in the GLWQA under Annex 4 (Nutrients). The DAP expands on the Collaborative implementation initiatives and includes the central basin as well as the western basin of Lake Erie.

Relevant DAP Goals:

- Achieve a 40% total spring load reduction in the amount of total and dissolved reactive phosphorus (TP and DRP) entering Lake Erie's western basin from the Maumee River by the year 2025. A spring (March – July) Flow-Weighted Mean Concentration (FWMC) of 0.23 mg/L TP and 0.05 mg/L DRP and a target of 860 metric tons (1.9 million lb) total phosphorus and 186 MT (410,000 lb) dissolved reactive phosphorus in the Maumee River is predicted to be a 40% reduction from the base year of 2008.
- Achieve a 40% total annual load reduction in the amount of total phosphorus entering Lake Erie's central basin by the year 2025. This goal applies to priority tributary watersheds to the central basin of Lake Erie in Ohio, which include the Maumee River.

Relevant Ohio DAP recommended actions to reduce nutrient loading:

- Focus on agricultural land management since this has been identified as a significant source of phosphorus.
- Restore wetlands to recover their function in removing nutrients from the waterways.

- Address community sources including home sewage treatment systems and wastewater treatment infrastructure.
- Continue to encourage the use of watershed planning at the county and local level to assist with placing nutrient reduction practices on farm fields and in-streams to maximize nutrient reduction potential.

Nine-Element Nonpoint Source Implementation Strategy (NPS-IS) for Wildcat Creek-Flatrock Creek HUC-12 (04100007 12 05)

https://epa.ohio.gov/dsw/nps/index#120845160-9-element-nps-is

Prepared for the Paulding County Soil and Water Conservation District by Civil & Environmental Consultants, Inc. Toledo, Ohio. Approved February 3, 2020.

Excerpts from the report:
In 2019, Paulding SWCD received a Watershed Coordinator Grant from the Ohio Department of Agriculture (ODA). In addition, the Paulding SWCD received a grant from the Ohio Lake Erie Commission (OLEC) to develop Nine-Element Nonpoint Source Implementation Strategies (NPS-IS) for five HUC-12 watersheds, one of which was the Wildcat Creek-Flatrock Creek HUC-12. The Wildcat Creek-Flatrock Creek HUC-12 was identified as a priority watershed within the Western Lake Erie Basin (WLEB) for watershed planning and nutrient reduction efforts due to the estimated loadings of total phosphorus and dissolved reactive (soluble) phosphorus that flows into the tributaries of the Maumee River and eventually, Lake Erie. The development of NPS-IS is critical to the efforts focused on implementing Ohio's Domestic Action Plan (DAP) to reduce total spring nutrient loadings to Lake Erie by 40% by the year 2025, with aspirations to reach a 20% reduction by 2020. The NPS-IS strategically identified and outlined key projects that should be implemented within the Wildcat Creek-Flatrock Creek HUC-12 to address management of NPS issues that have both near-field and far-field impacts.

Within the HUC-12, Flatrock Creek was found to be in Full Attainment of its Warmwater Habitat (WWH) designation, while Wildcat Creek was found to be in Partial Attainment of its WWH designation, due to underperforming macroinvertebrate communities at its single sampling location. Impairment at this site is attributed to sedimentation/siltation, direct habitat alterations and flow regime alterations caused by agricultural activities and row crop production with subsurface drainage (OEPA, 2016a).

Sedimentation may be decreased by the implementation of agricultural BMPs that help stabilize soil loss from row crop fields. This would be particularly beneficial to implement in the contributing lands in the drainage area to Wildcat Creek. In addition, BMP implementation that reduces soil loss also simultaneously helps reduce nutrient loss, as nutrients are adsorbed to soil particulates; thus, helping to make progress toward nutrient reduction goals outlined in the DAP.

Goals: The OEPA has modeled nutrient loadings associated with various land uses and sources within each HUC-12 in the Maumee River Basin and has set phosphorus reduction goals for each associated source, based upon springtime load estimates. To achieve the desired phosphorus reduction from agricultural land use in the Wildcat Creek-Flatrock Creek HUC-12, the following goals have been established: Goal 1. Reduce springtime phosphorus loading contributions on prioritized agricultural lands to a level at or below 12,000 lbs/year (40% reduction.) Goal 2. Achieve an Invertebrate Community Index score at or above Good at St. Rt. 500 in Wildcat Creek (RM 0.27).

The implementation strategy identified in the NPS-IS is discussed in greater detail in Section Three, Wildcat Creek Subwatershed.

Plan-It-Allen Comprehensive Plan, 2007 (http://www.planyourcommunity.org/)

Developed under the guidance of the Comprehensive Plan Committee of Allen County and Fort Wayne, Indiana, for the progressive growth of the greater Allen County community.

Indiana State law says that the primary goal of a Comprehensive Plan is the "promotion of public health, safety, morals, convenience, order, or the general welfare and for the sake of efficiency and economy in the process of development" [Indiana Code 36-7-4-501]. According to Indiana Code; a Comprehensive Plan is required to include the following three elements:

- A statement of objectives for future development.
- Statement(s) of policy for land use development.
- Statement(s) of policy for the development of public ways, public places, public lands, public structures, and public utilities.

Relevant Goals and Objectives

- Encourage revitalization, remodels, and new development along existing infrastructure.
- Discourage development in growth not currently served by a sanitary sewer.
- Encourage sustainable growth by conserving natural features and environmentally sensitive land.
- Identify and implement additional floodplain and watershed management tools.
- Ensure the conservation of significant land resources, including but not limited to agricultural land, woodlands, and wetlands.
- Pursue wetland restoration initiatives.
- Protect wildlife habitats and limit invasive species.
- Preserve and improve the quality of groundwater and surface water resources.
- Support and collaborate in the establishment of watershed management plans that recommend actions to major sources of surface water contamination.
- Encourage the expansion of riparian buffers.
- Protect the natural and built environment through comprehensive floodplain management initiatives.

Western Lake Erie Basin Partnership Strategic Plan

The Western Lake Erie Basin Partnership formed in 2006. The Partnership brought together 14 federal, state, and regional partners to create a comprehensive watershed management partnership. In 2007, the partnership adopted a strategic plan to improve water quality throughout the Western Lake Erie Basin. Relevant Goals and Objectives have been identified in the following categories:

- Invasive Species Control
- Habitat Conservation and Species Management
- Stream Health/Water Quality
- Nonpoint Source Pollution
- Sustainable and Balanced Growth
- Hydrologic Management/Flood Attenuation
- Forest Resource Protection
- Native Plant Communities
- Public Information/Education

Biological and Water Quality Study of Lower Auglaize River Tributaries, Ohio EPA Technical Report EAS/2016-11-06

Twenty-eight streams in the lower Auglaize River tributaries study area were evaluated for beneficial use potential in 2014 and 2015. Biological sampling stations established in the Wildcat Creek-Flatrock Creek HUC-12 and the Headwaters Flatrock Creek HUC-12 also fall within the Flatrock Creek WMP project area (Figure 2.20). Significant findings and recommendations are outlined below.

Ohio EPA Sampling Stations

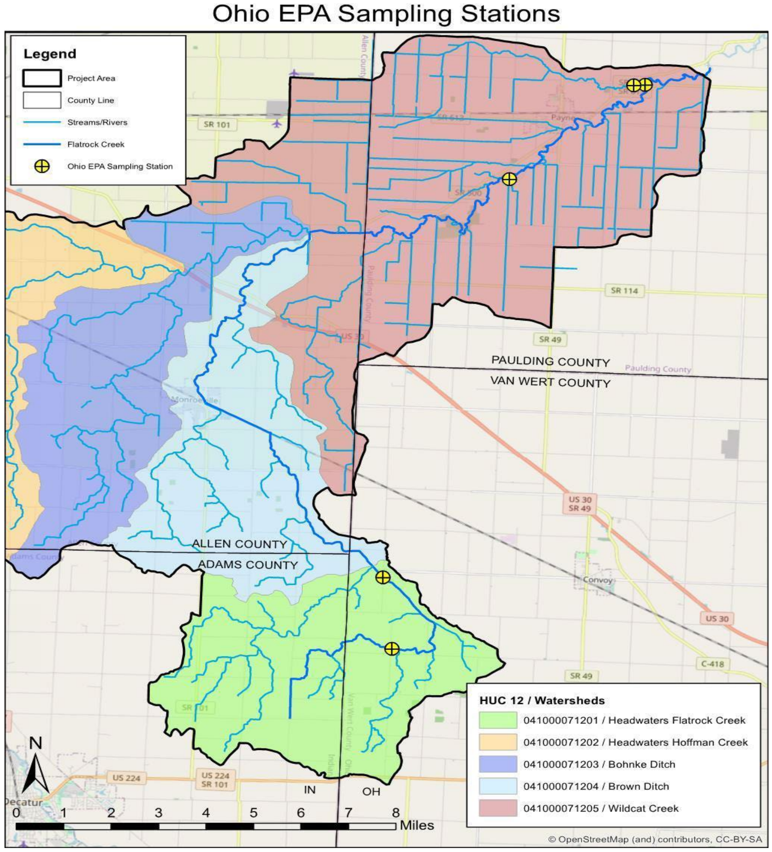

Figure 2.20 Ohio EPA Sampling Stations

From the headwaters to river mile (RM) 51.68, Flatrock Creek is given the designation of Modified Warmwater Habitat (MWH), due to pervasive modifications caused by channelization. Downstream from RM 51.68 until it crosses into Indiana, Flatrock Creek is considered to be capable of supporting WWH aquatic communities. Once Flatrock enters Ohio again at RM 35.39, it is designated as a WWH stream. Data gathered in Flatrock Creek shows the biological communities are reaching full attainment of their respective designations while communities in Wildcat Creek are not (Table 2.12). Underperforming macroinvertebrate communities in Wildcat Creek are attributed to sedimentation/siltation and direct habitat and flow regime alterations caused by agricultural activities and row crop production. For reference, water quality standards for the Huron-Erie Lake Plains Ecoregion are listed in Table 2.13.

Table 2.12: Biological Indices Scores for Sites in the Headwaters Flatrock Creek HUC-12 and the Wildcat Creek-Flatrock Creek HUC-12. (Source: OEPA, 2016a)

River Mile	Drainage Area (mi^2)	IBI	MIwb[a]	ICI[b]	QHEI	Attainment Status	Location
Flatrock Creek (MWH)							
51.68[H]	6.30	34	N/A	F	25.3	Full	Kings Church Rd.
Flatrock Creek (WWH)							
48.30[H]	13.4	30	N/A	MG	51.0	Full	Werner Rd.
28.84[W]	119.0	32	7.03[ns]	30[ns]	58.0	Full	Upstream Payne at Pugh Rd.
23.72 [W]	145.0	33	8.02	36	76.0	Full	NE of Payne at St. Rt. 613
Wildcat Creek (WWH)							
0.27[H]	7.90	36	N/A	F*	37.3	Partial	NE of Payne at St. Rt. 500

NOTES
IBI Index of Biotic Integrity
MIwb Modified Index of Well Being
a The Modified Index of Well Being (MIwb) is not applicable to headwater sites (drainage ≤20 mi2).
ICI Invertebrate Community Index
b Narrative evaluation used in lieu of ICI (G=Good; MG=Marginally Good; H Fair =High Fair; F=Fair; L Fair=Low Fair; P=Poor; VP=Very Poor).
QHEI Qualitative Habitat Evaluation Index
* Significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the poor to very poor range.
ns Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).
H Headwater sample
W Wading sample
N/A Not applicable

Table 2.13 Water Quality Standards for the Huron-Erie Lake Plains Ecoregion

HELP Ecoregion	MWH WQS[a]			WWH WQS		
	Wading	Headwater	Boat	Wading	Headwater	Boat
IBI	22	20	20/22	32	28	34
MIwb	5.6	N/A	5.7/5.7	7.3	N/A	8.6
ICI	22	22	22	34	34	34
QHEI[b]	43.5	43.5	43.5	60	60	60

(Source: OEPA, 2013)

NOTES:
WQS Water Quality Standards

a) Modified Warmwater Habitat (MWH) standards are dependent on type of MWH. MWH-C (due to channelization) is listed first; MWH-I (due to impoundment) is listed second. All MWH streams in this NPS-IS are MWH-C, Unless otherwise noted.

b) QHEI is not a criteria included in Ohio WQS; however, it has been shown to be highly correlated with the health of aquatic communities. In general, sites scoring 60 or above support healthy aquatic assemblages indicative of WWH. For MWH, OEPA suggests a score of 43.5 for the support of tolerant aquatic assemblages (Ohio EPA, 2013b).

N/A MIwb not applicable to headwater sampling locations with drainage areas ≤ 20 mi^2.

General recommendations were made across the entire Lower Auglaize area including those areas that are contained within the Flatrock Creek WMP project area.

1. Managing Stormwater, Sedimentation, and Direct Habitat Alterations

The Lower Auglaize River tributaries and the overall water quality downstream are directly affected by stormwater drainage and the ways the watershed is buffered from precipitation events. Reduction of sediment, nutrients, fertilizers/chemicals, erosion, and hydrologic modifications can be accomplished through proper stormwater management. Re-establishing natural riparian buffers (wetland and wooded riparian corridors) in the watershed to help slow storm water and filter pollutants are positive mechanisms to reduce stormwater pollution. In addition to restoring riparian buffers, an effort should be made to take advantage of the stream's natural assimilative capacities. Natural development of stream channels provides an array of beneficial services including settling fine sediments into adjacent floodplains, processing of nutrients into productive biomass, improved water quality, creation of natural instream habitats, increased carrying capacity of biomass, channel stabilization, and the slowing of erosion.

2. Threatened Enrichment and Bacteria

Organic enrichment was a problem detected in this watershed study. All of the streams in the study were found to have high levels of organic enrichment in all or parts of their reaches. Most of the sites had extensive amounts of agricultural land drained by subsurface tiles and drastically reduced riparian buffers along the stream. Land applications of livestock manure should always be done with caution and follow proper BMPs. Buffering streams from storm runoff by allowing vegetated buffers to grow and instituting BMPs for field tile filtration will reduce sedimentation from storm events. It will also help filter organics before they wash into streams, reduce downstream erosion/loss of farmland, and lessen the amount of nutrients and fertilizers washing into the western basin of Lake Erie. These practices will decrease nutrients that feed toxic algal blooms.

2.5 Threatened/Endangered Plants and Animals

The Auglaize watershed is home to a few federally endangered and threatened species as well as potential candidates to be on these lists. The US Fish and Wildlife Service (USFWS) maintains a database of these species in each county which is shown in Table 2.14. The vast majority of the listed species rely on streams, rivers and forested wetlands to survive as their numbers continually decline. Urbanization and agricultural farmland have contributed to the decline or transformation of many of these valuable habitats.

The Purple Lilliput Mussel is listed as a candidate on the federal level in our research area. The major threat to their habitat is chemical and organic pollution, siltation, and channel alteration. Another contributor to the Purple Lilliput's declining habitat is cattle wading in small streams where this species lives.

Blanding's Turtle is listed as a candidate on the Federal list and their decline has been attributed to destruction of suitable habitat as well as high road mortality due to urbanization into their habitats.

The Rayed Bean Mussel was once found in 115 streams, canals, and lakes. Now they are only found in 31 streams and 1 lake. This is a 73% reduction. Threats to the Rayed Bean include: dams, pollution, sedimentation, and nonnative species. Dams affect the natural flow of rivers, water temperatures, and their host fish. The host fish needs to be able to move upstream to aid in the mussels' reproduction cycle. Rayed Beans cannot survive in still water impounded by dams. Rayed Beans are sedentary and are highly impacted by various pollutants and sediments that inhabit the water from agriculture and non-agriculture sources.

The protection of native species that are on the Federal Endangered list is critical to keep the native balance in the ecosystem of our project area. Without changing practices that impact water habitats, many species will continually be impacted until they are extinct.

Table 2.14 Threatened and Endangered Species			
Species	Common Name	Status	Habitat Characteristics
Mussels			
Pleurobema clava	Clubshell	Endangered	Clean, loose sand and gravel in medium to small rivers and streams
Obovaria subrotunda	Round Hickorynut	Candidate	Medium to large rivers and along shores of Lake Erie and Lake St. Clair, near mouth rivers in sand and gravel substrates in areas with moderate flow
Toxolasma lividus	Purple Lilliput	Candidate	Well packed sand or gravel in small to medium sized streams
Villosa fabalis	Rayed Bean	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers and Lake Erie
Epioblasma triquetra	Snuffbox	Endangered	Small to medium-sized creeks in areas with a swift current and some larger rivers and Lake Erie
Epioblasma obliquata perobliqua	White Catspaw	Endangered	Coarse sand or gravel bottoms of small to mid-sized freshwater streams and rivers. Prefers shallow water and requires a swift current to avoid being buried in silt.
Epioblasma rangiana	Northern Riffleshell	Endangered	Large streams and small rivers in firm sand of riffle areas; Lake Erie
Theliderma cylindrica	Rabbitsfoot	Threatened	Rivers

Table 2.14 Threatened and Endangered Species			
Species	Common Name	Status	Habitat Characteristics
Reptiles			
Clemmys guttata	Spotted Turtle	Candidate	Shallow, sluggish waters of ditches, small streams, marshes, bogs and pond edges. Occasionally in wet woods and meadows
Emydoidea blandingii	Blanding's Turtle	Candidate	Marshy shorelines, inland streams and wet meadows
Sistrurus catenatus	Eastern Massasauga	Threatened	Open to forested wetlands and adjacent upland
Mammals			
Myotis sodalis	Indiana Bat	Endangered	Small to medium river and stream corridors with well-developed riparian woods; woodlots within 1 to 3 miles of small to medium rivers and streams; and upland forests.
Myotis septentrionalis	Northern Long-eared Bat	Threatened	Roosts and forages in upland forests during late spring and summer

2.6 Watershed Inventory Summary

There are four primary characteristics that are considered major influencers on water quality in the Flatrock Creek watershed. They are topography, soil types, hydrology, and land use. Most typically, where water quality and land use concerns are identified, there is a definable relationship represented by two or more characteristics. Examples of these relationships are listed below.

The areas of the watershed with flat topography and slow soil infiltration rates adjacent to the main stem of Flatrock Creek are subject to the detrimental effects of flood waters. Generally speaking, these areas were historical floodplain wetlands that have been converted to the primary land use in the project area, agriculture. Flood waters cause erosion on the land and in the creek channel. Nutrients on the land and in the creek banks are picked up by flood waters and washed into the creek. This is exacerbated in areas where the riparian buffer/buffer strips are not present and adoption of conservation tillage practices is low.

A conflict exists between on-site waste disposal system usage and soil types with low permeability. The project area's dominant soil types are not suitable for septic system usage and County Health Department officials have noted that 40% - 60% of the existing systems are in need of repair/replacement. This leads to *E.coli* and nutrient levels in surface water that often exceed the target water quality levels.

The dominant flat topography and slow soil permeability rates in agricultural areas is often mitigated with the installation of extensive tile drainage systems. Where tile riser surface inlets are used, storm water runoff, often carrying high nutrient loads, directly enters the tile system and discharges to streams/ditches/creeks. This contributes to excessive nutrient loads in the receiving water.

2.7 Water Quality Data

Water Quality Targets

The water quality targets adopted for the project are listed in Table 2.15. Where available, Indiana and Ohio targets were used. The values were used to interpret inventory data and define problems.

Table 2.15 Water Quality Monitoring Parameters and Targets		
Parameter	Target	Reference
pH	>6 and <9	327 IAC 2-1-6
Temperature	4.44 - 29.44 degree C	327 IAC 2-1-6
Dissolved Oxygen	>4 mg/L and <12 mg/L	327 IAC 2-1-6
Nitrate-nitrite	<1.6 mg/L	US EPA reference level (2000)
Atrazine	≤3.0 ppb	US EPA drinking water MCL
Escherichia Coli	≤235 cfu/100 ml (single sample)	327 IAC 2-1.5-8
Turbidity	<10.4 NTU	US EPA recommendation (2000)
Total Suspended Solids	<25 mg/L	Based on Rule 50 of MI water quality standards
Total Dissolved Solids	<750 mg/L	327-IAC-2-1-6
Total Phosphorus	<0.08 mg/L Tributaries <0.30 mg/L Mainstem	Ohio State Standard 327-IAC 2-1.5-8
Dissolved Reactive Phosphorus	<0.05 mg/L	North Carolina State University Recommendation
Total Ammonia	≤0.21 mg/L depending on temperature	327 IAC 2-1-6
Pollution Tolerance Index	>23 points = Excellent 17 - 22 points = Good 11 - 16 points = Fair <10 points = Poor	Hoosier Riverwatch (2015)

Water Quality Sampling

Several water quality assessment projects have been completed in the project area. These include the Indiana and Ohio Integrated Reports discussed below and the local Allen County SWCD led monitoring performed as part of this project (Figure 2.21). The results of the SWCD monitoring efforts are discussed in Section 3 on the subwatershed level.

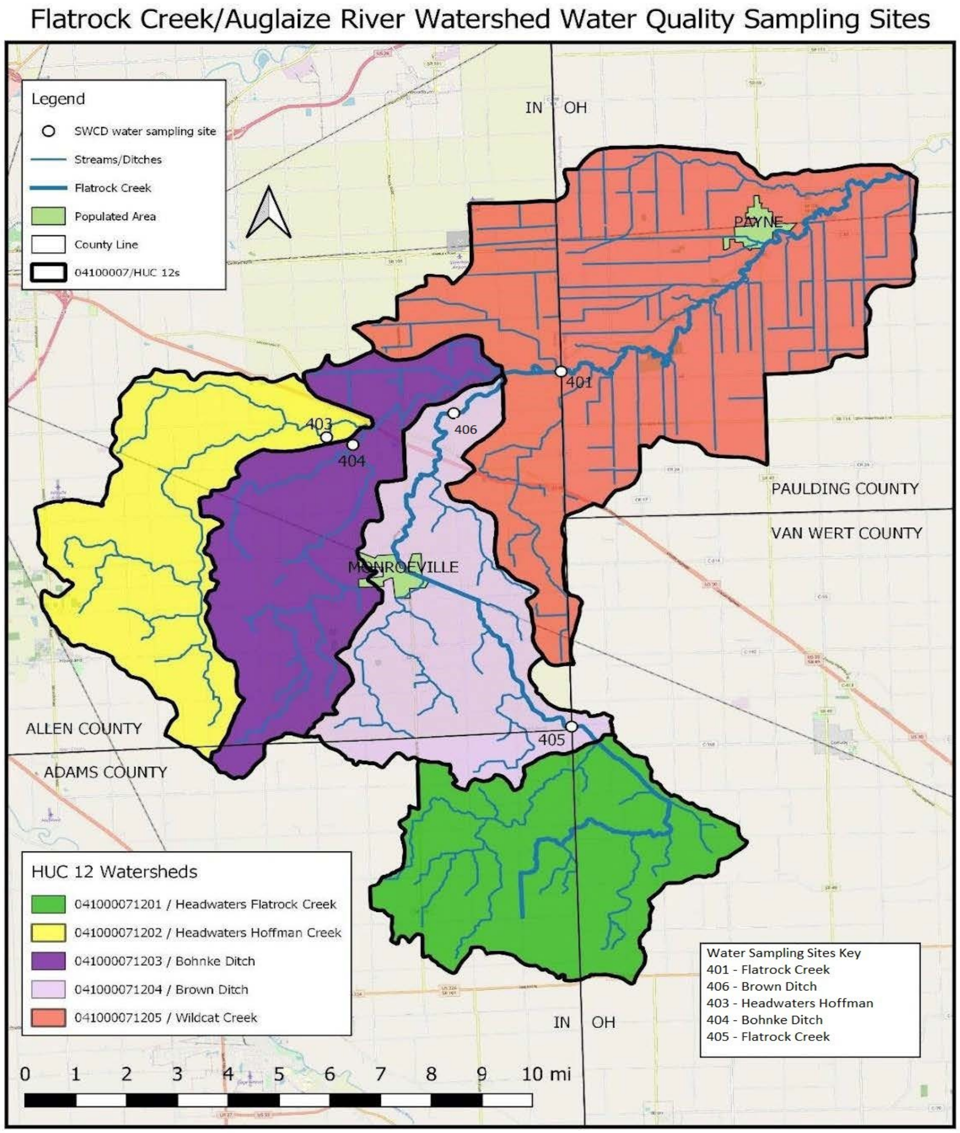

Figure 2.21 Water Sampling Sites Location Map

IDEM and Ohio EPA Integrated Reports, 2020

Section 305(b) of the Clean Water Act (CWA) requires states to assess and report on whether surface waters support the beneficial uses designated in water quality standards.

IDEM's CWA Section 305(b) assessments are made in accordance with IDEM's Consolidated Assessment and Listing Methodology (CALM) by comparing existing and readily available water quality data to the applicable water quality criteria in the State's water quality standards.

The assessment of Ohio surface waters can be a complex process. It is dependent on the interaction of use designations (goals set for waters), water quality criteria designed to protect these uses, and other provisions, such as antidegradation, intended to maintain existing high-quality waters. In addition, Ohio EPA has a systematic and comprehensive watershed-based monitoring strategy (Ohio EPA Five-Year Surface Water Monitoring Strategy: 2000-2004, Ohio EPA 1999) designed to assess the status of designated uses. The program accounts for natural, predictable sources of variability such as stream size and ecoregion. Finally, this information forms the basis of the 303(d) (TMDL) list of impaired waters which is a major driving force in developing restoration and protection strategies for these waters. The OEPA report indicates the general condition of Ohio's waters and lists those waters that are currently impaired and may require Total Maximum Daily Load (TMDL) development in order to meet water quality standards.

Impaired waterways are located in three of the five subwatersheds in the project area (Figure 2.22).

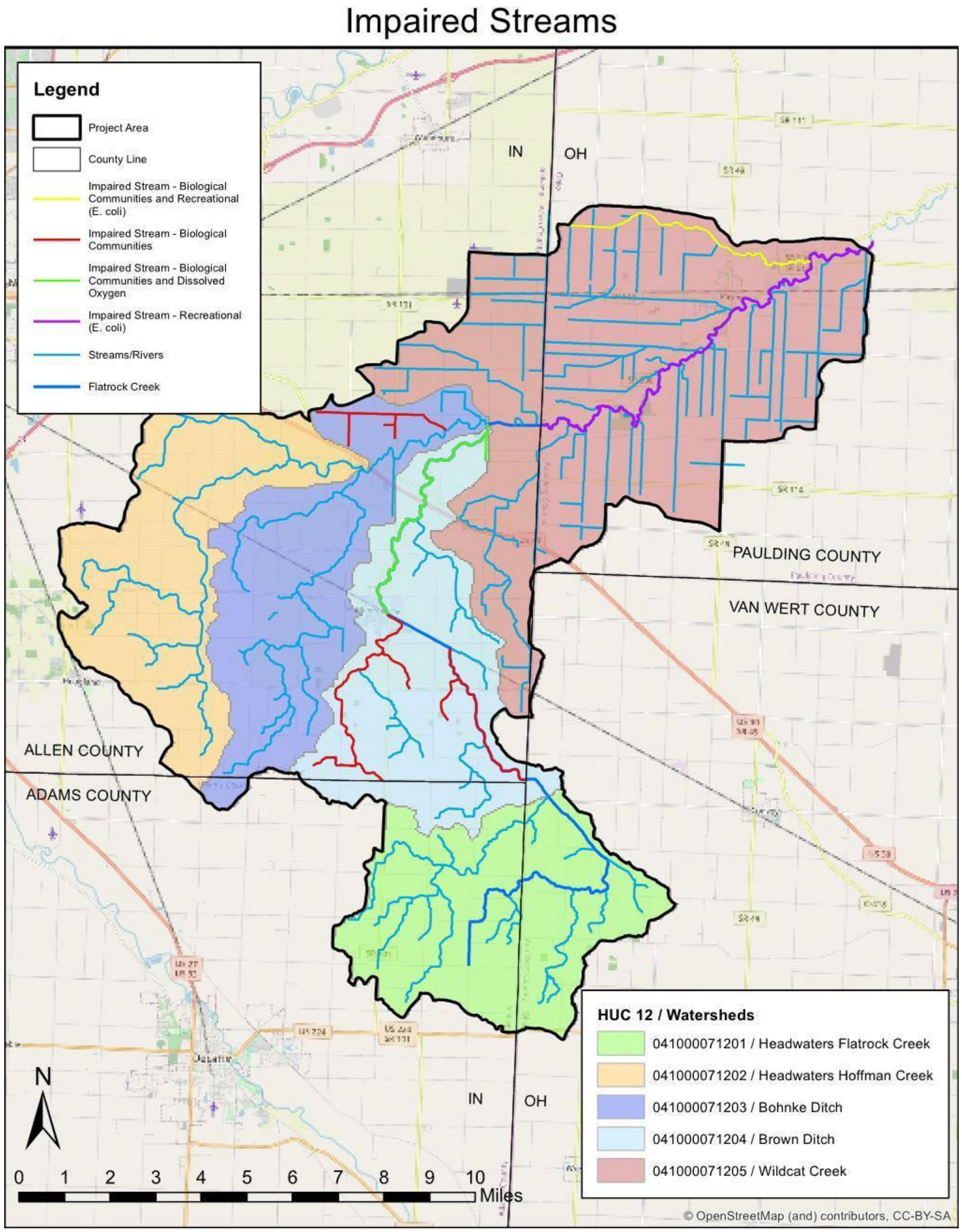

Figure 2.22 303(d) Impaired Waters

Within Indiana, 24.75 miles of streams contain impairments related to biological communities and/or dissolved oxygen (Table 2.16). Ohio reports impairment at the subwatershed level rather than individual stream segments. However, sampling locations in Wildcat Creek and Flatrock Creek within the Wildcat Creek-Flatrock Creek HUC-12 show impairment in at least 25.25 miles related to biological impairment (due to sedimentation) or recreational impairment (*Escherichia coli)*. This is representative of the subwatershed.

