Upper St. Joseph River Watershed Management Plan

HUCs 0410000301, 0410000302, 0410000303, 0410000304

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With Guidance from the Upper St. Joseph River Watershed Project Steering Committee

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List of Acronyms

AFOs	Animal feeding operations
AU	Assessment Unit
BMPs	Best Management Practices
BUSTR	Bureau of Underground Storage Tank Regulations
CAFF	Confined Animal Feeding Facility
CAFOs	Concentrated Animal Feeding Operations
CFOs	Confined Feeding Operations
CFU	Colony-Forming Unit
CNPCP	Coastal Nonpoint Pollution Control Plan
CPWSS	Community Public Water Supply Systems
CSO	Combined Sewer Overflow
CWA	Clean Water Act
DEQ	Department of Environmental Quality
DMR	Discharge Monitoring Report
DNR	Department of Natural Resources
DO	Dissolved oxygen
DRP	Dissolved Reactive Phosphorus
FCAs	Fish Consumption Advisory
HEL	Highly Erodible Land
HUC	Hydrologic Unit Codes
IDEM	Indiana Department of Environmental Management
IFM	Industrial Fluids Management
IN	Indiana
INDOT	Indiana Department of Transportation
IPFW	Indiana University-Purdue University, Fort Wayne
IR	Integrated Report

LTCP	Long Term Control Plan
LUSTs	Leaky underground storage tanks
MCL	Maximum Contaminant Level
MCM	Minimum Control Measures
mg/L	Milligram per Liter
MGD	Million gallons per day
mIBI	Macroinvertebrate Index of Biotic Integrity
MRBC	Maumee River Basin Commission
MS4	Municipal Separate Storm Sewer System
MWWH-C	Modified Warm Water Habitat-Channelized
NFA	No Further Action
NGOs	Non-governmental Organizations
NOAA	National Oceanic and atmospheric Administration
NPDESP	National Pollution Discharge Elimination System Permits
NRCS	Natural Resource Conservation Service
NSP	Nonpoint source pollution
NTUs	Nephelometric Turbidity Units
NWI	National Wetland Inventory
ODOT	Ohio Department of Transportation
OEPA	Ohio Environmental Protection Agency
OH	Ohio
OSDS	On-site Disposal System
PCBs	Polychlorinated biphenyls
PHEL	Potentially Highly Erodible Land
ppb	Parts Per Billion
RC&D	Resource Conservation and Development
SCSC	Steuben County Lakes Council
SWCD	Soil and Water Conservation District
SWPP	Source Water Protection Plans

SWQMP	Storm Water Quality Management Plan
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UDO	Unified Development Ordinance
UMRW	Upper Maumee River Watershed
US EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USFWS	United States Fish & Wildlife Service
USGS	United States Geologic Survey
USJRW	Upper Saint Joseph River Watershed
USTs	Underground storage tanks
VOCs	Volatile Organic Compounds
WHPP	Wellhead Protection Plan
WLEB	Western Lake Erie Basin
WMP	Watershed Management Plan
WTP	Water Treatment Plant

1.0 Introduction

There are over 3.5 million miles of open waterways that stretch across the diverse landscape of the United States. People have long taken advantage of this natural and abundant resource, by building towns on their banks and using them for transportation, sustenance, and recreation among other ecosystem-services. However, concern over water quality and the hypoxic zones at the mouth of the Mississippi River and at Chesapeake Bay, and now in the Great Lakes, has put people into action to determine the cause and source of the pollution entering our waterways, and to find ways to prevent the pollution runoff. A comprehensive watershed management plan (WMP) is one way to determine where the problems in a watershed are and how to fix those problems. The Indiana Department of Environmental Management (IDEM) defines a WMP as "a strategy and a work plan for achieving water resource goals that provides assessment and management information for a geographically defined watershed."

The St. Joseph River, a major tributary to the Maumee River which feeds into Lake Erie, is over 86 miles long and is the drinking water source for more than 250,000 residents of the Fort Wayne, Indiana area. The Upper St. Joseph River Watershed is where the headwaters of the St. Joseph River are located and is the topic of this WMP. After careful and methodical evaluation of the watershed, the steering committee made up of local stakeholders in the Upper St. Joseph River Watershed (USJRW), determined goals and actions to address concerns and problems identified throughout the watershed with the intent that the WMP will be adopted and implemented by government, environmental groups, businesses, and landowners.

1.1 St. Joseph River Watershed Initiative Partnership

The St. Joseph River Watershed Initiative Partnership (Initiative), a 501(c)3 non-profit organization run by a board of directors which is composed of representatives from local Soil and Water Conservation Districts, government, universities, businesses, and concerned citizens, recognized the impact a WMP would have on a community and the water quality of a watershed and began writing WMPs in 1999, with the first, the greater St. Joseph River Watershed (Hydrologic Unit Code 04100003) being approved in 2001 by IDEM. The Initiative has prided itself in its ability to cross political boundaries and engage all stakeholders in the watershed, as a watershed approach to water quality is the only way to have a long term positive impact on the quality of our river systems. The St. Joseph River WMP includes a large area crossing state lines into Ohio, Michigan and Indiana. However, since the WMP covers such a large area it was difficult to hone in on specific areas of concern in each of the subwatersheds located within HUC 04100003 which is why goal #1 of the greater St. Joseph River WMP is "By 2020, organize stakeholders and produce watershed plans for the HUC-11 subwatersheds which have not yet been completed…" Note that HUCs were converted to 10 and 12 digit scales nationwide in 2008. Therefore, the Initiative's goal for HUC-11 subwatersheds would now be referred to as HUC 10 subwatersheds.

The Initiative has written WMPs for three subwatersheds within the greater St. Joseph River Watershed; the Lower St. Joseph River – Bear Creek Watershed, Cedar Creek Watershed, and the Middle St. Joseph River Watershed. After those WMPs, there were another four HUC-10 subwatersheds that still required comprehensive WMPs. In an effort to reach the goal of having comprehensive WMPs written for each of the smaller 10 digit HUCs in the St. Joseph River Watershed, the Initiative applied for, and was awarded a CWA§319 grant through IDEM in 2011 to write a WMP for the Upper St. Joseph River Watershed, which is comprised of four 10 digit HUCs, 0410000301, 0410000302, 0410000303, and 0410000304, respectively. The grant officially began in February, 2012.

1.2 Upper Saint Joseph River Watershed Project Steering Committee

To be successful, the WMP process must be driven by the stakeholders in the watershed as they are the only ones that can effect change within their watershed. Therefore, the Initiative hosted a grant "kick-off" event on July 18, 2012 to educate the public on water quality within the USJRW and to engage the public with the hope of forming a steering committee made up of people representing a myriad of different stakeholders that would guide the progress of the WMP. The event Included a bus tour of the watershed passing key areas in the project area Including Lake Seneca and Clear Lake, Bridgewater Dairy and their anaerobic digesters, a two-stage ditch, and one of the Initiative's water quality sampling sites. Between stops, several speakers including representatives from the Initiative, The Nature Conservancy, Williams, Steuben, and St. Joseph County Soil and Water Conservation Districts, and representatives from the Clear Lake and Lake Seneca Lake Associations all spoke about problems they have witnessed in the watershed and what activities they are doing to improve water quality within the St. Joseph River watershed. The event was a success with 40 stakeholders in attendance who openly expressed their concern over water quality in the Upper St. Joseph River watershed. Several stakeholders committed to becoming a member of the Upper St. Joseph River Watershed Steering Committee. A list of committee members can be seen in Table 1.1.

Table 1.1: USJRW Steering Committee Members

Name	Affiliation
Janna Sebald	MI Dept. of Environmental Quality
Lucas Gabbard	Hillsdale County SWCD, MI
Kayleen Hart	Steuben County SWCD, IN
Annie Skinner	Clear Lake Conservancy, IN
Dr. Leon Weaver	Bridgewater Dairy, OH
Bob Flickinger	Ohio Dept. of Natural Resources – Division of Wildlife
Don Luepke	Clear Lake Conservancy, IN
Tom Blood	Hamilton Lake – Lake Association, IN
Mark Schenkel	Lake Seneca Resident, OH
Zachery Martin	Steuben County SWCD, IN
Bert Brown	Williams County SWCD, OH

The watershed is very large, passing through three states and five counties, which necessitated a diverse group of steering committee members, dedicated to improving the water quality within the Upper St. Joseph River Watershed, and the greater Western Lake Erie Basin was needed. As can be seen in the above table, the USJRW project was able to gain support and participation from a broad group of stakeholders, including landowners, lake associations, Conservation Districts, and State Agencies.

The USJRW steering committee met on a quarterly basis, at a minimum and more often toward the latter half of the WMP development, starting in March, 2012. It was important to alternate the location of the meetings between the three states to give every stakeholder the best possible opportunity to attend a decision making meeting. Therefore, the meetings were either held at Lake Seneca, Clear Lake, or in Hillsdale County at the Amboy Township Hall. All background information for the watershed including historical data, land uses, water quality, and pollutant loading was gathered by SNRT, Inc. and Initiative staff. The information was then presented to the steering committee at each meeting and through e-mail communications. All problems, goals, and suggested management measures represented in this document were decided upon by discussion and general consensus of the steering committee. Final decisions were made in person at the steering committee meetings, as well as through on-line surveys.

The Steering Committee adopted the Initiative's mission statement as their guiding principle for decision making regarding the Upper St. Joseph River Watershed. The Initiative's mission statement reads as follows; "To improve water quality in the St. Joseph River Watershed by promoting economically and environmentally compatible land uses and practices".

The USJRW steering committee does not have legal status of any kind and is comprised of a group of concerned organizations and individuals who are working together to protect and restore the USJRW. The Steering Committee meetings were facilitated primarily by the Watershed Coordinator from the Initiative, with assistance from a Senior Project Manager from SNRT, Inc. The USJRW Steering Committee does not have specific operational procedures or bylaws, and as mentioned above, all decisions were made by general consensus after in-depth discussions.

1.3 Stakeholder Concerns

Stakeholders present at the kick-off meeting expressed many concerns over landuse in the watershed and the overall water quality of open waterways in the Upper St. Joe Watershed. Stakeholders concerns, as well as some additional concerns expressed by the Steering Committee, are outlined in Table 1.2 below. The Table also describes the relevance that each of the concerns has to this project and the potential problem that may result from the concern.

Table 1.2: Public Concerns, There Relevance, and Potential Problems

Concern	Relevance	Potential Problem
Sediment Runoff from Agriculture Land	Conventionally tilled farm land located on potentially or highly erodible land increases the potential for soil erosion. Also, unbuffered streambanks, and tile inlets allow for sediment to discharge directly into surface water. Sedimentation increases costs to Lake Associations for dredging.	Sedimentation, turbidity, and impaired biotic community

Concern	Relevance	Potential Problem
Sediment Runoff from Urban Areas	Urban areas contribute to soil erosion and sedimentation as construction significantly disturbs the land, and impervious surfaces collect sediment that runs into storm drains or directly in surface water during heavy rain events.	Sedimentation, turbidity, and impaired biotic community
Runoff from CAFOs and other small scale animal operations	Stormwater will pick up pollutants from barnyards and carry them to open water if it is not properly contained or diverted from ditches, streams, rivers, and ponds. CAFOs have a large concentration of manure in one area. A leak or break in the manure containment area would pose a significant risk to water quality, aquatic life, and recreational activities in the lakes.	*E. coli*, sediment, nutrients, impaired biotic community
Leaking, failed, or straight pipe septic systems	Most homes in the rural areas and on many of the lakes in the area have on-site sewage treatment which may leak wastewater into open water.	*E. coli*, sediment, nutrients, impaired biotic community
Log Jams	Many large log jams have been noted in the watershed. Log jams will divert water from its normal coarse and cause stream bank erosion	Sedimentation, soil erosion, and flooding
Excessive nutrients and bacteria in the lakes	Many lake residents are unaware of how they affect the nutrient and bacteria levels in their lakes which can come from lawn fertilizer, pet waste, improperly managed on-site sewage treatment.	Turbidity, *E. coli*, and nutrients, impaired biotic community
Lake residents and urban landowners using lawn fertilizer	Many landowners in the watershed apply fertilizer to their lawns without following fertilizer application guidelines and without testing their soil first to determine the correct amount of fertilizer to apply.	Nutrients, excessive aquatic plant growth, and impaired biotic community
Stream Bank Erosion	An Increase in surface runoff and stream channel modification can Increase the potential for stream bank erosion	Sedimentation, turbidity, and impaired biotic community
Improper Construction Site Management	Construction sites Increase sediment runoff, erosion, and may have an impact on water quality from leaks from heavy equipment used at the site.	Sedimentation, turbidity, and impaired biotic community

Concern	Relevance	Potential Problem
Wetland Preservation and Protection	Wetlands play a vital role in the ecosystem as they act as natural sponges for floodwaters and pollutant uptake. Wetlands are also habitat to many State and Federally listed endangered and threatened species.	Flooding, and impaired biotic community
Invasive species	Lakes are often prone to the speedy spread of invasive species that can beat out local flora and fauna which are necessary for a healthy ecosystem. The Increase in invasive species can also inhibit recreational opportunities such as fishing, boating, and wildlife watching.	Impaired biotic community, loss of recreation areas
Illegal Dump Sites	Several areas throughout the watershed have been noted where people dump unwanted items Including appliances, yard waste, and general trash.	Impaired biotic community, heavy metals, nutrients, household contaminants
Livestock Access to Open Water	It has been found that livestock have access to open water for drinking water or to move between adjacent pastures within the USJRW which causes stream bank erosion and allows for discharge and runoff of pollutants	Sedimentation, Turbidity, impaired biotic community, *E. coli*
Industrial Discharge	There are several NPDES permitted facilities located within the USJRW that have the potential to discharge in excess to permit levels which will have a major effect on water quality	Sedimentation, Turbidity, impaired biotic community, nutrients, heavy metals
Lack of Education Regarding Best Management Practices	Many landowners in the USJRW do not know the effects their actions have on water quality nor do they know the types of practices that can be put into place to decrease their impact due to a lack of education and outreach efforts in the watershed	Lack of installation of best management practices to reduce NPS runoff
Lack of Consistent Funding for Conservation Agencies	County conservation agencies rely heavily on State and Federal funds to keep their doors open. Recent economic hardship has forced some conservation districts to close their doors which effects the conservation efforts in the county	Lack of installation of best management practices to reduce NPS runoff

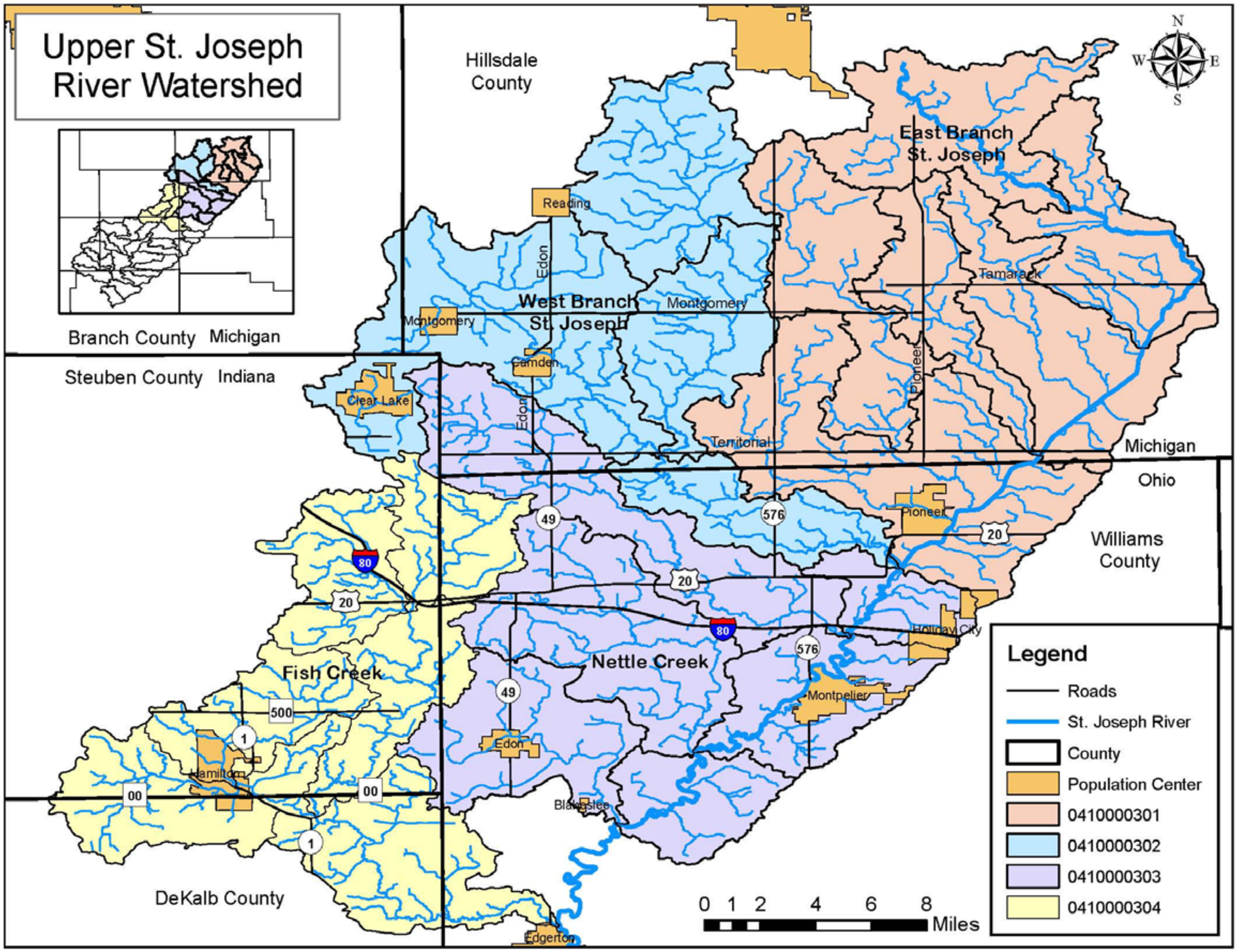
2.0 Physical Description of Watershed

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 a two digit and defines a particular region. The more digits to a HUC the more specific the drainage area is. The Upper St. Joseph River watershed (USJRW) consists of four 10 digit HUCs (0410000301, 0410000302, 0410000303, 0410000304) located within the St. Joseph River watershed, a greater eight digit HUC (04100003) which is part of the Western Lake Erie basin (041000). The four 10 digit HUCs, East Branch-St. Joseph (0410000301), West Branch-St. Joseph (0410000302), Nettle Creek (0410000303), and Fish Creek (0410000304) will be discussed in further detail in Section 3 of this WMP.

The St. Joseph River begins in Hillsdale County, MI and flows southwesterly through Hillsdale County, MI, Williams and Defiance County, OH, DeKalb County, IN and finally through Allen County, IN where it meets the Maumee River in Fort Wayne. The Maumee River then flows east and north to Toledo, OH where it empties into Lake Erie. The Upper St. Joseph River watershed is located within southern Hillsdale County, the very southeasterly edge of Branch County Michigan, the northwest half of Williams County, Ohio, eastern Steuben County, and the northeast edge of DeKalb County, Indiana. Figure 2.1 shows the boundaries of the four HUC 10s present in the Upper St. Joseph River Watershed and the boundary of each HUC 12 within the greater HUC 10s. The watershed is 343,468 acres (537 square miles) and the major land use within the watershed, totaling over 68%, is agriculture (row crops and hay/pasture fields). There are also several small residential areas located within the watershed Including Reading, Camden, and Montgomery Michigan; Pioneer, Holiday City, Montpelier, Edon, and Blakeslee Ohio; and Clear Lake and Hamilton, Indiana.

Figure 2.1 Upper St. Joseph River Watershed



2.2 Geology, Topography and Soils

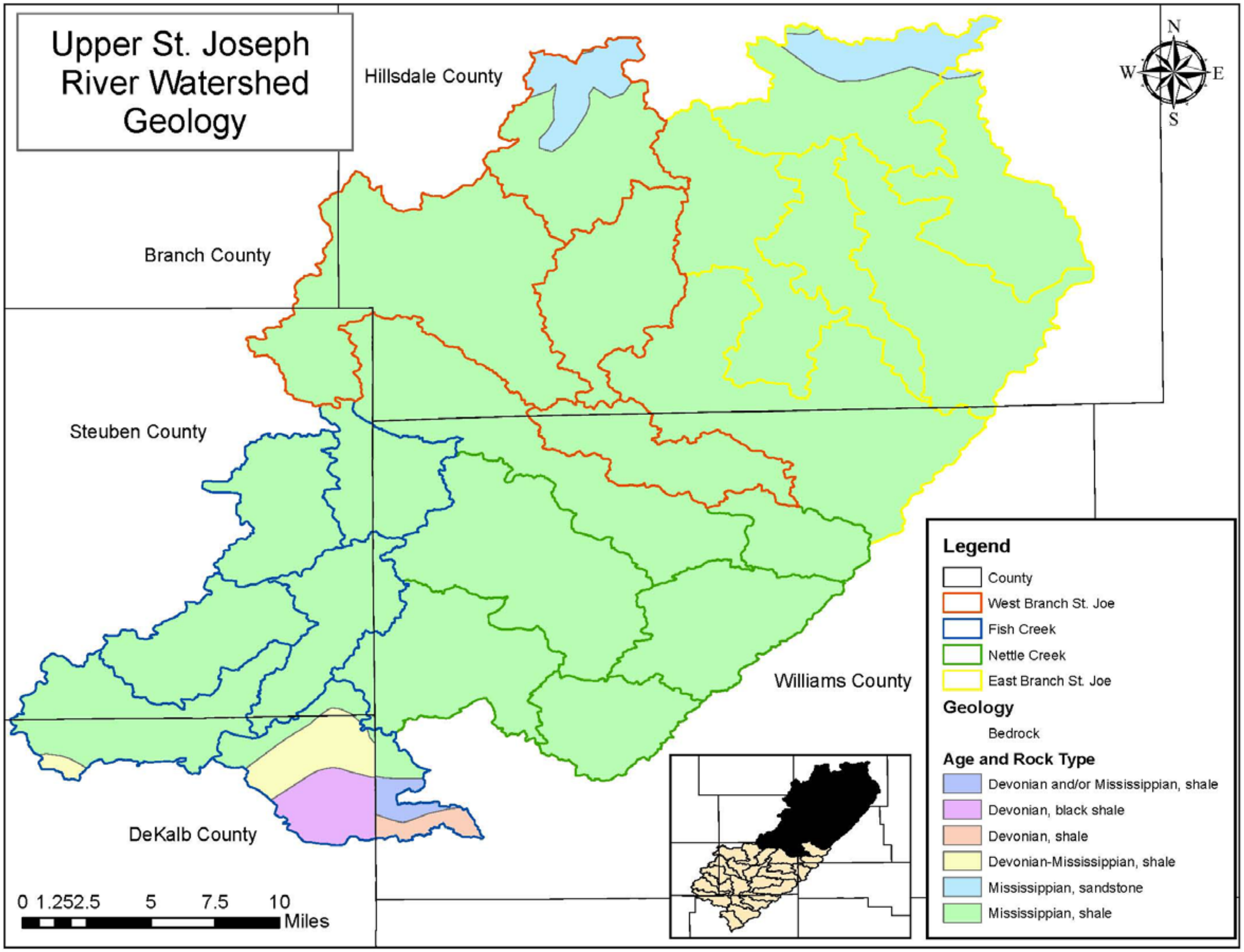
This Section describes the geology, topography, and soils of the USJRW which has made the area into the agricultural landscape it is today.

2.2.1 Geology

The landscape of southern Michigan, and northern Indiana and Ohio is directly influenced by the last great glaciation which occurred over 14,000 years ago; the Wisconsinan glaciation. The glaciers significantly changed the landscape of the project area, filling and damming rivers which created lakes (Including Lake Erie), as well as flattening the rolling hills that were present before the glaciers, mostly in Indiana and Ohio. The Wisconsinan glaciation extended as far south as Terre Haute and Richmond, Indiana and follows the line from Ashtabula County in northeast Ohio down to Hamilton County in southwest Ohio. As the glaciers melted they deposited rock, dirt and sand that they picked up while traveling across the landscape from Canada. Where the glaciers melted relatively rapidly, glacial till ridges, called moraines, were left. Southern Michigan is dominated by rolling hills left from the Saginaw Lobe which dug tunnel channels into the earth and left sand and gravel deposits.

The bedrock of the project area was deposited during the Devonian or Mississippian Age, some 300 to 360 million years ago and can be found at depths up to 1200 feet below the surface. The rocks deposited during the Devonian Age predominately consist of sedimentary rocks such as siltstone, shale, and sandstone. As can be seen in Figure 2.2 the predominant bedrock of the project area is shale. The surficial geology overlaying the bedrock ranges in thickness from 500 to 600 feet. The unconsolidated deposits, above the bedrock, are between 200 feet thick in the northern portion of the watershed and 500 feet thick in the southern portion of the watershed. The project area is covered in glaciofluvial material over the deeper clay deposits. The glaciofluvial material consists of mostly sand and gravel.

Figure 2.2 Upper St. Joseph River Watershed Geology



2.2.2 Topography

The project area is located within the Auburn Morainal Complex physiographic region in Indiana (Natural Resource Conservation Service), the Steuben Till Plain and Central Ohio Clayey Till Plain physiographic regions in Ohio (OH DNR), and the Hillsdale Highlands and Huron-Erie Drift Uplands physiographic regions in Michigan (Michigan State University). The topography of the area is relatively homogenous. The elevation is between 1050 feet above sea level at the headwaters of the St. Joseph River and 850 feet at the southern edge of the watershed. The land is relatively homogenous and flat in the southern edge of the watershed, however the landscape is dominated by low rolling hills as a result of the Saginaw Lobe as described in Section 2.2.1.

2.2.3 Soils

The project area is comprised of 21 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 taken from the Branch, DeKalb, Hillsdale, Steuben, and Williams county USDA soil surveys.

Table 2.1: Soil Associations

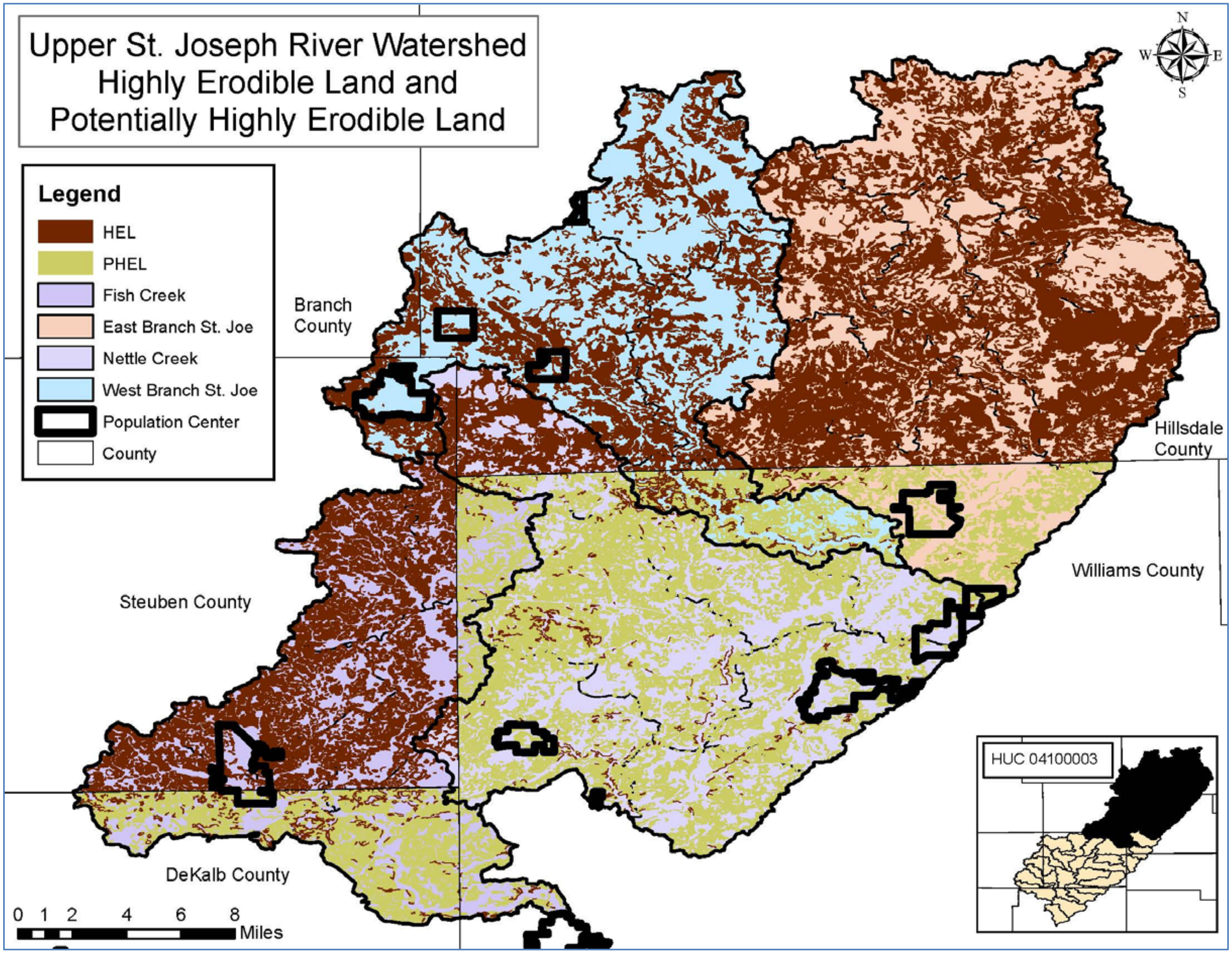
County	Soil Association	Association Description
Branch	Morley-Locke-Houghton	Nearly level to gently rolling, well drained and somewhat poorly drained, silty and loamy soils on till plains and moraines and level, very poorly drained, mucky soils in swamps and depressions
DeKalb	Glynwood-Pewamo-Morley	Deep, moderately well drained, very poorly drained, and well drained, nearly level to steep, loamy, clayey, and silty soils; on till plains and moraines
	Blount-Pewamo-Glynwood	Deep, moderately well drained to very poorly drained, nearly level and gently sloping, silty, clayey, and loamy soils; on till plains and moraines
	Strawn-Conover	Deep, well drained and somewhat poorly drained, nearly level to strongly sloping, loamy soils; on moraines
	Boyer-Landes-Sebewa	Deep, well drained, moderately well drained, and very poorly drained, nearly level to moderately sloping, loamy soils underlain by sand and gravel; on terraces, outwash plains, and moraines
Hillsdale	Riddles-Hillsdale	Fine to coarse loamy soils, mesic Typic Hapludalfs

County	Soil Association	Association Description
	Miami-Williamstown-Conover	Fine-loamy, mixed, mesic Aquic Hapludalfs, mesic Typic Hapludalfs, , and mesic Udollic Ochraqualfs
	Morley-Glynwood-Blount	Fine, illitic, mesic Typic Hapludalfs, mesic Aquic Hapludalfs, and mesic Aeric Ochraqualfs
	Fox-Boyer	Fine to coarse loamy soil over sandy or sandy-skeletal, mixed, mesic Typic Hapludalfs
	Coloma-Matherton-Gilford	Mixed, mesic Alfic Udipsamments, Fine to coarse loamy soil over sandy or sandy-skeletal, mixed, mesic Udollic Ochraqualfs and mixed mesic Typic Haplaquolls
	Houghton-Gilford	Euic, mesic Typic Medisaprists and Coarse-loamy soil, mixed, mesic Typic Haplaquolls
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
	Plainfield-Chelsea-Grandby Variant	Deep, nearly level to moderately sloping, excessively drained and very poorly drained, sandy soils on outwash plains and bottom land
	Riddles-Miami-Brookston	Deep, nearly level to moderately steep, well drained and very poorly drained, loamy soils on till plains
	Glynwood-Morley-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
Williams	Blount-Pewamo	Nearly level and gently sloping, somewhat poorly drained and very poorly drained soils that have clayey and loamy subsoil; on uplands

County	Soil Association	Association Description
	Blount-Oshtemo-Sloan	Nearly level to sloping, somewhat poorly drained, well drained and very poorly drained soils that have a sandy to clayey subsoil; on terraces and flood plains
	Blount-Glynwood	Nearly level to steep, somewhat poorly drained and moderately well drained soils that have a clayey and loamy subsoil; on uplands
	Blount, loamy substratum-Glynwood	Nearly level to moderately steep, somewhat poorly drained and moderately well drained soils that have a clayey and loamy subsoil; on uplands
	Glynwood-Rawson	Gently sloping to moderately steep, moderately well drained soils that have a loamy and clayey subsoil; on uplands

The NRCS maintains a database of highly erodible (HEL) and 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 USJRW Steering Committee expressed concern regarding sediment runoff from agricultural land which can be exacerbated should landowners farm HEL or PHEL without taking precautions to prevent soil erosion. The presence of HEL and PHEL in farmland can contribute significantly to NPS by increasing the amount of sediment carrying other pollutants such as, nutrients and pesticides, to open water. Twenty-nine percent (29%) of the soils in the project area are considered to be HEL and 16.8% are considered to be PHEL by the NRCS. Figure 2.3 is a map of the project area depicting the location of HEL and PHEL. It is important to note that each county designates soils differently and that Hillsdale, Branch, and Steuben counties do not have PHEL designations.

Figure 2.3: Highly and Potentially Highly Erodible Land Classification



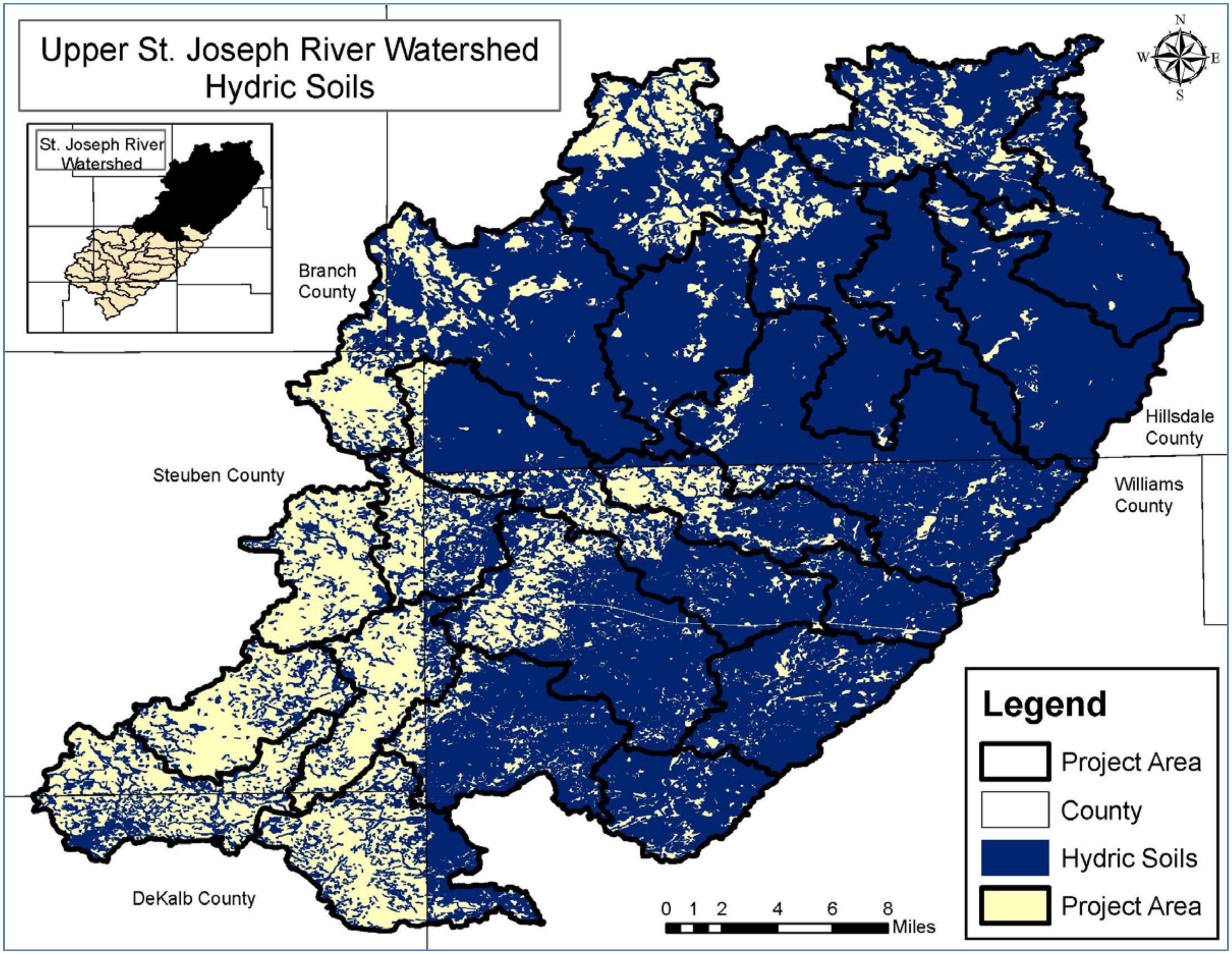
Several soils present within the project area are classified by the local Natural Resource Conservation Service (NRCS) as hydric as can be seen in the following Figure 2.4. Hydric soils comprise nearly 231,040 acres, or 67.3% of the project area. Hydric soils can pose threats to surface water when farmed 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. The USJRW Steering Committee expressed concern regarding excessive nutrients and bacteria in surface water and field tiles installed due to the presence of hydric soils can provide a direct conduit for water polluted with fertilizer, land applied manure, and sediment to reach surface waters.

The USJRW Steering Committee expressed concern regarding leaking and failing septic systems, both of which may be a result of improper placement of septic systems due to soil type. Hydric soils are 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 Histels 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:
        - 1.) 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
        - 2.) water table at a depth of 0.5 foot 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
        - 3.) 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.
3. Soils that are frequently ponded for long/very long duration at the growing season.
4. Soils that are frequently flooded for long/very long duration at the growing season.

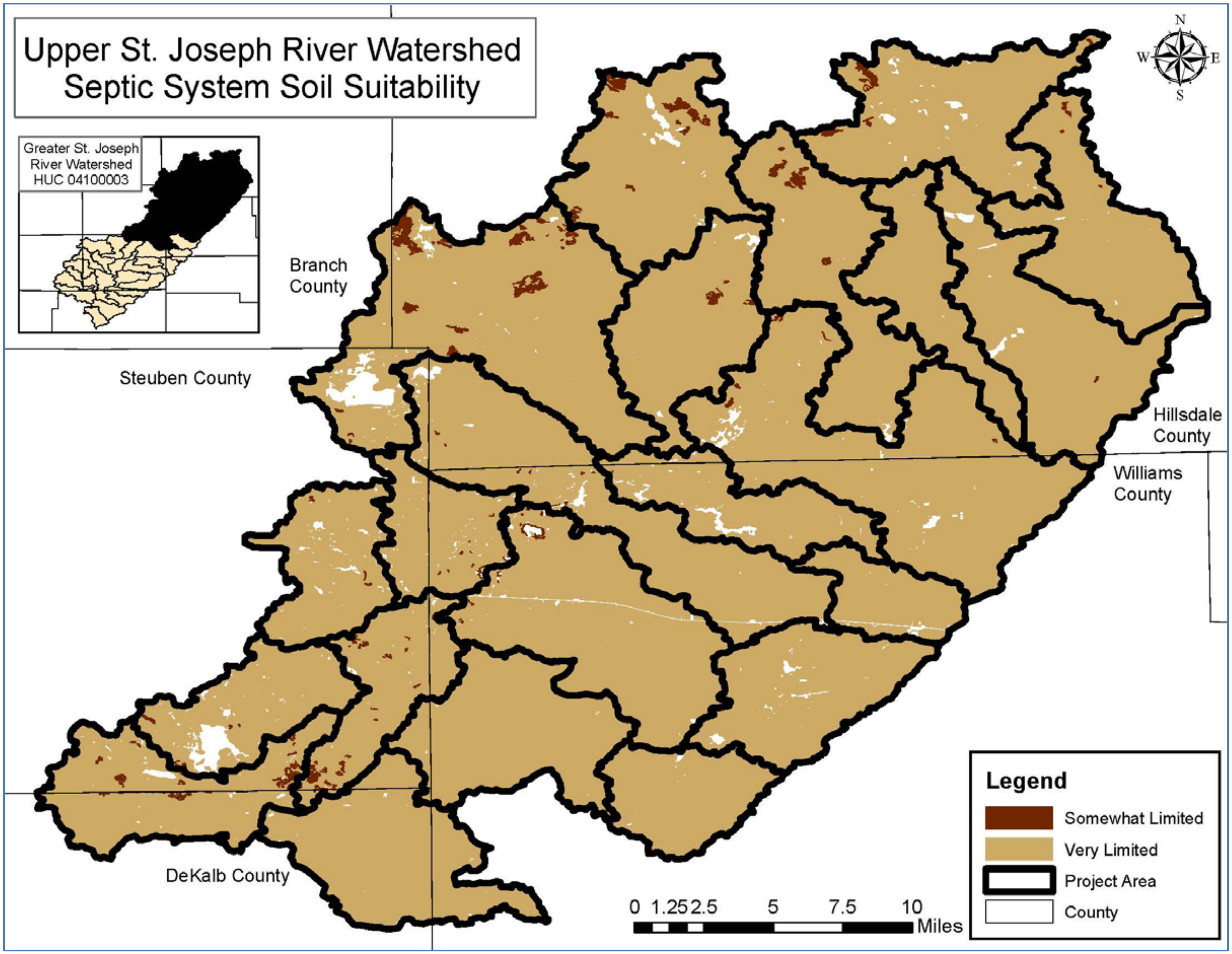
Hydric soils, while posing a significant problem when farmed, also are quite beneficial as they are prime locations to create or restore wetlands. The USJRW Steering Committee expressed concern regarding the protection and of wetlands. Wetlands are great resources as they supply many ecological benefits. Wetlands will be discussed in further detail in section 2.4.

Figure 2.4: Hydric Soils in the Upper St. Joseph River Watershed



Soil type is important to consider when installing on-site sewage waste disposal systems. Traditional septic systems utilize the soil to absorb effluent discharged from the tank into absorption fields. Septic 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 USJRW project area uses septic systems to process their wastewater. There are 13 wastewater treatment facilities servicing the 10,215 residents living within the watershed and many of those facilities service only small lake communities. However, nearly all soils (96.5%) located within the project area are rated as "very limited" and 1% of the soils are rated as "somewhat limited" for septic usage according to the NRCS. "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 3% of the project area can safely handle a septic system (Figure 2.5), the ideal situation would be to not install any septic systems and revert to an above ground mound system or hook up to a centralized sewer system. Another option that is relatively new to the Midwestern portion of the United States is installing "decentralized" waste treatment facilities. More information can be found at "http://www.ctic.purdue.edu/resourcedisplay/386/".

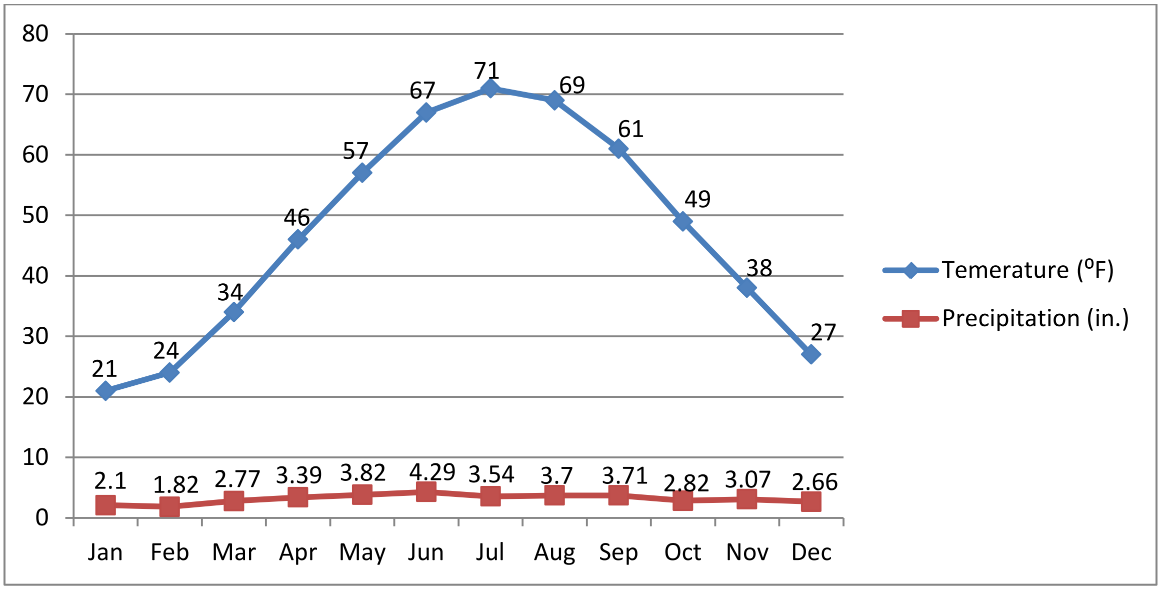
Figure 2.5: Soils Suitable for Septic Placement



2.3 Climate

The climate in the project area is considered temperate with warm summers and cold winters. According to the National Weather Service, the average high in July is 82^{o}F and the average low in January is 13^{o} and there is typically 37 Inches of precipitation each year. Figure 2.6 graphically illustrates the average temperature range and precipitation per month within the project area.

Figure 2.6: Watershed Climate



2.4 Hydrology

According to the National Hydrography Dataset (NHD) compiled by the USGS there are over 1500 stream miles located within the St. Joseph River watershed 836 miles of streams, rivers, ditches, and canals are located solely within the Upper St. Joseph River sub-watershed as can be seen in Table 2.2 and Figure 2.7. The portion of the St. Joseph River located within the project area is 56 miles long. All streams located within the USJRW are considered to be warm water streams. While the St. Joseph River is not well known as a prime fishing location, anglers can catch catfish, crappie, and bass. There are no rivers or streams in the Upper St. Joseph River Watershed that are designated by state or federal agencies as scenic or wild rivers. The NHD defines the waterways presented in Table 2.2 as:

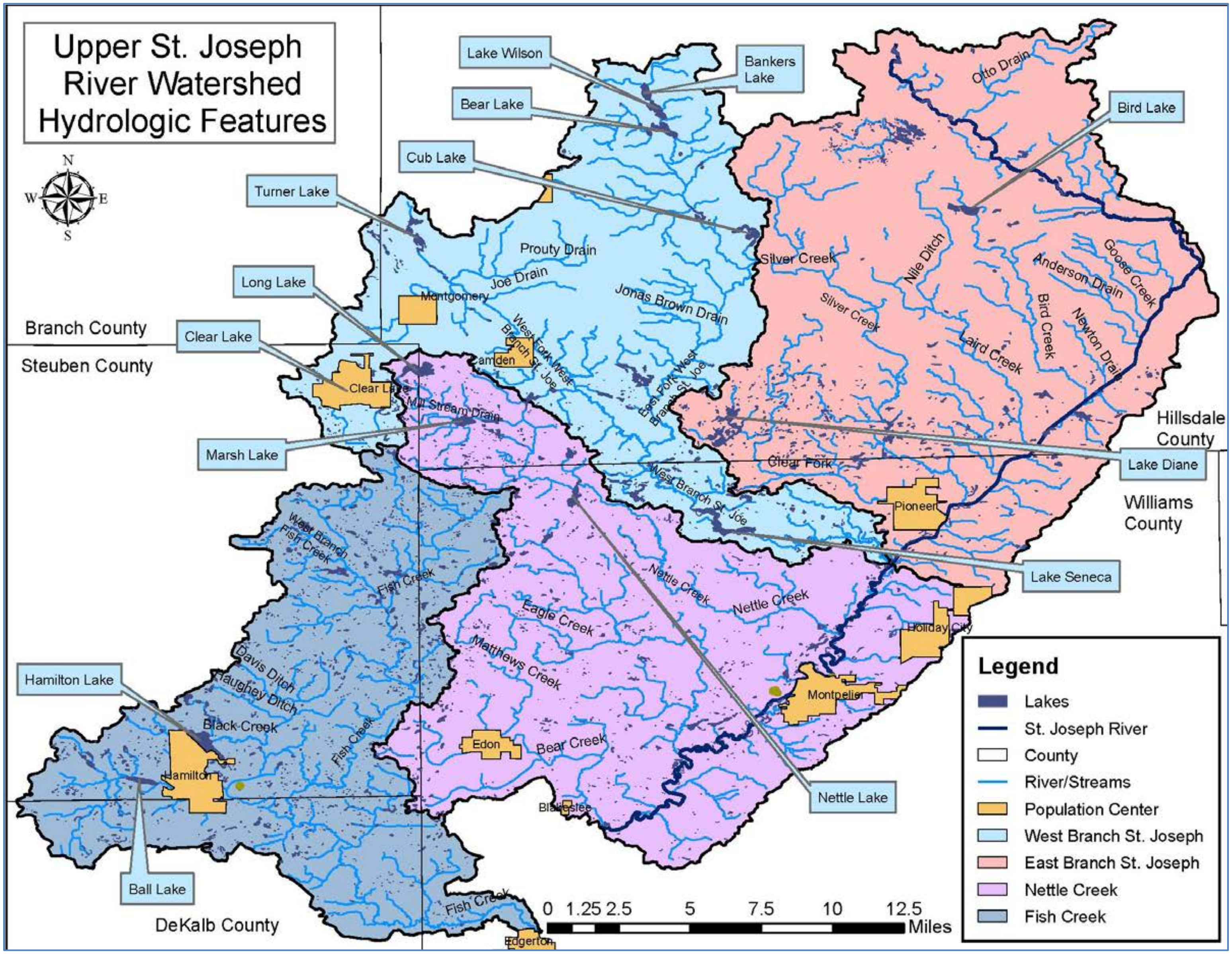
- Stream/River – A body of flowing water
- Artificial Path – A feature that represents flow through a two-dimensional feature, such as a lake of double-banked stream
- Connector Path – Established a known, but non-specific connection between two non-adjacent network segments that each has flow
- Canal/Ditch – 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 a watercraft

Table 2.2: Stream Miles in the Upper St. Joseph River Watershed

Artificial Path	Canal/Ditch	Connector Ditch	Stream/River
78.95 (mi)	82.06 (mi)	1.45 (mi)	673.75 (mi)
		Total	836.21 miles

There are many lakes located in the Upper St. Joseph River Watershed Including the large built-up lakes of Clear Lake (807.74 acres), Long Lake (148.64 acres), Hamilton Lake (802 acres), Ball Lake (84.40 acres), Nettle Lake (100.70 acres), Bird Lake (115.07 acres), and Lake Seneca (240.83 acres); as well as lakes that are just beginning to be developed Including Bear Lake (104.54 acres), Lake Wilson (96.61 acres), and Bankers Lake (68.27 acres).

Figure 2.7: Hydrologic Features



The St. Joseph River is a very slow flowing river, at times it may even seem to be not flowing at all. For this reason, it is a great river to canoe for the person interested in admiring the beautiful scenery as the banks of the St. Joseph are dominated by beach, maple, and sycamore trees and is home to many different types of terrestrial and aquatic wildlife Including the endangered Indiana Bat and Copperbelly Water Snake. The Indiana, Ohio and Michigan DNR list several canoe launching sites along the St. Joseph River. The ODNR lists six sites on the St. Joseph River within the USJRW, three launch sites on Nettle Lake, one on Lake Seneca, and five in the Lake Su An Wildlife Area. The IN DNR only lists three boat launch sites, all on Lakes Including Clear Lake, Hamilton Lake, and Ball Lake. The MI DNR Recreational Boating Information System lists five boat launch sites including one on Little Long Lake, Lake Diane, Cub Lake, Bird Lake, and Bear Lake.

Stakeholders in the watershed voiced concern regarding the many log jams that are found in the St. Joseph River. The slow flow of the St. Joseph River contributes to the buildup of fallen trees and branches causing log jams in the river as there is not enough velocity in the river to push the broken tree limbs and downed trunks downstream. Log jams contribute to bank cutting and sedimentation of the river system.

2.4.1 State Designated Uses and Special River Segments

Waters of the State are given designated uses by the regulating state agency. These designated uses influence the water quality standards and targets that are used to list waters as impaired. All waters of Michigan and Indiana are given the following designated uses, at a minimum;

- Agriculture
- Navigation
- Industrial waste water
- Warmwater fishery
- Other indigenous aquatic life and wildlife
- Partial body contact (full body contact from May 1st –October 31st)
- Fish consumption

All of the watershed located in Ohio within the USJRW is designated as a Warm Water Habitat for aquatic life use (with the exception of Fish Creek which is designated as an Exceptional Water Habitat and Bear Creek which is designated as a Modified Water Habitat), as an Agriculture and Industrial Water Supply and for Primary Contact for Recreation, which means the waters must be suitable for full body contact during the recreational season.

The ODNR passed the very first "scenic rivers act" in the U.S. with the intent to preserve Ohio's remaining streams and rivers that are relatively unaltered and have many of their natural characteristics intact. Other states have followed Ohio's lead and have designated certain rivers that are relatively unaltered or have some other important attribute worthy of preservation. None of the states within the USJRW have river segments listed as scenic or natural within the USJRW. However, Indiana has listed the Fish Creek from the Ohio/Indiana line to the Indiana/Ohio line as "Outstanding". An outstanding rating means the river was listed due to one of the following criteria:

- Rivers identified in State inventories or Assessments as having statewide or greater significance.
- State Fishing River or,
- High Water Quality River

2.4.2 Legal and Regulated Drains

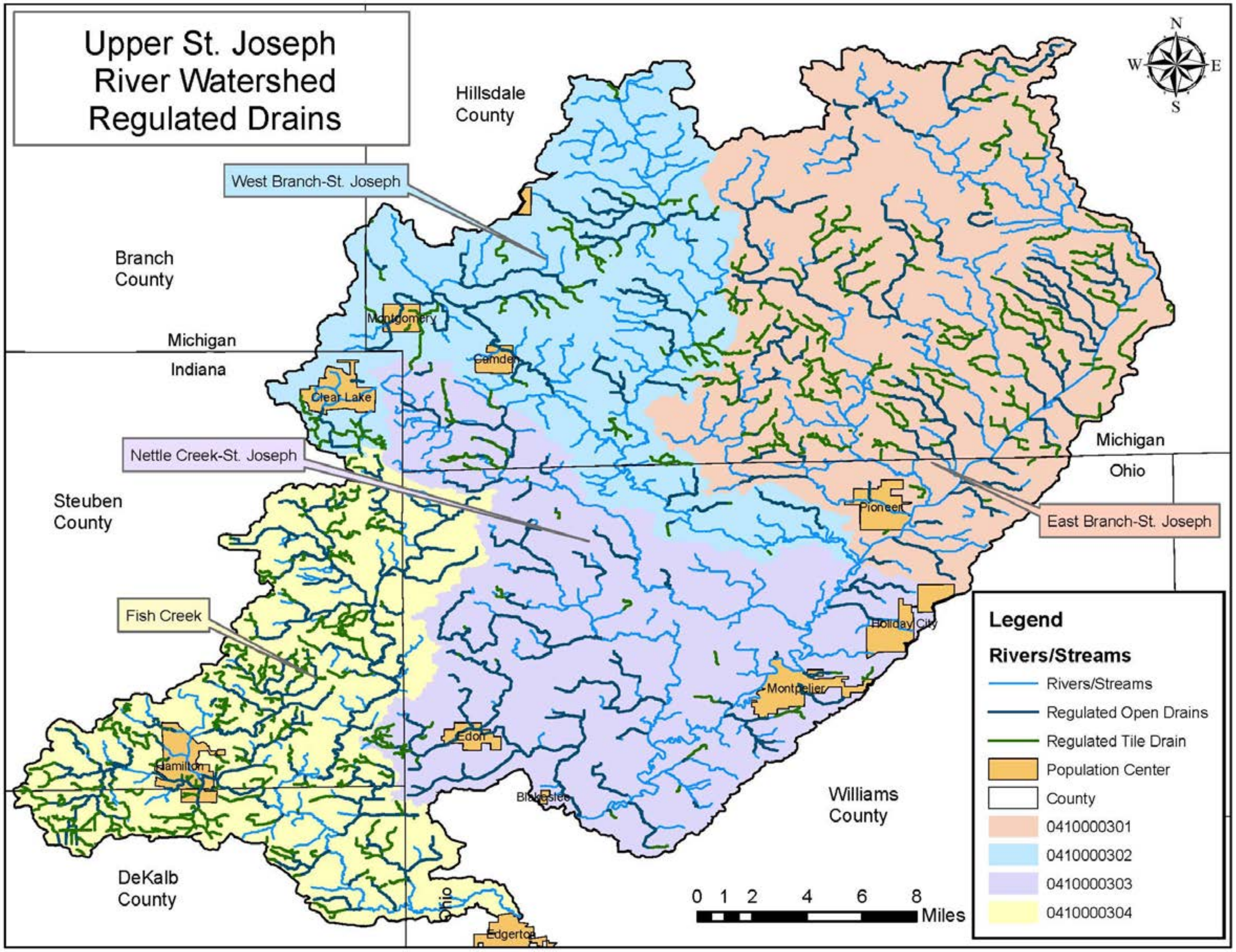
The natural streams, as well as legal drains, within the project area are used as a means to carry excess water from the land so that it may be used for agriculture, commerce, industry, and many other purposes. However, due to the slow flow of the St. Joseph River system, many of the tributaries have been channelized to Increase the velocity of water flowing downstream and decrease the risk of ponding and flooding, especially within the agricultural community.

Local drainage boards, SWCDs, and County Engineering Departments are charged with maintaining many of the streams and ditches so that they may continue to function properly. These maintained waterways are often referred to as legal drains. There are 395.67 miles of legal drains maintained by the county government within the USJRW. Table 2.3 provides a breakdown of legal drain miles, open and tiled drains, within the project area for each county and Figure 2.8 is a map with the regulated drains delineated.

Table 2.3: Legal Drain Miles

County	DeKalb	Williams	Hillsdale	Steuben	Branch
Miles Open Drain	24.46	115.4	147.35	108.46	0
					Total =395.67 miles
Miles Tile Drain	37.32	12.48	140.05	77.35	0
					Total = 267.20 miles

Figure 2.8: Regulated Drains in the Upper St. Joseph River Watershed



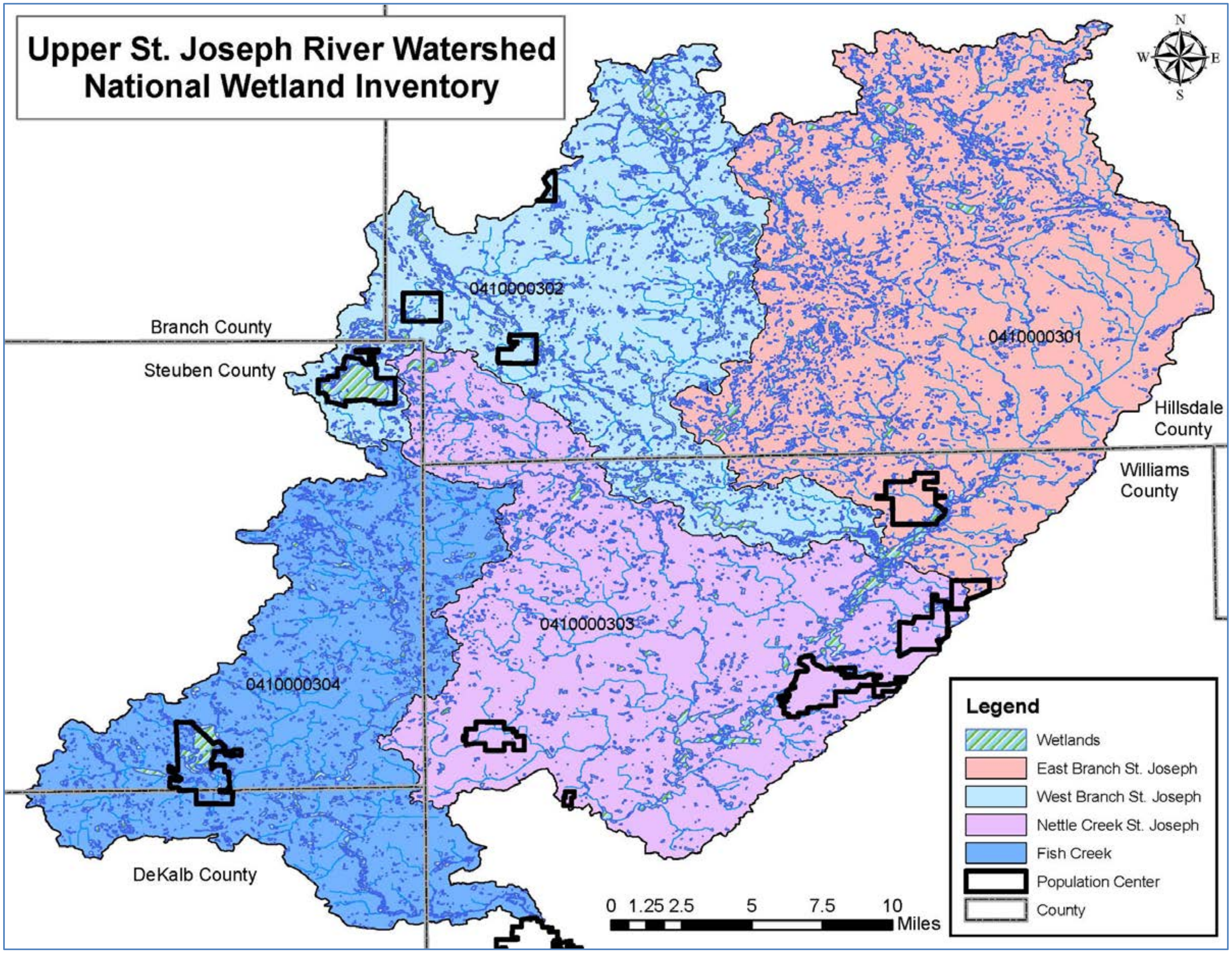
2.4.3 Wetlands in the Upper St. Joseph River Watershed

The USJRW lies just north and west of the historic Great Black Swamp, which has since been drained and converted to prime Midwestern farmland. The proximity of the project area to this historic swamp accounts for the presence of so much hydric soil resulting in the many wetlands that are present in the watershed today. Table 2.4 provides the number of acres of each type of wetland present within the project area. Wetlands play an integral role in our lives as recreation areas for wildlife and bird watching, and fishing, as well as many other recreational past-times. Wetlands are also important as they help to lessen the impact of flooding and act as pollution sinks. The watershed has lost nearly 80% of the wetlands that used to be present when early settlers realized the crop production potential on the fertile soils of the wetlands. For that reason, many of the wetlands were drained using underground tile drains and drainage ditches. Today there are approximately 55,700 acres of wetlands present in the project area. Figure 2.8 shows where the wetlands within the project area have been delineated as determined by the USFWS National Wetland Inventory (NWI). The wetlands delineated in Figure 2.9 were not verified by a ground survey so should not be considered definite wetland boundaries but rather estimations only.

Table 2.4: Wetland Delineation in the Upper St. Joseph River Watershed

Emergent Freshwater Wetland	Forested/Shrub Wetland	Pond	Lake	Riverine	Other	Total	Units
12,068.24	33,333.93	3,214.94	6,871.83	186.57	24.58	55,700.09	Acres

Figure 2.9: National Wetland Inventory



2.4.4 Lakes and Drinking Water

There are many lakes located in the Upper St. Joseph River Watershed Including the large built-up lakes of Clear Lake (807.74 acres), Long Lake (148.64 acres), Hamilton Lake (784.16 acres), Ball Lake (84.40 acres), Nettle Lake (100.70 acres), Bird Lake (115.07 acres), and Lake Seneca (240.83 acres); as well as lakes that are just beginning to be developed Including Bear Lake (104.54 acres), Lake Wilson (96.61 acres), and Bankers Lake (68.27 acres). The lakes in the region provide recreational outlets, as well as help to boost the economy of the surrounding towns. Many lakes are experiencing issues with sedimentation, invasive species, and harmful algal blooms. For those reasons, special consideration must be given to the lakes, as they pose a valuable and very unique resource to the area.

The USJRW is located within the MICHINDOH aquifer boundary (Figure 2.10), which is a glacial, sand and gravel aquifer. The aquifer is at a depth of just below ground surface to 200 feet deep. In 2007 the City of Bryan, OH petitioned the US EPA to designate the MINCHINDOH aquifer as a Sole Source Aquifer as it provides water to more than 385,000 people who withdraw 72 million gallons of water a day. According to the EPA Region 5 webpage, last updated in December, 2011, the US EPA is continuing to do additional research before it will make a final determination.

All residents in the watershed acquire their drinking water through wells. The Incorporated areas of Montpelier, Pioneer, Edon, and Edgerton, Ohio, Hamilton, Indiana and Waldron, Camden and Reading, Michigan all supply water to their residents through groundwater wells from the MICHINDOH Aquifer and have some sort of protection plan in place to protect the groundwater from contamination which will be discussed in Section 2.8. 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 health departments report very few areas where the water has proven to be inadequate over the past six years. The wells are deemed inadequate for drinking if they test positive for the presence of fecal coliforms.

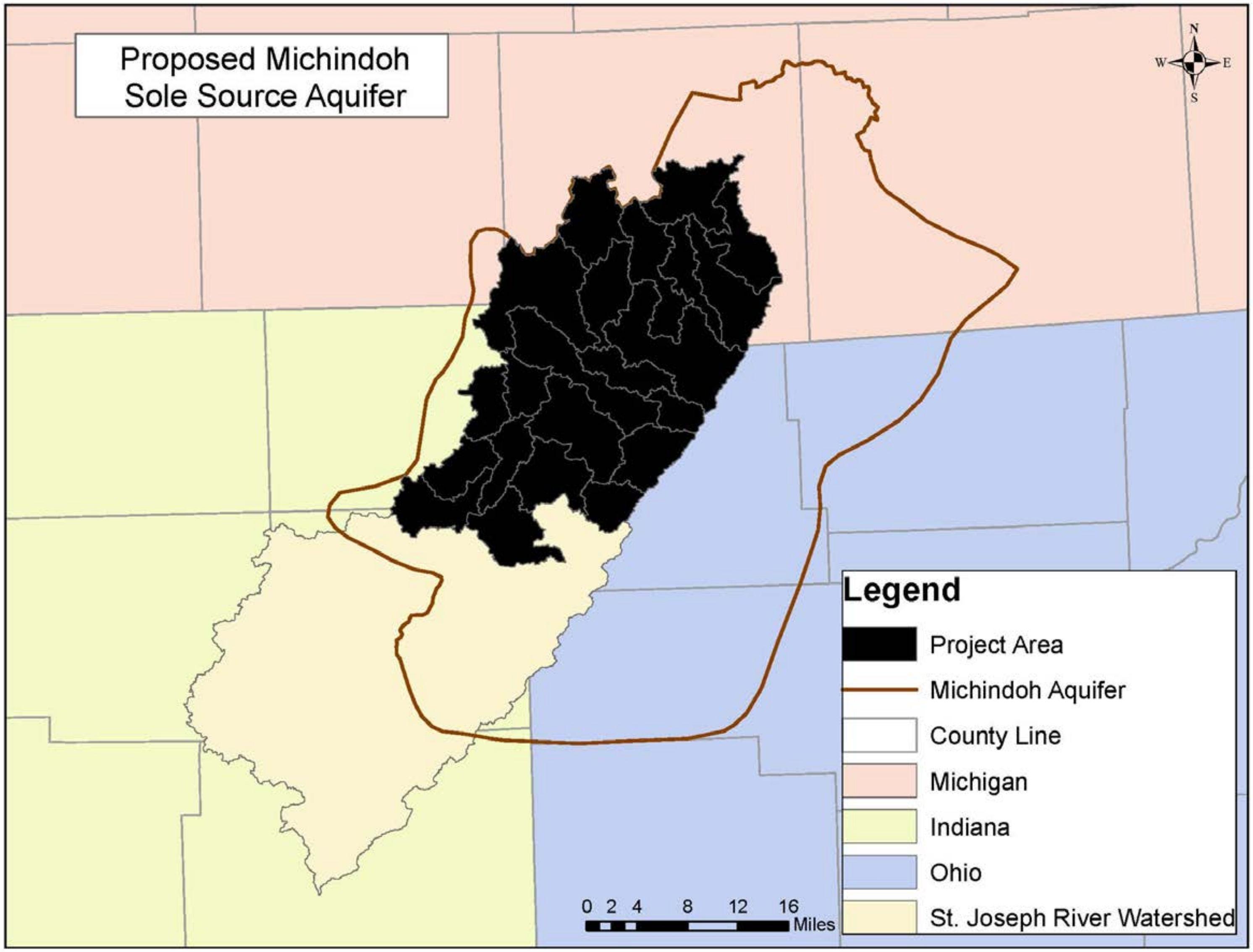
A survey of water withdrawals done by the USGS in 2005 showed that Indiana, Ohio, and Michigan withdraw 1104 million gallons of water per day from ground water resources. Table 2.5 shows the total water withdrawals for Indiana, Ohio, and Michigan.

Table 2.5: Water Withdrawals in Indiana, Ohio, and Michigan (2005)

State	% of Population	Ground-water (Mgal/day)	Surface water (Mgal/day)	Total (Mgal/day)
Indiana	74	356	320	676
Ohio	83	488	647	1430
Michigan	71	260	883	1140
Total (Mgal/day)		1104	1850	2954

According to the Western Lake Erie Basin Study; St. Joseph Watershed Assessment conducted by the US Army Corp of Engineers, 14.9 million gallons of groundwater is withdrawn daily in the St. Joseph River Watershed. 86% of that is for public usage, 8.1% for industry, 0.9% for agriculture, 2.5% for mining, 1.7% for golf courses, and 0.4% for other uses.

Figure 2.10: MICHINDOH Sole Source Aquifer Boundary



2.4.5 Dams

There are 21 dams located within the USJRW, with the majority of those being located in Michigan. There are three dams located in the USJRW project area in Indiana. The dams were erected to form recreational and/or residential lakes. Hamilton Lake located in Steuben County was created in 1832 when several small lakes were dammed to form Hamilton Lake, which is the fourth largest lake in Indiana. Water levels in the lake are managed by the IN DNR at a dam at the north end and one at the south end of Hamilton Lake. Borrow Lake Dam, located in Steuben County, is also managed by the IN DNR. Little information is available regarding the dam; however it forms the 60 acre Borror Lake in Fish Creek subwatershed just southeast of the Fish Creek Wildlife Area. There is one dam located in the USJRW in Ohio. The West Branch St. Joseph River was dammed in Williams County in the late 1960's by a developer who wanted to build a residential lake community. Lake Seneca is the resulting lake from the dam. Most residents at Lake Seneca live there year round; however the population does Increase during the recreational months. Finally, there are 17 dams located in the USJRW in Michigan, all within Hillsdale County. 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, 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. At least five of the dams where the construction date is known, are well beyond their expected life span. More information about all of the dams located in the USJRW, Including a map depicting the location of each of the dams, can be found in Appendix A.

2.4.6 Floodplains and Levees

The St. Joseph River is not known to flood regularly largely because the river is fed by the glacial lakes in the northern portion of the watershed. However, flooding in general can be linked to economic hardship, water impairment, and the destruction of key wildlife habitat. There is one gage station located in the St. Joseph River near Newville, IN where the flood stage is set at 12 feet. There have been few instances of the St. Joseph River exceeding this stage, but very little damage has occurred. Indiana State Law formed the Maumee River Basin Commission (MRBC) in the 1990's to help communities within the Maumee River Basin reduce flood loss and implement sustainable watershed management by offering cost-share Incentives to buyout structures within the floodplain, convert agricultural land to natural areas and wetlands, and help property owners flood proof their structure. The MRBC also provides flood education to the public, as well as facilitates the removal of obstructions within local waterways.

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 USJRW 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 Pioneer and Montpelier, OH and Hamilton and Clear Lake, IN; all of which are located within a 100 year floodplain according to the Federal Emergency Management

Agency. Imperviousness adds to the amount of water within the river, as well as the velocity and erosive power of the river. Ohio and Indiana state agencies have made available floodplain maps for their states. Ohio state agencies have deemed the St. Joseph River and many of its tributaries (approximately 16,148 acres) to be in a 100 year flood plain which means there is a 1% annual chance of the area becoming flooded. Indiana agencies have designated Clear Lake, Hamilton Lake, and parts of Fish Creek and its tributaries to also be within a 100 year flood plain (approximately 5,039 acres). Indiana agencies have also deemed other parts of Fish Creek to be at high risk of flooding (approximately 883 acres). Michigan has only just begun to digitize their floodplain maps. The only portions of the watershed available for MI are small sections of Reading, Camden, and Cambria Townships. A map showing the designated flood plains in the USJRW can be found in Appendix A. Please note that GIS files are not available for MI and the mapped floodplain on the map was 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 USJRW.

2.5 Land use

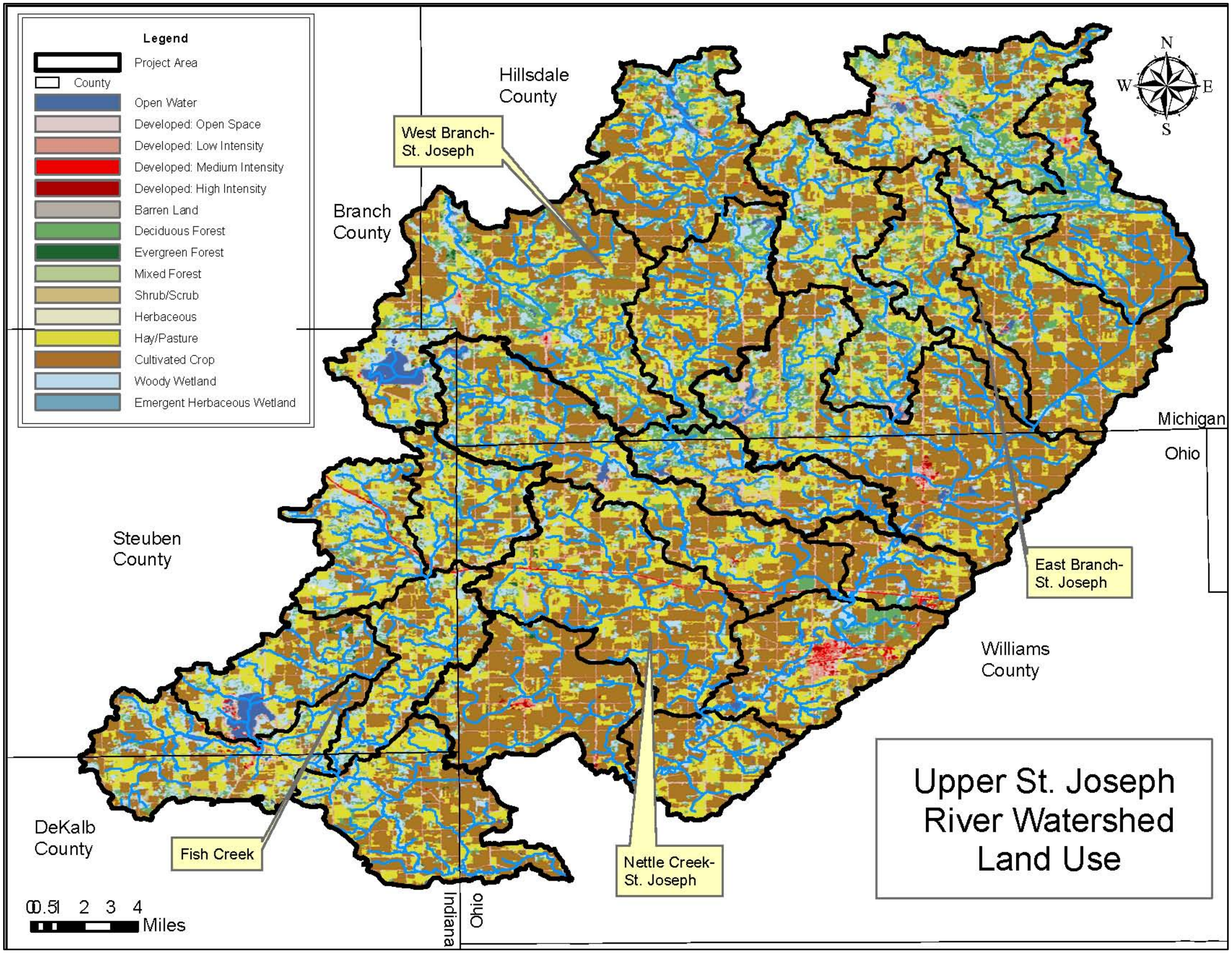
Land use in the project area greatly influences the quality of the water resources. Land in agricultural production has the potential to erode, especially if over worked or if it is conventionally tilled annually. Thus soil particles carrying high levels of nutrients and pesticides have the potential to reach open water sources and effect aquatic plants and animals and cause the water to become non-potable. Livestock rearing, which is prevalent in the Northern portion of the project area, 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 a more in depth look at the land use in the watershed by breaking it down to HUC 10 subwatersheds.

The predominant land use in the watershed is agriculture as can be seen in Figure 2.11. There are few urban settings Including the Incorporated areas of Reading (P=1074), Camden (P=509), and Montgomery (P=342) in Michigan, Pioneer (P=1379), Holiday City (P=52), Montpelier (P=4067), Edon (P=832), and Blakeslee (P=96) in Ohio, and Clear Lake (P=337) and Hamilton (P=1527) in Indiana. The land used for agriculture is either in row crops, Including corn, soybeans, grain or hay, in pasture, or used for livestock production. Table 2.6 below shows the number of acres of land in each type of land use per sub-watershed.

Table 2.6: Land Use in the Upper St. Joseph River Watershed

Land use	Open Water	Open Space	Developed Low Intensity	Developed Medium Intensity	Developed High Intensity	Deciduous Forest	Evergreen Forest	Mixed Forest
Acres	4811.0 (1.4%)	15,629.0 (4.4%)	7855.9 (2.1%)	1289.4 (<1%)	310.0 (<1%)	36,059.8 (10.2%)	744.4 (<1%)	319.7 (<1%)
Land use	Shrub/ Scrub	Herbaceous	Hay/ Pasture	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Forest	Barren Land	
Acres	696.6 (<1%)	1479.6 (<1%)	93,857.7 (26.5%)	147,987.8 (41.8%)	41,556.3 (11.8%)	817.1 (<1%)	232.9 (<1%)	

Figure 2.11: Land Use in the Upper St. Joseph River Watershed



2.5.1: Tillage Transect

Since the counties located within the project area are predominately agriculture based, a tillage transect is performed in each county typically every other year (Steuben County performs a tillage transect annually) to gage the adoption of various conservation tillage practices and to get an accurate count of crop acreage. Hillsdale and Branch counties are the exception to this as a tillage transect has not been reported since 1993. The Western Lake Erie Basin (WLEB) specialist of the ODNR disseminated a power point presentation to interested parties in 2012 which shows the adoption of conservation tillage practices since 2006 in each of the HUC 8 watersheds within the WLEB (excluding Michigan). Data from the 2006 and 2012 tillage transects for the St. Joseph River Watershed are displayed in Table 2.7.

Table2.7: Tillage Data in the St. Joseph River Watershed (excluding Michigan)

Crop	Corn		Beans		
Year	2006	2012	2006	2012	Unit
No-Till	36.9	34.5	78.5	54.8	Percent
Mulch-Till/Strip-Till	13.7	11.8	7.2	24.9	Percent

2.5.2: Septic System Usage

There are 13 areas where the population is served by a centralized sewer system including the incorporated areas of Camden and Reading, Michigan, Hamilton and Clear Lake, Indiana, and Edon, Montpelier, and Pioneer, Ohio as well as many smaller lake communities. (See Figure 2.1 for map of incorporated areas.) However, all rural areas located within the USJRW rely on on-site sewage disposal, as do some of the built-up lakes including the heavily populated Lake Seneca. It should also be noted that there is a large Amish population in the watershed, located mostly in Hillsdale County and the eastern edge of Steuben County, all of which utilize on-site sewage disposal. DeKalb and Williams County Health Departments were contacted to obtain statistics on the number of septic systems in use within the county and the number of those that are currently failing and discharging untreated waste to either ground or surface water. The Williams County Health Department did not provide the total number of septic systems in use but did provide the county's estimate of 2,087 septic systems currently failing. DeKalb County Health Department has record of 4,408 septic systems in use throughout the county and estimates that 50% of those are failing. Steuben, Hillsdale, and Branch counties could not provide an accurate estimate of failing septic systems. 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. 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.

2.5.4: Confined Feeding Operations

Stakeholders voiced concern about animal feeding operations (AFOs) 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 totaling nearly 9,000 animals; one in Michigan and Ohio and two in Indiana. 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. Table 2.8 below is a list of all CFOs in the project area and Figure 2.12 shows their location.

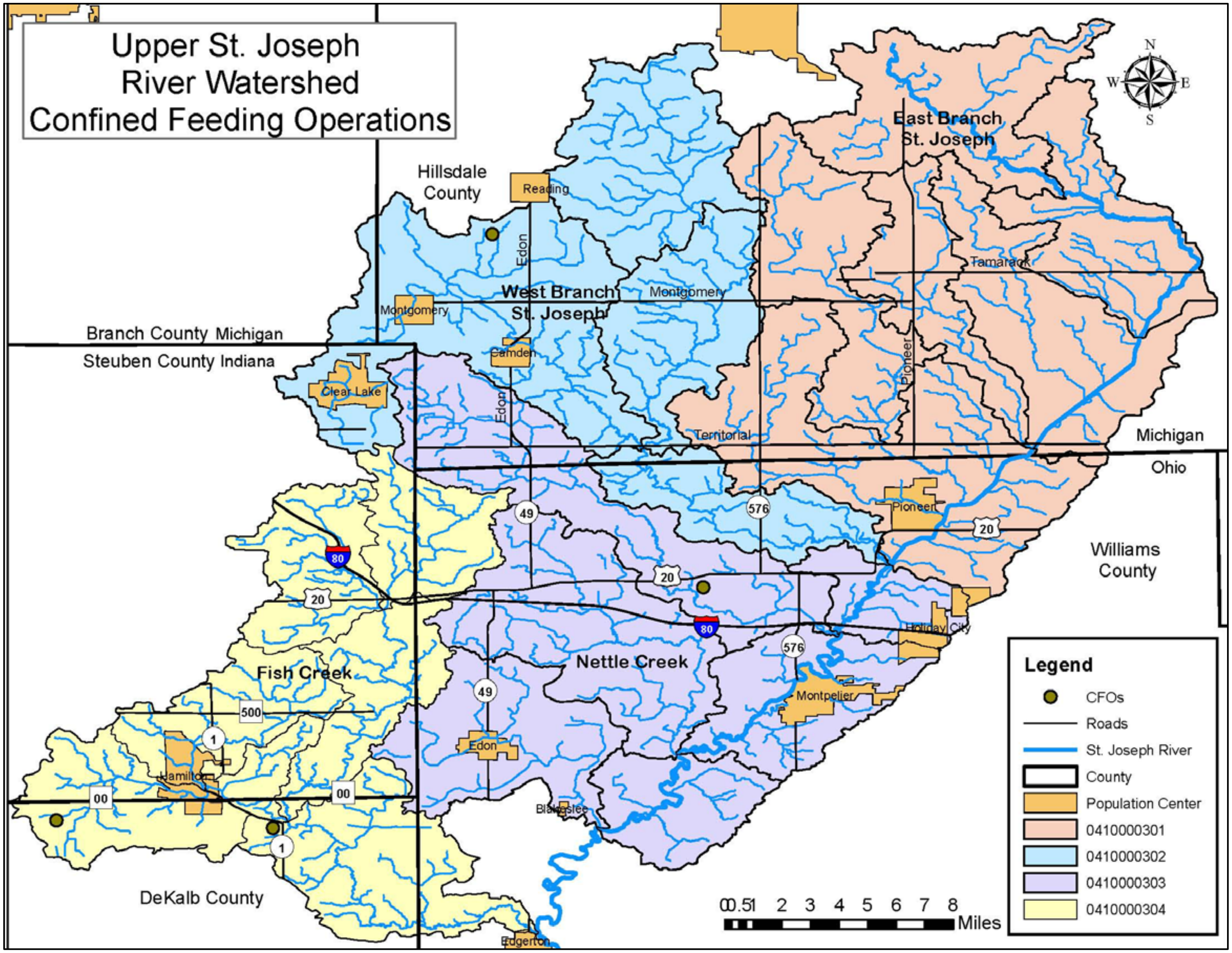
Table 2.8: CFO/CAFOs Located within the Upper St. Joseph River Watershed

Operation	Sub-watershed	Designation	Animal Type	Animal #
Bridgewater Dairy, LLC	Nettle Creek	CAFO	Dairy	3,900
Triple T Farms	West Branch	CAFO	Swine	1,600
Long Lane Farms, Inc.	Fish Creek	CFO	Swine	2,035
Brand Farms	Fish Creek	CFO	Beef/Dairy	120/980

2.5.5: Windshield Survey

A windshield survey was conducted throughout the watershed to identify areas where NPS may be an issue. The survey was conducted in May through September 2012, with two people per vehicle, driving each road within each subwatershed, and making note of any areas of significant soil loss, livestock access to open water, or other potential pollution sources. The survey revealed several areas of erosion, areas where livestock had direct access to open water, and a lack of vegetative buffer along open ditches and streams throughout the watershed. The windshield survey will be discussed in further detail in Section three of this WMP.

