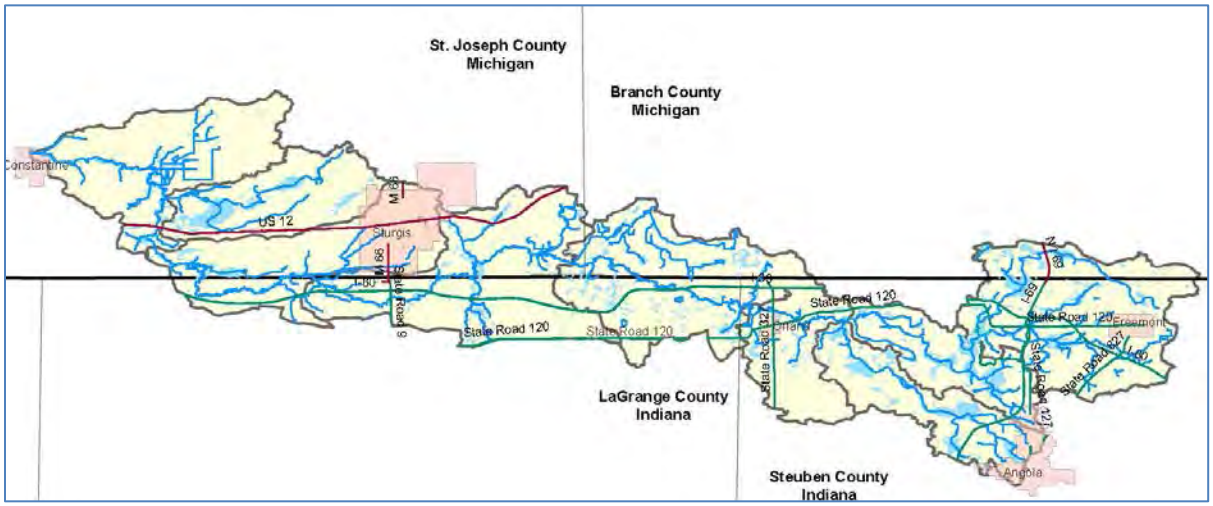
Fawn River Watershed Management Plan

HUC 0405000108

April, 2015



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This project has been funded wholly or in part by the United State Environmental Protection Agency under assistance agreement C600E72012 to the Indiana Department of Environmental Management. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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List of Acronyms

AFOs	Animal feeding operations
AU	Assessment Unit
BMPs	Best Management Practices
CAFF	Confined Animal Feeding Facility
CAFOs	Concentrated Animal Feeding Operations
CFOs	Confined Feeding Operations
cfu	Colony-Forming Unit
CSO	Combined Sewer Overflow
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DNR	Department of Natural Resources
DO	Dissolved oxygen
DRP	Dissolved Reactive Phosphorus
FRP	Fawn River Project
FCAs	Fish Consumption Advisory
HEL	Highly Erodible Land
HUC	Hydrologic Unit Codes
IDEM	Indiana Department of Environmental Management
IN	Indiana
INDOT	Indiana Department of Transportation
IR	Integrated Report
LTCP	Long Term Control Plan
LUSTs	Leaky underground storage tanks
MCL	Maximum Contaminant Level
MCM	Minimum Control Measures
MDEQ	Michigan Department of Environmental Quality
mg/L	Milligram per Liter
MGD	Million gallons per day
mIBI	Macroinvertebrate Index of Biotic Integrity
MS4	Municipal Separate Storm Sewer System
NFA	No Further Action
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resource Conservation Service
NPS	Nonpoint source pollution
NTUs	Nephelometric Turbidity Units
NWI	National Wetland Inventory
PCBs	Polychlorinated biphenyls
PHEL	Potentially Highly Erodible Land
ppb	Parts Per Billion

QAPP RC&D	Quality Assurance Project Plan Resource Conservation and Development
SWCD	Soil and Water Conservation District
SCLC	Steuben County Lakes Council
SWQMP	Storm Water Quality Management Plan
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
TP	Total Phosphorus
UDO	Unified Development Ordinance
US EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
USTs	Underground storage tanks
WHPP	Wellhead Protection Plan
WMP	Watershed Management Plan
WWTP	Waste Water Treatment Plant

1.0 Introduction

The LaGrange County Soil and Water Conservation District (SWCD) has been working with landowners and producers in LaGrange County to provide education on water quality issues and sustainable farming for the past 17 years. The relationship that has been formed between the SWCD and the farmers in the community has afforded the SWCD the ability to write comprehensive watershed management plans (WMP) for the Little Elkhart River, the Little Elkhart River Addendum, and Pigeon River and begin implementation of those WMPs with full support and help from the community. Monthly water testing in the Little Elkhart River system has shown improvements in water quality indicating that the SWCD's and local farmer's efforts to implement best management practices and improve water quality have made a difference in the watershed. It is anticipated as BMP implementation continues in the Pigeon River system, similar NPS pollution reductions will be achieved.

The success seen in previous watershed projects led the SWCD to look at surrounding watersheds to see if they could expand their efforts to include the Fawn River system. Steuben County SWCD had similar interests in this watershed resulting in a close partnership with the LaGrange County SWCD.

Agriculture is the major land usage for the entire drainage. Seed corn production is a major component along the drainage from western Steuben County, Indiana until it empties into the St. Joseph River. Other food production such as green beans, beets, and potatoes also play a significant role along the corridor. An important aspect in this type of agricultural landscape is the use of traditional practices which includes fall plowing that exposes fields to wind and sheet erosion. Evidence suggests traditional tillage practices may be having an influence on water quality in the watershed due to parts of the drainage being listed on the IDEM 303(d) list for impaired biotic communities. Big Otter Lake Inlet, Follette Creek, Walters Lake Inlet, Marsh Lake Outlet, and Green Lake Outlet are listed for impaired biotic communities in the draft 2012 Integrated Report.

Livestock operations are a growing commodity within the watershed. The Amish community is rather small along the Fawn River when compared to the Little Elkhart and Pigeon River drainages, but this community continues to grow resulting in an expansion of livestock based agriculture. Livestock related issues have been documented and are validated in water testing results with Crooked Creek, located in the Fawn River-Orland sub-watershed being listed as an impaired water body for *E.coli*.

Urban influences likely have an impact on the water quality throughout the watershed. Angola (p=8612) in Steuben County, is an Municipal Separate Storm Sewer System (MS4) city that currently affects Tamarack Lake (040500010802) and Lakes James-Crooked Creek (040500010803) sub-watersheds. It is anticipated that as the city grows north, the sub-watershed of Snow Lake (040500010801) will be included in the city's drainage area. Other urban influences include Fremont (p=2138), Howe (p=807), and Orland (p=434) in Indiana, and

the majority of Sturgis, Michigan (p=10,994). The town of Constantine, Michigan (p=2076) primarily influences the St. Joseph River directly, but may contribute to the Fawn River along the northern edge of the watershed, in residential areas. In addition, the majority of lake systems within the river drainage have dense residential areas along the shorelines. These residential lake areas likely have an effect on the lake systems through use of lawn fertilizers, the increased use of seawalls rather than natural shorelines, and on lakes without centralized sewers, septic systems may be a significant problem.

After taking the above findings into consideration, both SWCDs met with several local organizations and agencies to present the above information and to collaborate on a project to write a WMP for the Fawn River watershed to develop an implementation plan to delist the impaired waterways from the IDEM 303(d) list outlined in the IDEM Integrated Report which is submitted to the US Environmental Protection Agency (EPA) every two years. A collaborative effort between the LaGrange County and Steuben County SWCDs, Branch County and St. Joseph County Conservation Districts, The Nature Conservancy, Pheasants Forever, LaGrange and Steuben County Lakes Councils, Indiana Department of Natural Resources (IN DNR), Friends of the St. Joe, the St. Joseph River Basin Commission, and many other organizations led to an application for funding to be submitted to IDEM through the CWA§319 grant program in September, 2011. The application was passed to the CWA§205(j) grant program and was approved for funding. The Fawn River Watershed project began in January, 2013.

Due to the high level of interest in all four counties it was decided to divide the area between east (Steuben and Branch Counties) and west (LaGrange and St. Joseph Counties). Steering Committees were developed for both locations which will allow a greater amount of participation in the planning process and not overwhelm meetings. This design gives every participant ample opportunity to voice their opinions. In April of 2013, steering committee meetings were held in Steuben and LaGrange Counties to kick off the project and begin listing stakeholder concerns for the Fawn River. The steering committee members were also charged with collecting additional concerns from their organizations and other concerned stakeholders. Tables 1.1 and 1.2 are lists of the two steering committee members and Table 1.3 lists current stakeholder concerns, as well as their relevance to this project.

Table 1.1: Steuben and Branch County Steering Committee Members

Name	Affiliation	Stakeholder Group
Kayleen Hart	Steuben County SWCD	Government/Conservation
Tom Green	Steuben County SWCD Supervisor	Government/ Coservation
Brian Musser	Natural Resource Conservation Service	Government/Conservation
Bill Schmidt	Steuben County Lakes Council	Lake Residents/Conservation
Eric Henion	Angola/Trine University MS4	Government/Stormwater
Anne Abernathy	Fremont Library and Fremont Parks	Government
Linda Hagerman	Lake George Conservancy	Lake Residents/Conservation
Renate Brenneke	Lake George Conservancy	Lake Residents/Conservation
Chris Snyder	Town of Fremont	Municipal Government
Beth Warner	The Nature Conservancy	Non-profit/Environment
Kathy Worst	Branch County Conservation District	Government/Conservation
Larry Gilbert	Steuben County Surveyor	Local Government
Neil Ledet	Indiana Department of Natural Resources	Environment

Table 1.2: LaGrange and St. Joseph County Steering Committee Members

Name	Affiliation	Stakeholder Group
Monroe Raber	Producer	Landowner
Neil Ledet	Indiana Department of Natural Resources	Environment
Jen Miller	St. Joseph County Conservation District	Government/Conservation
Leslie Raymer	LaGrange County Lakes Council	Lake Resident/Conservation
Rex Pranger	LaGrange County Surveyor	Government
Karen Mackowiak	St. Joseph River Basin Commission	Indiana State Government
Kevin Shide	LaGrange - Natural Resource Conservation Svc.	Government
Gary Heller	LaGrange County Commissioner	Government

Table 1.3: Stakeholder Concerns

Concerns	Relevance	Potential Problem
Livestock access to open water	It has been noted that livestock often have regular access to open water for drinking or to move between adjacent pastures	*E. coli* contamination, excess nutrients, erosion, sediment
Stormwater runoff from livestock operations	Stormwater will pick up pollutants from barnyards and pastures and carry them to open water if it is not properly contained or diverted from ditches, streams, rivers, and ponds	*E. coli* contamination, excess nutrients, and sediment
Increase in impervious surfaces	As the urban areas in the watershed expand, so does the impervious surfaces which increases stormwater runoff which can carry pollutants to open water	Oil and grease, Excess sediment, nutrients
Fertilizer used on urban lawns	As the urban centers and lakes in watershed expand so do the number of homes. Many homeowners are unaware of how to follow guidelines for lawn fertilizers and may over-apply fertilizer which has the potential to run over the land and into waterways	Excess nutrients and impaired biotic communities
Lakes in the area becoming more developed	Over fertilization of lawns around lakes in the area has been noted in the past. Also, as more homes are added the natural shoreline is often degraded, removed, or replaced with a seawall which may increase the chance for nutrients to reach open water and sediment from shoreline erosion.	Excess sediment, nutrients, impaired biotic communities, *E. coli*
Septic system discharge	Septic systems, if not properly maintained, can leak effluent into ground water or leach into surface waters. Many small lakes have concentrated residential areas still using septic systems.	Excess nutrients, sediment, *E. coli*
Lack of no-till and cover crop practices	Seed corn and other food crop field preparation does not include no-till or cover crop practices. In addition fall plowing that leave fields unprotected from erosion is a common practice throughout the drainage.	*E. coli* contamination, excess nutrients and sediments

Concerns	Relevance	Potential Problem
Wetland Conservation	Northeast Indiana has lost many of its historic wetlands which play a vital role in the ecosystem as they absorb floodwaters and pollution	Flooding, lack of wildlife and aquatic habitat, and impaired biotic communities
Stream Bank Erosion	An increase in surface runoff and stream channel modification can increase the potential for stream bank erosion	Sedimentation, turbidity, impaired biotic community
Sedimentation	Sedimentation of the surface water, especially within the Lake system is a concern expressed by stakeholders most anywhere surrounded by agricultural land. This concern has increased with the reduction of conservation tillage practices in the area over the past several years.	Sedimentation, turbidity, impaired biotic community

2.0 Physical Description of the Watershed

This Section will describe the Fawn River watershed in detail to provide a general understanding of the physical attributes of the area that led to its current landuse.

2.1 Watershed Location

A watershed is an area with defined boundaries such that all land and waterways drain into a particular point. Watersheds are given "addresses" called Hydrologic Unit Codes (HUC) that identify where they are located within the United States and into which point they drain. The largest HUC is two digits and defines a particular region. The more digits to a HUC the more specific the drainage area is. The Fawn River drainage is a 10 digit HUC (0405000108) located within the greater St. Joseph River – Lake Michigan watershed, an 8 digit HUC (04050001), shown in Figure 2. The Fawn River watershed is divided into nine, 12 digit HUCs; Snow Lake (040500010801), Tamarack Lake (040500010802), Lake James-Crooked Creek (040500010803), Town of Orland-Fawn River (040500010804), Himebaugh Drain–Fawn River (040500010805), Clear Lake-Fawn River (040500010806), Wegner Ditch-Fawn River (040500010807), Sherman Mill Creek (040500010808), and Fawn River Drain-Fawn River (040500010809). Each of the sub-watersheds will be discussed in detail in Section 3 of the WMP.

The Fawn River watershed, located in Steuben and LaGrange County, Indiana, and Branch and St. Joseph County, Michigan encompasses 165,361 acres of land including over 70 lakes. The Fawn River drainage begins in Steuben County, Indiana at Fish Lake north of the town of Fremont and flows northwest for a short distance before entering Branch County, Michigan

where it encompasses several large lake systems. The drainage then turns south reentering Steuben County, Indiana where it encompasses many large and small lake systems north and northwest of the city of Angola. This portion of the river system involves the bulk of the county's largest lakes that are a significant economic base for the region. From this point the river flows west by northwest and enters LaGrange County, Indiana in the northeast corner and continues for a short distance before reentering Branch County, Michigan. The river flows west by northwest and enters St. Joseph County, Michigan southeast of the town of Sturgis where it turns southwest reentering LaGrange County, Indiana north of the town of Howe. This portion of the river encompasses many large and small lake systems in both Michigan Counties. The river flows west from Howe paralleling Interstate 80/90 to the northwest corner of LaGrange County, Indiana before turning north flowing into St. Joseph County, Michigan. The river drainage continues north encompassing several large and small lake systems before turning west where it empties into the St. Joseph River-Lake Michigan north of the town of Constantine, Michigan. The percent of the Fawn River watershed located within each of the four counties is depicted in Figure 2.1 and the Fawn River watershed is depicted in Figure 2.3.

Figure 2.1: Fawn River Watershed Percentage of Area per County

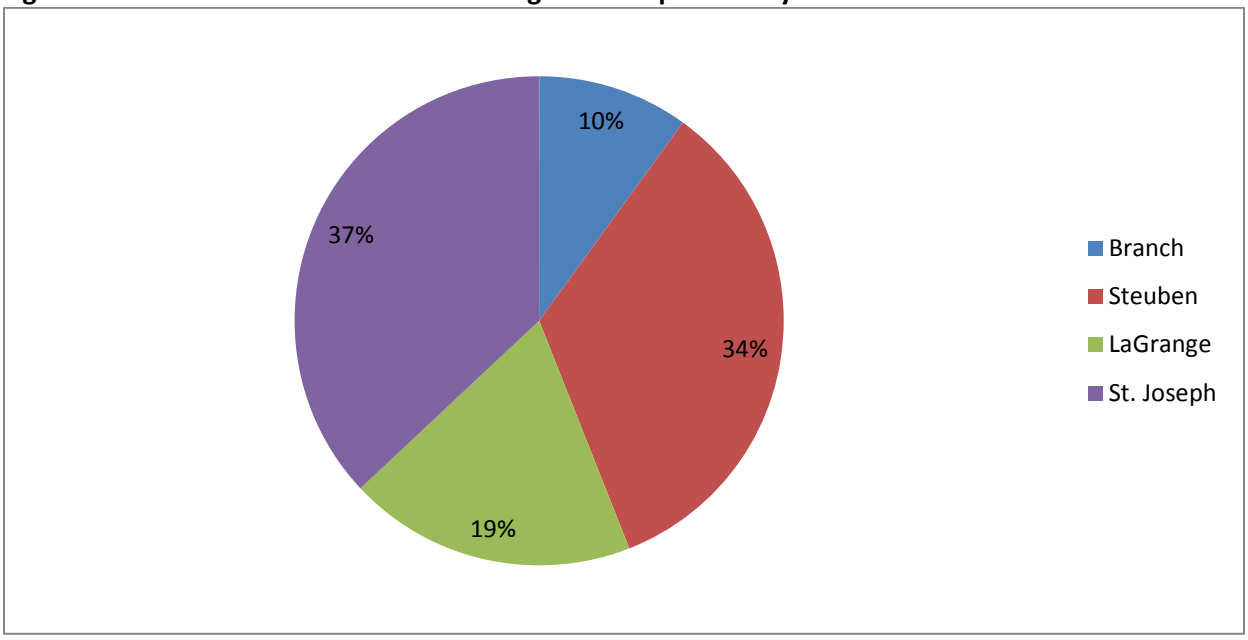


Figure 2.2: Fawn River Watershed Location

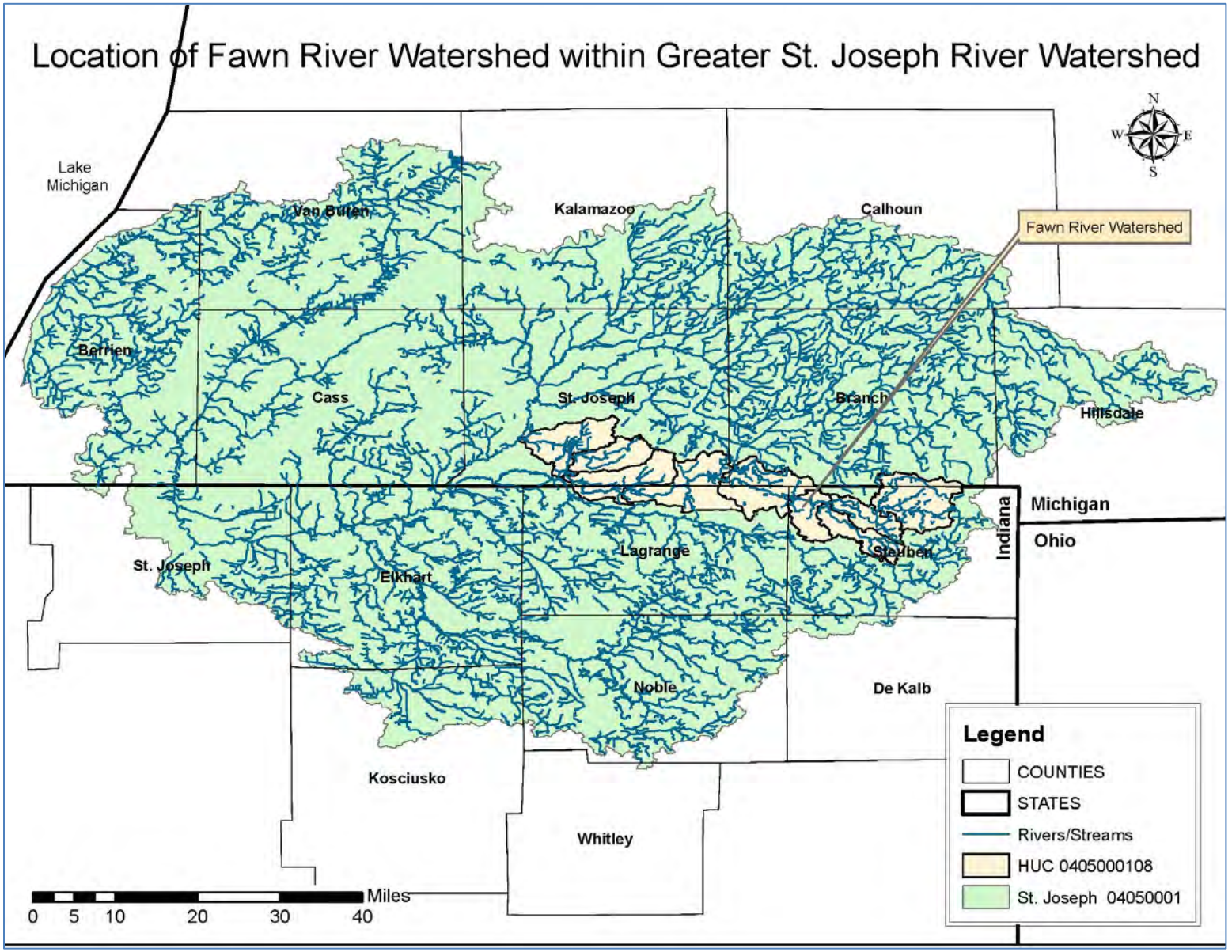
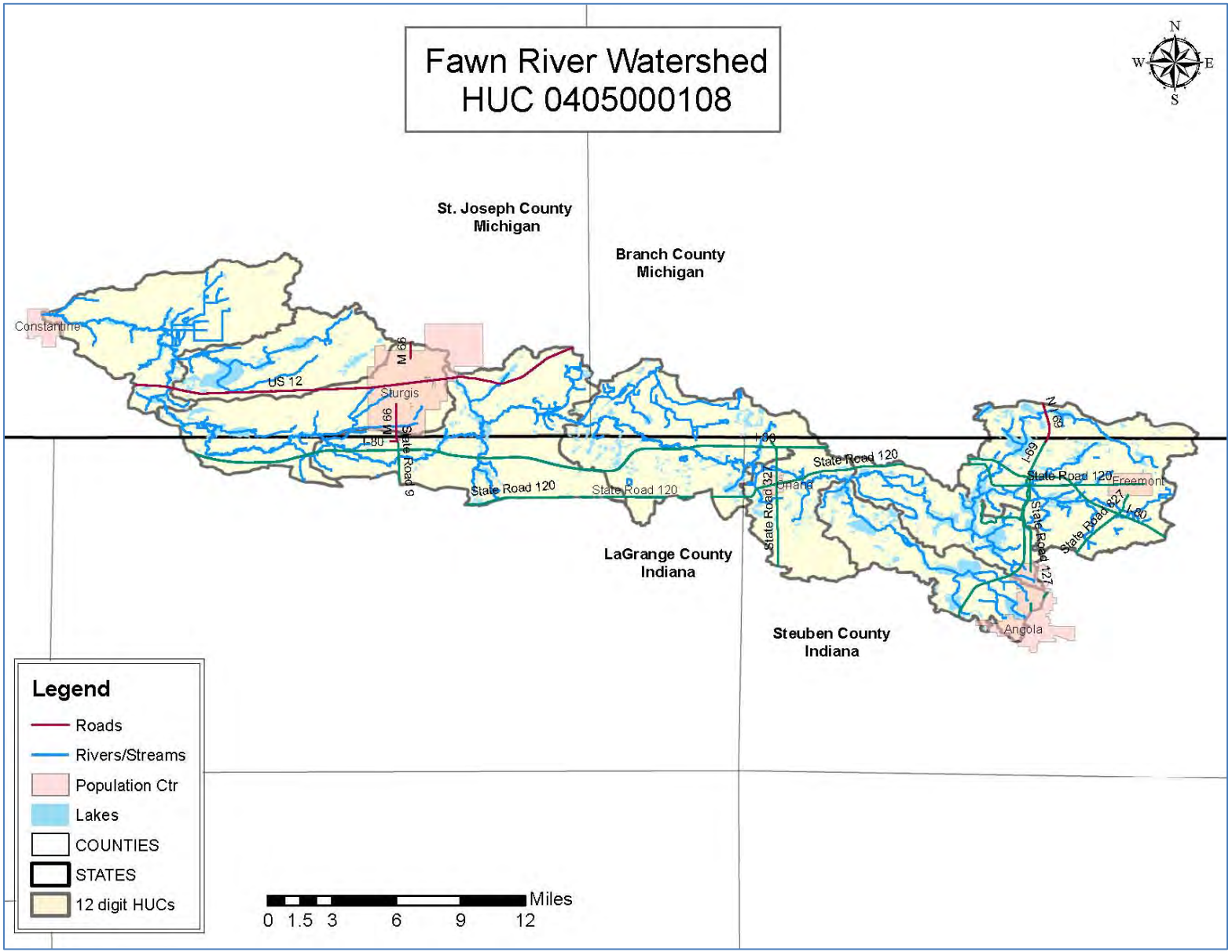