Table 2.16 303(d) Impaired Waters			
Subwatershed	Stream Name	Miles	Impairment
Bohnke Ditch	Gromeux Ditch	4.48	Biological Communities
Brown Ditch	Brown Ditch	8.00	Biological Communities
	Flatrock Creek	5.08	Biological Communities
	Flatrock Creek	7.19	Biological Communities and Dissolved Oxygen
Headwaters Flatrock Creek	--	--	--
Headwaters Hoffman	--	--	--
Wildcat Creek-Flatrock Creek	Wildcat Creek	6.57	Biological Communities and Recreational (E. coli)
	Flatrock Creek	18.68	Recreational (E. coli)

2.8 Watershed Inventory by Subwatershed

Bohnke Ditch Subwatershed, HUC 04100071203

The Bohnke Ditch subwatershed is located in Indiana, east of the Headwaters Hoffman subwatershed and west of the Brown Ditch subwatershed. It is approximately 14,694 acres in size and has 34 miles of streams. According to the 303(d) and List of Impaired Waters, 4.48 miles of streams are classified as impaired for Impaired Biotic Communities (Table 2.16, Figure 2.23). Approximately 20 miles of streams have inadequate buffer strips (Table 2.20 and Figure 2.26) and 11.4 miles of streams are experiencing bank erosion problems (Figure 2.16). The main land uses are 88% agriculture (12,978 acres), 6% forest (802 acres), 5% open space/park (735 acres), 0.6% grassland (89 acres), 0.4% residential (63 acres), 0.1% wetlands (19 acres), and 0.05% open water (8 acres) (Figure 2.24). Historically, nearly the entire subwatershed was covered in wetlands however only 0.1% of the original acres remain (Figure 2.7). There are 2 unsewered communities in the subwatershed, Boston and Zulu (Figure 2.9). Nearly 100% of the soil types in the subwatershed are classified as “very limited” for septic system usage (Figure 2.10). There are no Underground Storage Tanks. There are 2 livestock operations (Table 2.10. Figure 2.17) and 4 National Pollution Discharge Elimination System facilities in the subwatershed (Table 2.11. Figure

2.18). Hydric soils types dominate the area (Figure 2.4). Sixty-seven percent (66.50%) of soils within Bohnke Ditch have a slow infiltration rate when thoroughly wet and 30.98% of soils have a very slow infiltration rate. Highly erodible soils are nearly absent (Figure 2.9). Less than 1% of the soils were highly erodible (0.05%), another 2% were possibly highly erodible (2.44%), and 97% were not highly erodible (97.43%). There are no Brownfield, Superfund, or Wellhead Protection areas present. Substantial flooding occurs regularly along the mainstem of Bohnke Ditch where it is classified as floodplain (Figure 2.8). There is one water quality monitoring site in this subwatershed, Site 404 (Table 2.17 and Figure 2.23).

Water Quality Data

Allen County SWCD water quality sampling site 404 is located in Bohnke Ditch subwatershed. It is located on Sampson Road approximately one mile south of Hwy. 30 (Figure 2.23). The coordinates are 41.014124, -84.882588. Water quality has been tested weekly at this site from April through July in the years 2019 to 2021. Table 2.18. is a summary of the data.

Table 2.17 Water Quality Data for Site 404 – Bohnke Ditch

Parameter	Target	# of Samples	Min	Max	Average	# not meeting target	% not meeting target
pH	>6 and <9	75	6.81	11.76	8.13	9	12
Temperature	4.44 - 29.44 degree C	77	5.7	27.3	17.4	0	0
Dissolved Oxygen	>4 mg/L and <12 mg/L	77	5.4	14.75	10.04	14	18
Nitrate/Nitrite	<1.6 mg/L	77	0.034	24.12	3.693	50	65
Atrazine	<3.0 ppb	57	0	8.12	1.15	6	11
E.coli	<235 cfu/100 ml (single sample)	68	0	16520	1178	42	62

Table 2.17 Water Quality Data for Site 404 – Bohnke Ditch							
Parameter	Target	# of Samples	Min	Max	Average	# not meeting target	% not meeting target
Total Phosphorus	<0.08 mg/L Tributaries	75	0.001	0.984	0.158	40	53
Dissolved Reactive Phosphorus	<0.05 mg/L	75	0	0.38	0.064	32	43
Turbidity	<10.4 NTU	77	1.2	385.9	25.7	25	32
Total Suspended Solids	<25 mg/L	76	1	332	24.0	11	14
Total Ammonia	<0.21 mg/L depending on temperature	46	0.02	1.55	0.13	6	13

Bohnke Ditch Watershed Water Quality Sampling Sites

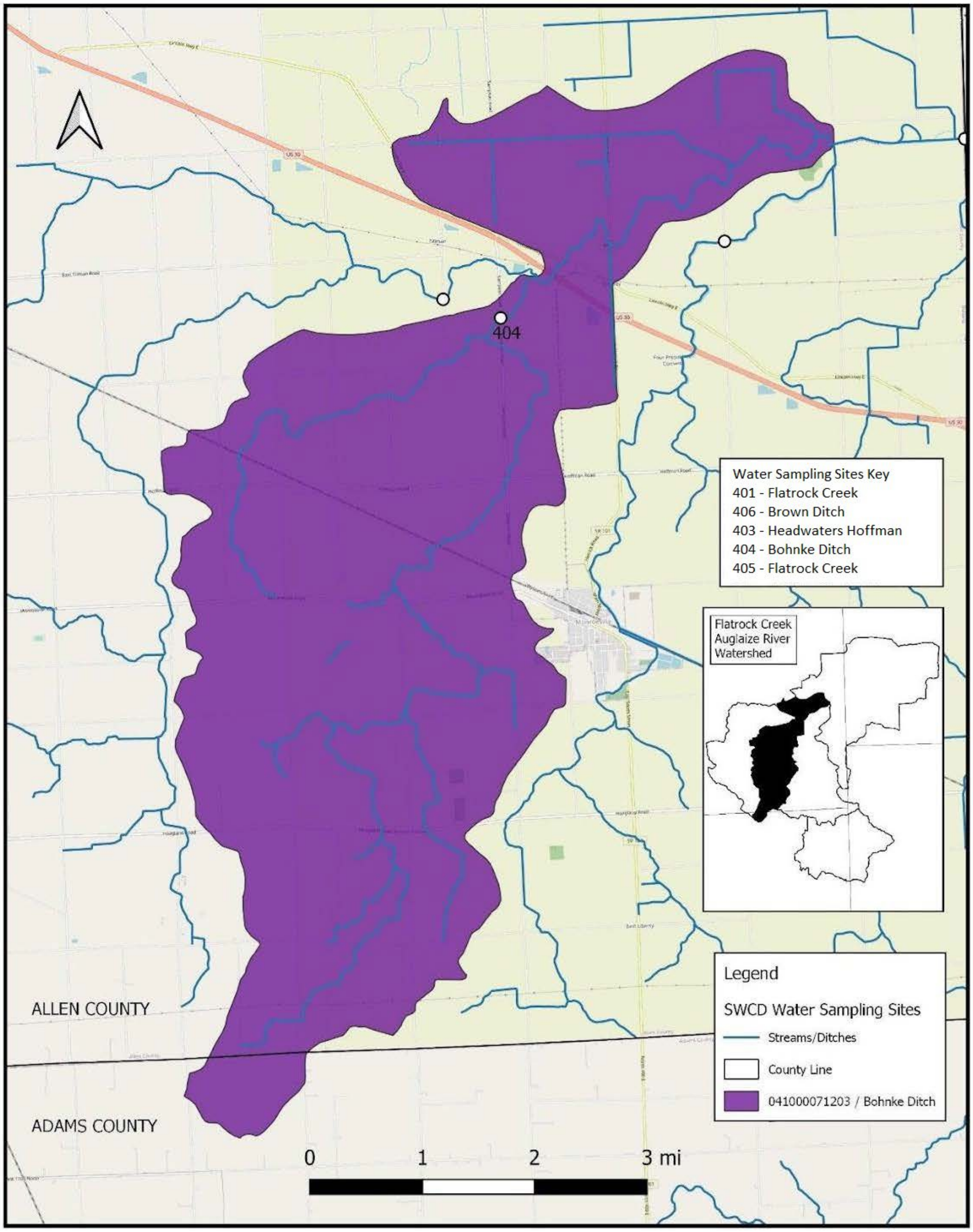

Figure 2.23 Bohnke Ditch Water Sampling Site Location Map

Land Use

The mainland uses in the Bohnke Ditch subwatershed are 88% agriculture (12,978 acres), 6% forest (802 acres), 5% open space/park (735 acres), 0.6% grassland (89 acres), 0.4% residential (63 acres), 0.1% wetlands (19 acres), and 0.05% open water (8 acres) (Figure 2.24) Land use in this subwatershed is not expected to dramatically change.

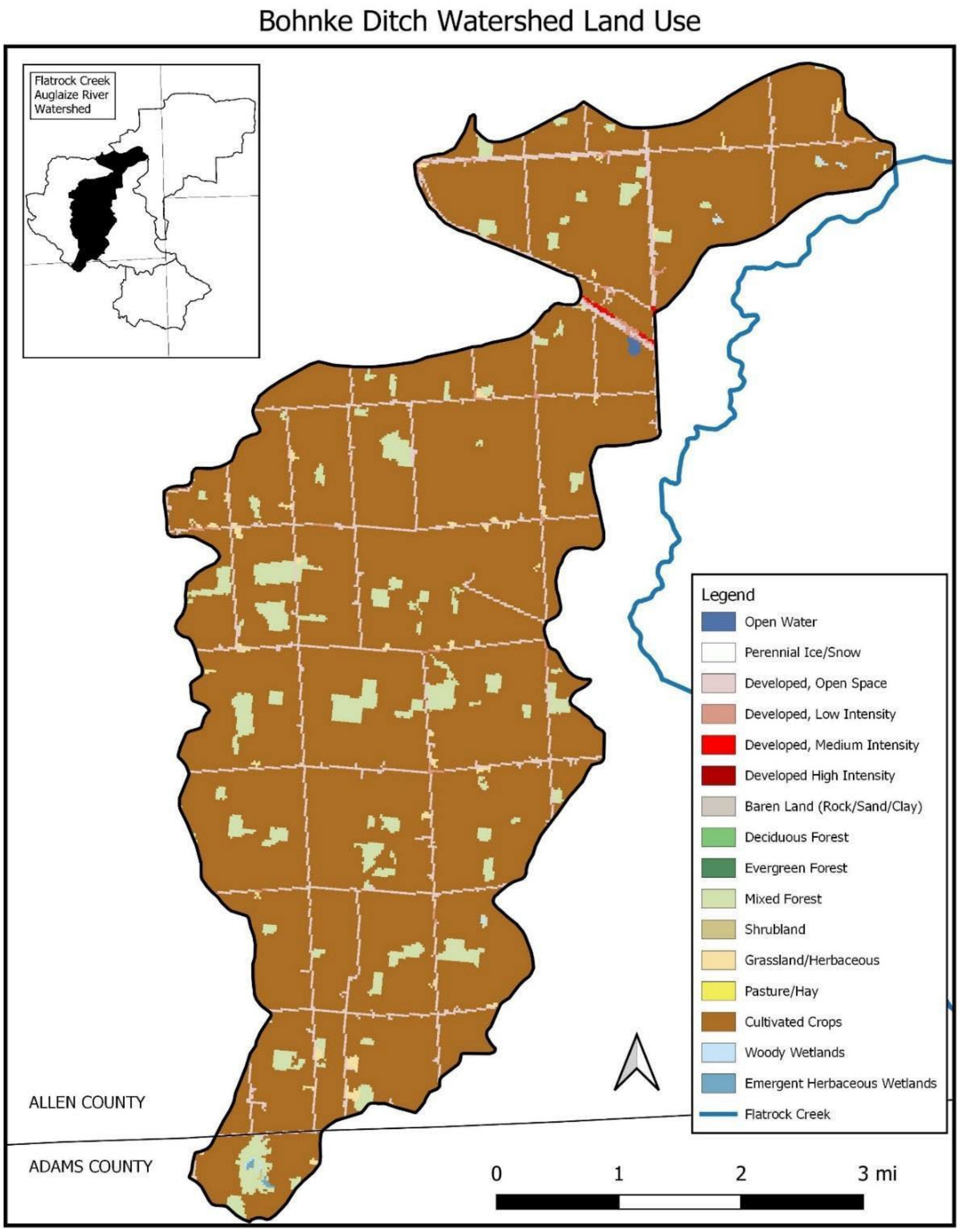

Figure 2.24 Bohnke Ditch Subwatershed Land Use

NPDES Facilities in Bohnke Ditch Subwatershed

Table 2.18 NPDES Facilities in Bohnke Ditch Subwatershed								
Permit Name	Permit Number	County	Street Address	City	State	State Water Body	Quarters with Noncompliance (3 years)	Formal Enforcement Actions (5 years)
Sampson Road	INR10L736	Allen	7200-8900 SAMPSON RD	MONROEVILLE	IN	Flatrock Creek	0	0
Allen Station Phase 2 Expansion Project	INR10L890	Allen	COUNTYWIDE	MONROEVILLE	IN	Flatrock Creek	0	0
Flatrock Road	INRA01403	Allen	FLATROCK RD & GROTRIAN RD	MONROEVILLE	IN	Flatrock Creek	0	0
Allen County Bridge 298	INRA01829	Allen	TERNET RD & ELLISON DITCH	MONROEVILLE	IN	Flatrock Creek	0	0

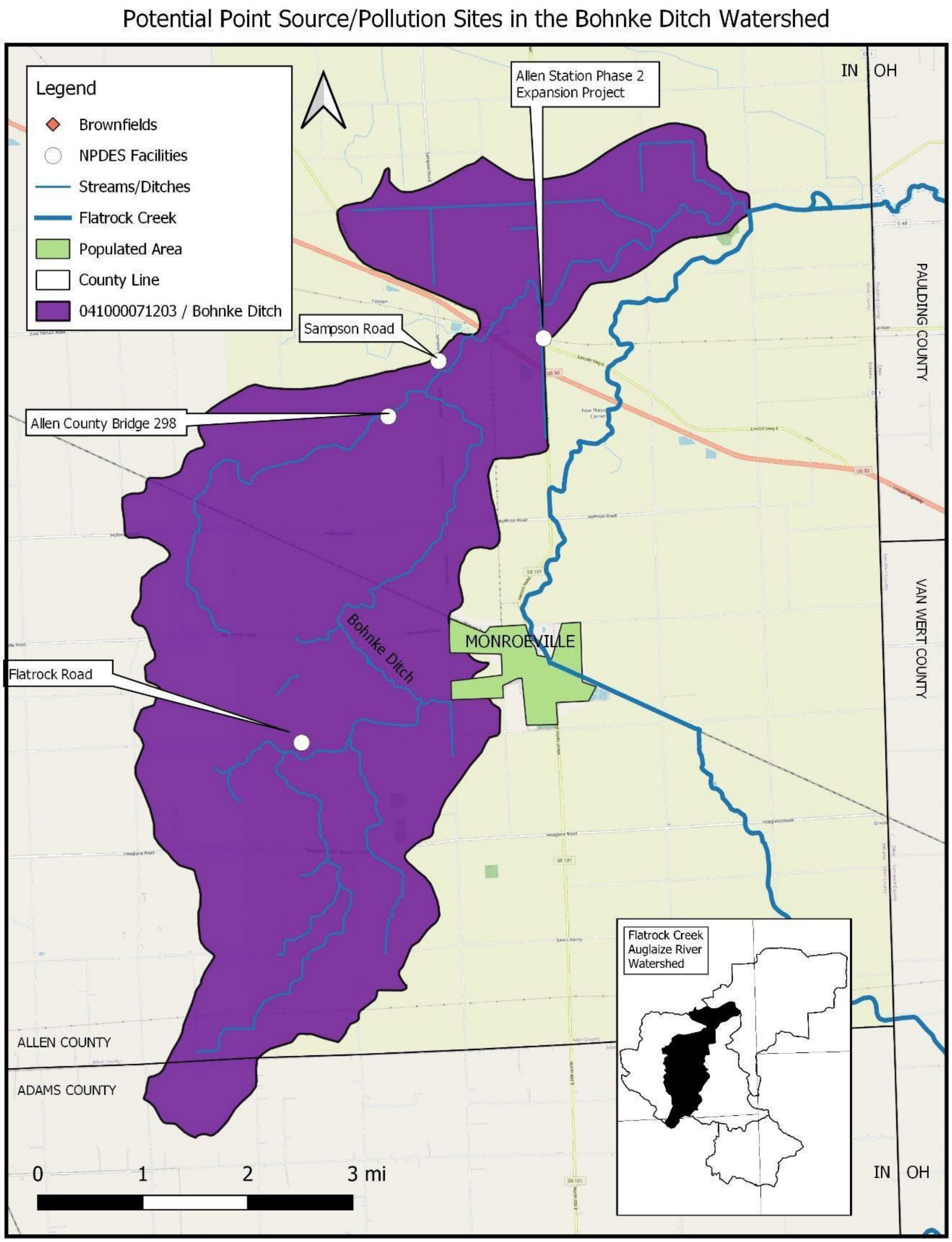

Figure 2.25 NPDES Facilities in Bohnke Ditch Subwatershed

Windshield Survey

During the windshield survey, a total of forty sites were evaluated in the Bohnke Ditch subwatershed. Two sites are in Adams County and 38 sites are in Allen County. Table 2.19 contains the results.

Table 2.19 Windshield Survey Results for Bohnke Ditch

Concern	Number Present in Adams County	Number Present in Allen County
Unbuffered Field Tile Inlets	1	19
Bank Erosion	0	14
Log Jams	0	1
Invasive Species	0	0
Flooding	0	1
Barnyard Runoff	0	0
Illegal Dumping	0	0
Sediment in Stream/Ditch	0	0
Lack of Residue on Crop Land	0	0
Manure on Surface, Not Incorporated	0	0

Buffer strip Inventory

The results for the Bohnke Ditch buffer strip inventory show that 42% of the total stream miles are adequately protected with buffer strips on both sides, 32% lack a buffer strip on one side, and 25% lack buffer strips on both sides (Table 2.20 and Figure 2.26).

Table 2.20. Bohnke Ditch Buffer strip Inventory	
Stream Mile Inventory	Stream Miles
Total stream miles	33.75
Miles of streams with inadequate buffer on both sides	8.64
Miles of streams with inadequate buffer on upstream left side	3.9
Miles of streams with inadequate buffer on upstream right side	7.03
Miles of streams with adequate buffer on both sides	14.18

Bohnke Ditch Watershed Riparian Buffer Zones

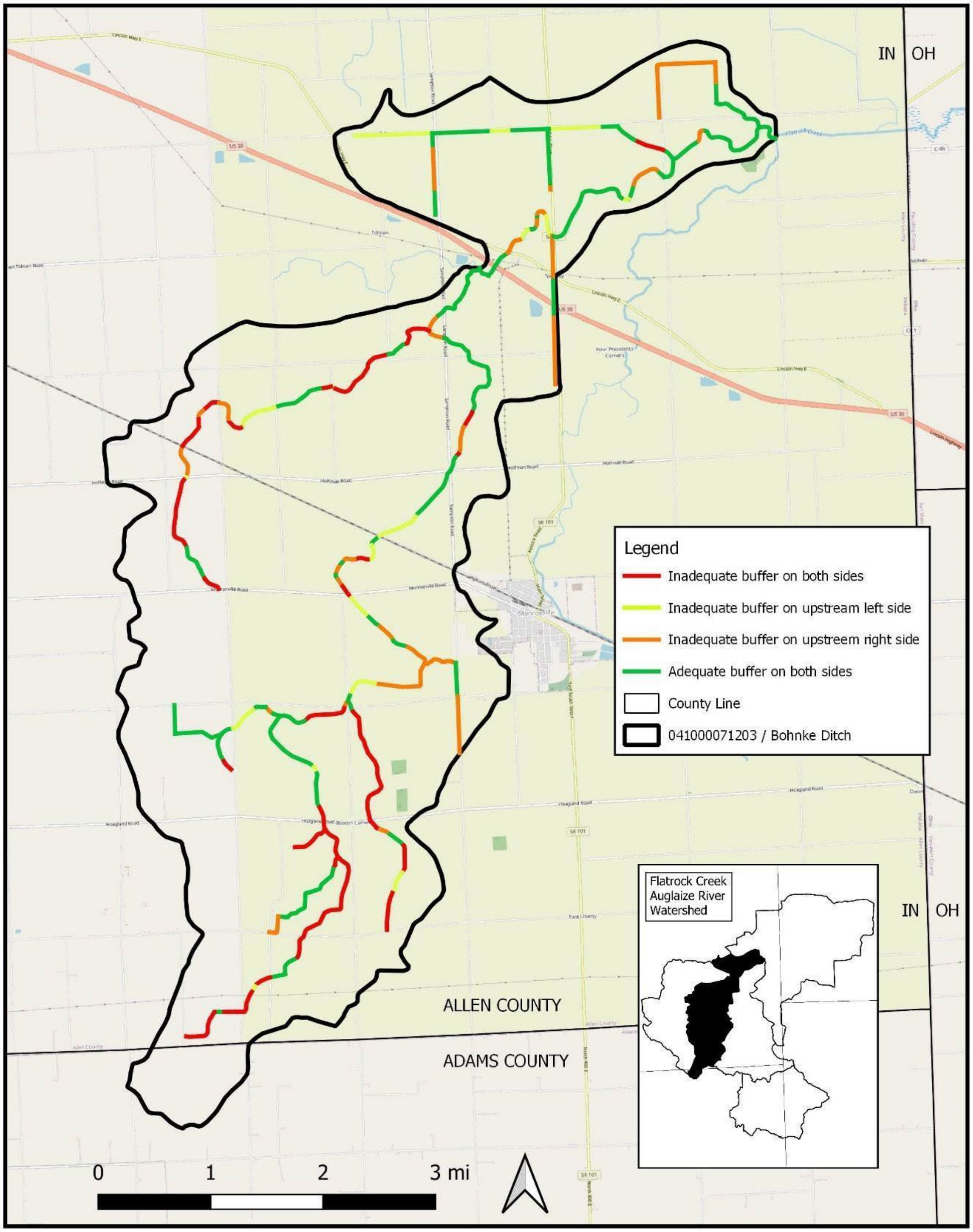

Figure 2.26 Bohnke Ditch Buffer strip Inventory

Bank Erosion Inventory

The desktop buffer strip inventory conducted for Bohnke Ditch shows that 5.7 miles of streams have bank erosion on both sides, 1.7 miles have bank erosion on the left side when looking downstream, 4 miles of streams have bank erosion on the right side when looking downstream, and 22 miles of streams do not exhibit signs of bank erosion. Figure 2.27 represents this information in percentages of the total and Figure 2.16 shows the inventory locations.

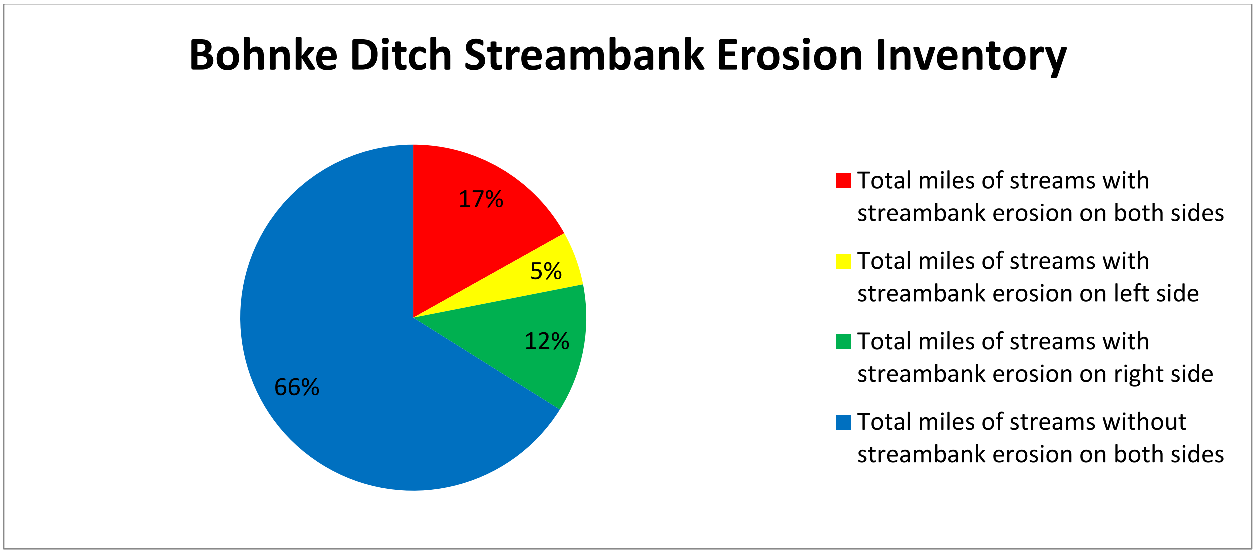

Figure 2.27 Bohnke Ditch Bank Erosion Inventory

Brown Ditch Subwatershed, HUC 041000071204

The Brown Ditch subwatershed is primarily located in Indiana with a small area in Ohio. It lies east of the Bohnke Ditch subwatershed, southwest of the Wildcat Creek subwatershed, and north of the Headwaters Flatrock Creek subwatershed. It covers approximately 15,602 acres with 15,286 acres in Indiana and 316 acres in Ohio. It has approximately 31 miles of streams (Figure 2.5). According to the 303(d) and 305(b) List of Impaired Waters, it has 13.08 miles of streams impaired for Impaired Biotic Communities, and 7.19 miles impaired for Impaired Biotic Communities and Dissolved Oxygen. (Table 2.16, Figure 2.22). Approximately 12.23 miles of streams have inadequate buffer strips (Table 2.23 and Figure 2.30) and 19.9 miles of streams are experiencing bank erosion problems (Figure 2.16 and Figure 2.32). The main land uses are 89% agriculture (13,907 acres), 2.28% forest (355 acres), 5.4% open space/park (849 acres), 0.9% grassland (138 acres), 1.6% residential (305 acres), 0.1% wetlands (17 acres), and 0.1% open water (17 acres) (Figure 2.29.) Historically, nearly the entire subwatershed was covered in wetlands however only 0.1% of the original acres remain (Figure 2.7). Nearly 100% of all the soil types in the subwatershed are classified as “very limited” for septic system usage (Figure 2.11). There are 2 Underground Storage Tanks and 5 Leaking Underground Storage Tanks (Figure 2.19). There are 4 National Pollution Discharge Elimination System facilities in the subwatershed (Table 2.25), one Brownfield site (Table 2.26), and no Superfund sites. Hydric soils types dominate the area (Figure 2.4). Fifty-eight percent (57.90%) of soils within Brown Ditch have a slow infiltration rate when thoroughly wet, and 37.05% of soils have a very slow infiltration rate. Highly erodible soils are nearly absent (Figure 2.9). Less than 1% of the soils were highly erodible (0.67%), another 7% were possibly highly erodible (7.24%), and 92% were not highly erodible (91.93%). The Town of Monroeville has a Wellhead

Protection area. Substantial flooding occurs regularly along the mainstem of Brown Ditch where it is classified as floodplain (Figure 2.8). There is one water quality monitoring site in this subwatershed, Site 406 (Figure 2.28).