Figure 2.12: CFOs in the Upper St. Joseph River Watershed



2.5.6: National Pollution Discharge Elimination System

The steering committee voiced concern about industrial discharge and runoff in the watershed. Facilities that discharge directly into a waterbody are required to obtain an NPDES permit from the overseeing state agency (IDEM, MI DEQ, and OH EPA). The permit regulates the amount of contaminants a facility can discharge into surface water and requires the facility to conduct regular water quality monitoring. 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 16 NPDES permitted facilities located within the project area which are outlined in Table 2.9. Figure 2.13 shows the location of the NPDES permitted facilities in the USJRW. The NPDES permitted facilities will also be mapped in their respective subwatershed in Section three of this WMP.

It should be noted that Chase Brass and Copper Co. located in Holiday City, OH has released 21 pounds of chemicals found in the toxic release inventory in the past five years; however, the specific chemical(s) that was released is not known.

Table 2.9: National Pollution Discharge Elimination System Permitted Facilities in the USJRW

Permit Name	Permit #	Issue Date	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3yrs)	Enforcement Actions (I=informal; F=formal)
Amboy Twp-Lake Diane WWSL	MIG580013	4/1/2004	Hillsdale	Tyson Trail	Camden	MI	Clear Fork Creek	0	0
Amboy Twp-WWSL	MIG580008	4/1/2004	Hillsdale	Merry Lake	Waldron	MI	Silver Lake	0	0
Aqua Ohio-Lake Seneca WTP	OH0138631	1/11/2007	Williams	Co. Rd. 8	Montpelier	OH	St. Joseph River	13	0
Camden WWSL	MIG580011	4/1/2004	Hillsdale	Jasper St.	Camden	MI	West Branch St. Joseph	0	0
Chase Brass and Copper Co.	OH0002941	11/28/1974	Williams	St. Rte. 15	Holiday City	OH	John Lattener Ditch	5	0
Edon WWTP	OH0095141	4/1/2007	Williams	E. Indiana	Edon	OH	Bear Creek	3	(I) 1
Exit One WWTP	OH0122351	11/1/1996	Williams	St. Rte. 49	Edon	OH	Eagle Creek	2	0
Hamilton Lake Conservancy District WWTP	IN0050822	5/4/1981	Steuben	E. 775 S.	Hamilton	IN	St. Joseph River	0	0
Hamilton Water Works	IN0060216	6/17/1999	Steuben	Railroad St.	Hamilton	IN	Fish Creek	1	(I) 1
Montpelier WTP #2	OH0138177	5/5/2006	Williams	Porter Rd	Montpelier	OH	St. Joseph River	0	0
Montpelier WWTP	OH0021831	1/20/1975	Williams	Creek Blvd	Montpelier	OH	St. Joseph River	2	(I) 1

Permit Name	Permit #	Issue Date	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3yrs)	Enforcement Actions (I=informal; F=formal)
Nettle Lake Area STP	OH0053376	8/1/2001	Williams	Co. Rd. 5-75	Montpelier	OH	Nettle Creek	3	0
Pioneer STP	OH0022535	4/28/1975	Williams	Unknown	Pioneer	OH	East Branch St. Joseph	9	0
Pittsford SSDS WWSL	MIG580006	4/1/2004	Hillsdale	Hudson Rd	Pittsford	MI	St. Joseph River	1	0
RC Plastics Inc	MIG250455	11/3/2007	Hillsdale	Hudson Rd	Osseo	MI	Twin Lakes Drain	Unknown	Unknown
Reading WWSL	MIG580009	10/1/2003	Hillsdale	Lilac Rd	Reading	MI	Prouty Drain	Unknown	(F) 1
Waldron WWSL	MIG580007	4/1/2004	Hillsdale	Tuttle Rd	Waldron	MI	East Branch St. Joseph	0	0

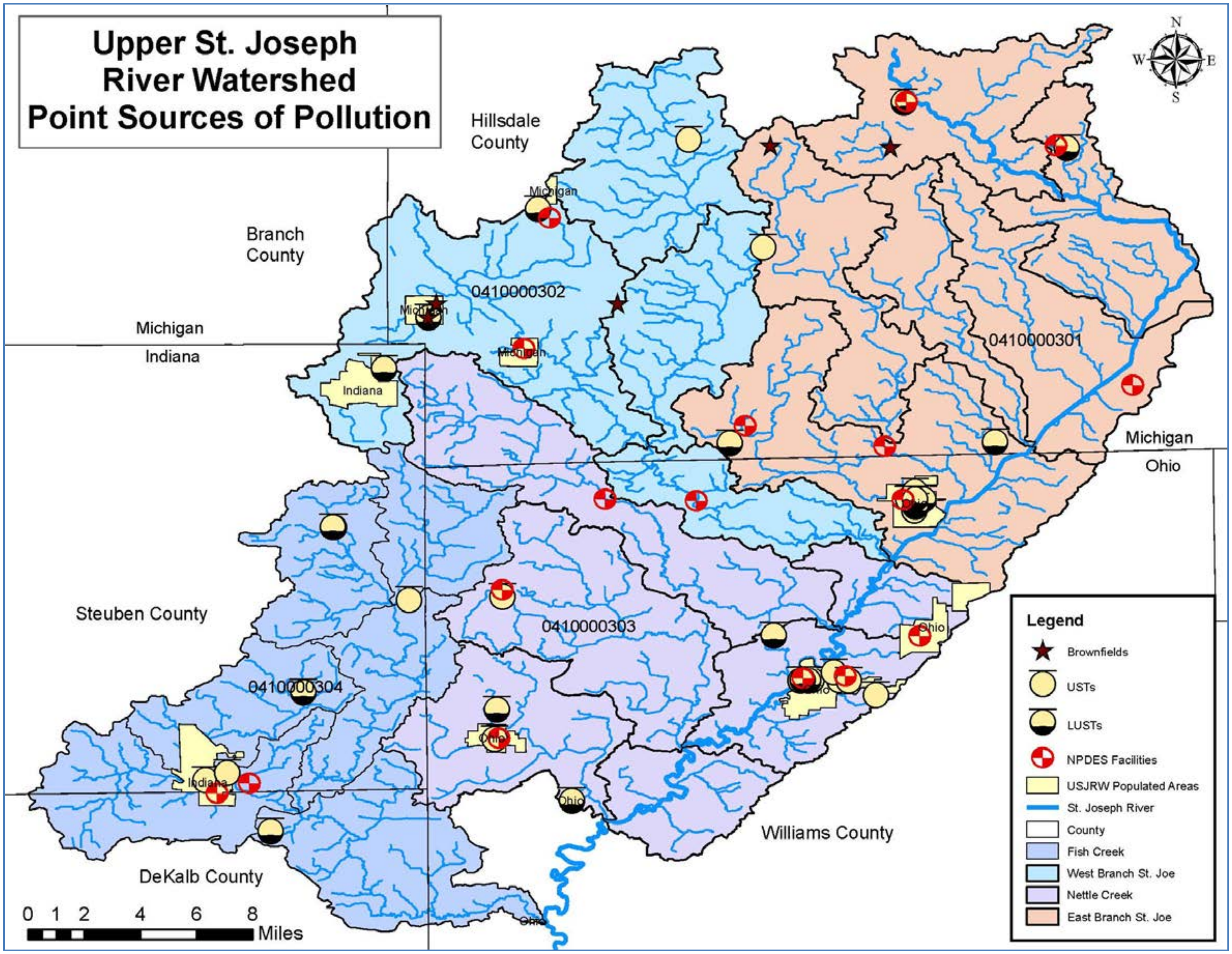
2.5.7: Potential Point Sources of Pollution

There are several different types of facilities and entities that can pose a threat to water quality even if the facility/entity is known to carry harmful chemicals and monitored. These types of facilities include Underground Storage Tanks (USTs), brownfields, superfund sites, and combined sewer overflow communities. There are no superfund sites or combined sewers located within the Upper St. Joseph River Watershed. However, there are several USTs, some of which are Leaking Underground Storage Tanks (LUSTs), and there are a few brownfields located in Michigan.

LUSTs will be discussed in more detail in Section 3.4 of this WMP.

Brownfields will be discussed in more detail in Section 3.4 of this WMP. The locations of all potential point sources of pollution are identified in Figure 2.13.

Figure 2.13: Potential Point Sources of Pollution in the Upper St. Joseph River Watershed



2.5.8: Community Parks

Twenty-five community parks are located within the project area totaling over 5,800 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 parks and/or nature preserves of note including the 2,400 acre Lake La Su An Wildlife Area, the 522 acres Douglas Woods managed by The Nature Conservancy, and the MI DNR managed, 2,500 acre Lost Nation State Game Area. Table 2.10 lists all parks located within the project area, how many acres or miles they encompass and who manages the parks.

Table 2.10: Community Parks in the Upper St. Joseph River Watershed

Name	Area	Ownership	Facilities/Activities
Historic Tree Grove	8 Acres	Village of Montpelier	Nature Walk
Montpelier Municipal Park	22 Acres	Village of Montpelier	Pool, volleyball, tennis courts, ball diamonds, playground, concession stand, and shelter house, restrooms, gardens
Nature Trail	2.5 Miles	Village of Montpelier	Access to fishing and canoeing, hiking, picnic area, and trails
Main Street Park	Unknown	Village of Montpelier	Green space, flower gardens, trees, park benches, and picnic tables
Bob Storrer Park	Unknown	Village of Montpelier	Green space
Mini Park	Unknown	Village of Montpelier	Flower garden , historic clock, park bench
Wabash Cannonball Trail	65 Miles	Several Partners Organized by Toledo Metropolitan Area Council of Governments	Hiking, biking, equestrian Trails
Pioneer Boy Scout Reservation	1,100 Acre	Erie Shores Council	camping, hiking, fishing, canoeing, rappelling, climbing, skiing, sledding
Mud Lake Bog State Nature Preserve	48.59 Acres	O DNR	Permit Required to Enter Preserve
Lake La Su An Wildlife Area	2,430 Acres	O DNR	Boat Launch, trails, latrines
Fish Creek Wildlife Area	158 Acres	O DNR	Fishing and Hunting
Nettle Lake Mounds - Ancient Hopewell	Unknown	Williams County Historical Society	Marker Indicating Four Mounds of the Hopewell Indians

Name	Area	Ownership	Facilities/Activities
Walz Park	Unknown	Village of Edon	Basketball, volleyball, and tennis courts, shelter house, playground, and pond
Harrold Baker Park	Unknown	Village of Edon	Green space
Girt Gnacy Memorial Park	Unknown	Town of Hamilton	Undisclosed
Fish Creek Trail	2.1 Miles	Town of Hamilton	Hiking Trails
Hamilton Lake Beach	Unknown	Town of Hamilton	Beach
Robb Hidden Canyon Nature Preserve	65 Acres	Acres Land Trust	Hiking and wildlife watching
Ball Lake Nature Preserve	27 Acres	Acres Land Trust	Hiking and wildlife watching
Douglas Woods	522 Acres	The Nature Conservancy	Wildlife Viewing and Hiking
Lost Nation State Game Area	2500 Acres	MI DNR	Hiking and wildlife watching
JC's Park	Unknown	Village of Camden	Basketball and playground
Bird Lake Park	250 feet waterfront	Hillsdale County	Public Beach
Wyman Park	Unknown	Village of Pioneer	Playground, baseball diamond
Crommer Park	Unknown	Village of Pioneer	Playground, baseball diamonds, shelter house, and picnic tables
Steuben Beach, Clear Lake	Unknown	Steuben County	Public beach, picnic tables

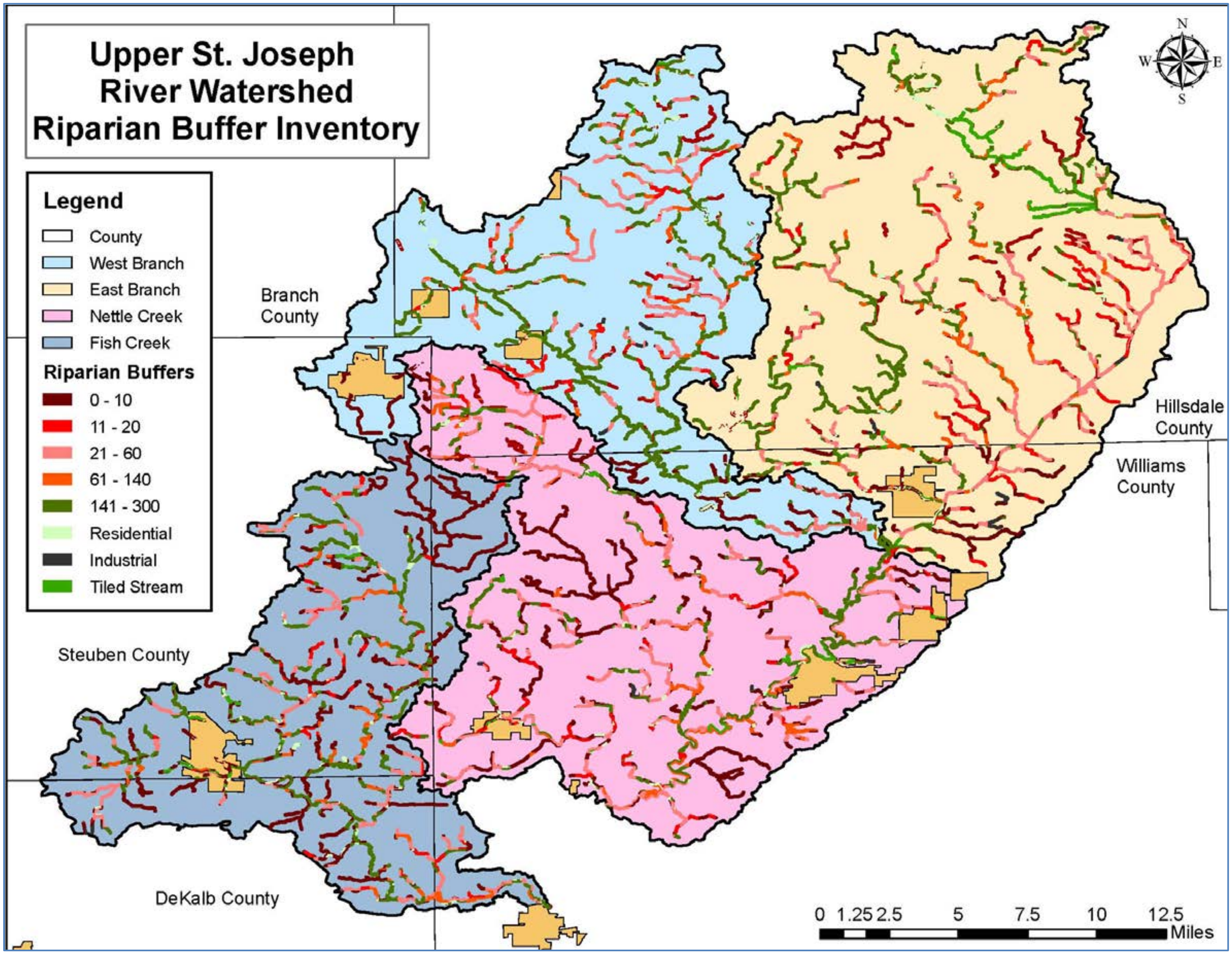
2.5.9: Riparian Buffer Inventory

Since over 68% of the watershed is used for agriculture, it is not surprising that many ditches and streams have been moved, straightened, and/or deepened to aid in the quick removal of water from agricultural fields. Furthermore, many landowners, especially with the rising prices being paid for agricultural commodities, are planting row crops as close to the stream bank as possible. This practice can increase sedimentation and nutrient levels in ditches and streams. Therefore, the Initiative contracted the Allen County Partnership for Water Quality to perform a stream buffer analysis within the Upper St. Joseph River Watershed. Parcel GIS layers were gathered from the Steuben, DeKalb and Hillsdale surveyors and the Williams County engineer and Ortho photography was also gathered from each respective county, though the origin of all ortho–photography was from the USDA. Table 2.11 below is a breakdown of the percentages of parcels that have anywhere from 0 to 300 foot buffers or are located within an urban or industrial area, or where the stream has been tiled and no longer exists on the surface as shown from the National Hydrological Data GIS layer. It should be noted, that a differentiation between grassed and woody vegetated buffers could not be easily determined from the desktop survey. Figure 2.14 is a map that shows the location of each buffer. Maps showing the stream buffers by subwatershed are provided in section 3.4; Land Use per Subwatershed.

Table 2.11: Riparian Buffer Inventory

	Buffer Width	# of Parcels	Percent of Parcels
	0 - 10	3740	51%
	11 - 20	281	4%
	21 - 60	647	9%
	61 - 140	304	4%
	141 - 300	1195	16%
	Urban/Residential	887	12%
	Industrial	46	1%
	Tiled Ditch	211	3%

Figure 2.14: Riparian Buffer Inventory in the Upper St. Joseph River Watershed



2.5.10 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 any 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 five identified brownfield sites located in the USJRW, all located in Michigan, three in the West Branch Subwatershed and two in the East Branch Subwatershed. The specific brownfield sites will be discussed in further detail in Section 3 of this WMP.

2.5.11 Underground Storage Tanks

An underground storage tank (UST) is essentially a container placed under the ground to store chemicals necessary to run a business or provide a service. Most USTs store chemicals such as 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 depending on the soil type, surface water, and contaminate them.

USTs are managed by the IDEM Office of Land Quality's Underground Storage Tank program, the OH Commerce Division of Fire Marshal, Bureau of Underground Storage Tank Regulations (BUSTR), and the MI Storage Tank Division of the Department of Licensing and Regulatory Affairs (LARA). However, the state of OH has not yet been granted state program approval by the US EPA to completely manage the UST program unsupervised. The states are charged with assuring all underground storage tanks meet both 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 up graded. There are currently 19 LUSTs located in the project area. LUSTs will be discussed in Section 3 under the respective subwatershed where they will also be mapped.

2.6 History of the Upper St. Joseph River Watershed

The Upper St. Joseph River Watershed is comprised of a diverse community with a rich history. Understanding the history of the USJRW will help with the understanding of how the watershed is being utilized and help to shape its future.

Because of the fertile land, and resources provided by the rivers and streams, the USJRW became an ideal location to settle. Settlers first began to arrive in the USJRW in the early 1800's traveling west to find fertile ground to settle. Due to the ideal soil in the area, settlement began in Michigan in the early to mid-1800's and the southern part of the watershed in the mid to late 1800's.

Many towns in the watershed were built along the rivers and streams to utilize the resource for flour, grist, wool, and hoop mills. However, it wasn't until the railroad came to the area that the towns really began to grow Including Pioneer and Montpelier, Ohio and Montgomery and Reading, Michigan.

There are three large lakes in the watershed that have permanent residents, rather than seasonal residents only. These lakes include Clear Lake, Hamilton Lake, and Lake Seneca.

With the arrival of the new railroad in 1870 which passed through northeast Indiana on to Jackson, Michigan, Clear Lake became a resort area for people from Fort Wayne, Toledo, and other Indiana and Ohio cities traveling on the railway. By 1875, the waters of Clear Lake provided the town with additional attractions, with the availability of sailing, rowboats, steamboats, and fishing. Although first petitioned for the Incorporation of Clear Lake was filed in 1928, it wasn't until 1932 that the petition was accepted and Clear Lake became an incorporated town. Clear Lake has continued to grow into not just a resort area, but is now home to 339 permanent residents according to the 2010 Census. Clear Lake uses a centralized sewer system.

Water recreation was also important to the development of Hamilton, In. Hamilton Lake is the fourth largest lake in Indiana. Formed by the receding glaciers thousands of years ago several small lakes were grouped around what is now the Village of Hamilton, IN. Those lakes were dammed in 1832 to create Hamilton Lake and in the last decade, Crystal Cove, a manmade addition, was added to Hamilton Lake making the total water cover over 800 acres. According to the 2010 Census, Hamilton has a population of around 1,500 people, however the population grows significantly in the summer due to the large number of summer homes located on the Lake.

Lake Seneca is the final large developed lake in the watershed with permanent residents. Lake Seneca was formed in in the late 1960's when a developer dammed the St. Joseph River to form a recreational town on the newly formed lake. Lake Seneca is small in comparison to Clear Lake and Hamilton Lake at only 270 acres, and a population of 465 residents; however the population does increase in the summer when people populate their summer homes on the Lake. Lake Seneca does not have a centralized sewer system.

Finally, a unique attribute of the USJRW is the large Amish population that settled in the area in in the early 1800's. Although the first Amish arrived in America in the mid-1700s, it wasn't until 1809 that the Amish begin settling in Ohio farming side by side with the Native Americans. By 1841 Amish settlement began in Northeast Indiana, which is now home to the third-largest Amish population in the country. The Amish population is spread throughout the USJRW but there is a large concentration of Amish in Hillsdale County. This is significant to the USJRW project due to their traditional farming techniques, and their unique community government which may pose a challenge when it comes to introducing farming techniques and best management practices.

There are also several places of significance located in the USJRW that are designated as a historic site by the U.S. Parks Department and listed on the National Registry of Historic Places. The IN DNR Historic Preservation and Archeology Division, Ohio Historical Society, and Michigan State Historic Preservation Office do not have any additional historic sites listed within the USJRW. Table 2.12, below, is a list of the five sites located within the USJRW that are considered important for historic preservation by the U.S. Parks Department.

Table 2.12: National Registry of Historic Places in the Upper St. Joseph River Watershed

Historical Name	Address	City	County	State	Significance	Period
Hill, James Delos, House	201 E Main St	Montpelier	Williams	Ohio	POLITICS /GOVERNMENT /COMMERCE	1875-1949
Nettle Lake Mound Group	Address Restricted	Nettle Lake	Williams	Ohio	ARCHAEOLOGICAL /INFORMATION POTENTIAL	Greater than 1000 yrs ago
Trunk Line Bridge No. 237	Burt Rd. over Silver Creek	Ransom	Hillsdale	Michigan	Architecture/ Commerce	1918
Lords, William L., House	Clear Lake Road	Fremont	Steuben	Indiana	Architecture	1848
Free Church	Old Road 1 N	Angola	Steuben	Indiana	Architecture	1876

2.7 Demographics

Understanding the demographics of the project area will help to focus the implementation efforts of the WMP to the areas where the suggested management measures will be accepted both scientifically and financially. Below is a description of the demographics of the USJRW and the growth patterns observed in the past decade. All demographic information was obtained from the 2010 Census unless otherwise noted.

2.7.1 Population Trends

The population in Hillsdale County has increased a negligible amount between 2000 and 2010 according to the US Census with an increase of only 161 people (<1% Increase). The population in both Indiana counties, according to the 2010 US Census has increased significantly between 2000 and 2010. Steuben County has increased by 971 people between the 2000 and 2010 US Census (nearly a 3% increase) and DeKalb County has increased by 1983 people between 2000 and 2010 (nearly a 5% increase). The Williams County population has decreased between 2000 and 2010 by 1546 people, which is significant with nearly a 4% decline in population. It is likely that the increase in Steuben County is due to the increase in homes surrounding Clear Lake, and a small increase around Hamilton Lake over the last decade. However, estimates for the 2012 population for each of the counties made by the US Census predicts a steady incline in all counties except Williams County where the population is estimated to continue to decline at nearly another 4%. Figure 2.15 shows the total population, and the male and female population. Figure 2.16 shows the age distribution of the population in the four counties located within the USJRW from the 2010 US Census.

Figure 2.15: Population of Each County Location in the Upper St. Joseph River Watershed

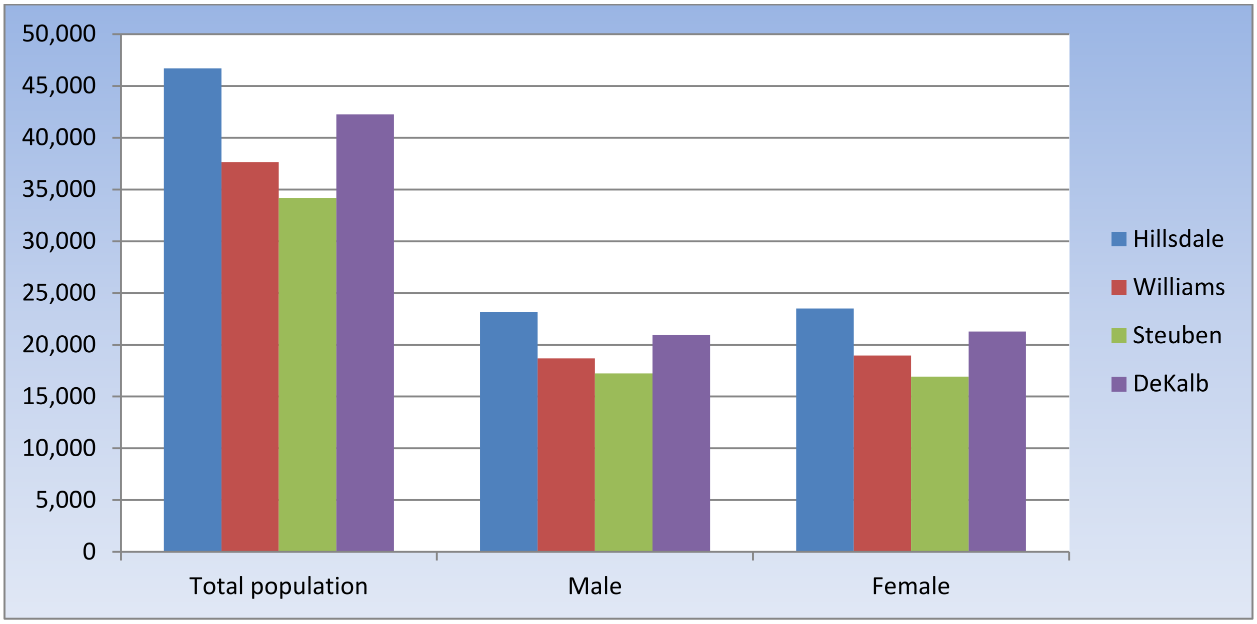
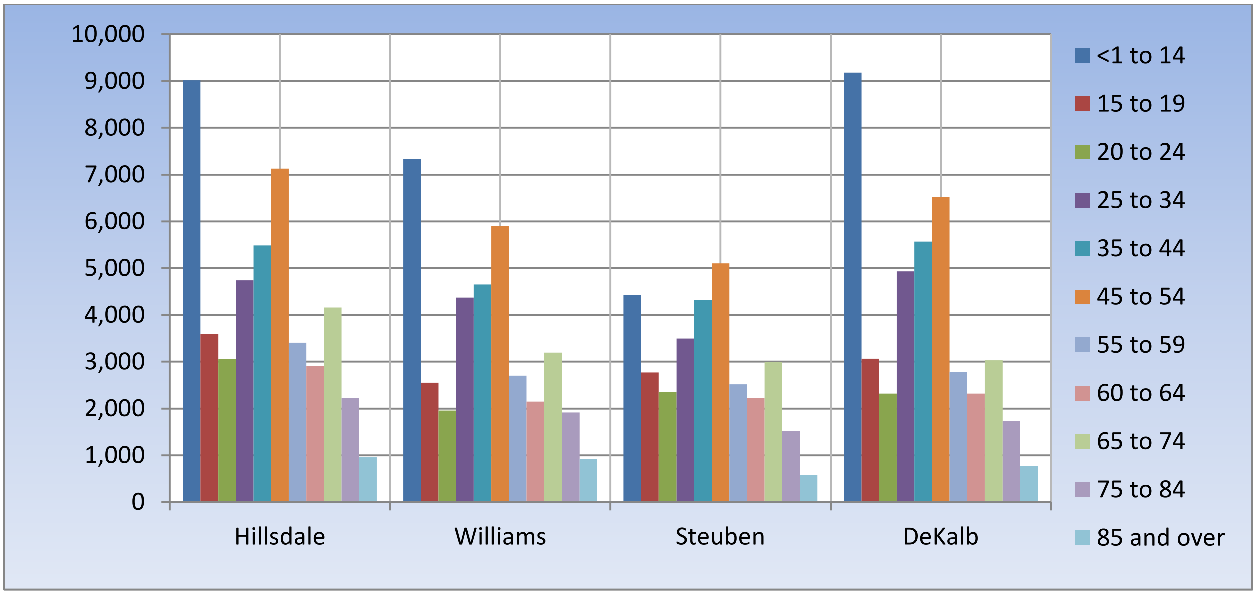


Figure 2.16: Population by Age in Each County Located in the Upper St. Joseph River Watershed



2.7.2 Education and Income Level

The significant increase in population in Indiana Counties located in the USJRW is likely because there are more opportunities for individuals with a higher education level to acquire higher paying jobs. The average income level in Steuben ($44,089) and DeKalb ($44,909) counties are 10% higher than that of Hillsdale ($40,396) and Williams ($40,735) Counties, though the percentage of the population 25 or older with a bachelor's degree or higher ranges from 16% in Steuben County to 11% in Williams County. This indicates a low variance in education level, though a somewhat significant difference in income level. This may be to the affluent areas of Clear Lake and Hamilton Lake, where many retired people of taken up residency. The lower income levels for Hillsdale and Williams County may be due to the fact that those counties are mostly rural and comprised of mostly small farms. The graphs below illustrate the education level and household income level for individuals 25 years old or older for the counties located in USJRW; Figure 2.17 and 2.18, respectively.

Figure 2.17: Education Level for Each County in the Upper St. Joseph River Watershed

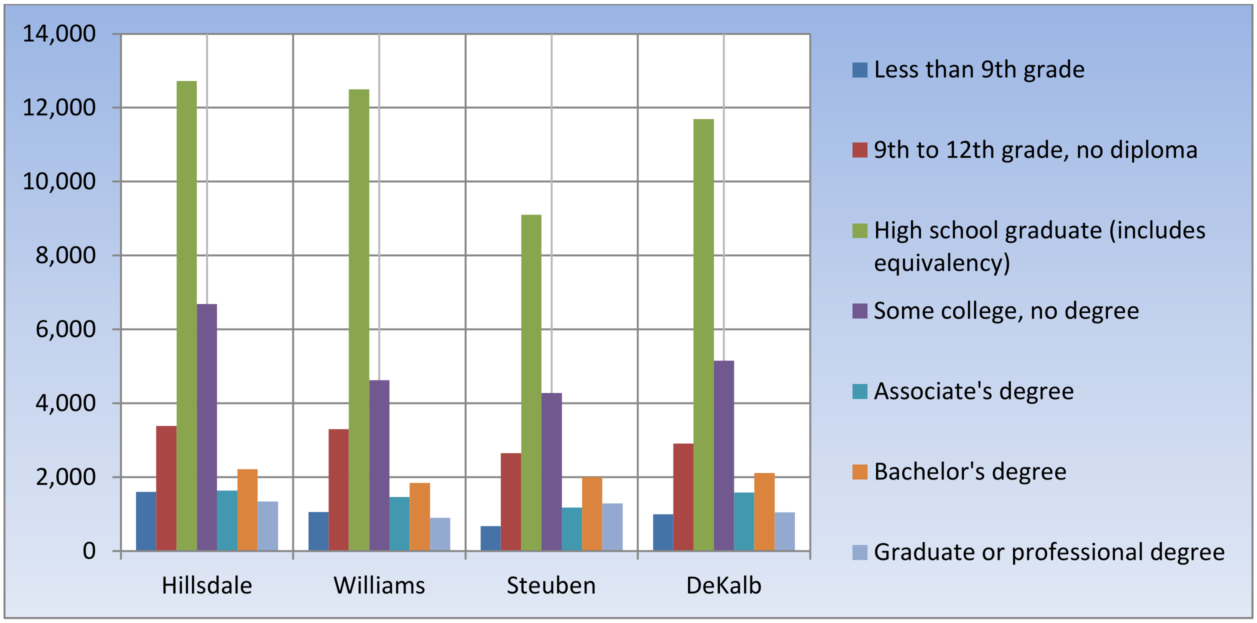
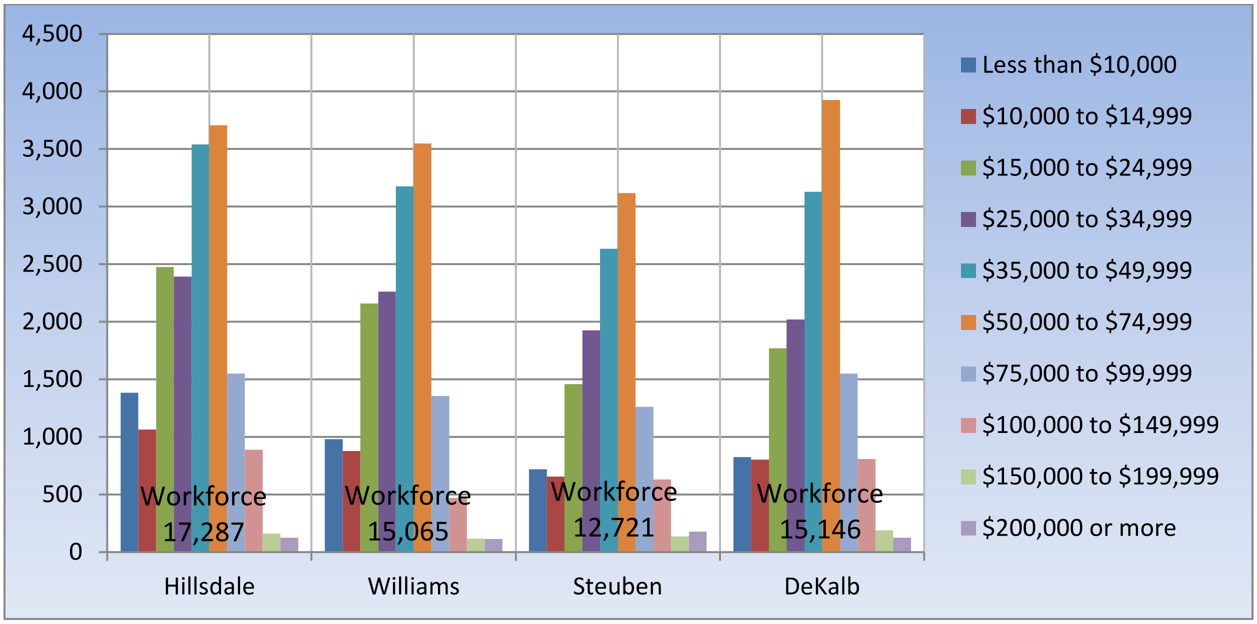


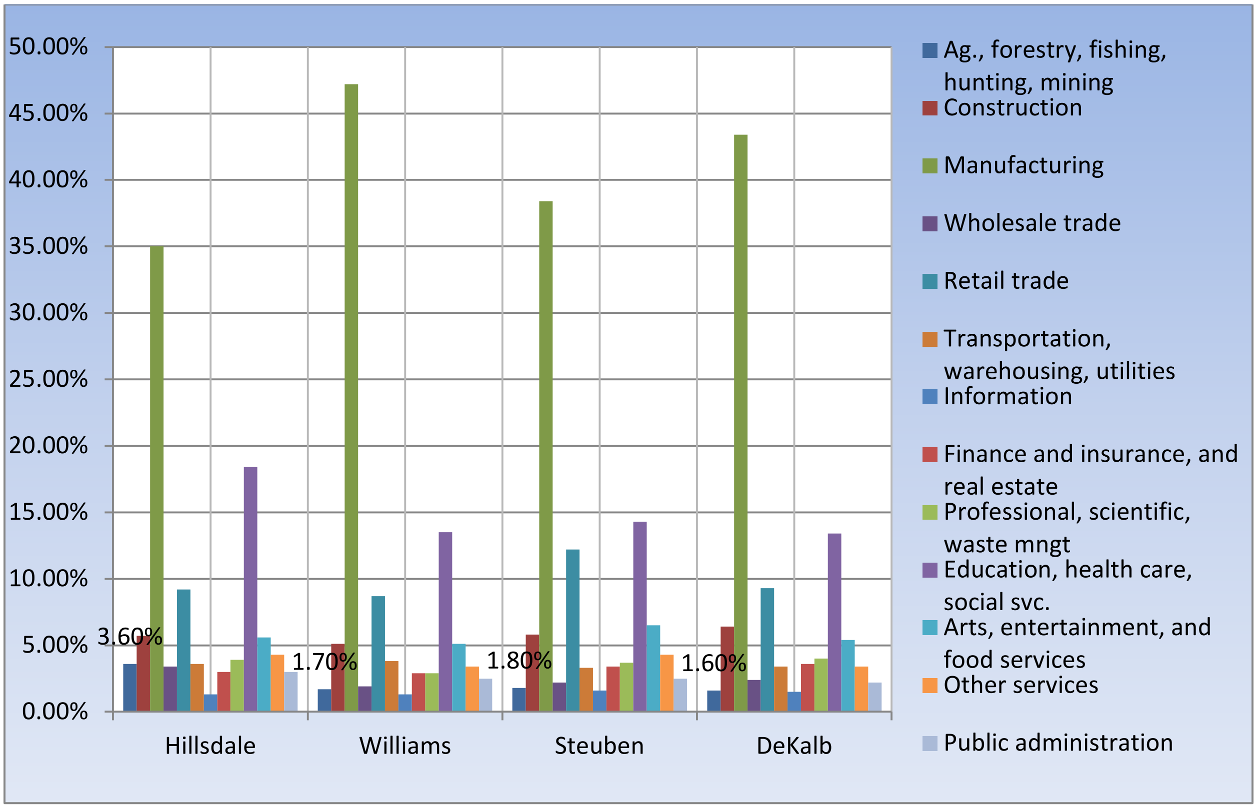
Figure 2.18: Income Level for Each County in the Upper St. Joseph River Watershed



2.7.3 Local Industry

Developed areas only comprise approximately 8% of the watershed and management measures will need to be implemented in those urbanized areas to decrease urban NPS pollution. However, the majority of the land use in the USJRW is agriculture, therefore producers will likely be the largest demographic targeted for the implementation of management measures in the watershed. According to 2000 US Census (2010 results are not currently available on the Census Bureau website), nearly 9% of the population within the four counties located in the USJRW work in agriculture, forestry, fishing, hunting and mining. The graph below illustrates the percentage of the population that works in each type of industry in each county. The percentages for agriculture, forestry, fishing, hunting, and mining are labeled on the graph.

Figure 2.19: Industry Workforce Percentages in Each County in the Upper St. Joseph River Watershed



2.7.4 Development

The increase in population in Hillsdale and Steuben counties may indicate that more construction of residential property and/or businesses is occurring. However, due to the economic depression that began in 2007, development is on the decline. The Hillsdale, Williams, and Steuben county planning departments were contacted to learn the number of permits that were issued for various construction projects in 2000 and 2012. DeKalb and Branch County planning departments were not contacted due to the small area of those counties that are located within the USJRW. Table 2.13 shows the number of permits, and what type of permit, was acquired in 2000 and 2012 in each county.

Table 2.13: County Building Permits in Upper St. Joseph River Watershed (2000 – 2012)

Type of Permit	Hillsdale		Williams		Steuben	
	2000	2012	2000	2012	2000	2012
Commercial	0	0	0	12	0	0
Residential	263	35	141	13	240	107

2.8 Previous Watershed Planning Efforts

The Saint Joseph River plays an important role for residents of Indiana, Ohio, and Michigan as it provides drinking water to the more than 250,000 residents of the city of Fort Wayne, IN, recreational opportunities throughout the watershed, and it eventually flows to the Great Lake Erie by way of the Maumee River. For these reasons, the St. Joseph River is important to understand and protect. Many studies of the river system and the surrounding land uses have been conducted, as well as, several city and county master plans have been written to outline problems and threats to our natural resources, and propose ways of protecting those resources. This section provides a description of each of the previous studies and watershed planning efforts that have been conducted since 2000, or are still in effect in the USJRW. Table 2.14 lists all studies that have been conducted in the Upper St. Joseph River Watershed and have been reviewed as part of this WMP and Figure 2.21 is a map showing the location of the planning efforts in the USJRW.

Table 2.14: Previous Studies in the Upper St. Joseph River Watershed

Study/Plan	Topic	Year	Writer	Stakeholder's Concerns
Ball Lake Diagnostic Study	Watershed Management	2000	F. X. Brown, Inc.	Streambank erosion, invasive species, BMP education, wetland preservation and protection, improper construction site management
St. Joseph River Watershed Management Plan/Update	Watershed Management	2001/ 2006	St. Joseph River Watershed Initiative	Agriculture and urban runoff, log jams, nutrient and bacteria in lakes, stream bank erosion, wetland protection and preservation, invasive species, industrial discharge, and BMP education
Hillsdale County Master Plan	County Planning	2002	Hillsdale County Government	Runoff from animal operations, leaking, failed, or straightpipe septic systems, streambank erosion, improper construction site management, wetland preservation and protection, lack of education regarding BMPs, sediment runoff
Bacteria Source Tracking	Water Quality	2004	St. Joseph River Watershed	Animal Operation runoff, excessive nutrients and bacteria in lakes, livestock

Study/Plan	Topic	Year	Writer	Stakeholder's Concerns
			Initiative	access to open water
DeKalb County Comprehensive Plan	County Planning	2004	DeKalb County Government	Leaking, failed, or straight pipe septic systems, excessive nutrients and bacteria in the lakes, streambank erosion, wetland preservation and protection, improper construction site management, sediment runoff, industrial discharge
Trends in Biological Integrity, Biochemistry and Aquatic Habitat in the Eastern Corn Belt Ecoregion: Implications for the Protection and Restoration of Streams in the St. Joseph River Watershed	Watershed Management	2005	Midwest Biodiversity Institute	Streambank erosion and sediment runoff
Black Creek Engineering Feasibility Study	Watershed Management/ Land Treatment	2006	Dynamic Environmental Solutions	Streambank erosion, sediment runoff, BMP education.
RWA of Riparian Buffers in the St. Joseph River Watershed	Water Quality and Land Treatment	2006	St. Joseph River Watershed Initiative	Invasive Species, streambank erosion
Steuben County Comprehensive Plan	County Planning	2006	Ground Rules	Leaking, failed, or straight pipe septic systems, excessive nutrients and bacteria in the lakes, streambank erosion, wetland preservation and protection, improper construction site management, sediment runoff
Clear Lake Comprehensive Plan and Zoning Ordinance	Town Planning	2006	Clear Lake Town Council	Excessive nutrients and bacteria in lakes, streambank erosion, improper construction site management, sediment runoff from urban areas, wetland preservation and protection

Study/Plan	Topic	Year	Writer	Stakeholder's Concerns
Aquatic Plant Management; Hamilton Lake	Watershed Management	2007	Aquatic Enhancement and Survey, Inc.	Invasive Species
Western Lake Erie Basin Strategic Plan	Watershed Management	2007	Western Lake Erie Basin Partnership	Excessive nutrients and bacteria, streambank erosion, wetland preservation and protections, invasive species, industrial discharge, lack of education regarding BMPs, sediment runoff
Aquatic Plant Management: Hamilton Lake (update)	Watershed Management	2008	Aquatic Enhancement and Survey, Inc.	Invasive Species
St. Joseph River Watershed Livestock Inventory	Land use/Watershed Planning	2008	St. Joseph River Watershed Initiative	Animal Operation runoff, excessive nutrients and bacteria in lakes, livestock access to open water
Western Lake Erie Basin Study: St. Joseph River Watershed	Watershed Management	2009	US Army Corp of Engineers	Agriculture and urban runoff, log jams, nutrient and bacteria in lakes, stream bank erosion, wetland protection and preservation, invasive species, industrial discharge, and BMP education
Hamilton Lake Sediment Removal Plan	Watershed Management/ Land Treatment/ Fisheries	2009	Williams Creek Consulting	Streambank erosion, excessive nutrients and bacteria in lakes, and sediment runoff
Black Creek Restoration Plan – Engineering Design	Watershed Management/ Land Treatment/ Fisheries	2009	Williams Creek Consulting	Streambank erosion
DeKalb County Unified Development Ordinance	County Planning	2009	DeKalb County Government	Industrial discharge, Improper construction site management, sediment runoff
Clear Lake Unified Development Ordinance	Town Planning	2009	Ground Rules	Industrial discharge, Improper construction site management, sediment runoff
Engineering Design and Natural Resources Assessment: Clear Lake Watershed	Watershed Planning/Water Quality	2011	Davey Resource Group	Streambank erosion, livestock access to open water, wetland preservation/protection, and sediment runoff from

Study/Plan	Topic	Year	Writer	Stakeholder's Concerns
				agricultural land and dirt roads
Branch County Master Plan (draft)	County Planning	2011	Branch County Government	Wetland preservation and protection
Ball Lake Aquatic Vegetation Management Plan (draft)	Water Quality/Fisheries	2012	Aquatic Weed Control	Invasive Species
Steuben County Ordinance for Storm Drainage and Erosion Control	Water Quality and Land Treatment	Unknown	Steuben County Government	Excessive nutrients and bacteria in lakes, streambank erosion, improper construction site management, sediment runoff from urban areas
The Upper St. Joseph River Watershed Strategic Plan	Watershed Management	Unknown	The Nature Conservancy	Wetland preservation and protection, runoff from urban and agricultural areas, streambank erosion, excessive nutrients and bacteria in water, invasive species

St. Joseph River Watershed Management Plan

The St. Joseph River Watershed Initiative was provided a CWA§319 grant in 2004 to revise the watershed management plan for the entire eight digit HUC St. Joseph River watershed (04100003) that was originally approved by IDEM in 2001. The revised WMP was completed and approved by IDEM in 2006. During the St. Joseph River WMP investigation it was found that Nettle Creek and East Branch-St. Joseph River subwatersheds are considered critical for sediment, the West Branch-St. Joseph subwatershed is considered critical for ammonia, phosphorus, and bacteria contamination, and Fish Creek is critical for habitat protection for the White Cats Paw Pearly Mussel as Fish Creek is the last known habitat of the endangered mussel. While the revised St. Joseph River WMP provided a lot of information, it was not detailed enough to pinpoint all the major issues that need to be addressed in each of the subwatersheds. For that reason, goal 1 of the St. Joseph River WMP is "By 2020, organize stakeholders and produce watershed plans for the HUC-11 subwatersheds which have not yet been completed…". It should be noted that since the approval of the St. Joseph River Watershed Management Plan the United States Geological Survey (USGS) re-delineated the boundaries of all HUCs and gave each HUC a new 10 or 12 digit "address". Therefore, the HUC-11s referred to in the above quote, now would be HUC-10s. The Upper St. Joseph River watershed is the sixth and final WMP developed in the St. Joseph River Watershed by the St. Joseph River Watershed Initiative.

Bacteria Source Tracking Investigation

The St. Joseph River Watershed Initiative performed a bacteria source tracking investigation on the Enterococci collected from grab samples throughout the St. Joseph River watershed between 2001 and 2004. An antibiotic resistance analysis was performed to determine the source of the bacteria collected. Five sampling sites were located in the Nettle Creek subwatershed. Results from the bacteria source analysis indicate that the majority of the bacteria found in the watershed is from horses, however it was also noted that there may be interference between horse bacteria and another bacteria source. However, there were two sites in Nettle Creek that were sampled a single time in 2002. The bacteria source analysis of those two sites indicated that geese were the major contributor to the bacteria in the stream. There were also two sites sampled in the West Branch-St. Joseph subwatershed once in 2002 and once in 2003, both indicating geese as the major contributor to bacteria and one site in the East Branch-St. Joseph subwatershed was tested in 2002 and 2003. The results of the analysis completed in 2002 in the East Branch indicated horses were the major contributor and results from 2003 indicated that geese were the major contributor to bacteria in the watershed. Table 2.15 below shows the distribution of bacteria sources found at all single sample sites in 2002 and 2003.

Table 2.15: Bacteria Source Tracking Analysis

Site #	Subwatershed	% Livestock		% Pets		% Geese		% Horse		% Human	
		2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
129	Nettle Creek	4.2		35.4		56.2		2.1		2.1	
132	Nettle Creek	8.7	9.5	16.7	9.5	41.7	69.1	16.7	0	12.5	11.9
125	West Branch	6.4	8.3	8.5	8.3	78.7	79.2	4.3	4.2	2.1	0
134	West Branch	13	16.7	10.9	10.4	71.7	60.4	2.2	4.2	2.2	8.3
126	East Branch	2.3	18.8	14	6.3	34.9	68.7	39.5	6.2	9.3	0

Rapid Watershed Assessment of Riparian Buffers in the St. Joseph River Watershed

A Cooperative Conservation Partnership Initiative grant was provided to the Ohio DNR to perform a rapid watershed assessment of the riparian buffers in the St. Joseph River watershed in 2006. The OH DNR contracted the Initiative to perform the study. The study was conducted to prioritize subwatersheds for the placement of riparian buffers to improve water quality and wildlife habitat. Five categories of information were determined to be the most useful in the ranking process; percent of watershed in crop production, percent of at least 30 meters of woodland in buffer zone, percent of natural vegetation in the watershed, water quality and species occurrence in the watershed. Using the above mentioned five parameters, the USJRW was ranked as being in fairly good condition as a whole. The East and West Branch subwatersheds were ranked as being in the best condition, Fish Creek subwatershed was in decent condition, while Nettle Creek subwatershed was in poor condition, meaning it had a high amount of land in crop production, little natural vegetation, few areas where 30 meters of buffer zone was covered by woodland, and low water quality and species occurrence. Landuses are continually changing, and since the Rapid Watershed Assessment (RWA) study took place over six years ago it is clear that the buffer zones in the watershed should be examined more closely. As part of this project, a more intense look at riparian buffers was examined and will be presented in section 3 of this WMP.

Western Lake Erie Basin Study: St. Joseph Watershed Assessment

In 2009 the US Army corps of Engineers completed a study of the St. Joseph River Watershed to provide watershed, city, and county planners with a tool to help restore, protect, and promote sustainable uses of water resources and the surrounding land within the Western Lake Erie Basin (WLEB). The study states that bacteria, pesticides, sediment, and excess nutrients are all water quality concerns throughout the eight digit HUC. It also states, that flooding is a major issue as it not only causes thousands of dollars in property damage, but also contributes pollutants to the water system. The WLEB St. Joseph study found that the majority of the pollution is coming from combined sewer outfalls, agriculture productions, flow and habitat modifications, waste water treatment plant outfalls, and septic systems. However, the WLEB study conceded that a more in depth study of each subwatershed should be completed so as to be more exact in the determination of problems and causes.

Western Lake Erie Basin Partnership Strategic Plan

The Western Lake Erie Basin Partnership was formed in 2006 after the US Army Corps of Engineers and US NRCS brought together 14 federal, state, and regional partners to create a comprehensive watershed management partnership comprised of key stakeholders located within the WLEB. In 2007, the WLEB Partnership adopted a strategic plan to improve water quality throughout the WLEB. The Plan Includes goals for the following topics;

- Invasive Aquatic Species Control
- Habitat Conservation and Species Management
- Stream and Coastal Health/Water Quality
- Areas of Concern/Contaminants
- Nonpoint Source Pollution

- Toxics
- Sustainable and Balanced Growth
- Hydrologic Management/Flooding Attenuation
- Forest Resource Protection
- Native Plant Community
- Public Information/Education

Many of the goals are in-line with concerns expressed by the USJRW stakeholders such as industrial discharge and runoff, land conversion/Increase in impervious surfaces, and nonpoint source pollution from AFOs, CFOs, and other animal operations.

DeKalb County Comprehensive Plan of 2004

In June, 2004 the Commissioners of DeKalb County adopted the DeKalb County Comprehensive Plan. This Plan is intended to be relevant for the county for the next five to ten years, at which point, the Plan will be updated. There are two chapters in the Plan that are relevant to the USJRW project; Chapter 5 – Protect Environmental Assets, and Chapter 7 – Provide High Quality Public Services.

Chapter 5 has four objectives relevant to this WMP Including;

1. Protecting the quality and quantity of water resources
2. Protect and enhance the natural environment
3. Allow for sustainable growth
4. Reduce risks of flooding

Chapter 5 encourages the development and protection of wetlands and swales for stormwater control, reducing point source discharges, enforcing wellhead protection plans, reserving open space, conserving tree stands, discouraging development of sensitive areas, the adoption of best management practices, allowing development within the 100 year flood plain on a minimal basis, and preserving regulated drains in the county.

Chapter 7 also has four objectives including;

1. Develop plans for community services to meet county growth
2. Enhance public services
3. Improve communication between city and county governments and agencies
4. Develop a county parks board and parks and recreation master plan, which have not yet been completed.

According to the Comprehensive Plan these objectives will be met by protecting future park and recreational areas, encouraging the donation of land to the County to be used as a public park, and establishing public parks that provide passive recreation.

DeKalb County Unified Development Ordinance (UDO)

The UDO was adopted by DeKalb County in January, 2009. The UDO is a plan to allow for development while not decreasing the quality of the land and its resources. The UDO outlined many development standards which will maintain the integrity of our natural resources including that no trees can be removed during construction unless they are dead or diseased, or replaced with comparable vegetation and setbacks from sensitive areas. Finally, the UDO outlined specific standards in wellhead protection areas, such as banning dry cleaners and laundromats, scrap yards, bulk chemical storage, CFOs, and put a maximum of 1000 gallons of above ground storage of liquid chemicals.

Hillsdale County Master Plan

The Hillsdale County Planning Commission adopted the County Comprehensive Plan at a public hearing on December 12, 2002. The Plan is intended to be a guide for sustainable development in the county over the next twenty years, however, as stated in the Executive Summary, no Plan can be effective unless it is continually reviewed and updated to accommodate for the ever changing circumstances of the area. Therefore, the Plan will be reviewed every five years, and updated at least every ten years.

The Comprehensive Plan outlines several issues in the county, and ways in which the issues will be addressed. Below is a list of issues that are addressed in the Comprehensive Plan and that are relevant to the USJRW project:

1. There is not currently a Unified Development Plan for the County, or in many of the rural communities.
2. There is not currently a county-wide Plan to address the need for farmland preservation.
3. Environmentally sensitive lands require a program or policy to assist in natural resource conservation and protection.
4. Animal waste application as fertilizer should not compromise the integrity of the environment.
5. The county should promote wetlands, floodplains, and ground water recharge areas as natural filters and stormwater retention areas to aid in the protection of those sensitive areas.
6. The Hillsdale County Conservation District should work with landowners to address the sedimentation issue found in the Maumee River Basin and tributaries.
7. A countywide plan is needed to address the known sites that are contaminated by one or more hazardous substances in the county.
8. A countywide policy or plan should be adopted to promote the protection of surface water.
9. Lakes with residential development should be encouraged to install a centralized sewer system to prevent environmental degradation.
10. Hillsdale County has a Parks and Recreation Master Plan which should be utilized to gain funding for facility improvement and land acquisition.

Steuben County Comprehensive Plan

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 USJRW planning project, those are to manage growth of the county and nurture environmental quality.

Several objectives and actions in the Plan address issues discussed by the USJRW steering committee. Those objectives and/or actions are as follows:

1. Require cluster designed residential development and allow Incentives to developers who do so while protecting and enhancing environmental features.

2. Establish policies that require new residential properties to connect to centralized sewer systems when developed within a reasonable proximity to infrastructure.
3. Discourage residential sprawl.
4. Update the Zoning Ordinance to aid in the preservation of natural areas.
5. Create a visioning audit to identify ecological resources, open spaces, agricultural districts, buffer zones, green ways, and wildlife areas.
6. Buffer sensitive land uses from new commercial and industrial developments.
7. Protect the water quality in the streams, lakes, and their watersheds.
8. Encourage the planting of native shade trees and evergreen trees to soften the impact of noise (which will also aid in stormwater uptake).
9. Minimize conflicts between growth and the environment.
10. 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 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.

St. Joseph River Watershed Livestock Inventory

The Initiative was awarded a grant from the OH DNR to do a complete livestock survey of the St. Joseph River Watershed in 2008. The Initiative and its partners drove each road within the entire HUC 8 to take a detailed survey of livestock in the watershed Including the number of livestock present, where they were housed, and what type of animal was present at the operation (excluding household pets such as dogs and cats). The inventory was completed in 2009. The inventory will help target education and outreach efforts, and where to spend cost-share dollars on livestock operations to improve water quality. The USJRW steering committee expressed concern regarding regulated and unregulated animal feeding operations in the project area.

The inventory counted 1,218 locations where livestock were present which Included 31,386 head of livestock in the USJRW Including beef cows, dairy cows, horses, sheep, pigs, goats, pheasant, elk, and alpaca. The average number of animals present at each location was 23, far below the threshold which would require State regulatory agency oversight. There were also 15 sites where livestock was noted to have access to open water and 13 sites where direct manure runoff was noted. It should be noted, that natural resource planners in OH have noticed a steady decline in the number of animal operations throughout Williams County, so the head count of the 2009 livestock inventory may be greater than the current head count. Livestock with direct access to open water was noted at several locations throughout the watershed during the Inventory. Livestock with direct access to open water can impact water quality by increasing sediment in the stream from the stream banks which become denude of vegetation from livestock walking down slope to the stream, and from fecal contamination which is occasionally deposited directly in the stream. Figure 2.20 shows the location of the livestock operations that were present during the 2009 inventory.

Clear Lake Comprehensive Plan and Zoning Ordinance

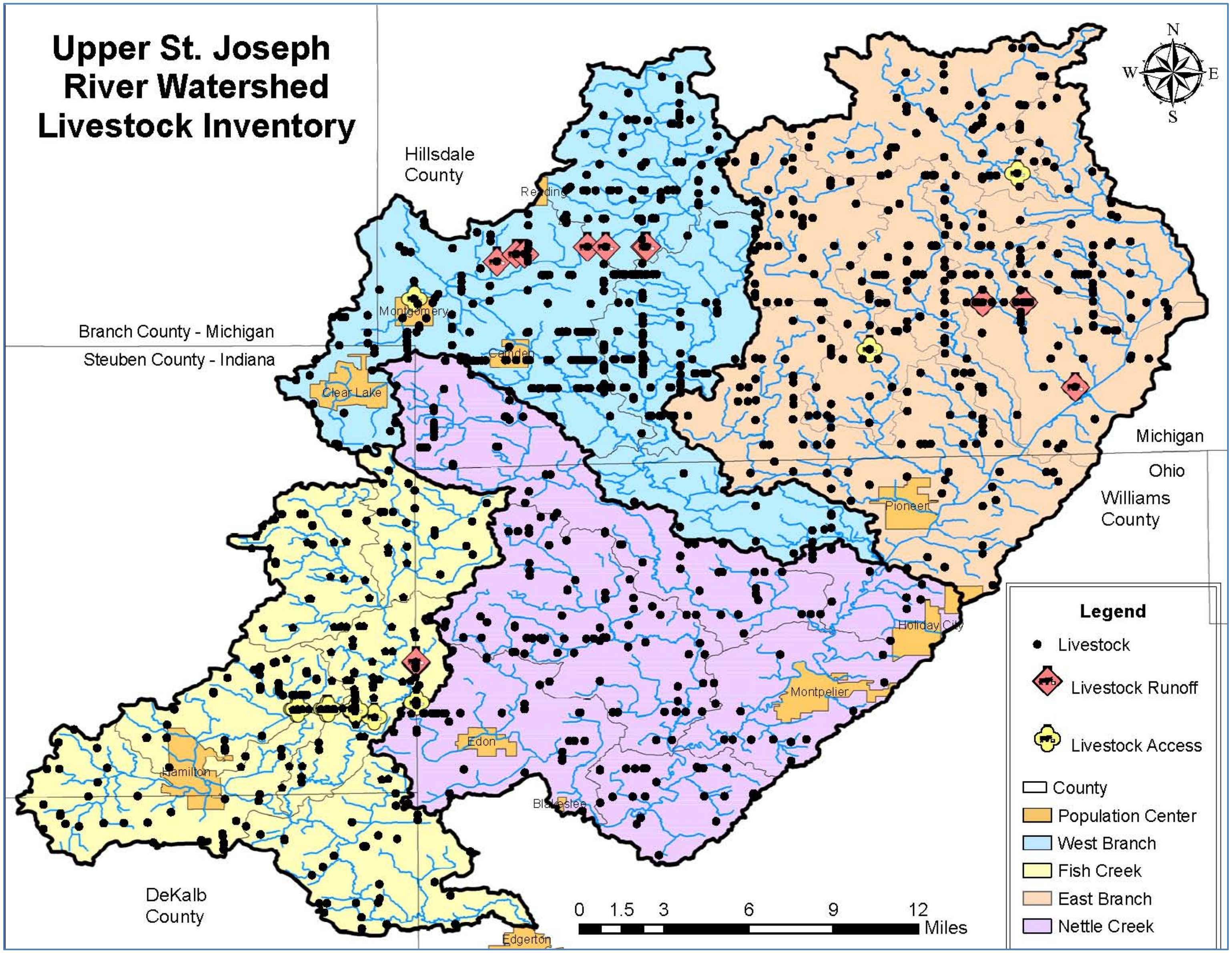
The Town of Clear Lake, IN accepted a Comprehensive Plan and Zoning Ordinance into practice in 2006. Many of the concerns expressed by the USJRW steering committee are addressed in the Clear Lake Plan. Some of the objectives outlined in the Plan which are relevant to this project are:

1. Protect environmentally sensitive areas including wetlands, streams, riparian corridors, and wildlife and aquatic habitat.
2. Provide and support programs that address water quality concerns.
3. Encourage the Clear Lake Town Council to acquire financial assistance to install greenway buffers, and implement conservation practices.
4. Prevent further development on Clear Lake

Clear Lake Unified Development Ordinance

The Clear Lake Unified Development Plan was adopted by the town in 2009. The Plan was designed to allow for sustainable growth and development while not diminishing the integrity of the aesthetic appeal of the lake or the environmental quality of the area. There are many aspects of the Plan that address concerns of the steering committee such as controlling erosion and stormwater runoff, requiring setbacks to environmentally sensitive areas, and preserving wetlands.

Figure 2.20: 2009 Livestock Inventory in the Upper St. Joseph River Watershed



Trends in Biological Integrity, Biochemistry and Aquatic Habitat in the Eastern Corn Belt Ecoregion: Implications for the Protection and Restoration of Streams in the St. Joseph River Watershed.

This report released by the Midwest Biodiversity Institute in 2005, prepared to assist The Nature Conservancy's implementation efforts in the Upper St. Joseph River Watershed, outlines many of the water quality issues in the St. Joseph River Watershed, and limitations to the current data available in the watershed. It is stated in the report that nutrients and sediment are major contributors to the loss of pollution intolerant aquatic life, but that sediment alone cannot be a measure of water quality and that IBI and QHEI scores should be evaluated to learn the true quality of stream habitat and overall quality.

Final conclusions of the report state that many of the streams in the watershed are channelized for agriculture production and even with implementation of conservation BMPs, aquatic habitat restoration will be very limited in those streams. However, in other areas of the watershed that are not as channelized, aquatic life responded favorably to conservation practices that were put into practice previously.

The report had six recommendations to improve water quality and aquatic habitat;

1.) Focus on headwaters that have high quality biota of their own
2.) Focus on headwaters with natural coarse substrates – loss of these to embeddedness would be a greater assimilative loss than to embeddedness in streams with naturally fine grained substrates
3.) Focus on waters that are direct tributaries of mainstem reaches first
4.) Work from bottom of headwater reach upstream to intercept sediments and nutrients, this can possibly assimilate the effects of poor quality tributaries
5.) Focus on waters that already have some channel function – if there is sufficient space easier to get restoration through
6.) Focus on a sub-basin as a test area with high probability of success

The Upper St. Joseph River Watershed Project Strategic Plan: The Nature Conservancy

The Nature Conservancy began studying the area of the Upper St. Joseph River Watershed in 1999 due to it being home to some of the most diverse aquatic life in the Great Lakes region. They developed a strategic plan to help focus conservation efforts in the watershed.

The Nature Conservancy's Strategic Plan for the USJRW outlines the major stressors to water quality as being siltation, hydrologic and riparian zone alterations, chemical perturbations, exotic and invasive species, and habitat loss and fragmentation. The Plan outlines the sources of those stressors to be NPS, excessive groundwater use and lack of protection of groundwater recharge areas, point sources and accidental toxic chemical releases, stream channelization and dredging, lack of education on biodiversity, and introduction of zebra mussels into the watershed. Finally, strategies to address the source of the stressors in the watershed was outlined Including facilitating the implementation of conservation tillage and other agricultural BMPs, riparian zone protection and restoration, and implementing a reforestation and wetland restoration program.

Branch County Master Plan Draft Update (2011)

A small portion of the USJRW is located in Branch County so the Branch County Master Plan is important to review. There are several issues observed by the USJRW steering committee that are addressed in the Master Plan Including;

1. Encourage conservation and protection of natural, scenic, lake and wooded areas for public enjoyment.
2. Prohibit floodplain development except for recreational purposes.
3. Identify and protect appropriate open space and wetland areas of the County and incorporate these areas in the recreation plan.
4. Encourage the development and maintenance of passive recreation areas including, swimming, picnicking and hiking areas.

All of the objectives listed above from the Master Plan will not only help improve recreational activities in the county to enhance the quality of life to residents of the county, but will also help to protect water quality.

Engineering Design and Natural Resources Assessment: Clear Lake Watershed

Clear Lake Township Land Conservancy was granted a Lake and River Enhancement grant from the IN Department of Natural Resources to identify and evaluate potential projects in the Cyrus Brouse Ditch Subwatershed and conduct a survey of critical areas in other subwatersheds, as well as assess critical wetlands in the entire Clear Lake Watershed.

The study outlined three critical areas including:

1. Unbuffered tile inlets in the Peter Smith Ditch and Harry Teeters Ditch Subwatersheds.
2. A horse pasture on East CR 700 North in the Alvin Patterson Ditch Subwatershed.
3. Gully erosion in the Peter Smith Ditch Subwatershed.

The study also outlined four areas of concern including:

1. A horse pasture south of SR 120 in the Peter Smith Ditch due to tile risers located in the pasture.
2. Yard waste being deposited in wetlands throughout the project area as the yard waste decomposition may contribute to excessive nutrients and will stifle the water holding capacity of wetlands.
3. Koeneman Lake may have reached its sediment holding capacity at the end of the Harry Teeters Ditch. Further testing should be conducted to determine the remaining holding capacity of the lake.
4. Runoff and erosion from dirt and gravel roads within the Clear Lake watershed.

The study also recommends the Clear Lake Township Land Conservancy work to develop ordinances for wetland protection as over 300 wetlands are present in the Clear Lake watershed, with several directly, or indirectly, attached to Clear Lake itself.

Finally, the study also outlined several BMPs to be implemented at specific locations to improve overall health of Clear Lake. Some of these BMPs Include streambank stabilization, grassed waterways, filter strips, roadway ditch repair, and replacing dirt and gravel roads with a more stable substrate to eliminate dirt road runoff into open water.

Ball Lake Diagnostic Study

The Ostego Ball Lake Association received an Indiana DNR Lake and River Enhancement (LARE) grant in 2000 to perform a study of Ball Lake and its watershed to determine potential NPS concerns and identify ways to address any concerns that were identified.

The major findings of the study were that the presence of highly erodible soils in the watershed has contributed to stream bank and road side ditch erosion which has contributed to the significant sedimentation of the lake and that the presence of invasive aquatic plants Including Eurasian Waterfoil and Purple loosestrife may be interfering with native vegetation growth and limiting quality aquatic habitat.

Recommendations presented in the study to combat potential water quality threats Include:

1. An in-depth survey of wildlife and aquatic habitat.
2. Installation of a vegetated buffer along lake and stream banks.
3. Controlling invasive species.
4. Installation of an oxygen system in Ball Lake to Increase hypolimnetic oxygenation.
5. Conduct a pesticide/herbicide screening program in Ball Lake's tributaries.
6. Promote the implementation of BMPs Including buffer strips, enrollment in the Conservation Reserve Program, vegetation in road side ditches, construction site runoff management, dirt and gravel road maintenance, wetland creation, and streambank restoration projects.

Ball Lake Aquatic Vegetation Management Plan (draft)

The Ball Lake Association was awarded an Indiana DNR LARE grant in 2012 to develop a plan to address the Increase in invasive aquatic plants in the lake, specifically Eurasian Waterfoil. The management plan for the control of Eurasian Waterfoil is for years 2013 through 2017 and includes the application of specific herbicides on the 17.2 acres of Ball Lake that is currently infested with Eurasian Waterfoil. It is also a goal of the Plan to maintain seven native aquatic plant species, at a minimum, in the lake. As of the writing of this WMP, implementation of the Vegetation Management Plan has not begun.

Black Creek Engineering Feasibility Study

The Hamilton Lake Association was awarded an Indiana DNR LARE grant in 2006 to perform a study to determine the best method of controlling the introduction of NPS into Hamilton Lake, via Black Creek which is located on the northeast shore of Hamilton Lake, and the best placement of BMPs for maximum effectiveness. The Hamilton Lake Association contracted Dynamic Environmental Solutions (DES) to conduct the study.

Several recommendations were made by DES to control sedimentation of the lake through from Black Creek but no recommendations were made to remediate sedimentation that has already built up in the Lake. The main recommendations of DES Include:

1. Stream bank stabilization projects at several sites along Black Creek.
2. Develop a Sediment Management Plan for the lake.
3. Work with the Steuben County SWCD to implement watershed level BMPs Including grade control structures and stream buffers.

Black Creek Restoration Plan – Engineering Design Study
Hamilton Lake Sediment Removal Plan

The Hamilton Lake Association was awarded an Indiana DNR LARE grant in 2009 to design a plan to address problems identified in the 2006 Black Creek study and to design a sediment control plan. Two separate Plans were written with the LARE grant funds. The Hamilton Lake Association contracted Williams Creek Consulting to conduct the study.

Five sites were identified in the study in which bioengineered BMPs are recommended to be installed to prevent further erosion of Black Creek along its bends. Native materials found on site should be used to limit the cost of the projects and to provide a more sustainable method of erosion control.

Williams Creek analyzed sediment samples at 38 sites between the Black Creek outlet to Hamilton Lake and Clark's Landing, south of the outlet of Black Creek. Two of the nine parameters tested for showed results above the acceptable level Including ammonia and barium. Two sites were identified for sediment removal; the Black Creek outlet to Hamilton Lake and Clark's Landing (south of the Black Creek outlet). A total of 18,900 cubic yards of sediment is estimated to be removed should the Plan be implemented.

Aquatic Plant Management Plan (2007-2011)
Aquatic Plant Management Plan Update 2008

The Hamilton Lake Association contracted Aquatic Enhancement and Survey, Inc. (AES) to write an Aquatic Plant Management Plan in 2006 and an update in 2008 using Indiana DNR LARE grant funds.

AES found hundreds of acres of lake which were infested with one of two invasive aquatic plant species; Eurasian Waterfoil and Curly leaf pondweed. The Plan update reviews herbicide application that took place previously in the lake and the results of those applications as well as, outlines a new herbicide application schedule for the lake to control the spread and growth of invasive plant species.

2.8.1 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. Hamilton, IN and Camden, Reading and Waldron, MI are all CPWSS' and have completed Phase I of their WHPP requirement. Hamilton has completed the first five years of their Phase II implementation and is currently writing their 5 year update. Table 2.16 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 Appendix C. Michigan has made available the delineation of wellhead protection plans which are also outlined on the map in Appendix C.

Table 2.16: Wellhead Protection Plans in the Upper St. Joseph River Watershed

Wellhead Protection Plans		
System Name	**Population Served**	**Phase**
Hamilton Water Works	2615	Phase II 5 year update
Camden	612	Phase I
Reading	1134	Phase I
Waldron	532	Phase I

2.8.2 Source Water Protection Plans

Source water protection plans (SWPPs) serve the same purpose as wellhead protection plans though the Plans require much less detail than a WHPP. There are several different types of SWPPs Including *Community Water Systems*, which are public water systems that supply water to the same population year round, *Non-transient Non-Community Water Systems*, which are water systems that supply water regularly to at least 25 people for at least six months out of the year, and *Transient Non-Community Water Systems*, which are public water systems that provide water in places like restaurants and gas stations where different populations pass through. There are six SWPPs for communities located in the Indiana portion of the USJRW, seven SWPPs for communities located in Michigan, and four SWPPs for communities located in Ohio. It should be noted that unlike Indiana and Michigan, Ohio has combined their WHPP and SWPP programs so all PWS' are considered Source Waters. The SWPPs located in the USJRW are listed in Tables 2.17 and 2.18. Each State allows for different information regarding their PWS' to be made public, so the same information is not presented for each SWPP. A map showing the delineation of the SWPP areas is located in Appendix C of this document.

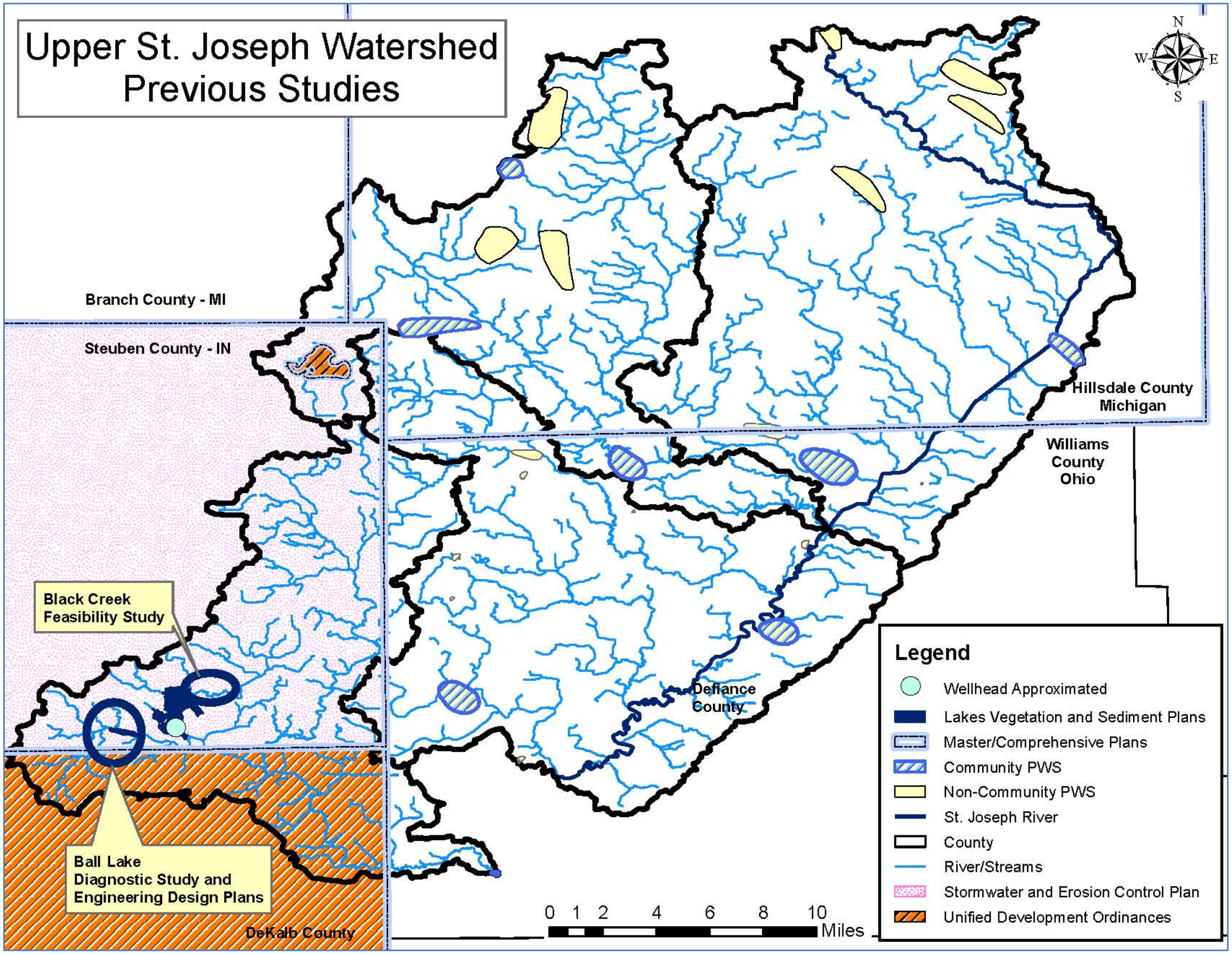
Table 2.17: Community Source Water Protection Plans

Source Water Protection - Community				
System Name	**Population Served**	**Gallons per Day**	**Phase**	**Susceptibility to Contamination**
Aqua Ohio - Seneca	750	67,965 GPD	Phase I	Low
Montpelier WTP	4374	2,000,000 GPD	Phase I	Low
Pioneer WTP	1300	648,000 GPD	Phase I	Low
Edgerton WTP	2012	341,000 GPD	Phase I	Low

Table 2.18: Non-Community Source Water Protection Plans

Source Water Protection-Non-Community				
System Name	**Population Served**	**Physical Address of Facility**	**Type**	**Susceptibility to Contamination**
Clear Lake Baptist Church	40	9050 East 700 North, Fremont, IN	Transient	High
Clear Lake General Store and Restaurant	40	630 East Clear Lake Drive, Fremont, IN	Transient	High
Clear Lake General Store and Restaurant	7	631 East Clear Lake Drive, Fremont, IN	Non-Transient	High
Clear Lake Lutheran Church	100	270 Outer Drive Clear Lake, Fremont, IN	Transient	Moderate
Clear Lake Yacht Club	110	186 Lake Drive, Clear Lake, Fremont, IN	Transient	High
Cold Springs, Inc.	25	260 LN, 120 Hamilton Lake, Hamilton, IN	Transient	High
Pittsford High School	Not Available	9304 Hamilton St. Pittsford, MI	Non-Transient	Not Available
MICHINDOH Ministries	Not Available	4545 E Bacon Rd, Hillsdale, MI	Transient	Not Available
Freedom Farm Christian School	Not Available	9400 Beecher Rd, Pittsford, MI	Transient	Not Available
Bird Lake Bible School	Not Available	7260 Bird Lake Rd S. Osseo, MI	Transient	Not Available
Camden-Frontier School	Not Available	4971 West Montgomery Rd, Camden, MI	Non-Transient	Not Available
Ramblewood Mobile Home Park	Not Available	409 State Road 9, Hillsdale, MI	Non-Transient	Not Available
Hillside Acres	Not Available	5200 Bankers Rd, Reading, MI	Non-Transient	Not Available

Figure 2.21: Previous Watershed Planning Efforts in the Upper St. Joseph River Watershed



2.9 Endangered Species

The USJRW 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 or candidates to become endangered on the federal level which can be seen in Table 2.12. There are several species of significance located within the USJRW which rely on wetland and upland forested areas for habitat, Including the White Cat's Paw Pearly Mussel (*Epioblasma obliquata perobliqua*) which currently can only be found in the Fish Creek.

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 urban areas. The Eastern Massasauga Rattlesnake lives in wetland areas, many of which have been drained to be used for agriculture. The ancestral Black Swamp in Ohio which has all, but the northeast corner of the swamp near Toledo, been drained and converted to farm land is one such wetland area in which the Eastern Massasauga would use as prime habitat. With much of the Eastern Massasauga's habitat being converted for other uses, the snakes numbers have declined dramatically. Finally, the last known population of White Cat's Paw Pearly Mussel is located in the St. Joseph River. These mussels live in streams that have a coarse sand or gravel bottom. With the Increase in intensive agriculture throughout the St. Joseph River watershed, the amount of sediment entering surface water has also Increased, thus smothering the mussels in the streambed. According to the United States Fish and Wildlife Service (USFWS), pesticides and fertilizers that runoff agricultural fields have also contributed to the demise of the White Cat's Paw Pearly Mussel as the mussels are filter feeders and take in contaminated water each time they eat. The protection of the habitat in which all the species listed in Table 2.16 live is essential to their survival.

Table 2.16: Federally Listed Endangered Species

COUNTY	SPECIES	COMMON NAME	STATUS	HABITAT
MAMMALS				
Williams (OH) Branch and Hillsdale (MI)	*Myotis sodalis*	Indiana Bat	Endangered	Hard wood forest and hardwood pine forest
MUSSELS				
Williams (OH) DeKalb and Steuben (IN) Hillsdale (MI)	*Pleurobema clava*	Clubshell	Endangered	Fresh water
Williams (OH) DeKalb (IN)	*Epioblasma torulosa rangiana*	Northern Riffleshell	Endangered	Well gravled river beds with swift flow
Williams (OH) DeKalb (IN)	*Epioblasma obliquata peroblique*	White Cat's Paw Pearly Mussel	Endangered	Fresh water
Williams (OH)	*Villosa fabalis*	Rayed Bean	Endangered	Fresh water
DeKalb (IN) Hillsdale (MI)	*Villosa fabalis*	Rayed Bean	Candidate	Fresh water
Williams (OH) DeKalb (IN)	Quadrula cylindrica cylindrica	Rabbitsfoot	Candidate	Fresh water
REPTILES				
Williams (OH) Steuben (IN) Branch and Hillsdale (MI)	*Nerodia erythogaster neglecta*	Copperbelly Water Snake	Threatened	Lowland Swamps
Steuben (IN) Branch and Hillsdale (MI)	*Sistrurus catenatus catenatus*	Eastern Massasauga	Candidate	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches and floodplain woods

COUNTY	SPECIES	COMMON NAME	STATUS	HABITAT
BIRDS				
Williams (OH)	*Haliaeetus Leucocephalus*	Bald Eagle	Species of Concern	Near Rivers with old trees
Butterflies and Moths				
Steuben (IN) Branch (MI)	*Neonympha mitchellii mitchellii*	Mitchell's Satyr	Endangered	Fens
Vegetation				
Steuben (IN)	Platanthera leucophaea	Prairie White-fringed Orchid	Threatened	Moist to mesic black soil prairies, sand prairies, thickets, pot hole marshes, and fens

The Indiana, Ohio, and Michigan DNR maintain lists of federally and state endangered and threatened species by county and/or state. The Indiana database of species includes those that are considered rare, extirpated, of special concern, significant, and on a watch list for the state. Ohio's list of species contains those that are potentially threatened, threatened, endangered, of concern, and of special interest. Michigan's list of species contains those that are considered extirpated, threatened, endangered, and of special concern. The endangered and threatened species spreadsheets for Williams, DeKalb, Steuben, Hillsdale, and Branch counties are Included in Appendix B.

2.10 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 USJRW. 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 2.17 is a list of invasive species that are located within one or more of the five counties that are located in the USJRW.

Table 2.17: Invasive Species by County

COUNTY	SPECIES	COMMON NAME	HABITAT
Vegetation			
Williams (OH)	*Senecio glabellus*	Cressleaf Groundsel	Openland
	Vitis L.	Grapevines	Forest
	Lonicera maackii	Honeysuckle, Amur	Forest
	Lonicera morrowii	Honeysuckle, Morrow	Forest
	Lonicera ttatarica	Honeysuckle, Tatarian	Forest
	Ploygonum perforliatum	Mile-a Minute Weed	Openland
	Chrysanthemum leucanthemu	Ox-Eye Daisy	Openland
	Conium maculatum	Poison Hemlock	Wetland
	Salsola kali	Russian Thistle	Openland
	Brassica kaber	Wild Mustard	Openland
	Pastinaca sativa	Wild Parsnip	Openland
	Daucus carota	Wild Carrot	Openland
	Carduus Nutans	Musk Thistle	Openland
Branch and Hillsdale (MI) DeKalb and Steuben (IN) Williams (OH)	*Elaeagnus umbellata*	Autumn Olive	Openland
	Rhamnus frangula	Buckthorn, Glossy	Wetland, Openland
	Rhamnus cathartica	Buckthorn, Common	Wetland, Openland
	Phragmites australis	Common Reed Grass	Wetland
	Alliaria petiolata	Garlic Mustard	Forest
	Lonicera japonica	Japanese Honeysuckle	Forest
	Polygonum cuspidatum	Japanese Knotweed	Forest
	Rosa multiflora	Multiflora Rose	Forest, Openland
	Lythrum salicaria	Purple Loosestrife	Wetland
	Phalaris arundinacea	Reed Canary Grass	Wetland
DeKalb and Steuben (IN)	*Sorghum almum*	Columbus Grass	Openland
	Lysimachia nummularia	Creeping Jenny	Forest, Wetland
	Securigera varia	Crown Vetch	Openland
	Potamogeton crispus	Curly-Leaf Pondweed	Wetland
	Hesperis matronalis	Dame's Rocket	Forest, Openland
	Sorghum halepense	Johnsongrass	Openland
	Acer platanoides	Norway Maple	Forest
	Celastrus orbiculatus	Oriental Bittersweet	Forest
	Littorina littorea	Periwinkle	Forest
	Ligustrum obtusifolium	Privet	Forest

COUNTY	SPECIES	COMMON NAME	HABITAT
	Euonymus fortunei	Purple Winter Creeper	Forest
	Sorghum bicolor	Shattercane	Openland
	Ulmus pumila	Siberian Elm	Forest
	Bromus inermis	Smooth Brome	Forest, Openland
	Melilotus officinalis	Sweet Clover	Openland
	Festuca arundinacea	Tall Fescue	Openland
	Morus alba	White Mulberry	Openland
DeKalb & Steuben (IN), Hillsdale & Branch (MI)	*Robinia pseudoacacia*	Black Locust	Openland
	Ailanthus altissima	Tree of Heaven	Forest
	Cirsium arvense	Canada Thistle	Openland
	Myriophyllum spicatum	Eurasian Watermilfoil	Wetland
Fish			
Hillsdale and Branch (MI)	*Lepomis microlophus*	Redear sunfish	Fresh Water
	Cyprinus carpio	Common carp	Fresh Water
Mussels			
Branch and Hillsdale (MI) Steuben (IN)	*Dreissena polymorpha*	zebra mussel	Fresh Water

2.11 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 predominate land use in the USJRW is agriculture due to the fertile soils, much of which use to be wetlands as can be seen by the amount of hydric soil present within the watershed (Figure 2.4, page 15). 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 to prevent crop land from becoming over saturated as can be seen in Figure 2.5 on page 21. 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. For these reasons best management practices should be implemented on agricultural land with hydric soils.