Figure 2.3: Fawn River Watershed



2.2 Geology, Topography, and Soils

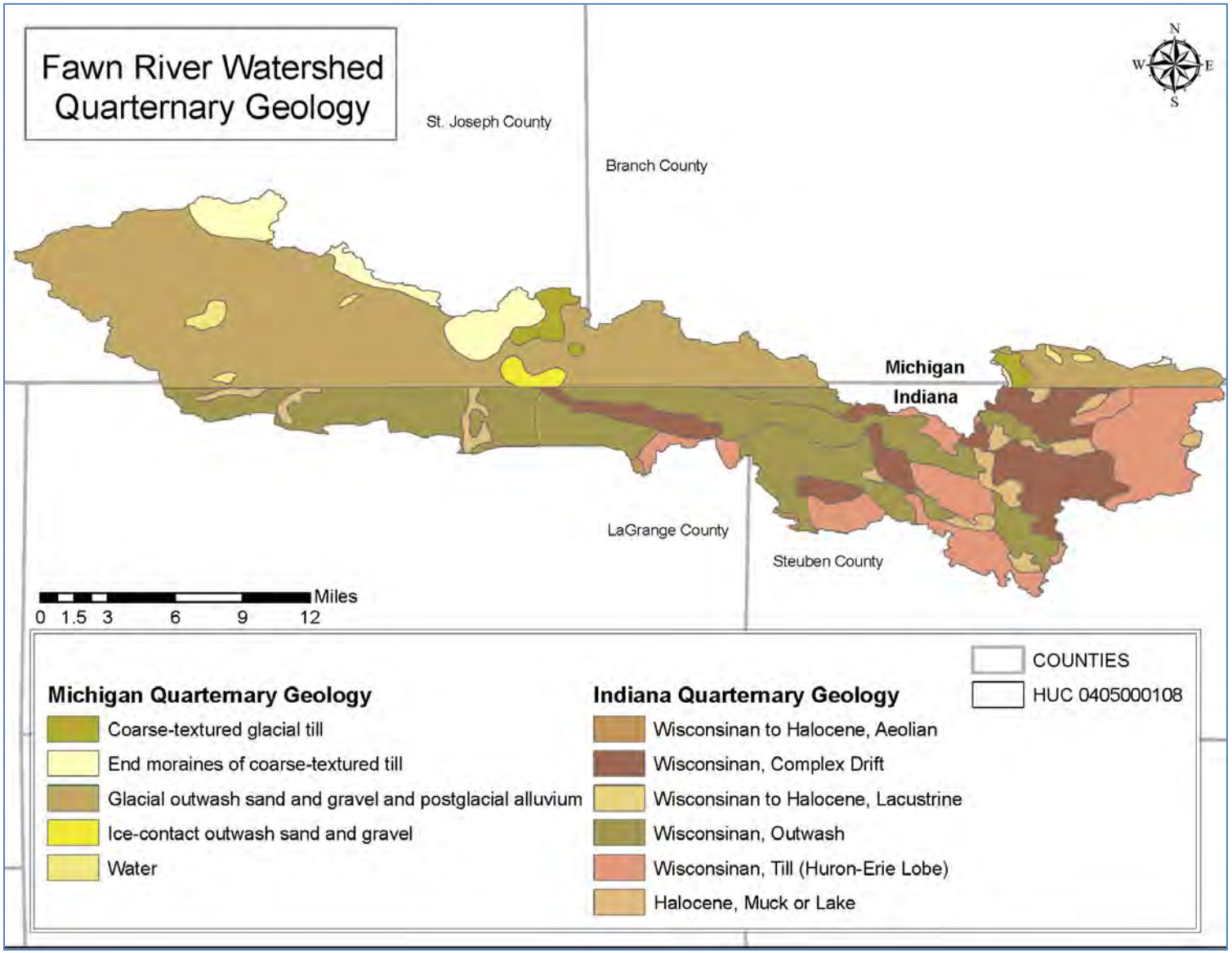
This Section describes the landscape of the area including the formation of the soils and topography present today, which makes the area a prime location for agriculture and the recreational destination it is.

2.2.1 Geology

The landscape of northern Indiana and southern Michigan is directly influenced by the last great glaciation which occurred over 10,000 years ago; the Lake Michigan Lobe of the Wisconsinan glaciation. The glaciers significantly changed the landscape of the project area, filling and damming rivers which created the present day Great Lakes. Prior to the glaciers sweeping over the land, the entire project area's landscape was comprised of rolling hills separated by broad valleys that were dominated by oak-hickory forests, and swamp and marsh lowlands. All of Indiana had the same characteristic rolling hills present in southern Indiana, as the limits of the Wisconsinan glaciation follows the line connecting Terre Haute, Edinburgh, and Richmond, Indiana. As the glaciers advanced and retreated, the massive structures flattened the land surface and wiped out whole forests. As the glaciers melted they formed the many kettle lakes that give northern Indiana and southern Michigan the nickname of "Lake Country". The melting glaciers also deposited rock, dirt and sand that they had picked up while traveling across the landscape. In the project area of northern Indiana and southern Michigan, where the glaciers melted relatively rapidly, glacial till ridges, called moraines, were left. However, the landscape is still much more level than pre-Wisconsinan times but presents a low hilly and rolling landscape.

The bedrock of the project area was deposited during the Mississippian Age, some 300 million years ago. The rocks deposited during the Mississippian Age are called the Borden Group and in the Fawn River watershed, consist primarily of shale and limestone in Indiana, and shale in Michigan. The type of bedrock present within the project area accounts for the ground water wells that supply drinking water to the population centers in the watershed including Sturgis, MI and Fremont and Angola, IN, as well as, the many wells that supply drinking water to the rural communities throughout the project area. The unconsolidated deposits, above the bedrock, are typically between 200 and 350 feet thick throughout the St. Joseph River – Lake Michigan watershed, however there are areas in extreme northeastern Steuben County with a thickness nearing 900 feet in thickness. The project area is covered in glaciofluvial material over the deeper clay deposits. The glaciofluvial material consists of mostly sand and gravel or loamy till and range in thickness from 5 to 25 feet in thickness. Figure 2.4 presents a map showing the geologic characteristics of the watershed.

Figure 2.4: Quarternary Geology of the Fawn River Watershed



2.2.2 Topography

The Fawn River watershed is located within the general physiographic province of the Central Lowlands, which can be broken down further to include the Southern Lower Peninsula Hills and Plains and Three River Lowlands physiographic regions in Michigan (Michigan State University), and the St. Joseph Drainageways and Warsaw Moraines and Drainageways in Indiana (IN DNR). The topography of the watershed is not drastically different from one end to the other with elevations ranging from 1070 feet above sea level at the headwaters to 800 feet above sea level where the Fawn outlets to the St. Joseph River. However, the landscape presents with low, rolling hills throughout the watershed with some flat plains between topographic peaks.

2.2.3 Soils

The project area is comprised of 15 general soil associations. Table 2.1 is a list of the soil associations present in the project area and a description of each association. Soil association descriptions were obtained from the Steuben, LaGrange, Branch, and St. Joseph county United States Department of Agriculture (USDA) soil surveys. The soil associations found throughout much of the Fawn River watershed are exceptionally productive soils, when properly drained and managed, which accounts for the heavy agriculture production present within the watershed. It should also be noted, that several of the soils associations in the watershed are ideal for wetlands, though many wetlands have been drained and converted to agriculture land.

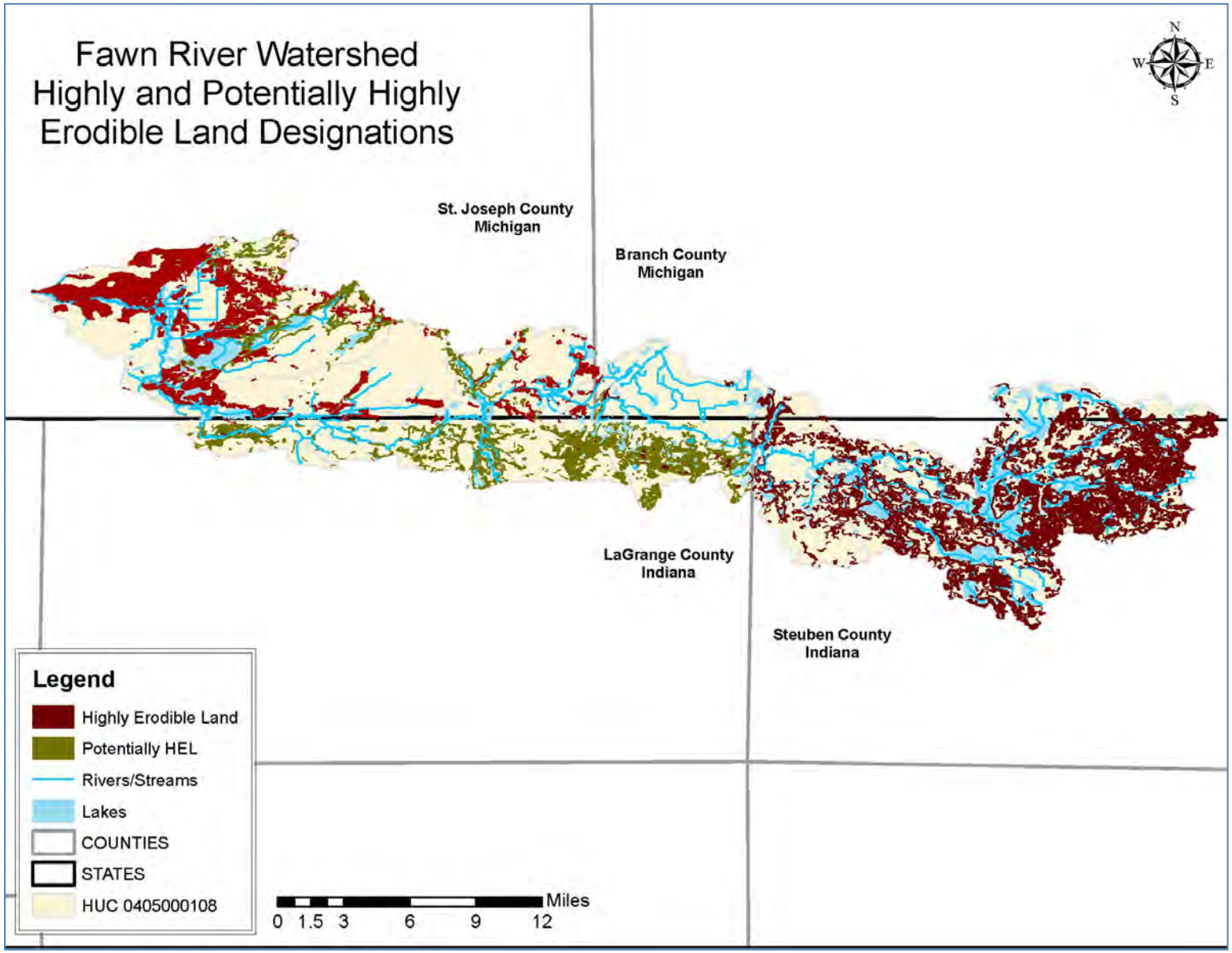
Table 2.1: General Soil Associations

County	Soil Association	Association Description
Steuben	Kosciusko-Ormas-Boyer	Nearly level to strongly sloping, well drained, loamy and sandy soils that are moderately deep or deep over sand and gravel; on outwash plains and moraines
	Riddles-Miami-Brookston	Deep, nearly level to moderately steep, well drained and very poorly drained, loamy soils on till plains
	Glynwood-Morely-Blount	Deep, nearly level to moderately steep, well drained to somewhat poorly drained, silty soils on till plains and moraines
	Houghton-Rensselaer-Milford	Deep, nearly level, very poorly drained, mucky, loamy, and silty soils in depressions on outwash plains and lake plains
LaGrange	Wawasee-Hillsdale-Conover	Nearly level to strongly sloping, well drained and somewhat poorly drained, moderately coarse textured and medium textured soils on till plains and moraines
	Boyer-Oshtemo	Nearly level to moderately steep, well drained, coarse textured soils on outwash plains, valley trains, moraines, and kames
	Shipshe-Parr	Nearly level to moderately sloping, well drained, moderately coarse textured and medium textured soils on outwash plains and till plains
	Houghton-Adrian	Nearly level, very poorly drained muck soils in depressional areas on outwash plains, till plains, and moraines

County	Soil Association	Association Description
Branch	Fox-Oshtemo-Ormas	Nearly level to moderately steep, well drained, loamy and sandy soils on outwash plains and moraines
	Fox-Houghton-Edwards	Nearly level to moderately sloping, well drained, loamy soils on outwash plains and moraines and level, very poorly drained, mucky soils in swamps, depressions, and drainageways
	Locke-Barry-Hillsdale	Level to moderately sloping, somewhat poorly drained, poorly drained, and well drained, loamy soils on till plains and moraines
St. Joseph	Adrian-Granby	Nearly level, very poorly drained and poorly drained mucky and loamy soils; in bogs and depressions and on outwash plains and lake plains
	Oshtemo-Spinks	Nearly level to gently rolling, well drained loamy and sandy soils; on outwash plains and moraines
	Hillsdale-Elmdale	Nearly level to gently rolling, well drained and moderately well drained loamy soils; on till plains and moraines
	Elston	Nearly level, well drained loamy soils; on outwash plains

The Fawn River steering committee and stakeholders expressed concern about soil erosion and sedimentation of streams, rivers, and lakes. The erosion issues present in the watershed may be due to unsustainable farming practices on land that is considered to be highly or potentially highly erodible. The Natural Resource Conservation Service (NRCS) maintains a database of highly erodible (HEL), potentially highly erodible land (PHEL), and hydric soils for each county. The soils that have been determined to be highly erodible are so designated by dividing their average rate of erosion by the soil loss tolerance, which is the maximum amount of soil loss that can occur before a long term reduction in productivity will be seen. Soils are determined potentially highly erodible based on the slope and length of the slope. The presence of HEL and PHEL in farmland can contribute significantly to nonpoint source pollution (NPS) by increasing the amount of sediment carrying other pollutants such as, nutrients and pesticides, to open water. Slightly over 26% of the soils present within the Fawn River watershed are considered to be HEL (20.17%) or PHEL (6.05%). Figure 2.5 is a map of the project area showing the location of HEL and PHEL in the watershed.

Figure 2.5: Highly and Potentially Highly Erodible Soil

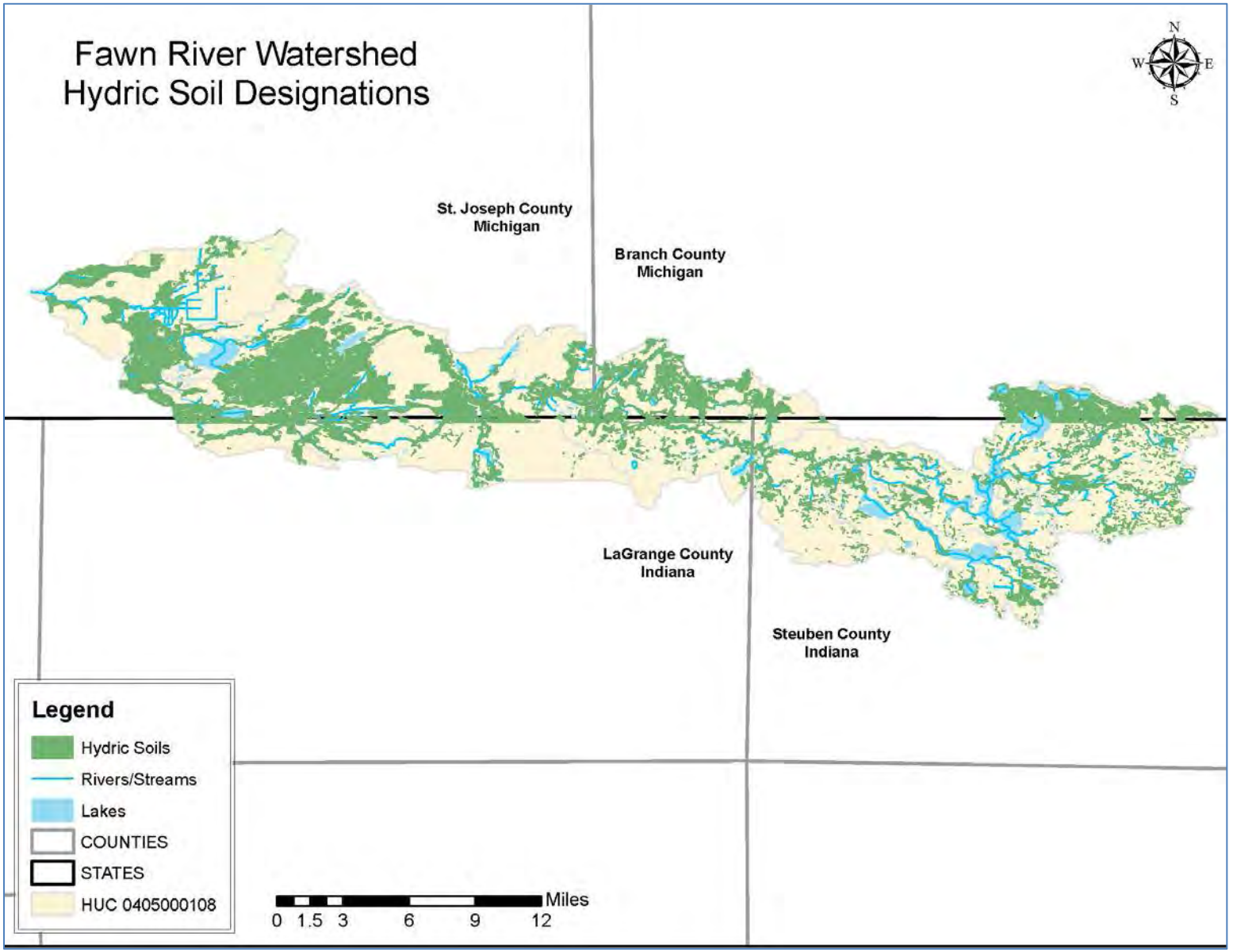


Hydric soils are present where wetlands are, or were. Several soils present within the project area are classified by the local NRCS as hydric as can be seen in Figure 2.6. The NRCS is in the process of standardizing soil classifications throughout the country; however Indiana and Michigan currently classify their soils differently. MI classifies all their major soil types as either hydric or not hydric while IN classifies their soils as hydric based on the dominant soil type and its associations. Hydric soils can pose threats to surface water when farmed due to excessive runoff of fertilizers, pesticides, and manure. Farmland located on hydric soils often requires the installation of field tiles to keep the fields from flooding or ponding. Field tiles can provide a direct conduit for water polluted with fertilizer, land applied manure, and sediment to reach surface waters. Hydric soils are also not suitable soils for septic usage as they do not allow for proper filtration of the septic leachate and may result in surface and/or groundwater contamination. Soils that are considered hydric are so classified for several reasons. The following explanation of hydric soils was taken from the NRCS, Field Office Technical Guide.

1) All Histols except for Folistels, and Histosols except for Folists.
2) Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that.
    a) Are somewhat poorly drained and have a water table at the surface (0.0 feet) during the growing season, or
    b) Are poorly drained or very poorly drained and have either:
        i) Water table at the surface (0.0 feet) during the growing season if textures are coarse sand, sand, or fine sand in all layers within a depth of 20 inches, or
        ii) Water table at a depth of 0.5 feet or less during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within a depth of 20 inches, or
        iii) Water table at a depth of 1.0 foot or less during the growing season if permeability is less than 6.0 in/hr in any layer within a depth of 20 inches.
    c) Soils that are frequently ponded for long/very long duration at the growing season.
    d) Soils that are frequesntly flooded for long/very long duration at the growing season.

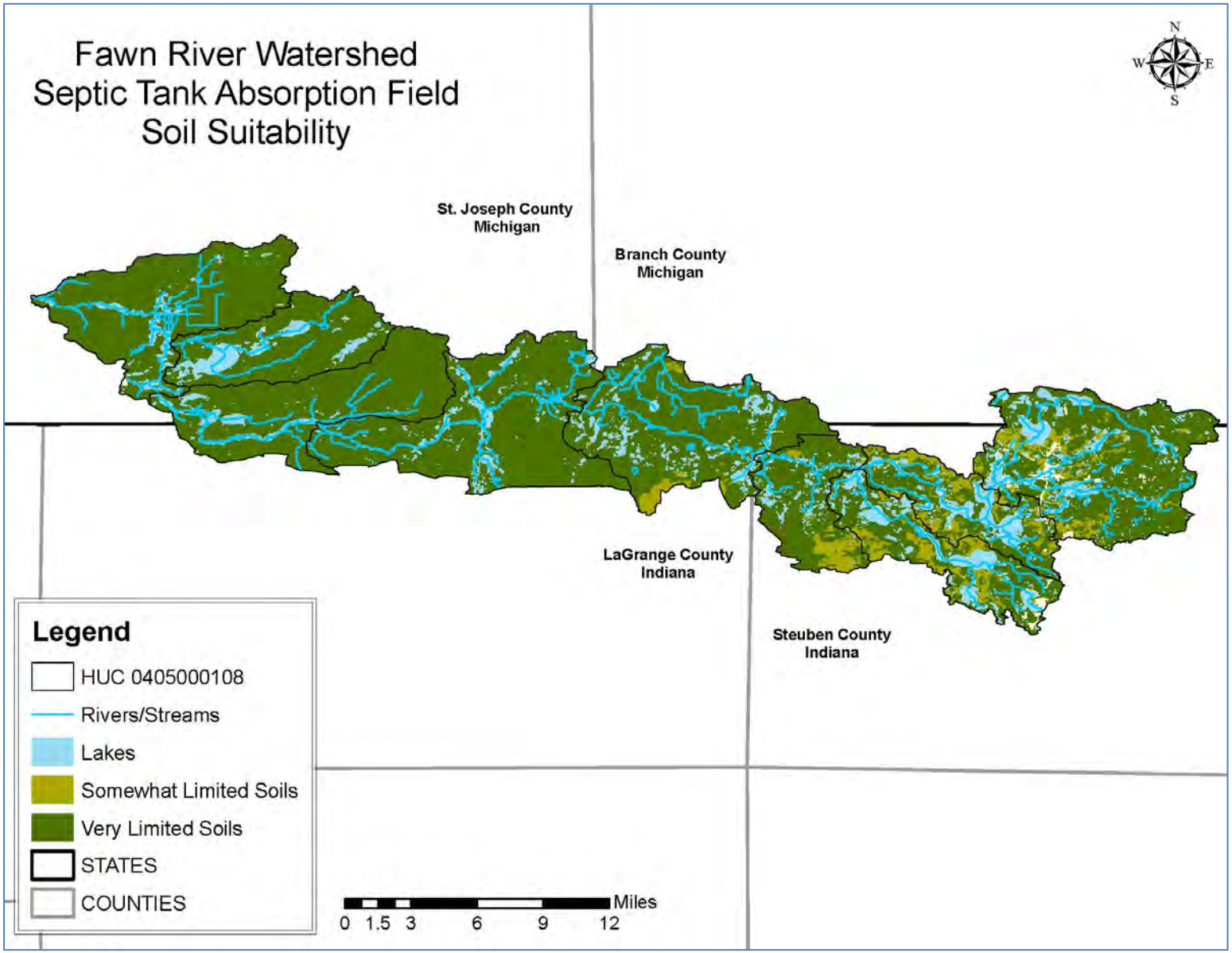
Hydric soils, while posing a significant problem when farmed, also are quite beneficial as they are prime locations to create or restore wetlands, which is a concern for the Fawn River steering committee and stakeholders. The Fawn River watershed is located where the many historic swamps once existed which were drained and converted to prime farmland in the late 19th century which may account for the presence of hydric soils as over 27.46% of the soil in the watershed is classified as hydric. Wetlands are great resources as they supply many ecological benefits and could help prevent polluted runoff from reaching open water.

Figure 2.6: Hydric Soils



Soil type is important to consider when installing an onsite sewage disposal system as traditional septic tanks utilize the soil to absorb effluent discharged from the tank into absorption fields. Septic tank absorption fields are subsurface systems of French drains that distribute septic liquid waste evenly throughout the designated area and into the natural soil. Soil properties and landscape features that affect the ability of the soil to properly absorb and filter the effluent should be considered when designing a septic system. Most of the rural population within the Fawn River project area uses septic systems to process their wastewater, as do several lake populations in the area. All incorporated population centers utilize a centralized sewer system to handle household effluent. The Fawn River steering committee expressed concern regarding failing on-site waste disposal systems and since the majority of the watershed is rural and using on-site waste disposal, it is important to note that most of the soils (84.67%) located within the project area are rated as "very limited" for septic usage according to the NRCS. The NRCS has classified 6.8% of the soils as "somewhat limited" for the installation of an on-site sewage processing. Somewhat limited means that modifications can be made to either the site of septic installation or to the system itself to overcome any potential problems. A designation of "Very limited" means that modifications to the septic system site, or septic system itself, are either impractical or impossible. However, since less than 9% of the project area can safely handle a septic system (Figure 2.7), the ideal situation would be to not install any septic systems and revert to an above ground mound system, a constructed wetland to process wastewater, hook up to a centralized sewer system, or utilize another innovative means to safely process wastewater.

