Little Portage Creek Watershed Management Plan

#2012-0017

Prepared for: Michigan Department of Environmental Quality

Prepared By:

Calhoun Conservation District
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STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
KALAMAZOO DISTRICT OFFICE

RICK SNYDER
GOVERNOR

C. HEIDI GRETHER
DIRECTOR

November 2, 2016

VIA E-MAL

Ms. Tracy Bronson
Calhoun County Conservation District
13464 Preston Drive
Marshall, Michigan 49068

Dear Ms. Bronson:

SUBJECT: Watershed Management Plans Approval for
Little Portage Creek Watershed Management Plan and
Portage River Watershed Management Plan

Thank you for submitting your watershed management plans titled "Little Portage Creek Watershed Management Plan" and "Portage River Watershed Management Plan" to the Department of Environmental Quality (DEQ) for review with respect to meeting criteria for: (1) the state Clean Michigan Initiative (CMI) Nonpoint Source Pollution Control program, and (2) the U.S. Environmental Protection Agency (EPA) Section 319, Nonpoint Source Management Program, of the federal Clean Water Act (CWA). The efforts and support of the Calhoun County Conservation District and your partners to preserve and protect Michigan's surface water resources are appreciated.

As you may know, the CMI program criteria are specified in Administrative Rules promulgated pursuant to Part 88, Water Pollution Prevention and Monitoring, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, effective October 27, 1999. The EPA requires that all implementation projects funded under Section 319,of the CWA, be supplemented by a watershed management plan that meets nine required elements as described in the EPA's document titled, "*Nonpoint Source Program and Grants Guidelines for States and Territories (April 12, 2013).*" Our review of the watershed management plans that we received on August 18, 2016, indicates that the plans meet both the CMI criteria and the EPA criteria, and are hereby approved for the purposes of the CMI Nonpoint Source Pollution Control program and the federal Section 319 program.

Please note that the DEQ watershed management plan approvals are only good for the effective life of the plan. In this case, the watershed plans describe actions that are proposed to be implemented over a 10-15 year period, after which an updated plan will likely need to be submitted to the DEQ for review and approval to maintain eligibility for both CMI and 319 funds. In addition, the plan approval is effective as long as the underlying assumptions within the plan remain relevant. Underlying assumptions would include, but are not limited to, things like designated use impairment, land use distribution, and stakeholder's goals and objectives. Updates of approved watershed management plans are expected to be endorsed by the entity that developed and received approval of the plan. For information regarding funds that may be available on the DEQ's Nonpoint Source Grant Program, please monitor our web site at www.michigan.gov/deqnonpointsourcepollution.

Feel free to contact me or Kalamazoo Water Resources District Office, Program Staff, Mr. Kyle Alexander, 269-568-2681, alexanderk7@michigan.gov, Department of Environmental Quality, Water Resources Division, 7953 Adobe Road, Kalamazoo, Michigan 49009-50-25, if you have questions about the plan approval.

Sincerely,

Jerrod Sanders, Supervisor
Water Resources Division
Kalamazoo District Office
269-350-1801
sandersj13@michigan.gov

JS:KA:dmm

cc: Mr. Bob Sweet, DEQ
Ms. Julia Kirkwood DEQ
Mr. Kyle Alexander, DEQ
Mr. Peter Vincent, DEQ

Brett Riser, Aquatic Biologist and Watershed Coordinator (CCD)
GIS contributions and field work from Mike Rubley (CCD)
Technical and field contributions from Rick Pierson (CCD)
Plan management & writing by Tracy Bronson (CCD)

We would like to thank the following individuals and organizations. Without their input, this plan would not be possible.

Editing and project direction by Chris Bauer (MDEQ), Alyssa Riley (MDEQ), Kyle Alexander (MDEQ), Julia Kirkwood (MDEQ), Joe Rathbun (MDEQ), Rob Zbiack (MDEQ), and Bob Sweet (MDEQ)

Landscape Level Wetland Functional Analysis by Jeremy Jones (MDEQ)

Technical assistance from Melanie Stoughton (KCD), Jean Gagliardo (Kalamazoo NRCS), and Linda Zabik (KCD)
Planning and zoning contributions from Wendy Ogilvie (FTCH)
MDNR Southern Lake Michigan Management Unit
Matt Meersman of Van Buren Conservation District (VBCD)
Friends of the St. Joe River Association (FotSJR)
John Wilkes Indian Lake Association President
Park Township
Charleston Township
Brady Township
Steering Committee Participants

We would also like to recognize the St. Joseph River Watershed Management Plan 2005, the Portage River Watershed Management Plan 2006, the Paw Paw River Watershed Management Plan 2008, and the St. Joseph River Assessment 1999 for providing a template and building blocks for this plan. This plan was developed in concert with the Portage River Watershed Management Plan. As a result, it will have similar and some of the same information, because the planning process was incorporated within the same project.

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1. Project Overview and Introduction

A watershed is defined as all of the land area that drains into a common low point, such as a lake or river. Rainwater and snowmelt run over the land and carry pollutants into those lakes and rivers. This form of pollution is nonpoint source pollution, since it originates from a variety of sources. Watershed management takes a holistic approach to natural resource protection, focusing on all the activities within the watershed boundaries that can impact water quality. This requires working across township, county, and sometimes state and international boundaries. The watershed management planning process also relies heavily on input form stakeholders within the watershed.

The 1987 amendments to the Clean Water Act (CWA) established the Section 319 Nonpoint Source Management Program. Section 319 addresses the need for greater federal leadership to help focus state and local nonpoint source efforts. Under Section 319, states, territories and tribes receive grant money that supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific nonpoint source implementation projects (http://water.epa.gov/polwaste/nps/cwact.cfm). Michigan's Nonpoint Source Program assists local units of government, non-profit entities, and numerous other state, federal, and local partners to reduce nonpoint source pollution statewide. The basis of their program is watershed management and our program works with stakeholders to develop and implement plans to protect the watersheds of the state (http://www.michigan.gov/deq/0,4561,7-135-3313_3682_3714---,00.html). The state awarded the Calhoun Conservation District with a 319 grant for Portage River/Little Portage Creek.

2. Watershed Description

2.1 Geographic Scope

Little Portage Creek Watershed (LPCW) (HUC 0405000109) encompasses an area of 59,975 acres (93.71 mi^2) in southeast Kalamazoo County, northeast St. Joseph County, and southwest Calhoun County. The watershed covers portions of Charleston, Leroy, Climax, Wakeshma, Brady, Mendon, Leonidas, Nottawa, Lockport, Fabius, Constantine, and Florence Townships. Major areas of human concentration within the watershed are the Village of Climax, Village of Fulton, Village of Mendon, and portions of the City of Three Rivers.

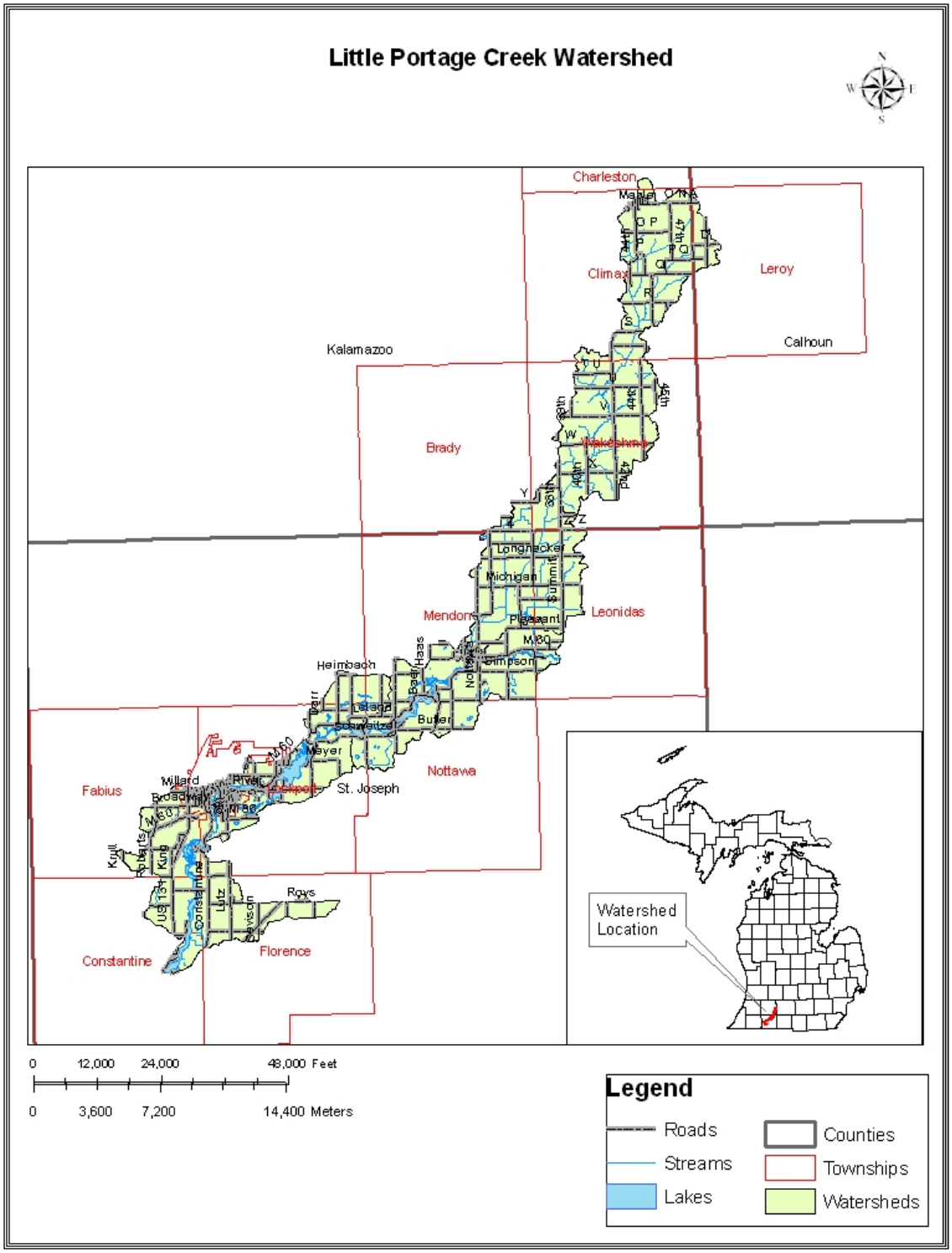

Figure 1. Map of Little Portage Creek Watershed

2.2 Ecoregion and Climate

The Little Portage Creek Watershed lies within the Southern Michigan/Northern Indiana Till Plains ecoregion. Rivers in the Southern Michigan/Northern Indiana Till Plains ecoregion are generally of good water quality in the headwaters. This ecoregion is drained predominantly by perennial rivers. Such rivers are typically sluggish and are bordered, often extensively, by wetland tracts. Drainage ditches and channelized rivers have been a common solution to assist drainage of areas that are too wet for settlement and agricultural needs (Goodwin et al., 2012).

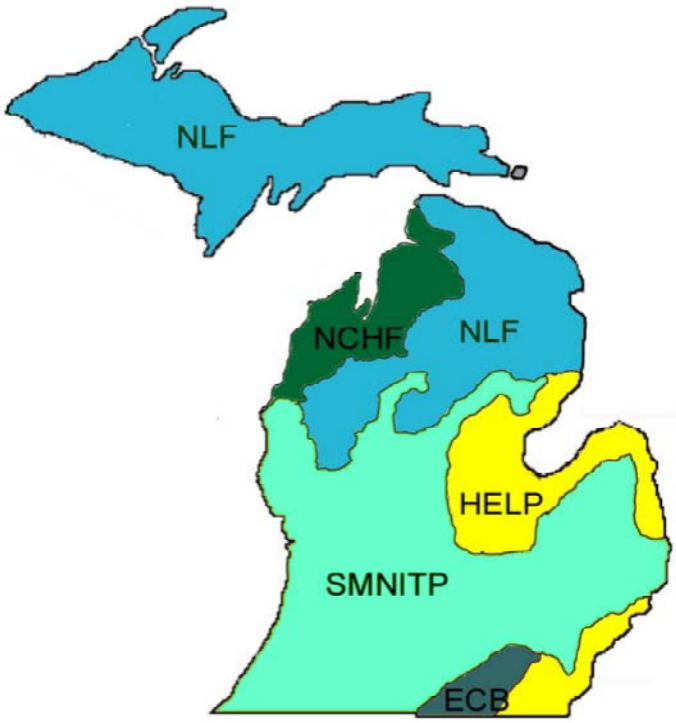

Figure 2. Ecoregions

Taken from MDEQ-IR 2012. Ecoregions of Michigan (Level III) (adapted from Omernik and Gallant, 1988).

SMNITP - Southern Michigan/Northern Indiana Till Plains **NCHF** - North Central Hardwood Forests
NLF - Northern Lakes and Forests **HELP** - Huron-Erie Lake Plains
ECB - Eastern Corn Belt Plains

The average winter temperature in this area is approximately 26.6° F. Average summer temperature is approximately 70.8° F. Total annual precipitation is approximately 34.2 inches. Average annual snowfall varies between Kalamazoo and St. Joseph Counties: Kalamazoo County averages 71.4 inches of snowfall per year, and St. Joseph County averages 45.6 inches. The prevailing wind direction for this area is southwesterly (Austin 1979, Cowan 1983).

2.3 Soils

An evaluation of soil texture classes show that 2,230 acres of water, 2,570 acres of muck, 21,915 acres of loam, 24,283 acres of sandy loam, 8,793 acre of loamy sand, and 185 acres of gravel exist in the watershed.

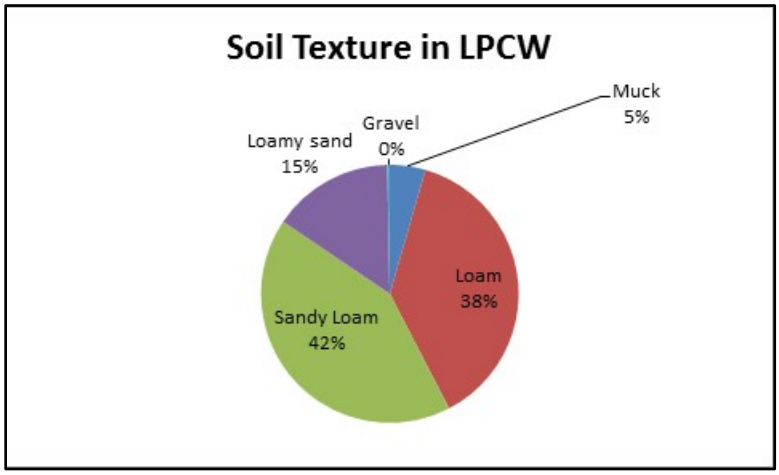

Figure 3. Soil Texture in LPCW

(Water/variable was omitted from this figure)

A depiction of locations of soil texture are as follows.

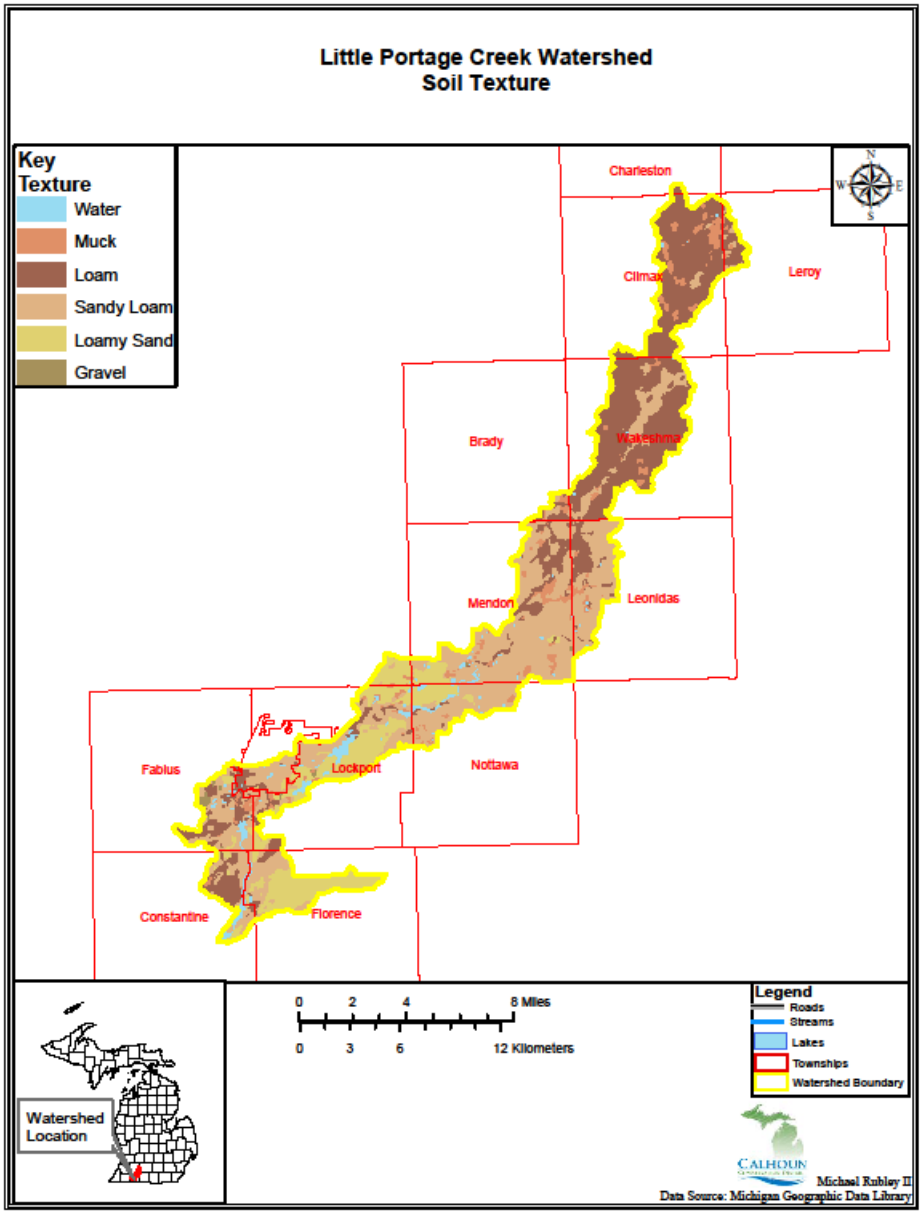

Figure 4. LPCW Soil Texture Locations

The watershed shows six primary soil formations: Coloma-Spinks-Oshtemo at 19,475 acres, Elston-Warsaw-Shipshe at 3,332 acres, Oshtemo-Kalamazoo-Houghton at 3,443 acres, Riddles-Hillsdale-Giffords at 22,406 acres, Schoolcraft-Kalamazoo-Elston at 4,038 acres, and Sebewa-Cohoctah-Brady at 7,281acres.

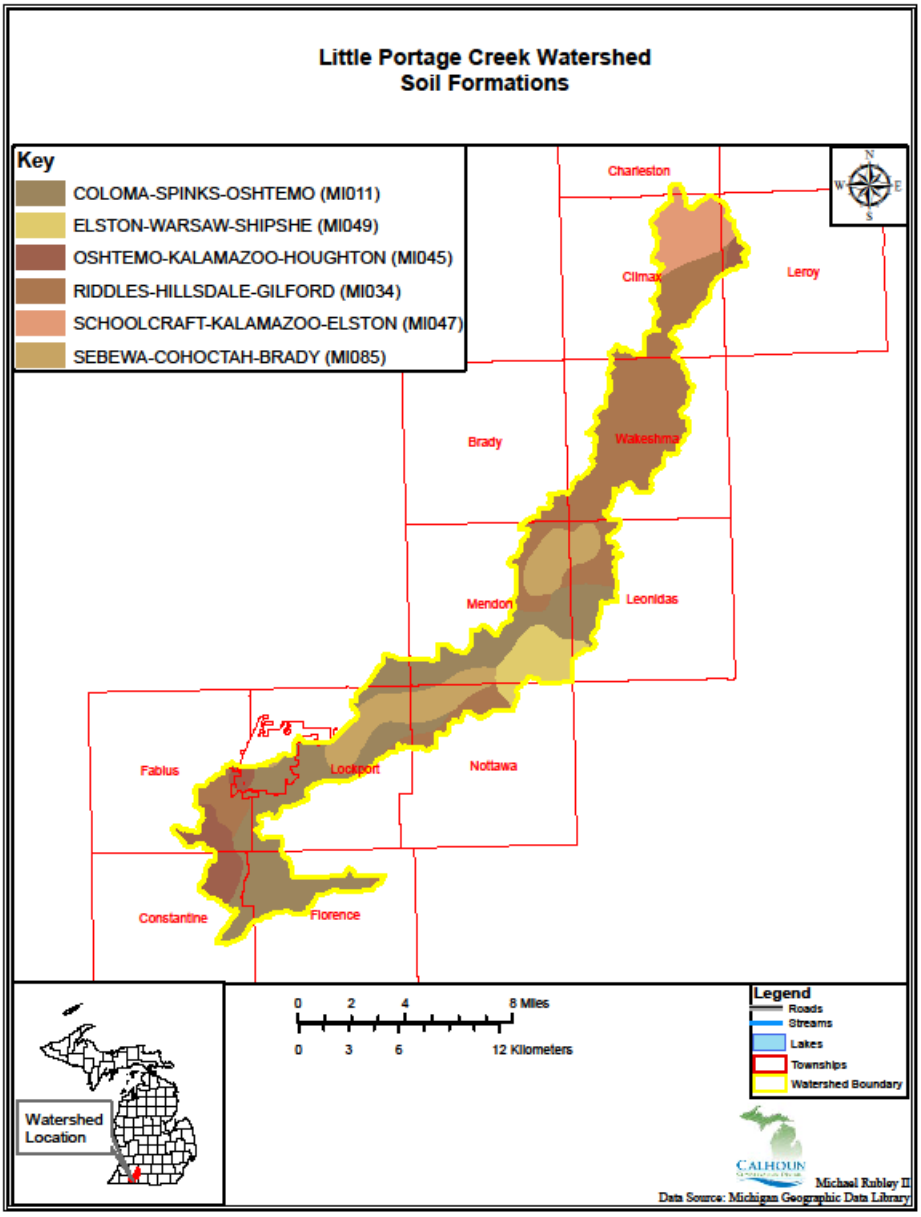

Figure 5. LPCW Soil Formations

There are four hydrologic soil groups (HSGs) that, along with land use, management practices, and hydrologic conditions, determine a soil's associated runoff curve, or runoff from rainfall:

- Group A—Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. This group is primarily sand with small amounts of clay.
- Group B—Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. This group tends to be about 20% clay and 80% sand.
- Group C—Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. These soils tend to be 30% clay and 70 % sand with loam mixed in.
- Group D—Soils in this group have high runoff potential.

A hydrologic rating showed that 3,589 acres of unknown/water, 8,793 acres of type A soils, 3,237 acres of type A/D soils, 34,891 acres of type B soils, 4,584 acres of type B/D soils, 4,421 acres of type C soils, and 460 acres of type D soils exist in the watershed.

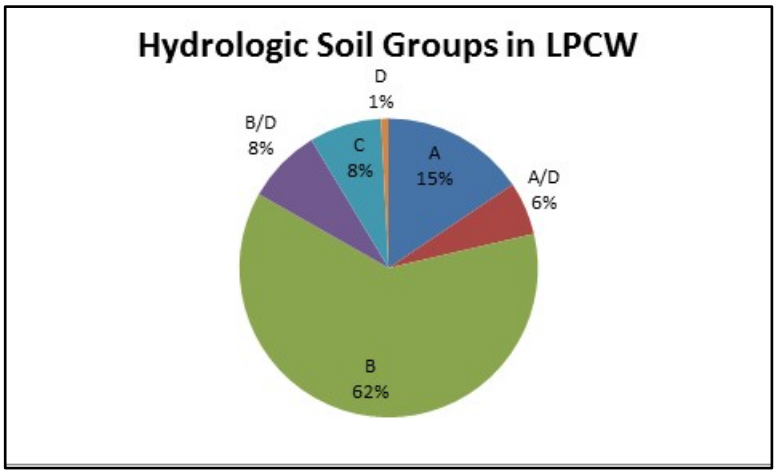

Figure 6. Hydrologic Soil Groups in LPCW

A depiction of where these soils are concentrated is shown the following figure.

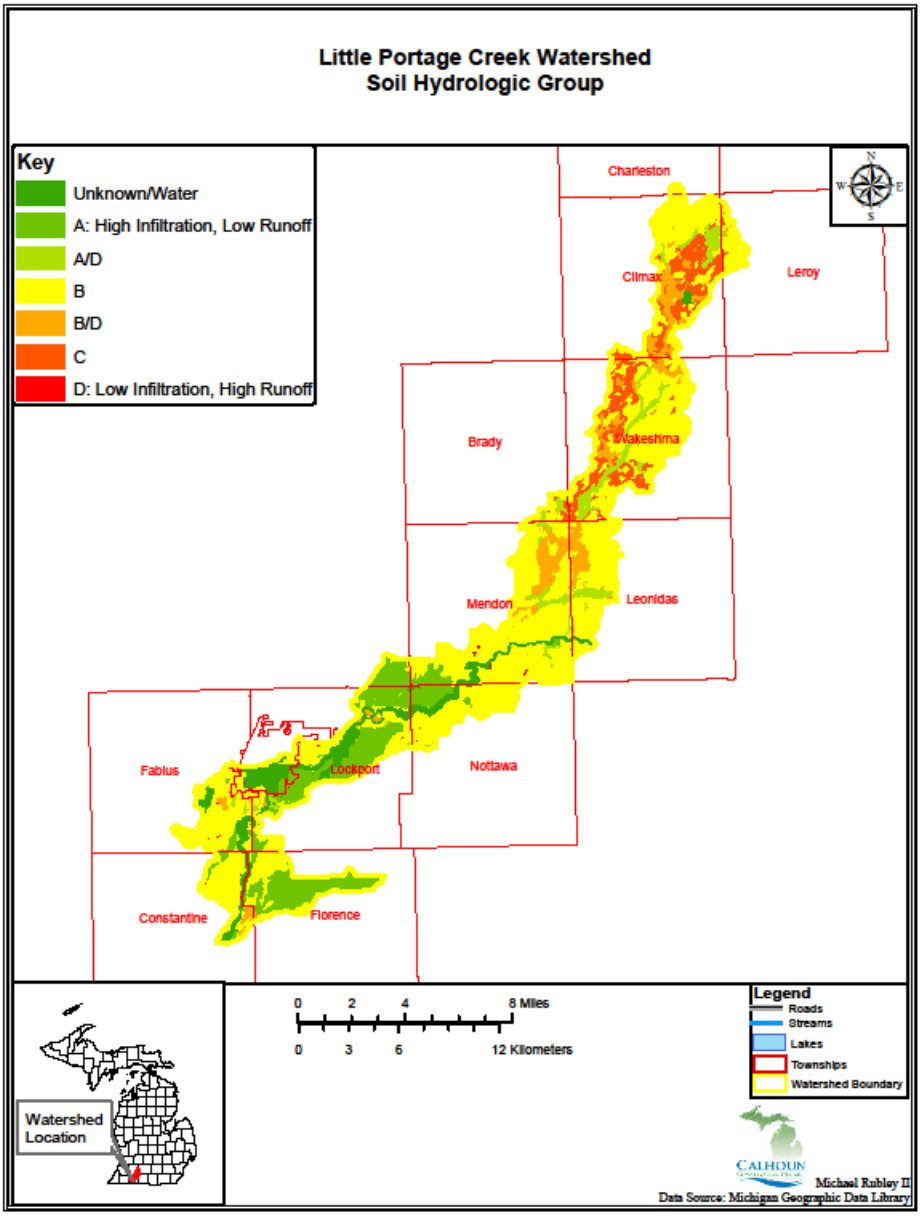

Figure 7. LPCW Soil Hydrologic Group Locations

The United States Department of Agriculture (USDA) defines prime farmland as having the soil quality, growing season, and moisture supply needed for the agricultural productivity to sustainably produce high yields of crops when treated and managed according to acceptable farming methods (https://en.wikipedia.org/wiki/Prime_farmland). Farmland Classification in the watershed was determined to be 6,556 acres of not prime farmland, 9,564 acres of prime farmland if drained, 13,171 acres of local importance, and 30,683 acre of prime farmland.