Many of the soils in the USJRW are considered to be HEL or PHEL as can be seen in Figure 2.3 on page 13. For this reason, it is important that special precautions 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 USJRW is agriculture, specifically row crops, sedimentation can have a major effect on water quality and biota. Tillage data collected by each county in the watershed (with the exception of those located in Michigan) indicates relatively low adoption of conservation tillage practices, especially with corn. It is also clear from Table 2.7 on page 28 that the number of acres that qualify as no-till has declined 7% for corn and 30% for beans between 2006 and 2012, likely a result of the rising commodity prices. Conservation tillage requires a minimum of 30% residue cover on the land. This 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.

There are 13 populated areas in the watershed that are currently served by a centralized sewer system, though much of the watershed 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 much of the project area, the estimates that were provided clearly identifies failing septic systems are a true issue in the watershed. The USDA soil survey for Williams, DeKalb, Steuben, Branch, and Hillsdale counties lists less than 3% of the soil in the project area as being suitable for on-site sewage treatment as can be seen in Figure 2.5 on page 17. These two facts may lead one to believe that bacteria contamination, and excessive nutrients found within the water system may be partly due to improperly sited septic systems and/or failing systems.

The entire population of the USJRW acquires their drinking water from the MICHINDOH aquifer which lies under the entire Upper St. Joseph River Watershed, as can be seen in Figure 2.10 on page 25. Field tiles and improperly placed or faulty septic systems can seriously affect the integrity of the aquifer to be used for drinking water as the contaminated effluent may not be entirely filtered as it percolates through the soil. For this reason, special precautions must be taken to ensure that the watershed's population's drinking water source is 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. However, 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 letting that landscape return to forest or wetland will provide more vital habitat for those endangered and threatened species. The DeKalb County Unified Development Ordinance has provisions made for the preservation of key forest land and not disturbing significant natural resources.

Table 2.18, 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 10 digit HUC level.

Table 2.18: Stakeholder Concerns and Evidence for Concerns

Concern	Evidence	Potential Problem
Sediment Runoff from Agriculture Land	43% of the landuse in the watershed is for cultivated crops and 46% of the soils in the watershed are considered either HEL or PHEL. The 2012 tillage transect for the watershed in IN and OH revealed that conservation tillage is on the decline and with a lower adoption rate for corn than beans. Also, several studies in the watershed revealed that sedimentation of the lakes and streams is a major impairment.	Sedimentation, turbidity, and impaired biotic community
Sediment Runoff from Urban Areas	3% of the watershed is developed with a population of greater than 10,000 people. The major interstate system/toll road runs through the watershed which will contribute sediment from road runoff. Many studies have been conducted in the past focusing on sediment Including several County and Town Master or Comprehensive Plans which focus on preventing sediment runoff.	Sedimentation, turbidity, and impaired biotic community
Runoff from CAFOs and other small scale animal operations	There are four large scale CFOs located in the watershed, two of which are classified as CAFOs. The livestock inventory conducted in 2009 found 1,218 locations where total of 31,386 head of livestock are housed. The livestock inventory also noted 15 locations where livestock had direct access to open water and 13 locations where there was direct discharge from the barnyard to open water.	*E. coli*, sediment, nutrients, impaired biotic community
Leaking, failed, or straight pipe septic systems	While estimations of leaking or failed septic systems was not obtained from Steuben, Hillsdale, or Branch County, Williams and DeKalb County Health Departments estimate that nearly half of all systems are currently failing. The bacteria source tracking investigation in 2003 revealed that 5% of the bacteria found at four different sample sites was from humans, though the test results are not verifiable.	*E. coli*, sediment, nutrients, impaired biotic community
Log Jams	There is no evidence of log jams in the Upper St. Joseph River at this point, however the St. Joseph River is known to be a slow flowing river system which often contributes to the formation of log jams.	Sedimentation, soil erosion, and flooding

Concern	Evidence	Potential Problem
Excessive nutrients and bacteria in the lakes	The bacteria source tracking study in 2003 tested sites in three of the subwatersheds and found bacteria from geese, humans, horses, livestock, and pets. Nearly 50% of the septic systems in DeKalb and Williams counties are known to be failing.	Turbidity, *E. coli*, and nutrients, impaired biotic community
Lake residents and urban landowners using lawn fertilizer	There are nearly 10,000 residents living in the Incorporated areas of the watershed as well as 7 built-up lakes and 3 developing lakes located in the watershed.	Nutrients, excessive aquatic plant growth, and impaired biotic community
Stream Bank Erosion	The RWA performed in 2006 ranked Nettle Creek as being in poor condition partially as a result of low frequency of buffers along streambanks. 46% of the soils in the watershed are classified as either HEL or PHEL. Several studies performed in the past mention stream bank erosion and sedimentation as a major issue in the project area. 51% of parcels have a buffer less than 10 feet in width and 64% of parcels have a buffer width of less than 60 feet.	Sedimentation, turbidity, and impaired biotic community
Improper Construction Site Management	There are nine Incorporated areas located in the watershed where there is the potential for additional growth and development. There are also three lakes that currently being developed with mostly residential houses.	Sedimentation, turbidity, and impaired biotic community
Wetland Preservation and Protection	Hydric soils make up 67% of the watershed's soils, which are prime soils for wetland placement. The watershed has lost nearly 80% of its historic wetlands as only 16% of the watershed land is covered by wetlands currently.	Flooding, and impaired biotic community
Invasive species	Many previous studies found milkweed, purple loosestrife and Eurasian Waterfoil in the lakes of the project area.	Impaired biotic community
Illegal Dump Sites	None found	impaired biotic community, heavy metals, nutrients, household contaminants

Concern	Evidence	Potential Problem
Livestock Access to Open Water	The 2009 livestock inventory noted 15 locations where livestock had direct access to open water. The bacteria source tracking study found livestock was the second largest contributor to bacteria in the water and that on average from four sample sites 13% of the samples collected had bacteria from livestock.	Sedimentation, Turbidity, impaired biotic community, *E. coli*
Industrial Discharge	There are 16 NPDES permitted facilities located in the watershed which have had a total of 39 effluent exceedances over the past three years.	Sedimentation, Turbidity, impaired biotic community, nutrients, heavy metals
Lack of Education Regarding Best Management Practices	It is a goal or objective to Increase the public's awareness of BMPs in most of the previous WMPs, comprehensive/master plans, strategic plans, and unified development plans that have been written for portions of the project area. There is no specific evidence at this point to provide evidence for this stakeholder concern.	Lack of installation of best management practices to reduce NPS runoff
Lack of Consistent Funding for Conservation Agencies	Federal, State, and Local governments have been cutting funding for environmental conservation over the past decade.	Lack of installation of best management practices to reduce NPS runoff

3.0 Watershed Inventory by Subwatershed

3.1 Water Quality Data

An important aspect of the watershed planning process is to examine current water quality data as well as historic data to understand the issues present in the watershed. The historic data, some of which has been collected since as early as 1993 will provide a baseline in which to compare the data collected by the Initiative in 2012. The historical data of consequence was combined with the watershed assessment that was done as part of this project to characterize water quality problems and their sources and tie them to stakeholder concerns. The following sections will provide a detailed description of all water quality data that has been collected in the watershed to date.

3.1.1 Water Quality Parameters

After a report entitled *Weed Killers by the Glass*, published by the Environmental Working Group in 1995 stated that Fort Wayne's drinking water contained high levels of agricultural pesticides, the Initiative began its water quality sampling program in the St. Joseph River watershed. As the program progressed, more parameters were added to the Initiative's analysis of water quality. The parameters that are sampled include atrazine, alachlor, metolachlor, dissolved oxygen, *E. coli*, turbidity, total dissolved solids, phosphorus, nitrite + nitrate, stream flow, and water temperature. The Initiative also is interested in determining the Qualitative Habitat Evaluation Index (QHEI) and the macroinvertebrate Index of Biotic Integrity (mIBI). Provided below is a description of why each of those parameters are important to the quality of water.

Ammonia - Ammonia is common in the water system as it is released in the waste of living mammals. It is also released in to the water system via farmland runoff as ammonium hydroxide is used as a fertilizer for row crops. Ammonia is important to measure for two reasons: the free form of ammonia, NH_3, is toxic to fish and can lower reproduction and growth of aquatic organisms, or even result in death, and the nitrification of ammonia removes dissolved oxygen from the water. Measuring the amount of ammonia in the water is also a good indicator for other pollutants that may be reaching the water as well. Due to the toxic nature of too much ammonia in the water, the state of Indiana has set a standard of between 0 and 0.21 mg/L, dependent on temperature.

Atrazine - Atrazine is one of the worlds most used pesticides by row crop producers to control weeds. Atrazine is a highly soluble chemical that is not easily broken down in the water table. It has been shown that high levels of atrazine can cause some aquatic animals to become sterile, hermaphroditic, or even convert males to females. There is still debate in the scientific world as to whether or not atrazine can cause cancer in humans. But people who consume water containing high levels of atrazine over an extended period of time have been noted as presenting with cardio vascular problems. For these reasons the US EPA has set the Maximum Contaminant Level (MCL) for atrazine at 3ppb.

Alachlor - Alachlor is an herbicide used predominantly on corn, sorghum, and soybeans to control annual grasses and broadleaf weeds. Alachlor is used regularly by producers within the St. Joseph River watershed. It has been shown that people drinking water containing excessive amount of Alachlor may present with eye, liver, kidney, or spleen problems. They may also experience anemia and an increased risk of getting cancer. For these reasons the US EPA has set the MCL for Alachlor to be 2 ppb.

Metolachlor - Metolachlor is a pre-emergent grass weed herbicide that is effective on corn, soybeans, sorghum, peanuts, and cotton fields. While the product is very effective, its use is on the decline due to the deleterious effects it may have on organisms. Metolachlor has been shown to be a cytotoxin (toxic to cells) and a genotoxin (a toxic substance that damages DNA). The US EPA gave metolachlor a category C rating meaning that there is limited evidence showing it to be a carcinogen. However, the US EPA has given metolachlor a health advisory level of 52.5 ppb in drinking water. The Initiative uses the target of 50 ppb which is the Canadian drinking water standard for Metolachlor.

Dissolved Oxygen - Dissolved oxygen (DO) is the measure of oxygen in the water available for uptake by aquatic life. Typically, streams with a DO level greater than 8 mg/L are considered very healthy and streams with DO levels less than 2 mg/L are very unhealthy as there is not enough oxygen to supply to aquatic life. DO is affected by many factors Including; temperature - the warmer the water the harder it is for oxygen to dissolve, flow –more oxygen can enter a stream where the water is moving faster and turning more, and aquatic plants – an influx of plant growth will use more oxygen than normal which does not leave enough available DO for other aquatic life, however photosynthesis will add oxygen to the water during the day. Thus, DO levels may change frequently when there is excessive aquatic plant growth. Excessive amounts of suspended or dissolved solids will decrease the amount of DO in the water. The state of Indiana has set a standard of at least an average of 5 mg/L per calendar day, but not less than 4 mg/L of DO for warm water streams. The US EPA recommends that DO not exceed 9 mg/L so as to avoid super-saturation of DO in the water system.

Temperature - As mentioned above, temperature can affect many aspects of the health of the water system. Water temperature is a controlling factor for aquatic organisms. If there are too many swings in water temperature, metabolic activities of aquatic organisms may slow, speed up, or even stop. Many things can affect water temperature Including stream canopy, dams, and industrial discharges. The state of Indiana has set a standard for water temperature (which may be found in 327 IAC 2-1-6) depending on if the waterbody is a cold or warm water system. All of the streams in the project area are considered warm water streams.

Escherichia coli - *E. coli* is a bacteria found in all animal and human waste. *E. coli* testing is used as an indicator of fecal contamination in the water. While not all *E. coli* is harmful, there are certain strains that can cause serious illness in humans. *E. coli* may be present in the water system due to faulty septic systems, CSO overflows, wildlife; particularly geese, and from contaminated stormwater runoff from animal feeding operations. Due to the serious health risks from certain forms of *E. coli*, and other bacteria that may be present in water, the state of Indiana has developed the full body contact standard of less than 235 CFU/100 ml of *E. coli* in any one water sample and less than 125 CFU/100 ml for the geometric mean of five equally spaced samples over a 30 day period.Total Kjeldahl Nitrogen - TKN is the sum of organic nitrogen, ammonia, and ammonium. High levels of TKN found in water is typically indicative of manure runoff from farmland or sludge discharging to the water from failing or inadequate septic systems. The level of TKN in the water is a good indicator of other pollutants that may be reaching the water. The US EPA recommends a target level not to exceed 0.076 mg/L.

Turbidity -Turbidity is the measure of the cloudiness of the water which may be caused by sediment or an overgrowth of aquatic plants or animals. High levels of turbidity can block out essential sunlight for submerged plants and animals and may raise water temperatures, which then can decrease DO. Sediment in the water causing it to be turbid can clog fish gills and smother nests when it settles, thus effecting the overall health of the aquatic biota. Turbid water may be caused from farm field erosion, feedlot or urban stormwater runoff, eroding stream banks, and excessive aquatic plant growth. The US EPA recommends that the turbidity in the water measure less than 10.4 NTUs.

pH - pH is the measure of a substances acidity or alkalinity and is an important factor in the health of a water system because if a stream is too acidic or basic it will affect the aquatic organisms' biological functions. A healthy stream typically has a pH between 6 and 9, depending on soil type and substances that come from dissolved bedrock. pH can also change the waters chemistry. For example, a higher pH means that a smaller amount of ammonia in the water may make it harmful to aquatic organisms and a lower pH may Increase the amount of metal present in the water as it will not dissolve as easily. For these reasons, the state of Indiana has set a standard for pH of between 6 and 9.

Total Suspended Solids - Total suspended solids (TSS) is a measure of organic and inorganic particulate matter in a water sample. TSS is measured by passing a water sample through a series of sieves of differing sizes, drying the particulate, and weighing the dried matter. The amount of Total Suspended Solids (TSS) in the water system will have the same type of deleterious effect on water quality as mentioned above under turbidity including, debilitating aquatic habitat and life, and carrying other pollutants to the water such as fertilizers and pathogens. The Michigan state standard for TSS is equal to or less than 20 mg/L to maintain a healthy aquatic ecosystem.

Total Dissolved Solids - Total dissolved solids are all dissolved organic or inorganic molecules that are found in the water. The difference between TDS and TSS is that TSS cannot pass through a sieve of 2 micrometers or smaller. So, the lower the TDS measurement in the water sample the purer the water is. TDS is a measurement of any pollutant in the water Including salt, metal, and other minerals. The IN state code has a standard of <750 mg/L to maintain a healthy aquatic ecosystem.

Phosphorus - Phosphorus is an essential nutrient for aquatic plants however, too much phosphorus can create an over growth of bacteria which can lower the DO in a water system and decrease the amount of light that penetrates the surface thus killing other aquatic life that depends on these for survival. Some types of bacteria that thrive when phosphorus levels are high, such as blue-green algae, are toxic when consumed by humans and wildlife. Excessive amounts of phosphorus have also been found in ground water thus increasing the bacteria growth in underground water systems. Phosphorus can reach surface and ground water through contaminated runoff from row crop fields, and urban lawns where fertilizer has been applied, animal feeding operations, faulty septic tanks, and the disposal of cleaning supplies containing phosphorus in landfills or down the drain. The state of Indiana has set a target of 0.3 mg/L of total phosphorus in a water sample to list a waterbody as impaired on the state's impaired water list as required by the CWA § 303(d), often referred to as the 303(d) list. The OEPA has set a standard of 0.08 mg/L in warm water headwater streams. The USJRW steering committee decided to use OEPA's target of 0.08 mg/L.

Dissolved Reactive Phosphorus (DRP)/Ortho-Phosphate – DRP is another form of phosphorus that is readily available for plant uptake once it reaches open water as it does not bind to soil particles. It is often considered the limiting factor to algae growth, which is a major concern throughout the natural resources world for the Upper Maumee River Watershed and Lake Erie. There has been an Increase in algal blooms in Lake Erie, as well as an Increase in DRP found throughout the WLEB. DRP can come from a variety of sources Including point source dischargers and non-point sources. The North Carolina State University recommends concentrations of DRP be less than 0.05 mg/L in water samples to maintain a viable aquatic ecosystem.

Nitrite - Nitrites are highly toxic to aquatic life and also toxic to humans, especially babies, if consumed in excessive amounts. Nitrites can cause shortness of breath and blue baby syndrome, which can lead to death in babies which is of great concern to those individuals who acquire their drinking water from wells. Nitrites are commonly found in the water system in trace amounts because nitrite is quickly oxidized to nitrate. However nitrites can be introduced in excessive amounts from sewage treatment plants if the oxidation process is interrupted, from farm field runoff, animal feeding lot runoff, and faulty septic systems. For the harmful health effects mentioned above, the state of Indiana adopted the US EPA MCL standard of less than 1 mg/L of nitrite in drinking water which is codified in 327 IAC 2-1-6.

Nitrate - Nitrates can have the same effect on the water system as phosphorus, only to a much lesser degree. Nitrates can be found at levels up to 30mg/L in some waters before detrimental effects on aquatic life occur. However, due to the fact that infants who consume water with nitrate levels exceeding the US EPA MCL of 10 mg/L can become ill, nitrates in drinking water should be of particular concern to people who use wells as their drinking water source. The most common sources of nitrates are from fertilizer runoff from row crop fields, faulty septic systems, and sewage. The USJRW steering committee and the Initiative decided to use the US EPA reference level for nitrates in the water system, which is set at 1.6 mg/L.

Macroinvertebrate Pollution Tolerance Index - The Macroinvertebrate Pollution Tolerance Index (mPTI) is used as an indicator of water quality. Macroinvertebrates are collected from the water system and classified down to the genus level. The number and type of macroinverbrates found show the overall health of the water as some macroinvertebrates can only survive when little to no contaminants are present. The USJRW steering committee and the Initiative set a target of the index ranking to be greater than 23 based on the Hoosier Riverwatch method of collecting and ranking samples. (>23= excellent, 17-22 = good, 11-16 = fair, <10 poor)

Qualitative Habitat Evaluation Index - The Qualitative Habitat Evaluation Index is another method used to determine the quality of a waterway. Various aspects of aquatic habitat are evaluated including in-stream habitat and the surrounding landuse, to determine the waterways ability to support aquatic life such as fish and macroinvertebrates. A score greater than 60 is considered to be a stream that is adequate for general good aquatic health based on the Hoosier Riverwatch method of collecting and ranking samples. (>100=excellent, >60=adequate)

3.1.2 Water Quality Targets

When the above parameters are combined a greater picture of the overall quality of the watershed can be gleaned. For the purpose of interpreting inventory data and defining problems, target values were identified for water quality parameters of concern by the USJRW steering committee (Table 3.1.1). It is important to note that the same parameters were not analyzed by each entity that collected water quality samples.

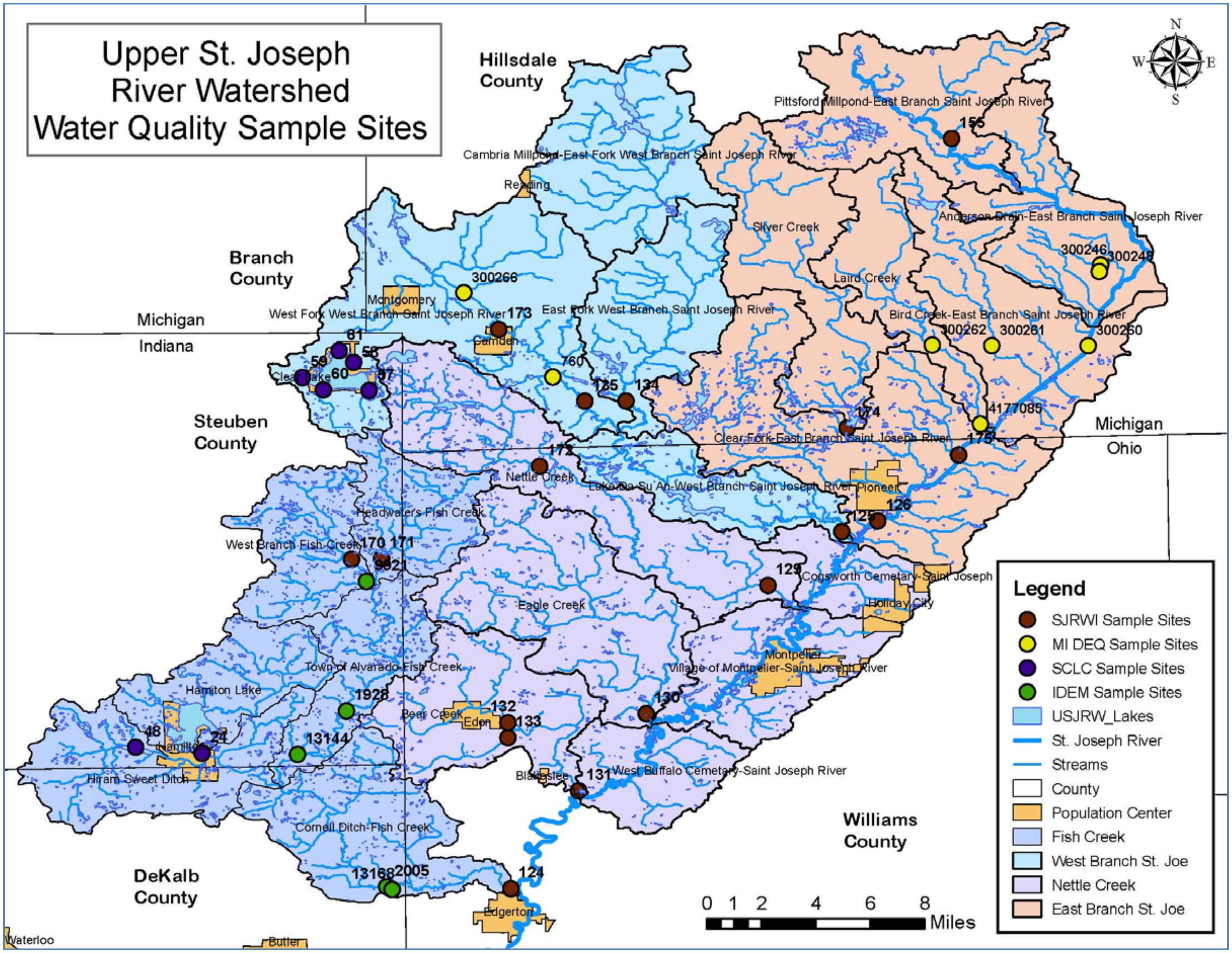
Table 3.1.1: Water Quality Targets

Parameter	Target	Source
Atrazine	< 3.0 ppb	US EPA drinking water MCL
Alachlor	< 2 ppb	US EPA drinking water MCL
Metolachlor	< 50 ppb	Canadian drinking water std
Dissolved Oxygen	>5mg/L but not < 4 mg/L and not > 9 mg/L (EPA recommendation)	327 IAC 2-1-6
Temperature	4.44 - 29.44 degrees C	327 IAC 2-1-6
Escherichia Coli	< 235 CFU/100 ml per single sample or 125 CFU/100ml geomean per 5 equally spaced samples over a 30 day period	327 IAC 2-1.5-8
Turbidity	< 10.4 NTU	US EPA recommendation (2000)
pH	> 6 and < 9	327 IAC 2-1-6
Total Suspended Solids	< 20 mg/L	Rule 50 of MI Water Quality Standards (Part 4 of Act 451)
Total Dissolved Solids	< 750 mg/L	327 IAC 2-1-6
Total Phosphorus	< 0.08 mg/L	Ohio State Standard
Ortho-Phosphate	< 0.05 mg/L	North Carolina State University Recommendation
Total Ammonia	< 0.21 mg/L depending on temperature	327 IAC 2-1-6
Total Kjeldahl Nitrogen (TKN)	<0.076 mg/L	US EPA Recommendation (2000)
Nitrite	< 1 mg/L	327 IAC 2-1-6
Nitrate + Nitrite	< 1.6 mg/L	US EPA reference level (2000)
Macroinvertebrates	>23 (Excellent)	Hoosier Riverwatch
Qualitative Habitat Evaluation	>60 (Adequate for General Good Health)	Hoosier Riverwatch

3.2 Historic Water Quality Sampling Efforts

A variety of water quality assessment projects have been completed within the USJRW. These Include the Indiana, Michigan, and Ohio Integrated Reports, the IDEM Watershed Assessment and Planning Branch studies, MI DEQ studies, water quality analysis by the Steuben County Lakes Council, and the Initiative's sampling program. A summary of each study's methodology and general results are discussed below. Subsequent sections detail specific study information as it relates to each HUC 10 subwatershed. Figure 3.1 displays all the historic sampling locations in the project area.

Figure 3.1: Water Quality Sample Sites in the Upper St. Joseph River Watershed



3.2.1 State Water Quality Integrated Reports

Each state is required to perform water quality analysis of its surface waters and report their findings to EPA in a report called the "Integrated Report" (IR) on a biannual basis, as mandated by the CWA§305(b). Prior to compiling the IR, a list of water bodies that do not meet state standards is developed as mandated by the Clean Water Act section 303(d). This has become commonly known as the 303(d) list. Many stream segments located within the USJRW are listed on the 2012 IDEM 303(d) list of impaired waters for *E. coli,* impaired biotic community, nutrients, and PCBs in fish tissue. IDEM's 2012 IR can be found at http://www.in.gov/idem/nps/2639.htm. Ohio's 2012 IR has also been approved by the US EPA and shows that the entire portion of the USJRW project area located within Ohio is impaired. The OEPA's Integrated Report can be found at http://www.epa.ohio.gov/dsw/tmdl/ohiointegratedreport.aspx. There are no water quality impairments in the portion of the USJRW located in Michigan. All waters located within MI are either fully supporting of their designated use, were not assessed or have insufficient information. The MI DEQ's Integrated Report can be found at http://www.michigan.gov/deqwater and the comprehensive list of assessment unit designated use support for the USJRW can be found in Appendix B2 at https://www.michigan.gov/documents/deq/wrd-swas-2012IR-appB2_370330_7.pdf, pages B-2869 through B-2894. A full list of those waters impaired, as designated by Indiana and Ohio, can be found in Table 3.2.1, and Table 3.2.2, and a map of those listed waters can be seen in Figure 3.2.

As part of the IDEM monitoring process, water samples are analyzed for numerous substances. Those relative to this WMP Include: nitrogen as ammonia, nitrate+nitrite, total phosphorus, TKN, pH, TDS, TSS, DO, turbidity, temperature, and *E. coli*. In addition to water chemistry data, IDEM utilizes the Probabilistic Monitoring Program to analyze fish and benthic aquatic macroinvertebrate community data to make habitat evaluations.

Data collected by IDEM since 2003 was analyzed and sorted for the purpose of this project.

Ohio EPA has not collected water quality data for the 303(d) list of impaired waters within the Upper St. Joseph River Watershed since 1997. Therefore, the data is considered to be too historic to be of use to this project.

Table 3.2.1: IDEMs 2012 Consolidated list of Impaired Waters in the Upper St. Joseph River Watershed

Assessment Unit	Assessment Unit Name	Recreation	Human Health /Fish Tissue	Aquatic Life Use	*E. coli*	IBC	Fish Tissue (PCBs)	Phosphorus	Fish Tissue (Hg)
INA0321_00	NETTLE CREEK	3	3	3					
INA0322_00	UNNAMED TRIBUTARY - HEADWATERS (MI)	3	3	3					
INA0322_01	CLEAR LAKE - UNNAMED INLET THROUGH ROUND LAKE	3	3	3					
INA0332_00	NETTLE CREEK - MILL STREAM DRAIN	3	3	3					
INA0336_00	BEAR CREEK AND TRIBUTARY	3	3	3					
INA0351_00	FISH CREEK TRIBS	3	3	3					
INA0351_T1064	FISH CREEK AND TRIBS	5A	3	2	5A				
INA0352_00	WEST BRANCH FISH CREEK TRIBS	3	3	3					
INA0352_01	FISH CREEK, WEST BRANCH	5A	3	5A	5A	5A			
INA0352_T1001	FISH CREEK, WEST BRANCH - UNNAMED TRIBUTARY	3	3	2					
INA0352_T1002	HANSELMAN BRANCH	3	3	2					

Assessment Unit	Assessment Unit Name	Recreation	Human Health /Fish Tissue	Aquatic Life Use	*E. coli*	IBC	Fish Tissue (PCBs)	Phosphorus	Fish Tissue (Hg)
INA0352_T1003	FISH CREEK, WEST BRANCH - UNNAMED TRIBUTARY	3	3	2					
INA0352_T1004	FISH CREEK, WEST BRANCH - UNNAMED TRIBUTARY	3	3	2					
INA0353_01	FISH CREEK	5A	3	2	5A				
INA0353_T1001	FISH CREEK - UNNAMED TRIBUTARY	3	3	2					
INA0353_T1002	FISH CREEK - UNNAMED TRIBUTARY	3	3	2					
INA0353_T1003	FISH CREEK - UNNAMED TRIBUTARY (OHIO)	3	3	2					
INA0353_T1004	FISH CREEK - UNNAMED TRIBUTARY	3	3	2					
INA0353_T1005	FISH CREEK - UNNAMED TRIBUTARY	3	3	2					
INA0354_00	BLACK CREEK AND TRIBUTARIES	3	3	3					

Assessment Unit	Assessment Unit Name	Recreation	Human Health /Fish Tissue	Aquatic Life Use	*E. coli*	IBC	Fish Tissue (PCBs)	Phosphorus	Fish Tissue (Hg)
INA0354_T1066	BLACK CREEK TRIB	3	3	2					
INA0354_T1076	BLACK CREEK	3	3	2					
INA03P1001_00	ANNE, LAKE	3	3	3					
INA03P1002_00	CLEAR LAKE	2	5B	2			5B		5B
INA03P1003_00	ROUND LAKE	3	3	3					
INA03P1004_00	MUD LAKE	3	3	3					
INA03P1006_00	LONG LAKE	3	3	3					
INA03P1007_00	MIRROR LAKE	3	3	3					
INA03P1008_00	HANDY LAKE	3	3	3					
INA03P1010_00	ROUND LAKE	3	3	3					
INA03P1011_00	HAMILTON LAKE	5A	5B	3			5B	5A	
INA03P1012_00	PERFECT LAKE	3	3	3					
INA03P1013_00	BALL LAKE	3	2	3					

Assessment Unit	Assessment Unit Name	Recreation	Human Health /Fish Tissue	Aquatic Life Use	*E. coli*	IBC	Fish Tissue (PCBs)	Phosphorus	Fish Tissue (Hg)
INA03P1014_00	TERRY LAKE	3	3	3					
INA03P1016_00	JACKSON LAKE	3	3	3					
INA0355_00	FISH CREEK-MYERS DITCH	3	3	2					
INA0355_T1071	HERMAN SWEET DITCH TRIB	2	3	3					
INA0355_T1072	HERMAN SWEET DITCH	5A	3	3	5A				
INA0356_01	FISH CREEK	5A	3	5A	5A	5A			
INA0356_02	CORNELL DITCH (OHIO)	3	3	3					
INA0356_T1001	FISH CREEK - UNNAMED TRIBUTARY	3	3	3					
INA0356_T1002	FISH CREEK - UNNAMED TRIBUTARY	3	3	3					
INA0356_T1003	FISH CREEK - UNNAMED TRIBUTARIES	3	3	5A		5A			
INA0356_T1004	FISH CREEK - UNNAMED TRIBUTARY (OHIO)	3	3	3					

Assessment Unit	Assessment Unit Name	Recreation	Human Health /Fish Tissue	Aquatic Life Use	*E. coli*	IBC	Fish Tissue (PCBs)	Phosphorus	Fish Tissue (Hg)
INA0356_T1005	FISH CREEK - UNNAMED TRIBUTARY	3	3	3					
INA0356_T1006	FISH CREEK - UNNAMED TRIBUTARY (ARTIC, IN)	3	3	3					

Category Description		Sub-Category
Category 1	Water Quality attainment for all designated uses and no use is threatened.	
Category 2	Water Quality attainment for some designated uses and no use is threatened; and insufficient data and information are available to determine if the remaining uses are attained or threatened.	
Category 3	Insufficient data and information are available to determine if any designated use is attained.	
Category 4	Waterway is impaired or threatened for one or more designated uses but does not require the development of a TMDL.	
	A TMDL has been completed that will result in the attainment of all applicable water quality standards.	A
	Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard.	B
	Impairment is not caused by a pollutant for which a TMDL can be calculated.	C
Category 5	The Water quality standard in not attained. Waters may be listed in both 5A and 5B depending on the parameters causing the impairment.	
	The waters are impaired or threatened for one or more designated uses by a pollutant(s) and require a TMDL(s).	A
	The waterbody AU is impaired due to the presence of mercury or PCBs, or both in the edible tissue of fish collected from them at levels exceeding Indiana's human health criteria for these contaminants. The state believes that a conventional TMDL is not the appropriate approach to address these pollutants.	B

Table 3.2.2: OEPAs 2012 303(d) list of Impaired Waters in the Upper St. Joseph River Watershed

Assessment Unit	Assessment Unit Name	Assessment Unit Size (Sq. Mi.)	Aquatic Life	Aquatic Life Uses	Recreation	Drinking Water Supply	Human Health/ Fish Tissue	Next Field Monitoring	Projected TMDL
41000030104	Bird Creek-East Branch	29.6	3x	WWH	3	N/A	3	2013	2016
41000030106	Clear Fork-East Branch	50	3x	WWH	3	N/A	5h (PCBs, Hg)	2013	2016
41000030204	Lake La Su An – West Branch	16.3	3x	WWH	3	N/A	1	2013	2016
41000030301	Nettle Creek	36.4	5hx*	WWH, MWH-C,LRW	3	N/A	1	2013	2016
41000030302	Cogswell Cemetery-St. Joe	9.8	5hx*	WWH, MWH-C, LRW	3	N/A	5h	2013	2016
41000030303	Eagle Creek	35	5hx*	WWH, MWH-C, LRW	3	N/A	5h	2013	2016
41000030304	Village of Montpelier-St. Joe	20.8	5hx*	WWH, MWH-C, LRW	3	N/A	5h	2013	2016
41000030305	Bear Creek	24.5	5hx*	WWH, MWH-C, LRW	3	N/A	5h	2013	2016
41000030306	West Buffalo Cemetery-St. Joe	13.7	5hx*	WWH, MWH-C, LRW	3	N/A	5h	2013	2016
41000030402	Headwaters Fish Creek	13.9	5h**	WWH	3	N/A	3	2013	2016

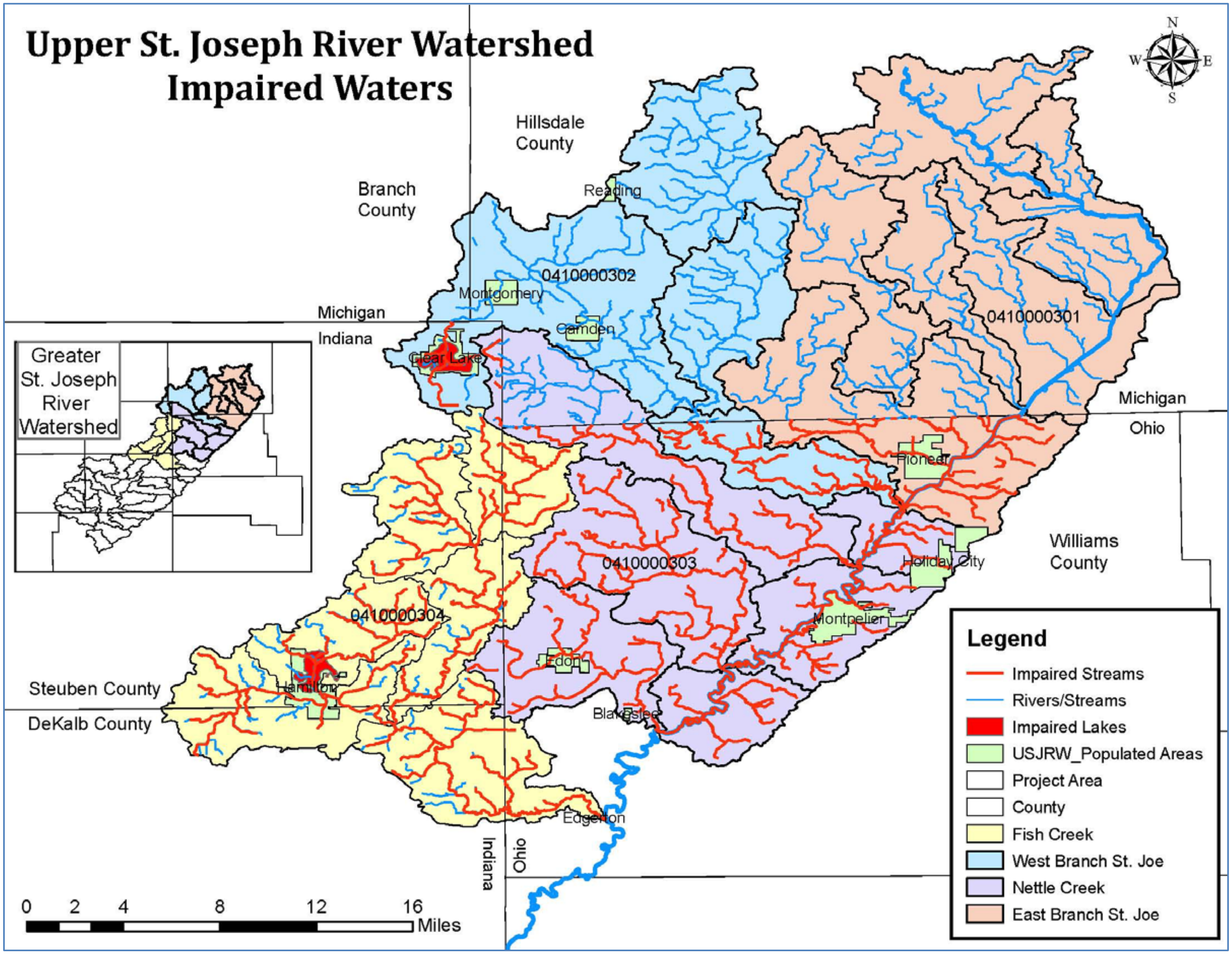
Assessment Unit	Assessment Unit Name	Assessment Unit Size (Sq. Mi.)	Aquatic Life	Aquatic Life Uses	Recreation	Drinking Water Supply	Human Health/ Fish Tissue	Next Field Monitoring	Projected TMDL
41000030405	Town of Alvarado - Fish Creek	16.1	3	Unknown	3	N/A	3	2013	2016
41000030406	Corenell Ditch-Fish Creek	24.7	5***	WWH	3	N/A	3	2013	2016

Category Description		Sub-Category	
Category 0	No waters currently utilized for water supply		
Category 1	Use attaining	h	Historical data
		x	Retained from 2010 IR
Category 2	Not applicable in new (2010) Ohio system		
Category3	Use attainment unknown	h	Historical data
		i	Insufficient data
		x	Retained from 2010 IR
Category 4	Impaired; TMDL not needed	A	TMDL complete
		B	Other required control measures will result in attainment of use
		C	Not a pollutant
		h	Historical data
		n	Natural causes and sources
		t	Category 4A may not tell the "whole story"
		x	Retained from 2010 IR
Category 5	Impaired; TMDL needed	M	Mercury
		h	Historical data
		x	Retained from 2010 IR

WWH = Warmwater Habitat; MWH-C=Modified Warmwater Habitat - Channelized, LRW=Limited Resource Water

Non-attainment due to- *Habitat Alteration, **Habitat Alteration and Nutrients, ***Sedimentation

Figure 3.2: Impaired Waters in the Upper St. Joseph River Watershed



3.2.2 Fish Consumption Advisory (FCA)

The Indiana Department of Environmental Management, the Indiana Department of Natural Resources and the Indiana Department of Health have worked together since 1972 on a collaborative effort to compile the Indiana Fish consumption advisory. The Ohio Department of Health works in cooperation with Ohio EPA and the Ohio Department of Natural Resources to issue sport fish consumption advisories annually. The fish consumption advisory in Michigan is issued by the Michigan Department of Community Health (MDCH) annually. It is important to note that a fish advisory on a body of water does not necessarily mean that the water is unsafe for other recreational activities.

Carp greater than 15 Inches and Walleye greater than 26 Inches are on the Do Not Consume list for all counties and water bodies located within Indiana. There are FCAs for several species of fish that can be found in the USJRW. Go to the Indiana State Department of Health's website for more information on Indiana's FCA. (http://www.in.gov/isdh/23650.htm). The Ohio Fish Consumption Advisory only has one listing specific for the USJRW in Lake La Su An, there is however general advisories for all waters in Ohio. Go to http://www.epa.state.oh.us/dsw/fishadvisory/index.aspx, for more information. There are no fish specifically designated as unsafe in the USJRW from the MDCH though there are several fish on a general advisory for all inland lakes, ponds, and impoundments. Visit www.michigan.gov/eatsafefish for more information regarding the Michigan FCA. Table 3.4 lists all species of fish that are on the Michigan, Indiana and Ohio FCA for the St. Joseph River.

Table 3.2.3: Fish Consumption Advisory in the Upper St. Joseph River Watershed

State	Fish Species	Size Limit	Frequency for Safe Consumption: Woman of Childbearing age, Nursing Moms, and Children <15 yrs	Frequency for Safe Consumption: General Population
Ohio	Channel Catfish	-	1X Month	
	All Fish from Ohio Waterbody	-	1X / Week unless there is a specific advisory.	
	Sport Fish from Ohio Waterbody	-		
	Largemouth Bass (Lake La Su An)	-	1X/ Month	
Indiana	Black Bass	-	1X / Month	1X / Week
	Channel Catfish	-	1X / Month	1X / Week
	Flathead Catfish	<38"	1X / Month	1X / Week
	Flathead Catfish	>38"	DO NOT EAT	1X / Month
	Sauger	<24"	1X / Month	1X / Week
	Sauger	>24"	DO NOT EAT	1X /Month
	Walleye	<24"	1X / Month	1X / Week
	Walleye	>24"	DO NOT EAT	1X /Month
	Northern Pike	-	1X /Month	1X / Week
	White Bass	-	1X / Month	1X / Week

State	Fish Species	Size Limit	Frequency for Safe Consumption	
			Woman of Childbearing age, Nursing Moms, and Children <15 yrs	General Population
	Striped Bass	<28"	1X / Month	1X / Week
	Striped Bass	>28"	DO NOT EAT	1X Month
	Rock Bass	-	1X / Month	1X / Week
Michigan	INLAND LAKES/ PONDS/ IMPOUNDMENTS			
	Rock Bass	> 9"	1X / Month	1X / Week
	Yellow Perch	>9"	1X / Month	1X / Week
	Crappie	>9"	1X / Month	1X / Week
	Largemouth Bass	>14"	1X / Month	1X / Week
	Smallmouth Bass	>14"	1X / Month	1X / Week
	Walleye	>14"	1X / Month	1X / Week
	Northern Pike	>22"	1X / Month	1X / Week
	Muskellunge	>30"	1X / Month	1X / Week

3.2.3 St. Joseph River Watershed Initiative Monitoring Protocol

As mentioned previously, the Initiative began its monitoring protocol after a report was released stating that the city of Fort Wayne's drinking water source was contaminated with pesticides. Since nearly 300,000 people in Fort Wayne and New Haven, Indiana acquire their drinking water from the St. Joseph River, the Initiative began monitoring the St. Joseph River and its tributaries in 1996 at 24 sites weekly through the recreational season of April through October. Indiana University-Purdue University Fort Wayne is contracted to pull the samples and deliver them to various labs for analysis. Seven of the Initiative's historic water quality monitoring sites are located in the USJRW.

The Initiative also performed water quality analysis during this project at ten additional sites located within the USJRW. The Initiative contracted Indiana University-Purdue University, Fort Wayne (IPFW) to perform water quality analysis at seventeen (17) sites total in the USJRW weekly from April through October of 2012. Parameters tested include atrazine, metolachlor, alachlor, *E. coli*, total coliform, total phosphorus, water temperature, pH, conductivity, TDS, D.O., turbidity, and nitrate+nitrites. Macroinvertebrate and habitat analysis at nine sites total in the USJRW was contracted to SNRT, Inc. Biological data was collected in October 2012 and were analyzed using the IN DNR Hoosier Riverwatch protocol. SNRT, Inc. was also contracted to collect flow rates at all 17 water quality sampling sites during base flow and again at high flow. Flow is collected with a portable Marsh McBirney Flo-Mate 2000. The water quality data collected by the Initiative will be presented in Section 3.3 under the respective subwatershed.

3.2.4 Steuben County Lakes Council

The Steuben County Lakes Council (SCLC) was formed over 40 years ago by lake residents throughout Steuben County who were concerned about the quality of the lakes they live on. Their mission is to educate the public about water quality and what they can do to improve the quality of the water they depend on. The SCLC began a water quality testing program in 2007 at some locations and over the years have expanded their sample sites to 65 different locations throughout the county. Seven of those sites are located within the USJRW. The SCLC has contracted the sampling, and analysis out to a local environmental consulting firm who tests for *E. coli*, total phosphorus, TSS, D.O. pH, and temperature. Data collected by the SCLC will be presented in the following section under the respective subwatershed.

3.2.5 MI Department of Environmental Quality

There is limited data available in the USJRW from the MI DEQ. Water quality samples were collected and analyzed from the West Branch and East Branch of the St. Joseph River Watershed once during 2004 or 2005. Samples were typically analyzed for nitrogen and phosphorus, except for the one site in Laird Creek subwatershed where pesticides and sediment were also analyzed.

The MI DEQ also did a two biosurveys in the USJRW Including one in 2003 at one site downstream of a CAFO in the West Branch, and one in 2010 at 11 sites in the West and East Branch St. Joseph subwatersheds. Results from water quality and biological analyses conducted by the MI DEQ will be discussed in the following section under each respective subwatershed.

3.3 Water Quality Data per Subwatershed

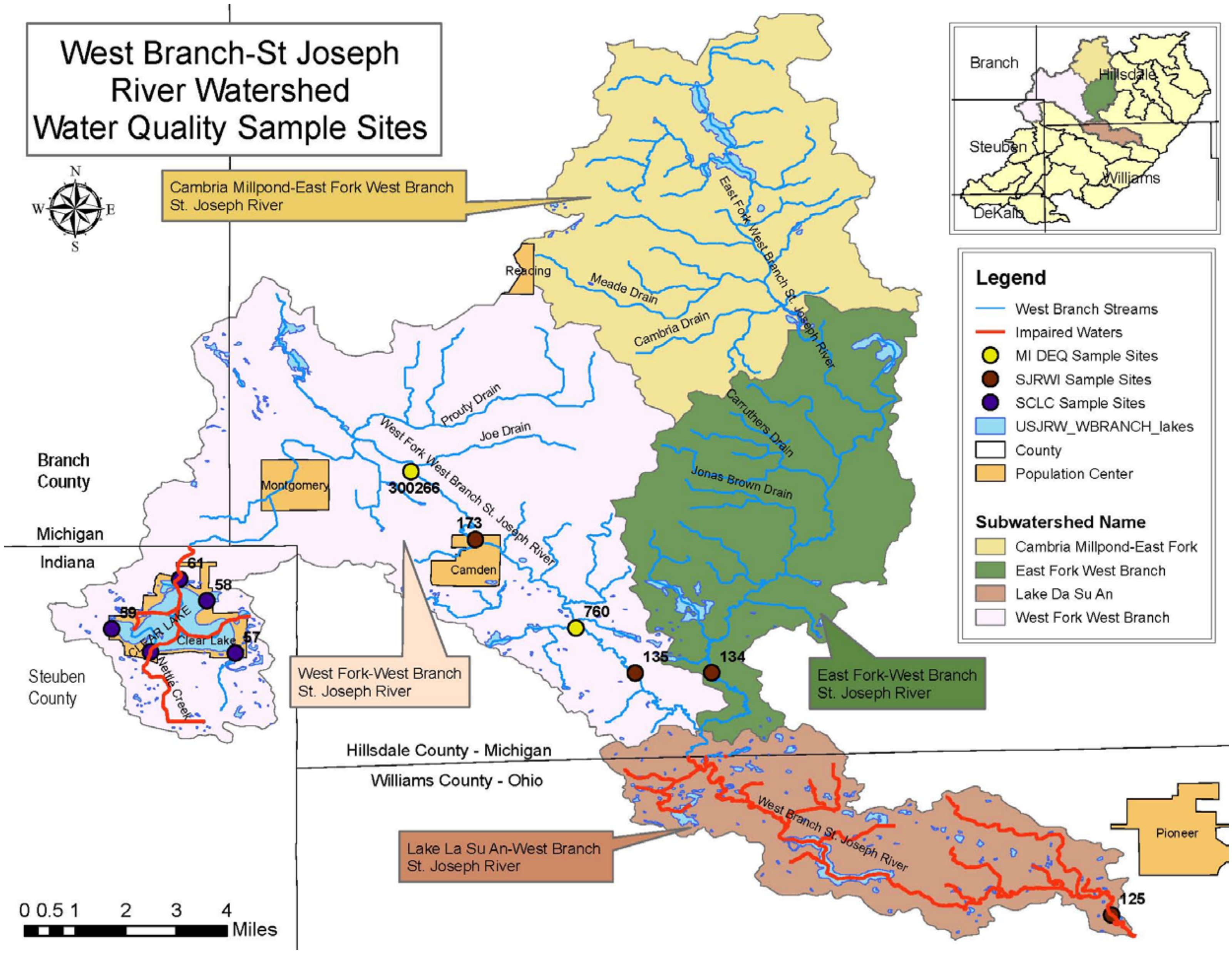
There are a total of 37 sample sites from one of the various organizations mentioned in Section 3.2 scattered throughout the Upper St. Joseph River Watershed, with several in each of the HUC 10 subwatersheds. Though, not all smaller HUC 12s were sampled. The following subsections will break down the water sampling by HUC 10, and note the specific subwatersheds where the sampling took place.

Some common trends found throughout the project area are that Atrazine has been found to exceed the MCLs in historic samples, though the frequency of exceedances of atrazine in samples has been on the decline over the past several years. It has also been found that phosphorus and turbidity levels in water samples commonly exceeded target levels throughout the watershed. Finally, biological and habitat data collected in 2012 is unexpectedly good when compared to the extreme turbidity levels found through the watershed.

3.3.1 West Branch St. Joseph River Watershed

There were a total of eleven sample sites in the West Branch-St. Joseph River subwatershed with samples reported by the MI DEQ, SCLC, and the Initiative. Figure 3.3 shows the location of all the sample sites in the West Branch – St. Joseph subwatershed. As you can see there are four HUC 12s located within the West Branch, however samples were only taken from three of the subwatersheds, with the majority of the samples taken from West Fork-West Branch subwatershed, and of those five sample sites were analyzed for the SCLC from tributaries of Clear Lake. The following subsections will review the analysis of the water samples from each of the subwatersheds.

Figure 3.3: Water Quality Sampling Sites in the West Branch-St. Joseph River Watershed



3.3.1.1West Fork-West Branch Subwatershed

As stated earlier, five samples were taken from tributaries of Clear Lake by the SCLC, it should be noted that Clear Lake is listed as impaired for mercury and PCBs in fish tissue. The MI DEQ had one site located in the West Fork-West Branch and the Initiative also had two sites located in this subwatershed and the US EPA tested for phosphorus at one site, reported to MI DEQ, in this subwatershed. A review of each sample site will follow.

The SCLC sampled water quality from the Harry Teeter Ditch, a tributary to Clear Lake in May, July, and August in 2011 and 2012. As can be seen in Table 3.3.1, DO did not meet state standards in two samples, *E. coli* exceeded the single sample standard in 50% of the samples, phosphorus exceeded target levels in 83% of the samples, and TSS exceeded the standard in one sample.

Table 3.3.1: Water Quality Analysis in the Harry Teeter Ditch by the SCLC

West Fork - West Branch (SCLC - Site 57)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	6	mg/L	1/6 < 4mg/L and 1/6 > 9mg/L	33%
E. coli	977.4	CFU/100ml	3/6	50%
pH	7.46	SU	0/6	0%
Phosphorus	0.35	mg/L	5/6	83%
Temperature	16.55	Celsius	0/6	0%
TSS	13.633	mg/L	1/6	17%

The SCLC sampled water quality from the Alvin Patterson Ditch, a tributary to Clear Lake once during the recreational season in 2007 and 2008, then in May, July, and August in 2011 and 2012. As can be seen in the below Table 3.3.2, DO exceeded the standard in 57% of the samples, *E. coli* exceeded the single sample state standard in 63% of the samples, and phosphorus exceeded the target level in 50% of the samples.

Table 3.3.2 Water Quality Analysis in the Alvin Patterson Ditch by the SCLC

West Fork - West Branch (SCLC - Site 58)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	3.826	mg/L	4/7 < 4mg/L and	57%
E. coli	391.35	CFU/100ml	5/8	63%
pH	7.15	SU	0/8	0%
Phosphorus	0.1395	mg/L	4/8	50%
Temperature	17.1571	Celsius	0/8	0%
TSS	3.584	mg/L	0/8	0%

The SCLC sampled water quality from the Smith Ditch, a tributary to Clear Lake, once during the recreational season in 2007 and 2008, then in May, July, and August in 2011 and May and twice in July in 2012. As can be seen in the below Table 3.3.3, *E. coli* exceeded the single sample state standard in two samples, with the highest number of CFUs being counted as 7,700 in July 2012, and phosphorus exceeded the target level in one of the samples.

Table 3.3.3 Water Quality Analysis in the Smith Ditch by the SCLC

West Fork - West Branch (SCLC - Site 59)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	6.45	mg/L	0/8	0%
E. coli	1290.83 (Mean)	CFU/100ml	2/8	25%
pH	7.245	SU	0/8	0%
Phosphorus	0.04683	mg/L	1/8	13%
Temperature	14.7125	Celsius	0/8	0%
TSS	4.0333	mg/L	0/8	0%

The SCLC sampled water quality from the Cyrus Brouse Ditch, a tributary to Clear Lake, once during the recreational season in 2007 and 2008, then in May, July, and August in 2010 and 2011 and in May and August in 2012. As can be seen in Table 3.3.4, DO and TSS exceeded the standard in 20% of the samples, phosphorus exceeded the target once and *E. coli* exceeded the standard in 70% of the samples with the highest CFU count being at 2,560 CFU.

Table 3.3.4 Water Quality Analysis in the Cyrus Brouse Ditch by the SCLC

Cyrus Brouse Ditch - Clear Lake Inlet in West Fork - West Branch (SCLC - Site 60)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.829	mg/L	2/10 > 9 mg/L	20%
E. coli	877.33 (Mean)	CFU/100ml	7/10	70%
pH	7.58	SU	0/10	0%
Phosphorus	0.0556	mg/L	1/10	10%
Temperature	15.13	Celsius	0/10	0%
TSS	31.94	mg/L	2/10	20%

The SCLC sampled water quality from the Clear Lake outlet, once in October 2007, May and October 2008, then in May, July, and August in 2009 thru 2012. As can be seen in Table 3.3.5 DO exceeded the standard in three samples and *E. coli* exceeded the standard in one sample. These results indicate that much of the pollution entering Clear Lake settles out in the lake prior to water leaving the lake to head downstream.

Table 3.3.5 Water Quality Analysis in the Clear Lake Outlet by the SCLC

Clear Lake Outlet in West Fork - West Branch (SCLC - Site 61)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.765	mg/L	3/15 > 9 mg/L	20%
E. coli	58.246 (Mean)	CFU/100ml	1/15	7%
pH	8.213	SU	0/15	0%
Phosphorus	0.012	mg/L	0/15	0%
Temperature	21.287	Celsius	0/15	0%
TSS	3.764	mg/L	0/15	0%

The MI DEQ sampled at site 300266 on the West Fork of the West Branch of the St. Joseph River once in June of 2005. As can be seen in Table 3.3.6, TKN exceeded the target level of 0.076 mg/L in that sample, though all other parameters were within the target levels.

Table 3.3.6 Water Quality Analysis at Site 300266 by MI DEQ

West Fork West Branch (MI DEQ - Site 300266)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.07	mg/L	0/1	0%
Nitrite	0.06	mg/L	0/1	0%
TKN	0.68	mg/L	1/1	100%
Nitrate+Nitrite	1.26	mg/L	0/1	0%
DRP	0.02	mg/L	0/1	0%
Phosphorus	0.06	mg/L	0/1	0%

The US EPA sampled phosphorus at one site on the West Fork of the West Branch of the St. Joseph River in October of 2010 though the results were obtained from the MI DEQ for use in this project. As can be in Table 3.3.7, phosphorus exceeded the target level of 0.08mg/L in that one sample.

Table 3.3.7 Water Quality Analysis at Site 760 by the US EPA

West Fork West Branch Mainstem (EPA - Site 760)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Phosphorus	0.275	mg/L	1/1	100%

The Initiative began sampling at site 173 on the West Fork of the West Branch of the St. Joseph River in 2012. They collected 24 samples total, weekly during the recreational season. As can be seen in Table 3.3.8, DO exceeded the standard in 33% of the samples, *E. coli* exceeded the standard in 78% of the samples, with the Geometric mean measuring high at 225.03, which is above the geometric mean IDEM standard or 125 CFU/100ml. Phosphorus exceeded the target level in five samples, and turbidity exceeded the target in 54% of the samples.

Table 3.3.8 Water Quality Analysis at Site 173 by the Initiative

West Fork-West Branch (Initiative, 2012 - Site 173)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.456	mg/L	8/24 > 9mg/L	33%
E. coli	410.435 (Mean) 225.03 (Geomean)	CFU/100ml	18/23 235 CFU/100ml	78%
Nitrate+Nitrite	0.226	mg/L	0/24	0%
pH	8.185	SU	0/24	0%
Phosphorus	0.086	mg/L	5/24	21%
Temperature	17.993	Celsius	0/24	0%
TDS	375	mg/L	0/24	0%
Turbidity	15.783	NTU	13/24	54%
Atrazine	0.053	ppb	0/24	0%
Alachlor	0.03	ppb	0/24	0%
Metolachlor	0.05	ppb	0/24	0%

The Initiative began water sampling in the West Fork of the West Branch of the St. Joseph River subwatershed in 2004 at sample site 135 located on the West Fork of the West Branch of the St. Joseph River, downstream from the Initiative's other sample site in the West Fork West Branch subwatershed. As can be seen in Table 3.3.9, DO did not meet target levels in 40% of the samples analyzed, *E. coli* did exceeded the standard in over 50% of the samples, phosphorus exceeded target levels in 55% of the samples, and turbidity exceeded the target in 87% of samples.

Table 3.3.9 Water Quality Analysis at Site 135 by the Initiative

West Fork-West Branch (Initiative, 2012 - Site 135)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.054	mg/L	17/263 < 4mg/L 88/263 > 9mg/L	40%
E. coli	750.82 (Mean 103.176 (Geomean)	CFU/100ml	186/365 (235 CFU/100ml)	51%
Nitrate+Nitrite	0.483	mg/L	1/107	0.9%
pH	8.176	SU	5/263 > 9mg/L	1.9%
Phosphorus	0.339	mg/L	62/112	55%
Temperature	17.864	Celsius	2/264 < 4.44 ^{o}C	0.8%
TDS	358.69	mg/L	0/237	0%
Turbidity	31.26	NTU	226/260	87%
Atrazine	0.263	ppb	9/270	3%
Alachlor	0.067	ppb	2/270	0.7%
Metolachlor	0.15	ppb	0/262	0%

3.3.1.2 East Fork West Branch St. Joseph River

The Initiative had one sample site located in the East Fork-West Branch St. Joseph River Subwatershed. Site 134 is an historic sample site with over 300 samples taken weekly during the recreational season since 2002. There are some instances when samples were not taken but it general, samples were taken on a very regular schedule. As can be seen in Table 3.3.10, major concerns in this subwatershed Include DO, *E. coli*, and phosphorus with samples not meeting target levels in 53%, 41% and 42 % of the samples, respectively. Turbidity is also a concern in this subwatershed as turbidity levels exceeded target levels in 65% of the samples. Atrazine exceeded the MCL in 13 samples (4%), all of which were in the spring after application of this pesticide. Habitat and Macroinvertebrate scores from samples taken in 2012 were both good at site 134.

Table 3.3.10 Water Quality Analysis at Site 134 by the Initiative

East Fork - West Branch (Initiative - Site 134)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.669	mg/L	15/296 < 4mg/L and 141/296 > 9mg/L	53%
E. coli	949.24 (Mean) 31.85 (Geomean)	CFU/100ml	157/379 (235 CFU/100ml)	41%
Nitrate+Nitrite	0.727	mg/L	14/143	10%
pH	8.19	SU	4/296 > 9 mg/L	1%
Phosphorus	0.094	mg/L	62/148	42%
Temperature	17.878	Celsius	1/297 < 4.44 ^oC and 1/297 > 29.44 ^oC	<1%
TDS	336.158	mg/L	0/270	0%
Turbidity	24.083	NTU	189/293	65%
Atrazine	0.598	ppb	13/305	4%
Alachlor	0.082	ppb	0/305	0%
Metolachlor	0.268	ppb	0/297	0%
Macroinvertebrate	23	Points	Excellent	
Habitat	83	Points	Good	

3.3.1.3 Lake La Su An-West Branch St. Joseph River

The Initiative has one sample site located in the Lake La Su An subwatershed, Site 125 which is an historic sample site. Sampling began at site 125 in 2002 which has resulted in nearly 300 samples. However, the Initiative began sampling for *E. coli* in the Lake La Su An subwatershed in 1998 resulting in 451 *E. coli* samples. As can be seen in Table 3.3.11, DO did not meet target levels in 32% of the samples, *E. coli* did not meet state standards in 37% of the samples, and phosphorus exceeded the target level in 53% of the samples. Of significance is the fact that turbidity did not meet the target level in 96% of the samples analyzed. Even though the turbidity levels were so high, macroinvertebrate and habitat scores from samples taken in 2012 were both excellent.

Table 3.3.11 Water Quality Analysis at Site 125 by the Initiative

Lake La Su An (Initiative - Site 125)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.8	mg/L	18/298 < 4mg/L and 76/298 > 9mg/L	32%
E. Coli	495.33 (Mean) 7.13 (Geomean)	CFU/100ml	168/451	37%
Nitrate+Nitrite	0.574	mg/L	10/143	7%
pH	8.183	SU	1/298 < 6 mg/L and 4/298 > 9 mg/L	2%
Phosphorus	0.122	mg/L	161/301	53%
Temperature	19.564	Celsius	1/299 < 4.44 ^{o}C and 1/299 > 29.44 ^{o}C	<1%
TDS	309.88	mg/L	1/272	<1%
Turbidity	45.54	NTU	283/296	96%
Atrazine	0.834	ppb	18/310	6%
Alachlor	0.124	ppb	2/310	<1%
Metolachlor	0.329	ppb	0/302	0%
Macroinvertebrate	41	Points	Excellent	
Habitat	94	Points	Good	

3.3.1.4 Summary of West Branch St. Joseph River Subwatershed

Over all, the West Branch St. Joseph River Subwatershed exhibits water quality concerns that are typical with the type of surrounding land use, which will be reviewed in the following Section 3.4. As can be seen in Table 3.3.12, the averages of *E. coli*, TKN, phosphorus, and turbidity all exceeded the target set by this project. However, it should be noted that TKN was only sampled one time, and therefore may not be a significant problem, especially since other nitrogen measurements did not exceed target levels. Those parameters highlighted in the table below, are those parameters that the averages for all samples taken within the West Branch St. Joseph River subwatershed that exceed the target levels set by this project.

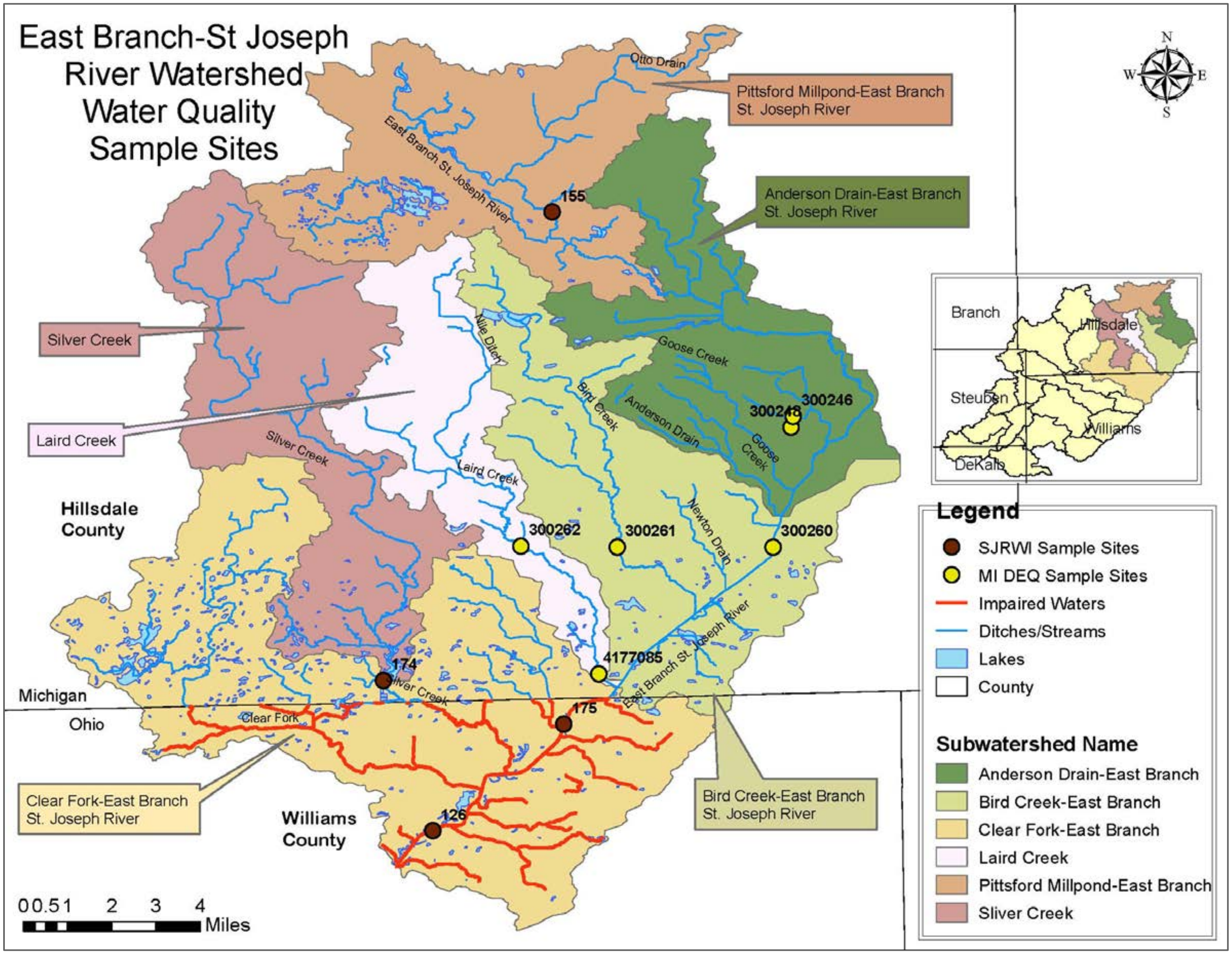
Table 3.3.12 Water Quality Averages for All Samples in the West Branch Subwatershed

Parameter	Mean	Unit	Target Level
Ammonia	0.07	mg/L	< 0.21 mg/L
D.O.	7.29	mg/L	> 5mg/L but not < 4 mg/L and not > 9 mg/L
E. Coli	695.18	CFU/100ml	< 235 CFU/100 ml per single
Nitrite	0.06	mg/L	< 1 mg/L
TKN	0.68	mg/L	< 0.076 mg/L
Nitrate+Nitrite	0.625	mg/L	< 1.6 mg/L
pH	7.856	SU	> 6 or < 9 SU
DRP	0.02	mg/L	< 0.05 mg/L
Phosphorus	0.16	mg/L	< 0.08 mg/L
Temperature	17.6	Celsius	4.44 - 29.44 degrees C
TDS	347.685	mg/L	< 750 mg/L
Turbidity	29.58	NTU	< 10.4 NTU
TSS	11.39	mg/L	< 20 mg/L
Atrazine	0.423	ppb	< 3.0 ppb
Alachlor	0.074	ppb	< 2 ppb
Metolachlor	0.19	ppb	< 50 ppb

3.3.2 East Branch St. Joseph River Watershed

There were a total of ten sample sites in the East Branch-St. Joseph River subwatershed with samples reported by the MI DEQ, and the Initiative. Figure 3.4 shows the location of all the sample sites in the East Branch – St. Joseph subwatershed. As can be seen in the figure below, there are six HUC 12s located within the East Branch, with at least one sample site located within each of the subwatersheds except for Silver Creek. However, Initiative's sample Site 174 is located at the confluence of Silver Creek and Clear Fork subwatersheds, thus Site 174 will accurately represent water quality within the Silver Creek subwatershed. The following subsections will review the analysis of the water samples from each of the subwatersheds.

Figure 3.4 Water Quality Sample Sites in the East Branch – St. Joseph River Watershed



3.3.2.1 Pittsford Millpond – East Branch St. Joseph River

The Initiative has one sample site located in the Pittsford Millpond subwatershed, Site 155 which is an historic sample site. Sampling began at site 155 in 2007 which has resulted in nearly 150 samples. As can be seen in Table 3.3.13, DO did not meet target levels in 38% of the samples, *E. coli* did not meet state standards in 35% of the samples, turbidity exceeded target levels in 25% of the samples and phosphorus exceeded the target level in 33% of the samples. Macroinvertebrate and habitat scores from samples taken in 2012 were both very good with a habitat score of 91 and a Pollution Tolerance Index (PTI) score of 36. It is somewhat surprising that exceedances were so high since the sample site is located in a pristine area at the headwaters of the St. Joseph River. This will be examined further after review of the land use inventory.

Table 3.3.13: Water Quality Analysis at Site 155 by the Initiative

Pittsford Millpond (Initiative - Site 155)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.739	mg/L	66/175 > 9mg/L	38%
E. coli	957.97 (Mean) 10.30 (Geomean)	CFU/100 mL	61/173	35%
Nitrate+Nitrite	0.682	mg/L	1/143	<1%
pH	8.211	SU	0/175	0%
Phosphorus	0.094	mg/L	49/148	33%
Temperature	19.063	Celsius	0/176	0%
TDS	356.063	mg/L	0/175	0%
Turbidity	6.845	NTU	44/173	25%
Atrazine	0.209	ppb	0/150	0%
Alachlor	0.051	ppb	0/150	0%
Metolachlor	0.119	ppb	0/150	0%
Macroinvertebrate	36	Points	Excellent	
Habitat	91	Points	Good	

3.3.2.2 Anderson Drain – East Branch St. Joseph River

The MI DEQ sampled water quality at two sites in the Anderson Drain subwatershed. Sample site 300246, which is located downstream of a CAFO was sampled once in May, 2004 and sample site 300248 was sampled once in July, 2005. A review of each sample site will follow.

Samples were taken from Site 300246 twice on May 13, 2004 for analysis. Results showed that nitrogen, and phosphorus (TP and DRP) did not meet target levels (Table 3.3.14). Site 300246 was directly downstream of a CAFO at the time of the sampling; however that CAFO is no longer located in the East Branch subwatershed. However, this sampling exercise does show the potential for polluted runoff from CAFOs.

Table 3.3.14 Water Quality Analysis at Site 300246 by the MI DEQ

Anderson Drain (MI DEQ - Site 300246)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.05	mg/L	0/1	0%
Nitrite	0.085	mg/L	0/1	0%
TKN	1.17	mg/L	2/2	100%
Nitrate+Nitrite	4.335	mg/L	2/2	100%
DRP	0.65	mg/L	1/2	50%
Phosphorus	0.2	mg/L	2/2	100%

The MI DEQ also sampled nearby at Site 300248 in July, 2005. The MI DEQ sampled that location twice on the same day to verify findings. It was found that nitrogen and phosphorus were also an issue at site 300248, as can be seen in Table 3.3.15.

Table 3.3.15 Water Quality Analysis at Site 300248 by the MI DEQ

Anderson Drain (MI DEQ - Site 300248)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.02	mg/L	0/1	0%
Nitrite	0.085	mg/L	0/2	0%
Nitrate+Nitrite	4.5	mg/L	2/2	100%
TKN	1.045	mg/L	2/2	100%
DRP	0.05	mg/L	1/2	50%
Phosphorus	0.13	mg/L	1/2	50%

3.3.2.3 Bird Creek – East Branch St. Joseph River Subwatershed

The MI DEQ sampled at two locations in the Bird Creek subwatershed. Sites 300260 and 300261 were sampled in June, 2005 twice each in the same day to verify results. Each sample site will be discussed below.

Site 300260, on the main stem of the East Branch of the St. Joseph River was sampled by the MI DEQ in June, 2005. Table 3.3.16 shows the results of those sampling efforts and as can be seen in the table, nitrogen is the only parameter that exceeded target levels.

Table 3.3.16 Water Quality Analysis at Site 300260 by the MI DEQ

Bird Creek (MI DEQ - Site 300260)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.055	mg/L	0/2	0%
Nitrite	0.02	mg/L	0/2	0%
Nitrate+Nitrite	0.795	mg/L	0/2	0%
TKN	0.66	mg/L	2/2	100%
DRP	0.02	mg/L	0/2	0%
Phosphorus	0.055	mg/L	0/2	0%

The MI DEQ also sampled water quality at Site 300261 on Bird Creek in June, 2005. Samples were taken three times from this site to verify results. As can be seen in Table 3.3.17, nitrogen is the only parameter that exceeded target levels during that round of sampling.

Table 3.3.17 Water Quality Analysis at Site 300261 by the MI DEQ

Bird Creek (MI DEQ - Site 300261)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.077	mg/L	0/3	0%
Nitrite	0.02	mg/L	0/3	0%
Nitrate+Nitrite	0.393	mg/L	0/3	0%
TKN	0.537	mg/L	1/3	33%
DRP	0.013	mg/L	0/3	0%
Phosphorus	0.043	mg/L	0/3	0%

3.3.2.4 Laird Creek – East Branch St. Joseph River

The USGS and MI DEQ sampled water quality at two sites located in the Laird Creek-East Branch subwatershed, Sites 4177085 and 300262, respectively. There is limited, and fairly old data available at these sites as both sites were only sampled on one day. Each sample site will be discussed below.

Site 300262 was sampled one time in June, 2005 and is located upstream from site 4177085 on Laird Creek. As can be seen in Table 3.3.18, nitrogen is the only pollutant that exceeded target levels on that particular sampling day.

Table 3.3.18 Water Quality Analysis at Site 300262 by the MI DEQ

Laird Creek (MI DEQ-Site 300262)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.05	mg/L	0/1	0%
Nitrite	0.02	mg/L	0/1	0%
TKN	0.78	mg/L	1/1	100%
Nitrate+Nitrite	0.45	mg/L	0/1	0%
DRP	0.02	mg/L	0/1	0%
Phosphorus	0.05	mg/L	0/1	0%

Site 4177085 was sampled as part of the USGS water sampling program and results were reported to the MI DEQ. This site was sampled in September, 2004 for several parameters, though those specific to the concerns of this project were the only ones examined for Inclusion in this WMP. As can be seen in Table 3.3.19 no parameters analyzed at site 4177085 exceeded target levels during that one sampling event.

Table 3.3.19 Water Quality Analysis at Site 04177085 by the USGS

Laird Creek (USGS-Site 04177085)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
TKN	0.57	mg/L	0/1	0%
Nitrate+Nitrite	0.04	mg/L	0/1	0%
DRP	0.033	mg/L	0/1	0%
Phosphorus	0.072	mg/L	0/1	0%
Atrazine	0.072	ppb	0/1	0%

3.3.2.5 Clear Fork – East Branch St. Joseph River

The Initiative sampled three sites in Clear Fork subwatershed, Site 174, which is located where Silver Creek outlets into the Clear Fork subwatershed and therefore results from that site are representative of pollutants entering the waterway within the Silver Creek subwatershed. Sites 126 and 175 are both located on the East Branch of the St. Joseph River. Each sample site will be discussed below.

Sample Site 174 is a new site added to the Initiative regular sampling schedule in 2012 as a result of this project. Samples were collected weekly during the recreational season. As can be seen in Table 3.3.20 DO exceeded the target level in 21% of the samples, *E. coli* exceeded the standard in 2 samples, though it is important to note that the average is 75.22 CFU/100ml, and phosphorus exceeded the target level in 46% of the samples. Of significant note, is that turbidity exceeded the target level in 96% of the samples analyzed.

Table 3.3.20 Water Quality Analysis at Site 174 by the Initiative

Clear Fork (Initiative, 2012 - Site 174)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.11	mg/L	5/24 > 9mg/L	21%
E. coli	75.22 (Mean) 1.0 (Geomean)	CFU/100ml	2/23	9%
Nitrate+Nitrite	0.06	mg/L	0/24	0%
pH	8.5	SU	0/24	0%
Phosphorus	0.093	mg/L	11/24	46%
Temperature	21.79	Celsius	0/24	0%
TDS	300	mg/L	0/24	0%
Turbidity	42.71	NTU	23/24	96%
Atrazine	0.18	ppb	0/24	0%
Alachlor	0.04	ppb	0/24	0%
Metolachlor	0.12	ppb	0/24	0%
Macroinvertebrate	29	Points	Excellent	
Habitat	87	Points	Good	

Sample Site 175 is also a new site that was added to the Initiative's normal sampling protocol in 2012 as a result of this project. Samples were taken weekly throughout the recreational season. As can be seen in Table 3.3.21 DO exceeded the target level in 21% of the samples, phosphorus exceeded the target level in 33% of the samples, and turbidity exceeded the target level in 42% of the samples. Of significant note is that *E. coli* exceeded the state standard in 78% of the samples with the average sample measuring 494.35 CFU/100ml and the geometric mean, which excludes any extreme outliers and is more representative of the number of CFU you would find at the sample site, is 400.36 CFU/100ml.

Table 3.3.21 Water Quality Analysis at Site 175 by the Initiative

Clear Fork (Initiative, 2012 - Site 175)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.141	mg/L	5/24 > 9mg/L	21%
E. coli	494.348 (Mean) 400.36 (Geomean)	CFU/100ml	18/23	78%
Nitrate+Nitrite	0.191	mg/L	0/24	0%
pH	8.357	SU	0/24	0%
Phosphorus	0.071	mg/L	8/24	33%
Temperature	19.439	Celsius	0/24	0%
TDS	356	mg/L	0/24	0%
Turbidity	20.325	NTU	10/24	42%
Atrazine	0.079	ppb	0/24	0%
Alachlor	0.026	ppb	0/24	0%
Metolachlor	0.068	ppb	0/24	0%

Sample Site 126 is an historic site of the Initiative's and samples have been gathered at this site weekly during the recreational season since 2002. As can be seen in Table 3.3.22 DO did not meet the target level in 31% of the samples with the majority of those being above the target of 9 mg/L. Nitrate+nitrite exceeded the target in 13% of the samples, and phosphorus exceeded the target level in 55% of the samples. Of significant note is that *E. coli* exceeded the standard in 62% of the samples with the highest reading being over 20,000 CFU/100ml. It should also be noted that 93% of the samples exceeded the target level for turbidity at this site.

Table 3.3.22 Water Quality Analysis at Site 126 by the Initiative

Clear Fork (Initiative - Site 126)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.908	mg/L	16/301 < 4mg/L and 78/301 > 9mg/L	31%
E. coli	1117.06 (Mean) 80.18 (Geomean)	CFU/100ml	282/452	62%
Nitrate+Nitrite	0.74	mg/L	18/143	13%
pH	8.133	SU	4/301 > 9 mg/L	1%
Phosphorus	0.124	mg/L	81/148	55%
Temperature	18.311	Celsius	1/302 < 4.44^{o}C	<1%
TDS	349	mg/L	0/275	0%
Turbidity	54.372	NTU	276/298	93%
Atrazine	0.593	ppb	15/310	5%
Alachlor	0.101	ppb	1/310	<1%
Metolachlor	0.246	ppb	0/302	0%
Macroinvertebrate	39	Points	Excellent	
Habitat	91	Points	Good	

3.3.2.6 Summary of East Branch St. Joseph River Subwatershed

The East Branch St. Joseph River Watershed exhibits water quality concerns that are typical of the surrounding land use, which will be examined closer in the following Section 3.4. As can be seen in Table 3.3.23, *E. coli*, TKN, Phosphorus, DRP, and turbidity all exceeded the targets set by this project. It should be noted that TKN and DRP were sampled on very few occasions and may not be representative of what is typical in the subwatershed. Those parameters which had averages that exceeded the target levels set by this project are highlighted in the table below.

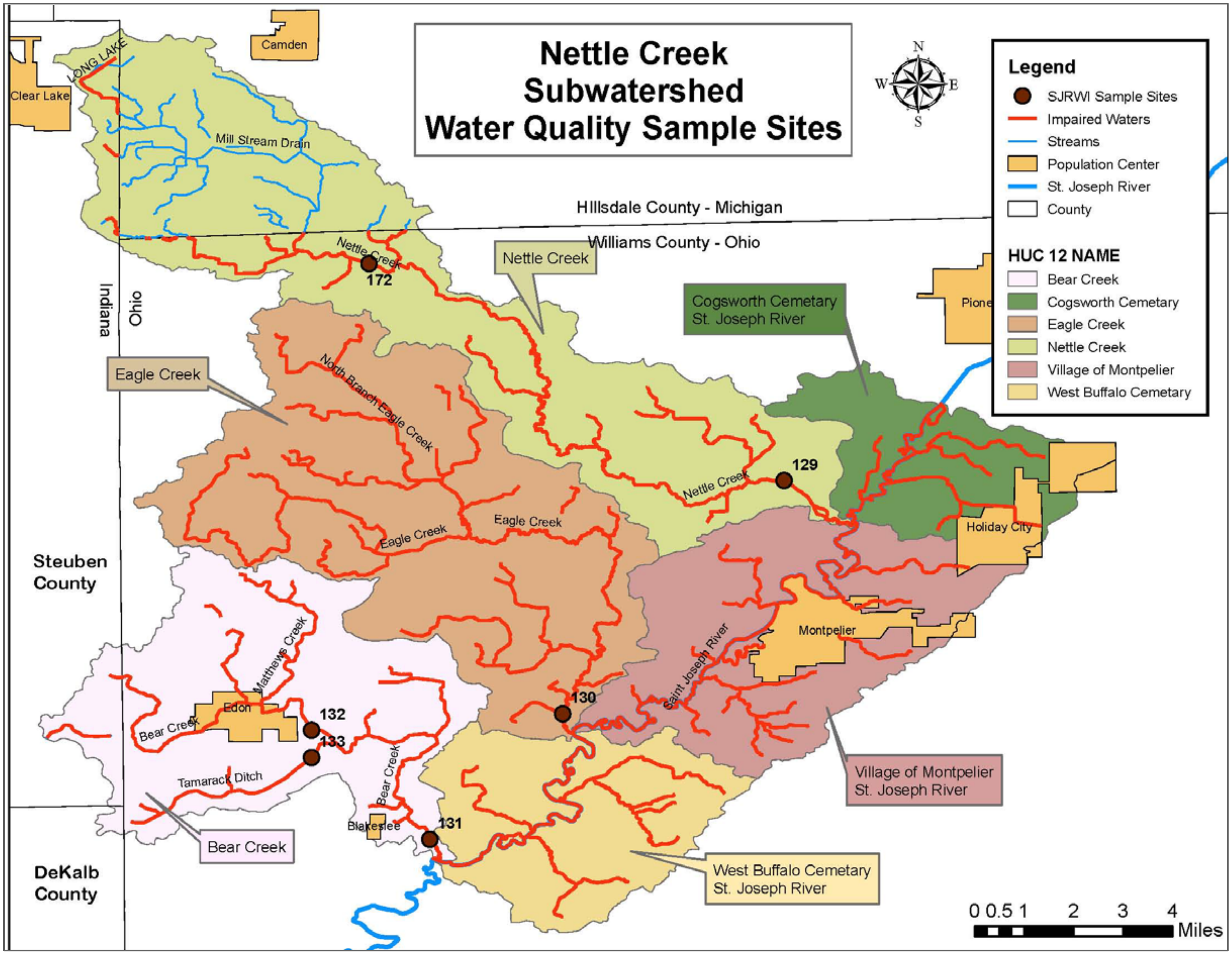
Table 3.3.23 Water Quality Averages of All Samples in the East Branch Subwatershed

Parameter	Mean	Unit	Target Level
D.O.	8.22	mg/L	> 5mg/L but not < 4 mg/L and not > 9 mg/L
E. coli	661.15	CFU	< 235 CFU/100 ml per single
Ammonia	0.15	mg/L	< 0.21 mg/L
TKN	0.794	mg/L	< 0.076 mg/L
Nitrate+Nitrite	1.22	mg/L	< 1.6 mg/L
pH	8.3	SU	> 6 or < 9 SU
Phosphorus	0.093	mg/L	< 0.08 mg/L
DRP	0.775	mg/L	<0.05 mg/L
Temperature	19.651	Celsius	4.44 - 29.44 degrees C
TDS	272.766	mg/L	< 750 mg/L
Turbidity	31.063	NTU	< 10.4 NTU
Atrazine	0.265	ppb	< 3.0 ppb
Alachlor	0.055	ppb	< 2 ppb
Metolachlor	0.138	ppb	< 50 ppb

3.3.3 Nettle Creek - St. Joseph River Watershed

There were a total of six sample sites in the Nettle Creek subwatershed. Water quality was only sampled by the Initiative in the Nettle Creek subwatershed. Four sites have been sampled for at least some parameters since 1997. Figure 3.5 shows the location of all the sample sites in the Nettle Creek subwatershed. As can be seen in the figure below, there are six HUC 12s located within the Nettle Creek subwatershed, with all sample sites located in the western subwatersheds and no samples in Cogsworth Cemetery, Village of Montpelier, or West Buffalo Cemetery subwatersheds. The following subsections will review the analysis of the water samples from each of the subwatersheds.