Water Quality Data

Allen County SWCD water quality sampling site 406 is located in the Brown Ditch subwatershed. The coordinates are 41.030820, -84.844822. Water quality has been tested weekly at this site from April 14, 2021, through July 28, 2021. Table 2.21 is a summary of the data.

Table 2.21. Water Quality Data for Site 406 – Brown Ditch

Parameter	Target	# of Samples	Min	Max	Average	# not meeting target	% not meeting target
pH	>6 and <9	16	7.46	8.36	7.87	0	0
Temperature	4.44 - 29.44 degree C	16	9.1	25.8	19.3	0	0
Dissolved Oxygen	>4 mg/L and <12 mg/L	16	6.79	11.66	8.99	0	0
Nitrate/Nitrite	<1.6 mg/L	15	2.063	20.781	6.24	15	100
Atrazine	<3.0 ppb	12	0.184	18.562	3.278	3	25
E.coli	<235 cfu/100 ml (single sample)	16	0	5600	910	11	68.8

Table 2.21. Water Quality Data for Site 406 – Brown Ditch							
Parameter	Target	# of Samples	Min	Max	Average	# not meeting target	% not meeting target
Total Phosphorus	<0.08 mg/L Tributaries	15	0.0051	0.632	0.138	7	46.7
Dissolved Reactive Phosphorus	<0.05 mg/L	15	0	0.191	0.061	7	46.7
Turbidity	<10.4 NTU	16	2.0	179.1	27.0	6	37.5
Total Suspended Solids	<25 mg/L	16	0.8	70.8	17.35	3	18.8
Total Ammonia	<0.21 mg/L depending on temperature	15	0.029	1.97	0.167	1	6.7

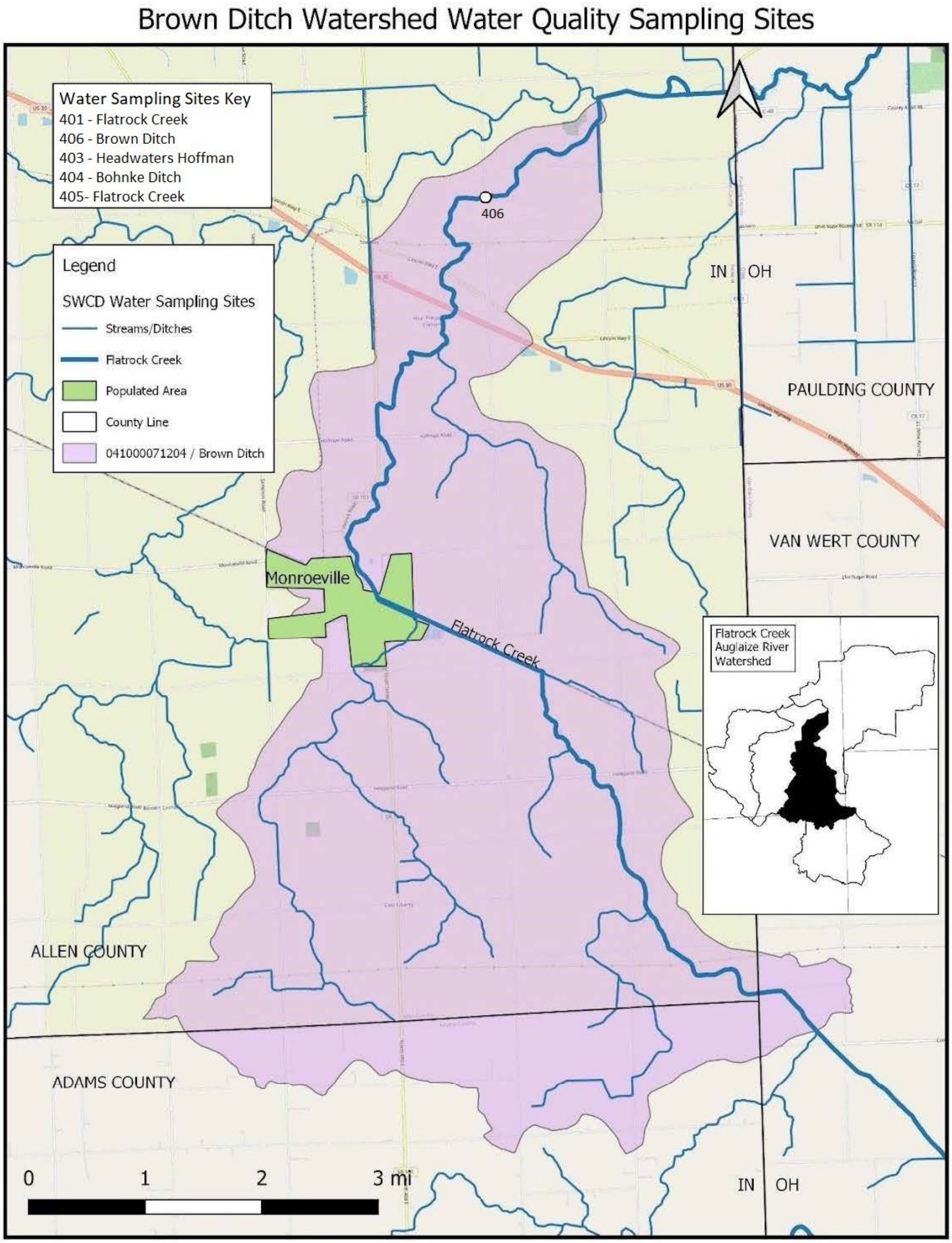

Figure 2.28 Brown Ditch Water Quality Sampling Site Location Map

Land Use

The main land uses in the Brown Ditch subwatershed are 89% agriculture (13,907 acres), 2.28% forest (355 acres), 5.4% open space/park (849 acres), 0.9% grassland (138 acres), 1.6% residential (305 acres), 0.1% wetlands (17 acres), and 0.1% open water (17 acres) (Figure 2.29). Land use in this subwatershed is not expected to dramatically change.

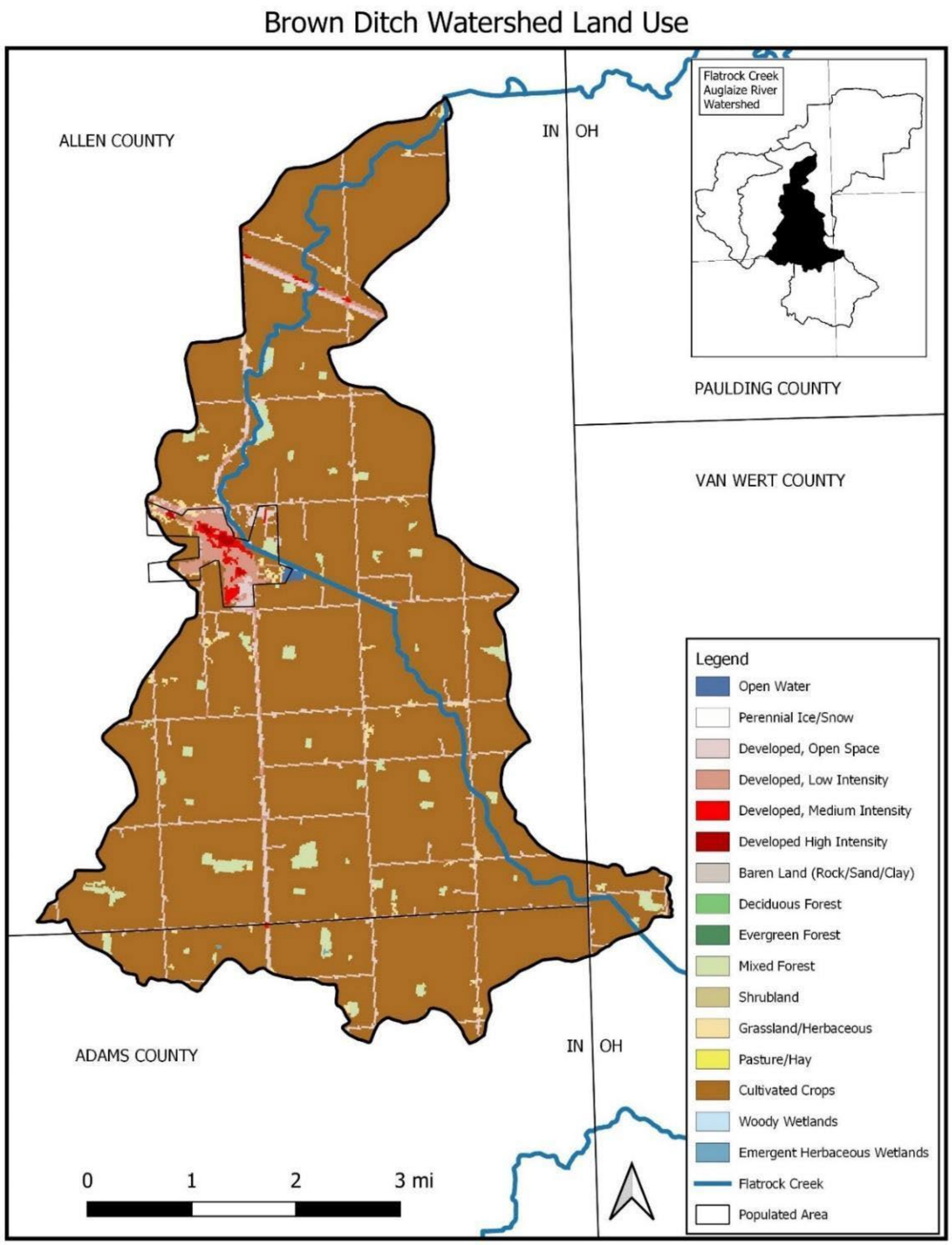

Figure 2.29 Brown Ditch Subwatershed Land Use

Windshield Survey

During the windshield survey, a total of ninety-five sites were evaluated in the Brown Ditch subwatershed. Twenty-two sites are in Adams County, seventy sites are in Allen County, and there are two sites in Van Wert County. Table 2.22 contains the results.

Table 2.22 Windshield Survey Results for Brown Ditch

Concern	Number Present in Allen County	Number Present in Adams County	Number Present in Van Wert County
Unbuffered Field Tile Inlets	38	20	2
Bank Erosion	26	2	0
Log Jams	0	0	0
Invasive Species	0	0	0
Flooding	0	0	0
Barnyard Runoff	0	0	0
Illegal Dumping	0	0	0
Sediment in stream/ditch	0	0	0
Lack of Residue on Crop Land	0	0	0
Manure on Surface, Not Incorporated	0	0	0

Buffer Strip Inventory

The results for the Brown Ditch buffer strip inventory show that 60.5 % of the total stream miles are adequately protected with buffer strips on both sides, 18.7% lack a buffer strip on one side, and 20.8% lack buffer strips on both sides (Table 2.23 and Figure 2.30).

Table 2.23 Brown Ditch Buffer Strip Inventory

Stream Mile Inventory	Stream Miles
Total stream miles	30.94
Miles of streams with inadequate buffer on both sides	6.45
Miles of streams with inadequate buffer on upstream left side (looking downstream)	3.74
Miles of streams with inadequate buffer on upstream right side (looking downstream)	2.04
Miles of streams with adequate buffer on both sides	18.71

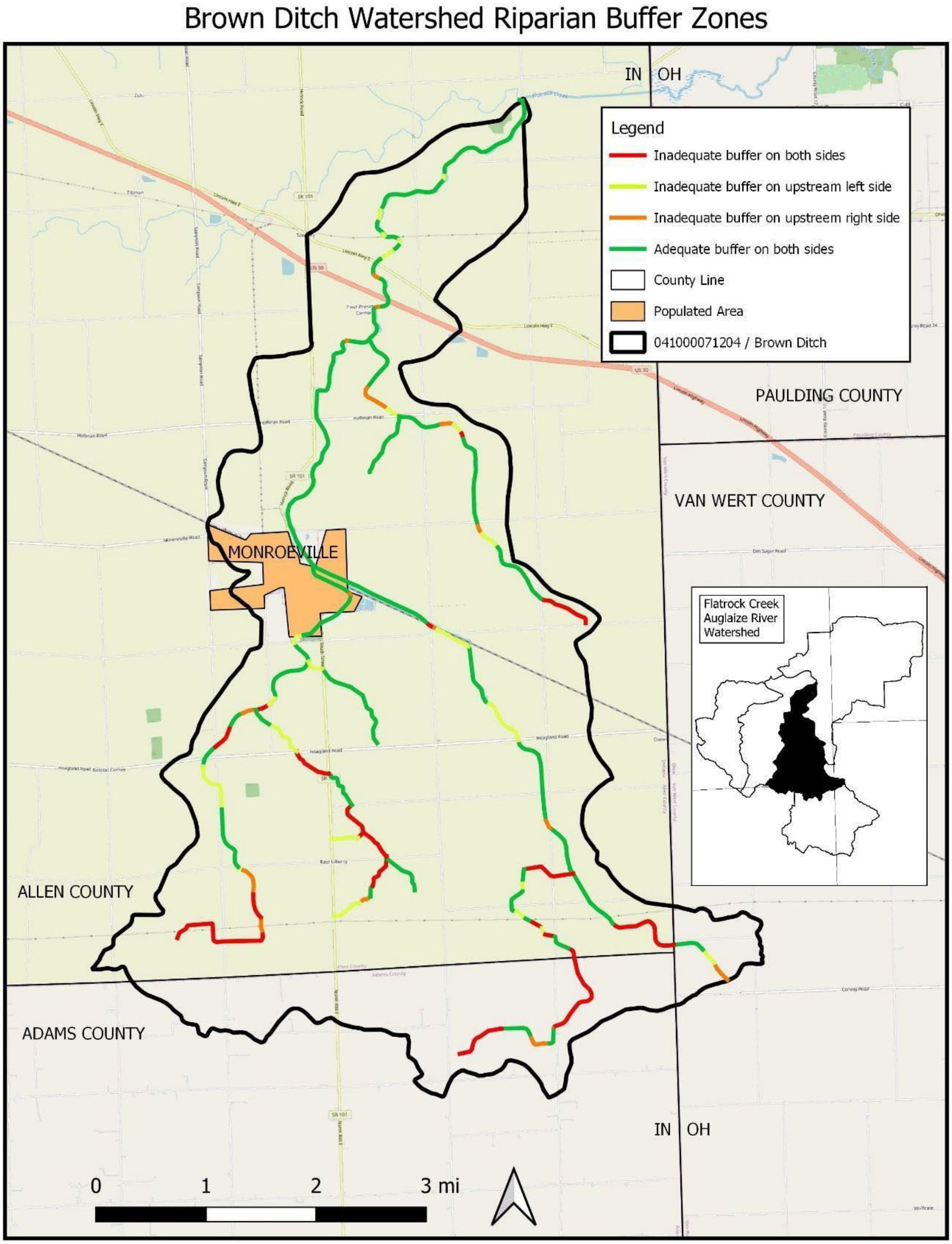

Figure 2.30 Brown Ditch Buffer Strip Inventory

National Pollution Discharge Elimination System Permitted Facilities in Brown Ditch Subwatershed

Table 2.24 NPDES Facilities in Brown Ditch Subwatershed as of July, 2020								
Permit Name	Permit Number	County	Street Address	City	State	State Water Body	Quarters with Noncompliance (3 years)	Formal Enforcement Actions (5 years)
Monroeville WWTP	IN0000906	Allen	200 UTILITY DR	MONROEVILLE	IN	Flatrock Creek	9	0
Whittern Road	INRA01406	Allen	14900-16400 WHITTERN RD	MONROEVILLE	IN	Flatrock Creek	0	0
Monroeville Community Park	INRA02533	Allen	421 MONROE ST	MONROEVILLE	IN	Flatrock Creek	0	0
Don Gerardot, Town of Monroeville	INRA04011	Allen	MONROEVILLE RD & S WASHINGTON ST	MONROEVILLE	IN	Flatrock Creek	0	0

Brownfield Site

Table 2.25 Brown Ditch Subwatershed Brownfield Site					
Permit Name	FRS ID	County	State	State Water Body	Disposition
Jerry Parker Marathon	4110701	Allen	IN	Flatrock Creek	Inactive

Potential Point Source/Pollution Sites in the Brown Ditch Watershed

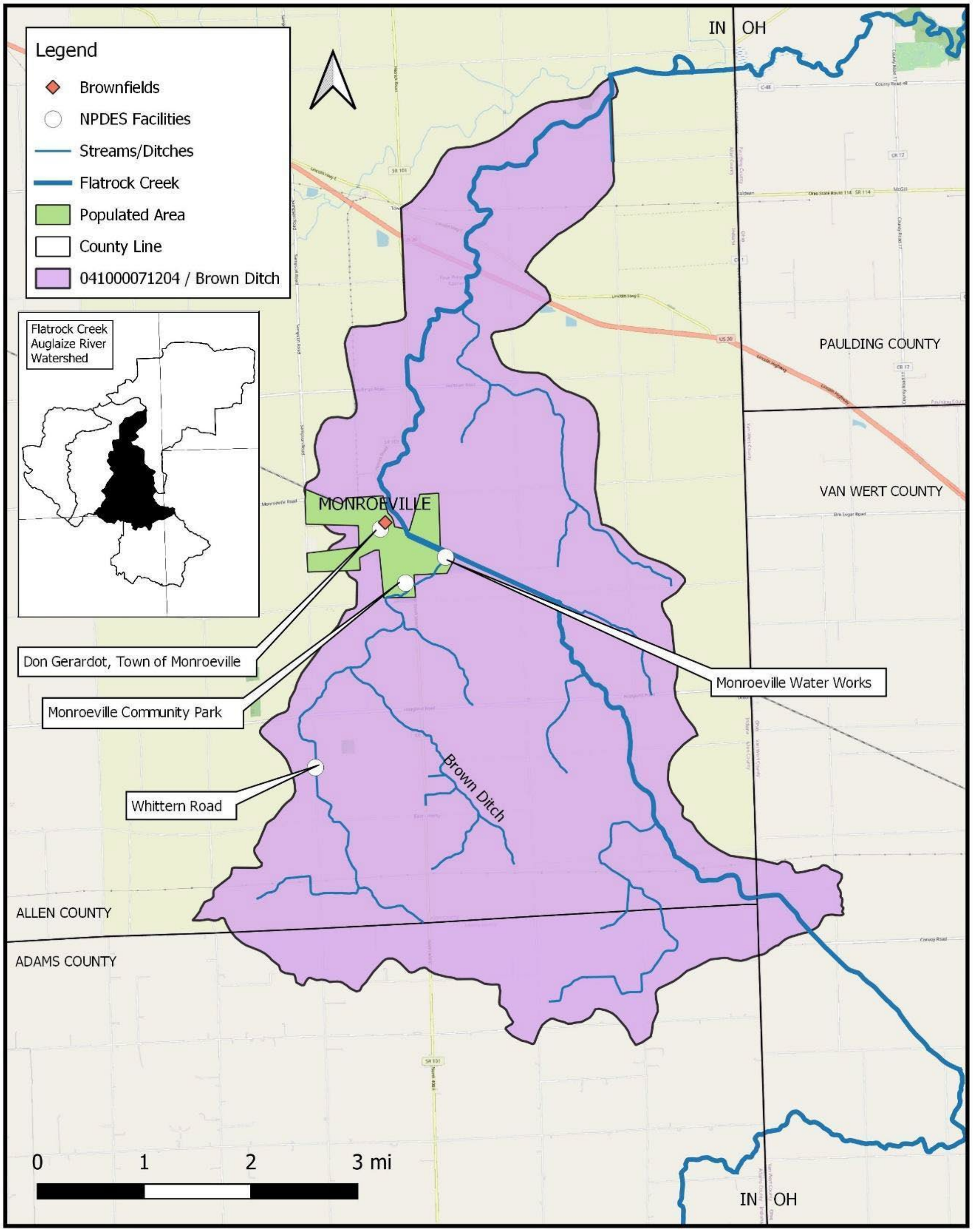

Figure 2.31 Brown Ditch Subwatershed NPDES Facilities

Bank Erosion Inventory

The desktop buffer strip inventory conducted for Brown Ditch shows that 13.7 miles of streams have bank erosion on both sides, 1.4 miles have bank erosion on the left side when looking downstream, 4.8 miles of streams have bank erosion on the right side when looking downstream, and 11 miles of streams do not exhibit signs of bank erosion. Figure 2.32 represents this information in percentages of the total. Figure 2.16 shows the inventory locations.

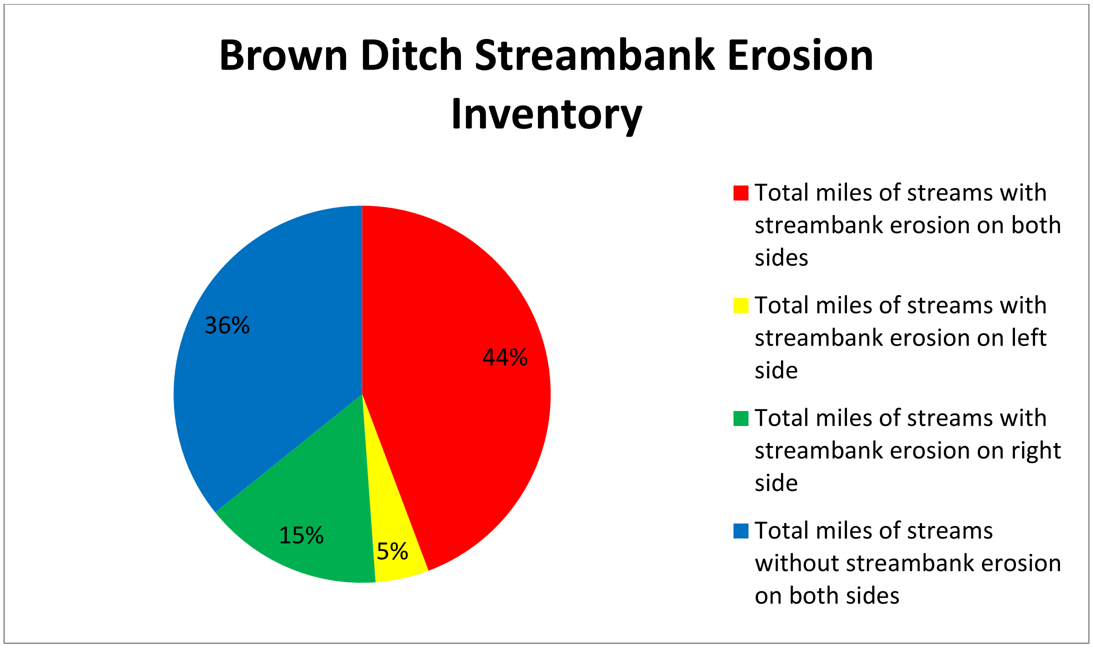

Figure 2.32 Brown Ditch Bank Erosion Inventory

Headwaters Flatrock Creek, HUC 041000071201

The Headwaters Flatrock Creek subwatershed is located in Indiana and Ohio. It lies south of the Brown Ditch subwatershed. It covers approximately 15,700 acres with 9,363 acres in Indiana and 6,337 acres in Ohio. It has approximately 33 miles of streams (Figure 2.5). According to the 303(d) and 305(b) List of Impaired Waters, it has 6.57 miles of streams impaired for *E.coli.* (Table 2.16 Figure 2.22) Approximately 13 miles of streams have inadequate buffer strips (Table 2.28 and Figure 2.35) and 11 miles of streams are experiencing bank erosion problems (Figure 2.16 and Figure 2.37). The main land uses are 89% agriculture (13,989 acres), 3.66% forest (574 acres), 4.9% open space/park (770 acres), 1.2% grassland (194 acres), and 0.05% residential (9 acres) (Figure 2.34.) Historically, nearly the entire subwatershed was covered in wetlands. Only 0.4% (64 acres) of the original wetland acres remain (Figure 2.7). The unsewered community of Wolfcale is in the subwatershed (Figure 2.10). Nearly 100% of all the soil types in the subwatershed are classified as "very limited" for septic system usage (Figure 2.11). There are 2 Underground Storage Tanks and 5 Leaking Underground Storage Tanks (Figure 2.19). There is one National Pollution Discharge Elimination System facility in the subwatershed (Table 2.11 and Figure 2.17) and no Brownfield or Superfund sites. Hydric soils types dominate the area (Figure 2.4). Forty-three percent (42.56%) of soils within Headwaters Flatrock Creek have a slow infiltration rate when thoroughly wet, and 57.20% of soils have a very slow infiltration rate. Highly erodible soils are nearly absent (Figure 2.9). Less than 1% of the soils were highly erodible (0.01%), 27% were possibly highly erodible (26.96%), and 73% were not highly erodible (73.00%). Flooding has not been identified as a problem in this watershed and there are no areas highlighted on the Flood Risk map (Figure 2.8). There is one water quality monitoring site that represents this subwatershed, Site 405 (Table 2.26 and Figure 2.33). The sampling site lies within the Brown Ditch subwatershed but is primarily representative of the Headwaters Flatrock Creek subwatershed.

Water Quality Data

Allen County SWCD water quality sampling site 405 represents the Headwaters Flatrock Creek subwatershed. It is located in the Brown Ditch subwatershed on the Indiana/Ohio state line approximately 200 feet south of Wallace Road (Ohio) (Figure 2.33). The coordinates are 40.923545, -84.803025. Water quality has been tested weekly at this site from March to July in the years 2020 and 2021. Table 2.26 is a summary of the data.