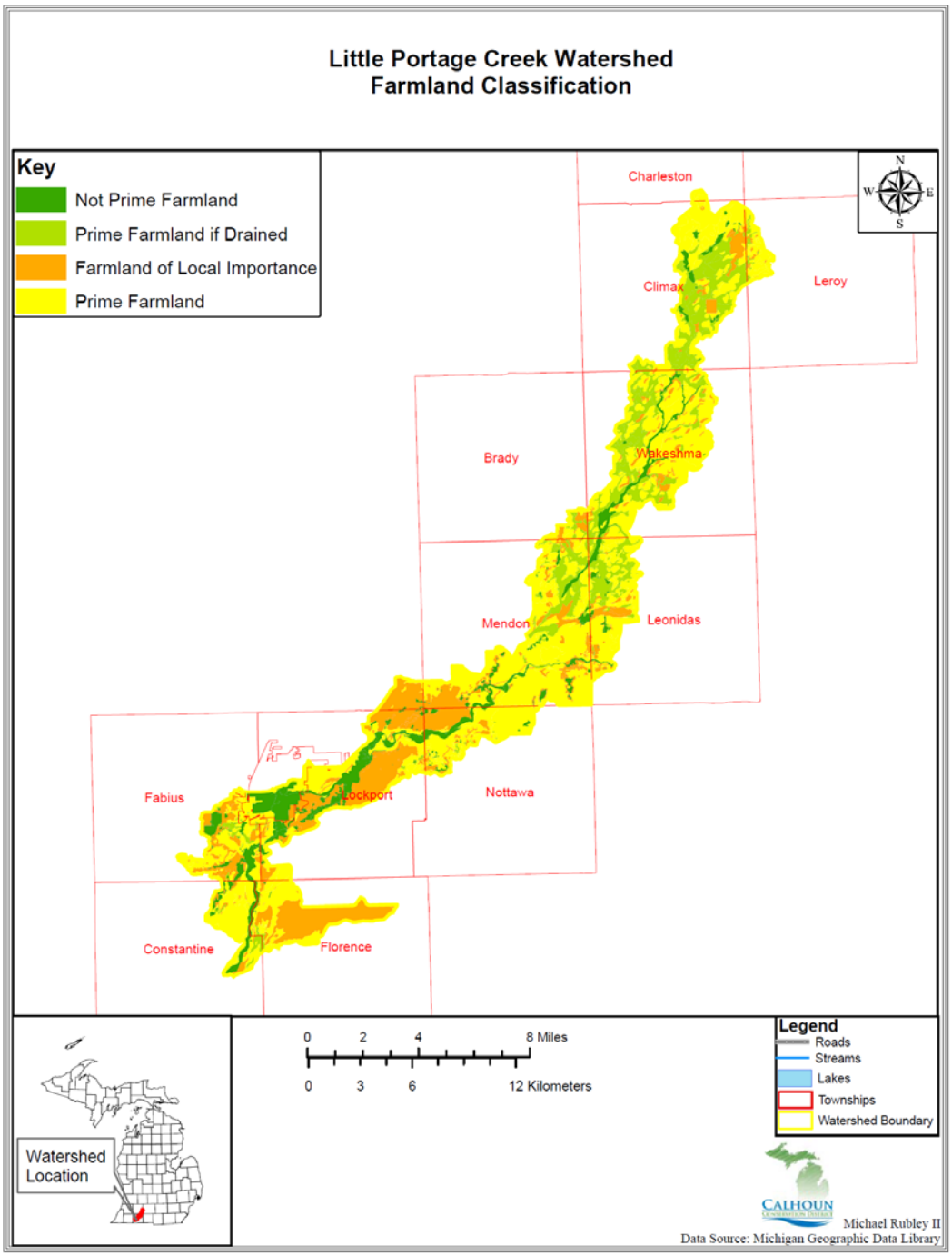

Figure 8. Farmland Classification in LPCW

Highly erodible land (HEL) refers to land that is very susceptible to erosion, including fields that have at least one third or 50 acres of soils with a natural erosion potential at least eight times their T value (T value is the maximum average soil loss in tons per year that will still allow economical maintenance of the current level of production into the future). An evaluation of the USDA - Farm Services Agency (USDA-FSA), designated HEL soils layer showed that 3,634 acres of highly erodible land exist in the watershed. Highly erodible land comprises 6 percent of the total land area of the watershed.

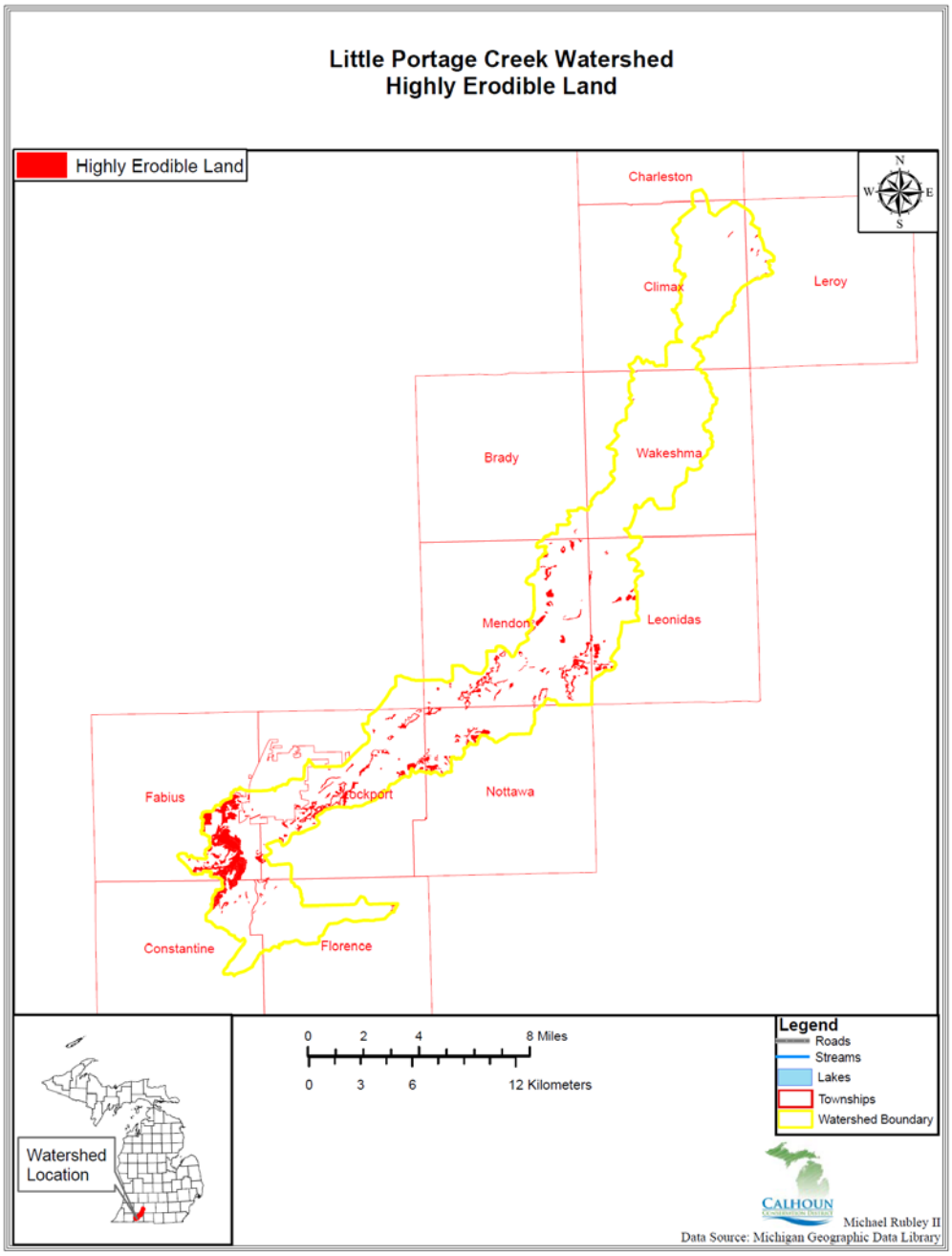

Figure 9. LPCW Highly Erodible Land

USDA-Natural Resources Conservation Service (NRCS) uses the Nitrogen Leaching Risk Assessment to assess a field's potential for nitrates to leach out of the plant root zone and into tile flow or groundwater. Nitrogen leaching potential is determined by combining the soil's hydrologic soil grouping, the local county's annual rainfall, and the local county's seasonal rainfall. The Nitrate Leaching Risk Index for LPCW shows that 3,474 acres are not rated/water, 44,472 acre of medium risk, 3,237 acres of medium/high risk, and 8,793 acres of high risk for nitrate leaching exist in the watershed. The following chart is an evaluation of the soil types, acreage and percentage of area in the watershed.

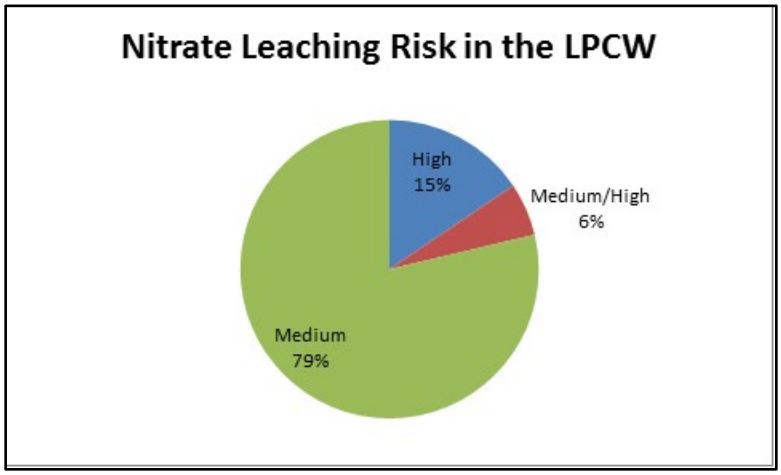

Figure 10. Nitrate Leaching Risk in the LPCW

The following figure depicts the locations of nitrate leaching risk within the LPCW.

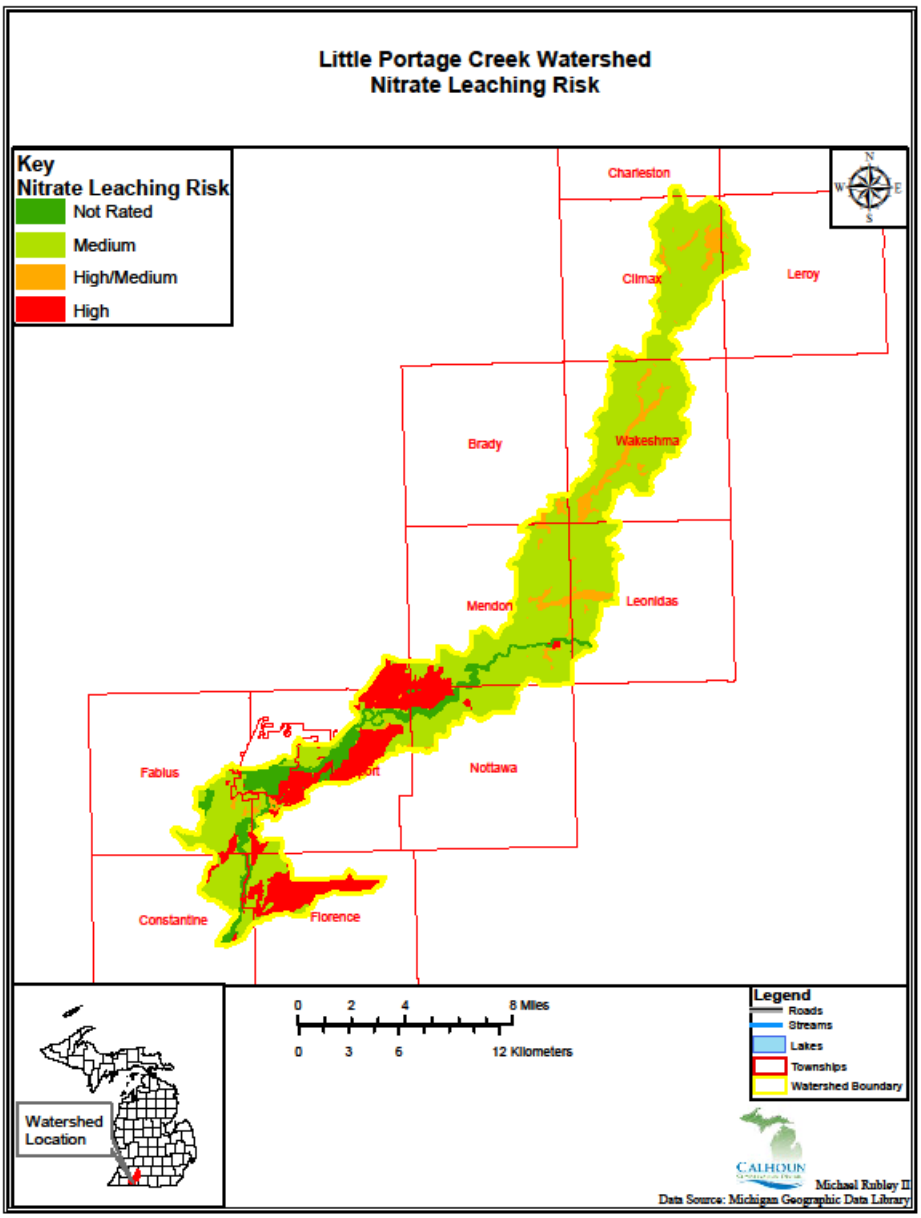

Figure 11. Nitrate Leaching Risk Locations in LPCW

Table 1. Soil Associations

Name	Acres	Percent of Watershed		Name	Acres	Percent of Watershed
Adrian Muck	1,161	1.94%		Houghton Muck	800	1.33%
Aquents and Histosols ponded	5	0.01%		Kalamazoo Loam	5,130	8.55%
Barry Loam	236	0.39%		Matherton Loam	106	0.18%
Boyer Sandy Loam	9	0.02%		Nottawa Sandy Loam	991	1.65%
Brady Sandy Loam	1,031	1.72%		Oshtemo Sandy Loam	10,346	17.25%
Bronson Sandy Loam	1,083	1.81%		Palms Muck	149	0.25%
Cohoctah Loam	592	0.99%		Pits/Gravel	185	0.31%
Dumps	126	0.21%		Riddles Loam	6,920	11.54%
Elmdale Sandy Loam	1,459	2.43%		Riddles Sandy Loam	437	0.73%
Elston Sandy Loam	2,450	4.09%		Schoolcraft Loam	637	1.06%
Gilford Fine Sandy Loam	29	0.05%		Sebewa Loam	3,726	6.21%
Gilford Sandy Loam	116	0.19%		Sleeth Loam	4,421	7.37%
Glendora Sandy Loam	695	1.16%		Spinks Loamy Sand	8,793	14.66%
Granby Sandy Loam	433	0.72%		Teasdale Sandy Loam	1,046	1.74%
Hillsdale Sandy Loam	3,247	5.41%		Udorthents Loam	21	0.04%
Histosols and Aquents, ponded	398	0.66%		Urban Land Oshtemo Complex	912	1.52%
Houghton and Sebewa, ponded	57	0.10%		Water	2,230	3.72%

The above table illustrates the soil types, acres, and their percentages in the LPCW.

2.3 Land Uses

A preliminary investigation of the land use land type with analysis determined the primary land use in the watershed is 70.60 percent agriculture, with forested land being the second largest land use at 14.12 percent. A breakdown of land use land cover acreage shows 42,364 acres of agriculture, 8,473 acres of forested land, 1,655 acres of wetland, 2,895 acres of open field, 2,700 acres of urban land, and 1,887 acres of water.

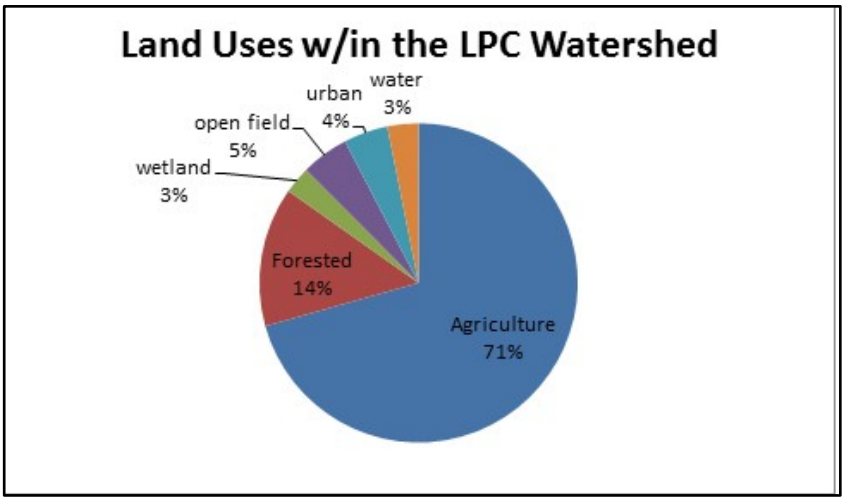

Figure 12. Land Use in LPCW

The following figure depicts the location of these uses throughout the LPCW.

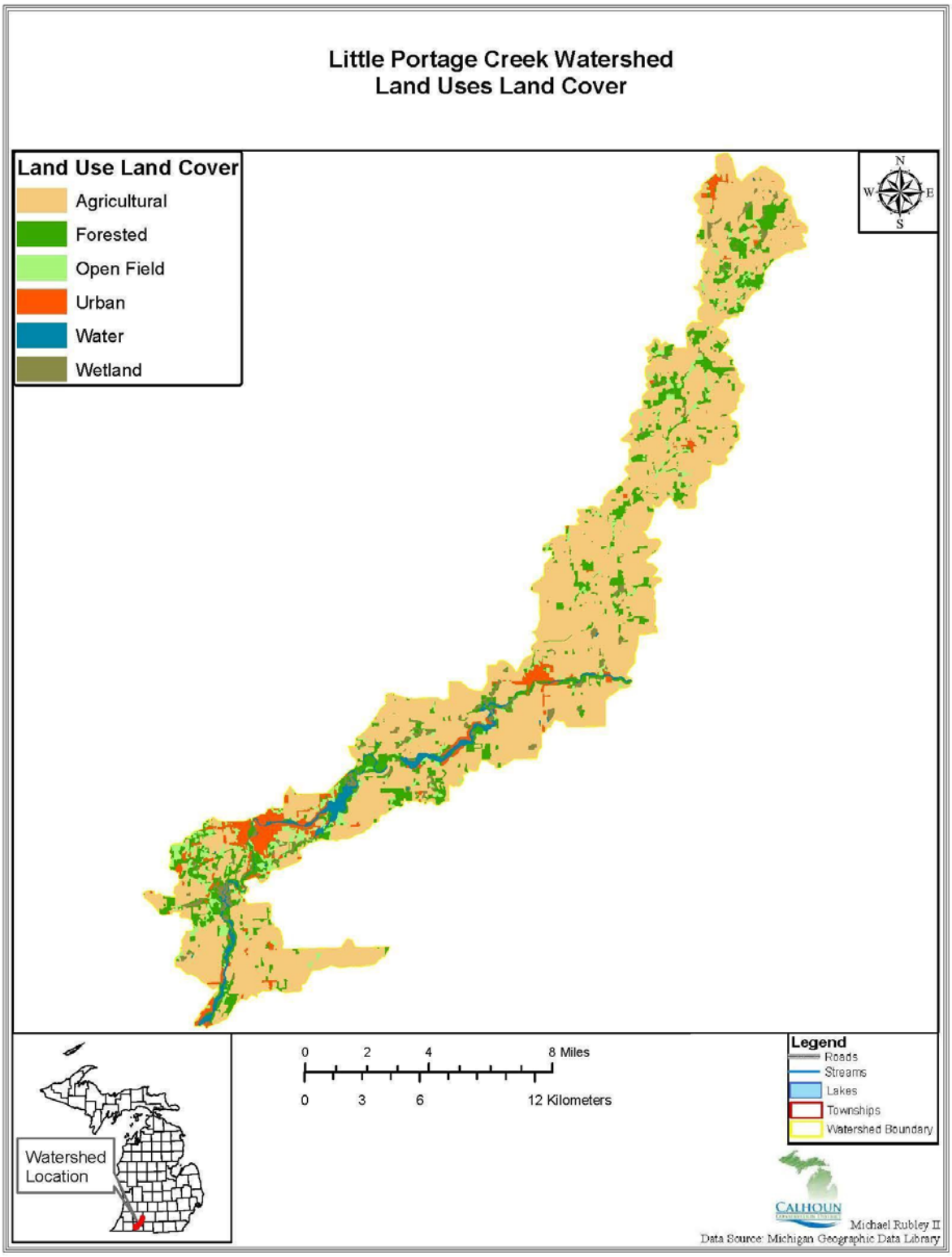

Figure 13. Land Use Land Cover Locations in LPCW

2.4 Hydrology

2.4.1 Geology and Groundwater

The Little Portage Creek Watershed lies within the larger St. Joseph River Watershed. The St. Joseph River Assessment (Wesley and Duffy, 1998) described the geology of the region.

> The retreat of glaciers 10,000 years ago shaped the contemporary landscape and left deposits that make up the surficial geology in the St. Joseph River basin. The basin consists of a mosaic of outwash sands, ice contact material (unsorted sands and gravel), coarse end moraine (sands and gravel), fine end moraine (loamy), and lake plain (Lineback et al. 1983). Glacial moraines with moderate elevation and pervious material have high water infiltration capacities and head pressure, which combine to produce high groundwater yields to low lying water bodies. Groundwater contribution to a stream determines the stability of both temperature and water flow. Basins, like the St. Joseph, with surficial geologic material dominated by outwash, ice contact, and coarse end moraine materials have higher groundwater yields compared to basins with less pervious and more fine textured materials (Bent 1971; Richards 1990; Wiley and Seelbach 1997)

The bedrock of the region is primarily composed of Coldwater Shale (Data sources are the 1:500,000 maps by R.L. Milstein, 1987, "Bedrock geology of southern Michigan"). Bedrock influenced ice movement during past glaciations, and most of Michigan is on soft bedrock that was easy for the glacier to move through and grind away. Because of this, most bedrock in Michigan is deeply buried beneath glacial material http://www.ncrs.fs.fed.us/gla/geology/mi-bedrock.htm.

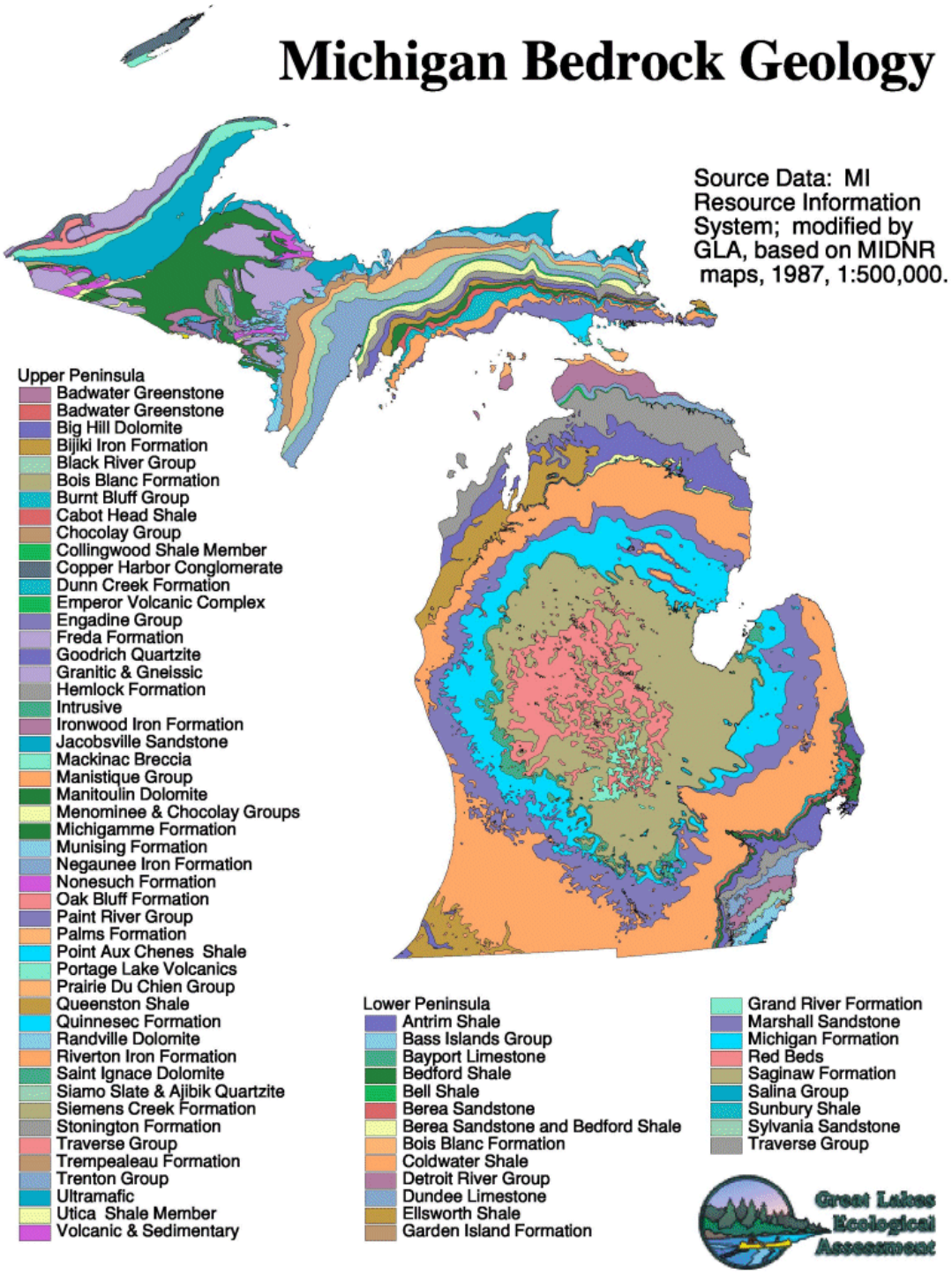

Figure 14. Michigan Bedrock Geology

2.4.2 Surface Water

The watershed contains 328 acres of lakes including one named lake accounting for 50.77 acres of the total 328 acres. Noah Lake is the only named lake in the watershed, and is also the largest of the lakes at 51acres. The watershed contains 159 miles of streams and drains that connect the Little Portage Creek Watershed with the St. Joseph River. The watershed contains 247 miles of roads, and an analysis of the road and stream layers shows that approximately 68 road stream crossings exist in the watershed.

2.4.3 Subwatersheds

Within the Little Portage Creek Watershed, four smaller subwatersheds or smaller drainages empty into smaller tributaries that drain into Little Portage Creek. The United States Geological Survey (USGS) classifies watersheds by hydrologic unit codes (HUCs) divided and sub-divided into successively smaller hydrologic units. The Little Portage Creek is designated as a 10 digit HUC containing four 12 digit HUC sub-watersheds that comprise the Little Portage Creek Watershed.

- The largest of the sub-watersheds is City of Florence-Saint Joseph River Watershed (HUC 12: 040500010904) encompassing an area of 20,467 acres.
- Headwaters Little Portage Creek Watershed (HUC 12: 040500010901) is the second largest with an area of 17,888 acres.
- Sturgis Dam-Saint Joseph River Watershed (HUC 12: 040500010903) at 11,177 acres.
- Little Portage Creek Watershed (HUC 12: 040500010902) is the smallest of the four sub watersheds at 10,442 acres.

HUC 12 Sub-watersheds of the LPCW

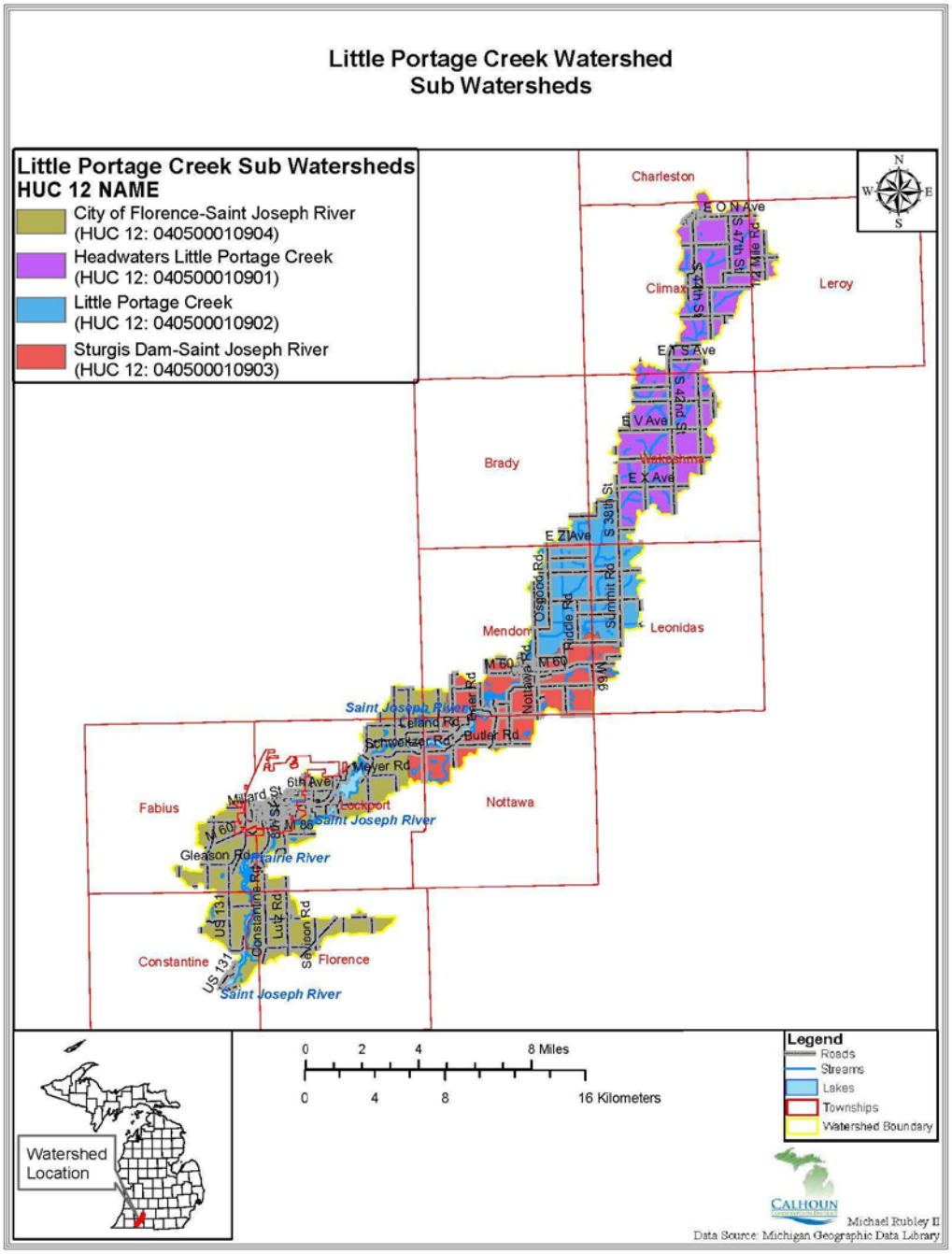

Figure 15. LPCW Sub-Watersheds

3. Community Profile

3.1 History of the Region

The region is thought to have been first occupied by its earliest residents the Hopewell, or "Mound Builders," an early race of American Indians from approximately 10 BCE to 400 CE. This farming civilization left behind mound structures that are still visible today. The Hopewell was followed by the Algonquin groups (Potawatomi, Chippewa, and Ottawa) and the Miami Tribe. The area at the time of European settlement was occupied primarily by the Potawatomi Tribe. The area's earliest documented visit by a European was Robert La Salle's visit to the mouth of the St. Joseph River, possibly in 1672 and for certain in 1679. The Treaty of 1795, between the United States and Spain, opened up the Northwest Territory for settlement. Then, the Treaty of 1821, known as the "Chicago Treaty," between the United States government and the Potawatomi, Chippewa, and Ottawa, opened up the area to European settlers. The Algonquin groups ceded all of their lands south of the Grand River. In 1827, they exchanged all their small reservations for one large reservation tract of land that encompassed parts of Kalamazoo and St. Joseph counties totaling approximately 73,600 acres (Hawkins, 9). The descendants of these tribes now have reservations in the following areas:

- Athens, MI—The Nottawaseppi Huron Band of Potawatomi
- Match-e-be-nash-she-wish Band—Reservation in Wayland Township, formerly known as the Gun Lake Band of Grand River Ottawa Indian
- Pokagen Band of Potawatomi (Pokegnek Bodewadmik)—Pokagen Reservation in New Buffalo Township.