Figure 2.7: Soil Septic Suitability in the Fawn River Watershed



2.3 Climate

The climate in the project area is considered temperate with warm summers and cold winters. The warmest month of the year is July with an average high of 83°F and average low of 61°F. The coldest month of the year is January with an average high of 30°F and low of 16°F. There is an average of 38.5 inches of precipitation each year. Figure 2.8 graphically illustrates the average temperature range per month and Figure 2.9 illustrates the average precipitation per month within the project area.

Figure 2.8: Average Monthly Temperatures within Fawn River Watershed

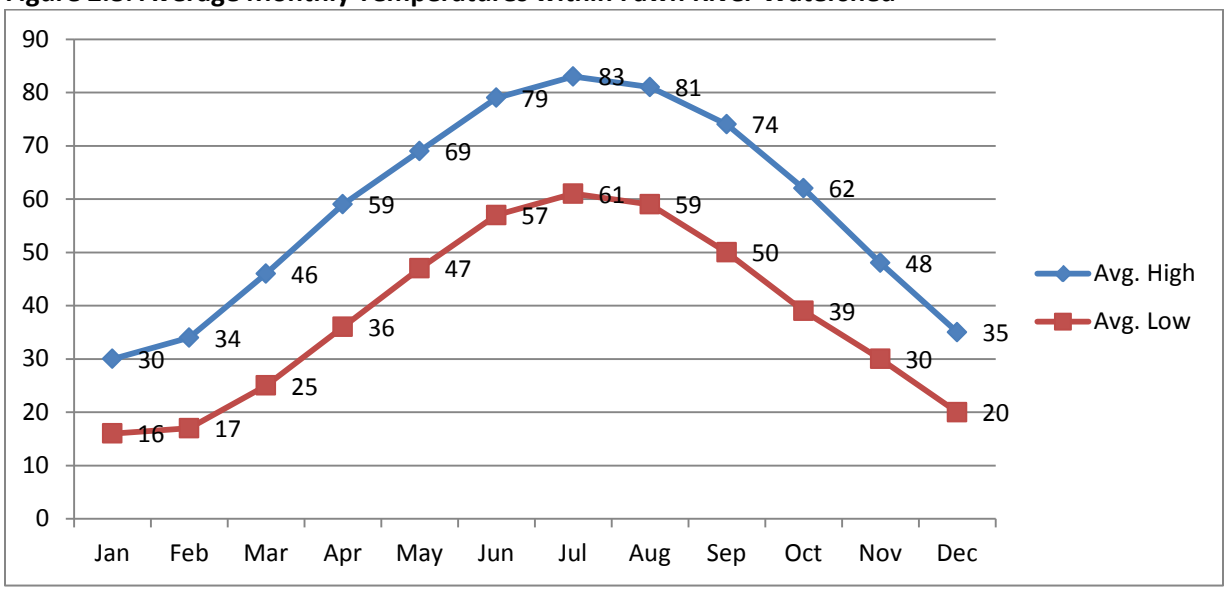
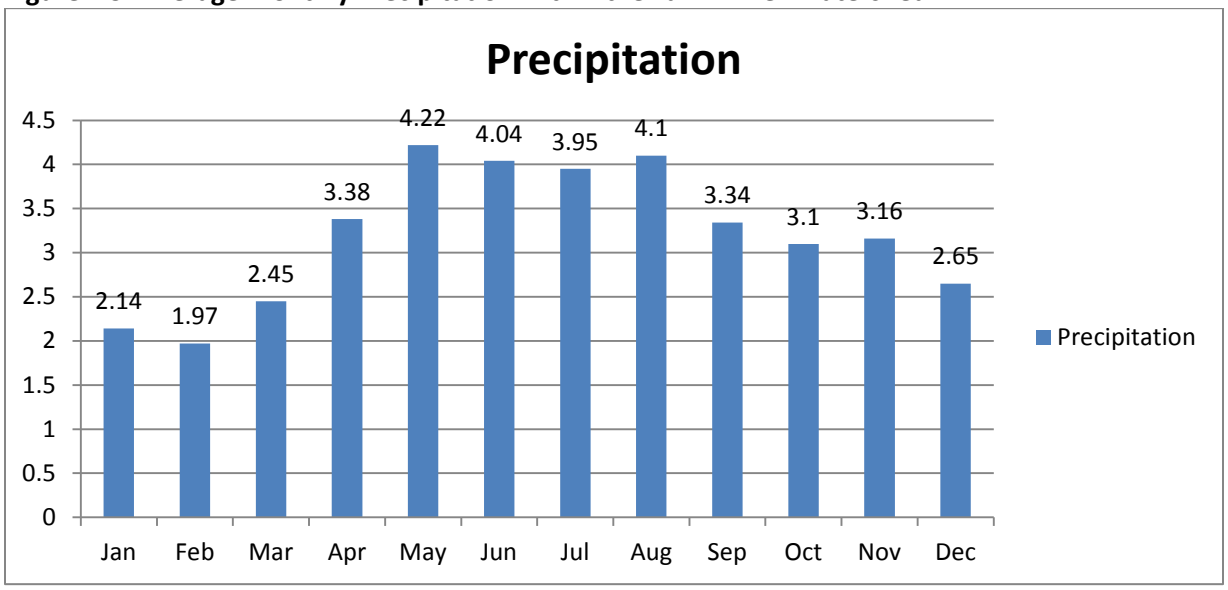


Figure 2.9: Average Monthly Precipitation within the Fawn River Watershed



2.4 Hydrology

There are 299.53 miles of streams, rivers, ditches, and canals located within the Fawn River Watershed according to the National Hydrography Dataset (NHD) which is released by the US Geological Survey (USGS). The Fawn River itself begins on the north edge of the town of Orland at the Indiana Department of Natural Resources (INDNR) Fawn River Fish Hatchery where Crooked Creek feeds into the hatchery and the Fawn exits the hatchery. The Fawn River measures 55.44 miles total between the hatchery and its confluence with the St. Joseph River – Lake Michigan. The Fawn River is listed by the Division of Recreation of the INDNR as "Outstanding" due to it being identified by the state natural heritage program, or similar program, as having outstanding ecological importance and because it is a state designated canoe route. Michigan does not have the Fawn River listed for any significance. Table 2.2 and Figure 2.10 represent the various types of flowing water in the Fawn River Watershed and a description of those various types is listed below.

- Stream/River – A body of flowing water.
- Artificial Path – A feature that represents flow through a two-dimensional feature, such as a lake or a double-banked stream.
- Connector Path – Establishes a known, but non-specific connection between two non-adjacent network segments that each has flow.
- Canal/Ditch – An artificial open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for watercraft.

Table 2.2: Stream Miles in the Fawn River Watershed

Stream/River	Artificial Path	Connector Path	Canal/Ditch	Unit
143.36	113.45	0.04	42.68	Miles
230.71	182.57	0.07	68.69	Kilometers
			Total = 299.53	Miles

It should be noted that since the flowing water types are determined through aerial photography, that they may not be classified correctly. As will be discussed in Section 2.4.2, there are more maintained ditches located within the Fawn River watershed than is described in the NHD.

2.4.1 Lakes

There are over 2000 lakes located within the Fawn River Watershed, with 70 of those lakes having given names, most of which are also populated and are, or are becoming built-up. The sizes of the lakes vary from as small as less than a quarter of an acre to as large as 1,842 acres (the Lake James chain). The high number of lakes account for 16,792.54 acres (6,795.7 hectares) of surface area within the watershed. Figure 2.11 shows the location of the lakes within the Fawn River Watershed.

Figure 2.10: Rivers and Streams in the Fawn River Watershed

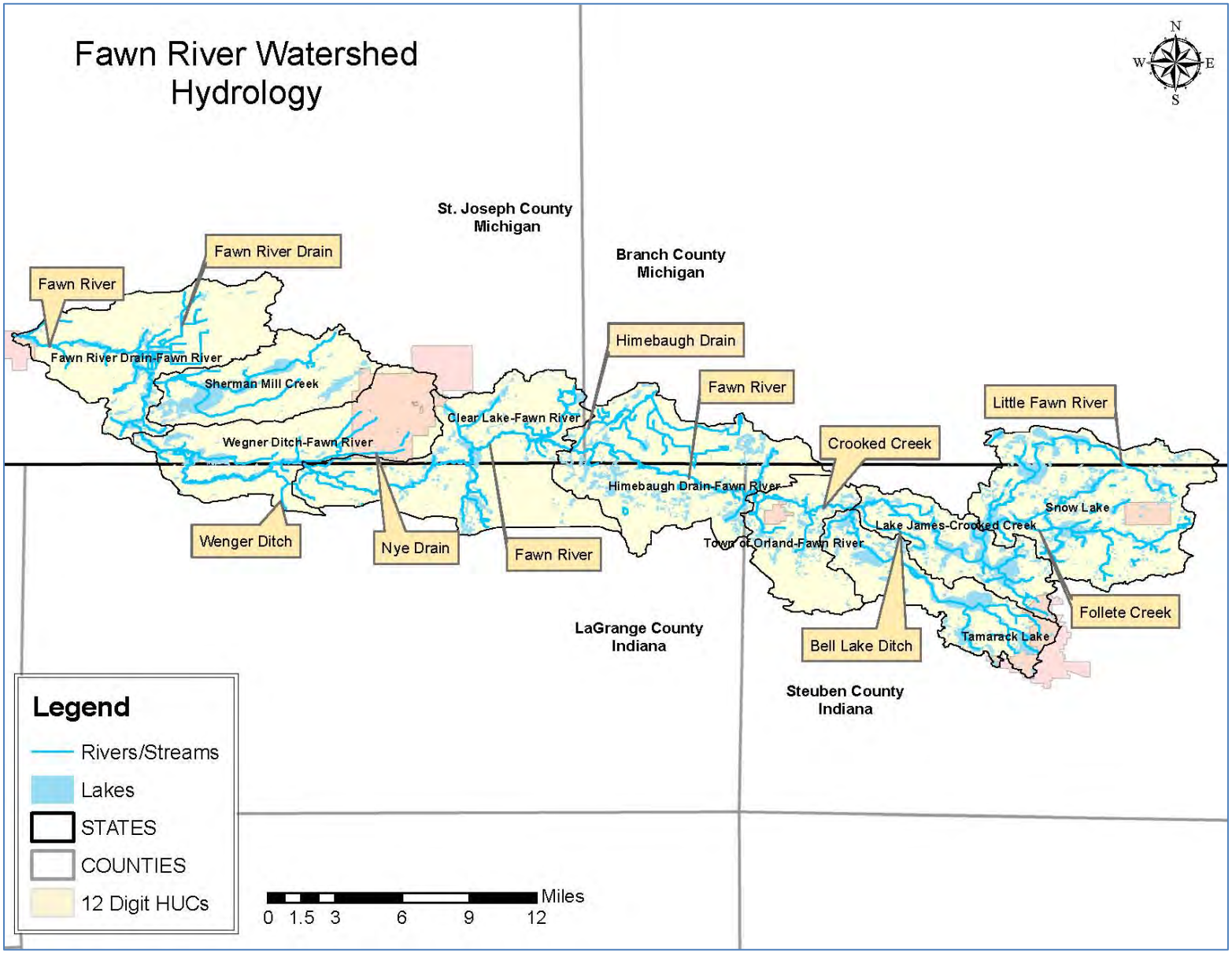
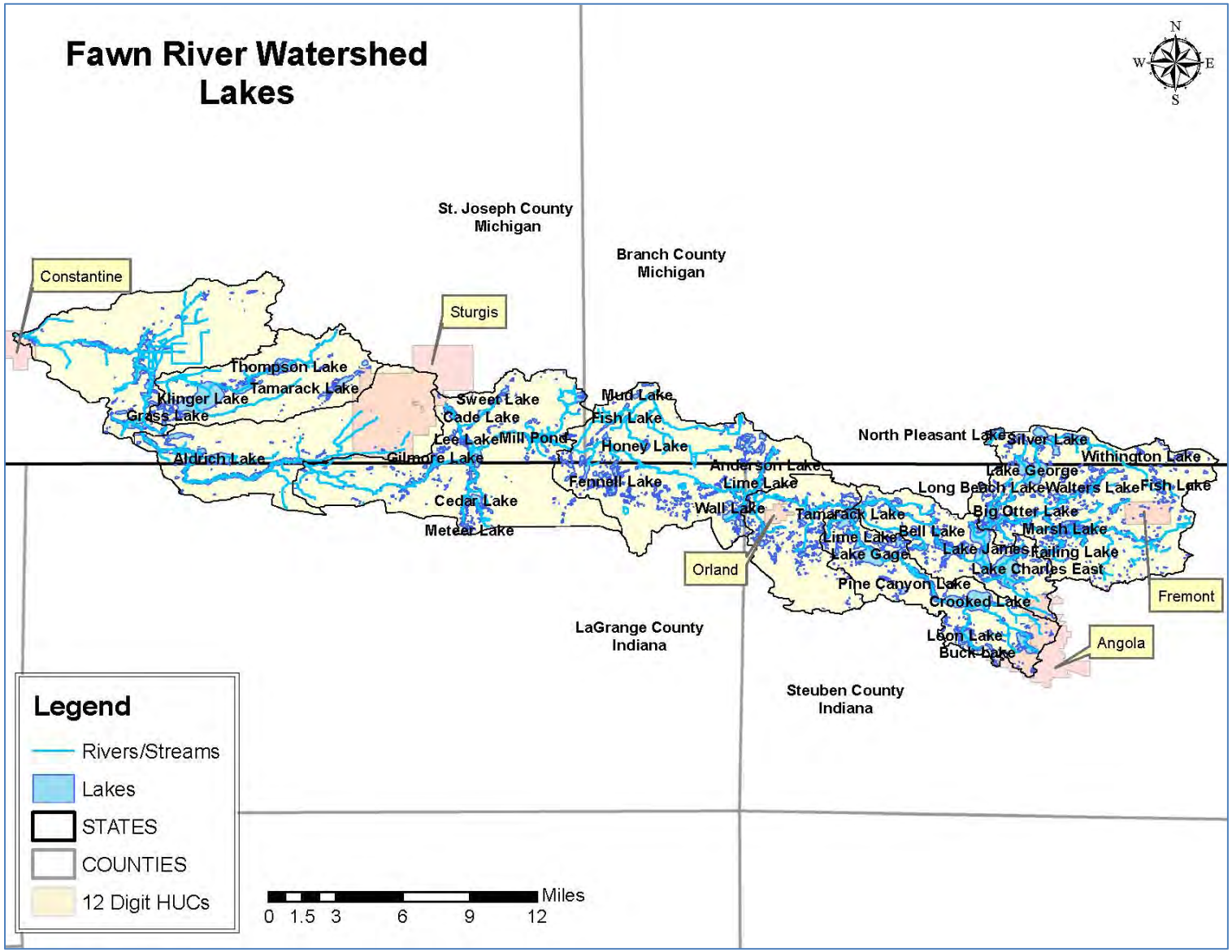


Figure 2.11: Lakes in the Fawn River Watershed



The lakes located in the Fawn River Watershed, specifically Steuben and LaGrange counties, are a major attraction to northeastern Indiana, bringing tourists in from around the tri-state area. Many residents of Fort Wayne, the second largest city in Indiana, have summer homes "at the lake" in northeast Indiana and it is estimated that the population of Angola nearly doubles during the warmer recreational months. Nearly all lakes of substantial size in the Fawn River Watershed are built-up now, and homes and businesses continue to be built in the area. Some struggles of this continues growth include the fact that the Regional Sewer Districts are struggling to ensure all new homes and facilities are hooked up to the centralized sewer system and the shorelines of the lakes are being turned into hardscapes which disrupts the natural aquatic ecosystem.

2.4.2 Legal Drains

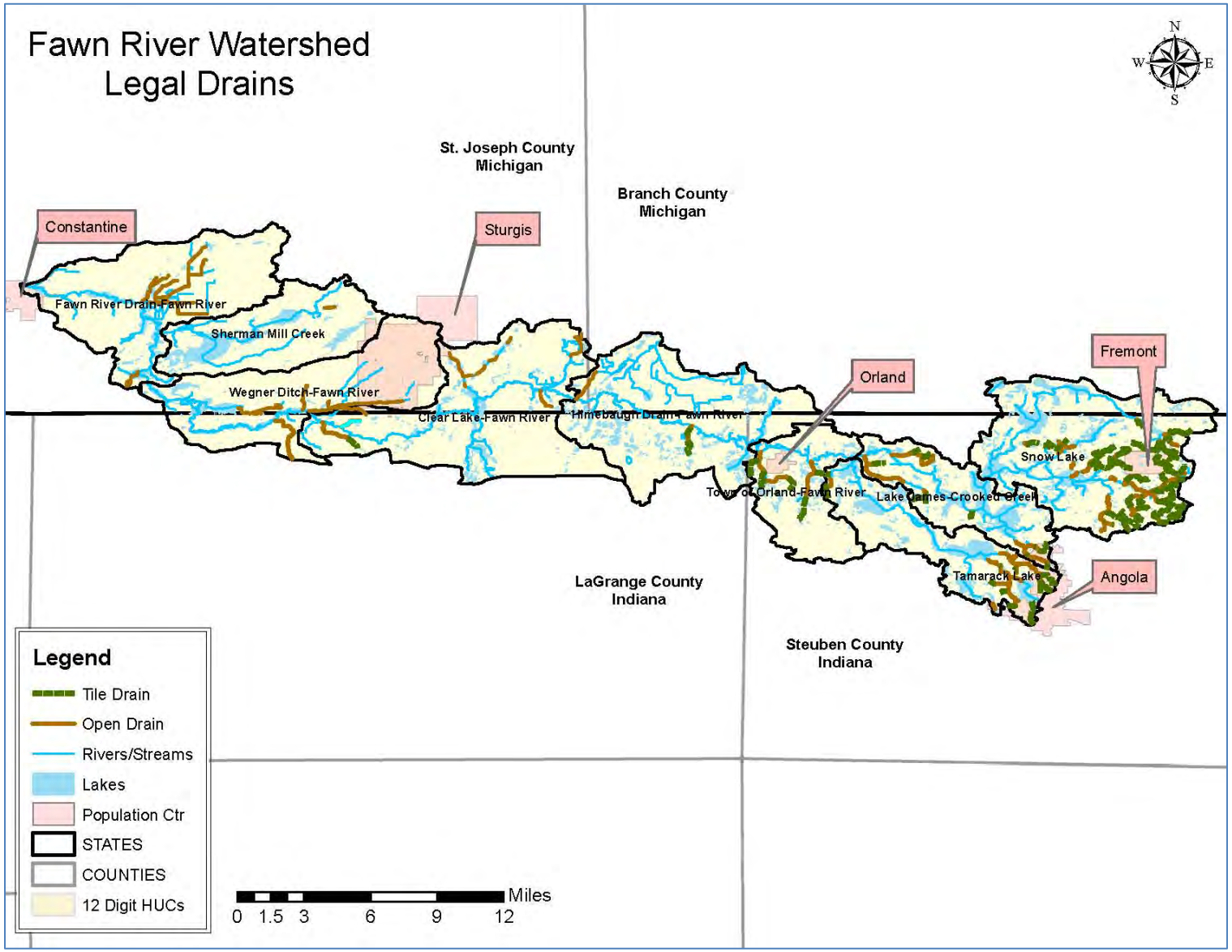
The natural streams, as well as legal drains, within the project area are used as a means to carry excess water from the land so that it may be used for agriculture, commerce, industry, and many other uses. However, due to flooding or ponding issues, many of the tributaries have been channelized to increase the velocity of water flowing downstream and decrease the risk of ponding and flooding. As can be seen in the Figure 2.10, above, many tributaries, specifically those located in St. Joseph County, have been channelized and straightened to aid in the draining of those heavily farmed areas.

Local drainage boards and County Surveyors are charged with maintaining many of the streams and ditches so that they may continue to function properly for their designed use. These maintained waterways are often referred to as legal drains. There are approximately 61.86 miles of legal surface drains and 44.18 miles of legal tile drains maintained by the county government within the Fawn River Watershed. St. Joseph County does not maintain records on any tile drains throughout the entire county, though they do assist with maintenance of tile drains, and Branch County does not have any regulated drains located within the project area. LaGrange County does not presently have the legal drains digitized, so paper maps were provided by the LaGrange County Surveyor Office and the drains were digitized by SNRT, Inc from the paper maps. Therefore, the total miles of legal drains located within LaGrange County may not be accurate. Table 2.3 provides a breakdown of legal drain miles within the project area for each county and Figure 2.12 shows the location of the legal drains.

Table 2.3: Legal Drains by County in the Fawn River Watershed

County	Steuben	LaGrange	St. Joseph	Branch	Total
Miles Open Drain	28.72	4.76	28.38	0	61.86
Miles Tiled Drain	42.33	1.85	0	0	44.18

Figure 2.12: Legal Drains in the Fawn River Watershed



2.4.3 Wetlands

Wetlands play an integral role in our lives. Wetlands are important habitat to many species of plants and animals, some of which are on the endangered species list. They provide recreational areas for wildlife and bird watching, fishing, and many other recreational past-times. Wetlands also help to lessen the impact of flooding and act as pollution sinks to absorb many pollutants prior to being released to open water. However, there are few wetlands still present in the Fawn River watershed compared to pre-settlement time. It was estimated by Friends of the St. Joseph River Association – Wetland Partnership, that the Fawn River Watershed has lost 39% of the wetlands present before settlement of the area. There are currently 26,798.56 acres of wetlands in the Fawn River watershed according to the National Wetland Inventory (NWI) which is based on 1979 data. The wetland land cover according to the NWI accounts for approximately 16% of the watershed area. The loss of wetlands has increased flooding and drought damage, as well as initiated the major decline in fish, bird, and wildlife species in the watershed.

There are several types of wetlands each providing different degrees of eco-services. The approximate area containing each type of wetland is outlined in Table 2.4 and described below.