Figure 3.5: Water Quality Sample Sites in the Nettle Creek Subwatershed



3.3.3.1Nettle Creek – Nettle Creek Subwatershed

There are two sample sites located in the Nettle Creek Subwatershed, both monitored by the Initiative. Site 129 is an historic site that has been sampled for some parameters since 1996 and site 172 is a new sample site that was added to the Initiative's monitoring protocol in 2012 as part of this project. As can be seen in Table 3.3.24 below, D.O., *E. coli*, phosphorus, and turbidity all exceeded the target levels at Site 172. The most significant exceedances were seen in *E. coli* which exceeded the state standard in 65% of the samples, and turbidity which exceeded the target level in 54% of the samples. It should be noted that the geometric mean for *E. coli*, which removes any extreme high and low readings and gives a more accurate number of CFUs that could be expected at any given time in the waterway, was 152.98 CFU/100ml which exceeds the state geometric mean standard of 125 CFU/100ml. Therefore, *E. coli* is likely a real problem at this sample site.

Table 3.3.24: Water Quality Analysis at Site 172 by the Initiative

Nettle Creek - Nettle Creek (Initiative, 2012 - Site 172)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	6.438	mg/L	2/24 > 9mg/L	8%
E. coli	481.74 (Mean) 152.98 (Geomean)	CFU/100ml	15/23	65%
Nitrate+Nitrite	0.229	mg/L	0/24	0%
pH	7.967	SU	0/24	0%
Phosphorus	0.056	mg/L	6/24	25%
Temperature	17.807	Celsius	0/24	0%
TDS	426	mg/L	0/24	0%
Turbidity	19.267	NTU	13/24	54%
Atrazine	0.047	ppb	0/24	0%
Alachlor	0.031	ppb	0/24	0%
Metolachlor	0.07	ppb	0/24	0%

As stated above, Site 129 has been sampled for some parameters, including pesticides, water temperature, pH, and *E. coli* since 1996 and other parameters were picked up at Site 129 in 2008. As can be seen in Table 3.3.25, DO did not meet the target level in 37% of the samples, *E. coli* exceeded the state standard in 58% of the samples, phosphorus exceeded target levels in 54% of the samples, and of special significance is the fact that turbidity exceeded target levels in 96% of the samples (252/262 samples). The macroinvertebrate score of 17 indicates that stressors are present which prohibit a thriving and diverse macroinvertebrate community. It is also important to note that most other parameters exceeded target levels set by this project also, but to a lesser degree.

Table 3.3.25: Water Quality Analysis at Site 129 by the Initiative

Nettle Creek - Nettle Creek (Initiative- Site 129)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.12	mg/L	15/264 < 4mg/L and 83/264 > 9 mg/L	37%
E. coli	1369.35 (Mean) 24.12 (Geomean)	CFU/100ml	261/449 (235 CFU/100ml)	58%
Nitrate+Nitrite	1.04	mg/L	26/141	18%
pH	7.99	SU	4/451 < 6 and 10/451 > 9	3%
Phosphorus	0.147	mg/L	77/142	54%
Temperature	18.33	^{o}C	8/451 < 4.44 and 1/451 > 29.44	<1%
TDS	293	mg/L	0/238	0%
Turbidity	79.24	NTU	252/262	96%
Atrazine	1.6	mg/L	72/411	18%
Alachlor	0.49	mg/L	22/411	5%
Metolachlor	0.62	mg/L	0/411	0%
Macroinvertebrates	17	Points	Good	
Habitat	65	Points	Adequate	

3.3.3.2 Eagle Creek-Nettle Creek Subwatershed

Site 130, an historic site sampled by the Initiative since 1996 is located in Eagle Creek subwatershed. This site was also only tested for pesticides, temperature, pH, and *E. coli* in 1996 and it wasn't until 2008 that other parameters were picked up for analysis. Site 130 is located at the most downstream point of Eagle Creek, before it outlets into the St. Joseph River and therefore represents the input from the entire Eagle Creek subwatershed. As can be seen in Table 3.3.26, all parameters, with the exception of TDS and Metolachlor exceed target levels. D.O. did not meet the target level in 29% of the samples, *E. coli* did not meet the state standard in 61% of the samples, nitrogen did not meet target levels in 23% of samples, phosphorus did not meet target levels in a significant 78% of samples, and turbidity exceeded target levels in 81% of the samples.

Table 3.3.26: Water Quality Analysis at Site 130 by the Initiative

Eagle Creek (Initiative - Site 130)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.45	mg/L	17/265 < 4 mg/L and 60/265 > 9 mg/L	29%
E. coli	796.91 (mean) 62.86 (geomean)	CFU/100ml	267/436	61%
Nitrate+Nitrite	0.726	mg/L	25/107	23%
pH	8.034	SU	3/265 > 9mg/L	1%
Phosphorus	0.142	mg/L	87/112	78%
Temperature	18.66	Celsius	2/266 < 4.44 ^{o}C	<1%
TDS	203.22	mg/L	0/239	0%
Turbidity	34.79	NTU	212/262	81%
Atrazine	0.622	ppb	26/275	9%
Alachlor	0.1	ppb	2/275	<1%
Metolachlor	0.285	ppb	0/266	0%

3.3.3.3 Bear Creek-Nettle Creek Subwatershed

There are three sample sites located in the Bear Creek subwatershed, all sampled by the Initiative. All sites located in Bear Creek subwatershed have some historical data available.

Sample Site 132, located on Mathews Ditch in the northwest portion of the subwatershed, is located downstream of the town of Edon, which may have contributed to some urban pollutants at this sample site. It should be noted that Edon does have a WWTP, however it discharges into Bear Creek and will not impact the water quality at Site 132. Site 132 has been sampled since 1999 for most parameters, though phosphorus and nitrogen were not added to the monitoring protocol until 2008. As can be seen in Table 3.3.27, all parameters, with the exception of Metolachlor did not meet target levels. Of significance are that D.O. did not meet target levels set by this project in 78% of the samples, *E. coli* exceeded target levels in 58% of the samples, nitrogen and phosphorus both exceeded target levels in 95% of the samples, and turbidity did not meet target levels in 66% of the samples. The extreme number of parameters, and to what extent, that did not meet target levels will be examined more closely in the following section where land use is discussed.

Table 3.3.27: Water Quality Analysis of Site 132 by the Initiative

Bear Creek (Initiative- Site 132)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	10.993	mg/L	13/291 < 4mg/L and 213/291 > 9mg/L	78%
E. coli	1086.95 (Mean) 57.83 (Geomean)	CFU/100ml	221/380	58%
Nitrate+Nitrite	4.511	mg/L	139/143	95%
pH	8.382	SU	34/291 > 9 mg/L	12%
Phosphorus	0.472	mg/L	141/148	95%
Temperature	20.25	Celsius	1/292 < 4.44^{o}C and 11/292 > 29.44 ^{o}C	4%
TDS	509.51	mg/L	24/265	9%
Turbidity	53.89	NTU	192/291	66%
Atrazine	1.156	ppb	30/302	10%
Alachlor	0.255	ppb	1/302	<1%
Metolachlor	0.954	ppb	0/294	0%
Macroinvertebrate	34	Points	Excellent	
Habitat	89	Points	Good	

Site 133, located on Tamarack Creek just before the confluence with Mathews Ditch to form Bear Creek, is also a historic site with most parameters being sampled since 1999. However, nitrate+nitrite and phosphorus were not added to the monitoring protocol until 2012 as part of this project. As can be seen in Table 3.3.28, nearly all parameters, with the exception of nitrogen and Metolachlor did not meet target levels set by this project. Of significance are that *E. coli* did not meet the state standard in 52% of the samples, phosphorus exceeded the target level in 57% of the samples, and turbidity exceeded target levels in 89% of the samples, and the average turbidity reading measured over 20 times greater than the target level.

Table 3.3.28: Water Quality Analysis at Site 133 by the Initiative

Bear Creek (Initiative, 2012 - Site 133)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.9	mg/L	2/137 < 4 mg/L and 6/137 > 9mg/L	6%
E. coli	972.77 (Mean) 228.842 (Geomean)	CFU/100ml	85/163	52%
Nitrate+Nitrite	0.08	mg/L	0/21	0%
pH	7.64	SU	1/137 < 6 and 2/137 > 9	2%
Phosphorus	0.234	mg/L	12/21	57%
Temperature	19.9	Celsius	2/137 < 4.44 ^{o}C and 6/137 > 29.44 ^{o}C	6%
TDS	430.52	mg/L	5/56	9%
Turbidity	220.97	NTU	99/111	89%
Atrazine	1.62	ppb	25/164	15%
Alachlor	0.53	ppb	4/164	2%
Metolachlor	0.85	ppb	0/164	0%

Finally, Site 131 is also an historic sample site of the Initiative's monitoring protocol. Sampling of field parameters Including temperature, pH, turbidity, and TDS began in 1996 as did monitoring of *E. coli* and pesticides. The Initiative began monitoring nitrate+nitrite and phosphorus in 2002. As can be seen in Table 3.3.29 all parameters, with the exception of TDS and Matolachlor, did not meet the target levels set by this project. Of significance are D.O. which did not meet the state standard in 62% of the samples, *E. coli* which exceeded the state standard in 54% of the samples, nitrogen which exceeded the target in 33% of the sample, phosphorus exceeded the target level in 70% of the samples, and turbidity exceeded the target level in 71% of the samples.

Table 3.3.29: Water Quality Analysis at Site 131 by the Initiative

Bear Creek (Initiative- Site 131)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	9.346	mg/L	15/265 < 4mg/L and 148/265 > 9mg/L	62%
E. coli	898.915 (mean) 42.535 (geomean)	CFU/100ml	235/436	54%
Nitrate+Nitrite	0.734	mg/L	35/107	33%
pH	8.162	SU	6/266 > 9 mg/L	2%
Phosphorus	0.136	mg/L	185/265	70%
Temperature	19.756	Celsius	1/267 < 4.44 ^{o}C	<1%
TDS	370.18	mg/L	0/240	0%
Turbidity	38.98	NTU	186/262	71%
Atrazine	2.24	ppb	37/274	14%
Alachlor	0.236	ppb	2/274	<1%
Metolachlor	1.057	ppb	0/266	0%

3.3.3.4 Summary of Nettle Creek Subwatershed

The Nettle Creek subwatershed exhibits water quality concerns similar to the other subwatersheds in the project area and are typical of the surrounding land use, which will be examined closer in the following Section 3.4. As can be seen in Table 3.3.30, *E. coli*, Phosphorus, and turbidity all exceeded the targets set by this project. Those parameters highlighted in the table below, are those parameters in which the averages for all samples taken within the Nettle Creek subwatershed that exceed the target levels set by this project.

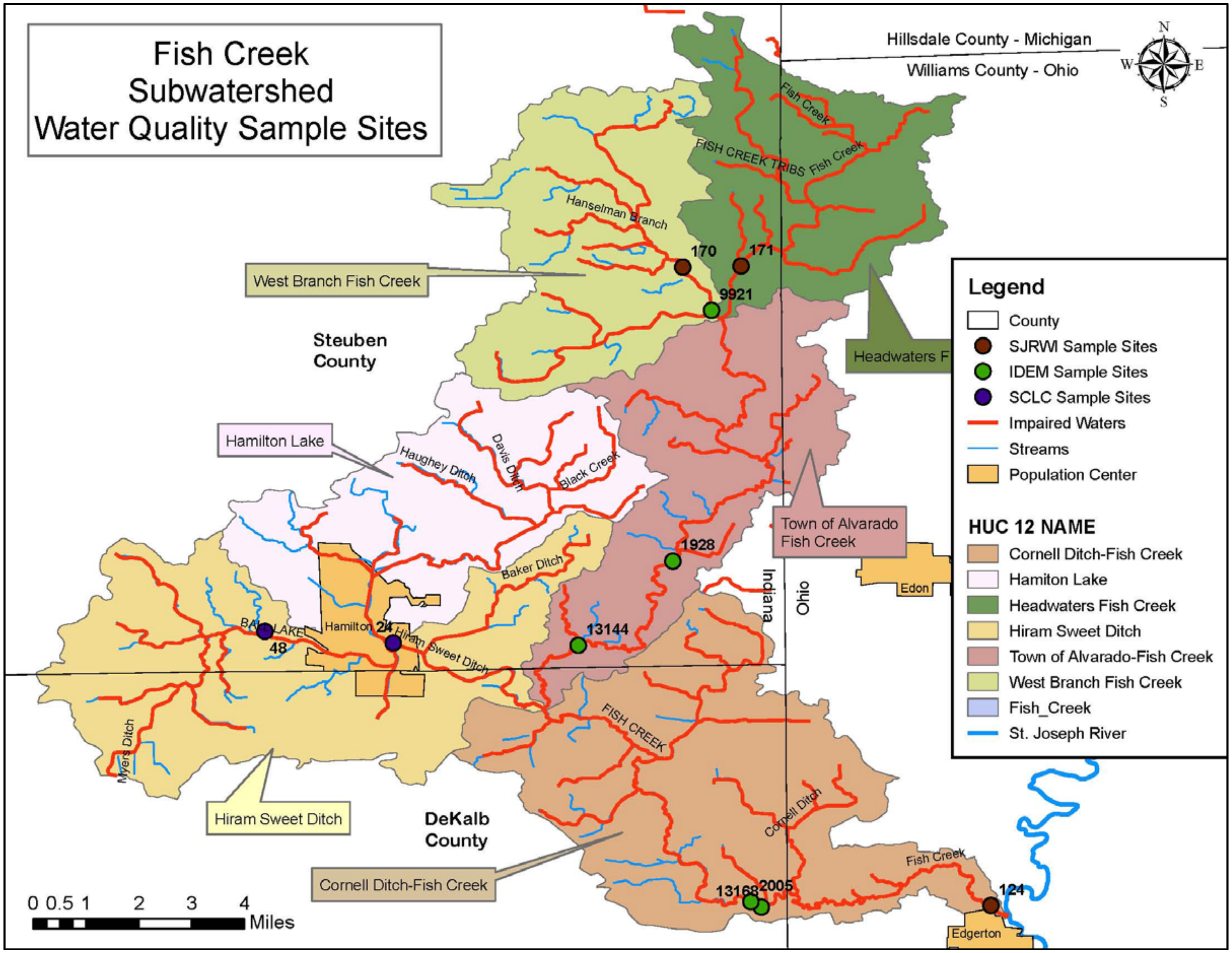
Table 3.3.30: Summary of Water Quality in the Nettle Creek Subwatershed

Parameter	Mean	Unit	Target Level
D.O.	8.53	mg/L	> 5mg/L but not < 4 mg/L and not > 9 mg/L
E. coli	992.66	CFU/100ml	< 235 CFU/100 ml per single
Nitrate+Nitrite	1.22	mg/L	< 1.6 mg/L
pH	8.13	SU	> 6 or < 9 SU
Phosphorus	0.20	mg/L	< 0.08 mg/L
Temperature	19.35	Celsius	4.44 - 29.44 ^{o}C
TDS	379.06	mg/L	< 750 mg/L
Turbidity	47.86	NTU	< 10.4 NTU
Atrazine	1.00	ppb	< 3.0 ppb
Alachlor	0.22	ppb	< 2 ppb
Metolachlor	0.56	ppb	< 50 ppb

3.3.4 Fish Creek – St. Joseph River Watershed

There were a total of ten sample sites in the Fish Creek subwatershed with samples reported by the SCLC, IDEM, and the Initiative. Figure 3.6 shows the location of all the sample sites in the Fish Creek subwatershed. As you can see there are six HUC 12s located within the Fish Creek subwatershed, and there was at least one sample site located in each subwatershed. Both samples taken by the SCLC were taken at lakes, one in Ball Lake, and the other at the outlet of Hamilton Lake which is impaired for phosphorus and PCBs in fish tissue. The following subsections will review the analysis of the water samples from each of the subwatersheds.

Figure 3.6: Water Quality Sample Sites in the Fish Creek Subwatershed



3.3.4.1 Fish Creek Headwaters Subwatershed

The Initiative has one sample site located in the Fish Creek Headwaters subwatershed; Site 171, which is a new site added to the Initiative's monitoring protocol in 2012 as part of this project. The sample site is located at the most southern point of the subwatershed, therefore water quality results obtained from this site represent the input from the entire Fish Creek Headwaters subwatershed.

As can be seen in Table 3.3.31, many parameters did not meet the water quality targets set by this project. *E. coli* did not meet the state standard in 59% of the samples with the geometric mean, which represents the number of CFUs of *E. coli* that would typically be found in the waterway, at 241.91 which is well above the geometric mean state standard of 125 CFU/100ml. Phosphorus exceeded the target level in 21% of the samples, and turbidity exceeded the target level in 25% of the samples.

Table 3.3.31: Water Quality Analysis at Site 171 by the Initiative

Headwaters-Fish Creek (Initiative, 2012 - Site 171)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.025	mg/L	1/24 > 9mg/L	4%
E. coli	455 (Mean) 241.91 (Geomean)	CFU/100ml	13/22 (235 CFU/100ml)	59%
Nitrate+Nitrite	0.319	mg/L	0/24	0%
pH	7.908	SU	0/24	0%
Phosphorus	0.056	mg/L	5/24	21%
Temperature	16.386	Celsius	0/24	0%
TDS	0.39	mg/L	0/24	0%
Turbidity	12.8	NTU	6/24	25%
Atrazine	0.081	ppb	0/24	0%
Alachlor	0.032	ppb	0/24	0%
Metolachlor	0.044	ppb	0/24	0%

3.3.4.2 West Branch-Fish Creek Subwatershed

There are two sample sites located in the West Branch-Fish Creek Subwatershed; Site 170 a new sample site of the Initiative's that was added to their monitoring program in 2012 as part of this project and sample Site 9921, a site of IDEMs that was sampled in 2005.

As can be seen in Table 3.3.32, D.O. *E. coli*, phosphorus, and turbidity all did not meet water quality target levels set by this project. D.O. did not meet the target in 17% of samples, *E. coli* did not meet the state standard in 61% of the samples, phosphorus did not meet the target level in 25% of the samples, and turbidity exceeded the target level in 54% of the samples. The macroinvertebrate score at this site was good, while the habitat score was merely adequate due to sedimentation.

Table 3.3.32: Water Quality Analysis at Site 170 by the Initiative

West Branch-Fish Creek (Initiative, 2012 - Site 170)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	6.577	mg/L	1/24 < 4 mg/L and 3/24 > 9mg/L	17%
E. coli	391.305 (Mean) 125.803 (Geomean)	CFU/100ml	14/23 (235 CFU/100ml)	61%
Nitrate+Nitrite	0.072	mg/L	0/24	0%
pH	7.829	SU	0/24	0%
Phosphorus	0.058	mg/L	6/24	25%
Temperature	17.308	Celsius	0/24	0%
TDS	538	mg/L	0/24	0%
Turbidity	17.021	NTU	13/24	54%
Atrazine	0.025	ppb	0/24	0%
Alachlor	0.028	ppb	0/24	0%
Metolachlor	0.027	ppb	0/24	0%
Macroinvertebrate	21	pts	Good	
Habitat	76	pts	Adequate	

As stated above, IDEM sampled field parameters in the West Branch-Fish Creek ten times during the recreational season in 2005, performed chemical analysis three times during that time frame, and measured the geometric mean of *E. coli* then as well. The sample site is located approximately one mile downstream of the Initiative's sample site 170 and therefore may serve as a baseline for water quality in the watershed. As can be seen in Table 3.3.33, D.O. exceeded the state standard in 30% of the samples, *E. coli* exceeded the state standard for a single sample in 100% of the samples, and the geometric mean exceeded the state standard of 125 CFU/100mls, nitrate+nitrite exceeded the target level in one sample and phosphorus exceeded the target in two samples. Finally, turbidity also exceeded the target in 30% of the samples.

Table 3.3.33: Water Quality Analysis at Site 9921 by IDEM

West Branch-Fish Creek (IDEM - Site 9921)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.033	mg/L	0/3	0
D.O.	8.418	mg/L	3/10 > 9 mg/L	30%
E. coli	564.52 (Mean) 494.73 (Geomean)	CFU/100 ml	5/5 (235 CFU/100ml)	100%
Nitrate+Nitrite	1.097	mg/L	1/3	33%
TKN	0	mg/L	0/3	0%
pH	7.793	SU	0/10	0%
Phosphorus	0.667	mg/L	2/3	67%
Temperature	19.262	Celsius	0/10	0%
TDS	503.33	mg/L	0/3	0%
TSS	5.667	mg/L	0/3	0%
Turbidity	14.248	NTU	3/10	30%

3.3.4.3 Town of Alvarado-Fish Creek Subwatershed

There are two sample sites located in the Town of Alvarado subwatershed, both sites were sampled by IDEM. Site 1928 is a fixed station that has been used since 1999 and collects data once monthly. However, only data collected since 2002 was used for this project as data before this time is too old to represent current conditions in the subwatershed. Data at Site 13144 was collected in 2010.

Site 1928 is located in the middle of the watershed on the Fish Creek, and therefore represents the input of the land use and runoff from the northern portion of the subwatershed. As can be seen in Table 3.3.34, nearly all parameters sampled in the subwatershed exceeded target levels set by this project, with the exception of pH and TDS. Of significance are that D.O. exceeded the water quality target in 54% of the samples, nitrate+nitrite exceeded the target level in 30% of the samples and TKN exceeded in 80% of the samples, phosphorus exceeded target levels in 35% of the samples, TSS exceeded target levels in 17% of the samples, and turbidity exceeded the target levels in 64% of the samples. Finally, it is important to note that temperature fell below the state standard for a warm water habitat in 21% of the samples.

Table 3.3.34: Water Quality Analysis at Site 1928 by IDEM

Town of Alvarado (IDEM - Site 1928)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.014	mg/L	2/106	2%
D.O.	9.64	mg/L	58/107 > 9 mg/L	54%
Nitrate+Nitrite	1.28	mg/L	32/106	30%
TKN	0.872	mg/L	85/106	80%
pH	7.97	SU	0/101	0%
Phosphorus	0.108	mg/L	37/106	35%
Temperature	12.606	Celsius	22/107 < 4.44 ^oC	21%
TDS	386.26	mg/L	0/106	0%
TSS	18.009	mg/L	18/106	17%
Turbidity	33.215	NTU	68/106	64%

IDEM sample Site 13144 is located downstream of all contributing tributaries to Fish Creek and represents all land use input from below sample Site 1928. As can be seen in Table 3.3.35, E.coli exceeded the state standard in 80% of the samples and the geometric mean exceeded the state standard of 125 CFU/100ml. Nitrate+nitrite, TKN, and TSS exceeded the target level in 33% of the samples, phosphorus exceeded the target level in 100% of the samples, and turbidity exceeded the target level in 90% of the samples. The high TSS and turbidity levels indicate a sedimentation issue at this sample site which will be examined more closely in the following Section 3.4.

Table 3.3.35: Water Quality Analysis at Site 13144 by IDEM

Town of Alvarado (IDEM - Site 13144)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0	mg/L	0/3	0
D.O.	5.959	mg/L	0/10	0%
E. coli	586.46 (Mean) 157.57(Geomean)	CFU/100 ml	4/5 (235 CFU/100ml)	80%
Nitrate+Nitrite	1	mg/L	1/3	33%
TKN	0.367	mg/L	1/3	33%
pH	7.84	SU	0/10	0%
Phosphorus	0.193	mg/L	3/3	100%
Temperature	17.061	Celsius	0/10	0%
TDS	386.67	mg/L	0/3	0%
TSS	17	mg/L	1/3	33%
Turbidity	16.952	NTU	9/10	90%

3.3.4.4 Hamilton Lake Subwatershed

The SCLC has one sample site located in Hamilton Lake subwatershed. Site 24 is located at the Hamilton Lake outlet. All streams in the Hamilton Lake subwatershed drain through Hamilton Lake prior to being sampled, therefore many of the pollutants have already settled out into the lake prior to being analyzed. The SCLC sampled water quality three times during the recreational season in 2008 through 2012. As can be seen in Table 3.3.36, D. O. exceeded the target level in 4 samples, and *E. coli* exceeded the state standard in one sample. It should be noted that Hamilton Lake homes and businesses are serviced by a centralized sewage treatment plant that discharges to Fish Creek, therefore the high *E. coli* reading would more than likely be associated with wildlife, specifically geese, rather than another source of bacteria.

Table 3.3.36: Water Quality Analysis at Site 24 by the SCLC

Hamilton Lake (SCLC - Site 24)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.785	mg/L	4/15 > 9mg/L	27%
E. coli	25.84	CFU/100ml	1/15	7%
pH	8.191	SU	0/15	0%
Phosphorus	0.0204	mg/L	0/15	0%
Temperature	23.101	Celsius	0/15	0%
TSS	3.808	mg/L	0/15	0%

3.3.4.5 Hiram Sweet Ditch Subwatershed

The SCLC also has one sample site located in the Hiram Sweet Ditch Subwatershed. Site 48 is located in Ball Lake, which is also served by the Hamilton Lake WWTP. It should be noted that water quality analysis of lakes is quite different than that of streams and that the analysis does not provide much detail regarding the rest of the watershed. However, results of the sampling that took place between 2008 and 2012 are presented in Table 3.3.37. As can be seen in the table, *E. coli* exceeded the target level in one sample, as did phosphorus. D.O. exceeded the target level in 40% of the samples. Again, high *E. coli* readings are likely due to the geese population at the lake rather than from anthropogenic causes.

Table 3.3.37: Water Quality Analysis at Site 48 by the SCLC

Ball Lake in Hiram Sweet Ditch Subwatershed (SCLC - Site 48)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.827	mg/L	6/15 > 9mg/L	40%
E. coli	31.354	CFU/100ml	1/15	7%
pH	8.269	SU	0/15	0%
Phosphorus	0.026	mg/L	1/15	7%
Temperature	23.313	Celsius	0/15	0%
TSS	4.07	mg/L	0/15	0%

3.3.4.6 Cornell Ditch-Fish Creek Subwatershed

There are three sample sites located in the Cornell Ditch subwatershed; two analyzed by IDEM and one by the Initiative. Sampling at IDEM Site 2005 began in 1999, but only samples taken since 2002 were used for this project. IDEM Site 13168 was sampled in 2010 and the Initiative's Site 124 is a historic site that has been sampled for pH, temperature, pesticides, and *E.c oli* since 1996, for turbidity and D.O. since 2000, for TDS since 2003, and for nutrients since 2008. The following subsections provide the results of each of the sample sites.

IDEM sample Sites 13168 and 2005 are located directly adjacent to each other and represent the same input from the watershed capturing land use and runoff contributions to water pollution in the south west portion of the subwatershed. As can be seen in Table 3.3.38, water quality at Site 13168 exceeded the target level for *E. coli* in 100% of the samples, and the geometric mean exceeded the state geometric mean standard by four times the standard. Phosphorus exceeded the target level in 100% of the samples, TSS exceeded the target level in one sample, and turbidity exceeded the target level in 80% of the samples.

Table 3.3.38: Water Quality Analysis at Site 13168 by IDEM

Cornell Ditch (IDEM - Site 13168)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0	mg/L	0/3	0%
D.O.	6.401	mg/L	0/10	0%
E. coli	680.12(Mean) 547.71(Geomean)	CFU/100 ml	5/5 (235 CFU/100ml)	100%
Nitrate+Nitrite	0.7	mg/L	0/3	0%
TKN	0	mg/L	0/3	0%
pH	8.001	SU	0/10	0%
Phosphorus	0.17	mg/L	3/3	100%
Temperature	16.942	Celsius	0/10	0%
TDS	363.33	mg/L	0/3	0%
TSS	21	mg/L	1/3	33%
Turbidity	27.249	NTU	8/10	80%

IDEM sample Site 2005 is a historic sample site where monthly samples have been collected annually since 2002. As can be seen in Table 3.3.39, D.O. exceeded the target level in 53% of the samples, nitrate+nitrogen exceeded target levels in 25% of the samples and TKN in 78% of the samples. Phosphorus exceeded the target levels in 34% of the samples, TSS exceeded the target level set by this project in 21% of the samples, and turbidity exceeded the target in 65% of the samples. Of significance is that temperature fell below the state standard for a warm water habitat in 21% of the samples.

Table 3.3.39: Water Quality Analysis at Site 2005 by IDEM

Cornell Ditch (IDEM - Site 2005)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.002	mg/L	0/118	0%
D.O.	9.368	mg/L	65/122 > 9mg/L	53%
Nitrate+Nitrite	1.147	mg/L	27/107	25%
TKN	0.787	mg/L	95/122	78%
pH	7.975	SU	0/109	0%
Phosphorus	0.081	mg/L	41/122	34%
Temperature	12.659	Celsius	26/123 < 4.44 ^{o}C	21%
TDS	344.41	mg/L	0/122	0%
TSS	16.524	mg/L	31/122	25%
Turbidity	28.53	NTU	72/110	65%

The Initiative has an historic sample site located in Cornell Ditch. Site 124 is located on Fish Creek right before the confluence of Fish Creek and the St. Joseph River, therefore Site 124 represents the land use input from the entire Cornell Ditch subwatershed. As can be seen in Table 3.3.40, all parameters, with the exception of Alachlor and Metolachlor, do not meet the water quality target levels set by this project. Of significance are that D.O. did not meet target levels in 34% of the samples, *E. coli* did not meet the state standard in 81% of the samples, nitrate+nitrite did not meet target levels in 13% of the samples, phosphorus did not meet target levels in 48% of the samples, and turbidity did not meet target levels in 85% of the samples. While many parameters where drastically above the water quality target, macroinvertebrate and habitat scores from 2012 were both good.

Table 3.3.40: Water Quality Analysis at Site 124 by the Initiative

Cornell Ditch (Initiative - Site 124)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.022	mg/L	12/293 < 4mg/L and 88/293 > 9mg/L	34%
E. coli	731.628 (Mean) 15.507 (Geomean)	CFU/100ml	203/452	81%
Nitrate+Nitrite	0.876	mg/L	18/141	13%
pH	8.127	SU	2/293 > 9mg/L	1%
Phosphorus	0.107	mg/L	71/147	48%
Temperature	18.569	Celsius	1/294 < 4.44 ^{o}C and 1/294 > 29.44 ^{o}C	1%
TDS	353	mg/L	0/267	0%
Turbidity	40.36	NTU	246/291	85%
Atrazine	0.882	ppb	21/302	7%
Alachlor	0.107	ppb	0/302	0%
Metolachlor	0.371	ppb	0/302	0%
Macroinvertebrate	21	pts	Good	
Habitat	81	pts	Good	

3.3.4.7 Summary of Fish Creek Subwatershed

The Fish Creek subwatershed exhibits water quality concerns similar to the other subwatersheds in the project area and are typical of the surrounding land use, which will be examined closer in the following Section 3.4. As can be seen in Table 3.3.41, *E. coli*, TKN, Phosphorus, and turbidity all exceeded the targets set by this project. Those parameters highlighted in the table below, are those parameters in which the averages for all samples taken within the Fish Creek subwatershed that exceed the target levels set by this project. Samples taken from Ball Lake and Hamilton Lake were excluded from the table below as the samples taken from the lakes are not representative of the watershed and cannot accurately be compared to samples taken from streams.

Table 3.3.41: Summary of Water Quality in the Fish Creek Subwatershed

Parameter	Mean	Unit	Target Level
Ammonia	0.01	mg/L	< 0.21 mg/L
D.O.	7.61	mg/L	> 5mg/L but not < 4 mg/L and not > 9 mg/L
E. coli	568.17	CFU/100 ml	< 235 CFU/100ml
Nitrate+Nitrite	0.81	mg/L	< 1.6 mg/L
TKN	0.41	mg/L	< 0.076 mg/L
pH	7.93	SU	> 6 or < 9 SU
Phosphorus	0.18	mg/L	< 0.08 mg/L
Temperature	16.35	Celsius	4.44 - 29.44 ^oC
TDS	408.13	mg/L	< 750 mg/L
TSS	15.64	mg/L	< 20 mg/L
Turbidity	23.8	NTU	< 10.4 NTU
Atrazine	0.33	ppb	< 3.0 ppb
Alachlor	0.06	ppb	< 2 ppb
Metolachlor	0.15	ppb	< 50ppb

3.3.5 Summary of Water Quality in the Upper St. Joseph River Watershed

As can be gleaned from the sections above and Table 3.3.42 below, the major water quality problems observed throughout the watershed are nitrogen, phosphorus, *E. coli* and turbidity. All of these pollutants can discharge from faulty septic systems, barnyard or animal feeding operation runoff, or improper application of manure on crop land. However, high nutrient and turbidity levels can also come directly from row crop fields either through surface runoff or tiled discharge. High nutrient and turbidity levels may also be the cause of inadequate dissolved oxygen levels found throughout the project area. Atrazine also exceeded EPA recommended MCLs after spring application, however atrazine is a minimal problem in comparison to *E. coli*, nutrients, and turbidity. Though, it should be noted that many best management practices that should be implemented to minimize the impact on water quality from nutrients and turbidity will also minimize the impact from herbicides and pesticides. Sources of pollutants will be easier to identify after combining the water quality analysis results with land use data, which will be discussed in the following Section 3.4.

Table 3.3.42 shows the average of all water quality data collected since 2002. Those values that are highlighted exceed the target levels set by this project for that parameter.

Table 3.3.42: Summary of All Water Quality Analyses in the Upper St. Joseph River Watershed

Parameter	West Branch-St. Joseph	East Branch-St. Joseph	Nettle Creek	Fish Creek
Alachlor (ppb)	0.074	0.055	0.22	0.06
Atrazine (ppb)	0.423	0.265	1	0.33
Metolachlor (ppb)	0.19	0.138	0.56	0.15
DO (mg/L)	7.29	8.22	8.53	7.61
E. coli (CFU/100ml)	695.18	661.15	992.66	568.17
Nitrogen, Ammonia (mg/L)	0.07	0.15		0.01
Nitrate+Nitrite (mg/L)	0.625	1.22	1.22	0.81
Nitrite (mg/L)	0.06			
TKN (mg/L)	0.68	0.794		0.41
pH (SU)	7.856	8.3	8.13	7.93
Dissolved Reactive Phosphorus (mg/L)	0.02	0.775		
Phosphorus, Total (mg/L)	0.16	0.093	0.2	0.18
Temperature ^{o}C	17.6	19.651	19.35	16.35
TDS (mg/L)	347.69	272.77	379.06	408.13
TSS (mg/L)	11.39			15.64
Turbidity (NTU)	29.58	31.06	47.86	23.8

3.4 Land Use by Subwatershed

This section will provide information that was obtained through windshield and desktop surveys of each subwatershed, as well as information that has been gathered via government agencies (i.e. IDEM, MI DEQ and OH EPA) and historic data found through research at the subwatershed level. The following sections will be by HUC 10 which will then provide a closer look at the 12-digit HUC level to further help identify specific contributors to water pollution in the project area. However it is important to note that there are particular trends that have been found watershed wide as described below.

The predominate land use in the project area is agriculture, as can be seen in Table 2.6, and Figure 2.11 in Section 2.5, encompassing over 68% of the total land use in the project area. Landowners using modern farming practices are scattered throughout the project area, however it should also be noted that there is a large Amish population in the Northwestern portion of the project area that uses more "traditional" farming practices passed down for generations. It is also common practice within the project area to farm up to the stream and ditch banks as is apparent in the riparian buffer inventory conducted as part of this project. The stream bank buffer inventory conducted as part of this project in 2013 revealed that 64% of the parcels within the USJRW have a riparian buffer less than 60 feet, with 55% of those parcels have a stream buffer equal to 0 – 10 feet in total width. The windshield survey conducted as part of this project revealed that erosion is a major issue contributing to NPS in surface waters, and reports from local health departments, as mentioned in Section 2, revealed that leaky septic systems may be a significant contributor to surface water pollution and the potential for groundwater pollution. In most cases, erosion control, buffering ditch banks, septic system education, and livestock management are the major BMP requirements in the USJRW.

Although there are few urban areas in the project area, it has been found that urban stakeholders do influence the water system in the project area but to a lesser degree overall when compared to the agricultural community. Education and outreach activities regarding septic tanks and stormwater management will be the most effective way of managing urban NPS in the USJRW. The utilization of small scale urban BMPs such as rain barrels and rain gardens will help with stormwater management in urban settings and provide a great resource for educational outreach. It will also be beneficial to work with local municipalities to educate local decision makers on the benefits of stormwater management and offer solutions to stormwater runoff problems. However, the quickest and most dramatic results in reducing nonpoint source pollutants in the USJRW lie in utilizing BMP installation within the agricultural community.

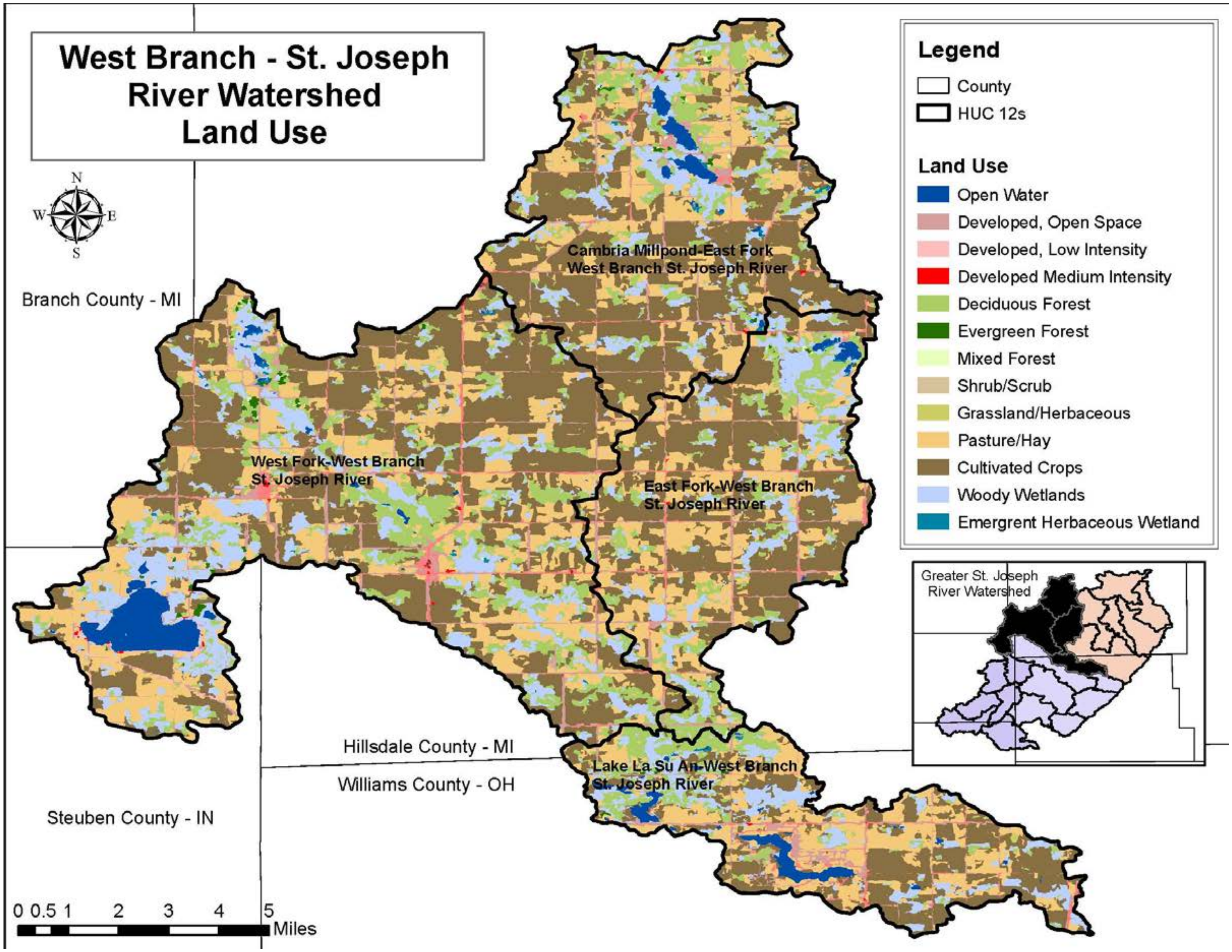
3.4.1 West Branch – St. Joseph River Watershed

The primary influence on water quality in the West Branch – St. Joseph River Watershed is agriculture, as can be seen in Table 3.4.1 and Figure 3.7. According to the National Land Cover Data from the USGS, over 63% of the West Branch watershed is agricultural with nearly 40% of that being in cultivated crops and the rest being hay or pasture land. Developed areas in the watershed comprise approximately 7% of the land use as populated areas of Montgomery, Camden and a small portion of Reading Michigan, Lake Seneca, Ohio, and Clear Lake, Indiana are located in the West Branch, with all but Lake Seneca located specifically in the West Fork-West Branch subwatershed.

Table 3.4.1: Land Use in the West Branch – St. Joseph River Watershed

Landuse	Open Water	Open Space	Dev. Low Intensity	Dev. Medium Intensity	Dev. High Intensity	Deciduous Forest	Evergreen Forest	Mixed Forest
Acres	1823.6 (2.44%)	3372.12 (4.51%)	1407.76 (1.88%)	83.74 (<1%)	12.84 (<1%)	9545.17 (12.78%)	235.4 (<1%)	87.6 (<1%)
Landuse	Shrub/ Scrub	Grassland/ Herbaceous	Hay/ Pasture	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Forest	Barren Land	**TOTAL**
Acres	105.36 (<1%)	345.12 (<1%)	18083.95 (24.21%)	29334.97 (39.27%)	10016.62 (13.41%)	201.39 (<1%)	48.63 (<1%)	74704.2

Figure 3.7: Land Use in the West Branch – St. Joseph River Watershed



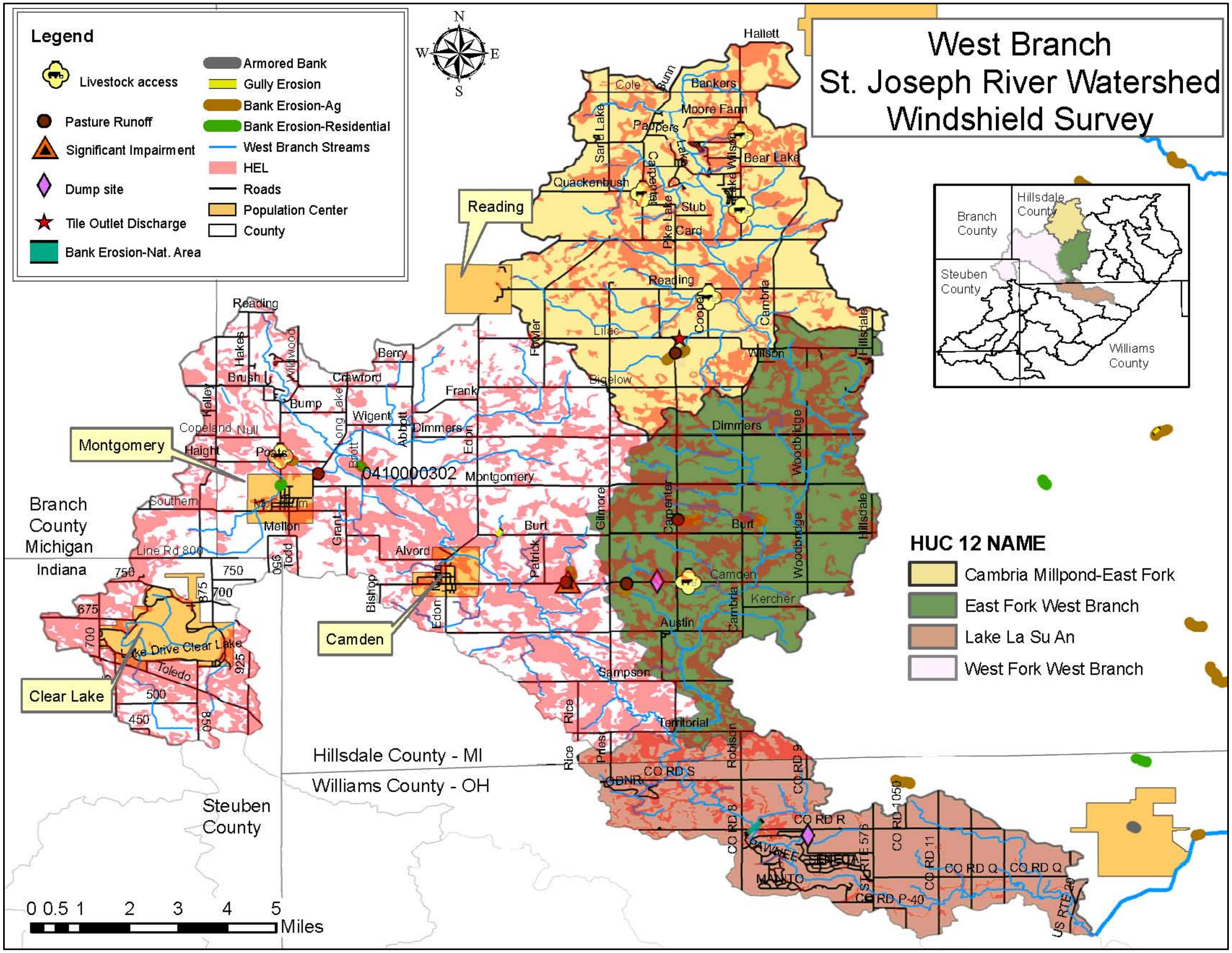
During the windshield survey, 26 sites of particular concern were noted scattered throughout the watershed ranging from livestock access to open water to streambank erosion. There were six total sites where livestock had direct access to open water, two illegal dump sites where garbage and debris were deposited along stream banks, five sites were a livestock pasture exhibited the potential for contaminated runoff to reach open water, 544 feet of streambank was eroded due to what appeared to be natural causes or possibly due to an Increase in stormwater runoff into the stream which Increases the general flow of the streams, 13,354 feet of streambank erosion surrounded by agricultural land, 1,885 feet of gully erosion located in agricultural fields, and approximately 500 feet of agriculture drainage ditch that has armored banks which facilitates faster stormwater delivery to open water. Finally, there is one area of significant impairment due to an extreme amount of algae growth in the stream likely due to runoff from a nearby chicken house, and there are two locations with tile discharge to open water from chicken houses. The potential pollution sites identified during the windshield survey are broken down by subwatershed in Table 3.4.2 and a map identifying each site can be seen in Figure 3.9.

Table 3.4.2: Windshield Survey Observations in the West Branch-St. Joseph River Watershed

	Cambria-Millpond	East Fork-West Branch	Lake La Su An	West Fork-West Branch	Total
Livestock Access	4	1		1	**6**
Significant Impairment				1	**1**
Dump Site		1	1		**2**
Tile Outlet Discharge	1			1	**2**
Pasture Runoff	1	2		2	**5**
Bank Erosion - Natural			544 ft		**544 ft**
Bank Erosion - Residential				672 ft	**672 ft**
Bank Erosion - Ag	4323 ft	5993 ft		3038 ft	**13,354 ft**
Armored Bank		528 ft			**528 ft**
Gully Erosion	303 ft	1085 ft		497 ft	**1,885 ft**

Figure 3.8 also shows the location of highly erodible land in the West Branch – St. Joseph River Watershed. As can be seen in the Figure, there is a significant amount of HEL located in Michigan and Indiana subwatersheds and may be a contributor to the amount of streambank erosion present in the watershed.

Figure 3.8: Windshield Survey Results in the West Branch-St. Joseph River Watershed

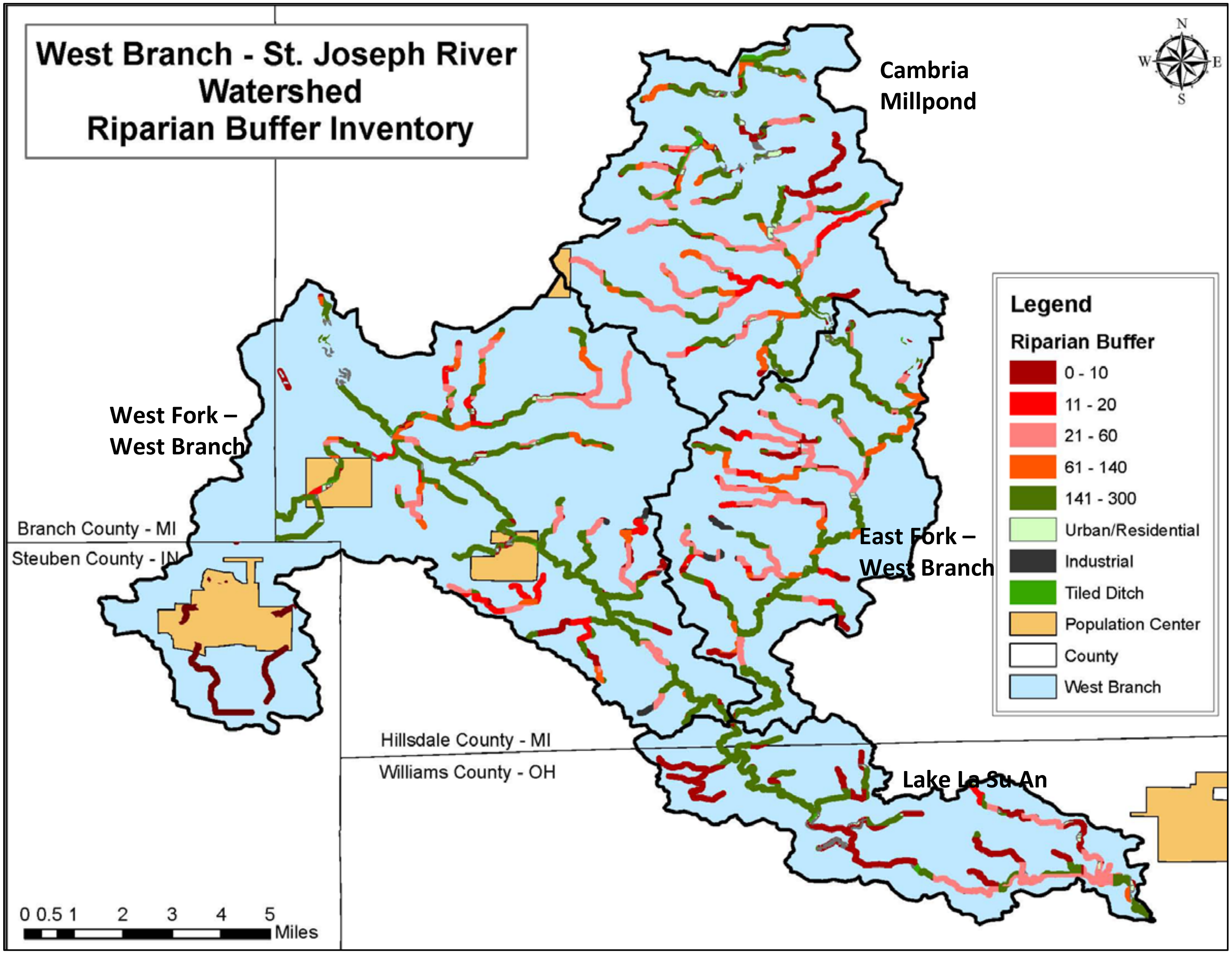


A vegetated riparian buffer will help to slow the flow of surface stormwater runoff to aid in the filtration of the water prior to it being deposited into an open water source such as a stream or ditch. Therefore, a larger riparian buffer provides greater filtration and reduces the risk of streambank erosion. Woody vegetated buffers, Including trees and brush, can also provide shading and habitat for aquatic organisms. The riparian buffer inventory conducted as part of this project in 2013 revealed that more than 50% of the parcels adjacent to open water has a riparian buffer of less than 60 feet with 45% of the parcels having less than 10 feet of riparian buffer. It should be noted that the West Fork-West Branch subwatershed had the least number of parcels adjacent to open water with a significant buffer as 54% of the parcels have a buffer less than 10 feet. Table 3.4.3 lists the percent of parcels that have a designated riparian buffer width in each subwatershed and Figure 3.9 is a map showing the location of those parcels and buffers.

Table 3.4.3: Riparian Buffer Widths in West Branch – St. Joseph River Watershed

	Buffer Width (ft)	Total # of Parcels	Total Percent of Parcels	Cambria Millpond	East Fork-West Branch St. Joseph	West Fork - West Branch St. Joseph	Lake La Su An
	0 - 10	778	45%	42%	33%	54%	39%
	11 - 20	45	3%	2%	5%	3%	<1%
	21 - 60	129	7%	8%	15%	5%	6%
	61 - 140	68	4%	4%	7%	4%	<1%
	141 - 300	359	21%	19%	32%	20%	13%
	Residential	336	19%	23%	5%	1%	39%
	Industrial	9	<1%	<1%	2%	<1%	0%
	Tiled Ditch	23	1%	2%	<1%	1%	1%

Figure 3.9: Riparian Buffer Inventory in the West Branch – St. Joseph River Watershed

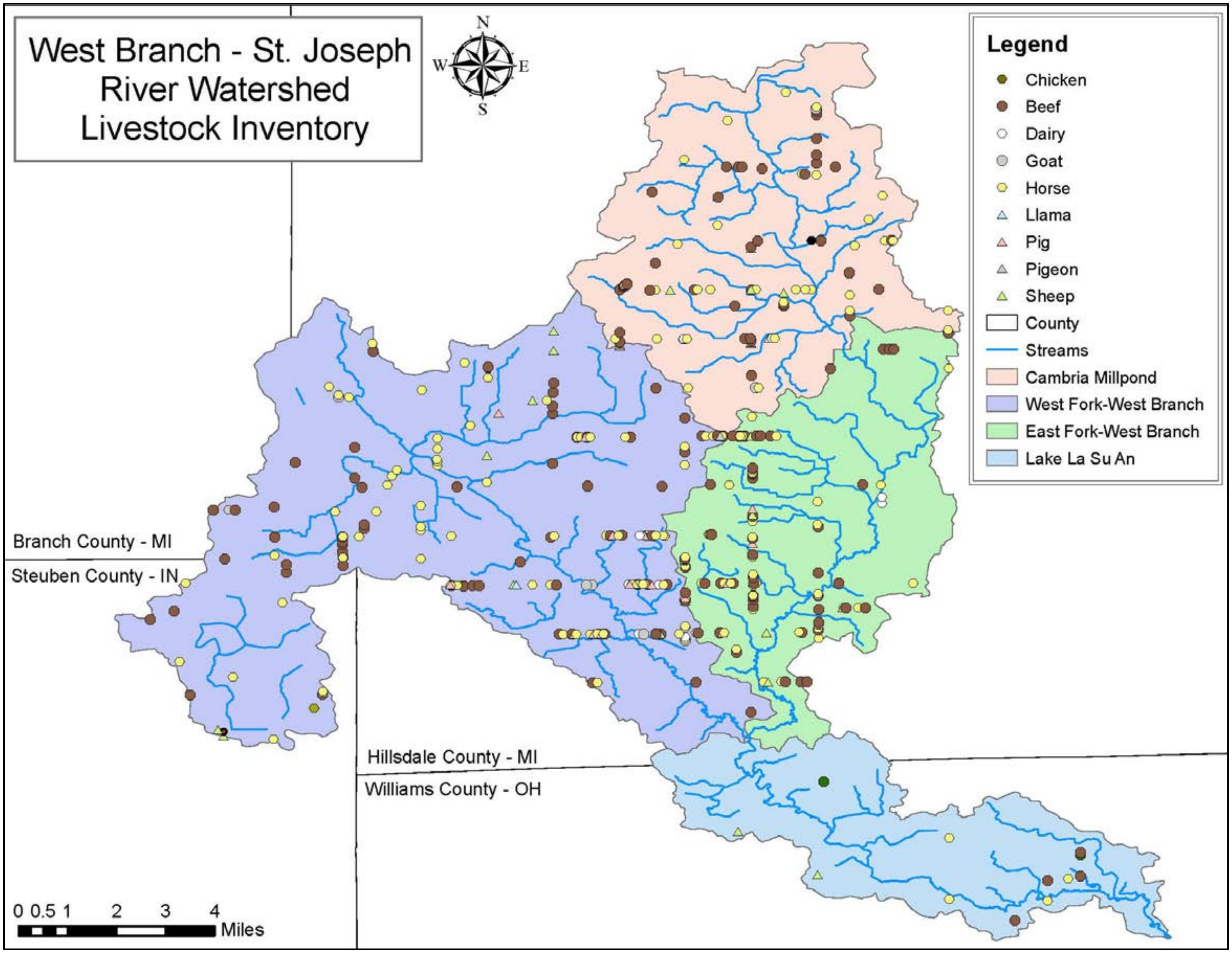


The Livestock inventory conducted in 2009 identified several small hobby farms located within the West Branch Watershed; mostly small horse or beef cow farms. As can be seen in Table 3.4.4, the investigators found a total of 390 properties with livestock present with an estimated 13,480 head of livestock total. Table 3.4.4 lists the type of animal identified in each subwatershed of the West Branch – St Joseph River Watershed and Figure 3.10 shows the location of each of the farms. It should be noted that the livestock inventory presented in this WMP was conducted over four years ago and therefore, the number of farms and animals present may have changed. However, this study is the most accurate count of animals available to date.

Table 3.4.4: Livestock Inventory in the West Branch – St. Joseph River Watershed

	Cambria Millpond		East Fork - West Branch		Lake La Su An		West Fork - West Branch		Total	
	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count
Alpaca					2	24			2	24
Beef	38	651	47	876	4	26	64	1296	153	2849
Chicken							1	20	1	20
Dairy	3	44	3	190			6	140	12	374
Goat	2	22	3	65			7	78	12	165
Horse	33	175	48	346	4	20	75	805	160	1346
Llama							1	2	1	2
Pig	4	415	10	1600			11	6110	25	8125
Pigeon							1	200	1	200
Sheep	6	111	4	72	2	56	11	136	23	375
Total	**86**	**1418**	**115**	**3149**	**12**	**126**	**177**	**8787**	**390**	**13,480**

Figure 3.10: Livestock Inventory in the West Branch – St. Joseph River Watershed



There are several point sources of pollution present within the West Branch – St. Joseph River Watershed that pose a potential risk of polluting surface and/or groundwater Including five Underground Storage Tanks (UST), three of which are leaking (LUST), one CAFO, two NPDES permitted facilities, and three brownfields. All point sources of pollution are listed in the following Tables 3.4.5 through 3.4.8 and the location is shown in Figure 3.11.

Table 3.4.5: Leaking USTs in the West Branch – St. Joseph River Watershed

Facility ID	Name	Address	City	State	Substance	Tank Status
West Fork - West Branch St. Joseph						
00036376	Montgomery Fire Department	125 W McCallum Street	Montgomery	MI	Gasoline	Currently in Use
00007430	Roost Oil Co	6651 S Edon Rd	Reading	MI	Diesel, Gasoline	Currently in Use
14211	4 Corners Grocery and Snack Bar	8680 E 700 N	Fremont	IN	Unknown/Soil and Groundwater/High Priority	Closed

Table 3.4.6: Brownfields Located in the West Branch – St. Joseph River Watershed

Site ID	Name	Address	City	State	Source of Contamination	Priority	Sub-Watershed
46	Crotty Corporation - Montgomery	115 East McCallum	Montgomery	MI	Unknown	16/48	West Fork-West Branch St. Joseph
15	Montgomery Dump	Montgomery Rd	Montgomery	MI	Domestic and Commercial Wastes	36/48	West Fork-West Branch St. Joseph
170	Camden-Frontier Schools	4971 Montgomery Rd	Camden	MI	Heating Oil	28/48	West Fork-West Branch St. Joseph

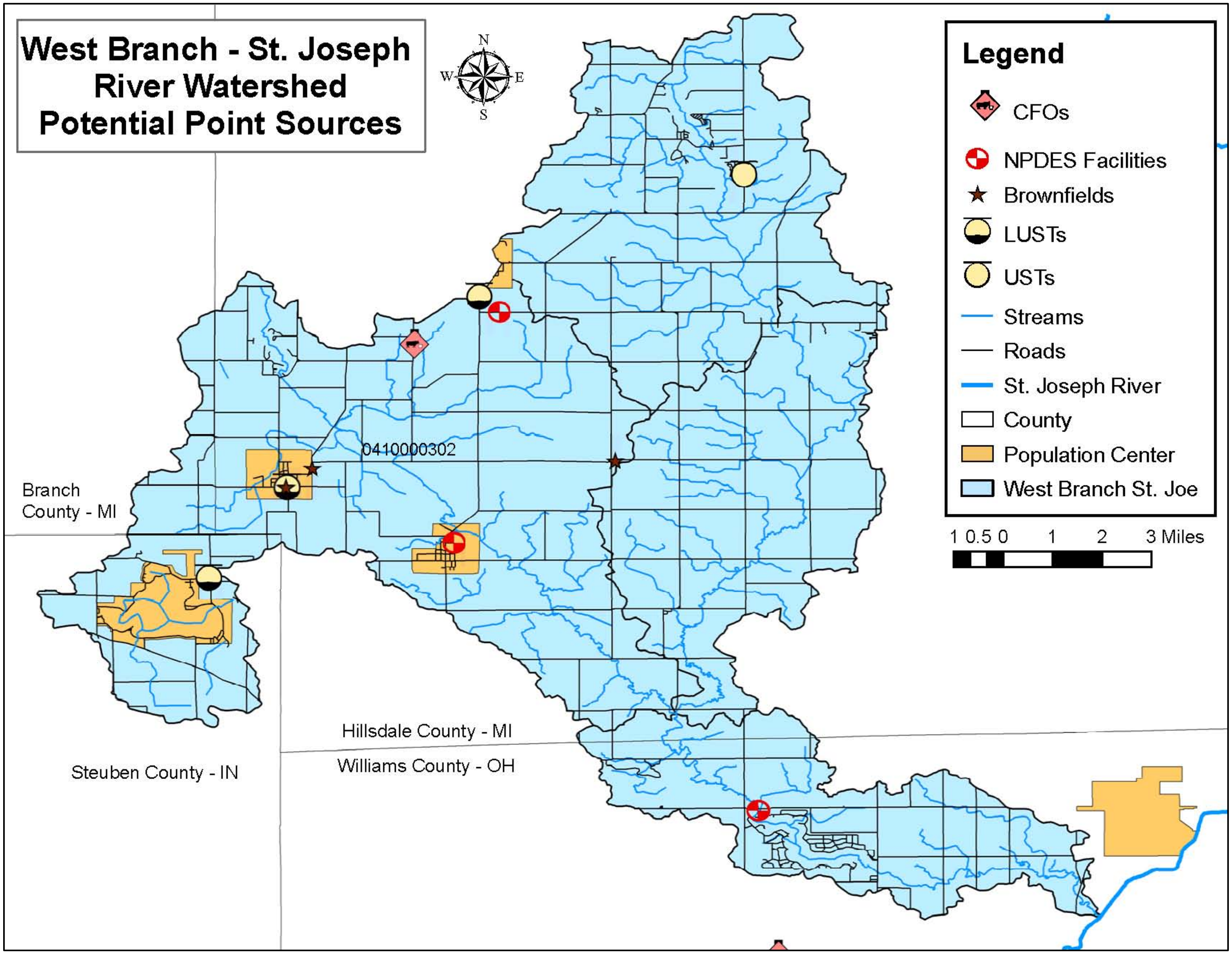
Table 3.4 7: Confined Feeding Operations in the West Branch – St. Joseph River Watershed

Operation	Sub-Watershed	Designation	Animal Type	Animal #
Triple T Farms	West Fork - West Branch St. Joseph	CAFO	Swine	1,600

Table 3.4.6: NPDES Permitted Facilities in the West Branch – St. Joseph River Watershed

Permit Name	Permit #	Issue Date	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3yrs)	Enforcement Actions (I=informal; F=formal)	Sub-Watershed
Aqua Ohio-Lake Seneca WTP	OH0138631	1/11/2007	Williams	Co. Rd. 8	Montpelier	OH	St. Joseph River	13	0	Lake La Su An
Reading WWSL	MIG580009	10/1/2003	Hillsdale	Lilac Rd	Reading	MI	Prouty Drain	Unknown	(F) 1	West Fork - West Branch

Figure 3.11: Potential Point Sources of Pollution in the West Branch – St. Joseph River Watershed



Water quality data collected in the West Branch – St. Joseph River Watershed indicate there is a problem with high *E. coli* levels in the water, as well as high nutrient and turbidity levels. Water samples were collected from the East Fork and West Fork – West Branch St. Joseph River Watersheds. However, more samples were collected from the West Fork, likely due to its higher population and more developed areas.

After examining the land use within the West Branch – St. Joseph it is clear that row crops, livestock, and urban areas all have an influence on water quality in this watershed. It also appears that the West Fork – West Branch subwatershed may be the most significant contributor to pollution in the West Branch – St. Joseph River Watershed as over 3000 feet of agriculture induced streambank erosion was observed during the windshield survey, 54% of the parcels adjacent to open water have less than a 10 ft riparian buffer, and the 2009 livestock inventory counted approximately 8,787 head of livestock present in the subwatershed. The West Fork – West Branch subwatershed is also the largest subwatershed in the West Branch – St. Joseph River Watershed and has the most impervious surfaces comprising the 6.5% of developed land in the watershed. However, the East Fork – West Branch subwatershed also presented with significant streambank erosion within the agricultural area of the subwatershed with nearly 6,000 ft of streambank in need of repair and over 1,000 feet of gullies observed during the windshield survey.

Overall, significant contributors to nonpoint source pollution in the West Branch – St. Joseph River Watershed are livestock, row crops with conventional tillage practices and a lack of riparian buffer, and impervious surfaces in the urban areas.

3.4.2 East Branch – St. Joseph River Watershed

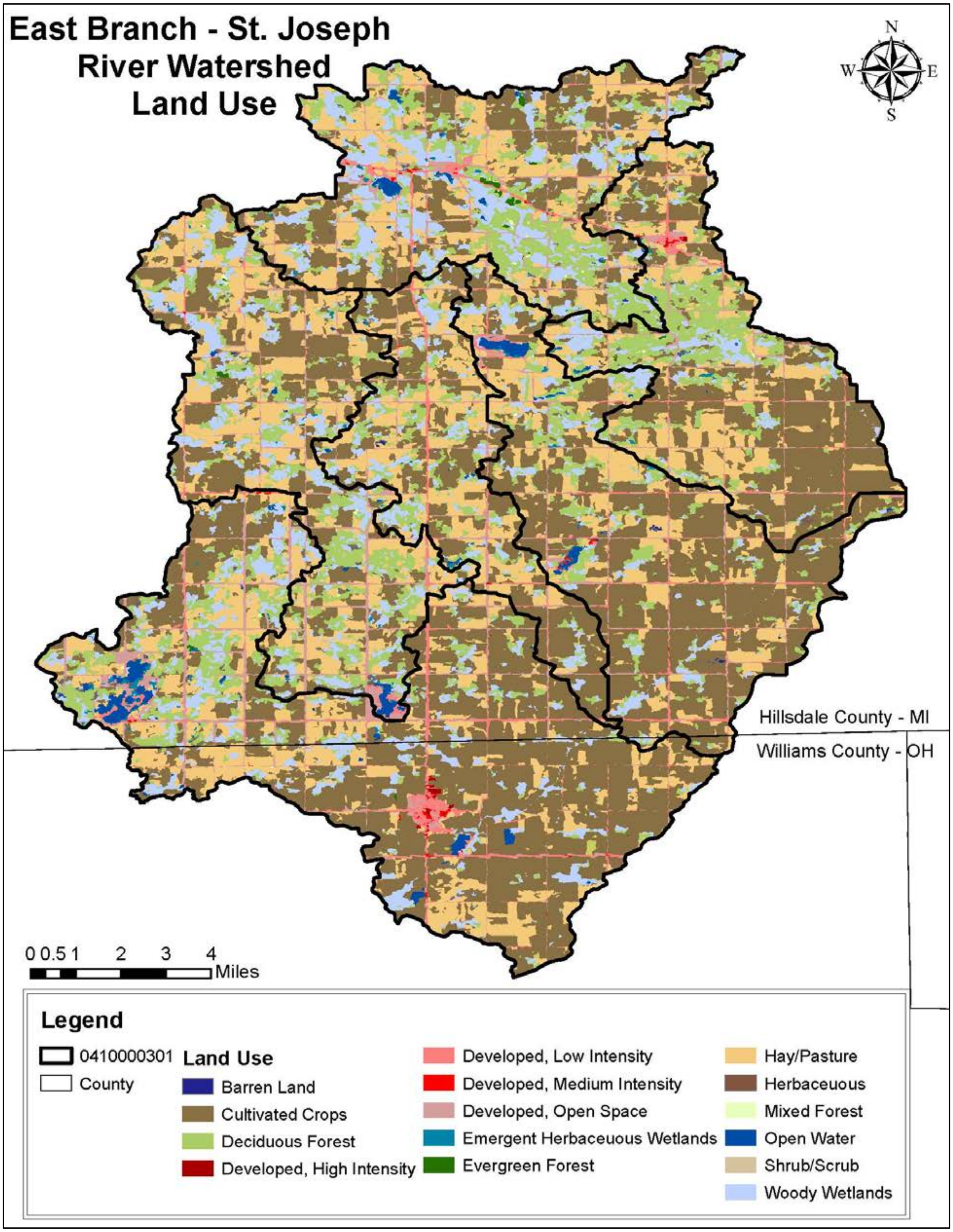
The East Branch – St. Joseph River Watershed is the largest of the four watersheds that comprise the Upper St. Joseph River Watershed at over 117,000 acres. The primary influence on water quality in the East Branch – St. Joseph River Watershed is agriculture, as can be seen in Table 3.4.7 and Figure 3.12. According to the National Land Cover Data from the USGS, over 66% of the East Branch watershed is agricultural with nearly 43% of that being in cultivated crops and the rest being hay or pasture land. Developed areas in the watershed make up approximately 7% of the land use, but note that 4.6% of that is "open land" which is comprised of parks or lawn grasses and generally has less than 20% impervious cover. The Village of Pioneer, Ohio (population – 1374) is located in the East branch – St. Joseph River Watershed and may contribute to water pollution from lawn fertilizers and discharge from the sewage treatment plant (STP).

The East Branch – St. Joseph River Watershed has a many undeveloped areas Including over 16,000 acres of deciduous forest, mostly in northern and western portions of the watershed, and over 13,000 acres of wetlands, again mostly in the northern and western portions of the watershed. Wetlands can play an important role in reducing impacts of flood waters and act as a pollution sink to prevent contaminated stormwater runoff from reaching open water sources. Both of these land uses are important to preserve for environmental and recreational purposes.

Table 3.4.7: Land Use in the East Branch – St. Joseph River Watershed

Landuse	Open Water	Open Space	Dev. Low Intensity	Dev. Medium Intensity	Dev. High Intensity	Deciduous Forest	Evergreen Forest	Mixed Forest
Acres	139.45 <1%	5405.65 4.60%	2695.35 2.30%	157.45 <1%	52.07 <1%	16144.46 13.75%	135.94 <1%	125.61 <1%
Landuse	Shrub/ Scrub	Grassland/ Herbaceous	Hay/ Pasture	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetland	Barren Land	**TOTAL**
Acres	270.44 <1%	606.09 <1%	27938.57 23.79%	50257.16 42.80%	12925.74 11.01%	443.3 <1%	128.79 <1%	117,426.07 100%

Figure 3.12: Land Use in the East Branch – St. Joseph River Watershed



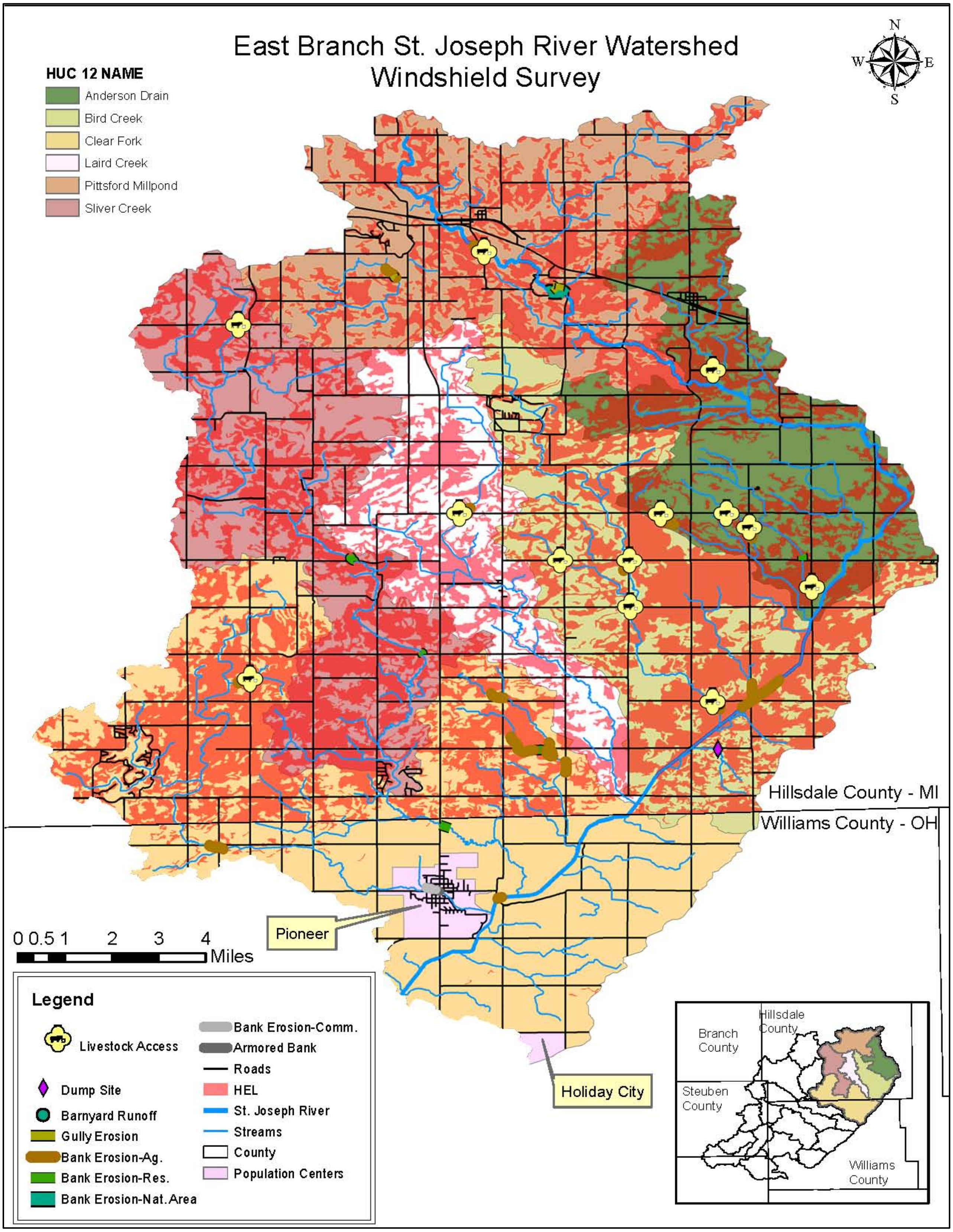
During the windshield survey, 50 sites of particular concern were noted scattered throughout the watershed ranging from livestock access to open water to streambank erosion. There were 13 total sites where livestock had direct access to open water at Amish and English farms containing horses, cattle, or sheep. There were two locations were livestock pastures exhibited the potential for contaminated runoff to reach open water, and one illegal dump site where garbage and debris is regularly dumped along the stream bank. Approximately 37,871 feet of streambank was found to be eroding, with over 31,000 ft of streambank erosion surrounded solely by agricultural land. There was also 496 feet of streambank that is cemented in Pioneer at the Municipal building and park, which also exhibited severe erosion upstream of the armored bank. Finally, approximately 3,268 feet of gully erosion was observed within crop fields located in the East Branch – St. Joseph River Watershed. The potential pollution sites identified during the windshield survey are broken down by subwatershed in Table 3.4.8 and a map identifying each site can be seen in Figure 3.13.

Table 3.4.8: Windshield Survey Observations in the East Branch – St. Joseph River Watershed

	Pittsford Millpond	**Anderson Drain**	**Silver Creek**	**Laird Creek**	**Bird Creek**	**Clear Fork**	**Total**
Livestock Access	1	5	1	1	4	1	13
Barnyard Runoff	1				1		2
Dump Site					1		1
Bank Erosion - Natural	1750 ft						1,750 ft
Bank Erosion - Commercial						1110 ft	1,110 ft
Bank Erosion - Residential		626 ft	1021 ft			2161 ft	3,808 ft
Bank Erosion - Ag	3014 ft	4837 ft		1296 ft	9729 ft	12,327 ft	31,203 ft
Armored Bank						496 ft	496 ft
Gully Erosion	1690 ft	800 ft		380 ft		398 ft	3,268 ft

Figure 3.14 also shows the location of highly erodible land in the East Branch – St. Joseph River Watershed. As can be seen in the Figure, there is a significant amount of HEL located in Michigan subwatersheds and may be a contributor to the amount of streambank and gully erosion present in the watershed.

Figure 3.13: Windshield Survey Observations in the East Branch – St. Joseph River Watershed

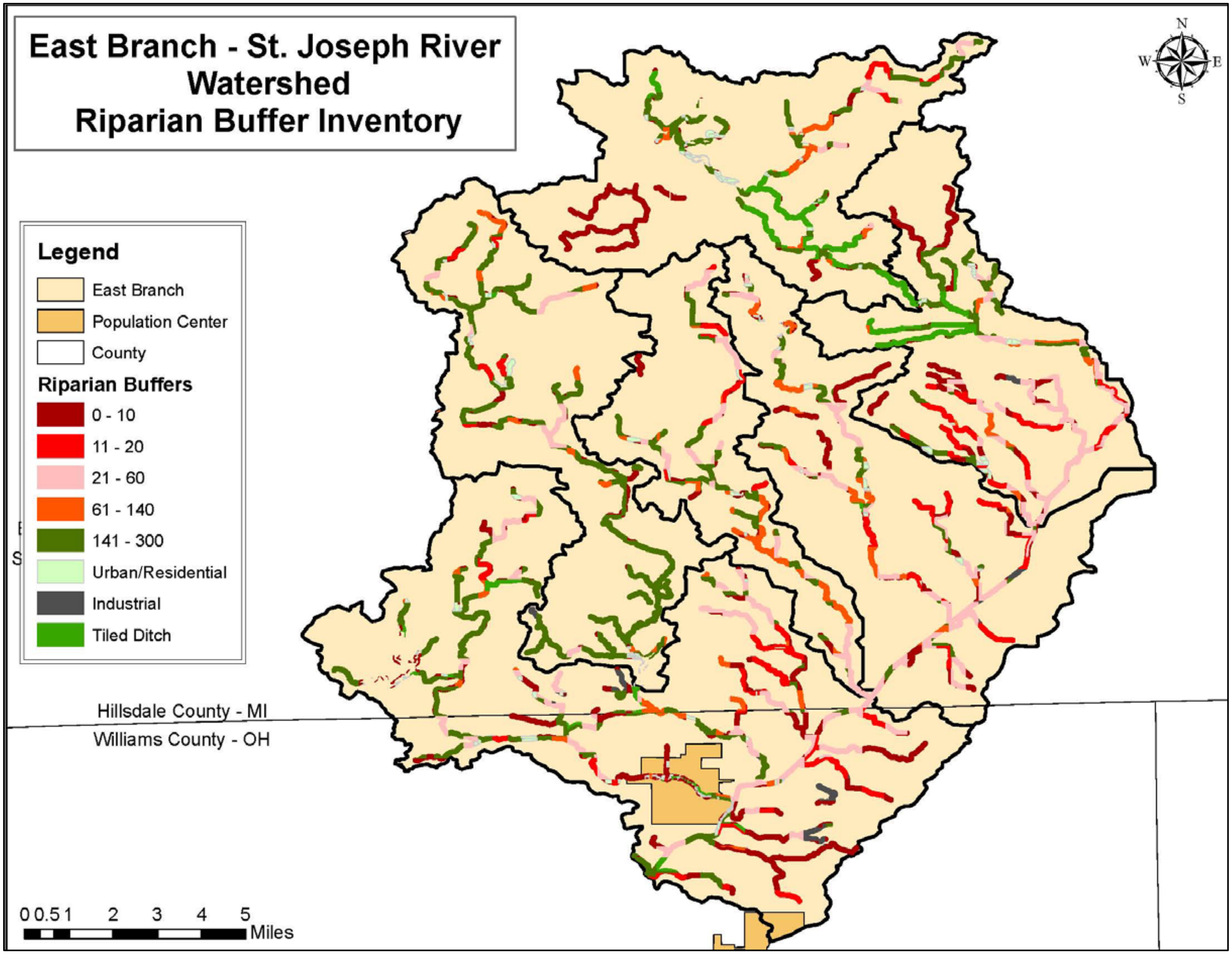


As stated in the previous section, vegetated riparian buffers can significantly reduce streambank erosion and prevent polluted runoff from reaching open water sources. The riparian buffer inventory conducted as part of this project in 2013 revealed that nearly 60% of the parcels adjacent to open water have a riparian buffer of less than 60ft with 45% of the parcels having less than 10 feet of riparian buffer. It should be noted that the Clear Fork - East Branch subwatershed had the least number of parcels adjacent to open water with a significant buffer as 54% of the parcels have a buffer less than 10 feet and that 42% of parcels adjacent to open water in the Silver Creek subwatershed have a riparian buffer of greater than 140 feet wide. Table 3.4.9 lists the percent of parcels that have a designated riparian buffer width in each subwatershed and Figure 3.14 is a map showing the location of those parcels and buffers.

Table 3.4.9: Riparian Buffer Width in East Branch – St. Joseph River Watershed

	Buffer Width	Total # of Parcels	Total Percent of Parcels	Pittsford Millpond	Anderson Drain	Laird Creek	Bird Creek	Silver Creek	Clear Fork-East Branch
	0 - 10	937	45%	44%	44%	35%	43%	23%	54%
	11 - 20	99	5%	2%	10%	9%	6%	2%	4%
	21 - 60	190	9%	4%	16%	16%	15%	5%	7%
	61 - 140	98	5%	5%	4%	14%	7%	4%	2%
	141 - 300	369	18%	23%	12%	20%	10%	42%	15%
	Urban/ Residential	299	14%	16%	7%	6%	17%	22%	14%
	Industrial	16	1%	0%	<1%	0%	<1%	<1%	1%
	Tiled Ditch	81	4%	7%	6%	0%	<1%	<1%	5%

Figure 3.14: Riparian Buffer Inventory in the East Branch – St. Joseph River Watershed

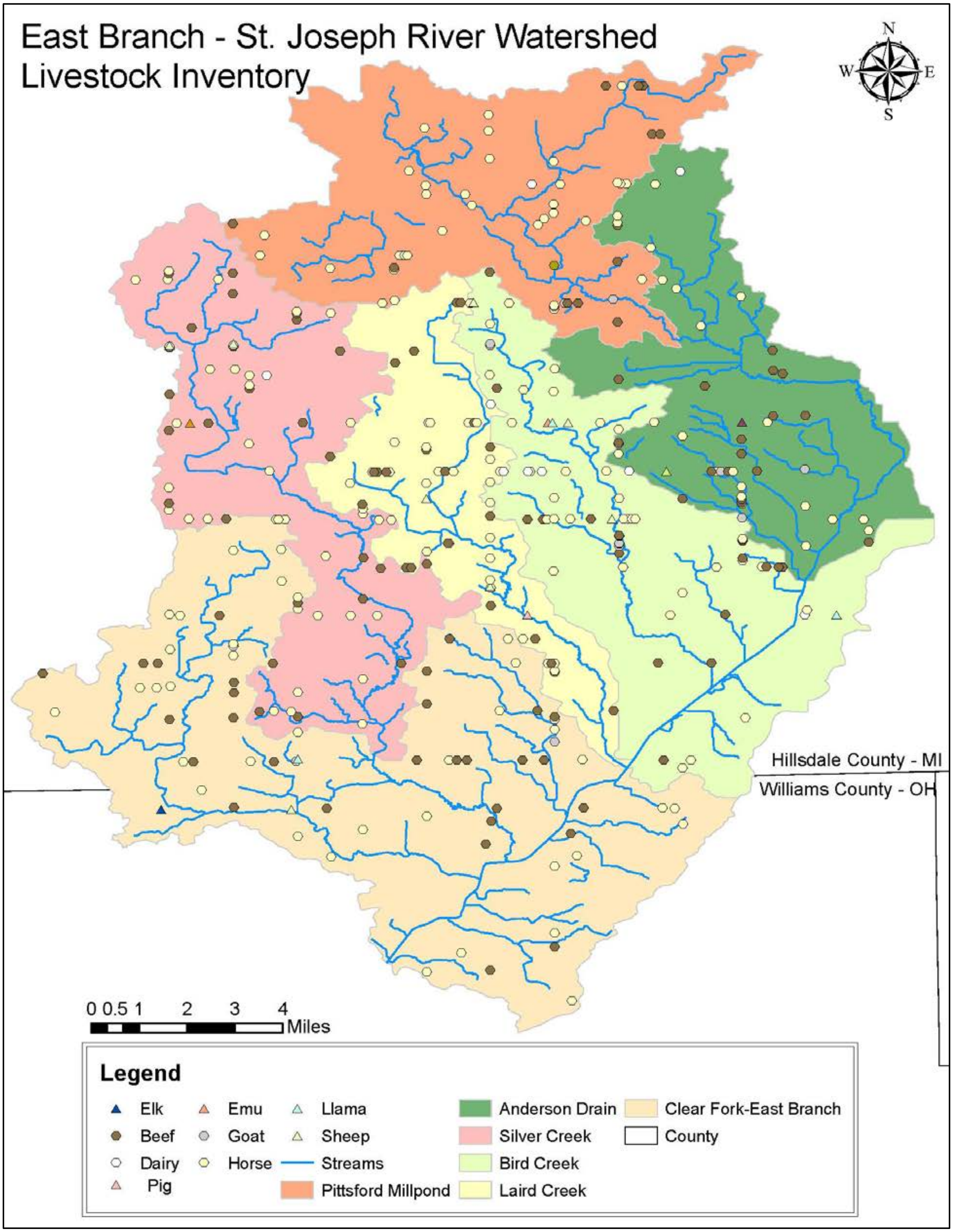


The Livestock inventory conducted in 2009 identified several small hobby farms located within the East Branch Watershed; mostly small horse or beef cow farms. As can be seen in Table 3.4.10, the investigators found a total of 642 properties with livestock present with an estimated 3,873 head of livestock total. While more properties housing livestock are present in the East Branch than the West Branch, note that the total number of livestock in the East Branch – St. Joseph River Watershed is nearly 25% of that which is present in the West Branch Watershed. Therefore, there is likely a greater potential for runoff from livestock operations in the West Branch, as those farms produce more overall manure. Table 3.4.10 lists the type of animal identified in each subwatershed of the East Branch – St Joseph River Watershed and Figure 3.15 shows the location of each of the farms. Remember, the livestock inventory presented in this WMP was conducted over four years ago and therefore, the number of farms and animals present may have changed. However, this study is the most accurate count of animals available to date.