The early European adventurers to the area were comprised primarily of fur-traders and the region was widely unsettled or "undiscovered" until the Chicago Treaty opened up the area for European-American settlement. Areas within the LPCW that were originally areas of American Indian settlement are the Village of Mendon and the City of Three Rivers.

Early European-American settlement resulted in dams springing up along small tributaries to power saw and grist mills. The forests and prairies of the area were cut and tilled. The lumber from the forests was used to build homes and barns and the prairies, to grow crops. Animals were hunted prolifically for meat and furs and all but extirpated from the area. Residents of the area wanted the St. Joseph kept open for navigation (to move goods) and a federal study (1879) was performed and determined it was adverse to this suggestion. At the time, the railroad was emerging as a leader of moving goods so the river's purpose turned to power production (Lane, 2010). Subsequently, hydroelectric dams began to pop up along the St. Joseph River, which severely altered the run-of-the-river flows and altered the stream's gradient. This would have drastic effects on stream health and water quality. Drain establishment practices were on-going throughout this period in order to develop agricultural lands and as a method to address malaria. The dredging opened up land for establishment and agricultural land use but has had a lasting detrimental effect on water quality and fish communities. Evidence of water quality degradation in the greater St. Joseph Watershed can be traced back to contamination of the river from South Bend to the mouth in 1925 and in the 1930's, Michigan approached Indiana in attempts to address the problem (Lane, 2010). Water quality has been an uphill battle but with the passing of federal and state water quality laws (i.e. The Clean Water Act (CWA) of 1972 and Michigan Environmental Protection Act of 1970, most of which is now covered under the Michigan Natural Resources and Environmental Protection Act (NREPA). LPCW

and its tributaries continue to be impaired from point source and nonpoint source pollutants, with federal, state, local and stakeholder groups fighting to address impairments and threats to water quality.

3.2 Governmental Units

Local governmental units that the LPCW fall within are comprised of counties, townships, cities and villages:

- **Counties:** Kalamazoo, St. Joseph, and Calhoun
- **Townships:** Charleston, Leroy, Climax, Wakeshma, Brady, Mendon, Leonidas, Nottawa, Lockport, Fabius, Constantine, and Florence
- **Cities, Villages and Communities:** Climax, Fulton, Mendon, and portions of Three Rivers

The table below illustrates the governmental units, counties, watershed area, percent of area in the LPCW, lakes, and rivers in the LPCW.

Table 2. Townships, Counties, Watershed Area, Percent of Area, Lakes, & Rivers in LPCW

Governmental Unit	County	Watershed Area (Sq. Mi.)	% Area in Watershed	Lake Area (acres)	River Length (Mi)
Leroy Township	Calhoun	1.5	1.6	0.3	0.1
Charleston Township	Kalamazoo	0.2	0.2	N/A	N/A
Climax Township	Kalamazoo	11.8	12.6	2.4	18.1
Wakeshma Township	Kalamazoo	16.5	17.6	11.1	28.7
Brady Township	Kalamazoo	1.0	1.1	N/A	2.6
Leonidas Township	St. Joseph	6.9	7.4	33.8	12.1
Mendon Township	St. Joseph	18.3	19.5	353.5	40.2
Nottawa Township	St. Joseph	5.9	6.3	329.6	12.0
Lockport Township	St. Joseph	11.7	12.4	895.7	45.6
Fabius Township	St. Joseph	5.6	5.9	197.9	10.9
Florence Township	St. Joseph	6.4	6.9	85.1	3.8
Constantine Township	St. Joseph	3.9	4.2	269.3	10.0

3.3 Demographics

Approximately 317, 689 people live within the counties (i.e. St. Joseph: 60,964 and Kalamazoo: 256,725) (U.S Census Bureau Quick Facts) that contain the majority of the watershed area. Of the total 317,689 people, 81% live within Kalamazoo County and 19% live within St. Joseph County. The small portion within Calhoun County is primarily rural and does not represent a significant amount of the population. Most of LPCW is considered rural. The only areas with urbanization are a small portion of the southern end of the Village of Climax, the Village of Mendon, the Village of Fulton, and some areas of the City of Three Rivers.

The Village of Climax has a population of 767 people, with 96.3% White, 0.5% African American, 0.1% Asian, 2% Latino, 0.3% other races, and 0.8% from two or more races. The population has experienced a -3% change since the 2000 census.

The Village of Mendon has a population of 870 people, with 94.9% White, 0.8% African American, 0.3% American Indian, 0.3% Asian, 2.2% Latino, 0.1% from other races, and 1.4% from two or more races. The population has experienced a 5% increase in population since the 2000 census.

The City of Three Rivers totals 7,811 people, with 82.6% Caucasian, 10.1% African American, 0.6% American Indian, 0.9% Asian, 5.2% Latino, and 0.6% Other. The population has grown 5.6% since 2000 according to City-Data.com.

The unincorporated community of Fulton lies within Wakeshma Township and does not have a known population. The overall population of Wakeshma Township is 1,301. Fulton represents a very small portion of this total. The Township's total population has experienced a -9% change in population.

LPCW Township population estimates

Table 3. LPCW Township Population Estimates

Townships within the LPC watershed	Population	Est. population within the LPC watershed
Climax	2463	594
Leroy	3712	135
Charleston	1975	13
Brady	4263	183
Leonidas	1239	234
Mendon	2775	1620
Nottawa	3999	583
Lockport	3814	2029
Fabius	3285	787
Constantine	4181	756
Florence	1436	321
Wakeshma	1301	894
Total	34443	**8149**

Population estimates were derived by using township land area within the LPCW, census data, and average density per square mile of township area.

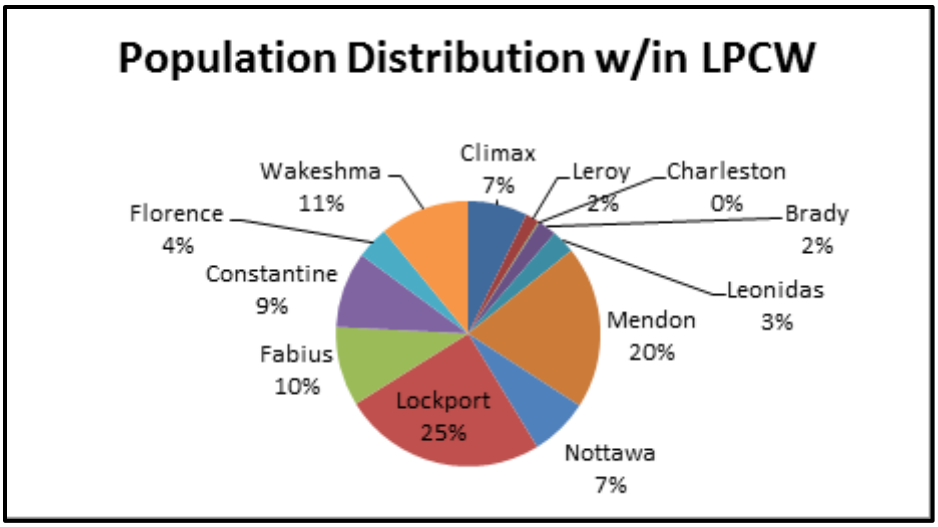

Figure 16. Population Distribution in the LPCW

The largest population is represented by Lockport, which contains portions of the Three Rivers population, and Mendon, which contains the village of Mendon.

3.4 Future Growth and Development

Generally growth within the LPCW has been minimal and some areas have experienced a negative change in population. The middle and upper portions of the watershed have experienced a loss of population: the village of Climax, at the northern end of the watershed near the headwaters, has experienced a loss of approximately 3% of the population and Wakeshma Township, including Fulton, has experienced a drop in approximately 1% of the population. The southern end of the watershed has experienced a slight growth in the population with the city of Three Rivers and the village of Mendon both increasing in population size by about 5%. The areas of the LPCW surrounding the M-60 corridor are areas likely to experience residential and industrial growth. Municipalities in this area and the rest of the watershed should consider planning for smart growth techniques to protect their water quality, while also getting the greatest possible benefit from every investment the community might make. Communities should look to conserve, restore, or enhance natural areas while incorporating, trees, rain gardens, vegetated roofs, and other practices that mimic natural systems in developed areas where rainwater falls. These types of approaches known as "green infrastructure" are an integral part of sustainable communities because they can help local governments and communities to protect the environment and human health, while providing other social and economic benefits, allowing communities to achieve more for their money (http://www.epa.gov/smartgrowth/green-infrastructure.html). The EPA has prepared a guide, *Enhancing Sustainable Communities With Green Infrastructure: A guide to help communities better manage stormwater while achieving other environmental, public health, social, and economic benefits (PDF)*, which assists communities with green infrastructure approaches for developing plans to address technical, regulatory, financial, and institutional obstacles to better manage stormwater. Rural communities should also consider future growth and development. Master planning and ordinance review should be given to consider types of development that are most likely to occur within the area, but unforeseen growth and developmental planning can be a pro-active precautionary step that can safeguard

communities. For a complete list of publications pertaining to rural smart growth, business and economic development, water, transportation and air quality, climate change, HUD-DOT-EPA and energy etc. see (http://www.epa.gov/smartgrowth/publications.htm).

4. Resource Management

4.1 Land Use and Water Quality

The way that we use the land ultimately affects water quality. Different types of land use are more "intense" and subsequently negatively affect the health of our rivers and streams. The way that we use our land also shapes ecology of our water resources. Changing the shape of our landscape can cause severe detriment to water quality. Locally, we look to land use planning and ordinances from local governmental units to control the way that we use the landscape. Local planning is essential to plan for urban sprawl, preservation of agricultural production, and interacting with the landscape in a manner that reduces our impacts to water quality. As of January 1, 2012, a State-level ban was placed on the use of phosphorous fertilizer applications on residential and commercial lawns. This included athletic fields and golf courses statewide. Federal protection typically is manifested through water quality funding administered through a state management body. In Michigan's case, it is administered through MDEQ.

Land use planning was once an afterthought. Now, it is essential to protect existing land uses, natural features, and the integrity of our natural resources. The landscape itself should dictate how we manage our land. Areas with extreme slopes, drainage, and soil formations that increase surfacewater runoff that slope toward waterbodies should incorporate conservation-friendly practices so as to lessen the effects to water quality. In areas of urban development consideration must be given to impervious surfaces and associated increased runoff that delivers pollutants to our waterbodies. Watershed planning takes an ecologically based approach with a holistic view of nonpoint source pollution. Nonpoint sources of pollution affect not only areas of entry but also areas downstream from its delivery source point. Land use within the LPCW is predominantly agricultural (71%). Subsequently, we should plan for this predominant use, as well as low intensity residential development. Where industrial and residential development occurs, smart growth and low intensity practices should be utilized to reduce the impacts to water quality.

4.2 Regulatory Authority and Water Resources

4.2.1 Water Bodies (rivers, drains, streams, lakes)

The Clean Water Act (CWA) covers a number of regulatory, funding, and education programs aimed at protecting and restoring the nation's surface water. Federal roles in protection are used as a blanket to provide national environmental standards with state and local governance at the local level. MDEQ's, Water Resource Division (WRD), is responsible for protecting the public trust waters of Michigan's inland lakes and streams under the authority of Part 301, Inland Lakes and Streams, of the Natural Resources and Environmental Protection Act, 1994 PA 451 (NREPA). WRD oversees dredging, filling, constructing or placing a structure on bottomlands, constructing or operating a marina, interfering with natural flow of water, or connecting a ditch or canal to an inland lake or stream. The Michigan Department of Natural Resources (MDNR) has the authority to regulate boating activities and MDNR access sites pertaining to human health and species protection (e.g. engine size, number of boats). MDNR is also responsible for managing fish and wildlife species within our waterbodies and regulation human

use of this resource. For further protection of our state's water resources, municipalities and local governments should consider enacting ordinances that protect water quality.

MDEQ regulates direct discharges into the state's waterbodies through the National Pollutant Discharge Elimination System (NPDES). This regulates the discharge of pollutants into surface waters by imposing effluent limitations. MDEQ's Municipal Separate Storm Sewer System (MS4) program is designed to reduce the discharge of pollutants to surface waters of the State, as well. An MS4 is a system of drainage (including roads, storm drains, pipes, ditches, etc.) that is not a combined sewer or part of a sewage treatment plant. MDEQ also administers the Federal Phase II Storm Water Regulations to address storm water discharges from small municipal separate storm sewer systems.
See http://www.michigan.gov/deq/0,4561,7-135-3313_3682_3716-24707--,00.html.

County Drain Commissioners or Water Resource Commissioners are responsible for the administration of the Drain Code of 1956, as amended. They are responsible for upholding the Drain Code which addresses construction and maintenance of drains, provides storm water guidance, delegates drain districts, and schedules maintenance. Kalamazoo, St. Joseph, and Calhoun County Drain Commissions and Water Resource Commission are responsible for drains within the LPCW. Kalamazoo County Soil Erosion and Sedimentation Control (SESC) is housed within the County Drain Commissioner's Office. The SESC Ordinance, established under Act 347 of 1974, as amended, is designed to regulate earth change activities and prevent erosion and sedimentation associated with those changes. The Drain Office regulates the ordinance except in governmental units that elect to do so.

St. Joseph County SESC is also housed within the Drain Commission Office. As of May 15th, 2012 the County Drain Commissioner is also the County Enforcement Agent (CEA). In Calhoun County the SESC program is administered by the Calhoun County Road Department (CCRD). CCRD staff can conduct an inspection to determine if an SESC permit is necessary. More information can be found at http://www.calhouncountyroads.com/about/services/soil-erosion-sedimentation-control-permits/.

4.2.2 Wetlands

There are federal, state and local laws and ordinances that govern and help to protect wetlands. The federal government protects wetlands through Section 404 of the Clean Water Act. Michigan received authorization from the federal government to administer Section 404 of the federal Clean Water Act in most areas of the state. The state-administered program must be consistent with requirements of the federal Clean Water Act. The MDEQ regulates wetlands within the state under Part 303, PA 451 Wetland Protection. This law establishes minimum wetland protection controls for regulated wetlands and requires a permit to conduct dredge, fill, or construction activities in regulated wetlands. However, it does not regulate all wetlands. Wetlands are regulated by MDEQ if they meet any of the following criteria:

- Connected to one of the Great Lakes (does not apply to the LPCW)
- Located within 1,000 feet of one of the Great Lakes (does not apply to the LPCW)
- Connected to an inland lake, pond, river or stream.
- Not connected to one of the Great Lakes or an inland lake, pond, stream, or river, but are more than 5 acres in size.

- Not connected to one of the Great Lakes, or and inland lake, pond, stream, or river, and less than 5 acres in size, but the DEQ has determined that these wetlands are essential to the preservation of the state's natural resources and has notified the property owner.

Naturally, there are "gaps" within the wetland protection laws of the state. This is where local governments have the authority to create wetland regulations that address wetlands not protected by the state. Part 303, section 324.30307 authorizes local units of government to adopt and administer their own wetland regulations, provided they are at least as restrictive as state regulations. It is important to note that local governments notify MDEQ. There are no local units of government that have enacted wetland ordinances within the LPCW, according to MDEQ's document *Communities with Wetland Ordinances* revised June 22nd, 2010.

Some local governmental units mention wetlands within zoning ordinances and master plans, which can give consideration to approving various permits pertaining to land use practices and developments, providing some wetland protection. There are currently no local governments in the LPCW that have enacted their own wetland ordinance(s).

The MDEQ provides guidance and documents to assist local governments in the development of wetland protection. These can be found at http://www.michigan.gov/deq/0,4561,7-135-3313_3687-24312--,00.html.

The United States Department of Agriculture's (USDA) Farm Service Agency (FSA) and the Natural Resource Conservation Service (NRCS) inherently protect wetlands on private lands through economic incentives and disincentives administered to agricultural producers who participate in incentive programs.

The Food Security Act of 1985, as amended, requires producers participating in most programs administered by FSA and NRCS to abide by certain conditions on any land, owned or farmed, that is considered a wetland. A participant who violates wetland conservation provisions is determined ineligible for applicable FSA and NRCS benefits for year(s) in violation.

4.2.3 Floodplains

A river, stream, lake, or drain may, on occasion, overflow its banks and inundate adjacent land areas. The land that is inundated by water is defined as a floodplain. In Michigan, and nationally, the term floodplain has come to mean the land area that will be inundated by the overflow of water resulting from a 100-year flood (a flood which has a 1% chance of occurring any given year). It is estimated that about 6% of Michigan's land is flood-prone, including about 200,000 buildings. (http://www.michigan.gov/deq/0,4561,7-135-3313_3684_3725---,00.html)

Floodplain guidance comes from both the state and federal governments and focuses on protecting people and property rather than natural resources (Ardizone and Wyckoff, 2003). Development within floodplains is regulated through Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended. This requires that a permit be obtained prior to any alteration or occupation of the 100-year floodplain of a river, stream, or drain. Floodplains are also regulated federally through the Federal Emergency Management Agency (FEMA). The MDEQ and FEMA have developed a *Quick Guide: Floodplain Management in Michigan* available at http://www.michigan.gov/documents/deq/lwm-quickguide_202673_7.pdf.

The floodplain is divided into two parts: the floodway, which carries most of the flow during a flood event, and the floodway fringe, an area of very slow moving water or "slack water." Floodways are the channel of a river or stream and those portions of the floodplain adjoining the channel which are reasonably required to carry and discharge the 100 year flood; these are high-hazard areas of rapidly moving water during times of flood. The purpose of Part 31 is to assure that the flow carrying capacity of a watercourse is not harmfully obstructed, and that the floodway portion of the floodplain is not used for residential construction. For a more in-depth review of floodplain management please refer to http://www.michigan.gov/deq/0,4561,7-135-3313_3684_3725-11255--,00.html. The minimum standard for residential construction within the 100-year floodplain requires that the lowest floor of a structure be elevated one-foot above the 100-year flood elevation. Local governmental ordinances and building standards must be met.

4.2.4 Groundwater

Although the plan addresses surface water runoff from nonpoint source pollutants, groundwater must also be considered. This is because there is interaction between surface water and groundwater, both from natural water cycle processes and from manmade interaction through well withdrawal and irrigation practices.

Within the LPCW, the Kalamazoo County Health Services, Branch-Hillsdale-St. Joseph Community Health Agency, and Calhoun County Health Department (CCHD) Environmental Division (ED) play a role in the protection of groundwater with regulation of the installation and design of septic systems. This authority was conferred upon the local health departments by Section 2441(1) of the Michigan Public Health Code, Act 368, 1978, as amended. Information on obtaining information and or permit requirements please refer to http://www.bhsj.org/eh/environment.htm for St. Joseph County information or http://www.kalcounty.com/eh/default.asp for the Kalamazoo County Environmental Health Division. An option that some local government authorities have enacted at the township and county level is a time-of-transfer sale inspection. When property is sold, an inspection is required. This option is gaining some popularity and has been instituted recently. Some people feel the need for a State mandated time-of-sale-transfer. There is also some added protection from real estate companies' sale transactions that can require septic tank testing at time-of-sale-transfer.

On a statewide level, monitoring groundwater is up to MDEQ and the Michigan Department of Agriculture and Rural Development (MDARD). Michigan's water use reporting program requires that industries with the capacity to withdraw over 100,000 gallons per day (70 gallons per minute) are required to report to the state the water withdrawals and water conservation practices of their pumps. This was initially mandated by the Public Act 148 of 2003, now Part 327 of P.A. 451 of 1994, NREPA.

A Great Lakes compact was signed by the Great Lakes Governors and Premiers (Annex 2001). It provided protections, which include a ban on new diversions of water outside of the Basin (Great Lakes-St. Lawrence River Basin) and stipulated that each state would create a program for the management and regulation of new or increased large withdrawals (http://www.michigan.gov/mdard/0,4610,7-125-1599_29980-89234--,00.html). The above-mentioned water use reporting program is Michigan's solution. Agricultural producers must report to MDARD and all other industries must report to MDEQ. Any new or proposed new or increased volume large capacity pumps must also consult the Michigan Water Withdrawal Assessment Tool (WWAT) prior to installation and subsequent reporting.

The Michigan Agriculture Environmental Assurance Program (MAEAP) provides some protection for private agricultural lands. The comprehensive, voluntary, proactive program is designed to reduce farmers' legal and environmental risks through a three-phase process: 1) education, 2) farm-specific risk assessment and practice implementation, and 3) on-farm verification that ensure the farmer has implemented environmentally sound practices. There are four programs: Farmstead; Cropping; Livestock; and the newly developed Forest, Wetlands, and Habitats System. Groundwater is considered in the education component and MAEAP provides annual well-water testing, focused primarily on nitrates and Coliform bacteria. Open, inactive wells are located and decommissioned to help protect possible groundwater contamination. More information can be found at http://www.maeap.org/ and your local conservation district will have information, as well. Kalamazoo Conservation District (KCD) http://www.kalamazooconservation.org/, Branch County Conservation District (BCCD) http://www.branchcd.org/index.htm, (covers St. Joseph County) and the Calhoun Conservation District (CCD) http://www.calhouncd.org/ all administer the MAEAP program .

Michigan participates in a voluntary Wellhead Protection Program (WHPP). The program is designed to safeguard public water supply systems (PWSS). Michigan's WHPP is composed of a set of guidelines that help communities protect their drinking water by identifying the area that contributes groundwater to PWSS wells, identifying sources of contamination within that area, and developing methods to cooperatively manage the area and minimize the threat to the PWSS. The only community that participates in WHPP within the LPCW is the Village of Mendon**.** It should be noted that there is a wellhead protection area for Three Rivers, which is located just outside of the LPCW.

LPCW Wellhead Protection Program Areas

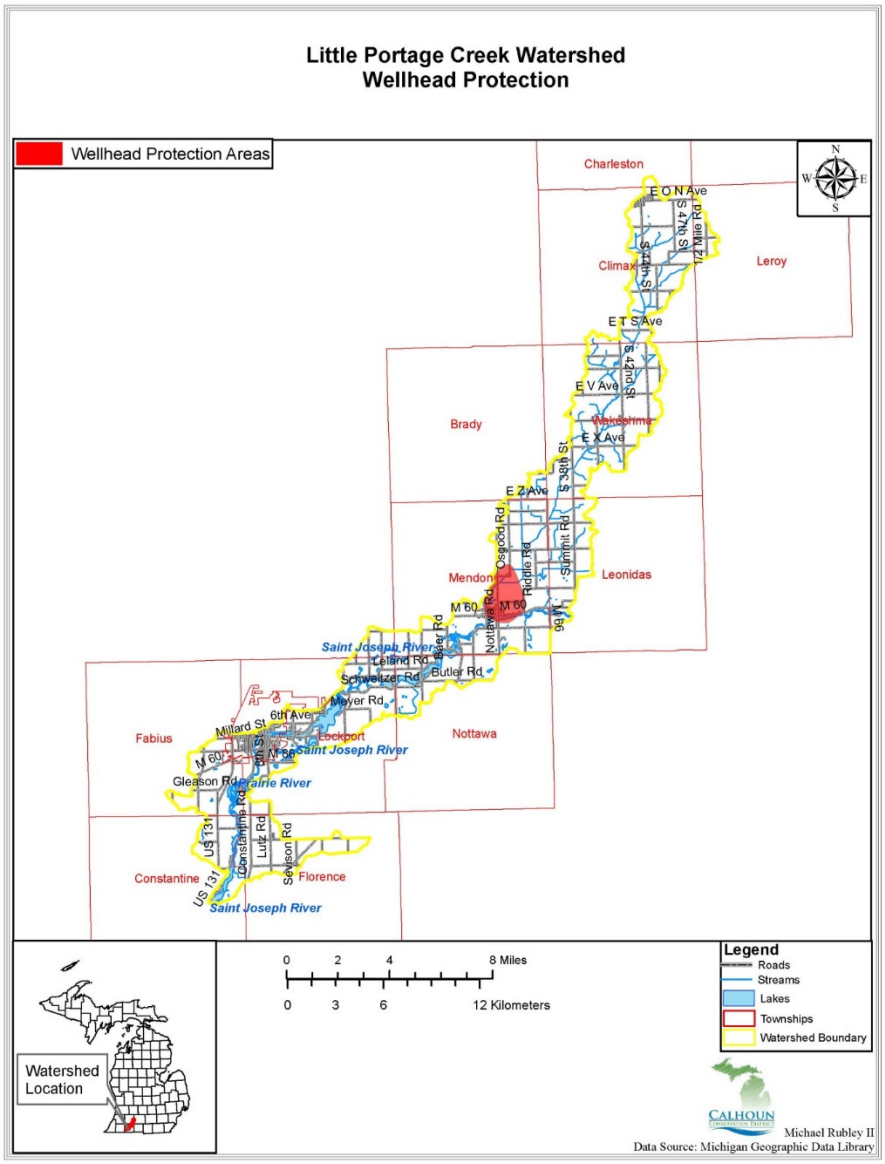

Figure 17. Wellhead Protection Areas in the LPCW

4.3 Local Water Quality Protection Policies

Local governments regulate land use mostly through master plans and zoning ordinances. Through the LPCW planning process, several local units of government agreed to work with CCD and Fishbeck, Thompson, Carr, and Huber Inc. (FTCH) to review of their master plans and zoning ordinances to evaluate their techniques for resource protection. CD and FTCH met with their planning commissions to evaluate townships' needs and wants pertaining to natural resources and water quality and how that was considered in the master plan and zoning ordinances. A document review for water resources protection considered

- Watershed Activities—plans and policies
- Stream corridors—plans and policies, development/redevelopment regulations
- Flood Control—plans and policies, development/redevelopment regulations
- Impervious Surface Reduction—plans and policies, development/redevelopment regulations, and design standards

However, these were not the only protections considered throughout the process. Planning considered uses of natural resource land use maps, farmland and open space preservation, wellhead protection, MDEQ-approved recreation plan, community identification of stormwater drainage systems, illicit discharges, sanitary sewer or septic systems, installation of public utilities, and other protections.

After meeting with townships on multiple occasions, an exhaustive review was performed for each planning commission with a detailed report. Each municipality was encouraged to accept recommendations for master plans and zoning ordinances to protect the integrity of its natural resource character and water quality.

For some of these townships, timing was appropriate due to the need to address the Michigan Planning Enabling Act 33 of 2008 (MPEA) (as well as amendments to Michigan Zoning Enabling Act). This act impacted every single planning commission in Michigan. It requires the review of the ordinance or resolution that created the planning commission in the first plan, with nearly all such ordinances needing to be amended or replaced (http://lu.msue.msu.edu/2008MPEA.htm). This site can be accessed for documents helping to summarize responsibilities of local governments pertaining to the MPEA.

Recommendations of the reviewed documents regarding planning for water quality protection and natural resource protections focused on the following.

Master Plan Revisions

1. Create a Resource Protection Overlay District (RPOD) and update the Master Map with identification of natural resources and RPOD delineation.
2. State the importance of a storm water management plan (SWMP), with a goal of increasing infiltration and decreasing imperviousness in new construction and redevelopment to reduce the amount of storm water runoff.

3. Broaden the water resources objectives and policies to include other natural resources, including floodplains, high-quality natural areas, woodlands, wetlands, and greenways.

Zoning Ordinance Revisions

1. Create specifications for an RPOD to protect natural resources.
2. Require building setbacks from water bodies (streams, rivers, lakes, wetlands) with a native vegetative buffer.
3. Protect wetlands through a township wetlands ordinance.
4. Improve parking lot standards to reduce impervious surfaces (shared parking, parking space size, and minimum parking requirements).
5. Improve site plan review.
    a. Identify natural features.
    b. Review standards for protection.
    c. Label Best Management Practices (BMPs).
6. Encouraging LID techniques and BMPs to reduce runoff and increase infiltration.
7. Coordinate with the County Soil Erosion and Sedimentation Control (SESC) program and require compliance with county SESC standards.
8. Coordinate with receipt of other required state and county permits.
9. Require new septic systems to be located at least 150 feet from a waterway.
10. Encourage the use of native species in landscaping to increase infiltration of storm water and to discourage the use of nonnative and/or invasive species.
11. Improve private road standards to reduce impervious surfaces.

Other Recommendations

1. Update the Capital Improvement Program to include policies related to natural resource protection and storm water management.
2. Develop a Master Recreation Plan and obtain approval of the plan from the Michigan Department of Natural Resources (MDNR).
3. Investigate funding options for conducting additional studies and projects to assist the township in implementing the recommendations in this report.

