Black River Watershed Management Plan

MDEQ/EGLE Tracking Codes
2002-0067
2005-0108
2017-0105

2005
Updated 2009
Updated 2021

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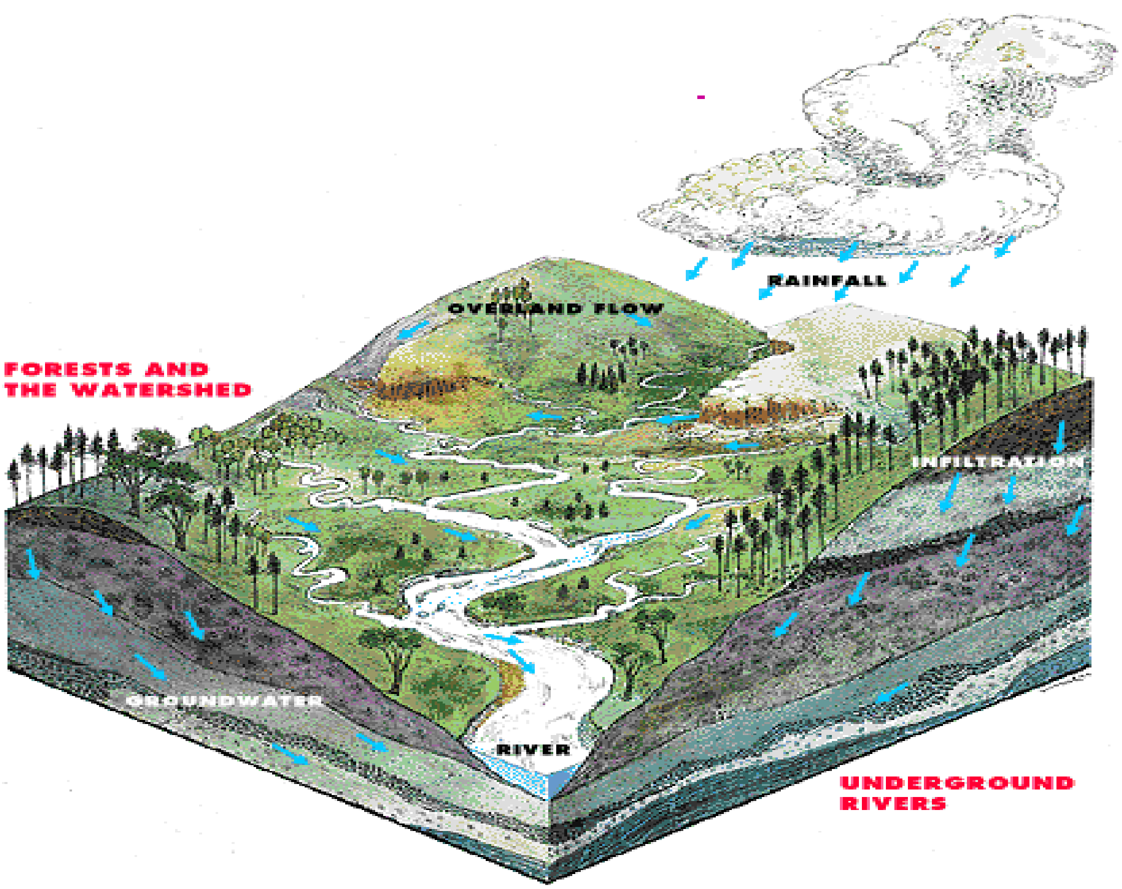
1 Project Overview and Introduction

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 referred to as nonpoint source, 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 from stakeholders within the watershed.

This Watershed Management Plan has been completed and updated through a Section 319 grant from the U.S. Environmental Protection Agency and administered by the Michigan Department Environment, Great Lakes and Energy. The first grant was awarded to the Van Buren Conservation District in the fall of 2002. Before this, a locally driven group of individuals and organizations known as the Black River Watershed Assembly had united in efforts to improve and protect the natural resources of the Black River Watershed (BRW).

This plan focuses specifically on nonpoint source pollution, a form of pollution that is generally not regulated. The primary aim of this plan is to protect and improve surface water quality in the Black River Watershed. Other goals include educating watershed residents on how they can work to improve and protect water quality, improving recreational opportunities on the river, and developing land use strategies that will protect water quality in the future. In particular, this plan serves to restore and protect the designated uses of the Black River (see section 6.5).

The Black River is a shared resource: people swim in it, and canoe in it; farmers use it for irrigating their crops; people build houses along it to take advantage of picturesque views. South Haven is full of marinas for boaters who moor in the Black River. All of these interests depend to some extent on clean, unpolluted water. The river empties into Lake Michigan, and therefore any pollution problems in the Black River have the potential to impact the Great Lakes. Thus, the citizens of the Black River Watershed have an obligation to do their best to protect and improve the water quality of the Black River, and by extent, Lake Michigan



2 Literature Review

Water quality is important to people, perhaps more so than any other natural resource protection goals (Weigel et al. 2004, Schueler 2000). The public is concerned with protecting drinking water quality, improving and protecting water quality in lakes, rivers and streams, and protecting watersheds (Weigel et al. 2004). Other complementary concerns include the creation of greenways, waterfront improvements, neighborhood revitalization, and protection from flooding (Schueler 2004).

> Watershed management involves identifying and prioritizing problems, promoting involvement by stakeholders, developing solutions and measuring success through monitoring and data collection.

Rivers are extraordinarily complex systems. Not until relatively recently did scientists begin to fully understand the interrelationships of the processes that occur in a healthy river system (Ward and Tockner 2001). For example, in the past, there was little consideration of floodplains and groundwater as part of the system (Ward and Tockner 2001).

Thus, the overall health of a river system is difficult to determine. Rivers that meet quantitative water quality standards may be lacking in other ways. For example, a waterway that meets water quality standards for chemical criteria may be devoid of mayflies, which are an important food source for trout (Palmer 1994). All portions of the system must be taken into account when researching the condition of a river.

Significant improvements have been made to water quality in many rivers due to point source controls on industrial and municipal discharges (Wolf and Wuycheck 2004). Nonpoint source pollution, on the other hand, remains a problem in many watersheds. Nonpoint source pollution is caused by pollutants that are carried into water bodies through runoff from roads, parking lots, farms, lawns, and other sources. This form of pollution is difficult to trace due to the diversity of originating sources. One method of managing nonpoint source pollution is through watershed management.

Watershed management is the process of managing land-use activities on upland areas so that impacts on water quality are minimized. Inherent in this process is the recognition of the interrelationships between land use, water, and soil, as well as the connection of upstream and downstream areas (Brooks et al. 1991, Ffolliott et al. 2002). Watershed management recognizes the array of uses of a watershed, including agriculture, wildlife habitat, recreation, and industry (Brooks et al. 1991, Satterlund and Adams 1992), and works to balance the demands that are placed on our water resources. One challenge of watershed management is to protect or improve water quality while maintaining these uses.

Watershed management has been attempted for at least fifty years in the United States, but the science continues to evolve. Thus, many current watershed management efforts are, at least in some part, experimental (National Research Council 1999). In the 1990s, watershed management became the new paradigm for resolving local environmental problems (Schueler and Holland 2000). Other relatively recent trends in environmental management relevant to watershed management include: a change from end-of-the-pipe pollution control measures to prevention of pollution; increased concerns about 'invisible' threats and chronic effects of pollution; awareness that nonpoint source pollution is now the major contributor to water pollution; and an increase in reliance on education programs to change behavior as it relates to environmental issues (Heathcote 1998).

Watersheds make an ideal planning unit when planning for the protection of ecological processes and habitats (Brody et al. 2004, Schueler and Holland 2000). Ecological processes, like watersheds, generally cross political boundaries. Improvements in downstream water quality can be undone by pollution upstream. However, due to the many political units that may be involved, the watershed boundary may be less useful for political and funding purposes (National Research Council 1999).

Because watershed management occurs across political boundaries, it requires buy-in from diverse agencies. No single entity has jurisdiction over all facets of the watershed, and thus watershed management requires effective collaboration from all of the political units within the watershed as well as state environmental agencies, non-profit organizations, and others. Though watershed management takes a broad geographic view, it is implemented at the local level through local land use policies. Furthermore, many factors that contribute to ecosystem degradation (such as habitat fragmentation and stormwater runoff) arise due to decisions made at the local level. On the other hand, decisions made at the local level to protect and improve ecosystems may be more effective and less expensive than those made at the state or federal level. Local land use decisions that are not made collaboratively have the potential to have a cumulative negative impact on the ecosystem (Brody et al. 2004).

Watershed management can focus on restoring degraded areas, but it can also set forth guidelines that will prevent future degradation to our water resources (Brooks et al. 1991). Beyond preventing future pollution, the most ambitious form of watershed management seeks to *improve* water quality conditions (Schueler 2004). This proactive, rather than reactive, approach will in most cases be more cost effective in the long term (Satterlund and Adams 1992). Additionally, watershed protection tools generally have a positive impact on the local economy (Schueler 2000).

A regulatory approach to an issue like watershed management is often punitive in nature and is costly to administer and enforce. Thus, some researchers feel that regulatory controls should only be used as a last resort after other programs (such as research, education, and technical assistance programs) have failed to achieve improvements (Satterlund and Adams 1992). On the other hand, the threat of future regulatory action is often an important motivator in encouraging collaboration to solve environmental problems in the present. Rather than treating environmental protection from a regulatory standpoint, watershed management strives to facilitate consensus and cooperation and ultimately solve problems relating to nonpoint source pollution and habitat loss (Lubell 2004).

Lubell (2004) argues that support from grassroots stakeholders is crucial to successful collaborative management. Grassroots stakeholders are those such as the fishers, farmers, and tourists: those who actually use the resource, not just elected officials and staff. Similarly, the National Research Council (1999) found that much watershed management in the mid- to late-20th century had been a "top-down" process, but that that approach had left out local-level decision makers. Their recommendation, therefore, was for watershed management to be driven by local stakeholders in a "bottom-up" approach.

Satterlund and Adams (1992) argue that education (particularly of policy makers, resource managers, and landowners) is essential to successfully implementing changes to improve watershed management. The growing population exacts a growing demand on water resources at the same time tourism and outdoor recreation are increasing. This points up the need for educating an urbanizing public about natural resources and rural land use (Satterlund and Adams 1992). Even rural landowners with access to technical assistance or subsidies (such as through programs administered by the Natural Resources Conservation Service) need to be educated about their options and the impacts on natural resources of their management. A study of landowners in Wisconsin found that educational programs had the most significant and long-lasting influence on management (Satterlund and Adams 1992).

The ultimate product of the watershed management planning effort is a watershed management plan. This plan should be a dynamic and flexible document and should be updated as conditions in the watershed change (Schueler and Holland 2000). Thus, to be successful, plans should be reviewed and updated regularly (Satterlund and Adams 1992, Heathcote 1998). In reality, however, many watershed management plans, once completed, are never read or updated again (Schueler and Holland 2000).

Despite the array of benefits that watershed management can produce, not all planning efforts are successful. These efforts are often constrained by lack of funding, lack of technical expertise, or limited availability of water quality data. Schueler and Holland (2000) interviewed a variety of watershed stakeholders, including municipal officials, environmental planners, consultants, and watershed researchers about the effectiveness of watershed management plans. The general consensus was that many plans had ultimately failed to protect their watersheds. The following were the reasons cited for this failure:

- plan was conducted at too great a geographic scale
- plan was a one-time study rather than a long-term and continuous management commitment
- lack of local ownership in the watershed management process
- plan skirted real issues about land use change in the watershed.
- budget for watershed plan was poor or unrealistic
- plan focused on the tools of watershed analysis rather than their outcomes
- document was too long or complex
- plan failed to critically assess adequacy of existing local programs
- plan recommendations were too general
- plan had no regulatory meaning
- key stakeholders were not involved in developing the management plan

Additionally, the Indiana Department of Environmental Management (2003) noted that watershed partnerships can fail due to conflicts, lack of a clear purpose, vague goals, lack of commitment, and a failure to include all stakeholders.

Schueler and Holland (2000) also made recommendations for creating effective watershed management plans:

- create a watershed management institution
- plan at the subwatershed scale

- commit to a continuous watershed management cycle
- accurately measure and forecast land use
- shift the location and density of future development
- produce integrated resource map for subwatershed
- devise specific criteria to guide subwatershed development
- emphasize strategic resource-based monitoring
- audit effectiveness of local watershed protection programs
- incorporate priorities from larger watershed management units
- actively engage stakeholders and include public early and often
- promote intra- and inter-agency coordination

Brody et al. (2004) also recommended that watershed management plans must have a factual basis (including a thorough inventory of natural resources and human impacts to these resources), must have clearly specified and measurable goals and objectives, and must define the actions that need to be taken. The plan "conceptualizes a commitment to implementing the final plan… [and] articulates mechanisms and procedures to implement the plan once it is adopted" (Brody et al. 2004, p. 37).

Some of these recommendations may be difficult to implement in real world situations, given the realities of tight budgets, development pressures, and political situations (Schuler and Holland 2000). However, these recommendations have great potential to improve watershed management plans in the future.

Though watershed management planning may be flawed in some cases, the potential benefits are significant. Beyond identifying steps to be taken to improve water quality, a plan can also be used to leverage grant funds, empower the community, and leverage agency support (Indiana Department of Environmental Management 2003). Collaborative relationships built during watershed management planning can carry over into other areas of environmental management. In many instances, collaborative watershed management may be the only method by which to address nonpoint source pollution.

3 Watershed Description

3.1 Geographic Scope

The Black River Watershed encompasses approximately 183,490 acres, or 287 square miles in Allegan and Van Buren Counties in southwestern Michigan. 43.8% of the watershed lies in Allegan County, and 56.2% lies in Van Buren County. A map of the watershed is shown in Figure 1, and a map displaying subwatersheds is shown in Figure 2. The primary townships encompassed by the watershed are listed in Table 1.

Table 1: Townships in the BRW

Townships in Allegan County	% of Township in the Black River Watershed	Townships in Van Buren County	% of Township in the Black River Watershed
Casco	92%	Arlington	77%
Cheshire	23%	Bangor	65%
Clyde	78%	Bloomingdale	53%
Ganges	59%	Columbia	100%
Lee	94%	Covert	22%
		Geneva	100%
		South Haven	40%
		Waverly	11%

The watershed boundary also encompasses small portions of Manlius, Saugatuck, and Valley Townships in Allegan County. However, no streams enter the watershed from these townships. There are also several cities and villages in the Black River Watershed. These are listed in Table 2. Other unincorporated communities in the watershed include Grand Junction, Pullman, and Lacota.

Table 2: Cities and villages in the BRW

City or Village	County
Fennville*	Allegan
Bangor	Van Buren
Breedsville	Van Buren
Bloomingdale	Van Buren
South Haven	Van Buren

*Though the boundaries of Fennville are technically within the Kalamazoo River Watershed, the cities' storm sewers drain to the Black River (G. Tuhacek, personal communication, February 17, 2004).

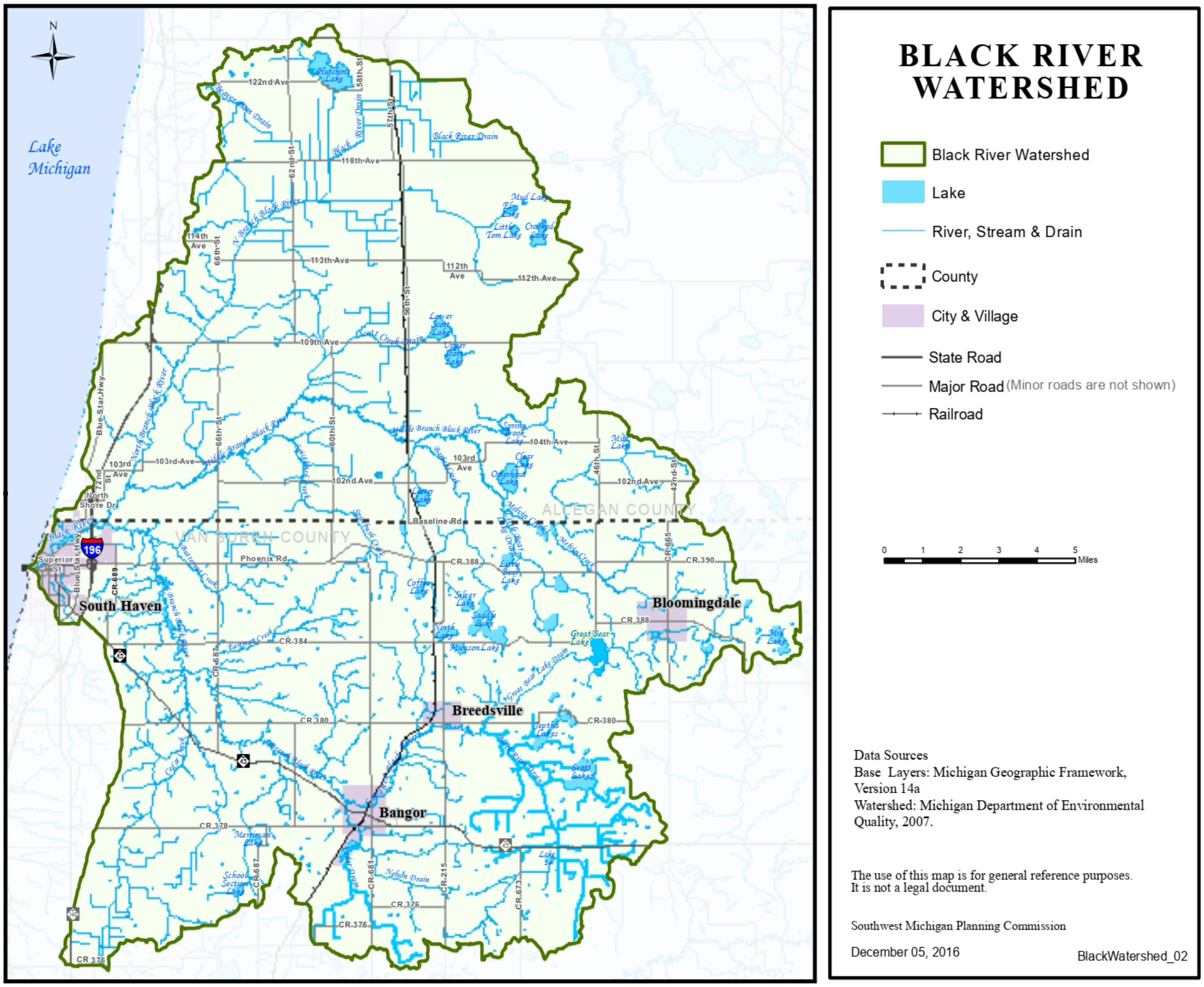


Figure 1: Black River Watershed (BRW) map

Figure 2: Subwatersheds of the BRW (12 digit HUCs), 2009

3.2 Topography

Glaciers shaped the landscape of Michigan, and the Black River Watershed is no exception. The surface (or quaternary) geology map (Figure 3) of the area shows that the landscape of the watershed is dominated by lacustrine sand and gravel, fine-textured glacial till, glacial outwash, and end moraines (MNFI and MDNR 1998). The bedrock of the watershed is primarily Coldwater shale, with a small area of Marshall Formation (MDEQ 1987). This bedrock is generally covered with 50 to 350 feet of glacial deposits (Albert 1995). The landscape tends to be flat to gently rolling with some steeper ravines.

Relief varies across the area. The highest elevation in the watershed is 836 feet above sea level, in the far southern portion of the watershed in Arlington Township (Van Buren County). The lowest elevation is representative of local base level, which at the western shores of Lake Michigan is 577 feet above mean sea level. Topographic variations are not significant in Allegan County (USGS 1985).

3.3 Soils

The principal soil associations in the watershed are Capac-Riddles-Selfridge and Gilford-Maumee-Sparta (Figure 4 and Table 3). The most prevalent soil series (in terms of area) in the watershed are Oakville fine sand, Selfridge loamy sand, Capac loam, Pipestone-Kingsville complex, Glendora loamy sand and Chelsea loamy fine sand. The Oakville series is usually well- or moderately well-drained and is found on outwash plains, lake plains, moraines, dunes and beach ridges. It can be poorly suited for crops due to droughtiness and erosion by wind (Knapp 1987). The Selfridge series is a nearly level and somewhat poorly drained soil. It is found on convex plains, knolls and side slopes. This soil is well suited for cropping with corn and soybeans (Bowman 1986). The Capac series is nearly level to undulating and somewhat poorly drained, and is found on flats, low ridges, knolls and foot slopes. These soils are well suited to cropland for corn, soybeans, small grain, hay, apples and pears (Knapp 1987). The Pipestone-Kingsville complex consists of nearly level, somewhat poorly drained soils. They are found on slight knolls, depressions, and natural drainageways. They can be frequently ponded. They are suited mostly for specialty crops, and if drained are well suited for blueberries (Bowman 1986). The Glendora series consists of nearly level, poorly drained soils and is usually found in floodplains. Due to periodic flooding, this soil is typically not used for crops (Knapp 1987). The Chelsea series is found in level to hilly areas on low ridges, knolls, flats and side slopes. It is usually excessively drained and is typically unsuitable to cropland due to droughtiness and wind and water erosion. Some crops (such as corn, small grain, soybeans, hay, peaches, cherries, potatoes and asparagus) can be grown (Knapp 1987). Tables of the individual soil units are located in Appendix A.

Table 3: General soil associations in the BRW

General Soil Associations	Acres
Capac-Riddles-Selfridge	81,618
Coloma-Spinks-Oshtemo	11,393
Gilford-Maumee-Sparta	34,712
Houghton-Carlisle-Adrian	1,527
Kingsville-Pipestone-Covert	20,277
Marlette-Capac-Spinks	4,790
Oakville-Covert-Adrian	20,540
Urbanland-Parkhill-Capac	8,629

Soils are classified by the Natural Resources Conservation Service for their runoff potential (Table 4). Analysis of these hydrologic soil groups can help determine which portions of the watershed are most important for groundwater recharge. Soils in group A have smallest runoff potential and those in group D have the highest runoff potential. Protection of areas with high infiltration capacity (group A soils) is important for maintaining hydrology and temperature regimes in the watershed. The majority of the watershed (about 67%) has soils with high or moderate infiltration rates. See also Appendix N, Figure 7 for a map of soil hydrogroups.

Table 4: Hydrologic soil groups in the BRW

Hydrologic Soil Group	Description	% of watershed
A	Sand, loamy sand or sandy loams with low runoff potential and high infiltration rates	37.6%
B	Silt loam or loams with moderate infiltration rates	29.5%
C	Sandy clay loams with low infiltration rates	11.0%
D	Clay loam, silty clay loam, sandy clay, silty clays with high runoff potential and low infiltration rates	20.3%
Water		1.6%

Another aspect of soils is their suitability for septic tank absorption fields. This watershed is primarily rural, and many homeowners rely on septic systems. The Natural Resources Conservation Service rates different soil types as "not limited," "somewhat limited," or "very limited" for their use as septic tank absorption fields. "Not limited" indicates that the soil has features that are very favorable for septics; good performance and low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for septics. Limitations can be overcome or minimized by special planning, design, or installation; fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for septic tank absorption fields. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected. The majority of soils in the Black River Watershed are considered very limited for use as septic system absorption fields (Figure 5), and, in fact no soils are considered "not limited."

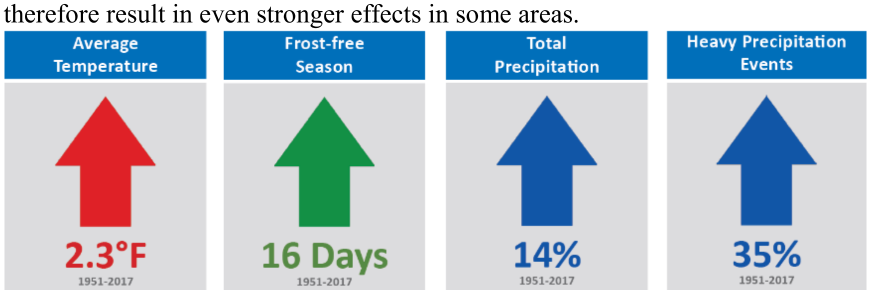
3.4 Ecosystem and Climate

The Black River Watershed is in the Berrien Springs (VI.3.1) and Southern Lake Michigan Lake Plain (VI.3.2) sub-subsections of the Southern Lower Michigan regional landscape ecosystem. This ecosystem has been highly modified by agriculture and development. With increased development of agricultural and urban areas, streams have been physically and chemically altered. Such changes affect wildlife habitat as well as water quality. Practices such as stream channeling and quarrying physically affect streams while chemical fertilizer and run off chemically alter the streams.

The Black River watershed also lies within the Southern Michigan, Northern Indiana Till Plains ecoregion. Ecoregions are delineated by their climates, soils, vegetation, land slope, and land use (Wolf and Wuycheck 2004). Rivers within this ecoregion tend to be of good quality in their headwaters, are typically slow flowing, and are sometimes bordered by extensive wetlands. Drainage ditches and channelized rivers are common in this ecoregion where land is too wet for agriculture or building (Wolf and Wuycheck 2004).

The Proximity of Lake Michigan and prevailing westerly winds moderate the climate and produce lake effect snow. The climate is influenced by the Maritime Tropical air mass, which tends to be a relatively warm and humid air mass (Albert 1995). According to US Climate Data for Bloomingdale, MI the total annual rainfall is approximately 39 inches and average annual snowfall is 98 inches. Average winter temperature is 36° F and average summer temperature is 59° F.

According to the Great Lakes Integrated Sciences and Assessments (GLISA), average temperature, frost-free season, total precipitation and heavy precipitation events for the Great Lakes region from 1951-2017 have all increased. Projected increases in droughts, severe storms, and flooding events may amplify the risk of erosion, sewage overflow, interference with transportation, and flood damage. Future changes in land use could have a far greater impact on water quality than climate change. The coupling of climate change and land use change could therefore result in even stronger effects in some areas.



The average temperature, frost-free season change, total precipitation, and heavy precipitation events for the Great Lakes region from 1951-2017.

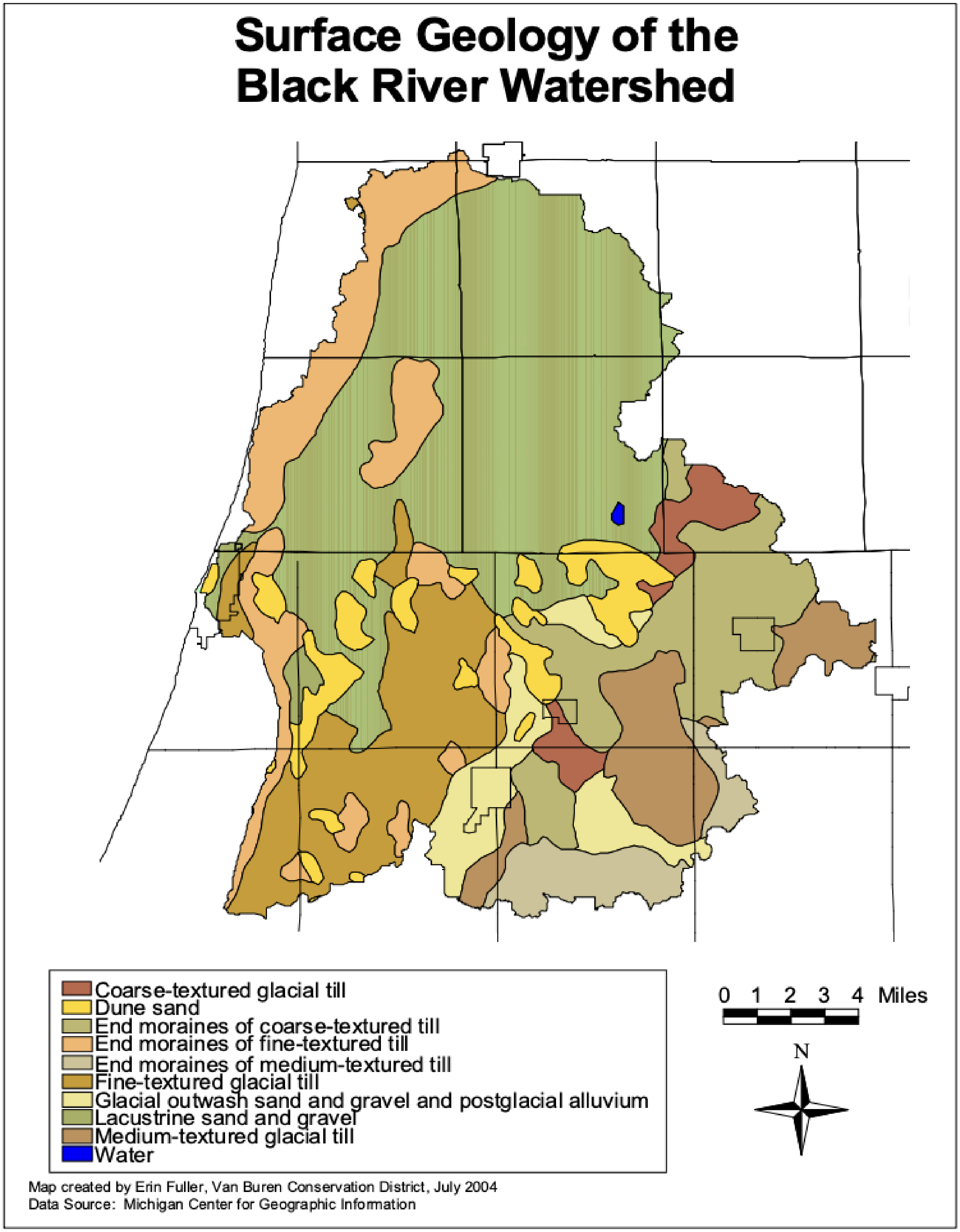


Figure 3: Surface geology of the BRW, 2004

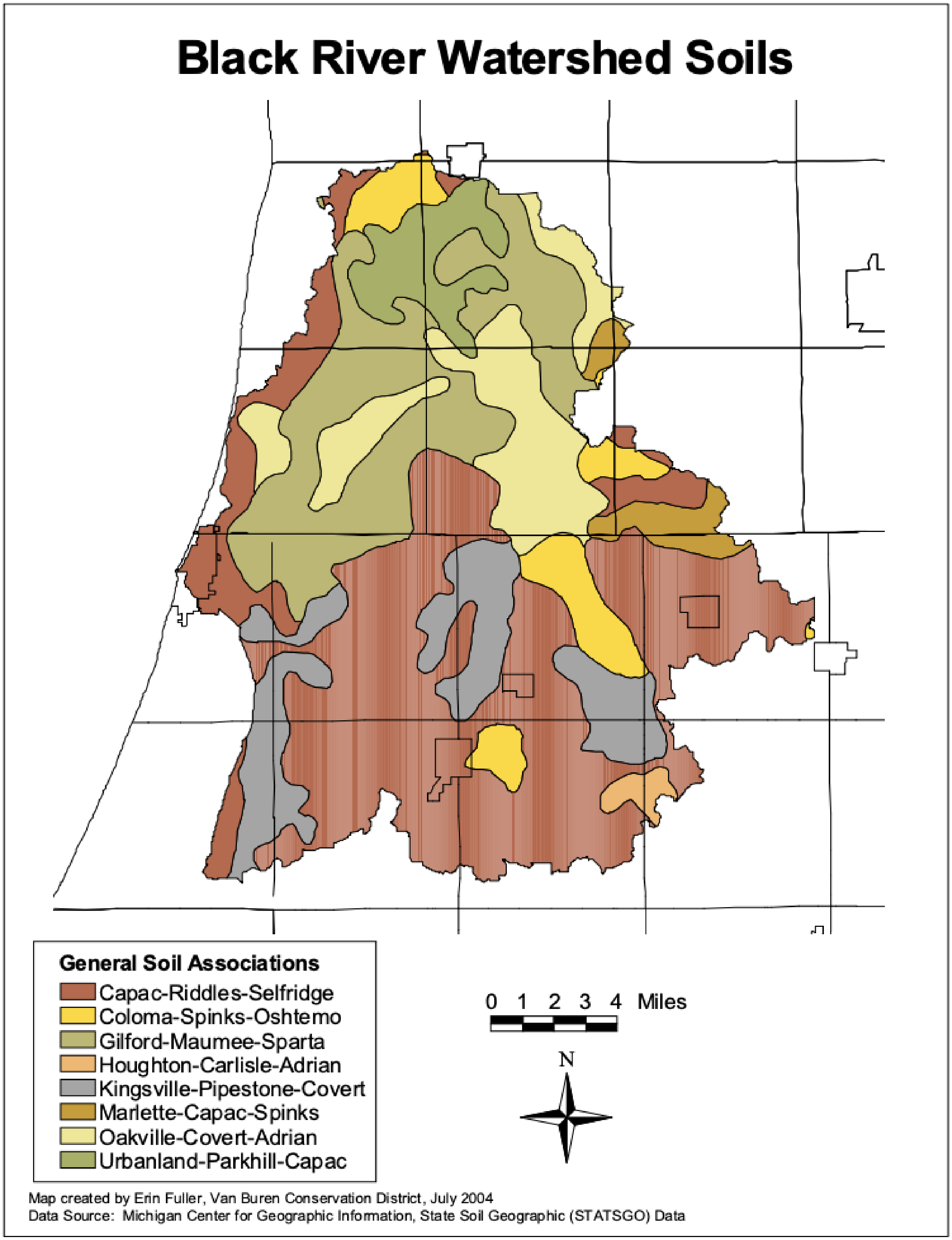


Figure 4: Soil associations, BRW, 2004

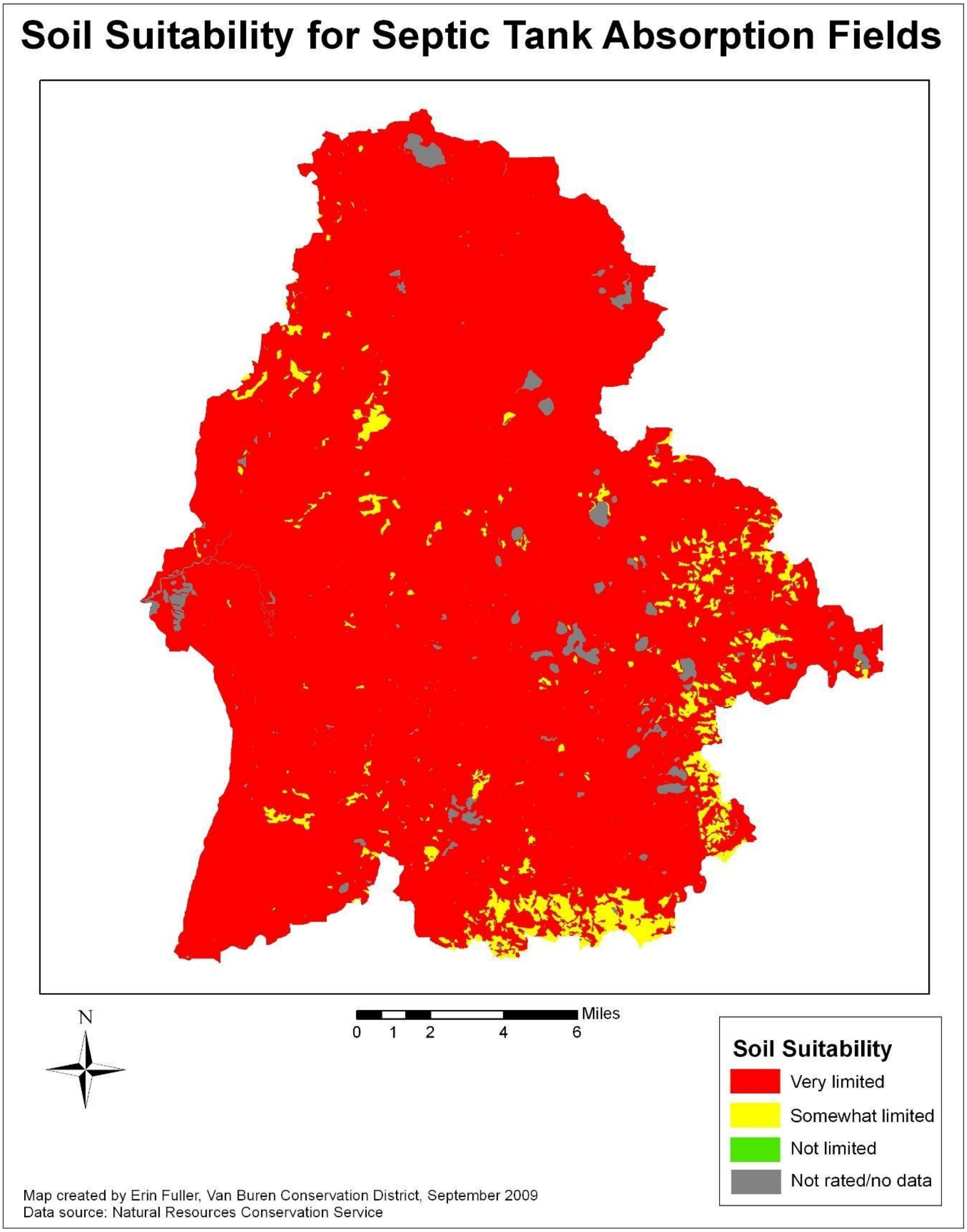


Figure 5: Soil suitability for septic tank absorption fields, BRW, 2009

3.5 Land Use and Land Cover

Prior to European settlement of the area in the 1800s, the Black River Watershed was primarily forested (Figure 6). The dominant forest type was Beech-Sugar Maple forest. The complete list of pre-settlement land cover types is shown in Table 5. The forest was used for lumbering beginning in the mid 1800s and continuing until the 1890s. (Pahl n.d.). As soon as the land was cleared of trees, land was cultivated for agriculture (Knapp 1987).