Table 2.26. Water Quality Data for Site 405 – Headwaters Flatrock Creek

Parameter	Target	# of Samples	Min	Max	Average	# not meeting target	% not meeting target
pH	>6 and <9	48	6.33	11.2	8.32	0	0
Temperature	4.44 - 29.44 degree C	49	6.0	27.7	17.0	0	0
Dissolved Oxygen	>4 mg/L and <12 mg/L	49	5.81	14.53	10.18	9	18.4
Nitrate/Nitrite	<1.6 mg/L	49	0.043	28.51	3.118	27	55.1
Atrazine	<3.0 ppb	30	0	12.5	2.79	8	26.7
E.coli	<235 cfu/100 ml (single sample)	49	0	16520	1567	31	63.3

Table 2.26. Water Quality Data for Site 405 – Headwaters Flatrock Creek							
Parameter	Target	# of Samples	Min	Max	Average	# not meeting target	% not meeting target
Total Phosphorus	<0.08 mg/L Tributaries	49	0.005	0.894	0.168	31	63.3
Dissolved Reactive Phosphorus	<0.05 mg/L	49	0	0.667	0.104	32	65.3
Turbidity	<10.4 NTU	48	2.2	181.7	24.7	25	52
Total Suspended Solids	<25 mg/L	49	1.2	244	23.13	11	22.4
Total Ammonia	<0.21 mg/L depending on temperature	48	0.01	2.94	0.204	6	12.5

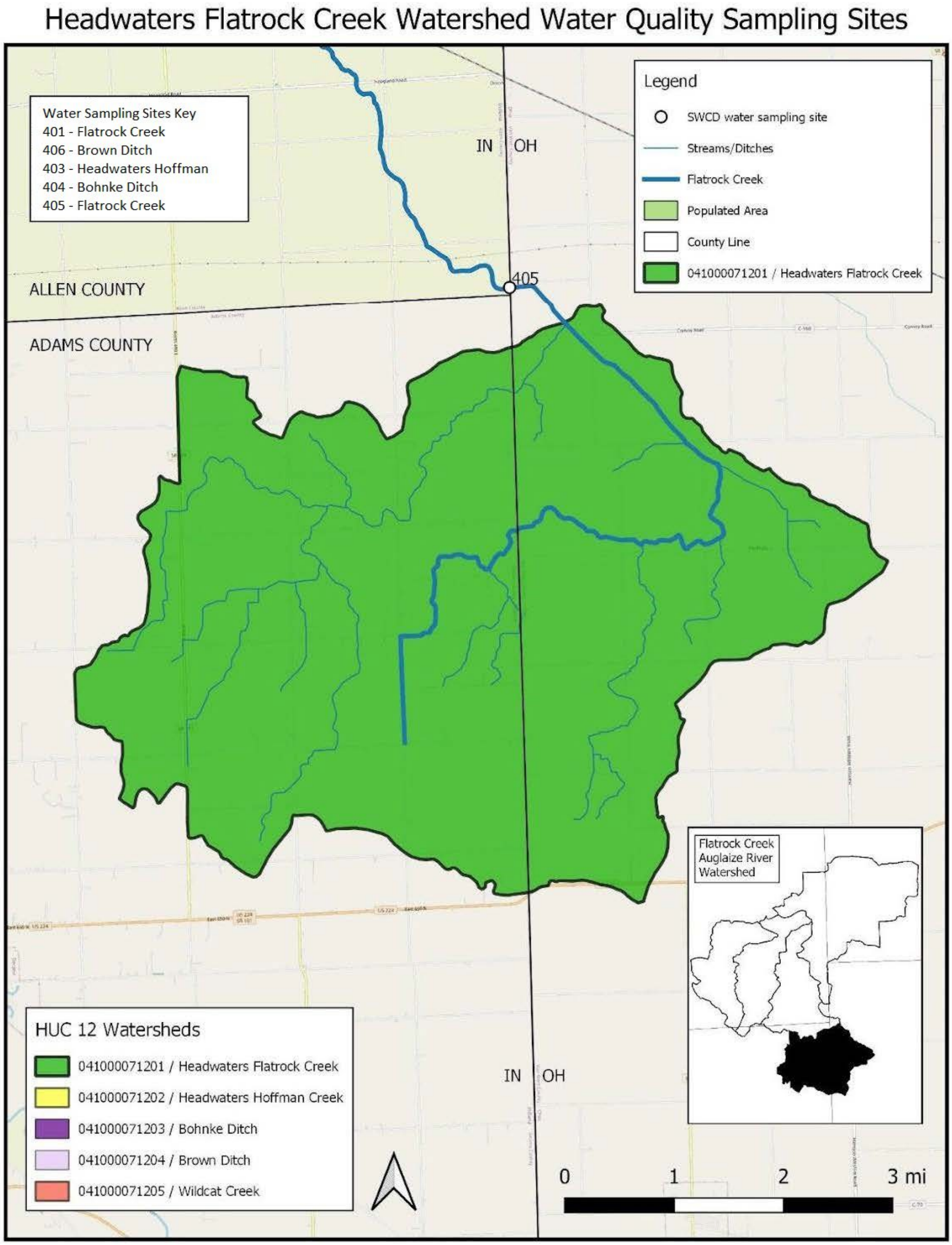

Figure 2.33 Headwaters Flatrock Creek Water Sampling Site Location Map

Land Use

The main land uses in the Headwaters Flatrock Creek subwatershed are 89% agriculture (13,989 acres), 3.66% forest (574 acres), 4.9% open space/park (770 acres), 1.2% grassland (194 acres), and 0.05% residential (9 acres) (Figure 2.34). Land use in this subwatershed is not expected to dramatically change.

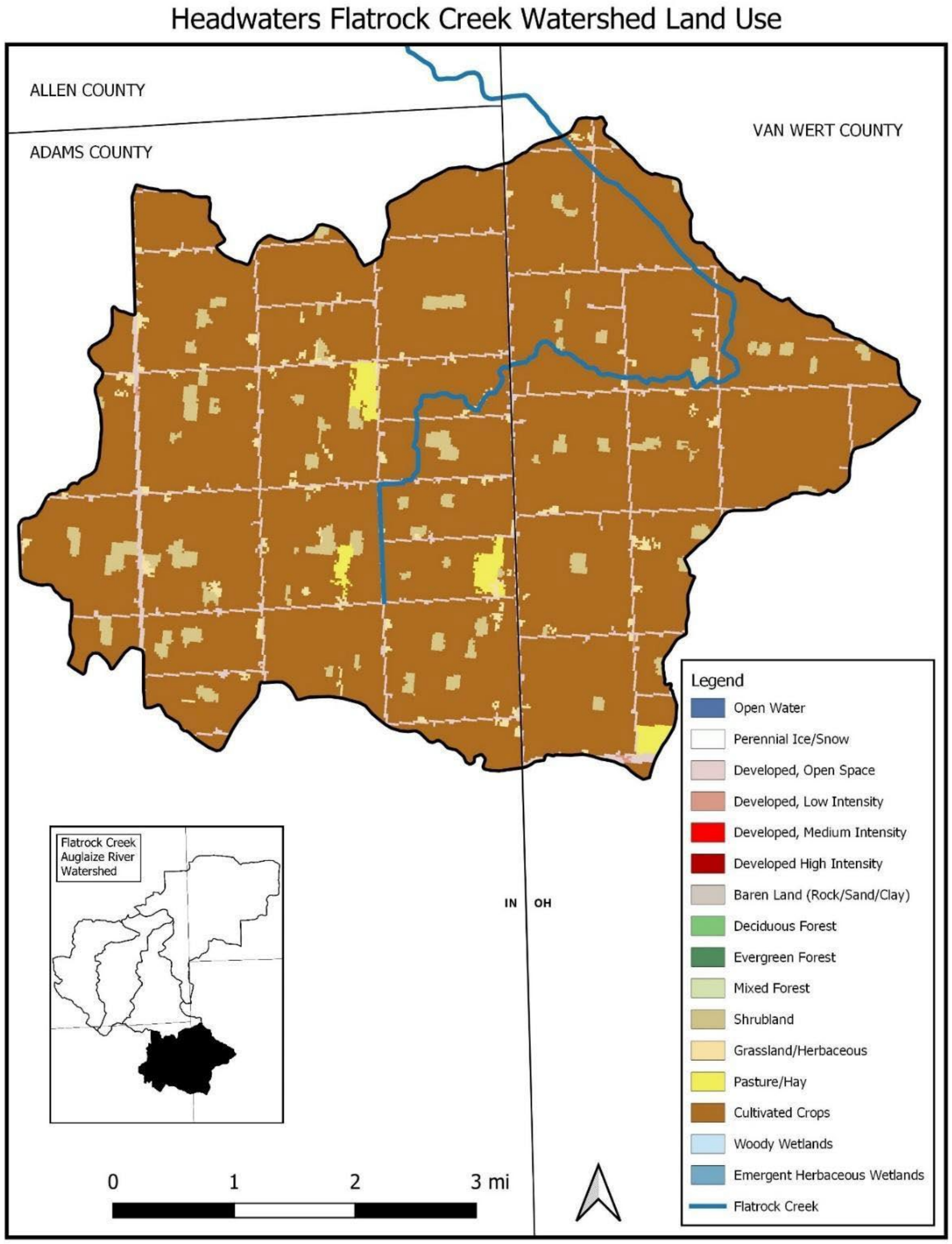

Figure 2.34 Land use in the Headwaters Flatrock Subwatershed

Windshield Survey

During the windshield survey, a total of one hundred twenty-three sites were evaluated in the Headwaters Flatrock Creek subwatershed. One hundred four sites are in Adams County and nineteen sites are in Van Wert County. Table 2.27 contains the results.

Table 2.27 Windshield Survey Results for Headwaters Flatrock Creek

Concern	Number Present in Adams County	Number Present in Van Wert County
Unbuffered Field Tile Inlets	88	9
Bank Erosion	10	7
Log Jams	0	0
Invasive Species	0	0
Flooding	0	0
Barnyard Runoff	0	0
Illegal Dumping	0	0
Sediment in stream/ditch	0	0
Lack of Residue on Crop Land	0	0
Manure on Surface, Not Incorporated	0	0

Buffer Strip Inventory

The results for the Headwaters Flatrock Creek buffer strip inventory show that 61% of stream miles are adequately protected with buffer strips on both sides, 17% lack a buffer strip on one side, and 21.5% lack buffer strips on both sides. Table 2.28 and Figure 2.35.

Table 2.28 Headwaters Flatrock Creek Buffer strip Inventory

Stream Mile Inventory	Stream Miles
Total stream miles	33.18
Miles of streams with inadequate buffer on both sides	7.16
Miles of streams with inadequate buffer on upstream left side	2.37
Miles of streams with inadequate buffer on upstream right side	3.33
Miles of streams with adequate buffer on both sides	20.32

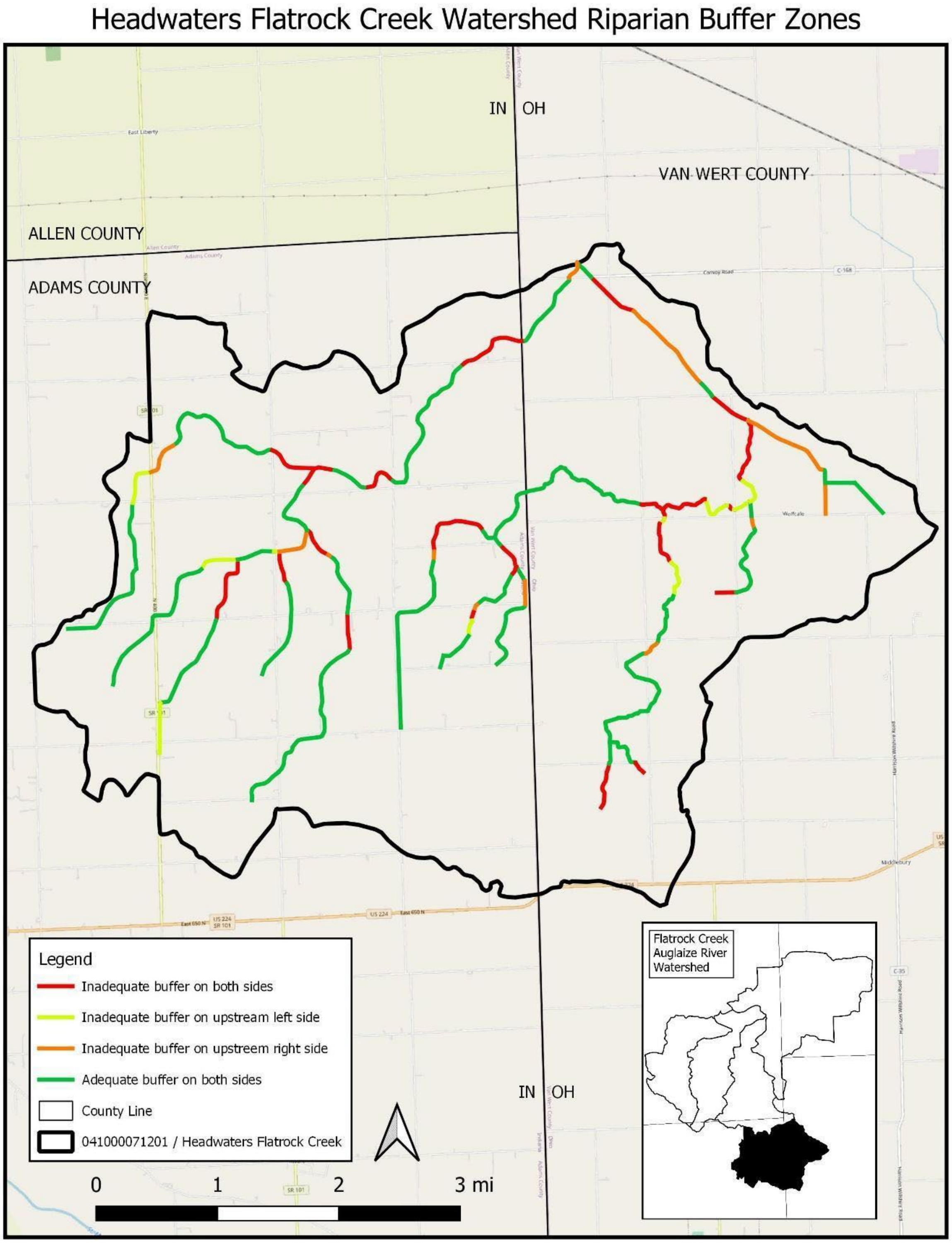

Figure 2.35 Headwaters Flatrock Creek Buffer strip Inventory

National Pollution Discharge Elimination System Sites in the Headwaters Flatrock Creek Subwatershed

Table 2.29 NPDES Facility in Headwaters Flatrock Creek Subwatershed as of July, 2020								
Permit Name	Permit Number	County	Street Address	City	State	State Water Body	Quarters with Noncompliance (3 years)	Formal Enforcement Actions (5 years)
Monmouth-Roe Acres & Rivare (Bobo) Service Areas - Contract "A"	INR10L397	Allen	N PIQUA RD & CR 850 N	DECATUR	IN	Flatrock Creek	0	0

Headwaters Flatrock Creek Watershed Potential Point Source Pollution Sites

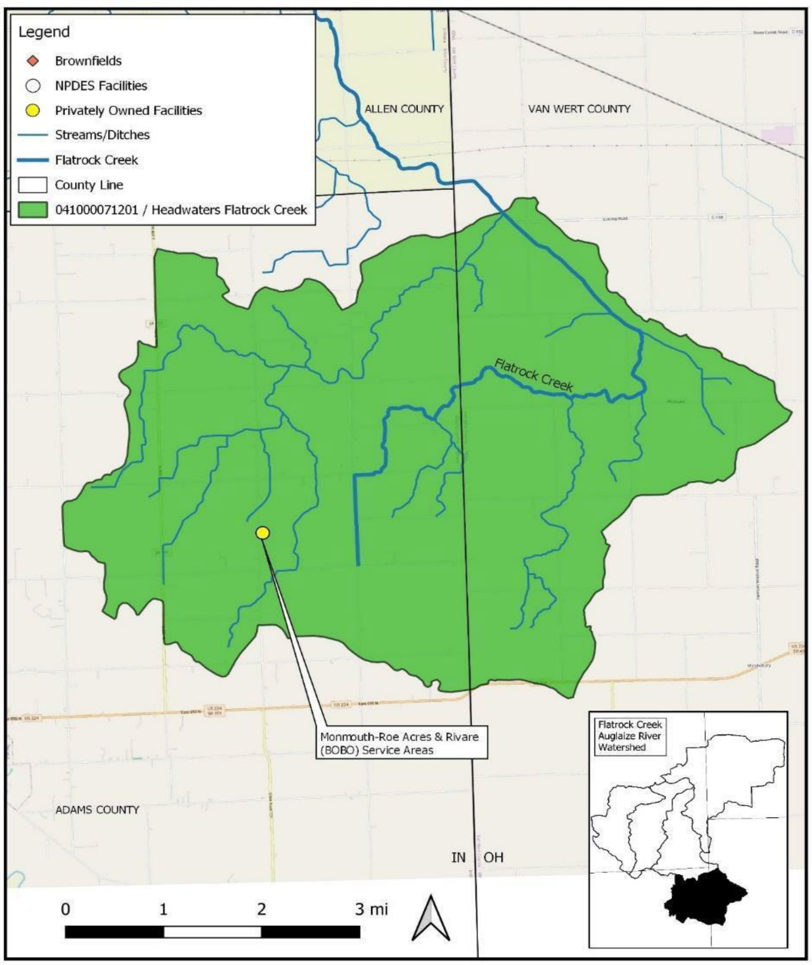

Figure 2.36 NPDES Facilities in the Headwaters Flatrock Creek Subwatershed

Bank Erosion Inventory

The desktop buffer strip inventory conducted for Headwaters Flatrock Ditch subwatershed shows that 10.2 miles of streams have bank erosion on both sides, 0.4 miles have bank erosion on the left side when looking downstream, 0.4 miles have bank erosion on the right side when looking downstream, and 22.3 miles do not exhibit signs of bank erosion. Figure 2.37 represents this information in percentages of the total and Figure 2.16 shows the inventory locations.

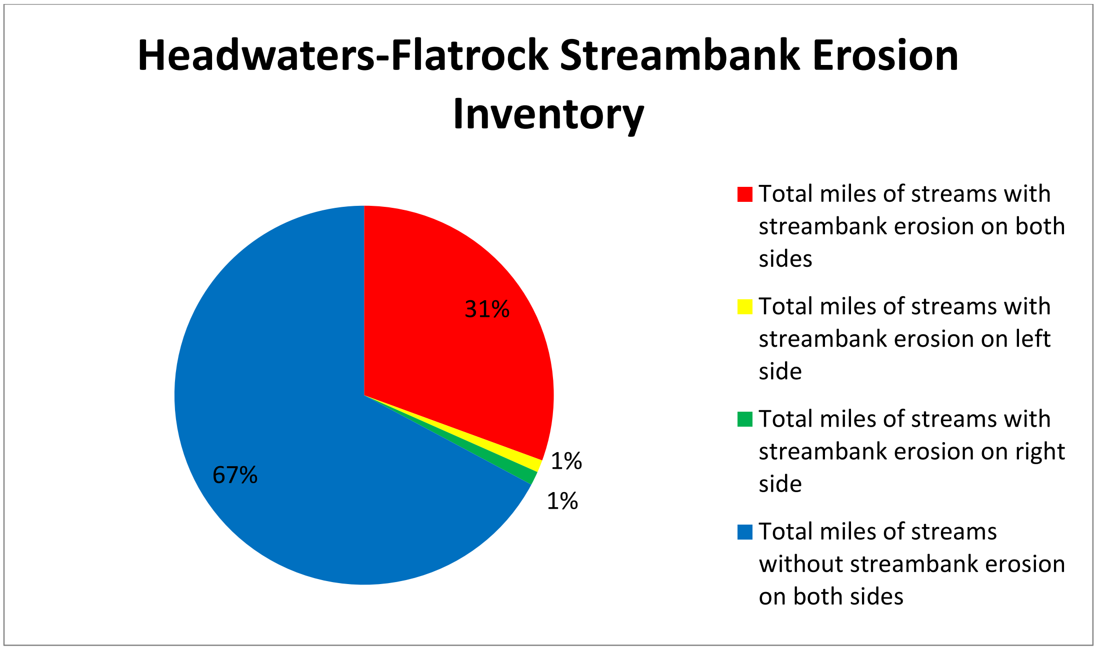

Figure 2.37 Headwaters Flatrock Creek Bank Erosion Inventory

Headwaters Hoffman Creek Subwatershed, HUC 041000071202

The Headwaters Hoffman Creek subwatershed is located in Indiana. It lies west of the Bohnke Ditch subwatershed. It covers approximately 14,887 acres and has approximately 23.9 miles of streams (Figure 2.5). No stream segments are listed in the 303(d) and 305(b) List of Impaired Waters. Approximately six miles of streams have inadequate buffer strips (Table 2.32 and Figure 2.40) and 9.6 miles of streams are experiencing bank erosion problems (Figure 2.16 and Figure 2.42). The main land uses are 87% agriculture (12,940 acres), 5.3% forest (786 acres), 5% open space/park (773 acres), 1.3% grassland (200 acres), 1% residential (145 acres), and 0.02% commercial/industrial (3 acres) (Figure 2.39). Historically, nearly the entire subwatershed was covered in wetlands. However, only 0.05% (7 acres) of the original acres remain (Figure 2.7). There are two unsewered communities in the subwatershed, Tillman and Maples (Figure 2.10). Nearly 100% of the soil types in the subwatershed are classified as “very limited” for septic system usage (Figure 2.11). There are no Underground Storage Tanks and no Leaking Underground Storage Tanks (Figure 2.19). There are no livestock operations (Table 2.10 and Figure 2.17). There is one National Pollution Discharge Elimination System facility in the subwatershed (Table 2.11 and Figure 2.18) and no Brownfield or Superfund sites. Hydric soils types dominate the area (Figure 2.4). Sixty-three percent (63.45%) of soils within Headwaters Hoffman Creek have a slow infiltration rate when thoroughly wet and 29.47% of soils have a very slow infiltration rate. Highly erodible soils are nearly absent (Figure 2.9). Less than 1% of the soils were highly erodible (0.03%), 2% were possibly highly erodible (2.02%), and 98% were not highly erodible (97.83%). Flooding along the main stem of Hoffman Creek has been identified as a problem in this watershed (see the Flood Risk map Figure 2.8). There is one water quality monitoring site that represents this subwatershed, Site 403 (Table 2.30 and Figure 2.38).

Water Quality Data

Allen County SWCD water quality sampling site 403 is located in Headwaters Hoffman Creek subwatershed. It is located on Ternet Road approximately 500 feet south of Tillman Road (Figure 2.38). The coordinates are 41.016426, -84.892520. Water quality has been tested at this site since 2019. Table 2.30 is a summary of data collected weekly from May to July in the years 2019 to 2021.

Table 2.30 Water Quality Data for Site 403 – Headwaters Hoffman Creek

Parameter	Target	# of Samples	Min	Max	Average	# not meeting target	% not meeting target
pH	>6 and <9	72	6.99	11.62	8.19	7	9.7
Temperature	4.44 - 29.44 degree C	74	5.8	28	17.61	0	0
Dissolved Oxygen	>4 mg/L and <12 mg/L	74	4.73	15.61	10.07	14	18.9
Nitrate/Nitrite	<1.6 mg/L	74	0.023	18.651	3.808	50	67.6
Atrazine	<3.0 ppb	59	0	12.75	1.473	7	11.9
E.coli	<235 cfu/100 ml (single sample)	74	0	14450	807	37	50

Table 2.30 Water Quality Data for Site 403 – Headwaters Hoffman Creek							
Parameter	Target	# of Samples	Min	Max	Average	# not meeting target	% not meeting target
Total Phosphorus	<0.08 mg/L Tributaries	74	0.005	2.554	0.213	42	56.8
Dissolved Reactive Phosphorus	<0.05 mg/L	74	-0.004	0.315	0.065	31	41.9
Turbidity	<10.4 NTU	73	1.6	141.4	18.1	25	34.2
Total Suspended Solids	<25 mg/L	72	0.8	197	19	10	13.9
Total Ammonia	<0.21 mg/L depending on temperature	45	0.01	1.8	0.09	1	2.2

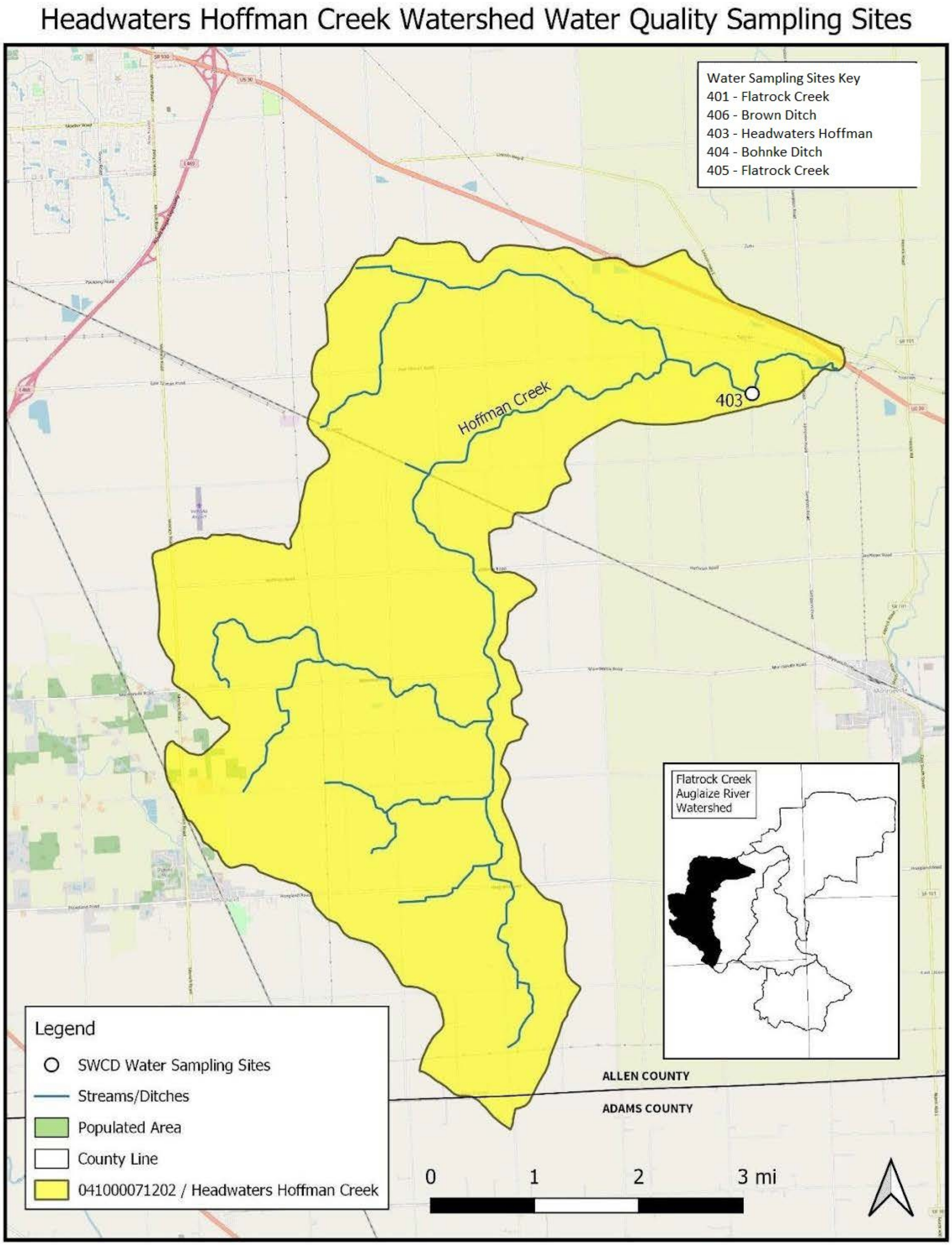

Figure 2.38 Headwaters Hoffman Creek Water Sampling Location Map

Land Use

The main land uses in the Headwaters Hoffman Creek subwatershed are 87% agriculture (12,952 acres), 5.3% forest (789 acres), 5% open space/park (773 acres), 1.3% grassland (200 acres), 1% residential (149 acres), 0.02% commercial/industrial (3 acres), 0.05% wetlands (7 acres), and 0.04% other (65 acres) (Figure 2.39). Land use in this subwatershed is not expected to dramatically change.