The townships that volunteered to have their plans and ordinances reviewed by FTCH and CD were

- Park Township, St. Joseph County
- Charleston Township, Kalamazoo County
- Brady Township, Kalamazoo County

To see a full review of the plans and zoning ordinance recommendations refer to <u>Appendix 1 – Master Plan and Zoning Ordinance Review.</u>

FEMA provides participation for local units of government in their National Floodplain Insurance Program (NFIP). Community participation in the NFIP is voluntary and based on an agreement between local governmental units and the Federal Government. It states that if a governmental unit will adopt and enforce a floodplain management ordinance to reduce the future flood risks to new construction in Special Flood Hazard Areas, the Federal Government will make flood insurance available within the community as a financial protection against flood losses.

4.4 Private Land Management

State and federal laws can only do so much to protect water quality. The majority of land holdings within the LPRW are privately owned. This would suggest that private landowners impact the land more than any other group within the watershed. Education of land use practices and how they affect our water resources could be one of the single most important factors to safeguard our water resources. Watershed education efforts through the federal and state government, county organizations and local stakeholder groups are the frontline to keeping our waters clean. There are many organizations that provide technical assistance to landowners regarding how to better manage their lands to protect natural resources and water quality. These organizations include the Natural Resource Conservation Service (NRCS), MSU County Extension Offices, Conservation Districts, Kalamazoo Nature Center (KNC), Native Connections of Three Rivers (private), United States Fish and Wildlife Service (USFWS), Michigan Department of Natural Resources (MDNR), Land Conservancies (Southwest Michigan Land Conservancy), Audubon Society, and the Nature Conservancy.

5. Natural Features

5.1 Protected Lands, Parks and River Access

There are currently no known natural areas within the LPCW. The nearest natural area is Fulton State Game Area located along Bear Creek directly east, adjacent to the LPCW. Parks within the LPCW include Covered Bridge Park, along the mainstem of the St. Joseph River which features one of the oldest covered bridges within the state. This 12-acre park is adjacent to the Sturgis hydroelectric dam, with public river access, picnic shelter, toilets, nature trails, ponds, and views of Langley Covered Bridge.

The City of Three Rivers maintains several parks within the watershed: portions of Scidmore Park, which is primarily within the Rocky River Watershed; Conservation Park, located off of S Main St. just south of the mainstem of the St. Joseph River, which has a shelter, boat launch and the opportunity for canoeing; and Marina Park, which is located on the north side of the St. Joseph River at the end of Jefferson St. and has a boat launch, fishing area with access to the dam pond/mainstem of the St. Joseph River.

The State of Michigan offers some public access points on Noah Lake a small natural lake just south of the mainstem of the St. Joseph River and Stump Bay along the St. Joseph River. There is a river access in Mendon (St. Joseph River) and canoe access at the village park, just off of Nottawa Road along the river as well.

5.2 Rivers/Stream/Drains

5.2.1 History and Background

Historically, during settlement by Europeans in the 1830s, the landscape was systematically drained to allow increased settlement and agricultural production. Malaria and other sicknesses were a concern and relief was commonly associated with draining the surface water off the landscape. As a result, a significant amount of Little Portage Creek and its tributaries have been morphologically altered from pre-settlement conditions. Streams in this ecoregion tend to maintain a sinuous pattern (meandering channel) when unaltered by humans. Areas of the creek and tributaries that have been altered and straightened are constantly working their way back toward this pattern and profile. Traditional drain maintenance

techniques of straightening channels have a very limited lifespan and result in continued expenditures for maintenance. Due to the current Drain Code of 1956, drain commissioners have to address petitioned drainage maintenance projects and as a result continue the cycle of perpetual impairments to channel morphology. There are many new and innovative drain maintenance techniques but a cost effective universal set of practices has not been established. (See Section Water Quality for a more in depth discussion on this topic).

Evidence of manipulating stream channels date back as far as eight millennia (eight thousand years) to the Jordan River Valley in the ancient city of Jericho. As agriculture and grazing expanded into the upper reaches of the watersheds, silts and sediments were carried downstream, clogging canals and reducing effectiveness. Removing the silts and diking river courses became labor intensive and some cultures resorted to enslaving others for labor (R. Lal, 2006). As far back as eight thousand years ago channelizing has been a labor intensive and expensive temporary fix to moving water. We still use the same method of channelizing and straightening streams to move water and experience the same problems that ancient civilizations experienced. New approaches to drain maintenance need to be established to alleviate problematic maintenance activities that have persisted for millennia, and which continually disturb natural channel evolution which is less impactful and are typically not associated with impairments to water quality.

5.2.2 Current Conditions and Threats

The channel morphology of the Little Portage Creek is variable, with the majority of its stream reaches heavily impacted by dredging and straightening. Some reaches in the headwaters have escaped manipulation and remain sinuous, or meandering. From the confluence of the Little Portage Creek upstream to E. W Ave. the drain is heavily channelized from dredging. From E. W Ave. upstream to 42nd Ave. the drain is sinuous and meandering. Then, from 42nd Ave. upstream to its headwaters near 44th Ave. just south of the Village of Climax, it is, again, heavily impacted from dredging.

Most of the watershed is maintained as a designated drain. MDEQ's 2012 Integrated Report determined that its warmwater fishery designation is impaired. This is most likely due to a lack of bed form diversity (i.e. conducive habitat—pool, riffle, run formations). This causes heavy siltation upon important gravel areas that provide spawning gravel, which is a direct result of channelization. Thompson, Carr & Huber, Inc. conducted a study for the Little Portage Intercounty Drain Board titled *Little Portage Creek Intercounty Drain Maintenance Prioritization*. This report determined that overall the drain is in fair to poor condition. CCD conducted a Bank Erosion Hazard Index inventory (BEHI), Near Bank Assessment (NBS) and bank and toe pin installations to collect baseline data for streambanks and to gain insight into impacts to water quality. The bank stability inventory, consisting of BEHI and NBS assessments and bank and toe pin installations, will be used to evaluate conditions of streambanks within the Little Portage Creek. A detailed geomorphic report can be found in Appendix 2 – Geomorphic Assessment of the LPCW.

Threats to natural stream processes in the LPCW are stream manipulation from dredging, irrigation, well-water withdrawal, lake-level control structures, low head and high head dams, perched/undersized culverts, nonpoint source pollutants, unregulated stream manipulation, development practices, road stream crossings and new road construction, and removal of riparian vegetation (i.e. thermal implications, bank stabilization).

5.2.3 Fish Assemblages

The Michigan Department of Natural Resources (MDNR) Fish Division (FD) prepared a fisheries assessment that was conducted by Michigan State University (MSU) and Lake Superior State University the summer of 2010. The following table depicts the species present.

Table 4. Fish Present in Little Portage Creek

Fish Present in LPC
Common carp
Creek chub
Common shiner
White sucker
Golden redhorse
Grass pickerel
Iowa darter
Johnny darter
Largemouth bass
Central mudminnow
Pirate perch

This survey was conducted on Little Portage Creek proper in St. Joseph County. The watershed delineation contains portions of the mainstem of the St. Joseph, which could, and most likely does, contain some of those species. Certain fish species inhabit both streams and lakes but some are very selective of the habitat (lotic type basins vs. headwater type streams) and the fish community assemblage in the basins formed by the Sturgis Dam and Three Rivers Dam. These basins contain oxbows, with bayou like areas, and conditions more consistent with a meso-euthrophic or eutrophic status (see the following Section 5.3 Lake for an explanation of these conditions). Fish have been stocked throughout these areas and above the river reach in Union Lake reservoir by MDNR. These fish species include bluegill, channel catfish, largemouth bass, northern pike, redear sunfish, and walleye. It is suspected that fish communities within this reach consist of a similar assemblage as above, as well as rough fish (i.e. common carp), minnow species, and gar.

5.2.4 Aquatic Plant Communities

The following plant species have been observed within the LPCW.

Natives

Elodea, largeleaf pondweed, northern milfoil, white and yellow lily pads, coontail, wild celery (*Vallisneria americana*), duckweed and emergent bulrush, arrowhead, numerous rushes, wild rice and cattails (some are non-native narrow-leaved cattail)

Invasive Exotic Aquatic Plants

Fanwort *(Cabomba)*, Eurasian watermilfoil, various leaved watermilfoil, curly-leaf pondweed, emergent Purple Loostrife, and Giant Common Reed (*Phragmites australis*).

5.3 Lakes

5.3.1 History and Background

There are very few lakes within the LPCW and only one is named. Lakes that are disconnected and not drained by an obvious channel formation of surface water are referred to as kettle lakes. Lakes in the Great Lakes Region were primarily formed from glaciation. Glaciers formed lake basins by gouging holes in loose soil or soft bedrock, depositing material across stream beds, or leaving buried chunks of ice that later melted to leave lake basins (see figure below). When these natural depressions or impoundments filled with water, they became lakes.

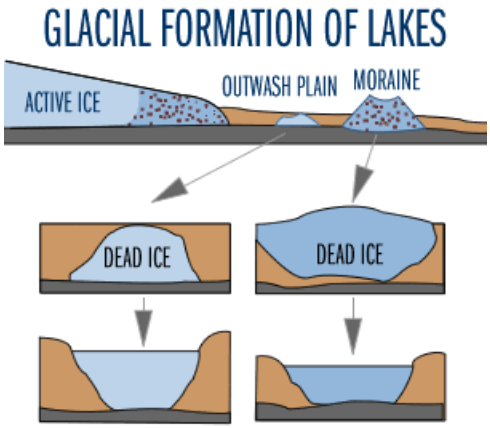

Figure 18. Glacial Formation of Lakes

USEPA's "A Primer on Limnology"

Lakes vary tremendously from their physical appearance, chemical makeup (e.g. nutrients, pH), and biological makeup (e.g. plant and animal life). Temperatures, ability of light to penetrate to different depths, winds, currents, and surrounding land uses all influence a lake's makeup and cause each lake to be unique. For the most part, lakes are generalized into three categories determined by nutrient concentrations, lake climate, and lake basin (i.e. depth and size). Trophic status is the term used to describe the nutrition supplied to the lake; oligotrophic, mesotrophic, and eutrophic are the most common trophic statuses. Oligotrophic lakes tend to be deep and lacking in nutrient-rich sediments. These types of lakes have cool water, low productivity and fish communities like cisco (lake herring), perch, walleye, and lake trout. Eutrophic lakes are highly productive, nutrient-enriched, shallow lakes that tend to have high amounts of detritus (dead organic matter originating from decaying plants). These systems have fish communities consisting of species like flathead catfish, dogfish, common carp, and other species tolerant of low oxygen levels and high temperatures. Hypereutrophic lakes are extreme examples of

eutrophication and usually do not support fish life, at least during summer months. Much of southern Michigan lakes are eutrophic and this process has been exacerbated from nonpoint source pollution. Mesotrophic lakes lie within the middle of this spectrum and are productive, enriched lakes with a middle range of nutrients and production of biological life. Mesotrophic lakes usually have an assemblage of cool water and warm water fish species like northern pike and largemouth, respectively.

Table 5. Lakes at a Glance in the LPCW

NAME	County	Acres	Depth Range	Public Access	CLMP*	Lake Assoc.	Surface Water Connection	Sewer
Noah Lake	St. Joseph	50.77	unknown	yes	No	unknown	Yes	Unknown/ suspected none

*Cooperative Lake Management Plan

5.3.2 Current Conditions and Threats

Nonpoint source pollution is a threat to lakes within the LPCW. E.coli (Escherichia coli), sediment and other forms of nonpoint source pollutants are delivered from surface water runoff into lakes and can make their way to the LPC via storm drains, ditches, and subsurface pathways. Historically, our water resources were used as ways to get rid of pollutants (i.e. dumping waste into surface water). Lakes were used much in the same way and have been interpreted as giant filters with buffering capacities. We now approach watershed management holistically. Actions on the land in the headwaters or upper reaches of the watershed affect waters downstream.

Since the Little Portage Creek Watershed Management Plan was written in conjunction with the adjacent Portage River Watershed Management Plan some data is relevant to both watersheds. The current lake conditions and threats are one example of data relevant to both watersheds. In the adjacent Portage River Watershed (PRW), in-lake management can reach upwards of $30,000 per year for aquatic weed management in Indian Lake (personal communication with Indian Lake Assoc.). Indian Lake Association has also been performing extensive data collection above and beyond CLMP testing. The Indian Lake Association determined the following.

- Lake basins will differ dramatically in water quality, especially when streams enter a lake.
- Phosphorous is likely the limiting nutrient for aquatic vegetation & algae growth (this has also been indicated in MDNR Status of the Fishery Resource Report 2011-120 Indian Lake) in Basin #1 of Indian Lake, which has three basins (basin #1 has two inlets and one outlet).
- Phosphorous concentrations at shoreline lawns are two times greater than CLMP measurements, but still in the mesotrophic range.
- Nitrate concentrations at shoreline lawns are in the mesotrophic range.
- Nutrient concentrations at road culvert sites are in the mesotrophic range
- Elevated nutrients entering Indian Lake through Portage River & Dorrance Creek are likely contributing to vegetation and algae growth in Basin #2, including harmful algae blooms.

- Individual sample variation demands continuing assessments to establish consensus trophic status and changing trends in nutrient status
- Water quality volunteers should leverage their data and expertise to initiate change in their lakes and streams by working with other agencies or groups.

Indian Lake Association also raises some valid unanswered questions:

1) Will the current TMDL study performed by MDEQ for *E. coli* reduce nutrient loads?
2) Are zebra mussels contributing to the growth of aquatic vegetation?
3) Does climate change contribute to the recent excessive growth of aquatic vegetation?
4) Does phosphorus in lake sediment control the growth of aquatic vegetation due to precipitation by calcium carbonate ($CaCO_3$)?

Although the LPCW has very few natural lakes that are connected by surface water, these same threats exist for lakes within the watershed.

5.4 Wetlands

5.4.1 History and Background

During European settlement, wetlands were systematically drained to prevent malaria outbreaks and to provide more farmland for production. This systematic drawdown of the water table through drainage consequently reduced the amount of wetlands throughout the PRW. Manipulation of the landscape may have been necessary to accommodate settlers' needs. However, two centuries later, we are starting to realize the importance of wetlands and the role they play in processing nonpoint source pollutants, providing flood storage, and providing critical habitat for sensitive animal species. According to the Landscape Level Wetland Functional Assessment Methodology Report, "the emergence of watershed management planning is driving an interest in understanding the relationship between wetland loss and degraded surface water quality." A bulleted list of evaluated wetland functions, as reported by the Little Portage Creek Watershed Landscape Level Wetland Functional Assessment (Enhanced NWI), 2013 follow.

- Flood Water Storage
- Streamflow Maintenance
- Nutrient Transformation
- Sediment and Other Particulate Retention
- Shoreline Stabilization
- Stream Shading
- Conservation of Rare and Imperiled Wetlands
- Ground Water Influence
- Fish Habitat
- Waterfowl/Water bird Habitat
- Shorebird Habitat
- Interior Forest Bird Habitat
- Carbon Sequestration
- Pathogen Retention

Some wetlands can provide all of these functions, but most wetlands within the LPCW provide at least one or more of these functions. Location, size, and type of wetlands all influence how they function and what role they play.

The following diagram, taken from the LPCW Landscape Level Wetland Functional Analysis (LLWFA), 2013, shows wetlands within a typical watershed.

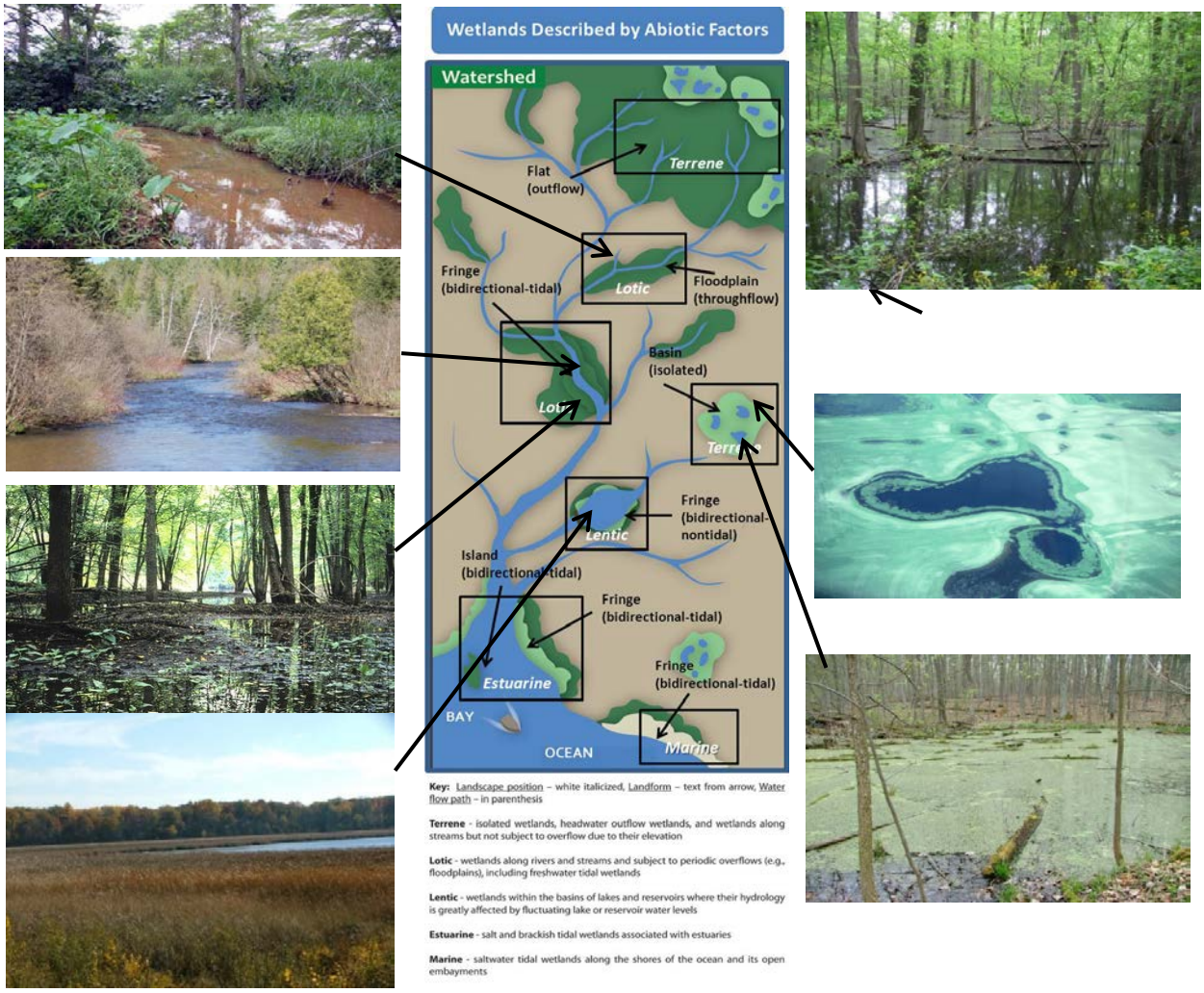

Figure 19. Wetlands Described by Abiotic Factors

5.4.2 Current Conditions and Threats

MDEQ's Landscape Level Wetland Functional Analysis shows the LPCW has lost 48% of its wetlands. Pre-European settlement wetland conditions consisted of approximately 9,515 acres of wetlands. Now, there are 4,951 existing acres of wetlands, totaling a loss of 4,564 acres. The average size of wetlands has decreased from 25 acres to an average size of 5.3 acres. The status and trend for LPCW is a significant loss of almost half its wetlands and a reduction in average wetland size of 78%. Most of the wetland loss has been from Mendon up towards the headwaters region, specifically the subwatersheds Headwaters Little Portage Creek (a loss of 23%) and Little Portage Creek (a loss of 71%).

Floodwater storage is important for reducing downstream flooding and lowering flood heights. Streamflow maintenance wetlands are sources of groundwater discharge that sustain streamflow in the watershed. Wetlands that have a fluctuating water table are best able to recycle nutrients. This function is of particular importance to the local water quality of our streams. Wetlands with vegetation support water quality maintenance by capturing sediments with bonded nutrients or heavy metals. Vegetated wetlands along waterbodies stabilize soils and reduce wave action, which reduces erosion potential. Wetlands have an ability to sequester or use carbon. This is an important aspect of water quality. Wetlands that perform water temperature control are due to proximity to streams and usually are forested or shrub-dominated.

The following table depicts the wetland function loss that LPCW has experienced since Pre-European settlement:

Table 6. Wetland Function Loss in LPCW

Function	% Change in Total Acreage	Net Acreage Lost
Flood Water Storage	-71	6513.23
Streamflow Maintenance	-21	2306.13
Nutrient Transformation	-48	4564.34
Sediment and Retention of other particulates	-43	2926.43
Shoreline Stabilization	-51	3880.57
Stream Shading	-71	2283.25
Carbon Sequestration	-61	2305.5
Ground Water Influence	-41	3768.41

Wetlands are extremely important for reptile and amphibian species like the Eastern Massasauga Rattlesnake (*Sistrurus catenatus catenatus*), a species of special concern; Northern Water Snake (*Nerodia sipedon sipedon*); the Northern Spring Peeper (*Pseudacris crucifer*); Wood Frog (*Rana sylvatica*); Northern Leopard Frog (*Rana pipiens*); and the Eastern American Toad (*Bufo americanus*). A unique kind of wetland, vernal ponds are wetlands that are isolated or not connected to other bodies of water. Within the LPCW, they support the Spotted Salamander (*Ambystoma maculatum*) and the Blue-spotted Salamander (*Ambystom laterale*).

Human interactions with wetlands are the main reason for wetland loss and threats. We cause degradation to wetlands by altering hydrology (quantity of water and flow rates), water quality degradation, increasing pollutants, and the introduction of non-native species (e.g. Eurasian Phragmites [*Phragmites australis australis*] and Purple Loostrife [*Lythrum salicaria*] has been observed in the PRW). Other threats to native wetland plants include Narrow-leafed Cattail (*Typha angustifolia*) and Reed Canary Grass (*Phalaris arundinacea*).

Hydrologic alterations are common within the LPCW. When the water table is altered, it changes surrounding wetlands, and the soil chemistry and plant and animal communities that live and grow within those wetlands. Hydrologic activities within the Watershed that negatively affect wetlands are deposition of fill material for development; drainage for agricultural production; dredging for stream channelization for development, agricultural production, and drain maintenance; diversion of water to irrigation ponds; damming and development of irrigation ponds; diversion to and from wetlands; and impervious surfaces, increasing water and pollutant runoff into wetlands.

Some examples of these observed practices within the LPCW are irrigation pond development, impervious surfaces within developed areas, agricultural tilling, road systems, dredging, drain maintenance, and filling and excavating of wetlands. Drainage and filling of wetlands, residential and industrial expansion, road systems, and agricultural expansion are major areas of concern that are threatening wetlands in the LPCW. Drain maintenance practices and tilling of agricultural fields move water from the landscape. Residential and industrial expansion increases impervious surfaces. Road systems alter hydrology and can divert surface drainage direction and can increase or decrease hydrologic water flows. The following map depicts potential wetland restoration areas.

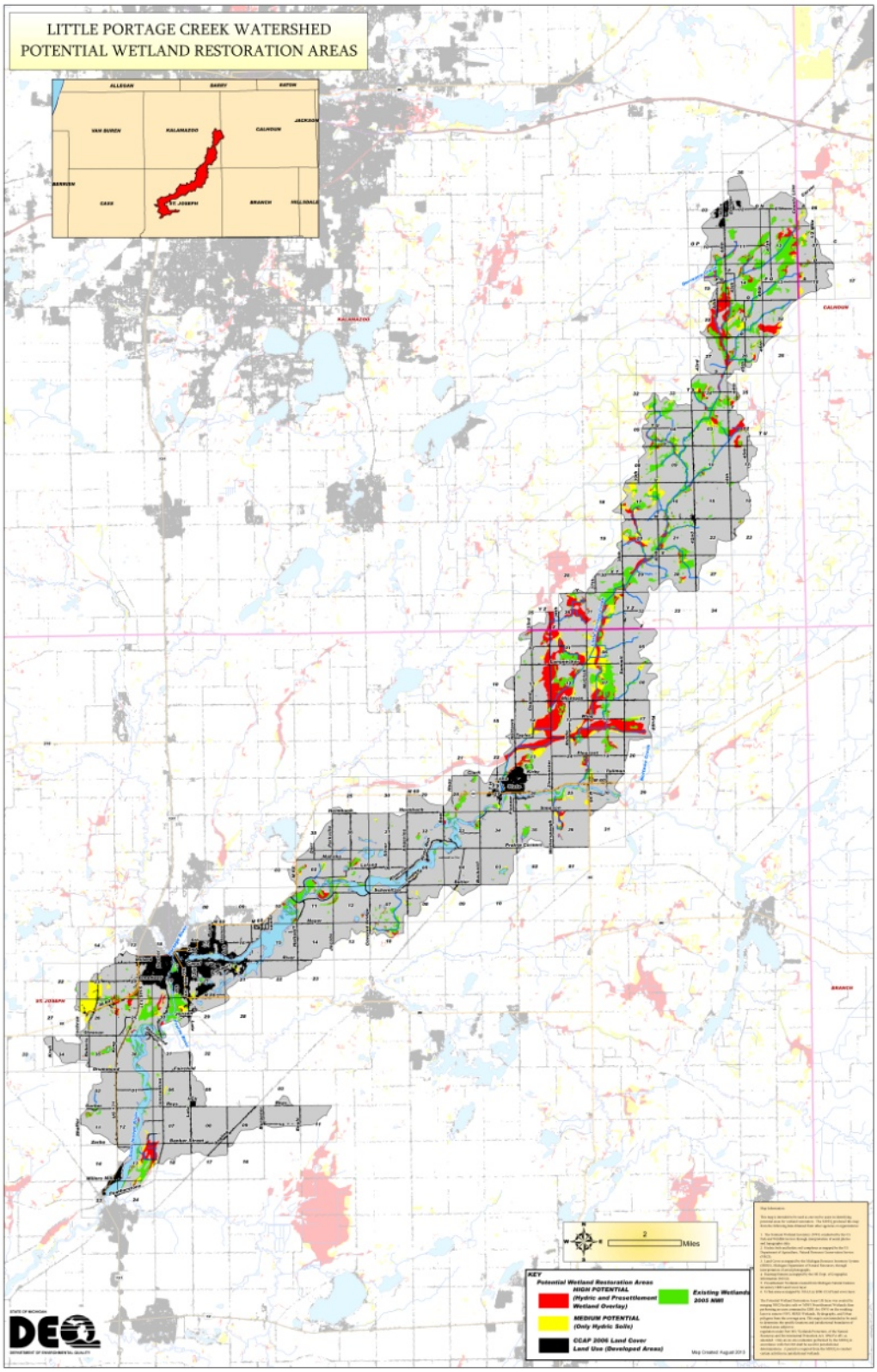

Figure 20. LPCW Potential Wetland Restoration Areas

For a complete wetland analysis see Appendix 2 - Landscape Level Wetland Functional Analysis.

5.5 Floodplains

5.5.1 History and Background

A floodplain is a level area near the stream channel that is inundated during moderate flow and is constructed by the river under present climatic conditions by deposition of sediments during overbank flooding (Leopold, 1994). What Leopold was referring to is the area around a stream, creek, drain, or other body of water that is occupied by water during periods of high volumes of water. Unconfined, flat valleys, which occur most commonly in lowland rivers, permit considerable meandering and lateral migration, and so tend to have well developed floodplains (Allan and Castillo, 2007). The LPCW displays these tendencies in its river channel and its floodplains. These floodplain areas tend to not have been developed or farmed due to the tendency to flood and due to their saturated soils. Precipitation makes its way through surfacewater and groundwater pathways and enters the stream either across the floodplain or through subsurface pathways. Then, it enters the river system via the hyporheic zone, the area directly below the bottom of the stream, or the area submersed below the stream. Floodplains are often part of wetlands. When wetlands are adjacent to waterbodies they are described as lotic wetlands (encompassing one or both sides of a river or stream) and lentic wetlands (surrounding a lake).

Before European settlement, the LPCW experienced very little manipulation from humans to its floodplains. Inhabitants likely built within the floodplain but structures were much more mobile and made from natural materials. The rivers and streams were used as highways for movement, fishing, and trapping. Floodplains had much less manipulation then than today. Structures like roads, culverts, bridges, and permanent homes are new human manipulations that have an effect on floodplain size and function.

5.5.2 Current Conditions and Threats

Wetland types within the PRW floodplains consist of paulustrine (nontidal wetlands dominated by trees, shrubs, and persistent emergent vegetation [e.g. cattails, lily-pads]) and are typically emergent, shrub-scrub, aquatic bed and forested wetland. These inundated areas provide spawning grounds for some fish species, particularly important to Northern Pike (*Esox luscius)*. Northern Pike spawn earlier than most species of midwestern fish—typically just after ice-out, February to April. Pike spawn in marsh areas with aquatic vegetation that is submerged and emergent like rushes, grasses, and sedges. Destruction of these spawning areas is a huge threat to the pike population. Floodplains are important areas for resident and migratory duck, geese and swan species. These areas provide food, habitat, and nesting for waterfowl.

Waterfowl observed using the LPCW:
Wood Duck (*Aix spona*)
Mallard (*Anus platyrhynchos*)

Amphibians and reptiles observed using the LPCW:
Eastern Box Turtle (*Terrapene carolina carolina*)
Spotted Turtle (*Clemmys guttata*) – State threatened species

Shorebirds observed using the LPCW:
Great Egret (*Ardea alba*)
Sandhill Crane (*Grus canadensis*)
Great Blue Heron (*Ardea herodias*)
Green Heron (*Butorides virescens*).