Table 5: 1800s land cover, BRW

Land Cover Type	Acres	% of total
Beech-Sugar Maple Forest	98276.2	53.6%
Beech-Sugar Maple-Hemlock Forest	22226.2	12.1%
Mixed Conifer Swamp	19736.5	10.8%
Mixed Hardwood Swamp	12805.5	7.0%
White Pine-Mixed Hardwood Forest	10257.8	5.6%
White Pine-White Oak Forest	7476.4	4.1%
Black Ash Swamp	3382.8	1.8%
Lake/River	3039.0	1.7%
Hemlock-White Pine Forest	2936.8	1.6%
Oak/Pine Barrens	1754.8	1.0%
Shrub Swamp/Emergent Marsh	1031.4	0.6%
Muskeg/Bog	413.1	0.2%
Cedar Swamp	149.7	0.1%
TOTAL	**183486.3**	**100.0%**

Source: Michigan Resource Information System 1978

The most current land use/land cover data for the Black River Watershed is from 2016 (C-CAP Regional Land Cover and Change). This shows agriculture (Cultivated Crops) as the dominant land use, followed by Forest and Scrub/Shrub (Figure 7). The complete list of land cover types in the 2016 land cover map is shown in Table 6.

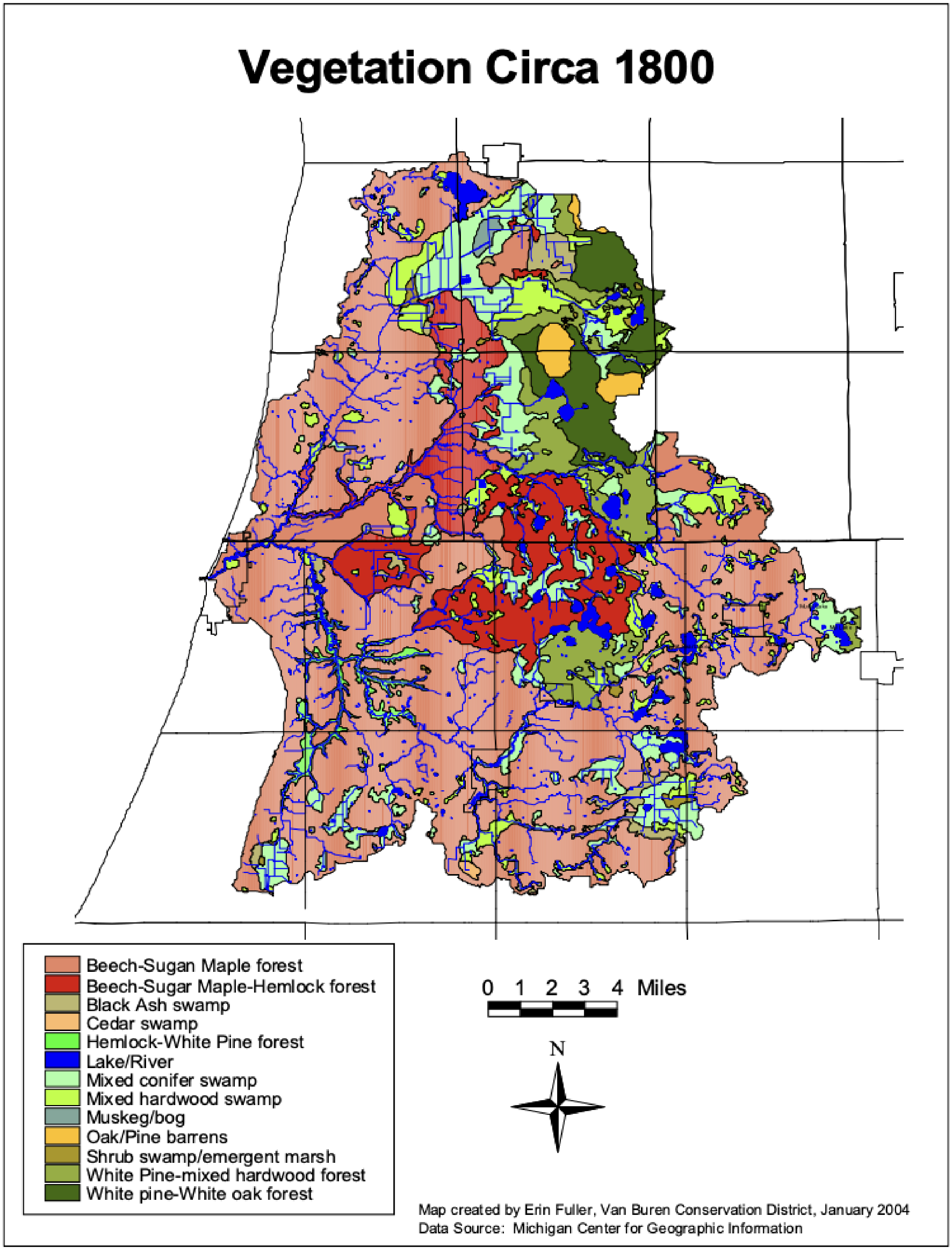


Figure 6: Presettlement vegetation, BRW, 2004

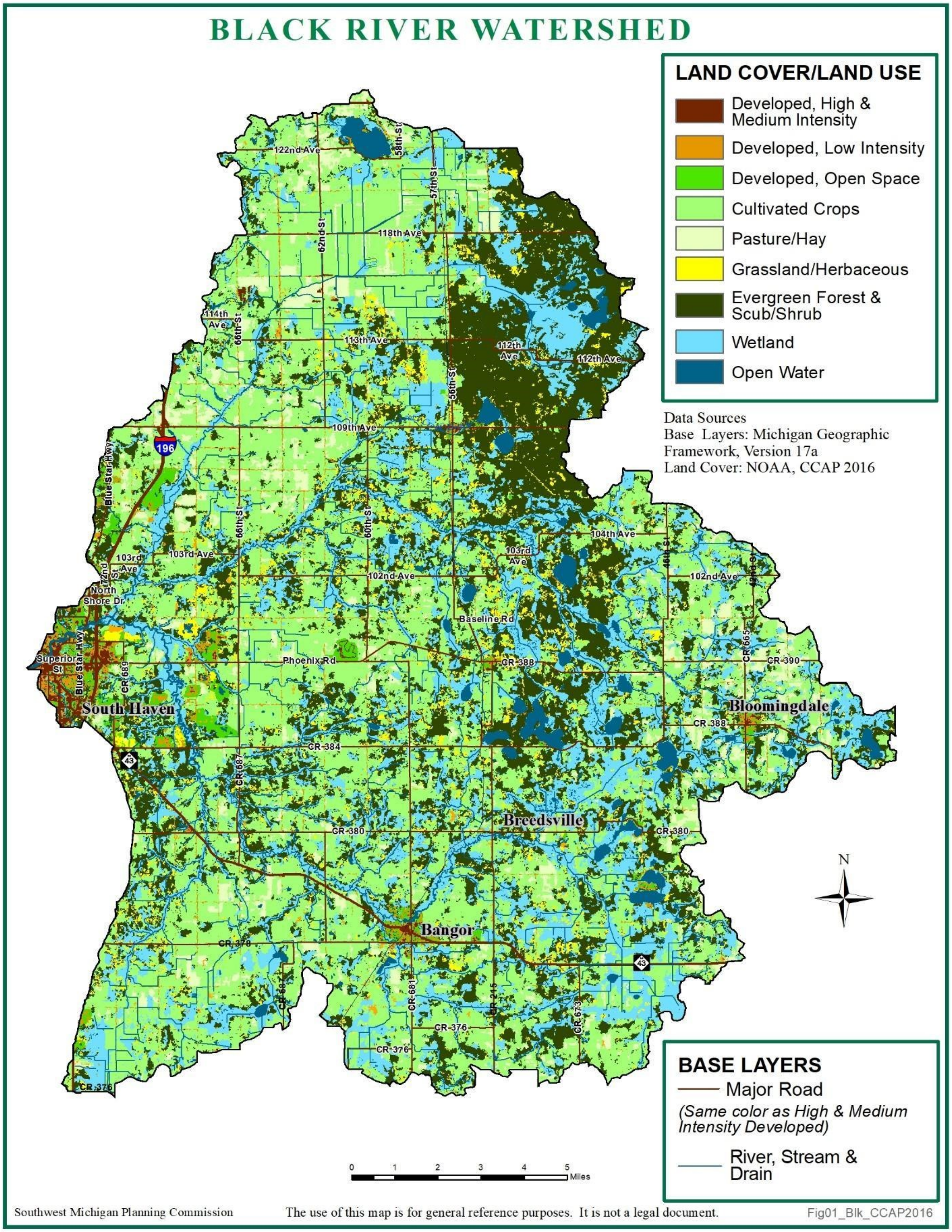


Figure 7: Land cover/land use, BRW, 2016

Table 6: 2016 land cover/land use, BRW

CLASS NAME	ACRES	PERCENT
High & Medium Intensity Developed	1,176	0.64%
Low Intensity Developed	6,142	3.35%
Open Space Developed	2,477	1.35%
Cultivated Crops	72,855	39.69%
Pasture/Hay	10,127	5.52%
Grassland/Herbaceous	6,751	3.68%
Forest & Scrub/Shrub	42,993	23.42%
Wetlands	37,804	20.60%
Open Water	3,230	1.76%

Source: NOAA's Coastal Change Analysis Program (C-CAP) 2016 Regional Land Cover Data

Land Cover Change

Land use/ land cover data is available from NOAA's Coastal Change Analysis Program (C-CAP). A summary of the results of these surveys is shown in Table 7. It is clear that there was a gain in development (high and low intensity) with a 44.8% increase. There was also a significant increase in barren land; when investigating those areas, it is golf course development that mostly accounts for this increase.

Table 7: Land use/land cover in 1975 and 2016, BRW

Level 1 Class Scheme	1975 (sq mi)	Loss (sq mi)	Gain (sq mi)	2016 (sq mi)	Net Change (sq mi)	Percent Change
High Intensity Developed	1.45	-0.03	0.41	1.84	0.38	26.4%
Low Intensity Developed	10.93	-0.07	2.07	12.93	2.01	18.4%
Cultivated	129.64	-3.23	3.25	129.66	0.02	0.0%
Grassland	12.05	-3.28	1.78	10.55	-1.50	-12.4%
Forested	58.26	-3.29	3.10	58.07	-0.19	-0.3%
Scrub/Shrub	9.71	-1.61	1.00	9.11	-0.61	-6.3%
Woody Wetland	55.72	-0.83	0.62	55.51	-0.21	-0.4%
Emergent Wetland	3.62	-0.42	0.23	3.43	-0.19	-5.1%
Barren Land	0.42	-0.13	0.33	0.62	0.20	47.7%
Open Water	5.00	-0.11	0.19	5.08	0.08	1.6%

Source: NOAA's Coastal Change Analysis Program (C-CAP) 1975 to 2016 Regional Land Cover Change

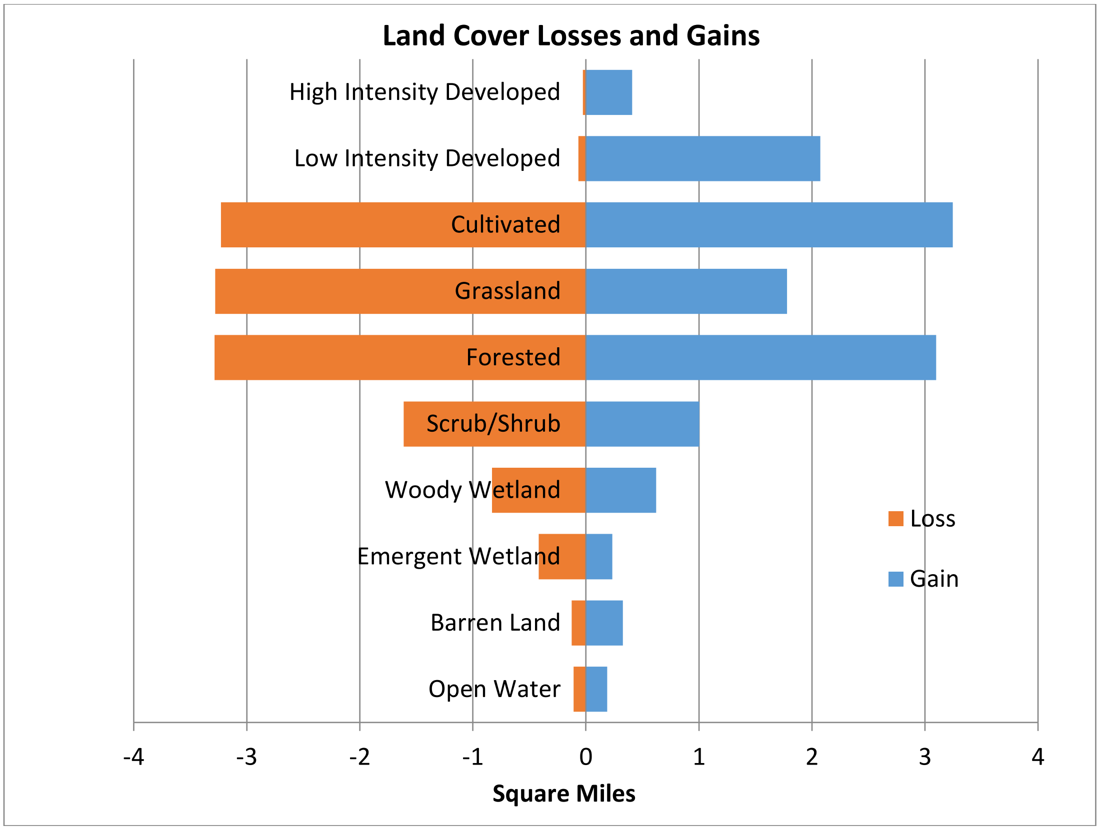


Figure 8: Land cover change, BRW, 1975-2016

The Figure below is an example of a large wetland loss, South of 36th Avenue where the Van Buren Trail crosses 72nd St. This approximately 215 acres in the South Branch Black River, Cedar Creek subwatershed was converted from forested wetland to cultivated from 2015-2017.

Figure 9: Example land use change, 2015, 2016, 2017

The aerial photograph shown below was taken in 2014, south of 34th Avenue near 72nd Street in the Cedar Creek, South Branch subwatershed.

The aerial photograph below is 2016, where seven acres of forested wetland has changed to cultivated shown on the east side of the photograph. In the upper left, is a change of five acres of forest to cultivated.

Figure 10: Example land use change, 2014-2016

3.6 Hydrology

The Black River Watershed contains approximately 530 miles of rivers, streams, and drains (this number does not include intermittent streams and likely under-represents county drains). The watershed also contains 43 named lakes and numerous (over 500) small, unnamed lakes and ponds. The named lakes are listed in Appendix B. The largest lake in the watershed is Hutchins Lake in Clyde and Ganges Townships (Allegan County), at 379 acres. Other large lakes in the watershed include Saddle Lake in Columbia Township (Van Buren County) at 283 acres, Osterhout Lake in Lee Township (Allegan County) at 172 acres, and Great Bear Lake in Bloomingdale and Columbia Townships (Van Buren County) at 166 acres. Most of these named lakes (and many of the smaller, unnamed ones) are connected by surface water to the Black River through streams and drains.

> Lakes in the watershed are generally either mesotrophic (having moderate nutrient levels) or eutrophic (having excessive nutrients)
>
> 65%-85% of the watershed's wetlands have been converted to other uses
>
> Sandy soils in the watershed make groundwater vulnerable to pollution

Based on studies by the Michigan Department of Environment, Great Lakes and Energy, lakes in southern lower Michigan tend to have moderate to high nutrient levels, while lakes with lower nutrient levels tend to be located in northern Michigan. This is likely due to the fertility of soils along with higher population density in southern Michigan. The lakes in the Black River Watershed that have been assessed have been determined to be either mesotrophic (lakes with a moderate level of nutrients) or eutrophic (lakes with excessive nutrient levels that are often subject to algal blooms and overgrowth of aquatic plants, leading to low oxygen levels). Lakes listed as eutrophic in the watershed are Lake Fourteen (Columbia Township), Lower Scott Lake (Lee Township), and Saddle Lake (Columbia Township) (Wolf and Wuycheck 2004). Great Bear Lake (Columbia and Bloomingdale Townships) is considered high eutrophic (Walterhouse 2004).

There are 17 dams on the Black River and its tributaries. Of these dams, 11 are privately owned, 4 are owned by local governments, and 2 are state-owned. Most of these are impassable to fish. The full list of these is shown in Appendix C.

Much of the wetland area in the watershed was drained during settlement to provide land for agriculture (wetland inventory, wetland loss, and potential wetland restoration area maps are shown in section 4.7). Many drains were dug, or streams were straightened in the late 1800s and early 1900s to improve the drainage of water. The majority of the drains are located in the headwaters of the North Branch of the Black River, though drains also exist in the headwaters of both the Middle and South branches. Approximately 65% to 85% of this watershed's wetlands have been converted to other uses since European settlement of the area. Maps of wetland change created by the Michigan Natural Features Inventory (MNFI n.d.) indicate that the area with the most wetland loss is the headwaters area of the North Branch in Ganges and Clyde Townships. The area around inland lakes has also experienced a considerable amount of wetland loss.

Groundwater supplies much of the water in the main stem and tributaries of the Black River. Groundwater seeps are visible along the banks in several locations. This helps keep water temperatures relatively cold, even in the summer. Groundwater and surface water are clearly closely linked, and any contamination of the former has the potential to significantly impact the latter. The predominance of sandy soils and the shallow water table in many portions of the watershed make the groundwater particularly vulnerable to pollution. Sources of groundwater pollution include leaking underground storage tanks and abandoned wells.

Much of the Black River and its tributaries are low gradient (or low slope). The profile is fairly typical, being steeper in the headwater regions and flatter near the mouth (Fongers 2004). Elevation changes between the headwaters and the mouth generally are not more than 5 feet per linear mile (though some headwaters have higher gradients). Water velocity is generally relatively slow. These factors contribute to the vulnerability of the system to sand and sediment deposition. Sand and sediment is deposited into the stream channel from eroding streambanks, and the stream lacks the energy to flush the deposits from the stream channel (Cooper 1999).

3.7 History of the Region

The rivers in this region of Michigan were the principal source of food and travel for the Native Americans that first inhabited the area. European explorers and fur traders arrived in the early 1600s, but the area was not settled until the late 1820s (Pahl n.d. and Bowman 1986). At that point lumbering became a major industry and sawmills and dams (to provide waterpower to the mills) were located on most of the rivers. This major clearing of land likely contributed a great deal of silt to the Black River. Mrs. A.B. Chase arrived in South Haven as a child in 1852. She recalls:

> We used to go out on the bank and watch the boats until they reached South Haven. We children crossed many a times on the dry sand bar at the mouth of the river, and when the wind went down, Old Mr. Bundy would come down with an ox team and plow through the sand, and in a few hours the river would flow again into the lake (excerpted in Appleyard 1996, p. 76).

The Black River (probably the South Branch) was cleared and widened for a 25-mile stretch to accommodate logs being floated down (Appleyard 1996). An early settler, Agnes Sheffer, recounted some of this history in "The Early History of South Haven":

> A saw mill was built in 1853 on the north side of the river. The river had been dragged for nearly 25 miles. The river was much wider and deeper than at the present time, which made it an easy run for logs from the pines lands up the river (excerpted in Appleyard 1996, p. 8).

By the 1860s, South Haven was a town of approximately 200 people, with a hotel, flour mill, lumber mills, tannery and several stores (Appleyard 1996). The piers at the mouth of the Black River in South Haven were first built in 1861, and a lighthouse was built on these piers in 1871 (Stieve 1977). The building of the piers gave rise to a busy harbor. Many ships were built in South Haven even before the turn of the 20th century. These ships were used for the transportation of products such as lumber, fruit, produce, wood pulp as well as passenger travel. In 1932, South Haven was the busiest foreign port on the Great Lakes (Stieve 1977). Much of the freight was wood pulp and other supplies for paper mills in the Kalamazoo area (Appleyard 1984).

The area was thickly forested and full of game when the settlers arrived. The January 8, 1855 edition of the Paw Paw Free Press contained the following advertisement:

> TO SPORTSMEN!
> All who take pleasure in hunting, will find plenty of amusement here. The woods on Black River and its branches are literally filled with game. Deer, Bear, Wolves and Turkeys are often met with. A good home will be found at the "FOREST HOUSE," which has lately changed hands, and is now kept by Mr. J.F. Withey who is ready and willing at all times to accommodate travelers and make them comfortable and happy.
> South Haven, Van Buren Co., Dec. '54

After the land was cleared during logging it was quickly cultivated for agriculture (Pahl n.d.). By 1921, most of the active logging had ended, and the fruit industry was on the rise (Appleyard 1984). The soils and climate of the region made it especially good for growing specialty crops like blueberries, apples and peaches.

The South Haven area has been a center for a variety of industries, including shipbuilding, tanneries, sawmills and commercial fishing. Fish species such as whitefish, perch and lake trout were all plentiful in the mid- to late-1800s. Sturgeon were also plentiful (Appleyard 1984). Oil was discovered in Bloomingdale in 1938, leading to the drilling of 108 oil wells and the building of two refineries. The oil boom lasted only a few years, and the oil business ended completely in 1963 (Van Buren Community Center n.d.).

The South Haven area became a resort destination in the late 1800s. Visitors arrived via lake steamer and lodging was available in a variety of hotels, farm resorts, family homes and summer cottages. Several parks and resorts arose along the Black River, including Riverside Park, Midway Park, Crescent Park, and Oakland Park. Launches carried resorters up and down the river.

The Bangor area has also been the center for several industries, many of which depended upon the Black River in some way. The first industry in Bangor was a sawmill built in 1846 on the banks of the Black River. Other mills soon followed, including a grist mill and a woolen mill. The Bangor Furnace Company was built in 1872. This blast furnace burned wood into charcoal for the manufacture of pig iron. This industry consumed a significant amount of the local virgin timber: approximately one square mile of local forest was cleared per year. The Bangor Chemical Works was built in 1877 to work in conjunction with the Bangor Furnace Company, producing chemicals that were derived from the furnace operations, including acetate of lime, wood alcohol, and acetic acid. By the mid-1880s both the furnace and chemical company were affected by the dwindling supply of local timber and lack of demand for iron. Both industries had ceased operations in Bangor by 1890. All the land that had been cleared for the operations of the blast furnace was potential farmland, and agriculture became the next major industry in the Bangor area (Emmert 2004).

All of these industries certainly impacted the Black River. The clearing of forests for the furnace and agriculture likely left the banks of the river unvegetated and unstable. Chemical pollutants from the industries were likely discharged into the river, as were pesticides (such as arsenate of lead) (Emmert 2004) and fertilizers from agricultural operations.

4 Natural Features of the Black River Watershed

4.1 Introduction

The landscape of the Black River Watershed has changed dramatically since the 1800s, prior to European settlement. The watershed was at that point nearly entirely forested (including both upland and lowland forest types) and wetlands. The current forest and wetland cover is now only about 44% of the landscape. Wetlands (including marshes and swamps) were also a significant portion of the pre-settlement landscape (about 20%).

Most of the native habitat remaining in the Black River Watershed consists of a variety of forest types. Most of this forest is deciduous, though there are also areas with evergreen and mixed forests as well. Of the wetlands remaining in the watershed, most consist of woody vegetation (i.e., swamps), though a few contain herbaceous emergent vegetation (i.e., marshes).

Table 8: Existing native habitat types, BRW

Habitat type	Acres
Central Hardwood	46,846.4
Lowland Hardwood	16,294.5
Pine	3,098.5
Shrub/Scrub Wetland	2,940.4
Lakes	2,606.9
Wooded Wetland	1,472.8
Emergent Wetland	371.2
Aquatic Bed Wetland	255.6
Lowland Conifer	101.5
Aspen, Birch	31.5

Source: MDNR 1999

Many stretches along the Black River have intact riparian forest habitat. A study of bird communities in forested riparian wetlands in southern Michigan (Inman et al. 2002) found that this type of habitat is important breeding habitat for bird species that are not always found in upland areas. Species composition, species richness, and densities of individual species varied markedly between forested wetlands and adjacent uplands. Loss of this type of habitat would thus have a major impact on those bird species that depend upon river corridors for food and nesting. Riparian forests also play a critical role in water quality. Deforestation of riparian areas leads to reduced stream habitat for benthic macroinvertebrates (animals without a backbone that live on the bottom of streams) and increased pollutant runoff. Forested stream channels are also more stable than deforested channels (Sweeny et al. 2004).

4.2 Species in the Black River Watershed

As of September 2004, a total of 471 species of plants, 130 species of birds, 70 species of fish, and 67 species of other wildlife (insects, reptiles, etc.) had been recorded for the Black River Watershed. This list was compiled from observations of the watershed coordinator, watershed technician, and other volunteers, as well as from species lists kept by the Southwest Michigan Land Conservancy for four properties under their ownership in the watershed (Appendix D). There are certainly many more species (especially invertebrates) that simply have not been catalogued for the watershed. Fish species were compiled by Kregg Smith, MDNR Fisheries biologist (Appendix E).

4.3 Unique Natural Features

A variety of rare species have been documented in the Black River Watershed. The Michigan Natural Features Inventory (MNFI) maintains a database of threatened and endangered species as well as species of special concern. This should not be considered an exhaustive inventory. For the Black River Watershed, this list contains 14 species of animals, 30 species of plants, one community (Coastal Plain Marsh), and one "other" element (Great Blue Heron Rookery). The Great Blue Heron Rookery is especially interesting because it may have existed as early as 1875. A journal article from 1895 recounts a visit to a heron rookery in Van Buren County at the approximate latitude of 42º 20 (Pericles 1895), which is the same latitude as the present rookery. This may also be the largest heron rookery in southwest Michigan.

The watershed contains one species that is federally endangered, the Karner Blue butterfly (*Lycaeides melissa samuelis*). The Eastern Massasauga (*Sistrurus catenatus catenatus*) is designated threatened under the Endangered Species Act of 1998. Species in the watershed that are listed at the state level as endangered include the migrant Loggerhead Shrike (*Lanius ludovicianus migrans*), Small-fruited Spike-rush (*Eleocharis microcarpa*), and Swamp or Black Cottonwood (*Populus heterophylla*). Other rare species that exist in the watershed include Red-shouldered Hawk (*Buteo lineatus*), Box Turtle (*Terrapene carolina carolina*), and Swamp Rose-mallow (*Hibiscus moscheutos*). A full list of these rare species can be found in Appendix F.

A population of state threatened Sessile Trillium (*Trillium sessile)* (also known as "toadshade") occurs along the South Branch of the Black River. This population is the northernmost population of this species yet discovered, and is one of the largest (B. Martinus, personal communication, May 1, 2004). This species is considered to be rare or uncommon in the state and possibly imperiled due to rarity.

4.4 Biological Surveys

The Michigan Department of Environment, Great Lakes and Energy has performed a number of biological surveys in the Black River Watershed. These surveys are examined in more depth in section 6.1. A 1988 survey of the Black River in Bangor found that aquatic habitat quality was low due to the amount of sand and silt, and that discharges into the river may have also contributed to poor habitat quality. Low macroinvertebrate species diversity was discovered downstream of these discharges (Hull 1989). PCBs were also detected in fish in this area in a 1989 study (Gashman 1990).

A 1992 survey determined that biological quality ranged from acceptable to excellent throughout the watershed (though one site above Bangor rated as poor). A lack of cobbles, boulders and woody debris in the substrate, as well as sand and silt eroding from stream banks were cited as contributing to an in-stream habitat rating of 'fair' for much of the watershed (Heaton 1997).

The conclusions were similar in a 1997 survey. In-stream habitat was again reported as being threatened by sediment deposition. This survey reported that "…channelization from various historical dredging events had removed channel diversity, reduced bank stability, and generally contributed to conditions that reduce the quality and quantity of stream biota" (Cooper 1999, p. 2).

The 2002 biological survey of the watershed had conclusions similar to previous surveys: "In summary, water quality throughout the Black River Watershed was adequate to support acceptable biological communities at locations with suitable riparian and in-stream habitat. Unfortunately, historic channelization and dredging of many streams, wetland drainage, sandy soils, and the current land management activities of riparian owners provides the aquatic biota of streams in the Black River Watershed with limited stable habitat." (Walterhouse 2003, p. 2)

The most recent survey was done in 2012. The survey report concluded that all sites were meeting the Other Indigenous Aquatic Life and Wildlife designated use. There were two habitat sites with marginal scores that would benefit from habitat restoration, specifically Barber Creek and Great Bear Lake Drain. The two NPS sites sampled in the watershed were South Branch Black River at Lyons Park as well as Haven and Max Lake Drain at Bloomingdale Park. Habitat scores improved at both sites between the 2007 and 2012 sampling. The South Branch Black River scores were comparable from 133 (Good) to 136 (Good) and Haven and Max Lake Drain increased from 101 (Marginal) to 141 (Good). These data show that habitat restoration has been successful for these NPS sites.

4.5 Fishery

Descriptions of the original fish communities for the Black River watershed prior to European settlement are not available. However, currently there have been seventy species of fish identified in the watershed (Appendix E). Nine species of fish have been introduced through management practices or inadvertently by human development in the Great Lakes Basin. Non-native species such as sea lamprey, alewife, and round goby use the Black River for spawning (Goodyear et al. 1982) and have a strong influence on fish communities through predation or competition (K. Smith, personal communication, September 20, 2004).

The Michigan Department of Natural Resources routinely stocks fish in the Black River. These include brown trout, steelhead, chinook salmon, northern pike, rainbow trout, walleye, and muskellunge. Tiger muskellunge were stocked historically, but are no longer stocked (K. Smith, personal communication, September 17, 2004). Stocking locations include the Black River in South Haven, Osterhout Lake (Lee Township), North Scott Lake (Arlington

Township), Barber Creek (Lee Township), Three Legged Lake (Bloomingdale Township), and Hutchins Lake (Ganges and Clyde Township) (Michigan Department of Natural Resources 2004).

Portions of the river are designated coldwater streams. These reaches are classified as coldwater streams by the MDNR because they are stocked with coldwater fish species. However, they do not necessarily contain reproducing populations of coldwater (salmonid) species. The fine substrate of North and Middle Branch is not conducive to the reproduction of these species. The coarser substrate of the South Branch has more potential to provide habitat for a reproducing population of salmonids (K. Smith, personal communication, March 2, 2004). However, much of this habitat is currently covered by sediment. Thus, management approaches on this branch need to address these sediment issues.

Other species that inhabit the Black River include longnose suckers and white suckers that enter the river to spawn (Goodyear et a. 1982), as well as common carp, largemouth bass, and rock bass (Gashman 1990). Non-native species such as sea lamprey and alewife have also been known to spawn in the Black River (Goodyear et al. 1982).

A fish consumption advisory exists for carp, northern pike and white sucker in the river below the Bangor Dam due to contamination from PCBs and chlordane (Michigan Department of Community Health 2004). For the most recent information on fish consumption advisories, visit the Michigan Department of Health and Human Services Michigan Fish and Wild Game Advisories.

The following water bodies in the Black River Watershed are regulated as coldwater fisheries:

- Black River Mainstream: From confluence of North and South branches down to Lake Michigan (Allegan and Van Buren Counties) Type 3
- Middle Branch Black River: From confluence of Spring Brook Creek (T1N, R15W, Section 22, Allegan County) downstream to confluence of Main Branch Black River Type 4
- North Branch Black River: From 111th Avenue (T1N, R16W, Section 3, Allegan County) downstream to confluence with Mainstream Type 1
- South Branch between the Bangor City Dam and the Hamilton Street Bridge Type 1
- South Branch Black River: From Hamilton Stream Bridge (T2S, R16W, Section 1, Van Buren County) downstream to confluence with mainstream (T1S, R17W, Section 2, Van Buren County) Type 3

The different types of trout streams are related to stream regulations. For example, Type I streams have an open season from the last Saturday in April to September 30, while Type III and IV streams are open all year.

The following are a listing of designated trout streams in the Black River Watershed.