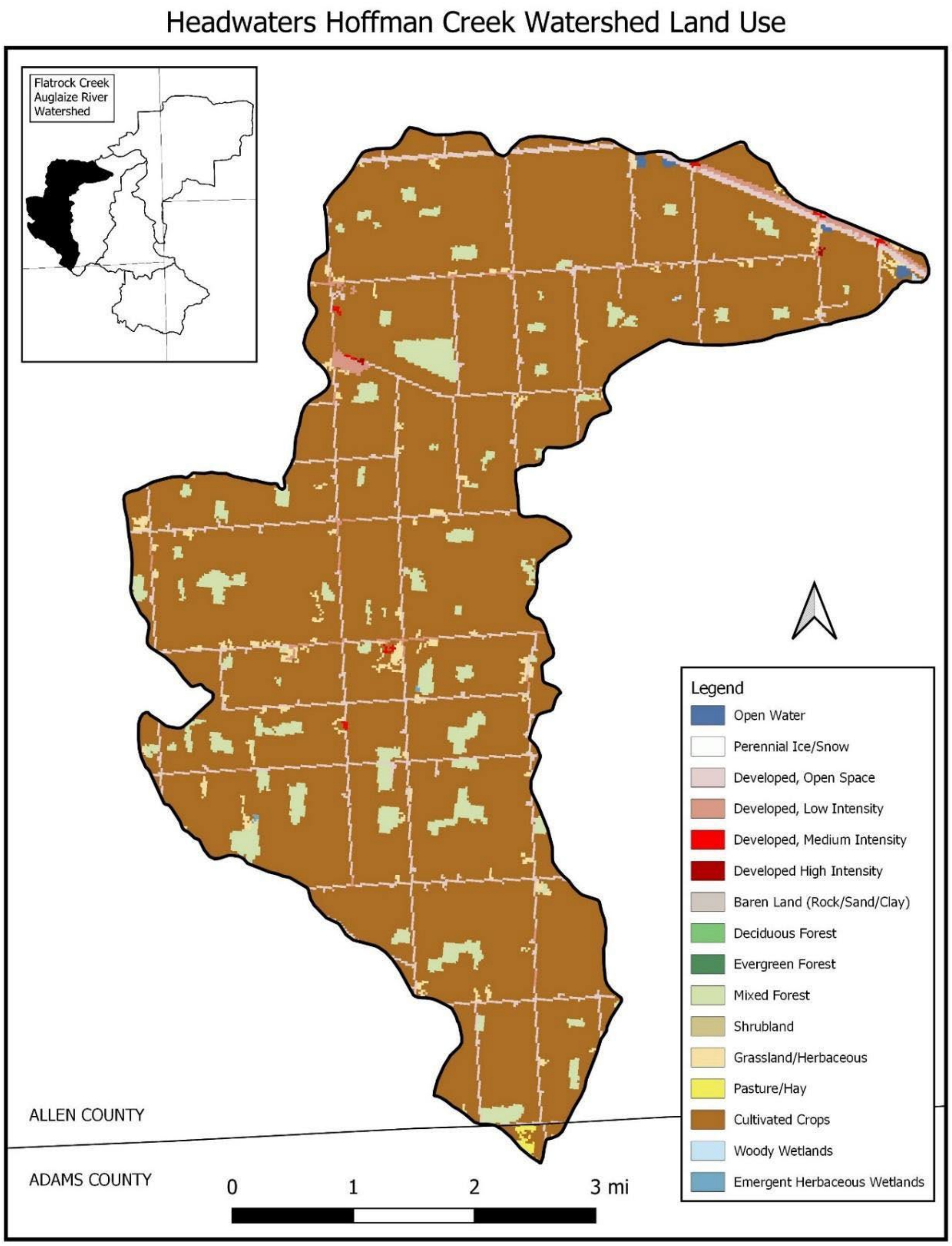

Figure 2.39 Land use in the Headwaters Hoffman Creek Subwatershed

Windshield Survey

During the windshield survey, a total of forty-three sites were evaluated in the Headwaters Hoffman Creek subwatershed. All forty-three sites are in Allen County. Table 2.31 contains the results.

Table 2.31 Windshield Survey Results for Headwaters Hoffman Creek

Concern	Number Present in Allen County
Unbuffered Field Tile Inlets	16
Bank Erosion	15
Log Jams	0
Invasive Species	0
Flooding	0
Barnyard Runoff	0
Illegal Dumping	1
Sediment in stream/ditch	0
Lack of Residue on Crop Land	0
Manure on Surface, Not Incorporated	0

Buffer Strip Inventory

The results for the Headwaters Hoffman Creek buffer strip inventory show that 72% of the total stream miles are adequately protected with buffer strips on both sides, 13.5% lack a buffer strip on one side, and 14% lack buffer strips on both sides. Table 2.32 and Figure 2.40.

Table 2.32 Headwaters Hoffman Creek Buffer strip Inventory

Stream Mile Inventory	Stream Miles
Total stream miles	23.86
Miles of streams with inadequate buffer on both sides	3.4
Miles of streams with inadequate buffer on upstream left side	1.33
Miles of streams with inadequate buffer on upstream right side	1.89
Miles of streams with adequate buffer on both sides	17.24

Headwaters Hoffman Creek Watershed Riparian Buffer Zones

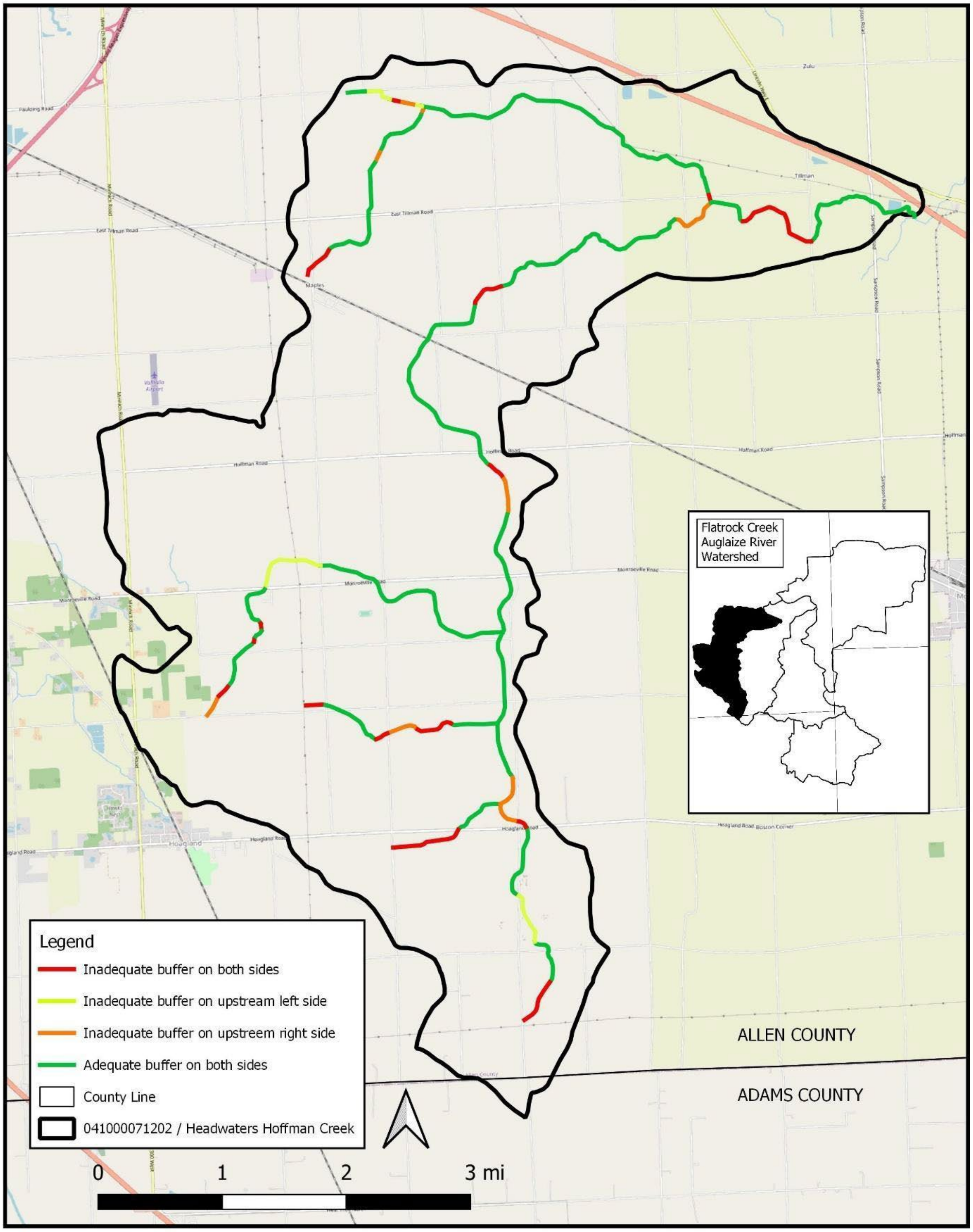

Figure 2.40 Headwaters Hoffman Creek Buffer Strip Inventory

National Pollution Discharge Elimination System Sites in the Headwaters Hoffman Creek Subwatershed

Table 2.33 NPDES Sites in Headwaters Hoffman Creek Subwatershed as of July, 2020

Permit Name	Permit Number	County	Street Address	City	State	State Water Body	Quarters with Noncompliance (3 years)	Formal Enforcement Actions (5 years)
Bradtmueller Farm	INR10P073	Allen	12102 E ROHRBACH RD	FORT WAYNE	IN	Flatrock Creek	0	0

Headwaters Hoffman Creek Watershed Potential Point Source Pollution Sites

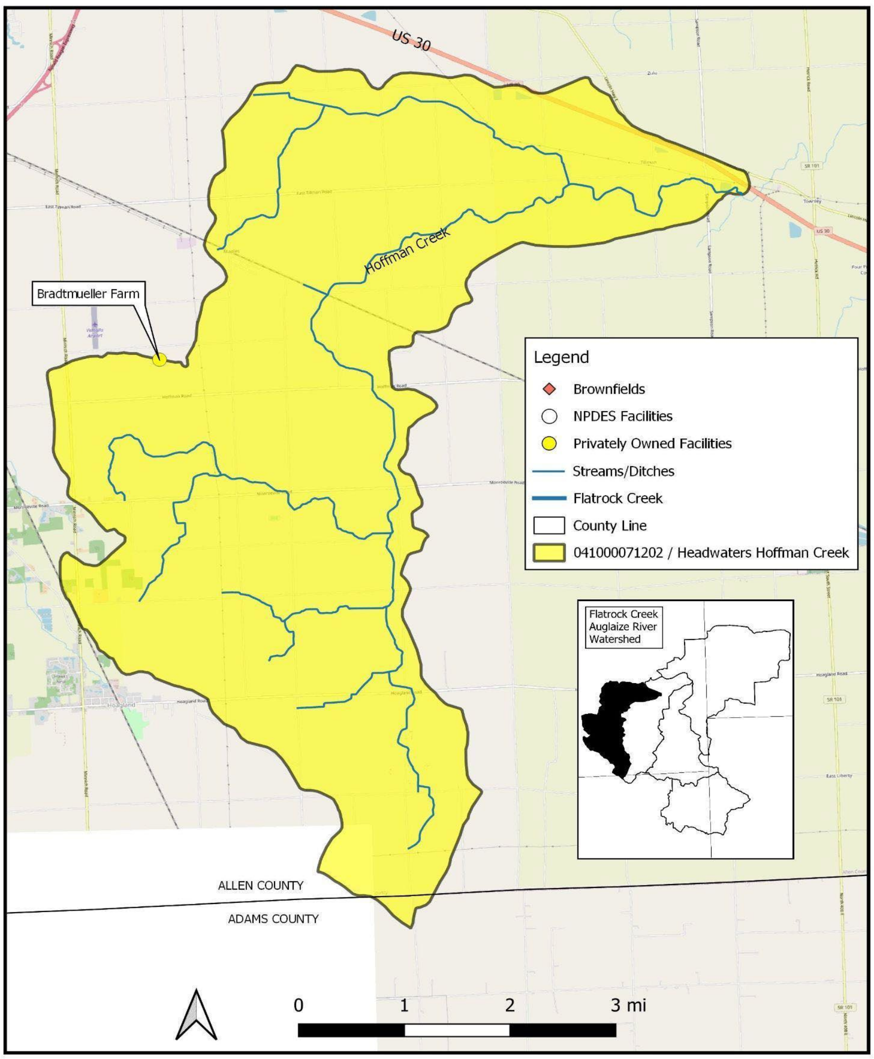

Figure 2.41 NPDES Sites in the Headwaters Hoffman Creek Subwatershed

Bank Erosion Inventory

The desktop bank erosion inventory conducted for Headwaters Hoffman Ditch subwatershed shows that 8.9 miles of streams have bank erosion on both sides, 0.2 miles have bank erosion on the left side when looking downstream, 0.5 miles have bank erosion on the right side when looking downstream, and 14.3 miles do not exhibit signs of bank erosion. Figure 2.42 represents this information in percentages of the total. Figure 2.16 shows the inventory locations.

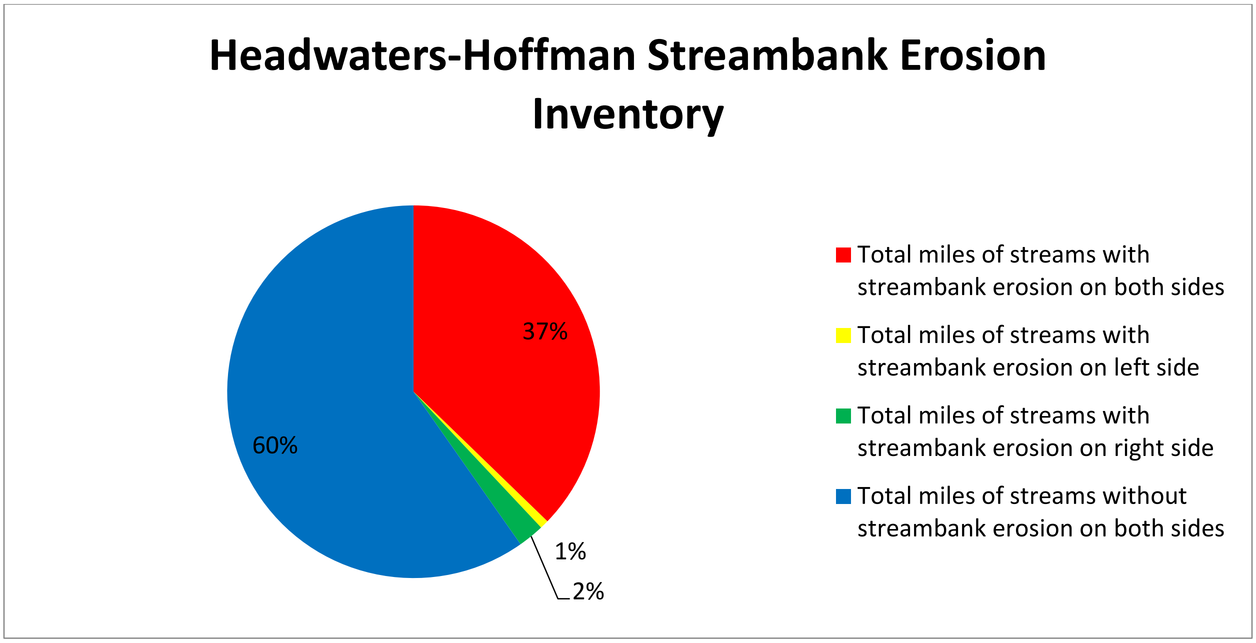

Figure 2.42 Headwaters Hoffman Creek Bank Erosion Inventory

Wildcat Creek, HUC 041000071205

The Wildcat Creek subwatershed is located in Indiana and Ohio. It is the northernmost subwatershed in the project area and lies northeast of the Bohnke Ditch and Brown Ditch subwatersheds. It is approximately 35,697 acres in size and has 166.7 miles of streams (Figure 2.5). Flatrock Creek flows through the center of the watershed and receives runoff from 22 tributaries, most of which are man-made drainage ditches. According to the 303(d) and 305(b) List of Impaired Waters, it has 6.57 miles of streams impaired for IBC and *E.coli* and 18.68 miles impaired for *E.coli* (Table 2.16 and Figure 2.22). Approximately 80.46 miles of streams have inadequate buffer strips (Table 2.36 and Figure 2.45) and 19.9 miles of streams are experiencing bank erosion problems (Figure 2.16 and Figure 2.47). The main land uses are 89% agriculture (31,802 acres), 1.1% forest (408 acres), 5.6% open space/park (1,995 acres), 0.9% grassland (307 acres), 1.6% residential (584 acres), 1.2% wetlands (443 acres), and 0.08% open water (29 acres) (Figure 2.44). Historically, nearly the entire subwatershed was covered in wetlands. Only 1.2% of the original wetland acres remain (Figure 2.7). Payne, Ohio is the only sewered community and there are two unsewered communities in the subwatershed, Edgerton and Dixon (Figure 2.10). Nearly 100% of the soil types in the subwatershed are classified as “very limited” for septic system usage (Figure 2.11). There are 2 Underground Storage Tanks and 2 Leaking Underground Storage Tanks (Figure 2.19). There are 2 livestock operations (Table 2.10 and Figure 2.17) and one National Pollution Discharge Elimination System facility, the Village of Payne Wastewater Treatment Plant (Table2.11 and Figure 2.18). Hydric soil types dominate the area (Figure 2.4). Ninety-six percent (96.18%) of soils within

Wildcat Creek have a slow infiltration rate when thoroughly wet and 2.24% of soils have a very slow infiltration rate. Highly erodible soils are nearly absent (Figure 2.9). Less than 1% of the soils were highly erodible (0.47%), 2% were possibly highly erodible (1.81%), and 98% were not highly erodible (97.60%). There are no Brownfield or Superfund areas present. The Village of Payne has a wellhead protection plan. Substantial flooding occurs regularly along the mainstem of Wildcat Creek and Flatrock Creek where it is classified as floodplain (Figure 2.8). There is one water quality monitoring site in this subwatershed, Site 401 (Table 2.34 and Figure 2.43).

Water Quality Data for Wildcat Creek Subwatershed

Allen County SWCD water quality sampling site 401 is located in Wildcat Creek subwatershed. It is located on the Indiana/Ohio state line on State Line Road (Figure 2.43). The coordinates are 41.035783, -84.803434. It is primarily representative of the entire Indiana portion of the Flatrock/Auglaize watershed. Table 2.34 is a summary of five years of data collected weekly from April to July in the years 2017 to 2021.

Table 2.34 Water Quality Data for Site 401 – Wildcat Creek							
Parameter	Target	# of Samples	Min	Max	Average	# not meeting target	% not meeting target
pH	>6 and <9	140	5.36	11.27	7.95	7	5
Temperature	4.44 - 29.44 degree C	143	4.34	28.76	18.88	1	0.7
Dissolved Oxygen	>4 mg/L and <12 mg/L	143	1.63	16.05	8.0	18	12.6
Nitrate/Nitrite	<1.6 mg/L	140	0	22.49	2.38	61	43.6
Atrazine	<3.0 ppb	124	0	11.74	1.69	20	16.1
E.coli	<235 cfu/100 ml (single sample)	141	0	8850	524.18	56	39.7

Table 2.34 Water Quality Data for Site 401 – Wildcat Creek							
Parameter	Target	# of Samples	Min	Max	Average	# not meeting target	% not meeting target
Total Phosphorus	<0.30 mg/L Mainstem	143	0.002	0.939	0.17	16	11.2
Dissolved Reactive Phosphorus	<0.05 mg/L	141	0	19.37	0.522	18	12.8
Turbidity	<10.4 NTU	143	8.3	539.0	66.9	142	99.3
Total Suspended Solids	<25 mg/L	82	2.5	602.0	46.8	54	65.9
Total Ammonia	<0.21 mg/L depending on temperature	51	0.03	1.53	0.089	2	3.9

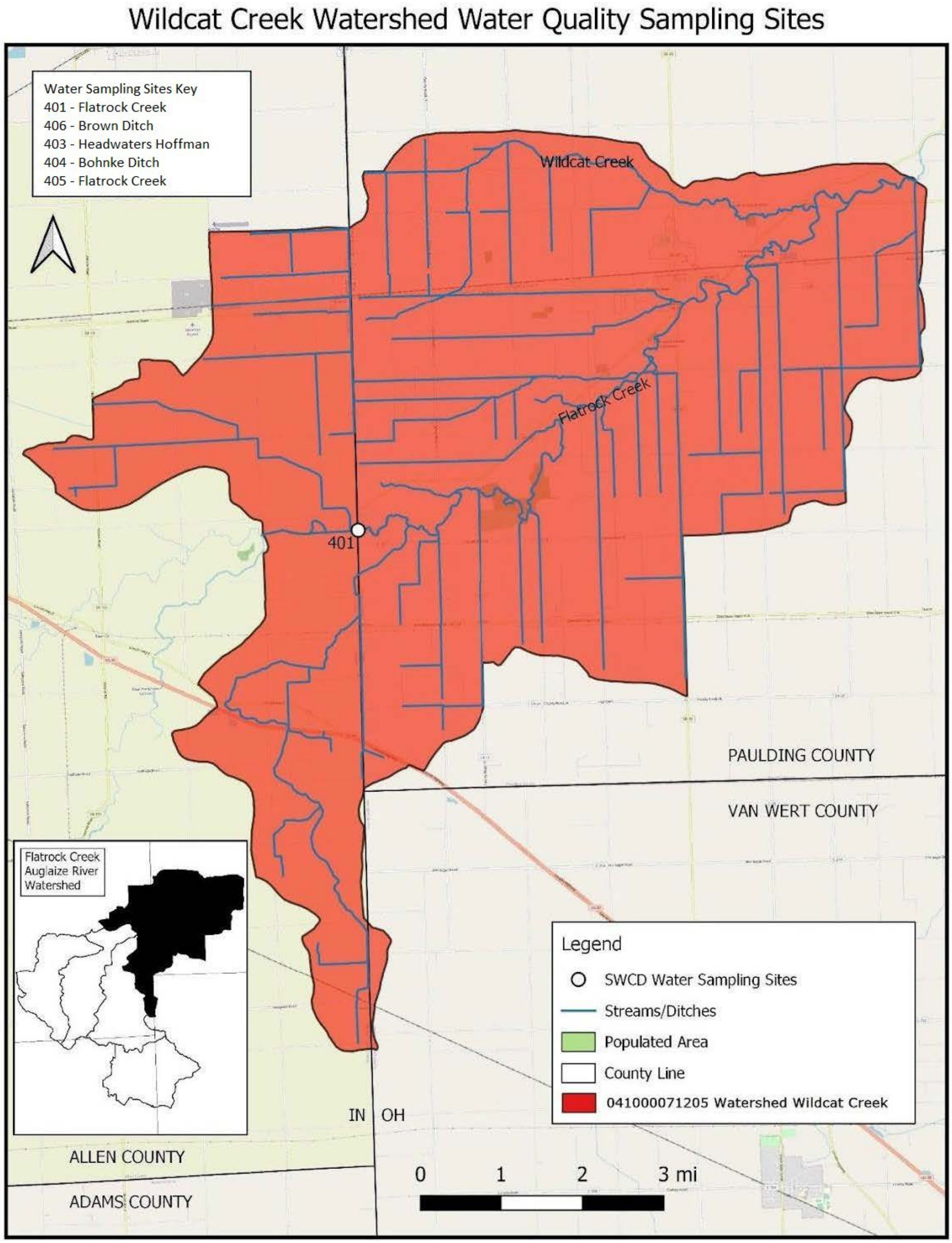

Figure 2.43 Wildcat Creek Water Sampling Site Location Map

Land Use

The main land uses in the Wildcat Creek subwatershed are 89% agriculture (31,802 acres), 1.1% forest (408 acres), 5.6% open space/park (1,995 acres), 0.9% grassland (307 acres), 1.6% residential (584 acres), 1.2% wetlands (443 acres), and 0.08% open water (29 acres) (Figure 2.44). Land use in this subwatershed is not expected to dramatically change.

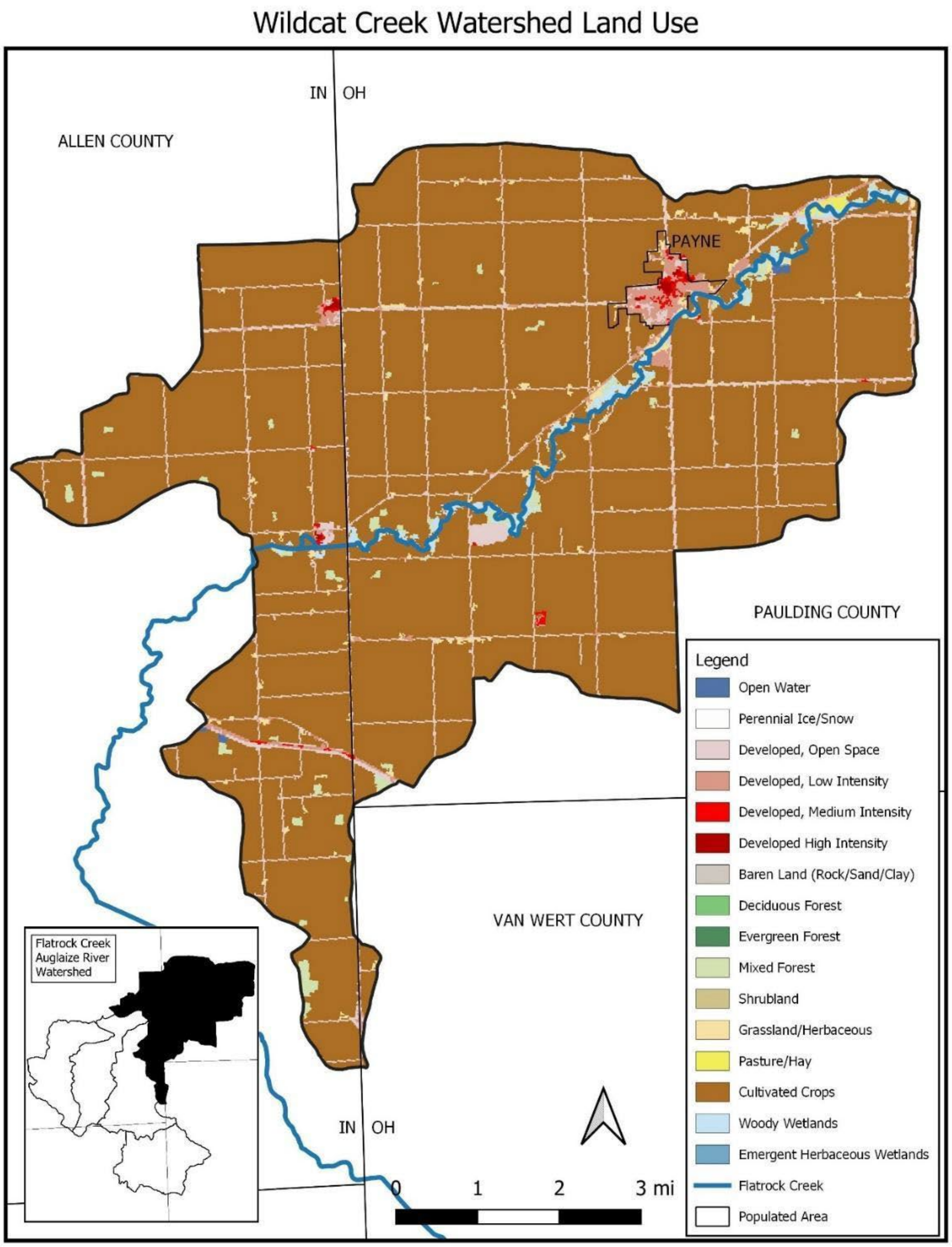

Figure 2.44 Wildcat Creek Subwatershed Land Use

Windshield Survey

During the windshield survey, a total of fifty-one sites were evaluated in the Wildcat Creek subwatershed. Twenty-five sites are in Allen County and twenty-six sites are in Paulding County. Table 2.35 contains the results.

Table 2.35 Windshield Survey Results for Wildcat Creek		
Concern	Number Present in Allen County	Number Present in Paulding County
Unbuffered Field Tile Inlets	14	4
Bank Erosion	4	5
Log Jams	0	4
Invasive Species	1	0
Flooding	4	1
Barnyard Runoff	0	0
Illegal Dumping	0	1
Sediment in stream/ditch	0	1
Manure on Surface, Not Incorporated	0	0

Buffer Strip Inventory

The results for the Wildcat Creek buffer strip inventory show that 52% of the total stream miles are adequately protected with buffer strips on both sides, 31% lack a buffer strip on one side, and 17% lack buffer strips on both sides (Table 2.36 and Figure 2.45).