- Freshwater Emergent Wetland – Palustrine; Herbaceous marsh, fen, swale, and wet meadow.
- Freshwater Forested/Shrub Wetland – Palustrine; Forested swamp or wetland shrub bog
- Freshwater Pond – Palustrine unconsolidated bottom or aquatic bed; pond
- Lake – Lacustrine wetland and deepwater; Lake or reservoir basin
- Riverine – Riverine wetland and deepwater; River or stream channel

Table 2.4: Wetland Classification within the Fawn River Watershed

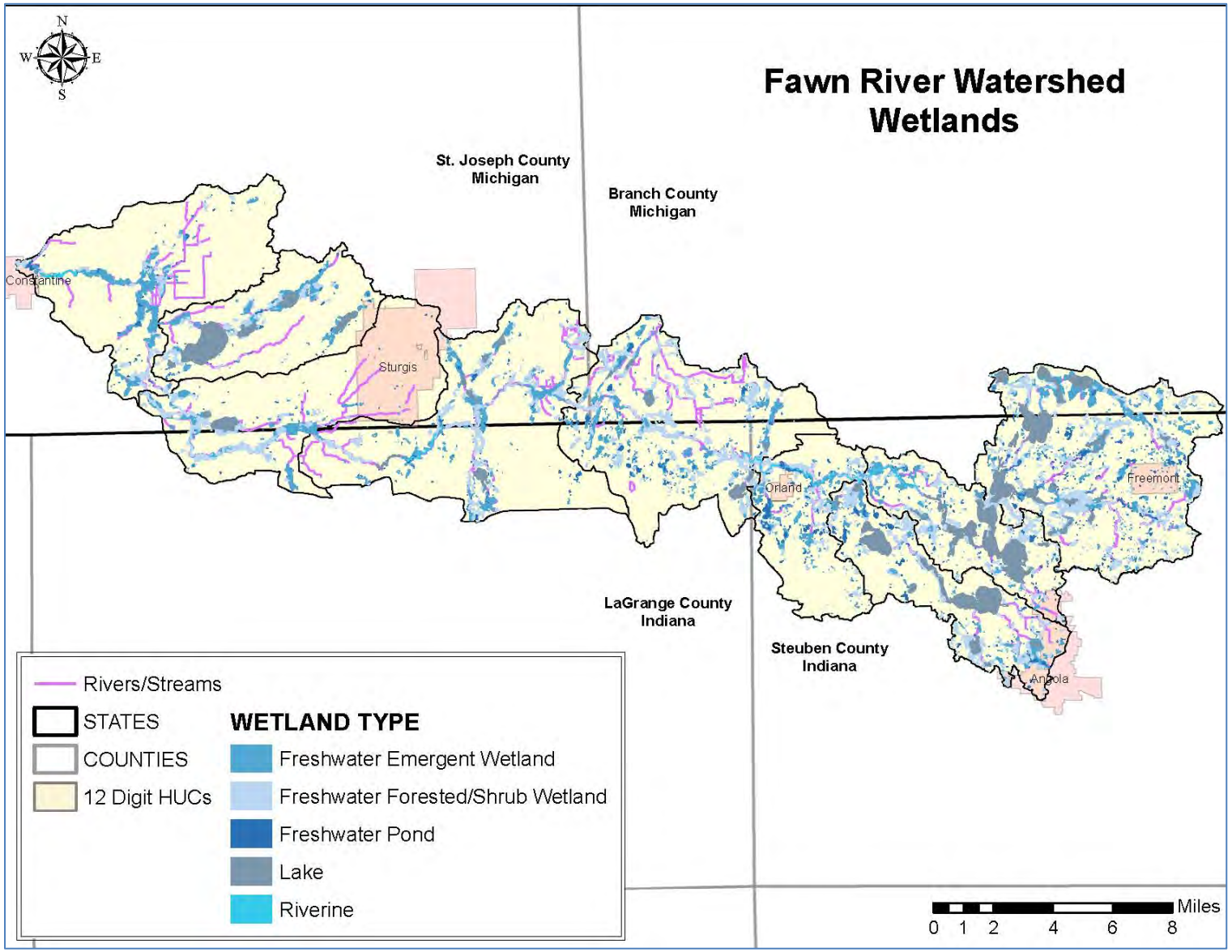
Wetland Type	Emergent	Forested/Shrub	Pond	Lake	Riverine
Acres	7487.75	9868.48	1440.34	7742.24	259.75
					Total = 26,798.56

It should be noted that an update to the 1979 NWI has been completed though it has not been made available to the public at this time. Matt Meersman of the Friends of the St. Joseph River Association was a part of a project involving the Michigan Department of Environmental Quality (MDEQ) that looked at the functional use of each wetland present in 2005, as well as that of pre-settlement wetlands to evaluate the functional use loss of wetlands in the entire St. Joseph River – Lake Michigan Watershed. That data has been supplied to this project by Matt Meersman. According to the wetland functional use study, the Fawn River watershed has lost 40% of its floodwater functional use, 36% of shoreline stabilization functional use, and a combined water quality functional use loss of 36% and habitat loss of 44%. It was also estimated that the Fawn River watershed has lost 61% of the ability to retain pathogens. These results suggest that the 39% loss in overall wetlands has had a greater impact on the quality of various aspects of the watershed. The wetland inventory conducted in 2005 shows approximately 616 acres of wetland has been lost between 1979 and 2005 (currently estimated at 26,182.4 acres) and nearly 11,000 acres of wetland has been lost since pre-settlement times. The publicly available, National Wetland Inventory, data was used for the analysis of acres per

wetland type here to keep consistent with other published data, studies, and reports. However, the wetland functional use study, conducted by the Friends of the St. Joseph River Association – Wetland Partnership, will be used to evaluate wetland loss at the Sub-watershed level in Section 3.

Figure 2.13 shows where the wetlands within the Fawn River watershed have been delineated by the US Fish and Wildlife Service's, NWI. The wetlands in Figure 2.12 were not verified by a ground survey so should not be considered definitive wetland boundaries but rather estimates only.

Figure 2.13: Current Wetlands in the Fawn River Watershed



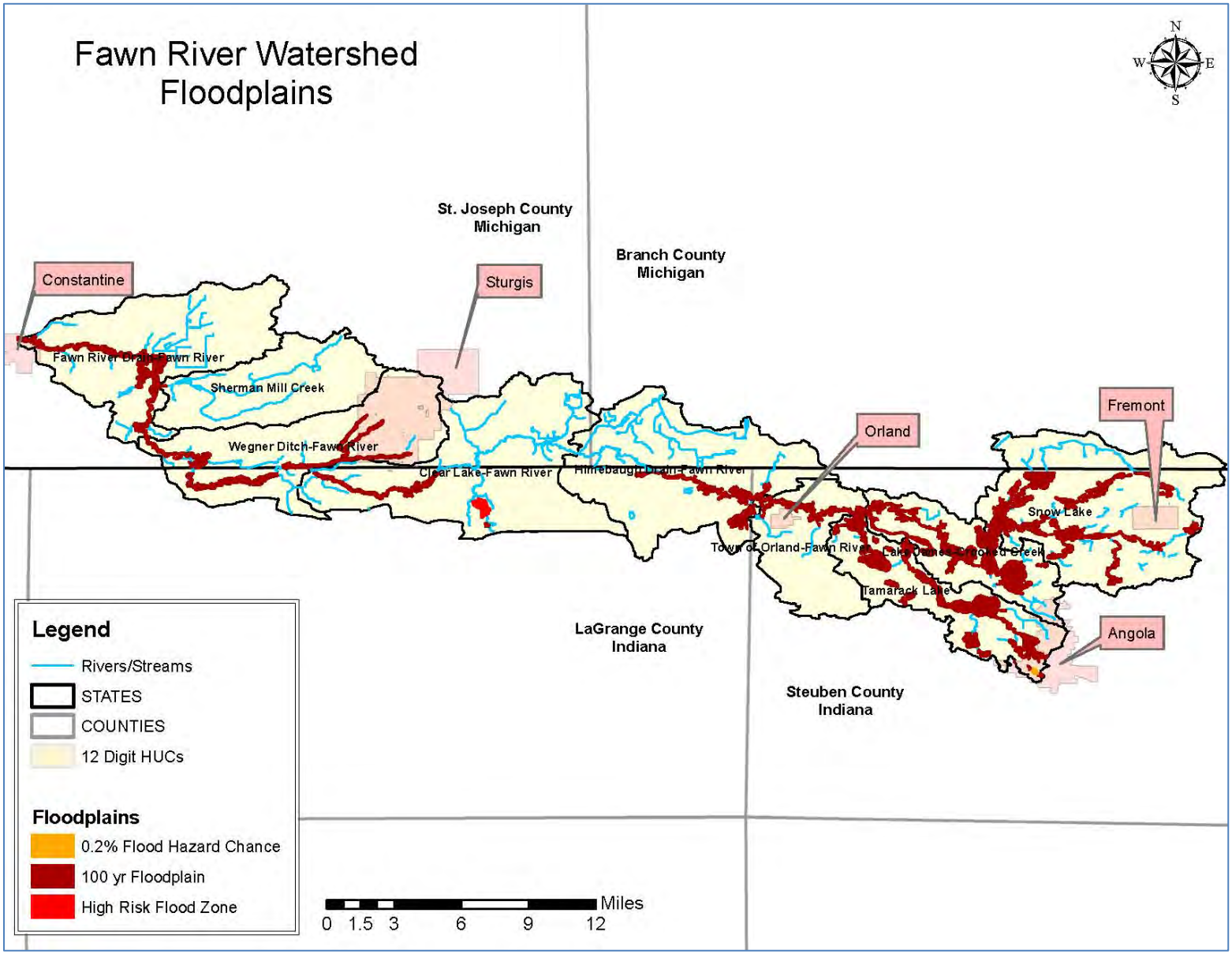
2.4.4 Floodplains and Levees

The Fawn River is not known to flood regularly largely because the river is fed by glacial lakes and is interconnected with a large aquifer system. However, flooding in general can be linked to economic hardship, water impairment, and the destruction of key wildlife habitat. There are three historic gage stations located within the Fawn River watershed, though none of them have been in use since the mid-1980s, the flood stage was set at 10 feet.

Floodplains are important to protect for environmental and economic reasons, as mentioned above. As was explained in Section 2.4.2, many open waterways in the Fawn River Watershed are under regular maintenance by the regulating offices in each county and as waterways are straightened and dredged, nature fights the banks to restore the natural sinuosity of the waterway and reestablish the streambank shelves to allow for floodwater to settle. Flooding can also be exacerbated by an increase in impervious surfaces such as those in and around Angola and Fremont, IN, and Sturgis, MI, as well as the many built-up lakes in the watershed. It should be noted that portions of Angola and Sturgis are located within the 100 year floodplain and are at risk of property and environmental damage from flooding according to the Federal Emergency Management Agency (FEMA). Imperviousness adds to the amount of water within the river, as well as the velocity and erosive power of the river. Indiana has made available floodplain maps to the public. Indiana agencies have designated Crooked Creek and much of the Fawn River, as well as most lake communities to be within a 100 year flood plain (approximately 9,505 acres) which means there is a 1% annual chance of the area becoming flooded. Indiana agencies have also deemed Cedar Lake, located in the Clear Lake – Fawn River sub-watershed, to be at high risk of flooding (approximately 149 acres) as well as approximately 13 acres located in Angola to be at a 0.2% risk of flooding. Michigan has only just begun to digitize their floodplain maps; therefore the entire watershed is not represented by flood risk maps in MI. The only portions of the watershed available for MI are located in St. Joseph County. A map showing the designated flood plains in the Fawn River is shown in Figure 2.14. Please note that GIS files are not available for MI and the flood risk areas on the map were digitized based on hard maps, and is an approximation only.

Due to the potential of flood damage to residences and businesses located within the floodplain, many areas will install levees as an urban flood protection measure. There are no levees located in the Fawn River watershed.

Figure 2.14: Floodplains Located within the Fawn River Watershed



2.4.5 Dams

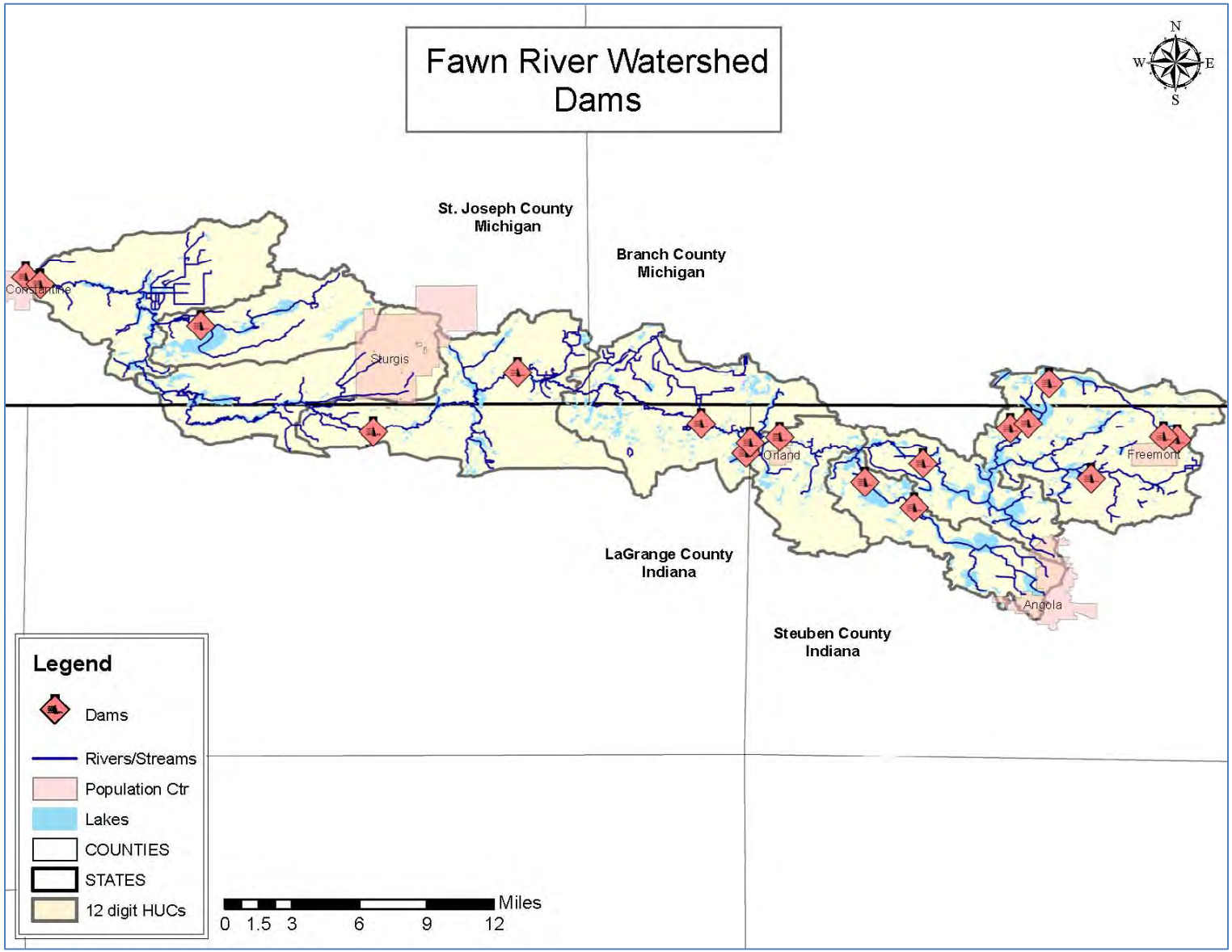
There are eleven dams located within the Fawn River Watershed. Five dams are located in St. Joseph County Michigan, and the remaining six dams are located in Steuben and LaGrange County, IN. Those dams are listed in Table 2.5, below. While dams can be beneficial to communities to supply recreational opportunities, drinking water reservoirs, hydroelectric power, and help control flood waters, they can also be detrimental to the natural hydrology and aquatic ecosystem. Some of the dangers of dams include blocking fish migration (discussed further in Section 2.6), slowing the natural flow of a river, altering the water temperature, decreasing oxygen levels, and causing silt, debris, and nutrients to collect in the waters behind the dam. Also, dams have an expected life span of about 50 years at which point their intended purpose may become compromised. A map of the dams and levees located within the project area can be seen in Figure 2.15.

Table 2.5: Dams Located in the Fawn River Watershed

Dam Name	Yr Completed	River Name	Pond Name	Pond Area	Sub-watershed
Fawn River Mill Dam	1830	Fawn River	Mill Pond	29.0	Fawn River Drain
Fawn River Power Company	1830	Fawn River	N/A	100.0	Clear Lake
Klinger Lake Level Control Structure	1969	Sherman Mill Creek	Klinger Lake	830.0	Sherman Mill Creek
Silver Lake Level Control Structure	N/A	Crooked Creek	Silver Lake	206.0	Snow Lake
Upper Constantine Dam	1948	Fawn River	N/A	90.0	Fawn River Drain
Minifenokee Lake Dam	1960	Unnamed Tributary	Lake Minfenokee	33.9	Snow Lake
Jimmerson Lake Dam	1945	Crooked Creek	Jimmerson Lake	305.3	Lake James
Fawn River Fishery Dam	N/A	Crooked Creek/ Fawn River	N/A	1.5	Town of Orland
Greenfield Mills Dam	1835	Fawn River	N/A	27.4	Himebaugh Drain
Long Beach Lake Dam	N/A	Little Fawn River	Long Beach Lake	16.6	Snow Lake
Lake George Dam	1927	Little Fawn River	Lake George	542.6	Snow Lake
Swaggers Plug Control Structure	N/A	Little Fawn River	Swaggers Lake	4.7	Snow Lake
Fish Lake Control Structure	N/A	Little Fawn River	Fish Lake	42	Snow Lake
Crooked Lake Control Structure	N/A	Carpenter Drain	Crooked Lake	785.3	Tamarack Lake
Lake Gage Control Structure	N/A	Carpenter Drain	Lake Gage	323.5	Tamarack Lake

Dam Name	Yr Completed	River Name	Pond Name	Pond Area	Sub-watershed
Mud Lake Control Structure	N/A	Unnamed Tributary	Mud Lake	37.6	Himebaugh Drain
Wall Lake Control Structure	N/A	Unnamed Tributary	Wall Lake	134.9	Himebaugh Drain
Star Mill Dam	1929	Fawn River	N/A	0	Clear Lake

Figure 2.15: Dams Located in the Fawn River Watershed



2.4.6 Drinking Water and Ground Water Resources

The Fawn River Watershed is located over three unconsolidated aquifer systems; the Howe Outwash Subsystem, Howe Outwash System, and Kendalville System. An unconsolidated aquifer means that the groundwater present within the Fawn River watershed is readily available for uptake and use to drinking and irrigation; however, it also means that the groundwater is more susceptible to contamination than consolidated aquifers. The thickness of the substrate over the aquifers varies from only 30 feet in depth at the southern edge of the Clear Lake sub-watershed, to 145 feet in depth throughout the majority of the rest of the watershed.

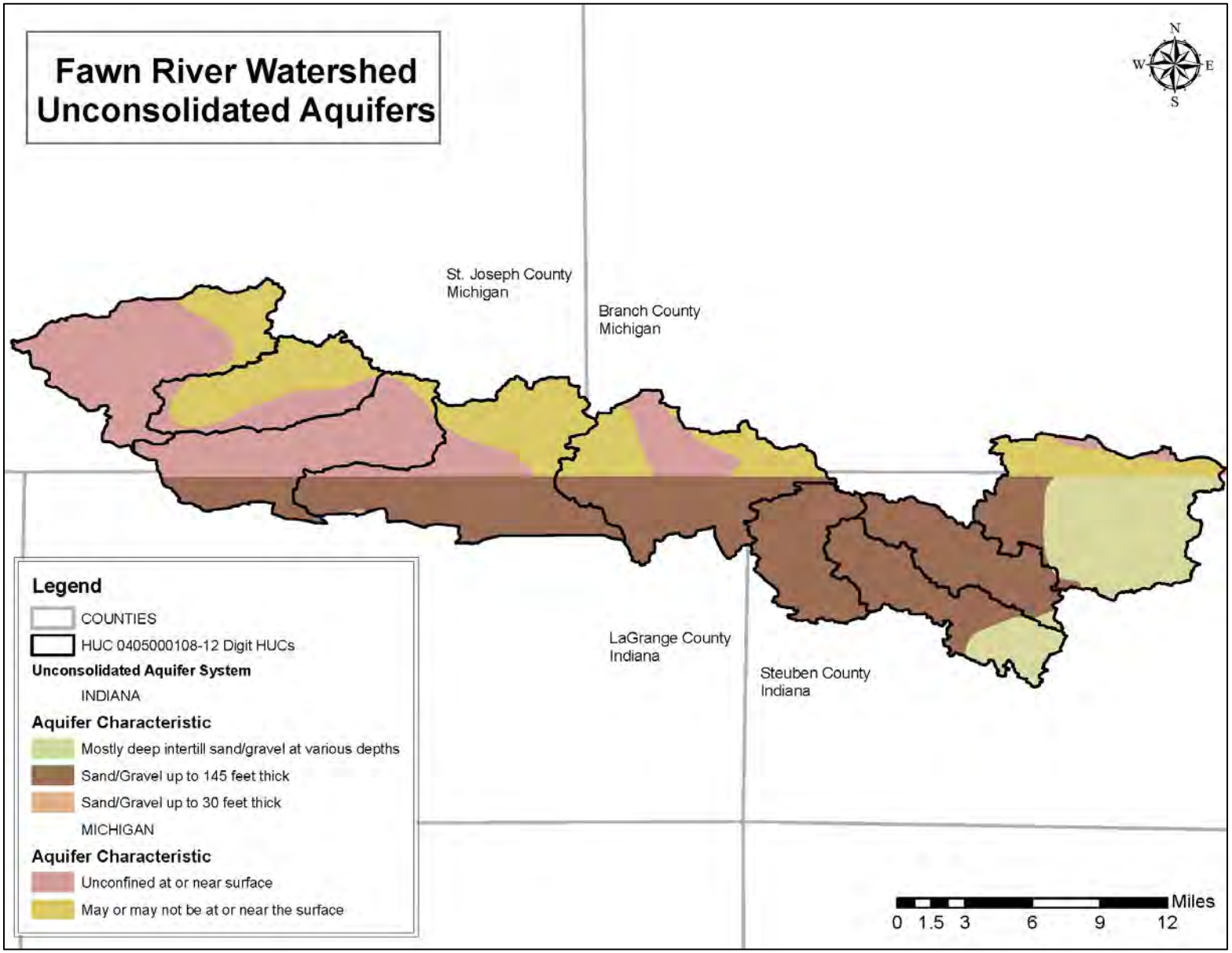
All residents in the watershed acquire their drinking water through wells. The incorporated areas of Fremont, Angola, Orland, Sturgis and Constantine supply drinking water to their residents through groundwater wells from one of the various aquifer systems located in the watershed and have some sort of protection plan in place to protect the groundwater from contamination, which will be discussed in Section 2.8. The other residents in the watershed have private water wells in which they obtain their drinking and irrigation water. The county health departments are responsible for the safety of the groundwater for private water wells and test the water before a new well can be installed. The wells are typically deemed inadequate for drinking if they test positive for the presence of fecal coliforms.

A survey of water withdrawals completed by the USGS in 2005 showed that Indiana and Michigan withdrew approximately 616 million gallons of water a day from ground water resources. Table 2.6 shows the total water withdrawals for Indiana and Michigan according to the 2005 USGS study. Figure 2.16 shows the aquifer system within the Fawn River watershed.

Table 2.6: Water Withdrawals in Indiana and Michigan (2005)

State	% of Population	Ground-water (Mgal/day)	Surface water (Mgal/day)	Total (Mgal/day)
Indiana	74	356	320	676
Michigan	71	260	883	1140
Total (Mgal/day)		616	1203	1816

Figure 2.16: Unconsolidated Aquifer System within the Fawn River Watershed



2.5 Land Use

Land use in the project area greatly influences the quality of the water resources. Land in agricultural production has the potential to erode, especially if over worked or if it is conventionally tilled annually. Thus soil particles carrying high levels of nutrients and pesticides have the potential to reach open water sources and effect aquatic plants and animals and cause the water to become non-potable. Livestock operations often can lead to high levels of bacteria in open water from manure storage areas that are not properly maintained or from livestock having direct access to open water sources. These two activities can also lead to high levels of sedimentation and nutrients in surface water. Industrial areas and urban centers can pose a threat to water quality due to the increased imperviousness of the landscape and industrial waste outfalls. For the reasons listed above, it is very important to investigate land use activities in the project area so as to determine the best method of remediating the pollution coming from the various land uses in the project area. Below is a general description of land uses in the project area. Section 3 of this WMP will provide an in depth look at the land use in the watershed by breaking it down to HUC 12 sub-watersheds.

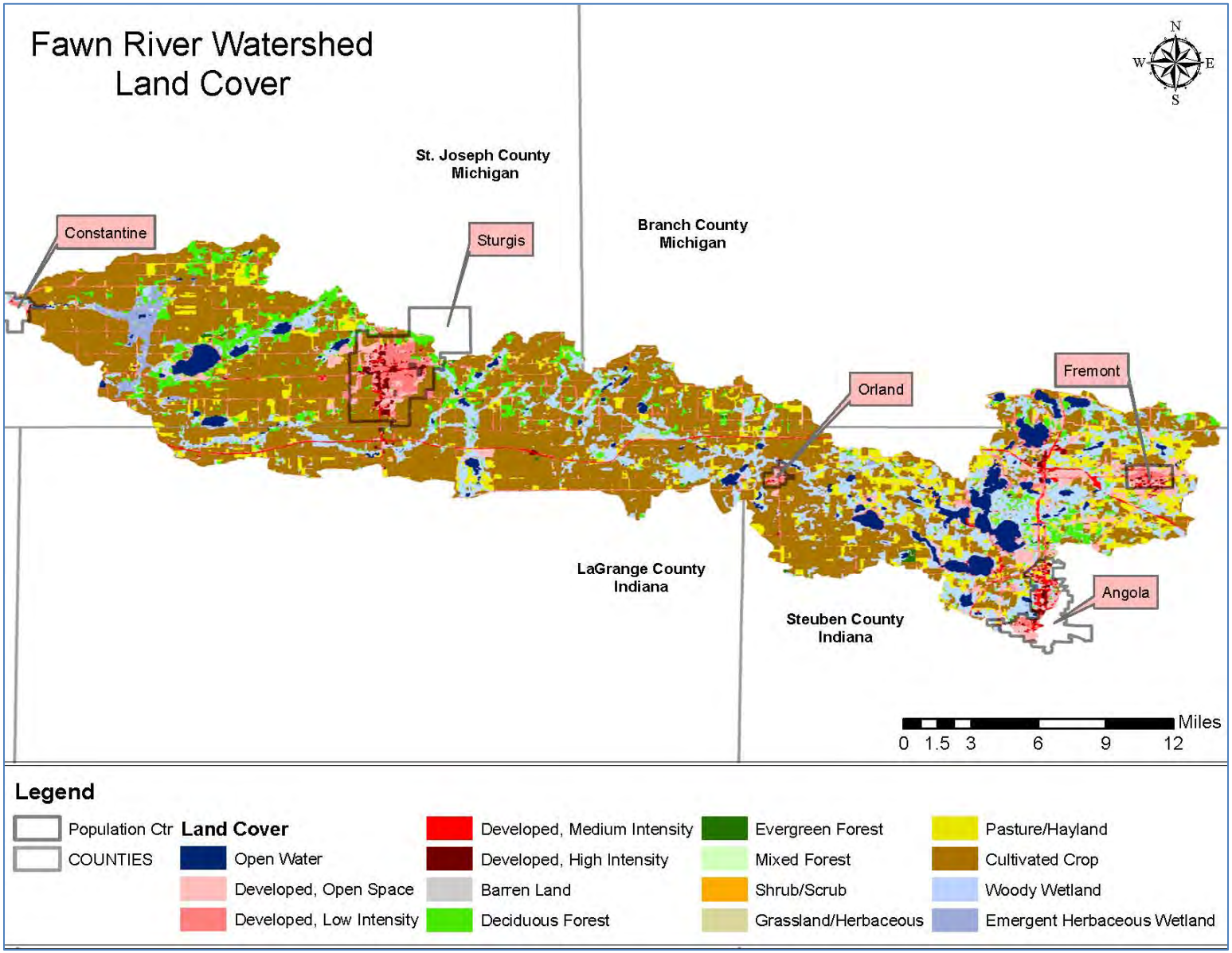
The predominant land use in the watershed is agriculture, specifically cultivated crops, as can be seen in Figure 2.17. It is important to note however, that wetlands take up nearly 16% of the land cover in the Fawn River watershed. There are few urban settings including Fremont, IN (Pop.=2,135), Orland, IN (Pop.=432), Sturgis, MI (Pop.=10,884), and part of Angola, IN (Pop.=8,591) and Constantine, MI (Pop.=2,057). Table 2.7 below shows the number of acres of land in each type of land use per state.