Table 3.4.10: Livestock Inventory in the East Branch – St. Joseph River Watershed

	Pittsford Millpond		Anderson Drain		Bird Creek		Laird Creek		Silver Creek		Clear Fork - East Branch		Total	
	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count
Beef	11	95	18	265	17	187	21	196	23	323	320	458	410	1524
Chicken	1	35											1	35
Dairy	1	100	2	230	5	109	4	147	2	80	1	60	15	726
Deer			1	10									1	10
Elk											1	10	1	10
Emu					1	6							1	6
Goat	3	20	3	9	3	40					2	12	11	81
Horse	33	90	24	81	34	155	26	116	33	104	39	138	189	684
Llama					2	12					1	4	3	16
Pig							1	500					1	500
Sheep			1	20	3	36	2	170	2	45	1	10	9	281
Total	**49**	**340**	**49**	**615**	**65**	**545**	**54**	**1129**	**60**	**552**	**365**	**692**	**642**	**3873**

Figure 3.15: Livestock Inventory in the Eat Branch – St. Joseph River Watershed



There are several point sources of pollution present within the East Branch – St. Joseph River Watershed that pose a potential risk of polluting surface and/or groundwater Including nine Underground Storage Tanks (UST), seven of which are leaking (LUST), six NPDES permitted facilities, and two brownfields. All point sources of pollution are listed in the following Tables 3.4.11 through 3.4.13 and the location of each pollution source is shown in Figure 3.16.

Table 3.4.11: Leaking USTs in the East Branch – St. Joseph River Watershed

Facility ID	Name	Address	City	State	Substance	Tank Status
Anderson Drain - East Branch St. Joseph						
00014548	Pittsford Gas ad Tire	4536 First St	Pittsford	MI	Kerosene	Currently in Use
Pittsford Millpond - East Branch St. Joseph						
00036796	Economy Service	4700 Hudson Rd	Osseo	MI	Gasoline, Diesel	Currently in Use
Clear Fork - East Branch St. Joseph						
000038370	Lake Diane Shore Side Plaza Inc.	1896 W Territorial Rd	Camden	MI	Gasoline	Currently in Use
00003682	Tri-State Pit Stop	7100 W Territorial Rd	Camden	MI	Gasoline	Currently in Use
86009983	SOHIO	State and Elm	Pioneer	OH	Unknown	Confirmed Release, TR2 Evaluation
86000213	North Central Local School	400 Baubice Street	Pioneer	OH	Unknown	Closed
86009988	Former Shell	102 N State Street	Pioneer	OH	Unknown	Confirmed Release

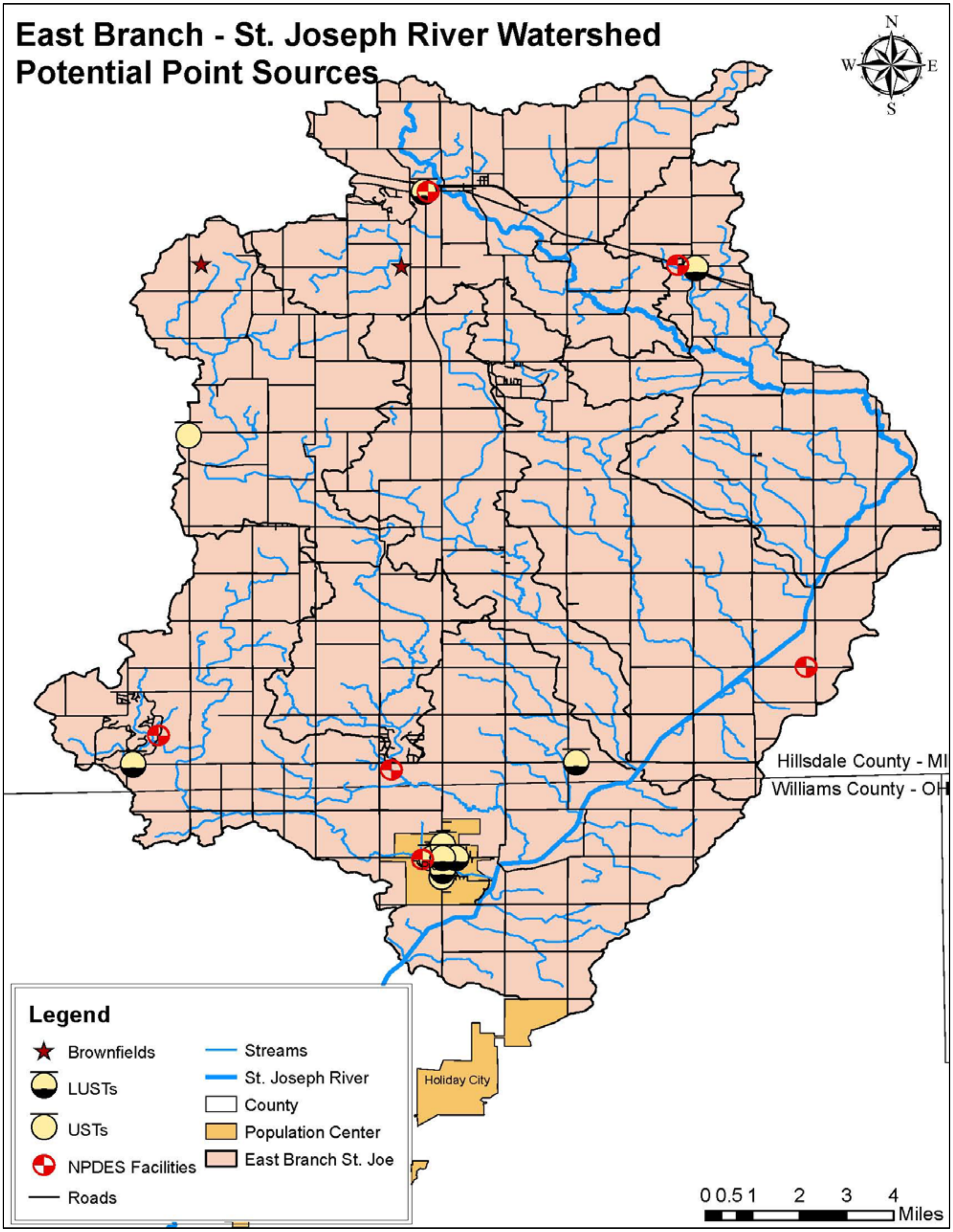
Table 3.4.12: Brownfields in the East Branch - St. Joseph River Watershed

Site ID	Name	Address	City	State	Source of Contamination	Sub-Watershed
30000036	Hillsdale and Cards Roads	RFD #3 Hillsdale Rd	Hillsdale	MI	Unknown	Silver Creek
30000292	Independence Professional Fireworks	4520 Lake Pleasant Rd	Osseo	MI	Explosives	Pittsford Millpond

Table 3.4.13: NPDES Permitted Facilities in the East Branch – St. Joseph River Watershed

Permit Name	Permit #	Issue Date	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3yrs)	Enforcement Actions (I=informal; F=formal)	Sub-Watershed
Amboy Twp-Lake Diane WWSL	MIG580013	4/1/2004	Hillsdale	Tyson Trail	Camden	MI	Clear Fork Creek	0	0	Clear Fork - East Branch
Amboy Twp-WWSL	MIG580008	4/1/2004	Hillsdale	Merry Lake	Waldron	MI	Silver Lake	0	0	Clear Fork - East Branch
Pioneer STP	OH0022535	4/28/1975	Williams	Unknown	Pioneer	OH	East Branch St. Joseph	9	0	Clear Fork - East Branch
Pittsford SSDS WWSL	MIG580006	4/1/2004	Hillsdale	Hudson Rd	Pittsford	MI	St. Joseph River	1	0	Anderson Drain - East Branch
RC Plastics Inc	MIG250455	11/3/2007	Hillsdale	Hudson Rd	Osseo	MI	Twin Lakes Drain	Unknown	Unknown	Pittsford Millpond - East Branch
Waldron WWSL	MIG580007	4/1/2004	Hillsdale	Tuttle Rd	Waldron	MI	East Branch St. Joseph	0	0	Bird Creek-East Branch

Figure 3.16: Potential Point Sources of Pollution in the East Branch – St. Joseph River Watershed



Water quality data collected in the East Branch – St. Joseph River Watershed indicate there is a problem with high *E. coli* levels in the water, as well as high nutrient and turbidity levels. Water samples were collected from all subwatersheds in the East Branch - St. Joseph River Watershed except Silver Creek. However, a sample was collected in Clear Fork, downstream from the confluence of Silver Creek, and therefore, all subwatersheds are represented in the water quality sampling analysis for the East Branch – St. Joseph River Watershed.

After examining the land use within the East Branch – St. Joseph it is clear that row crops and livestock have the most significant influence on water quality in this watershed. It appears that streambank erosion induced by agriculture practices may be the most significant contributor to the high turbidity levels seen in the watershed as over 31,000 feet of stream bank surrounded by agriculture land, needs to be repaired, as was observed during the windshield survey, with over 12,000 feet of that being in the Clear Fork subwatershed. There is also a lot of land classified as HEL, according to the County soil surveys which may contribute to the high turbidity levels found through water sampling. It should also be noted that Clear Fork had the greatest percent of parcels adjacent to open water with less than a 20 foot buffer at 58% and that Silver Creek had the least percent of parcels adjacent to open water with less than a 20 foot buffer at 25%.

The most significant contributors to livestock induced pollution in the water are likely Laird Creek, Bird Creek, and Anderson Drain as those three subwatersheds housed 10 of the 13 sites where livestock were observed to have access to open water during the windshield survey. Also, Laird Creek was found to have the highest concentration of livestock per operation according to the 2009 livestock inventory with an average of 21 animals per farm, where the East Branch – St. Joseph River watershed overall average is only 6 animals per farm.

Urban areas may also be a contributor to pollution in the East Fork – St. Joseph River Watershed, specifically the Clear Fork subwatershed, as the Village of Pioneer is located in that subwatershed and is the only subwatershed exhibiting commercial landuse induced streambank erosion (1,110 ft of erosion) and also has the most feet of streambank adjacent to residential property in need of stabilization (2,161 ft). Pioneer also houses several potential point sources of pollution Including LUSTs and NPDES permitted facilities.

Overall, significant contributors to nonpoint source pollution in the East Branch – St. Joseph River Watershed are livestock, row crops with conventional tillage practices and a lack of riparian buffer. Also, after examining land use surrounding Pioneer and comparing water samples upstream and downstream from Pioneer, Pioneer may also be a significant contributor to water pollution.

3.4.3 Nettle Creek Watershed

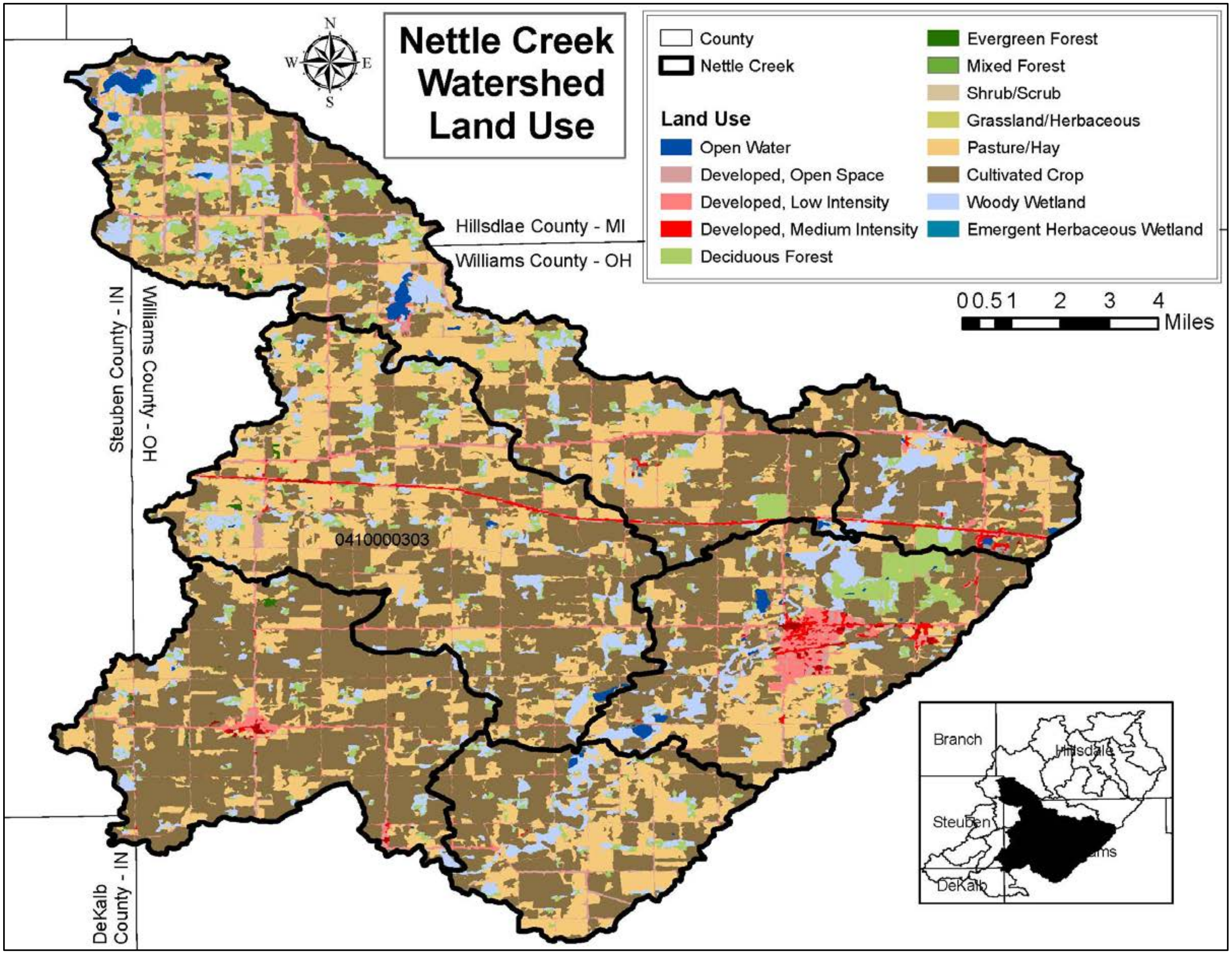
The Nettle Creek Watershed is the second largest of the four watersheds that comprise the Upper St. Joseph River Watershed at over 102,000 acres. The primary influence on water quality in the Nettle Creek Watershed is agriculture, as can be seen in Table 3.4.14 and Figure 3.17. According to the National Land Cover Data from the USGS, nearly 78% of the Nettle Creek watershed is agricultural with over 50% of that being in cultivated crops and the rest being hay or pasture land. Developed areas in the watershed make up slightly over 7% of the land use, but note that 3.7% of that is “open land” which is comprised of parks or lawn grasses and generally has less than 20% impervious cover. Montpelier (P=4,076) and Edon (P=832) are located wholly within the Nettle Creek Watershed, and Blakeslee (P=96) and Holiday City (P=52), Ohio are located partially within Nettle Creek Watershed and may contribute to water pollution from lawn fertilizers and discharge from the waste water treatment plants (WWTPs) and sewage treatment plant (STP).

The Nettle Creek Watershed has a few undeveloped areas including over 5,700 acres of deciduous or evergreen forest, mostly in northeastern portion of the watershed, just north of Montpelier. Woody wetlands are scattered throughout the watershed, mostly along the St. Joseph River riparian area, and making up over 8% of the watershed land use. Wetlands can play an important role in reducing impacts of flood waters and act as a pollution sink to prevent contaminated stormwater runoff from reaching open water sources. Both of these land uses are important to preserve for environmental and recreational purposes.

Table 3.4.14: Land Use in the Nettle Creek Watershed

Landuse	Open Water	Open Space	Dev. Low Intensity	Dev. Medium Intensity	Dev. High Intensity	Deciduous Forest	Evergreen Forest	Mixed Forest
Acres	706.76 <1%	3784.49 3.71%	2811.55 2.75%	730.89 <1%	187.53 <1%	5609.48 5.49%	144.33 <1%	37.7 <1%
Landuse	**Shrub / Scrub**	**Grassland/ Herbaceous**	**Hay/ Pasture**	**Cultivated Crops**	**Woody Wetlands**	**Emergent Herbaceous Wetland**	**Barren Land**	**TOTAL**
Acres	30.62 <1%	178.87 <1%	28070.7 27.48%	51447.35 50.37%	8289.67 8.12%	50.78 <1%	53.99 <1%	102134.7 100%

Figure 3.17: Land Use in the Nettle Creek Watershed



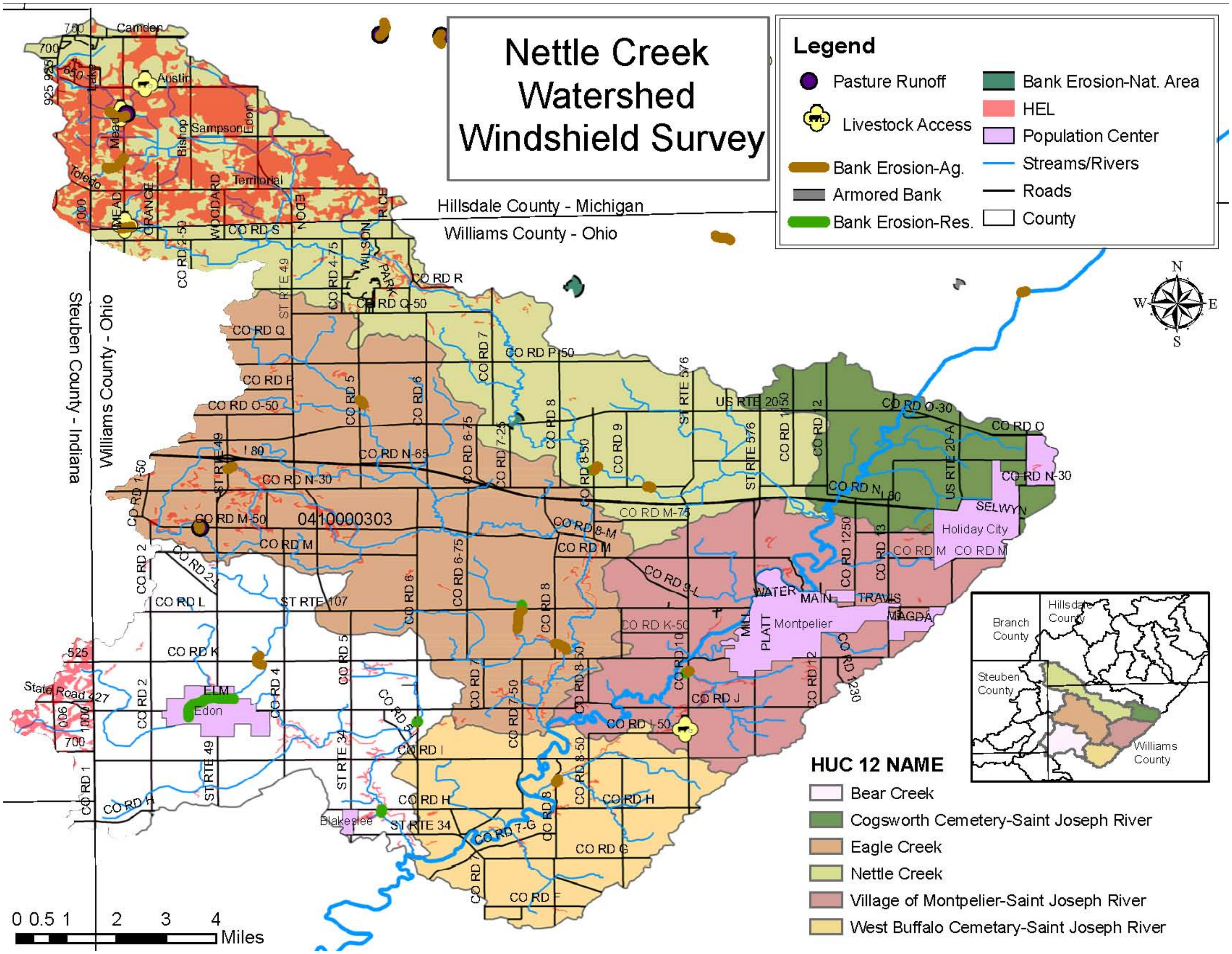
During the windshield survey, 27 sites of particular concern were noted scattered throughout the watershed ranging from livestock access to open water to streambank erosion. There were four total sites where livestock had direct access to open water; two cattle farms, one with horses and one with sheep. There were two locations were livestock pastures exhibited the potential for contaminated runoff to reach open water. Approximately 20,153 feet of streambank was found to be eroding, with over 13,000 ft of streambank erosion directly adjacent to agricultural land. There was also approximately 99 feet of streambank that was armored with rip rap in Bear Creek subwatershed to prevent streambank erosion, though it did not appear to be as effective as other streambank stabilization methods could be. There was 277 feet of streambank with erosion issues, though a direct source of the erosion was not present as the area is surrounded by natural area. Finally, approximately 6,508 feet of streambank erosion was observed adjacent to residential property which could be prevented with wider riparian buffers and other stormwater control methods as turf lawns do not absorb water as well as natural ground cover. Table 3.4.15 lists the potential pollution sites identified during the windshield survey by subwatershed and Figure 3.19 shows the location of each site. No issues were observed in the Cogsworth Cemetery subwatershed during the windshield survey.

Table 3.4 15: Windshield Survey Observations in the Nettle Creek Watershed

	Nettle Creek	Cogsworth Cemetary	Eagle Creek	Village of Montpelier	Bear Creek	West Buffalo Cemetery	Total
Livestock Access	3			1			4
Pasture Runoff	1		1				2
Bank Erosion - Residential	172 ft (1)		581 ft (1)	233 ft (1)	5522 ft (3)		6,508 ft
Bank Erosion - Ag	6277 ft (5)		5239 ft (5)	132 ft (1)	1297 ft (1)	423 ft (1)	13,368 ft
Armored Bank					99 ft		99 ft
Bank Erosion _ Natural	277 ft						277 ft

Figure 3.18 also shows the location of highly erodible land in the Nettle Creek Watershed. As can be seen in the Figure, there is a significant amount of HEL located in Michigan and Indiana subwatersheds and may be a contributor to the amount of streambank erosion present in the watershed. Ohio exhibits little HEL, though referring back to Figure 2.3, a significant amount of soil is classified as PHEL in the Williams County Soil Survey.

Figure 3.18: Windshield Survey Observations in the Nettle Creek Watershed

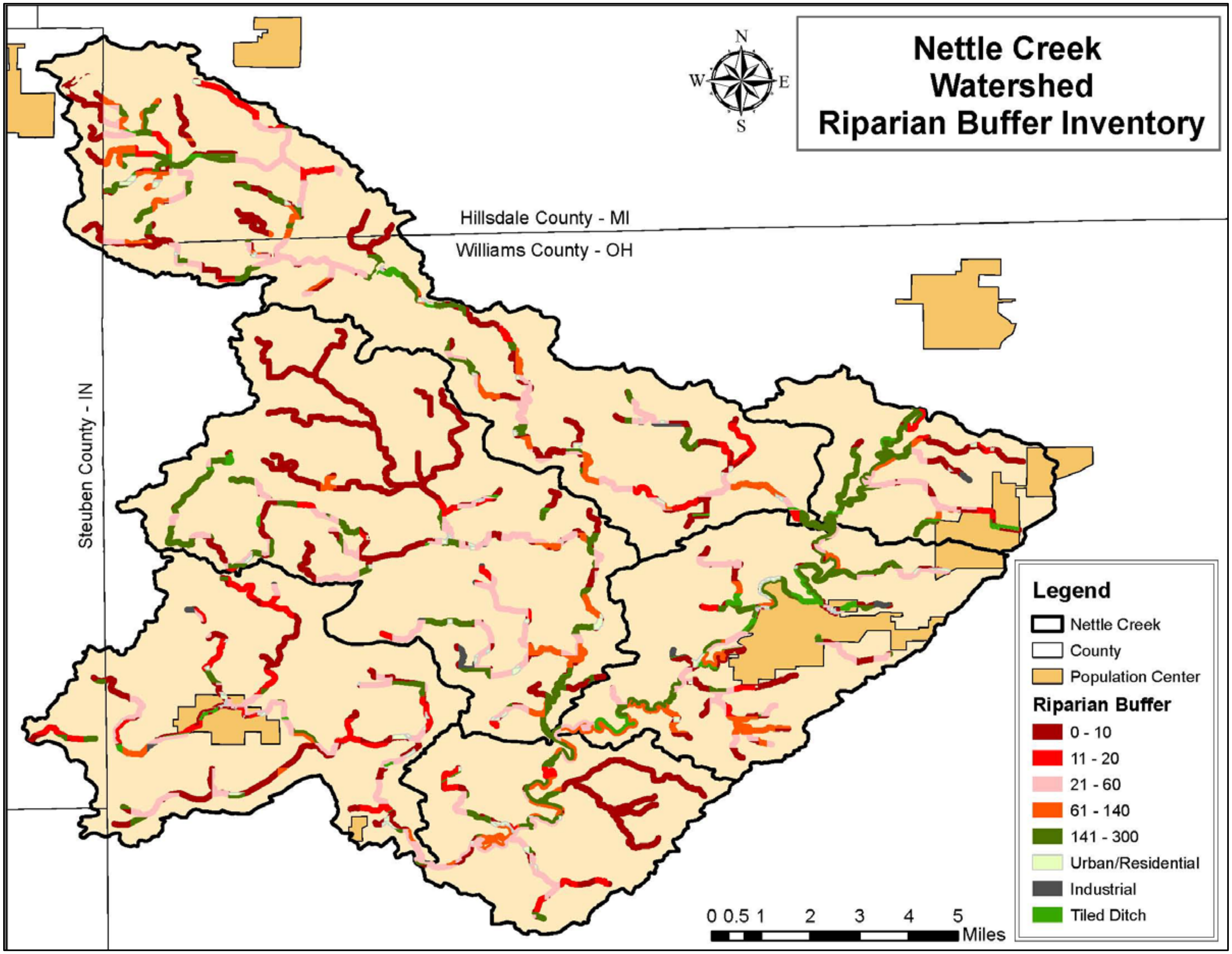


As stated in the previous section, vegetated riparian buffers can significantly reduce streambank erosion and prevent polluted runoff from reaching open water sources. The riparian buffer inventory conducted as part of this project in 2013 revealed that nearly 70% of the parcels adjacent to open water have a riparian buffer of less than 60 ft with 53% of the parcels having less than 10 feet of riparian buffer. It should be noted that the Bear Creek subwatershed had the least number of parcels adjacent to open water with a significant buffer as 66% of the parcels have a buffer less than 20 feet . Table 3.4.16 lists the percent of parcels that have a designated riparian buffer width in each subwatershed and Figure 3.19 is a map showing the location of those parcels and buffers.

Table 3.4.16: Riparian Buffer Inventory in Nettle Creek Watershed

	Buffer Width	Total # of Parcels	Total Percent of Parcels	Nettle Creek - Nettle Creek	Cogsworth Cemetery	Eagle Creek	Village of Montpelier	Bear Creek	West Buffalo Cemetery
	0 - 10	872	53%	49%	45%	57%	51%	55%	51%
	11 - 20	85	5%	5%	7%	4%	1%	11%	6%
	21 - 60	181	11%	12%	10%	12%	8%	11%	14%
	61 - 140	78	5%	8%	3%	3%	4%	1%	9%
	141 - 300	190	11%	13%	24%	13%	12%	5%	13%
	Urban/ Residential	174	10%	10%	3%	7%	17%	12%	7%
	Industrial	15	1%	<1%	1%	1%	<1%	1%	0%
	Tiled Ditch	64	4%	2%	7%	3%	7%	4%	<1%

Figure 3.19: Riparian Buffer Inventory in Nettle Creek Watershed

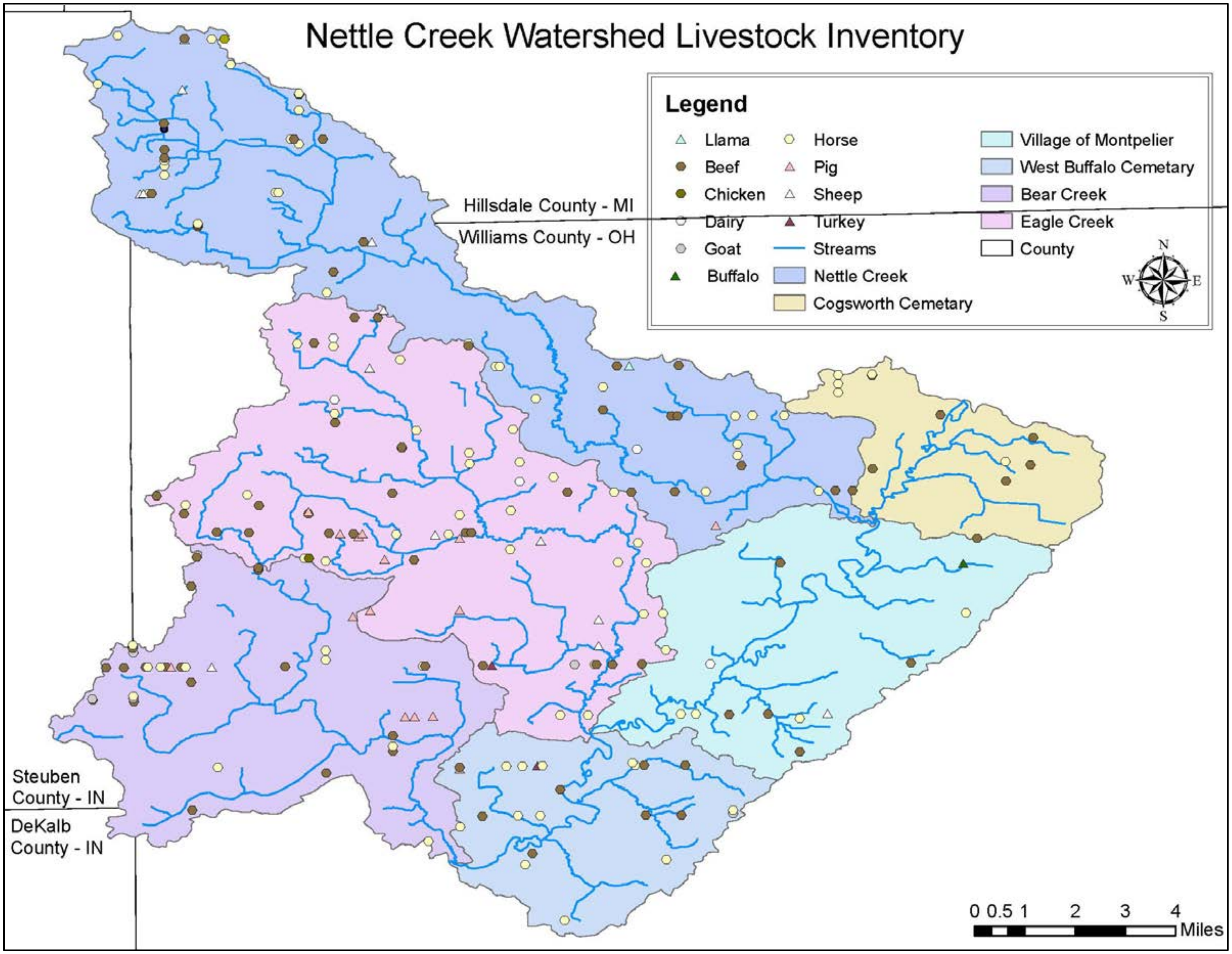


The Livestock inventory conducted in 2009 identified several small hobby farms located within the Nettle Creek Watershed; mostly small horse or beef cow farms, though there are more pig farms located in Nettle Creek than the other three watersheds that make up the Upper St. Joseph River Watershed. As can be seen in Table 3.4.17, the investigators found a total of 213 properties with livestock present with an estimated 9,784 head of livestock total. It should be noted that Nettle Creek has the second highest population of livestock of the four watersheds that make up this project's area though the average number of livestock present at each location is greater than in the other watersheds. Therefore, proper manure management is very important in the Nettle Creek watershed as there is likely a greater potential for runoff from livestock operations in the Nettle Creek watershed, as the farms produce more overall manure. Table 3.4.17 lists the type of animal identified in each subwatershed of the Nettle Creek Watershed and Figure 3.20 shows the location of each of the farms. Remember, the livestock inventory presented in this WMP was conducted over four years ago and therefore, the number of farms and animals present may have changed. However, this study is the most accurate count of animals available to date.

Table 3.4.17: Livestock Inventory in the Nettle Creek Watershed

	Nettle Creek - Nettle Creek		Cogsworth Cemetery - Nettle Creek		Village of Montpelier - Nettle Creek		Eagle Creek		Bear Creek		West Buffalo Cemetery - Nettle Creek		Total	
	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count
Beef	22	260	7	61	6	49	23	609	20	1285	8	194	86	2458
Buffalo					1	10							1	10
Chicken	1	30					1	20					2	50
Dairy	1	5000			1	40	3	175					5	5215
Goat							1	4	3	380	1	50	5	434
Horse	28	147	5	24	5	14	29	91	13	84	11	47	91	407
Pig	1	20					8	263	5	660	1	10	15	953
Sheep	5	228			1	4			1	15			7	247
Turkey											1	10	1	10
Total	**58**	**5685**	**12**	**85**	**14**	**117**	**65**	**1162**	**42**	**2424**	**22**	**311**	**213**	**9784**

Figure 3.20: Livestock Inventory in the Nettle Creek Watershed



There are several point sources of pollution present within the Nettle Creek Watershed that pose a potential risk of polluting surface and/or groundwater including 12 Underground Storage Tanks (UST), five of which are leaking (LUST), six NPDES permitted facilities, and one CAFO. All point sources of pollution are listed in the following Tables 3.4.18 through 3.4.20 and the location of each pollution source is shown in Figure 3.21.

Table 3.4.18: Leaking Underground Storage Tanks in the Nettle Creek Watershed

Facility ID	Name	Address	City	State	Substance	Tank Status
Bear Creek						
86002251	The Big Three	512 Washington St	Blakeslee	OH	Unknown	Confirmed Release/Tier 1 Eval.
86000581	Edon Main Stop	11024 St Rt 49	Edon	OH	Unknown	Confirmed Release/Tier 1 Eval.
Village of Montpelier - St. Joseph River						
86006975	Circle K 5633	106 Main St	Montpelier	OH	Unknown	Confirmed Release/Tier 1 Eval.
8610031	Powers and Sons	410 W Main St	Montpelier	OH	Unknown	Confirmed Release
86002955	Holiday City Stop n Go	St Rt 15	Montpelier	OH	Unknown	Confirmed Release/Deficiency

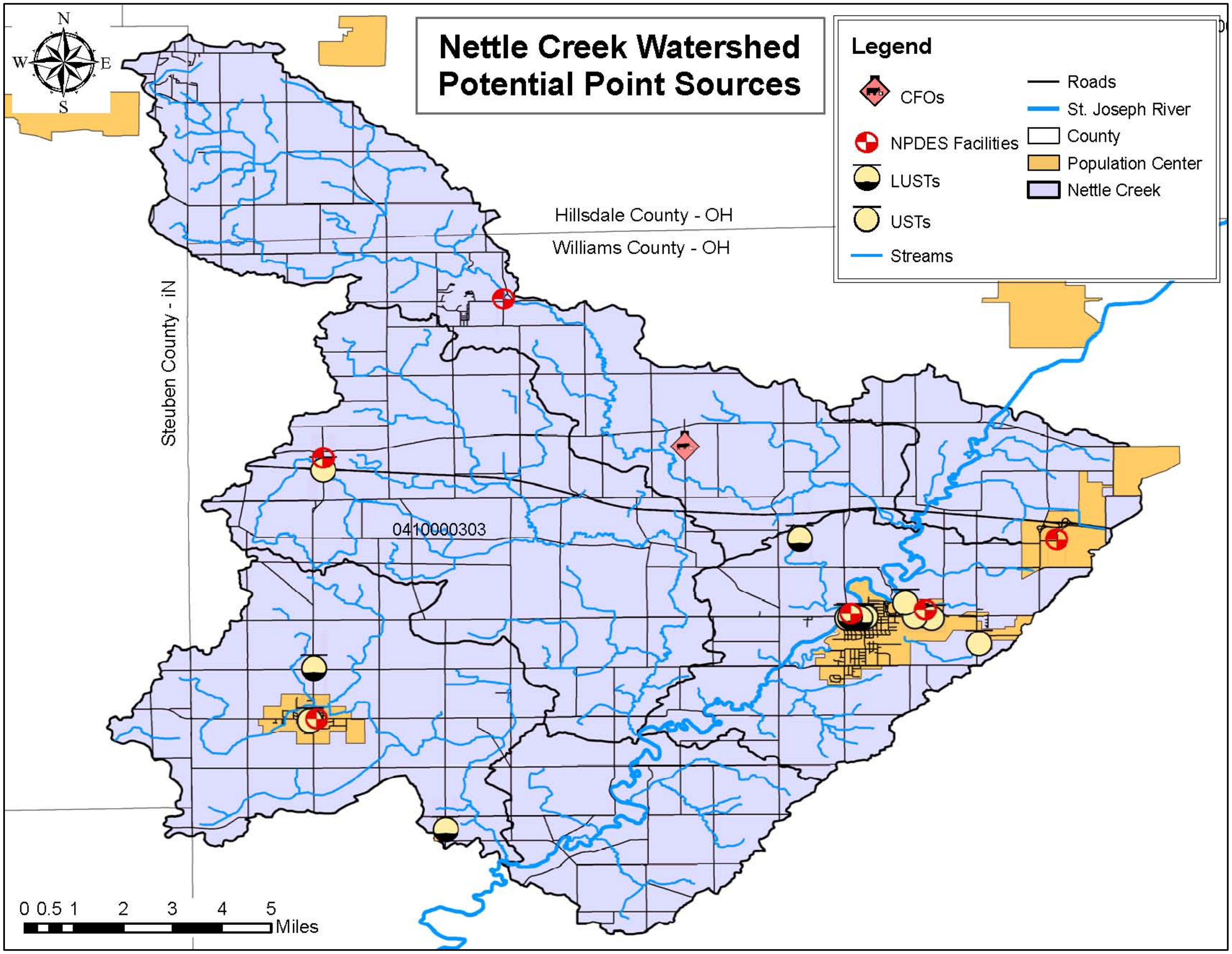
Table 3.4.19: Confined Feeding Operations in the Nettle Creek Watershed

Operation	Sub-watershed	Designation	Animal Type	Animal #
Bridgewater Dairy, LLC	Nettle Creek	CAFO	Dairy	3,900

Table 3.4.20: NPDES Permitted Facilities in the Nettle Creek Watershed

Permit Name	Permit #	Issue Date	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3yrs)	Enforcement Actions (I=informal; F=formal)	Sub-Watershed
Chase Brass and Copper Co.	OH0002941	11/28/1974	Williams	St. Rte. 15	Holiday City	OH	John Lattener Ditch	5	0	Village of Montpelier - St. Joseph River
Edon WWTP	OH0095141	4/1/2007	Williams	E. Indiana	Edon	OH	Bear Creek	3	(I) 1	Bear Creek
Exit One WWTP	OH0122351	11/1/1996	Williams	St. Rte. 49	Edon	OH	Eagle Creek	2	0	Eagle Creek
Montpelier WTP #2	OH0138177	5/5/2006	Williams	Porter Rd	Montpelier	OH	St. Joseph River	0	0	Village of Montpelier - St. Joseph River
Montpelier WWTP	OH0021831	1/20/1975	Williams	Creek Blvd	Montpelier	OH	St. Joseph River	2	(I) 1	Village of Montpelier - St. Joseph River
Nettle Lake Area STP	OH0053376	8/1/2001	Williams	Co. Rd. 5-75	Montpelier	OH	Nettle Creek	3	0	Nettle Creek

Figure 3.21: Potential Point Sources of Pollution in the Nettle Creek Watershed



Water quality data collected in the Nettle Creek Watershed indicate there is a problem with high *E. coli* levels in the water, as well as high phosphorus and turbidity levels. It should be noted that averages for the three parameters mentioned above measured higher in the Nettle Creek watershed than the other three watersheds that comprise the USJRW. It should also be noted that even though the watershed average for nitrogen did not exceed target levels, nitrate+nitrite levels in Bear Creek measured higher than target levels in 95% of the samples at Site 132; downstream from the Edon WWTP. Water samples were collected from Nettle Creek, Eagle Creek, and Bear Creek subwatershed.

After examining the land use within the Nettle Creek Watershed it is clear that row crops, livestock, and urban areas have the most significant influence on water quality in this watershed. It appears that streambank erosion induced by agriculture practices may be the most significant contributor to the high turbidity levels seen in the watershed as over 13,000 feet of stream bank surrounded by agriculture land, need to be repaired, as was observed during the windshield survey, with 86% of those eroding streambanks being in Nettle Creek and Eagle Creek subwatersheds. There is also a significant amount of land being classified as HEL in the portions of the watershed located in MI and IN and a significant amount of land in the watershed located in Ohio classified as PHEL, according to the County soil surveys, which may contribute to the high turbidity levels found through water sampling.

The riparian buffer inventory revealed that Bear Creek has the most significant percent of parcels adjacent to open water with less than 20 feet of riparian buffer and Eagle Creek has the most significant percent of those with less than a 10 foot buffer. Though, a lack of riparian buffer is significant throughout the watershed with the percent of parcels adjacent to open water with a buffer of less than 20 feet ranging from 52% - 66%.

The most significant contributor to livestock induced pollution in the water is likely Nettle Creek – Nettle Creek subwatershed since three sites were located during the windshield survey where livestock have direct access to open water, and according to the livestock inventory, it has the most livestock present (though likely due to the presence of Bridgewater Dairy which is a CAFO housing up to 3,600 animals). It should be noted too, that the investigators of the livestock inventory estimated the CAFO to house 5,000 animals, but through further investigation is in known the dairy is much smaller. Therefore, excluding the dairy from the livestock inventory would show 685 head of livestock present in the Nettle Creek – Nettle Creek subwatershed at 57 locations which would not be a significant issue. Of significance, is the animal density of the sites identified during the livestock inventory in Bear Creek. According to the estimated numbers, each farm would house 57 animals on average, which could pose a threat due to the high volume of manure produced at each location. Proper manure management would be necessary to limit the potential for polluted runoff from those sites.

Urban areas may also be a contributor to pollution in the Nettle Creek Watershed, specifically the Bear Creek and the Village of Montpelier – St. Joseph subwatersheds, as those subwatersheds encompass the urban areas located in the Nettle Creek watershed. Water Quality analysis in the Bear Creek subwatershed indicate that significant pollution is being deposited in the stream via surface flow or a NPDES permitted facility outfall. Bear Creek also exhibited the most significant amount of streambank erosion adjacent to residential property accounting for 85% of the residential streambank erosion in the Nettle Creek Watershed.

Overall, significant contributors to nonpoint source pollution in the Nettle Creek Watershed are livestock, row crops with conventional tillage practices and a lack of riparian buffer and urban areas, specifically Edon and Montpelier.

3.4.3 Fish Creek Watershed

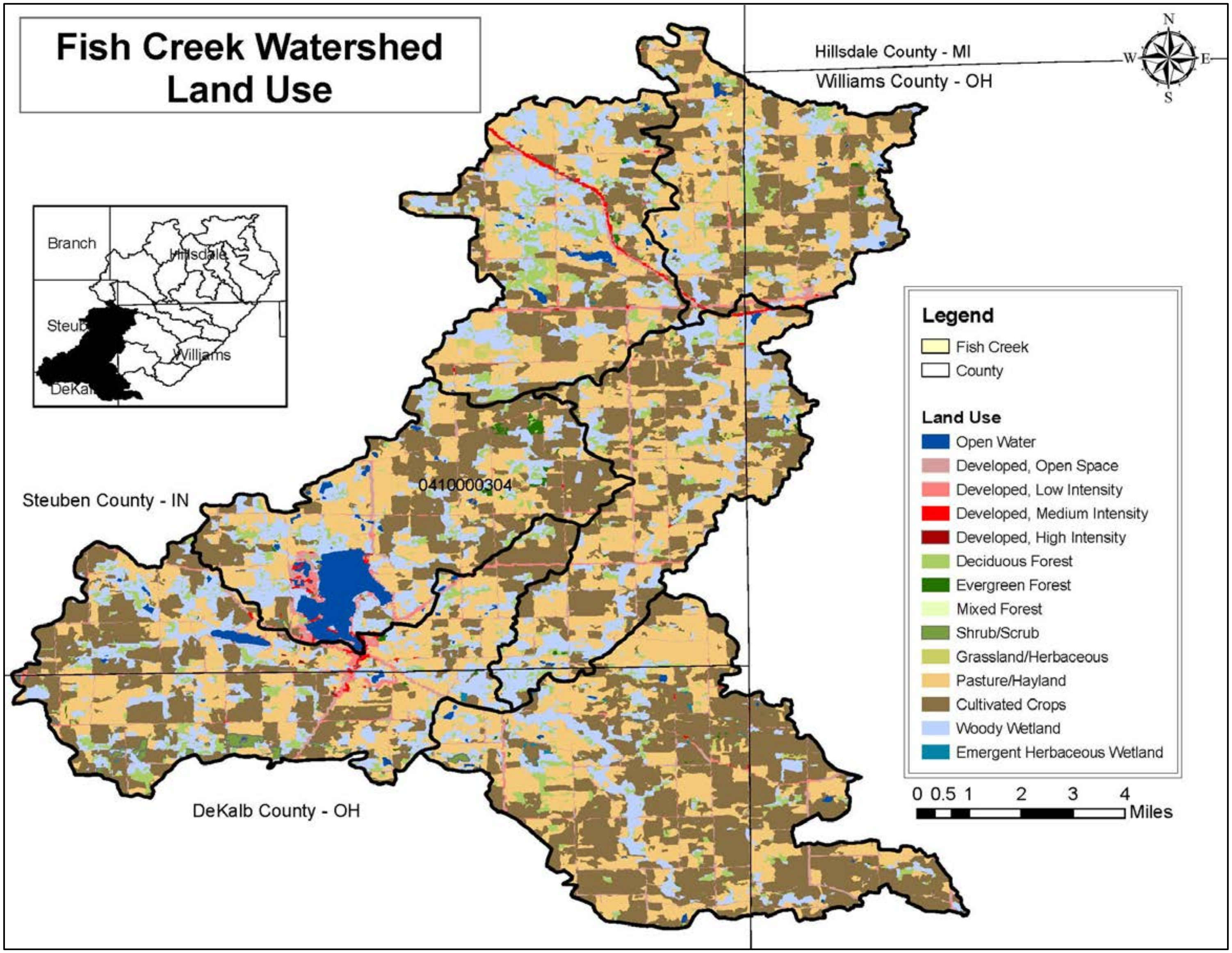
The Fish Creek Watershed is the third largest of the four watersheds that comprise the Upper St. Joseph River Watershed at over 78,710.50 acres. The primary influence on water quality in the Fish Creek Watershed is agriculture, as can be seen in Table 3.4.21 and Figure 3.22. According to the National Land Cover Data from the USGS, approximately 70% of the Fish Creek watershed is agriculture, which is almost evenly split between row crops and pasture or hay land. Developed areas in the watershed make up just under 6% of the land use, but note that 4.05% of that is "open land" which is comprised of parks or lawn grasses and generally has less than 20% impervious cover. Hamilton, Indiana (P=1,527) is located within Fish Creek Watershed and may contribute to water pollution from lawn fertilizers and discharge from the waste water treatment plant (WWTP).

The Fish Creek Watershed has a few undeveloped areas including over 5000 acres of deciduous or evergreen forest, mostly in northeastern portion of the watershed, just north of Montpelier. Woody wetlands are scattered throughout the watershed, though are mostly along the Fish Creek riparian area, and making up nearly 15% of the watershed land use. Wetlands can play an important role in reducing impacts of flood waters and act as a pollution sink to prevent contaminated stormwater runoff from reaching open water sources. The number of acres that are undeveloped may be attributed to a settlement made due to a diesel fuel spill in 1993. Since then, more than 700 acres of land have been reforested and over 400,000 trees have been planted. Many landowners signed 20 year agreements to keep the land forested. Many of those agreements are due to expire in the next several years, leaving the land open to be converted to a different land use. It will be important to work with these land owners to preserve and protect the forested land and wetlands for environmental and recreational purposes.

Table 3.4.21: Land Use in the Fish Creek Watershed

Landuse	Open Water	Open Space	Dev. Low Intensity	Dev. Medium Intensity	Dev. High Intensity	Deciduous Forest	Evergreen Forest	Mixed Forest
Acres	1333.79 1.69%	3185.03 4.05%	1048.37 1.33%	324.82 <1%	49.87 <1%	4939.81 6.28%	229.5 <1%	48.3 <1%
Landuse	Shrub/ Scrub	Grassland/ Herbaceous	Hay/ Pasture	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Forest	Barren Land	**TOTAL**
Acres	262.37 <1%	309.34 <1%	26416.36 33.56%	28976.03 36.81%	11499.12 14.61%	87.79 <1%	0 0	78710.50 100%

Figure 3.22: Land Use in the Fish Creek Watershed

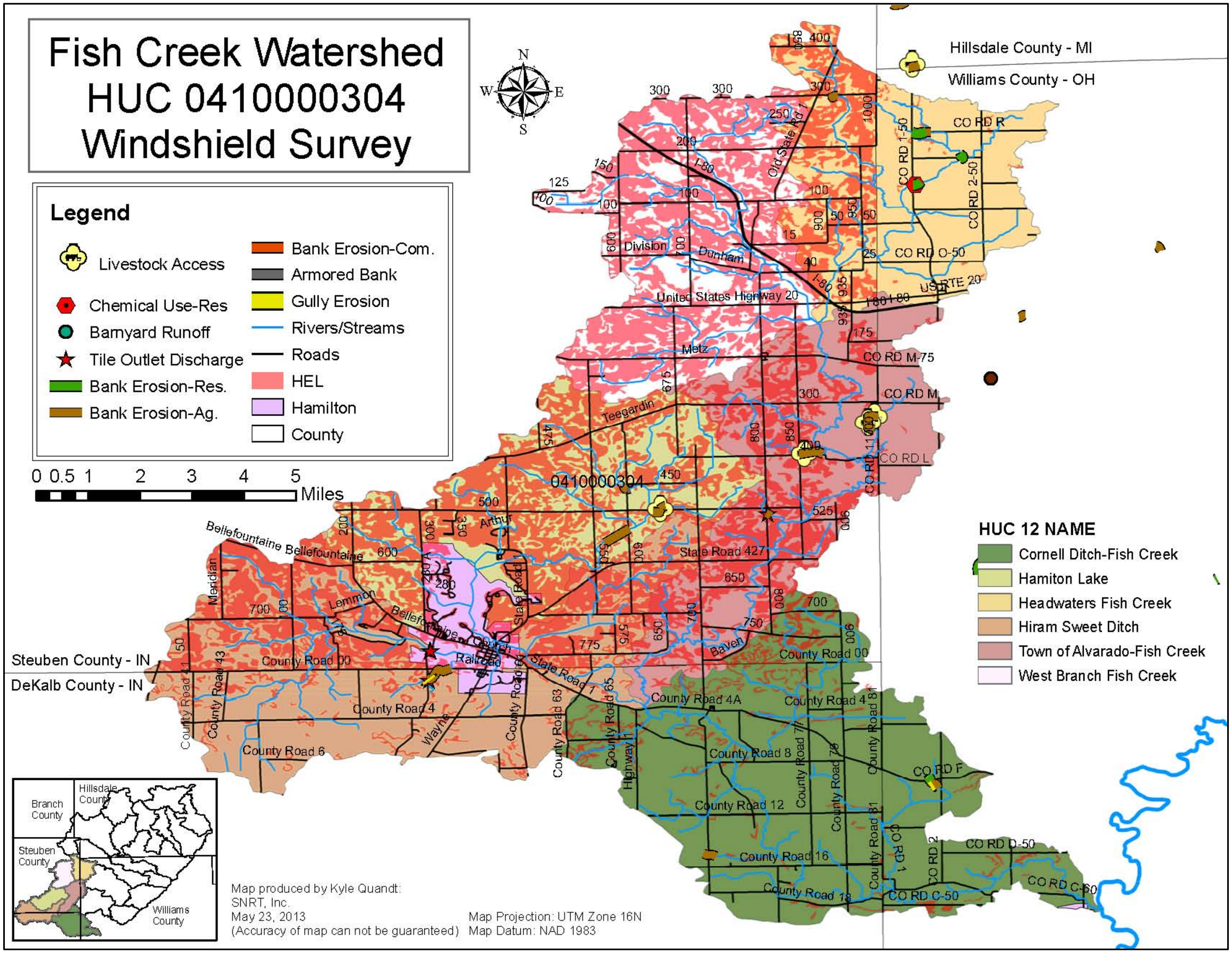


During the windshield survey, 30 sites of particular concern were noted scattered throughout the watershed ranging from livestock access to open water to streambank erosion. There were four total sites where livestock had direct access to open water; two Amish cattle farms, and two Amish farms with horse access to open water. One site was observed where the streambanks adjacent to a residential property was completely denude of vegetation and appeared as though chemicals were used to kill the vegetation. Four sites were observed where underground tiles were discharging into a stream or ditch; two sites were along the Fish Creek at the Fish Creek walking trail where new construction was taking place in the open field that was being drained by the tiles, another tile was in a Hiram Sweet Ditch subwatershed at a row crop field, though it was discharging during a drought. The last tile was located on an Amish farm and was discharging from a barn. Approximately 16,524 feet of streambank was found to be eroding, with 13,712 ft of streambank erosion directly adjacent to agricultural land. There was also approximately 427 feet of streambank that was armored with cement. One site was located in Hamilton at Homestead Rd, and the other was on S 600 E and is an ideal location to install a two-stage ditch to protect the streambanks from erosion. Two locations were observed with gully erosion from agriculture fields, totaling over 300 feet of erosion. Table 3.4.22 lists the potential pollution sites identified during the windshield survey by subwatershed and Figure 3.23 shows the location of each site.

Table 3.4.22: Windshield Survey Observations in the Fish Creek Watershed

	West Branch Fish Creek	Headwaters Fish Creek	Hamilton Lake	Town of Alvarado	Hiram Sweet Ditch	Cornell Ditch	Total
Livestock Access			1	3			4
Tile Outlet Discharge				1	3		4
Chemical Use-Residential		1					1
Bank Erosion - Commercial					309 ft		309 ft
Bank Erosion - Residential		2423 ft (3)				389 ft (1)	2,812 ft
Bank Erosion - Ag		963 ft (2)	3834 ft (4)	4533 ft (3)	2403 ft (1)	1979 ft (2)	13,712 ft
Armored Bank			271 ft		156 ft		427 ft
Gully Erosion					140 ft	204 ft	308 ft

Figure 3.23: Windshield Survey Observations in the Fish Creek Watershed

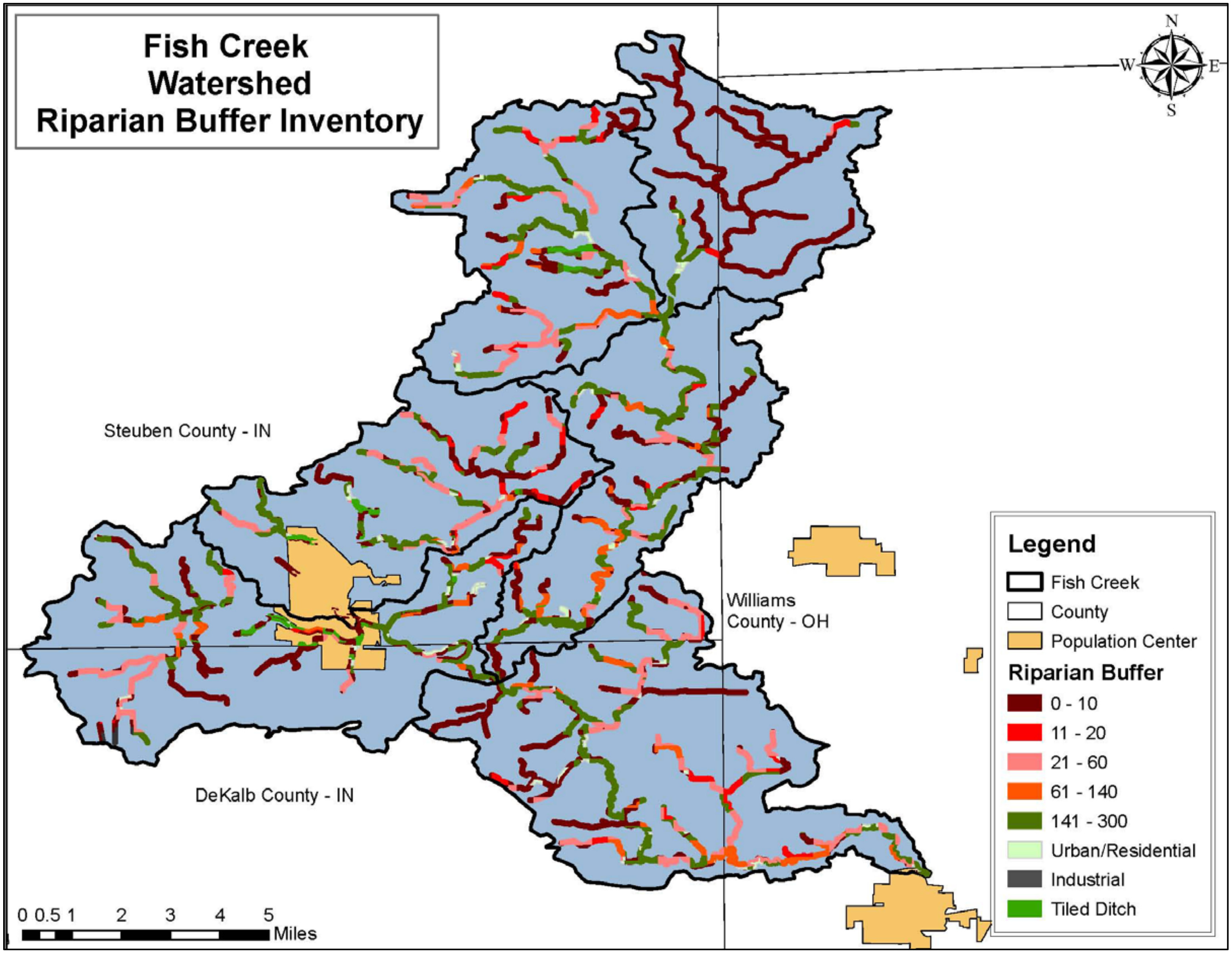


As stated in the previous section, vegetated riparian buffers can significantly reduce streambank erosion and prevent polluted runoff from reaching open water sources. The riparian buffer inventory conducted as part of this project in 2013 revealed that 74% of the parcels adjacent to open water have a riparian buffer of less than 60 ft with 63% of the parcels having less than 10 feet of riparian buffer. It should be noted that the Headwaters Fish Creek subwatershed had the least number of parcels adjacent to open water with a significant buffer as 87% of the parcels have a buffer width of less than 10 feet, though it is important to note that none of the subwatersheds in Fish Creek Watershed have a significant riparian buffer. Table 3.4.23 lists the percent of parcels that have a designated riparian buffer width in each subwatershed and Figure 3.24 is a map showing the location of those parcels and buffers.

Table 3.4.23: Riparian Buffer Inventory in the Fish Creek Watershed

	Buffer Width	Total # of Parcels	Total Percent of Parcels	West Branch -Fish Creek	Headwaters Fish Creek	Hamilton Lake	Hiram Sweet	Town of Alvarado	Cornell Ditch
	0 - 10	1156	63%	34%	87%	74%	71%	49%	53%
	11 - 20	56	3%	7%	1%	4%	<1%	3%	4%
	21 - 60	149	8%	18%	0%	6%	5%	7%	14%
	61 - 140	61	3%	6%	1%	<1%	3%	6%	6%
	141 - 300	284	15%	29%	8%	10%	11%	28%	17%
	Urban/ Residential	78	4%	4%	2%	3%	4%	4%	7%
	Industrial	6	0%	0%	0%	<1%	<1%	<1%	0%
	Tiled Ditch	44	2%	2%	0%	2%	5%	1%	<1%

Figure 3.24: Riparian Buffer Inventory in the Fish Creek Watershed

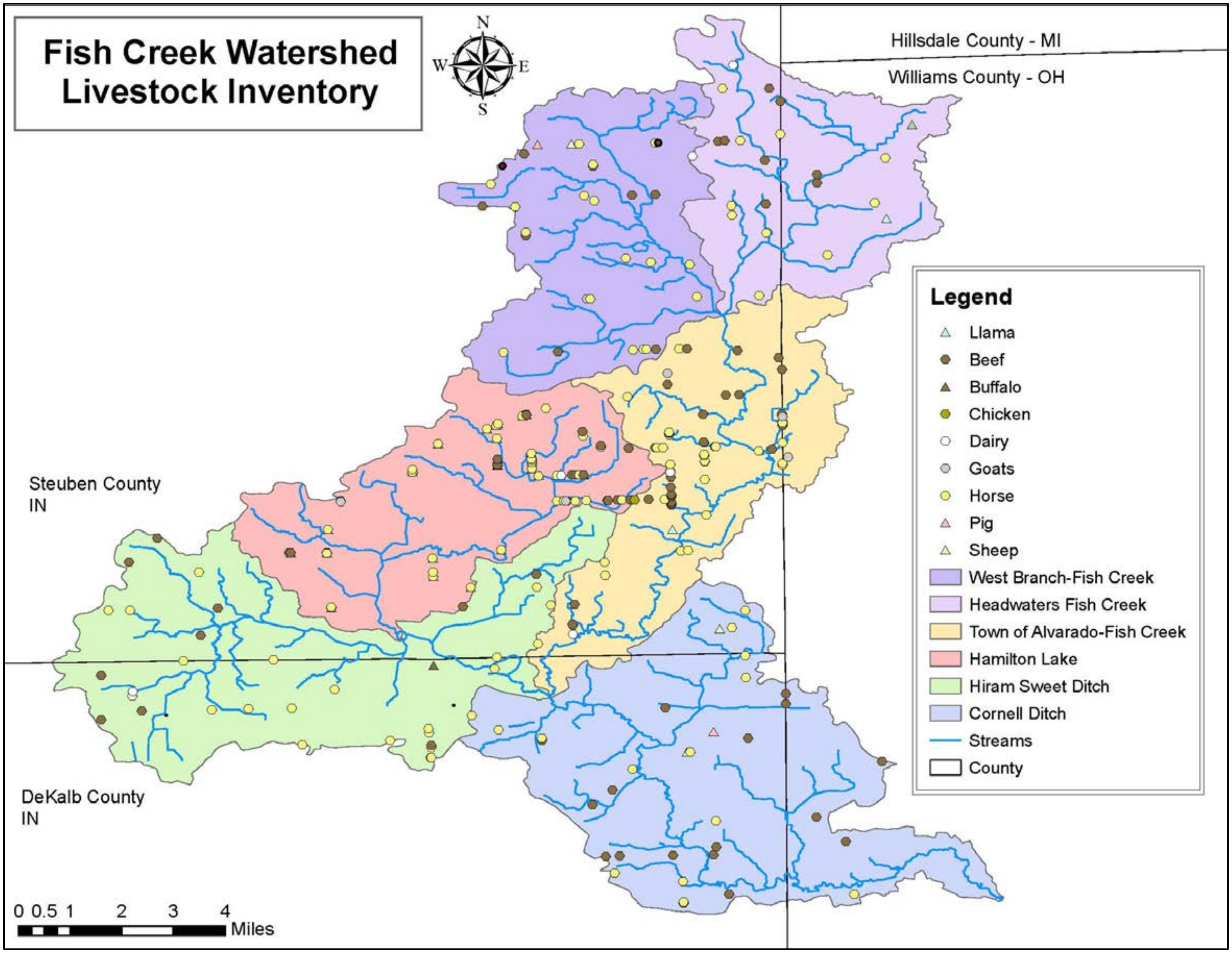


The Livestock inventory conducted in 2009 identified several small hobby farms located within the Fish Creek Watershed; mostly small horse or beef cow farms. As can be seen in Table 3.4.24, the investigators found a total of 240 properties with livestock present with an estimated 4,095 head of livestock total. There were not any significant finds during the inventory, and no one subwatershed appears to have a more significant potential of polluted runoff from unregulated livestock operations. Table 3.4.24 lists the type of animal identified in each subwatershed of the Fish Creek Watershed and Figure 3.25 shows the location of each of the farms. Remember, the livestock inventory presented in this WMP was conducted over four years ago and therefore, the number of farms and animals present may have changed. However, this study is the most accurate count of animals available to date.

Table 3.4.24: Livestock Inventory in the Fish Creek Watershed

	West Branch - Fish Creek		Headwaters Fish Creek		Town of Alvarado - Fish Creek		Hamilton Lake		Hiram Sweet Ditch		Cornell Ditch		Total	
	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count	Farms	Head Count
Beef	8	79	8	147	29	569	16	291	10	68	17	140	88	1294
Buffalo									1	6			1	6
Chicken							2	40					2	40
Dairy			2	200	4	205	1	30	2	330			9	765
Goat	1	1			3	262	2	46	1	3			7	312
Horse	17	48	8	36	29	159	40	260	19	59	12	30	125	592
Llama			1	2	1	4							2	6
Pig	1	10									1	1000	2	1010
Sheep	1	10	1	20	1	10					1	30	4	70
Total	**28**	**148**	**20**	**405**	**67**	**1209**	**61**	**667**	**33**	**466**	**31**	**1200**	240	4095

Figure 3.25: Livestock Inventory in the Fish Creek Watershed



There are several point sources of pollution present within the Fish Creek Watershed that pose a potential risk of polluting surface and/or groundwater Including nine Underground Storage Tanks (UST), four of which are leaking (LUST), two NPDES permitted facilities, and two CFOs. All point sources of pollution are listed in the following Tables 3.4.25 through 3.4.27 and the location of each pollution source is shown in Figure 3.26.

Table 3.4.25: Leaking Underground Storage Tanks in the Fish Creek Watershed

Facility ID	Name	Address	City	State	Substance	Tank Status
Cornell Ditch - Fish Creek						
6947	Universal Tool and Stamping Co	6544 SR 6	Butler	IN	Unknown/Soil/ Low Priority	Closed
Hamilton Lake						
18423	Appollo Landfill	CR 450 S and CR 600 E	Angola	IN	Unknown/Soil/Low Priority	Discontinued/ Active
West Branch - Fish Creek						
3842	Eastpoint Toll Plaza	1550 N 700 E Milepost	Angola	IN	Free Product/ Low Priority	Closed
3842 (2nd LUST)	Eastpoint Toll Plaza	1551 N 700 E Milepost	Angola	IN	Free Product/ Low Priority	Closed

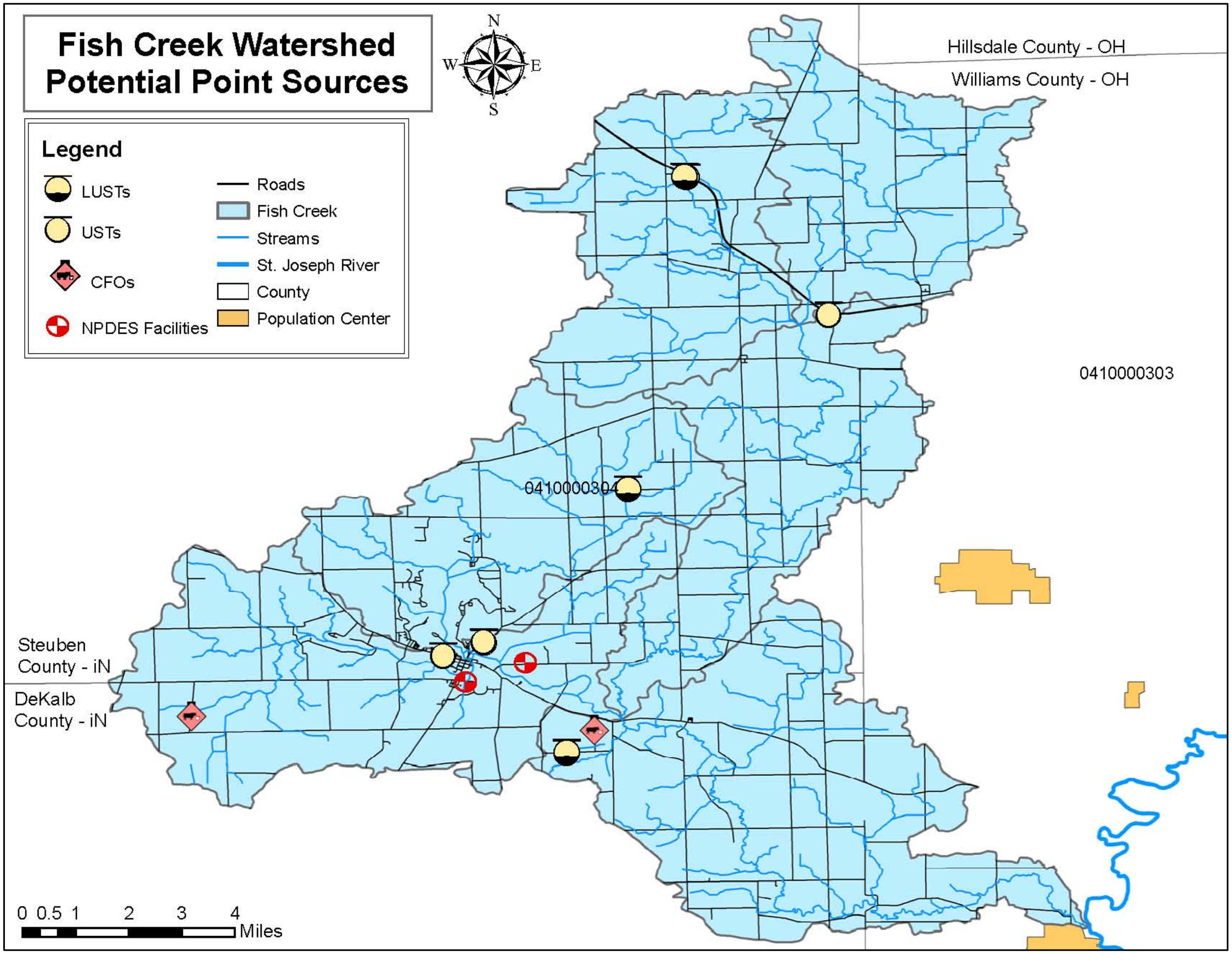
Table 3.4.26: Confined Feeding Operations in the Fish Creek Watershed

Operation	Sub-watershed	Designation	Animal Type	Animal #
Long Lane Farms, Inc.	Cornell Ditch - Fish Creek	CFO	Swine	2,035
Brand Farms	Hiram Sweet - Fish Creek	CFO	Beef/Dairy	120/980

Table 3.4.27: NPDES Permitted Facilities in the Fish Creek Watershed

Permit Name	Permit #	Issue Date	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3yrs)	Enforcement Actions (I=informal; F=formal)
Hamilton Lake Conservancy District WWTP	IN0050822	5/4/1981	Steuben	E. 775 S.	Hamilton	IN	St. Joseph River	0	0
Hamilton Water Works	IN0060216	6/17/1999	Steuben	Railroad St.	Hamilton	IN	Fish Creek	1	(I) 1

Figure 3.26: Potential Point Sources of Pollution in the Fish Creek Watershed



Water quality data collected in the Fish Creek Watershed indicate there is a problem with high *E. coli* levels in the water, as well as high nutrient and turbidity levels. It should be noted that averages for nitrogen and turbidity measured lower in the Fish Creek watershed than the other three watersheds that comprise the USJRW, though they were still well above the targets set for this project. Water samples were collected from all subwatersheds in Fish Creek except for Hamilton Lake. It should be noted that phosphorus exceeded target levels regularly in all subwatersheds greater than 30% of the time and *E. coli* regularly exceeded the state standard in greater than 50% of the samples in all sampled subwatershed, indicating that the sources of nutrient and *E. coli* pollution are not specific to a particular subwatershed.

After examining the land use within the Fish Creek Watershed it is clear that row crops and livestock have the most significant influence on water quality in this watershed. Streambank erosion associated with the lack of filter strips utilized on agriculture lands may be the most significant contributor to the high turbidity levels seen in the watershed as over 13,700 feet of stream bank surrounded by agriculture land needs to be repaired. Livestock with access to open are contributing to high E.coli levels and streambank erosion. Hamilton Lake subwatershed may have the most significant streambank impairment as four sites of agriculture induced streambank erosion was observed during the windshield survey totaling more than 3,800 feet of bank in need of repair. There is also a significant amount of land that is classified as HEL in the Fish Creek watershed which may contribute to the 308 feet of gully erosion and nearly 17,000 feet of stream bank erosion, as well as high turbidity levels found through water sampling.

The riparian buffer inventory revealed that the Headwaters Fish Creek Subwatershed has the most significant percent of parcels adjacent to open water with less than 10 feet of riparian buffer at 87% of the parcels. The lack of riparian buffer in Hamilton Lake may contribute to the amount of streambank erosion observed in that subwatershed during the windshield survey. It should be noted that a lack of riparian buffer is common throughout the watershed, with the exception of the West Branch – Fish Creek subwatershed, as the average percent of parcels in the watershed adjacent to open water with a buffer of greater than 60 feet is only 18%, and 63% have a riparian buffer less than 10 feet.

The most significant contributor to livestock induced pollution in the water is likely the Town of Alvarado subwatershed since three sites were located during the windshield survey where livestock have direct access to open water. The livestock inventory did not reveal any significant pollution sources from livestock in the Fish Creek watershed. Though, according to the inventory, the Headwaters – Fish Creek subwatershed livestock farms had the greatest number of livestock per farm, and therefore a greater concentration of manure will be produced at the farms in that subwatershed.

Urban areas may also be a contributor to pollution in the Fish Creek Watershed, specifically the Hiram Sweet subwatershed since it encompasses the town of Hamilton, the only urban area located in the Fish Creek watershed. However, there is no water quality data downstream of Hamilton to substantiate claims of being a significant pollution source. Though practices of lawn fertilization and a lack of riparian buffer along residential properties indicate common urban NPS problems exist within Hamilton.

Overall, significant contributors to nonpoint source pollution in the Fish Creek Watershed are livestock, row crops with conventional tillage practices and a lack of riparian buffer and urban areas, specifically Hamilton.

3.5 Watershed Inventory Summary

To better understand the water quality problems in the Upper St. Joseph River Watershed and what influences may be contributing to those problems, a map was developed outlining the water quality issues in each subwatershed as well as showing the results of the land use inventory, specifically those sites that were identified during the windshield survey, as well as other points of interest that may be contributing to the degradation of water quality (Figure 3.27). As can be seen in the figure E. coli, nutrients, and turbidity were elevated in nearly all subwatersheds that had water quality sampled.

After examining water quality and land uses throughout the USJRW, it can be determined that the problems and concerns contributing to water quality impairments within the watershed are fairly homogenous throughout the project area, with the exception of the larger urban areas with NPDES permitted discharges and Increased surface flow due to higher amounts of imperviousness. It is also important to mention that there is a slight shift in agricultural land use from the East and West Branch watersheds, where there is a higher number of livestock operations, to the Fish Creek and Nettle Creek watersheds, where there is a greater number of row crops.

Land uses throughout the watershed are primarily row crops and pasture fields. Though there is a significant amount of land classified as forest and wetland that are important to protect and preserve, especially in the East and West Branch subwatersheds. Fish Creek presents with a significant amount of woody wetlands that should be protected and preserved for its flood control and pollution sink capabilities.

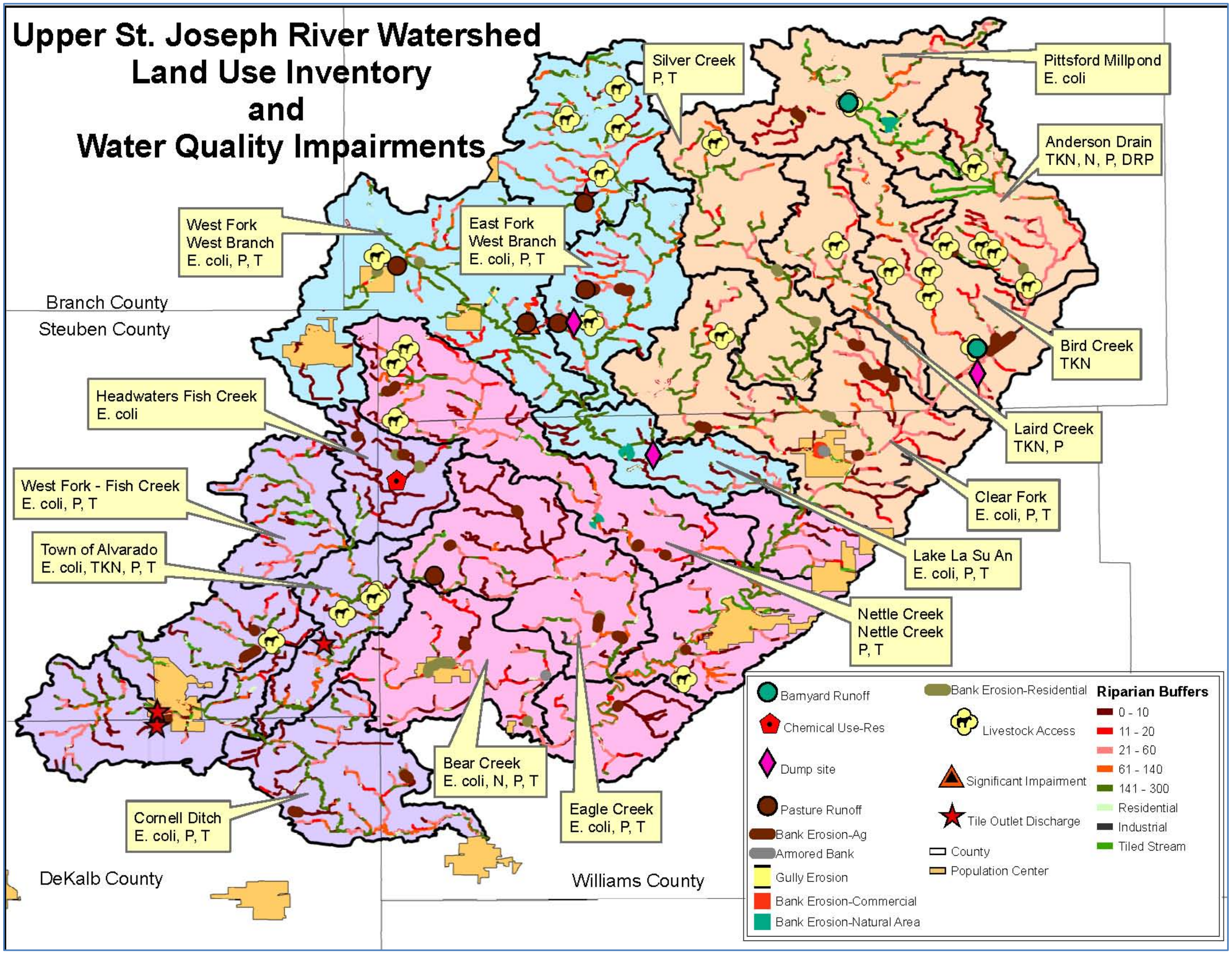
The soils in the USJRW are ideal for row crops as they are nutrient rich soils, however there is a significant amount conventional tillage still being used which may be an explanation for the high turbidity levels found throughout the watershed (note that tillage practices in Michigan are currently unknown). It was also noted that the large Amish community in the project area, largely uses moldboard tillage, which significantly disturbs the soil and Increases soil erosion. Another possible explanation for the high turbidity levels found throughout the watershed is that nearly 46% of the watershed is considered to be highly or potentially higher erodible land. This land requires special consideration when being worked, though many landowners are unaware of those precautions.

The majority of the project area is rural, and centralized sewer systems are only present in the incorporated areas. Therefore, it can be assumed that on-site sewage treatment is prevalent throughout the project area which poses a significant threat to water quality since 96.5% of the soils are classified as “Very Limited” and 1% are classified as “Somewhat Limited” for septic placement. Estimates acquired from local Health Departments, and United States averages indicate that upwards of 4,000 septic systems are currently, or at risk of failing. This further justifies the assumption that leaking septic systems may be contributing to bacteria, nutrient, and sediment contamination in the USJRW.

The windshield survey revealed several possible contributors to the degradation of water quality in the USJRW Including mowed residential lawns that have no riparian buffer which may have pet waste and fertilizer and pesticides that are often used on turf lawns runoff into open water. There are also a few golf courses and cemeteries that are located in the project area that may contribute to water pollution from fertilizer, pesticides, a lack of riparian buffer and wildlife waste. Some more significant problems identified during the windshield survey are; 28 sites where livestock have direct access to open water, 71,637 feet of streambank erosion within the agricultural community, 13,800 feet of streambank erosion within the urban community and 1,419 feet of streambank erosion within a commercial setting, 5,461 feet of gully erosion, six tile drains that were discharging during a drought season when all other tile drains were dry, and nine sites of either barnyard or pasture runoff discharging to open water. Each of these sites and observations made during the windshield survey provide a direct means for pollution to enter surface water and can be remediated with the implementation of BMPs.

There is a significant lack of riparian buffer throughout the USJRW with 51% of parcels adjacent to open water having a riparian buffer of less than 10 feet. Riparian buffers help to slow the movement of surface flow to streams and ditches which decreases the corrosive power of stormflow on sensitive streambanks as well as allows for more infiltration of water which helps prevent the potential for flooding and allows for pollutants to settle out or be absorbed by plants before it reaches open water sources.

Figure 3.27: Water Quality Concerns and Land Use Inventory Summary in the Upper St. Joseph River Watershed



3.6 Analysis of Stakeholder Concerns

Stakeholders in the Upper St. Joseph River Watershed expressed concerns regarding water quality and land uses during the public meeting held in 2012 and additional concerns were raised after performing the watershed inventory. These concerns are outlined in Table 3.6.1 as well as whether or not the concerns are supported by the collected data, quantifiable, outside the scope of this project, and whether or not the steering committee would like to focus implementation efforts on the concerns.

There were three concerns voiced by stakeholders that the steering committee voted to not address in this watershed management plan due to the limited resources available and there are other agencies or organizations that are currently working on the issues. Those concerns Include industrial discharge, improper construction site management, and log jams. Industrial discharge will not be a focus of this WMP because the steering committee believes that its efforts would be better spent on NPS pollution prevention and industrial facilities are point sources of pollution regulated by the state's oversight agency. That is not to say, however, that should a problem of excess pollution be found during water quality sampling, and the source is identified as an industrial facility, that the steering committee would not take action to help address the issue. Construction sites are managed by OEPA, MDEQ or IDEM if the activity disturbs one or more acres of land or if it disturbs less than one acre but is part of a larger construction project. Due to this project's limited resources, the steering committee has voted to focus efforts on pollution sources that are not regulated. Finally, the steering committee voted to not address log jams within the project area, again due to limited available resources to this project, and log jams are typically addressed by the local surveyor or county engineer and often require the acquisition of permits through the county, state and federal oversight agencies.

Table 3.6.1: Analysis of Stakeholder Concerns

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Sediment Runoff from Agriculture Land	Yes	Water Quality results indicate sedimentation issue as all subwatersheds sampled for turbidity exceeded the target level for turbidity.	Yes	No	Yes
		43% of the landuse in the watershed is for cultivated crops and 46% of the soils in the watershed are considered either HEL or PHEL.			
		The 2012 tillage transect for the watershed in IN and OH revealed that conservation tillage is on the decline and with a lower adoption rate for corn than beans.			
		Several studies in the watershed revealed that sedimentation of the lakes and streams is a major impairment.			
		Moldboard tillage practices, known to Increase erosion on crop fields, were found to be common practice among Amish farmers in the watershed.			
Sediment Runoff from Urban Areas	Yes	3% of the watershed is developed with a population of greater than 10,000 people. With the East Branch and Nettle Creek having the greatest amount of Low, Medium or High Intensity Developed Land.	Yes	No	Yes
		Many studies have been conducted in the past focusing on sediment Including several County and Town Master or Comprehensive Plans which focus on preventing sediment runoff. Including one Clear Lake study that specifically identified gravel and dirt roads around Clear Lake as a significant contributor to sedimentation of open water.			
		Water quality samples taken from sites 132 and 133, adjacent to Edon, OH, had extremely high turbidity readings, as did water quality samples taken at site 126, downstream from Pioneer, OH.			