Table 2.36 Wildcat Creek Buffer Strip Inventory	
Stream Mile Inventory	Stream Miles
Total stream miles	166.7
Miles of streams with inadequate buffer on both sides	29
Miles of streams with inadequate buffer on upstream left side	31
Miles of streams with inadequate buffer on upstream right side	20.3
Miles of streams with adequate buffer on both sides	86.3

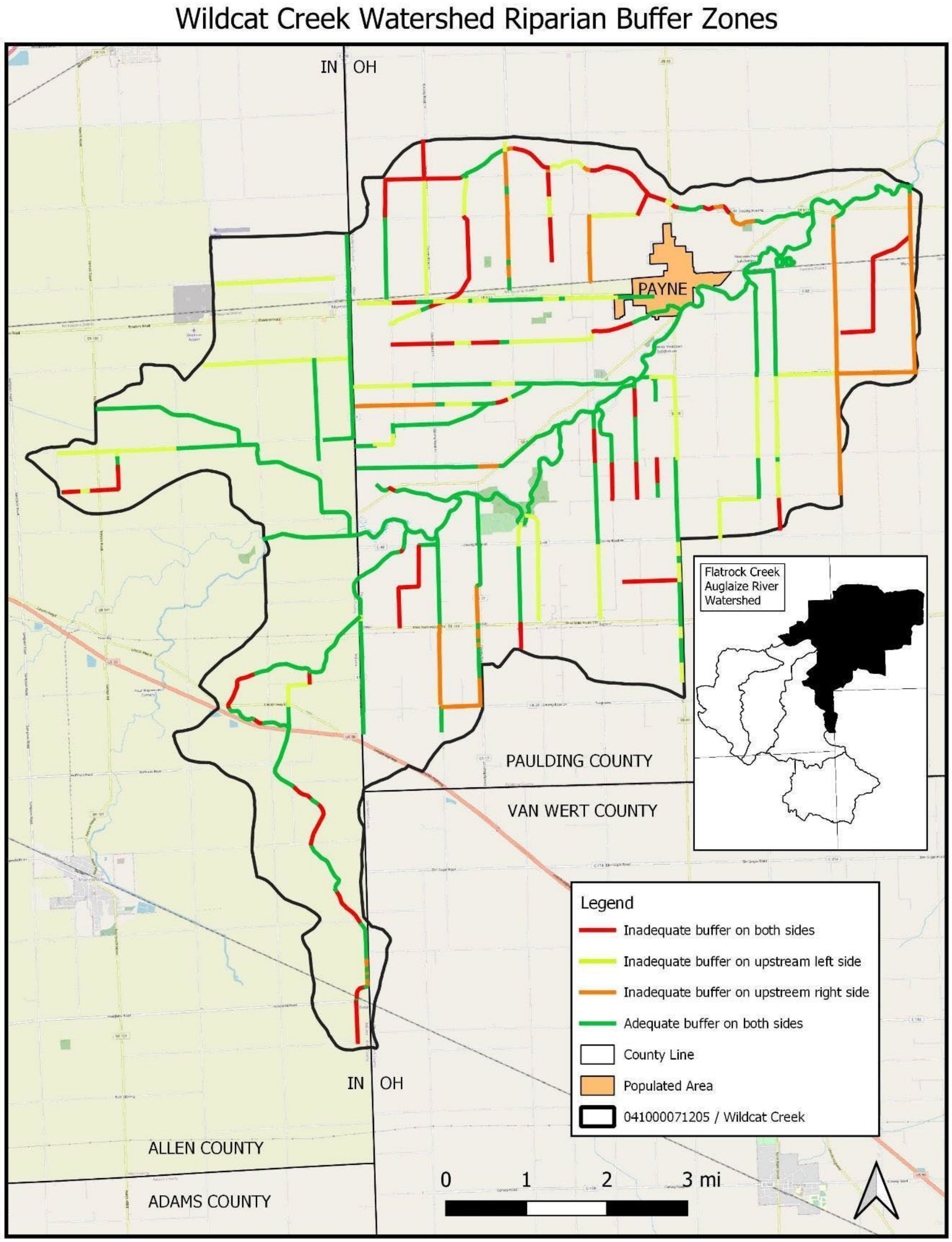

Figure 2.45 Wildcat Creek Buffer Strip Inventory

National Pollution Discharge Elimination System Sites in the Wildcat Creek Subwatershed

Table 2.37 NPDES Facilities in Wildcat Creek Subwatershed as of July, 2020

Permit Name	Permit Number	County	Street Address	City	State	State Water Body	Quarters with Noncompliance (3 years)	Formal Enforcement Actions (5 years)
Village of Payne Waste Water Treatment Plant	11000982317	Paulding	211 N. Laura St.	Payne	OH	Flatrock Creek	8	0

Wildcat Creek Watershed Potential Point Source Pollution Sites

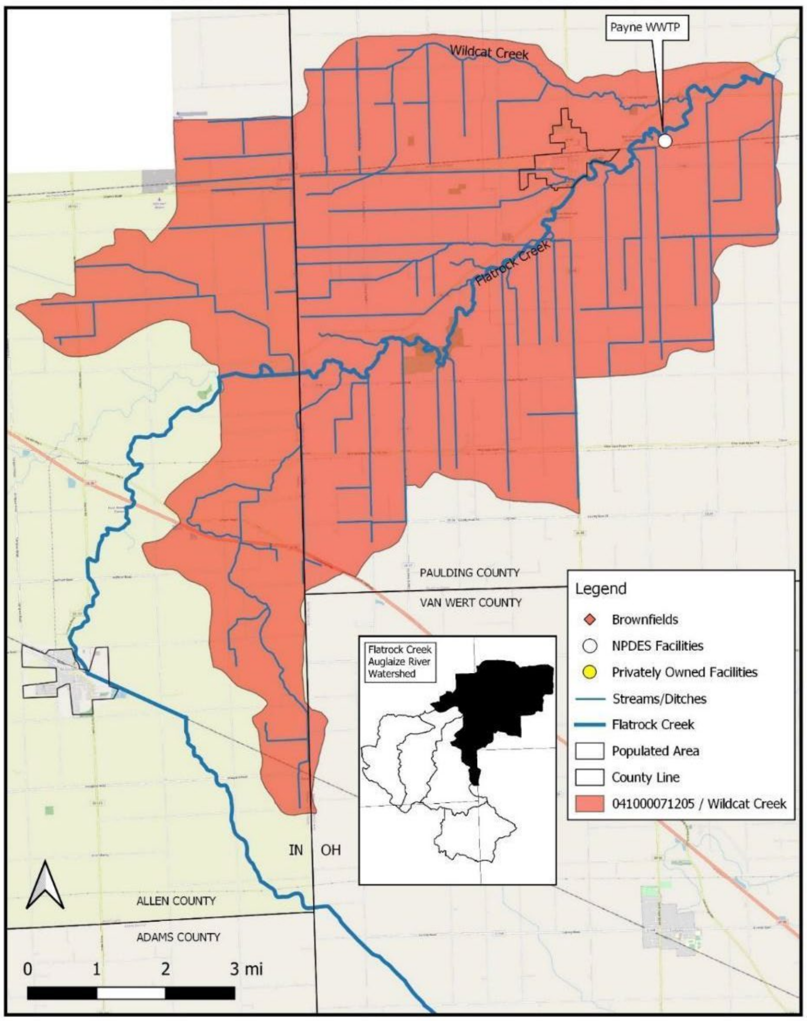

Figure 2.46 NPDES Facilities in the Wildcat Creek Subwatershed

Bank Erosion Inventory

The desktop bank erosion inventory conducted for Wildcat Creek subwatershed shows that 7.8 miles of streams have bank erosion on both sides, 6.7 miles have bank erosion on the left side when looking downstream, 5.4 miles have bank erosion on the right side when looking downstream, and 146.8 miles do not exhibit signs of bank erosion. Figure 2.47 represents this information in percentages of the total and Figure 2.16 shows the inventory locations.

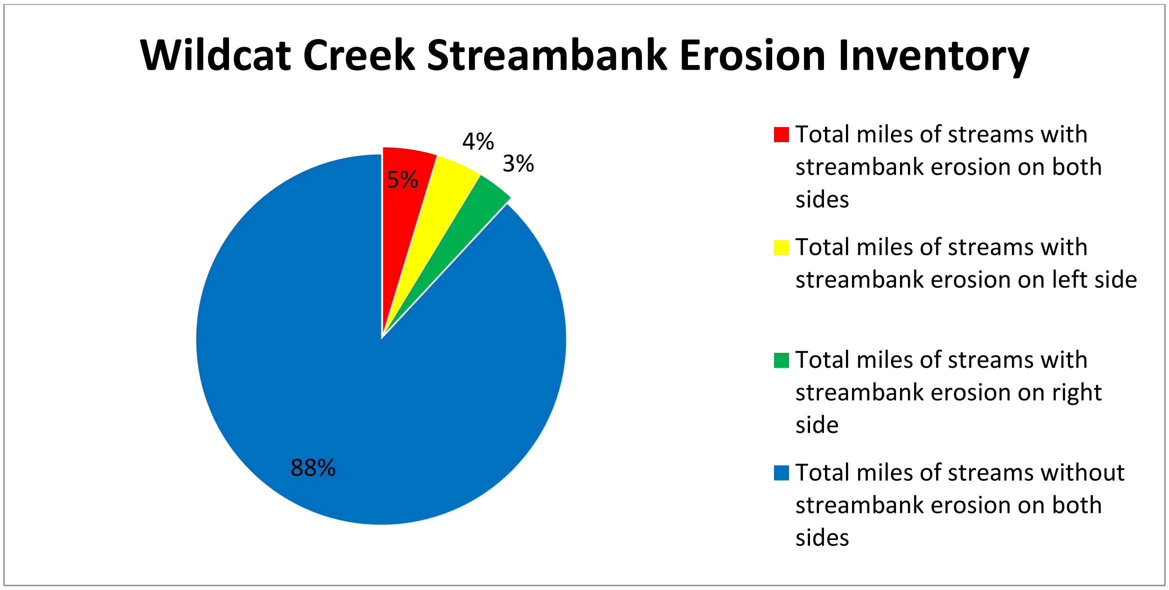

Figure 2.47 Wildcat Creek Bank Erosion Inventory

Non-Element Nonpoint Source Implementation Strategy (NPS-IS) for Wildcat Creek-Flatrock Creek HUC-12 *(04100007 12 05)*

The *NPS-IS for Wildcat Creek-Flatrock Creek HUC-12* was prepared for the Paulding County Soil and Water Conservation District by Civil & Environmental Consultants, Inc. Toledo, Ohio and approved on February 3, 2020. The development of Nine-Element Nonpoint Source Implementation Strategies is considered by OEPA as critical to the efforts of Ohio's Domestic Action Plan. (See page 26 in "Other Planning Efforts'' section for more background information.)

The report identifies the primary objectives necessary to achieve the springtime phosphorus load reduction goal of 8,000 pounds for the Wildcat Creek-Flatrock Creek HUC-12.

Objective 1: Implement nutrient management planning (soil testing and variable rate fertilization) on at least 5,100 additional acres.
Objective 2: Plant cover crops on at least 10,000 additional acres annually.
Objective 3: Reduce nutrient loss from subsurface tile drainage through the installation of drainage water management structures that drain at least 1,100 acres.
Objective 4: Reduce nutrient loss from subsurface tile drainage through the installation of blind inlets that drain at least 1,200 acres.

Objective 5: Reduce erosion and nutrient loss through the installation of grassed waterways that receive/treat surface water from at least 1,600 acres.
Objective 6: Implement subsurface fertilizer application on at least 900 acres annually that currently do not utilize the technology.
Objective 7: Reduce erosion and nutrient loss through the installation of buffer strips/buffers (of at least a 50 ft setback) that receive/treat surface water from least 4,200 acres.
Objective 8: Create, enhance, and/or restore at least 300 acres of wetlands for treatment of agricultural runoff and/or nutrient reduction purposes from 7,500 total agricultural acres.

3.0 Watershed Inventory Summary

Analysis of water quality data and land use throughout the project area show what influences are contributing to water quality challenges. The information is presented in Table 3.1 and in Figure 2.48. Figure 2.48 shows the most important findings in each subwatershed.

Most important finding in each subwatershed

Bohnke Ditch Subwatershed: Agriculture is the dominate land use (88%), and 4.48 miles of streams are listed on the 303(d) list with IBC concerns. The Allen County water quality sampling data documents the following percentage of exceedances of water quality targets: Dissolved Oxygen, 18%; Nitrate/Nitrite, 65%; Total Phosphorus, 53%; Dissolved Phosphorus, 43%; *E.coli*, 62%; Turbidity, 32%. Desktop surveys showed that 20 miles of streams have inadequate field buffers, and 11 stream miles have bank erosion present. The primary concerns found during the windshield survey were unbuffered tile inlets, bank erosion, log jams, and issues associated with flooding.

Brown Ditch Subwatershed: Agriculture is the dominate land use (89%), 13.1 miles of streams are listed on the 303(d) list with IBC concerns and 7.19 miles of streams are listed for IBC and DO concerns. The Allen County water quality sampling data documents the following percentage of exceedances of water quality targets: Nitrate/Nitrite, 100%; Total Phosphorus, 47%; Dissolved Phosphorus, 47%; *E.coli*, 69%; Turbidity, 38%. Desktop surveys showed that 12 miles of streams have inadequate field buffers, and 20 stream miles have bank erosion present. The primary concerns found during the windshield survey were unbuffered tile inlets and bank erosion.

Headwaters Flatrock Creek Subwatershed: Agriculture is the dominate land use (89%). The Allen County water quality sampling data documents the following percentage of exceedances of water quality targets: Dissolved Oxygen, 18%; Nitrate/Nitrite, 55%; Total Phosphorus, 63%; Dissolved Phosphorus, 65%; *E.coli*, 63%; Turbidity, 52%. Desktop surveys showed that 13 miles of streams have inadequate field buffers, and 11 stream miles have bank erosion present. The primary concern found during the windshield survey was unbuffered tile inlets.

Headwaters Hoffman Creek Subwatershed: Agriculture is the dominate land use (87%). The Allen County water quality sampling data documents the following percentage of exceedances of water quality targets: Dissolved Oxygen, 19%; Nitrate/Nitrite, 68%; Total Phosphorus, 57%; Dissolved Phosphorus, 42%; *E.coli*, 50%; Turbidity, 34%. Desktop surveys showed that 12 miles of streams have inadequate field buffers, and 20 stream miles have bank erosion present. The primary concerns found during the windshield survey were unbuffered tile inlets and bank erosion.

Wildcat Creek Subwatershed: Agriculture is the dominate land use (89%), and 18.68 miles of streams are listed on the 303(d) list with E.coli concerns. The Allen County water quality sampling data documents the following percentage of exceedances of water quality targets: Dissolved Oxygen, 13%; Nitrate/Nitrite, 44%; Total Phosphorus, 11%; Dissolved Phosphorus, 13%; *E.coli*, 40%; Turbidity, 99%. Desktop surveys showed that 90 miles of streams have inadequate field buffers, and 20 stream miles have bank erosion present. The primary concerns found during the windshield survey were unbuffered tile inlets, bank erosion, log jams, and issues associated with flooding.

Table 3.1 Watershed Inventory Summary Data by Subwatershed													
Subwatershed	Land Use %			2020 303(d) List Stream Miles			Allen County Water Quality Data % Exceedance						
	Agriculture	Forest	Developed	E. coli Only	IBC Only	IBC and DO	Dissolved Oxygen	Nitrate/ Nitrite	Total Phosphorous	Dissolved Reactive Phosphorous	E. coli	Turbidity
Bohnke Ditch	88	6	0		4.48		18	65	53	43	62	32
Brown Ditch	89	2	2		13.1	7.19	0	100	47	47	69	38
Headwaters Flatrock Creek	89	4	0				18	55	63	65	63	52
Headwaters Hoffman Creek	87	5	1				19	68	57	42	50	34
Wildcat Creek	89	1	2	18.68		6.57	13	44	11	13	40	99

Table 3.2 Watershed Inventory Summary Data by Subwatershed										
Subwatershed	Total Stream Miles	Inadequate Buffers-Miles	Bank Erosion-Miles	Number of CFO/CAFFs	Number of CAFOs	Number of NPDES Facilities	Number of USTs	Number of LUSTs	Total Findings on Windshield Survey	Primary Resource Concerns (Windshield Survey)
Bohnke Ditch	34	20	11	1	1	4	0	0	36	Unbuffered Tile Inlets, Bank Erosion, Log Jams, Flooding
Brown Ditch	31	12	20	0	0	4	2	5	89	Unbuffered Tile Inlets, Bank Erosion
Headwaters Flatrock Creek	33	13	11	0	0	1	0	0	97	Unbuffered Field Tile Inlets
Headwaters Hoffman Creek	24	7	10	0	0	4	2	1	32	Unbuffered Field Tile Inlets, Bank Erosion, Illegal Dumping
Wildcat Creek	167	90	20	2	0	1	3	1	39	Unbuffered Field Tile Inlets, Bank Erosion, Log Jams, Invasive Species, Flooding, Illegal Dumping, Sediment in Stream/Ditch

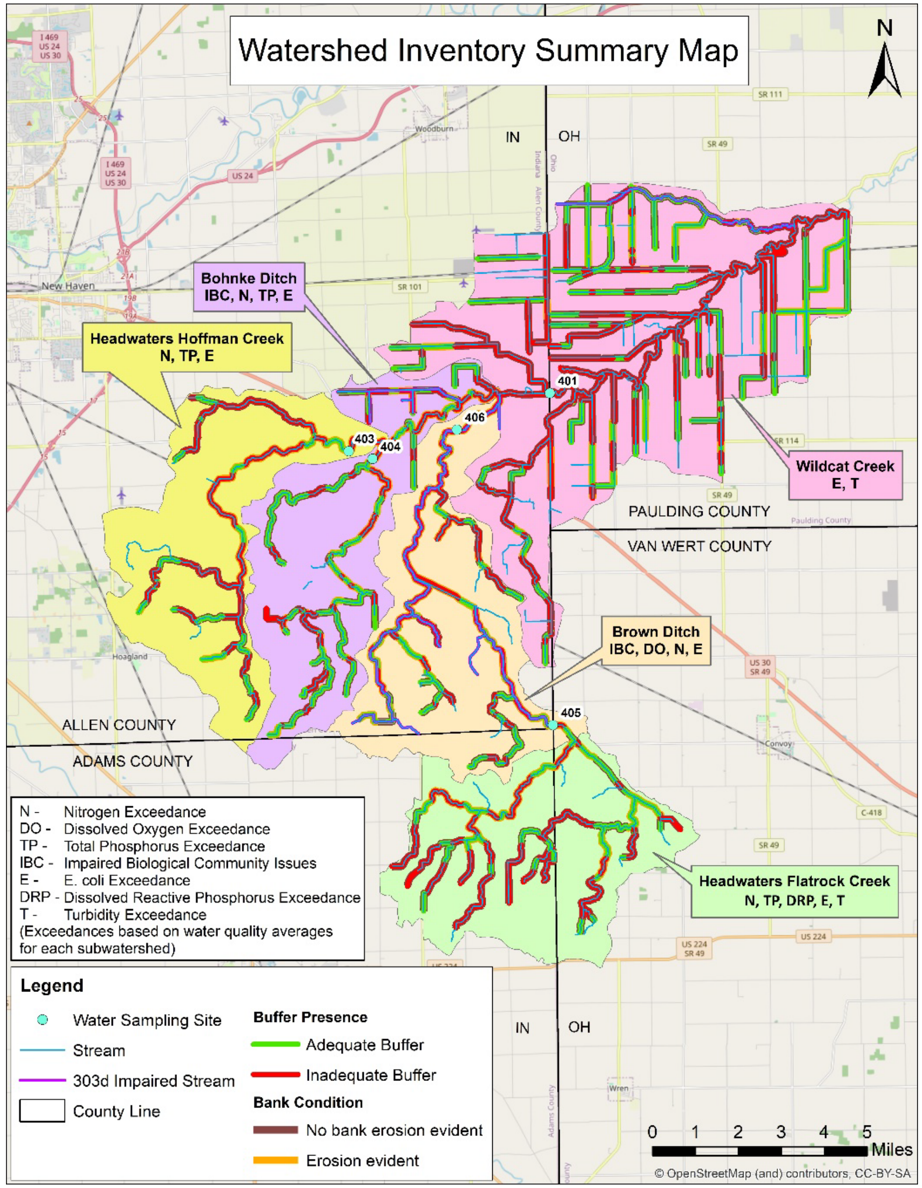

Figure 2.48 Watershed Inventory Summary Map

3.1 Analysis of Stakeholder Concerns

The list of concerns generated by the Steering Committee and general public (original on page 3, Table 1.2) was analyzed at the July, 2021 Steering Committee meeting to form a consensus to determine if: the concern is supported by data, there is evidence of the concern, the concern is within the project's scope, the concern is quantifiable, and the group wants to focus on it.

To adequately complete the analysis, the original list was reformatted to better capture and define the relevance of each concern (Table 3.3).

It was agreed that none of the concerns are outside the scope of the project. However, issues related to hazardous wastes and trash were let go due to lack of evidence. No evidence was found to dispel or confirm the presence of a limestone shelf in Flatrock Creek downstream of the Indiana/Ohio state line. However, the group decided to recommend and support further investigation to determine the effects (if present) of flooding. The concerns relating to livestock in streams/ditches and barnyard runoff are not supported by evidence gathered during the windshield survey. In consideration that land use was only observed from roads, the Steering Committee decided to focus on this issue. It was determined that if it is occurring anywhere in the watershed, it needs to be addressed.

Table 3.3 Analysis of Stakeholder Concerns

Concerns	Supported By Data?	Evidence for Concern	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Flooding	Yes	Corn and soybean fodder washing from fields plugging ditches. (Windshield Survey, 6 sites)	Yes	No	Yes
Flooding	No	Unresolved issue of a limestone shelf in the Flatrock downstream of the Indiana/Ohio state line that holds back water.	No	No	Yes

Concerns	Supported By Data?	Evidence for Concern	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Log Jams	Yes	Log jams in Ohio hold back water in the Flatrock Creek and cause flooding. (Windshield Survey, 5 sites)	Yes	No	Yes
Rural Legal Drains	Yes	Lack of coordination between Indiana and Ohio drainage authorities contributes to flooding problems.	Yes	No	No
Stream/Ditch Bank Erosion	Yes	Prevalent throughout the watershed especially in areas where stream/ditch banks are subject to flooding. (Windshield Survey, 84 sites. Bank Erosion Inventory, 72 miles of eroding banks.)	Yes	No	Yes
Illegal Dumping into Ditches	Construction waste - yes, hazardous waste - no, trash -no	Concrete containing metals, construction waste, hazardous wastes, trash. (Windshield Survey, 2 sites)	Yes	No	Yes - construction waste
Need for more Water Quality Research	Yes	Two sub-watersheds have their headwaters in Ohio and the contribution to poor water quality from the Ohio area is unknown.	Yes	No	Yes

Concerns	Supported By Data?	Evidence for Concern	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Lack of Water Quality Education and Outreach	No	Residents unaware of resource concerns. No materials/activities are available to specifically address the project area.	No	No	Yes
High E. coli Levels	Yes	Historic and current water quality data collected at the Indiana/Ohio state line from the Flatrock Creek, which is representative of the Indiana portion of the watershed (sample site # 401) identifies 40% of E.coli samples exceed the water quality target level.	Yes	No	Yes
High Turbidity Levels	Yes	Historic water quality data collected at the Indiana/Ohio state line from the Flatrock Creek, which is representative of the Indiana portion of the watershed (sample site # 401) identifies 99% of Turbidity samples exceed the water quality target level.	Yes	No	Yes
High Total Phosphorus Levels	Yes	Historic water quality data collected at the Indiana/Ohio state line from the Flatrock Creek, which is representative of the Indiana portion of the watershed (sample site # 401) identifies 11% of Total Phosphorus samples exceed the water quality target level.	Yes	No	Yes

Concerns	Supported By Data?	Evidence for Concern	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Faulty or Absent Septic Systems	Yes	Failing/absent septic systems. Older homes or businesses where on-site waste disposal system is inadequate, compromised, or totally absent. (99.7% of soil types are "Very Limited" for septic use)Health Departments in all counties estimate that 50% to 60% of septic systems are in failure status or in need of maintenance.	Yes	No	Yes
Excessive Nutrients entering Streams/Ditches. Runoff from farmland and residential/commercial properties where organic and/or inorganic fertilizer has been applied.	Yes	. Water quality data by subwatershed revealed the following water quality target exceedances: Bohnke - N-65%, TP-53%, DRP-43%; Brown - N-100%, TP-47, DRP-43%; Headwaters Flatrock - N-55%, TP-63%, DRP-65%; Headwaters Hoffman - N-68%, TP-57%, DRP-42; Wildcat Creek - N-44%, TP-11%, DRP-13%.	Yes	No	Yes

Concerns	Supported By Data?	Evidence for Concern	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Excessive Sediment in Water Column	Yes	Buffer Inventory, 142 miles of stream banks with inadequate buffers. Bank Erosion Inventory, 72 miles of eroding banks. Water quality data revealed that turbidity levels in Bohnke Ditch exceed the limit in 32% of samples, 38% of samples in Brown Ditch, 52% of samples in Headwaters Flatrock Creek, 34% in Headwaters Hoffman Ditch, and 99% in Wildcat Creek.	Yes	No	Yes
Lack of Buffer strips	Yes	Buffer Strip Inventory, 142 stream miles lack adequate buffer strips	Yes	No	Yes
Lack of Residue/Cover on Ag Fields	Yes	Only 10% of fields are in no-till/cover crops.	Yes	No	Yes

Concerns	Supported By Data?	Evidence for Concern	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Unbuffered Tile Field Inlets	Yes	Tile field inlets provide a direct conduit for sediment and other pollutants to flow directly into streams/ditches. (Windshield Survey, 211 sites)	Yes	No	Yes
Barnyard Runoff	No	Stormwater picks up pollutants from barnyards and carries them to streams/ditches. (4 CFO/CAFOs)	No	No	Yes
Stream/Ditches Listed as Impaired by IDEM	Yes	303(d) List of Impaired Streams, E.coli – 18.68 miles, IBC - 17.58 miles, IBC and DO - 1376 miles.	Yes	No	Yes
Drained Wetlands	Yes	Lack of wetlands near streams that filter runoff. (Land Use Inventory, <2,007 acres, roughly 2% of original wetlands remain)	Yes	No	Yes

Potential Causes of Water Quality Problems

The analysis of concerns was linked to the information found throughout the watershed investigation process and is presented in Table 3.4. It shows the concerns and the associated water quality problems.

Table 3.4 Concerns, Problems

Concerns	Problem
Flooding	Erosion, Sedimentation, High Nutrient Levels, Impaired Biotic Communities, E.coli
Log Jams	Erosion, Sedimentation
Rural Legal Drains	Erosion, Sedimentation
Stream/Ditch Bank Erosion	Erosion, Sedimentation, High Nutrient Levels
Illegal Dumping into Ditches	Erosion
Need for more Water Quality Research	Erosion, Sedimentation, High Nutrient Loads, High E.coli Levels.

Concerns	Problem
Lack of Water Quality Education and Outreach	Sedimentation, High Nutrient Loads, High E.coli Levels.
High E. coli Levels	High E.coli Levels
High Turbidity Levels	Sedimentation, Impaired Biotic Communities
High Phosphorus Levels	High Nutrient Loads
Faulty or Absent Septic Systems	High Nutrient Loads, High E.coli Levels
Excessive Nutrients Entering Streams/Ditches	High Nutrient Loads
Excessive Sediment in Water Column	Sedimentation, Impaired Biotic Communities
Lack of Buffer strips	Erosion, Sedimentation, High Nutrient Loads

Concerns	Problem
Lack of Residue/Cover on Ag Fields	Sedimentation, High Nutrient Loads
Unbuffered Tile Field Inlets	Sedimentation, High Nutrient Loads
Barnyard Runoff	High Nutrient Loads, High E.coli Levels
Stream/Ditches Listed as Impaired by IDEM	High Nutrient Loads, Dissolved Oxygen, Sedimentation, E.coli, Impaired Biotic Communities
Drained Wetlands	High Nutrient Loads, Impaired Biotic Communities, Sedimentation

Potential Sources Resulting in Water Quality Problems

The potential sources of water quality problems identified during the watershed inventory process have been linked to the problems and potential causes (Table 3.5).