FISHERIES ORDER

Designated Trout Streams for Michigan
Order 210.21

By authority conferred on the Natural Resources Commission and the Department of Natural Resources by Part 487 of 1994 PA 451, MCL 324.48701 to 324.48740, ordered on September 10, 2020, the following section(s) of the Fisheries Order shall read effective April 1, 2021, as follows:

The streams and portions of streams in the list which follows are hereby designated as trout streams:

Key to Designation List:

Unless otherwise described, the location description listed after the stream name indicates the downstream limit of the trout designation. All of the stream and its tributaries, unless excepted, from that point upstream are designated trout waters. Exceptions are italicized.

Black River Basin	
South Branch Black River Mainstream from T1S, R17W, S2, to T2S, R16W, S1	Van Buren
Moon Lake Drain (T1S, R16W, S20)	Van Buren
Three Mile Creek (T2S, R16W, S2)	Van Buren
Middle Branch Black River Mainstream up to confluence of Spring Brook Creek (T1N, R15W, S22)	Allegan
Spicebush Creek (T1N, R16W, S23)	Allegan, Van Buren
Barber Creek (T1N, R15W, S21)	Allegan, Van Buren
Spring Brook Creek (T1N, R15W, S22)	Allegan
North Branch Black River Mainstream from confluence to T1N, R16W, S3	Allegan

4.6 Invasive Species

Invasive species are species that are not native to the habitat that they inhabit, and cause damage to the local environment, economy, or human health. They can destroy habitat for native plants and animals, greatly inhibiting biodiversity, impacting water quality, and increasing erosion. Additionally, economic impacts range from loss of ecosystem services, impacts to infrastructure, lowered recreation access, and decreased property values. Invasive species in the wetlands and waterways of the Black River Watershed include Purple Loosestrife (Lythrum salicaria), Eurasian Milfoil (Myriophyllum spicatum), invasive Phragmties (Phragmites australis var. australis), and Zebra mussels (Dreissena polymorpha). Several other invasive species inhabit upland habitats in the watershed, including Garlic Mustard (Alliaria petiolata), kudzu (Pueraria montana), and Japanese knotweed (Fallopia japonica).

Aquatic invasive species are of high concern throughout Michigan, especially in watersheds with high recreation use. Most aquatic plants, such as hydrilla and Eurasian milfoil, can reproduce via fracturing, making both motorized and paddle boats major vectors. Additionally, recreation can increase the introduction of fish diseases or invasive species used as bait, such as red swamp crayfish or, more commonly, earthworms. Lastly, illuvial flow can lead to the spread of some invasive species designed to take advantage of these pathways, including knotweeds, which can lead to bank collapse and then utilize river flow to move reproductive pieces of the plant downstream, establishing new populations.

Interestingly, Invasive species pose a unique threat to Southwest Michigan and the Black River, in that their introduction and establishment is likely to be exacerbated by climate change. Climate change will have a significant impact on many aspects of our waters, but with increased disturbance, invasives will flourish in areas denuded of native species. Additionally, species that have traditionally been unable to establish in Michigan, such as mile-a-minute vine (*Pericaria perfoliata*), will be able to create new populations. A prime current example of this is Hemlock woolly adelgid (*Adelges tsugae*), which was found in its first established population in Michigan in 2016. Hemlock woolly adelgid, or HWA, has been found in the Eastern USA for over 50 years, killing millions of trees, but had failed to establish in the Upper Midwest due to low winter temperatures. However, with warming winters, HWA has now been established in at least 5 Michigan counties, including Allegan. HWA threatens the over 170 million hemlock trees in Michigan, which are key to maintaining our rivers and streams, particularly in cooling sport fisheries. In all likelihood, this kind of establishment will only increase as Michigan's climate continues to change. As such adaptive, forward-looking planning is key.

In managing invasive species, prevention is always considered a better, more effective, cheaper option than management and removal. The window during which established species can be eradicated is very short, before it becomes too large of an infection to effectively remediate. Therefore, prioritization should be given to prevention, survey, and early detection and rapid response efforts. However, some species, such as invasive *Phragmites*, are well established on a landscape scale, but many wetlands would benefit from active management and removal of this species. Therefore, population specific planning and treatment, both to restore high quality areas and minimize seed source, will be vital in management.

4.7 National Wetlands Inventory

The National Wetlands Inventory is a record of wetlands location and classification as defined by the U.S. Fish & Wildlife Service. These maps were created by interpreting aerial photographs. As such, they are not as accurate as on-the ground wetland delineation. However, they do provide general information on wetlands in the area. The wetland classes identified in the National Wetland Inventory for the Black River Watershed are aquatic bed, emergent, forested, scrub-shrub, unconsolidated bottom, and unconsolidated shore (Figure 11: National Wetlands Inventory and Potential Wetland Restoration Areas

12). Some of these wetlands are adjacent to the lakes and rivers in the watershed, while others are geographically isolated from any apparent surface water connection. Forested wetlands are the largest class of wetlands in the watershed, followed by emergent wetlands.

Wetland Functions

Wetlands play a crucial role in protecting water quality. They trap and filter pollutants and sediment out of surface and groundwater. They also absorb floodwaters, protecting downstream areas from flooding impacts. Wetlands provide habitat for a variety of species, and wetland vegetation helps stabilize shorelines that would otherwise be vulnerable to erosion caused by waves (Cwikiel 1996). Management measures need to be taken to protect remaining wetlands in the watershed. Not all wetlands are regulated at the state or federal levels; these can be protected at the local level, thorough planning and zoning.

Wetland Loss

For the period 1986 to 1997, wetlands were estimated to be lost at the rate of 58,500 acres annually in the United States (Dahl 2000). While this is a large improvement over the past, the goal of no net wetland loss has not been met (Dahl 2000). Forested wetlands have experienced the greatest declines, leaving the U.S. with the least amount of forested wetlands in the nation's history (Dahl 2000). Analysis of wetland loss indicates that urban and rural development, agriculture and silviculture are primarily responsible (Dahl 2000). It has been estimated that Michigan has lost 50% of its original wetland habitats (Cwikiel 2003).

Significant wetland loss has occurred in the Black River Watershed. According to EGLE's Landscape Level Wetland Function Assessment, loss per subwatershed ranged from a low of -2% (indicating a slight gain of wetland area) to a high of 74% of wetlands lost with an overall loss of 52% on the entire watershed. Further loss should be prevented, and any wetland restoration or reconstruction should be encouraged.

Wetland Restoration

MEGLE staff has prepared a map of potential wetland restoration areas in the watershed Figure 11. This map displays areas of the watershed that are not currently wetland but have wetland soils and were mapped as wetland on a presettlement vegetation map. This map can help guide efforts on where wetland restoration efforts may be most successful. Further information on wetland loss can be found in the Watershed Assessment section. Recommendations regarding wetlands can be found in section 8.2.8 of this plan, as well as in Table 27.

Table 9: Wetland acreage and loss by subwatersheds, BRW, 2011 (see Figure 12)

SUBWATERSHED	CURRENT WETLANDS (ACRES)	PRESETTLEMENT WETLANDS (ACRES) (includes current wetlands)	WETLAND LOSS (ACRES)	WETLANDS LOSS (PERCENT)
Barber Creek	1,620	2,581	961	37%
Black River Drain	3,960	8,965	5,005	56%
Black River Drain at 111th Avenue	1,042	4,007	2,965	74%
Black River Mouth	180	457	278	61%
Extension Drain	2,527	7,190	4,663	65%
Great Bear Lake Drain	1,995	3,998	2,003	50%
Maple Creek	1,099	2,830	1,731	61%
Middle Branch at Spicebush Creek	832	818	-14	-2%
Middle Branch at the Mouth	531	839	308	37%
North Branch	846	1,165	318	27%
North Branch at Spring Brook	3,060	4,191	1,132	27%
Scott Creek Drain	1,787	1,956	169	9%
South Branch	1,617	3,850	2,233	58%
South Branch at Cedar Creek	2,799	7,757	4,958	64%
South Branch at Maple Creek	1,257	2,837	1,580	56%
South Branch at the Mouth	1,297	2,959	1,662	56%
Spice Bush	988	1,967	979	50%
Spring Brook	571	562	-9	-2%
Grand Total	***28,008***	***58,927***	***30,920***	***52%***

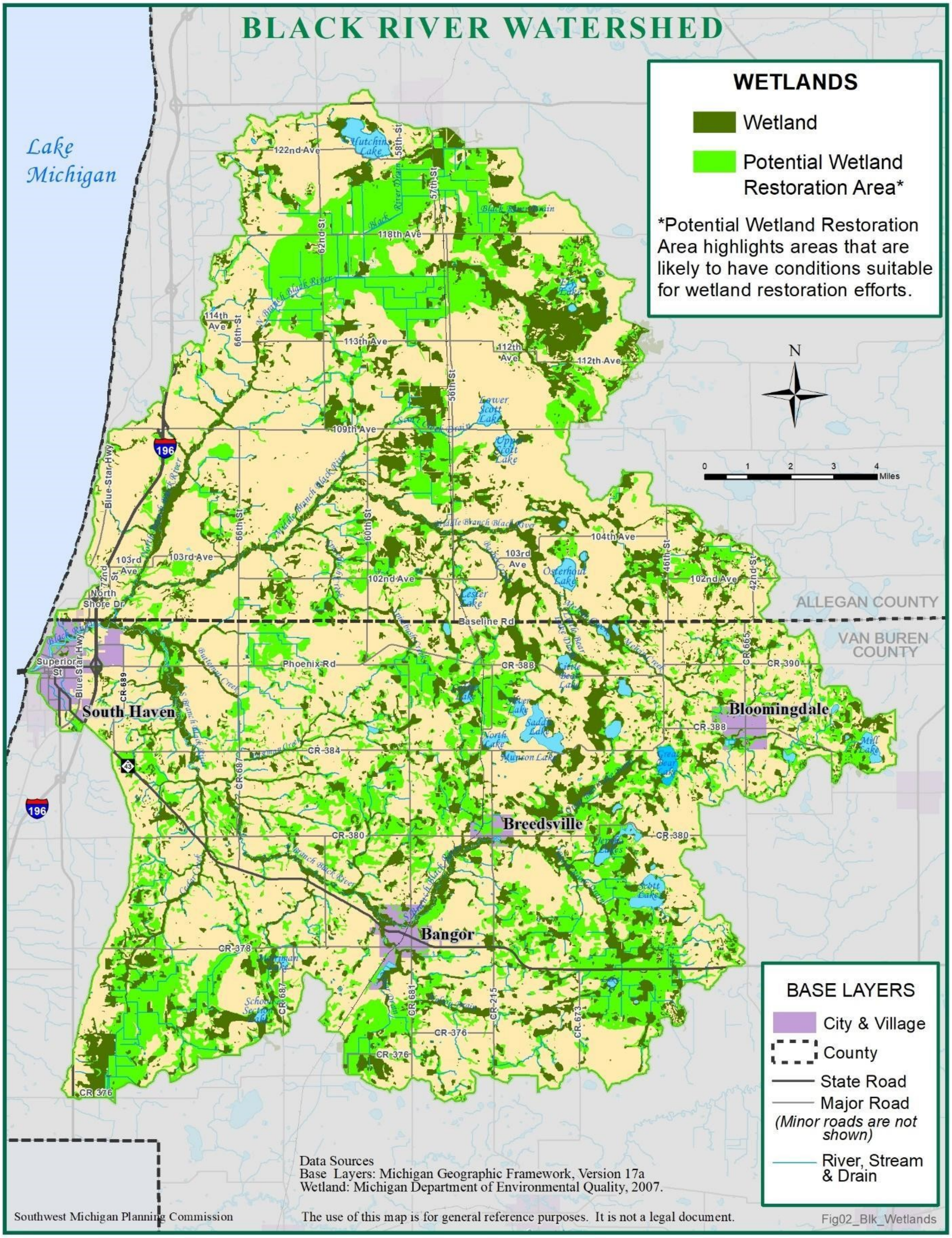


Figure 11: National wetlands inventory and potential wetland restoration areas, BRW, 2007

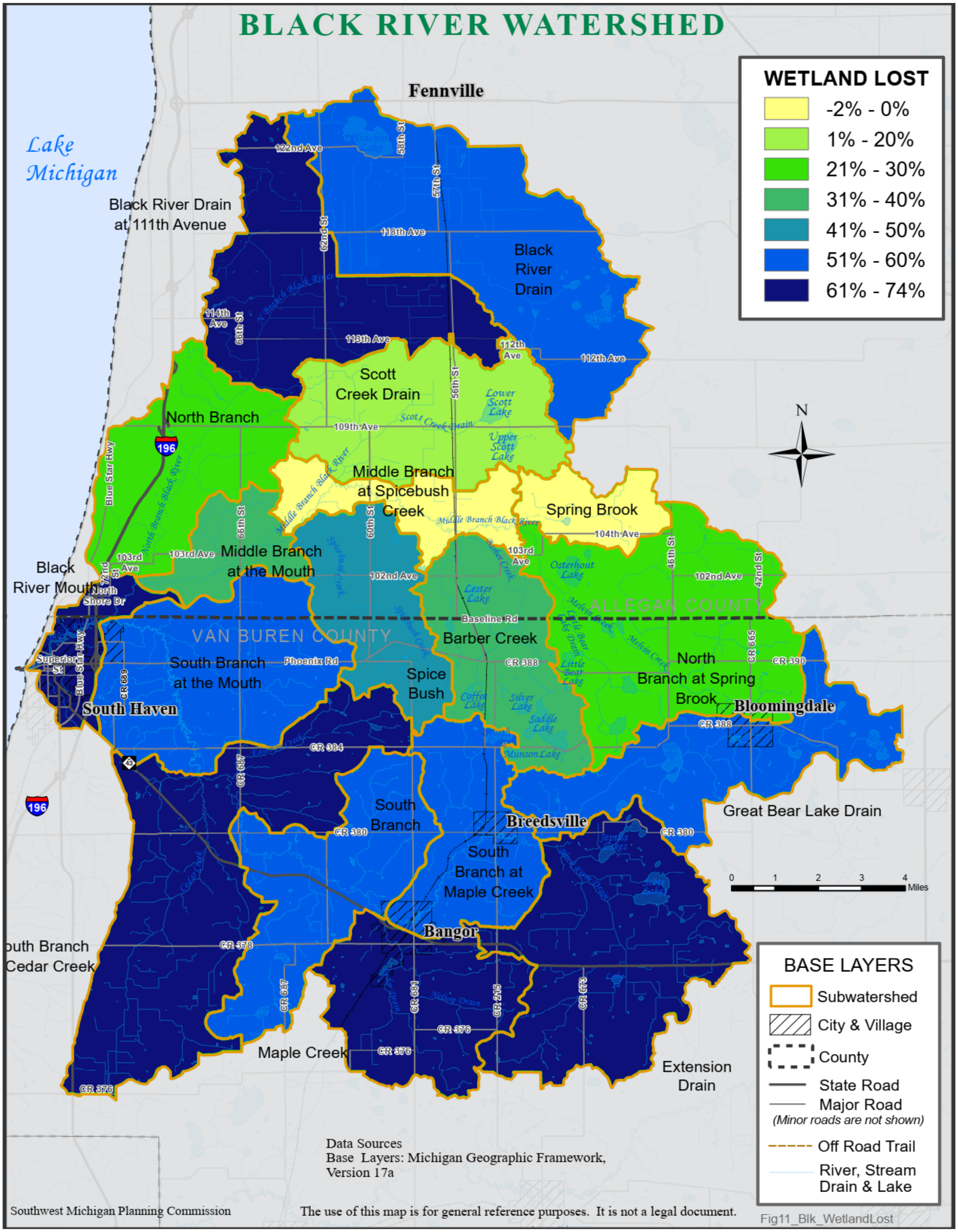


Figure 12: Wetland loss, by subwatershed, BRW, 2011

Michigan’s wellhead protection program assists local communities utilizing groundwater for their municipal drinking water supply systems in protecting their water source. A wellhead protection program minimizes the potential for contamination by identifying and protecting the area that contributes water to municipal water supply wells and avoids costly groundwater clean-ups. The following map shows the areas with a well head protection program in place in the watershed.

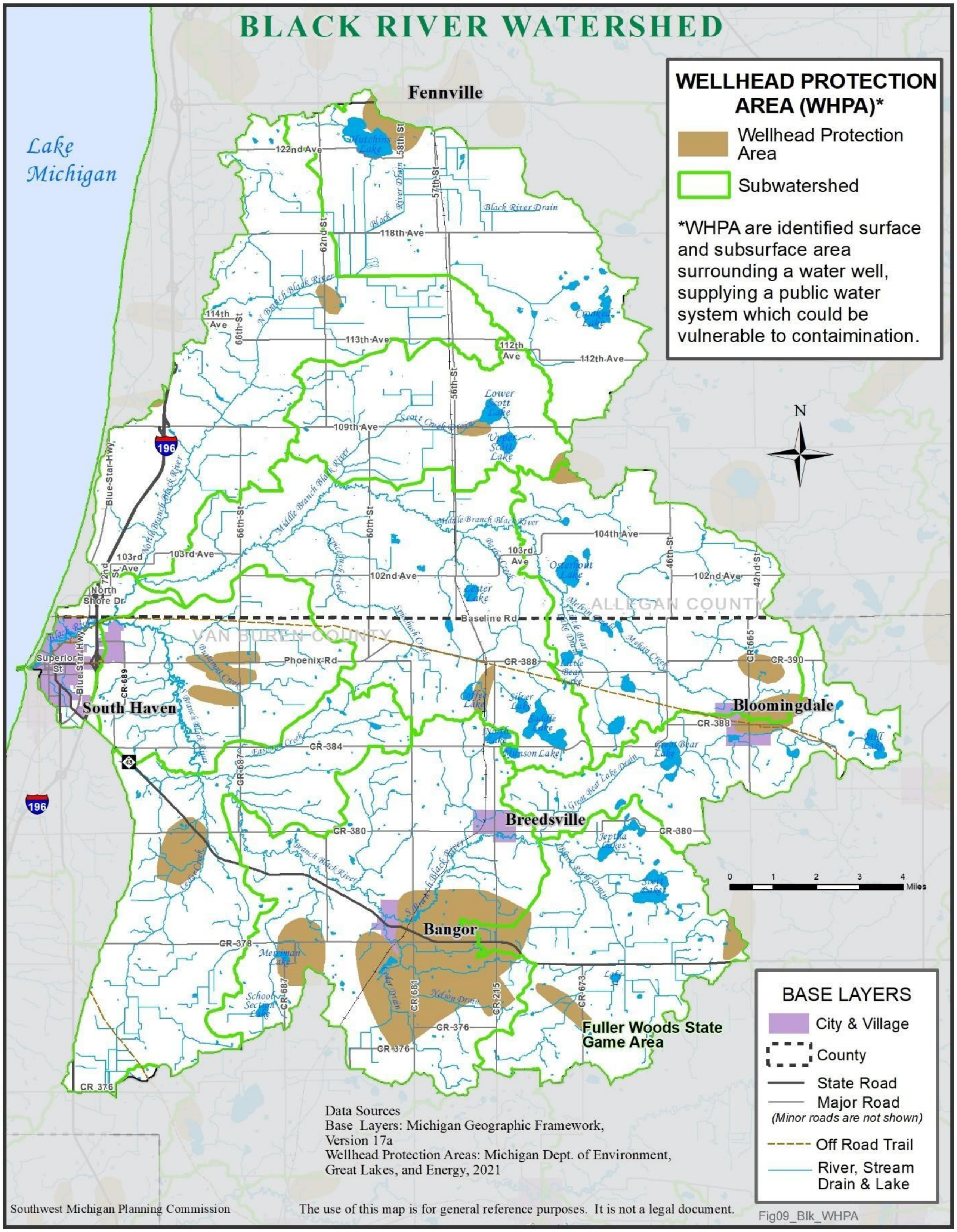


Figure 13: Wellhead Protection Areas (WHPA), BRW, 2021

4.8 Farmland

According to the American Farmland Trust, between 2001 and 2016 11 million acres of farmland and ranchland were converted to urban and highly developed land use (4.1 million acres) or low-density residential land use (nearly 7 million acres). In Michigan, in 2007 there were 56,014 farms compared to only 47,644 in 2017. Farmland in acreage decreased from 10,031,807 acres in 2007 to only 9,764,090 acres in 2017 in Michigan.

Farms within the Black River Watershed account for the vast majority of fruit/berry/nut production within Southwest Michigan, which ranks #1 in the state for fruit production. Van Buren County is ranked #1 in the nation for blueberry and cucumber production and second in the state for grape production. Allegan County ranks #1 in the state for total market value of agricultural production, and also ranks highly for fruit production. Southwest Michigan ranks highest in the state for acres of greenhouse and nursery operations.

Conversion pressures are an especially grave concern to the state of agriculture in the Black River Watershed, as Allegan and Van Buren Counties rank 2nd and 3rd respectively as the most agriculturally vulnerable counties between now and 2020 in the state (*MSU Land Transformation Analysis*.) Farmland loss and conversion threaten to erode the agricultural base in the watershed and ultimately devastate Michigan's #1 economic industry. Considering growth projections, lack of funding for purchase of development rights efforts, and inadequate zoning and subdivision regulations in the areas comprising the Black River Watershed, direct agricultural preservation through conservation easements and PA 116 enrollment is critical to this region's agricultural prosperity. Communities should work to find sustainable funding for purchase of development rights programs.

University Outreach (UO) at the University of Michigan-Flint, on behalf of the Southwest Michigan Land Conservancy (SWMLC), developed an Agricultural Lands Inventory for the Black River Watershed. This inventory uses a multi-criterion scoring approach to identify agricultural lands throughout the Black River Watershed that are highest priority for perpetual conservation. See Appendix G for more details on this inventory, and for maps of land protected under PA 116 and priority areas for protection.

About 39% of the land in the Black River Watershed is cultivated. Most of the agricultural land in the watershed is in pasture or hay, followed by blueberries, corn and soybeans.

Table 10: Major crops by acreage, BRW, 2019

CULTIVATED*	ACRES	PERCENT
Blueberries	15,085	21.2%
Corn	14,636	20.6%
Grains	1,539	2.2%
Orchards	4,568	6.4%
Pasture/Hay	21,790	30.7%
Soybeans	12,256	17.3%
Vegetables	1,119	1.6%
TOTAL ACRES	**70,994**	

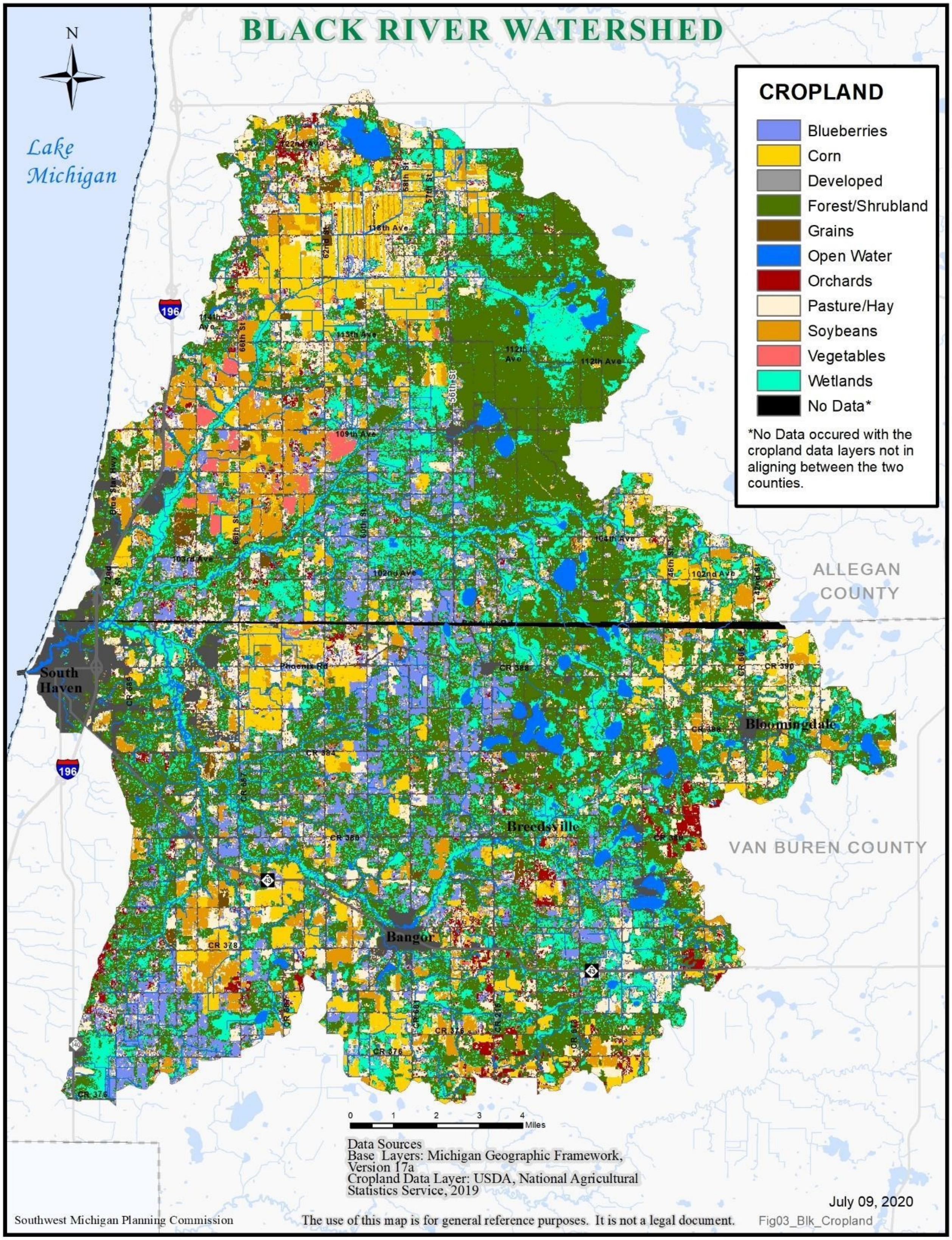


Figure 14: Cropland in the BRW, 2019

4.9 High Quality Natural Areas

Several high-quality natural areas exist in the Black River Watershed, including one property owned by the Michigan Nature Association and four properties owned by the Southwest Michigan Land Conservancy. These properties include a variety of habitats, such as wetlands, floodplains and upland forests, and support a diversity of plant and animal life. Additional high quality natural areas likely exist in private ownership.

The State of Michigan also owns a considerable amount of land in the watershed. Most of this is a part of the 45,000-acre Allegan State Game Area (of which approximately 12,200 acres are located in the Black River Watershed, with the remaining acreage located in the Kalamazoo River Watershed). The game area is highly diverse, containing over 800 plant species, and 30 threatened or endangered species (Michigan Department of Natural Resources 1993).

A map showing the approximate locations of lands owned by the State of Michigan, the Southwest Michigan Land Conservancy, and the Michigan Nature Association is shown in (the State ownership data is specific only to the quarter-quarter section).

For the 2021 plan update, the Southwest Michigan Land Conservancy (SWMLC) created a Strategic Land Conservation Plan for the Black and Paw Paw River Watersheds. This plan identified 6 areas in the Black River Watershed to concentrate on for land protection (Figure 16). The plan identifying priority landowners and associated maps can be found in the appendix H.

For the 2005 plan, the SWMLC created a Land Protection Priority Model focusing on water quality protection. This model was created using a Geographic Information System with input from a committee of stakeholders. The attributes considered when computing conservation values in the model were land cover, hydrology (presence of lakes or streams), presence of designated trout lakes or streams, groundwater recharge rate, species rarity index, proximity to existing protected areas, presence of a nature trail, and presence of a corridor or bottleneck. The full report on methodology can be found in Appendix G. The Southwest Michigan Land Conservancy will use this model to help target land for protection in the future. Communities can also use this model to locate parks or open spaces or provide protection measures at the local level through planning and zoning for these high-quality natural areas.

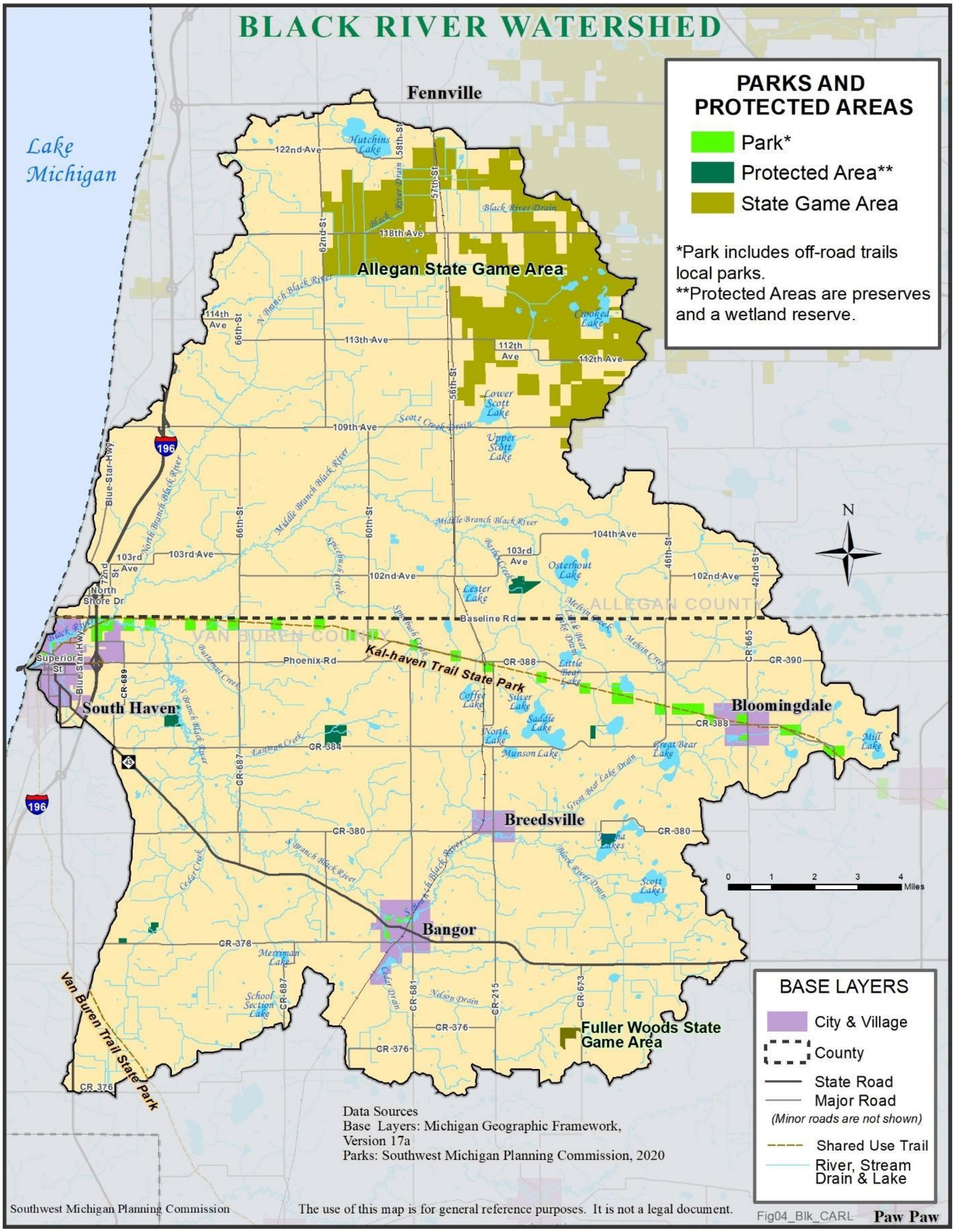


Figure 15: Preserved and state-owned land in the BRW, 2020

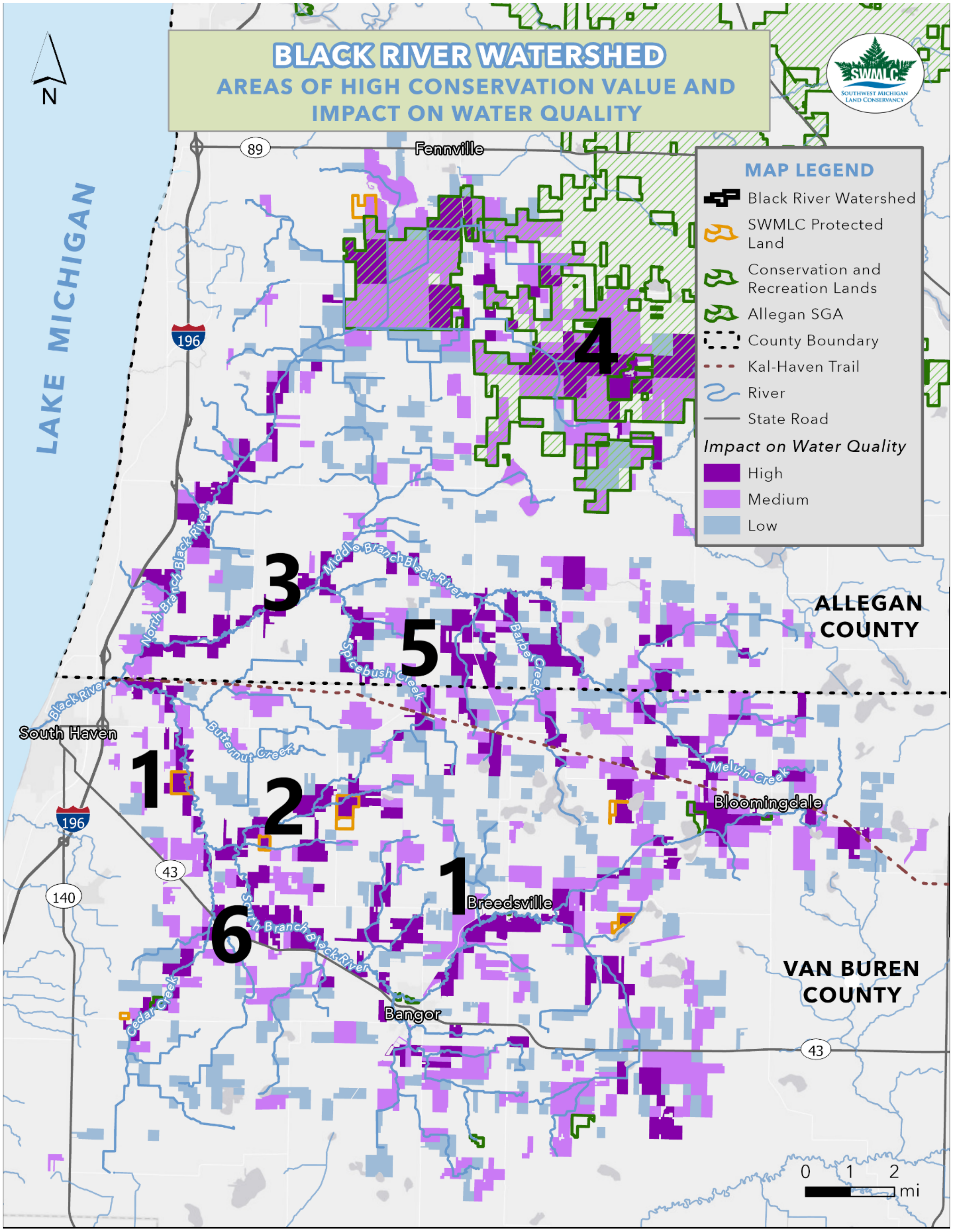


Figure 16: SWMLC Strategic Land Conservation Plan, 2020

5 Community Profile

5.1 Demographics

The Black River Watershed is primarily a rural area. The population is increasing, slightly (Table 11). Only one subwatershed (North Branch Black River) has a median household income that is more than the Michigan median household income of $57,144 (Table 12).