Woodland birds observed using the LPCW:
Cedar Waxwing (*Bombycilla cedroroum*)
Yellow Warbler (*Denroica petechia*)
Baltimore Oriole (*Icterus galbula*)
Eastern Kingbird (*Tyrannus tyrannus*)
Gray Catbird (*Dumetella carolinensis*)
Hairy Woodpecker (*Picoides villosus*)
Downy Woodpecker (*Picoides pubescens*)
Pileated Woodpecker (*Dryocopus pileatus*)

Birds of prey observed using the LPCW:
Cooper's Hawk (*Accipiter cooperii*)
Red-tailed Hawk (*Buteo jamaicensis*)
American Kestrel (*Falco sparverius*)

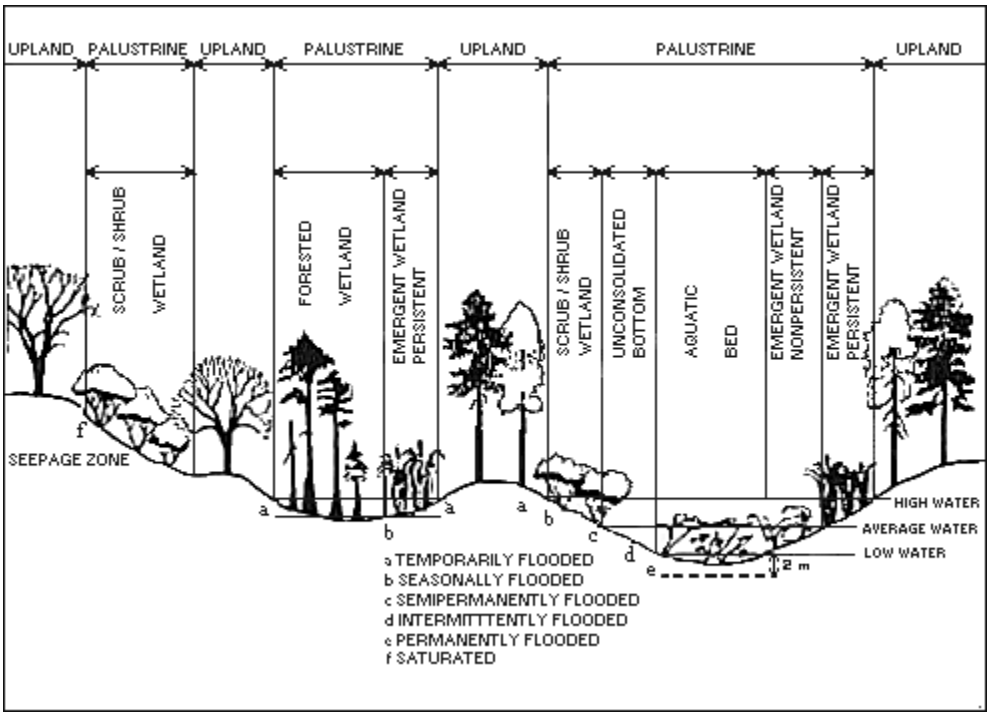

Figure 21. Wetland Classification

(Taken from USGS *Classification of Wetlands and Deepwater Habitats of the United States* http://www.npwrc.usgs.gov/resource/wetlands/classwet/palustri.htm)

Some portions of the LPCW floodplain are forested with tree, shrub and plant species.

Dominant tree species in the LPCW consist of
Silver Maple (*Acer saccharinum*)
Swamp White Oak (*Quercus bicolor*)
American Elm (*Ulmus* americana)
Slippery Elm (*Ulmus rubra*)
Basswood (*Tilia americana*)
Eastern Cottonwood (*Populus deltoids*)

Common shrub species include

Buttonbush (*Cephalanthus occidentalis*)
Red-osier Dogwood (*Cornus sericea*)
Silky Dogwood (*Cornus amomum*)
Speckled Alder (*Alnus incana*)
Spicebush (*Lindera benzoin*)

Common plant species include
Trillium (*Trillium nivale*)
Wild Ginger (*Asarum canadense*)
Wild Geranium (*Geranium maculatum*)
Eastern Skunk Cabbage (*Symplocarpus foetidus*)
Jack-in-the-Pulpit (*Arisaema triphyllum*).

Floodplains are often considered the last line of defense against nonpoint source pollutants and a home to unique wetland plant species that have the ability to process pollutants and absorb and use excess nutrients and fertilizer. Broad, expansive floodplains are associated with having large barriers to defense, and river reaches with narrow floodplains (less than 25-30 feet) are inadequate in protecting from nonpoint source runoff.

Human alterations to the stream from road building, improper bridge culvert installation, drainage, surface and groundwater withdrawals from irrigation, and building within floodplains are currently threatening floodplains.

5.6 Groundwater

5.6.1 Background and History

Groundwater is the water that is located in the porous areas between sand, gravel, silt, and clays below Earth's surface. This saturated zone is highly important to humans because we get almost 100% of our drinking water from the groundwater.

When rain falls to the ground, the water does not stop moving. Some of it flows along the land surface to streams or lakes, while some is used by plants. Some evaporates and returns to the atmosphere, and some seeps underground, into pores between the soils and bedrock formations called aquifers. Water is not stagnant: it moves via channels in these areas.

Nearly 100% of people in the watershed get their drinking water from groundwater (St. Joseph Watershed Management Plan, 2005). Water suppliers (cities and villages) drill wells through soil and rock into aquifers to reach the ground water and supply the public with drinking water. Rural homes have their own private wells drilled on their property.

5.6.2 Current Conditions and Threats

Most of the LPCW is comprised of Galesburg-Vicksburg outwash plain. Coldwater Shale Formation lies under the glacial outwash plain. Information from some drillers has depths of over 4,000 feet of shale, approximately 626 feet in Charleston Twp. The thickness of the shale limits the freshwater supply to the deposits above the shale (Luukkonen et al., 2004) or in essence the shallow area of glacial deposits above the shale. This means that most of the LPCW's groundwater is highly permeable.

Thick glacial sand and gravel deposits provide most groundwater supply. The deposits range in thickness from 50 to about 600 feet. Most wells are completed at depths of less than 75 feet in the sand and gravels that yield adequate water supplies (Rheaume, 1990).

Nitrates are a major concern within Kalamazoo and St. Joseph Counties because of the shallow permeable water table. Nitrates are a concern because elevated levels in well water have been known to cause blue-baby syndrome (i.e. methaemoglobinemia), which can lead to death in the elderly and in infants. The average concentration of nitrates in the ground water wells in Kalamazoo County was 0.01mg/L, which is equal to the statewide average. The highest average of nitrate (48.60 mg/L) was found in Charleston Twp. (Chowdhury et al., 2003). The World Health Organization (WHO) cites keeping nitrates below 50mg/L as an effective treatment measure. The USEPA set the level of contaminants in drinking water at which no health effects are likely to occur at 10mg/L. This level is far below the WHO's level and was set at this level of protection based on the best available science to prevent potential health problems (USEPA).

Major factors affecting groundwater contamination within the LPCW determined from Rheaume were municipal and industrial inputs, agricultural and rural residential inputs, animal wastes, septic-tank discharges, and fertilizer applications.

Geohydrologic factors that affect susceptibility of ground water to contamination are depth to water, net recharge or "the amount of water per unit area of land which penetrates the ground surface and reaches the water table" (Rheaume, 2003) and (Aller and others, 1985), topography, aquifer media "path length" in general the larger the particle size the less retention time of water (sand and gravel channel contaminants faster), soil media or the upper portion of the ground composition (fines retain water and promote filtration, biodegradation, sorption, and volatization where larger particles (sand) promote groundwater infiltration, and finally hydraulic conductivity of the aquifer (ability of groundwater to move via groundwater channels).

Irrigation is a major withdrawal of groundwater within the LPCW. Bedell, 1979 determined that St. Joseph County ranked 2nd in amount of irrigation water used and number of irrigators in the state. St. Joseph County ranked 1st in number of irrigated acres. St. Joseph County contains more irrigated land than any other county east of the Mississippi (Michigan State University Extension of St. Joseph County, 2006).

Table 7. Acres of Irrigated Land in St. Joseph County

Acres of Irrigated Land	1997	2002
St. Joseph County	94,999	103,980
Michigan	407,071	456,278
% in St. Joe County	23%	23%

Source: http://www.nass.usda.gov/

St. Joseph has experienced a 9 % increase in irrigation acreage from 1997 to 2002.

Not all of irrigated land is from groundwater withdrawal. However, the sheer amount of irrigated land poses implications for groundwater. Rheaume concluded that potential nitrogen inputs are 41.9% from precipitation, 4.7% from septic tanks, 2.5% from animal wastes, and 50.9% from fertilizers. The trend was that average concentrations increase as fertilizer application increases and percentage of area irrigated increases.

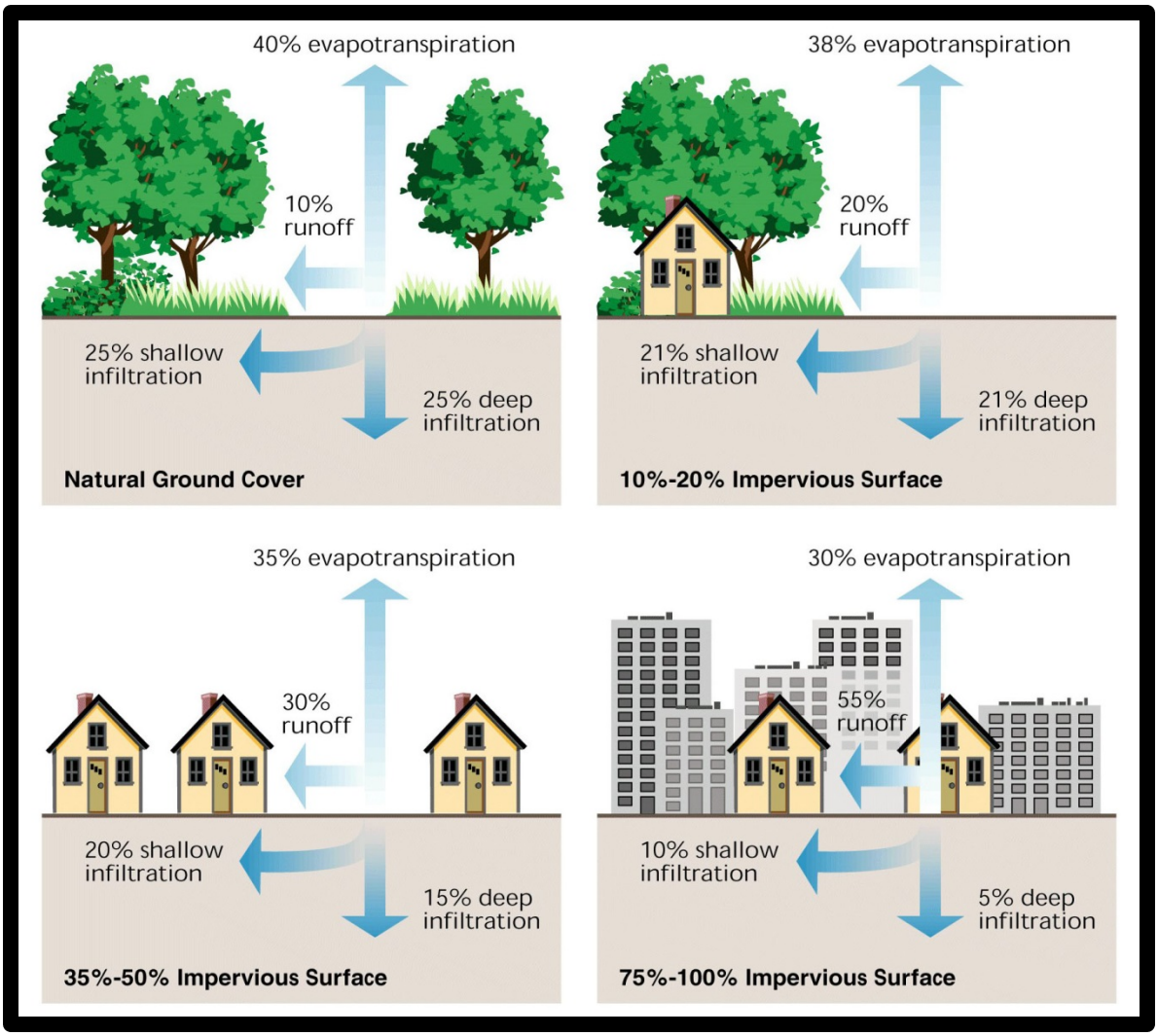

Figure 22. From Stream Corridor Restoration: Principles, Processes, and Practices

http://www.nrcs.usda.gov/Technical/stream_restoration/. Federal Interagency Stream Restoration Workshop

5.7 Forests

5.7.1 Background and History

When settlers arrived to the region, there were accounts of large oak, beech, and maple forests. The area was well known for its broken landscape of upland forested areas with mixed prairie. Forested wetlands and forested floodplain comprised a large portion of woodlands. These areas are still important today.

5.7.2 Current Conditions and Threats

Forest makes up the second largest land use at 14.12 percent, or approximately 8473 acres, within the LPCW. Current threats to forests within the LPCW are the emerald ash borer, oak wilt, pathogens, viruses, blight, development, and clearing land for agriculture.

6. Plan Development Process

6.1 Public Input

Public input and stakeholder concerns were derived from a review of existing materials, interviews with stakeholders, and other forms of stakeholder input such as informal surveys and conversations.

From this public input, the term "desired uses" is used to represent those uses of the watershed that may not be protected by law, but are of interest to local stakeholders.

Table 8. Desired Uses of the LPCW

Desired use	Source
*Environmental education	Fishbeck, Thompson, Carr and Huber, Inc. 2001
*Maintain commercial discharges	Fishbeck, Thompson, Carr and Huber, Inc. 2001
*+Protect wetlands	Fishbeck, Thompson, Carr and Huber, Inc. 2001, stakeholder interviews
*+Protect riparian corridors/floodplains	Stakeholder interviews
*+Protect wildlife corridors and breeding areas	Stakeholder interviews
*Expanding existing protected open space	Stakeholder interviews
*Explore natural rivers designation	Stakeholder input
River corridor maintenance for kayaking	Steering committee survey
Agriculture	Steering committee survey
Abandoning old drains	Stakeholder interviews
River connectivity (i.e. fish passage)	Stakeholder interviews
Irrigation	Steering committee survey
Protection of wild rice	Steering committee survey
Stream access sites for recreational use and resource protection	Steering committee survey
Increased protection of water quality through township ordinances	Steering committee survey
Mandatory buffer strips along riparian corridors	Steering committee survey

Desired use	Source
Wet meadow, sedge plantings and protection	Steering committee survey
Streambank stabilization	Steering committee survey
Moneys allocated for water quality from local, state, and federal government graphically represented on a watershed basis	Steering committee survey
Soil phosphorous concentrations of fields made available to the public	Steering committee survey
Hunting and fishing	Steering committee survey
Fish habitat improvement	Steering committee survey
Water recreation without excessive vegetation, *E. coli*, or toxic algal blooms	Steering committee survey
Controlled animal access	Steering committee survey
Warmwater fishery	Steering committee survey
Subsistence hunting and fishing for tribal members	Steering committee survey
Harvesting wild rice and other gathering activities	Steering committee survey
Total body contact (e.g. swimming) and partial body contact (e.g. fishing, canoeing)	Steering committee survey
Continued watershed monitoring	Steering committee/watershed residents

*Taken from Portage River 2006
+Expressed desire during planning phase of Portage River 2014

Stakeholder concerns include agricultural run-off—*E.coli*, phosphorous and nitrogen associated with sediment—hydrologic manipulation from dredging, sediment from roads, goose waste runoff, *E. coli*, stormwater outfalls connected directly to lakes, too much natural debris in the stream, not enough natural debris in the stream, unnatural streambank erosion, road-stream crossing erosion, unauthorized public access leading to trespassing and bank erosion, vandalism on private property where the river is accessible to the public, trash dumping, and lack of collaboration between units of government.

Stakeholder input was gained throughout the watershed planning process through personal communication, stakeholder steering committee meetings, and from the Portage River Watershed Management Plan 2006.

6.2 Previous Studies/Reports

Calhoun Conservation District: Calhoun Conservation District (CD) performed a Bank Erosion Hazard Index (BEHI) study and installed bank pins to measure erosion rates of streambanks and susceptibility to degradation of water quality in the Portage River. See Appendix 2 – Geomorphic Assessment of the LPCW.

MDEQ's Total Maximum Daily Load (TMDL) for *E. coli* in Little Portage Creek Kalamazoo, St. Joseph, and Calhoun Counties 2012: A TMDL study was performed by MDEQ biologists from 2010 to 2012. This is part of MDEQ's biennial report and USEPA's requirements for states to determine TMDLs for water bodies that are not meeting water quality standards (WQS). Elevated levels of *E. coli* were suspected within the watershed and had been previously tested by Kalamazoo County Health and Environmental Services. Partial Body Contact and Total Body Contact exceedances were found throughout the watershed. Failing or poorly designed on-site septic-discharge systems (OSDS) were determined to likely contribute a significant source from unsewered areas. Michigan is the only state in the United States with no unified statewide sanitary code with decentralized regulatory authority over OSDS (Rippke 2012, and Sacks and Flardeau, 2004). And according to (Rippke, 2012), neither Calhoun, Kalamazoo, nor St. Joseph Counties operates a time-of-sale OSDS Inspection Program, which was cited as ensuring that OSDS are functioning properly each time property is bought or sold. There have been a small amount (estimated 21 within the watershed area) of repair permits submitted to Kalamazoo County and St. Joseph (9 estimated within the watershed area). Kalamazoo has a Sewer Use Ordinance, which requires if a dwelling is within 200 ft. of a sanitary sewer it must tie into it. St. Joseph also has an ordinance but the ordinance doesn't specify requirements. There are a large number of rural stressors that have been identified as well. Percent cover of agricultural land with poor drainage, large Confined Animal Feed Operations (CAFOs) and Animal Feed Operations (AFOs). The presence of these CAFOs and AFOs indicate that a large amount of manure is produced, and must be disposed of through land based application.

Little Portage Creek Drain Morphological Assessment 2009: The Kalamazoo County Drain Commissioner (KCDC) hired Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) to conduct a morphological assessment to develop recommendations to improve the function and quality of the drain. The assessment evaluated the Drain from St. Joseph County north into the non-designated portion of Little Portage Creek to assess Drain characteristics, including cross sectional area, width to depth ratio, pattern, profile and other morphological features. Overall, the entire assessment area, including the Creek and Drain, is in poor condition due to excessive erosion, sedimentation, channel widening, undercutting, inadequate culvert sizing, fallen trees, blockages, and lack of vegetation.

Kalamazoo County Health and Community Services Environmental Health: The Kalamazoo County Health and Community Services Department monitored surface water quality at locations throughout the county. In LPCW, the creek and county drains were monitored from 2001 to 2009. During each sampling event measurements of water temperature, dissolved oxygen, pH, conductivity, and turbidity were also recorded. The sampling procedures did not comply with Michigan's Water Quality Standards

requirements, but the results can be used to assess general water quality. Many of the sites sampled have had high levels of *E. coli* at least once since sampling began in 2001. Bacterial sources are found in both rural and urban drainages. Higher bacteria counts are evident at most surface water monitoring locations within 24 hours of a rain event (Kalamazoo County Human Services Department 2004). Since 2009 Kalamazoo has not maintained the same monitoring regime and currently at this time only monitors beach locations in Kalamazoo County.

St. Joseph River Watershed: The Little Portage Creek is a subbasin of the St. Joseph River Watershed. A plan has been developed for the St. Joseph River Watershed (DeGraves 2005), and some information from that plan is applicable to the Little Portage Creek Watershed. This watershed management plan identifies agriculture as having the most significant impact on surface waters in the St. Joseph River basin. In this WMP, LPCW basin was not identified as having any impaired, threatened or designated uses. It should be noted that the plan was developed in 2005 and may not have considered more recent information.

A Biological Survey of Sites in the Upper St. Joseph River Watershed: Aquatic biologists from the MDEQ's Water Resources division determined that fish community sampling of Little Portage Creek were not supporting the warmwater fishery designated use. Macroinvertebrate information was not collected throughout the LPCW during this study.

6.3 Watershed Inventory

CCD performed multiple inventories of the watershed from 2012 through 2014 to locate, identify, and prioritize nonpoint source pollutants in the Watershed. Multiple forms of inventory were used ranging from desktop analysis (i.e. GIS, areal imagery), driving the road system, walking stream reaches, and in-stream studies.

A span of two seasons of inventory resulted in establishing and conducting a geomorphic assessment of the LPCW and a systematic analysis was taken to evaluate known, impaired and suspected areas contributing nonpoint sources of pollution. A desktop analysis of those areas, as well as factors like land use/land cover, soil types, and location to waterbodies contributing to surface water that is connected to Little Portage Creek and surrounding tributaries was evaluated pre and post field inventory.

Ground truthing suspected areas from the desktop analysis resulted in mapping concerns if they were validated and in some cases measurements were taken and used to estimate contributions. After compassing almost every road within the watershed and time spent walking tributaries and floating stretches of navigable reaches of the river, conditions within the watershed were able to be evaluated with confidence. A combination of desktop analysis and ground truthing lead to a better understanding of actual problem areas and risks associated with those areas. It is impossible to monitor all issues within the watershed, so management recommendations and areas that are threatened or impaired were determined so using a combination of observation, evaluation, and actual field data or measurements.

Driving the watershed provided observation evaluation of land based practices and a chance to map areas that were receiving land based application of manure and herbicides and pesticides adjacent to pathways of delivery to waterbodies. Floating stretches of the watershed allowed practitioners to evaluate in-stream conditions and make observations of stream reaches and natural vs. human induced impacts and how much those were threatening each particular stream reach. Culverts and dirt roads impacting or

contributing to nonpoint source pollution were recorded when found contributing to waterbodies. Multiple inventories after rain events allowed insight into suspended sediment delivery from tributaries and visual observation of elevated levels of nonpoint source runoff. Often times this lead to an area that was ½ mile to a mile from the actual waterbody. These areas would not have been located had practitioners not performed ground truthing and located nonpoint source pathways.

Watershed inventory should include the land area surrounding the stream and tributaries, the riparian area surrounding the stream and tributaries, and areas in-stream or within the channel itself. Nonpoint source pollutants originate from agricultural lands, urban areas and other land use types surrounding the channel, from the riparian area and channel bank, and from within the channel itself, but often the material within the channel itself comes from sources outside of the channel. As a result, inventory has to be directed toward the suspected pollutants typically associated with nonpoint source pollutants (i.e. overland runoff). Runoff brings sediment, fertilizers, pesticides, salts and other pollutants into the stream causing impairments to water quality. Arial imagery is used to look at: stream channel pattern which can indicate areas of stream manipulation, riparian areas lacking a sufficient buffer (natural vegetation greater than or equal to approximately 25-30 ft.)

The stream channel pattern itself can indicate if a stream has been manipulated. Undisturbed stream channels have a quicker ability to recover from impairments than does channelized or dredged streams. Stream channels that have a meandering or sinuous pattern are typically “natural” or have been left undisturbed. These types of streams have a floodplain (floodable area that is inundated with water from the channel at high flows) that is connected to the stream vs. an entrenched stream and floodplain that is disconnected from the stream. Think of a typical southern Michigan drainage ditch that is very deep and the actual wetted channel and stream surface is far below the top of the bank, this is an entrenched stream. Streams that are entrenched cannot overtop its banks and as a result move more water downstream quicker resulting in more erosional forces and downstream flooding. A stream that is connected to its floodplain deposits sediment and water onto the floodplain where physicochemical processes (the chemical changes that occur—often associated with the filtering of pollutants and toxins) are allowed to take place. The more connected our streams are to their floodplains and these processes filter nonpoint source pollutants that have moved overland into streams. It has been indicated that floodplain and wetland restoration is a productive best management practice for dealing with *E.coli.*

6.4 Watershed Research and Modeling

MDEQ Landscape Level Wetland Functional Analysis

The National Wetland Inventory (NWI) database was developed by the US Fish and Wildlife Service Northeast Region (USFWS-NE) using spatial information to estimate qualitative loss of wetland functions. Based on that original technique developed additional information was added to the NWI databaseto characterize 13 general wetland functions at a landscape level. In cooperation with the Michigan Non-Point Source unit, this technique was applied to assist with watershed management plans with wetland conservation and restoration strategies for their watershed projects. Please see Appendix 3 - Landscape Level Wetland Functional Analysis.

STEPL Pollutant Loads Analysis

The Spreadsheet Tool for Estimating Pollutant Load (STEPL) uses algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result form the implementation of various best management practices (BMPs). It computes watershed surface runoff, nutrient loads, including nitrogen, phosphorus, biological oxygen demand, and sediment delivery based on various land uses and practices. Annual nutrient loading is calculated based on runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load is calculated based on the Universal Soil Loss Equation (USLE) and sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies (http://it.tetratech-ffx.com/steplweb/). See Appendix 4 – Pollutant Load Estimates and Reductions for the complete analysis.

Geomorphic Analysis/BEHI/Bank Pins

In order to gain a better understanding of susceptibility of stream banks to erosion, a bank stability assessment consisting of the Bank Erosion Hazard Index (BEHI), near-bank stress (NBS) and bank and toe pin installations were performed in the Portage River/Little Portage Creek Watersheds at 12 stations in each watershed. A morphological assessment was prepared by Fishbeck, Thompson, Carr & Huber (FTCH) in 2009 of Little Portage Creek that determined the overall drain was in fair to poor condition with problems including but not limited to erosion, sedimentation, undercutting, lack of vegetation and improper maintenance activities. A portion of Little Portage Creek is not maintained as a designated drain (headwaters region) but portions in Kalamazoo County and most of St. Joseph County are maintained as a designated drain resulting in heavy channelization, increased conveyance, and disconnection from the floodplain, and decreased bank stability.

The bank stability inventory performed by Calhoun Conservation District (CCD) attempted to understand what portions of the watershed have an elevated risk of contributing sediment to the watershed. A general watershed inventory will also be performed to locate, investigate and identify water quality pollutants and their sources in each priority sub watershed. Secondary data relating to potential *E. coli* contributions were be collected throughout the inventory process.

See Appendix 2 – Geomorphic Assessment of the LPCW for the full report.

7. Water Quality Summary

7.1 Federal Water Quality

Under the Clean Water Act (CWA), every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the goal of "swimmable/fishable" waters. Water quality standards are ambient standards as opposed to discharge-type standards. These ambient standards, through a process of back calculation procedures known as total maximum daily loads (TMDLs) form the basis of water quality based permit limitations that regulate the discharge of pollutants into surface waters under the National Pollutant Discharge Elimination System (NPDES) permit program.

The State of Michigan's Part 4 Rules (of Part 31, Water Resources Protection, of Act 451 of 1994) specify water quality standards which shall be met in all waters of the state. Common water pollutants and related water quality standards for Michigan waters are described below.

Sediment

Sediment is soil, sand, and minerals that can take the form of bedload, suspended or dissolved material. Sediment harms aquatic wildlife by altering the natural streambed and increasing the turbidity of the water, making it "cloudy". Sedimentation may result in gill damage and suffocation of fish, as well as having a negative impact on spawning habitat. Increased turbidity from sediment affects light penetration resulting in changes in oxygen concentrations and water temperature that could affect aquatic wildlife. Sediment can also affect water levels by filling in the stream bottom, causing water levels to rise. Lakes, ponds and wetland areas can be greatly altered by sedimentation. Other pollutants, such as phosphorus and metals, can bind themselves to the finer sediment particles. Sedimentation provides a path for these pollutants to enter the waterway or water body.

Related water quality standards

Total Suspended Solids (TSS) - Rule 50 of the Michigan Water Quality Standards (Part 4 of Act 451) states that waters of the state shall not have any of the following unnatural physical properties in quantities which are or may become injurious to any designated use: turbidity, color, oil films, floating solids, foam, settle able solids, suspended solids, and deposits. This kind of rule, which does not establish a numeric level, is known as a "narrative standard." Most people consider water with a TSS concentration less than 20 mg/l to be clear. Water with TSS levels between 40 and 80 mg/l tends to appear cloudy, while water with concentrations over 150 mg/l usually appears dirty. The nature of the particles that comprise the suspended solids may cause these numbers to vary.

Nutrients

Although certain nutrients are required by aquatic plants in order to survive, an overabundance can be detrimental to the aquatic ecosystem. Nitrogen and phosphorus are generally available in limited supply in an unaltered watershed but can quickly become abundant in a watershed with agricultural and urban development. In abundance, nitrogen and phosphorus accelerate the natural aging process of a water body and allow exotic species to better compete with native plants. Wastewater treatment plants and combined sewer overflows are the most common point sources of nutrients. Nonpoint sources of nutrients include fertilizers and organic waste carried within water runoff. Excessive nutrients increase weed and algae growth impacting recreational use on the water body. Decomposition of the increased weeds and algae lowers dissolved oxygen levels resulting in a negative impact aquatic wildlife and fish populations.

Related water quality standards

Phosphorus - Rule 60 of the Michigan Water Quality Standards (Part 4 of Act 451) limits phosphorus concentrations in point source discharges to 1 mg/l of total phosphorus as a monthly average. The rule states that other limits may be placed in permits when deemed necessary. The rule also requires that nutrients be limited as necessary to prevent excessive growth of aquatic plants, fungi or bacteria, which could impair designated uses of the surface water.

Dissolved Oxygen - Rule 64 of the Michigan Water Quality Standards (Part 4 of Act 451) includes minimum concentrations of dissolved oxygen, which must be met in surface waters of the state. This rule states that surface waters designated as coldwater fisheries must meet a minimum dissolved oxygen standard of 7 mg/l, while surface waters protected for warmwater fish and aquatic life must meet a minimum dissolved oxygen standard of 5 mg/l.