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Runoff from CAFOs	Yes	There are four permitted CFOs located within the watershed totaling over 8,600 animals between them. It is known that at least one CAFO located outside of the project area spreads manure on land located within the USJRW. Therefore, there is a possibility that more CAFOs are doing the same which may be a source of nutrients in surface water from manure fertilizer runoff. *E. coli* and phosphorus exceeded target levels in all subwatersheds where those parameters were sampled.	Yes	No	Yes
Runoff from small scale animal operations	Yes	The windshield survey conducted in 2012 identified 26 locations that have livestock access to open water, 7 sites that demonstrated pasture runoff, and 2 sites with barnyard runoff. The 2009 Livestock inventory identified 1,218 locations where livestock were present with over 31,000 animals total. The average E.coli and turbidity levels exceeded the target water quality levels set by this project in all subwatersheds in the Upper St. Joe. The livestock inventory also noted 15 locations where livestock had direct access to open water and 13 locations where there was direct discharge from the barnyard to open water.	Yes	No	Yes
Leaking, failed, or straight pipe septic systems	Yes	Williams and DeKalb County Health Departments estimate that nearly half of all systems are currently failing (near 4,000 in the watershed). The bacteria source tracking investigation in 2003 revealed that 5% of the bacteria found at four different sample sites was from humans, though the test results are not verifiable. Only the unincorporated areas of the watershed are serviced by a centralized sewer system, therefore all other homes utilize on-site waste disposal systems.	Yes	No	Yes

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Leaking, failed, or straight pipe septic systems	Yes	95.6% of the soils in the project area are considered "Very Limited" and 1% of the soils are considered "Some what Limited" for the placement of on-site waste disposal systems which indicates most systems are not properly placed and are at risk of failing.	Yes	No	Yes
		No straightpipe septic systems were observed in the project area. Though, this does not mean that they are not present, only that they were not identified during the inventory.			
Log Jams	No	The St. Joseph River is known to be a slow flowing river system which often contributes to the formation of log jams.	No	No	No
		No significant log jams were found during the windshield survey. Though that does not mean they are not present, only that they were not seen during the 2012 inventory.			
Excessive nutrients and bacteria in the lakes	Yes	The bacteria source tracking study in 2003 tested sites in three of the subwatersheds and found bacteria from geese, humans, horses, livestock, and pets.	Yes	No	Yes
		Refer to evidence for leaking, failed or straightpipe systems.			
		All of the averages from water quality samples taken in most subwatersheds were higher than the state standard or target level for *E. coli*, phosphorus, and/or nitrogen.			
Lake residents and urban landowners using lawn fertilizer	No	There are nearly 10,000 residents living in the Incorporated areas of the watershed as well as 7 built-up lakes and 3 developing lakes located in the watershed.	No	No	Yes
		Only one site was noted during the windshield survey where herbicides were possibly used to kill vegetation along a riparian buffer.			
		All of the averages from water quality samples taken in most subwatersheds were higher than the target level for phosphorus, and/or nitrogen which may be from urban fertilizer use.			

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Stream Bank Erosion	Yes	The riparian buffer inventory identified 63.85% of parcels located adjacent to open water in the Upper St. Joe Watershed have riparian buffers less than 60 ft with 51.15% of those parcels having a riparian buffer less than 10 ft wide. All watersheds in the USJRW had the percent of parcels with less than a 10 foot buffer range from 48% in the West Branch to 66% in Fish Creek.	Yes	No	Yes
		The windshield survey conducted in 2012 identified approximately 89,150 feet of streambank erosion, with 71,637 feet of that being surrounded by strictly agricultural land.			
		The average turbidity levels measured in water samples exceeded the target level set by this project in all subwatershed.			
Improper Construction Site Management	No	There are nine Incorporated areas located in the watershed where there is the potential for additional growth and development. There are also three lakes that are currently being developed with mostly residential houses.	No	No	No
		No significant findings were made during the windshield survey. Though it should be noted that construction in the five counties of the project area has been on the decline over the past decade. Housing trends indicate that construction may be on the rise again soon, though only construction permits through 2012 were obtainable at the time of this project.			
Wetland Preservation and Protection	Yes	Hydric soils make up 67% of the watershed's soils, which are prime soils for wetland placement.	Yes	No	Yes
		The watershed has lost nearly 80% of its historic wetlands as only 16% of the watershed land is covered by wetlands currently.			

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Wetland Preservation and Protection	Yes	There is a significant amount of wetlands present in each watershed of the USJRW which provide many environmental benefits Including flood control and act as pollution sinks as well as provide important habitat to endangered and threatened species. West Branch - 14%; Fish Creek - 15%, Nettle Creek - 9%, East Branch - 12%.	Yes	No	Yes
		The endangered Mitchell's Satyr butterfly, and threatened Copperbelly Watersnake, Easter Massasauga Rattlesnake, and Prairie White-fringed Orchid all rely on wetlands as habitat.			
Invasive species	Yes	Many previous studies found milkweed, purple loosestrife and Eurasian Watermilfoil in the lakes of the project area.	Yes	No	Yes
		47 invasive species can currently be found in the USJRW			
Illegal Garbage Dump Sites	Yes	3 illegal garbage dump sites were identified during the windshield survey. Though these sites are often found deeper in the woods along riparian areas, therefore more dump sites may be present in the project area.	Yes	No	Yes
Livestock Access to Open Water	Yes	The 2009 livestock inventory noted 15 locations where livestock had direct access to open water.	Yes	No	Yes
		The bacteria source tracking study found livestock was the second largest contributor to bacteria in the water and that on average from four sample sites 13% of the samples collected had bacteria from livestock.			
		The 2012 windshield survey identified 26 locations where livestock have direct access to open water, with the majority of these sites being in the East and West Branch watersheds.			

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Industrial Discharge	Yes	There are 16 NPDES permitted facilities located in the watershed which have had a total of 39 effluent exceedances over the past three years. Water quality samples taken from site 132, downstream of the Edon WWTP did not meet target levels for many water quality parameters; *E. coli* - 58%, D.O. - 78%, nitrate+nitrite - 95%, phosphorus 95%, turbidity 66%.	Yes	Yes	No
Lack of Education Regarding Best Management Practices	No	It is a goal or objective to Increase the public's awareness of BMPs in most of the previous WMPs, comprehensive/master plans, strategic plans, and unified development plans that have been written for portions of the project area.	No	No	Yes
Lack of Consistent Funding for Conservation Agencies	No	Stakeholders and Steering Committee members have experienced, first-hand, budget cuts that are diminishing the effectiveness of their offices.	No	No	Yes

4.0 Pollution Problems and Sources

4.1 Potential Causes of Water Quality Problems

In this section concerns identified by stakeholders in the watershed and through the watershed inventory will be linked to problems found through the watershed investigation. Additionally, potential causes for the problems identified will be expressed. Finally, potential sources will be identified. Table 4.1 shows the connection between stakeholder concerns, problems found in the watershed, and the potential causes of those problems.

Table 4.1: Concerns, Problems, and Potential Causes

Concern	Problem	Potential Cause(s)
- Runoff from CAFOs - Runoff from small scale animal operations - Leaking, failed, or straight pipe septic systems - Excessive nutrients and bacteria in the lakes - Livestock access to open water	High levels of *E. coli* were discovered in area streams after reviewing historic and current water quality data.	- *E. coli* levels exceed the state standard - Improperly managed manure and inadequate manure storage - Stakeholders are unaware of proper septic system maintenance - Area producers are unaware of the water quality threat of allowing livestock direct access to open water. - Area producers lack proper manure storage and/or utilize improper manure application processes, such as applying manure as fertilizer on frozen ground - Area streams are listed as impaired for *E. coli* and recreational uses on the IN 303(d) list - Lack of education and outreach on the cumulative effects of BMP implementation

Concern	Problem	Potential Cause(s)
- Sediment Runoff from agriculture land - Sediment runoff from urban areas - Runoff from CAFOs - Runoff from small scale animal operations - Leaking, failed, or straight pipe septic systems - Excessive nutrients and bacteria in the lakes - Lake residents and urban landowners improperly using lawn fertilizers - Livestock access to open water - Lack of education and outreach regarding best management practices - Lack of consistent funding for conservation agencies	Area streams have nutrient levels that exceed the target levels set by this project	- Historic TKN data exceed the target level set by this project - DRP exceeded the target levels set by this project in East Branch-St. Joseph subwatershed - TP exceeded the target level set by this project - Hamilton Lake is listed as impaired for phosphorus on the IN 303(d) list - Area streams are listed as impaired for aquatic life uses and human health on the OH 303(d) list - Lack of education and outreach on the cumulative effects of BMP implementation
- Sediment runoff from agriculture land - Sediment runoff from urban areas - Runoff from CAFOs - Runoff from small scale animal operations - Excessive nutrients and bacteria in the lakes - Lake residents and urban landowners using lawn fertilizer - Stream bank erosion - Wetland preservation and protection - Livestock access to open water - Lack of education regarding best management practices - Lack of consistent funding for Conservation agencies	Best Management Practices to limit nonpoint source pollution are underutilized in the watershed	- Turbidity levels exceed the target level set by this project - Historic TKN data exceed the target level set by this project - DRP exceeded the target levels set by this project in East Branch-St. Joseph subwatershed - TP exceeded the target level set by this project - Hamilton Lake is listed as impaired for phosphorus on the IN 303(d) list - Area streams are listed as impaired for aquatic life uses and human health on the OH 303(d) list - Lack of education and outreach on the cumulative effects of BMP implementation - Federal, State, and Local funding to address conservation issues has been cut over the past decade

Concern	Problem	Potential Cause(s)
- Sediment runoff from agriculture land - Sediment runoff from urban areas - Runoff from CAFOs - Runoff from small scale animal operations - Leaking, failed, and straight pipe septic systems - Stream bank erosion - Wetland preservation and protection - Livestock Access to open water - Lack of education and outreach regarding best management practices	Area streams have turbidity levels that exceed the target levels set by this project.	- Areas streams are listed on the IN and OH 303(d) list as impaired for aquatic life use and Impaired Biotic Community - Turbidity levels exceed the target level set by this project - Lack of education and outreach on the cumulative effects of BMP implementation
- Sediment runoff from agriculture land - Sediment runoff from urban areas - Runoff from CAFOs - Runoff from small scale animal operations - Leaking, failed, and straight pipe septic systems - Stream bank erosion - Wetland preservation and protection - Livestock Access to open water - Lack of education and outreach regarding best management practices - Lack of consistent funding for conservation agencies	Sections of the St. Joseph River and its tributaries are listed as impaired on the IN and OH 303(d) list	- Turbidity levels exceed the target level set by this project - *E. coli* levels exceed the state standard - Lack of education and outreach on the cumulative effects of BMP implementation - Lack of communication across political boundaries to address watershed management issues
- Streambank erosion - Sediment runoff from agriculture land - Sediment runoff from urban land - Wetland preservation and protection - Invasive species	There are 12 species listed on the federal endangered species list located within the project area.	- D.O. did not meet target levels and state standards during analysis of a single sample in many instances - Turbidity levels exceeded the target level - Lack of adequate riparian buffer

Concern	Problem	Potential Cause(s)
- Lack of consistent funding for conservation agencies	Lack of consistent funding for conservation agencies	- There is little education directed towards local officials and other funding sources regarding the importance of watershed management and best management practices - The federal government has been cutting funds directed toward watershed restoration
- Sediment runoff from agriculture land - Runoff from CAFOs - Runoff from small scale animal operations - Excessive nutrients and bacteria in lakes - Stream bank erosion - Livestock Access to open water - Lack of education regarding best management practices	Agriculture landowners acknowledge that much of the water quality issues are due to agricultural practices but believe they have exhausted all possible practices to limit polluted runoff from their land	- Turbidity levels exceed the target level set by this project - Historic TKN data exceed the target level set by this project - DRP exceeded the target levels set by this project in East Branch-St. Joseph subwatershed - TP exceeded the target level set by this project - Hamilton Lake is listed as impaired for phosphorus on the IN 303(d) list - Area streams are listed as impaired for aquatic life uses and human health on the OH 303(d) list - Lack of education and outreach on the cumulative effects of BMP implementation

4.2 Potential Sources of Water Quality Issues

Now that stakeholder concerns have been linked to water quality problems and potential causes of those problems, and a thorough watershed inventory has been conducted, potential sources to the problems can be identified. Outlining the sources to the problems found in the watershed will help to narrow the land area of where to focus efforts which will have the greatest impact on improving water quality.

Table 4.2: Problems, Causes, and Potential Sources

Problem	Potential Cause(s)	Potential Source(s)
High levels of *E. coli* were discovered in area streams after reviewing historic and current water quality data.	- *E. coli* levels exceed the state standard - Area producers are unaware of the water quality threat of not having adequate manure storage - Stakeholders are unaware of proper septic system maintenance - Area producers are unaware of the water quality threat of allowing livestock direct access to open water. - Area producers lack proper manure storage and/or utilize improper manure application processes, such as applying manure as fertilizer on frozen ground - Area streams are listed as impaired for *E. coli* and recreational uses on the IN 303(d) list - Lack of education and outreach on the cumulative effects of BMP implementation	- Much of the rural community utilizes on-site waste disposal systems and the local Health Departments estimate that over 4,000 septic systems are currently failing in the USJRW. - 27 locations were identified during the 2012 windshield survey where livestock had direct access to open water (6 in West Branch-St. Joseph, 13 in East Branch-St. Joseph, 4 in Nettle Creek, 4 in Fish Creek). - 7 sites were identified during the 2012 windshield survey where pasture runoff was a potential issue (5 in West Branch-St. Joseph, 2 in Nettle Creek) - 2 sites were identified in the East Branch – St. Joseph during the 2012 windshield survey where barnyard runoff was an issue. - The 2009 livestock inventory identified 15 additional locations where livestock had direct access to open water and 13 locations where there was direct discharge from a barnyard to open water. - 96.5% of the soils in the watershed are classified as "very limited" for the placement of on-site waste disposal systems. - Pet waste from urban areas predominately in West Fork-West Branch, Lake La Su An, Clear Fork-East Branch, Village of Montpelier, St. Joseph, Cogsworth Cemetery – St. Joseph, Bear Creek, Hamilton Lake, and Hiram Sweet Ditch subwatersheds. - 13 WWTPs located in the watershed, predominately those that have had effluent exceedances in the past 3 years (4 in Nettle Creek, and 1 in West Fork-West Branch. - Two CFOs and two CAFOs located in Nettle Creek, West Branch, and Fish Creek Watersheds.

Problem	Potential Cause(s)	Potential Source(s)
Area streams have nutrient levels that exceed the target levels set by this project	- Historic TKN data exceed the target level set by this project - DRP exceeded the target levels set by this project in East Branch-St. Joseph subwatershed - TP exceeded the target level set by this project - Hamilton Lake is listed as impaired for phosphorus on the IN 303(d) list - Area streams are listed as impaired for aquatic life uses and human health on the OH 303(d) list - Lack of education and outreach on the cumulative effects of BMP implementation	- Lack of proper management of PHEL and HEL (29% and 16.8% of the soils in the watershed, respectively) on agricultural land throughout the project area. - 64% of the parcels throughout the project area lack a riparian buffer of at least 60 feet with 51% of that being parcels with less than a 20 foot buffer. - Improperly placed and/or faulty septic systems throughout the project area with an estimate of over 4,000 currently failing. - Livestock with direct access to open water (6 in West Branch-St. Joseph, 13 in East Branch-St. Joseph, 4 in Nettle Creek, 4 in Fish Creek). - Barnyard Runoff to open water (2 in East Branch-St. Joseph). - Pasture Runoff to open water (5 in West Branch-St. Joseph, 2 in Nettle Creek). - The 2009 livestock inventory identified 15 additional locations where livestock had direct access to open water and 13 locations where there was direct discharge from a barnyard to open water. - Two CFOs and two CAFOs located in Nettle Creek, West Branch, and Fish Creek Watersheds. - While not all field tiles were identified during the windshield survey it was common to see unbuffered tile inlets and few tiles were noted to be discharging to open water even during a drought. - 53.7% of corn and 20.3% of beans are conventionally tilled in the watershed. - An estimated 71,637 feet of stream bank surrounded by agriculture land with an additional 17,513 feet of streambank surrounded by residential lawns and businesses was found to be eroding during the 2012 windshield survey scattered throughout the watershed. - 13 WWTPs located in the watershed, predominately those that have had effluent exceedances in the past 3 years(4 in Nettle Creek, and 1 in West Fork-West Branch. -

Problem	Potential Cause(s)	Potential Source(s)
		- Two CFOs and two CAFOs located in Nettle Creek, West Branch, and Fish Creek Watersheds. - It is common practice for residential land owners to apply fertilizers to their turf lawns which has the potential to runoff to open water. - 1,550 feet of armored banks was observed during the 2012 windshield survey which can act as a direct conduit for polluted runoff to reach open water. - 96.5% of the soils in the watershed are classified as "very limited" for the placement of on-site waste disposal systems. - Pet waste from urban areas predominately in West Fork-West Branch, Lake La Su An, Clear Fork-East Branch, Village of Montpelier, St. Joseph, Cogsworth Cemetery – St. Joseph, Bear Creek, Hamilton Lake, and Hiram Sweet Ditch subwatersheds.
Best Management Practices to limit nonpoint source pollution are underutilized in the watershed	- Turbidity levels exceed the target level set by this project - Historic TKN data exceed the target level set by this project - DRP exceeded the target levels set by this project in East Branch-St. Joseph subwatershed - TP exceeded the target level set by this project - Hamilton Lake is listed as impaired for phosphorus on the IN 303(d) list - Area streams are listed as impaired for aquatic life uses and human health on the OH 303(d) list - Lack of education and outreach on the cumulative effects of BMP implementation - Federal, State, and Local funds to	- Lack of education and outreach events. - Continued drop in Federal and local funding to promote agricultural BMPs.

Problem	Potential Cause(s)	Potential Source(s)
	address conservation issues has been cut over the past decade	
Area streams have turbidity levels that exceed the target levels set by this project.	- Areas streams are listed on the IN and OH 303(d) list as impaired for aquatic life use and Impaired Biotic Community - Turbidity levels exceed the target level set by this project - Lack of education and outreach on the cumulative effects of BMP implementation	- Lack of proper management of PHEL and HEL (29% and 16.8% of the soils in the watershed, respectively) on agricultural land throughout the project area. - 64% of the parcels throughout the project area lack a riparian buffer of at least 60 feet with 51% of that being parcels with less than a 20 foot buffer. - Improperly placed and/or faulty septic systems throughout the project area with an estimate of over 4,000 currently failing. - Livestock with direct access to open water (6 - West Branch-St. Joseph, 13-East Branch-St. Joseph, 4 in Nettle Creek, 4-Fish Creek). - Barnyard Runoff to open water (2 in East Branch-St. Joseph). - Pasture Runoff to open water (5 in West Branch-St. Joseph, 2 in Nettle Creek). - The 2009 livestock inventory identified 15 additional locations where livestock had direct access to open water and 13 locations where there was direct discharge from a barnyard to open water. - Two CFOs and two CAFOs located in Nettle Creek, West Branch, and Fish Creek Watersheds. - While not all field tiles were identified during the windshield survey it was common to see unbuffered tile inlets and some tiles were noted to be discharging to open water even during a drought. - 53.7% of corn and 20.3% of beans are conventionally tilled in the watershed. - An estimated 71,637 feet of stream bank surrounded by agriculture land with an additional 17,513 feet of streambank surrounded by residential lawns and businesses was found to be eroding during the 2012 windshield survey scattered throughout the watershed. - 13 WWTPs located in the watershed, predominately those that have had effluent exceedances in the past 3 years (4 in Nettle Creek, and 1 in West Fork-West Branch).

Problem	Potential Cause(s)	Potential Source(s)
		- Moldboard tillage was found to be common practice within the Amish community in the watershed.
Sections of the St. Joseph River and its tributaries are listed as impaired on the IN and OH 303(d) list	- Turbidity levels exceed the target level set by this project - *E. coli* levels exceed the state standard - Lack of education and outreach on the cumulative effects of BMP implementation - Lack of communication across political boundaries to address watershed management issues	- Much of the rural community utilizes on-site waste disposal systems and the local Health Departments estimate that over 4,000 septic systems are currently failing in the USJRW. - 27 locations were identified during the 2012 windshield survey where livestock had direct access to open water (6 in West Branch-St. Joseph, 13 in East Branch-St. Joseph, 4 in Nettle Creek, 4 in Fish Creek). - 7 sites were identified during the 2012 windshield survey where pasture runoff was a potential issue (5 in West Branch-St. Joseph, 2 in Nettle Creek) - 2 sites were identified in the East Branch – St. Joseph during the 2012 windshield survey where barnyard runoff was an issue. - The 2009 livestock inventory identified 15 additional locations where livestock had direct access to open water and 13 locations where there was direct discharge from a barnyard to open water. - 96.5% of the soils in the watershed are classified as "very limited" for the placement of on-site waste disposal systems. - Pet waste from urban areas predominately in West Fork-West Branch, Lake La Su An, Clear Fork-East Branch, Village of Montpelier, St. Joseph, Cogsworth Cemetery – St. Joseph, Bear Creek, Hamilton Lake, and Hiram Sweet Ditch subwatersheds. - 13 WWTPs located in the watershed, predominately those that have had effluent exceedances in the past 3 years. - Two CFOs and two CAFOs located in Nettle Creek, West Branch, and Fish Creek Watersheds. - Lack of proper management of PHEL and HEL (29% and 16.8% of the soils in the watershed, respectively) on agricultural land throughout the project area. - 64% of the parcels throughout the project area lack a riparian buffer

Problem	Potential Cause(s)	Potential Source(s)
		of at least 60 feet with 51% of that being parcels with less than a 20 foot buffer. - While not all field tiles were identified during the windshield survey it was common to see unbuffered tile inlets and few tiles were noted to be discharging to open water even during a drought. - 53.7% of corn and 20.3% of beans are conventionally tilled in the watershed. - An estimated 71,637 feet of stream bank surrounded by agriculture land with an additional 17,513 feet of streambank surrounded by residential lawns and businesses was found to be eroding during the 2012 windshield survey scattered throughout the watershed. - Moldboard tillage was found to be common practice within the Amish community in the watershed.
There are 12 species listed on the federal endangered species list located within the project area.	- D.O. did not meet target levels and state standards during analysis of a single sample in many instances - Turbidity levels exceeded the target level - Lack of adequate riparian buffer	- 64% of the parcels throughout the project area lack a riparian buffer of at least 60 feet with 51% of that being parcels with less than a 20 foot buffer. - An estimated 71,637 feet of stream bank surrounded by agriculture land with an additional 17,513 feet of streambank surrounded by residential lawns and businesses was found to be eroding during the 2012 windshield survey scattered throughout the watershed. - 27 locations were identified during the 2012 windshield survey where livestock had direct access to open water (6-West Branch-St. Joseph, 13-East Branch-St. Joseph, 4-Nettle Creek, 4-Fish Creek). - 7 sites were identified during the 2012 windshield survey where pasture runoff was a potential issue (5-West Branch-St. Joseph, 2-Nettle Creek) - 2 sites were identified in the East Branch – St. Joseph during the 2012 windshield survey where barnyard runoff was an issue. - The 2009 livestock inventory identified 15 additional locations where livestock had direct access to open water and 13 locations where there was direct discharge from a barnyard to open water. - Less than 12% of the watershed is considered forested and less than 13% of the watershed is considered to be wetland.

Problem	Potential Cause(s)	Potential Source(s)
		- 47 invasive species are listed as being present in the watershed. - The watershed has lost nearly 80% of the historic wetlands, which many of the endangered species rely on for habitat.
Lack of consistent funding for conservation agencies	- There is little education directed towards local officials and other funding sources regarding the importance of watershed management and best management practices - Federal, state, and local governments have been cutting funds directed toward watershed restoration	- There is little education directed towards local officials and other funding sources regarding the importance of watershed management and best management practices - The federal and local governments have been cutting funds directed toward watershed restoration
Agriculture landowners acknowledge that much of the water quality issues are due to agricultural practices but believe they have exhausted all possible practices to limit polluted runoff from their land	- Turbidity levels exceed the target level set by this project - Historic TKN data exceed the target level set by this project - DRP exceeded the target levels set by this project in East Branch-St. Joseph subwatershed - TP exceeded the target level set by this project - Hamilton Lake is listed as impaired for phosphorus on the IN 303(d) list - Area streams are listed as impaired for aquatic life uses and human health on the OH 303(d) list - Lack of education and outreach on the cumulative effects of BMP implementation	- Lack of education and outreach activities. - The federal and local governments have been cutting funds directed toward watershed restoration

4.3 Pollution Loads and Necessary Load Reductions

After close review of historic water quality data from the Initiative, IDEM, Steuben County Lakes Council, MI DEQ, and current water quality data from the Initiative it was decided that, for consistency of parameters measured in each of the subwatersheds, as well as quality assurance techniques and weather conditions, pollution loads and subsequent load reductions would be based on data collected by the Initiative in 2012 only, which was funded through the 319 grant used for this project. Current pollution loads were determined for the St. Joseph River and its tributaries, and when compared to the water quality targets set by the USJRW steering committee and outlined in Section 3, provides detail on how much pollution loads will need to be reduced to meet the targets set by this project.

Water quality samples were taken by the Initiative from seventeen sites in eleven of the twenty-two HUC12 subwatersheds. Adequate water quality samples were taken to provide a baseline look at water quality in each of the four HUC10 subwatersheds. Current pollution loads and load reductions were analyzed for nitrate+nitrite, total phosphorus, DRP and TDS. Methods are not available to accurately assess turbidity and *E.coli* loads, but Table 4.8 shows the average concentration of turbidity and *E. coli* per sample site and an overall average for the entire project area. Scientists believe that Dissolved Reactive Phosphorus (DRP) is the limiting factor to plant growth in Lake Erie, which has been on the Incline over the past several years and having a profound impact on the health of the Western Lake Erie Basin, Including tourism and the fishing industry of the area. For those reasons, it was important to simulate the contribution of DRP to Lake Erie from the USJRW. Therefore, the Initiative worked with Purdue University to use their newly calibrated Soil and Water Assessment Tool (SWAT) model to determine current DRP loads for each sample site located within the USJRW.

SWAT is a process-based distributed-parameter watershed scale simulation model designed for use in gauged as well as ungauged basins to simulate long term effects of various watershed management decisions on hydrology and water quality response {*Arnold et al., 1998*}. It performs well for long-term continuous simulations at both monthly and annual time scales {*Borah and Bera, 2004; Gassman et al., 2007*}. The SWAT model divides a watershed into subwatersheds based on the outlets selected by the user. Subbasins are further divided into land areas called hydrologic response units (HRUs), based on land use, management, and soil properties. The climatic input data used are precipitation, temperature, solar radiation, relative humidity, and wind speed on a daily or subdaily basis from multiple climatic gauge locations. SWAT simulates the flow and transport of nutrients, sediment and chemicals at the subbasin or the HRU level.

Loads were determined by using the following equation; cfs * (X * 0.001) * 984.2589781, where cfs equals the average flow of the stream measured in cubic feet per second, X equals the average parameter measurement in mg/l, and 984.2589781 is a conversion factor to make the outcome equal tons per year. Table 4.3 is a reminder of the target concentrations for each of the parameters of concern that were set by this project's steering committee. Table 4.4 through Table 4.7 show the current and target loads and load reductions needed for nitrate+nitrite, total phosphorus, dissolved reactive phosphorus and TDS. TSS was not measured consistently throughout the project area and therefore, was not used to develop loads. However, it should be mentioned that TSS exceeded the target level of 20 mg/L in the Cyrus Brouse Ditch in the West Fork-West Branch subwatershed and in Cornell ditch in Fish Creek subwatershed. Turbidity levels did exceed target concentrations in all HUC10 subwatersheds. Nitrate+nitrite loads exceeded the target load in Bear Creek Subwatershed at site 132 and total phosphorus loads exceeded target loads at all sample sites except for Clear Fork site 175, Nettle Creek site 172, Headwaters Fish Creek site 170 and West Branch-Fish Creek site 125.

Table 4.3: Target Concentrations for Parameters of Concern

Parameter of Concern	Target Concentration
Nitrate+Nitrite	<1.6 mg/l
Total Phosphorus	<0.08 mg/l
Turbidity	< 10 NTU
E. coli	<235 CFU/100 ml
Total Dissolved Solids	< 750 mg/l
Total Suspended Solids	< 20 mg/l

Table 4.4: Nitrate+Nitrite Pollution Load Reductions Necessary to Meet Target Loads

			2012 Load	Target Load	Reduction Needed
Subwatershed	**Site Number**	**Mean CF/S**	**Nitrate+Nitrite (Tons/yr)**	**Nitrate+Nitrite (Tons/yr)**	**Nitrite+ Nitrite (Tons/yr)**
West Fork-West Branch	173	8.44	1.88	13.29	0.00
West Fork-West Branch	135	75.57	35.93	119.01	0.00
East Fork-West Branch	134	15.98	11.43	25.17	0.00
Lake La Su An - West Branch	125	58.81	33.23	92.61	0.00
Pittsford Millpond - East Branch	155	17.96	12.06	28.28	0.00
Clear Fork - East Fork	174	7.93	0.05	12.49	0.00
Clear Fork - East Fork	175	7.09	1.33	11.17	0.00
Clear Fork - East Fork	126	37.97	27.66	59.80	0.00
Nettle Creek - Nettle Creek	172	5.36	1.21	8.44	0.00
Nettle Creek - Nettle Creek	129	3.81	3.90	6.00	0.00
Eagle Creek - Nettle Creek	130	6.71	4.79	10.57	0.00
Bear Creek - Nettle Creek	132	16.32	72.46	25.70	46.76
Bear Creek - Nettle Creek	133	15.91	1.25	25.06	0.00
Bear Creek - Nettle Creek	131	109.57	79.16	172.55	0.00
Headwaters Fish Creek	171	6.08	1.91	9.57	0.00
West Branch-Fish Creek	170	5.23	0.37	8.24	0.00
Cornell Ditch - Fish Creek	124	9.38	8.09	14.77	0.00

Table 4.5: Total Phosphorus Pollution Load Reductions Necessary to Meet Target Loads

			2012 Load	Target Load	Reduction Needed
Subwatershed	Site Number	Mean CF/S	Total Phosphorus (Tons/yr)	Total Phosphorus (Tons/yr)	Total Phosphorus (Tons/yr)
West Fork-West Branch	173	8.44	0.71	0.66	0.05
West Fork-West Branch	135	75.57	25.21	5.95	19.26
East Fork-West Branch	134	15.98	1.48	1.26	0.22
Lake La Su An - West Branch	125	58.81	7.06	4.63	2.43
Pittsford Millpond - East Branch	155	17.96	1.66	1.41	0.25
Clear Fork - East Branch	174	7.93	0.73	0.62	0.10
Clear Fork - East Branch	175	7.09	0.50	0.56	0.00
Clear Fork - East Branch	126	37.97	4.63	2.99	1.64
Nettle Creek - Nettle Creek	172	5.36	0.30	0.42	0.00
Nettle Creek - Nettle Creek	129	3.81	0.55	0.30	0.25
Eagle Creek - Nettle Creek	130	6.71	0.94	0.53	0.41
Bear Creek - Nettle Creek	132	16.32	7.58	1.29	6.30
Bear Creek - Nettle Creek	133	15.91	3.66	1.25	2.41
Bear Creek - Nettle Creek	131	109.57	14.67	8.63	6.04
Headwaters Fish Creek	171	6.08	0.34	0.48	0.00
West Branch-Fish Creek	170	5.23	0.30	0.41	0.00
Cornell Ditch - Fish Creek	124	9.38	0.99	0.74	0.25

Table 4.6: Total Dissolved Solid Pollution Load Reductions Necessary to Meet Target Loads

			2013 Load	Target Load	Reduction Needed
Subwatershed	**Site Number**	**Mean CF/S**	**TDS (Tons/yr)**	**TDS (Tons/yr)**	**TDS (Tons/yr)**
West Fork-West Branch	173	8.44	3115.18	6230.36	0.00
West Fork-West Branch	135	75.57	26679.52	55785.34	0.00
East Fork-West Branch	134	15.98	5287.25	11796.34	0.00
Lake La Su An - West Branch	125	58.81	17937.18	43413.20	0.00
Pittsford Millpond - East Branch	155	17.96	6294.23	13257.97	0.00
Clear Fork - East Fork	174	7.93	2341.55	5853.88	0.00
Clear Fork - East Fork	175	7.09	2484.31	5233.80	0.00
Clear Fork - East Fork	126	37.97	13042.94	28029.24	0.00
Nettle Creek - Nettle Creek	172	5.36	2247.42	3956.72	0.00
Nettle Creek - Nettle Creek	129	3.81	1098.76	2812.52	0.00
Eagle Creek - Nettle Creek	130	6.71	1342.14	4953.28	0.00
Bear Creek - Nettle Creek	132	16.32	8184.31	12047.33	0.00
Bear Creek - Nettle Creek	133	15.91	6741.75	11744.67	0.00
Bear Creek - Nettle Creek	131	109.57	39922.16	80883.94	0.00
Headwaters Fish Creek	171	6.08	2.33	4488.22	0.00
West Branch-Fish Creek	170	5.23	2769.45	3860.76	0.00
Cornell Ditch - Fish Creek	124	9.38	3259.02	6924.26	0.00

Table 4.7: **Dissolved Reactive Phosphorus Pollution Load Reductions Necessary to Meet Target**

			SWAT Load	Target Load	Reduction Needed
Subwatershed	**Site Number**	**Mean CF/S**	**Dissolved Reactive Phosphorus (Tons/yr)**	**Dissolved Reactive Phosphorus (Tons/yr)**	**Dissolved Reactive Phosphorus (Tons/yr)**
West Fork-West Branch	173	45.2	2.67	2.22	0.45
West Fork-West Branch	135	57.7	3.22	2.84	0.38
East Fork-West Branch	134	54	2.57	2.66	0.00
Lake La Su An - West Branch	125	135.7	6.52	6.68	0.00
Pittsford Millpond - East Branch	155	13.7	0.63	0.67	0.00
Clear Fork - East Fork	174	32.4	1.24	1.59	0.00
Clear Fork - East Fork	175	88	5.31	4.33	0.98
Clear Fork - East Fork	126	163	9.05	8.02	1.03
Nettle Creek - Nettle Creek	172	15.6	0.81	0.77	0.04
Nettle Creek - Nettle Creek	129	33.5	1.66	1.65	0.01
Eagle Creek - Nettle Creek	130	34	1.54	1.67	0.00
Bear Creek - Nettle Creek	132	11.1	0.71	0.55	0.16
Bear Creek - Nettle Creek	133	2.9	0.22	0.14	0.08
Bear Creek - Nettle Creek	131	19.9	1.37	0.98	0.39
Headwaters Fish Creek	171	21.3	0.81	1.05	0.00
West Branch-Fish Creek	170	14.3	0.37	0.70	0.00
Cornell Ditch - Fish Creek	124	147.4	5.78	7.25	0.00

Even though load reductions cannot be determined for turbidity and *E. coli* it is important to understand the magnitude of the problem each of these parameters pose to the health of the watershed. Therefore, Table 4.8 shows the average concentration of turbidity and *E. coli* per sample site and an overall average for the entire project area. The geometric mean for *E. coli* is also shown for each sample site as the geometric mean provides a clearer look at the typical condition of the site by taking out the samples with extreme outliers. However, the average *E. coli* count provides information as to whether or not *E. coli* can be an issue in the watershed. Those cells highlighted in pink in Table 4.7 are those with an average that exceeds the target level set by this project. The cells highlighted in lilac are those with a geometric mean that exceeded the state standard for *E. coli* and should be considered prior to those whose average concentration exceeded, but the geometric mean did not.

Table 4.8 Average Concentration for Turbidity and *E. coli* per Sample Site

Subwatershed	Site Number	Turbidity (NTU)	*E. coli* (CFU/100ml) Average (Geometric Mean)
West Fork-West Branch	173	15.783	410.435 *(225.03)*
West Fork-West Branch	135	22.263	424.349 *(103.176)*
East Fork-West Branch	134	24.083	949.24 *(31.85)*
Lake La Su An - West Branch	125	45.54	495.33 *(7.13)*
Pittsford Millpond - East Branch	155	6.845	957.97 *(10.30)*
Clear Fork - East Fork	174	42.71	75.22 *(1.0)*
Clear Fork - East Fork	175	20.325	494.348 *(400.36)*
Clear Fork - East Fork	126	54.372	1117.06 *(80.18)*
Nettle Creek - Nettle Creek	172	19.267	481.74 *(152.98)*
Nettle Creek - Nettle Creek	129	79.24	1369.35 *(24.12)*
Eagle Creek - Nettle Creek	130	34.79	796.91 *(62.86)*
Bear Creek - Nettle Creek	132	53.89	1086.95 *(57.83)*
Bear Creek - Nettle Creek	133	220.97	972.77 *(228.842)*
Bear Creek - Nettle Creek	131	38.98	898.915 *(42.535)*
Headwaters Fish Creek	171	12.8	455 *(241.91)*
West Branch-Fish Creek	170	17.021	391.305 *(125.803)*
Cornell Ditch - Fish Creek	124	40.36	731.628 *(15.507)*
Project Area Average		**44.07288235**	**712.266 *(106.55)***

5.0 Critical Areas and Project Goals

5.1 Critical Areas to Focus Implementation

Critical areas are defined by IDEM as those areas that have been identified through historical studies, land use information, and water quality data, in the project area as needing implementation efforts to improve current water quality or that will mitigate the impact of potential sources of NPS to protect water quality. Identifying critical areas and goals to address those critical areas will focus efforts in the watershed on the areas that will have the greatest impact on improving water quality in the USJRW. This Section will identify the critical areas located within the USJRW project area and outline the goals necessary to address those critical areas. Please note that if there are several areas that are considered critical for a particular practice or parameter, a “priority” may be assigned to each area so that implementation will be focused on the areas that will have the biggest impact on water quality first. Once all possible implementation efforts have been exhausted in Priority Area 1, efforts will be focused in Priority Area 2, and then in Priority 3 areas.

5.1.1 Pollutant Based Critical Areas

As stated in Section 4.3, load reductions were needed in Bear Creek-Nettle Creek, at sample site 132 for nitrate+nitrite. However, this sample site is located directly downstream of the Edon WWTP that has had several discharge exceedances reported to the US EPA over the past three years. It is likely that the load reductions needed at this sample site are due to the effluent discharge from the WWTP. The USJRW Steering Committee has decided not to address this since greater impacts on water quality issues in the USJRW will be made by the group focusing on NPS problems. Therefore, a critical area has not been assigned for nitrate+nitrite load reductions. However, continued monitoring at site 132 is important.

Total Phosphorus load reductions are needed at 13 of the 17 sample sites located in the USJRW, as is stated in Section 4.3. Therefore, the drainage area of those 13 sites is considered critical for phosphorus loading and necessary BMPs to mitigate the TP loading problems will need to be implemented in those areas. Since so many of the sample sites are in need of load reductions for phosphorus, the USJRW steering committee decided to prioritize the implementation efforts to work on reducing the largest loads first. Therefore, those sample sites with a necessary load reduction of greater than six tons per year will be priority one, those sample sites with a necessary load reduction of two – six tons per year will be priority two, and those sample sites with a necessary load reduction of less than two tons per year will be priority three. Table 5.1 identifies the priority level of each sample site.

Table 5.1: Priority Level for Implementation Efforts for Total Phosphorus Reductions

Sample Site	Subwatershed	Priority Level
135	West Fork-West Branch	**1**
132	Bear Creek – Nettle Creek	**1**
131	Bear Creek- Nettle Creek	**1**
125	Lake La Su An	**2**
133	Bear Creek-Nettle Creek	**2**
173	West Fork – West Branch	**3**
134	Cambria Millpond – East Fork and East Fork – West Branch	**3**
155	Pittsford Millpond – East Branch	**3**
174	Clear Fork-East Branch	**3**
126	Clear Fork – East Branch	**3**
129	Nettle Creek – Nettle Creek	**3**
130	Eagle Creek – Nettle Creek	**3**
124	Cornell Ditch – Fish Creek	**3**

The Initiative sampled for TDS at each of the sample sites in 2012. Current and target loads were calculated for TDS, and no reduction in loads was found to be necessary. However, turbidity levels were also measured at each sample site by the Initiative in 2012 and average turbidity levels exceeded the Indiana state standard of 10.4 NTU at 16 of the 17 sample sites. Therefore, the drainage area of those 16 sample sites where average turbidity levels exceeded the target are considered critical for turbidity. Due to the fact that 16 of the subwatersheds above sampling points are in need of implementation efforts to reduce sediment delivery to open water, the USJRW steering committee decided to focus efforts on the subwatersheds with the highest turbidity levels first. Therefore, those sample sites with an average turbidity level of greater than 50 NTU will be priority 1 for implementation, those samples sites with an average between 20 and 49 NTU will be priority 2 for implementation, and those with sample sites with an average between 10.4 and 20 NTU will be priority 3 for implementation. Table 5.2 identifies the priority level of each sample site.

Table 5.2: Priority Level for Implementation Efforts for Turbidity Reductions

Sample Site	Subwatershed	Priority Level
126	Clear Fork-East Branch	**1**
129	Nettle Creek-Nettle Creek	**1**
132	Bear Creek-Nettle Creek	**1**
133	Bear Creek-Nettle Creek	**1**
135	West Fork-West Branch	**2**
134	East Fork-West Branch	**2**
125	Lake La Su An-West Branch	**2**
174	Clear Fork-East Branch	**2**
175	Clear Fork-East Branch	**2**
130	Eagle Creek-Nettle Creek	**2**
131	Bear Creek-Nettle Creek	**2**
124	Cornell Ditch-Fish Creek	**2**
173	West Fork-West Branch	**3**
172	Nettle Creek-Nettle Creek	**3**
171	Headwaters Fish Creek	**3**
170	West Branch – Fish Creek	**3**

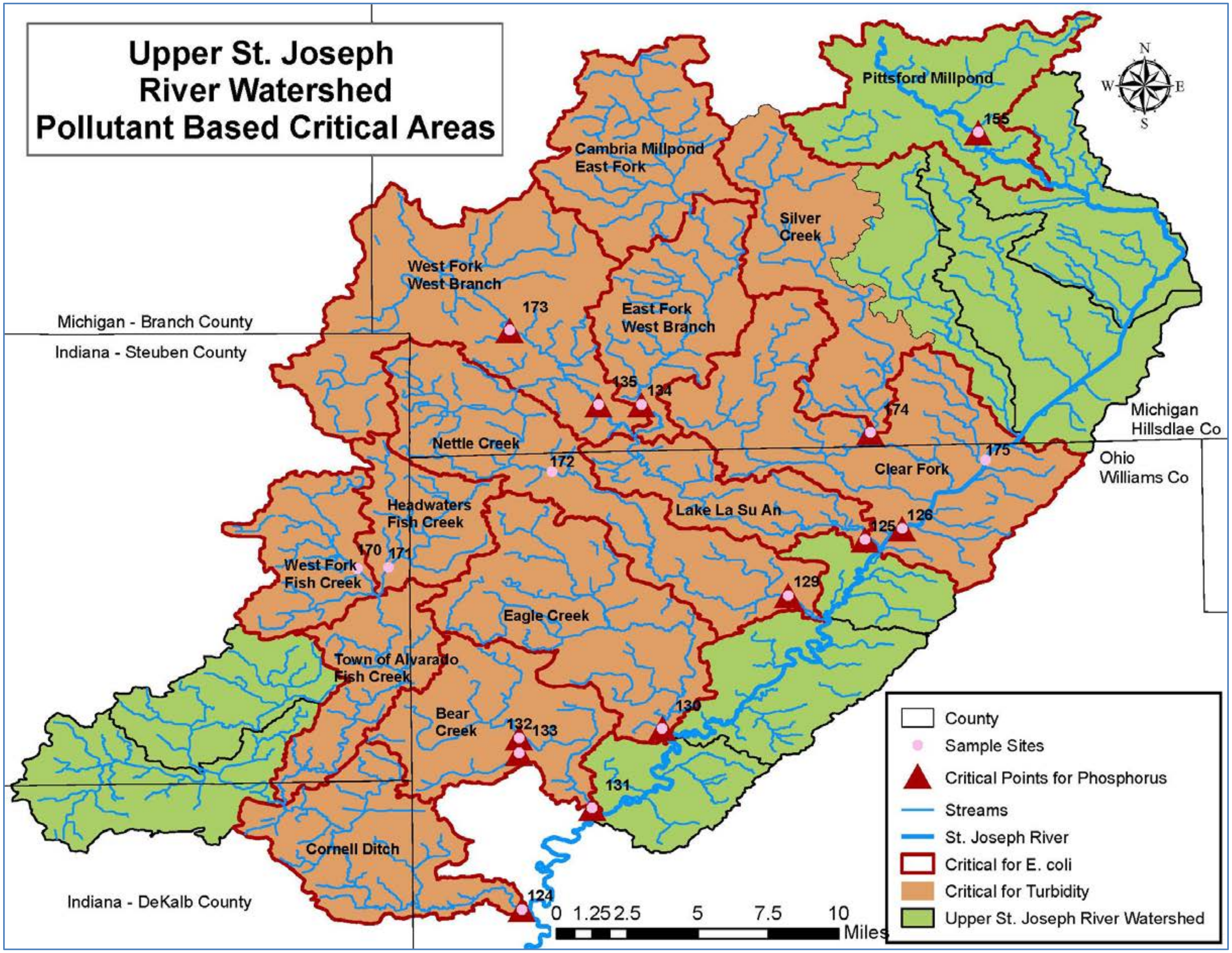
Load reductions for *E. coli* cannot be accurately measured. However, *E. coli* can cause surface water to be unhealthy for aquatic life, recreation, and drinking and should therefore be considered when addressing contributors to NPS in the USJRW. The Initiative collected *E. coli* samples during their 2012 water quality sampling efforts and the results revealed that 16 of the 17 sample sites exceeded the single sample Indiana state standard of 235 CFU/100ml. Therefore, the drainage area to those 16 sample sites are considered to be critical for management measures to address *E. coli* sources. It is important to note that 6 of the 17 sample sites exceeded the Indiana state standard for the geometric mean of 125 CFU/100ml. As explained above, the geometric mean provides a more accurate representation of the typical count for *E. coli* at each of the sample sites by excluding extreme outliers. For this reason, the drainage area of those sample sites with a geometric mean greater than the state standard are considered to be priority one for implementation efforts. Table 5.3 below identifies those critical sample sites and their priority level for implementation.

Table 5.3: Priority Level for Implementation Efforts *E. coli* Reductions

Sample Site	Subwatershed	Priority Level
173	West Fork-West Branch	**1**
175	Clear Fork-East Branch	**1**
172	Nettle Creek-Nettle Creek	**1**
133	Bear Creek-Nettle Creek	**1**
171	Headwaters Fish Creek	**1**
170	West Branch-Fish Creek	**1**
135	West Fork-West Branch	**2**
134	East Fork-West Branch	**2**
125	Lake La Su An-West Branch	**2**
155	Pittsford Millpond-East Branch	**2**
126	Clear Fork-East Fork	**2**
129	Nettle Creek-Nettle Creek	**2**
130	Eagle Creek-Nettle Creek	**2**
132	Bear Creek-Nettle Creek	**2**
131	Bear Creek-Nettle Creek	**2**
124	Cornell Ditch-Fish Creek	**2**

Figure 5.1 below is a map identifying the areas that are deemed critical due to the exceedance of one or more parameters.

Figure 5.1: Pollutant Based Critical Areas



5.1.2 Dissolved Reactive Phosphorus Based Critical Areas

Research has shown that the greatest contributor to DRP and sediment to Lake Erie is the Maumee River Basin, which includes the St. Joseph River Watershed. Therefore, the USJRW steering committee felt it was important to focus efforts on reducing the amount of DRP in the river and make potential sources of DRP critical for implementation efforts. Delivery of DRP is very different from particulate phosphorus which is accounted for in the critical areas for total phosphorus. DRP does not attach to soil particles and can freely percolate through the soil for delivery to open water through field tiles. DRP can also reach open water through septic tank leachate, turf grass fertilizer, manure runoff from field application, livestock access to open water, and barnyard and pasture runoff. Therefore, these potential sources of DRP are considered critical to put effort towards implementation to minimize, and potentially eliminate DRP from reaching open water.

The Soil and Water Assessment Tool (SWAT) model ran by Purdue University identified areas of concern for DRP loading. Purdue was asked to simulate the load from the drainage areas for each of the Initiative sample sites in the USJRW. Table 5.4 lists the sample sites with a drainage area loading that is in need of reductions according to the SWAT model. However, since not all the drainage areas were simulated, it is a safe assumption that DRP loading may be coming from several other areas as was described in the above paragraph and table. Therefore, addressing sources of DRP within the below drainage areas will be priority one of implementation. Once all avenues have been explored to reduce, or eliminate DRP loading from those drainage areas, the sources of DRP will be examined in the remainder of the watershed.

Table 5.4: Dissolved Reactive Phosphorus Loading Critical Points for Implementation

Sample Site	Subwatershed
173	West Fork-West Branch
175	Clear Fork-East Branch
172	Nettle Creek-Nettle Creek
133	Bear Creek-Nettle Creek
135	West Fork-West Branch
126	Clear Fork-East Fork
129	Nettle Creek-Nettle Creek
132	Bear Creek-Nettle Creek
131	Bear Creek-Nettle Creek

Table 5.5 lists the areas in the project area that critical sources of DRP have been exhibited. Figure 5.2 is a map showing the USJRW with the cultivated crop land and pasture fields delineated, of which both land uses have the potential to be tiled and leach DRP into open water. The cultivated crops delineated in Figure 5.2 are also potential areas where manure will be spread as fertilizer, possibly during the fall or on frozen ground. It is important to note that an inventory of tiled fields and land where manure is spread on frozen ground was not conducted; therefore, not all cultivated crop fields will be critical sources of DRP. Critical areas will be identified at the individual field during the implementation phase of the project. Figure 5.2 also shows the location of built-up lakes and urbanized

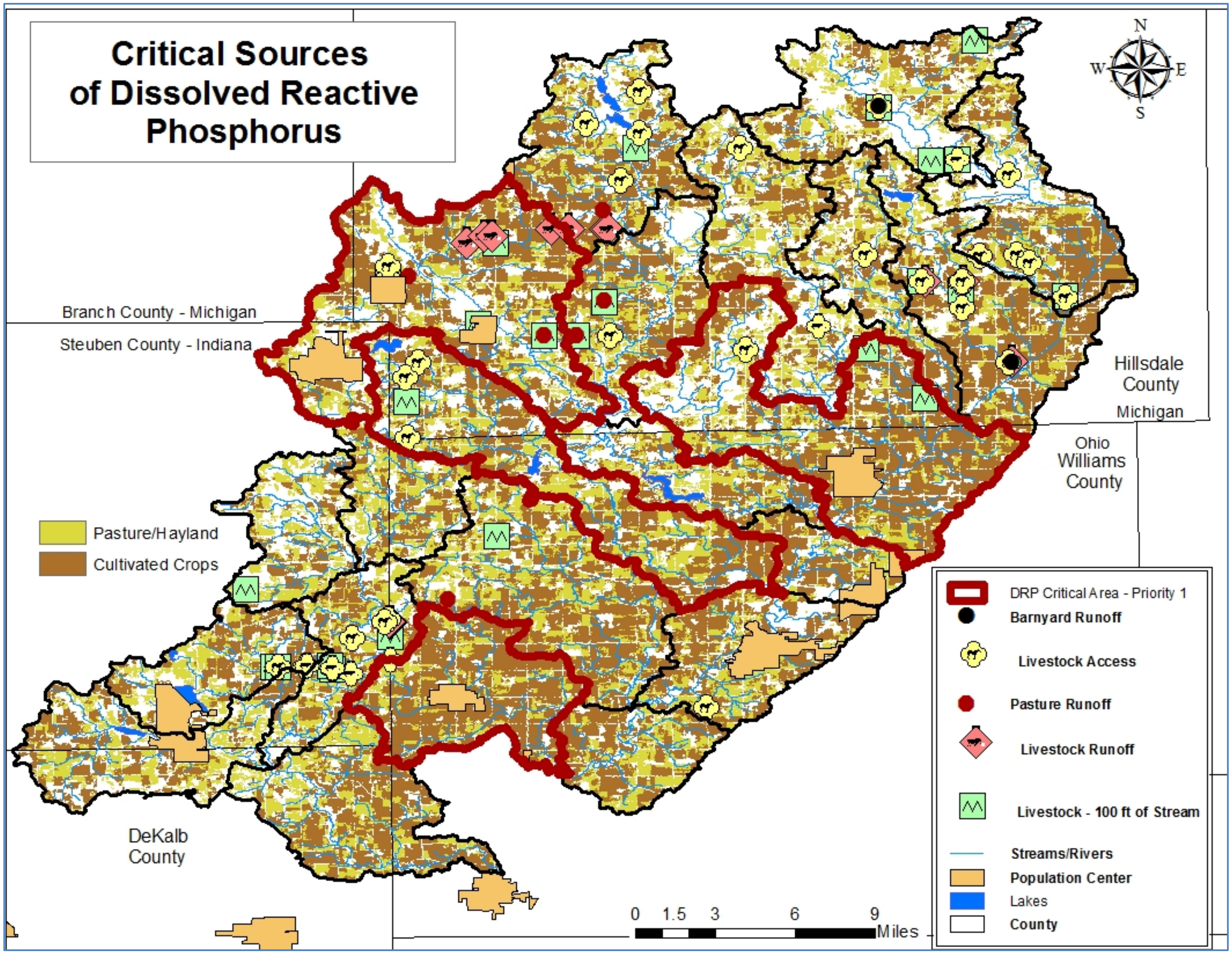
areas where lawn fertilizer is used which also has the potential to allow DRP to runoff into open water. And Figure 5.2 shows the location of all current livestock issues that were found through windshield and desktop surveys. The USJRW steering committee not only considers the current animal operations that are discharging into open water critical sources, but all future animal operations that are found to be discharging to open water as well.

Table 5.5: Critical Sources of Dissolved Reactive Phosphorus Remediation

Critical Source	Critical Source	Number or Acreage
Tiled Fields Improperly Managed for Nutrients	Tiled Agricultural Crop Fields Watershed Wide	147,987 Acres[1]
Tiled Fields Improperly Managed for Nutrients	Tiled Pastures Watershed Wide	93,857 Acres[1]
Turf Grass Fertilizer	Urban Areas and Built-up Lakes Watershed Wide	95,787 Acres[1]
Current and Future Pasture and Barnyard Runoff	Watershed Wide	22 Sites (2012)[2]
Current and Future Livestock Operations within 100' of Water	Watershed Wide	26 Sites (2012)[2]
Current and Future Livestock with Direct Access to Open Water	Watershed Wide	42 Sites (2012)[2]
Current and Future Leaking, Failed, or Straight pipe Septic Systems	Public Education and Outreach Watershed Wide	± 6,200 Homes[3] (2013)
Manure Application in the Fall or on Frozen Ground	Agricultural Area Watershed Wide	147,987 Acres[1]

[1] Acreage taken from USGS land use analysis. Critical sources may not Include the entire area, but management measures will need to be inventoried at each site prior to determining if it is a critical source of DRP.
[2] Total number was derived from a combination of the 2012 windshield survey and the 2009 livestock inventory.
[3] Total number is an estimate from the County Health Departments in the project area.

Figure 5.2: Dissolved Reactive Phosphorus Critical Areas and Critical Sources of DRP



Symbol labeled "livestock runoff" is from the 2009 livestock inventory where runoff was noted, though the source (barnyard or pasture runoff) was not described.

5.1.3 Buffer Width and Streambank Erosion Based Critical Area

The USJRW Steering Committee expressed concern regarding excess sediment runoff from agriculture fields discharging into open water and streambank erosion throughout the project areas.

The windshield survey and computer based survey of stream buffers revealed that many of the streams in the watershed lack an adequate buffer to filter runoff before it enters the stream or supply suitable habitat for wildlife. Over 64% of the parcels adjacent to open water in the USJRW have a stream buffer of less than 60 feet in width and 51% of parcels adjacent to open water have a stream buffer of less than 10 feet in width.

Stream buffers are important to water quality. Vegetated buffers help to slow the velocity of storm flow which allows time for sediment, much of which carries other pollutants attached to the soil particles, to settle out before entering the stream. They also help keep soil in place to prevent stream bank erosion. With the majority of streams in the watershed having inadequate buffers, the steering committee has decided to make stream buffer installation a priority of the project.

The health of larger streams and rivers depend on a healthy headwater stream network. For that reason, the steering committee has decided to make all stream buffers less than 60 feet in width at headwater streams critical for the installation of riparian buffer strips. The steering committee has also decided to follow the NRCS recommended widths for an adequate riparian buffer. The NRCS recommends that land with a slope of 0 – 2% have a minimum of a 20 foot buffer, land with a slope of 2 – 4% have a minimum of a 40 foot buffer, and land with a slope greater than 4% have a minimum buffer of 60 feet. Slope in relation to stream buffers has not been inventoried at this time and will be assessed at the field level at the time of implementation, at which time priority will be given to those areas where the most significant runoff and erosion potential exists.

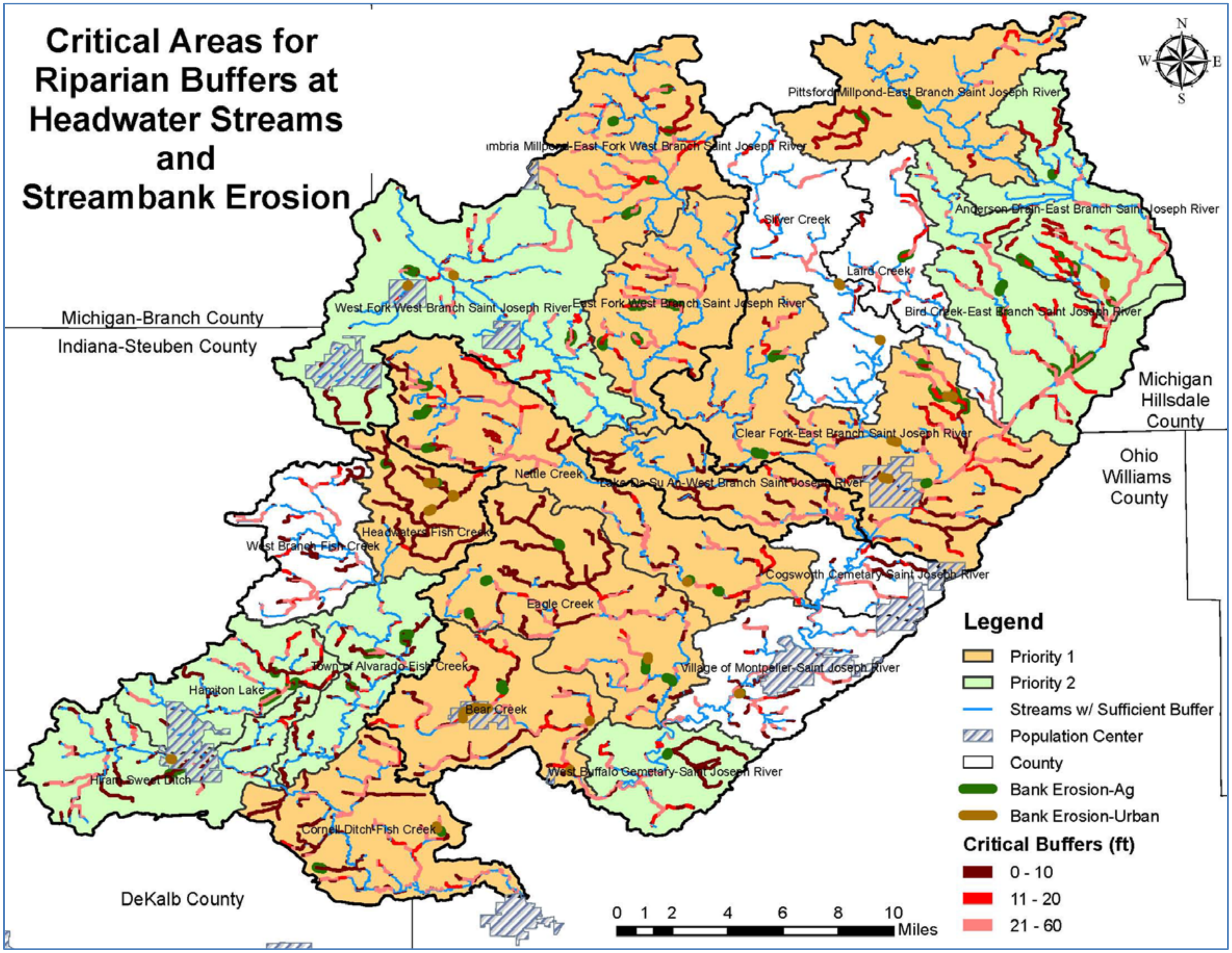
The windshield survey conducted in 2012 in the USJRW revealed approximately 71,637 linear feet of stream bank erosion along streams within the agricultural landscape and 17,513 linear feet of stream bank erosion along streams within the urban landscape in the USJRW. This streambank erosion may be due to a lack of adequate riparian buffer to slow the velocity and erosive power of stormwater, agricultural crop fields that are farming up to the streambank, the lack of adoption of conservation tillage practices, other conventional farming techniques, and the Increase in impervious surfaces in urban areas. Management measures will need to be taken at the areas identified during the windshield survey, and any future bank erosion sites to prevent further erosion and sedimentation of the stream.

Figure 5.3 is a map showing the location of the land parcels with a riparian buffer of less than 60 feet, as well as the location of streambank erosion that was observed during the windshield survey. As can be seen in the map, streambank erosion was often observed at, or directly downstream of where the riparian buffer is less than 60 feet. Based on the information depicted in the map, and necessary load reductions in the HUC 12s, the installation of riparian buffers at headwater streams and streambank erosion remediation will be prioritized per subwatershed, as outlined in Table 5.6. It should be noted that based on how the buffer inventory was provided to us by the contractor hired to perform the analysis, there is no way to determine the actual stream miles that need a riparian buffer or the acreage of stream buffer than is needed at this time. However, the map in Figure 5.3 provides a picture of where to start the implementation process in regards to riparian buffers.

Table 5.6: Critical Area for Stream Buffers Based on Slope

Priority	Subwatershed
1	Pittsford Millpond – East Branch
1	Clear Fork – East Branch
1	Cambria Millpond – East Fork – West Branch
1	East Fork – West Branch
1	Lake La Su An – West Branch
1	Headwaters Fish Creek
1	Cornell Ditch – Fish Creek
1	Eagle Creek – Nettle Creek
1	Bear Creek – Nettle Creek
1	Nettle Creek – Nettle Creek
2	Anderson Drain – East Branch
2	Bird Creek – East Branch
2	West Fork – West Branch
2	Hiram Sweet Ditch
2	Hamilton Lake
2	Town of Alvarado – Fish Creek
2	West Buffalo Cemetery – Nettle Creek

Figure 5.3: Critical Area for Stream Buffer Width and Streambank Erosion



5.1.4 Urban Landuse Based Critical Area

The USJRW Steering Committee voiced several concerns regarding urban land uses that affect water quality including sediment runoff in lake communities and urban areas, as well as excessive lawn fertilizer used in lake communities and urbanized areas.

Urban pollutants can be much different than those found throughout the agricultural community. For example, fertilizer from urban lawns, golf courses, parks and cemeteries often contain nutrients that are in excess to what the grass typically uses and are more likely to runoff during wet weather events than fertilizers used in agriculture. It is also common to have runoff of sediment, oil, gas and other substances from automobiles, and salts from the roads. Pet waste left on lawns, dog parks, and other public areas, can make its way into open water and Increase *E. coli* and nutrient levels, as can wildlife and bird waste, which is often a problem at urban retention ponds. Finally, excess stormwater, due to the Increase in imperviousness within urban areas, can become a pollutant itself by causing surface and stream bank erosion. For these reasons, the USJRW steering committee decided to make all urban areas in the watershed critical to reduce the amount of stormflow reaching open water. Riparian buffers located within urban areas are of particular concern, as the stream buffers can slow the velocity of surface water flow allowing some pollutants to settle out prior to reaching open water, and can help eliminate the erosive power of excess stormwater.

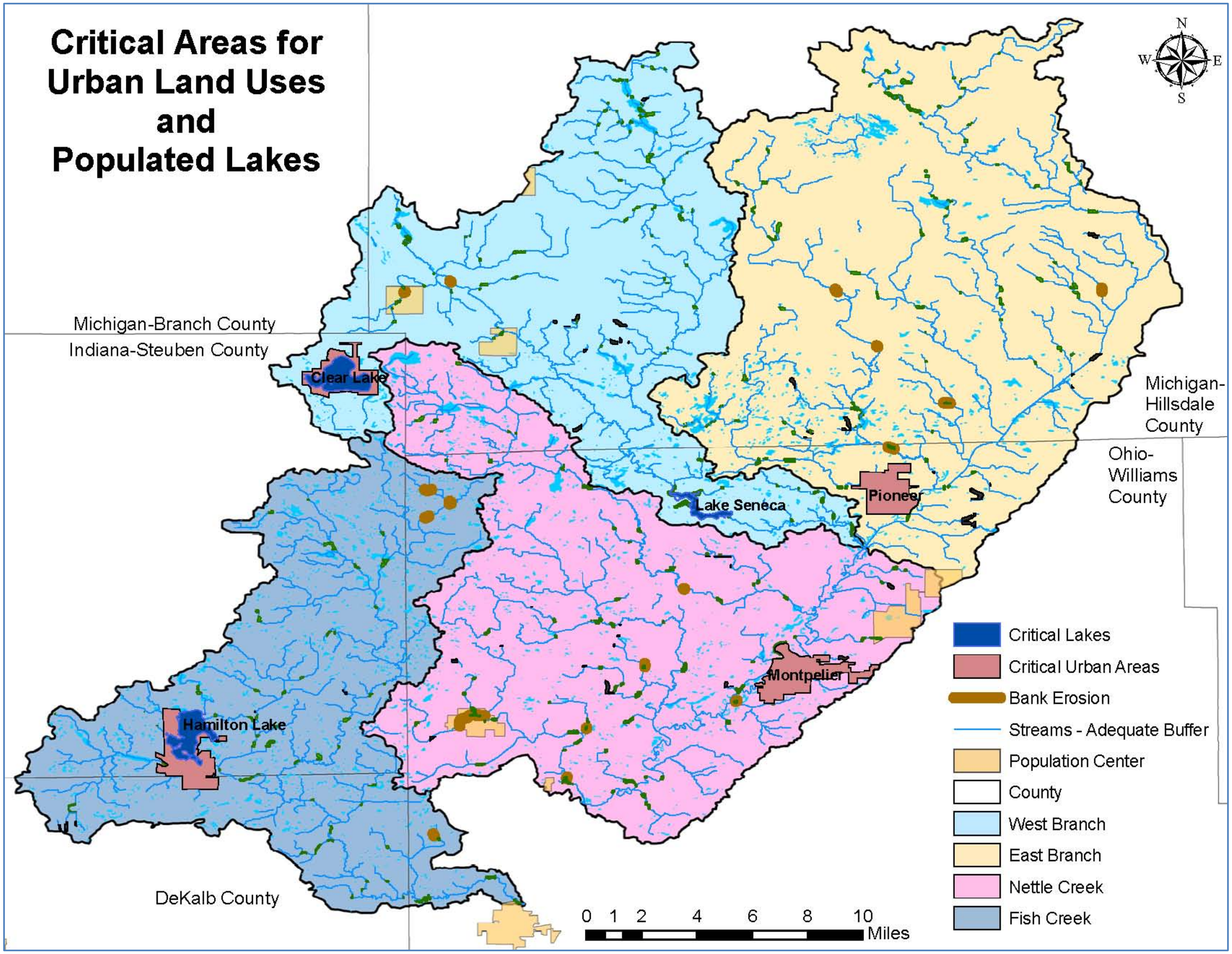
It was common to see residential properties in urban areas, in lake settings, and at industrial sites with little to no riparian buffer. As was observed during the windshield survey, most homeowners mow their lawns directly up to the streambank/shoreline to maximize their lawn space, and many commercial and industrial facilities did not have a stream buffer as the land is used for parking, or another aspect of the business.

The windshield survey conducted in 2012 in the USJRW revealed approximately 17,513 linear feet of stream bank erosion along streams within the urban landscape in the USJRW. This streambank erosion may be due to a lack of adequate riparian buffer to slow the velocity and erosive power of stormwater exacerbated by the increase in imperviousness. Many of the populated lakes in the USJRW have sea walls installed as a means of shoreline protection. However, this practice increases wave action thus increases erosion elsewhere as well as stirs up sediments that carry excess nutrients that are released into the water.

Management measures will need to be taken to slow the velocity of urban stormwater, decrease the amount of surface flow from urban areas, and reduce the amount of nutrients that make their way to open water from stormwater runoff from lawns in which excessive fertilizer was used. The USJRW has decided to consider the urbanized areas of Clear Lake, Lake Seneca, and Hamilton Lake critical due to the dense population around the lakes, and the towns of Pioneer and Montpelier due to their location on the St. Joseph River critical for the implementation of stormwater related runoff management measures.

Figure 5.4 shows the location of all population centers that are considered to be critical within the USJRW Including Clear Lake, Lake Seneca, Hamilton Lake, Pioneer, and Montpelier.

Figure 5.6: Critical Areas for Urban Land Uses and Populated Lakes



5.2 Summary of Critical Areas

The USJRW steering committee looked closely at all available data that has been gathered throughout this watershed investigation and determined that several areas in particular are contributing to NPS and the degradation of water quality within the USJRW. Therefore, those areas were deemed critical by the steering committee and are summarized below. Table 5.7 lists the sample sites whose drainage area is considered critical for various pollutants and the priority level assigned to each site. Management measures to address the pollutants deemed a priority one will be implemented first. Below the table is an additional list of critical areas in the USJRW.

Table 5.7: Pollutant Based Critical Area Summary

Sample Site	Subwatershed	Total Phosphorus Priority	Dissolved Reactive Phosphorus Priority	Turbidity Priority	E. coli Priority
135	**West Fork-West Branch**	**1**	**1**	**2**	**2**
173	**West Fork - West Branch**	**3**	**1**	**3**	**1**
134	**East Fork - West Branch**	**3**	**-**	**2**	**2**
125	**Lake La Su An - West Branch**	**2**	**-**	**2**	**2**
155	**Pittsford Millpond-East Branch**	**3**	**-**	**-**	**2**
174	**Clear Fork - East Branch**	**3**	**-**	**2**	**-**
175	**Clear Fork - East Branch**	**-**	**1**	**2**	**1**
126	**Clear Fork - East Branch**	**3**	**1**	**1**	**2**
132	**Bear Creek-Nettle Creek**	**1**	**1**	**1**	**2**
131	**Bear Creek-Nettle Creek**	**1**	**1**	**2**	**2**
133	**Bear Creek-Nettle Creek**	**2**	**1**	**1**	**1**
172	**Nettle Creek-Nettle Creek**	**-**	**1**	**3**	**1**
129	**Nettle Creek-Nettle Creek**	**3**	**1**	**1**	**2**
130	**Eagle Creek-Nettle Creek**	**3**	**-**	**2**	**2**
171	**Headwaters-Fish Creek**	**-**	**-**	**3**	**1**
124	**Cornell Ditch - Fish Creek**	**3**	**-**	**2**	**2**
170	**West Branch-Fish Creek**	**-**	**-**	**3**	**1**

- Riparian Buffers less than 60 feet in Headwater Streams
  - Priority 1 – (East Branch St. Joseph) Pittsford Millpond, Clear Fork, (West Branch St. Joseph) Cambria Millpond, East Fork – West Branch, Lake La Su An, (Fish Creek) Headwaters Fish Creek, Cornell Ditch, (Nettle Creek) Eagle Creek, Bear Creek, Nettle Creek.
  - Priority 2 – (East Branch St. Joseph) Anderson Drain, Bird Creek, (West Branch St. Joseph) West Fork, (Fish Creek) Hiram Sweet Ditch, Hamilton Lake, Town of Alvarado, (Nettle Creek) West Buffalo Cemetery
- Urban Land Uses and Populated Lakes
  - Pioneer and Montpelier, Ohio, Clear Lake and Hamilton Lake, IN and Lake Seneca, Ohio

5.3 Project Goals and Progress Indicators

The USJRW steering committee used historic studies, land use, and water quality data, as well as current data, stakeholder input, problems found during the project investigation, and identified critical areas to determine overall goals for the watershed. The overarching goal of the project is to reduce pollutant loads and mitigate pollution sources so that water quality measurements will meet the project's target levels and/or state or federal water quality standards. However, to reach that principle goal of improving the quality of water in the USJRW smaller, more attainable, goals were written. Each of the goal statements in the following section is written to take small steps toward meeting the main goal of this project.

It is also important to be able to measure the progress being made toward meeting each of the goals. Therefore, indicators were determined that will be used as a measurement tool which are listed in the following section as well.

5.3.1 Reduce Phosphorus Loading

The average historic total phosphorus levels measured in the USJRW exceeded the target level in all four HUC 10 subwatersheds. The average concentration of TP exceeded the target set by this project in 13 of the 16 subwatersheds where TP was measured. Pollutant loads were determined using the 2012 water quality data sampled as part of this project and TP loads exceeded the target loads at 13 of the 17 sample sites. According to the calculate pollutant loads a total reduction of 39.2% is necessary to meet water quality targets set by this project.

Goal Statement – Phosphorus

The goal of this project is for TP levels in sampled water to meet the target level of 0.08 mg/L in all tributaries of the St. Joseph River. To accomplish this phosphorus loads will be reduced by 10% by year 2020, by 20% by year 2030, and by 39.2% by year 2044.

Indicator

Water quality and administrative indicators will be used to show the progress toward meeting the goal for phosphorus levels in the USJRW.

Water Quality Indicator

Phosphorus will be measured weekly during the recreational season annually at seventeen sample sites within the USJRW after three to five years of implementation. To determine if the milestones set for the phosphorus goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in phosphorus loading with more samples meeting the target level for total phosphorus of 0.08 mg/L in tributaries of the St. Joseph River each year of sampling after three to five years of implementation.

Administrative Indicator

The load reductions as a result of best management practices that are installed in the watershed, as determined by load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loading of total phosphorus to reach the 86.4% reduction needed to meet the target load.

Administrative Indicator

The number of best management practices that can reduce phosphorus levels that are installed in the watershed will be monitored. Dissolved Reactive and Total phosphorus reductions will be monitored separately. Annual milestones for each of the various BMPs that can reduce phosphorus levels are described in the Action Register in Section 6.

5.3.2 Reduce Dissolved Reactive Phosphorus Loading

Dissolved reactive phosphorus was not measured in water samples within the USJRW. However, the SWAT model indicated there was excess loading of DRP in several subwatersheds. It is also known that DRP loading comes from several practices that are regularly used throughout the USJRW.

Goal Statement

The goal of this project is to have all sampled water within the USJRW meet the target water quality level for DRP of < 0.05 mg/L in 50% of the samples by 2020, 75% of the samples by 2030, and all water samples by 2044. This would require a 2% reduction in DRP loading according to the SWAT model.

Indicator

Water quality indicators will be used to show the progress toward meeting the goal for DRP levels in the USJRW. Administrative goals will also be used to measure the progress toward meeting the goal for DRP levels in the USJRW.

Water Quality Indicator

DRP will be measured weekly during the recreational season annually at seventeen sample sites within the USJRW. DRP sampling will begin immediately after funding is acquired, and will continue for a minimum of two years, to help form a baseline loading in the USJRW. Sampling efforts will resume after three to five years of implementation. To determine if the milestones set for the DRP goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in DRP loading with more samples meeting the target level for DRP of 0.05 mg/L each year of sampling after three to five years of implementation.

Administrative Indicator

The load reductions of DRP, as a result of best management practices that are installed in the watershed, as determined by load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loading of DRP to reach the 2% reduction needed (as modeled by the SWAT) to meet the target load.

Administrative Indicator

The number of best management practices that can reduce DRP levels that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that may reduce DRP levels are described in the Action Register in Section 6.

5.3.3 Reduce Sediment Loading

The average turbidity levels measured in the USJRW in 2012 by the Initiative exceeded the target level in all subwatersheds where turbidity samples were taken except for the very headwaters in the Pittsford Millpond-East Branch subwatershed. The highest turbidity reading was in the Bear Creek-Nettle Creek subwatershed at 220.97 NTU.

Goal Statement – Turbidity

The goal of this project is to have all sampled water within the USJRW meet the target water quality level for turbidity of 10.4 NTU in 20% of samples by 2020, 50% of samples by 2030, and in all of the samples by 2044.

Indicator

Water quality indicators will be used to show the progress toward meeting the goal for sediment levels in the USJRW. Administrative goals will also be used to measure the progress toward meeting the goal for turbidity levels in the USJRW.

Water Quality Indicator

Turbidity will be measured weekly during the recreational season annually at the seventeen sample sites within the USJRW that were measured in 2012 after three to five years of implementation. To determine if the milestones set for the turbidity goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in turbidity readings with more samples meeting the target level for turbidity of 10.4 NTU each year of sampling after three to five years of implementation.

Administrative Indicator

The number of best management practices that can reduce soil erosion and turbidity levels that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that can reduce sediment levels are described in the Action register in Section 6.

5.3.4 Reduce *E. coli* Loading

After analyzing both water quality data collected by this project in 2012 and all historical water quality data, *E. coli* levels averaged to exceed the state standard of 235 CFU/100ml in all four HUC 10 subwatersheds located within the USJRW. The 2012 *E. coli* samples collected as part of this project revealed that all of the sample sites, except for Site 174 in the Clear Fork-East Branch, exceeded either the single sample state standard, the geometric mean state standard or both. Excessive *E. coli* could be from wildlife, leaking, failed, or straight pipe on-site waste management, WWTPs, livestock with access to the stream, manure application or animal operations located within the USJRW.

Goal Statement – *E. coli*

The goal of this project is to have 30% of water quality samples meet the single sample state standard of 235 CFU/100ml for *E. coli* by 2020, 50% by 2030, and all water quality samples meet the single sample state standard for *E. coli* by 2044.

Indicator

Water quality indicators will be used to show the progress toward meeting the goal for *E. coli* levels in the USJRW. Administrative goals will also be used to measure the progress toward meeting the goal for *E. coli* levels in the USJRW.

Water Quality Indicator

E. coli will be measured weekly during the recreational season annually at the seventeen sample sites within the USJRW that were measured in 2012 after three to five years of implementation. To determine if the milestones set for the *E. coli* goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in *E. coli* with more samples meeting the target level for *E. coli* of 235 CFU/100ml for a single sample each year of sampling after three to five years of implementation.

Administrative Indicator

The number of best management practices that can reduce *E. coli* levels that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that can reduce E. coli levels are described in the Action register in Section 6.

5.3.5 Increase the Use of Riparian Buffers/Filter Strips

The land use and riparian buffer inventory performed in 2013 revealed that 64% of the parcels adjacent to open water have a riparian buffer of less than 60 feet wide with 51% of the parcels having less than a 10 foot buffer. The buffer inventory could not verify if the buffers were woody or not. However, it is known that riparian buffers have the ability to slow the velocity of stormwater runoff thus allowing time for the water, and the pollutants it carries to absorb into the soil or settle out prior to reaching open water. Forested riparian buffers can provide more storm flow absorption as a medium sized tree is estimated to utilize over 2,300 gallons of water annually.

Goal Statement

It is the goal of this project to have at least 20% of parcels adjacent to open water to have a minimum of a 20 foot riparian buffer by 2020, 50% by 2030, and 80% of parcels adjacent to open water to have a minimum of a 20 foot buffer by 2044.

Indicator

Administrative indicators will be used to measure the success toward meeting the goal of Increasing the installation and usage of riparian buffers.

Administrative Indicator

The number of landowners who install a minimum of a 20 foot riparian buffer will be measured. It is expected that the installation of riparian buffers will Increase annually to meet the goal set by this project.

Administrative Indicator
The total acreage draining into a 20 foot riparian buffer that is installed each year will be measured. Annual milestones for the installation of riparian buffers is described in the Action Register in Section 6.

Administrative Indicator
A revised desktop buffer inventory will be conducted in 2030, halfway through the implementation phase on the USJRW project, to determine if the project is nearing the goal of 50% of parcels adjacent to a headwater streams having a minimum of a 20 foot riparian buffer in 2030.

5.3.6 Mitigate Runoff from Animal Feeding Operations

Both small scale and large animal feeding operations located within the USJRW are a concern as they are a threat to water quality from sediment and fecal runoff, as well as nutrient loads to surrounding ditches and streams. The windshield survey and 2009 livestock inventory identified several points of concern where there is the potential for open water to become contaminated due to improper management of livestock and/or livestock waste. The inventories mentioned above identified 40 locations where livestock had access to open water, 7 sites where direct discharge was seen from an adjacent pasture field, and 15 sites where barnyard runoff was identified.

Goal Statement
It is the goal of this project to exclude all current and future livestock from open water and eliminate the potential for polluted runoff from barnyards and pasture fields from reaching open water by 2034.

Indicator
Water quality and administrative indicators will be used to show the progress toward meeting the goal for excluding all livestock from open water and mitigating potential runoff from barnyards and pastures in the USJRW.

Water Quality Indicator
E. coli, turbidity, and nutrients will be measured weekly during the recreational season annually at the seventeen sample sites that were measured in 2012 after three to five years of implementation. To determine if livestock management techniques are effective it is expected that water quality samples will show a decreasing trend in turbidity and *E. coli* readings and nutrient loading with more samples meeting the target level for each parameter each year of sampling after three to five years of implementation.

Administrative Indicator
The load reductions as a result of best management practices that are installed in the watershed, as determined by load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loading of sediment and nutrients to reach the reductions needed to meet the target loads.

Administrative Indicator

The number of livestock exclusion fencing BMPs and other BMPs to reduce the impact of barnyard and pasture runoff in the watershed will be monitored, as well as the potential volume of manure being contained at each site in which a livestock BMP is implemented in the watershed will be monitored. Specific milestones for the implementation of livestock related BMPs that can reduce sediment, E. coli and nutrients are outlined in the Action Register Section 6.

5.3.7 Increase Knowledge Regarding On-Site Waste Management

Less than 3% of all soils located within the USJRW are considered acceptable for the installation of on-site waste management facilities without additional amendments; however most residents located in the rural areas of the project area have septic systems to manage their waste water. Many homeowners are unaware of the potential risks to surface and ground water, and their property if the system is not properly maintained. Leaking, failing, or straight pipe septic systems pose a threat to water quality by Increasing nutrient, sediment and bacteria levels in the water.

Goal Statement

It is the goal of this project to educate home owners about failing, leaking, and straight pipe septic systems by developing and promoting an education and outreach program regarding septic system placement and maintenance by 2015 and eliminate 50% of failing, leaking, and straight piped septic systems in the watershed by 2035 and all leaking, failing, and straight piped septic systems by 2044.

Indicator

Water quality, social, and administrative indicators will be used to show the progress toward meeting the goal for developing and promoting an education program regarding septic systems in the USJRW.

Water Quality Indicator

E. coli and nutrients will be measured weekly during the recreational season annually at the seventeen sample sites within the USJRW that were measured in 2012 after three to five years of implementation. To determine if the education and outreach program is effective, it would be expected that water quality samples will show a decreasing trend in *E. coli* and nutrients in on-site waste disposal education and outreach targeted areas with more samples meeting the target level for *E. coli* and nutrients each year of sampling after three to five years of implementation.

Social Indicator

A pre and post indicator survey regarding septic system functionality and maintenance will be conducted at workshops to determine individual's knowledge regarding septic systems and the amount in which that knowledge Increases as a result of the workshop. It would be expected that 75% of the attendants of the workshops would have a better understanding of septic systems after the workshop.

Administrative Indicator

The number of people who attend septic system maintenance workshops will be monitored. It is a goal to have 25% of targeted households show representation at the septic tank outreach events.

Administrative Indicator

The number of households that enlist septic system companies to provide regular maintenance and/or repair leaking, failed, and straight-piped septic systems will be monitored. This will be accomplished by developing partnerships with haulers and establishing self-reporting procedures that track their numbers to watch for trends in data. It is expected that the education and outreach program will increase the number of households performing regular septic maintenance and repairing improperlyfunctioning systems. A 30% Increase in the number of households that perform
maintenance and repairs on their septic systems after 2 years of septic education and outreach would be an adequate indicator of success toward meeting the goal of Increasing knowledge about proper septic system maintenance.