It should be noted here that while irrigation is used for row crops throughout the project area, it is predominately used in St. Joseph County. Jennifer Miller, Administrator for the St. Joseph County Soil and Water Conservation District, explained that St. Joseph County uses the most irrigation for agriculture between all the counties in the state of Michigan. The St. Joseph County Master Plan states that 44% of all crop land in the county is irrigated which accounts for 23% of all irrigated land in Michigan. Irrigation use must be monitored to ensure the aquifer system can support the amount of irrigation taking place, and that the use of irrigation does not promote soil and fertilizer runoff from fields to open water.

Table 2.7: Land Use/Land Cover in Fawn River Watershed

NLCD Land Use Designation	Acres	%
Open Water	9405.65	4.76%
Developed Open Space	11265.96	5.70%
Developed Low Intensity	8639.33	4.37%
Developed Medium Insensity	2436.08	1.23%
Developed High Intensity	1097.74	0.56%
Barren Land	241.39	0.12%
Deciduous Forest	13048.83	6.61%
Evergreen Forest	549.27	0.28%
Shrub/Scrub	68.62	0.03%
Mixed Forest	223.64	0.11%
Grassland Herbaceous	845.62	0.43%
Pasture Hayland	17197.4	8.71%
Row Crops	102,147.47	51.73%
Woody Wetland	27101.87	13.72%
Emergent Herbaceous Wetlands	3207.28	1.62%
Total	197,476.11	100.00%

Figure 2.17: Land Use/ Land Cover in Fawn River Watershed



2.5.1 Tillage Transect Data

Tillage transects are a method of data collection concerning the use of various tillage practices used within the agricultural community. They are typically performed to gage the adoption of various conservation tillage practices and to get an accurate count of crop acreage. The amount of land utilizing cover crops is often collected during tillage transects as well. Indiana counties typically perform tillage transects on a biennial basis due to the high percentage of agricultural land use in the State. Michigan counties do not regularly perform any farm field transect data and the State has not performed a tillage transect since 1993. Jerry Grigar, the MI NRCS State Agronomist, believes there are more beans and small grains in no-till currently than when the data was last collected. The St. Joseph County NRCS District Conservationist has not noted a change in tillage over the past several years; however the Branch County SWCD believes that no-till is on the rise in their county. Steuben County has been very successful at encouraging and implementing conservation tillage practices with 80% of all corn fields and 96% of all soybean fields being in some form of conservation tillage. However, LaGrange County has been more successful at implementing cover crops as a management technique. This may be due to the high number of Amish farmers located within LaGrange County who have a harder time implementing no-till due to equipment constraints. Table 2.8 shows the number of acres in conservation tillage in St. Joseph and Branch counties, and Table 2.9 shows the percentage of fields utilizing conservation tillage and those utilizing cover crops in Steuben and LaGrange counties.

Table 2.8: Tillage Transect Data for Michigan Counties in 1993

County	Year Data Collected	No-Till		Ridge Till (All fields)	Mulch Till (All fields)
		Corn	Soybeans		
St. Joseph	1993	20000	14000	430	41800
Branch	1993	10600	11750	330	21018

Acreage is conventional tillage is not available for MI counties.

Table 2.9: Tillage Transect and Cover Crop Data for Indiana Counties in 2013

Tillage Type	Crops	Steuben	LaGrange
No-Till	Corn	31%	31%
Strip Till		0%	0%
Ridge Till		0%	0%
Mulch Till		23%	7%
Reduced Till		26%	8%
Cover Crops		1%	7%
Conventional Tillage		20%	54%
No-Till	Beans	68%	63%
Strip Till		0%	0%
Ridge Till		0%	0%
Mulch Till		18%	4%
Reduced Till		10%	10%
Cover Crops		1%	12%
Conventional Tillage		4%	24%

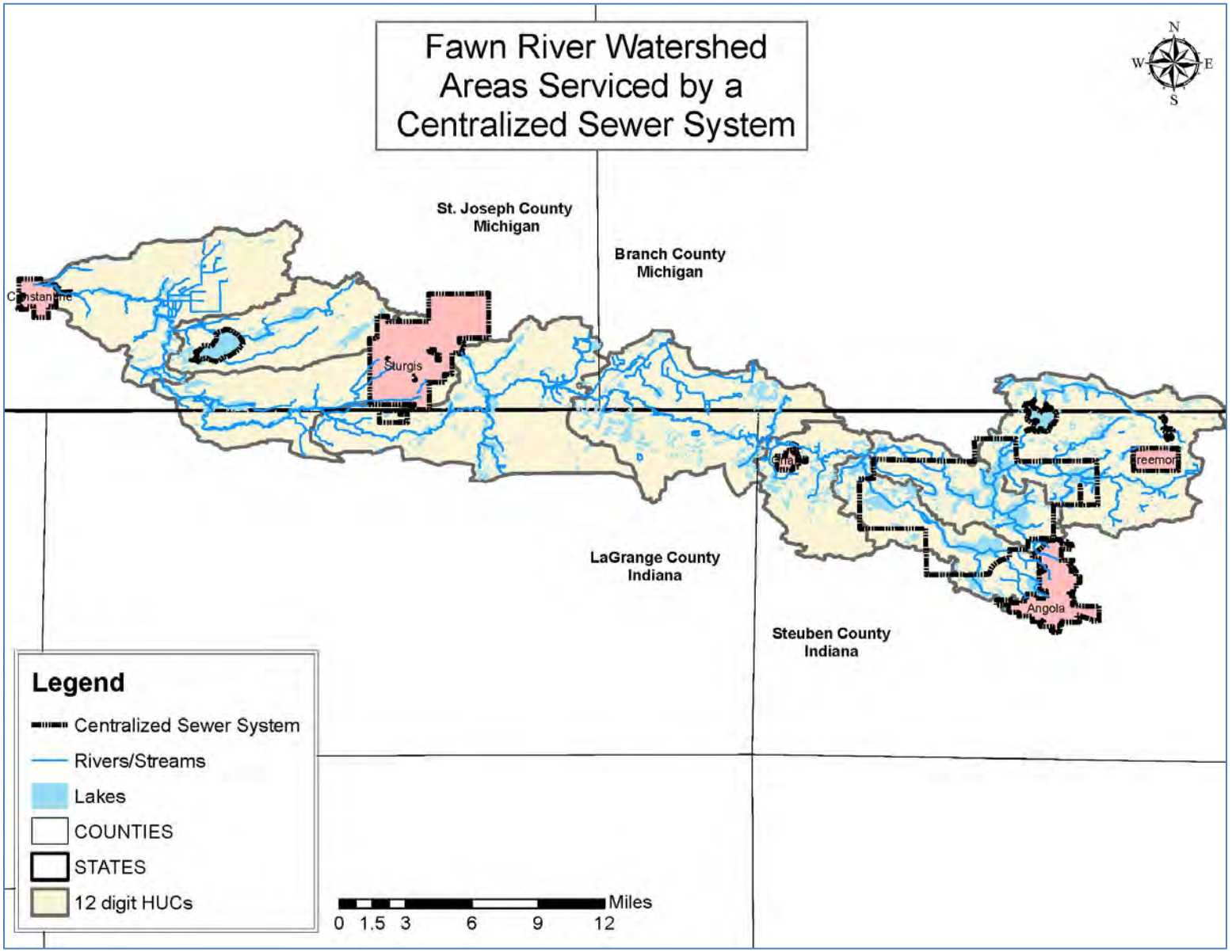
2.5.2 Septic System Usage

There are 10 populated areas that are served by a centralized sewer system. Most of the built-up lakes in the watershed are serviced by the Regional Sewer District with the exception of some homes along Lake George, Long Beach Lake, Barton Lake (both south west of Lake George), and Lime Lake which is located just northeast of Orland. The populated area of Waldon Woods, north of Lake Gage is also not serviced at this time. The Steuben Lakes Regional Waste District (SLRWD) is working to supply sewers to all the populated areas within the near future, including Snow Lake, Big Otter and Little Otter Lake, Lake Charles East and West. The SLRWD does currently supply sewers to some homes surrounding Lake Pleasant, and are in the planning process of running sewers to more of the Lake Pleasant homes. Also, all towns and cities located within the watershed are currently serviced by a sewer system. Figure 2.18 below, outlines all the areas where a centralized sewer system is currently being used. However, it is important to note that all rural areas located within the Fawn River watershed rely on on-site sewage disposal. It should also be noted that many of the smaller, built-up lakes are not currently serviced by a sewer system.

Much of the population in the Fawn River watershed currently relies on on-site waste disposal which can cause a contamination problem of surface and groundwater if the system is not properly installed and/or maintained. The number of failing or leaking septic systems is hard to estimate, as many of the systems are not on record with the local health departments. The county Health Departments located in the Fawn River Watershed were unable to provide an accurate estimate of leaking, failed or straight-piped septic systems for their counties. However, according to the US EPA, about 25% of households in the United States utilize on-site sewage disposal and anywhere from 1% - 5% of those systems are failing. Another study conducted by the National Environmental Service Center in 1992 and 1998 estimated that approximately 25% to 30% of on-site sewage treatment systems in Ohio, a similar landscape to that found in Indiana and Michigan, are failing. Though, due to the majority of the population in the Fawn River watershed being located within the rural community, it is expected that higher than 25% to 30% of the population within the watershed utilize on-site waste disposal systems. Septic system leachate may increase nutrient levels, as well as, fecal coliform, including the harmful *E. coli* bacteria, in both surface water and ground water, which is the sole source of drinking water within the project area.

It should also be noted that failing or leaking septic systems within the Fawn River Watershed are likely due to them being placed in areas where the soil in deemed as not suitable for a septic system. The soil located within the project area is predominantly sandy and/or gravelly which allows for rapid permeation of septic effluent.

Figure 2.18: Communities Served by a Centralized Sewer System



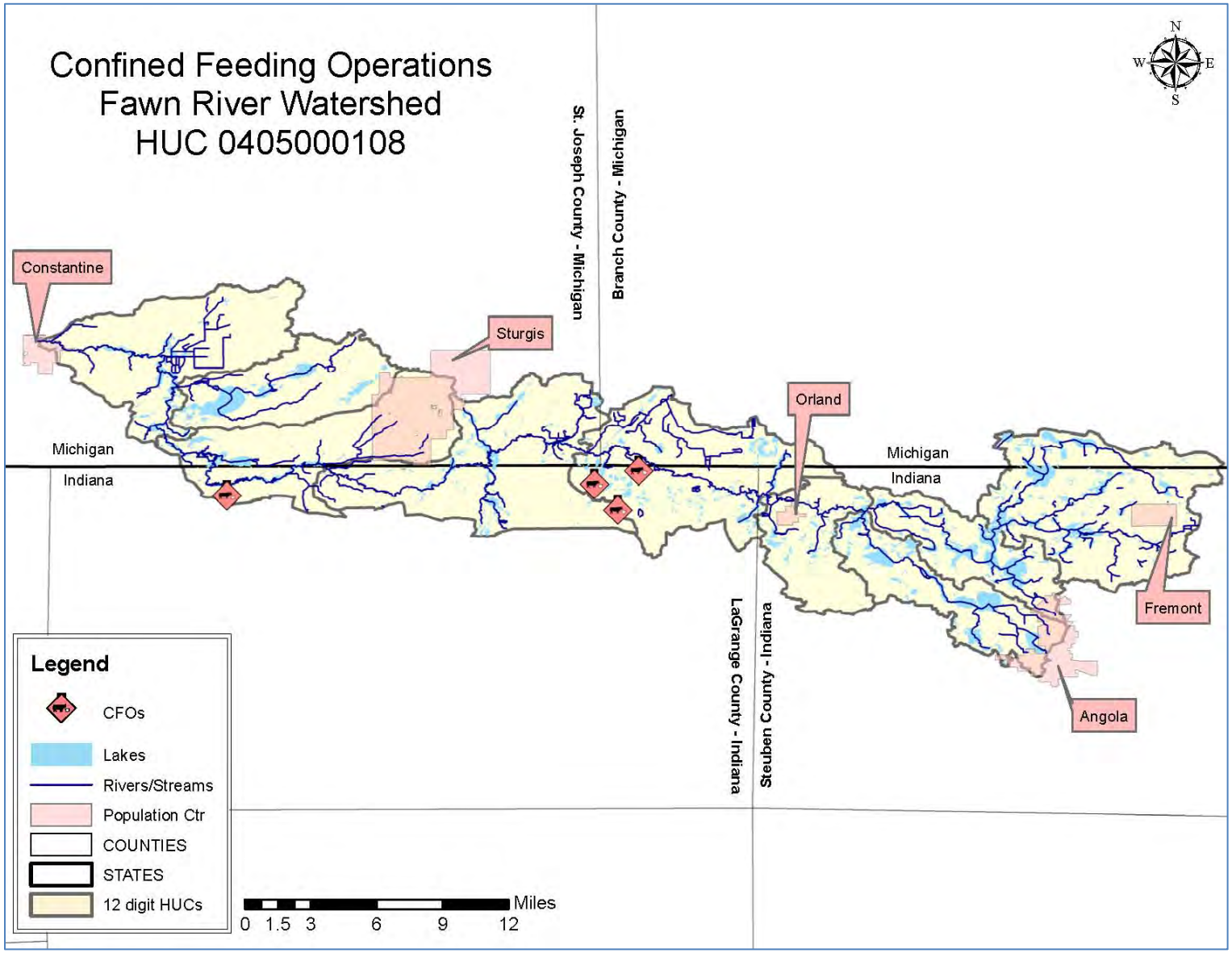
2.5.3 Confined Feeding Operations

Stakeholders voiced concern about stormwater runoff from livestock operations located within the project area as they can present a significant pollution problem if animal waste is not properly managed, such as proper storage of the manure and application of the manure as fertilizer on crop fields. There are four permitted confined feeding operations (CFOs) located within the project area; one in Wegner Ditch and three in Himebaugh Drain sub-watershed, all in Indiana. The four CFOs have a combined animal count of nearly 250,000. A confined feeding operation is so designated if there are 300 cattle, 500 horses, 600 swine or sheep, or 30,000 fowl present on the property and confined for at least 45 days during the year where there is no ground cover or vegetation present over at least half of the animals' confinement area. If the size of the operation is very large, or there have been compliance issues with an operation in the past, the CFO may be designated as a Concentrated Animal Feeding Operation (CAFO), and will be required to obtain a National Pollution Discharge Elimination System (NPDES) permit. The Steering Committee voiced concern regarding animal feeding operations, both regulated and non-regulated facilities. There are several smaller livestock operations located within the project area. Though, most are not located directly adjacent to a stream and therefore, were not inventoried during the WMP planning process. Those that were identified as a potential pollution problem in the watershed are listed as such in the respective sub-watershed Section. Table 2.10 below is a list of all CFOs in the project area and Figure 2.19 shows their location.

Table 2.10: Confined Feeding Operations in the Fawn River Watershed

Operation Name	County	Sub-watershed	Program	Animal Type	Animal #
Laurent D Jennings	Lagrange	Himebaugh Drain	CFO	Swine/Beef Cattle	2300/25
Contract Pork	Lagrange	Himebaugh Drain	CFO	Swine	6000
Michael Fanning Farms	Lagrange	Himebaugh Drain	CFO	Swine	1430
N & M Incorporated Fawn River Farm	Lagrange	Wegner Ditch	CFO	Broilers	240,000

Figure 2.19: Confined Feeding Operations in the Fawn River Watershed



2.5.4: Windshield Survey

A windshield survey was conducted throughout the watershed to identify areas where nonpoint source pollution (NPS) may be an issue. The survey was conducted in May 2014, with two people per vehicle, driving each road within each sub-watershed, and making note of any areas of significant soil loss, lack of riparian buffer, livestock access to open water, or other potential pollution sources. The notes taken during the windshield survey were then verified via a "desktop survey" of the watershed using 2011 aerial photography. The most significant potential NPS source identified during the windshield survey was a lack of riparian buffer along open water. However, other issues were also noted including conventionally tilled fields, sea walls and fetilized turf grass directly along the shoreline of built-up lakes, and some livestock issues, including one site where livestock have direct access to open water. It was also observed that many row crop farmers in the watershed are using irrigation on their fields. The windshield survey will be discussed in further detail, at the sub-watershed level, in Section three of this WMP.

2.5.5 National Pollution Discharge Elimination System

Facilities that discharge directly into a water body are required to obtain an National Pollution Discharge Elimination System (NPDES) permit from the overseeing state agency (IDEM and MDEQ). The permit regulates the amount of contaminants a facility can discharge into surface water and requires the facility to conduct regular water quality monitoring (typically monthly). While these facilities are regulated by the State, there is the potential that they may have accidental discharges above permit limits, or in some cases, the facilities may release a substance that they are not required to report to the State which may pose a threat to water quality; phosphorus is a common parameter not required to be reported. There are 11 NPDES permitted facilities located within the Fawn River. The NPDES facilities were obtained from the US EPA's Enforcement and Compliance History Online (ECHO) website. ECHO allows the user to search for various permitted facilities by HUC 12 and will supply myriad data. Table 2.9 lists each facility, their permit number and address, the number of quarters the facility was in non-compliance over the past three years, as well as the reason for the violation. Pollutants in bold in Table 2.11 are those pollutants that caused a significant violation. Figure 2.17 is a map showing the location of each of the permitted facilities. The NPDES permitted facilities will also be mapped in their respective sub-watershed in Section 3 of this WMP.

It should be noted that there are two facilities located within the Fawn River watershed, with discharge points in the neighboring Pigeon River/Pigeon Creek watershed. Those facilities are listed in Table 2.11 and are highlighted in yellow.

Table 2.11: NPDES Permitted Facilities in the Fawn River Watershed

Permit Name	Permit #	County Name	Address	City	HUC 12	Lat.	Long.	Receiving Water Body Name	Qrts in Non-compliance (3 yrs)	Pollutant
Fremont WWTP	IN 0022942	Steuben	1715 SR 120	Fremont	040500010801	41.729681	-85.023148	Crooked Creek via Marsh Lake via Trib	5	BOD, E. coli, N, P, and TSS
Pokagon State Park	IN 0030309	Steuben	450 Lane 100 Lake James	Angola	040500010803	41.718028	-85.03667	Crooked Creek via Snow Lake	4	BOD, E. coli, P, and TSS **T Ammonia**
Angola Travelers Mall Mobil	IN 0032891	Steuben	7265 N Baker Rd	Fremont	040500010801	41.746056	-84.991417	St. Joseph via Big Otter Lake/ Walters Lake/ unnamed trib	10	**Chlorine**, E. coli, **T Ammonia**, **P**
Western Con-solidated Technologies	IN 0054011	Steuben	700 W Swagger Dr	Fremont	040500010801	41.712017	-84.979955	Unnamed Trib to Marsh Pond	4	**Chlorine**, Oil and Grease
Meridian Automotive Systems	IN G250062	Steuben	3000 Woodhull Dr	Angola	040500010803	41.6713	-85.0039	Pigeon Creek via Croxton Ditch	5	Temp
Sturgis-Big Hill Rd LF	MI 0047716	St. Joseph	US 12 and Big Hill Rd	Sturgis	040500010806	41.801944	-85.387778	Moe Drain	0	N/A
Travel Plaza - Ernie Pyle	IN 0050300	LaGrange	5000 E 750 N	Howe	040500010806	41.745194	-85.329083	Pigeon River via Unnamed Trib	2	non-RNCV
City of Sturgis WWTP	MI 0020451	St. Joseph	70250 Treatment Plant Rd	Surgis	040500010807	41.773611	-85.432778	Fawn River	1	non-RNCV/C

Permit Name	Permit #	County Name	Address	City	HUC 12	Lat.	Long.	Receiving Water Body Name	Qrts in Non-compliance (3 yrs)	Pollutant
Abbott Nutrition	MI 0025313	St. Joseph	901 N Centervill e Rd	Sturgis	040500010807	41.8095	-85.426	Nye Drain	1 (RCRA) 0 (CWA)	Sulfuryl Flouride
Sturgis Well Field - SF	MI 0053465	St. Joseph	309 N Prospect St	Sturgis	040500010807	41.804444	-85.414722	Fawn River via Nye Drain	0	N/A
MI Milk Producers Assoc.	MI 0001414	St. Joseph	125 Depot St	Constantine	040500010809	41.843611	-85.665278	St. Joseph River	1	pH

2.5.6 Brownfields

Brownfields are defined by the USEPA as "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant". Examining these sites in closer detail to determine potential future uses for the sites by cleaning up environmental hazards present, will help to protect the environment, can improve the local economy, and reduces pressure on currently undeveloped lands for future development. The EPA, States, and local municipalities often offer assistance in the form of grants and low interest rate loans for the cleanup and redevelopment of identified and potential brownfield sites.

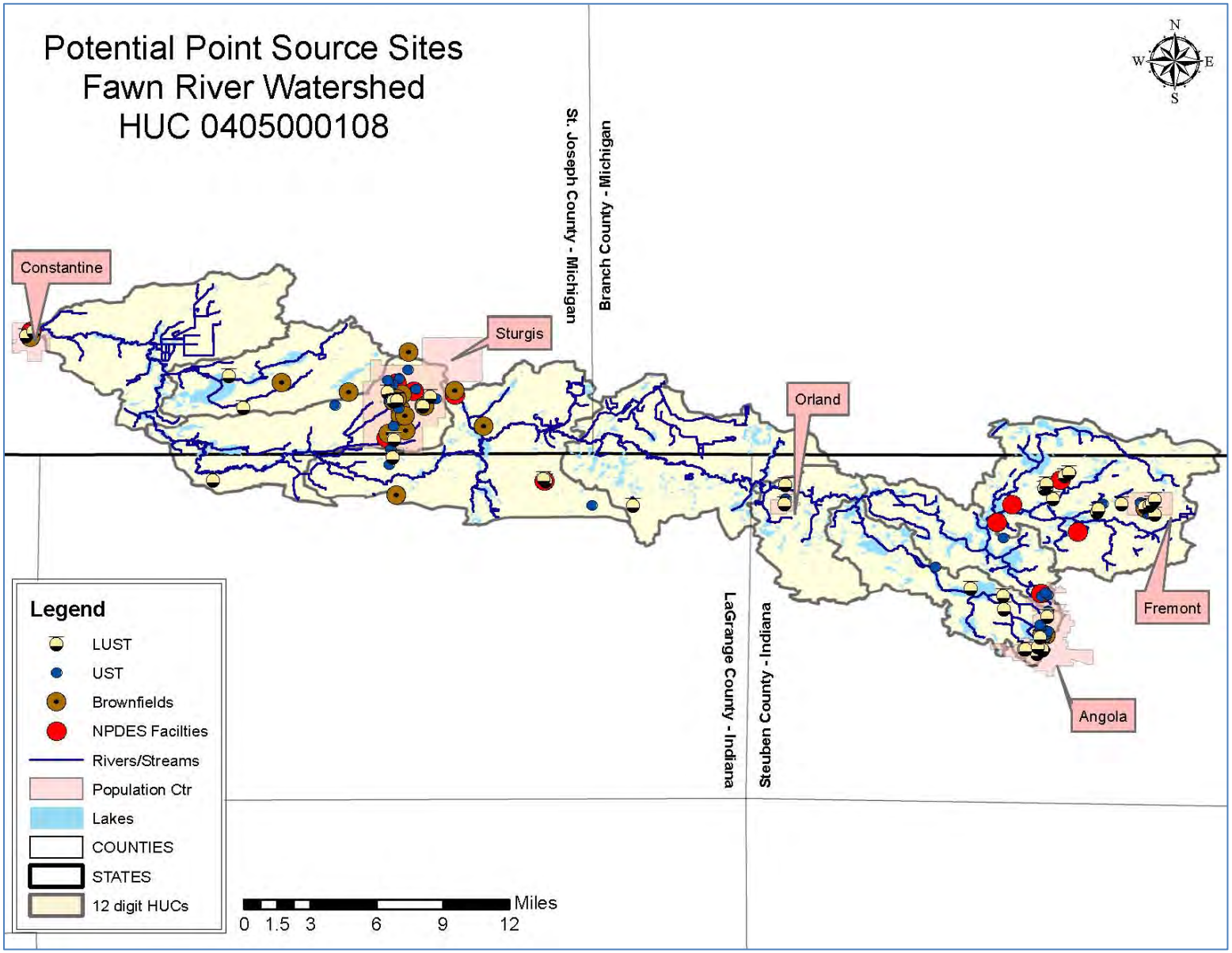
There are no brownfield sites that have a Brownfield Redevelopment Plan or that have received funding according to the state Brownfield district offices located within the Fawn River watershed. However, IDEM and MI DEQ have lists of potentially contaminated sites. There are four sites listed by IDEM as being a Brownfield and MI DEQ has listed 16 sites that are considered potentially contaminated within the Fawn River watershed. Figure 2.20 is a map delineating each specific brownfield site. The specific brownfield sites will be discussed in further detail in Section 3 of this WMP.