Table 3.5 Problems, Potential Causes, Potential Sources		
Problem	Potential Causes	Potential Sources
High Nutrient Loads	Nutrient levels exceed target, bank erosion, lack of education, inadequate septic systems, wastewater treatment plant discharges, soil types with slow infiltration rates, area producers are unaware of the cumulative effects of best management practices	The Bank Erosion Inventory revealed 72 miles of eroding banks According to information provided by local county health departments, 40% to 60% of septic systems need repair or replacement. No educational materials that are specific to the project area are available. There are two wastewater treatment plants that discharge to waters of the state. The Tillage Transect revealed that conventional tillage is more common (51%) than no-till (38%) and mulch till (9%). Tillage can result in ag sediment and nutrient runoff. 89% of the watershed is in cultivated crops which are fertilized to promote plant growth. Nearly 100% of the soil types in the watershed have a slow to very slow infiltration rate and limiting layers that impede the downward movement of water.
Sedimentation and Erosion	Cropland and streambank erosion, turbidity and TSS levels exceed targets, area producers are unaware of the cumulative effects of best management practices	The Bank Erosion Inventory revealed 72 miles of eroding banks. The Stream Buffer Inventory revealed 142 miles of inadequate buffers. The Windshield Survey revealed unbuffered tile inlets in every subwatershed and log jams in Bohnke Ditch and Wildcat Creek. Only 2% of wetlands remain in the project area effectively eliminating wetlands as a source for filtering stormwater runoff. According to the most recent Auglaize-Flatrock Transect in 2021, 16% of the fields identified in the transect had winter cover.

Problem	Potential Causes	Potential Sources
High E.coli Levels	E.coli, lack of education	All County Health Departments estimated that 40% to 60% of septic systems are in failure status. Nearly 100% of the soil types in the watershed have a slow to very slow infiltration rate and limiting layers that impede the downward movement of water. CSO's occur in Monroeville, IN and Payne, OH. Pet waste concentrated in urban areas (Monroeville, IN and Payne, OH). No watershed-specific water quality educational materials are available. Nearly 90% of the land use in all subwatersheds is agriculture where the potential for fertilizer loss (in the form of manure) is great due to unsustainable farming practices.
Impaired Biotic Communities	Erosion, low dissolved oxygen levels, turbidity	The Bank Erosion Inventory revealed 72 miles of eroding banks. The Stream Buffer Inventory revealed 142 miles of inadequate buffers. The Windshield Survey revealed unbuffered tile inlets in every subwatershed. Only 2% of wetlands remain in the project area effectively eliminating wetlands as a source for filtering stormwater runoff. Failing septic systems, improper fertilizer and manure applications, and animal access to water bodies are also potential sources of nutrients and sediment that impair biotic communities.

4.0 Watershed Pollutant Load Reductions

Bruce Cleland with Tetra Tech, Inc., an environmental consulting firm, was hired to calculate pollutant loads and load reductions for total phosphorus, dissolved reactive phosphorus, nitrogen, and total suspended solids. To accomplish this using an integrated approach, Tetra Tech evaluated the Allen County SWCD water quality sampling data (spatial patterns, temporal variability), flow conditions, and watershed hydrology.

Phosphorus

Load reduction estimates for phosphorus in the Flatrock – Auglaize WMP project area are based on the Great Lakes Water Quality Agreement (GLWQA) Annex 4 targets established for the Maumee River Basin. These include spring load targets (March – July) for both total phosphorus (860 metric tons) and dissolved reactive phosphorus (186 metric tons), as well as an annual load target for total phosphorus (2,288 metric tons).

Existing and target loads used the Annex 4 TMDL Methodology (A4TM) developed by an interagency workgroup composed of staff from IDEM, Michigan DEQ, Ohio EPA, and USEPA Region 5 (TetraTech, 2018 [1]). The A4TM distributes the Annex 4 targets and existing loads to the HUC-12 scale based on the flow contribution of the individual subwatersheds. These values were cross-checked against data collected by the Allen County SWCD to ensure that the load estimates reflect conditions observed in the Flatrock-Auglaize WMP project area.

[1] TetraTech. August 2018. *Methodology for Connecting Annex 4 Water Quality Targets with TMDLs in the Maumee River Basin -- Final Draft.* Prepared for U.S. Environmental Protection Agency, Indiana Department of Environmental Management, Michigan Department of Environmental Quality, Ohio Environmental Protection Agency. Cleveland, OH.

Table 4.1 Flatrock – Auglaize total phosphorus load and reduction estimates

HUC	Subwatershed Name	Size *(acres)*	Spring Load *(lbs/year)*			Annual Load (*lbs/year)*		
			Existing	Target	*Reduction*	Existing	Target	*Reduction*
12-02	Hoffman Headwaters	14,887	11,950	7,340	4,610	33,600	20,100	13,500
12-03	Bohnke Ditch	14,694	11,800	7,250	4,550	33,100	19,900	13,200
12-01	Flatrock Headwaters	15,700	12,600	7,740	4,860	35,400	21,200	14,200
12-04	Brown Ditch	15,602	12,530	7,700	4,830	35,200	21,100	14,100
12-05	Wildcat Creek*	35,697	28,700	17,600	11,100	80,500	48,300	32,200
	Project Area Totals	96,580	77,580	47,630	29,950	217,800	130,600	87,200

* Loads and reduction estimates for the Flatrock – Wildcat Creek subwatershed (04100007 12-05) are based on ones developed for the entire area above site 401. Data was not collected at or near the outlet of this HUC-12. However, loads originating in this subwatershed are likely reflected through sample results from the other monitoring sites given similarities in land use, cropping patterns, and management practices across the entire Flatrock – Auglaize WMP project area.

Dissolved reactive phosphorus loads are presented in this document for reference purposes only since at the time of this writing, there is no widely used reduction estimate method/model available.

Table 4.2 Flatrock – Auglaize dissolved reactive phosphorus load and reduction estimates					
HUC	Subwatershed Name	Size *(acres)*	Spring Load (*lbs/year)*		
			Existing	Target	*Reduction*
12-02	Hoffman Headwaters	14,887	2,650	1,590	1,060
12-03	Bohnke Ditch	14,694	2,610	1,570	1,040
12-01	Flatrock Headwaters	15,700	2,790	1,670	1,120
12-04	Brown Ditch	15,602	2,770	1,660	1,110
12-05	Wildcat Creek*	35,697	6,340	3,800	2,540
	Project Area Totals	96,580	17,160	10,290	6,870

Nitrogen

Load reduction estimates for nitrate/nitrite (NO_2+NO_3) in the Flatrock – Auglaize WMP project area are based on recommended values from USEPA for the protection of biological communities. The target of 1.6 mg/L represents a dividing line between mesotrophic and eutrophic streams. Target and existing loads were estimated based on the duration curve methodology (USEPA, 2007[2]). Flows were determined through relationships using the Allen County SWCD "bridge-to-water" sample measurements and USGS data from stream gages in HUC-12 subwatersheds adjacent to the Flatrock – Auglaize WMP project area. Loads for each duration curve zone were calculated, and then summed to determine annual values. Unit area loads (pounds per acre per year) were compared to values derived from data collected at several USGS WLEB sites to ensure that they reflect conditions observed across the Maumee River Basin. In addition, these unit area loads were also compared to estimates calculated with STEPL.

[2]USEPA. 2007. *An Approach for Using Load Duration Curves in the Development of TMDLs*. EPA 841-B-07-006. Watershed Branch, Office of Wetlands, Oceans and Watersheds, Washington, DC**.**

Table 4.3 Flatrock – Auglaize NO_2+NO_3 load and reduction estimates					
HUC	Subwatershed Name	Size *(acres)*	Annual Load *(lbs/year)*		
			Existing	Target	*Reduction*
12-02	Hoffman Headwaters	14,887	145,000	97,100	47,900
12-03	Bohnke Ditch	14,694	125,000	95,800	29,200
12-01	Flatrock Headwaters	15,700	148,000	102,400	45,600
12-04	Brown Ditch	15,602	155,000	101,700	53,300
12-05	Wildcat Creek*	35,697	354,500	232,700	121,800
	Project Area Totals	96,580	927,500	629,700	297,800

Total Suspended Solids

The target for total suspended solids is 25 mg/L, which serves as the basis for determining the annual load target. While this value is reasonable as an overall average concentration objective, using it to identify annual load target results in some reduction needs for implementation. This is due to the fact that TSS concentrations are naturally elevated at higher flows (and subsequently higher loads). Guidance provided by IDEM appears to recognize this based on information in the literature (USEPA & the American Fisheries Society). Biological assessments and TMDL development in Michigan also acknowledge the relationship between flow and TSS. Target and existing loads were estimated based on the duration curve methodology described for nitrate.

The table below reflects the 25 mg/L target.

Table 4.4 Flatrock – Auglaize total suspended solids load and reduction estimates

HUC	Subwatershed Name	Size *(acres)*	Annual Load *(tons/year)*		
			Existing	Target	*Reduction*
12-02	Hoffman Headwaters	14,887	1,460	760	700
12-03	Bohnke Ditch	14,694	2,460	750	1,710
12-01	Flatrock Headwaters	15,700	2,560	800	1,760
12-04	Brown Ditch	15,602	2,700	790	1,910
12-05	Wildcat Creek*	35,697	6,180	1,810	4,370
	Project Area Totals	96,580	15,360	4,910	10,450

Bacteria

Indiana's water quality criteria establish the target for *E. coli,* <235 cfu/100 mL in a single sample. This has been used to determine the percentage of *E.coli* samples that exceed the target. The Steering Committee decided to base the percentage of reduction needed on zero exceedances of the target. The data comes from the Allen County SWCD's water quality sampling program and is expressed in the percentage of samples that exceed the target.

Table 4.5 Flatrock – Auglaize *E. coli* readings that exceed the target

HUC	Subwatershed Name	Size *(acres)*	% Not Meeting Target and Reduction Needed
12-02	Hoffman Headwaters	14,887	50
12-03	Bohnke Ditch	14,694	62
12-01	Flatrock Headwaters	15,700	63
12-04	Brown Ditch	15,602	69
12-05	Wildcat Creek	35,697	40

4.1 Goals and Objectives

The Steering Committee used the Tetra Tech load reduction data to develop the goal statements for total phosphorus, nitrogen, and total suspended sediment. Dissolved reactive phosphorus loads are presented in this document for reference purposes only since at the time of this writing, there is no widely used reduction estimate method/model available. It is assumed that an overall reduction in total phosphorus loads will also reduce dissolved reactive phosphorus.

The *E.coli* goal is expressed in the percentage of decrease needed to meet the target number, <235 cfu/100 ml.

No specific goals were developed for Impaired Biotic Communities since the total phosphorus, nitrogen, and total suspended sediment goals will work toward addressing it.

The goals are derived from the list of stakeholder concerns and all the research done in the project area. Where appropriate, similar concerns have been combined into one goal.

The committee decided to set goals in 3-year increments to keep track of progress being made.

Watershed Goals

Goal 1 – Reduce the total phosphorus load. The load reduction needed to meet the annual target of 2,288 metric tons/year is 87,200 lbs/yr.

Decrease the total phosphorus load by 20% in 3 years (17,440 lbs)
Decrease the total phosphorus load by 40% in 6 years (34,880 lbs)
Decrease the total phosphorus load by 60% in 9 years (52,320 lbs)
Decrease the total phosphorus load by 80% in 12 years (69,760 lbs)
Decrease the total phosphorus load by 100% in 15 years (87,200 lbs)

Goal 2 – Reduce the nitrogen load. The load reduction needed to meet the annual load target of 1.6 mg/L is 297,800 lbs/yr.

Decrease the nitrogen load by 20% in 3 years (59,560 lbs)
Decrease the nitrogen load by 40% in 6 years (119,120 lbs)
Decrease the nitrogen load by 60% in 9 years (178,680 lbs)
Decrease the nitrogen load by 80% in 12 years (238,240 lbs)
Decrease the nitrogen load by 100% in 15 years (297,800 lbs)

Goal 3 – Reduce the sediment load (calculated in TSS). The load reduction needed to meet the 25 mg/L target is 10,450 tons/yr.

Reduce the sediment load by 20% in 3 years (2,090 tons)
Reduce the sediment load by 40% in 6 years (4,180 tons)
Reduce the sediment load by 60% in 9 years (6,270 tons)
Reduce the sediment load by 80% in 12 years (8,360 tons)
Reduce the sediment load by 100% in 15 years (10,450 tons)
Install buffer strips along streams/ditches.
Utilize BMPs that reduce erosion on crop land and residential/commercial areas.
Stabilize eroding stream/ditch banks.
Increase the adoption of residue management on agricultural land.
Increase the use of cover crops on agricultural land.

Goal 4 – Reduce the *E.coli* load not only to meet the single sample water quality target of <235 cfu/100 ml, but to have impaired stream segments delisted.

Reduce the *E.coli* load in the Headwater Hoffman subwatershed by 50% in 15 years.
Reduce the *E.coli* load in the Bohnke Ditch subwatershed by 62% in 15 years.
Reduce the *E.coli* load in the Headwaters Flatrock subwatershed by 63% in 15 years.
Reduce the *E.coli* load in the Brown Ditch subwatershed by 69% in 15 years.
Reduce the *E.coli* load in the Wildcat Creek subwatershed by 40% in 15 years.

Provide education on septic systems through 2 workshops and publications every 2 years for 15 years.
Restrict livestock access to streams and ditches.
Ensure that animal waste in barnyards is properly contained and utilized.
Provide education to agricultural producers on manure management.
Develop Comprehensive Manure Management Plans for all livestock producers.

Goal 5 – Reduce the impacts of flooding and coordinate rural legal drain management across counties and states in the watershed.

Encourage partnerships with government agencies and landowners to adopt a watershed approach to flooding and rural drain management.
Request a full-scale survey from FEMA of the Flatrock Creek from its inception to Payne, OH to assess hydrologic issues and develop/implement an action plan.
Identify and remove log jams that are inhibiting flow.
Install water quality BMP's in areas where flood impacts cannot be mitigated and flooding will continue to occur.

Goal 6 – Stabilize eroding stream/ditch banks and increase the use of buffer strips.

Work with government agencies and landowners to effectively stabilize eroding stream banks.
Eliminate the installation of construction waste on ditch banks unless permitted by local authorities.
Install buffer strips along streams and ditches.
Utilize agricultural BMPs that slow water down (residue management, drainage water management, detention basins, wetlands).

Goal 7 – Collect and utilize water quality sampling data from current and future water quality sampling programs.

Ensure water quality sampling programs are appropriately designed and fully funded.
Utilize water quality data in decisions that affect the watershed.

Goal 8 – Increase public awareness of water quality concerns and how individual choices impact the watershed.

Educate stakeholders on agriculture and urban resource concerns through 2 workshops and/or publications that are representative of the project area per year for 15 years.

Goal 9 – Eliminate unbuffered field tile inlets that allow sediment and nutrients to enter streams/ditches.

Conduct an inventory of all field tile inlets within 1 year.

Install field tile inlet buffers on 100% of field tile inlets within 5 years.

Goal 10 – Increase wetland acres in the watershed.

Educate landowners on the benefits of wetlands for water management, nutrient/sediment capture, and wildlife habitat through 2 workshops and/or publications every 2 years.

Create/enhance wetland acres on urban and agricultural land by 1% (20 acres) for 15 years.

4.2 Goal Objectives and Indicators

Objectives and indicators for each of the goals have been developed by the Steering Committee. The goals have been grouped by resource concerns.

Nutrients

Goal 1 - Reduce the total phosphorus load. The load reduction needed to meet the annual target of 2,288 metric tons/year is 87,200 lbs/yr.
Goal 2 - Reduce the nitrogen load. The load reduction needed to meet the annual load target of 1.6 mg/L is 297,800 lbs/yr.
Goal 9 – Eliminate unbuffered field tile inlets that allow nutrients to enter streams/ditches.

Conduct an inventory of all field tile inlets within 1 year.

Install field tile inlet buffers on 100% of field tile inlets within 5 years.

<table>
<tr><th colspan="6">Table 4.6 Nutrient Goal Objectives and Indicators</th></tr>
<tr><th>Objective</th><th>Action</th><th>Target Audience</th><th>Performed By</th><th>Time Schedule</th><th>Indicator</th></tr>
<tr><th colspan="6">Cropland & Livestock</th></tr>
<tr><td rowspan="3">Promote the installation of field tile inlet buffers on 100% of field tile inlets within 5 years</td><td>Educate landowners and operators on the impacts unbuffered field tile inlets have on water quality through workshops and publications</td><td rowspan="3">Landowners and operators</td><td rowspan="3">SWCD and partners</td><td rowspan="3">2022-2027</td><td rowspan="3"># of publications distributed

# of people attending workshops

# of field tile inlet buffers installed

Pounds of phosphorus and nitrogen reduced from the calculated load reductions for the buffers installed

Water quality improvements based on monitoring for P and N</td></tr>
<tr><td>Conduct an inventory of all field tile inlets within one year</td></tr>
<tr><td>Provide financial assistance to farmers who install field tile inlet buffers</td></tr>
</table>

Objective	Action	Target Audience	Performed By	Time Schedule	Indicator
Educate landowners and operators on proper nutrient management and application (commercial fertilizer and manure)	Educate through publications and workshops	Landowners and operators, livestock owners	SWCD and partner staff	2022-2037	# of publications distributed # of people attending workshops # of nutrient management plans developed # of nutrient management plans implemented Pounds of phosphorus and nitrogen reduced from BMP’s installed Water quality improvements based on monitoring for P and N
	Provide financial assistance to farmers for installing BMPs and developing and implementing nutrient management plans				
Promote the use of cover crops on all cropland acres	Educate through publications and field days	Landowners and operators, livestock owners	SWCD and partner staff	2022-2037	# of publications distributed # of people attending workshops # of acres planted to cover crops Pounds of phosphorus and nitrogen reduced from BMP’s installed Water quality improvements based on monitoring for P and N
	Provide financial assistance to plant/manage cover crops				
Urban					
Promote proper nutrient management in urban areas	Educate through publications and workshops	General public	SWCD and partner staff, NGO’s	2022-2037	# of publications # of people attending workshops

Sediment

Goal 3 – Reduce the sediment load (calculated in TSS). The load reduction needed to meet the 25 mg/L target is 10,450 tons/yr.
Goal 6 – Stabilize eroding stream/ditch banks and increase the use of buffer strips.

Work with government agencies and landowners to effectively stabilize eroding stream banks.
Eliminate the installation of construction waste on ditch banks unless permitted by local authorities.
Install buffer strips along streams and ditches.
Utilize agricultural BMPs that slow water down (residue management, drainage water management, detention basins, wetlands).

Table 4.7 Sediment Goal Objectives and Indicators

Objective	Action	Target Audience	Performed By	Time Schedule	Indicator
Cropland					
Utilize BMPs that decrease erosion by slowing water down	Education through field days/workshops about residue management, drainage water management, detention basins, and wetlands	Landowners and operators	SWCD and partners	2022-2037	# of people attending workshops # of acres where BMPs are installed Tons of sediment calculated from load reductions for BMPs installed Water quality improvements based on monitoring for TSS and turbidity
	Provide financial assistance to farmers who utilize BMPs				

Objective	Action	Target Audience	Performed By	Time Schedule	Indicator
Stabilize eroding stream/ditch banks	Work with government agencies and landowners to effectively stabilize eroding stream banks Eliminate the installation of construction waste on ditch banks unless permitted by local authorities Install buffer strips along streams/ditches Provide financial assistance to farmers who utilize BMPs	Landowners and operators	SWCD and partners, local Surveyor and Engineer Depts.	2022-2037	# of landowners who install buffer strips # of landowners who replace construction waste with appropriate materials # of acres of buffer strips installed # of landowners enrolled in cost-share programs for buffer strips Tons of sediment calculated from the load reductions for BMPs installed Water quality improvements based on monitoring for TSS and turbidity
Increase the adoption of residue management and cover crops on agricultural land	Education through field days/workshops about residue management and cover crops Provide financial assistance to farmers who convert from tillage to no-till and/or plant cover crops	Landowners and operators	SWCD and partners	2022-2037	# of people attending workshops # of acres converted # of acres planted with cover crops Change in tillage transect data Tons of sediment calculated from the load reductions for BMPs installed Water quality improvements based on monitoring for turbidity and TSS

Bacteria

Goal 4 – Reduce the *E.coli* load not only to meet the single sample water quality target of <235 cfu/100 ml, but to have impaired stream segments delisted.

- Provide education on septic systems through 2 workshops and publications every 2 years for 15 years.
- Restrict livestock access to streams and ditches.
- Ensure that animal waste in barnyards is properly contained and utilized.
- Provide education to agricultural producers on manure management.
- Develop Comprehensive Manure Management Plans for all livestock producers.

Table 4.8 Bacteria Goal Objectives and Indicators					
Objective	Action	Target Audience	Performed By	Time Schedule	Indicator
Cropland & Livestock					
Utilize BMPs that prevent livestock manure from entering streams/ditches	Educate livestock owners on the proper manure management through field days/workshops	Landowners and operators	SWCD and partners	2022-2037	# of people attending workshops # of feet of exclusion fencing installed # of BMPs installed # of acres where BMPs are installed Water quality improvements based on monitoring for *E.coli*
	Provide financial assistance to farmers who utilize livestock BMPs and Comprehensive Manure Management Plans				
	Develop Comprehensive Manure Management Plans for all livestock producers				
Urban Septic Systems					
Educate homeowners and renters on septic systems and maintenance	Create and distribute publications about septic systems	Homeowners and renters	SWCD and partners, Board of Health	2022-2037	# of publications distributed # of attendees at workshops # of acres of buffer strips installed Water quality improvements based on monitoring for *E.coli*
	Conduct septic system workshops				

Goal 5 – Reduce the impacts of flooding and coordinate rural legal drain management across counties and states in the watershed.

- Encourage partnerships with government agencies and landowners to adopt a watershed approach to flooding and rural drain management.
- Request a full-scale survey from FEMA of the Flatrock Creek from its inception to Payne, OH to assess hydrologic issues and develop/implement an action plan.
- Identify and remove log jams that are inhibiting flow.
- Install water quality BMP's in areas where flood impacts cannot be mitigated and flooding will continue to occur.

Table 4.9 Flooding Goal Objectives and Indicators

Objective	Action	Target Audience	Performed By	Time Schedule	Indicator
Encourage partnerships with government agencies and landowners to adopt a watershed approach to flooding and rural drain management	Request a full-scale survey from FEMA of the Flatrock Creek from its inception to Payne, OH to assess hydrologic issues and develop/implement an action plan	FEMA	Maumee River Basin Commission, County Surveyors and Engineers, landowners, SWCDs and partners	2022-2023	Completion of full-scale survey and action plan # of actions from plan implemented # of partnerships created # of participants in partnerships
	Establish working partnerships for rural drain management with agencies and landowners	County Surveyors and Engineers, landowners			

Objective	Action	Target Audience	Performed By	Time Schedule	Indicator
Identify and eliminate log jams that are contributing to flooding and unstable banks in Flatrock Creek and its tributaries	Inventory log jams in Flatrock Creek and tributaries	County Surveyors and Engineers	Maumee River Basin Commission, SWCDs, County Surveyors and Engineers	2022-2024	Completion of log jam inventory Completion of study on the effects of log jams # of log jams removed # of stream/ditch banks stabilized
	Study the effects of log jams on flooding and bank destabilization				
	Remove problematic log jams				
Install water quality BMP's in areas where flood impacts cannot be mitigated and flooding will continue to occur	Educate landowners affected by flooding on BMPs that reduce impacts at field days and workshops	Landowners and producers	Maumee River Basin Commission, SWCDs, County Surveyors and Engineers	2022 - 2037	# of field days and workshops # of participants at field days and workshops # of BMPs installed

Goal 7 – Collect and utilize water quality sampling data from current and future water quality sampling programs.

Ensure water quality sampling programs are appropriately designed and fully funded.
Utilize water quality data in decisions that affect the watershed.

Table 4.10 Water Quality Sampling Goal Objectives and Indicators

Objective	Action	Target Audience	Performed By	Time Schedule	Indicator
Monitor water quality in Flatrock Creek and its tributaries	Ensure water quality sampling programs are appropriately designed and fully funded	IDEM, OEPA, SWCDs and partners	IDEM, OEPA, SWCDs and partners	2022 - 2037	Implementation of water quality monitoring programs
Utilize water quality data in decisions that affect the watershed	Analyze water quality data, observing trends and challenges Present water quality data analysis to government agencies, academia, and the public Enter water quality data into the Water Quality Information System Database	IDEM, OEPA, SWCDs and partners, public	IDEM, OEPA, SWCDs and partners	2022 - 2037	Completion of yearly data entry into the Water Quality Information System # of presentations created # of presentations delivered # of participants at presentations # of actions taken as a result of the data

Goal 8 – Ensure no net loss of existing wetland acres and increase wetland acres in the watershed.

Educate landowners on the benefits of wetlands for water management, nutrient/sediment capture, and wildlife habitat through 2 workshops and/or publications every 2 years. Create/enhance wetland acres on urban and agricultural land by 1% for 15 years.

Table 4.11 Wetland Goal Objectives and Indicators

Objective	Action	Target Audience	Performed By	Time Schedule	Indicator
Educate the public on the importance of wetlands in the project area	Conduct field days and workshops about the benefits of wetlands	Landowners, producers, general public	SWCDs and partners	2022 - 2037	# of wetland publications created # of publications distributed # of workshops and field days # of participants at field days and workshops
Ensure no net loss of existing wetland acres and increase wetland acres in the watershed	Inventory existing wetlands and potential restoration/ enhancement sites Provide funding for wetland restoration/ enhancement	Landowners, producers, general public	SWCDs, USDA – NRCS, IDEM, OEPA, The Nature Conservancy	2022 - 2037	# of wetland acres created/enhanced # of participants in USDA and/or privately funded wetland restoration programs Tons of sediment calculated from the load reductions for wetlands Pounds of phosphorus and nitrogen from the load reductions for wetlands

Goal 9 – Increase public awareness of water quality concerns and how individual choices impact the watershed.

Educate stakeholders on agriculture and urban resource concerns through 2 workshops and/or publications that are representative of the project area per year for 15 years. Establish a watershed working group in the Flatrock-Auglaize Watershed that will meet semi-annually. The public would be invited to at least one watershed working group meeting annually to further share information on BMP installation and load reductions. In addition to the annual meeting, stakeholders would be directly invited to other workshops and field days in or near the watershed area.

Table 4.12 Public Awareness Goal Objectives and Indicators

Objective	Action	Target Audience	Performed By	Time Schedule	Indicator
Educate the public on water quality concerns and what they can do to be part of the solution to pollution	Hold two educational events/workshops annually	Landowners, producers, general public	SWCDs and partners	2022 - 2037	# of water quality publications created # of publications distributed # of workshops and field days # of participants at field days and workshops
	Create and distribute one material on water quality and BMPs that are specific to the project area per year				
Educate and promote best management practices to landowners, operators, and the public	Hold two educational events/workshops annually	Landowners, producers, general public	SWCDs and partners	2022 - 2037	# of water quality publications created # of publications distributed # of workshops and field days # of participants at field days and workshops
	Create and distribute one material on water quality and BMPs that are specific to the project area per year				

Critical Areas

The combined research (available in previous sections on water quality monitoring, land use, windshield survey, and the 303(d) list) completed on the Flatrock-Auglaize watershed project area has been analyzed to determine the critical areas in the watershed. For the purposes of this document, critical areas are defined as places/locations where water quality is the worst, high pollutant loads are produced, and where best management practices are needed the most. A Priority area ranking system has been assigned so that implementation efforts will be focused on the areas that have the biggest impact on water quality first. Implementation of this WMP should begin in Priority 1 subwatersheds. Once all Priority 1 implementation efforts have been completed, efforts should be focused on Priority 2 subwatersheds. The designation of "no priority" does not mean that there is no need for improvement or that there aren't any resource concerns to address. This designation is used because EPA does not allow the entire watershed to be considered critical. (Figure 2.2)

Nutrient based critical areas were based on water quality data, land use inventory, the windshield survey, and the 303(d) list. Wildcat Creek has been assigned the designation of "no priority" because the majority of the subwatershed is located in Ohio, the WMP is written for Indiana, and implementation efforts will be focused in Indiana. Indiana will not fund implementation in the Ohio portion of the subwatershed since it is downstream of the Indiana/Ohio state line, however funding sources are available in Ohio such as H2Ohio and the Great Lakes Restoration Initiative Program.

Priority 1 subwatersheds – Brown Ditch, Headwaters Flatrock Creek.

Priority 2 subwatersheds – Headwaters Hoffman Creek, Bohnke Ditch.

No Priority subwatershed - Wildcat Creek.

The critical areas for inadequate buffer strips are based on the inventory completed during the research phase of this project. The Steering Committee decided to designate all locations with inadequate buffer strips as priority 1 critical areas. Figure 4.2.