5.3.8 Reduce the Impact of Stormwater Runoff in Urbanized Areas

An Increase in impervious surfaces poses a threat to water quality as it allows for a direct conduit for stormwater runoff, carrying pollution such as bacteria from wildlife and pet waste, lawn fertilizer, sediment, road salts, and other urban pollutants to reach open water. Increased imperviousness also Increases the velocity and erosive power of stormwater which can Increase streambank erosion and sedimentation of surface waters. The USJRW project does not have access to a stormwater modeling program to provide estimates of the volume of water that runs over land in urban areas. However, stakeholder observations have proven that stormflow is a valid concern within the USJRW. Stakeholders also expressed concern regarding excessive nutrients and bacteria in the lakes as well as the use of high phosphorus content lawn fertilizers on property adjacent to the lakes at the initial public meetings held in 2012. Upon further investigation, it was found that there is also concern from lake residents regarding sediment runoff from agricultural land that can have an impact on the quality of water in the lakes as well as fill lake channels. Algal blooms are becoming more prevalent in developed lakes which may be due to fertilizer runoff from agricultural land, lawn fertilizer, or leaking or failed septic systems. Some lakes and their channels are in need of dredging due to the amount of sediment that is being deposited from shoreline erosion, streambank erosion, and agricultural runoff. Invasive plants and aquatic life are also impacting the health of the lake ecosystem. Finally, on-site waste disposal systems may also impact the water quality of the lakes due to an Increase in nutrients and bacteria when the systems fail or leak. Many of the larger developed lakes Including Clear Lake, Hamilton Lake and Ball Lake are on centralized sewer systems, though some others may not have that capability, including the well-developed Lake Seneca.

Goal Statement

It is the goal of this project to decrease the amount of polluted stormwater runoff from reaching open water by implementing an urban best management practice program by 2016 in the critical urban areas Including Pioneer and Montpelier Ohio and Clear Lake, Hamilton Lake, and Lake Seneca.

Indicator

Water quality, social, and administrative indicators will be used to measure the success toward meeting the goal of reducing the amount of polluted stormwater from reaching open water in the USJRW.

Water Quality Indicator

E. coli, turbidity, and nutrients will be measured weekly during the recreational season annually at the seventeen sample sites within the USJRW that were measured in 2012 after three to five years of implementation. Additionally, water quality samples will be collected downstream of the urbanized critical areas monthly during the recreational season after five years of implementation. To determine if the education and outreach, and BMPs installed in urban areas are effective at reducing nutrient loadings, and E. coli and turbidity readings, it would be expected to see that water quality samples are showing a decreasing trend in *E. coli* and nutrients with more samples meeting the target level for each parameter each year of sampling after three to five years of implementation.

Social Indicator

A pre and post social indicator survey will be conducted in the urban areas within the USJRW to learn the degree in which behavioral changes have been made after five years of implementation of the urban stormwater management program. It is expected that the post-implementation survey will show that at least 30% of the respondents are more aware of the impact stormwater has on water quality and how their actions affect water quality.

Administrative Indicator

The number of urban BMP workshops and urban pollution outreach events held annually will be measured. One urban workshop and one lake workshop held annually will be a measure of success to meeting the goal of implementing an urban/lake education and outreach program.

Administrative Indicator

The number of attendants at each of the workshops and educational programs will be measured. Since there is no baseline as urban workshops are not regularly held in the USJRW, 20 attendants at each workshop and educational program will be a measure of success.

Administrative Indicator

The load reductions as a result of best management practices that are installed in the Urban areas of the watershed, as determined by load reduction models, will be monitored. Annual milestones for each of the various BMPs that can reduce urban pollutant levels are described in the Action register in Section 6.

5.4 Management Measures to Address Critical Areas

In order to address the concerns leading to the designation of the above mentioned critical areas, best management practices and conservation measures will need to be taken. The Upper St. Joseph River Watershed Steering Committee considered the plethora of management practices and measures available to address the critical area concerns and determined that certain practices will have the greatest impact on the critical areas and will be the focus of phase two of the Upper St. Joseph River Watershed project. In Table 5.8 below, several practices and measures are outlined, and their predicted load reduction is presented, which will be the focus of the implementation efforts in the USJRW. It should be noted that the following list is not all inclusive and other practices and management measures may be added to the list in the future.

Table 5.8: Best Management Practices/Measures to Address Critical Areas

Critical Area	Reason for Being Critical	BMP or Management Measure	Estimated Load Reduction per BMP (See Section 7 for Assumptions used for Load Reductions)		
			Sediment	Phosphorus	Nitrogen
Phosphorus (Sample Site Drainage) **Priority 1** 135, 131,132 **Priority 2** 125, 133 **Priority 3** 173, 134, 155, 174, 126, 129, 130, 124 **Turbidity** (Sample Site Drainage) **Priority 1** 126,129,132,133 **Priority 2** 135, 134,125, 174, 175, 131, 130, 124 **Priority 3** 173, 172, 171, 170 **Dissolved Reactive Phosphorus** (Sample Site Drainage) 173, 175, 172, 135, 126, 129, 132, 131 , 175 **E. coli** (Sample Site Drainage) **Priority 1** 173, 175, 133, 172, 171, 170 **Priority 2** 135, 134, 125,	Particulate and Dissolved Reactive Phosphorus, Turbidity, and/or *E. coli*	Agriculture, Urban, and Septic System Education Program	N/A	N/A	N/A
		Septic System Workshop	N/A	N/A	N/A
		Nutrient / Pesticide Management	0.614 ton/ac/yr	1.10 lbs/ac/yr	6.67 lbs/ac/yr
		Cover Crops	2.0 ton/ac/yr	2.88 lbs/ac/yr	14.83 lbs/ac/yr
		Two-stage ditch[1]	80 ton/yr	76.6 lbs/yr	153 lbs/yr
		Conservation Tillage/Mulch Till[3]	0.77 ton/ac/yr	0.12 lbs/ac/yr	2.37 lbs/ac/yr
		Conservation Tillage/No-Till[3]	0.36 ton/ac/yr	0.08 lbs/ac/yr	1.13 lbs/ac/yr
		Blind Inlets	***	***	***
		Wetland (Restoration/Creation)[1]	14.82 ton/yr	20 lbs/yr	120 lbs/yr
		Drainage Water Management	***	***	***
		Soil Amendments (Gypsum)[8,9]	0.47 ton/ac/yr	1.49 lbs/ac/yr	0.44 lbs/ac/yr

Critical Area	Reason for Being Critical	BMP or Management Measure	Estimated Load Reduction per BMP (See Section 7 for Assumptions used for Load Reductions)		
			Sediment	Phosphorus	Nitrogen
155, 126, 132, 131, 129, 130, 124		Grassed Waterway[1]	30.4 ton/yr	25.8 lbs/yr	51.6 lbs/yr
		Native Vegetation Planting (Switch Grass)[3]	2.68 ton/ac/yr	4.65 lbs/ac/yr	26.72 lbs/ac/yr
		Education Program Geared Toward Livestock Operators	N/A	N/A	N/A
		Limited Access Stream Crossing/Exclusion Fencing (along with Streambank Erosion Practices and/or Alternative Watering Facility)[2]	74.1 ton/yr	107.8 lbs/yr	342 lbs/yr
		Rotational Grazing	***	***	***
		Manure Holding Facilities / Dry Stack Areas[1]	N/A	190 lbs/yr	2097 lbs/yr
		Comprehensive Nutrient Management Plans	***	***	***
		Riparian Buffers of at least 20' adjacent to Barnyards and Pasture Fields[1]	N/A	94 lbs/yr	N/A
		Runoff Management System at Livestock Operations (Diversions, Berms, Gutters, Etc.)[1]	N/A	221 lb/yr	1452 lbs/yr
		Annual Ag. And Urban Workshops/Field Days	***	***	***

Critical Area	Reason for Being Critical	BMP or Management Measure	Estimated Load Reduction per BMP (See Section 7 for Assumptions used for Load Reductions)		
			Sediment	Phosphorus	Nitrogen
		Repair/replace Leaking On-Site Waste Disposal Systems[7]	248.2 lbs/yr	6.5 lbs/yr	55 lbs/yr
Headwater Stream Buffers **Priority 1** Pittsford Millpond, Clear Fork - West Branch, Cambria Millpond, East Fork - West Branch, Lake La Su An, Headwaters Fish Creek, Cornell Ditch, Eagle Creek, Bear Creek, Nettle Creek - Nettle Creek **Priority 2** Anderson Drain, Bird Creek, West Fork - West Branch, Hiram Sweet Ditch, Hamilton Lake, Town of Alvarado, West Buffalo Cemetery	Nitrogen, Phosphorus, Turbidity	Riparian Buffers of at least 20' 40' on a 2-4% slope 60' on >4% slope[2]	210.4 ton/yr	342 lbs/yr	1162.6 lbs/yr
		Streambank Stabilization[1]	80 ton/yr	76.6 lbs/yr	153 lbs/yr
		Drainage Water Management	***	***	***
		Blind Inlets	***	***	***
		Filter Strip[2]	210.4 ton/yr	342 lbs/yr	1162.6 lbs/yr
		Two-stage ditch[1]	80 ton/yr	76.6 lbs/yr	153 lbs/yr
Urban Stormwater Pioneer, Montpelier, Clear Lake, Hamilton	Nitrogen, Phosphorus,	Rain Barrels[2]	0.2 ton/yr	0.15 lbs/yr	0.81 lbs/yr
		Cisterns (Commercial)[2]	0.2 ton/yr	1 lbs/yr	1.0 lbs/yr
		Monthly Street Sweeping[2]	22.76 ton/yr	58.7 lbs/yr	0

Critical Area	Reason for Being Critical	BMP or Management Measure	Estimated Load Reduction per BMP (See Section 7 for Assumptions used for Load Reductions)		
			Sediment	Phosphorus	Nitrogen
Lake, Lake Seneca	*E. coli*, and Turbidity				
Urban Stormwater Pioneer, Montpelier, Clear Lake, Hamilton Lake, Lake Seneca	Nitrogen, Phosphorus, *E. coli*, and Turbidity	Rain Gardens (Residential)[2]	0.18 ton/yr	0.1 lbs/yr	2 lbs/yr
		Rain Gardens (Commercial)[2]	0.5 ton/yr	1 lbs/yr	4 lbs/yr
		Green Roof[6]	N/A	N/A	N/A
		Wetland Restoration/Creation[1]	0.60 ton/yr	2 lbs/yr	6 lbs/yr
		Curb Cuts (Combined with other LID practices)	***	***	***
		Bioswale[2]	0.1 ton/yr	0.4 lbs/yr	0.9 lbs/yr
		Extended Wet Detention[2]	4.9 ton/yr	20.7 lbs/yr	116.1 lbs/yr
		Infiltration Trench[2]	0.2 ton/yr	1 lbs/yr	5 lbs/yr
		Pervious Pavement[2]	5.1 ton/y	19.6 lbs/yr	256.7 lbs/yr
		Native Vegetation Planting	***	***	***
		Pet Waste Disposal Receptacle	***	***	***
		Wildlife Exclusion at Stormwater Basins	***	***	***
		Encourage the Sale of Phosphorus Free Fertilizers at Local Retailers	N/A	N/A	N/A
		Urban Fertilizer Education Program	N/A	N/A	N/A
		Stable Substrate to Replace "Dirt" Roads	***	***	***
		Riparian Buffer of at least 10' Residential[2]	0.1 ton/yr	0.7 lbs/yr	3.6 lbs/yr
		Riparian Buffer of at least 10' Commercial[2]	4.1 ton/yr	13.7 lbs/yr	120.8 lbs/yr
		Two-stage ditch	***	***	***
		Streambank Stabilization	***	***	***
		Shoreline Stabilization	***	***	***

Critical Area	Reason for Being Critical	BMP or Management Measure	Estimated Load Reduction per BMP (See Section 7 for Assumptions used for Load Reductions)		
			Sediment	Phosphorus	Nitrogen
		Natural Shoreline	***	***	***
		Repair/replace Leaking On-Site Waste Disposal Systems[7]	248.2 lbs/yr	6.5 lbs/yr	55 lbs/yr
		Tree Planting[4]	N/A	N/A	N/A

[1]Region 5 Load Reduction Model; [2]STEP-L Load Reduction Model; ***Too many variables, too new of a technology to estimate, or a model does not exist to estimate load reductions; [3]SWAT Load Reduction Model, [4]A medium sized tree is estimated to uptake 2380 gallons of water annually (Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service, Davis, California. July 2002); [5]TP loss estimated to be cut by 57% and DRP by 29% according to a study in the periodical Agricultural and Food Science, [6]Extensive Green Roofs have the capacity to absorb 50% of rainfall, [7]Estimates found in the Onsite Wastewater Treatment Systems Manual, US EPA, 2002.); [8]TP loss estimated to be cut by 57% according to a study in the periodical Agricultural and Food Science, [9]DRP loss is estimated to be cut by 66% and sediment by 56% compared to controls fields reported in the National Soil Erosion Research Laboratory

6.0 Action Register to Accomplish Goals

The goals set by the Upper St. Joseph River Watershed Steering Committee are ambitious, yet attainable if proper and reasonable objectives are set to work toward reaching the goals of the project. The objectives are outlined in the following Action Register and each also has milestones to reach within a certain timeframe to determine the progress toward reaching each of the goals and help with momentum for the project. The Action Register not only outlines the objectives to reach each goal and the objectives measureable milestones, but also outlines a cost estimate to reach each objective and/or milestone, and the partners and technical assistance that will be needed to reach each objective.

6.1 Action Register to Address the Nutrient and Turbidity Goals (Goals 1, 2, and 3)

Goal 1 - The goal of this project is for TP levels in sampled water to meet the target level of 0.08 mg/L in all tributaries of the St. Joseph River. To accomplish this phosphorus loads will be reduced by 10% by year 2020, by 20% by year 2030, and by 39.2% by year 2044. **Goal 2** - The goal of this project is to have all sampled water within the USJRW meet the target water quality level for DRP of < 0.05 mg/L in 50% of the samples by 2020, 75% of the samples by 2030, and all water samples by 2044. This would require a 2% reduction in DRP loading according to the SWAT model. **Goal 3** - The goal of this project is to have all sampled water within the USJRW meet the target water quality level for turbidity of 10.4 NTU in 20% of samples by 2020, 50% of samples by 2030, and in all of the samples by 2044.
Indicator #1: Phosphorus, and Turbidity will be measured weekly during the recreational season annually at seventeen sample sites within the USJRW after three to five years of implementation. To determine if the milestones set for the goals are being met, nutrient concentrations and turbidity should be showing a decreasing trend, with more samples meeting target levels during each sampling cycle. DRP and TSS will be added after funding is acquired. **Indicator #2**: The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall Loadings. **Indicator #3**: The number of best management practices that can reduce nutrients and turbidity levels that are installed in the watershed will be monitored. Annual goals for each of the various BMPs that can reduce nitrogen levels are described in the below Action register.

<table>
<tr><th colspan="6">The Below Actions will be implemented in Critical Areas for Phosphorus, Turbidity, and Dissolved Reactive Phosphorus
Including Drainage Areas of West Fork West Branch, East Fork – West Branch, Pittsford Millpond, Clear Fork – East Branch, Bear Creek – Nettle Creek, Nettle Creek – Nettle Creek, Eagle Creek – Nettle Creek, Headwaters Fish Creek, Cornell Ditch – Fish Creek and West Branch – Fish Creek</th></tr>
<tr><th>Objective</th><th>Target Audience</th><th>Implementation Timeframe</th><th>Milestone</th><th>Estimated Cost</th><th>Partners (P) / Technical Assistance (TA)</th></tr>
<tr><td rowspan="7">Develop and Implement an Agriculture Education Program</td><td rowspan="7">Upper St. Joseph River Watershed Agricultural landowners and operators</td><td rowspan="7">Within the first twelve months after WMP approval</td><td>Hire Personnel to Implement the WMP (6 months)</td><td>$60,000/ year</td><td rowspan="7">Hillsdale, Branch, Steuben, Williams, and DeKalb, County SWCDs, Surveyors/Engineers, and NRCS Offices (P, TA) Purdue, MI State and OH State Extensions (P, TA) Andersons (P, TA), Farm Bureau (P), The Nature Conservancy (P), Conservation Action Project (CAP) (P, TA), Tri-State Watershed Alliance (P, TA), IDEM, MI DEQ, and OEPA (P), IN DNR, ODNR, MI DNR (P, TA), MDA, ODA, INDA, (P, TA)</td></tr>
<tr><td>Secure Funding to Promote Education Program (6 months)</td><td rowspan="5">$2,300 /year</td></tr>
<tr><td>Compile an ag. education/outreach plan (6 months)</td></tr>
<tr><td>Make contact with local agriculture businesses to partner on outreach efforts (6 months)</td></tr>
<tr><td>Develop and disseminate an ag. education brochure (8 months)</td></tr>
<tr><td>Hold first annual ag. BMP workshop/field day (12 months)</td></tr>
<tr><td>Install a Demonstration Agricultural BMP in the Watershed in an underserved community (18 months)</td><td>$7,500/ BMP</td></tr>
</table>

The Below Actions will be implemented in Critical Areas for Phosphorus, Turbidity, and Dissolved Reactive Phosphorus Including Drainage Areas of West Fork West Branch, East Fork – West Branch, Pittsford Millpond, Clear Fork – East Branch, Bear Creek – Nettle Creek, Nettle Creek – Nettle Creek, Eagle Creek – Nettle Creek, Headwaters Fish Creek, Cornell Ditch – Fish Creek and West Branch – Fish Creek					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Begin an Annual Water Quality Monitoring Program to Include Historic Parameters and TSS and DRP	Upper St. Joseph River Watershed Stakeholders	Within 3 Years After WMP Approval	Secure Funding to begin water quality monitoring (30 months)	$500	Hillsdale, Branch, Steuben, Williams, and DeKalb, County SWCDs, Surveyors/Engineers, and NRCS Offices (P, TA) Purdue, MI State and OH State Extensions (P, TA) Andersons (P, TA), Farm Bureau (P), The Nature Conservancy (P), Conservation Action Project (CAP) (P, TA), Tri-State Watershed Alliance (P, TA), IDEM, MI DEQ, and OEPA (P), IN DNR, ODNR, MI DNR (P, TA), MDA, ODA, INDA, (P, TA)
		3 to 5 Years After Implementation	Monthly Sampling for nutrients, *E. coli*, turbidity and TSS begins. (3 years)	$20,500/ year	
Develop and Promote a Cost-Share Program	Upper St. Joseph River Watershed Agricultural landowners and operators	Ongoing	Secure Funding to Implement Cost-Share Program (6 months)	$1,500/ year	
			Cost-Share Program Developed (3 months)		
			Develop and Disseminate a Cost-Share Brochure (6 months)		
Implement an Agricultural Cost-Share Program	Upper St. Joseph River Watershed Agricultural landowners and operators	Ongoing	Install 5000 Acres of Cover Crops Annually (2014 - 2044)	$200,000/ year	
			Install 1 Two-stage Ditch Every Two Years (1000 linear foot minimum) (2014-2044)	$10,000/ BMP	
			Implement Conservation Tillage on 4000 Acres Annually - Mulch Till (2014 - 2044)	$85,000/ year	
			Implement Conservation Tillage on 3500 Acres Annually - No-Till (2014 - 2044)	$75,000/ year	

The Below Actions will be implemented in Critical Areas for Phosphorus, Turbidity, and Dissolved Reactive Phosphorus Including Drainage Areas of West Fork West Branch, East Fork – West Branch, Pittsford Millpond, Clear Fork – East Branch, Bear Creek – Nettle Creek, Nettle Creek – Nettle Creek, Eagle Creek – Nettle Creek, Headwaters Fish Creek, Cornell Ditch – Fish Creek and West Branch – Fish Creek					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Implement an Agricultural Cost-Share Program	Upper St. Joseph River Watershed Agricultural landowners and operators	Ongoing	Install Blind Inlets on 8 Properties with at least a 20 acres contributing area Annually (2014 - 2044)	$1,200/ BMP	Hillsdale, Branch, Steuben, Williams, and DeKalb, County SWCDs, Surveyors/Engineers, and NRCS Offices (P, TA) Purdue, MI State and OH State Extensions (P, TA) Andersons (P, TA), Farm Bureau (P), The Nature Conservancy (P), Conservation Action Project (CAP) (P, TA), Tri-State Watershed Alliance (P, TA), IDEM, MI DEQ, and OEPA (P), IN DNR, ODNR, MI DNR (P, TA), MDA, ODA, INDA, (P, TA)
			Install Buffers at Tile Inlets on 8 Properties with at least a 20 acre contributing area Annually (2014 - 2044)	$8,000 / year	
			Install/Restore Two Wetlands Annually with 100 Acres Contributing Area (2014 - 2044)	$8,000/ year	
			Implement Nutrient/Pesticide Management on 5000 Acres Annually (2014 - 2044)	$25,000/ year	
			Install Native Vegetation Plantings on 500 acres annually (2014 - 2044)	$150,000/ year	
			Implement soil amendments to improve nutrient uptake on 5000 Acres Annually (2014 - 2044)	$5,000/ year	
			Install Drainage Water Management Practices at 20 Properties with a 20 acres contributing area Annually (2013 - 2044)	$70,000/ year	
			Install 3000 lf of Grassed Waterways Annually (2014 - 2044)	$50,000/ year	

The Below Actions will be implemented in Critical Areas for Phosphorus, Turbidity, and Dissolved Reactive Phosphorus Including Drainage Areas of West Fork West Branch, East Fork – West Branch, Pittsford Millpond, Clear Fork – East Branch, Bear Creek – Nettle Creek, Nettle Creek – Nettle Creek, Eagle Creek – Nettle Creek, Headwaters Fish Creek, Cornell Ditch – Fish Creek and West Branch – Fish Creek					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
			Implement Filter Strips/Saturated Buffers on 3000 acres of Crop Land Annually (2014 - 2044)	$100,000/ year	

6.2 Action Register to Address the Buffer Goal (Goal 5)

Goal #5: It is the goal of this project to have at least 20% of parcels adjacent to open water to have a minimum of a 20 foot riparian buffer by 2020, 50% by 2030, and 80% of parcels adjacent to open water to have a minimum of a 20 foot buffer by 2044.

Indicator #1: The number of landowners who install a minimum of a 20 foot riparian buffer will be measured. It is expected that the installation of riparian buffers will Increase annually to meet the goal set by this project.
Indicator #2: The total acreage draining into a 20 foot riparian buffer that is installed each year will be measured. Annual milestones for the installation of riparian buffers is described in the below Action Register.
Indicator #3: A revised desktop buffer inventory will be conducted in 2030, halfway through the implementation phase on the USJRW project, to determine if the project is nearing the goal of 50% of parcels adjacent to a headwater streams having a minimum of a 20 foot riparian buffer in 2030.

The Below Actions will be implemented in Critical Areas for Riparian Buffers and Streambank Erosion
Including Subwatershed: Priority 1- Pittsford Millpond, Clear Fork – West Branch, Cambria Millpond, East Fork – West Branch, Lake LaSu An, Headwaters Fish Creek, Cornell Ditch, Eagle Creek, Bear Creek, Nettle Creek – Nettle Creek; Priority 2 – Anderson Drain, Bird Creek, West Fork – West Branch, Hiram Sweet Ditch, Hamilton Lake – Fish Creek, Town of Alvarado, and West Buffalo Cemetery – Nettle Creek

Objective	Target Audience	Implementation Timeframe	Milestone	Estimated Cost	Partners (P) / Technical Assistance (TA)
Develop and Implement an Agriculture Education Program	Upper St. Joseph River Watershed Agricultural landowners and operators	Within the first twelve months after WMP approval	Hire Personnel to Implement the WMP (6 months)	$60,000/ year*	Hillsdale, Branch, DeKalb, Williams, and Steuben County SWCDs and NRCS Offices (P, TA) Purdue, MI State, and Ohio State Extensions (P, TA) IDEM, MI DEQ and ODNR (P)
			Secure Funding to Promote Education Program (6 months)	$2,300 /year*	
			Compile an ag. education/outreach plan (6 months)		
			Develop and disseminate an ag. education brochure (8 months)		
			Hold first annual ag. BMP workshop/field day (12 months)		
			Purchase Two Billboards/County Advertising Stream Buffers (12 months)	$5,000	

The Below Actions will be implemented in Critical Areas for Riparian Buffers and Streambank Erosion Including Subwatershed: Priority 1- Pittsford Millpond, Clear Fork – West Branch, Cambria Millpond, East Fork – West Branch, Lake LaSu An, Headwaters Fish Creek, Cornell Ditch, Eagle Creek, Bear Creek, Nettle Creek – Nettle Creek; Priority 2 – Anderson Drain, Bird Creek, West Fork – West Branch, Hiram Sweet Ditch, Hamilton Lake – Fish Creek, Town of Alvarado, and West Buffalo Cemetery – Nettle Creek					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Update the Riparian Buffer Inventory Conducted in 2013	Upper St. Joseph River Watershed Agricultural landowners and operators	During the Fifth Year After WMP approval	Update the geo-referenced inventory of Stream Buffers within the UMRW (every 5 years)	$3,500/ every 5 years	Hillsdale, Branch, DeKalb, Williams, and Steuben County SWCDs and NRCS Offices (P) Purdue, MI State, and OH State Extensions (P)
Develop and Promote a Cost-Share Program	Upper St. Joseph River Watershed Agricultural landowners and operators	Ongoing	Cost-Share Program Developed (3 months)	$1,500/ year*	Hillsdale, Branch, DeKalb, Williams, and Steuben County SWCDs and NRCS Offices, Purdue, MI State, and OH State Extensions (P, TA), The Nature Conservancy (P), Tri-State Watershed Alliance (P)
			Develop and Disseminate a Cost-Share Brochure (4 months)		
Implement a Cost-Share Program	Upper St. Joseph River Watershed Stakeholders	Ongoing	Secure Funding to Implement Cost-Share Program (12 months)	$500*	Hillsdale, Branch, DeKalb, Williams, and Steuben County SWCDs and NRCS and Surveyor/Engineer/ Drainage Board Offices (P, TA) Purdue, MI State and
			Implement Filter Strips/Saturated Buffers on 3000 acres of Crop Land Annually (2014 - 2044)	$100,000/ year	

The Below Actions will be implemented in Critical Areas for Riparian Buffers and Streambank Erosion Including Subwatershed: Priority 1- Pittsford Millpond, Clear Fork – West Branch, Cambria Millpond, East Fork – West Branch, Lake LaSu An, Headwaters Fish Creek, Cornell Ditch, Eagle Creek, Bear Creek, Nettle Creek – Nettle Creek; Priority 2 – Anderson Drain, Bird Creek, West Fork – West Branch, Hiram Sweet Ditch, Hamilton Lake – Fish Creek, Town of Alvarado, and West Buffalo Cemetery – Nettle Creek					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Implement a Cost-Share Program	Upper St. Joseph River Watershed Stakeholders	Ongoing	Increase Stream Buffer to a Minimum of 20 Feet in Width on 4000 Acres of Crop Land Annually (2014 - 2044)	$200,000/ year	Ohio State Extensions (P, TA) IDEM, MI DNR, and ODNR (P)
			Increase Stream Buffer to a Minimum of 20 Feet in Width on 150 Acres of Urbanized Land Annually (2014 - 2044)	N/A	
			Install 3000 linear feet of Streambank Stabilization Practices Annually (2014 - 2044)	$120,000/ year	
* Cost accounted for in a previous goal's action register.					

6.3 Action Register to Address Septic System and *E. coli* Goals (Goals 4 and 7)

Goal #4: The goal of this project is to have 30% of water quality samples meet the single sample state standard of 235 CFU/100ml for *E. coli* by 2020, 50% by 2030, and all water quality samples meet the single sample state standard for *E. coli* by 2044. **Goal #7:** It is the goal of this project to educate home owners about failing, leaking, and straight pipe septic systems by developing and promoting an education and outreach program regarding septic system placement and maintenance by 2015 and eliminate 50% of failing, leaking, and straight piped septic systems in the watershed by 2035 and all leaking, failing, and straight piped septic systems by 2044.
Indicator #1: *E. coli* will be measured weekly during the recreational season annually at the seventeen sample sites within the USJRW that were measured in 2012 after three to five years of implementation. To determine if the milestones set for the *E. coli* goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in *E. coli* with more samples meeting the target level for *E. coli* of 235 CFU/100ml for a single sample each year of sampling after three to five years of implementation. **Indicator #2**: The number of best management practices that can reduce *E. coli* levels that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that can reduce E. coli levels (specifically septic tank remediation in this Action Register) are described in the below Action Register. **Indicator #3**: A pre and post indicator survey regarding septic system functionality and maintenance will be conducted at workshops to determine individual's knowledge regarding septic systems and the amount in which that knowledge Increases as a result of the workshop. It would be expected that 75% of the attendants of the workshops would have a better understanding of septic systems after the workshop. **Indicator #4**: The number of people who attend septic system maintenance workshops will be monitored. It is a goal to have 25% of targeted households show representation at the septic tank outreach events. **Indicator #5**: The number of households that enlist septic system companies to provide regular maintenance and/or repair leaking, failed, and straight-piped septic systems will be monitored. It is expected that the education and outreach program will Increase the number of households performing regular septic maintenance and repairing improperly functioning systems. A 30% Increase in the number of households that perform maintenance and repairs on their septic systems after 2 years of septic education and outreach would be an adequate indicator of success toward meeting the goal of Increasing knowledge about proper septic system maintenance.

The Below Actions will be implemented in Critical Areas for E. coli Including Drainage Areas: Priority 1- West Fork - West Branch, East Fork - West Branch, Lake La Su An - West Branch, Pittsford Millpond, Clear Fork - East Branch, Bear Creek, Nettle Creek - Nettle Creek, Eagle Creek, Headwaters Fish Creek, Cornell Ditch, and West Branch - Fish Creek					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement a Septic System Educational Program	Upper St. Joseph River Watershed Stakeholders Utilizing Septics	Ongoing	Hire Personnel to Implement the WMP (6 months)	$60,000/ year*	Hillsdale, Branch, DeKalb, Williams, and Steuben County Health Departments and SWCDs (P,TA) Septic Issues, Collaborative Solutions working group (P), Rural Community Assistance Partnership (RCAP) (P, TA)
			Secure Funding to Promote Education Program (12 months)	$1,500/ year	
			Develop and/or Disseminate a Septic System Maintenance Brochure (12 months)		
			Hold an Annual Septic System Workshop for homeowners and one for installers (12 months)		
Partner With Local Agencies and Organizations	Upper St. Joseph River Watershed Stakeholders	Ongoing	Meet with County Health Departments Annually (6 months)	$900/ year	Hillsdale, Branch, DeKalb, Williams, and Steuben County Health Departments

The Below Actions will be implemented in Critical Areas for E. coli Including Drainage Areas: Priority 1- West Fork - West Branch, East Fork - West Branch, Lake La Su An - West Branch, Pittsford Millpond, Clear Fork - East Branch, Bear Creek, Nettle Creek - Nettle Creek, Eagle Creek, Headwaters Fish Creek, Cornell Ditch, and West Branch - Fish Creek					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
to Provide Education on Septic Maintenance and Placement	Utilizing Septics		Meet with Other Organizations Addressing Septic Issues biannually (6 months)		and SWCDs (P,TA) Septic Issues, Collaborative Solutions working group (P), RCAP (P, TA), Tri-State Watershed Alliance (P), City and Town Utilities (P, TA), MSU, Purdue, and OSU Extension Offices (P, TA)
Develop and Promote a Septic System Cost-share program	Upper St. Joseph River Watershed Stakeholders	Ongoing	Secure Funding to Conduct a Septic System Inventory (18 months)	$500/ year	
			Partner With Local Health Departments to Inventory Septic Systems to Help Target Cost-share Program (18 months)		
			Include Promotion of Septic System Cost-share Program in Septic System Brochure and at Workshops (18 months)		
Offer Cost-share Assistance for Septic System Repair/ Replacement/ Elimination	Upper St. Joseph River Watershed Stakeholders Utilizing Septics	Ongoing	Secure Funding to Provide Cost-share Assistance (12 months)	$100,000/ year	
			Repair, Replace, or eliminate 10 Leaking, Failed or Straight Pipe Septic Systems Annually (24 months)		

The Below Actions will be implemented in Critical Areas for E. coli Including Drainage Areas: Priority 1- West Fork - West Branch, East Fork - West Branch, Lake La Su An - West Branch, Pittsford Millpond, Clear Fork - East Branch, Bear Creek, Nettle Creek - Nettle Creek, Eagle Creek, Headwaters Fish Creek, Cornell Ditch, and West Branch - Fish Creek					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Promote a Septic System Maintenance Program	Upper St. Joseph River Watershed Stakeholders Utilizing Septics	Ongoing	Work with Local Septic System Businesses to Offer Discounts to Stakeholders Who Sign up for Regular Septic Maintenance (12 months)	$1000/ yearly	Hillsdale, Branch, DeKalb, Williams, and Steuben County Health Departments and SWCDs (P) Septic Issues, Collaborative Solutions working group, Local Septic Maintenance and Installation Companies (P, TA)
			Develop and Disseminate a Brochure Advertising the Companies that Offer a Discount with a Service Contract (13 months)		

6.4 Action Register to Address Livestock and *E. coli* Goals (Goals 4 and 6)

Goal #4: The goal of this project is to have 30% of water quality samples meet the single sample state standard of 235 CFU/100ml for *E. coli* by 2020, 50% by 2030, and all water quality samples meet the single sample state standard for *E. coli* by 2044.

Goal #6: It is the goal of this project to exclude all current and future livestock from open water and eliminate the potential for polluted runoff from barnyards and pasture fields from reaching open water by 2034.

Indicator #1: *E. coli,* sediment indicators, and nutrients will be measured weekly during the recreational season annually at the seventeen sample sites within the USJRW that were measured in 2012 after three to five years of implementation. To determine if the milestones set for the goals are being met, it would be expected to see that water quality samples are showing a decreasing trend in *E. coli*, turbidity, TSS and nutrients with more samples meeting the target levels each year of sampling after three to five years of implementation.

Indicator #2: The number of best management practices that can reduce *E. coli* levels that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs (specifically livestock related issues in this Action Register) that can reduce E. coli levels are described in the below Action Register.

Indicator #3: The load reductions as a result of best management practices that are installed in the watershed, as determined by load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loading of sediment and nutrients to reach the reductions needed to meet the target loads. (Load reduction models cannot predict turbidity and *E. coli* loads).

Indicator #4: The number of livestock exclusion fencing BMPs and other BMPs to reduce the impact of barnyard and pasture runoff in the watershed will be monitored, as well as the potential volume of manure being contained at each site in which a livestock BMP is implemented in the watershed will be monitored.

The Below Actions will be implemented in Critical Areas for Phosphorus, Turbidity, Dissolved Reactive Phosphorus, and *E. coli*
Including Drainage Areas of West Fork West Branch, East Fork – West Branch, Pittsford Millpond, Clear Fork – East Branch, Bear Creek – Nettle Creek, Nettle Creek – Nettle Creek, Eagle Creek – Nettle Creek, Headwaters Fish Creek, Cornell Ditch – Fish Creek and West Branch – Fish Creek

Objective	Target Audience	Implementation Timeframe	Milestone	Estimated Cost	Partners (P) / Technical Assistance (TA)
Develop and Implement an Agriculture Education	Upper St. Joseph River Watershed Livestock	Within the first twelve months after WMP approval	Hire Personnel to Implement the WMP (6 months)	$60,000/ year*	Hillsdale, Branch, DeKalb, Williams, and Steuben County SWCDs and NRCS
			Compile a livestock education/outreach plan (6 months)	$1,800 /year	

The Below Actions will be implemented in Critical Areas for Phosphorus, Turbidity, Dissolved Reactive Phosphorus, and *E. coli* Including Drainage Areas of West Fork West Branch, East Fork – West Branch, Pittsford Millpond, Clear Fork – East Branch, Bear Creek – Nettle Creek, Nettle Creek – Nettle Creek, Eagle Creek – Nettle Creek, Headwaters Fish Creek, Cornell Ditch – Fish Creek and West Branch – Fish Creek					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Program Geared Toward Livestock Operators	Operators		Develop and disseminate a livestock education brochure (8 months)		Offices (P, TA) Purdue, MI State, and Ohio State Extensions (P, TA)
			Hold first annual pasture walk (12 months)		
			Install a Demonstration Limited Access Stream Crossing in and Underserved Community in the Watershed (12 months)	$5,000	
Develop and Promote a Cost-Share Program	Upper St. Joseph River Watershed Livestock Operators	Ongoing	Cost-Share Program Developed (3 months)	$1,500/ year*	
			Develop and Disseminate a Cost-Share Brochure (4 months)		
Implement an Agricultural Cost-Share Program	Upper St. Joseph River Watershed Livestock Operators	Ongoing	Identify All Locations Where Livestock Have Direct Access to Open Water (1 year)	$3,000	Hillsdale, Branch, DeKalb, Williams, and Steuben County SWCDs and NRCS Offices (P, TA) Purdue, MI State, and Ohio State Extensions (P) Area CCAs (TA)
			Install a Limited Access Stream Crossing or Exclusion Fencing, and Streambank Erosion Practices or Filter Strips at 5 Operations Annually Until All Livestock Have Been Excluded (2014 - 2044)	$2,500/ BMP	
			Implement Rotational Grazing or other Pasture Management Practice on 5 Property Annually Until All Livestock Operators are Utilizing Rotational Grazing (2014 - 2044)	$12,500/ year	
			Increase Stream Buffer to a Minimum of 20 Feet in Width on 750 Acres of Pasture Land Annually (2014 - 2044)	$150,000/ year	

The Below Actions will be implemented in Critical Areas for Phosphorus, Turbidity, Dissolved Reactive Phosphorus, and *E. coli* Including Drainage Areas of West Fork West Branch, East Fork – West Branch, Pittsford Millpond, Clear Fork – East Branch, Bear Creek – Nettle Creek, Nettle Creek – Nettle Creek, Eagle Creek – Nettle Creek, Headwaters Fish Creek, Cornell Ditch – Fish Creek and West Branch – Fish Creek					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Implement an Agricultural Cost-Share Program	Upper St. Joseph River Watershed Livestock Operators		Install a Manure Management System at 5 Properties Annually Until All Livestock Operators Have Adequate Storage (2014 - 2044)	$100,000 / year	Hillsdale, Branch, DeKalb, Williams, and Steuben County SWCDs and NRCS Offices (P, TA) Purdue, MI State, and Ohio State Extensions (P) Area CCAs (TA)
			Install 3 Animal Mortality Facilities/Composting Facilities Annually (2014 - 2044)	$6,000 / year	
			Install a Runoff Management System at 5 Livestock Facilities Annually (2014 - 2044)	$3,500 / year	
			Write 5 Comprehensive Nutrient Management Plans Annually Until All Livestock Operators Have a CNMP (2014 - 2044)	$20,000 / year	
* Cost accounted for in a previous goal's action register.					

6.5 Action Register to Address Polluted Stormwater Goal (Goal 8)

Goal #8: It is the goal of this project to decrease the amount of polluted stormwater runoff from reaching open water by implementing an urban best management practice program by 2016.
Indicator #1: *E. coli*, sediment, and nutrients will be measured at a minimum monthly throughout the year at the nine historic sample sites in Indiana and the eight proposed sample sites in Ohio, ideally samples will be measured weekly during the recreational season. Sampling efforts will begin after three to five years of implementing the urban stormwater management program. Indicator #2: The load reductions as a result of best management practices that are installed in the Urban areas of the watershed, as determined by load reduction models, will be monitored. Indicator #3: The number of urban BMP workshops and urban pollution outreach events held annually will be measured. Indicator #4: The number of attendees at each of the workshops and educational programs will be measured. Indicator #5: The number of urban best management practices that can reduce stormwater flow and/or urban pollutants that are installed in the watershed will be monitored.

Objective	Target Audience	Implementation Timeframe	Milestone	Estimated Cost	Partners (P) / Technical Assistance (TA)
Work with City and County Planners to Address Increase in Stormwater	City and County Planners	Within the First Fifteen Months After WMP Approval	Hire Personnel to Implement the WMP (6 months)	$60,000/ year*	Hillsdale, Williams, and Steuben County Planning Commissions (P) Reading, Montgomery, Camden, Pioneer, Holiday City, Montpelier, Edon, Hamilton and Clear Lake Administrators, and Decision Makers (P)
			Make contact with City and County Planners (10 months)	$900/ year	
			Meet with City and County Decision Makers Bi-monthly (12 months)		
			Work with City and County Planners to Encourage Low Impact Design for New Development (15 months)		

<table>
<tr><th>Objective</th><th>Target Audience</th><th>Implementation Timeframe</th><th>Milestone</th><th>Estimated Cost</th><th>Partners (P) / Technical Assistance (TA)</th></tr>
<tr><td rowspan="6">Develop and Implement an Urban Education Program</td><td rowspan="6">Upper St. Joseph River Watershed Stakeholders</td><td rowspan="6">Within the First Fifteen Months After WMP Approval</td><td>Partner with organizations that currently provide urban education and outreach (6 months)</td><td rowspan="4">$1,500/ year</td><td rowspan="6">Hillsdale, Williams, and Steuben County SWCDs (P)
City and County Parks Departments (P)
The Nature Conservancy (P, TA), Tri-state Watershed Alliance (P, TA), US EPA Urban Waters Initiative (P, TA), IN DNR, MI DNR, and O DNR (P, TA)</td></tr>
<tr><td>Compile an urban education/outreach plan (8 months)</td></tr>
<tr><td>Develop and disseminate an urban education brochure (10 months)</td></tr>
<tr><td>Hold first annual urban BMP workshop (12 months)</td></tr>
<tr><td>Encourage an "Adopt a Stream" Program to Raise Awareness About Stream Health and Keep Streambanks Clear of Debris (12 months)</td><td>$5,000/ year</td></tr>
<tr><td>Install a Demonstration Urban BMP in the Watershed (15 months)</td><td>$10,000/ year</td></tr>
<tr><td rowspan="2">Develop and Promote an Urban Cost-Share Program</td><td rowspan="2">Upper St. Joseph River Watershed Urban Stakeholders</td><td rowspan="2">Ongoing</td><td>Cost-Share Program Developed (6 months)</td><td rowspan="2">$1,500/ year</td><td rowspan="2">Hillsdale, Steuben, and Williams County SWCDs and Planning Departments (P, TA)
City and County Planners (P)
Stakeholders (P), The Nature Conservancy (P), Tri-State Watershed Alliance (P)</td></tr>
<tr><td>Develop and Disseminate a Cost-Share Brochure (6 months)</td></tr>
</table>

Objective	Target Audience	Implementation Timeframe	Milestone	Estimated Cost	Partners (P) / Technical Assistance (TA)
Provide Cost-share Dollars to Implement Urban BMPs	Upper St. Joseph River Watershed Urban Stakeholders	Ongoing	Install 10 Residential Rain Barrels and 2 Commercial Rain Barrels/Cisterns Annually	$5,000/ year	Hillsdale, Williams, and Steuben County SWCDs (P, TA) City and County Planning and Parks Departments (P), County Engineers (P, TA) Stakeholders (P), The Nature Conservancy (P, TA), Tri-State Watershed Alliance (P), ODNR, MI DNR and IN DNR (TA), US EPA Urban Waters Initiative (P, TA)
			Install 5 Rain Gardens Annually	$5,000/ year	
			Monthly Street Sweeping Program in Pioneer, Montpelier, Clear Lake, and Hamilton Lake (18 months)	$100,000/ year	
			Tree Planting Program Implemented (1 year)	$2,000/ year	
			One Wetland Restoration/Creation Project Implemented Biennially (2 years)	$8,000/ BMP	
			Commit One New Developer to, or One Existing Development to Retrofit to LID Techniques (curb cuts, bioswale, extended wet detention, etc) Biennially (3 years)	$15,000/ Develop-ment	
			Install Pervious Pavement at 1 Sites Annually (2 years)	$7,500/ year	
			Install Native Vegetation at One Large Industrial or Commercial Site Annually (2 years)	$10,000/ year	
			Install a Minimum of a 10 ft Riparian Buffer at 3 Residential and 1 Commercial Properties Annually (1 year)	$6,000/ year	
			Install One Green Roof Biennially (2 year)	$25,000/ BMP	

Objective	Target Audience	Implementation Timeframe	Milestone	Estimated Cost	Partners (P) / Technical Assistance (TA)
			Install Pet Waste and Trash Receptacles At 10 Parks and/or Along Public Walking Paths Annually Until All Public Areas Have Receptacles (12 months - 5 years)	$5,000	
			Install Wildlife Exclusion Practices in 1 Stormwater Basins That Drain to Open Water Annually (12 months)	$1,500/ year	
* Cost accounted for in a previous goal's action register.					

6.6 Action Register to Reduce the Impact of Stormwater in Urbanized Areas (Goal 8)

Goal #8: It is the goal of this project to decrease the amount of polluted stormwater runoff from reaching open water by implementing an urban best management practice program by 2016 in critical urban areas Including Pioneer and Montpelier Ohio and Clear Lake, Hamilton Lake, and Lake Seneca.
Indicator #1: *E. coli*, sediment indicators, and nutrients will be measured weekly during the recreational season annually at the seventeen sample sites within the USJRW that were measured in 2012 after three to five years of implementation. Additionally, water quality samples will be collected downstream of the urbanized critical areas monthly during the recreational season after five years of implementation. To determine if the education and outreach, and BMPs installed in urban areas are effective at reducing nutrient loadings, and E. coli and turbidity readings, it would be expected to see that water quality samples are showing a decreasing trend in turbidity, *E. coli* and nutrients with more samples meeting the target level for each parameter each year of sampling after three to five years of implementation. Indicator #2: A pre and post social indicator survey will be conducted in the urban areas within the USJRW to learn the degree in which behavioral changes have been made after five years of implementation of the urban stormwater management program. It is expected that the post-implementation survey will show that at least 30% of the respondents are more aware of the impact stormwater has on water quality and how their actions affect water quality. Indicator #3: The number of urban BMP workshops and urban pollution outreach events held annually will be measured. One urban workshop and one lake workshop held annually will be a measure of success to meeting the goal of implementing an urban/lake education and outreach program. **Indicator #4**: The number of attendants at each of the workshops and educational programs will be measured. Since there is no baseline as urban workshops are not regularly held in the USJRW, 20 attendants at each workshop and educational program will be a measure of success. **Indicator #5**: The load reductions as a result of best management practices that are installed in the urban areas of the watershed, as determined by load reduction models, will be monitored. Annual milestones for each of the various BMPs that can reduce urban pollutant levels are described in the below Action Register.

*There are two different action registers for the goal to reduce the impact of stormwater in urbanized areas; one for lake residents, and one for towns as the two land uses are very different and will require different management measures to improve the surrounding water quality.

The Below Actions will be implemented in Critical Areas for Heavily Populated Lakes Including Clear Lake, Hamilton Lake, and Lake Seneca					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Meet with Lake Associations to Learn Individual Lake Needs and Concerns	Upper St. Joseph River Watershed Lake Stakeholders	Within the first twelve months after WMP approval	Hire Personnel to Implement the WMP (6 months)	$60,000/ year*	IN DNR, MI DNR and ODNR (P, TA), Hillsdale, Steuben and Williams County SWCDs, Area Lake Associations and Conservancies, and groups, US EPA Urban Waters Initiative (P, TA), IDEM, MI DEQ, and OEPA (P), County Health Departments (P, TA), Michigan Natural Shoreline Partnership (P, TA), Rural Community Assistance Partnership (P, TA)
			Meet with Lake Associations Semi-annually (6 months)	$1,800/ year	
			Work with Lake Stakeholders to Identify Specific Problem Areas and Possible Solutions (12 months)		
			Identify Funding Sources (12 months)		
Develop and Implement a Lakes BMP Education and Outreach Program	Upper St. Joseph River Watershed Lake Stakeholders	Within the first eight months after WMP approval	Secure Funding to Promote Education Program (6 months)	$500/ year	
			Partner with Steuben County's "Lake Living" Educational Program (6 months)		
			Develop and disseminate a "Living on the Lake" education brochure (8 months)		
			Hold first annual Lake workshop/field day (BMPs, invasive plants, proper fertilizer use) (8 months)		
Partner with Lake Groups to Acquire Funding to Eliminate On-Site Waste Disposal Systems	Lake Seneca Stakeholders	Within the first 24 months after WMP approval	Meet With Lake Associations Who Utilize On-site Waste Disposal Systems Annually to Discuss Alternatives to On-site Waste Disposal (12 months)	$1,000/ year	
			Assist Lake Associations Apply for Funding to Eliminate On-site Waste Disposal Systems (24 months)		
			Work with Local Septic System Businesses to Offer Discounts to Stakeholders Who Sign up for Regular Septic Maintenance (12 months)	N/A	

The Below Actions will be implemented in Critical Areas for Heavily Populated Lakes Including Clear Lake, Hamilton Lake, and Lake Seneca					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Partner with Lake Groups to Encourage the Replacement of Ineffective Dirt Roads with a more Stable Substrate.	County Planners/ Department of Transportation	Within 24 months after WMP approval	Make Contact with County Planners to Explain Concerns Regarding Dirt Roads (12 months)	$3,000	Area Lake Associations, Conservancies, and Groups (P), County Planners and Departments of Transportation (P, TA)
			Meet with County Planners Semi Annually (14 months)		
			Encourage an "Adopt a County Road" Program to Help fund Replacement of Dirt used for Roads and Keep County Roads Clean (24 month)	$1,500	
			A County-Dirt Road Substrate Replacement Program is Implemented During Regular Road Maintenance (24 months)	N/A	
Develop and Promote an Urban-Lake Cost-Share Program	Upper St. Joseph River Watershed Lake Stakeholders	Ongoing	Cost-Share Program Developed (6 months)	$1,500/ year	Hillsdale, Steuben and Williams County SWCDs (P, TA) Lake Associations and Conservancies (P) Stakeholders (P), Tri-State Watershed Alliance (P), US EPA Urban Waters Initiative (P, TA)
			Develop and Disseminate a Cost-Share Brochure (6 months)		
Implement a Lakes Community Cost-share program	Upper St. Joseph River Watershed Lake Stakeholders	Beginning within 24 months after WMP approval and ongoing from there	Install 100 ft of Natural Shoreline Annually (2 years)	$7,500 / BMP	Hillsdale, Steuben and Williams County SWCDs (P, TA) Lake Associations and Conservancies (P) Stakeholders (P), Tri-
			Stabilize 50 feet of Shoreline Annually (2 years)	$15,000 / BMP	
			Begin Tree Planting Program (30 months)	$2,000/ year	

The Below Actions will be implemented in Critical Areas for Heavily Populated Lakes **Including Clear Lake, Hamilton Lake, and Lake Seneca**					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Implement a Lakes Community Cost-share program	Upper St. Joseph River Watershed Lake Stakeholders	Beginning within 24 months after WMP approval and ongoing from there	Install Pervious Pavement at one Site with a 10 acre contributing area Annually (3 years)	$7,500/ year	State Watershed Alliance (P), US EPA Urban Waters Initiative (P, TA), MI DEQ, IDEM, OEPA, MI DNR, IN DNR, ODNR, (P, TA), Michigan Natural Shoreline Partnership (P, TA)
			Install a Minimum of a 10 foot Vegetated Buffer/Filter Strip Along two Lake Properties with a 10 acre contributing area Annually (30 year)	$2,000/ year	
			Install 10 Rain Barrels at Residential Lake Property Annually (24 months)	$750/ year	
			Install 3 Rain Gardens at Residential Lake Properties with a one acre contributing area Annually (24 months)	$3,000/ year	
			Install Native Vegetation Plantings on 10 Acres Annually (2 year)	$4,000/ year	
			Restore one Wetland with a 5 acre contributing area Biennially (2 years)	$4,000/ year	
			Install one Wildlife Exclusion Measure at Lake Channels and Beaches until All Have Wildlife Exclusion (36 months)	$10,000/ BMP	
			Install Pet and Trash Waste Receptacles at all Public Areas Surrounding the Lakes (1 year)	$3,000	
* Cost accounted for in a previous goal's action register.					

The Below Actions will be implemented in Critical Areas for Urbanized Areas Located Directly on the River or Built-up Lake
Including Pioneer and Montpelier, Ohio and Hamilton and Clear Lake, Indiana

Objective	Target Audience	Implementation Timeframe	Milestone	Estimated Cost	Partners (P) / Technical Assistance (TA)
Work with City and County Planners to Address Increase in Stormwater	City and County Planners	Within the First Fifteen Months After WMP Approval	Hire Personnel to Implement the WMP (6 months)	$60,000/ year*	Hillsdale, , Williams, and Steuben County Planning Commissions (P) Reading, Montgomery, Camden, Pioneer, Holiday City, Montpelier, Edon, Hamilton and Clear Lake Administrators, and Decision Makers (P)
			Make contact with City and County Planners (10 months)	$900/ year	
			Meet with City and County Decision Makers Bi-monthly (12 months)		
			Work with City and County Planners to Encourage Low Impact Design for New Development (15 months)		
Develop and Implement an Urban Education Program	Upper St. Joseph River Watershed Stakeholders	Within the First Fifteen Months After WMP Approval	Partner with organizations that currently provide urban education and outreach (6 months)	$1,500/ year	Hillsdale, , Williams, and Steuben County SWCDs (P) City and County Parks Departments (P) The Nature Conservancy (P, TA), Tri-state Watershed Alliance (P, TA), US EPA Urban Waters Initiative (P, TA), IN DNR, MI DNR, and O DNR (P, TA)
			Compile an urban education/outreach plan (8 months)		
			Develop and disseminate an urban education brochure (10 months)		
			Hold first annual urban BMP workshop (12 months)		
			Encourage an "Adopt a Stream" Program to Raise Awareness About Stream Health and Keep Streambanks Clear of Debris (12 months)	$5,000/ year	
			Install a Demonstration Urban BMP in the Watershed (15 months)	$10,000/ year	

The Below Actions will be implemented in Critical Areas for Urbanized Areas Located Directly on the River or Built-up Lake Including Pioneer and Montpelier, Ohio and Hamilton and Clear Lake, Indiana					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Promote an Urban Cost-Share Program	Upper St. Joseph River Watershed Urban Stakeholders	Ongoing	Cost-Share Program Developed (6 months)	$1,500/ year	Hillsdale, , Steuben, and Williams County SWCDs and Planning Departments (P, TA) City and County Planners (P) Stakeholders (P), The Nature Conservancy (P), Tri-State Watershed Alliance (P)
			Develop and Disseminate a Cost-Share Brochure (6 months)		
Provide Cost-share Dollars to Implement Urban BMPs	Upper St. Joseph River Watershed Urban Stakeholders	Ongoing	Install 10 Residential Rain Barrels Annually (2 years)	$5,000/ year	Hillsdale, , Williams, and Steuben County SWCDs (P, TA) City and County Planning and Parks Departments (P), County Engineers (P, TA) Stakeholders (P), The Nature Conservancy (P, TA), Tri-State Watershed Alliance (P), ODNR, MI DNR and IN DNR (TA), US EPA Urban Waters Initiative (P, TA)
			Install 2 Commercial Cisterns/Rain Barrels Annually (2 years)	$3000/ year	
			Install 5 Rain Gardens Annually	$5,000/ year	
			Monthly Street Sweeping Program in Pioneer, Montpelier, Clear Lake, and Hamilton Lake (30 months)	$100,000/ year	
			Tree Planting Program Implemented (2 years)	$2,000/ year	
			One Wetland Restoration/Creation Project Implemented Biennially (2 years)	$8,000/ BMP	
			Commit One New Developer to, or One Existing Development to Retrofit to LID Techniques (curb cuts, bioswale, extended wet detention, etc) Biennially (3 years)	$15,000/ Develop-ment	

The Below Actions will be implemented in Critical Areas for Urbanized Areas Located Directly on the River or Built-up Lake Including Pioneer and Montpelier, Ohio and Hamilton and Clear Lake, Indiana					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Provide Cost-share Dollars to Implement Urban BMPs	Upper St. Joseph River Watershed Urban Stakeholders	Ongoing	Install Pervious Pavement at 1 Site Annually (2 years)	$7,500/ year	Hillsdale, Williams, and Steuben County SWCDs (P, TA) City and County Planning and Parks Departments (P), County Engineers (P, TA) Stakeholders (P), The Nature Conservancy (P, TA), Tri-State Watershed Alliance (P), ODNR, MI DNR and IN DNR (TA), US EPA Urban Waters Initiative (P, TA)
			Install Native Vegetation at One Large Industrial or Commercial Site Annually (2 years)	$10,000/ year	
			Install a Minimum of a 10 ft Riparian Buffer at 3 Residential Properties with at least one acre of contributing land Annually (1 year)	$6,000/ year	
			Install a Minimum of a 10 ft Riparian Buffer at 1 Commercial Property with at least 10 acres of contributing land Annually (1 year)	$5000/ year	
			Install One Green Roof Biennially (2 year)	$25,000/ BMP	
			Install Pet Waste and Trash Receptacles At 10 Parks and/or Along Public Walking Paths Annually Until All Public Areas Have Receptacles (2 years - 5 years)	$5,000	
			Install Wildlife Exclusion Practices in 1 Stormwater Basins That Drain to Open Water Annually (3 years)	$1,500/ year	
* Cost accounted for in a previous goal's action register.					

7.0 Potential Annual Load Reductions after Implementation

Actions outlined in Section 6 were determined by considering a combination of aspects of watershed management including how likely it is to get landowners willing to participate in a cost-share program to implement on-the-ground BMPs and the potential load reductions that would result from their implementation. Using the Spreadsheet Tool for Estimating Pollution Load (STEPL), the Region 5 load reduction model, both of which can be found at http://it.tetratech-ffx.com/steplweb/, and the SWAT model provided by Purdue University, potential load reductions were determined for nitrogen, phosphorus, and sediment on a per BMP basis following the Action Registers outlined in Section 6 of this document. It should be noted that the SWAT model is the only available load reduction model that can predict load reductions for DRP.

The load reduction models available for public use at this time do have some limitations in that not all BMPs can be modeled and as stated earlier in this WMP, estimates for *E. coli* cannot be determined accurately. Therefore, narrative assumptions for the benefit of certain BMPs and possible load reductions will be provided.

It is important to note that assumptions were made for the model inputs as exact acreage of implementation is dependent on the support for participation that is received by landowners in the project area. The load reductions presented in this document are derived from a model and are best guess scenarios only, and only account for year one of the implementation of a BMP assuming that no BMPs were there in the past, or are currently being used. It is understood throughout the conservation community that pollutant load reductions from BMPs have a cumulative effect and that the reductions in pollutant loads will increase significantly as they are implemented year after year or in combination with other BMPs. Accurate load reductions will be determined when the USJRW project performs water quality analysis on the 17 proposed sample sites in the USJRW after three to five years of implementation. It should also be noted that several BMPs that the USJRW steering committee would like to promote and implement in the critical areas of the USJRW do not have models in which a load reduction can be determined. Table 7.1 shows the estimated load reduction after one year of implementation of the USJRW Action Register.

Table 7.1: Action Register BMP Load Reductions after One Year

Load Reductions	Sediment (Tons)	Total Phosphorus (lbs)	DRP (lbs)
Needed	Unknown	79,220	7040
After Implementation	32,862.34	56,925.9	2370.57
Delta	-	22,294.1	4669.43

Barnyard Runoff Management Systems

The load reduction for a runoff management system was determined using the Region 5 load reduction model Feedlot worksheet. The USJRW steering committee estimated that it is feasible to install five runoff management systems annually until all identified problem animal operations have adequate runoff control. The windshield survey conducted as part of this WMP' development and the livestock inventory performed in 2009 identified 24 locations where livestock operations pose a threat to surface water. The number of animals present at each site could not be verified at the time of observation so it was assumed that 40 dairy cows and 10 young cows were present, as well as 10 horses since the majority of the sites were Amish owned. It is important to note that there may be more animal operations present within the USJRW that were not identified as a problem during the windshield survey and livestock inventory.

Bioswale

The load reduction for the implementation of a bioswale was estimated using the STEPL load reduction model for a vegetated swale. The USJRW estimates that a bioswale will be implemented in one LID design every two years though it is more likely that multiple bioswales may be implemented as part of a BMP "train" to increase stormwater infiltration and filter pollutants prior to being discharged to a storm sewer or directly into open water. Assumptions made to determine a load reduction include a 10 acre contributing area with one acre affected by the BMP. Since it is not known where the BMP will be implemented in the watershed, an average of load reduction estimates for each of the urban critical areas was used for the final estimation.

Extended Wet Detention

The load reduction for the implementation of extended wet detention was estimated using the STEPL load reduction model. The USJRW estimates that extended wet detention will be implemented in one LID design every two years. Though it is likely that extended wet detention will be implemented as part of a BMP "train" to increase stormwater infiltration and filter pollutants prior to being discharged to a storm sewer or directly into open water. Assumptions made to determine a load reduction include a 10 acre contributing area. Since it is not known where the BMP will be implemented in the watershed, an average of load reduction estimate for commercial, institutional, and industrial land uses for each of the urban critical areas was used for the final estimation.

Cisterns (Commercial)

The load reduction for the implementation of cisterns on a commercial property was estimated using the STEPL load reduction model. The USJRW steering committee estimated that it is feasible to install two commercial cisterns annually. It is not clear yet where the cost-share program for the installation of a commercial cistern will be accepted, therefore it was assumed that two commercial cisterns within any of the critical areas to reduce polluted stormwater in the watershed. Additional assumptions made to run the load reduction model include a 15 acre contributing area, with one acre affected by the BMP and the installation of a 300 gallon cistern.

Conservation Tillage

The load reduction for conservation tillage was determined by Purdue using the SWAT model. Estimations were made by Purdue, based on the BMPs that have already been installed in the watershed on all corn and soybean fields throughout the watershed. Estimates were made for both no-till and mulch-till practices. The USJRW steering committee estimated that it is feasible to enlist 4000 acres of land in the cost-share program for mulch-till and 3500 acres of land for no-till practices annually.

Cover Crops

Load reductions for cover crops were determined by Purdue using the SWAT model. Assumptions used for the model were that cereal rye was planted one day after the previous crop was harvested and killed one week prior to the next crop being planted and left on the field as a residue. The USJRW steering committee estimated that it is feasible to enlist 5000 acres of land in a cover crop cost share program annually. Since it is impossible to know at this point where the cost-share program for cover crops will be accepted, the 5000 anticipated acres of land which will utilize the cover crop program was averaged throughout the entire critical area for nutrients and turbidity within the USJRW.

Filter Strips/Saturated Buffer/Riparian Buffer

The load reduction for filter strips and riparian buffers were determined using the STEPL load reduction model for filter strips. Estimates were determined using data obtained for Steuben County, Indiana and Hillsdale County, Michigan with an average rainfall assumed from the Fort Wayne weather station, which is the closest to the project area. The load reductions from each county were then averaged since it is not clear where the cost-share program will be accepted and where the filter strip BMP will be implemented. The USJRW steering committee estimated that it was feasible to install stream buffers to protect surface water and slow the flow of storm water for 3000 contributing acres of crop land annually.

Grassed Waterway

The load reduction for grassed waterways was determined using the Region 5 load reduction model gully stabilization worksheet. The USJRW steering committee estimated that it is feasible to install 3000 linear feet of grassed waterways annually. For the purposes of estimating a load reduction a 300 linear foot grassed waterway in an agriculture field consisting of loams, sandy clay loams, and sandy clay soils was assumed. It was assumed that the top width of the gully is 10 ft and the bottom width is 5 ft. The depth of the gully is 1 ft and the length is 300 ft. Finally, the P concentration of the soil was assumed to be 0.0005 lbs/lb soil and the N concentration of the soil was assumed to be 0.001 lbs/lb soil.

Infiltration Trench

The load reduction for the implementation of an infiltration trench was estimated using the STEPL load reduction model. The USJRW estimates that an infiltration trench will be implemented in one LID design every two years. Though it is likely that multiple infiltration trenches will be implemented as part of a BMP “train” to increase stormwater infiltration and filter pollutants prior to being discharged to a storm sewer or directly into open water. Assumptions made to determine a load reduction include a 10 acre contributing area. Since it is not known where the BMP will be implemented in the watershed, an average of load reduction estimate for commercial, institutional, and industrial landuses for each of the urban critical areas was used for the final estimation.

Limited Access Stream Crossing and Fencing

The load reduction for Limited Access Stream Crossing and Fencing was determined by the STEPL load reduction model. The USJRW steering committee estimated that it is feasible to install fencing, a limited access stream crossing, and streambank stabilization at all 42 sites identified during the 2009 livestock inventory or the 2012 windshield survey where livestock were seen in the stream and that the BMPs will be implemented at five sites annually until all have been excluded. It was assumed for modeling purposes that there were 30 head of livestock which were dairy and/or beef cattle and 10 horses present on 50 acres of pasture land and 50 acres of crop land.

Manure Storage Facility

The load reduction for manure storage facility was determined using the Region 5 load reduction model Feedlot worksheet. The USJRW steering committee estimated that it is feasible to install five manure storage facilities, as part of an overall manure management system, annually until all identified problem animal operations have adequate manure storage. The windshield survey conducted as part of this WMP' development and the livestock inventory performed in 2009 identified 24 locations where livestock operations pose a threat to surface water. The number of animals present at each site could not be verified at the time of observation so it was assumed that 40 dairy cows and 10 young cows were present, as well as 10 horses since the majority of the sites were Amish owned. It is important to note that there may be more animal operations present within the USJRW that was not identified as a problem during the investigation for the compilation of the WMP. As new operations are identified that may pose a threat to water quality and BMPs are implemented, the potential pollution load will be greater than presented in this model. The Region 5 load reduction model does not estimate a load reduction for sediment from implementing this BMP.

Native Vegetation Planting

The load reduction for native vegetation plantings was estimated by Purdue using the SWAT model. Estimates were based on BMPs that have already been installed in all corn and soybean fields throughout the watershed. Switchgrass was the plant simulated for the plantings. The USJRW steering committee believes it to be feasible to install native vegetation plantings on 500 acres within the agricultural community annually. It is not known at this time where the BMP will be accepted and implemented, so it is assumed that the 500 acres will be implemented annually throughout the critical areas for nutrients and turbidity.

Nutrient and Pesticide Management

The USJRW steering committee also plans to promote nutrient and pesticide management which often involves modifications to current farm equipment for the application of pesticides and nutrients Including RTK, GPS, and others in areas within the watershed that are deemed critical for nutrients. These types of modifications to existing applicators can Increase crop efficiency while decreasing the potential for overspray, which often leads to NPS reaching open water. The University of Missouri has several suggestions of how to optimize plant growth while limiting water and air pollution listed on their Division of Plant Science website, http://plantsci.missouri.edu/nutrientmanagement/nitrogen/practices.htm, and equipment modifications is one suggestion. The USJRW steering committee believes it is feasible to implement nutrient management on 5000 acres of crop land annually.

The engineers at Purdue University who have recalibrated the SWAT model suggest using a general 20% reduction in nutrient loading as an estimate when implementing the above nutrient management practices. Therefore, a 20% reduction of the total loading for each of the parameter loadings was calculated for the purposes of this WMP. However, the most accurate reductions will be calculated by subtracting the current fertilizer use, from the previous year's fertilizer use after implementation at the individual farm level.

Pervious Pavement

The load reduction for the implementation of pervious pavement was determined using the STEPL load reduction, urban worksheet. The USJRW steering committee estimates that it is feasible to install pervious pavement at two sites annually (one in a typical urban setting and one in a built-up lake setting). Assumptions made to determine a load reduction for pervious pavement include a five acre contributing area with one acre affected by the BMP. Since it is not known where the BMP will be implemented in the watershed, an average reduction estimate for all the urban areas was calculated.

Rain Barrel (Residential)

The load reduction for the implementation of rain barrels on a residential property was estimated using the STEPL load reduction model. The USJRW steering committee estimated that it is feasible to install 20 residential rain barrels annually (ten in urban areas, and ten in lake communities). It is not clear yet where the cost-share program for the installation of a rain barrels will be accepted, therefore it was assumed that the rain barrels will be installed throughout the urban areas deemed critical. Assumptions made to run the load reduction model include a 1 acre contributing area and the installation of a 50 gallon rain barrel.

Rain Garden

The load reduction for the implementation of a rain garden was estimated using the STEPL load reduction model, urban worksheet, for both residential and commercial properties. The USJRW steering committee estimated that it is feasible to install eight rain gardens annually (five in urban areas and three within a lake community). It is not clear yet where the cost-share program for the installation of a rain barrels will be accepted, therefore it was assumed that seven rain gardens were installed within a residential area and one rain garden was installed at a commercial site within the critical area for urban and lake communities. It was assumed for the purposes of running the STEPL load reduction model that the contributing area to the rain garden was one acre for residential properties and 10 acres for commercial properties.

Riparian Buffers at Livestock Operations

The load reduction for the implementation of a minimum of a 20 foot riparian buffer adjacent to a barnyard or pasture field was estimated using the Region 5 load reduction model, feedlot worksheet. It was assumed there were 40 head of dairy cow and 10 young dairy stock present on the farm with a 0-24% paved area. The selected BMP from the available list in the Region 5 model was filter strip. The USJRW steering committee believes it is feasible to install a minimum of a 20' riparian buffer on 750 acres of contributing land from a livestock operation annually. It is not known at this time where the BMP will be accepted and implemented, so the load reductions for each county in the watershed was averaged to determine an approximate reduction for riparian buffers at livestock operations.

Riparian Buffers in Urban Areas

The load reduction for the implementation of a 10' riparian buffer was estimated using the STEPL load reduction model, urban worksheet. A load reduction was assumed for installing a buffer in a residential and commercial setting using the following assumptions; a one acre contributing area and 10 acre contributing area, respectively. The USJRW steering committee believed it to be feasible to install a riparian buffer at three residential properties (one acre contributing area) and one commercial property (ten acres contributing area) annually.

Runoff Management System for Livestock Operations

The load reduction for the implementation of a runoff management system at livestock operations was estimated using the Region 5 load reduction model. A runoff management system may consist of diversions, roof gutters, berms, and other measures to capture or divert stormwater so that it does not run through an area of high manure content at a livestock operation (typically a barnyard). The USJRW steering committee believes it is feasible to implement a runoff management system at five properties annually. Assumptions made to run the model Include 40 head of dairy cattle and 10 young dairy stock with a 75%-100% paved area. Since the majority of livestock operations within the watershed are located in Hillsdale County, Hillsdale was used as the default county if the model and the annual rain fall in Fort Wayne, IN was used as it is the closest weather station.

Soil Amendments (Gypsum)

Load reductions for gypsum application were determined by examining several studies that have been done on the practice. While each study showed a different percent load reductions, the delta between the reductions was minimal. Therefore, the reductions used for the purposes of estimating load reductions after implementation of the USJRW Management Plan are 57% load reduction for total phosphorus, 66% for dissolved reactive phosphorus, and 56% for sediment. The USJRW steering committee believes it is feasible to enlist 5000 acres of crop land annually for the application of gypsum to Increase nutrient uptake.

Street Sweeping

The load reduction for the implementation of the street cleaning program was estimated by the STEPL load reduction model, urban worksheet. The USJRW steering committee set a goal of starting a monthly street sweeping program in all urban areas in the watershed within 30 months of beginning implementation of this WMP. To run the load reduction model for the street sweeping program in each target area, the total acreage of developed land considered to be critical in the watershed was put in the STEPL load reduction, which estimates "weekly" street sweeping. Since the USJRW believes it is only feasible to begin a monthly cleaning program due to the high cost, a load reduction for monthly street sweeping was derived from the weekly load reduction estimates presented in the model.

Two-Stage Ditch Stream Bank Stabilization Design

Load reductions for 2-Stage Ditch designs were determined using the Region 5 load reduction model worksheet for bank stabilization. The USJRW steering committee estimated that it was feasible to install a 1000 linear foot 2-Stage ditch within the agricultural community every other year. It is not clear yet where the cost-share program for the installation of a 2-Stage Ditch will be most accepted so it was assumed that a 1000 linear foot 2-Stage Ditch was installed within the area of the watershed deemed critical for nutrient and sediment loading in the agricultural community. Assumptions made were that the depth of the 2-Stage Ditch design would be 10 feet and that the P concentration of the soil is 0.0005 lbs/lbs soil and the N concentration of the soil is 0.001 lbs/lb soil. The lateral recession rate was 0.1 which indicates moderate bank erosion with few rills and some vegetative overhang above the stream.

Wetland

The load reduction for wetland restoration/creation was determined using the Region 5 load reduction model urban worksheet. The USJRW steering committee estimated that is feasible to enlist one agricultural landowner to install a wetland with a contributing land area of 100 acres annually, and one wetland to be created, restored, or enhanced every other year in the lake community and in an urban setting, each with a 10 acre contributing area. Since it is impossible to know at this point where the cost-share program for wetland restoration/creation will be accepted, it was assumed that the milestones were met within the timeframe designated in the action register. Wetland detention was the chosen BMP to be implemented in the Region 5 load reduction model urban worksheet, and the total acres of agricultural land was set to 100, or the total acres of residential property was set to 10, while leaving all other land uses with zero acres of land contributing to the wetland BMP to determine pollutant load reductions.

Un-Modeled BMPs Listed in the Action Register

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

Blind Inlets

The USJRW steering committee plans to promote the implementation of blind inlets on crop land with unmanaged tile inlets in those areas deemed critical for nutrients and turbidity. Blind inlets are a relatively new technology and research continues to determine how effective the technology is in lessening the pollutant load through tile inlets in crop land. One such study, conducted by the USDA Agriculture Research Service (ARS) in the St. Joseph River Watershed in 2010 indicates that blind inlets do in fact, have a significant impact on the amount of sediment and nutrients released to open water through field tiles. A copy of the study can be found at http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=267832.

Drainage Water Management

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

Rotational Grazing

Rotational Grazing is a practice used which can improve the health of the livestock, pasture plant and soil health, fish and wildlife habitat, as well as water quality. The University of Illinois Extension Office lists several studies which identify pastures as one of the best options for reducing runoff, erosion, and phosphorus pollution (http://www.livestocktrail.illinois.edu/pasturenet/paperDisplay.cfm?ContentID=6618). The Extension also refers to another study conducted by the Agricultural Research Service (ARS) which showed rainfall better infiltrated pasture land than adjacent wooded areas that were considered "pristine". For those reasons, it can be expected that implementing rotational grazing at the sites identified as posing a potential threat to water quality within the watershed, and any other sites that are noted in the future, would have a significant impact on the amount of runoff, which has the potential to carry fecal coliform and nutrients, reaching open water sources. Another benefit of rotational grazing is that plants have time to recover between grazing periods, thus Increases plant and soil health and decreasing the potential for erosion.

Urban Best Management Practices

Many management practices for urban areas cannot be modeled for potential load reductions due to them being a new technology and the variability between implementation sites. EPA has released a new load reduction model that may determine the best location to put urban BMPs within a critical area, and potential load reductions. However, until a more detailed evaluation of the implementation area for urban pollutants is done, the model will not be useful. However, it will be used during the implementation phase to determine where the "biggest bang for the buck" will occur when placing BMPs.

Lake Community BMPs

There are currently no models available to determine load reductions for many of the BMPs the USJRW steering committee would like to implement within the Lake Communities in the watershed. Those BMPs Include shoreline stabilization and natural shoreline design. More information regarding lake shoreline protection can be found at the Michigan Natural Shoreline Partnership's website; https://sites.google.com/site/mishorelinepartnership/home.

8.0 Ohio Coastal Nonpoint Pollution Control Program

Per the Coastal Zone Act of 1990, each coastal state is required to submit for approval a coastal nonpoint pollution control program (CNPCP) to the US EPA and the National Oceanic and Atmospheric Administration (NOAA) with the purpose "to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters, working in close conjunction with other State and local authorities."

Ohio was granted conditional approval of their CNPCP, administered by the ODNR, in 2002. Ohio therefore, requires all WMPs compiled for watersheds located within the Lake Erie Basin to describe how the NPS management measures outlined in the CNPCP will be addressed. The following sections describe the management measures that will be taken to address the issues outlined in Appendix 8 of the Ohio CNPCP which can be found in Appendix D of this document.

There are several Management Measures outlined in the Ohio CNPCP that are applicable in Upper St. Joseph River Watershed. Those applicable management measures are listed below.

Applicable Management Measures

1. New Development
2. Watershed Protection
3. Site Development
4. Existing Development
5. Establish Protective Setbacks
6. Reduce Nitrogen Loading by 50%
7. Operating On-Site Disposal Systems
8. New On-Site Disposal Systems
9. Planning, Siting, and Developing Roads and Highways
10. Bridges
11. Road, Highway, and Bridge Operation and Maintenance
12. Road, Highway, and Bridge Runoff Systems
13. Operation and Maintenance Program for Existing Channels to Protect Surface Water and Restore In-stream and Riparian Habitat
14. Dams
15. Eroding Streambanks and Shorelines

Non-applicable Management Measures

State Operated/Managed Roads, Highways, and Bridges

State operated roads, highways and bridges are subject to state rules and regulations. Those transportation corridors that are in development are subject to Rule 5 permitting and those corridors that are already in existence are subject to State's NPDES Stormwater Pollution Prevention Plans.

The majority of the management measures listed in the Ohio CNPCP are addressed in Section 6 of this WMP. However, further explanation of how those management measures will be implemented in the USJRW is provided below.

8.1 New Development/Site Development/Establish Protective Setbacks

There are eight small communities located wholly within the project area. All communities are small enough that a stormwater protection plan is not mandated by EPA, or any regulating state agency. Therefore, there are no regulations beyond the EPA mandate to control stormwater if 1 acre or more of land is disturbed, in place at this time. However, the Steuben County government, under Ordinance 673, developed a Stormwater Management Plan. The purpose of that Plan is to "reduce the hazard to public health and safety caused by excessive stormwater runoff, to enhance economic objective, and to protect, conserve and promote orderly development of land and water…".

The DeKalb County Planning Commission adopted a county Comprehensive Plan in 2004 which Includes management measures on new development Including " discouraging development of sensitive areas, the adoption of best management practices" and "allowing development within the 100 year flood plain on a minimal basis." DeKalb County also adopted the DeKalb County Unified Development Ordinance in 2009 which puts into place many development standards to reduce the risk of water pollution and excessive sediment runoff, as well as setbacks from environmentally sensitive areas.

The Steuben County government adopted their revised Comprehensive Plan in 2006 which outlines strategies to manage growth and nurture environmental quality. Specific policies outlined in the Plan are to discourage sprawl and Incentivize developers to build "cluster communities" while protecting and/or enhancing environmental features, buffer sensitive areas, and conserve existing natural areas.

The community of Clear Lake, located within Steuben County, has a Unified Development Plan adopted in 2009, and a Comprehensive Planning a Zoning Ordinance adopted in 2006. Both plans were designed to allow for development of the area without decreasing the integrity of the natural environment and outline goals and strategies to protect environmentally sensitive areas, require setbacks to those areas, and increase greenway and lake BMPs.

The Hillsdale County Planning Commission adopted their County Comprehensive Plan in 2002. The Plan predominately lays out a strategy to develop more specific Plans to reduce the impact of development on our natural resources, Including a Unified Development Plan, a farmland preservation strategy, a strategy to protect environmentally sensitive areas, and the promotion for the protection of wetlands, floodplains, groundwater recharge areas, and other sensitive areas.

The Branch County Master Plan, which was adopted in 2011 includes goals to encourage conservation and preservation of natural areas, and prohibit floodplain development.

The USJRW Steering Committee has outlined plans in the Action Register to work with City and County Planners to reduce stormwater runoff, encourage Low Impact Designs for all new developments, and encourage the adoption of protective setbacks for sensitive areas outlined in this WMP.

8.2 Watershed Protection

Implementation of this Watershed Management Plan will meet the management measure of watershed protection. All previous studies outlined in Section 2.8 offer ideas of how to mediate NPS within the USJRW as well. Plans outlined in the Action Registers for each of the goals of the USJRW project express how watershed protection will be accomplished including, but not limited to; wetland restoration and creation, implementation of BMPs, and working with City and County Planners and other influential organizations within the watershed to promote environmental stewardship.

8.3 Existing Development

As mentioned above there are eight population centers located within the USJRW. There are not any CSO communities located within the watershed. However, existing development is influencing water quality throughout the urbanized areas, including the lake communities within the USJRW. The US Census Bureau predicts a small, yet steady Increase in population throughout the project area, except for Williams County, which may impact the existing infrastructure and cause an Increase in urban pollution. The windshield survey conducted as part of this project revealed several areas of urbanization induced streambank erosion, as well as direct runoff from roads and parking lots into area streams.

The USJRW project will meet with City and County planners to develop a plan to address the excess of stormwater runoff from the urbanized areas and to encourage BMP retrofits to limit stormwater runoff, as well as implement a monthly street cleaning program. The USJRW project will work with private residential landowners to install other stormwater control practices such as rain gardens, wetland restoration and creation, and rain barrels or cisterns. The USJRW project will also work with larger businesses and industrial areas to implement BMPs above and beyond any requirements to control stormwater by cost-sharing on green roofs, pervious pavement, and install native vegetation.

8.4 Reduce Nitrogen Loading

The USJRW project tested nitrate+nitrite as an indicator of nitrogen levels within the waters of the USJRW. The water quality testing conducted by the USJRW project indicated that a 55% load reduction of nitrate+nitrite is needed at sample site 132 in the Bear Creek-Nettle Creek subwatershed to reach the goal of 1.6 mg/l. It is believed that the excessive nitrogen is coming from the Town of Edon's WWTP, which has reported several effluent exceedances of their NPDES permit to EPA in the past. While working with NPDES permitted facilities is outside the scope of this project, many of the BMPs outlined in the Action Register for nutrients, septic tank discharge, livestock, and urbanized areas will have a direct effect on the amount of nitrogen reaching open water from nonpoint sources of pollution.

8.5 Operating and New On-Site Disposal Systems

Most incorporated areas located within the USJRW are on centralized sewer systems. However, most of the rural community within the USJRW utilizes on-site sewage disposal systems as well as some of the larger, populated Lakes Including Lake Seneca, OH. There is a high occurrence of septic system failure throughout the Midwest. This is likely due to the soil type of the area (less than 3% of soils in the USJRW are designated as suitable soils for on-site sewage disposal systems). The Williams County Health Department estimates that there are currently 2,087 failing on-site waste disposal systems, the DeKalb County Health Department estimates there are 2,204 failing systems located within the county, though Steuben, Hillsdale, and Branch counties could not provide an accurate estimate of the number of failing septic systems in the county. The US EPA estimates that approximately 1% - 5% of systems in use are currently failing. Failing sewage disposal systems pose a threat of excessive nutrients, bacteria, and sediment reaching ground and surface waters. State and County Health Departments have regulations for the installation of all new on-site disposal systems. However, often times, existing on-site disposal systems are grandfathered into the new laws.

The USJRW set a goal of Increasing knowledge of on-site sewage waste management systems with the objectives of working with local agencies and other organizations to develop an educational program regarding septic system placement and management, provide cost-share dollars for system replacement, maintenance, or elimination, and work with local septic system companies to provide discounts to landowners who sign up for regular maintenance on their system.

8.6 Planning, Siting, and Developing Roads and Highways

The development of new roads can cause a significant risk to surface waters and sensitive areas as heavy equipment is used which has the potential to leak gas and oil, and soil disturbances can Increase sedimentation of surrounding water resources. The best time to address these concerns is during the planning phase of the new road at which time, siting and development of the road should be considered to limit any detrimental effects on surrounding sensitive areas and water resources. Environmental impact assessments (EIA) are often required before construction of the new road can take place which will identify any potential harm to the surrounding environment. If, during the EIA, it is found that building a road in a particular location will cause harm to the environment, measures will need to be taken to minimize the impact of the road to the highest degree possible, or the road will need to be sited elsewhere. The use of BMPs during road construction is also very important as it will minimize the effects on water resources by minimizing land disturbances. The OCNPCP has three requirements to meet during the planning, siting, and development of roads and highways:

1. Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss
2. Limit land disturbance such as clearing and grading and cut and fill to reduce erosion and sediment loss
3. Limit disturbance of natural drainage features and vegetation

8.7 Bridges

Pollution from bridge decks can have an impact on water resources. Therefore, the OCNPCP requires that bridge maintenance and design be considered to limit the impact on critical habitat, fisheries, shellfish beds, wetlands, and domestic water supplies.

Bridge maintenance is on a regular rotating schedule with the State and County Departments of Transportation for inspection and repair as needed. There are no plans in the near term for bridge development within the watershed. However, it was noted during the windshield survey conducted in 2012 that many bridges located throughout the watershed present with soil erosion leading from the bridge. Increasing riparian buffers at these sites, as noted in the Action Register for increasing buffer width, will have an impact on streambank erosion. Also, the street sweeping program described in the Action Register for urbanized areas will eliminate some of the bridge runoff from reaching open water sources within the urban areas of the watershed.

8.8 Road, Highway, and Bridge Operation and Maintenance

Operation and maintenance of roads, highways, and bridges is performed by the Indiana, Michigan, or Ohio Department of Transportation, local county, or township. Each entity must follow the good housekeeping rules laid out in their NPDES permit, if one exists. The USJRW project plans to meet with local city and county planners to improve road, highway, and bridge housekeeping and as mentioned above, will work with local entities to incorporate a regular street sweeping program. Sediment runoff from dirt roads surrounding Clear Lake was noted as a problem in previous studies and is a major concern for the Clear Lake Association. Therefore, the USJRW steering committee has also made an objective to work with local lake groups to facilitate meetings with local planners to replace those eroding roads with a more stable substrate.

8.9 Road, Highway, and Bridge Runoff Systems

The majority of the pollution in the USJRW is a result of agricultural land as it comprises over 77% of the watershed. Though, there are some areas where improvement can be made to mitigate the impact of excessive stormwater from urban areas. There are few storm drains located within the watershed, none of which are connected to a combined sewer system. The USJRW steering committee has outlined ways to reduce the risk of polluted runoff from reaching open water from roads, highways, and bridges by encouraging, and providing cost-share dollars to implement LID on new developments, or installing retrofits to Incorporate bioswales, extended wet detention, wetlands, curb cuts, tree plantings, and pervious pavement to reduce the amount of stormwater runoff from impervious surfaces reaching open water sources. The USJRW also plans to work with City and County Planners to determine the best means of minimizing the impact of stormwater runoff from roads, highways, and bridges.