2.5.10 Underground Storage Tanks

An underground storage tank (UST) is a container placed under ground to store chemicals necessary to run a business or provide a service. Most USTs store gasoline, diesel, kerosene, or dry cleaner chemicals, though USTs are not limited to those chemicals alone. USTs pose a risk to the surrounding environment as they have the potential to leak (LUSTs) their contents into the soil which can leach into groundwater or surface water and contaminate them or leach into surrounding soils.

USTs are managed by the IDEM Office of Land Quality's Underground Storage Tank program and the MI Department of Licensing and Regulatory Affairs. The states are charged with insuring all USTs meet state and federal regulations so as to not contaminate surrounding land and/or water resources. The states are also responsible for making sure those tanks that do not meet requirements are properly closed or upgraded. There are currently 125 USTs located in the project area, 94 of which are currently leaking. All USTs and LUSTs located within the Fawn River Watershed are identified on the map of potential point sources of pollution in Figure 2.20. LUSTs will be discussed further in Section 3 under the respective sub-watershed.

Figure 2.20: Potential Point Sources of Pollution in the Fawn River Watershed



2.5.11: Parks

Thirty-eight parks and preserves are located within the project area totaling over 3,356 acres of land. Many of the parks are small municipal parks which are predominantly used by local residents and are supplied with playground equipment and picnic tables for the public to enjoy. However, there are a few larger trails, parks and nature preserves of note including the 1,260 acre Pokagon State Park, a large forested area along the shores of Lake James managed by the Indiana DNR, the 120 acre Fawn River Fen which provides prime habitat to many wetland animals, managed by The Nature Conservancy, the 135.2 acre Fawn River Nature Preserve managed by Acres Land Trust, and many other large preserves which provide habitat to many rare, threatened, or endangered species. The Fawn River is noted as one of the cleanest navigable rivers in Indiana by recreational enthusiasts, likely due to the amount of natural land surrounding the river and areas lakes, so preservation of these pristine properties is vital to the area's flora and fauna. Table 2.12 lists all parks located within the project area, how many acres or miles they encompass, who manages them and what type of activities are available at each site. Figure 2.21 is a map showing the location of each of the parks.

Table 2.12: Parks and Nature Preserves in the Fawn River Watershed

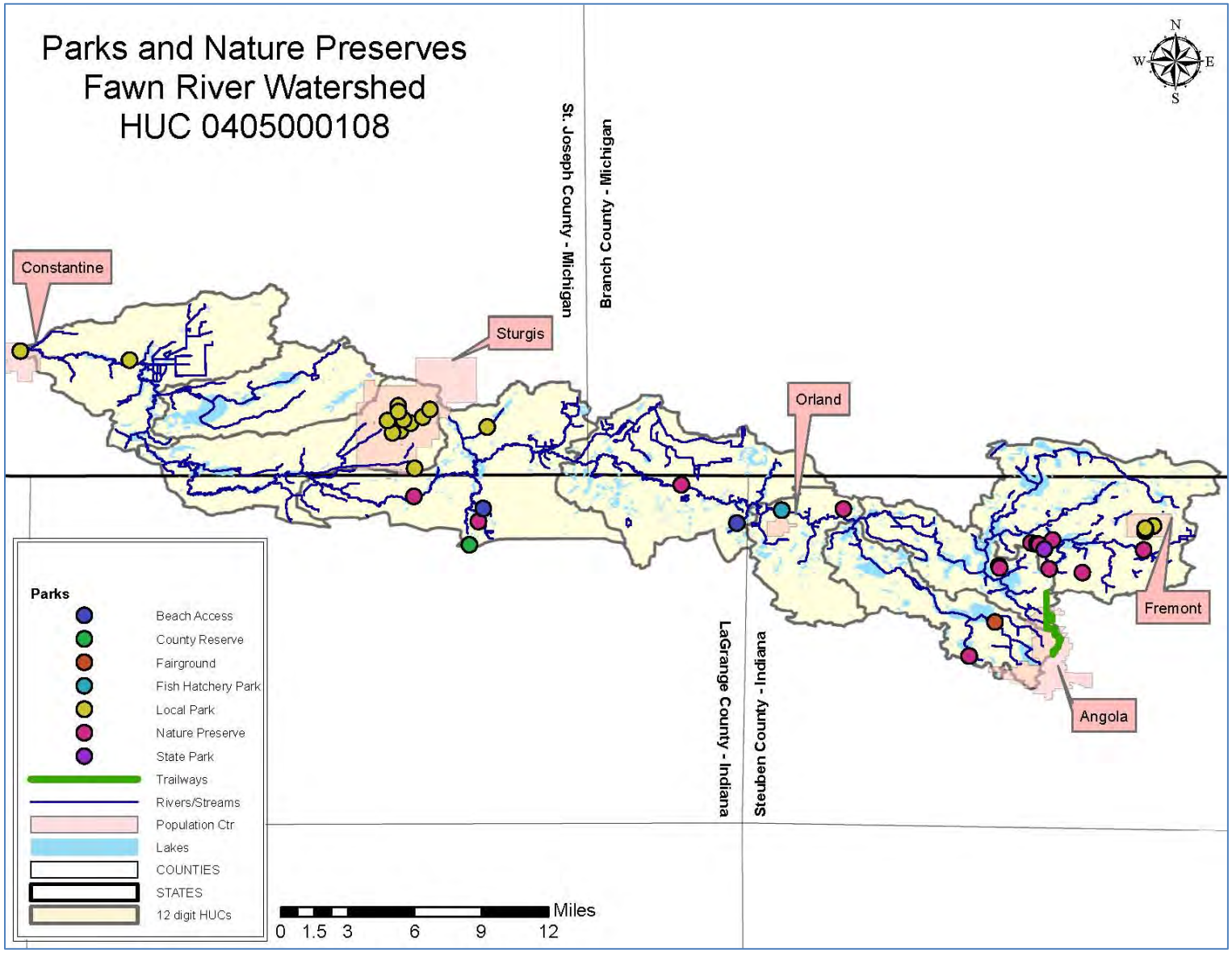
Name	Area	Ownership	Facilities/Activities
Cade Lake County Park	98 acres	St. Joseph County	Camping, hiking, beach on Cade Lake, fishing, boating, picnic area, playground
Jim Timm County Park	95 acres	St. Joseph County	Natural Area (woodland and wetland) hiking trail (more trails and boardwalk planned)
Riverview Park	Unknown	Constantine Township	Wooded Area, playground, basketball courts
Oaklawn Terrace Park	26 acres	City of Sturgis	Tree canopy, ice skating/roller skating, ampitheater, playground, picnic shelters
Arthur Carls Park	1.9 acres	City of Sturgis	playground, basketball court, picnic area
Franks Park	19.5 acres	City of Sturgis	sports complex, playground, restrooms
Free Church Park	0.6 acres	City of Sturgis	benches and floral display
Shadowlawn Park	0.5 acres	City of Sturgis	open green space
Memorial Park	3.7 acres	City of Sturgis	open green space, tree canopy, playground
Pioneer Park	0.5 acres	City of Sturgis	Marker for Judge John Sturgis, flower beds, green space
Thurston Woods	27 acres	City of Sturgis	paved trail, picnic areas, open green space, picnic shelters, wooded area, and playground

Name	Area	Ownership	Facilities/Activities
Old Depot Park	2.3 acres	City of Sturgis	Museum, gazebo, picnic area, and playground
Langrick Park	1.8 acres	City of Sturgis	Playground, basketball, sand volleyball, tennis, and handball courts
Cedar Lake Beach	Unspecified	LaGrange County	Unstaffed lake swimming access
Wall Lake Beach	Unspecified	LaGrange County	Unstaffed lake swimming access
Duff Nature Preserve	Unspecified	LaGrange County/Acres Land Trust	Wetland Nature Preserve on Cedar Lake
Pine Knob Park	99 Acres	LaGrange County	Hunting and fishing, archery targets, hiking, fishing, picnic area, wetlands
McClue Nature Preserve	80 acres	Steuben County Commissioners/ Acres Land Trust	30 acres of old growth forest, nature trails, parking lot
Steuben 4-H and Campground	Approx. 60 acres	Steuben County	Buildings and facilities for the annual Steuben County 4-H Fair and seasonal recreation/education. Horse and Pony arenas, managed turf grass/green space. Large oak trees along shore of Crooked Lake.
Fremont Town Park	Unspecified	Town of Fremont	Baseball diamonds, open green space, playground, and pavilion
Fremont Moose Skate Park	Unspecified	Town of Fremont	Open green space, skateboarding facility
Fremont Vistula Park	Unspecified	Fremont Schools	Baseball diamonds, tree cover, walking trails, playground
Broad Street Youth Park (proposed)	Unspecified	Town of Fremont	Open green space, tree canopy, pond, paved walking trail, semi-natural setting, pavilion, ball diamond, (connects to Moose Skate Park)
Angola Recreational Trailway	Approximately 1.5 miles (add. 1.3 mi. proposed)	City of Angola	Paved walking/biking trail
Fawn River Nature Preserve	135.2 acres	Acres Land Trust	Old growth and 2nd growth forest, Fawn River, 1.5 mile walking trails, wildlife and bird watching, parking lot
Beechwood Nature Preserve	89.8 acres	Acres Land Trust	Forest and meadow, 1.7 mile walking trail, wildlife and bird watching, parking lot

Name	Area	Ownership	Facilities/Activities
Foster Nature Preserve	2.7 acres	Acres Land Trust	Little Otter Lake, forest, access from Beechwood NP, 0.1 mile walking trail, wildlife and bird watching
Manjeri Nature Preserve	0.8 acres	Acres Land Trust	Little Otter Lake, forest access from Beechwood NP, 0.1 mile walking trail, wildlife and bird watching
Ropchan Wildlife Refuge and Nature Preserve	184 acres	Acres Land Trust/ INDNR Division of Fish and Wildlife	Cemetary Lake, adjacent to INDNR wetland conservation area, old and new growth forest, wetlands, 4.7 mile walking trail, platform at lake for wildlife and bird watching, parking lot
Ropchan Memorial Nature Preserve	79 acres	Acres Land Trust	Forest, wetland, wildlife and bird watching, wildlife viewing, 1.3 mile walking trail, parking lot
Wing Haven Nature Preserve	262.5 acres	Acres Land Trust	Seven Sisters Lake, 19th century log buildings, 1.9 mile walking trail, wetland fens, forest, meadows, wildlife and bird watching, wildlife viewing, parking lot
Fawn River Fen	120 acres	The Nature Conservancy	Fawn River, grass sedge fen, wildlife and bird watching
Pokagon State Park	1,260 acres	IN Dept. of Natural Resources	Lake James and Snow Lake access, Lake James beach, 1.6 mile bike trail, 11 mile walking trail, boat rental, camping, fishing, inn/lodge, nature center, picnic areas, saddle horses and 2 mile trail, Tobaggan Run, cross country sking, sledding, ice skating, wetlands and forest
Trine State Recreation Area	186 acres	IN Dept. of Natural Resources/ 101 Lakes Trust	Forest, 3.5 mile walking trail, sledding, Gentian Lake access and canoe rental, lodge and cabins
Loon Lake Nature Preserve	99 acres	INDNR, Division of Nature Preserves	North shore of Loon Lake, parking lot, walking trail, forest, meadow, and wetland areas (home to several threatened and endangered plant species), wildlife and bird watching
Potawatomi Nature Preserve	256 acres	INDNR, State Parks and Reservoirs	Located within Pokagon State Park, old growth forest, marsh and wetland areas, forest, Pokagon hiking trails pass through the preserve

Name	Area	Ownership	Facilities/Activities
Marsh Lake Nature Preserve	103 acres	INDNR, Division of Fish and Wildlife	Parking lot, no hiking trails, hunting in season, wetland habitats, old growth forest
Fawn River Fish Hatchery	Unspecified	INDNR	Fish rearing ponds, green space, access to Fawn River and fishing along property from the River, self-guided tour of facility and informational signs at each pond

Figure 2.21: Parks and Nature Preserves in the Fawn River Watershed



2.6 Previous Watershed Planning Efforts

The Fawn River watershed is a unique watershed due to the many lakes and natural setting of the Fawn River. The hydrologic features of the watershed are used extensively by local residents and tourists, which puts additional stress of the water resources. For these reasons, the Fawn River and its tributaries, as well as the lake system are important to understand and protect. There have been many studies conducted on the lakes of the area to control invasive aquatic plant species and sedimentation, but few studies of the river system and the surrounding land uses have been conducted. There are also few city and county master plans that have been written to outline problems and threats to our natural resources, and propose ways of protecting those resources in the watershed. This section provides a description of each of the previous studies and watershed planning efforts that have been conducted over the past decade. Figure 2.23 delineates the jurisdiction of each of the studies or plans that have been conducted in the watershed.

2.6.1 City and County Management Plans

The purpose of Municipal Management Plans is to identify potential issues in the area and determine a means of addressing those issues. All counties within the Fawn River Watershed have comprehensive or master plans, however not all populated areas do; Orland and Constantine do not have Plans.

Branch County Master Land Use Plan

The Branch County Master Plan was first written in 1974 and updated in 1997 by the Branch County Planning Commission in cooperation with the South-central Michigan Planning Council. The Master Plan outlines two concerns that can be connected to this project including prime agricultural land being utilized for development and the lack of tourism opportunities in the county relating to the many lakes located within the county. The Master Plan identified several potential opportunities to address the concerns, which are listed below.

- Encourage cooperation between agriculture and lake property owners with regard to water issues, where water quality is the most important issue for the future.
- Land that is not suited for agriculture should be developed for recreation.
- Work with Tourism Bureau to promote advantages of the county including the great fishing opportunities in the many lakes of the county.
- Provide recreation facilities to preserve and enhance the County's natural features by encouraging:
    - Control lakeshore and stream bank development
    - Encourage conservation and protection of natural areas
    - Prohibit floodplain development except for recreational purposes

The objectives outline in the Branch County Master Plan will help to address identified stakeholder concerns including an increase in impervious surfaces, lakes in the area becoming more developed, wetland conservation and streambank erosion.

St. Joseph County Michigan Master Plan

The St Joseph County Planning Commission, recognizing the fertile soil and abundance of ground water for irrigation, developed a County Master Plan in 1997 focusing on the protection

of prime farmland within the county, while also taking into account the natural resources of the area. Several of the goals established during the development of the Master Plan are directly related to concerns expressed by the Fawn River Project Steering Committee. Those goals are listed below.

- "Provide for the development of sanitary sewers, improved sanitary disposal systems…"
- "…encourage long-term commitments to environmentally sound agricultural activities…"
- "Encourage intensive livestock operations …to locate away from areas prone to flooding."
- "Do not over-plan or over-zone for commercial (or industrial) development."
- "Establish a minimum setback for vegetative buffer along lakeshore or stream (and septic tanks and drainfields)."
- "Direct animal grazing landward of the vegetative buffer strip (along lakeshores and streams)."

The St. Joseph County Planning Commission has been updating their Master Plan regularly. The last update was completed in 2007 and it had a stronger focus on environmental conservation and preservation including such goals as maintaining a 1:1 ratio of "built-up" area and open and/or green space. The 2007 update also included a map of areas where increased sewer system capacity is necessary to maintain the integrity of the surrounding natural resources. Figure 2.20 is a map, taken from the 2007 Master Plan update, showing where the current wastewater treatment plants are and where new or expanded systems should be constructed to meet the projected population growth. The blue oval drawn on the map represents the approximate area of St. Joseph County located within the Fawn River project area.

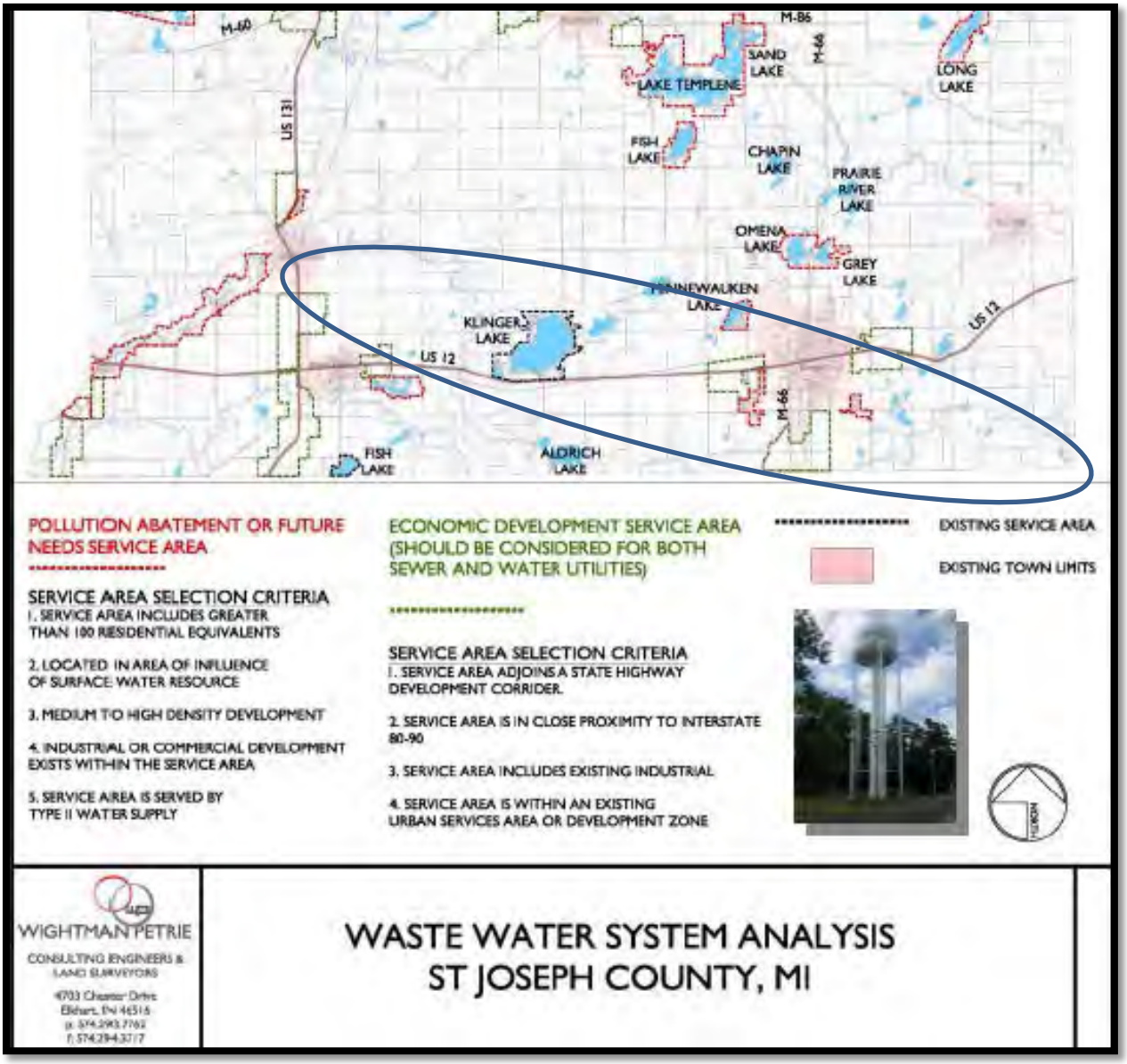
LaGrange County Comprehensive Plan

On December 6, 2010, the LaGrange County released their Comprehensive Plan. The Plan consists of two major subsections; the Planning Foundation and the Land Use Plan. The Planning Foundation takes natural resources into account, recognizing the uniqueness of the landscape of the county, where the Land Use Plan outlines strategies to limit the impact of urban sprawl and other construction activities on the natural environment. Goals and concerns outlined in the Plan that relate to the concerns of stakeholders in the watershed are:

- "New development will be built in a manner that maintains the integrity of the natural environment"
- "Water and water quality are valuable resources to the county both as a source of recreation and lifestyle but also as a life necessity"
- "…Urban sprawl will be minimized"
- "…poorly installed groundwater wells, placement of waste removal systems, improper manure management, or uncontrolled storm water runoff can create safety hazards…"
- "Encourage commercial uses, which are not associated with homes or farms, to locate on paved roadways"
- "Development of residential uses should be permitted at densities not to exceed two units per acre where adequate sanitary sewer services are available…housing units that have no access to sanitary sewer services should be restricted to one unit per acre…"

LaGrange County recognizes the value of the lake system and natural resources they have available in the county and have planned for their preservation to the best of their ability in the County Comprehensive Plan.

Figure 2.22: Existing and Planned Waste Water Treatment Services in St. Joseph County



<u>Steuben County Comprehensive Plan</u>

The Steuben County government saw a need to update the Old County Master Plan in 2005 as the area continued to grow due to the high quality of life, lakes, and other natural resources in the county. The Steuben County Comprehensive Plan was completed and adopted by the county government in 2006. Two aspects of the county Plan are relevant to the Fawn River

Watershed planning project, those are to manage growth of the county and nurture environmental quality.
Several objectives and actions in the Plan address issues described by the Fawn River stakeholders. Those objectives and/or actions are as follows:

- Require cluster designed residential development and allow incentives to developers who do so while protecting and enhancing environmental features
- Establish policies that require new residential properties to connect to centralized sewer systems when developed within a reasonable proximity to infrastructure
- Discourage residential sprawl
- Update the Zoning Ordinance to aid in the preservation of natural areas
- Create a visioning audit to identify ecological resources, open spaces, agricultural districts, buffer zones, green ways, and wildlife areas
- Buffer sensitive land uses from new commercial and industrial developments.
- Protect the water quality in the streams, lakes, and their watersheds
- Encourage the planting of native shade trees and evergreen trees to soften the impact of noise (which will also aid in stormwater uptake)
- Minimize conflicts between growth and the environment
- Conserve existing natural areas including woodlots, wildlife habitat, riparian corridors, littoral corridors, open spaces, wetlands, and floodplains

Steuben County Ordinance for Storm Drainage and Erosion Control

Under Ordinance number 673, Steuben County was responsible for the development of a plan to manage storm water runoff in the county. As stated in the ordinance the purpose of the ordinance is to "reduce the hazard to public health and safety caused by excessive stormwater runoff, to enhance economic objectives, and to protect, conserve and promote the orderly development of land and water resources within the regulatory area". The regulatory area of the ordinance includes all of Steuben County.

The ordinance outlines regulations regarding open channel design, stormwater detention, and erosion and sediment control. All activities in the ordinance will not only meet the objectives outlined above, but will also improve water quality by limiting the amount of stormwater which can carry pollutants to open water sources.