Temperature/Flow

Removal of streambank vegetation decreases the shading of a water body, which can lead to an increase in temperature. Impounded areas can also have a higher water temperature relative to a free-flowing stream. Heated runoff from impervious surfaces and cooling water from industrial processes can alter the normal temperature range of a waterway. Surges of heated water during rainstorms can shock and stress aquatic wildlife, which are adapted to "normal" temperature conditions. Increased areas of impervious surfaces, such as parking lots and driveways, and reduced infiltration from other land use types, such as lawns and bare ground, leads to an increase in runoff. Increased runoff reduces groundwater recharge and leads to highly variable flow patterns. These flow patterns can alter stream morphology and increase the possibility of flooding downstream.

Related water quality standards

Temperature - Rules 69 through 75 of the Michigan Water Quality Standards (Part 4 of Act 451) specify temperature standards which must be met in the Great Lakes and connecting waters, inland lakes, and rivers, streams and impoundments. The rules state that the Great Lakes and connecting waters and inland lakes shall not receive a heat load which increases the temperature of the receiving water more than 3 degrees Fahrenheit above the existing natural water temperature (after mixing with the receiving water). Rivers, streams and impoundments shall not receive a heat load, which increases the temperature of the receiving water more than 2 degrees Fahrenheit for coldwater fisheries, and 5 degrees Fahrenheit for warmwater fisheries. These waters shall not receive a heat load, which increases the temperature of the receiving water above monthly maximum temperatures (after mixing). Monthly maximum temperatures for each water body or grouping of water bodies are listed in the rules. The rules state that inland lakes shall not receive a heat load, which would increase the temperature of the hypolimnion (the dense, cooler layer of water at the bottom of a lake) or decrease its volume. Further provisions protect migrating salmon populations, stating that warmwater rivers and inland lakes serving as principal migratory routes shall not receive a heat load which may adversely affect salmonid migration.

Bacteria/Pathogens

Bacteria are among the simplest, smallest, and most abundant organisms on earth. While the vast majority of bacteria are not harmful, certain types of bacteria cause disease in humans and animals. Concerns about bacterial contamination of surface waters led to the development of analytical methods to measure the presence of waterborne bacteria. Since 1880, coliform bacteria have been used to assess the quality of water and the likelihood of pathogens being present. Combined sewer overflows in urban areas and failing septic systems in residential or rural areas can contribute large numbers of coliforms and other bacteria to surface water and groundwater. Agricultural sources of bacteria include livestock excrement from barnyards, pastures, rangelands, feedlots, and uncontrolled manure storage areas. Stormwater runoff from residential, rural and urban areas can transport waste material from domestic pets and wildlife into surface waters. Land application of manure and sewage sludge can also result in water contamination. Bacteria from both human and animal sources can cause disease in humans.

Related water quality standards

Bacteria - Rule 62 of the Michigan Water Quality Standards (Part 4 of Act 451) limits the concentration of microorganisms in surface waters of the state and surface water discharges. Waters of the state, which are protected for total body contact recreation, must meet limits of 130 Escherichia coli (E. coli) per 100 milliliters (ml) water as a 30- day average and 300 E. coli per 100 ml water at any time. The total body contact recreation standard only applies from May 1 to October 1. The limit for waters of the state, which are protected for partial body contact recreation, is 1000 E. coli per 100 ml water. Discharges containing treated or untreated human sewage shall not contain more than 200 fecal coliform bacteria per 100 ml water as a monthly average and 400 fecal coliform bacteria per 100 ml water as a 7-day average. For

infectious organisms which are not addressed by Rule 62, The Department of Environmental Quality has the authority to set limits on a case-by-case basis to assure that designated uses are protected.

Chemical Pollutants

Chemical pollutants such as gasoline and oil can enter surface water through runoff from roads and parking lots, or from boating. Other sources can be approved processes such as permitted application of herbicides to inland lakes to prevent the growth of aquatic nuisance plants. Other chemical pollutants consist of pesticides and herbicide runoff from commercial, agricultural, municipal or residential uses. Impacts of chemical pollutants vary widely with the chemical.

Related water quality standards

pH - Rule 53 of the Michigan Water Quality Standards (Part 4 of Act 451) states that the hydrogen ion concentration expressed as pH shall be maintained within the range of 6.5 to 9.0 in all waters of the state.

7.2 Designated Uses

The State of Michigan's Part 4 Rules also require that all designated uses of the receiving water be protected. Designated uses include: agriculture, navigation, industrial water supply, public water supply at the point of water intake, warmwater or coldwater fish and other indigenous aquatic life and wildlife, partial body contact recreation, and total body contact recreation from May 1 to October 31.

The following table summarizes these designated uses and provides appropriate definitions.

Table 9. Designated Uses of the LPCW

Designated Use	General Definition
Agriculture	Water supply for cropland irrigation and livestock watering
Industrial Water Supply	Water utilized in industrial processes
*Public Water Supply	Public drinking water source
Navigation	Waters capable of being used for shipping, travel, or other transport by private, military, or commercial vessels
Warm water Fishery	Supports reproduction of warm water fish
Coldwater Fishery (as applicable)	Supports reproduction of cold water fish
Other indigenous aquatic life and wildlife	Supports reproduction of indigenous animals, plants and insects
Partial body contact	Water quality standards are maintained for canoeing, and wading
Total body contact	Water quality standards are maintained for swimming & water skiing

* Public Water Supply use is not applicable in the watershed because no communities withdraw water directly from surface water

7.3 Impairments

Water quality testing has been performed to determine whether or not the designated uses are impaired. MDEQ has performed studies to look at the designated uses and determined that most of Little Portage Creek is impaired due to the presence of E. *coli*. Fish and macroinvertebrate (small insects without a backbone which comprise an important part of the aquatic food chain) studies are used as indicators by MDEQ to determine the health of the fishery. It was determined that a poor rating of these indicated that

the warmwater fishery was impaired compared to other rivers and creeks with similar characteristics. Macroinvertebrates and fish are influenced by water quality, habitat availability, food and streamflow (Harmon et al., 2012). Little Portage Creek is suffering from degradation to its stream channel from human alteration from practices like dredging and straitening and excessive amounts of sediment which fill in pools that provide critical cover for fish and riffles which are critical to sensitive fish spawning and macroinvertebrates.

The Michigan Department of Environmental Quality (MDEQ) 2012 Integrated Report listed these findings:

> *Biosurvey sampling conducted at a single station in 2005 resulted in a poor fish metric score, and an acceptable macroinvertebrate metric score. The total and partial body contact recreation designated uses are impaired, with an E. coli TMDL scheduled for 2012. Additionally the warmwater fishery designated use is impaired due to anthropogenic substrate alterations. There is local interest in developing a WMP.*

This report has been considered addressed through the current watershed management planning process.

Current designations of impaired waters summarized from the Integrated Report, 2014 are as follows:

Table 10. Impaired Uses in the LPCW (non-point source related)

Water Body	**AUID**	**Impaired Use**	**Cause**	**TMDL Status**
Headwaters Little Portage Creek	0901-01	Total Body Contact Recreation	*Escherichia* coli	2012
Headwaters Little Portage Creek	0901-01	Partial Body Contact Recreation	*Escherichia* coli	2012
Headwaters Little Portage Creek	0901-01	Warm Water Fishery	Other anthropogenic substrate alterations	none
Headwaters Little Portage Creek	0901-01	Warm Water Fishery	Other flow regime alterations	none
Little Portage Creek and all tributaries from St. Joseph River confluence upstream to Unnamed tributary downstream of X Avenue.	0902-01, 02	Total Body Contact Recreation	*Escherichia* coli	2012
Little Portage Creek and all tributaries from St. Joseph River confluence upstream to Unnamed tributary downstream of X Avenue.	0902-01, 02	Partial Body Contact Recreation	*Escherichia* coli	2012
Little Portage Creek and all tributaries from St. Joseph River confluence upstream to Unnamed tributary downstream of X Avenue.	0902-01, 02	Warmwater Fishery	Other anthropogenic substrate alterations	none
Little Portage Creek and all tributaries from St. Joseph River confluence upstream to Unnamed	0902-01, 02	Warmwater Fishery	Other flow regime alterations	none

tributary downstream of X Avenue.				

Table 11. Impaired Uses in the LPCW (consumption related)

Water Body	AUID	Impaired Use	Cause	TMDL Status
Headwaters Little Portage Creek	0901-01	Fish Consumption	Mercury and PCB in Fish Tissue	2014
Little Portage Creek and all tributaries from St. Joseph River confluence upstream to Unnamed tributary downstream of X Avenue.	0902-01	Fish Consumption	Mercury and PCB in Fish Tissue	2014

Navigation, Industrial Water Supply, Agriculture, Warm Water Fishery, and Other Indigenous Aquatic Life and Wildlife are all currently being met. The warmwater fishery is impaired and there is no existing coldwater fishery. The State of Michigan also considers Fish Consumption a designated use for all waterbodies. There is a generic, statewide, mercury-based fish consumption advisory that applies to all of Michigan's inland lakes.

Navigation. The mainstem of the St. Joseph River and portions of several of its tributaries are declared legally navigable by the courts. All waters in the St. Joseph River basin are presumed navigable unless legally declared non-navigable. The Little Portage River (Creek), St. Joseph County is the only stream in the basin that has been declared non-navigable by the Michigan Supreme Court (Wesley and Duffy, 1999).

Public Water Supply. There are no municipal drinking water systems on the river. The primary source for drinking water comes from groundwater through private wells and municipal.

Industrial Water Supply. Supply for industrial processes. National Pollutant Discharge Elimination System (NPDES) is designed to protect Michigan's public waterbodies and is administered by the MDEQ.

The state of Michigan has determined that the discharge of pollutants to navigable waters is not a right. A discharge permit is required to use public resources for waste disposal and limits the amount of pollutants that may be discharged.

Agriculture. All uses for agriculture are currently being met. There is surface water withdrawal for irrigation and livestock watering from Little Portage Creek and its tributaries.

Warm Water Fishery. The warm water fishery designation is not being met within the entire Little Portage Creek stream reach.

Other Indigenous Aquatic Life and Wildlife. All uses for Other Indigenous Aquatic Life and Wildlife are being met.

These determinations are made by MDEQ technical staff to their standards and assessment practices. It may be perceived that some uses are not being met but an overall determination is made on a watershed basis.

7.4 Potential Impairments

Water quality can vary greatly within a single watershed. An overall assessment of the Little Portage Creek watershed's designated uses was made using several sources of information such as MDEQ's Integrated Reports, MDNR Fisheries Reports, Stakeholder input, MDEQ's Landscape Level Wetland Functional Analysis, and CCD staff inventories. Potential impairments exist throughout all waterbodies.

Table 12. Pollutants Threatening Designated Uses & Their Rankings

Designated use	Pollutant causing threat	Ranking
Navigation (threatened)	Sediment	1
	Large Woody Debris	2
	Lack of Public Access	5
	Hydrology	3
	Nutrients	4
Warmwater fishery (threatened)	Hydrology (i.e. lack of sinuosity, channelization, dredging)	1
	Sediment	2
	Temperature	3
	Bacteria/pathogens*	4
	Nutrients	5
	Chemical pollutants	6
Other indigenous aquatic life and wildlife (threatened)	Sediment	1
	Hydrology	2
	Temperature	3
	Chemical pollutants	4
	Nutrients	5
	Bacteria/pathogens	6

Partial body contact recreation (threatened)	Bacteria/pathogens (i.e. *E.coli*)	1
	Nutrients	2
Total body contact recreation (threatened)	Bacteria/pathogens (i.e. *E. coli*)	1
	Nutrients	2

* Largemouth bass virus

Table 13 shows the pollutants that have been identified in the watershed and their typical sources and causes.

Table 13. Pollutants, Sources, and Causes in LPCW

Pollutant/Problem*	Sources*	Causes*	Documented Presence in Watershed
1. Bacteria/pathogens (K)	1. Livestock (K)	1. Manure Application (K)	Lack of adherence to manure management plans. Improper handling or spreading. Manure management not used by small to medium sized operations. CAFO's can sell manure to landowners and then apply to landscape for landowner with no restrictions.
		2. Livestock facility runoff (S)	Improper manure storage and feedlot run-off.
		3. Unrestricted access (K)	Livestock observed in stream. Fenced livestock areas still allow for overland surface run-off (observed by technician).
	2. Wildlife (geese) (K)	1. Lack of riparian buffers (K)	Lack of vegetative buffer and mowing to lakeshore/stream edge makes conducive habitat for geese.
	3. Septic systems (S)	1. Poorly maintained, designed, or sited septic systems (S)	Stakeholder interviews with lake landowners stated that using dye in toilet revealed infiltration into lake

Pollutant/Problem*	Sources*	Causes*	Documented Presence in Watershed
1. Bacteria/pathogens (K) 2. (con't)		2. Lack of education or awareness (S)	Improper installation, design, and maintenance.
	4. Storm water runoff (S)	1. Change in land use (increase in impervious surface causing higher volumes of runoff) (S)	Loss of sediment and nutrient retention capacity of floodplains and wetlands. Documented by pre-settlement vs. present floodplains/wetlands. Tile drains routed to lake shore. Road and drain tiles leading to river and lakes. Surface water run-off from parking lots, roads and driveways.
		2. Lack of education or awareness (S)	Improper design, construction and or lack of installation of proper drainage methods (i.e. riser pipe, retention basin).
		3. Poor storm water management practices (S)	Urban/residential growth. Wetland drainage.
		4. Lack of riparian buffers (S)	Lack of natural shoreline design. Mowing to stream edge.

2. Sediment (K)	1. Cropland run-off (K)	1. Conventional tillage practices. Plowing adjacent to water bodies. Agricultural tiled drains. (K)	Agriculture makes up over 70% of the watershed. Documented by Watershed Technician
		2. Unrestricted access (K)	Agriculture makes up over 70% of the watershed. Documented by watershed technician.
	2. Stream bank erosion (K)	1. Change in hydrology (channelization/ditching, e.g.) (K)	Stream reaches straightened for increased drainage.
		2. Removal of stream bank vegetation (K)	Stream reaches straightened for increased drainage.
		3. Natural debris deflecting water into banks (K)	Stakeholder group observations (i.e. lake associations, watershed technicians).
		4. Improper road-stream crossing design (S)	Portage River WMP 2006
		5. Human access (K)	Portage River WMP 2006
		6. Livestock access (S)	Unimpeded access has created bank instability, lack of vegetation, and gully formation.

2. Sediment (K) *(con't)*	3. Storm water runoff (S)	1. Change in land use (increase in impervious surface causing higher volumes of runoff) (S)	Loss of sediment and nutrient retention capacity of floodplains and wetlands. Documented by pre-settlement vs. present floodplains/wetlands. Tile drains routed to lake shore. Road and drain tiles leading to river and lakes. Surfacewater run-off from parking lots, roads, driveways.
		2. Lack of education or awareness (S)	Improper design, construction and/or lack of installation of proper drainage methods (i.e. riser pipe, retention basin).
		3. Poor storm water management practices (S)	Urban/residential growth. Wetland drainage.
		4. Lack of riparian buffers (S)	Lack of natural shoreline design. Mowing to stream edge.
	4. Roads (K)	1. Dirt roads w/significant gradient (K)	Steep gradient roads contributing sediment because of lack of turnouts.
	5. Road-stream crossings (S)	1. Improper road-stream crossing design (S)	Portage River WMP 2006
		2. Gravel road grading (S)	Portage River WMP 2006
	6. Construction site runoff (S)	1. Lack of or improperly installed erosion control measures (S)	Portage River WMP 2006

3. Nutrients (K)	3.Fertilizer use (K)	1. Improper application (S)	Lack of adherence to nutrient management plans. No nutrient management plan.
		2. Lack of adequate buffers (S)	Less than 25-30 ft. of buffer along surfacewater.
		3. Tiled drains and open drains (S)	Agricultural tiled drains and open drains
		4. Lack of education or awareness (S)	No knowledge of nutrient management.
	2. Livestock (S)	1. Unrestricted access (K)	Documented by watershed technician.
		2. Lack of riparian buffers (K)	Documented by watershed technician.
	3. Septic systems (S)	1. Poorly maintained, designed, or sited septic systems (S)	Septic systems are widespread throughout the majority of the watershed. Some residential lake communities still do not have lake wide sewer systems.
		2. Lack of education or awareness (S)	Lack of knowledge of proper installation, design and maintenance.
	4. Wildlife (geese) (K)	1. Lack of riparian buffers (S)	Lack of vegetative buffer and mowing to lakeshore/stream edge makes conducive habitat for geese.

3. Nutrients (K) *(con't)*	5. Storm water runoff (S)	1. Change in land use (increase in impervious surface causing higher volumes of runoff) (S)	Loss of sediment and nutrient retention capacity of floodplains and wetlands. Documented by pre-settlement vs. present floodplains/wetlands. Tile drains routed to lake shore. Road and drain tiles leading to river and lakes. Surface water run-off from parking lots, roads and driveways.
		2. Lack of education or awareness (S)	Improper design, construction and or lack of installation of proper drainage methods (i.e. riser pipe, retention basin).
		3. Poor storm water management practices (S)	Urban/residential growth. Wetland drainage.
		4. Lack of riparian buffers (S)	Lack of natural shoreline design. Mowing to stream edge.
4. Hydrology (K)	1. Surface water (K)	1. Historic settlement and draining of landscape (K)	Pre-settlement vs. present wetlands/floodplain
	2. Reduction of base flow (K)	2. Drought (K)	Historical records indicate.
	3. Water use (K)	3. Withdrawals (K)	Increased withdrawals from agricultural irrigation. A model predicts water use.

	4. Low groundwater levels (S)	4. Increased impervious surfaces (S)	Increasing flashiness of stream resulting in less groundwater recharge/retention
		5. Lack of education or awareness (S)	Urban/residential growth. Wetland drainage.
Temperature (S)	1. Wetland/ Floodplain loss	1. Settlement, drainage, agriculture, and development (K)	Groundwater recharge is lost. Water retention/filtration is lost increasing temperature.
	2. Lack of riparian buffers (S)	1. Insufficient land use planning (S)	Urban residential growth.
		2. Change in land use (increase in impervious surface causing higher volumes of runoff) (S)	Reduced water infiltration/percolation resulting in increased water temperature.
	3. Storm water runoff (S)	1. Lack of education or awareness (S)	Urbanized storm water drainage systems.
		2. Poor storm water management practices (S)	Reduced water infiltration/percolation resulting in increased water temperature.
		3. Lack of riparian buffers (S)	Extensive low density and agriculture along many water bodies.
		4. Agricultural pesticides applied to croplands drains	Observed by watershed technician.
6. Chemical pollutants (oils, metals, pesticides, etc.) (S)	1. Storm water runoff (S)	1. Change in land use (increase in impervious surface causing higher volumes of runoff) (S)	Documented by pre-settlement vs. present floodplains/wetlands. Tile drains routed to lake shore. Road and drain tiles leading to river and lakes. Surface water run-off from parking lots, roads and driveways.

		2. Lack of education or awareness (S)	
		3. Poor storm water management practices (S)	Urban/residential development
		4. Lack of riparian buffers (S)	Extensive low density and agriculture along many water bodies.

**K=Known S=Suspected*

8. Critical & Priority Areas, Pollutants, Source

Critical areas are areas that have been determined to be contributing, or have the potential to contribute, a majority of the pollutants threatening and impairing water quality within LPCW. Priority areas have been determined through historical information, studies and reports performed separate from nonpoint source funding within the LPCW, computer modeling, aerial imagery, Arcmap GIS, and watershed inventory and studies performed due to nonpoint source funding. These areas were identified and grouped into protection, agricultural, and urban areas.

8.1 Protection Areas

Protection within LPCW should address preventing and protecting waterbodies from receiving nonpoint source pollutants that will directly impact water quality. Prioritization was determined by proximity to surface water bodies, likelihood of pathway contribution to waterbody, development pressure, existing impairments, soils, land use, and protection provided currently. High, medium, and low designation was established to prioritize for protection. Review of LPCW was taken with a holistic approach, however factors were given to prioritize management from an approach that looks at natural resources/areas currently providing high protection, medium protection and low protection. Natural resource protection and proper land use management for each particular use is extremely important to insure water quality protection. Certain land use practices can contribute higher levels of nonpoint source pollutants and are more “dangerous” for short periods of time and/or can be continuous problems. Areas that are continually contributing to waterbodies become an extreme contributor to degradation and need to be addressed through BMP’s.

Protection areas are areas that were determined to possess certain natural resource features or characteristics that were deemed corrective to and resilient to non-point source pollutants. These characteristics can help to filter, process, and store pollutants in-order to lessen the impacts to the resource from nonpoint source pollutants.

Each subwatershed was represented on the y-axis and each metric was represented on the x-axis. For each subwatershed each individual metric was marked within those columns. A total was determined from those columns and a score delineated to each subwatershed in order to rank protection zones. Protection priority watersheds were highlighted in green with a protection buffer (dark green) around surface water that has characteristics which are resilient toward nonpoint source pollution. The parameters wetland loss and pollutant loading were weighted more heavily and impairments, E. *coli* studies data and watershed analysis were weighted less heavily.

1. **Wetland Retention and functions** – Up to two marks were awarded within this category. Marks were awarded if wetland loss was under 15% and if there were multiple functions provided by those wetlands.
2. **No Impairments -** an analysis of MDEQ's 2012 and 2014 Integrated Report was used to delineate a mark for the impairment parameter. Marks were given when impairments listings were not currently listed.
3. **Escherichia coli-** Water quality data performed by Kalamazoo County Health and Community Services from approximately 2002 to 2009 was used to determine elevated levels of *E. coli.* A complete analysis of the data resulted in ranking each subwatershed from the sum of all stations sampled within those subwatersheds that yielded results which exceeded 300 bacteria colonies per 100ml of water, between 130 and 299 bacteria colonies per 100ml of water and less than 130 ml of water. The categories established from the count was highest, high, medium, low, and none. The count and those categories were used to determine whether or not each subwatershed received a mark.
4. **Watershed analysis and inventory**-Multiple watershed inventories and analysis were conducted to determine factors contributing non-point source pollutants (i.e. geomorphic assessment, aerial inventory, land based agricultural survey etc.) to the watershed and those watersheds resilience and ability to recover from and process those pollutants. Watersheds that had less of a risk received a mark and those with.

Subwatersheds were totaled from all columns and assigned a protection designation: light green – low, green – protect, and dark green – river corridor/floodplain protection.

Green- 4 marks or more

Dark Green – River corridor/floodplain protection

Light Green – Other subwatersheds have areas of resilience (current wetlands etc.) and should be considered for protection.

Table 14. Subwatershed Prioritization Matrix

Watershed	Current Wetlands	No DEQ Impairments	Lowest Pollutants Loads	Lower E. *coli*	Watershed Analysis	Total
City of Florence	I	I		I	II	5
Sturgis Dam		I	I	I	I	4
Little Portage Creek			I			1
Headwaters Little Portage Creek						0

The results from this matrix can be observed in Figure 23, below.

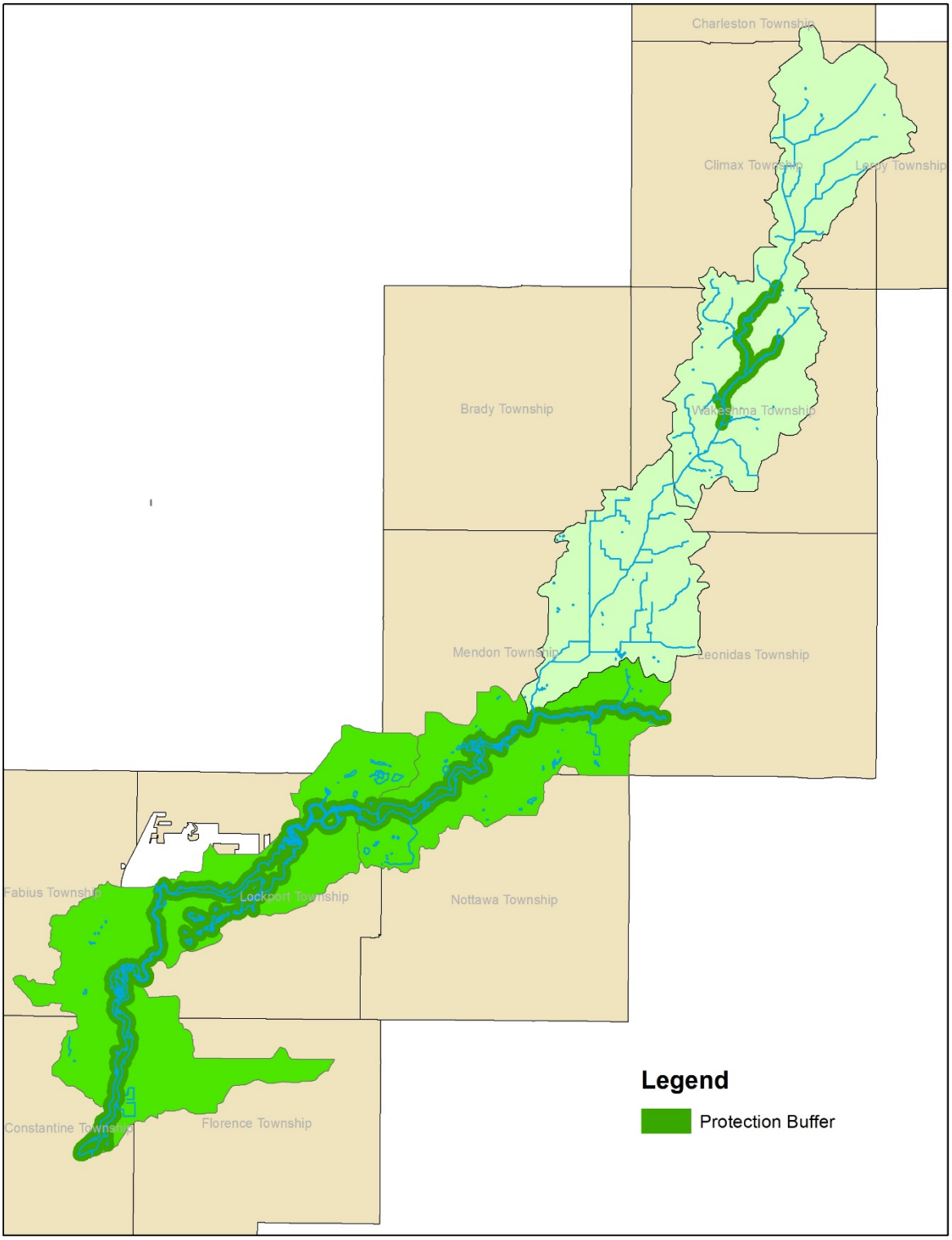

Figure 23. Protection Areas in the LPCW

8.1.1 Protection Area Pollutants and Sources

Protection Area Pollutants and Sources

Kalamazoo County Health and Community Services data, watershed surveys and studies, land use/land cover, aerial imagery, (Rippke, 2012), and other information. This information was used to evaluate the risk or threat of these areas to contribute to degradation of water quality within the PRW.

Protection Pollutants are prioritized as follows:

1. **Bacteria and Pathogens-** are a known pollutant within LPCW. Kalamazoo County Health and Community Services determined high levels of *E. coli* within the Watershed. MDEQ is currently performing a TMDL pertaining to *E. coli*. Agricultural practices, wildlife, and illicit septage systems are threatening LPCW.

2. **Sediment-** is the number one pollutant in the St. Joseph River Watershed (Degraves, 2005) and is severely impacting water quality within the LPCW. Agricultural runoff and stream manipulation are threatening LPC within the watershed and in-stream sedimentation, stream banks, and agricultural runoff are severely impacting the Watershed.

3. **Nutrients-** are a major threat to LPCW. Nutrients are often bound to sediments and agricultural runoff. Nutrients are contributing to algal growth.

4. **Hydrologic Flow Alterations-** Channel manipulations from drain establishment/maintenance practices have impaired the ability for LPC to process pollutants, as well as improper culvert sizing/placement.

4. **Pesticides and Herbicides-** have been observed and suspected throughout LPCW. Evidence of their use has been observed along stream and tributary courses. Urban areas and communities surrounding lakes are likely contributors.

5. **Temperature-** is a concern because of its direct effect upon aquatic life and raises in water temperatures are usually due to riparian corridor changes such as deforestation and increased surface runoff.

6. **Oils, grease and metals-** are suspected within the LPCW. Irrigation units adjacent to streams and urban areas are suspected to be contributing these pollutants.

In the protection areas pollutant sources are prioritized as follows:

1. **Livestock manure and wildlife-** elevated levels of *E. coli* documented in the LPCW (Rippke, 2012). Manure has been observed been applied to drains in upper reaches of the watershed.

2. **Agricultural Runoff and stream banks-** due to channelization (a moderate to amount of natural erosion occurs and not deemed to be significant)

3. **Agricultural fertilizer-** Nitrogen and phosphorus is suspected to be delivered to waterbodies from runoff, tiling, and sandy soils.

4. **Septage waste-** haulers are suspected to be leaking and have been observed on roads.

5. **Herbicide and pesticide application-** have been observed being applied next to and within streams and generally tend to be applied in small tributary reaches.

8.1.2 Agricultural Management (Protection) Areas

The agricultural management area rankings are based on the following parameters: wetland loss, pollutant loadings, impairments, E. coli studies data, and watershed analysis and inventory. A matrix with these parameters was used to rank areas for management based on priority levels very high, high, medium and low.

Each subwatershed was represented on the y-axis and each metric was represented on the x-axis. For each subwatershed each individual metric was marked within those columns. A total count of marks was used to indicate a priority level of very high (red), high (orange), medium (light green) and low (dark green). The parameters wetland loss, N, P, sediment loading, impairments, and E. coli studies data were weighted the same and watershed analysis was weighted more heavily due to identified nonpoint source contributions from inventories and multiple years' worth of information.