8.10 Operation and Maintenance Program for Existing Channels to Protect Surface Water and Restore In-stream and Riparian Habitat

Changes made to existing channels, or channel construction, can impact the integrity of the water system as a whole and may alter wildlife and aquatic habitat and can alter the chemical and physical integrity of the stream channel Including, sediment, turbidity, salinity, temperature, nutrients, dissolved oxygen, and other contaminants. The riparian buffer inventory conducted in 2012-2013 indicated that 51% or all agricultural parcels adjacent to open water have less than a 10' riparian buffer, and 64% have less than a 60' buffer. The inventory also indicated that 13% of the parcels in the watershed adjacent to open water are urbanized areas that lack an adequate buffer to slow the force of stormwater.

County drainage boards, surveyors, and engineers are charged with maintaining county drains and ditches and there are 395.67 miles of legal drains maintained by the county government within the USJRW. The practices enlisted to maintain the drains are often detrimental to the integrity of the water way and riparian habitat. For these reasons, the USJRW project plans to work with City and County Planners and county surveyors to implement a method that will maintain the integrity of the stream system, while serving the purpose of the stream channel modification. The USJRW project will also encourage the use of a two-stage ditch design which will limit sedimentation and help to mediate Increased nutrients in the stream channel, as well as offer cost-share dollars when possible to implement the two-stage stream design. The USJRW project will also cost-share on the installation of a minimum of a 20' riparian buffer on all streams within agricultural community and a minimum of a 10' buffer within the urban community.

8.11 Dams

Dams have the potential to cause many adverse impacts on water quality and aquatic life by Increasing temperature and siltation, and decreasing dissolved oxygen levels, thus degrading aquatic habitat. Dam removal will restore the natural flow of a river as well as the natural ecological processes in the river system by eliminating the excessive sediment buildup at the dam and temperatures and DO levels will often return to acceptable levels.

There are 21 dams located within the USJRW and their impact on water quality has not been assessed. Dams are regulated and inspected the respective program within the Indiana, Ohio, and Michigan DNR. Dams in the watershed, especially those nearing the end of their expected useful life, should be evaluated by the respective state agency to determine their functional and operational status. Removal of the dam should be considered, should the inspection show that it has reached the end of its useful life.

8.11Eroding Streambanks and Shorelines

Streambanks often begin to erode due to stream channel and bank modification and an Increase in stormflow. Streambank erosion can cause economic hardship for farmers and landowners who rely on property adjacent to open water, as well as impact aquatic and wildlife habitat. There is great concern regarding streambank and shoreline erosion within the USJRW. The windshield survey conducted in 2012 revealed an estimated 71,637 feet of stream bank surrounded by agriculture land with an additional 17,513 feet of streambank surrounded by residential lawns and businesses were eroding scattered throughout the watershed. Area lakes, specifically Clear Lake and Lake Seneca have expressed concern regarding shoreline erosion. The Clear Lake Conservatory has already begun to encourage the use of natural shoreline protection to combat the eroding banks.

It is the goal of the USJRW project to limit excessive storm flow runoff and the Steering Committee has developed a plan, which is outlined in the action register in Section 6, of how to accomplish that goal. The USJRW also plans to work with landowners to offer cost-share dollars to implement BMPs that will protect streambanks from erosion, as well as cost-share on the installation of natural shoreline and stabilize shorelines and streambanks.

9.0 Future Activity

After extensive research conducted over two and a half years in the USJRW, the resulting Watershed Management Plan is full of information regarding common land uses and practices, as well as historic and present day water quality issues found in the subwatersheds located within the greater SJRW. However since this information is not common knowledge, the USJRW project will introduce key findings in the WMP and the cost-share program to the public through at least one public meeting held in Michigan, Indiana and Ohio, within 4 months of the final WMP approval. The meetings will be advertised through local media outlets Including newspapers, SWCD, NRCS, and FSA offices. Other means of advertisement will be pursued as well. Teaching USJRW stakeholders about the extent of water quality problems within the watershed, as well as the watershed’s contribution to the algal blooms in the Western Lake Erie Basin, will hopefully illicit concern as well as a willingness to change behaviors to have a positive impact on water quality.

The next steps in the USJRW project is for the Steering Committee to develop a cost-share program that will Include, at a minimum, those management measures outlined in the Action Registers in Section 6.0 of this WMP, and the various Incentive levels that will be used to encourage the adoption of those management measures. The Steering Committee will work closely with all Conservation Districts located within the project area, as well as the partners outlined in the Action Register to make sure their cost-share recommendations are realistic for the demographic of the area, and to utilize their help for promoting the cost share program. A key component of the cost-share programs success is the education and outreach aspect of the USJRW project. Field days and workshops regarding agricultural and urban land uses and BMPs will be held annually, as part of this project, however, partnering with other organizations such as other county SWCD and NRCS offices, The Nature Conservancy, the IN and OH DNR, the MDEQ and smaller non-profit groups that focus on water quality and sustainable land uses, will prove to be integral in promoting practices to improve the health of the USJRW. Pre and post workshop surveys will be used at some of the educational events to determine if a true impact is being made through the education and outreach programs or if revisions to the program need to be made to yield a greater impact.

It is the goal of the USJRW project that this WMP will be reviewed and utilized by other organizations within the Upper St. Joseph River Watershed Including the DeKalb, Steuben, Branch, Hillsdale and Williams County SWCDs, The Nature Conservancy's Western Lake Erie Basin Project, County Drainage Boards, Surveyors and Engineers, City and County Planning Departments, and other organizations concerned about the water quality of the Upper St. Joseph River Watershed. The USJRW project's first priority will be to obtain funding to pursue the objectives outlined in the Action Register; however we hope to work with other organizations that plan to do the same.

A watershed is continually changing as land uses change, towns begin to expand, new businesses organize in the area, farmland is converted to other uses, or wetlands are drained or moved to accommodate development or farming. These changes in the USJRW have continued to have an enormous impact on the Western Lake Erie Basin. During the writing of this document a massive algal bloom formed in Lake Erie at the mouth of the Maumee River which left nearly 400,000 residents of Toledo without drinking water for two days. The algal bloom in Lake Erie in 2011 was the largest on record and reached from Toledo nearly 100 miles east to Cleveland and was at depths up to 60 feet. Annual harmful algal blooms in Lake Erie could cause catastrophic deaths of aquatic life, seriously impact Toledo's drinking water, and have a major impact of the local economy surrounding Lake Erie. The Maumee River is the largest contributor of sediment and nutrients to Lake Erie, a portion of which comes from the St. Joseph River.

As the watershed continues to change, so must the actions taken to maintain and/or improve the integrity of the water quality. Therefore, the Upper St. Joseph River Watershed Management Plan must remain a 'living document' and be updated by the SJRWI, or its partners, at a minimum, every five years.

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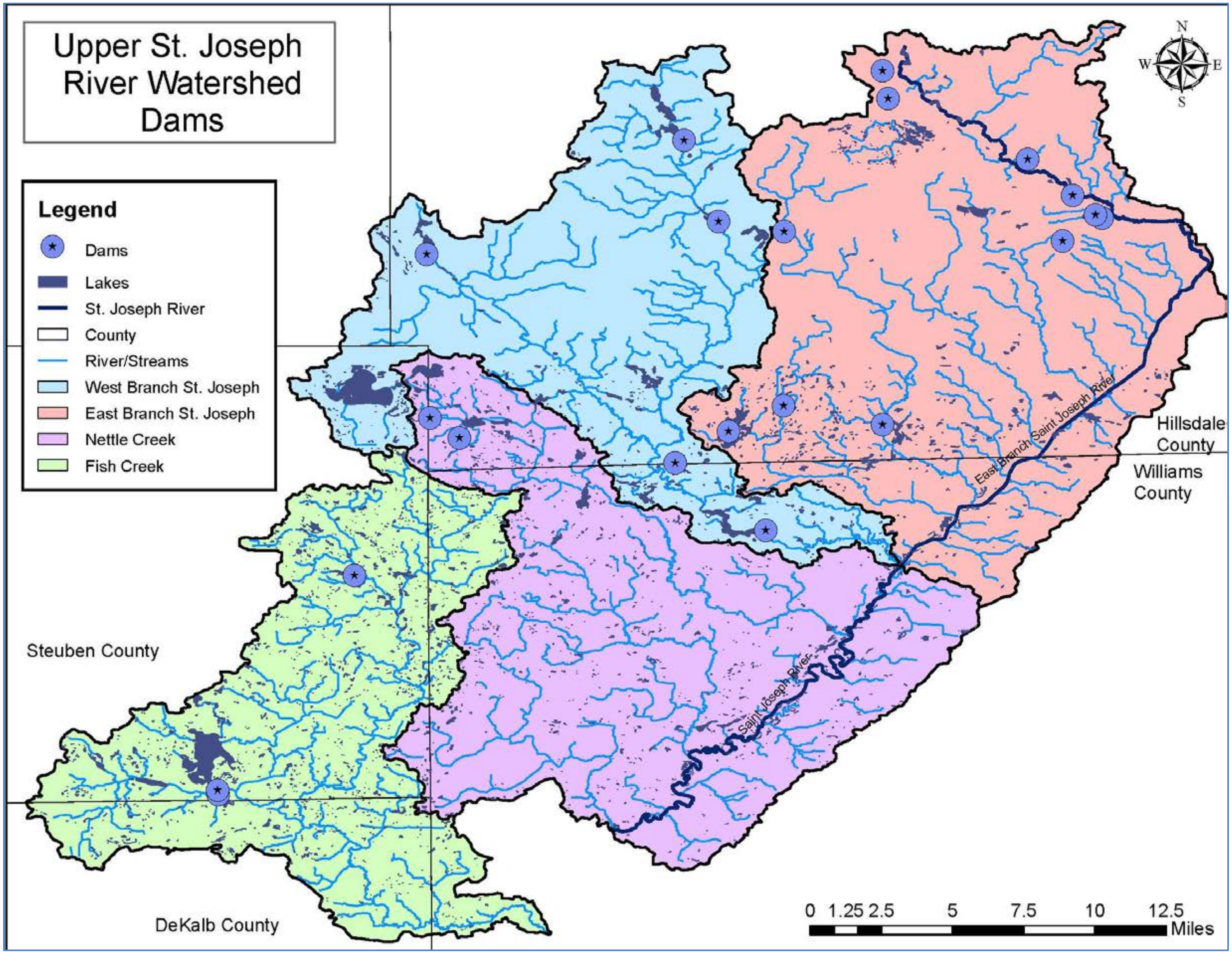
Appendix A

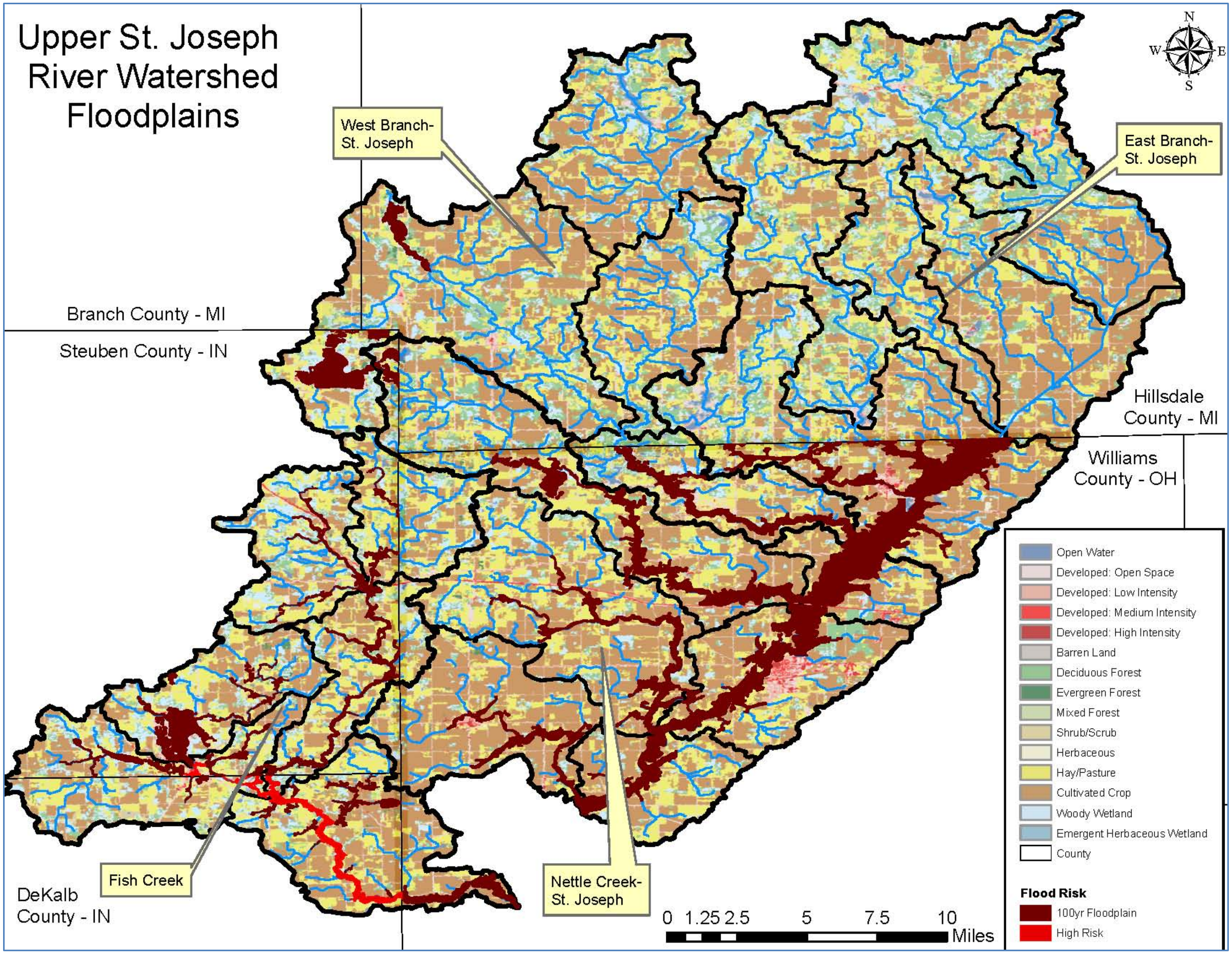
Dam Name	POP NAME	POND NAME	POND ACRES	LATITUDE	LONGITUDE	BUILT	RIVER
Hillsdale County, Michigan							
Bear Lake Dam	Bear Lake Level Control Structure	Bear Lake	117	41.864722	-84.675833	1989	E Fork W Br St Joseph River
Cambria Mill Pond Dam		Cambria Mill Pond	38	41.823333	-84.658333	1890	E Fork W Br St Joseph River
Pittsford Mill Dam	Ross Dam	Pittsford Mill Pond	8	41.836667	-84.478333	1872	East Branch St Joseph River
Lime Lake Dam	East Lime Lake		90	41.782373	-84.377477	1960	Lime Lake Outlet
Merry Lake Dam	Merry Lake Level Control Structure	Merry Lake	100	41.72	-84.575	1966	Silver Creek
Schilling Dam			4	41.818333	-84.625	1979	Silver Creek
Eby Dam			2	41.723333	-84.805	Unknown	Tributary to Mill Stream Drain
Lost Nation Lake # 5 Dam	Lake #5	Pittsford State Game Area # 5	25	41.855	-84.501111	1956	Trib to E Br St Joseph
Lost Nation Lake #1 Dam	Pittsford State Game Area Pond #1	Lake #1	7	41.825	-84.463333	1955	Trib to E Br St Joseph River
Lost Nation Lake #2 Dam	Pittsford State Game Area Pond #2	Lake #2	16	41.826667	-84.466667	1953	Trib to E Br St Joseph River
Weatherwood Dam	Fry Dam	Weatherwood Lake	27	41.9	-84.575	1970	Trib to E Br St Joseph River
Bunce Dam			2	41.713333	-84.79	Unknown	Trib to Mill Stream Drain

Dam Name	POP NAME	POND NAME	POND ACRES	LATITUDE	LONGITUDE	BUILT	RIVER
Pleasant Lake Dam	Pleasant Lake Level Control Structure	Pleasant Lake	74	41.885833	-84.572222	1982	Trib W Br St Joseph River
Lake Diane Dam	Goforth Lake Dam	Lake Diane	290	41.716667	-84.653333	1966	Tributary to Clark Fork Creek
Dunn Dam			4	41.729722	-84.625278	Unknown	Tributary to Clear Fork
Walters Dam			2	41.998333	-84.395	1965	Tributary to Fisk Drain
Thomas Dam			3	41.913333	-84.368333	1971	Tributary to Horseshoe Lake
Grabouske Dam			2	41.813333	-84.483333	1978	Tributary to Lake # 2
Manitou Properties Dam 1		Fawn Lake	6	41.778637	-84.368966	1972	Tributary to Lime Creek
Manitou Properties Dam 2		Springer Lake	15	41.779462	-84.372093	1972	Tributary to Lime Creek
Ribeck Mead and Turner Dam		Ribeck, Mead and Turner Lakes	125	41.806667	-84.806667	1880	W Fork W Br St Joseph River
Toledo Boy Scouts Dam		Lake Mac Nichol	12	41.700574	-84.680403	1967	West Branch St. Joseph River
Steuben County, Indiana							
Hamilton South Dam		Hamilton Lake	755.39	41.531799	-84.912804	Unknown	Hamilton Lake System
Hamilton North Dam		Hamilton Lake	755.39	41.5341	-84.913002	Unknown	Hamilton Lake System
Borror Lake Dam		Borror Lake	82	41.643299	-84.843399	Unknown	Unnamed tributary to West Branch - Fish Creek

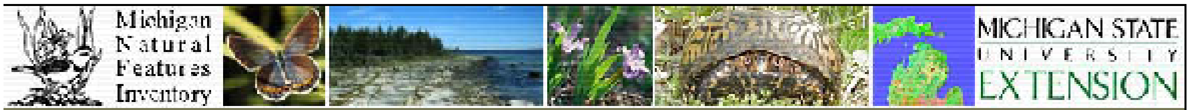
Dam Name	POP NAME	POND NAME	POND ACRES	LATITUDE	LONGITUDE	BUILT	RIVER
Williams County, Ohio							
Lake Seneca Dam		Lake Seneca		41.666302	-84.634201	1960's	West Branch - St. Joseph River



Upper St. Joseph River Watershed Dams
Legend
Dams
Lakes
St. Joseph River
County
River/Streams
West Branch St. Joseph
East Branch St. Joseph
Nettle Creek
Fish Creek
N
W
E
S
Hillsdale County
Williams County
Steuben County
DeKalb County
East Branch Saint Joseph River
Saint Joseph River
0 1.25 2.5 5 7.5 10 12.5
Miles


Upper St. Joseph River Watershed Floodplains
West Branch-St. Joseph
East Branch-St. Joseph
Branch County - MI
Steuben County - IN
Hillsdale County - MI
Williams County - OH
Fish Creek
Nettle Creek-St. Joseph
DeKalb County - IN
0 1.25 2.5 5 7.5 10 Miles
Open Water
Developed: Open Space
Developed: Low Intensity
Developed: Medium Intensity
Developed: High Intensity
Barren Land
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrub/Scrub
Herbaceous
Hay/Pasture
Cultivated Crop
Woody Wetland
Emergent Herbaceous Wetland
County
Flood Risk
100yr Floodplain
High Risk

Appendix B



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County Element Data

Choose a new county

Hillsdale County

Current as of 5/21/2009

Status Code Definitions

Scientific Name	Common Name	Federal Status	State Status
Acris crepitans blanchardi	Blanchard's cricket frog		T
Agrimonia rostellata	Beaked agrimony		T
Alasmidonta marginata	Elktoe		SC
Alasmidonta viridis	Slippershell		T
Ambystoma texanum	Smallmouth salamander		E
Ammocrypta pellucida	Eastern sand darter		T
Ammodramus henslowii	Henslow's sparrow		E
Asio flammeus	Short-eared owl		E
Baptisia lactea	White or prairie false indigo		SC
Calephelis mutica	Swamp metalmark		SC
Carex conjuncta	Sedge		T
Carex lupuliformis	False hop sedge		T
Cirsium hillii	Hill's thistle		SC
Clinostomus elongatus	Redside dace		E
Coregonus artedi	Lake herring or Cisco		T
Cypripedium candidum	White lady slipper		T
Dendroica cerulea	Cerulean warbler		T
Dichanthelium leibergii	Leiberg's panic grass		T
Echinacea purpurea	Purple coneflower		X
Eleocharis equisetoides	Horsetail spike rush		SC
Emys blandingii	Blanding's turtle		SC
Erimyzon claviformis	Creek chubsucker		E
Erynnis baptisiae	Wild indigo duskywing		SC
Etheostoma spectabile	Orangethroat darter		SC
Floodplain Forest			
Fraxinus profunda	Pumpkin ash		T
Fundulus dispar	Starhead topminnow		SC
Galearis spectabilis	Showy orchis		T
Great Blue Heron Rookery	Great Blue Heron Rookery		
Lampsilis fasciola	Wavyrayed lampmussel		T
Lepisosteus oculatus	Spotted gar		SC

Liparis liliifolia	Purple twayblade		SC
Mesic Southern Forest	Rich Forest, Central Midwest Type		
Moxostoma carinatum	River redhorse		T
Myotis sodalis	Indiana bat	LE	E
Nerodia erythrogaster neglecta	Copperbelly water snake	LT	E
Notropis amblops	Bigeye chub		X
Notropis anogenus	Pugnose shiner		E
Notropis photogenis	Silver shiner		E
Noturus miurus	Brindled madtom		SC
Opsopoeodus emiliae	Pugnose minnow		E
Panax quinquefolius	Ginseng		T
Pantherophis spiloides	Gray ratsnake		SC
Plantago cordata	Heart-leaved plantain		E
Pleurobema clava	Clubshell	LE	E
Pleurobema sintoxia	Round pigtoe		SC
Prairie Fen	Alkaline Shrub/herb Fen, Midwest Type		
Scutellaria nervosa	Skullcap		E
Seiurus motacilla	Louisiana waterthrush		T
Silene stellata	Starry campion		T
Sistrurus catenatus catenatus	Eastern massasauga	C	SC
Sisyrinchium strictum	Blue-eyed-grass		SC
Southern Hardwood Swamp			
Sturnella neglecta	Western meadowlark		SC
Terrapene carolina carolina	Eastern box turtle		SC
Toxolasma lividus	Purple lilliput		E
Valeriana edulis var. ciliata	Edible valerian		T
Venustaconcha ellipsiformis	Ellipse		SC
Viburnum prunifolium	Black haw		SC
Villosa fabalis	Rayed bean	C	E
Villosa iris	Rainbow		SC
Wilsonia citrina	Hooded warbler		SC

For assistance with this site, email mnfi@msu.edu

Ohio Biodiversity Database
Rare Species List for Williams Co.
As of 10/15/2010

Last Recorded	Scientific Name	Common Name	State Status	Federal Status
PLANTS				
2005	*Acorus americanus*	American Sweet-flag	P	
2000	*Agalinis purpurea var. parviflora*	Small Purple-foxglove	E	
2003	*Betula pumila*	Swamp Birch	T	
2009	*Carex alata*	Broad-winged Sedge	P	
2003	*Carex aquatilis*	Leafy Tussock Sedge	P	
2008	*Carex atherodes*	Wheat Sedge	P	
2005	*Carex aurea*	Golden-fruited Sedge	P	
1989	*Carex bebbii*	Bebb's Sedge	P	
2009	*Carex diandra*	Lesser Panicled Sedge	T	
2009	*Carex lasiocarpa*	Slender Sedge	P	
2000	*Carex retrorsa*	Reflexed Bladder Sedge	E	
2009	*Carex sprengelii*	Sprengel's Sedge	T	
2000	*Cornus canadensis*	Bunchberry	E	
2009	*Eleocharis flavescens*	Green Spike-rush	T	
2009	*Eleocharis quinqueflora*	Few-flowered Spike-rush	T	
1981	*Helianthemum canadense*	Canada Frostweed	T	
2000	*Hieracium longipilum*	Long-bearded Hawkweed	E	
2000	*Hypericum boreale*	Northern St. John's-wort	T	
2000	*Krigia virginica*	Virginia Dwarf-dandelion	T	
2000	*Larix laricina*	Tamarack	P	
1980	*Lathyrus ochroleucus*	Yellow Vetchling	E	
2009	*Moehringia lateriflora*	Grove Sandwort	P	
2009	*Myriophyllum sibiricum*	American Water-milfoil	T	
1979	*Ophioglossum pusillum*	Northern Adder's-tongue	E	
2005	*Panicum boreale*	Northern Panic Grass	P	
1974	*Phlox latifolia*	Mountain Phlox	E	
2001	*Plagiothecium latebricola*	Lurking Leskea	T	
1991	*Plantago patagonica*	Woolly Plantain	E	
2001	*Platanthera flava*	Tubercled Rein Orchid	P	
2008	*Platanthera psycodes*	Small Purple Fringed Orchid	T	
2000	*Polygala polygama*	Racemed Milkwort	T	
2000	*Potamogeton natans*	Floating Pondweed	P	
1969	*Potamogeton praelongus*	White-stemmed Pondweed	E	
2009	*Potamogeton zosteriformis*	Flat-stemmed Pondweed	T	

P=Potentially Threatened, T=Threatened, E=Endangered, SC=Species of Concern
SI=Special Interest, FT=Federally Threatened, FE=Federally Endangered

Last Recorded	Scientific Name	Common Name	State Status	Federal Status
2009	*Salix candida*	Hoary Willow	P	
1989	*Salix petiolaris*	Slender Willow	T	
2007	*Salix serissima*	Autumn Willow	P	
1988	*Schoenoplectus subterminalis*	Swaying-rush	E	
2000	*Sida hermaphrodita*	Virginia-mallow	P	
2005	*Spiranthes lucida*	Shining Ladies'-tresses	P	
1997	*Utricularia intermedia*	Flat-leaved Bladderwort	T	
1991	*Utricularia minor*	Lesser Bladderwort	T	
ANIMALS				
1997	*Aeshna canadensis*	Canada Darner	E	
1996	*Aeshna clepsydra*	Mottled Darner	E	
1987	*Ambystoma laterale*	Blue-spotted Salamander	E	
1992	*Ammocrypta pellucida*	Eastern Sand Darter	SC	
1995	*Catocala gracilis*	Graceful Underwing	E	
1987	*Cistothorus platensis*	Sedge Wren	SC	
2000	*Clemmys guttata*	Spotted Turtle	T	
2000	*Cyclonaias tuberculata*	Purple Wartyback	SC	
2000	*Emydoidea blandingii*	Blanding's Turtle	SC	
1994	*Enallagma ebrium*	Marsh Bluet	T	
2000	*Epioblasma obliquata perobliqua*	White Catspaw	E	FE
1988	*Epioblasma torulosa rangiana*	Northern Riffleshell	E	FE
2006	*Erimyzon sucetta*	Lake Chubsucker	T	
1987	*Etheostoma exile*	Iowa Darter	SC	
1992	*Gomphus externus*	Plains Clubtail	E	
2010	*Haliaeetus leucocephalus*	Bald Eagle	T	
1994	*Ischnura kellicotti*	Lilypad Forktail	E	
1994	*Ladona julia*	Chalk-fronted Corporal	E	
2002	*Lampsilis fasciola*	Wavy-rayed Lampmussel	SC	
2002	*Lasmigona compressa*	Creek Heelsplitter	SC	
1986	*Ligumia recta*	Black Sandshell	T	
1992	*Melanchra assimilis*	Similar Black Noctuid	E	
1997	*Moxostoma valenciennesi*	Greater Redhorse	T	
1990	*Nerodia erythrogaster neglecta*	Copperbelly Water Snake	E	FT
1980	*Notropis heterodon*	Blackchin Shiner	E	
1982	*Opsopoeodus emiliae*	Pugnose Minnow	E	
2002	*Pleurobema clava*	Clubshell	E	FE
2002	*Pleurobema sintoxia*	Round Pigtoe	SC	
2002	*Ptychobranchus fasciolaris*	Kidneyshell	SC	

P=Potentially Threatened, T=Threatened, E=Endangered, SC=Species of Concern
SI=Special Interest, FT=Federally Threatened, FE=Federally Endangered

Last Recorded	Scientific Name	Common Name	State Status	Federal Status
2000	*Quadrula cylindrica cylindrica*	Rabbitsfoot	E	
2002	*Simpsonaias ambigua*	Salamander Mussel	SC	
1985	*Toxolasma lividus*	Purple Lilliput	E	
2000	*Villosa fabalis*	Rayed Bean	E	

P=Potentially Threatened, T=Threatened, E=Endangered, SC=Species of Concern
SI=Special Interest, FT=Federally Threatened, FE=Federally Endangered

Indiana County Endangered, Threatened and Rare Species List

County: Steuben

Species Name	Common Name	FED	STATE	GRANK	SRANK
Mollusk: Bivalvia (Mussels)					
Lampsilis fasciola	Wavyrayed Lampmussel		SSC	G5	S3
Pleurobema clava	Clubshell	LE	SE	G2	S1
Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Toxolasma lividus	Purple Lilliput		SSC	G3	S2
Venustaconcha ellipsiformis	Ellipse		SSC	G4	S2
Insect: Lepidoptera (Butterflies & Moths)					
Capis curvata	A Noctuid Moth		ST	G4	S2S3
Catocala praeclara	Praeclara Underwing		SR	G5	S2S3
Chortodes enervata	The Many-lined Cordgrass Moth		ST	G4	S1
Chortodes inquinata	Tufted Sedge Moth		ST	GNR	S1S2
Dasychira cinnamomea	A Moth		SR	G4	S1
Euphydryas phaeton	Baltimore		SR	G4	S2
Euphyes dukesi	Scarce Swamp Skipper		ST	G3	S1S2
Exyra rolandiana	Pitcher Window Moth		SE	G4	S1S2
Hesperia leonardus	Leonard's Skipper	No Status	SR	G4	S2
Iodopepla u-album	A Noctuid Moth		SR	G5	S2
Leucania inermis	A Moth		SR	G4	S2S3
Leucania multilinea			SR	G5	S1S2
Lycaena dorcas dorcas	Dorcas Copper		SR	G5TU	S2
Macrochilo absorptalis	A Moth		SR	G4G5	S2S3
Macrochilo hypocritalis	A Noctuid Moth		SR	G4	S2
Melanchra assimilis	The Shadowy Arches		SE	G5	S1S2
Melanomma auricinctaria	Huckleberry Eye-spot Moth		SR	G4	S2S3
Neonympha mitchellii mitchellii	Mitchell's Satyr	LE	SE	G2T2	S1
Papaipema appassionata	The Pitcher Plant Borer Moth		SE	G4	S1
Papaipema limpida	The Ironweed Borer Moth		SR	G4	S1S2
Papaipema silphii	Silphium Borer Moth		ST	G3G4	S2
Poanes viator viator	Big Broad-winged Skipper		ST	G5T4	S2
Insect: Odonata (Dragonflies & Damselflies)					
Aeshna mutata	Spatterdock Darner		ST	G4	S1S2
Cordulegaster bilineata	Brown Spiketail		SE	G5	S1
Sympetrum semicinctum	Band-winged Meadowhawk		SR	G5	S2S3
Fish					
Coregonus artedi	Cisco		SSC	G5	S2
Amphibian					
Ambystoma laterale	Blue-spotted Salamander		SSC	G5	S2
Hemidactylium scutatum	Four-toed Salamander		SE	G5	S2
Necturus maculosus	Common mudpuppy		SSC	G5	S2
Rana pipiens	Northern Leopard Frog		SSC	G5	S2

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

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

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

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

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

Indiana County Endangered, Threatened and Rare Species List

County: Steuben

Species Name	Common Name	FED	STATE	GRANK	SRANK
Reptile					
Clemmys guttata	Spotted Turtle		SE	G5	S2
Clonophis kirtlandii	Kirtland's Snake		SE	G2	S2
Emydoidea blandingii	Blanding's Turtle		SE	G4	S2
Nerodia erythrogaster neglecta	Copperbelly Water Snake	PS:LT	SE	G5T3	S2
Sistrurus catenatus catenatus	Eastern Massasauga	C	SE	G3G4T3T4Q	S2
Bird					
Ammodramus henslowii	Henslow's Sparrow		SE	G4	S3B
Ardea alba	Great Egret		SSC	G5	S1B
Botaurus lentiginosus	American Bittern		SE	G4	S2B
Chlidonias niger	Black Tern		SE	G4	S1B
Cistothorus palustris	Marsh Wren		SE	G5	S3B
Cistothorus platensis	Sedge Wren		SE	G5	S3B
Dendroica cerulea	Cerulean Warbler		SE	G4	S3B
Gallinula chloropus	Common Moorhen	No Status	SE	G5	S3B
Grus canadensis	Sandhill Crane	No Status	SSC	G5	S2B,S1N
Ixobrychus exilis	Least Bittern		SE	G5	S3B
Pandion haliaetus	Osprey		SE	G5	S1B
Rallus elegans	King Rail		SE	G4	S1B
Rallus limicola	Virginia Rail		SE	G5	S3B
Mammal					
Condylura cristata	Star-nosed Mole		SSC	G5	S2?
Lynx rufus	Bobcat	No Status	SSC	G5	S1
Mustela nivalis	Least Weasel		SSC	G5	S2?
Taxidea taxus	American Badger		SSC	G5	S2
Vascular Plant					
Actaea rubra	Red Baneberry		SR	G5	S2
Andromeda glaucophylla	Bog Rosemary		SR	G5	S2
Arabis missouriensis var. deamii	Missouri Rockcress		SE	G5T3?Q	S1
Arethusa bulbosa	Swamp-pink		SX	G4	SX
Aster borealis	Rushlike Aster		SR	G5	S2
Aster sericeus	Western Silvery Aster		SR	G5	S2
Bidens beckii	Beck Water-marigold		ST	G4G5	S1
Carex alopecoidea	Foxtail Sedge		SE	G5	S1
Carex bebbii	Bebb's Sedge		ST	G5	S2
Carex brunnescens	Brownish Sedge		SE	G5	S1
Carex disperma	Softleaf Sedge		SE	G5	S1
Carex flava	Yellow Sedge		ST	G5	S2
Carex livida	Livid Sedge		SE	G5	S1
Carex pedunculata	Longstalk Sedge		SR	G5	S2

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Indiana County Endangered, Threatened and Rare Species List

County: Steuben

Species Name	Common Name	FED	STATE	GRANK	SRANK
Carex seorsa	Weak Stellate Sedge		SR	G4	S2
Chimaphila umbellata ssp. cisatlantica	Pipsissewa		ST	G5T5	S2
Circaea alpina	Small Enchanter's Nightshade		SX	G5	SX
Cirsium hillii	Hill's Thistle		SE	G3	S1
Clintonia borealis	Clinton Lily		SE	G5	S1
Coeloglossum viride var. virescens	Long-bract Green Orchis		ST	G5T5	S2
Conioselinum chinense	Hemlock Parsley		SE	G5	S1
Cornus canadensis	Bunchberry		SE	G5	S1
Cypripedium calceolus var. parviflorum	Small Yellow Lady's-slipper		SR	G5	S2
Cypripedium candidum	Small White Lady's-slipper		WL	G4	S2
Deschampsia cespitosa	Tufted Hairgrass		SR	G5	S2
Diervilla lonicera	Northern Bush-honeysuckle		SR	G5	S2
Drosera intermedia	Spoon-leaved Sundew		SR	G5	S2
Eleocharis equisetoides	Horse-tail Spikerush		SE	G4	S1
Eleocharis robbinsii	Robbins Spikerush		SR	G4G5	S2
Eriocaulon aquaticum	Pipewort		SE	G5	S1
Eriophorum angustifolium	Narrow-leaved Cotton-grass		SR	G5	S2
Eriophorum gracile	Slender Cotton-grass		ST	G5	S2
Eriophorum viridicarinatum	Green-keeled Cotton-grass		SR	G5	S2
Fuirena pumila	Dwarf Umbrella-sedge		ST	G4	S2
Geum rivale	Purple Avens		SE	G5	S1
Glyceria borealis	Small Floating Manna-grass		SE	G5	S1
Glyceria grandis	American Manna-grass		SX	G5	SH
Gnaphalium macounii	Winged Cudweed		SX	G5	SX
Hydrocotyle americana	American Water-pennywort		SE	G5	S1
Hypericum pyramidatum	Great St. John's-wort		ST	G4	S1
Juniperus communis	Ground Juniper		SR	G5	S2
Lathyrus ochroleucus	Pale Vetchling Peavine		SE	G4G5	S1
Lathyrus venosus	Smooth Veiny Pea		ST	G5	S2
Lemna valdiviana	Pale Duckweed		SE	G5	S1
Lonicera canadensis	American Fly-honeysuckle		SX	G5	SX
Luzula acuminata	Hairy Woodrush		SE	G5	S1
Lycopodium hickeyi	Hickey's Clubmoss		SR	G5	S2
Matteuccia struthiopteris	Ostrich Fern		SR	G5	S2
Milium effusum	Tall Millet-grass		SR	G5	S2
Myriophyllum verticillatum	Whorled Water-milfoil		SR	G5	S2
Oryzopsis racemosa	Black-fruit Mountain-ricegrass		SR	G5	S2
Panicum boreale	Northern Witchgrass		SR	G5	S2
Panicum leibergii	Leiberg's Witchgrass		ST	G5	S2
Panicum subvillosum	A Panic-grass		SE	GNRQ	S1

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Indiana County Endangered, Threatened and Rare Species List

County: Steuben

Species Name	Common Name	FED	STATE	GRANK	SRANK
Pinus strobus	Eastern White Pine		SR	G5	S2
Platanthera ciliaris	Yellow-fringe Orchis		SE	G5	S1
Platanthera hyperborea	Leafy Northern Green Orchis		ST	G5	S2
Platanthera leucophaea	Prairie White-fringed Orchid	LT	SE	G2G3	S1
Platanthera psycodes	Small Purple-fringe Orchis		SR	G5	S2
Poa alsodes	Grove Meadow Grass		SR	G4G5	S2
Poa paludigena	Bog Bluegrass		WL	G3	S3
Potamogeton epihydrus	Nuttall Pondweed		SE	G5	S1
Potamogeton friesii	Fries' Pondweed		ST	G4	S1
Potamogeton praelongus	White-stem Pondweed		ST	G5	S1
Potamogeton pusillus	Slender Pondweed		WL	G5	S2
Potamogeton richardsonii	Redheadgrass		SR	G5	S2
Potamogeton robbinsii	Flatleaf Pondweed		SR	G5	S2
Psilocarya scirpoides	Long-beaked Baldrush		ST	G4	S2
Pyrola asarifolia	Pink Wintergreen		SE	G5	S1
Pyrola rotundifolia var. americana	American Wintergreen		SR	G5	S2
Rhynchospora macrostachya	Tall Beaked-rush		SR	G4	S2
Salix serissima	Autumn Willow		ST	G4	S2
Scirpus subterminalis	Water Bulrush		SR	G4G5	S2
Sorbus decora	Northern Mountain-ash		SX	G4G5	SX
Spiranthes lucida	Shining Ladies'-tresses		SR	G5	S2
Spiranthes magnicamporum	Great Plains Ladies'-tresses		SE	G4	S1
Tofieldia glutinosa	False Asphodel		SR	G4G5	S2
Triglochin palustris	Marsh Arrow-grass		SR	G5	S2
Utricularia cornuta	Horned Bladderwort		ST	G5	S2
Utricularia minor	Lesser Bladderwort		ST	G5	S1
Utricularia purpurea	Purple Bladderwort		SR	G5	S2
Utricularia resupinata	Northeastern Bladderwort		SE	G4	S1
Vaccinium oxycoccos	Small Cranberry		ST	G5	S2
Viburnum cassinoides	Northern Wild-raisin		SE	G5T5	S1
Viburnum opulus var. americanum	Highbush-cranberry		SE	G5T5	S1
Zannichellia palustris	Horned Pondweed		SR	G5	S2
Zigadenus elegans var. glaucus	White Camas		SR	G5T4T5	S2
High Quality Natural Community					
Forest - floodplain wet	Wet Floodplain Forest		SG	G3?	S3
Forest - upland dry	Dry Upland Forest		SG	G4	S4
Forest - upland dry-mesic	Dry-mesic Upland Forest		SG	G4	S4
Forest - upland mesic	Mesic Upland Forest		SG	G3?	S3
Lake - lake	Lake		SG	GNR	S2
Wetland - beach marl	Marl Beach		SG	G3	S2

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Indiana County Endangered, Threatened and Rare Species List

County: Steuben

Species Name	Common Name	FED	STATE	GRANK	SRANK
Wetland - bog acid	Acid Bog		SG	G3	S2
Wetland - bog circumneutral	Circumneutral Bog		SG	G3	S3
Wetland - fen	Fen		SG	G3	S3
Wetland - fen forested	Forested Fen		SG	G3	S1
Wetland - flat muck	Muck Flat		SG	G2	S2
Wetland - marsh	Marsh		SG	GU	S4
Wetland - meadow sedge	Sedge Meadow		SG	G3?	S1
Wetland - swamp forest	Forested Swamp		SG	G2?	S2
Wetland - swamp shrub	Shrub Swamp		SG	GU	S2

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Indiana County Endangered, Threatened and Rare Species List

County: De Kalb

Species Name	Common Name	FED	STATE	GRANK	SRANK
Mollusk: Bivalvia (Mussels)					
Epioblasma obliquata perobliqua	White Cat's Paw Pearlymussel	LE	SE	G1T1	SX
Epioblasma torulosa rangiana	Northern Riffleshell	LE	SE	G2T2	SX
Lampsilis fasciola	Wavyrayed Lampmussel		SSC	G5	S3
Obovaria subrotunda	Round Hickorynut		SSC	G4	S1
Pleurobema clava	Clubshell	LE	SE	G2	S1
Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Quadrula cylindrica cylindrica	Rabbitsfoot	C	SE	G3G4T3	S1
Simpsonaias ambigua	Salamander Mussel		SSC	G3	S2
Toxolasma lividus	Purple Lilliput		SSC	G3	S2
Villosa fabalis	Rayed Bean	C	SSC	G2	S1
Insect: Lepidoptera (Butterflies & Moths)					
Catocala marmorata	Marbled Underwing Moth		SE	G3G4	S1
Fish					
Moxostoma valenciennesi	Greater Redhorse		SE	G4	S2
Amphibian					
Ambystoma laterale	Blue-spotted Salamander		SSC	G5	S2
Reptile					
Emydoidea blandingii	Blanding's Turtle		SE	G4	S2
Thamnophis butleri	Butler's Garter Snake		SE	G4	S1
Bird					
Buteo platypterus	Broad-winged Hawk	No Status	SSC	G5	S3B
Circus cyaneus	Northern Harrier		SE	G5	S2
Cistothorus platensis	Sedge Wren		SE	G5	S3B
Rallus limicola	Virginia Rail		SE	G5	S3B
Mammal					
Lynx rufus	Bobcat	No Status	SSC	G5	S1
Taxidea taxus	American Badger		SSC	G5	S2
Vascular Plant					
Andromeda glaucophylla	Bog Rosemary		SR	G5	S2
Botrychium simplex	Least Grape-fern		SE	G5	S1
Carex echinata	Little Prickly Sedge		SE	G5	S1
Coeloglossum viride var. virescens	Long-bract Green Orchis		ST	G5T5	S2
Eriophorum spissum	Dense Cotton-grass		SX	G5T5	SX
Glyceria grandis	American Manna-grass		SX	G5	SH
Lathyrus ochroleucus	Pale Vetchling Peavine		SE	G4G5	S1
Luzula acuminata	Hairy Woodrush		SE	G5	S1
Milium effusum	Tall Millet-grass		SR	G5	S2
Panax trifolius	Dwarf Ginseng		WL	G5	S2

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Indiana County Endangered, Threatened and Rare Species List

County: De Kalb

Species Name	Common Name	FED	STATE	GRANK	SRANK
Poa alsodes	Grove Meadow Grass		SR	G4G5	S2
Poa paludigena	Bog Bluegrass		WL	G3	S3
Potamogeton friesii	Fries' Pondweed		ST	G4	S1
Sida hermaphrodita	Virginia Mallow		SE	G3	S1
Utricularia cornuta	Horned Bladderwort		ST	G5	S2
High Quality Natural Community					
Forest - floodplain mesic	Mesic Floodplain Forest		SG	G3?	S1
Forest - upland dry-mesic	Dry-mesic Upland Forest		SG	G4	S4
Forest - upland mesic	Mesic Upland Forest		SG	G3?	S3
Wetland - swamp shrub	Shrub Swamp		SG	GU	S2

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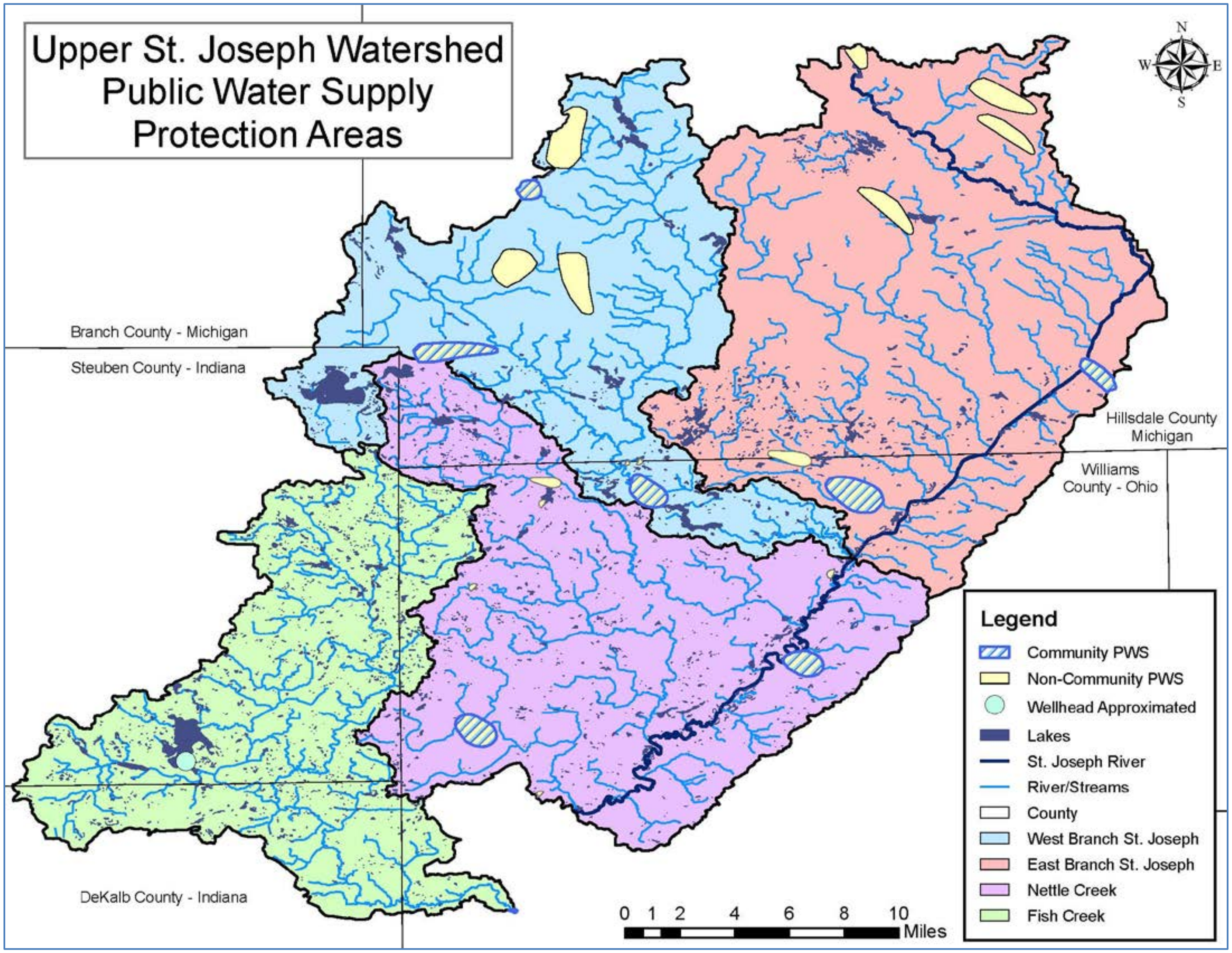
Appendix C



Upper St. Joseph Watershed
Public Water Supply
Protection Areas
N
W
E
S
Branch County - Michigan
Steuben County - Indiana
Hillsdale County
Michigan
Williams
County - Ohio
DeKalb County - Indiana
0 1 2 4 6 8 10
Miles
Legend
Community PWS
Non-Community PWS
Wellhead Approximated
Lakes
St. Joseph River
River/Streams
County
West Branch St. Joseph
East Branch St. Joseph
Nettle Creek
Fish Creek

Appendix D

October 2010
GUIDANCE FOR WATERSHED PROJECTS TO ADDRESS OHIO'S COASTAL NONPOINT POLLUTION CONTROL PROGRAM (CNPCP)

A brief history of the Coastal Nonpoint Pollution Control Program

In recognition of the intense pressures facing our nation's coastal regions, Congress enacted the Coastal Zone Management Act (CZMA) which was signed into law on October 27, 1972. To address more specifically the impacts of nonpoint source pollution on coastal water quality, Congress enacted section 6217 of the Coastal Zone Act in November 1990. Section 6217 requires that each state with an approved coastal zone management program develop and submit for approval a Coastal Nonpoint Pollution Control Program(CNPCP) to the US EPA and the National Oceanic and Atmospheric Administration (NOAA). The purpose of the program "shall be to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters, working in close conjunction with other State and local authorities."

To gain Federal approval, each state CNPCP must provide for the implementation, at a minimum, of management measures in conformance with those specified in the USEPA guidance published under subsection (g) of section 6217.

Status of Ohio's Coastal Nonpoint Pollution Control Program (CNPCP)
(November 24, 2003)

The Ohio CNPCP is administered by the ODNR Division of Soil and Water Conservation. Ohio received conditional approval of the CNPCP on June 04, 2002.

<u>Year One Conditions</u>
Ohio was provided one year to submit a legal opinion verifying that Ohio "has in place back-up authorities that can be used as enforceable policies and mechanisms in order to prevent nonpoint source based pollution and require management measure implementation." The legal opinion was developed by John Shailer, Assistant Attorney General-Environmental Enforcement Section/ODNR, and submitted by ODNR Office of Coastal Management to NOAA and USEPA June 04, 2003. The one-year conditions have been met.

<u>Year Two Conditions</u>
There are specific conditions that will need to be met for Ohio to receive final approval of its CNPCP. These conditions are organized by the major nonpoint source categories and subcategories. **These can be found on page 8 of the Appendix 8 update- outline of a watershed plan from "A guide to Developing Local Watershed Action Plans in Ohio"**.

<u>NPS Management Measures that need addressed by Lake Erie Basin Watersheds</u>
This area Includes the entire Lake Erie Watershed, which Includes portions of 35 counties and covers an area of 11,649 square miles. **The major sub-watersheds, or streams within the Lake Erie watershed Include the Maumee, Portage, Sandusky, Huron, Vermillion, Black, Rocky, Chagrin, Cuyahoga, Grand and Ashtabula.**

Watershed plans within the Ohio Lake Erie Basin must (others are strongly encouraged) describe how the following **Management Measures** of the Ohio Coastal Nonpoint Pollution Control Program will be implemented within the specific watershed, if watershed inventory or sources and causes of impairment indicate applicability:

Management Measures (Defined)
Management measures" are defined in section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) as economically achievable measures to control the addition of pollutants to our coastal waters, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives.

Management Practices (Defined) – Specific practices found on web links provided.
In addition to specifying management measures, this chapter also lists and describes management practices for illustrative purposes only. While State programs are required to specify management measures in conformity with this guidance, State programs need not specify or require the implementation of the particular management practices described in this document. However, as a practical matter, EPA anticipates that the management measures generally will be implemented by applying one or more management practices appropriate to the source, location, and climate. The practices listed in this document have been found by EPA to be representative of the types of practices that can be applied successfully to achieve the management measures. EPA has also used some of these practices, or appropriate combinations of these practices, as a basis for estimating the effectiveness, costs, and economic impacts of achieving the management measures. (Economic impacts of the management measures are addressed in a separate document entitled *Economic Impacts of EPA Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*.)

EPA recognizes that there is often site-specific, regional, and national variability in the selection of appropriate practices, as well as in the design constraints and pollution control effectiveness of practices. The list of practices for each management measure is not all-Inclusive and does not preclude States or local agencies from using other technically sound practices. In all cases, however, the practice or set of practices chosen by a State needs to achieve the management measure.

URBAN

New Development Management Measure- This management measure is intended to accomplish the following: (1) decrease the erosive potential of Increased runoff volumes and velocities associated with development-induced changes in hydrology; (2) remove suspended solids and associated pollutants entrained in runoff that result from activities occurring during and after development; (3) retain hydrological conditions to closely resemble those of the predisturbance condition; and (4) preserve natural systems Including in-stream habitat.[2] For the purposes of this management measure, "similar" is defined as "resembling though not completely identical."

During the development process, both the existing landscape and hydrology can be significantly altered. As development occurs, the following changes to the land may occur (USEPA, 1977):

- Soil porosity decreases;
- Impermeable surfaces Increase;
- Channels and conveyances are constructed;
- Slopes Increase;
- Vegetative cover decreases; and
- Surface roughness decreases.

These changes result in increased runoff volume and velocities, which may lead to Increased erosion of streambanks, steep slopes, and unvegetated areas (Novotny, 1991). In addition, destruction of in-stream and riparian habitat, Increases in water temperature (Schueler et al., 1992), streambed scouring, and downstream siltation of streambed substrate, riparian areas, estuarine habitat, and reef systems may occur. An example of predicted effects of Increased levels of urbanization on runoff volumes is presented in Table 4-4 (USDA-SCS, 1986). Methods are also available to compute peak runoff rates (USDA-SCS, 1986).

1. By design or performance:
    - After construction has been completed and the site is permanently stabilized, reduce the average annual total suspended solid (TSS) loadings by 80 percent. For the purposes of this measure, an 80 percent TSS reduction is to be determined on an average annual basis, or
    - Reduce the postdevelopment loadings of TSS so that the average annual TSS loadings are no greater than predevelopment loadings, and
2. To the extent practicable, maintain postdevelopment peak runoff rate and average volume at levels that are similar to predevelopment levels.

Sound watershed management requires that both structural and nonstructural measures be employed to mitigate the adverse impacts of storm water. Nonstructural Management Measures II.B and II.C can be effectively used in conjunction with Management Measure II.A to reduce both the short- and long-term costs of meeting the treatment goals of this management measure.

Applicability

This management measure is intended to be applied by States to control urban runoff and treat associated pollutants generated from new development, redevelopment, and new and relocated roads, highways, and bridges. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal nonpoint source (NPS) programs in conformity with this management measure and will have flexibility in doing so. The application of management measures by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

For design purposes, postdevelopment peak runoff rate and average volume should be based on the 2-year/24-hour storm. **Areas under Stormwater Phase II permit requirements are exempt.**

http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-2a.html

Watershed Protection Management Measure- The purpose of this management measure is to reduce the generation of nonpoint source pollutants and to mitigate the impacts of urban runoff and associated pollutants that result from new development or redevelopment, including the construction of new and relocated roads, highways, and bridges. The measure is intended to provide general goals for States and local governments to use in developing comprehensive programs for guiding future development and land use activities in a manner that will prevent and mitigate the effects of nonpoint source pollution.

A watershed is a geographic region where water drains into a particular receiving waterbody. As discussed in the introduction, comprehensive planning is an effective nonstructural tool available to control nonpoint source pollution. Where possible, growth should be directed toward areas where it can be sustained with a minimal impact on the natural environment (Meeks, 1990). Poorly planned growth and development have the potential to degrade and destroy entire natural drainage systems and surface waters (Mantel et al., 1990). Defined land use designations and zoning direct development away from areas where land disturbance activities or pollutant loadings from subsequent development would severely impact surface waters. Defined land use designations and zoning also protect environmentally sensitive areas such as riparian areas, wetlands, and vegetative buffers that serve as filters and trap sediments, nutrients, and chemical pollutants. Refer to Chapter 7 for a thorough description of the benefits of wetlands and vegetative buffers.

Areas such as streamside buffers and wetlands may also have the added benefit of providing long-term pollutant removal capabilities without the comparatively high costs usually associated with structural controls. Conservation or preservation of these areas is important to water quality protection. Land acquisition programs help to preserve areas critical to maintaining surface water quality. Buffer strips along streambanks provide protection for stream ecosystems and help to stabilize the stream and prevent streambank erosion (Holler, 1989). Buffer strips protect and maintain near-stream vegetation that attenuates the release of sediment into stream channels and prevent excessive loadings. Levels of suspended solids Increase at a slower rate in stream channel sections with well-developed riparian vegetation (Holler, 1989).

The availability of infrastructure specifically sewage treatment facilities, is also a factor in watershed planning. If centralized sewage treatment is not available, onsite disposal systems (OSDS) most likely will be used for sewage treatment. Because of potential ground-water and surface water contamination from OSDS, density restrictions may be needed in areas where OSDS will be used for sewage treatment. Section VI of this chapter contains a more detailed discussion of siting densities for OSDS.

Develop a watershed protection program to:

1. Avoid conversion, to the extent practicable, of areas that are particularly susceptible to erosion and sediment loss;
2. Preserve areas that provide important water quality benefits and/or are necessary to maintain riparian and aquatic biota; and
3. Site development, Including roads, highways, and bridges, to protect to the extent practicable the natural integrity of waterbodies and natural drainage systems.

1. Applicability

This management measure is intended to be applied by States to new development or redevelopment including construction of new and relocated roads, highways, and bridges that generate nonpoint source pollutants. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal nonpoint source programs in conformity with this management measure and will have flexibility in doing so. The application of management measures by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.
http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-2b.html

Site Development- The goal of this management measure is to reduce the generation of nonpoint source pollution and to mitigate the impacts of urban runoff and associated pollutants from all site development, including activities associated with roads, highways, and bridges. Management Measure II.C is intended to provide guidance for controlling nonpoint source pollution through the proper design and development of individual sites. This management measures differs from Management Measure II.A, which applies to postdevelopment runoff, in that Management Measure II.C is intended to provide controls and policies that are to be applied during the site planning and review process. These controls and policies are necessary to ensure that development occurs so that nonpoint source concerns are incorporated during the site selection and the project design and review phases. While the goals of the Watershed Protection Management Measure (II.B) are similar, Management Measure II.C is intended to apply to individual sites rather than watershed basins or regional drainage basins. The goals of both the Site Development and Watershed Protection Management Measures are, however, intended to be complementary and the measures should be used within a comprehensive framework to reduce nonpoint source pollution.

Plan, design, and develop sites to:

1. Protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss;
2. Limit Increases of impervious areas, except where necessary;
3. Limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss; and

Limit disturbance of natural drainage features and vegetation.

Applicability

This management measure is intended to be applied by States to all site development activities including those associated with roads, highways, and bridges. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have flexibility in doing so. The application of management measures by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-2c.html

Existing Development Management- The purpose of this management measure is to protect or improve surface water quality by the development and implementation of watershed management programs that pursue the following objectives:

1. Reduce surface water runoff pollution loadings from areas where development has already occurred;
2. Limit surface water runoff volumes in order to minimize sediment loadings resulting from the erosion of streambanks and other natural conveyance systems; and
3. Preserve, enhance, or establish buffers that provide water quality benefits along waterbodies and their tributaries.

Maintenance of water quality becomes increasingly difficult as areas of impervious surface Increase and urbanization occurs. For the purpose of this guidance, urbanized areas are those areas where the presence of "man-made" impervious surfaces results in Increased peak runoff volumes and pollutant loadings that permanently alter one or more of the following: stream channels, natural drainageways, and in-stream and adjacent riparian habitat so that predevelopment aquatic flora and fauna are eliminated or reduced to unsustainable levels and predevelopment water quality has been degraded. Increased bank cutting, streambed scouring, siltation damaging to aquatic flora and fauna, Increases in water temperature, decreases in dissolved oxygen, changes to the natural structure and flow of the stream or river, and the presence of anthropogenic pollutants that are not generated from agricultural activities, in general, are indications of urbanization.

The effects of urbanization have been well described in the introduction to this chapter. Protection of water quality in urbanized areas is difficult because of a range of factors. These factors include diverse pollutant loadings, large runoff volumes, limited areas suitable for surface water runoff treatment systems, high implementation costs associated with structural controls, and the destruction or absence of buffer zones that can filter pollutants and prevent the destabilization of streambanks and shorelines.

As discussed in Section II.B of this chapter, comprehensive watershed planning facilitates integration of source reduction activities and treatment strategies to mitigate the effects of urban runoff. Through the use of watershed management, States and local governments can identify local water quality objectives and focus resources on control of specific pollutants and sources. Watershed plans typically incorporate a combination of nonstructural and structural practices.

An important nonstructural component of many watershed management plans is the identification and preservation of buffers and natural systems. These areas help to maintain and improve surface water quality by filtering and infiltrating urban runoff. In areas of existing development, natural buffers and conveyance systems may have been altered as urbanization occurred. Where possible and appropriate, additional impacts to these areas should be minimized and if degraded, the functions of these areas restored. The preservation, enhancement, or establishment of buffers along waterbodies is generally recommended throughout the section 6217 management area as an important tool for reducing NPS impacts. The establishment and protection of buffers, however, is most appropriate along surface waterbodies and their tributaries where water quality and the biological integrity of the waterbody is dependent on the presence of an adequate buffer/riparian area. Buffers may be necessary where the buffer/riparian area (1) reduces significant NPS pollutant loadings, (2) provides habitat necessary to maintain the biological integrity of the receiving water, and (3) reduces undesirable thermal impacts to the waterbody. For a discussion of protection and restoration of wetlands and riparian areas, refer to Chapter 7.

Institutional controls, such as permits, inspection, and operation and maintenance requirements, are also essential components of a watershed management program. The effectiveness of many of the practices described in this chapter is dependent on administrative controls such as inspections. Without effective compliance mechanisms and operation and maintenance requirements, many of these practices will not perform satisfactorily.

Where existing development precludes the use of effective nonstructural controls, structural practices may be the only suitable option to decrease the NPS pollution loads generated from developed areas. In such situations, a watershed plan can be used to integrate the construction of new surface water runoff treatment structures and the retrofit of existing surface water runoff management systems.

Retrofitting is a process that involves the modification of existing surface water runoff control structures or surface water runoff conveyance systems, which were initially designed to control flooding, not to serve a water quality improvement function. By enlarging existing surface water runoff structures, changing the inflow and outflow characteristics of the device, and increasing detention times of the runoff, sediment and associated pollutants can be removed from the runoff. Retrofit of structural controls, however, is often the only feasible alternative for improving water quality in developed areas. Where the presence of existing development or financial constraints limits treatment options, targeting may be necessary to identify priority pollutants and select the most appropriate retrofits.

Once key pollutants have been identified, an achievable water quality target for the receiving water should be set to improve current levels based on an identified objective or to prevent degradation of current water quality. Extensive site evaluations should then be performed to assess the performance of existing surface water runoff management systems and to pinpoint low-cost structural changes or maintenance programs for improving pollutant-removal efficiency. Where flooding problems exist, water quality controls should be incorporated into the design of surface water runoff controls. Available land area is often limited in urban areas, and the lack of suitable areas will frequently restrict the use of conventional pond systems. In heavily urbanized areas, sand filters or water quality inlets with oil/grit separators may be appropriate for retrofits because they do not limit land usage.

Develop and implement watershed management programs to reduce runoff pollutant concentrations and volumes from existing development:

1. Identify priority local and/or regional watershed pollutant reduction opportunities, e.g., improvements to existing urban runoff control structures;
2. Contain a schedule for implementing appropriate controls;
3. Limit destruction of natural conveyance systems; and
4. Where appropriate, preserve, enhance, or establish buffers along surface waterbodies and their tributaries.

<u>Applicability</u>
This management measure is intended to be applied by States to all urban areas and existing development in order to reduce surface water runoff pollutant loadings from such areas. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have flexibility in doing so. The application of management measures by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA). **Areas under Stormwater Phase II permit requirements are exempt.**
http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-4.html

New On-Site Disposal Systems - The purpose of this management measure is to protect the 6217 management area from pollutants discharged by OSDS. The measure requires that OSDS be sited, designed, and installed so that impacts to waterbodies will be reduced, to the extent practicable. Factors such as soil type, soil depth, depth to water table, rate of sea level rise, and topography must be considered in siting and installing conventional OSDS.

1. Ensure that new Onsite Disposal Systems (OSDS) are located, designed, installed, operated, inspected, and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into ground waters that are closely hydrologically connected to surface waters. Where necessary to meet these objectives:

(a) discourage the installation of garbage disposals to reduce hydraulic and nutrient loadings; and (b) where low-volume plumbing fixtures have not been installed in new developments or redevelopments, reduce total hydraulic loadings to the OSDS by 25 percent. Implement OSDS inspection schedules for preconstruction, construction, and postconstruction.

2. Direct placement of OSDS away from unsuitable areas. Where OSDS placement in unsuitable areas is not practicable, ensure that the OSDS is designed or sited at a density so as not to adversely affect surface waters or ground water that is closely hydrologically connected to surface water. Unsuitable areas Include, but are not limited to, areas with poorly or excessively drained soils; areas with shallow water tables or areas with high seasonal water tables; areas overlaying fractured bedrock that drain directly to ground water; areas within floodplains; or areas where nutrient and/or pathogen concentrations in the effluent cannot be sufficiently treated or reduced before the effluent reaches sensitive waterbodies;
3. Establish protective setbacks from surface waters, wetlands, and floodplains for conventional as well as alternative OSDS. The lateral setbacks should be based on soil type, slope, hydrologic factors, and type of OSDS. Where uniform protective setbacks cannot be achieved, site development with OSDS so as not to adversely affect waterbodies and/or contribute to a public health nuisance;
4. Establish protective separation distances between OSDS system components and groundwater which is closely hydrologically connected to surface waters. The separation distances should be based on soil type, distance to ground water, hydrologic factors, and type of OSDS;
5. Where conditions indicate that nitrogen-limited surface waters may be adversely affected by excess nitrogen loadings from ground water, require the installation of OSDS that reduce total nitrogen loadings by 50 percent to ground water that is closely hydrologically connected to surface water.

Applicability

This management measure is intended to be applied by States to all new OSDS Including package plants and small-scale or regional treatment facilities not covered by NPDES regulations in order to manage the siting, design, installation, and operation and maintenance of all such OSDS. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have flexibility in doing so. The application of management measure by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-2c.html

Operating On-Site Disposal Systems-The purpose of this management measure is to minimize pollutant loadings from operating OSDS. This management measure requires that OSDS be modified, operated, repaired, and maintained to reduce nutrient and pathogen loadings in order to protect and enhance surface waters. In the past, it has been a common practice to site conventional OSDS in coastal areas that have inadequate separation distances to ground water, fractured bedrock, sandy soils, or other conditions that prevent or do not allow adequate treatment of OSDS-generated pollutants. Eutrophication in surface waters has also been attributed to the low nitrogen reductions provided by conventional OSDS designs.

1. Establish and implement policies and systems to ensure that existing OSDS are operated and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into ground waters that are closely hydrologically connected to surface waters. Where necessary to meet these objectives, encourage the reduced use of garbage disposals, encourage the use of low-volume plumbing fixtures, and reduce total phosphorus loadings to the OSDS by 15 percent (if the use of low-level phosphate detergents has not been required or widely adopted by OSDS users). Establish and implement policies that require an OSDS to be repaired, replaced, or modified where the OSDS fails, or threatens or impairs surface waters;
2. Inspect OSDS at a frequency adequate to ascertain whether OSDS are failing;
3. Consider replacing or upgrading OSDS to treat influent so that total nitrogen loadings in the effluent are reduced by 50 percent. This provision applies only:
    - where conditions indicate that nitrogen-limited surface waters may be adversely affected by significant ground water nitrogen loadings from OSDS, and
    - where nitrogen loadings from OSDS are delivered to ground water that is closely hydrologically connected to surface water.

Applicability

This management measure is intended to be applied by States to all operating OSDS. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have flexibility in doing so. The application of management measures by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. This management measure does not apply to existing conventional OSDS that meet all of the following criteria: (1) treat wastewater from a single family home; (2) are sited where OSDS density is less than or equal to one OSDS per 20 acres; and (3) the OSDS is sited at least 1,250 feet away from surface waters.
http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-5b.html

Planning, Siting and Developing Roads and Highways (Local Only)- The best time to address control of NPS pollution from roads and highways is during the initial planning and design phase. New roads and highways should be located with consideration of natural drainage patterns and planned to avoid encroachment on surface waters and wet areas. Where this is not possible, appropriate controls will be needed to minimize the impacts of NPS runoff on surface waters.

Plan, site, and develop roads and highways to:

1. Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss;
2. Limit land disturbance such as clearing and grading and cut and fill to reduce erosion and sediment loss; and
3. Limit disturbance of natural drainage features and vegetation.

Applicability

This measure is intended to be applied by States to site development and land disturbing activities for new, relocated, and reconstructed (widened) roads (Including residential streets) and highways in order to reduce the generation of nonpoint source pollutants and to mitigate the impacts of urban runoff and associated pollutants from such activities. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have some flexibility in doing so. The application of management measures by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-7a.html

Bridges (Local Only)- This measure requires that NPS runoff impacts on surface waters from bridge decks be assessed and that appropriate management and treatment be employed to protect critical habitats, wetlands, fisheries, shellfish beds, and domestic water supplies. The siting of bridges should be a coordinated effort among the States, the FHWA, the U.S. Coast Guard, and the Army Corps of Engineers. Locating bridges in coastal areas can cause significant erosion and sedimentation, resulting in the loss of wetlands and riparian areas. Additionally, since bridge pavements are extensions of the connecting highway, runoff waters from bridge decks also deliver loadings of heavy metals, hydrocarbons, toxic substances, and deicing chemicals to surface waters as a result of discharge through scupper drains with no overland buffering. Bridge maintenance can also contribute heavy loads of lead, rust particles, paint, abrasive, solvents, and cleaners into surface waters. Protection against possible pollutant overloads can be afforded by minimizing the use of scuppers on bridges traversing very sensitive waters and conveying deck drainage to land for treatment. Whenever practical, bridge structures should be located to avoid crossing over sensitive fisheries and shellfish-harvesting areas to prevent washing polluted runoff through scuppers into the waters below. Also, bridge design should account for potential scour and erosion, which may affect shellfish beds and bottom sediments.

Site, design, and maintain bridge structures so that sensitive and valuable aquatic ecosystems and areas providing important water quality benefits are protected from adverse effects.

Applicability (Local Only)

This management measure is intended to be applied by States to new, relocated, and rehabilitated bridge structures in order to control erosion, streambed scouring, and surface runoff from such activities. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have some flexibility in doing so. The application of management measures by States is described more fully in Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-7b.html

Operation and Maintenance of Roads, Highways and Bridges - incorporate pollution prevention procedures into the operation and maintenance of roads, highways, and bridges to reduce pollutant loadings to surface waters.

Substantial amounts of eroded material and other pollutants can be generated by operation and maintenance procedures for roads, highways, and bridges, and from sparsely vegetated areas, cracked pavements, potholes, and poorly operating urban runoff control structures. This measure is intended to ensure that pollutant loadings from roads, highways, and bridges are minimized by the development and implementation of a program and associated practices to ensure that sediment and toxic substance loadings from operation and maintenance activities do not impair coastal surface waters. The program to be developed, using the practices described in this management measure, should consist of and identify standard operating procedures for nutrient and pesticide management, road salt use minimization, and maintenance guidelines (e.g., capture and contain paint chips and other particulates from bridge maintenance operations, resurfacing, and pothole repairs).

Incorporate pollution prevention procedures into the operation and maintenance of roads, highways, and bridges to reduce pollutant loadings to surface waters.

Applicability

This management measure is intended to be applied by States to existing, restored, and rehabilitated roads, highways, and bridges. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measures and will have some flexibility in doing so. The application of measures by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. **Areas under Stormwater Phase II permit requirements are exempt.**
http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-7e.html

Runoff Systems for Roads, Highways, and Bridges- Develop and implement runoff management systems for existing roads, highways, and bridges to reduce runoff pollutant concentrations and volumes entering surface waters.

This measure requires that operation and maintenance systems Include the development of retrofit projects, where needed, to collect NPS pollutant loadings from existing, reconstructed, and rehabilitated roads, highways, and bridges. Poorly designed or maintained roads and bridges can generate significant erosion and pollution loads containing heavy metals, hydrocarbons, sediment, and debris that run off into and threaten the quality of surface waters and their tributaries. In areas where such adverse impacts to surface waters can be attributed to adjacent roads or bridges, retrofit management projects to protect these waters may be needed (e.g., installation of structural or nonstructural pollution controls). Retrofit projects can be located in existing rights-of-way, within interchange loops, or on adjacent land areas. Areas with severe erosion and pollution runoff problems may require relocation or reconstruction to mitigate these impacts.

Runoff management systems are a combination of nonstructural and structural practices selected to reduce nonpoint source loadings from roads, highways, and bridges. These systems are expected to include structural improvements to existing runoff control structures for water quality purposes; construction of new runoff control devices, where necessary to protect water quality; and scheduled operation and maintenance activities for these runoff control practices. Typical runoff controls for roads, highways, and bridges include vegetated filter strips, grassed swales, detention basins, constructed wetlands, and infiltration trenches.

1. Identify priority and watershed pollutant reduction opportunities (e.g., improvements to existing urban runoff control structures; and
2. Establish schedules for implementing appropriate controls.

Applicability

This management measure is intended to be applied by States to existing, resurfaced, restored, and rehabilitated roads, highways, and bridges that contribute to adverse effects in surface waters. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have some flexibility in doing so. The application of management measures by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. **Areas under Stormwater Phase II permit requirements are exempt.**
http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-7f.html

HYDROMODIFICATION

Channelization and Channel Modification (Physical and Chemical Characteristics of Suface Waters)- The purpose of this management measure is to ensure that the planning process for new hydromodification projects addresses changes to physical and chemical characteristics of surface waters that may occur as a result of the proposed work. Implementation of this management measure is intended to occur concurrently with the implementation of Management Measure B (Instream and Riparian Habitat Restoration) of this section. For existing projects, the purpose of this management measure is to ensure that the operation and maintenance program uses any opportunities available to improve the physical and chemical characteristics of the surface waters. Changes created by channelization and channel modification activities are problematic if they unexpectedly alter environmental parameters to levels outside normal or desired ranges. The physical and chemical characteristics of surface waters that may be influenced by channelization and channel modification Include sediment, turbidity, salinity, temperature, nutrients, dissolved oxygen, oxygen demand, and contaminants.

Implementation of this management measure in the planning process for new projects will require a two-pronged approach:

1. Evaluate, with numerical models for some situations, the types of NPS pollution related to instream changes and watershed development.
2. Address some types of NPS problems stemming from instream changes or watershed development with a combination of nonstructural and structural practices.

Applicability

This management measure is intended to be applied by States to public and private channelization and channel modification activities in order to prevent the degradation of physical and chemical characteristics of surface waters from such activities. This management measure applies to any proposed channelization or channel modification projects, including levees, to evaluate potential changes in surface water characteristics, as well as to existing modified channels that can be targeted for opportunities to improve the surface water characteristics necessary to support desired fish and wildlife. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with management measures and will have some flexibility in doing so. The application of this management measure by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. http://www.epa.gov/owow/nps/MMGI/Chapter6/ch6-2a.html#Description

Channelization and Channel Modification (Instream and Riparian Habitat Restoration)- The purpose of this management measure is to correct or prevent detrimental changes to instream and riparian habitat from the impacts of channelization and channel modification projects. Implementation of this management measure is intended to occur concurrently with the implementation of Management Measure A (Physical and Chemical Characteristics of Surface Waters) of this section.

Contact between floodwaters and overbank soil and vegetation can be increased by a combination of setback levees and use of compound-channel designs. Levees set back away from the streambank (setback levees) can be constructed to allow for overbank flooding, which provides surface water contact to important streamside areas (Including wetlands and riparian areas). Additionally, setback levees still function to protect adjacent property from flood damage. Compound-channel designs consist of an Incised, narrow channel to carry surface water during low (base)-flow periods, a staged overbank area into which the flow can expand during design flow events, and an extended overbank area, sometimes with meanders, for high-flow events. Planting of the extended overbank with suitable vegetation completes the design.

Preservation of ecosystem benefits can be achieved by site-specific design to obtain predefined optimum or existing ranges of physical environmental conditions. Mathematical models can be used to assist in site-specific design. Instream and riparian habitat alterations caused by secondary effects can be evaluated by the use of models and other decision aids in the design process of a channelization and channel modification activity. After using models to evaluate secondary effects, restoration programs can be established.

Applicability

This management measure pertains to surface waters where channelization and channel modification have altered or have the potential to alter instream and riparian habitat such that historically present fish or wildlife are adversely affected. This management measure is intended to apply to any proposed channelization or channel modification project to determine changes in instream and riparian habitat and to existing modified channels to evaluate possible improvements to instream and riparian habitat. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with management measures and will have some flexibility in doing so. The application of this management measure by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

Dams (Protection of Surface Water Quality and Instream and Riparian Habitat)- The purpose of this management measure is to protect the quality of surface waters and aquatic habitat in reservoirs and in the downstream portions of rivers and streams that are influenced by the quality of water contained in the releases (tail water) from reservoir impoundments. Impacts from the operation of dams to surface water quality and aquatic and riparian habitat should be assessed and the potential for improvement evaluated. Additionally, new upstream and downstream impacts to surface water quality and aquatic and riparian habitat caused by the implementation of practices should also be considered in the assessment. The overall program approach is to evaluate a set of practices that can be applied individually or in combination to protect and improve surface water quality and aquatic habitat in reservoirs, as well as in areas downstream of dams. Then, the program should implement the most cost-effective operations to protect surface water quality and aquatic and riparian habitat and to improve the water quality and aquatic and riparian habitat where economically feasible.

Applicability

This management measure is intended to be applied by States to dam operations that result in the loss of desirable surface water quality, and of desirable instream and riparian habitat. Dams are defined as constructed impoundments which are either:

- 25 feet or more in height *and* greater than 15 acre-feet in capacity, or
- 6 feet or more in height *and* greater than 50 acre-feet in capacity.

This measure does not apply to projects that fall under NPDES jurisdiction. This measure also does not apply to the extent that its implementation under State law is precluded under *California* v. *Federal Energy Regulatory Commission*, 110 S. Ct. 2024 (1990) (addressing the supersedence of State instream flow requirements by Federal flow requirements set forth in FERC licenses for hydroelectric power plants under the Federal Power Act). http://www.epa.gov/owow/nps/MMGI/Chapter6/ch6-3c.html

Eroding Streambanks and Shorelines-Several streambank and shoreline stabilization techniques will be effective in controlling coastal erosion wherever it is a source of nonpoint pollution. Techniques involving marsh creation and vegetative bank stabilization ("soil bioengineering") will usually be effective at sites with limited exposure to strong currents or wind-generated waves. In other cases, the use of engineering approaches, Including beach nourishment or coastal structures, may need to be considered. In addition to controlling those sources of sediment input to surface waters which are causing NPS pollution, these techniques can halt the destruction of wetlands and riparian areas located along the shorelines of surface waters. Once these features are protected, they can serve as a filter for surface water runoff from upland areas, or as a sink for nutrients, contaminants, or sediment already present as NPS pollution in surface waters

Applicability

This management measure is intended to be applied by States to eroding shorelines in coastal bays, and to eroding streambanks in coastal rivers and creeks. The measure does not imply that all shoreline and streambank erosion must be controlled. Some amount of natural erosion is necessary to provide the sediment for beaches in estuaries and coastal bays, for point bars and channel deposits in rivers, and for substrate in tidal flats and wetlands. The measure, however, applies to eroding shorelines and streambanks that constitute an NPS problem in surface waters. It is not intended to hamper the efforts of any States or localities to retreat rather than to harden the shoreline. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this measure and will have some flexibility in doing so. The application of management measures by States is described more fully in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. http://www.epa.gov/owow/nps/MMGI/Chapter6/ch6-4.html

ADDITIONAL INFORMATION ON OHIO'S COASTAL NONPOINT POLLUTION CONTROL PROGRAM:

http://www.dnr.state.oh.us/soilandwater/coastalnonpointprogram.htm
(above is a link to the ODNR, Division of SWC's coastal program) The following information came from that site:
In order to address the unique nonpoint pollution concerns within the Lake Erie basin and to focus public resources on the most achievable solutions, the Ohio Department of Natural Resources and the Ohio Environmental Protection Agency with funding from the National Oceanic and Atmospheric Administration (NOAA) developed the Ohio Coastal Nonpoint Pollution Control Program Plan. The plan was submitted to NOAA and the U.S. Environmental Protection Agency for comment in September 2000. We arrived at this important milestone thanks to the hard work of numerous individuals, organizations, and other Lake Erie stakeholders. With this achievement, we look confidently toward a successful future. A copy of the Executive Summary is available for viewing or downloading by clicking on the link below:

Executive Summary (in Acrobat Reader 4.0* format) <docs/CNPCPexecsumm.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/CNPCPexecsumm.pdf

Executive Summary (Microsoft Word format or text only) <docs/ExecutiveSummaryText.doc>

http://www.dnr.state.oh.us/soilandwater/docs/ExecutiveSummaryText.doc

You can also view or download the complete program plan in Acrobat Reader 4.0* format by clicking on the link below:

Coastal Nonpoint Pollution Control Program Plan (36.4 mb) <docs/FinalCNPCP.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/FinalCNPCP.pdf

Or, download or view a specific chapter by clicking on the corresponding link below:

Chapter 1 (Introduction and Program Summary) <docs/Chapter%2001.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2001.pdf

Chapter 2 (General Program Overview) <docs/Chapter%2002.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2002.pdf

Chapter 3 (Management Measures for Agricultural Sources) <docs/Chapter%2003.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2003.pdf

Chapter 4 (Management for Forestry: Request for Exclusion for Forestry) <docs/Chapter%2004.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2004.pdf

Chapter 5 (Management Measures for Urban Areas) <docs/Chapter%2005.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2005.pdf

Chapter 6 (Management Measures for Marinas and Recreational Boating) <docs/Chapter%2006.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2006.pdf

Chapter 7 (Management Measures for Hydromodification) <docs/Chapter%2007.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2007.pdf

Chapter 8 (Management Measures for Wetlands and Riparian Areas) <docs/Chapter%2008.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2008.pdf

Chapter 9 (Additional Management Measures for Critical Coastal Areas and Impaired or Threatened Areas) <docs/Chapter%2009.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2009.pdf

Chapter 10 (Developing Sustainable Watershed Protection Programs) <docs/Chapter%2010.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2010.pdf

Chapter 11 (Water Quality Monitoring and Tracking Techniques) <docs/Chapter%2011.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2011.pdf

Chapter 12 (Conclusions) <docs/Chapter%2012.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2012.pdf

Chapter 13 (References and Bibliography) <docs/Chapter%2013.pdf>

http://www.dnr.state.oh.us/soilandwater/docs/Chapter%2013.pdf

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(419) 609-4102 phone
(419) 609-4158 fax

Endorsements and Distribution List

We, the undersigned, agree to support the implementation of the Upper St. Joseph River Watershed Management Plan by partnering with the St. Joseph River Watershed Initiative, offering technical assistance, or pursuing funding of our own to implement the WMP.

Organization	Signature	Title
DeKalb County Soil and Water Conservation District		
Branch County Soil and Water Conservation District		
Steuben County Soil and Water Conservation District		
Williams County Soil and Water Conservation District		
Hillsdale County Conservation District		
Steuben County Natural Resource Conservation Service		
DeKalb County Natural Resource Conservation Service		
Williams County Natural Resource Conservation Service		
Hillsdale County Natural Resource Conservation Service		
Steuben County Surveyors Office		
DeKalb County Surveyor Office		
Williams County Engineers Office		
Hillsdale County Drainage Board		
Purdue University Extension		
Ohio State University Extension		
Michigan State University Extension		
The Nature Conservancy		
The Maumee River Basin Commission		
Western Lake Erie Basin Commission		
Tri-State Watershed Alliance		

Organization	Signature	Title
Village of Montpelier, Ohio		
Village of Pioneer, Ohio		
Village of Edon, Ohio		
Village of Holiday City, Ohio		
Town of Clear Lake, Indiana		
Town of Hamilton, Indiana		
Village of Edon, Ohio		
Village of Holiday City, Ohio		
Village of Montgomery, Michigan		
Village of Camden, Michigan		
Clear Lake Association		
Clear Lake Conservancy		
Steuben County Lakes Council		
Lake Seneca Association		
Hamilton Lake Association		
Steuben County Health Department		
DeKalb County Health Department		
Williams County Health Department		
Hillsdale County Health Department		
Steuben County Parks Department		
DeKalb County Parks Department		
Williams County Parks Department		
Hillsdale County Parks		

Organization	Signature	Title
Department		
Andersons		
Michigan Department of Natural Resources		
Indiana Department of Natural Resources		
Ohio Department of Natural Resources		
Michigan Department of Agriculture		
Indiana Department of Agriculture		
Ohio Department of Agriculture		
Michigan Natural Shoreline Partnership		
Ohio Conservation Action Project		
Indiana Department of Environmental Management – Office of Water		
Ohio EPA – Division of Surface Water		
Michigan Department of Environmental Quality - Division of Water		