Table 11: Demographic profile, BRW

Variable	Black River Watershed	Allegan County	Van Buren County	Michigan
2019 Total Population	27,853	121,018	76,368	10,097,897
2024 Total Population	28,277	126,278	76,839	10,233,588
2019-2024 Population: Annual Growth Rate	0.30%	0.85%	0.12%	0.27%
2019 Education: High School Diploma (%)	30.55%	32.58%	26.67%	24.84%
2019 Education: Bachelor's Degree (%)	12.10%	15.82%	14.41%	17.92%
2019 Education: Graduate/Professional Degree (%)	6.80%	7.94%	7.68%	11.79%
2019 White Population (%)	79.55%	91.47%	85.39%	77.44%
2019 Black/African American Population (%)	5.82%	1.45%	3.78%	13.89%
2019 American Indian/Alaska Native Population (%)	1.08%	0.67%	0.88%	0.66%
2019 Asian Population (%)	0.65%	0.86%	0.69%	3.35%
2019 Pacific Islander Population (%)	0.05%	0.02%	0.03%	0.03%
2019 Other Race Population (%)	9.48%	3.14%	6.21%	1.76%
2019 Population of Two or More Races (%)	3.38%	2.38%	3.03%	2.87%
2019 Hispanic Population (%)	17.18%	7.60%	12.03%	5.28%
2019 Minority Population (%)	26.68%	12.11%	19.39%	25.38%
2019 Median Household Income	$47,597	$61,698	$52,807	$55,885
2014-2018 ACS Households Below the Poverty Level (%)	15.64%	9.78%	13.31%	14.02%
2019 Participated in environmental group or cause in last 12 months (%)	2.87%	2.88%	2.87%	3.68%
2019 Contributed to environmental organization in last 12 months (%)	4.01%	4.58%	4.44%	5.25%

Source: U.S. Census Bureau America Community Survey 5 year 2014-2018 (ESRI Community Survey)

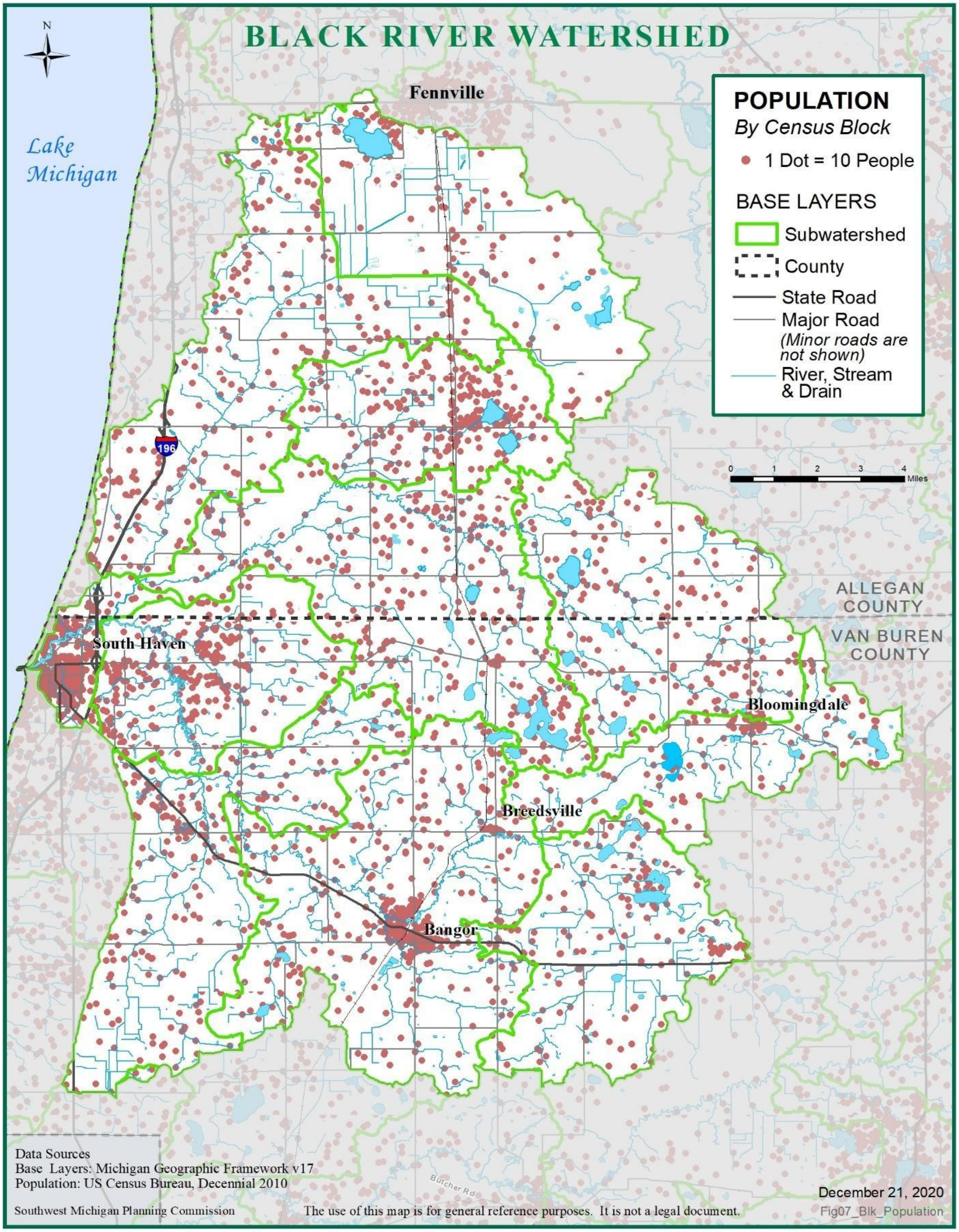


Figure 17: Population by Census Block, BRW, 2010

Table 12: Demographic profiles for Black River Subwatersheds

Name	Site	2019 Median Household Income	2010 Total Population	2010 Population Density (Pop per Square Mile)
Black River Drain (Beaver Dam Drain)	201	$48,412	1,054	35.9
Black River Drain (111th Ave)	202	$56,629	1,497	72.7
North Branch Black River	203	$66,564	862	58.0
Spring Brook	204	$56,300	246	49.9
North Branch (Spring Brook)	205	$53,719	1,709	69.2
Barber Creek	206	$52,603	1,061	79.9
Scott Creek	207	$39,571	2,445	142.6
Spicebrush Creek	208	$42,916	795	70.8
Middle Branch (Spicebrush Creek)	209	$43,452	710	99.4
Middle Branch	210	$52,369	429	78.1
Black River Extension	212	$47,539	1,553	64.1
Great Bear Lake Drain	213	$50,308	1,087	65.4
Maple Creek	214	$43,949	1,794	126.8
South Branch (Maple Creek)	215	$40,665	1,726	143.5
South Branch (Gauge # 4102700)	216	$48,431	1,155	70.3
South Branch (Cedar Creek)	217	$44,081	2,306	75.3
South Branch Black River	218	$44,113	2,733	142.6
Black River (Mouth)	219	$52,119	4,231	872.3

Source: 2019 Median Household Income, ESRI Community Analyst. 2010 Population U.S. Census Bureau Decennial 2010 Census

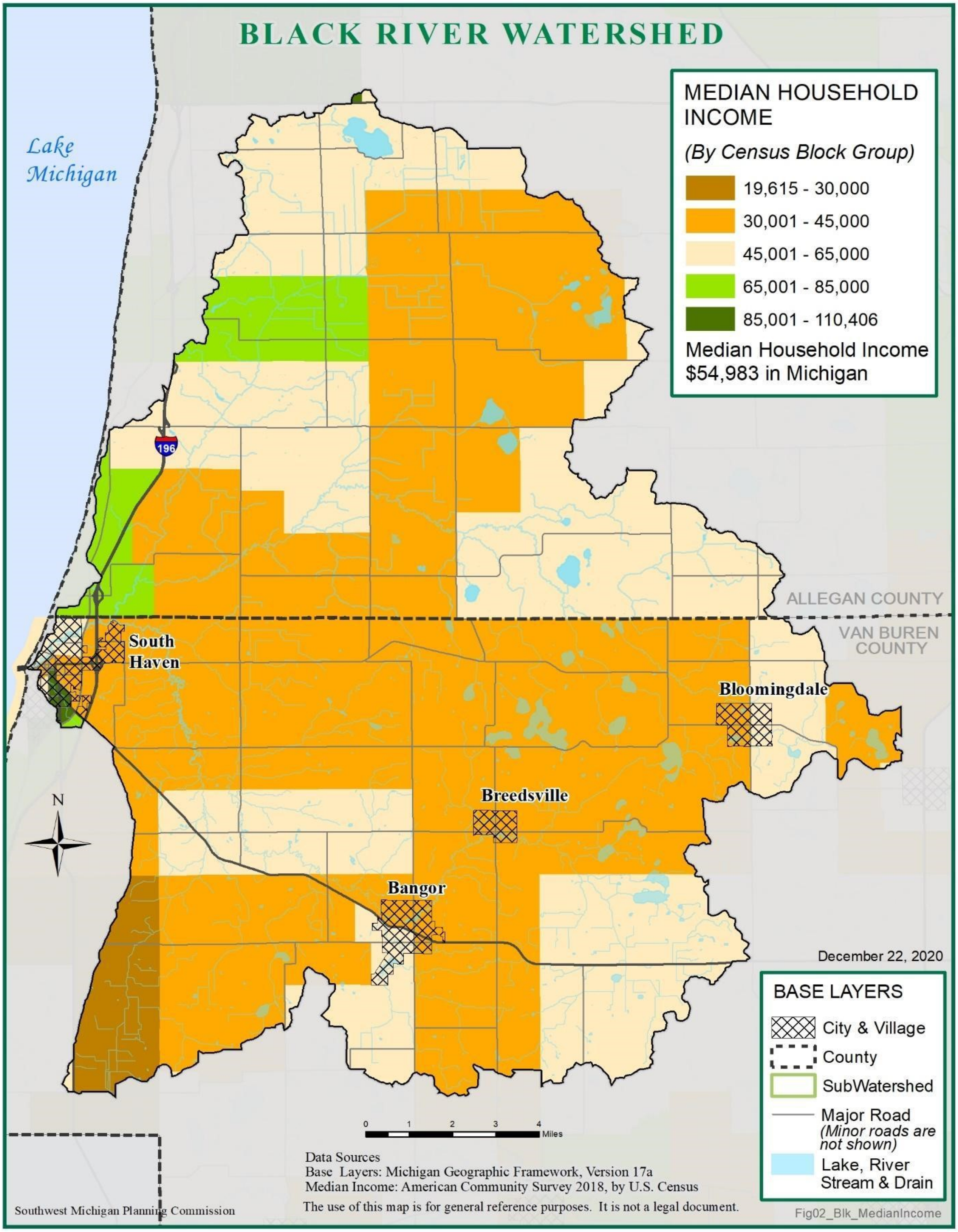


Figure 18: Median household income, BRW, 2018

5.2 Planning and Zoning

A variety of different activities occur on the landscape, and these have varying degrees of impact on surface water quality. In attempting to improve and protect water quality, it is therefore necessary to locate these activities in areas where their impacts on water quality will be mitigated. From the watershed perspective, land use activities will not only affect the immediate area in which they occur, but also all downstream areas (Brooks et al. 1991). Thus, land use planning has significant potential to positively affect water quality in the Black River Watershed.

An in-depth analysis of planning and zoning in the watershed needs to be completed. This would assist municipalities in making decisions that would affect water quality. Table 13 shows which communities in the watershed have zoning and master plans

A few municipalities have already adopted or proposed ordinances that are protective of water quality. These include an ordinance that requires inspection of septic systems when a property changes hands and an ordinance creating a resource development district that protects habitat for wildlife and native flora, as well as protecting natural water features. Through the Black River Watershed Implementation Grant (2006-2009), several communities in the watershed received assistance to update master plans and zoning ordinances to include language protective of water quality. A description of this project is available in Appendix I, and examples of this language are available at www.swmpc.org/ordinances.asp.

Table 13: Planning and zoning in the BRW, as of 2018

Municipality	Zoning?	Master Plan?	Plan Date
Casco Township	Yes	Yes - Casco Township Master Plan	2016
Cheshire Township	Yes	Yes - Cheshire Township Land Use Plan	2001
Clyde Township	Yes	Yes- Clyde Twp. Master Plan	2005 (update/amendment)
Ganges Township	Yes	Yes - Master Plan, Ganges Township	2012
Lee Township	Yes	Yes – Master Plan, Lee Township	2015 (Published Draft 2017)
Arlington Township	Yes	Yes	2009
Bangor Township	Yes	Yes - Bangor Township Master Plan	2002
Bloomingdale Township	No	Yes – Land Use plan (2010)	2010
Columbia Township	Yes	Yes	2009
Covert Township	Yes	Yes	2004
Geneva Township	Yes	Yes	2009
South Haven Township	Yes	Yes	2009
Waverly Township	Yes	Yes	2012
Bangor City	Yes	Yes - Parks, Recreation, Cultural, and Natural Areas Master Plan	2008-2013
Village of Breedsville	Yes	No	N/A
Village of Bloomingdale	No	No	N/A
South Haven City	Yes	Yes	2018

6 Water Quality in the Black River Watershed

6.1 Previous Studies

The Michigan Department of Environment, Great Lakes and Energy maintains a list of water bodies that do not attain water quality standards (the 303 (d) list). Many of the water bodies on this list are in southern lower Michigan. This is likely due to the higher population density and concentration of development, industry, roads, and prime agricultural lands in this portion of Michigan (Wolf and Wuycheck 2004). The most common causes of nonattainment status are habitat alteration, high concentrations of toxic organic chemicals (like PCBs), pathogens, sediment, and mercury. The most common sources of pollutants are hydromodification, inconclusive sources (such as atmospheric deposition), and agriculture (Wolf and Wuycheck 2004). For the most current list of waterbodies attainment status see the EGLE Water Quality and Pollution Control in Michigan Sections 303(d), 305(b), and 314 Integrated Report.

See Appendix J for excerpts and summaries of previous studies that have been done in the watershed by organizations such as the Michigan Department of Environment, Great Lakes and Energy and the Michigan Department of Natural Resources. These studies can help locate current problem areas in the watershed, but some information in them may be outdated (for example, areas in Bangor have undergone remediation for PCBs and heavy metals since these reports were completed). Updated reports will be added to this plan as they become available.

6.1.1 The Great Bear Lake TMDL

The Great Bear Lake TMDL focuses on reducing nutrient and sediment loading from 8,000 acres of watershed upstream of Great Bear Lake, which includes the Haven and Max Lake Drain and smaller agricultural tributary drains, all of which are warmwater designated water bodies in Van Buren County. The TMDL reach is 150 acres, the size of Great Bear Lake.

TMDLs (Total Maximum Daily Loads) are developed for waterbodies that do not meet water quality standards. A TMDL represents the maximum loading of a pollutant that can be discharged to a water body while still allowing that waterbody to meet water quality standards.

The Non-Point Source (NPS) and natural background levels of phosphorus are combined to produce the Load Allocation (LA). The primary NPS of phosphorus in the Great Bear Lake watershed are runoff from various land uses, septic tanks in the vicinity of the lake, and precipitation that falls directly on the lake. The current estimated NPS loading is 1,797 pounds/year. **The total LA is 1,268 pounds/year for NPS and background, which equates to a 29% reduction in phosphorus.**

Preliminary modeling indicates that a substantial portion of the annual phosphorus load delivered to Great Bear Lake is attributable to the agricultural land uses in the watershed. However, other NPS problems have been identified by district staff, particularly the septic tank issues, that need to be addressed. (source: MDEQ, Phosphorus Total Maximum Daily Load for Great Bear Lake Van Buren County, September 2004) https://www.michigan.gov/documents/deq/wrd-swas-tmdl-greatbearlake_451035_7.pdf

6.2 Watershed Analysis

The watershed inventory consisted of road-stream crossing inventories, "windshield" surveys, and canoeing, kayaking, or walking stretches of stream to identify potential problem areas. Aerial photographs were also studied extensively to help locate potential problem areas. A road-stream crossing inventory was performed by the Michigan Department of Environment, Great Lakes and Energy in 2001. A follow-up survey was performed during the course of the Black River Watershed Project between 2002 and 2005.

6.2.1 Aerial Photograph Review

Aerial photographs were reviewed to determine the approximate number of houses around the lakes in the watershed. This was done to give an estimate of pollutant loadings from septic tanks. A residency rate of 3.5 individuals per dwelling was used, with an estimate of 0.25 pounds of phosphorus/capita/year. This estimate is the amount of phosphorus reaching the lake after treatment and discharge to the drainage field (Walterhouse 2004).

This estimate may be off, since many of these lake homes are likely not occupied year-round. However, some septic systems may be failing or inadequate and thus contributing greater amounts of phosphorus. County Health Department staff estimate that 1% of septic systems are actively failing, and 60% are not up to code (systems in heavy soils, not meeting isolation distance to water table, etc.) (M. Bjorkman, personal communication, 10 July 2007). The lakes with the greatest estimated phosphorus loads from septic tanks are those with the most adjacent houses, such as Saddle Lake, South Scott Lake (Van Buren County), Hutchins Lake, and Great Bear Lake (Table 14).

Aerial photographs were also reviewed to examine change in the river channel. Aerials of the watershed in 1938 were compared to more recent aerials of the watershed (1998 aerial photos for Allegan County and 2003 aerial photos for Van Buren County). The river is obscured by vegetation in some portions of these photographs, and thus, not all reaches of the river were analyzed. In general, the North Branch of the Black River has much the same pattern today as it did in 1938. Some portions were straighter in 1938 and are today showing signs of re-meandering, especially a portion in Casco Township north of 109th Avenue. Also, many more drains exist now than in 1938. The Middle Branch has retained a similar pattern since 1938. It is a meandering river, and some meanders have cutoff since 1938. The South Branch has been the most dynamic branch since 1938. The river in Geneva Township especially appears to be straighter and less meandering than it was in 1938. From the confluence of the South Branch and Cedar Creek in southern Geneva Township to the City of Bangor, the river appears to have the same pattern (where it is visible on both sets of aerials). Upstream of Bangor, however, meander cutoffs and oxbows indicate more change.

Recent aerial photos (1998 for Allegan County and 2003 for Van Buren County) were also reviewed to locate areas that lack vegetative buffers along the riparian corridor. This review revealed 4595 linear feet lacking buffers in agricultural areas and 4326 linear feet of buffers lacking in residential areas. This is likely an underestimate, since smaller drains and streams are not clearly visible in these photographs.

Table 14: Estimated phosphorus loading from septic tanks around lakes in the BRW

Name	Township	Acres	Connected to Black River?	# houses within 300 ft. (estimated)	Lbs Phosphorus/per year
Saddle Lake	Columbia	282.5	Yes	155	135.6
South Scott Lake	Arlington	118.1	Yes	154	134.8
Hutchins Lake	Ganges/Clyde	378.8	Yes	134	117.3
Great Bear Lake	Bloomingdale/Columbia	166.2	Yes	114	99.8
North Scott Lake	Arlington/Columbia	76.3	Yes	92	80.5
Lower Scott Lake	Lee	119.5	Yes	63	55.1
Osterhout Lake	Lee	171.9	Yes	56	49.0
Mill Lake	Bloomingdale	107	Yes	53	46.4
Upper Jeptha Lake	Columbia	58.8	Yes	42	36.8
Silver Lake	Columbia	50.1	Yes	41	35.9
Upper Scott Lake	Lee	94.4	Yes	29	25.4
North Lake	Columbia	60.6	Yes	25	21.9
S. Branch Black River (Breedsville Mill Pond)	Columbia	7.9	Yes	24	21.0
Munson Lake	Columbia	38.5	No	17	14.9
Lake Eleven	Columbia	53.9	Yes	16	14.0
Merriman Lake	Bangor	27.1	Yes	13	11.4
Lester Lake	Lee	60.4	Yes	12	10.5
Little Bear Lake	Columbia	46.1	Maybe/Wetland	9	7.9
Ely Lake	Clyde	27	Yes	4	3.5
Moon Lake	Geneva	14.6	Yes	4	3.5
Coffee Lake	Columbia	40.4	Yes	3	2.6

Name	Township	Acres	Connected to Black River?	# houses within 300 ft. (estimated)	Lbs Phosphorus/per year
Crooked Lake	Clyde	96.9	No	3	2.6
Deer Lake	Columbia	30.4	Yes	3	2.6
Manitt Lake	Casco	0.7	No	2	1.8
Spring Brook Lake	Lee	15.3	Yes	2	1.8
Clear Lake	Lee	19.7	No	1	0.9
Lake Fourteen	Arlington	20.9	Yes	1	0.9
Max Lake	Bloomingdale	28	Yes	1	0.9
Munn Lake	Bloomingdale	12.3	Yes	1	0.9
Picture Lake	Geneva	5	Yes	1	0.9
School Section Lake	Bangor	36.1	Yes	1	0.9
Abernathy Lake	Waverly	4.1	Yes	0	0.0
Lake Fourteen	Columbia	69.5	Yes	0	0.0
Little Tom Lake	Clyde	18.1	By Wetland	0	0.0
Lower Jeptha Lake	Columbia	55.4	Yes	0	0.0
Max Lake	Waverly	4.4	Yes	0	0.0
Moriah Lake	Columbia	17	Yes	0	0.0
Mud Lake	Cheshire	3.9	Yes	0	0.0
Mud Lake	Clyde	4.4	No	0	0.0
Mud Lake	Columbia	23.4	Yes	0	0.0
S. Branch Black River (Bangor Mill Pond)	Bangor/Arlington	22.7	Yes	5	0.0
Skunk Lake	Bloomingdale	6.6	Yes	0	0.0
Stillwell Lake	Columbia	18.3	Yes	0	0.0

6.2.2 Road-Stream Crossing Inventory

A Road-stream crossing inventory was performed by Michigan Department of Environment, Great Lakes and Energy staff in the spring and summer of 2001. These surveys were completed at approximately 80% of the road-stream crossings in the watershed. Investigators recorded a variety of information about each site, including physical characteristics and potential pollution sources. This data has been entered into a Geographic Information System (GIS) to facilitate the review of data. Figure 19 shows the rankings of all the sites visited. 212 road-stream crossings were visited in total. Six of these were considered to be in "poor" condition; ten in "fair" condition, and the rest were in "good" condition. Several of the "poor" sites were degraded due to unrestricted livestock access. While this information is certainly useful to help locate problem areas, it may not present an accurate picture of water quality. For example, data on turbidity may not be very useful, as some sites were visited after a rainfall and some were visited during dry periods. Furthermore, the dataset is now several years old and is somewhat incomplete. For example, problems with bridges or culverts were not recorded in this road-stream crossing inventory.

All sites were revisited between June 2003 and April 2004 to take photographs of the sites and note any problem areas. During this period, some road-stream crossings were identified as having problems (such as erosion around a bridge or culvert, or improper culvert sizing and placement). This list will be updated as new areas are found (or problem areas are remediated). Other problem areas were also discovered, including uncontrolled livestock access to streams, streambank erosion, incised stream beds, and areas lacking in a vegetative buffer along the stream.

6.2.3 Canoe and Kayak Trips

Sections of the watershed were visited via canoe, kayak, or by foot. The prevalence of snags and large woody debris makes canoe or kayak passage difficult to impossible in many portions of the river. In addition, the extremely silty substrate of some of the streams makes wading difficult. Thus, not all portions of the watershed were visited. Figure 20 shows the river reaches that were canoed, kayaked or walked during the course of the project. Photos and notes were taken in those reaches that were accessible by boat or foot.

Approximately 14 miles of the Black River were canoed or kayaked by the watershed coordinator and several volunteers. Much of the river is too shallow or is filled with debris dams, making canoeing and kayaking difficult. The sections that were canoed or kayaked were: the North Branch from the crossing at 68th St. downstream to the crossing at 103rd Ave; the North Branch from the confluence with the South Branch upstream to the confluence with the Middle Branch; the Middle Branch from 68th St. downstream to 70th St. in Casco Township; the South Branch from the crossing at CR 388 to the mouth; and the South Branch from Lion's Park in Bangor to approximately 1 mile downstream.

Most of the 14 miles that were canoed or kayaked had a wide buffer of natural vegetation. This buffer is primarily forest, though there are small portions of emergent wetland (Figure 21). The exception is the stretch upstream of the river mouth (approximately 2 miles). The area in South Haven is very developed, with numerous marinas and residential developments to the edge of the river (Figure 22). Once upstream of this section, the river corridor is primarily forested and rural.

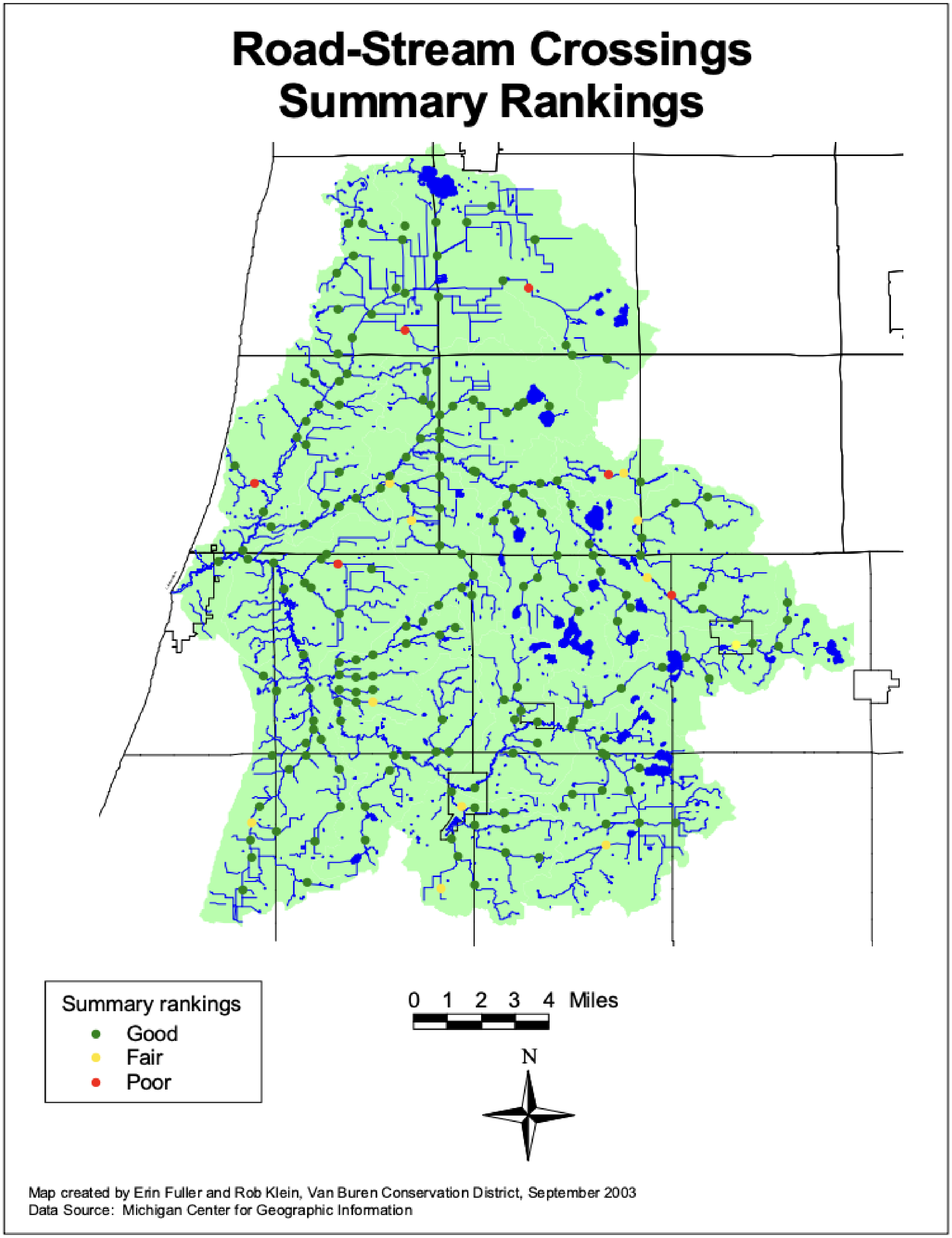


Figure 19: Rankings of road/stream crossings in the BRW, 2004

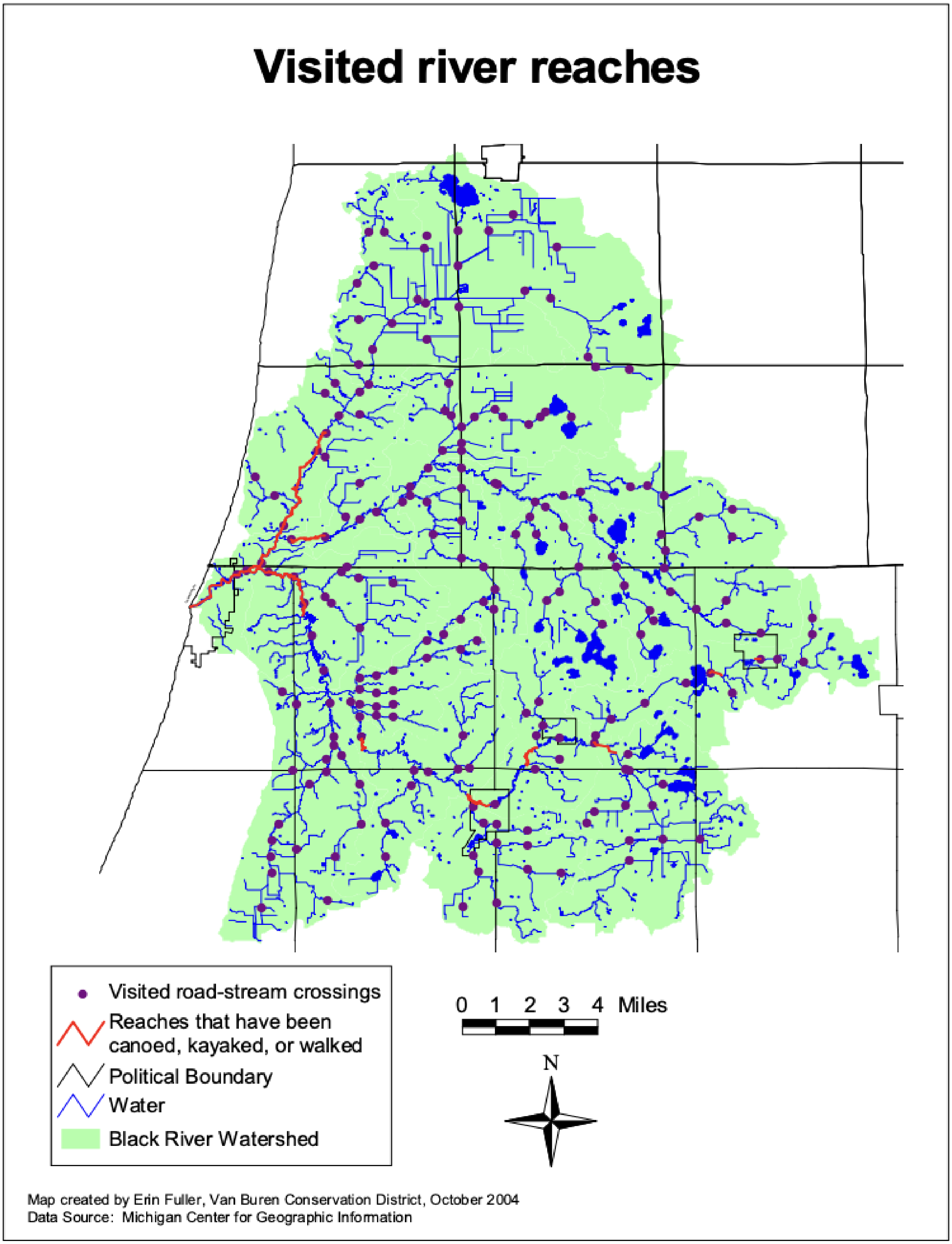


Figure 20: Visited river reaches in the BRW, 2004

Figure 21: Natural vegetation buffer along the North Branch (Casco Twp.), 2004

Figure 22: The Black River in South Haven, near the river mouth, 2004

The North Branch of the river downstream of 108th Ave. is primarily forested. Very few houses are visible along the river. The floodplain is wide, and woody debris is prevalent within the channel. The banks appeared stable and well-vegetated. There were a few small emergent wetlands along this stretch, dominated mostly by Reed Canary Grass (Figure 23).

Figure 23: Emergent wetland along the North Branch, 2004

The Middle Branch in Casco Township is primarily forested along the river corridor. Some bank erosion is occurring but is not severe. Some tree roots are exposed along the riverbank, but the trees are in many cases adapting to the erosion by growing straight (Figure 24). The substrate is primarily sand, with some gravel areas.

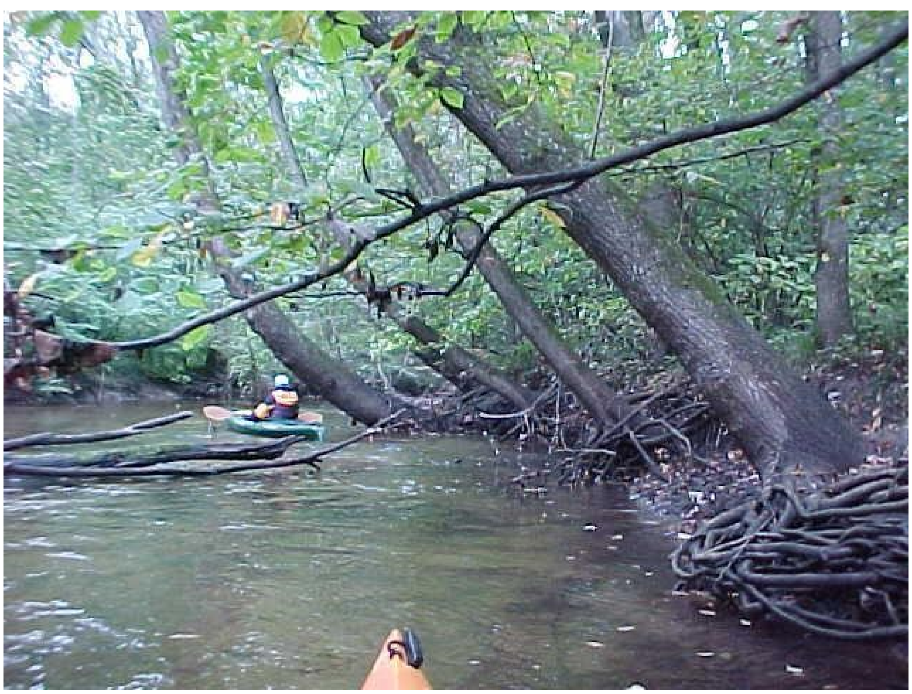


Figure 24: Trees responding to erosion along the Middle Branch, 2004

Upstream of the confluence with the North Branch, the banks of the South Branch are in some places quite high and eroding (Figure 25). This is in most cases not a result of current land use practices, as the river is forested along most of these sections.