1. **Wetland loss**- A mark was awarded to each subwatershed if the percentage of wetland loss exceeded 15%.
2. **Pollutants loading**- Marks were awarded to each subwatershed if nitrogen loading exceeded a 80,000lbs., phosphorus loading exceeding 20,000lbs., and sediment loading exceeding 3,000lbs. through a STEPL analysis. Those amounts were determined to be excessive within the overall watershed.
3. **Impairments**- an analysis of MDEQ's 2012 and 2014 Integrated Report was used to delineate a mark for the impairment parameter.
4. **Escherichia coli-** Water quality data performed by Kalamazoo County Health and Community Services from approximately 2002 to 2009 was used to determine elevated levels of *E. coli.* A complete analysis of the data resulted in ranking each subwatershed from the sum of all stations sampled within those subwatersheds that yielded results which exceeded 300 bacteria colonies per 100ml of water, between 130 and 299 bacteria colonies per 100ml of water and less than 130 ml of water. The categories established from the count was highest, high, medium, low, and none. The count and those categories were used to determine whether or not each subwatershed received a mark.
5. **Watershed analysis and inventory**-Multiple watershed inventories and analysis were conducted to determine factors contributing non-point source pollutants (i.e. geomorphic assessment, aerial inventory, land based agricultural survey etc.) to the watershed and those watersheds resilience and ability to recover from and process those pollutants. Watersheds that had a risk received a mark and multiple risks from observations were given two marks.

Subwatersheds were totaled from all columns and assigned a priority level.

Table 15. Agricultural Subwatershed Priority Matrix

Watershed	Wetland Loss	N, P, Sediment Loading	Impairments	E. *coli*	Watershed Analysis	Total
City of Florence		I				1
Sturgis Dam	I	I				2
Little Portage Creek	I	I	I	I	I	5
Headwaters Little Portage Creek	I	I	I	I	II	6

The results from this matrix can be observed in Figure 24 Agricultural Management Areas and Priority Ranking, below.

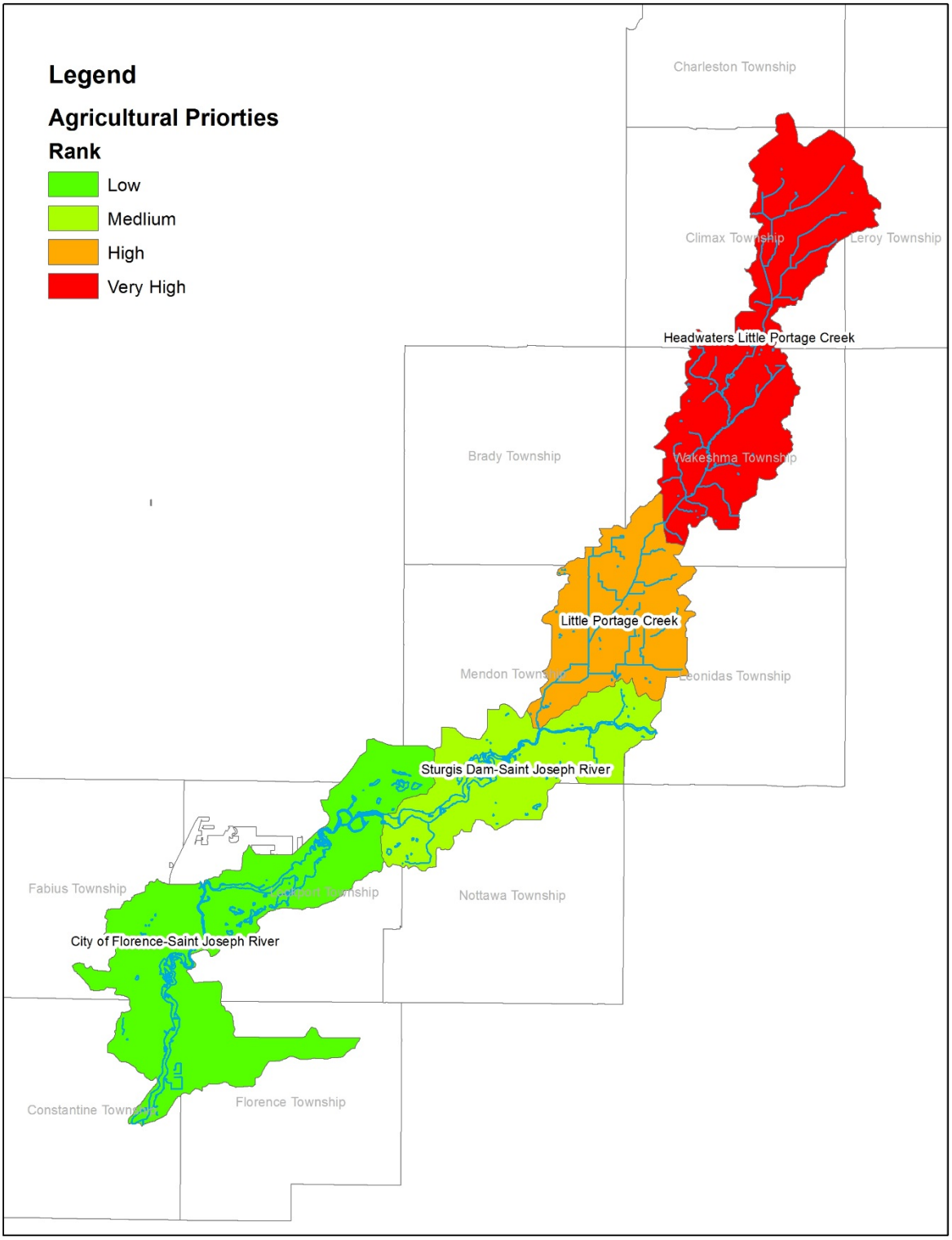

Figure 24. Agricultural Management Areas and Priority Ranking

Agricultural Management Area and Pollutant Sources

In agricultural management areas the prioritization of pollutants and sources is based on suspected significance to impaired and threatened water quality.

1**. Bacteria and Pathogens-** are a known pollutant within the LPCW (Rippke, 2012). Elevated levels are associated with human health risks.

2. **Sediment**- associated with agricultural runoff introduces nutrients like nitrogen and phosphorus into our waterways. Sediment has been observed entering waterbodies throughout the LPCW.

3. **Nutrients-** Nitrogen and phosphorus are common nutrients associated with non-point source pollutants. Nutrients are suspected throughout the LPCW.

4. **Pesticides and Herbicides-** have been observed being applied next to and within streams and generally tend to be applied in small tributary reaches.

5. **Temperature-** concern because deforestation in agricultural areas can lead to increases in temperature of streams leading to decreased oxygen levels available for survival during critical July-mean stress periods. Water withdrawal (lowering groundwater inputs) and surfacewater runoff can increase temperatures.

6. **Oil, grease, and metals-** are a concern due to the proximity of irrigation pumps (gasoline tanks) in and surrounding the stream and tributaries.

In agricultural management areas, the pollutant sources are prioritized as follows:

1. **Agricultural Runoff and stream banks**- erosion from agricultural fields and due to channelization increasing exposure of stream banks (a moderate amount of natural erosion occurs and is not deemed to be significant)

2**. Livestock manure and septage waste**- manure application is documented throughout the watershed. It has been applied adjacent to streams and has been observed running into waterbodies. Septage haulers leak onto roads and spill large amounts on agricultural fields.

3. **Fertilizer**- Nitrogen and phosphorus is suspected to be delivered to waterbodies from runoff, tiling, and sandy soils.

4. **Pesticide and herbicide application**- pesticide and herbicide application has been observed applied to drains, stream banks, and adjacent to waterbodies.

8.1.3 Urban Management (Protection) Areas

The urban management (protection) areas are based upon likely contributions of pollutants to the watershed, amount of urban land cover, problems identified by the CCD, management agencies, stakeholder groups, and municipalities, and watershed steering committee members.

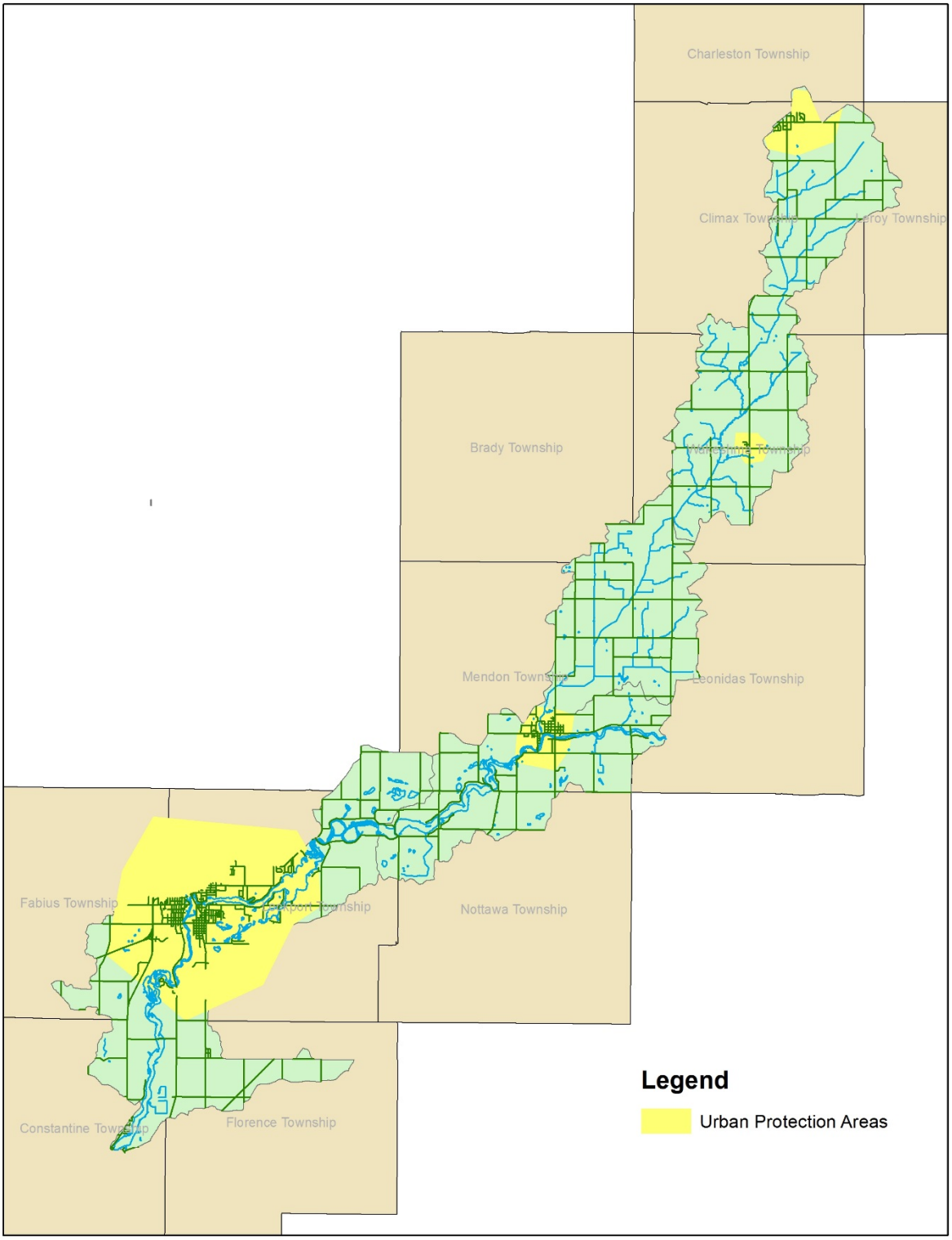

Figure 25. Urban Management (Protection) Areas

In the urban management (protection) areas, the pollutants are prioritized as follows:

1. **Bacteria and Pathogens-** are suspected to be delivered from pet waste, wildlife, sewer system failure and illicit connections

2. **Sediment**- associated with agricultural runoff introduces nutrients like nitrogen and phosphorus into our waterways. Sediment has been observed entering waterbodies throughout the LPCW.

3. **Nutrients**- are a known pollutant in urban storm water runoff.

4. **Temperature**- impervious surfaces can cause increases in urban areas.

5. **Pesticides and herbicides**- are suspected to be contributed from lawns in urban areas.

In urban management (protection) areas, the pollutant sources are prioritized as follows:

1. **Storm water runoff**- A majority of pollutants impairing or threatening designated uses in urban areas are found in storm water runoff, which largely results from impervious surfaces.

2. **Stream banks and shorelines**- increases in impervious surfaces cause flashiness and undersized storm drains increase velocities at the effluent causing increased erosion.

3. **Septage waste**- Septic systems are suspected to be a source of bacteria and pathogens.

4. **Wildlife**- geese have been suspected to cause high levels of E.coli in the LPCW.

8.2 Critical Problem Areas

The CDs, management agencies, steering committee and other stakeholders identified historic and emerging problem areas that are considered to be negatively affecting water quality (see Figure 26). These areas included inadequate buffers, unpaved road erosion, and agricultural practices (manure runoff and erosion).

Additional problem areas within the Little Portage Creek watershed include:

Areas within 1000 feet of the following features:

- Lakes
- Tributary streams, including drains
- Wetlands
- Agricultural land
- Urban areas that drain to surface waters via storm sewers or drainage ditches
- Areas of steep slopes (10% slope or greater) contiguous with any priority perimeter described above.

More problem areas are described in the Geomorphic Assessment (Appendix 1 – Geomorphic Assessment of the PRW), Water Quality Statement by Waterbody (Appendix 8 – Water Quality Statement by Waterbody), and the Master Plan & Zoning Ordinance Reviews (Appendix 3 – Master Plan and Zoning Ordinance Review).

Knowing that land uses change and new water quality issues or concerns can occur at any time, this list of problem areas should be considered, at best, a partial list that will need continual evaluation and updates.

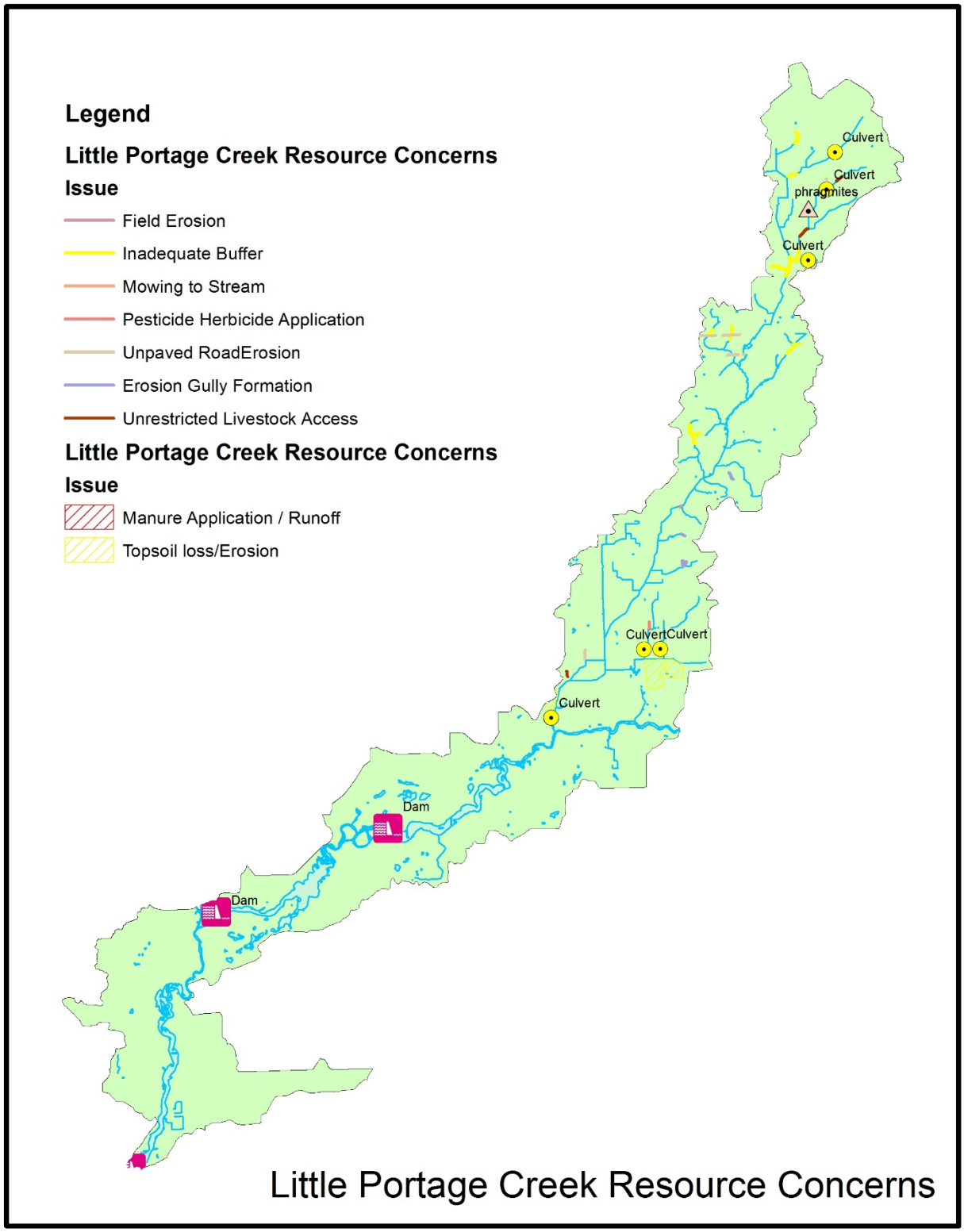

Figure 26. LPCW Resource Concerns

9. Goals and Objectives

Setting goals and objectives are necessary to implement an effective management strategy. Objectives help to set up obtainable steps to meet goals. Nonpoint source goals are not always achievable due to a multitude of factors but nonetheless are something to work towards.

9.1 Goals for Designated Uses

Ultimately LPCW has three goals to address designated uses:

1) Reduce nonpoint source pollutants impairing designated uses within the LPCW from agricultural and urban uses
2) Protect and preserve natural resources and processes that are reducing nonpoint source pollutants and stop practices that are significantly reducing the LPCW from recovery.
3) Implement an information and education program to increase awareness of the LPCW watershed non-point source pollution issues through demonstration sites, workshops, partnerships, host website, landowner guide, brochures and targeted letters.

Objectives for these goals are listed in Table XX

9.2 Goals for Desired Uses

Table 16. LPCW Desired Uses & Definitions

LPCW Desired Use	General Definition
Safe water use recreation	Reduce human health concerns within the water to improve water recreation.
Proper land use management from landowners	Promote sound agricultural and residential and municipal development use.
Continued watershed monitoring and implementation	Monitoring and protection of water resources and proper land use practices which reduce nonpoint source pollution.
Coordinated development	Promote and achieve the environmental and economic benefits of planned communities through land use planning and low impact development.
Protect and enhance natural features that protect water quality	Protect critical natural features (wetlands, floodplains) that allow for natural stream function and processes to recover from stream degradation and nonpoint source pollution.
Protect stream stage and groundwater levels	Regulate the amount of surface water and groundwater to where it is not drawn below average stream stage or groundwater reserve levels.

The following goals were developed to address the desired uses identified by stakeholders. Objectives for these goals are listed below.

1) **Safe Water Use Recreation/Increased Water Use Recreation**
    - Reduce agricultural manure application amounts (reduce the influx of *E. coli*)
    - Stop the spreading of manure until within a two day period of incorporation
    - Stop illicit discharge from septic tanks
    - Continue stream monitoring
    - Reduce nutrients from illicit septic tanks, sediment and nutrients associated with sediments from agricultural lands
    - Protect, encourage, and support parks/recreational access
    - Establish use of recreational rights by establishment of a "recreational" definition of legal navigability vs. the current "commercial" definition.
2) **Proper land use management from landowners**
    - Maintain setbacks from streams, tributaries and drains
    - Implement minimum tillage practices and bmp's to reduce nonpoint source pollutants
    - Work with FSA, NRCS and CD's to reduce impacts to surface water and groundwater
    - Properly store and dispose of fertilizers, pesticides, oil, other contaminants
    - Protect river quality by supporting educational programs for farmers, land developers, and other resource users that teach land and water management practices that prevent further degradation of aquatic resources.
    - Protect groundwater and stream water flows by educating landowners to laws requiring reporting water use under MDEQ's Water Use Program
3) **Continued watershed monitoring and implementation**
    - Continue to develop strategies with State, federal, county and private watershed monitoring to insure pollution is reduced
    - Monitoring separate from MDEQ's Water Use Program to insure water levels are not depleted from increased irrigation practices
    - Beach monitoring, well monitoring, and nutrient monitoring to understand areas of pollution risk
    - Implementation of BMPs to alleviate nonpoint source "problem areas"
    - Coordinate lake association monitoring with CD implementation
4) **Coordinated development**
    - Review local plans, ordinances and regulations addressing storm water management, nonpoint source pollution, and related water quality and natural resource issues
    - Promote setbacks and buffer strips along waterbodies
    - Develop model language for development standards
    - Develop resource maps for planning officials
    - Gain local commitment from municipalities to consider watershed context in planning efforts and to recognize storm water planning early in site planning and evaluation
    - Conduct technical workshops and provide technical assistance throughout the watershed regarding the importance of coordinated watershed and land use planning

- Develop a communication plan targeting mayors, city managers, county administrators, governing bodies, planning commissioners, community development corporations, and neighborhoods about the importance of watershed and land use planning

5) **Protect and enhance natural features that protect water quality**
    - Build support from municipalities and managing parties to enact and enforce building codes, floodplain and wetland protection, and river corridor consideration.
    - Establish protection policies through local governments
    - Promote permanent land conservancy of wetlands, floodplains, and prairies through Land Conservancies
    - Utilize NRCS and CD's to establish agricultural conservation practices
    - Plan and implement hydrologic friendly road stream crossings
6) **Protect stream stage and groundwater levels**
    - Gain an understanding of normal surface water levels during low flow periods
    - Establish baseline levels of surface water during low flow periods
    - Regulate water withdrawal of irrigation units and industry
    - Protect groundwater and stream water flows by educating landowners to laws requiring reporting water use under MDEQ's Water Use Program
    - Monitoring separate from MDEQ's Water Use Program to insure water levels are not depleted from increased irrigation practices

10. Implementation Strategies

This is one of the most important chapters of the plan—without proper strategy to attack and combat nonpoint source inputs—it can be hard to find a place to start. This chapter is designed to provide a management strategy and options for protecting and improving water quality in LPCW. Consider the fact that it will be impossible to implement urban and agricultural conservation practices on the majority of the watershed. As a result, priority sub-watershed management must take place and problem site management must also take place until nonpoint source levels can be kept in check or until new controls can be established watershed wide that will prevent every potential source from becoming a major contributor (i.e. increased regulation).

New and innovative techniques for planning and implementation are always welcome to help managers and stakeholders tackle the task of reducing pollutants but in the past a combination of one or more of the following has helped to reduce nonpoint source pollutants: educating land users and implementing cultural change; monetary incentives displayed through actual savings with practices; implementing BMPs to reduce problem sites and major contributing subwatersheds; restoring hydrologic function and the streams ability to process pollutants; and preservation and protection of current and existing natural resources. Only then can nonpoint source pollutants, which are a direct result of human activities, be rendered to the minimal.

In agricultural areas land use is highly subjective to agricultural commodity pricing and as a result tends to suffer from a protection standpoint when prices are up. Land is worth more in production than out. The Conservation Reserve Program (CRP) provides landowners with incentive to keep land out of production benefiting wildlife and water quality and providing agricultural commodity price support through the

reduction of surplus. However, the ethanol policy makes the curb of surplus unnecessary and the average cost of $57 dollars paid per acre by CRP is far less than the average on marginal corn ground (Volume 6, Issue 2 Stearns Pheasants Forever, 2013). The average on dry land (non-irrigated land) in southwest MI was approximately $552 acre (personal communication with Calhoun County MEAEP Coordinator, 2015). Lands in the western Midwest and other areas (e.g. Minnesota, Iowa, South Dakota) have seen increased production and CRP acres drastically reduced. The price of an acre of land has increased upwards of 8-10 thousand dollars in some areas. And nationally 9.7 million acres of CRP have been lost in the past five years, to a 25 year low with corn increasing by 13 million acres and the USDA determined that the CRP Program reduces soil erosion by 450 million tons per year all the while protecting surface waters from sediment and nutrient enrichment with the enrollment of 1.8 million acres of streamside and forested buffers.

10.1 Management Area Implementation

10.1.1 Protection Area Implementation

Protection Area Tasks

The following tasks should be implemented within targeted subwatersheds in high and medium protection areas:

Tasks to begin within 1-5 years:

- Enact/improve water quality protection related ordinances (see Chapter 4.3)
- Protect and restore wetlands (see Landscape Level Wetland Functional Assessment Report and Section 5.4)
- Develop and enact design and maintenance standards considering water quality for road stream crossings
- Enact a septic system time-of-sale transfer inspection ordinance at County level
- Identify and correct road/stream crossing sites
- Pave approaches that are contributing sediment and nonpoint sources of pollution
- Use innovative drain maintenance techniques and properly size road stream crosssings to extend the life of drain maintenance practices and to allow improved hydraulics.
- Institute a manure management program to educate landowners on proper time application, storage, and management to prevent elevated levels of *E. coli* from entering the system
- Use MEAEP to combat poor agricultural practices

Tasks to begin in 6-10 years:

- Protect sensitive lands
- Institute mandatory buffers to help to stop nonpoint sources of surfacewater pollution and institute and follow setbacks for application of manure, pesticides, and herbicides
- Identify and correct failing septic systems

Tasks to begin within 11-15 years

- Enact all townships within areas to establish updated zoning ordinances and update master plans to consider water quality

10.1.2 Agricultural Area Implementation

Agricultural Area Tasks

TMDL Management Direction:

(Rippke, 2012) prepared the *TMDL for E. coli in Little Portage Creek*, and made agricultural implementation recommendations. It is the consensus that these management recommendations should be taken into consideration. Priority catchments to address rural contamination issues are: 17, 24, 25, 8, 2, and 11. These recommendations are and can be found in Appendix:

It should be noted that the following bullet points, catchments, and tables referenced refer to (Rippke, 2012)

- Focused effort by local health departments and other agencies to locate and address failing OSDS and illicit connections, particularly upstream of sites 6 and 11, where human bacteriodes has been detected. This effort could include the adoption of a time-of-sale OSDS inspection program where none exists
- Outreach and educate residents on the signs that their residence may have a failing OSDS or improper connections to surface water body.
- Riparian vegetated buffer strips in agricultural areas that are not artificially drained (tiled). Catchments 11-13 and 25 had less than 20 percent of their stream miles buffered with natural vegetation (Table 7).
- Promote wetland restoration projects in areas where historic wetlands have been lost and would be beneficial for removing *E. coli* from runoff (see LLWFA in Section 5.2).
- Conduct agricultural tillage and artificial drainage survey of the watershed, followed by implementing water table management (controlled drainage) where manure is applied to artificially drained land.
- Outreach to agricultural community to encourage becoming MEAEP-verified and/or the use of best management practices on manure storage, composting, and application and the development of nutrient management plans.
- Livestock exclusion from riparian areas and providing vegetated buffers between pasture and water.

End of (Rippke, 2012) recommendations

General Management Direction:

The following tasks should be focused in the high and medium priority agricultural management areas as indicated:

Tasks to begin within 1-5 years:

-

- Utilize alternative drain maintenance/construction techniques (such as two-stage ditch design, natural channel design- meander pattern and profile, cross vanes, log armoring, etc)
- Restore riparian buffers and stabilize eroding streambanks (high priority banks which contribute unnatural amounts of erosion (See Geomorphic Assesment)
- Prevent and limit livestock access to stream with fencing and crossing (institute in combination with buffer strip to prevent runoff)
- Install agricultural BMPs (liquid and animal storage, animal composting, filter strips, no-tillage, cover crops, grassed waterways, etc).
- Protect and restore wetlands (see Landscape Level Wetland Functional Assessment report to determine and Section 5.4)

Tasks to begin within 6-10 years:

- Develop and implement manure management plans
- Utilize soil testing to determine appropriate application rates for fertilizers and pesticides
- Utilize integrated pest management
- Construct secondary containment facilities for chemical/fuel handling areas (need to have these for irrigation fueling pads with priority given to those located within river corridor)
- Improve and enforce septage waste disposal regulations

10.1.3 Urban Area Implementation

Urban Area Tasks

TMDL Management Direction:

(Rippke, 2012) prepared the *TMDL for E. coli in Little Portage Creek*, and made urban implementation recommendations. It is the consensus that these management recommendations should be taken into consideration. The top five priority catchments to address urban contamination issues are: 15, 1, 5, 8 and 16. These recommendations are and can be found in Appendix:

It should be noted that the following bullet points, catchements, and tables referenced refer to (Rippke, 2012)

- Survey of Mendon and Climax storm sewer outfalls to look for dry-weather discharges or other signs of illicit connections.
- Outreach to educate residents on backyard conservation, which include proper pet waste management, rain gardens, rain barrels, improving storm water infiltration and storage, and discouragement of congregating wildlife. This effort could be targeted to residents in the villages of Mendon, Climax, and Fulton, as well as riparian land owners throughout the watershed.
- Outreach to educate residents on the signs that their residence may have improper connections to a sanitary or storm sewer or a surface water body.
- Adoption of pet waste ordinances.

End of (Rippke, 2012) recommendations

General Management Direction:
The following tasks should be focused in the high and medium priority urban management areas as indicated.
Tasks to begin within 1-5 years:

- Utilize stormwater best management practices (road/parking lot sweeping, stormceptors, rain gardens, constructed wetlands, vegetated swales, etc)
- Enact stormwater and post construction control ordinances (see the Southwest Michigan Planning Commissions Low Impact Development for Michigan; A Design Guide for Implementers and Reviewers at www.swmpc.org/downloads/lidmanual.pdf or see model stormwater ordinance at www.swmpc.org/ordinances.asp).
- Identify and correct illicit connections or discharges to stormwater system
- Utilize best management practices for road maintenance (such as alternative deicing methods)

Tasks to begin within 6-10 years:

- Install sewer systems in urban areas around populated lakes
- Increase or expand household hazardous waste disposal options
- Distribute spill kits

Tasks to begin within 11-15 years:

Properly maintain and design municipal sewer system infrastructure

10.2 Information and Education

It sounds elementary but a well implemented information and education strategy can lead to reform of traditional activities that cause degradation to water quality. People that use the land are not always aware that the day to day activities they are performing contribute to water quality degradation. Informing the public of what actions affect water quality and how they can change their activities to lessen the effects of nonpoint source pollution is critical.