Angola Indiana Comprehensive Plan

Recognizing the importance of strategic planning to a vital and thriving city, Angola Planning Commission worked with consultants to devise a comprehensive plan for the City of Angola. The Plan was adopted by the Angola City Council in October, 2012. Part Two of the Plan outlines concerns and objectives, some of which relate to Fawn River stakeholder concerns including:

- Requiring all new structures to connect to public waste disposal system
- Encourage use of abandoned and under-utilized buildings prior to permitting new construction for businesses
- Require setbacks of development from environmentally sensitive areas
- Incentivize for conservation and preservation of environmentally sensitive areas
- Maintain stormwater management and erosion control ordinances

- Encourage development that reduces the city's environmental footprint

Fawn River Watershed stakeholder concerns, such as the increase in impervious surfaces, septic system discharge, wetland conservation, and streambank erosion will be partially addressed in the City of Angola if the objectives outlined in the Comprehensive Plan are met.

Angola Parks and Recreation 5-Year Master Plan

The City of Angola Parks and Recreation Master Plan was adopted in 2013 and is due to be updated in 2017. The Master Plan addresses several concerns of the Fawn River watershed stakeholders including:

- Preventing development on floodplains and in wetlands
- Maintaining their "Tree City USA" program
- Acquisition of the "center Lakes" area on the northwest edge of the city to add it to the city's park system as a nature preserve.

While the Angola Parks Department has some plans to maintain existing environemental projects and possibly acquire additional natural areas, it does not seem to take full advantage of the potential of the environmental resources of the area including prime wetland locations and other green spaces.

Fremont Comprehensive Plan

The Town of Fremont developed a draft Comprehensive Plan in 2013 with input from the Town of Fremont government and over 200 residents of the town. The Plan recommends a thorough review of the Comprehensive Plan by the Fremont Plan Commission and Town Council before 2024. There are several recommendations in the Comprehensive Plan that are in line with concerns expressed by the Fawn River stakeholders including:

- Require all new construction within the Town limits be hooked up to a centralized sewer system
- Protect conservation areas and provide incentives to preserve environmentally sensitive areas
- Establish stormwater management and erosion control ordinances
- Encourage development practices that reduce the town's footprint on the environment
- Encourage the use of native plants for new developments

If the above objectives in the Comprehensive Plan are met some of the stakeholder concerns will be addressed including wetland conservation, streambank erosion, increase in impervious surfaces, and septic system discharge.

(Sturgis) Master Plan of Future Land Use

The city of Sturgis, Michigan developed a landuse master plan to address concerns of residents, as well as, maintain and improve existing conditions of the city. The Master Plan addresses two if the Fawn River Watershed's stakeholder's concerns including an increase in impervious surfaces and wetland conservation by listing the following objectives within the Master Plan;

- "Preserve, protect, and improve historic, natural, scenic, or environmentally sensitive areas for appropriate public use and enjoyment and habitat protection."
- "Upgrade and maintain existing industrial areas" with the intention of utilizing existing structures prior to construction of new industrial facilities.

2.6.2 Watershed Management Plans

St. Joseph River Watershed Management Plan

There is only one watershed management plan that includes any of the Fawn River; the St. Joseph River Watershed Management Plan. The Friends of the Saint Joe River Association, a 501(c)3 organization, completed a watershed management plan for the entire St. Joseph River watershed (HUC 04050001) in 2005. The watershed is 4,685 square miles and includes 15 counties in Michigan and Indiana. Because of the large size of the watershed, the WMP is vague in its description of the Fawn River watershed and the water quality problems in the watershed. However, the plan noted the Fawn River watershed as being critical for agricultural practices that degrade water quality. Using a SWAT model, it was determined that the most effective BMPs to limit NPS pollution from entering the Fawn River are no-till practices, and edge of field filter strips. The WMP also recognizes the LaGrange County SWCD for its efforts to reduce sediment, nutrient, and pathogen contamination of surface water by implementing a livestock management program.

Michigan Great Lakes Plan

The Great Lakes provide vast opportunities to Michigan and are the driving force to its economy. Due to the importance of the Great Lakes to the economy and health of the state of Michigan, the Michigan Office of the Great Lakes prepared the MI Great Lakes Plan (MiGLP) which was completed in January, 2009. Many problems outlined in the MiGLP are in line with concerns voiced by Fawn River stakeholders such as controlling NPS, protecting and restoring wetlands, sustainable living (including development), and excluding phosphorus from lawn fertilizers. The MiGLP outlines specific objectives and recommendations to accomplish the goal of protecting the overall health of the Great Lakes, including reducing pollution discharging into the Great Lakes via their tributaries. The MiGLP also describes potential partners and funding sources to accomplish the goals.

2.6.3 Lake Management Plans

There are eleven lakes located within the Fawn River watershed that have had studies and/or management plans written for them. Most of the plans involve sediment control and/or removal, and aquatic vegetation management. A brief description of those plans is below. A

Crooked Lake

- Crooked Lake Monitoring Study
    - JF New, an environmental consulting firm, was hired by the Crooked Lake Association to conduct water quality analysis at three sample sites in 2003. One on a Loon lake tributary, on Carpenter Drain, and on Palfreyman Drain. Parameters collected included pH, Dissolved Oxygen, Temperature, Nitrogen, Phosphorus, Total Suspended Solids, and *E. coli*. The water quality analysis indicated that the water feeding into Crooked Lake is in full support of aquatic life as the parameters tested measured below the recommended target limits.

- Crooked Lake Engineering Feasibility Study
    - Based on a previous monitoring study of Crooked Lake, the Crooked Lake Engineering Feasibility Study looked at five potential projects to address sedimentation issues in Crooked Creek. These included streambank stabilization of Carpenter Drain, stormwater management at the 4-H Park, stream reconstruction at Palfreyman Drain at the Highway Department, facility, and eight potential wetland restoration projects. The study concluded that all projects were feasible except for the wetland restoration due to the lack of landowner participation. Completed projects are described below.
- Carpenter Drain Design/Build Report
    - In 2005, JF New, an environmental consulting firm, stabilized approximately 200 lineal feet of eroded bank and removed large pieces of debris in the channel which were the major sources of the erosion problem. JF New recommended monitoring of the site for the next five years. A follow-up report was not completed for this site.
- Steuben County 4-H Park, Stormwater and Sediment Reduction Design Project
    - JF New, an environmental consulting firm installed four raingardens, 462 linear feet of french drains which empty into the raingardens, adjacent to two service roads, 200 feet of eroding roads were paved including the addition of a curb to direct stormwater runoff, two catch basins (dry wells were installed, the project also called for the installation of a woodland berm for stormwater storage. Construction of most of the features was completed by November 2006.
- Crooked Lake Aquatic Vegetation Management Plan (AVMPs)
    - Crooked Lake Association began hiring a consultant to write AVMPs in 2007 when the DNR first identified nuisance plants within the Lake, specifically the invasive species including Starry Stonewart, Eurasion Watermilfoil, and Curly Pondweed. The latest AVMP for Crooked Lake was written in 2013. It is estimated that approximately 10% of Crooked Lake has been invaded by these three invasive plant species. The AVMP provides suggestions on the best use of funds and treatment areas to control the spread of the nuisance aquatic plants.

Lake George

- Aquatic Vegetation Management Plan Update 2013; Lake George
    - The Lake George Cottagers Association hired a contractor in 2006 to develop an AVMP for Eurasion watermilfoil. Most of the areas of concentrated watermilfoil have been treated annually since 2007. However, in 2009 Starry stonewart, another invasive plant species was discovered on Lake George. The AVMP was then updated to include the new plant species. The AVMP provides suggestions on the best use of funds and treatment areas to control the spread of the nuisance aquatic plants.

Lake James Chain

- Lake Diagnostic Study; Lake James, Snow Lake, Big Otter Lake, and Little otter Lakes
    - A diagnostic study was conducted on four lakes in the Lake James chain of lakes in 2006 to measure water quality and assess land use in the watershed that may impact water quality. Water quality and land use results indicated a need to control nutrient loading and invasive aquatic plant species in the lakes. Several recommendations were made to help improve water quality including;
        - Control invasive wetland and aquatic plant species
        - Network with Lake associations to improve overall water quality
        - Investigate the possibility to conduct a monitoring study to determine the impact of wastewater effluent

        - Avoid the redirection of stormwater drainage from other watersheds to the Lake James watershed
        - Implement a Lake resident education program about proper land and shoreline management
        - Work with NRCS and SWCD to implement best management practices on highly erodible land
        - Increase water quality sampling on the Lakes
    - Other more specific recommendations were also provided in the study including the following, a map of priority areas can be found on page 176 of the Study;
        - Stabilize the shore of Lake James, Croxton Ditch, Walter's Lake Drain, Follet Creek, and Crooked Creek watersheds.
        - Restore wetlands in Croxton Ditch and Walter's Lakes Drain watersheds
        - Protect wetlands and insure the practice of proper erosion control on disturbed lands
- Phase II – Engineering Feasibility Study and Engineering Design
    - The Middle Croxton Ditch running through the Lake James Golf Club properties has a lot of sediment due to streambank erosion. This study was conducted to learn the feasibility of reducing sediment loading into the Croxton Ditch, thus into the Lake James Chain. A engineering design was developed to restore approximately 840 linear feet of Croxton Ditch within the Golf Club property. The Steuben County Surveyor was granted funds to implement the design in 2014. The Study also determined that it would be feasible to conduct four dredging projects at an irrigation pond and sediment trap at the Gold Club.

Jimmerson Lake

- Jimmerson Lake Diagnostic Study
    - The Jimmerson Lake Association received a IN DNR grant to conduct a diagnostic study to learn the potential problems in the Lake and hired Commonwealth Biomonitoring to conduct the study. Problems identified within the Jimmerson Lake watershed and potential solutions include;
        - High percentage of highly erodible land surrounding the land which accounts for excessive erosion of land surrounding the lake and may contribute to the sediment loading in the lake
        - Stormwater runoff from Buena Vista area on the north shores of the lake contributing high nutrient and sediment loadings
        - More speed boats are used on Jimmerson Lake when compared to other Indiana lakes which may disrupt native emergent aquatic vegetation in the lake.
        - Concrete seawalls contribute to shoreline erosion and loss of aquatic plant and animal diversity
        - The many wetland and forested areas surrounding the lake should be purchased by the Jimmerson Lake association and be managed as conservation areas
        - Over 90% of the watershed upstream of Jimmerson Lake does not have any landuse planning. All lakes in the watershed should implement a lake management plan, including surrounding landuse management.

- Lake and River Enhancement Engineering Feasibility Study for Jimmerson Lake
    - Donan Engineering, Inc was contracted by the Jimmerson Lake Association to conduct and engineering feasibility study to install management practices that would prolong the life of the lake. The proposed practices to mitigate pollution problems in Jimmerson Lake include;
        - Sediment basins to capture sediment from the highly erodible land used for agriculture in the watershed in Section 5 of Pleasant Township
        - Conserve the many valuable wetlands surrounding Jimmerson Lake by purchasing a conservation easement for wetland areas that are slated for development
        - Install "No Wake" buoys at key locations to protect aquatic vegetation beds and the lake's shoreline
        - Implement an education and outreach program to educate the public about stormwater discharges and their impacts on water quality
        - Develop and enforce construction site ordinances to prevent erosion and ensure sediment does not discharge into open waters
- 2013 Aquatic Plant Management Plan Update for Jimmerson Lake
    - The first AVMP written for Jimmerson Lake was in 2005 and an update was written in 2006, 2008, 2012, and 2013. According to the 2013 update, Jimmerson Lake is oligotrophic, which indicated relatively good water quality. The lake has been colonized by the invasive species of Eurasion watermilfoil, curlyleaf pondweed, and starry stonewort. Another, non-native plant has been identified in the lake, spiny naiad, however it does not appear to be a prolific grower and does not appear to be a threat. Over 20% of the lake was noted as having starry stonewort. Eurasion watermilfoil and curlyleaf pondweed are prolific growers, though do not cover as much of the lake as does starry stonewort. The Jimmerson Lake Association has received IN DNR funding since 2005 to treat invasive aquatic vegetation in the lake. The 2013 update provides recommendations of where the most effective area of the lake is to treat invasive species.

West Otter Lake

- West Otter Lake Aquatic vegetation Management Plan Update 2013
    - The West Otter Lake Association acquired IN DNR funding to complete an AVMP, which was completed in 2005. An update to the AVMP was completed in 2006, 2012 and 2014. The invasive species of Eurasion watermilfoil and curlyleaf pondweed have colonized in West Otter Lake. Spiny naiad, another non-native aquatic plant species, is present in the Lake but does not pose a threat to the integrity of the lake. The 2013 update recognizes that in areas of dense growth of the lake, surface mats of the invasive species exist and impede recreational activities, specifically in the northwest portion of the lake near the public access site and on lake channels. The AVMP update provides recommendations of areas to treat the invasive species that would make the greatest impact to controlling the spread of the plants.

Lake Gage and Lime Lake

- Lake Gage and Lime Lake Engineering Feasibility Study
    - The Lake Gage and Lime Lake Association received an IN DNR grant to conduct an engineering feasibility study to determine the most effective means of reducing sedimentation of the two lakes in 2004. The study was conducted in three parts; 1) Habitat restoration of Concorde Creek, the main tributary to Lime Lake, 2) Wetland

integrity scoring and how the Concorde Creek project would affect the wetlands, 3) Restoration of a natural watercourse which was dredged and straightened that flows through a natural wetland area at the southeast end of Lake Gage. It was determined that streambank restoration of Concorde Creek would reduce sedimentation of Lime lake and improve the quality of surrounding wetlands and that restoring the natural watercourse would also reduce erosion and sedimentation of Lake Gage.

- Concorde Creek Channel Restoration Project Design Report
    - Following design specifications outlined in a 2008 Design project for Concorde Creek by JF New for the Lake Gage and Lime Lake Association, approximately 578 feet of channel in Concorde Creek was restored to its historic meander. To accomplish this, three earthen dams and reconstruction of the channel took place. The restored stream has better access to the natural floodplain which will allow for nutrients and sediment to settle out prior to being discharged into the lake. Also, nearly 400 feet of eroding channel was filled and native vegetation was planted to eliminate sedimentation from that area. It is expected that native flora and fauna habitat has been restored in this section of Concorde Creek and that nutrient and sediment loading to Lake Gage will be significantly reduced.
- Lake Gage and Lime Lake Aquatic Vegetation Management Plan
    - The Lake Gage and Lime Lake Association contracted Aquatic Weed Control to conduct a vegetation survey and propose a management plan to address any invasive species colonies found during the survey in 2012. Eurasian watermilfoil was found in the two lakes, mainly in areas with depths less than 10 feet and curlyleaf pondweed was found in Lime Lake. The frequency of Eurasian watermilfoil was up to 11.4% in Lake Gage and 30% in Lime Lake. The frequency of the plant in the two lakes is relatively low when compared to other Indiana lakes, so recommendations were made to monitor the growth of the plant only, and not spend funds to treat it at this point. However, specific recommendations were provided in the AVMP to maintain the lakes' integrity.
        - Reduce Eurasian watermilfoil to 10% or less in Lime Lake
        - Maintain Eurasian watermilfoil below 10% in Lake Gage
        - Maintain 8 native plant species in Lime Lake
        - Maintain 6 native plant species in Lake Gage

Wall Lake

- Lake Diagnostic Study
    - The Wall Lake Fisherman's Association, in conjunction with the IN DNR Division of Fish and Wildlife, contracted Aquatic Enhancement and Survey, Inc in 2005 to conduct a study of the lake's biological and chemical integrity. Based on findings during the water quality and landuse investigation the following recommendations were given;
        - Seek long term, legal protection of surrounding wetlands and woodlands
        - Begin a program to control purple loosestrife and prevent the spread of invasive plants into wetlands
        - Continue fish management activities and assess the 2005 walleye stocking of Wall Lake
        - Seek to connect Wall Lake residents to a central sewer system
        - Enhance wetland habitat in the watershed
        - Work with NRCS and SWCD staff to install best management practices on agricultural land in the watershed
- Aquatic Vegetation management Plan Update 2014

- Wall Lake Fisherman's Association first acquired grant funds from the IN DNR in 2005 to write an AVMP, which was completed in 2006. Since the first AVMP, an update has been completed in 2007, 2008, 2009, 2012, and 2014. Eurasion watermilfoil, starry stonewort, and curlyleaf pondweed have all been introduced to Wall Lake. Starry stonewort is a relatively new species in Wall Lake and treatment for this species first began in 2010. A terrestrial invasive plant species, purple loosestrife, has also begun to establish itself in surrounding wetland areas. Recommended treatment areas and rates of application are outlined in the AVMP. Specific recommendations to control the growth of invasive plant species in Wall Lake include;
  - Limit the occurrence of curlyleaf pondweed and Eurasian watermilfoil in late season sampling to 5% or less
  - Maintain a minimum of 10 native plant species with a diversity rate of 0.80

Cedar Lake

- Cedar Lake Diagnostic Study
  - The IN DNR Lake and River Enhancement staff performed a diagnostic study of Cedar Lake in 2009 and 2010, with the final report being released in 2010. The study found that the water quality is generally good and clear. There is little diversity in aquatic vegetation, and presents few recreational barriers, except for a few midsummer algae blooms. There is a diverse group of fish species found in Cedar Lake, which keeps the fishery at a satisfactory level. The study state's that the lake is only 70% built-up, which is far less built up than surrounding lakes and the Lake is surrounded by pristine wetlands which may filter many pollutants out prior to stormflow reaching Cedar Lake. The study suggests several steps to take to maintain the high quality of Cedar Lake including:
    - Promotion of BMPs to Lake residents such as;
      - Phosphorus free fertilizer
      - Shoreline habitat improvement
      - Installation of rain gardens and rain barrels to capture stormflow
      - And preventative maintenance of septic systems
    - Take precautions to avoid spreading aquatic invasive species
    - Maintain a volunteer base to take regular water quality samples through Hoosier Riverwatch
    - Protect and promote the importance of surrounding wetlands
    - Partner with LaGrange county SWCD and surveyor to promote BMPs to limit erosion of nutrients and sediment from agriculture, timber harvest, and construction projects.

  Following the above recommendations, not only in the Cedar Lake watershed but throughout the lake community, will help to address Fawn River stakeholder concerns such as wetland conservation, lack of no-till and cover crop practices, septic system discharge, and urban fertilizer use .

2.6.4 Other Studies

St. Joseph River Watershed Fish Migration Barrier Inventory

The Potawatomi Resource Conservation and Development Council (RC&D) conducted a study, which was published in 2011, of culvert, dams, and bridges located within the St. Joseph, Lake Michigan watershed to determine if the structures posed a problem for the necessary migration of aquatic life. The study used a scoring method on the impact the structures had on

aquatic habitat, whether or not a partner agency or organization put priority on a particular structure, the cost of removal or modification to the structure, and a social score to determine the purpose of the structure. Then the scores were used to determine the priority of removal or modification to the structure.

Results from the study indicated that one hydroelectric dam, the Star Mill Dam, located on the Fawn River in LaGrange County was a high priority for removal or modification. The results of the study also indicated that there were four culverts located on the Fawn River that did not allow the passage of some aquatic species (three in LaGrange County and one in St. Joseph County) and one culvert that became a barrier at high flows in LaGrange County. The study suggests further investigation of these sites to determine the best means of modifying them to allow for the safe passage of aquatic life.

Fawn River Restoration

It has been estimated that approximately 100,000 cubic yards of sediment was released in 1998 from the Fawn River Fish Hatchery when their fish pond dams needed to be lowered to allow for repairs. The sediment covered what was a gravel floor, and filled a deep thalweg, which buried prime aquatic habitat. Landowners adjacent to the Fawn River sought funding for restoration efforts, which was awarded to the landowners in 2011. The funds were put into the Fawn River Restoration and Conservation Charitable Trust (Trust).

The Trust hired an environmental consulting firm to do the restoration. Sediment was removed and the thalweg was restored. Additionally, large woody debris structures were installed to restore the sinuosity of the stream. The restoration work looks to be effective and the Trust plans to expand restoration efforts to other areas of the Fawn River.

2.6.5 Wellhead Protection Plans

The majority of the rural community utilizes private water wells located on their property. Smaller incorporated areas and villages also acquire their drinking water from groundwater wells; however those wells are overseen by the State environmental regulating agency. Those communities are commonly known as community public water supply systems (CPWSS). A CPWSS is designated as such if it has 15 service connections or supplies drinking water to at least 25 people, according to the federal Safe Drinking Water Act. The entity controlling the system is required to develop a Wellhead Protection Plan (WHPP). A WHPP must contain five elements; 1) Establishment of a local planning team, 2) Wellhead Protection Area Delineation of where ground water is being drawn from, 3) Inventory of existing and potential sources of contamination to identify known and potential areas of contamination within the wellhead protection area, 4) Wellhead Protection Area Management to provide ways to reduce the risks found in step three, and 5) Contingency Plan in case of a water supply emergency. It is also important to identify areas for new wells to meet existing and future water supply needs. There are two phases of wellhead protection. Phase I is the development of the WHPP which involves delineating the protection area and determining sources of potential contamination. Phase II is the implementation of the WHPP. Table 2.13 identifies those CPWSSs located within

the project area and which phase they are currently in. A map of well head protection areas in Indiana is not available since the delineation of such areas is not made public; however an approximate location of the WHPP was used and is delineated on a map which can be found in Figure 2.23. Michigan has made available the delineation of wellhead protection plans which are also outlined in the below figure.

Table 2.13: Wellhead Protection Plans in the Fawn River Watershed

System Name	Population Served	Source	Phase	Watershed
Constantine	2095	GW	Unknown	Fawn River Drain
Sturgis	11920	GW	Unknown	Wegner Ditch
Memory Lane Mobile Home Park	568	GW	Unknown	Wegner Ditch
Fawn River Crossing	587	GW	Phase II	Wegner Ditch
Angola Water Department	8276	GW	5 yr update	Tamarack Lake
Fremont Water Department	1697	GW	Phase II	Snow Lake
Mobil-Rama	30	GW	Phase II	Snow Lake
Or-An Tc/Cleveland Tr. S.	46	GW	Phase II	Lake James
Linda Ann Mobile Home Court	30	GW	Phase II	Tamarack Lake
Leisure Lakes Mobile Home Court	27	GW	Phase II	Lake James
Orland Water Works	341	GW	Phase II	Town of Orland-Fawn River
Coachlight Mobile Home Court (Lots 1-18)	48	GW	Phase II	Lake James
Glen Eden Association	35	GW	Phase II	Lake James

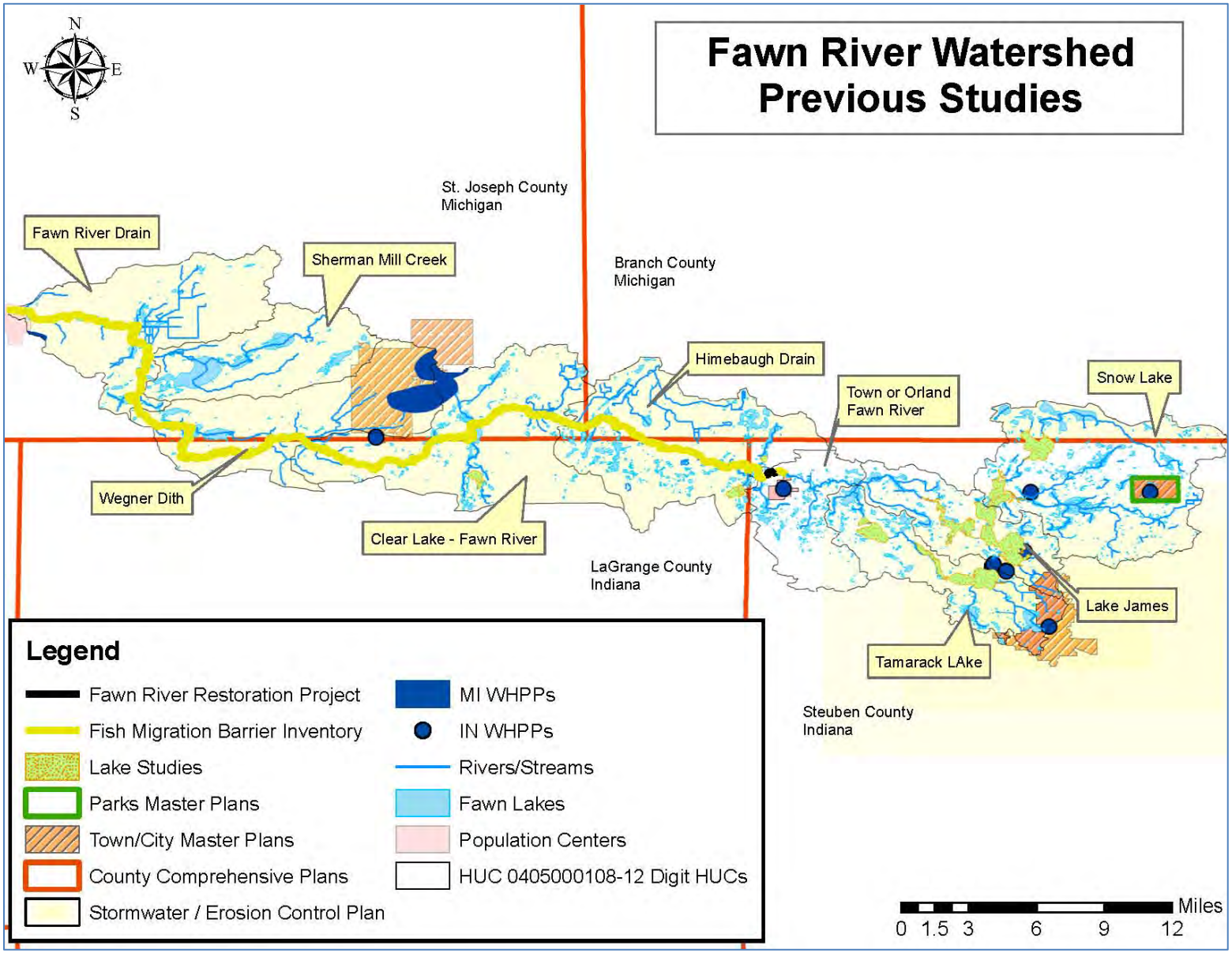
2.6.6 Municipal Separate Storm Sewer System

The federal Clean Water Act requires storm water discharges from larger urbanized areas to be permitted under the National Pollutant Discharge Elimination System (NPDES) program. These communities are referred to as Municipal Separate Storm Sewer System (MS4) Communities and are required to develop a Storm Water Quality Management Plan.