Figure 25: High, eroding bank along the South Branch, 2004

The South Branch between Phoenix St. and 70th St. has high, somewhat unstable banks. Roots of many trees have been undercut, indicating that the channel of the river is changing faster than the vegetation can adapt (Figure 26).

Figure 26: Undercutting of tree roots along the South Branch, 2004

The South Branch downstream of Lion's Park in Bangor is very forested. The prevalence of woody debris makes this a slow and difficult paddle (Figure 27).

Figure 27: Canoeists negotiate a large tree across the South Branch, downstream of Bangor, 2004

Portions of the watershed were inventoried by foot if they were impassable by canoe or kayak. However, the nature of the river substrate made this difficult and at times impossible. Sections examined by foot (by wading or walking along the banks of the river) were:

- South Branch Black River downstream of Breedsville (Columbia Twp. Section 32).
- Haven and Max Lake Drain upstream of Great Bear Lake (Bloomingdale Twp. Section 19)
- Haven and Max Lake Drain downstream of CR 665 (Bloomingdale Twp. Section 17)
- South Branch Black River upstream of Breedsville (Columbia Twp. Section 34)
- South Branch Black River between Bangor and South Haven (Geneva Twp. Section 33)

6.2.4 Bank Erosion Study

Rates of bank erosion at 8 sites in the watershed were measured using erosion pins. The pins (sections of wooden dowel) were placed in the streambanks in June 2004 and measured throughout the summer to determine how much soil was eroding (or being deposited) around them. Though not enough sites were monitored to draw conclusions about the watershed, it was clear that at least in some areas, the river channel is actively changing. The full report is located in Appendix K.

6.2.5 Impervious Surface Analysis

Impervious surfaces are those surfaces such as roads, parking lots and rooftops that do not allow infiltration of rainwater and snowmelt. As impervious surface areas increase in a watershed, so does runoff. Runoff is usually warmer than groundwater and can carry a variety of pollutants into streams, such as sediment, fertilizers, pesticides, or oil. Recent research also indicates that potentially carcinogenic compounds may leach from asphalt-based and coal tar-based sealants that are used on paved areas (Perkins 2004). In addition, streams surrounded by a high percentage of impervious surfaces will have a “flashy” hydrological regime in which the stream receives floods after rain events and snowmelt but is deprived of water during the dry season due to decreased infiltration (Wyckoff et al. 2003). Studies have shown that as the land cover of a watershed becomes 8-10% impervious surface, water quality is negatively impacted. Above 10% impervious cover in a watershed, water quality typically begins to degrade (Wyckoff et al. 2003). High flows from storms scour the banks, causing erosion and loss of vegetation (Perkins

2004). A typical suburban development with homes on 1/3 acre lots is approximately 35% impervious (Perkins 2004).

An online land use analysis tool was used to estimate impervious surface cover in the watershed (Choi and Engel 2004). This model uses 1992 land use/land cover data and estimates the amount of impervious cover associated with that land use (Table 15). Using this model, an average of 2.19% of the Black River Watershed is composed of impervious surfaces. This is below the level at which water quality begins to degrade. However, this is important data to monitor. It is more cost effective to plan ahead to protect water quality by keeping the impervious cover under the 10% threshold than it is to try to restore the river system after it has already been degraded (Wyckoff et al. 2003). Additionally, within the watershed, impervious surface coverage varies widely. High-density areas may have impervious surface coverage of greater than 10% (unfortunately the model only works at the subwatershed level).

Table 15: Impervious cover percentage based on land use category

Land Use Category	Impervious Cover
Agriculture, Pasture/Grass, Forest	1.9%
Water/Wetland	0.0%
Low Density Residential	15.4%
High Density Residential	36.4%
Industrial	53.4%
Commercial	72.2%

Source: Choi and Engel 2004

The following impervious surface maps indicate that most of these areas are located in towns (South Haven, Bangor, Bloomingdale, Grand Junction, Pullman) and populated lakes.

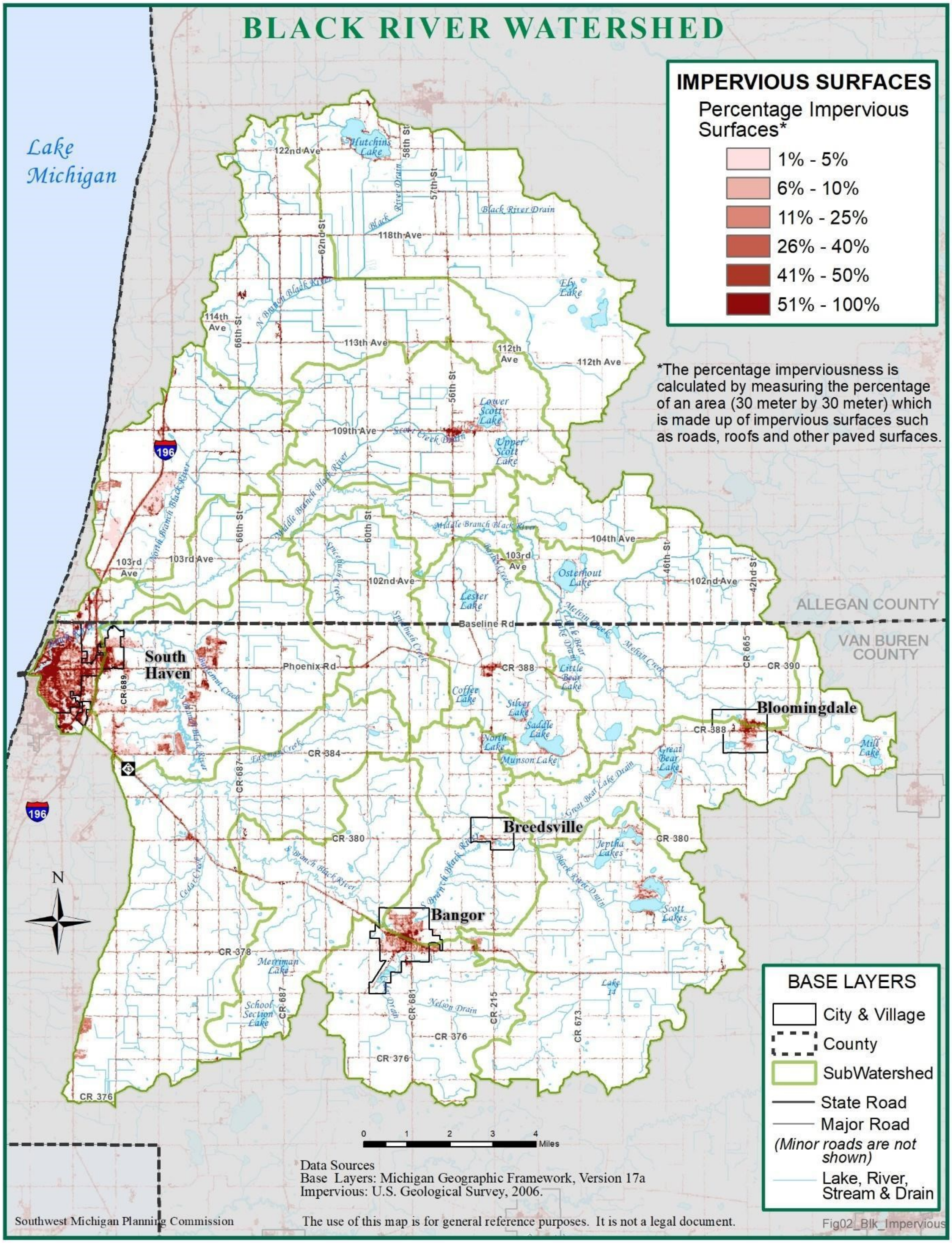


Figure 28: Impervious surfaces in the BRW, 2006

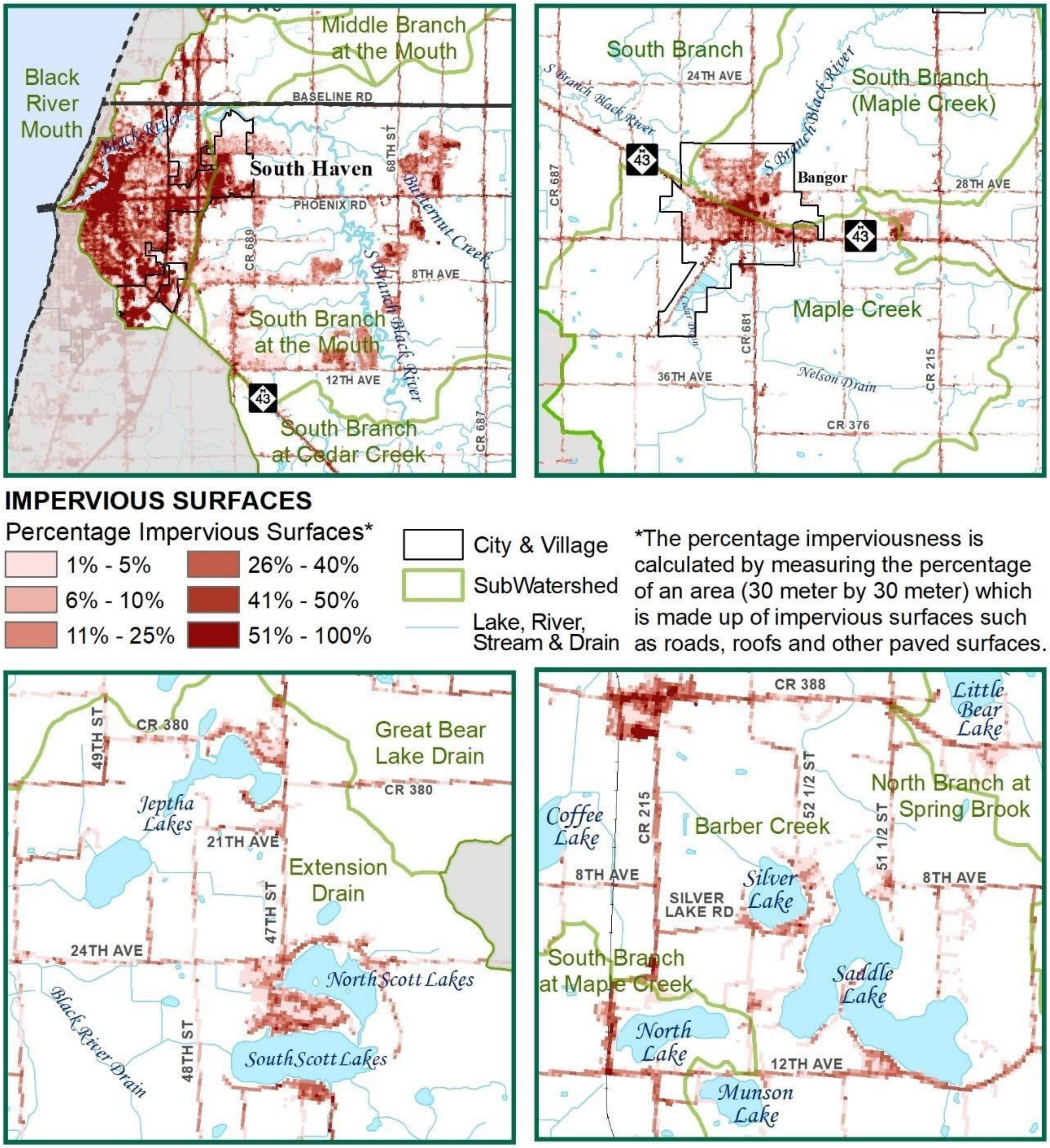


Figure 29: Impervious surfaces in the BRW, detailed, 2006

6.2.6 Build-Out and Long-Term Hydrologic Impact Analysis (L-THIA)

In 2009, Kieser & Associates completed a build-out analysis and long-term hydrologic impact analysis for the Black River Watershed. The purpose of this analysis was to calculate current runoff volume and pollutant load conditions and evaluate the impact of future land use changes on water quality (specifically runoff volume, total suspended solids, phosphorus and nitrogen). In the model, land use change was based on future land use maps from local municipal master plans. This report will be instrumental in working with governmental units on master plan and zoning ordinance updates to improve and protect water quality. The model was also used to determine current pollutant loading. Sources of non-point source pollutants in the Black River Watershed are primarily from agriculture and urban areas. Modeling results show that though agriculture is the largest non-point source of pollutants in the watershed, urban land uses contribute over 25% of the total pollutant load even though they only occupy about 5% of the land area. Additionally, the results of this model helped identify areas where future development is expected to threaten water quality. See section 6.7 for results of this study. Information contained in this report was used in the subwatershed matrix (Table 25). The full report can be found in Appendix L.

6.2.7 Landscape Level Wetland Function Assessment

Based on a technique developed in the US Fish and Wildlife Service' Northeast Region (USFWS-NE), additional information can be added to the National Wetland Inventory database to characterize 9 general wetland functions at a landscape level. This technique was applied in the Black River Watershed to assist local planners with wetland conservation and restoration strategies for their watershed.

Wetland databases for presettlement and 1998 conditions were prepared to allow comparison of wetland condition in these two eras. Before European settlement, the Black River watershed contained almost 59,000 acres of wetland or 32% of the total watershed area. By 1998, the total wetland area had been reduced to (28,000 acres) which is only about 15% of the total watershed area. This is a loss of 52% of the wetlands in acreage. Conversion to farmland was the main reason for wetland loss. Conversion of forested wetland to emergent/scrub-shrub wetland due to logging practices and drainage also played a role in the cumulative impact of wetland functional loss.

However, just lost acreage of wetland does not tell the whole story. With the loss of wetlands, we want to better understand the loss of the important functions that wetlands provide. The following maps provide an overview of wetlands (existing and lost) that have or had high or medium significance for three different functions: floodwater storage, sediment and other particulate retention and nutrient transformation.

Table 16: Wetland function assessment in the BRW

SUBWATERSHED	CURRENT WETLANDS (ACRES)	PRE-SETTLEMENT WETLANDS (ACRES)	WETLAND LOSS (ACRES)	WETLAND LOSS	FLOODWATER RETENTION	STREAMFLOW MAINTENANCE	NUTRIENT TRANSFORMATION	SEDIMENT AND OTHER PARTICULATE RETENTION	SHORELINE STABILIZATION	GROUND WATER RECHARGE
Barber Creek	1,620	2,581	961	37%	46%	47%	37%	53%	43%	49%
Black River Drain	3,960	8,965	5,005	56%	75%	61%	47%	56%	64%	62%
Black River Drain at 111th Avenue	1,042	4,007	2,965	74%	86%	79%	74%	86%	83%	10%
Black River Mouth	180	457	278	61%	56%	56%	65%	55%	35%	82%
Extension Drain	2,527	7,190	4,663	65%	72%	70%	63%	61%	64%	68%
Great Bear Lake Drain	1,995	3,998	2,003	50%	55%	57%	46%	55%	59%	54%
Maple Creek	1,099	2,830	1,731	61%	64%	67%	57%	45%	56%	68%
Middle Branch at Spicebush Creek	832	818	-14	-2%	9%	-26%	3%	-4%	7%	43%
Middle Branch at the Mouth	531	839	308	37%	39%	40%	25%	8%	24%	43%
North Branch	846	1,165	318	27%	18%	30%	24%	15%	21%	47%
North Branch at Spring Brook	3,060	4,191	1,132	27%	33%	34%	27%	21%	31%	30%
Scott Creek Drain	1,787	1,956	169	9%	59%	-4%	-1%	-77%	0%	44%
South Branch	1,617	3,850	2,233	58%	60%	61%	46%	20%	54%	66%
South Branch at Cedar Creek	2,799	7,757	4,958	64%	75%	71%	48%	48%	69%	68%
South Branch at Maple Creek	1,257	2,837	1,580	56%	57%	63%	47%	5%	47%	62%
South Branch at the Mouth	1,297	2,959	1,662	56%	46%	57%	44%	17%	41%	55%
Spicebush	988	1,967	979	50%	60%	54%	37%	35%	46%	63%
Spring Brook	571	562	-9	-2%	8%	3%	6%	13%	2%	25%
Grand Total	**28,008**	**58,927**	**30,920**	**52%**	**61%**	**58%**	**45%**	**43%**	**55%**	**54%**

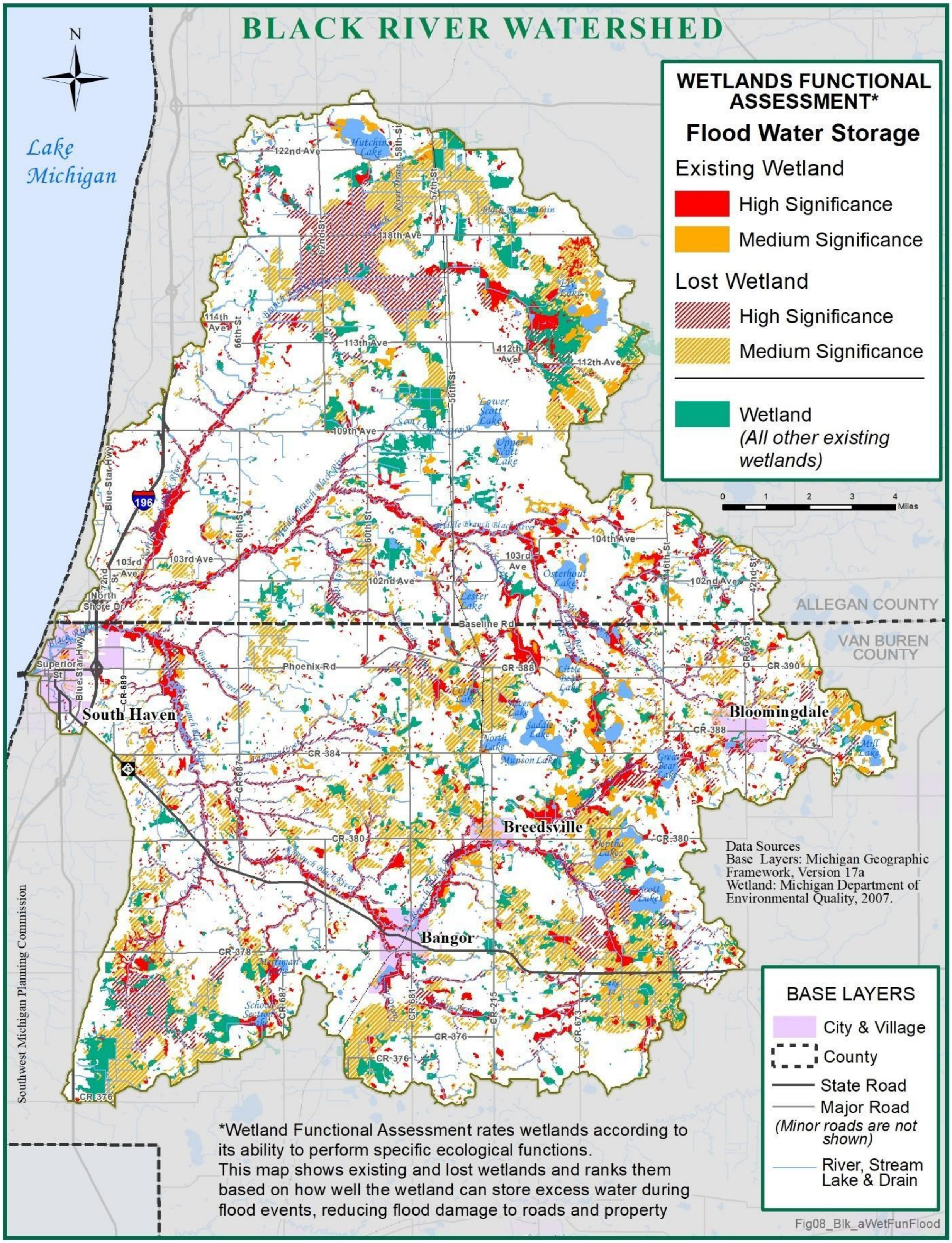


Figure 30: Wetland functional assessment in the BRW, flood water storage, 2007

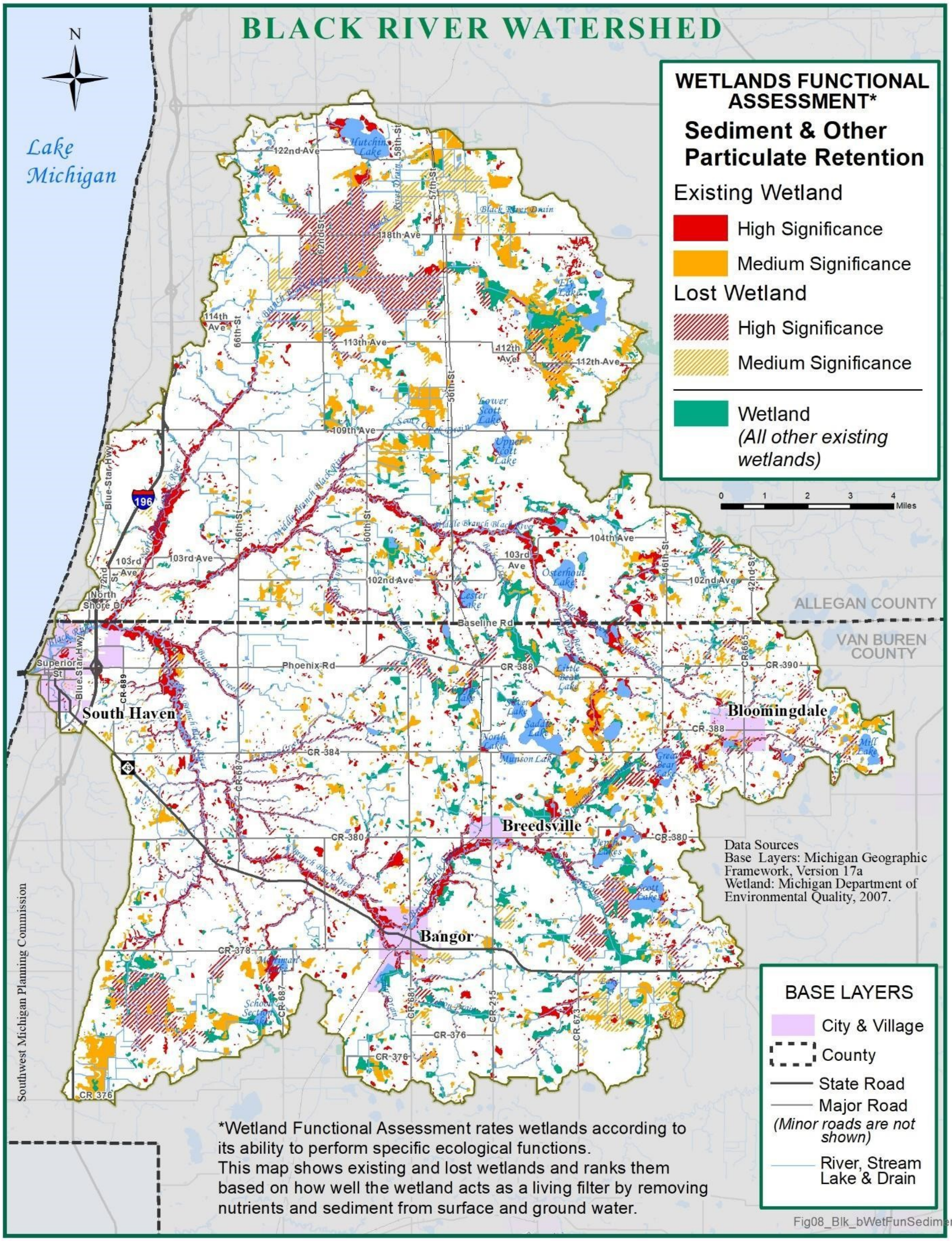


Figure 31: Wetland functional assessment in the BRW, sediment and other particulate retention, 2007

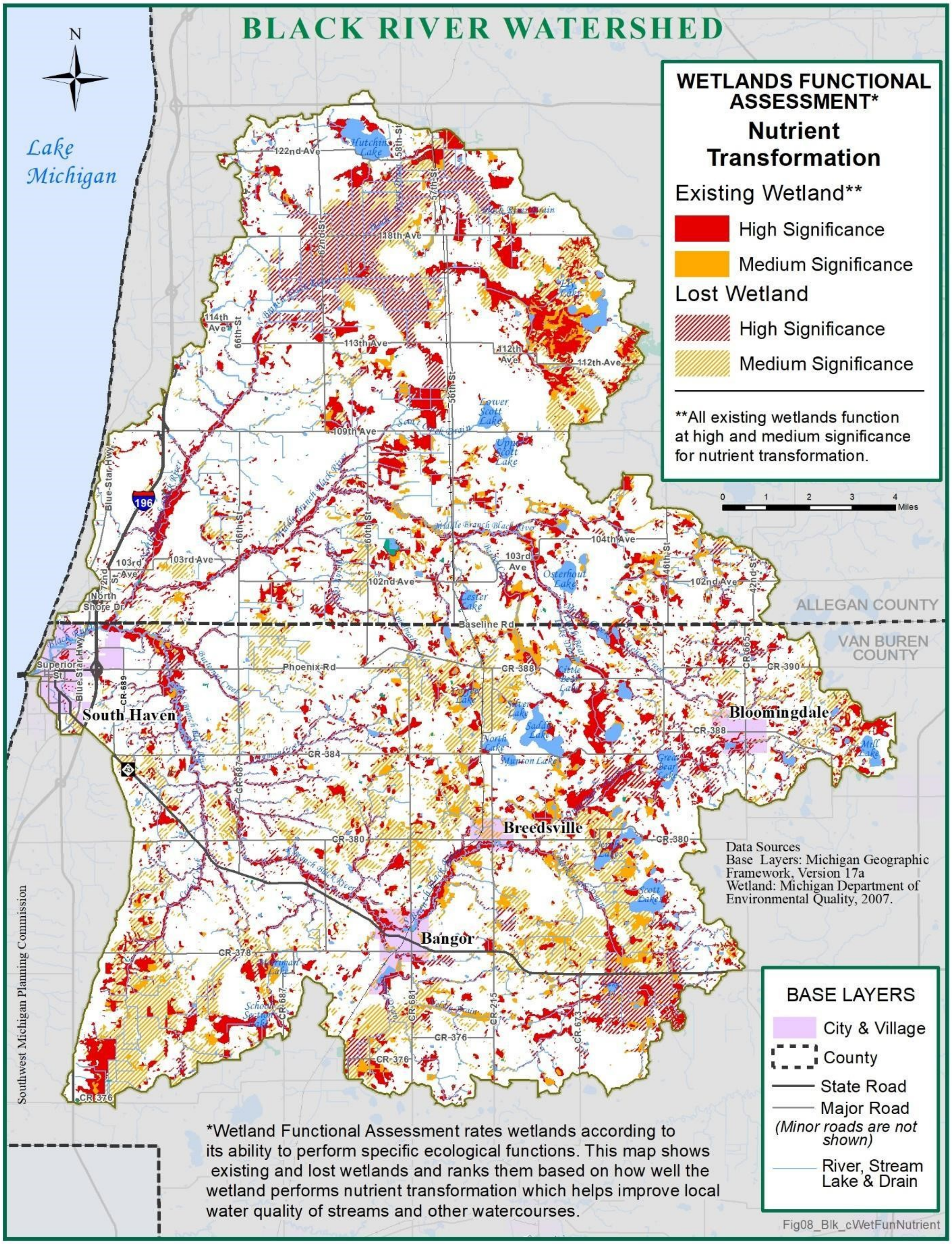


Figure 32: Wetland functional assessment in the BRW, nutrient transformation, 2007

6.2.8 Agricultural Inventory

The purpose of the agricultural inventory was to obtain an understanding of general management practices used in the watersheds, identify potential agricultural-based sources and causes of nonpoint source pollution, determine areas where management practices could be altered to better protect water quality, and to prioritize these areas based on their potential to contribute nonpoint source pollutants to surface waters during runoff events. The inventory was conducted for two watersheds in the Black, the Great Bear Lake Drain and the North Branch for the 2021 plan update. The inventory was coordinated by SWMPC and the Berrien County Conservation District with assistance from the Van Buren Conservation District and Michigan Department of EGLE. The Two Rivers Coalition provided volunteers for the inventory effort.

The following features were assigned points to rank the inventoried fields to prioritize them for further follow-up like using the U.S. EPA Spreadsheet Tool for Estimating Pollutant Loads (STEPL) Model and to contact owners for outreach about best management practices for tillage, cover crops and buffers.

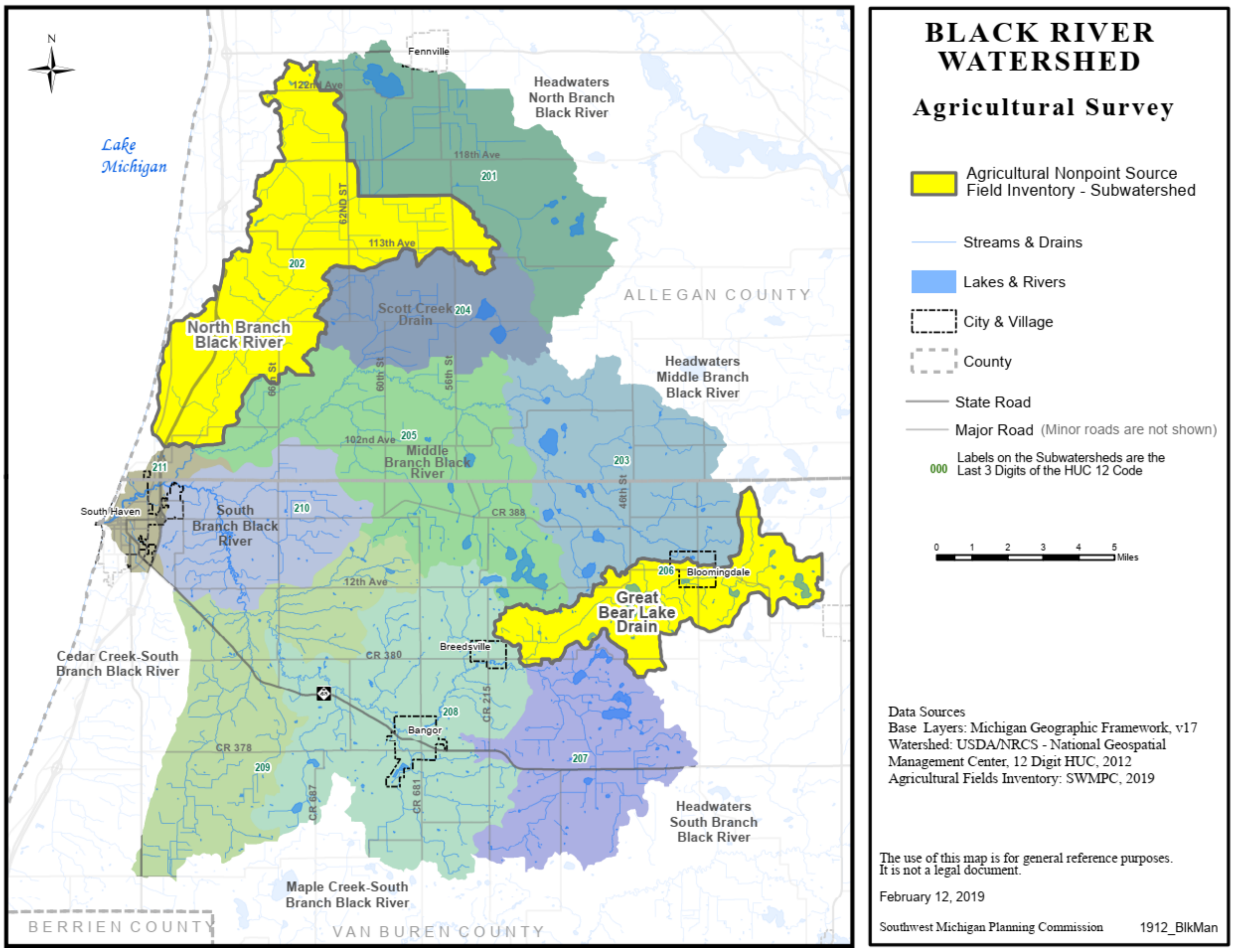


Figure 33: Agricultural survey, BRW

Table 17: Agricultural inventory, BRW

Feature	Points assigned	Details	Source
Manure Fields	5	Great Bear Lake and North Branch had QAPP as source	Vincent, Peter (DEQ) Date: Oct 26, 2018

Stream or Drain crosses Field with no filter strip/riparian buffer (minimum 25 ft)	25	Visual check for filter strip/riparian buffer– ESRI imagery	Selection using: North Branch - NHD plus NHDFlowLines (USGS) and Allegan Drain (Allegan County GIS Data) Hydropoly, Hydrolines (MCGI) Great Bear Lake – Hydrolines, Hydropoly (MCGI) Berrien County Drains (Berrrien County) Van Buren County Drains (Van Buren County)
Parcel is within 25 ft of water with No Filter Strip/Riparian Buffer	10	Visual check using ESRI imagery for filter strip/riparian buffer (minimum of 25 ft)	Same list as above for selection
No Filter Strip present	1	No Filter strip	Original Data Creation with initial digitizing work by BCCD
No Cover Crop	1	North Branch using fall 19 data Great Bear Lake using Fall 18 (only spring 19 data) Note: Using the same year for Fall Tillage FEATURE	Field Inventory
Fall Tillage	Plowed = 1 Chisel Plowed = 1	No fall tillage = P (Plowed) in any watershed	Field Inventory
Farm (flag) - Flagged: Manure Storage Issues Visible and Run off Pathways Visible YES	15	Both fields had YES in all cases for manure storage issues and run off pathways visible, Visual check to farm fields and added number	Windshield Survey by Nancy Carpenter BCCD Dec 2020
Sum of the above fields	58	Highest possible score is 58	

Table 18: Summary of fields with priority total numbers

Priority Total	**42-35**	**18-17**	**16-15**	**12**	**11-10**	**6-5**	**4-2**
Sub-watershed	Number of fields by priority total						
Black – North Branch	4	12	13	21	42	15	0
Black – Great Bear Lake	0	1	1	1	1	0	4

The Natural Resources Conservation Service suggests buffers of 2.5 times the full width of the stream or 35 feet from a body of water.

For riparian buffers, The United States Department of Agriculture Natural Resource Conservation Service (USDA NRCS) recommends a minimum filter strip width of 20 feet for controlling suspended sediment and associated runoff, or 30 feet for controlling dissolved contaminants in runoff (USDA NRCS, 2011b). They further recommend widening the filter strip, depending on land slope, soil type, and flow length (USDA NRCS, 2011c), up to a maximum of 216 feet.