An information and education strategy was developed and implemented during Phase 1 of the Portage River/Little Portage Creek Watershed planning process (see Appendix 4 – Social Survey). Phase 1 is merely the planning stage before implementation.

Target Audience	Description of Audience	General Message Ideas	Potential Activities
Businesses	This includes businesses that perform activities that can impact water quality, for example lawn care/landscape companies, car washes, etc.	Clean water helps to ensure a higher quality of life that attracts workers and other businesses	Workshops, presentations, brochures, flyers, fact sheets, one-on-one contact
Developers/ Contractors/ Engineers	Developers, builders, engineers	Water quality is an important consideration to property values	Newsletter articles, workshops, presentations, tours, brochures, flyers, fact sheets, trainings
Farmers/ Producers	Agricultural landowners and renters of agricultural lands	Protecting water quality is a long-term investment that can save money by decreasing inputs	Workshops, presentations, brochures, flyers, fact sheets, one-on-one contact, tours, media articles
Government Officials/Staff	Elected and appointed officials of cities, townships, villages, counties, drain and road commissioners, state & federal elected officials	Water quality is tied to economic growth, property values, tax revenue, and public health	Training, workshops, presentations, brochures, flyers, fact sheets, WMP, one-on-one contact, media articles
Children/ Students	Any child visiting, living in, or attending school in the watershed	We all depend on clean water	Student stream monitoring, teacher trainings, videos, curriculum
Property Owners	All property owners in the watershed, including absentee	Water quality can impact property values and health	Media, flyers, brochures, fact sheets, website, tax bill inserts, workshops, presentations, one-on-one contact, signage
Riparian Property Owners	Owners of property adjacent to the River, stream, drain, or lake	Water quality can impact property values and health	Media, flyers, brochures, fact sheets, website, tax bill inserts, workshops, presentations, one-on-one contact, signage
Recreational users	Anyone engaging in recreational activities within the watershed	Healthy water is important for enjoying recreational activities	Website, kiosks, brochures/flyers/fact sheets, media

Table 17. I & E Strategy to Reach All Audiences of LPCW with Water Quality Messages

10.3 Planning and Studies

A geomorphic assessment of the LPCW was performed by the CD to analyze the amounts of natural streambank erosion vs. human induced erosion from agriculture and drain maintenance/establishment. Sediment is a major polluter and was determined through the Portage River Watershed Management Plan 2006 and the St. Joseph River WMP 2005 to be the major nonpoint source pollutant. The Kalamazoo County Drain Commission hired FTCH to perform an analysis of LPC. This report concluded that the entire assessment area, including the Creek and Drain, is in poor condition due to excessive erosion, sedimentation, channel widening, undercutting, inadequate culvert sizing, fallen trees, blockages, and lack of vegetation. Aquatic biologists from the Water Resources division determined that fish community sampling of Little Portage Creek were not supporting the warmwater fishery designated use reported in *A Biological Survey of Sites in the Upper St. Joseph River Watershed*. Macroinvertebrate information was not collected throughout the LPCW during this study. MDEQ biologists finished a TMDL study and determined that LPC was not meeting total water body contact recreation and partial water body contact recreation due to *E. coli.* MDEQ also performed a LLWFA that determined that LPCW has lost approximately 48% of its wetlands from Pre-European Settlement. A highly manipulated stream channel, nonpoint source pollutant loads from surface water runoff, and very little natural resource protection has all contributed to the degradation of LPCW. Although not determined as a priority watershed in (Degraves, 2005), these impairments and evidence from watershed work would indicate a need for implementation and collaborative efforts from management agencies, priority funding, and stakeholder groups to attempt to alleviate degradation to water quality.

10.4 Current Efforts

Kalamazoo, Calhoun, and St. Joseph MAEAP provide annual well-water testing focused primarily on nitrates and Coliform bacteria. Residents within the watershed who are not aware of their results should participate in this program.

Hopefully, the management plan will be used for implementing the management strategy. There are no more known LPCW efforts. MDEQ and MDNR perform random rotational based sampling regimes determined in the year previous to sampling. There are no known efforts planned by MDNR at this time. Future monitoring by MDEQ will take place on a five-year rotational basis monitoring effort, when resources allow, and once actions have been performed to address the concerns of sources contributing to *E. coli*, as describe in the TMDL for LPCW.

MDEQ does regulate CAFOs and AFOs when they are of a certain size. For more on AFOs and CAFOs please see http://www.michigan.gov/deq/0,4561,7-135-3313_3682_3713-96774--,00.html. There are approximately 15 AFOs within the LPCW and 1 adjacent or on the border with land within the watershed. Kalamazoo, St. Joseph, Calhoun and Branch County offer MEAEP assistance to private individuals working towards environmentally friendly agricultural practices and agricultural producers with federal contracts have to comply with BMPs and certain considerations given to federal requirements administered through Farm Service Agency (FSA) and the Natural Resource Conservation Service (NRCS).

Protection Areas (see Figure 23) High priority: Sturgis Dam-St Joseph River, City of Florence-St. Joseph River, and the 100-year floodplain valley plus a 30' riparian buffer

Task	Pollutant	Source	Cause	Begin Implementation	Potential Partners	Estimated Cost	Potential Funding or Program	Milestones (after implementation begins)	Proposed Evaluation Method
Enact/Improve water quality protection related ordinances	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Streambanks, Stormwater runoff (impervious surfaces and storm drains)	Increased flow fluctuations, Insufficient land use planning	2016-2020	Municipalities, Land conservancies	$10,000 per municipality	Municipalities, MDEQ 319	By 2020: 3 municipalities By 2023: 7 municipalities By 2026: 13 municipalities	Number of ordinances enacted, Number of municipalities with ordinances
Protect/restore wetlands	Sediment	Streambanks	Increased flow fluctuations	2016-2020	Land conservancies, Nature Centers, Ducks Unlimited, NRCS, Counties, land use planners	$3,000-$6,000/acre to purchase $3,000/acre for easement	MDEQ 319, NAWCA, Ducks Unlimited, Counties	By 2020: 120 acres By 2023: 320 acres By 2026: 720 acres	Number of acres protected/restored, Number of landowners protecting/restoring wetlands, Estimate pollutant load reduction
Develop & enact design & maintenance standards for road stream crossings	Sediment	Streambanks	Lack of riparian buffers	2016-2020	Road Commissions, Municipalities, Land conservancies, Drain Commissions	$5,000/agency	Road Commissions, Municipalities, Drain Commissions (road agencies)	By 2020: 1 road agencies By 2023: 2 road agencies By 2026: 3 road agencies	Number of agencies enacting improved standards
Enact a septic system time-of-sale transfer inspection ordinance at County level	Nutrients, bacteria/ pathogens	Septage waste	Improper design or maintenance of septic systems	2016-2020	County Health Depts, Land conservancies	$2,000/county	Counties	By 2020: 1 county By 2023: 2 counties By 2026: 3 counties	Number of counties enacting ordinances
Identify, correct road/stream crossing sites	Sediment	Streambanks	Lack of riparian buffers, failing culverts	2016-2020	Road Commissions, Municipalities, Drain Commissions	$10,000-$150,000/site	Road Commissions, Municipalities, Drain Commissions (road agencies), grants	By 2020: 1 county By 2023: 2 counties By 2026: 3 counties	Number of road/stream crossing sites corrected
Pave approaches that contribute sediment and nonpoint sources of pollution	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff	Improper design, lack of stormwater mgmt	2016-2020	Road Commissions, Municipalities, Drain Commissions	$5,000-$20,000/site	Road Commissions, Municipalities, Drain Commissions, grants	By 2020: 1 county By 2023: 2 counties By 2026: 3 counties	Number of paved approaches

Use innovative drain maintenance techniques and properly size road stream crossings to extend the life of drain maintenance practices and allow improved hydraulics	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Streambanks, Stormwater runoff	Improper design, lack of stormwater mgmt, lack of land use planning	2016-2020	Drain Commissions, Municipalities, Road Commissions, Land conservancies	$10,000-$300,000/site (depending on technique)	Drain Commissions, Road Commissions, Municipalities, grants	By 2020: 1 site By 2023: 7 sites By 2026: 11 sites	Number of innovative drain maintenance techniques utilized, number or road stream crossings propertly sized
Institute manure mgmt program for education, storage, and mgmt	E.coli	Agriculture	Improper timing, lack of education, lack of mgmt planning	2016-2020	NRCS, Technical Service Providers, Conservation Districts, Ag producers	$500-$5000/per plan	NRCS Farm Bill, grants	By 2020: 5 plans By 2023: 12 plans By 2026: 20 plans	Number of plans written, Estimate pollutant loading reduction
Use MAEAP to combat poor ag practices	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Agriculture	Lack of education, lack of planning	2016-2020	NRCS, Technical Service Providers, Conservation Districts, Ag producers	$30,000 per County	MDARD	By 2020: 10 MAEAP verifications By 2023: 15 MAEAP verifications By 2026: 20 MAEAP verifications	Number of MAEAP verified farms
Protect sensitive lands	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff	Insufficient land use planning	2021-2025	Land conservancies, Municipalities, Counties, land use planners, landowners	$3,000-$6,000/acre to purchase $3,000/acre for easement	MDEQ 319, NAWCA, Ducks Unlimited, Counties, grants	By 2026: 200 acres By 2029: 500 acres By 2032: 1000 acres	Number of acres protected, Estimate pollutant load reduction
Institute mandatory buffers to help stop nonpoint sources of surface water pollution and institute and follow setbacks for application of manure, pesticides, herbicides	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff, Agriculture, Riparian Landowners	Insufficient land use planning, insufficient education, lack of planning	2021-2025	Municipalities, land use planners, landowners	$700/acre	NRCS Farm Bill, grants, landowners, Municipalities	By 2026: 100 acres By 2029: 300 acres By 2032: 500 acres	Number of acres, Estimate pollutant load reduction
Identify and correct failing septic systems	Nutrients, bacteria/ pathogens	Septage waste	Improper design or maintenance of septic systems	2021-2025	Landowners, Health Departments	$200-$6000/system	USDA Rural Development	By 2026: 5 systems By 2029: 13 systems By 2032: 28 systems	Number of systems identified and corrected, Estimate pollutant load reduction

Agricultural Management Areas (See Figure24)- VERY High priority watersheds: Headwaters Little Portage Creek. High priority watersheds: Little Portage Creek

Task	Pollutant	Source	Cause	Begin Implementation	Potential Partners	Estimated Cost	Potential Funding or Program	Milestones (after implementation begins)	Proposed Evaluation Method
Focused effort by local health departments and other agencies to locate and address failing OSDS and illicit connections where human bacteroides has been detected	E coli	Failing OSDS, stormwater runoff, livestock, manure land applications, wildlife	Illicit connections, artificial drainage, manure, lack of buffer strips	2016-2020	County Health Depts, MDEQ	$500-$15,000	Landowner, grants	By 2026: 10 sites corrected By 2029: 15 sites corrected By 2032: 25 sites corrected	Estimate pollutant load reduction
Outreach & education to residents on signs of failing OSDS or improper connections	E coli	Failing OSDS, Improper connections	Lack of education	2016-2020	County Health Dept, MDEQ	$15,000/yr	County Health Depts, MDEQ	By 2026: 1 County Ed Prog By 2029: 2 County Ed Progs By 2032: 3 County Ed Progs	Number of residents reached
Install riparian vegetated buffer strips in ag areas that are not tiled	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Ag fields, streambanks	Lack of buffer strips to filter pollutants	2016-2020	NRCS, Ag producers, MAEAP, Conservation Districts	$700/acre	NRCS, grants	By 2026: 500 acres By 2029: 800 acres By 2032: 1500 acres	Estimate pollutant load reduction
Promote wetland restoration projects in areas where historic wetlands have been lost and would be beneficial for removing E coli from runoff	E coli	Stormwater runoff, improper ag applications	Loss of historic wetlands & their functions	2016-2020	NRCS Farm Bill, CD's land use planners, MAEAP	$3,000-$6,000/acre to purchase $3,000/acre for easement	NRCS, USFWS, grants	By 2026: 3 restored wetlands By 2029: 8 restored wetlands By 2032: 12 restored wetlands	Estimate pollutant load reduction

Conduct ag tillage and artificial drainage survey of watershed, followed by implementing water table mgmt where manure is applied to artificially drained land	E coli	Improper manure management practices	Lack of education, artificial drainage	2016-2020	NRCS Farm Bill, CD's, Land use planners, MAEAP	$1,000/acre	NRCS Farm Bill, MAEAP, grants	By 2026: 5 farms utilizing water table mgmt By 2029: 10 farms utilizing water table mgmt By 2032: 20 farms utilizing water table mgmt	Estimate pollutant load reduction
Outreach to ag community to encourage MAEAP verifications and/or the use of bmps on manure storage, composting, application & development of nutrient mgmt plans	E coli	Improper manure management practices	Lack of education	2016-2020	NRCS Farm Bill, CD's MAEAP	$30,000/County	MAEAP, grants	By 2026: 10 MAEAP verifications By 2029: 15 MAEAP verifications By 2032: 20 MAEAP verifications	Number of MAEAP verified farms
Livestock exclusion from riparian areas and providing vegetated buffers between pasture and water	E coli	Livestock access to water	Lack of livestock exclusion, lack of buffers	2016-2020	NRCS Farm Bill, MAEAP, CD's	$1,000-$3,000/acre	MAEAP, NRCS Farm Bill, grants	By 2026: 3 sites By 2029: 6 sites By 2032: 10 sites	Estimate pollutant load reduction
Develop & implement manure management plans	Nutrients, bacteria/ pathogens	Livestock waste	Improper manure management	2016-2020	NRCS, Conservation Districts	$4,000-$10,000/plan	Farm Bill Programs, MAEAP	By 2026: 2 plans By 2029: 5 plans By 2032: 8 plans	Number of plans developed, E.coli monitoring program
Utilize soil testing to determine appropriate application rates for fertilizers and pesticides	Nutrients, pesticides	Stormwater runoff (lawns, parks, golf courses, agricultural lands)	Improper application or overuse of fertilizers and pesticides	2016-2020	MSU-E	$4/acre/year for field crops $14/acre/year for specialty crops	None known	By 2026: 20 tests By 2029: 30 tests By 2032: 45 tests	Number of soil tests performed
Utilize integrated pest management	Nutrients, pesticides	Stormwater runoff (lawns, parks, golf courses, agricultural lands)	Improper application or overuse of fertilizers and pesticides	2016-2020	MSU-E, NRCS	30/acre/year for field crops $120/acre/year for orchards $80/acre/year for vegetables	None known	By 2026: 5 landowners By 2029: 8 landowners By 2032: 12 landowners	Number of landowners utilizing IPM

Urban Management Areas (See Figure 25) - High priority areas: Climax, Fulton, Mendon, Three Rivers

Task	Pollutant	Source	Cause	Begin Implementation	Potential Partners	Estimated Cost	Potential Funding or Program	Milestones (after implementation begins)	Proposed Evaluation Method
Utilize stormwater best management practices	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff (impervious surfaces and storm drains), streambanks	Lack of stormwater management, increased flow fluctuations	2016-2020	Municipalities, Drain Commissions, Road Commissions	Practice dependent	Municipalities, MDEQ	By 2026: 2 municipalities By 2029: 4 municipalities By 2032: 6 municipalities	Number of municipalities using BMPs, estimate pollutant load reductions
Enact and enforce stormwater control ordinances	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff (impervious surfaces and storm drains)	Lack of stormwater management	2016-2020	Municipalities, Drain Commissions, Road Commissions	$5,000/municipality	Municipalities, MDEQ	By 2026: 2 municipalities By 2029: 4 municipalities By 2032: 6 municipalities	Number of municipalities with ordinances enacted & enforced
Identify and correct illicit discharges or connections	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff (impervious surfaces and storm drains)	Illicit connections or discharges	2016-2020	Drain Commissions, Road Commissions, Municipalities	$500 - $5,000/site	Drain Commissions, Municipalities, Road Commissions	By 2026: 2 sites By 2029: 4 sites By 2032: 6 sites	Number of connections or discharges identified and corrected
Utilize best management practices for road maintenance	Sediment, salt	Stormwater runoff (roads and parking lots)	Improper road salt/sand application and snow disposal	2016-2020	Road Commission, Municipalities	$50-$1,000/practice	Road Commission, Municipalities	By 2026: 2 road agencies By 2029: 3 road agencies By 2032: 5 road agencies	Number of road agencies adopting improved practices, Estimate sediment load reduction
Increase household hazardous waste disposal options	Nutrients, pesticides, oil, grease, fuel	Stormwater runoff (lawns, parks, golf courses, agricultural lands, impervious surfaces, storm drains)	Improper storage/disposal of hazardous materials	2016-2020	Counties, Health Departments	$15,000/yr	Counties, Health Departments, Municipalities, Landfills, Private Sector	By 2026: increase by 2 days/sites By 2029: increase by 3 days/sites By 2032: increase by 5 days/sites	Number of disposal sites/days, Amount of waste collected

Distribute spill kits	Oil, grease, fuels	Stormwater runoff (impervious surfaces and storm drains)	Spills and leaks	2016-2020	Conservation Districts	$200/kit	MAEAP, Conservation Districts	By 2026: 10 kits By 2029: 20 kits By 2032: 50 kits	Number of spill kits distributed
Proper maintenance and design of sewer system infrastructure	Nutrients, bacteria/pathogens	Septage waste	Sewer system/infrastructure failure	2016-2020	Municipalities, Drain Commissions, Road Commissions	Dependent on needs	Municipalities, MDEQ, USDA Rural Development	By 2026: 2 municipalities By 2029: 4 municipalities By 2032: 6 municipalities	Number of system improvements, Number of municipalities with regular system inspection

11. Evaluation

Evaluation after the development of the plan, BMPs, and knowledge and awareness of watershed residents will help to understand the effectiveness of the watershed planning and implementation process and ultimately its effects on water quality. Measuring results and sharing information moves an effective plan forward toward achieving higher levels of water quality. This success cannot be measured instantaneously it needs to be monitored over time. The Calhoun Conservation District, in partnership with local, state, and federal conservation and environmental agencies such as the Kalamazoo County Health Department, MDEQ, MDNR, USGS, and EPA should be the responsible party for managing, coordinating, and evaluating the effectiveness of implementation tasks.

11.1 Knowledge and Awareness

Knowledge and awareness is a building block for changing our thoughts and actions on how we interact with the environment. Actually changing our way of thinking and our interaction with the land can result in positive change for water quality. Our first evaluation should consider knowledge and awareness. Documenting this change can help us understand effectiveness of our efforts. Ways used to measure and evaluate this during the planning and implementation process are and can be:

1.) Large watershed scale pre and post social survey of watershed residents
2.) Evaluating attendees and number of participants at watershed workshops (soil health workshop, MNSP)
3.) Targeted mailings to watershed residents with identified areas of protection or in need of BMPs (watershed model
4.) Use of websites (CCD, KCD, SJCD), pamphlets (landowners guide etc.), and other documents produced to educate landowners and watershed residents

11.2 Documenting Implementation

Implementation of BMPs or best management practices should alleviate identified water quality degradations to certain water bodies. Certain targeted concerns that are contributing considerable amounts of nonpoint source pollutants to LPCW need to receive spot treatment to allow the watershed to recover as a whole. Watershed recovery can take decades but in order to stop continued polluting and start the recovery process BMPs need to be installed to address these threats. The evaluation will involve identifying and tracking individuals, organizations, and governmental units involved in implementing and adopting BMPs. These are typically structural, vegetative, or managerial. Overall documentation can involve a number of BMPs installed, look at BMP estimated pollutant reductions and attempt to measure actual reductions.

11.3 Monitoring Water Quality

Water quality monitoring can comprise a suite of different parameters. Federal, state, and local units of government as well as private organizations all monitor water quality in different forms and project scope. Water quality monitoring should be continuous and should take place year after year. This is not always possible and often time unfeasible. Costly monitoring equipment, software and training is a challenge for organizations and units of government. Between federal, state, and local monitoring efforts measurable parameters and standardized information can be used to measure and describe past and current water conditions and quality.

1. Lake that voluntarily performs CLMP monitoring could be expanded throughout the PRW.

2. Benthic Macroinvertebrate monitoring over a continued seasonal sampling regime would yield much better information as to what subwatersheds are continually being impaired with sediment

3. Thermal monitoring needs to be performed. 2014 was an especially cool year but tributaries in the headwater region indicate that they could be considered for a cold-transitional classification. Importance should be given to protecting riparian areas and stream pattern and profile within these reaches.

4. *E. coli* monitoring needs to be continued and built upon. MDEQs TMDL characterized current conditions within the LPCW but continued monitoring to determine effectiveness of education and awareness, agricultural compliance, and BMP installations will need to be performed to determine success. MDEQ will consider monitoring this after measures have been taken and BMPs installed.

5. Nitrate and phosphorus levels need to be monitored tributaries to determine subwatersheds prioritization. Some private individuals have performed testing to establish baseline information in the neighboring PRW, efforts could be expanded to include LPCW. This could be expanded and coordinated to continue to add to data sets and understanding current conditions. This could lead to added implementation and protection.

11.4 Estimating Pollutant Load Reductions

The last level of evaluation is to estimate pollutant load reductions. Pollutant loadings are a quantifiable amount of pollution that is being delivered to a water body. Pollutant load reductions can be calculated based on the ability of an installed BMP to reduce the targeted pollutant. STEPL (Spreadsheet Tool for Estimating Pollutant Load) was chosen as the model to use for calculating load reductions in the Portage River watershed.

STEPL Pollutant Loads Analysis

The Spreadsheet Tool for Estimating Pollutant Load (STEPL) uses algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). It computes watershed surface runoff, nutrient loads, including nitrogen, phosphorus, biological oxygen demand, and sediment delivery based on various land uses and practices. Annual nutrient loading is calculated based on runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load is calculated based on the Universal Soil Loss Equation (USLE) and sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies (http://it.tetratech-ffx.com/steplweb/).

STEPL worksheets require data entry on specific physical characteristics of the watershed and probable best management practices (BMPs) which can be applied. Some data are constants based on geographic location, soil types, and other factors. Other sets of data can be varied. Particular attention was given to the “affective area” of any BMP. Affective area refers to the total acreage to which a selected BMP practice applies. Since the watershed is mostly in agricultural use, no BMP practice could be retroactively and/or successfully applied to the entire watershed. Therefore, a percentage was applied to each land use type to find the affective area. (Example: Wetlands in the watershed equal 8,797 acres. If BMPs could be applied to affect 10% of the wetland space, the “affective area” would be 88 acres with numbers rounded to the nearest whole.) Because of the uncertainty of the effectiveness of various BMPs on load reduction, the percentage of affective area was adjusted to reflect a 25% rate.

The STEPL Pollutant Loads Analysis was used to determine load reductions after implementation of various BMPs for the PRW, using 25% of affective area. Appendix 6 – Pollutant Load Estimates and Reductions provides the complete analysis.

Pollutant load reduction tasks include protecting and restoring wetlands and sensitive lands, correcting failing septic systems, installing agricultural BMPs, restoring riparian buffers and stabilizing streambanks, correcting road/stream crossings, etc.

Overall reductions in the Portage River watershed through agricultural BMPs will reduce nonpoint source pollution significantly, as illustrated in Appendix 8. Additionally, to address the threatened uses of Partial and Total Body Contact, BMPs must be implemented in agricultural, protection, and urban areas to ensure all water bodies meet water quality standards for E.coli. For Total Body Contact, E.coli levels need to be reduced to 130 E.coli per 100 milliliters (ml) water as a 30 day average and 300 E.coli per 100 ml water at any time during the period of May 1 to October 1 to meet the water quality standard. For Partial Body Contact, E.coli levels need to be reduced to 1000 E.coli per 100 ml water to meet the water quality standard. Examples of BMPs that could be used for E.coli reduction include buffers, livestock management, irrigation management, manure management, proper septic installation and maintenance, bioretention areas, and proper pet waste disposal.

11.5 Evaluating the Watershed Management Plan

The watershed management plan needs to be updated to include changing land cover, demographics, local water quality protection policies, environmental protection laws (e.g. statewide phosphorus ban), TMDLs, prioritization areas, pollutants, and sources and goals and objectives and implementation strategies.

- Land Cover (Chapter 2.4)
- Demographics- with every new US census
- Future Growth and Development- every 5-10 years
- Local Water Quality Protection Policies- every 3 years
- Water Quality Summary – every two years with the release of MDEQ Integrated Reports
- Scheduled TMDLs- every two years with the release of MDEQ Integrated Reports or when a TMDL is completed
- Prioritization of areas, pollutants and sources- every 5-10 years
- Goals and Objectives- every 5-10 years
- Implementation Strategy- review annually and update as needed

Geomorphic Assessment/Bank Pin Analysis/BEHI Analysis

An assessment of LPCW was performed by the CCD in 2013 and 2014 as a means of evaluating stream stability and overall channel morphologic conditions. Please see Appendix 1 – Geomorphic Assessment of the LPCW for the full assessment report.

12. Steering Committee Members

Name	Association/Organization
W. Christopher Barnes, PE	City of Portage
Don Schultz	Township Supervisor
Matt Meersman	Friends of the St. Joseph River, Inc
Mark Parks	Friends of Portage Lake
John Wilks	Indian Lake Association
Linda Zabik	MAEAP Technician
Melanie Stoughton	Kalamazoo CD
Patricia Crowley	Kalamazoo County Drain Commissioner
John Byrnes	Kalamazoo County Road Commission
Josh Crandall	NRCS-District Conservationist
Joseph Eichorn	Park Township Supervisor
Patrick White	Pavilion Township
Jeffery Wenzel	St. Joseph County Drain Commissioner
Carol Higgins	St. Joseph CD
Rebeca Burns	Branch, Hillsdale, St. Joseph Community Health
Kathy Worst	Branch CD
Geoff Cripe	SWMLC
Matthew Crawford	Village of Vicksburg
Alyssa Riley	MDEQ-WRD NPS
Chris Bauer	MDEQ-WRD NPS
Wendy Oglivie	Fishbeck, Thompson, Carr, & Huber
Julia Kirkwood	MDEQ-WRD NPS
Steve Allen	Nottawaseppi Huron Band of Potawatomi
Eric Kerney	Nottawaseppi Huron Band of Potawatomi
Tracy Bronson	Calhoun CD
Diana Irizarry	NRCS-District Conservationist

Bill Martin	
Brian Gundermann	MDNR
Doug Brewer	West Lake Association
Jean Gagliardo	NRCS-District Conservationist
Rob Zbiciak	MDEQ
John Speeter	Long Lake Association

13. Acronym Glossary

AFO	Animal Feeding Operation
AUID	Assessment Unit Identification
BEHI	Bank Erosion Hazard Index
BMP(s)	Best Management Practice(s)
CAFO	Confined Animal Feeding Operation
CCD	Calhoun Conservation District
CCRD	Calhoun County Road Department
CD	Conservation District
CEA	County Enforcement Agency
CFR	Code of Federal Regulations
CLMP	Cooperative Lake Management Plan
CRP	Conservation Reserve Program (Federal Farm Bill)
CWA	Clean Water Act
E. coli	Escherichia coli
FSA	Farm Services Agency
FTCH	Fishbeck, Thompson, Carr, and Huber Inc.
HUC	Hydrologic Unit Code
KCD	Kalamazoo Conservation District
KNC	Kalamazoo Nature Center
LLWFA	Landscape Level Wetland Functional Analysis
LPCW	Little Portage Creek Watershed
LUST	Leaking Underground Storage Tank
MAEAP	Michigan Agriculture Environmental Assurance Program
MDARD	Michigan Department of Agriculture and Rural Development
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MiCorps	Michigan Clean Water Corps
MNSP	Michigan Natural Shoreline Partnership
MPEA	Michigan Planning Enabling Act
MS4	Municipal Separate Storm Sewer System
MSU	Michigan State University
NAWCA	North American Wetland Conservation Act
NBS	Near Bank Assessment
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NREPA	Natural Resources and Environmental Protection Act
NWI	National Wetland Inventory
PCB	Poly Chlorinated Byphenol
pH	Power of Hydrogen (acidity level)
PRW	Portage River Watershed
PWSS	Public Water Supply Systems
RPOD	Resource Protection Overlay District
SESC	Soil Erosion and Sedimentation Control
SJCD	St. Joseph Conservation District
STEPL	Spreadsheet Tool for Estimating Pollutant Load
SWDA	Safe Water Drinking Act
SWMLC	South West Michigan Land Conservancy
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency

USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
WHO	World Health Organization
WHPP	Wellhead Protection Program
WMP	Watershed Management Plan
WQS	Water Quality Standards
WRD	MDEQ Water Resources Division
WWAT	Water Withdrawal Assessment Tool

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15. Appendices

Appendix 1. Geomorphic Assessment Final Report
Appendix 2. Landscape Level Wetland Functional Analysis
Appendix 3. Master Plan and Zoning Ordinance Review
Appendix 4. Social Survey
Appendix 5. MDNR Fisheries Reports
Appendix 6. Pollutant Load Estimates and Reductions
Appendix 7. Common Pollutants, Sources, Water Quality Standards
Appendix 8. Water Quality Statement by Water Body
Appendix 9. Indian Lake Presentation
Appendix 10. Little Portage Creek TMDL
Appendix 11. Resource Concerns - Prioritized