The City of Angola and Trine University are co-permitted and is the only entity located within the project area designated as an MS4 community. IDEM describes a MS4 as "a conveyance or system of conveyances owned by a state, city, town, or other public entity that discharges to waters of the United States and is designed or used for collecting or conveying storm water." The reason that MS4s are required is that urban storm water runoff has one of highest potentials for carrying pollutants to our waterways and as such, the Federal Clean Water Act requires that certain storm water dischargers acquire a National Pollutant Discharge Elimination System (NPDES) permit. Being an MS4 community, Angola was required to develop a Storm Water Quality Management Plan (SWQMP). The SWQMP must include six management techniques, referred to as "minimum control measures" (MCMs) including; 1) Public education and outreach; 2) Public participation and involvement; 3) Illicit discharge,

detection and elimination; 4) Construction site runoff control; 5) Post-construction site runoff control; and 6) Pollution prevention and good housekeeping. Essentially, the MCMs list several management practices to limit the amount of storm water entering the sewers on a regular basis. Only about half of the City of Angola is located in Fawn River watershed, and the sewer conveyance system discharges storm water to the Pigeon Creek watershed. However, since the Pigeon Creek is also part of the larger St. Joseph River watershed, promotion of the MCMs outlined in the SWQMP should be promoted through this project for the portion of the MS4 community located within the project area, at a minimum.

Figure 2.23: Historic and Existing Studies in the Fawn River Watershed



2.7 Endangered Species

The Fawn River watershed is home to many federally and state listed endangered and threatened species. The US Fish and Wildlife Service (USFWS) maintains a database of those species that are either endangered, threatened, or candidates to become endangered on the federal level which can be seen in Table 2.14. There are several species of significance located within the Fawn River watershed which rely on wetland and upland forested areas for habitat, including the three mussel species, two butterflies, two snakes, an important plant species and the Indiana Bat.

According to the USFWS, the Indiana Bat population has decreased by over half since it was originally listed as endangered in 1967. This decrease in population can be attributed to human activities disturbing the Indiana Bat's habitat. Indiana Bats are very vulnerable to disturbances in their hibernation grounds as they hibernate in mass numbers (20,000 to 50,000) in caves in southern Indiana. The reason the bats population has declined in northern Indiana is mainly due to their breeding and feeding grounds, riparian and upland forests, being cleared for agricultural land and expanding urbanization. The Eastern Massasauga Rattlesnake lives in wetland areas, many of which have been drained to be used for agriculture. With much of the Eastern Massasauga's habitat being converted for other uses, the snakes numbers have declined dramatically. Many of the species listed as endangered at the federal level rely on wetland habitat for survival, and the clearing of that key land feature has caused the decline in those species numbers. State's Fish and Wildlife Agencies have listed several additional species not found on the federal list as endangered or threatened. The protection of the habitat in which all the species listed in Table 2.12 live is essential to their survival.

Table 2.14: Federally Listed Endangered Species

County	Species	Common Name	Status	Habitat	Image
Mammal					
St. Joseph, Branch, LaGrange	*Myotis sodalis*	Indiana Bat	Endangered	Hibernation in caves, swarming in wooded areas and stream riparian corridors	
Mussels					
Steuben	*Pleurobema clava*	Clubshell	Endangered	Fresh water, Rivers	
LaGrange	*Epioblasma triquetra*	Snuffbox	Endangered	Small to medium sized creeks with swift current and sand, gravel or cobble substrate (can be found in Lake Erie and some larger rivers)	
LaGrange	*Villosa fabalis*	Rayed Bean	Endangered	Smaller headwater creeks, sometimes larger rivers	

County	Species	Common Name	Status	Habitat	Image
Insects					
St. Joseph, Branch, Steuben, LaGrange	*Neonympha mitchellii mitchellii*	Mitchell's Satyr	Endangered	Fens	
LaGrange	*Lycaeides melissa samuelis*	Karner Blue	Endangered	Pine and oak savanna/barrens supporting wild lupine and nectar plants	
Reptiles					
St. Joseph, Branch, Steuben, LaGrange	*Sistrurus catenatus catenatus*	Eastern Massasauga	Candidate	Wetlands and adjacent uplands	
St. Joseph, Branch, Steuben, LaGrange	*Nerodia erythrogaster neglacta*	Copperbelly Watersnake	Threatened	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches, and floodplain woods	
Birds					
LaGrange	*Haliaeetus leucocephalus*	Bald Eagle	Threatened, Proposed for Delisting	Near water with old trees	

County	Species	Common Name	Status	Habitat	Image
Plants					
St. Joseph, Steuben, LaGrange	*Platanthera leucophaea*	Prairie White-fringed Orchid (Eastern Prairie Fringed Orchid)	Threatened	Mesic praire to wetlands, grassy habitat with little to no woody encroachment	

2.11 Invasive Species

Invasive species are those organisms that do not naturally occur in a specific area and when introduced will cause deleterious effects on the ecology of the area. Invasive species may be one of the greatest threats to the natural areas within the Fawn River Watershed. Due to the fact that the newly introduced organism does not have natural predators, the organism can spread through an area quickly and can out compete native organisms that make an ecosystem thrive. Invasive species are of particular concern to the lake communities as invasive plants and aquatic organisms have already caused a decline in native plants and fish. Invasive species are also easily transported through the lake community as seeds, eggs, and actual organisms will attach themselves to boats which are then used in multiple different lakes, essentially transporting the organisms between different lakes. Table 2.15 is a list of invasive species that are located throughout the greater St. Joseph – Lake Michigan watershed, and can likely be found within the Fawn River watershed. That list of invasive species was obtained from the USDA-NRCS electronic Field Office Technical Guide (eFOTG). Table 2.16 is a list of invasive plant species that can be found in one or more of the four counties in which the Fawn River watershed is located. The eFOTG does not have the invasive plants listed for Indiana; therefore, the invasive plants list for Indiana was obtained from the Purdue University Extension website.

Table 2.15: Invasive Species in the St. Joseph-Lake Michigan Watershed

Common Name	Scientific Name	Habitat	Exotic / Native / Transplant	Source of Species	Image
Coelenterates					
Freshwater jellyfish	*Craspedacusta sowerbyi*	Freshwater	Exotic	Tranported with ornamental aquatic plants from China	
Crustacean					
scud	*Echinogammarus ischnus*	Freshwater- Marine	Exotic	Ballast water from Black Sea and Caspian Sea drainage	
Fish					
American shad	*Alosa sapidissima*	Freshwater - Marine	Native	Stocking in non-native waters	
Oscar	*Astronotus ocellatus*	Freshwater	Exotic	Stocking in non-native waters	
unidentified pacu	*Colossoma or Piaractus sp.*	Freshwater	Exotic	Aquarium releases or escapes from fish farms	
Grass carp	*Ctenopharyngodon idella*	Freshwater	Exotic	Stocking in non-native waters	

Common Name	Scientific Name	Habitat	Exotic / Native / Transplant	Source of Species	Image
Common carp	*Cyprinus carpio*	Freshwater	Exotic	Unauthorized stocking in non-native waters in 1800s	
Redear Sunfish	*Lepomis microlophus*	Freshwater	Native	Stocking in non-native waters	
Round goby	*Neogobius melanostomus*	Freshwater	Exotic	Ballast water from Black Sea	
Rainbow trout	*Oncorhynchus mykiss*	Freshwater - Marine	Native	Stocking in non-native waters	
Chinook Salmon	*Oncorhynchus tshawytscha*	Freshwater - Marine	Native	Stocking in non-native waters	
Coastal rainbow trout	*Oncorhynchus mykiss irideus*	Freshwater - Marine	Native	Stocking in non-native waters	
Sea Lamprey	*Petromyzon marinus*	Freshwater - Marine	Non-native to freshwater	Possibly introduced through the Erie Canal	

Common Name	Scientific Name	Habitat	Exotic / Native / Transplant	Source of Species	Image
pirapatinga, red-bellied pacu	*Piaractus brachypomus*	Freshwater	Exotic	Aquarium releases	
Atlantic Salmon	*Salmo salar*	Freshwater - Marine	Native	Stocking in non-native waters	
Brown trout	*Salmo trutta*	Freshwater	Exotic	Imported from Germany for sportfishing stock	
Brook Trout	*Salvelinus fontinalis*	Freshwater	Native	Stocking in non-native waters	
Lake Trout	*Salvelinus namaycush*	Freshwater	Native	Stocking in non-native waters	
Saugeye	*Sander canadensis x vitreus*	Freshwater	Native hybrid	Unknown	
Mullusks					
zebra mussel	*Dreissena polymorpha*	Freshwater	Exotic	Ballast water from Black Sea ship to Great Lakes	

Common Name	Scientific Name	Habitat	Exotic / Native / Transplant	Source of Species	Image
quagga mussel	*Dreissena rostriformis bugensis*	Freshwater	Exotic	Ballast water from Dneiper River drainage of Unkrain and Caspian Sea	
Chinese mysterysnail	*Cipangopaludina chinensis malleata*	Freshwater	Exotic	Sold in Chinese food markets in 1800s, possible aquarium release	
Reptiles					
American Alligator	*Alligator mississippiensis*	Freshwater	Native	Escaped or released pets	
Alligator Snapping Turtle	*Macrochelys temminckii*	Freshwater	Native	Released pets	
Insects					
Common Pine Shoot Beetle	*Tomicus piniperda*	Pine trees	Exotic	Native to Europe. Discovered in Ohio in 1992	

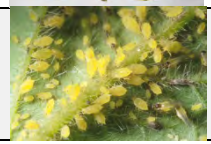
Common Name	Scientific Name	Habitat	Exotic / Native / Transplant	Source of Species	Image
Emerald Ash Borer	*Agrilus planipennis*	Ash Trees	Exotic	Likely cargo ships from eastern Russia, northern China, Japan or Korea. Discovered in 2002	
European Gypsy Moth	*Lymantria dispar dispar*	Temperate Forests	Exotic	Native to temperate forest of western Europe. Discovered in US in 1869	
Soybean Aphid	*Aphis glycines*	Underside of Soybean leaves	Exotic	Native to Asia. Discovered in 2000	

Table 2.16: List of Invasive Plant Species per County

Counties	Common Name	Scientific Name	Habitat
St. Joseph, Branch, Steuben, LaGrange	Asian Bush Honeysuckle(s)	*Includes many Lonicera*	Forest
	Autumn Olive	*Elaeagnus umbellata*	Openland
	Black Locust	*Robinia pseudoacacia*	Openland
	Canada Thistle	*Cirsium arvense*	Openland
	Common Reed; Phragmites	*Phragmites australis*	Wetland
	Curly-Leaf Pondweed	*Potamofeton crispus*	Wetland
	Eurasian Watermilfoil	*Myriophyllum spicatum*	Wetland
	Garlic Mustard	*Alliaria periolata*	Forest
	Japanese Knotweed	*Polygonum cuspidatum*	Forest
	Multiflora Rose	*Rosa multiflora*	Forest, Openland
	Norway Maple	*Acer platanoides*	Forest
	Purple Loosestrife	*Lythrum salicaria*	Wetland
	Reed Canary Grass	*Phalaris arundinacea*	Wetland
	Tree of Heaven	*Ailanthus altissima*	Forest

Counties	Common Name	Scientific Name	Habitat
St. Joseph, Branch, Steuben	Japanese Honeysuckle	*Lonicera japonica*	Forest
St. Joseph, Branch, LaGrange	Oriental Bittersweet	*Celastrus orbiculatus*	Forest
St. Joseph, Branch	amur cork-tree	*Phellodendron amurense*	Forest and Openland
	Baby's breath	*Gypsophila scorzonerifolia*	alkaline or limestone shores
	Bell's honeysuckle	*Lonicera x bella*	Forests, Openland
	Black jetbead	*Rhodotypos scandens*	Forest, Openland
	Black swallowwort	*Cynanchum louiseae*	Forest and open land
	Common buckthorn	*Rhamnus cathartica*	Forest, wetlands, Openland
	European fly honeysuckle	*Lonicera xylosteum*	Forest and Openland
	European frog-bit	*Hydrocharis morsus-ranae*	Wetland
	Flowering rush	*Butomus umbellatus*	Wetland
	Giant hogweed	*Heracleum mantegassianum*	Openland
	Giant knotweed	*Fallopia sachalinensis*	Floodplain forests, Openland
	Glossy buckthorn	*Rhamnus frangula*	wetlands, prairie, forests
	Hydrilla	*Hydrilla verticillata*	Wetland
	Japanese barberry	*Berberbis thunbergii*	Forest, Openland
	Japanese silt grass	*Microstegium vimineum*	Forests, riparian cooridor, openland
	kudzu	*Pueraria montana*	Openland
	Leafy spurge	*Euphorbia esula*	Openland and riparian areas
	Morrow's honeysuckle	*Lonicera morrowii*	Forest

Counties	Common Name	Scientific Name	Habitat
	pale swallowwort	*Cynanchum rossicum*	Upland forests and openland
	Reed mannagrass	*Glyceria maxima*	Wetland
	Russian Olive	*Elaegnus angustifolia*	Riparian areas, fields, openland
	Scotch pine	*Pinus sylvestris*	Openland
	Spotted knapweed	*Centaurea maculosa*	Openland
	Tartarian honeysuckle	*Lonicera ttatarica*	Forest
	Variable-leaf watermilfoil	*Myriophyllum heterophyllum*	Wetland
	water-hyacinth	*Eichornia crassipes*	Wetland
Steuben	Creeping Jenny	*Lysimachia nummularia*	Forest, Wetland
Steuben, LaGrange	Buckthorn(s)	*Rhamnus (frngula) cathartica)*	Wetland, openland
	Crown Vetch	*Securigera varia*	Openland
	Dame's Rocket	*Hesperis matronalis*	Forest, Openland
	Periwinkle	*Littorina littorea*	Forest
	Privet(s)	*Ligustrum obtusifolium*	Forest
	Purple Winter Creeper	*Euonymus fortunei*	Forest
	Siberian Elm	*Ulmus pumila*	Forest
	Smooth Brome	*Bromus inermis*	Forest, Openland
	Star-of-Bethlehem	*Ornithogalum nutans and O. umbelatum*	Wetland and riparian areas
	Sweet Clover(s)	*Melilotus officinalis*	Openland
	Tall Fescue	*Festuca arundinacea*	Openland
	White Mulberry	*Morus alba*	Openland

2.12 Summary of Watershed Inventory

All of the elements described above, when combined, can provide a larger picture of how the watershed functions and what activities may pose a greater threat to our water resources. This section will summarize the characteristics of the project area and describe how they relate to each other. This will be examined more closely in subsequent sections.

The predominant land use in the Fawn River watershed is agriculture due to the fertile soils, much of which used to be wetlands as can be seen by the amount of hydric soil present within the watershed (Figure 2.6). Hydric soils are not ideal for agricultural use due to the frequency of ponding and/or flooding. When soils are over saturated, excess nutrients and animal waste often wash off the field and may discharge directly into surface waters. Many landowners install field tiles or petition to convert open water to legal drains to be maintained by the county surveyor or engineer to prevent crop land from becoming over saturated. As can be seen in Figure 2.12, many streams and ditches have been converted to be on regular maintenance by the County, especially in Steuben County; 66.86 miles of open drain and 44.18 miles of tiled drains. However, this practice provides a direct means for nutrients, sediment, and bacteria to enter surface water, or depending on the depth to the water table, to groundwater resources used for crop irrigation or drinking water. For these reasons best management practices should be implemented on agricultural land with hydric soils, especially those using field tiles to drain the crop land.

Although only a little more than 7% of the watershed is considered developed, it is important to focus water quality improvement efforts in the urban areas specifically surrounding developed lakes. Fertilizer used on urban lawns can exacerbate aquatic plant growth which can alter the aquatic ecosystem, as well as inhibit regular recreational activities on the lakes. Many lakes in the watershed have begun to implement a “no phosphorus” fertilizer program as phosphorus is considered the limiting agent to algae growth. Also, many residents on the lakes have installed concrete sea walls at their property’s shoreline. The hard surface sea walls often destroys the gradual transition from shallow to deep water, and the crashing of the waves on the wall causes bottom sediments to stir up which increases turbidity. The use of sea walls can destroy habitat for many fish species, including their spawning areas, and block access to and from the water for turtles, frogs and other creatures that need access to land for feedings, resting and nesting.

There are several populated areas located within the Fawn River watershed including Fremont and Angola, IN and Sturgis, MI. While only Angola is required to have education and outreach regarding stormwater control due to it being an MS 4 community, stormwater management should be promoted in all populated areas, as urban stormwater has the greatest potential to carry many pollutants to open water including oil, grease, lawn fertilizer, salts, sediment, and other pollutants that can be harmful to the aquatic ecosystem.

Nearly ¼ of all soils in the watershed are considered HEL or PHEL, as can be seen in Figure 2.45. Since so much of the farmed land in the watershed is considered to be erodible, special precautions should be taken by those producers working HEL and PHEL land to limit the amount

of soil erosion. As soil erodes, it can increase stream and lake sedimentation. The eroding soil particles often carry nutrients that bind to the particles to open water sources as well. This may cause an increase in phosphorus and nitrogen levels within the water system, leading to unsuitable water quality.

Since the majority of the land use in the Fawn River watershed is agriculture, specifically row crops (greater than 48% of the watershed); sedimentation can have a major effect on water quality and biota. Tillage data collected by each county (except those in MI in which a transect has not been conducted in decades) in the watershed indicates a relatively fair adoption of conservation tillage practices, especially in Steuben County with 80% of corn and 96% of beans utilizing conservation tillage. Conservation tillage requires a minimum of 30% residue cover on the land. This type of tillage decreases the potential for soil erosion, decreases soil compaction, and can save the producer time and money by minimizing the number of passes made on each field while preparing for the next planting season.

It was noted during the windshield survey that many producers are utilizing field irrigation sprinklers to water their crops, and also that many fields lack an adequate buffer to slow stormwater and absorb fertilizer and other pollutants prior to reaching open water. As mentioned above, conventional tillage increases erosion of farm fields, and irrigations, without proper management can do the same, as well as wash off nutrients meant for plant uptake. For these reasons, it is important to install adequate riparian buffers adjacent to crop fields.

There are 10 populated areas that are currently served by a centralized sewer system including all towns and cities located in the watershed, as well as some of the built up lakes. However, much of the watershed, approximately 82% is rural and therefore, many homes utilize on-site sewage treatment for their household effluent. While accurate estimates of the number of failing or failed septic systems could not be obtained for the project area, the US EPA estimates that up to 5% of all septic systems are currently failing. The USDA soil survey for Steuben, LaGrange, St. Joseph and Branch counties lists less than 10% of the soil in the project area as being suitable for septic system treatment as can be seen in Figure 2.7 on page 17. These two facts may lead one to believe that bacteria contamination, and excessive nutrients found within the water samples may be partly due to improperly sited septic systems and/or failing systems.

The entire population of the Fawn River watershed obtains their drinking water from groundwater, including the major population centers of Angola, Fremont, Orland, Sturgis, and Constantine from wells. Field tiles and improperly placed or faulty septic systems can seriously affect the integrity of the groundwater aquifer to be used for drinking water as the contaminated effluent may not be entirely filtered as it percolates through the soil. Leaking underground storage tanks can also pollute groundwater, contaminating drinking water with various harmful chemicals. For this reason, special precautions must be taken to ensure that the watershed's populations drinking water source in not polluted.

As stated earlier, the majority of the land within the project area is used for agriculture and many of the wetlands that were once present have been drained for pasture land or row crops.

As mentioned in Section 2.4.3, it is estimated that the entire St. Joseph River Watershed has lost 53% of its historic wetlands. Wetlands play an important role in our ecosystem, not only as flood water traps and pollution sinks, but also as prime habitat for many of the species listed as endangered or threatened. For instance, the Indiana Bat, Copperbelly Water Snake, and Massasauga Rattlesnake all prefer the habitat provided by wetlands. Forest land, much of which has been cleared for agriculture, is also a vital habitat for endangered species, such as the Indiana Bat. Leaving some agricultural land fallow and replanting the fields with native vegetation to allow the landscape to return to forest or wetland will provide more vital habitat for those endangered and threatened species. Many of the strategic and comprehensive planning efforts by local governments and interest groups have made goals for conserving and protecting natural areas including LaGrange and Steuben County Master Plans, the Fremont and Angola Comprehensive Plans, the Angola Parks and Recreation Master Plan, and the City of Sturgis Master Plan.

Table 2.16, below, links those concerns that stakeholders from the public meetings had regarding the project area and water resources, to evidence found during the initial project area inventory. More evidence will be provided in subsequent sections at the 12 digit HUC level.

Table 2.16: Stakeholder Concerns and Relevant Evidence for Concern

Concerns	Evidence	Potential Problem
Livestock access to open water	One site was noted during the windshield survey that allowed for livestock to have direct access to open water.	*E. coli* contamination, excess nutrients, erosion, sediment
Stormwater runoff from livestock operations	A few livestock issues were noted during the windshield survey (discussed in more detail in subsequent Sections). There are four CFOs located within the watershed. Nearly 10% of the watershed land use is considered to be pasture/hayland which would indicate the presence of livestock in those areas. Gently rolling hills of the watershed and the lack of riparian buffers allow for runoff to reach open water easily.	*E. coli* contamination, excess nutrients, and sediment
Increase in impervious surfaces	70 built-up lakes located within the watershed which increases the number of driveways, patios, and access roads.	Oil and grease, Excess sediment, nutrients

Concerns	Evidence	Potential Problem
Fertilizer used on urban lawns	70 built-up lakes in the project area. Many lake residences have lush and green lawns which indicate the use of commercial fertilizers. The same situation can be seen in many naighborhoods and residential areas in Angola, Fremont, and Sturgis.	Excess nutrients and impaired biotic communities
Lakes in the area becoming more developed	Lakes within the area continue to allow for construction of new homes as well as there already being 70 built-up lakes in the watershed.	Excess sediment, nutrients, impaired biotic communities, *E. coli*
Septic system discharge	There are 10 populated areas in the watershed that are serviced by a centralized sewer system. Many built-up lakes located throughout the watershed are utilizing on-site waste disposal systems and the entire rural population utilizes on-site waste disposal. It is estimated that nearly 5% of all septic systems in the US are currently failing.	Excess nutrients, sediment, *E. coli*
Lack of no-till and cover crop practices	MI counties has not performed a tillage transect since 1993 and District Conservationist could not provide an estimate of current tillage usage but only 2% of all crops in Steuben County and 19% of all crops in LaGrange County use cover crops. 31% of corn in Steuben and LaGrange counties are in no-till and 68% and 63% of beans in Steuben and LaGrange counties, respectively, are in no-till.	*E. coli* contamination, excess nutrients and sediments
Wetland Conservation	According to the NWI, approximately 16% of the watershed is considered to be wetland. The Friends of the St. Joseph River Association - Wetland Partnership estimates nearly a 53% decrease in wetlands and comparing 1979 wetland data to 2005 data, the Fawn River watershed has lost approximately 616 acres of wetlands within that time.	Flooding, lack of wildlife and aquatic habitat and pollution sequestration, and impaired biotic communities
Stream Bank Erosion	The windshield survey revealed a lack of riparian buffer throughout the watershed which may increase streambank erosion.	Sedimentation, turbidity, impaired biotic community