The maps below show which fields conducted cover crop or reduced/no-tillage practices and which fields are within 25 feet of a river, stream, drain or lake. Based on the summary of features presented above, a map of priority fields was created (with red being the highest priority). These high priority fields pose the most threat to water quality and BMP outreach and implementation efforts should be focused in these areas.

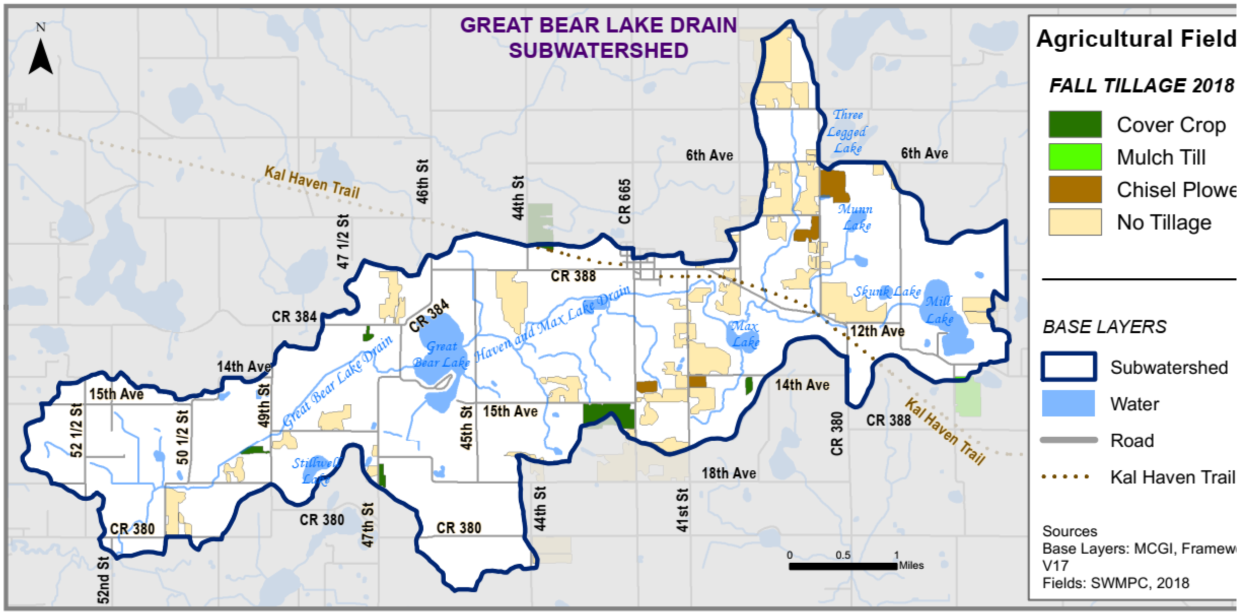


Figure 34: Great Bear Lake Drain subwatershed, 2018 fall tillage

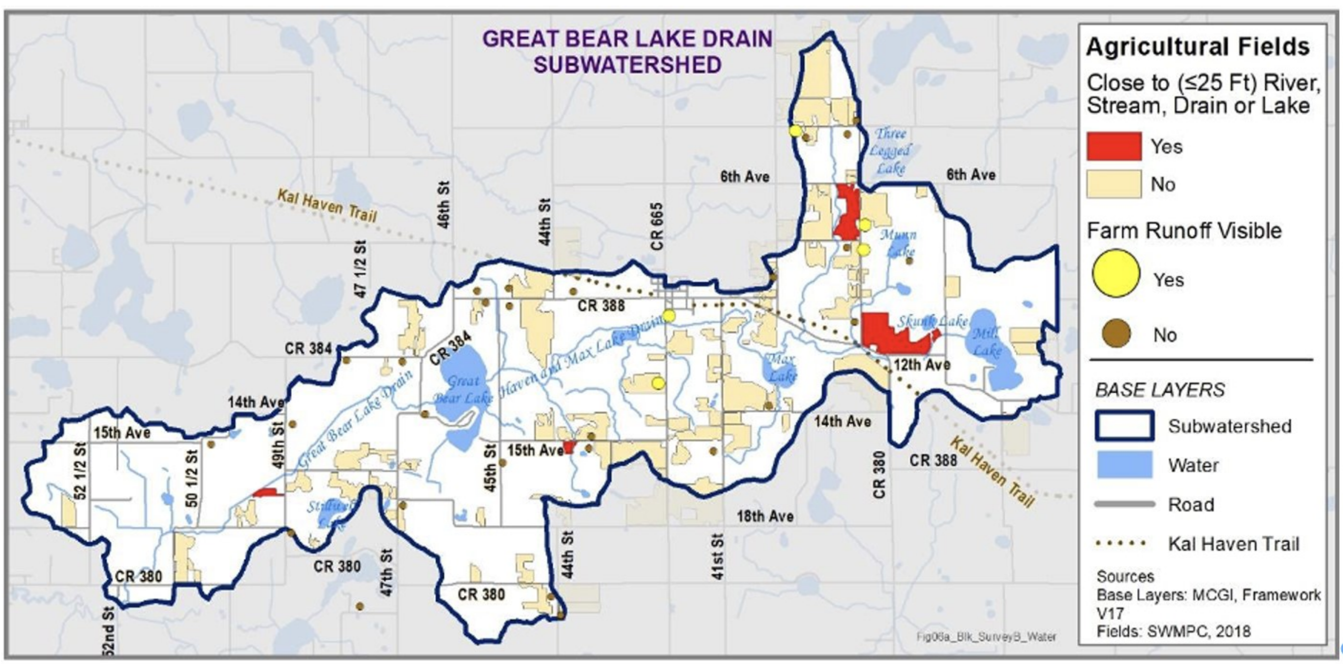


Figure 35: Great Bear Lake Drain subwatershed, 2018 runoff potential

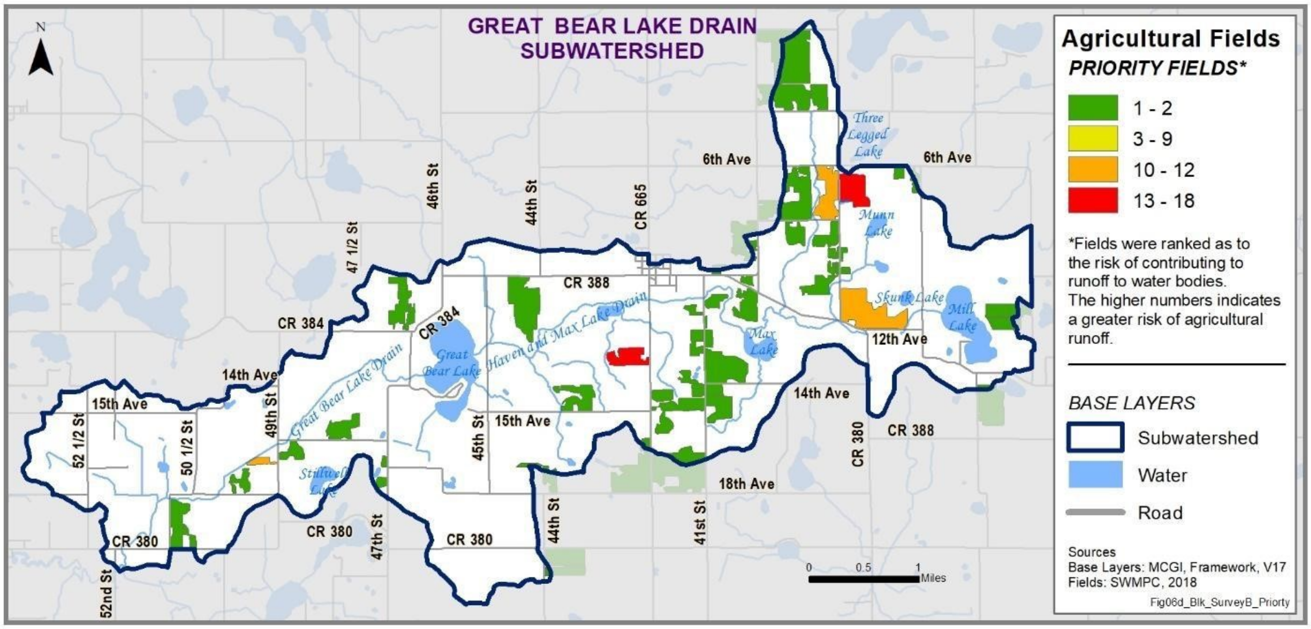


Figure 36: Great Bear Lake Drain subwatershed, 2018 priority agricultural fields

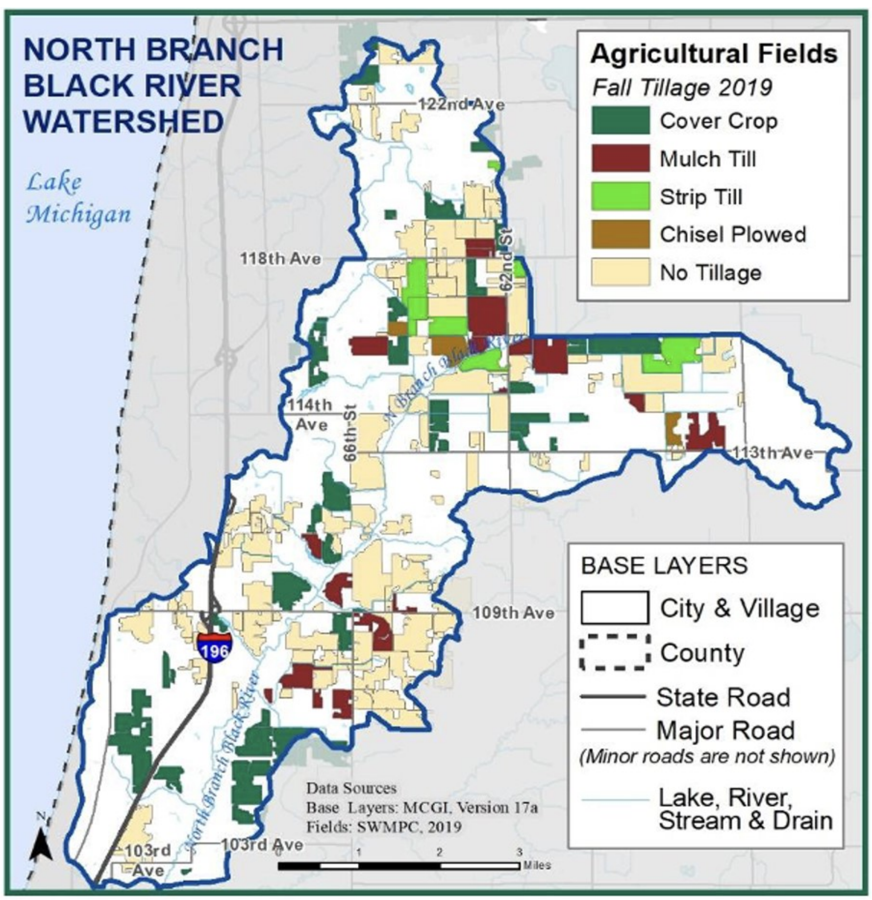


Figure 37: North Branch, 2019 fall tillage

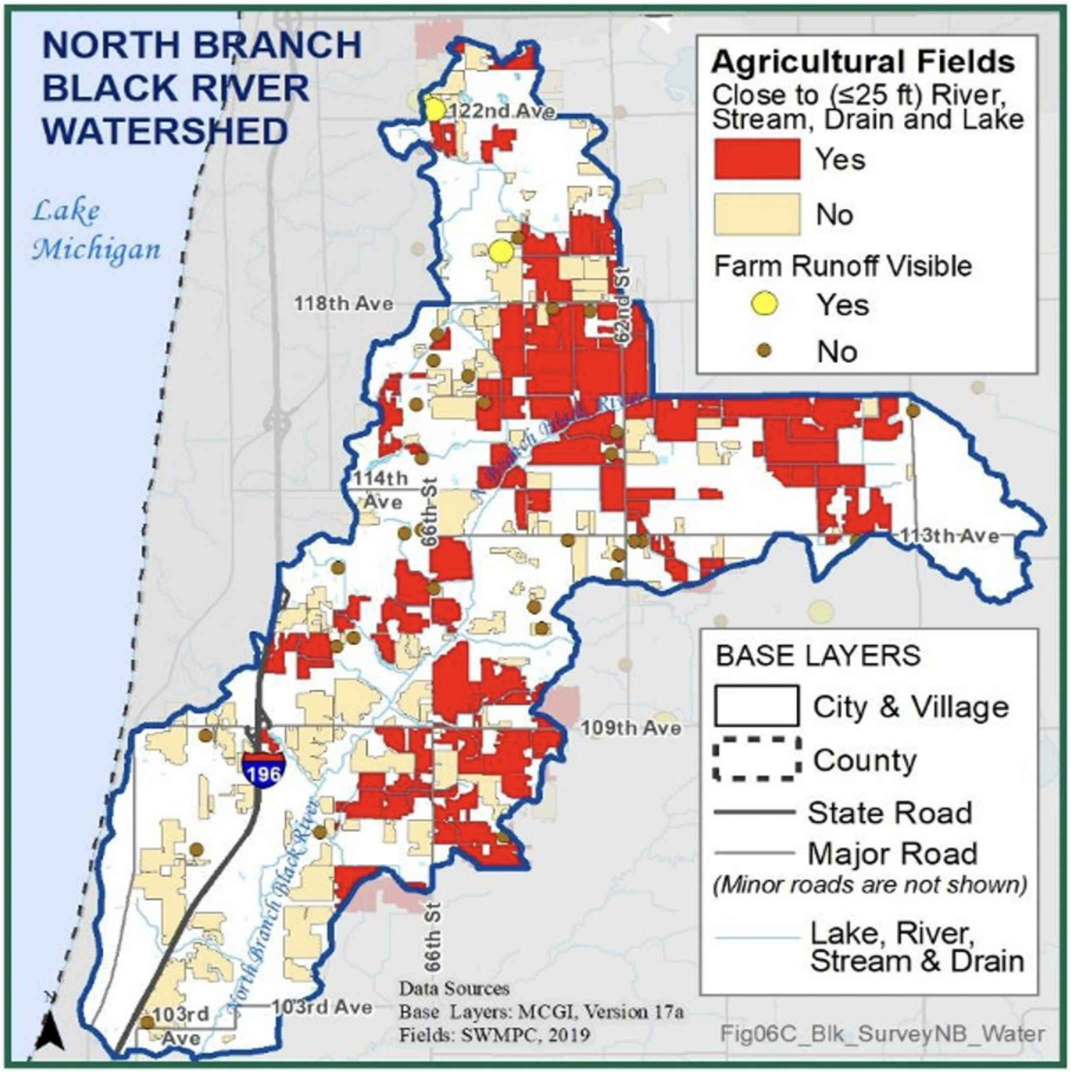


Figure 38: North Branch, 2019 runoff potential

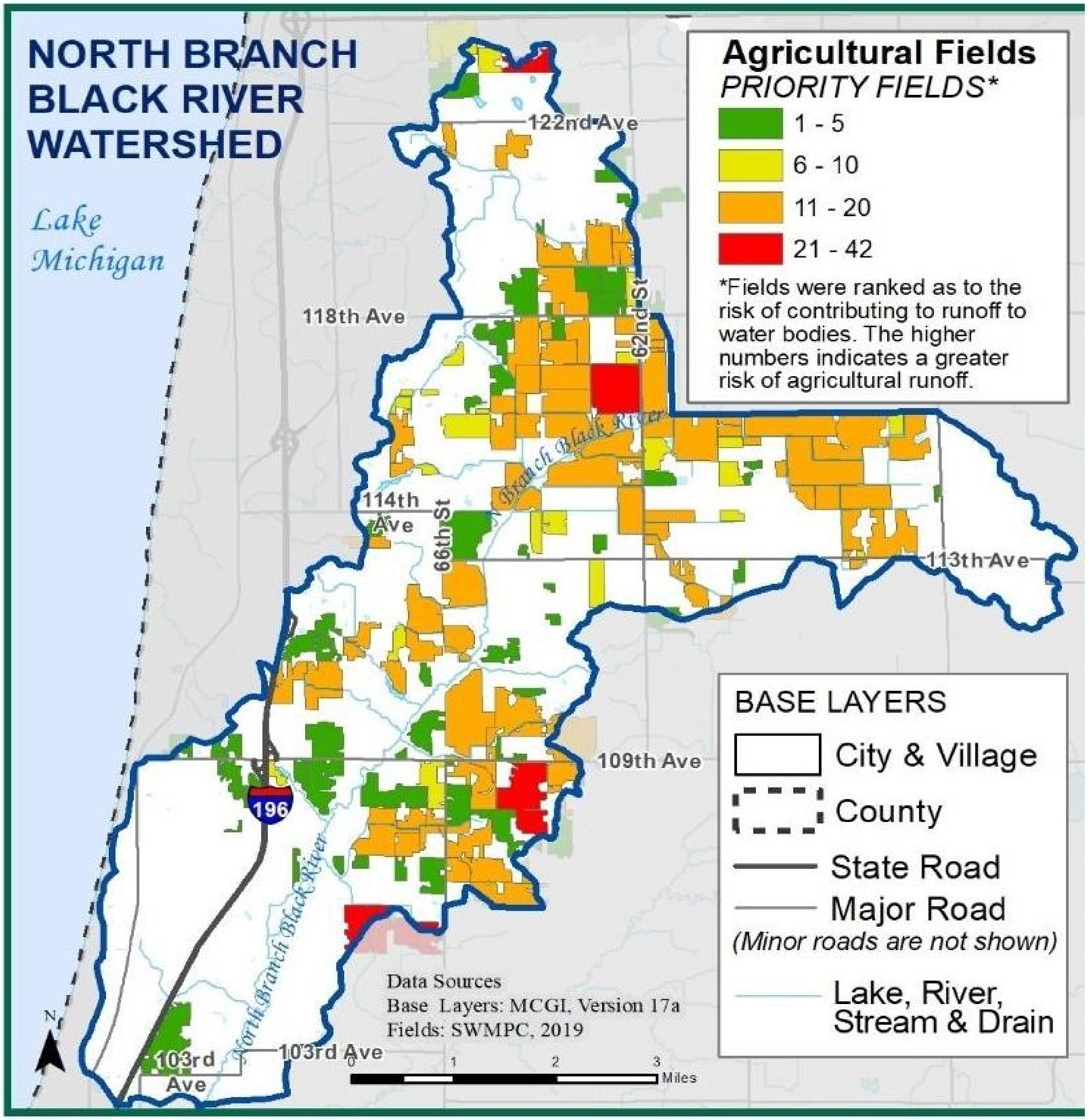


Figure 39: North Branch BRW, 2019 priority agricultural fields

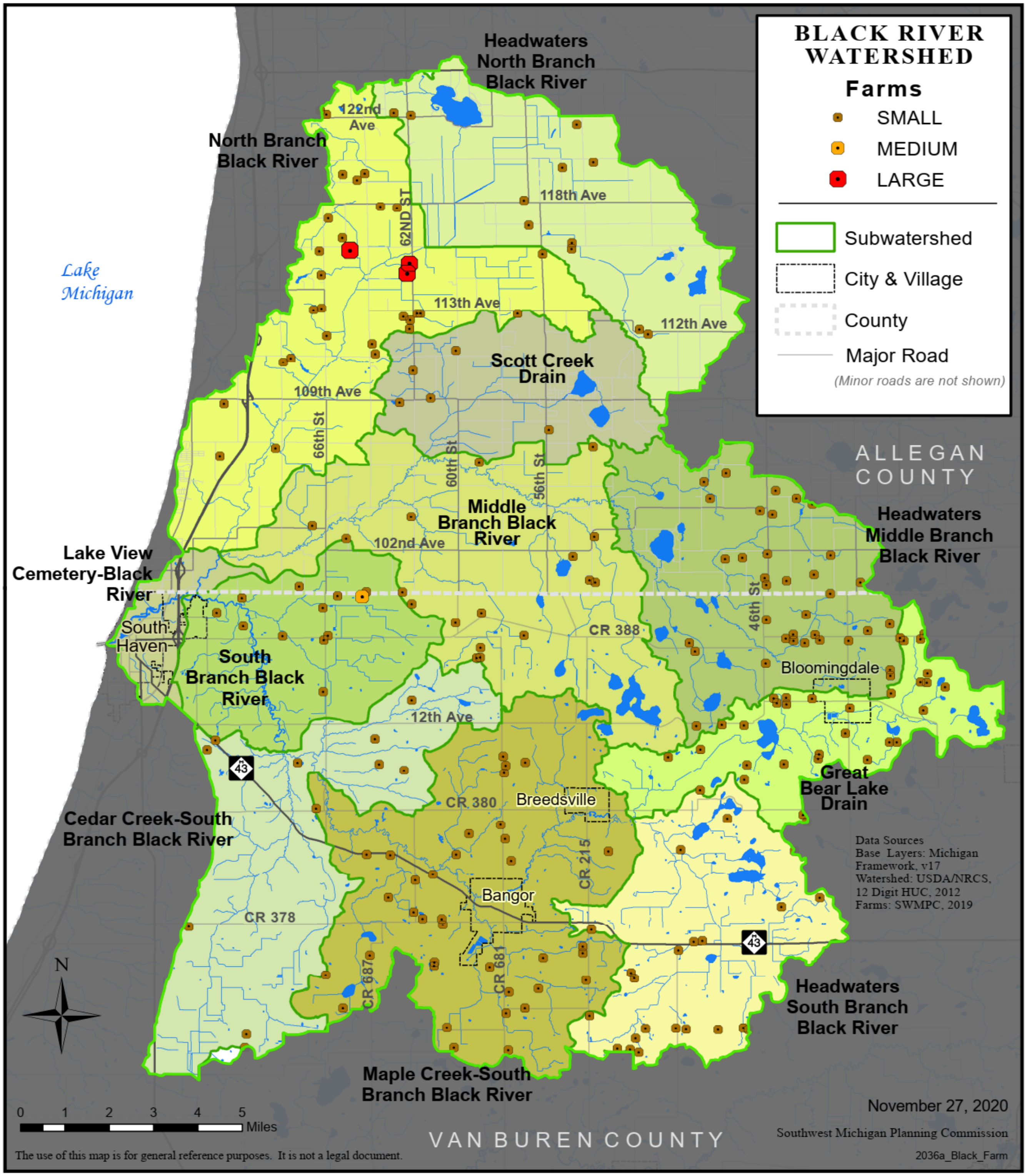


Figure 40: Farms in the BRW, 2020

6.2.9 E. coli Monitoring

Two Rivers Coalition has been conducting E. coli testing in both the Black River and Paw Paw River watersheds since 2017. That testing is expensive and has only been possible thanks to the generosity of the following donors: Jimmy Scott family, Freshwater Future, Van Buren Conservation District, Dick and Carol Purdy and a recent MEGLE grant. TRC has monitoring 10 sites in the Black River watershed over the years during dry and wet weather conditions. Along with testing for E. coli, Two Rivers Coalition also utilized canines to determine if human sewage was present in the samples collected. These results are shown in the maps and graphs below.