The critical area designated for flooding issues is identified as the main stem of Flatrock Creek. (Figure 2.8)

E.coli based critical areas were identified using the 303(d) list, CAFO locations, and water quality data. Wildcat Creek has been assigned the designation of "no priority" because the majority of the subwatershed is located in Ohio, the WMP is written for Indiana, and implementation efforts will be focused in Indiana. Indiana will not fund implementation in the Ohio portion of the subwatershed since it is downstream of the Indiana/Ohio state line.

Priority 1 subwatersheds – Headwater Flatrock Creek, Brown Ditch.

Priority 2 subwatersheds – Headwaters Hoffman Creek, Bohnke Ditch

No Priority subwatershed - Wildcat Creek.

Sediment based critical areas were determined using the 303(d) list for Impaired Biotic Communities and water quality data. Wildcat Creek has been assigned the designation of "no priority" because the majority of the subwatershed is located in Ohio, the WMP is written for Indiana, and implementation efforts will be focused in Indiana. Indiana will not fund implementation in the Ohio portion of the subwatershed since it is downstream of the Indiana/Ohio state line.

Priority 1 subwatersheds – Brown Ditch

Priority 2 subwatersheds – Headwaters Hoffman Creek, Bohnke Ditch, Headwaters Flatrock

No Priority subwatershed - Wildcat Creek.

The critical areas for bank erosion are based on the inventory completed during the research phase of this project. The Steering Committee decided to designate all locations with bank erosion as priority 1 critical areas. Figure 4.1.

Critical areas for urban land uses were determined using the land use inventory and windshield survey data and are identified as: all municipalities in the project area. (Figure 4.1)

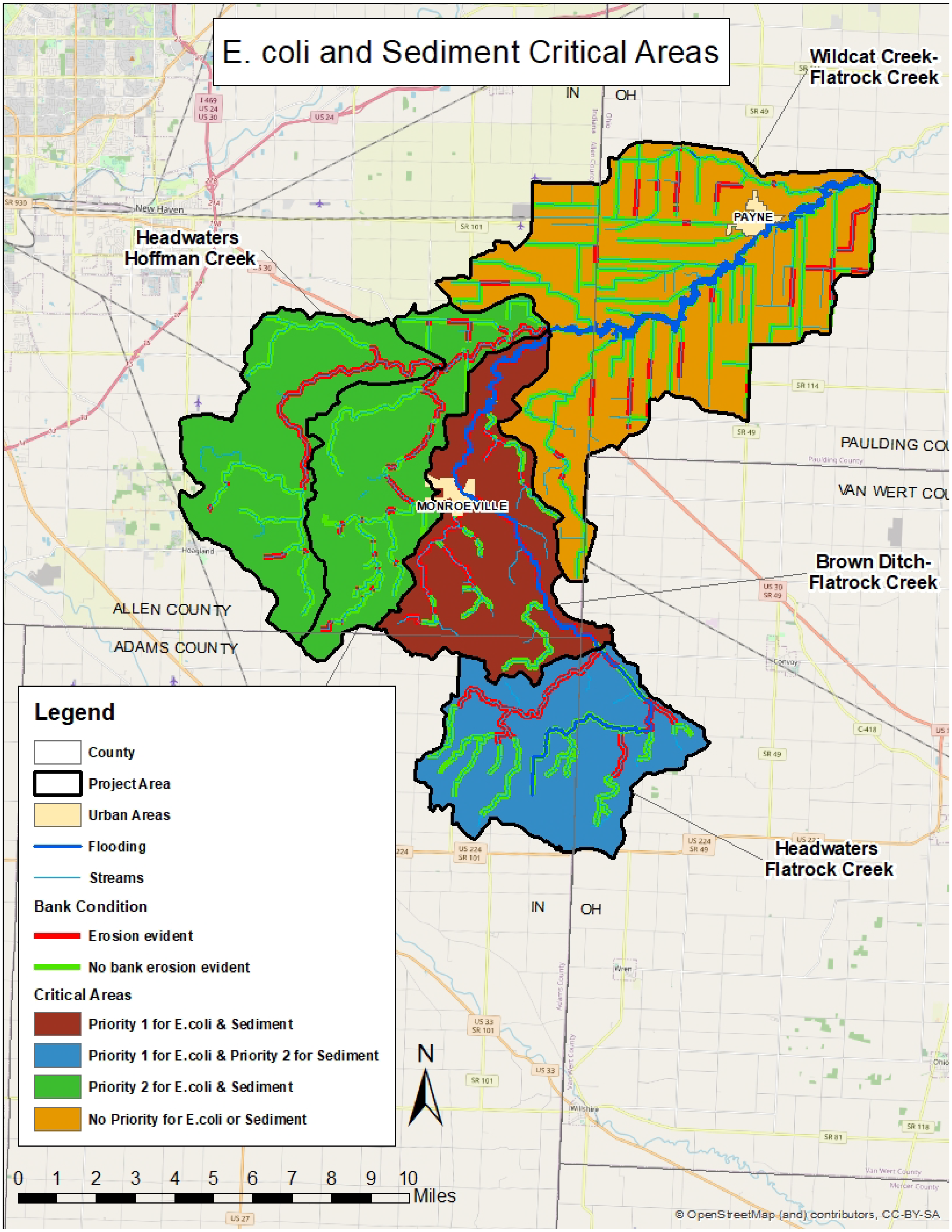

Figure 4.1 E. coli and Sediment Critical Areas map

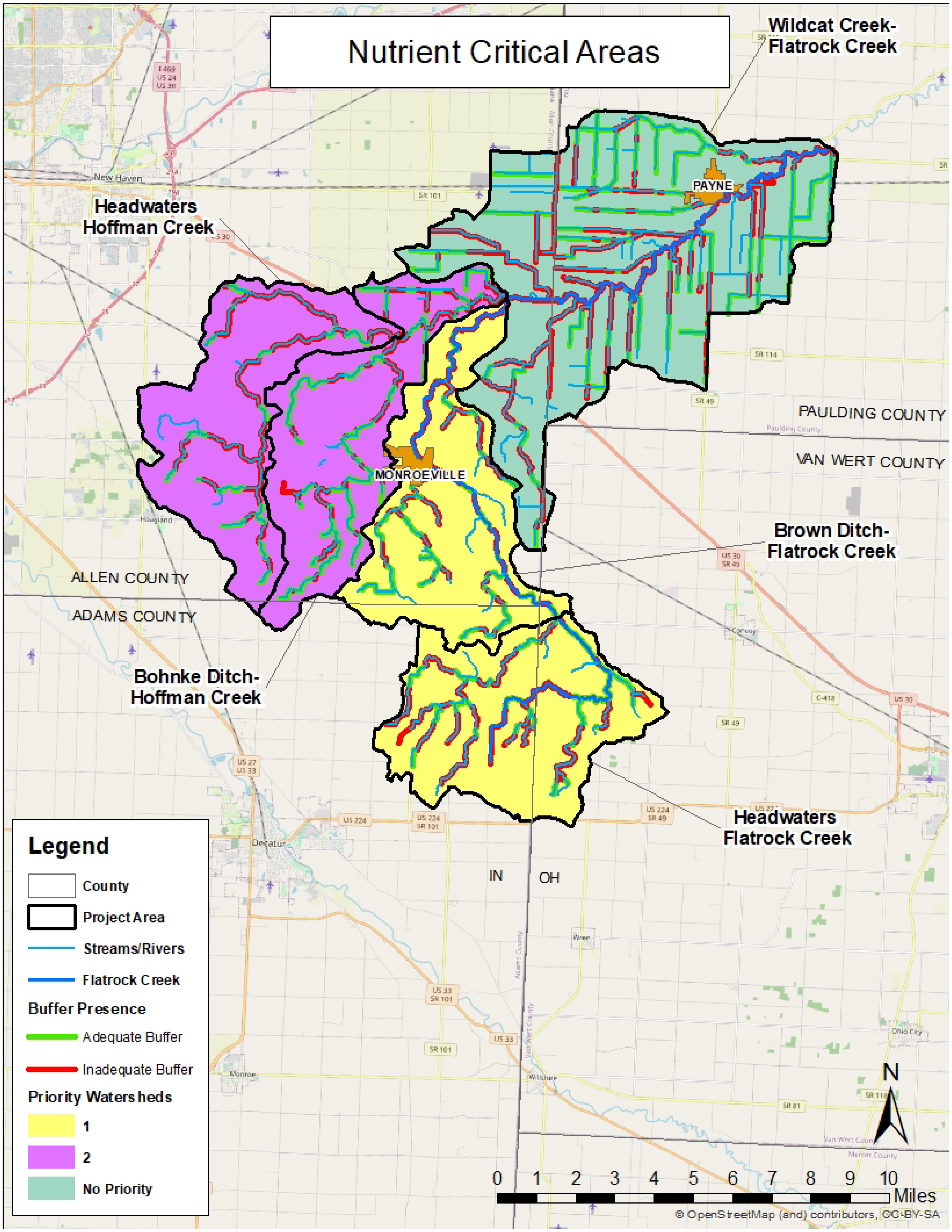

Figure 4.2 Nutrient Critical Areas map

5.0 Implementation Strategy and Load Reductions

Actions outlined in Section 5 were determined by examining a combination of watershed management methods including the likelihood of receiving landowner buy-in to implement best management practices on their property, the potential load reductions that would result from implementation, and the overall cost of each practice. Using the Spreadsheet Tool for Estimating Pollution Loads (STEPL) and the Region 5 load reduction models, both of which can be found on the IDEM website under watershed assessment, most BMPs could be modeled to determine an estimated pollution load reduction. Blind inlet load reductions were obtained from Gonzalez, Smith, and Livingston (2016). Wetland load reductions were obtained from Hoffmann, Heiberg, Audet, et. al. (2012) and Woltemade (2000). Load reductions for those that could not be modeled through the above-mentioned models were garnered from the Upper Maumee WMP. Load reductions for tree planting were estimated using the IDEM Tree Load Reduction Calculator.

It is important to note that assumptions were made for the model inputs as exact acreage of implementation is dependent on the support for participation that is received by landowners in the project area. The load reductions presented in this document are derived from a model and are best estimate scenarios only, and only account for the BMPs planned to be installed as part of this project, assuming that no BMPs were implemented in the past or are currently being used. It is understood throughout the conservation community that load reductions from BMPs have a cumulative effect and that the reductions in pollutant loads will increase exponentially as they are implemented year after year or in combination with multiple BMPs. Accurate load reductions will be determined when water quality analysis is conducted in the future, post implementation. Table 5.1 shows the estimated load reduction after implementation of the proposed practices. As exhibited in Table 5.1, according to estimated load reductions from various models, sediment and nitrogen target load reductions will be exceeded by the end of the 15-year Watershed Management Plan implementation. However, phosphorus loads fall short by 3,482 lbs. It is important to note that while not all BMP load reductions can be modeled, the proposed BMPs have a proven record of reducing nutrient and sediment loading. Based on historical research, it is assumed that the implementation of this WMP will result in target loads being met for sediment, nitrogen, and phosphorus.

Table 5.1 Expected Pollutant Load Reductions Summary, After Implementation			
	Nitrogen (lbs)	Phosphorus (lbs)	Sediment (tons)
Needed	297,800	87,200	10,450
Estimated	303,129	83,718	44,955.11
Overage / Shortage in Required Load Reduction	+ 5,329	- 3,482	+ 34,505.11
Total BMP Implementation Cost	$9,302,700		

As stated above, not all BMPs that are listed in the implementation plan can be modeled to determine pollutant load reductions as they are either new technologies or there are too many variables involved to give an accurate estimate. These BMPs are listed below.

Drainage Water Management

The Steering Committee plans to promote the use of drainage water management in areas deemed critical for nutrient and sediment loads throughout the watershed. Drainage Water Management allows landowners to manage the water table under their crop fields, allowing levels to be higher in the summer when water is scarce and lower in the spring when there is an abundance of water. This practice is known to keep nutrients on the fields and can increase crop production as much as 25 bushels of soybeans and 70 bushels of corn per acre annually, according to the NRCS, National Water Ag Water Management Team. However, an accurate model to predict pollutant load reductions is not available at this time. For more information on this practice, visit www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/manage/.

Comprehensive Nutrient Management Plan

The Steering Committee plans to promote the use of Comprehensive Nutrient Management Planning (CNMP) in the project area deemed critical for *E. coli* and/or high soil test phosphorus levels where livestock operations can be found. A CNMP is a document that explains the current nutrient output of animals on a farm and how to best utilize those nutrients on crop land, promoting healthy soils and increasing yield while preventing manure runoff from the farm. Since the CNMP will only produce a load reduction if implemented, and each implementation plan in the CNMP is different, load reductions could not be determined.

Pet Waste Receptacles

The Steering Committee intends to promote the installation of pet waste receptacles in public parks located within the urban critical area. Pet waste left on the ground contributes to bacteria and nutrient loads and turbidity in water. Providing a receptacle that includes bags and a trash can for waste will eliminate the NPS from dog waste left on the ground. There is not currently a model to estimate load reductions from installation of pet waste receptacles.

5.1 Expected Load Reductions Based on BMPs

Table 5.2 BMP Expected Load Reductions for Nutrients and Sediment							
Partners (P) and Technical Assistance (TA): IDEM (TA); OEPA (TA); SWCD / NRCS Offices (P, TA); Purdue Extension (P, TA); Farm Bureau (P); The Nature Conservancy (P, TA); Maumee Watershed Alliance (P, TA)							
Estimated Total Cost to Implement: $5,836,000							
Critical Area	**Practice**	**Milestone**	**Total Quantity Installed**	**Nitrogen (lbs)**	**Phosphorus (lbs)**	**Sediment (tons)**	**Estimated Cost**
Nutrients ***Priority 1*** Brown Ditch, Headwaters Flatrock Creek ***Priority 2*** Headwaters Hoffman Creek, Bohnke Creek **Sediment** ***Priority 1*** Brown Ditch ***Priority 2*** Headwaters Hoffman Creek, Bohnke Ditch, Headwaters Flatrock Creek	Blind Inlets	Ten (10) structures/year for 15 years	150 Blind Inlets	20,588	7,538	563	$180,000
	Nutrient Management	750 acres/year for 10 years	7,500 acres	66,700	11,000	6,140	$150,000
	Cover Crops	1000 acres/year for 15 years	15,000 acres	28,050	2,550	300	$600,000
	Two-Stage Ditch	1000 linear feet every 2 years for 15 years	7,000 linear feet	896	434	21	$280,000
	Conservation Tillage	1000 acres/year for 15 years	15,000 acres	27,450	13,050	1,200	$375,000
	Wetland Restoration / Creation	One (1) project every other year for 15 years	7 Wetland Projects	938	210	15	$240,000
	Drainage Water Management	One project/year for 15 years	15 Drainage Water Management Structures	***	***	***	$75,000

	Practice	Milestone	Total Quantity Installed	Nitrogen (lbs)	Phosphorus (lbs)	Sediment (tons)	Estimated Cost
	Soil Amendments (Gypsum)	1000 acres every 2 years for 15 years	7,000 acres	-	10,430	3,290	$280,000
	Grassed Waterway	15 acres every 2 years for 15 years	105 acres	366	90	13	$300,000
	Native Plantings (switchgrass)	300 acres planted/year for 15 years	4,500 acres	110,915	24,750	10,350	$1,500,000
	Forested Riparian Buffers	Install one (1) practice annually for 7 years	7 practices (100 ft wide)	1,428	329	28	$350,000
	Grass Riparian Buffer	Install two (2) practices annually for 15 years	30 practices (35 ft wide)	4,470	1,290	120	$700,000
	Buffer strip / Saturated Buffer	Two (2) sites/year for 7 years	14 sites - 2,100 acres/8,400 lf	21,736	4,558	3,676	$56,000
	Repair/Replace Faulty On-Site Waste Disposal Systems	Repair/Replace five (5)/year for 15 years	Repair/Replace 75 faulty waste disposal systems	4,125	487.5	18,615	$750,000
				Nitrogen (lbs)	**Phosphorus (lbs)**	**Sediment (tons)**	**Estimated Cost**
Total Load Reduction & Total Cost				**287,662**	**76,717**	**44,331**	**$5,836,000**

*** BMP accounted for in a previous table**
***** Load Reductions Unavailable**
- Either load reduction unavailable or load reduction accounted for in a previous table

Table 5.3 BMPs for Inadequate Buffers and Streambank Erosion							
Partners (P) and Technical Assistance (TA): IDEM (TA); SWCD / NRCS Offices (P, TA); Purdue Extension (P, TA); Farm Bureau (P); The Nature Conservancy (P, TA); Maumee Watershed Alliance (P, TA)							
Estimated Total Cost to Implement: $1,450,000							
Critical Area	**Practice**	**Milestone**	**Total Quantity Installed**	**Nitrogen (lbs)**	**Phosphorus (lbs)**	**Sediment (tons)**	**Estimated Cost**
Entire Watershed Where Inadequate Riparian Buffer and Bank Erosion are Found	Forested Riparian Buffer*	One acre every two yrs for 15 yrs*	7 practices (100 ft wide)	-	-	-	
	Grass Riparian Buffer*	One acre every two yrs for 15 yrs*	30 practices (35 ft wide)	-	-	-	
	Streambank Stabilization	1000 lf/yr for 7 yrs	7,000 lf	2,241	519	42	$1,400,000
	Grade Stabilization Structure	2 structures /yr for 7 yrs	14 (300 lf structures)	907.2	453.6	453.6	$50,000
	Buffer strip / Saturated Buffer*	Two (2) sites/year for 7 years*	14 sites - 2,100 acres/8,400 lf*	-	-	-	

Critical Area	Practice	Milestone	Total Quantity Installed	Nitrogen (lbs)	Phosphorus (lbs)	Sediment (tons)	Estimated Cost
	Forested Riparian* Buffers	Install one (1) practice* annually for 7 years	7 practices (100 ft wide)*	-	-	-	
	Grass Riparian Buffer*	Install two (2) practices annually for 15 years*	30 practices (35 ft wide)*	-	-	-	
				Nitrogen (lbs)	**Phosphorus (lbs)**	**Sediment (tons)**	**Estimated Cost**
Total Load Reduction				**3,148**	**973**	**496**	**$1,450,000**
*** BMP accounted for in a previous table** ***** Load Reductions Unavailable** **- Either load reduction unavailable or load reduction accounted for in a previous table**							

Table 5.4 BMPs for Urban Areas							
Partners (P) and Technical Assistance (TA): IDEM (TA); OEPA (TA); SWCD / NRCS Offices (P, TA); Purdue Extension (P, TA); Farm Bureau (P); The Nature Conservancy (P, TA); Maumee Watershed Alliance (P, TA); Town of Monroeville, IN (P); City of Payne, OH							
Estimated Total Cost to Implement: $1,205,000							
Critical Area	**Practice**	**Milestone**	**Total Quantity Installed**	**Nitrogen (lbs)**	**Phosphorus (lbs)**	**Sediment (tons)**	**Estimated Cost**
Urban Areas of Monroeville and Payne located in Brown Ditch and Wildcat Creek Subwatersheds	Pet Disposal Receptacles *	Installation at each park located within the urban areas*	8 Pet Disposal Receptacles*	***	***	***	
	Rain Barrels	Install ten (10)/ year for 15 years	150 Rain Barrels	121.5	22.5	30	$15,000
	Rain Gardens	Install four (4)/year for 15 years	60 Rain Gardens	120	6	10.5	$90,000
	Bioswale	Install one (1) every other year for 15 years	7 Bioswales (10 acres contributing)	4.2	2.1	0.7	$750,000
	Pervious Pavement	Install one (1) every year for 5 years	5 Projects	399.3	37.7	8.4	$300,000
	Tree Planting	Plant 20 trees in public areas annually for 10 years	200 Trees	333	768	11.0	$50,000

	Practice	Milestone	Total Quantity Installed	Nitrogen (lbs)	Phosphorus (lbs)	Sediment (tons)	Estimated Cost
	Wetland Restoration / Creation*	One (1) project every other year for 15 years*	7 Wetland Projects*	-	-	-	
	Streambank Stabilization *	1000 lf/yr for 7 yrs*	7500 lf*	-	-	-	
	Two-Stage Ditch*	1000 linear feet every 2 years for 15 years*	7,000 linear feet*	-	-	-	
	Buffer strip / Saturated Buffer*	Two (2) sites/year for 7 years*	14 sites - 2,100 acres/8,400 lf*	-	-	-	
	Forested Riparian Buffers*	Install one (1) practice* annually for 7 years	7 practices (100 ft wide)*	-	-	-	
				Nitrogen (lbs)	**Phosphorus (lbs)**	**Sediment (tons)**	**Estimated Cost**
Total Load Reduction				**978**	**836**	**61**	**$1,205,000**

*** BMP accounted for in a previous table**
***** Load Reductions Unavailable**
- Either load reduction unavailable or load reduction accounted for in a previous table

Table 5.5 BMPs for *E.coli* Load Reductions							
Partners (P) and Technical Assistance (TA): IDEM (TA); OEPA (TA) SWCD / NRCS Offices (P, TA); Purdue Extension (P, TA); Farm Bureau (P); The Nature Conservancy (P, TA); Maumee Watershed Alliance (P, TA)							
Estimated Total Cost to Implement: $811,700							
Critical Area	**Practice**	**Milestone**	**Total Quantity Installed**	**Nitrogen (lbs)**	**Phosphorus (lbs)**	**Sediment (tons)**	**Estimated Cost**
E. coli **Priority 1** Brown Ditch, Headwaters Flatrock Creek **Priority 2** Headwaters Hoffman Creek, Bohnke Creek	Repair/Replace Faulty On-Site Waste Disposal Systems	Repair/Replace five (5)/year for 15 years*	Repair/Replac e 75 faulty waste disposal systems*	-	-	-	
	Comprehensive Nutrient Management Plans	Write five (5) CNMPs/year for 7 years	30 CNMPs	***	***	***	$150,000
	Runoff Management Systems	Two (2) projects/year for 5 years	10 projects	-	2,840	-	$115,000
	Limited Access Stream Crossing	One (1) project/year for 7 years	7 Limited Access Stream Crossings	1,359.40	168.7	67.9	$91,000
	Manure Holding Facilities	One (1) project/year for 7 years	7 Manure Management Facilities	9,982	903	-	$250,000
	Riparian Buffers adjacent to barnyards/pastures	One (1) project/year for 7 years	7 projects	-	1,281	-	$200,000

	Practice	Milestone	Total Quantity Installed	Nitrogen (lbs)	Phosphorus (lbs)	Sediment (tons)	Estimated Cost
	Pet Disposal Receptacles*	Installation at each park located within the urban areas*	8 Pet Disposal Receptacles*	***	***	***	$5,700
				Nitrogen (lbs)	**Phosphorus (lbs)**	**Sediment (tons)**	**Estimated Cost**
Total Load Reduction				**11,341**	**5,193**	**68**	**$811,700**
*** BMP accounted for in a previous table** ***** Load Reductions Unavailable** **- Either load reduction unavailable or load reduction accounted for in a previous table**							

5.2 Future Activities

The WMP will be utilized to implement strategies that reduce non-point source pollution. SWCDs, conservation agencies, and nonprofit organizations will obtain implementation funding through grants and private sources. Potential sources of funding include Clean Water Indiana, Clean Water Act Section 319, Indiana Lake and River Enhancement (LARE) Program, Great Lakes Restoration Initiative (GLRI), Natural Resources Conservation Service (NRCS) Contribution Agreements, and the Great Lakes Sediment and Nutrient Reduction Program. In addition, the District will also be seeking private foundation funds and other local funding opportunities. Cost-share opportunities will be established to encourage participation in programs that promote the use of best management practices. Education and outreach programs focusing on the WMP and implementation will be conducted to inform the public.

The WMP is a living document that will require periodic updates as land use and water quality conditions change as a result of BMPs being implemented. SWCDs in the project area will explore adaptive management and implement whenever appropriate. The District and its partners will be responsible for monitoring these changes at a minimum of every five years to provide guidance on when to update the WMP.

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5.3 Tracking Goals and the Effectiveness of Implementation

Information and data will need to be collected throughout implementation of the WMP to determine the effectiveness of the plan and its impact on water quality, and to aid in plan re-evaluation. Water quality indicators will be tracked through monitoring and modeling load reductions. Land use changes will be tracked through windshield surveys, tillage transects, and buffer strip/bank erosion inventories. Public education and outreach will be tracked by the number of people attending workshops/field days, the number of educational programs, and the number of publications created and distributed.

The following strategy has been developed for this purpose.

Table 5.6 Strategies for Tracking the Effectiveness of Implementation

Tracking Strategy	Frequency	Estimated Cost	Partners	Technical Assistance
BMP Load Reductions	Continuously, as installed	NA	SWCDs, NRCS, Indiana Dept. of Agriculture, Ohio EPA	Staff, IDEM, SWCD
Water Monitoring	Yearly	$50,000	Allen SWCD and partners	Staff, SWCD, City of Fort Wayne, St. Joseph River Watershed Initiative, Purdue

				University Fort Wayne
Number of BMPs Installed	Continuously, as installed	NA	SWCDs, NRCS, Indiana Dept. of Agriculture, Ohio EPA	Staff and partners
Tracking Strategy	Frequency	Estimated Cost	Partners	Technical Assistance
Number of Educational Publications	Yearly	NA	NA	NA
Windshield Survey	Every 5 years	NA	SWCDs	Staff
Buffer strip Inventory	Every 5 to 6 years	NA	Allen SWCD	Staff
Bank Erosion Inventory	Every 5 to 6 years	NA	Allen SWCD	Staff
Tillage Transect	Yearly	NA	SWCDs	Staff
Attendance at Workshops/Field Days	Yearly	NA	SWCDs, NRCS, Indiana Dept. of Agriculture, Ohio EPA, TNC	NA

Acronyms and Abbreviations

The acronyms and abbreviations below are commonly used by organizations working to restore Ohio and Indiana watersheds and are found throughout this document.

§319	Section 319 of the Clean Water Act
ALU	Aquatic Life Use
BMP	Best Management Practice
CAFF	Confined Animal Feeding Facility
CAFO	Concentrated Animal Feeding Operation
CRP	Conservation Reserve Program
CTIC	Conservation Tillage Information Center
DAP	Domestic Action Plan
DRP	Dissolved Reactive Phosphorus
E. coli	Escherichia coli
ECBP	Eastern Corn Belt Plains Ecoregion
EQIP	Environmental Quality Incentives Program
FLS	Federally Listed Species
FSA	Farm Service Agency
GLC	Great Lakes Commission
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
H2Ohio	H2Ohio Initiative (Ohio state funding mechanism for water quality improvement)
HAB	Harmful Algal Bloom
HSTS	Home Sewage Treatment System
HUC	Hydrologic Unit Code
IAC	Indiana Administrative Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
IDEM	Indiana Department of Environmental Management
IJC	International Joint Commission
LF	Linear Feet

N	Nitrogen (Nitrate + Nitrite)
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NPS-IS	Nonpoint Source-Implementation Strategy
NRCS	Natural Resources Conservation Service
ODA	Ohio Department of Agriculture
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OLEC	Ohio Lake Erie Commission
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
STEPL	Spreadsheet Tool for Estimating Pollutant Loads
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAP	Watershed Action Plan
WLEB	Western Lake Erie Basin
WMP	Watershed Management Plan
WQS	Water Quality Standards
WRP	Wetland Reserve Program
WWH	Warmwater Habitat
WWTP	Wastewater Treatment Plant

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Indiana Map
http://indianamap.org/resources.php

Ohio Domestic Action Plan
lakeerie.ohio.gov/planning-and-priorities/02-domestic-action-plan/02-domestic-action-plan

Indiana's Great Lakes Water Quality Agreement Domestic Action Plan for the Western Lake Erie Basin
www.in.gov/isda/files/Lake-Erie-Domestic-Action-Plan-Final.pdf#

USDA NRCS Field Office Technical Guide, Indiana and Ohio
efotg.sc.egov.usda.gov/#/state/IN/documents
efotg.sc.egov.usda.gov/#/state/OH/documents

Spreadsheet Tool for Estimating Pollutant Loads (STEPL)
www.epa.gov/nps/spreadsheet-tool-estimating-pollutant-loads-stepl

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