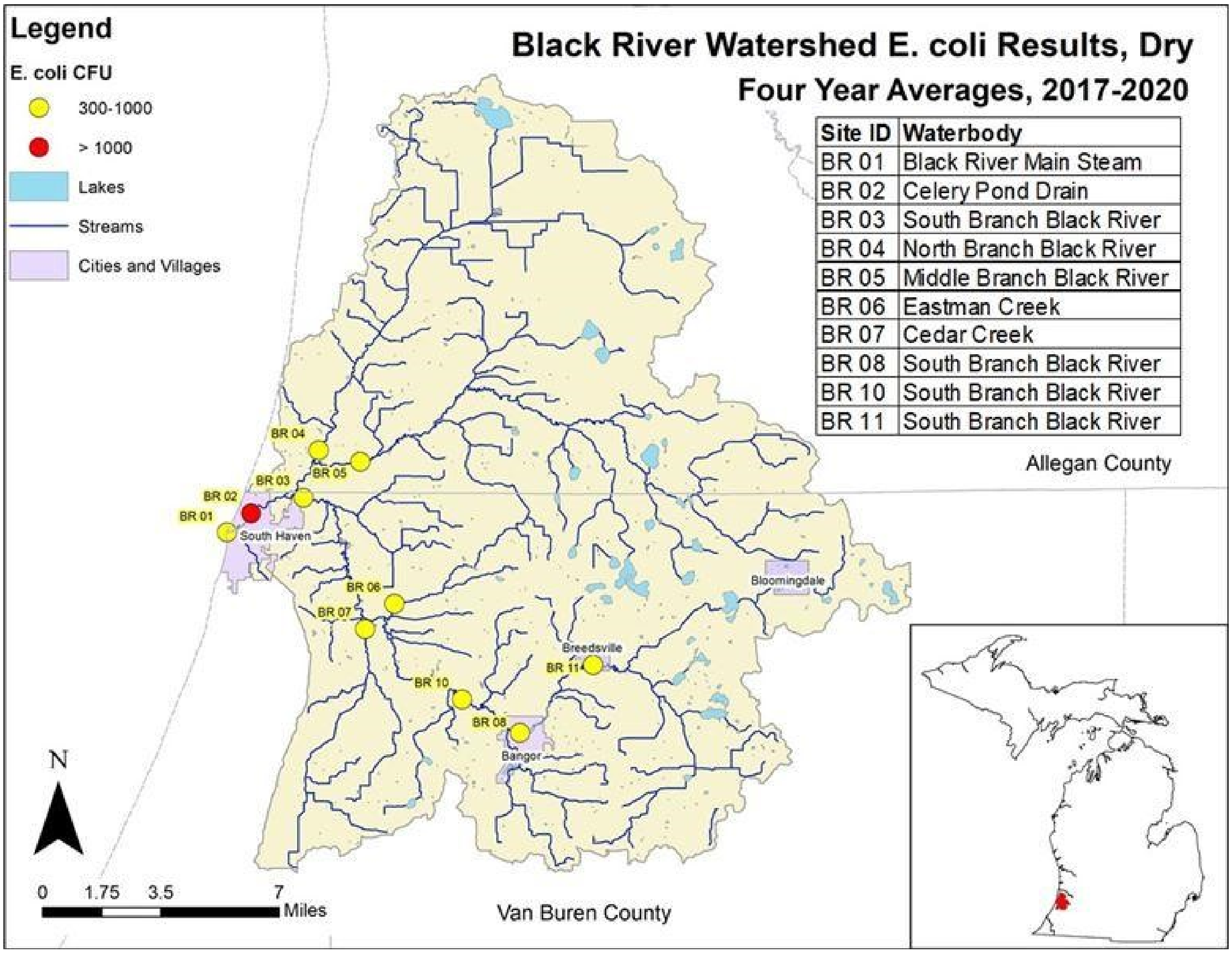


Figure 41: E. coli results, dry, BRW, averages 2017-2020

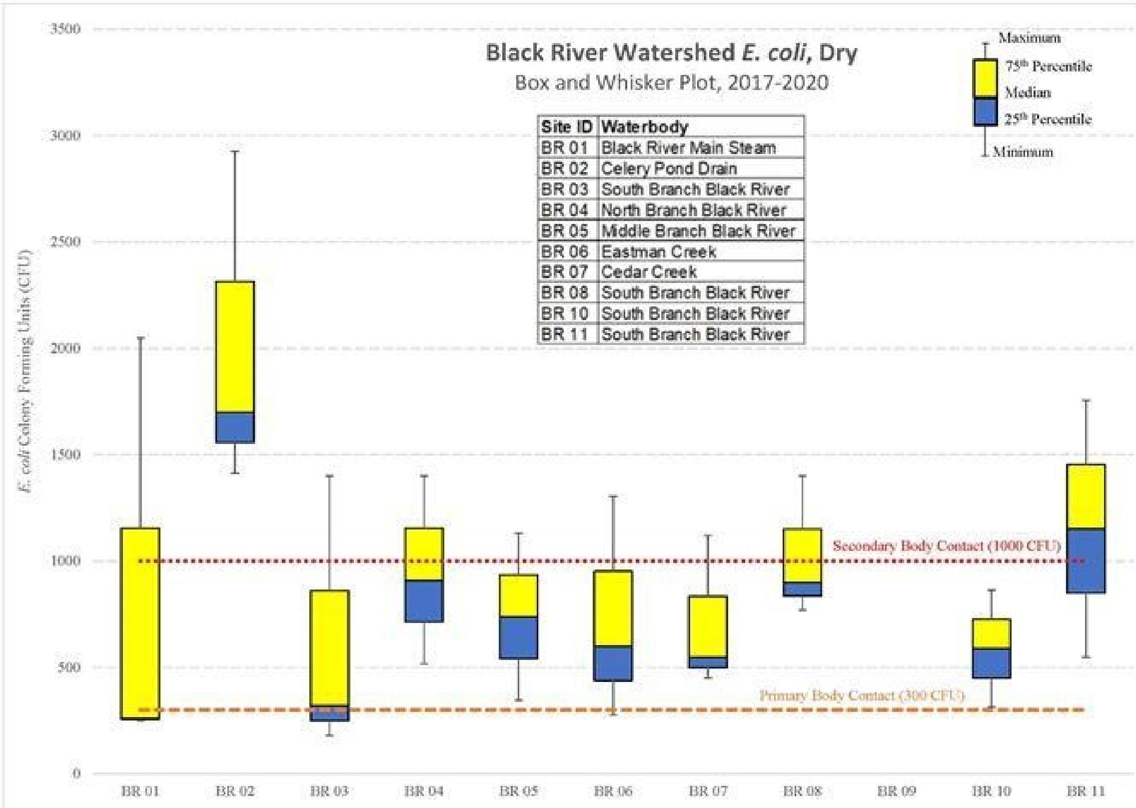


Figure 42: E. coli, dry, box and whisker plot, BRW, 2017-2020

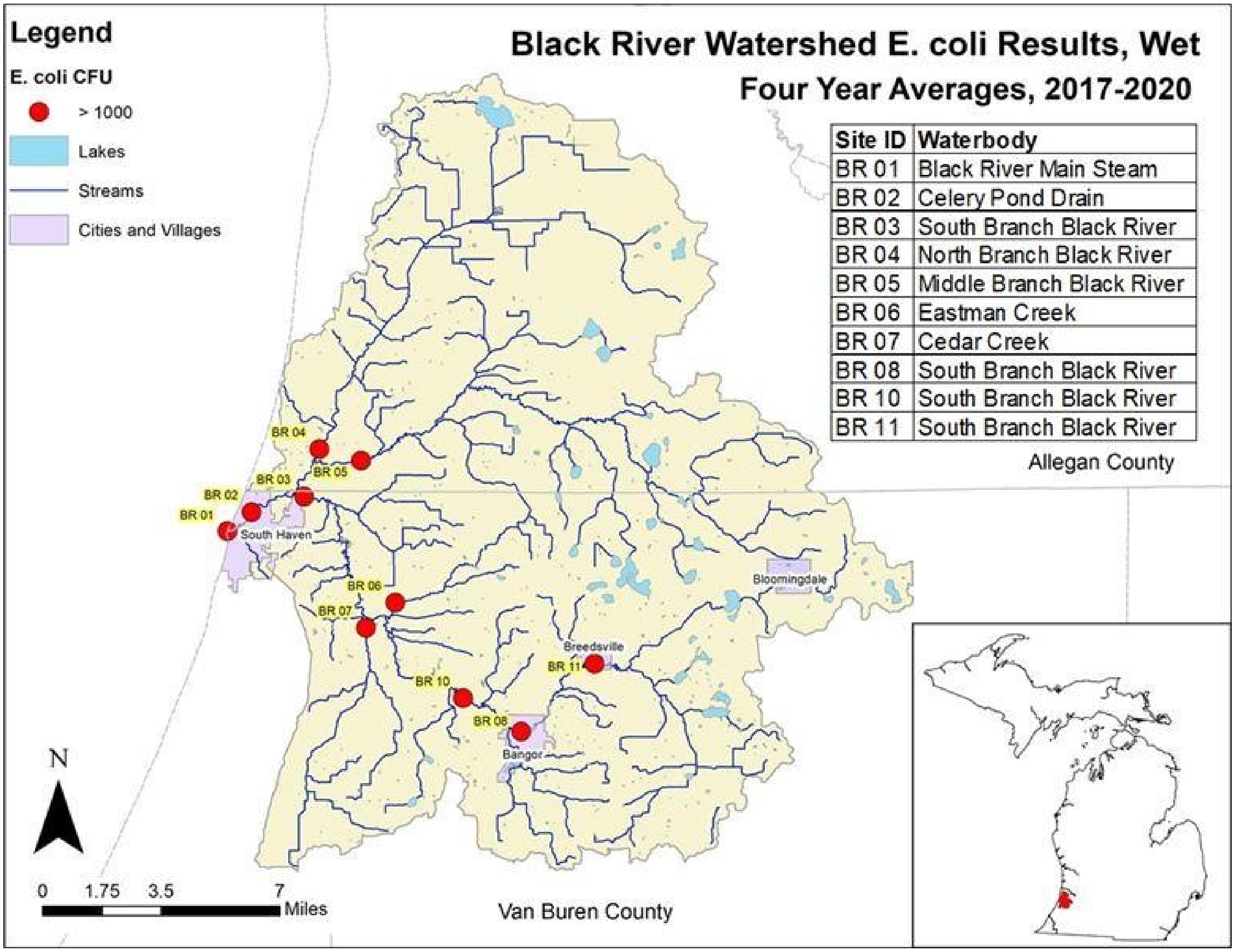


Figure 43: E. coli results, wet, BRW, averages 2017-2020

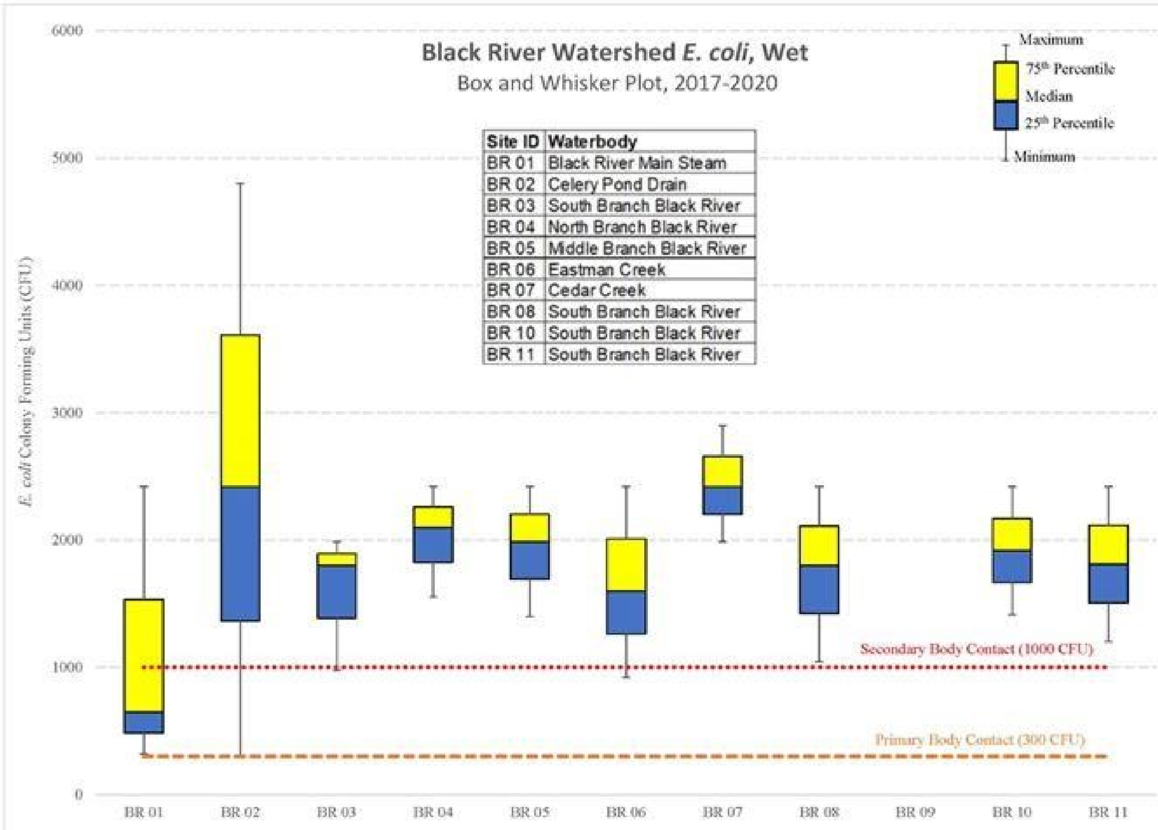


Figure 44: E. coli, wet, box and whisker plot, BRW, 2017-2020

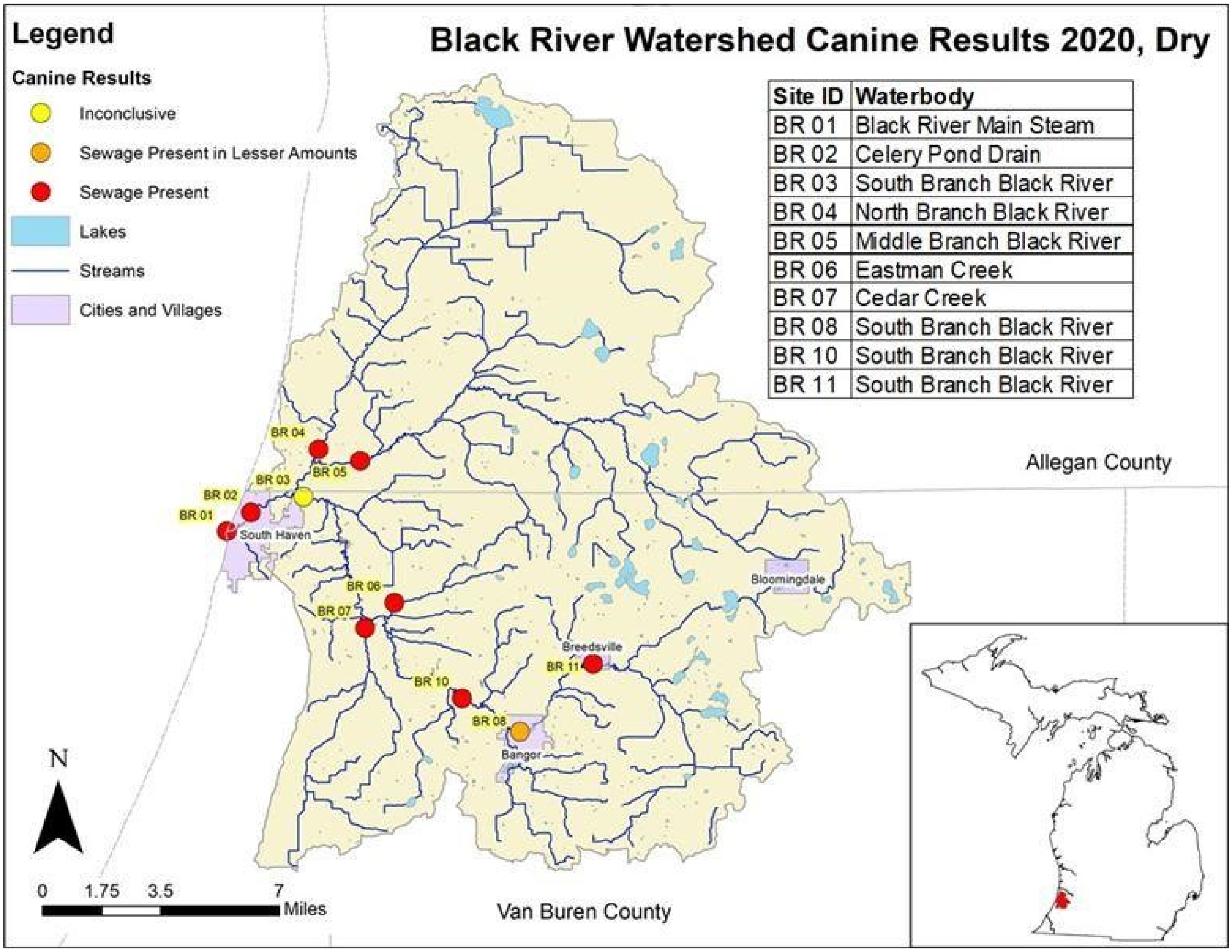


Figure 45: Canine results, dry, BRW, 2020

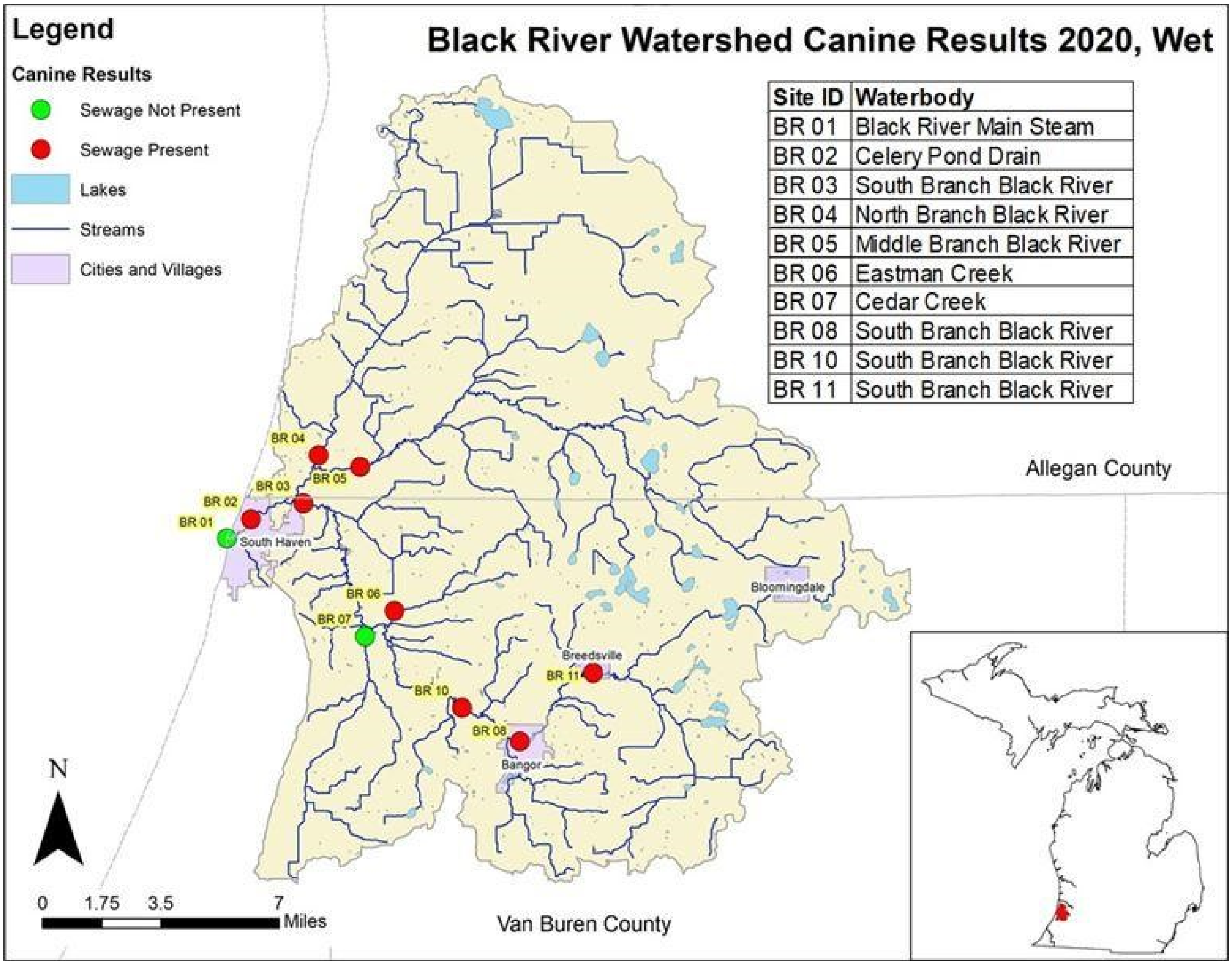


Figure 46: Canine results, wet, BRW, 2020

6.2.10 National Pollutant Discharge Elimination System permits

Facilities with National Pollutant Discharge Elimination System (NPDES) permits are regulated by the state of Michigan and the U.S. EPA to discharge certain approved pollutants to surface waters. The number of permitted point sources is not static due to old permits expiring and new permits commencing. At the writing of this document, 18 active permits were held by facilities and municipalities that discharge to the Black River watershed (Table 19). Of those active permits, five are NDPES storm water permits and 13 are individual and general NPDES permittees.

U.S. EPA provides this description of the NPDES permit program:

> As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man- made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states. Since its introduction in 1972, the NPDES permit program is responsible for significant improvements to our Nation's water quality.

Table 19: National Pollutant Discharge Elimination System (NPDES) Permit sites in the BRW, 2021

Site name	Permit number	Permit category	COC permit type	Site address	Site city
Bangor WWSL	MIG580286	NPDES Certificate of Coverage under General Permit (COC)	Wastewater Stabilization Lagoon	Ollie Hosier Drive	Bangor
Pistolesi-Dragonfly Kitchen-Van Buren	MIR115950	NPDES Construction Storm Water Notice of Coverage (NOC)		24685 County Road 681	Bangor
Bangor Plastics-Bangor	MIS410434	NPDES Certificate of Coverage under General Permit (COC)	SW-Industrial CY4	809 Washington Street	Bangor
Freestone Pickle	MIS410714	NPDES Certificate of Coverage under General Permit (COC)	SW-Industrial CY4	610 North Center Street	Bangor
Marrone Mich Manufacturing	MIS410743	NPDES Certificate of Coverage under General Permit (COC)	SW-Industrial CY4	700 Industrial Park Road	Bangor
Bloomingdale Village WWTP	MI0058842	NPDES Individual Permit		430 West Kalamazoo Street	Bloomingdale
Breedsville Assoc. Fac-Van Buren	MIR116060	NPDES Construction Storm Water Notice of Coverage (NOC)		186 W. Howard St.	Breedsville
Entergy-Palisades Power Plt	MI0001457	NPDES Individual Permit		27780 Blue Star Memorial Highway	Covert
Scenic View-CAFO	MIG010106	NPDES Certificate of Coverage under General Permit (COC)	CAFO	1530 and 1510 62nd Street	Fennville
Hillside Farms-116th-CAFO	MIG010207	NPDES Certificate of Coverage under General Permit (COC)	CAFO	6470 116th Ave.	Fennville

Site name	Permit number	Permit category	COC permit type	Site address	Site city
Allegan CRC-103rd, 52nd, 104th Rehab Proj	MIR116179	NPDES Construction Storm Water Notice of Coverage (NOC)		5184 104th Avenue	Grand Junction
South Haven Area Water Sewer Authority WWTP	MI0020320	NPDES Individual Permit		269-767-1742	South Haven
Baseline Farm-CAFO/Dykhuis Farms Inc.	MIG010075	NPDES Certificate of Coverage under General Permit (COC)	CAFO	64233 Baseline Rd.	South Haven
Port of Call West MHC	MIG580106	NPDES Certificate of Coverage under General Permit (COC)	Wastewater Stabilization Lagoon	68304 County Road 380	South Haven
All Seasons Marine-South Haven	MIS210798	NPDES Certificate of Coverage under General Permit (COC)	SW-Industrial CY2	234 Black River Street	South Haven
South Haven Regional Airport	MIS410247	NPDES Certificate of Coverage under General Permit (COC)	SW-Industrial CY4	73020 County Road 380	South Haven
South Haven Area Water Sewer Authority WWTP	NEC186796	NPDES Industrial Storm Water No Exposure Certificate (NEC)		269-767-1742	South Haven
B & K Machine Prod-South Haven	NEC187019	NPDES Industrial Storm Water No Exposure Certificate (NEC)		100 Aylworth Avenue	South Haven

6.3 Watershed Sites of Concern

Sites of concern discovered during the watershed inventories were divided into four categories: road stream crossing sites of concern, streambank erosion sites of concern, agricultural sites of concern, and residential and municipal sites of concern.

6.3.1 Road-Stream Crossing Sites of Concern

The primary pollutant entering surface water at road-streams crossings is sediment. Sediment can enter the waterway as a result of erosion around bridges or culverts, or due to incorrect placement of a culvert. Culverts may also be undersized, which increases the velocity of the water as it travels through the culvert. This can increase erosion on the downstream side of the culvert. The slope of the roadbed can also direct sediment-laden runoff directly into a waterway. Trash/debris is one pollutant that is found primarily at road-stream crossings, since these are the primary public access point to the river and its tributaries. Much evidence of illegal dumping was found at road stream crossings during the course of the field inventory, and it is recommended that these points be the focus of future river clean-up days. Other pollutants that can be found at road-stream crossings include chemical pollutants like salts, gasoline and oil. Though these parameters were not tested for during the course of this study, it is likely that they are entering the surface water in at least small concentrations.

BMPs for road stream crossing problems include re-orienting culverts, replacing culverts with ones of the correct sizes, cleaning and maintaining blocked culverts, and adding bioengineering or riprap. However, there are few grant programs that cover costs of culvert and bridge replacement or repair. Numerous problem areas were found at road stream crossings. These sites are shown in Figure 39 and listed in Appendix M. Causes of pollution included gravel road grading, improper culvert sizing and placement, and erosion from/around bridges, culverts or roads.

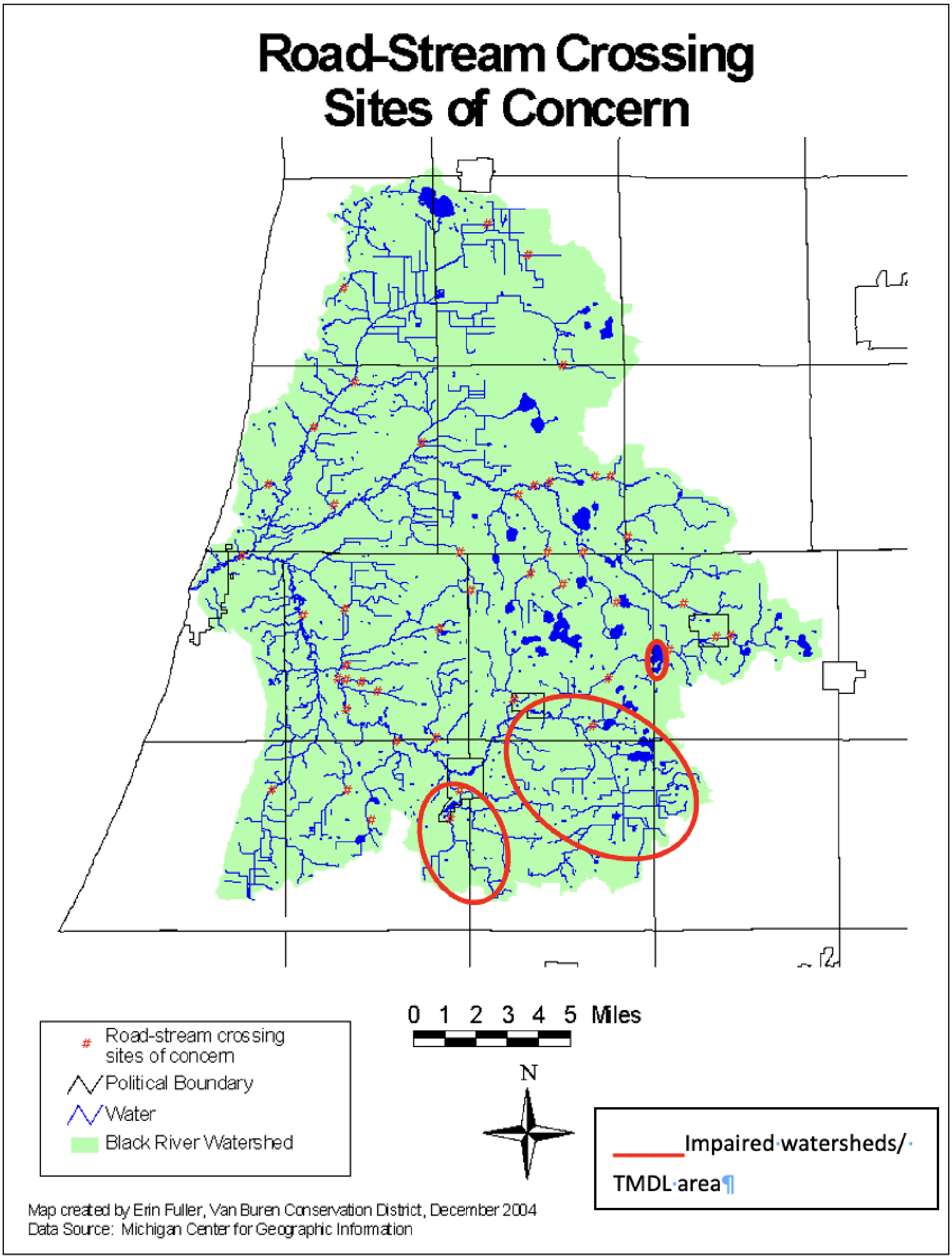


Figure 47: Road-stream crossing sites of concern in the BRW, 2004

6.3.2 Streambank Erosion Sites of Concern

Sedimentation in the Black River Watershed is likely primarily a result of bank erosion. While there are certainly other sources of sedimentation, the banks appear to be eroding in many locations. This can be a result of the land use along the stream bank or changes in hydrology. For example, increased runoff from hardened surfaces results in a higher volume of water in the stream channel that is more erosive. Sediment can carry additional pollutants such as nutrients and heavy metals.

Sites with streambank erosion occurring are shown in Figure 40 and listed in Appendix M. Causes of erosion at these sites included human access, removal of streambank vegetation, and site development and construction. At some of these sites, the cause of the erosion was easily determined. At most, however, the causes are not immediately visible and are likely related to past changes in the hydrologic regime (such as channelization and ditching, loss of wetlands, and increase in hardened surfaces resulting in greater runoff). Streambank erosion sites can be addressed with a variety of bioengineering techniques (such as soil lifts, log crib walls and others). However, a more complete understanding of the hydrology of the Black River and the causes of the streambank erosion is necessary before BMPs are implemented at many of these sites. In addition, while most of the eroding sites listed are at road-stream crossings (because those sites are the most accessible and visible in the watershed), there are stretches of streams that are eroding away from road-stream crossings. Besides being difficult to properly inventory the river between road-stream crossings, it would not be feasible to “fix” all of these stretches with structural BMPs. Instead, steps should be taken to improve the hydrology of the river.

Other stretches of river exhibited streambank erosion for long stretches. These include:

- The South Branch, downstream of Phoenix Rd. in Geneva Township (BR-13), to approximately 70th St. (BR-05)
- Much of the Haven & Max Lake Drain
- Drains in Allegan

6.3.3 Agricultural Sites of Concern

Nonpoint source pollution from agricultural sources can include sediment, nutrients (from fertilizer runoff or animal waste), chemical pollutants (from pesticides), and bacteria/pathogens (from animal waste). In addition, silage leachate can have a significant impact on water quality. As little as one gallon of leachate introduced into a river or stream can lower the oxygen content of 10,000 gallons of water to a level at which fish cannot survive (Cropper and Dupoldt 1995). Many agricultural issues can be addressed through programs offered through the Natural Resources Conservation Service, as well as through education. Problem areas identified through the watershed inventory included areas in which livestock have uncontrolled access to streams (leading to eroded banks and livestock waste deposited directly into the waterway) and farm fields with little to no buffer along the waterway. It should be noted, however, that despite the large percentage of agricultural land use in the watershed, relatively few areas are degraded as a direct result of agricultural practices. The main stem (North, Middle and South Branches) of the river is for the most part surrounded by a wide vegetative buffer. Agricultural land use likely has more of an impact on the smaller designated drains.

Agricultural sites of concern are shown in Figure 41 and Appendix M. Pollutant loading from agricultural sites of concern is approximated at 2,602 tons/year of sediment, 3,225 lbs/year of phosphorus, and 6,470 lbs/year of nitrogen. Sources of pollution included livestock and a lack of vegetated buffer.

6.3.4 Residential and Municipal Sites of Concern

Nonpoint source pollutants from residential and municipal sources can include sediment, nutrients, bacteria/pathogens, temperature, chemical pollutants, and trash/debris. These are all potential pollutants, but the degree to which they actually pollute a water body varies greatly. Without extensive water testing of the Black River, it is impossible to fully ascertain the pollutant load contributed by residential and municipal areas. However, generalizations can be made to locate potential problem areas. For example, lawns that are mowed to the edge of a waterway are indicators of several potential problems: the banks in these areas are not likely to remain stable (as grass has a short root system that fails to provide bank stability), and there is no vegetative filter system in place to remove sediment, nutrients, or chemical pollutants before they reach the waterway.

Sites of concern in residential and municipal areas are shown in Figure 42 and listed in Appendix M. These sites were found during field surveys and may not include all problem areas. Pollutant loading from residential and municipal sites of concern is approximated at 412 tons/year of sediment, 1,331 lbs/year of phosphorus, and 11,896 lbs/year of nitrogen. Causes of pollution included removal of streambank vegetation, change in hydrology (increase in hardened surfaces) and poor stormwater management practices.

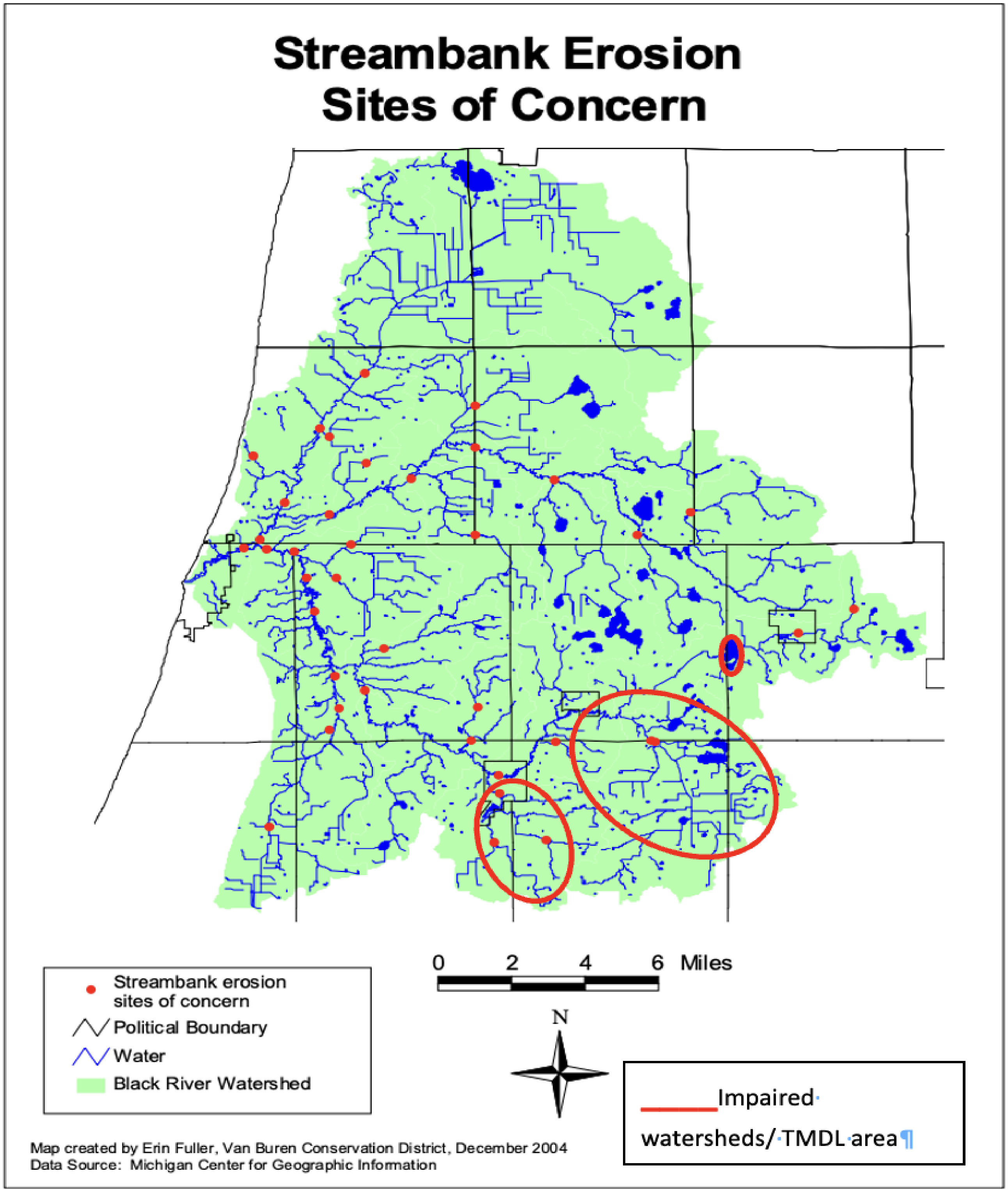


Figure 48: Streambank erosion sites of concern in the BRW, 2004

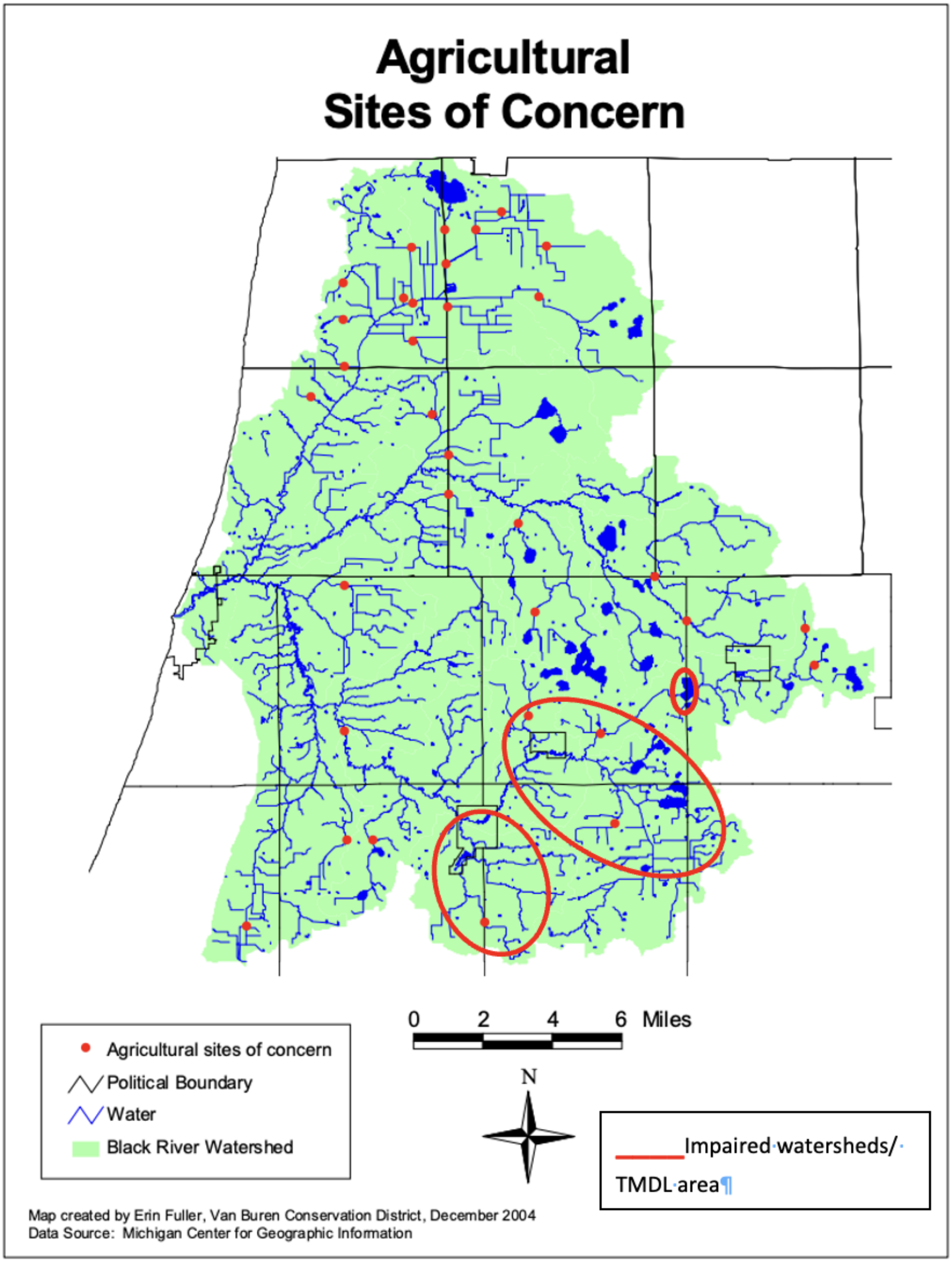


Figure 49: Agricultural sites of concern in the BRW, 2004

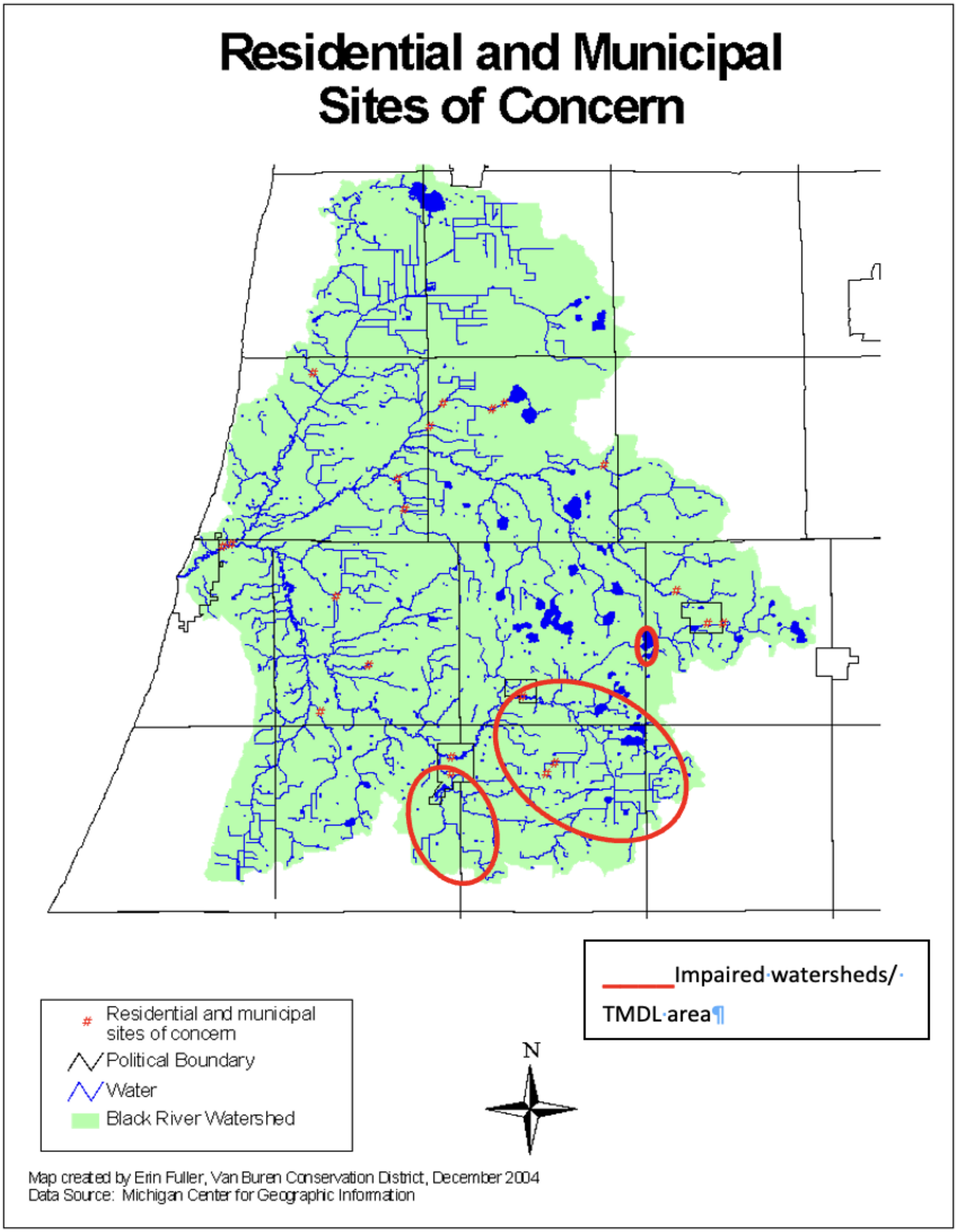


Figure 50: Residential and municipal sites of concern in the BRW, 2004

6.4 Hydrology and Stream Morphology

Historically, many rivers and streams have been straightened and channelized. This was done primarily to increase drainage for the creation or improvement of agricultural land. This straightening results in a concentration of stream power which can lead to incision of the stream channel, leaving the riparian vegetation perched above the stream such that it may never be flooded (Malanson 1993). Thus, the value of flood protection for downstream areas is lost. The increased velocity also increases the river's erosive force (Palmer 1994). In 1984, the U.S. Fish & Wildlife Service estimated that 67% of the nation's degraded stream segments were degraded due to flow alteration (other causes of degradation included chemical pollution and habitat loss) (Palmer 1994).

6.4.1 Hydrology Study

A hydrologic model for the Black River Watershed was developed by the Michigan Department of Environment, Great Lakes and Energy during the course of this project (Fongers 2004) (Appendix N). This model compares land use from a circa-1800s scenario with 1978. The model shows that there has been an increase in volume of runoff and peak flows since presettlement times (for both 2-year and 25-year storms). For the 25-year storms, this increase can cause or aggravate flooding. For the 2-year storms, channel-forming flows will increase, which can cause stream instability.

The flows of the three branches of the river were shown to peak at different times after a rain event. This helps to limit flooding effects downstream of the confluence of the three branches. Thus, any land use changes that would result in the branches peaking at the same time should be carefully evaluated for their potential downstream effects.

> Some streams in the watershed may have yields that are too high to support a trout fishery. Yield is the amount of peak flow divided by the drainage area.

This model can also be used to evaluate trout habitat based on yield (cubic feet per second per acre). Yields over a certain amount correspond with impaired or poor habitat for trout. Based on the 1978 land-use scenario, the Great Bear Lake Drain is classified as impaired for trout habitat, and habitat is classified as poor above Great Bear Lake. Six subbasins were above the target yield for fisheries (0.0075 cfs/acre): Haven and Max Lake Drain to Great Bear Lake, Maple Creek to mouth, S. Branch Black River to Confluence with Cedar Creek, Butternut Creek to mouth, Middle Branch Black River to mouth, and Black River to mouth. In studies of other rivers, streams with yields above 0.0105 cfs/acre have been shown to not have trout present. Subbasins with yields above this level include Haven and Max Lake Drain to Great Bear Lake, Maple Creek to mouth, S. Branch Black River to Confluence with Cedar Creek, and Butternut Creek to mouth.

6.4.2 Stream Morphology Study

An assessment of the morphology of the Black River was performed at several locations in the watershed (Appendix O). Kregg Smith, MDNR Fisheries Biologist, performed the assessment. The stream reaches were classified according to the methodology described by Rosgen (1996) (Table 17). Data collected on stream dimension, pattern and profile may guide the design criteria for structures to be used for restoring stream function.

Table 20: River delineation data collected at six stream reaches in the BRW, 2004

Waterbody	Location	Entrenchment ratio	Width/ depth ratio	Sinuosity	Slope	Channel Material	Stream type (Rosgen)
North Branch	68th St.	19.7	10.7	1.1	0.002	Glendora Loamy Sand	E5
Middle Branch	60th St.	>2.2	13.39	1.57	0.002	Glendora Loamy Sand	C5
South Branch	Hamilton St., City of Bangor	>2.2	14.83	1.2	0.002	Glendora Sandy Loam	C5
Haven/Max Lake Drain	42nd St.	>2.2	8.41	1.47	0.003	Algansee-Cohoctah	E5
South Branch	Phoenix Rd.	<1.4	6.2	1.13	0.0004	Algansee-Cohoctah	F6

Waterbody	Location	Entrenchment ratio	Width/ depth ratio	Sinuosity	Slope	Channel Material	Stream type (Rosgen)
Middle Branch	68th St.	<1.4	11.2	1.32	0.0013	Glendora Loamy Sand	F5

Source: Smith 2004

The E5 stream type is generally low-gradient, highly meandering, and is very stable and efficient with little deposition of materials. The C5 stream type generally has a broad floodplain, a low-gradient channel, and is relatively meandering. F stream types are generally deeply entrenched, meandering, and can experience high levels of bank erosion and sediment transport. F5 channels have a predominantly sandy substrate while F6 channels typically have a silt/clay substrate (Rosgen 1996).

More sites will be assessed in the future, and the previous sites will be revisited to track changes over time.

6.4.3 Channel Incision

Some stretches of the river were determined to be incised, included portions of Cedar Creek, the North Branch, the Black River Drain, the South Branch, and the Haven & Max Lake Drain. Incised channels have downcut their beds to the point at which the river is no longer connected to its floodplain. This results in more scouring of the channel because the water (and its energy) is confined to the channel and cannot escape onto the floodplain to dissipate the energy. It has been estimated that 75 to 80% of the sediment that is moved in the Black River comes from the streambanks as a result of channel incision and an overwide channel (C. Freiburger, personal communication, December 16, 2003).

6.5 Designated Uses

A designated use is a recognized use of water by state and federal water quality programs. All surface waters in the state of Michigan are designated and shall be protected for all of the uses listed below in Table 16 (R323.1100 of Part 4, Part 31 of PA 451, 1994, revised 4/2/99). The table also indicates whether the use is currently met, threatened, or impaired in the Black River Watershed. Designated uses in many water bodies in the Black River Watershed are threatened or impaired due to habitat loss or fragmentation, rather than any specific pollutants. For the designated use assessment, only pollutant-based impairments and threats are considered.

Table 21: Designated/Existing uses in the BRW

Designated/Existing Use	General Definition	Designated Use: Met, Threatened or Impaired
Agriculture	water supply for cropland irrigation and livestock watering	Met
Industrial Water Supply	water utilized in industrial processes	Met
Public Water Supply	public drinking water source	N/A*
Navigation	waters capable of being used for shipping, travel, or other transport by private, military, or commercial vessels	Threatened (for canoes and kayaks on stretches of the North, Middle, and South Branches, South Haven harbor)
Warmwater Fishery	supports reproduction of warmwater fish	Threatened (North & Middle Branches)
Coldwater Fishery †	supports reproduction of coldwater fish	Threatened (South Branch)
Other Indigenous Aquatic Life and Wildlife	supports reproduction of indigenous animals, plants, and insects	Impaired/Threatened
Partial Body Contact	water quality standards are maintained for skiing, canoeing and wading	Threatened
Total Body Contact	water quality standards are maintained for swimming	Threatened (Insufficient data)

*No communities withdraw drinking water directly from the Black River. The South Haven municipal water intake is located offshore in Lake Michigan and is rarely affected by flows from the Black River.

The Clean Water Act requires each state to prepare a biennial Integrated Report on the quality of the state's water resource. The 2008 Integrated Report (LeSage and Smith 2008) identifies watershed segments that are not supporting designated uses. The 2020 Integrated Report used a different methodology and therefore some of the stream reaches were not identified as not supporting designated uses. It should also be noted that most water bodies in the watershed are not assessed for many of the designated uses. For both 2008 and 2020, designated uses that are not supported in the Black River Watershed include "other indigenous aquatic life and wildlife" and "fish consumption." Causes include phosphorus, other anthropogenic substrate alterations, other flow regime alterations, and PCB in fish tissue. Table 19 shows the designated uses not being met in 2008 and the updated status for 2020. Figure 43 shows the locations in which these designated uses are not met in 2008 and Figure 44 shows designated uses not being met in 2020. .

Table 22: Impaired segments in the 2008 Integrated Report and 2020 status update, BRW

Impaired Designated Use	AUID	Location	2008 Cause	2020 Status
Other Indigenous Aquatic Life and Wildlife	040500020201-03	Black River Drain, unnamed trib. To Black River Drain, unnamed trib. To Hutchins Lk.	Other anthropogenic substrate alterations/ Other flow regime alterations	Insufficient information
Other Indigenous Aquatic Life and Wildlife	040500020202-01	Black River Drain, unnamed tribs. To Black River Drain	Other anthropogenic substrate alterations/Other flow regime alterations	Fully supporting
Other Indigenous Aquatic Life and Wildlife	040500020203-04	Melvin Creek	Other anthropogenic substrate alterations/ Other flow regime alterations	Fully supporting
Other Indigenous Aquatic Life and Wildlife	040500020206-01	Great Bear Lake Drain	Other anthropogenic substrate alterations/Other flow regime alterations	Fully supporting
Other Indigenous Aquatic Life and Wildlife	040500020206-03	Great Bear Lake	Phosphorus (total)	No change
Other Indigenous Aquatic Life and Wildlife	040500020207-02	Lower Jeptha Lake Drain	Other anthropogenic substrate alterations/Other flow regime alterations	No change
Other Indigenous Aquatic Life and Wildlife	040500020208-02	Cedar Drain	Other anthropogenic substrate alterations/Other flow regime alterations	No change

Impaired Designated Use	AUID	Location	2008 Cause	2020 Status
Other Indigenous Aquatic Life and Wildlife	040500020209-02	Cedar Creek	Other anthropogenic substrate alterations/Other flow regime alterations	Fully supporting
Other Indigenous Aquatic Life and Wildlife	040500020209-04	Unnamed trib. To Cedar Creek	Other anthropogenic substrate alterations/Other flow regime alterations	Insufficient information
Fish Consumption*	040500020208-01	Merriman Lk. Outlet, Bangor impoundment, School Section Lk. Outlet, South Branch Black River, unnamed tribs. to South Branch Black River	PCB in fish tissue	No change
Fish Consumption*	040500020209-01	South Branch Black River, unnamed tribs to South Branch Black River	PCB in fish tissue	No change
Fish Consumption*	040500020210-01	South Branch Black River, unnamed tribs to South Branch Black River	PCB in fish tissue	No change
Fish Consumption*	040500020211-01	Black River	PCB in fish tissue	No change
Fish Consumption*	040500020201-02	Hutchins Lake	n/a	Mercury in fish tissue
Fish Consumption*/Other Indigenous Aquatic Life and Wildlife	040500020205-02	Silver Lake inlet	n/a	Mercury in water column
Fish Consumption*/Other Indigenous Aquatic Life and Wildlife	040500020205-03	Barber Creek, Middle Branch Black River, and Spicebush Creek	n/a	Mercury in water column

* The impairment of fish consumption is not addressed in this plan, as it is not considered a nonpoint source pollution issue.

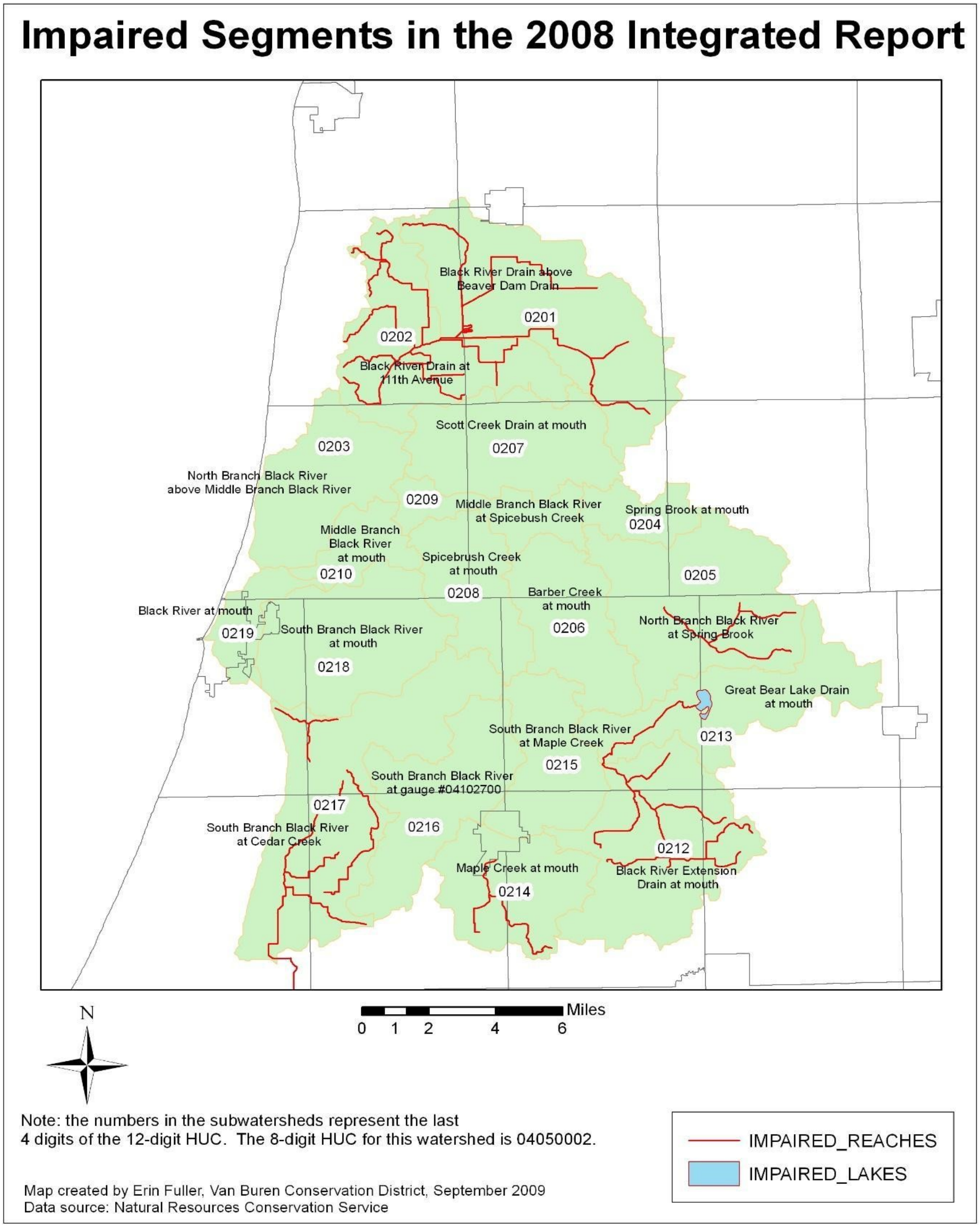


Figure 51: Impaired Segments in 2008 Integrated Report, BRW

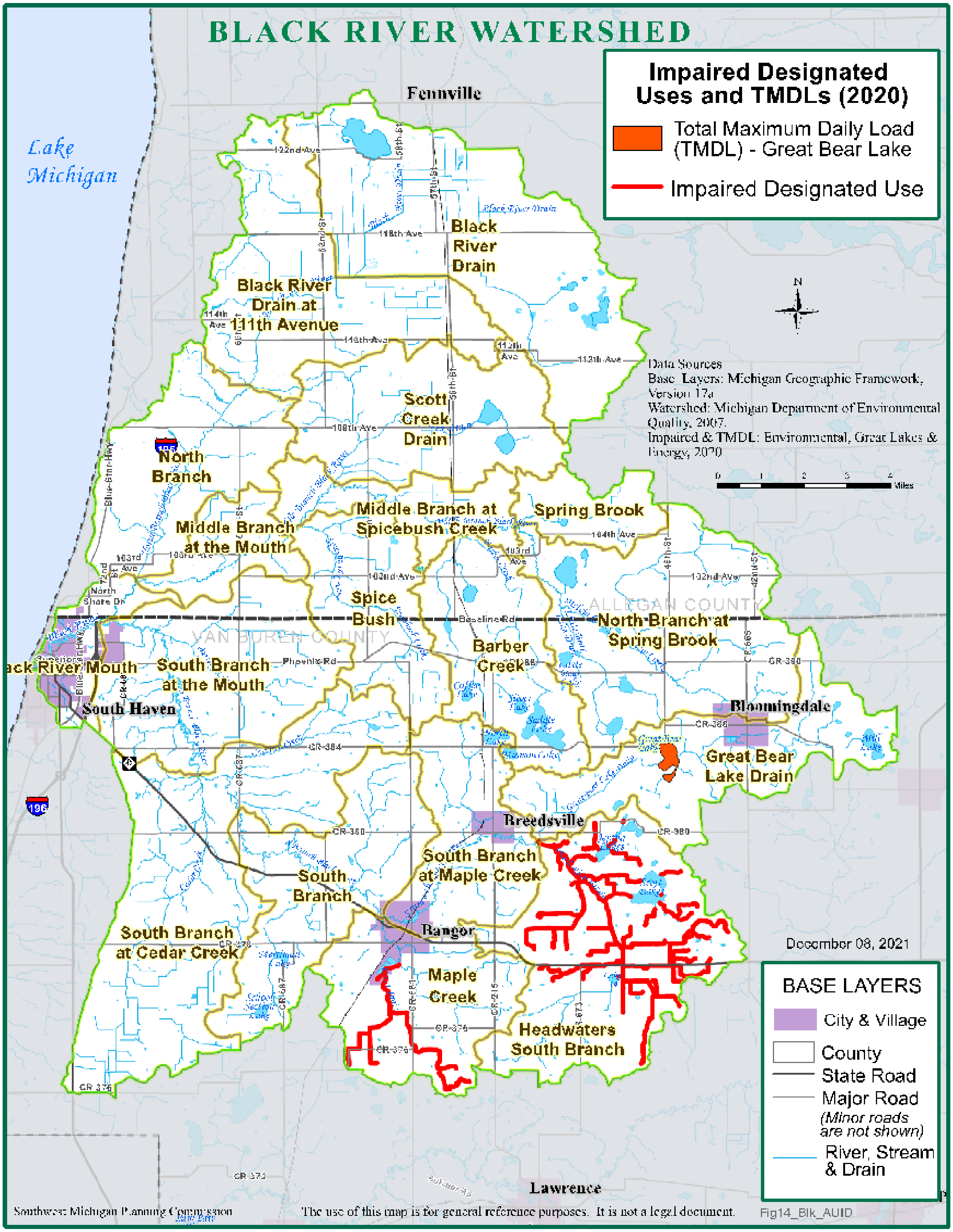


Figure 52: Impaired designated uses and TDMLs in the BRW, 2020

6.6 Desired Uses and Stakeholder Concerns

Desired uses for the Black River Watershed have been identified through stakeholder meetings and public participation. The following desired uses are also designated uses (see Table 18) and are addressed through recommendations in this plan:

- Maintain the water supply for agricultural uses (cropland uses and livestock watering)
- Maintain the water supply for industrial uses (industrial processes)
- Improve and maintain warm and coldwater fishery
- Improve and maintain the habitat for other indigenous aquatic life
- Improve partial body contact (water quality standards for water skiing, canoeing and wading)
- Improve total body contact (water quality standards are maintained for swimming)

The following are additional concerns brought up at public meetings that are indirectly related to water quality. Goals set forth in this watershed management plan also address these issues.

- Improve recreation infrastructure along river
  - Signage along river, access sites, remove log jams in portions for canoeing opportunities, canoe stops with bathrooms and picnic areas, remove litter and trash along banks
  - Establish trail/boardwalk along river in Bangor
- Maintain and protect wildlife habitat, specifically Great Blue Heron population near Breedsville
- Increase awareness and stewardship ethic in the Black River Watershed
  - Enhance public involvement

Stakeholder concerns are shown in Table 20. These were identified through public meetings, interviews, and other forms of public participation.

Table 23: Stakeholder concerns, BRW

Nutrients	Farms improperly spreading manure
	Farms with inadequate stream buffers
	Runoff from agricultural land
	Inadequate on-site septic systems
	Residential landscaping
	Overpopulation of Canada Geese in the Allegan State Game Area
	Waterfowl activity
	Excessive algae blooms
	Lake weed growth
Aquatic Wildlife	Lake weed growth impacting fish habitat
	Fish habitat lacking or degraded
	Dams and other barriers to fish runs
	Pollution has impacted fishery
	Exotic plants invading lakes and streams
	Largemouth Bass virus impacting bass and perch (Lower Scott Lake)
General Wildlife	Overpopulation of Canada Geese in Allegan State Game Area
	Exotic fauna such as zebra mussels and rusty crayfish may invade river and lakes
	Introduction of non-native species
	Reduction of biological diversity
	Loss of wildlife habitat
Development Issues	Wetland protection/restoration needed
	Lack of coordination between municipal governments and non-governmental economic development promoters
	Coordination of zoning regulations, incentives for low impact development, etc. are necessary for watershed protection
	Lack of planning and zoning communication/coordination
	Headwater protection
	Areas of the watershed are in need of economic development

	Development needs to occur with river protection and stormwater management that respects natural drainage and hydrology
	Region needs to capitalize on the amenity provided by the river for recreation and tourism
	Riverfront sites (esp. in Bangor) are available to residential or commercial development
	Impermeable surfaces and channelized waterways result in a pulse pattern of runoff and flow rather than even runoff sustained over a longer period of time
Recreation	Lack of canoeing/kayaking opportunities
	Fisheries on the river are degraded
Sedimentation	Increase in sedimentation from short-sighted land-use practices
	Sediment from road runoff
	Sediment from Kal-Haven Trail
	Improper drain maintenance procedures and lack of agricultural best management practices (reduced/no- tillage, cover crops, buffer strips)
Chemical Pollutants	Possibility of cyanide from former Breedsville tannery
	Industrial runoff and dumping resulting in PCBs, cyanide and other toxins in the water and sediments
	Petroleum pollution from outboard motors and personal watercraft
	Road commissions using herbicides near/over water and culverts
Water Levels	River and lakes suffer from low/high water levels
	Wells and pumping diminishing the surface aquifers
Other	Garbage/debris entering river from dumping, littering and runoff

6.7 Sources and Causes of Pollution and Water Quality Impairments

Sources for water pollution are broken down into two categories: point source pollution and nonpoint source pollution. Point source pollution is the release of a discharge from a pipe, outfall or other direct input into a body of water. Common examples of point source pollution are factories and wastewater treatment facilities. Point source pollution discharges are monitored under the Clean Water Act and source discharges are required to obtain a permit to ensure compliance with water quality standards under the act. This permitting process assists in the restoration of degraded water bodies and drinking water supplies. Water quality has improved significantly in many areas due to point source controls on industrial and municipal discharges (Wolf and Wuycheck 2004). The National Pollution Discharge Elimination System (NPDES) is the permitting process for point source discharges. The facilities holding NPDES permits in the Black River Watershed are listed in Appendix P. These facilities are required to report to the Michigan Department of Environment, Great Lakes and Energy on a regular basis.

Though not the focus of this plan, point source pollution has had a significant impact on the Black River. A previous study identified contaminants such as arsenic, chromium, copper, mercury, nickel, lead, zinc, acetone, methyl ethyl ketone, tolulene, ethylbenzene and xylene in Scott Creek, a tributary of the Middle Branch (Heaton 1997). The Bangor Mill Pond area has also had chemical contamination as a result of point source discharges. Pollutants such as heavy metals, PCBs, oils, chlorides and dissolved salts have all been found in this area (Hull 1989, Gashman 1990, Heaton 1997, Wolf and Wuycheck 2004). A major clean-up of this area was undertaken to resolve this issue (Wolf and Wuycheck 2004, L. Nielsen, personal communication, June 15, 2004).

A pollutant load is the total amount of pollutants entering a waterbody.

Nonpoint source pollution, the greatest water resource concern within the Black River Watershed, is not as easily identified. Nonpoint source pollution is caused when rain, snowmelt, wind, or gravity carries pollutants off the land and into the waterbodies. Roads, parking lots and driveways, farms, home lawns, golf courses, storm sewers, and businesses collectively contribute to nonpoint source pollution. Nonpoint source pollution is often overlooked because it can be a less visible form of pollution. Common forms of nonpoint source pollution are discussed in the next section.

Sources of non-point source pollutants in the Black River Watershed are primarily from agriculture and urban areas. Modeling results show that though agriculture is the largest non-point source of pollutants in the watershed, urban land uses contribute over 25% of the total pollutant load even though they only occupy about 5% of the land area (Table 21, see Appendix L for the full report). Total watershed loading values for sediment, phosphorus and nitrogen are discussed in sections 6.7.1and 6.7.2.

Table 24: Percentage of pollutant load and runoff volume per land use for the BRW

		% of total load/volume			
Land Use Category (2001 land use)	**2001 land use breakdown**	**Total Suspended Solids**	**Total Phosphorus**	**Total Nitrogen**	**Runoff**
Agriculture	42.8%	65.6	62.0	77.2	58.4
Forest	22.0%	3.1	2.5	3.0	7.9
High density urban	0.5%	1.8	1.7	1.5	1.9
Low density urban	1.5%	0.9	2.4	1.8	1.6
Transportation	3.4%	26.0	29.4	14.0	23.8
Urban Open	0.1%	0.0	0.0	0.0	0.0
Rural Open	12.8%	2.5	2.0	2.5	6.4
Water	1.1%	0.0	0.0	0.0	0.0
Wetlands	16.0%	0.0	0.0	0.0	0.0

Source: Kieser & Associates 2009 (Appendix L)

6.7.1 Sediment

Sediment is soil, sand, and minerals that can take the form of bedload, suspended or dissolved material. The first problems with sedimentation within the Black River likely began during the logging period when the river was used for log transportation, and the land was deforested. This likely resulted in large amounts of sediment washing into the river. While logging is no longer the primary cause, sedimentation is still the greatest water pollution concern within the Black River Watershed (as well as the rest of the country).

Impacts:

- 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 that may result 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. As this occurs habitat for macroinvertebrates (as well as spawning habitat for fish) is covered.
- Certain pollutants, such as phosphorus and metals, can bind themselves to the finer sediment particles and will eventually enter the waterway or waterbody.

Pollutant Loading: According to the build-out analysis (see Appendix L), TSS loading for the watershed is currently 7,718,662 lbs/year. For a breakdown by both subwatershed and township, see the full report.

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, settleable 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 Total Suspended Solids 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.

6.7.2 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 under development. In abundance, nitrogen and phosphorus accelerate the growth rate of aquatic plants and speed up the natural aging process of a waterbody.

This is referred to as "cultural eutrophication" when the addition of nutrients is related to human activities. Sources of these nutrients include fertilizers and organic waste carried within water runoff.

Impacts:

- Excessive nutrients increase weed and algae growth impacting recreational use on the waterbody.
- Decomposition of the increased weeds and algae lowers oxygen levels resulting in a negative impact on aquatic wildlife and reducing fishing opportunities.
- Exotic species can better compete with natural plants when nutrients are found in abundance.

Pollutant Loading: According to the build-out analysis (see Appendix L), total phosphorus loading for the watershed is currently 20,857 lbs/year and total nitrogen loading is 270,633 lbs/year. For a breakdown by both subwatershed and township, see the full report.

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.

6.7.3 Temperature

Change in temperature is often a forgotten pollutant. Heated runoff from impermeable surfaces alters the normal temperature range for the waterways affecting the aquatic wildlife. Impermeable surfaces, such as parking lots and driveways, and reduced infiltration on other land use types (such as lawns) lead to an increased amount of runoff. In addition, removal of streambank vegetation decreases the shading of a waterbody and can lead to an increase in temperature. Impounded areas can also have a higher water temperature relative to a free-flowing stream.

Temperature was only measured in one previous study of the Black River. In that study (MI/DEQ/WD-03/067), temperature does not appear to be increased. In fact, temperature at all sites measured was within the parameters for a coldwater fishery.

Impacts:

- Surges of heated water during rainstorms can shock and stress aquatic wildlife that have adapted to the "normal" temperature conditions.
- A change in temperature can affect the rate of photosynthesis by aquatic plants as well as the metabolic rate of aquatic organisms (Earth Force 2004).

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.

6.7.4 Bacteria/Pathogens

Bacteria and pathogens may enter surface water from improper manure management, improper disposal of pet wastes, poorly maintained septic systems, failure or overflows of sewer systems or even from high populations of waterfowl. Fecal coliform bacteria are often monitored because they can be an indicator of high levels of pathogens. The Two Rivers Coalition has conducted E. coli sampling in the Black River Watershed. Many sites in the watershed are above partial and full body contact standards. Please visit http://www.tworiverscoalition.org/ecoli.asp for current maps and sampling results.

Impacts:

- High levels of pathogens can lead to human illnesses and diseases, and thus can impair body contact recreation in a waterbody.

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 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.

6.7.5 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:

- Impacts of chemical pollutants vary widely with the chemical; however, chemical pollution can cause a variety of health risks to humans and wildlife.

Related water quality standards:

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

6.7.6 Trash and Debris

Trash can enter the river through direct dumping from an uninformed or uncaring public. Natural debris such as trees fall into the river as part of a natural process. This natural debris is an important part of the ecology of a stream. However, too much natural debris in the river can cause impairments

Impacts:

- Trash can be hazardous to aquatic wildlife
- Trash and litter along the river is visually unappealing
- Debris jams can cause impairments to navigation
- Debris jams can cause streambank erosion if they divert the flow of water against the banks
- Debris jams can block flow and exacerbate local flooding

6.8 Designated Uses, Threats, and Pollutants

Rankings for Table 22, Table 23 and Table 24 were derived from meetings and discussion with stakeholders, the Steering Committee and the Technical Committee.

Table 25: Designated uses, threats, and pollutants in the BRW

Designated Use	Pollutants causing threat or impairment	Ranking
Agriculture	N/A	N/A
Industrial Water Supply	N/A	N/A
Public Water Supply	N/A	N/A
Navigation	Trash/debris	1
	Nutrients	2
	Sediment	3
	Invasive species	4
Warmwater Fishery	Sediment	1
	Nutrients	2
	Pathogens/bacteria	3
	Temperature	4
Coldwater Fishery	Sediment	1
	Temperature	2
	Nutrients	3
	Pathogens/bacteria	4
Other Indigenous Aquatic Life and Wildlife	Sediment	1
	Nutrients	2
	Temperature	3
Partial Body Contact	Pathogens/bacteria	1
	Nutrients	2
	Sediment	3
Total Body Contact	Pathogens/bacteria	1
	Nutrients	2
	Sediment	3

Table 26: Pollutants of concern and their sources in the BRW

Pollutants* and Rankings	Source
Sediment (k) Rank: 1	Streambank Erosion/Lack of agricultural BMPS (cover crops, reduced/no-tillage, buffer strips)
	Road-Stream crossings
	Storm water runoff from impervious surfaces
	Livestock access
Nutrients (k) Rank: 2	Storm water runoff from impervious surfaces
	Septic systems
	Direct inputs
	Streambank erosion/ Lack of agricultural BMPS (cover crops, reduced/no-tillage, buffer strips)
	Livestock access
	High waterfowl population
	Fertilizer use (residential, commercial, agricultural, municipal)
Bacteria/Pathogens (k) Rank: 3	Septic systems
	Livestock access
	Storm water runoff from impervious areas
	High waterfowl population

Pollutants* and Rankings	Source
Temperature (s) Rank: 4	Storm water runoff
	Lack of tree cover/vegetative buffer along drains/streams/rivers.
Trash/debris (k) Rank: 5	Direct inputs
Chemical pollutants (Oils, pesticides, herbicides, salts, etc.) (k) Rank: 6	Storm water runoff from impervious areas
	Direct inputs
	Car related impervious surfaces (roads, parking lots)
	Storm drains
	Road-stream crossings
Invasive Species (k) Rank: 7	Non-native species' adaptability and lack of predators

**k = known and s = suspected*

Table 27: Sources and causes of pollutants of concern in the BRW

Sources *	Causes	Rank
Stream Bank Erosion/Stream Channel Erosion (k)	Removal of streambank vegetation (k)	1
	Change in hydrology (channelization/ditching, wetland loss, etc.) (k)	2
	Lack of agricultural erosion control measures (k)	3
	Improper culvert sizing and placement (k)	4
	Site development and construction (k)	5
	Livestock access (k)	6
	Human access (k)	7
Road Stream Crossings (k)	Improper culvert sizing and placement (k)	1
	Erosion from/around bridges, culverts and roads (k)	2
	Gravel road grading (s)	3
	Poorly installed or lack of erosion control measures (k)	4
	Winter road salting (s)	5
Direct Inputs (k)	Improper disposal of grass clippings, brush (k)	1
	Boating (k)	2
	Poor pollution prevention practices (s)	3
	Improper boat fueling practices (s)	4
	Houseboat septage (s)	5
Stormwater Runoff (k)	Change in land use (increase in hardened surfaces causing higher volumes of runoff) (k)	1
	Insufficient land use planning (k)	2
	Poor storm water management practices (k)	3
Livestock (k)	Improper manure management practices (s)	1
	Unrestricted access (k)	2
Septic Systems (s)	Poorly maintained, designed, or sited septic systems (s)	1
	Lack of education (k)	2
High Waterfowl Population (k)	Management for Canada Geese in the Allegan State Game Area (k)	1
	Unrestricted access (k)	2
Lack of (or removal of) Vegetative Buffer (k)	Insufficient land use planning (k)	1
	Lack of education on importance of vegetative buffers (k)	2
	Poorly maintained vegetative buffers (s)	3
Impervious/hardened surfaces (k)	Decreased infiltration due to change in land use (k)	1
	Insufficient land use planning (k)	2
	Increase in roads and parking lots from development (k)	3
Fertilizer use (residential, commercial, agricultural, municipal) (s)	Improper application (s)	1
	Lack of vegetative buffer (s)	2
Pesticide use (residential, commercial, agricultural, municipal) (k)	Improper application (k)	1
	Lack of vegetative buffer (s)	2
Storm Drains (s)	Improper oil disposal and vehicle maintenance (s)	1
	Illicit connections (s)	2

**k = known and s = suspect*

7 Priority Areas

7.1 Priority Restoration Areas

Priority areas are those portions of the watershed that contribute, or have the potential to contribute, the most pollutants that impact water quality. By identifying priority areas, implementation can be targeted to the areas where most benefit can be achieved. The watershed was prioritized at the subwatershed level. A subwatershed matrix was developed to incorporate several of the different studies that have been completed in this watershed. The matrix gives a score for each subwatershed based on waterbodies listed in the 2008 Integrated Report, pollutant loading in the L-THIA model (see Appendix L), increase in loading in a 25% build-out scenario (see Appendix L), yields over the fisheries target (see Appendix N), TMDL (Total Maximum Daily Load) developed or pending, and wetland loss. This matrix is found in Table 25 and a map is shown Figure 45. Subwatersheds were scored as follows:

Total maximum score available = 6 points

- Contains impaired segment in 2008/2020 Integrated Report = 1 point
- TMDL developed or pending = 1 point
- High pollutant loading in L-THIA model* = 1 point
- Significant increase in nutrient & sediment loads and runoff volume in 25% build-out scenario = 1 point
- Hydrologic study: subbasin yields over fisheries target = 1 point
  Wetland loss: 0-10.0% = 0 points; 10.1-20.0% = 0.5 points; 20.1% and above = 1 point

TMDLs (Total Maximum Daily Loads) are developed for waterbodies that do not meet water quality standards. A TMDL represents the maximum loading of a pollutant that can be discharged to a water body while still allowing that waterbody to meet water quality standards.

*The top three loading (per acre) subwatersheds were chosen for the subwatershed matrix. The same three subwatersheds had the highest loadings per acre for TSS, phosphorus and nitrogen, and they were significantly higher than the rest of the subwatersheds for each pollutant. See Appendix L for the complete report on loading for all subwatersheds.

Once scored, the subwatersheds were divided into three levels based on their score: Priority area 1 (scores of 3 points and above), Priority area 2 (scores of 1.5 to 2.5 points), and Priority area 3 (scores of 0 to 1 points). Thus, Priority area 1 is the highest priority area to be addressed with action in the watershed action plan shown in Table 30. This methodology provided four subwatersheds in priority area 1. This oversimplifies the issues in each subwatershed but does provide us with a method for prioritizing subwatersheds in which to focus best management practice implementation.

7.2 Priority Preservation Areas

Additionally, the Southwest Michigan Land Conservancy, along with local volunteers, completed a GIS-based land protection priority model for the watershed (see Section 4.9 and Appendix G). This model identifies both natural areas and agricultural areas for protection. See Appendix G for a full report on the methodology that was used to create these models. This model should be used to guide land protection efforts in the watershed. For the most part, these priority preservation areas are located in undeveloped, headwaters areas. Areas around the Allegan State Game Area scored highly, as did wetland complexes in the Pullman area, undeveloped river corridor, the area around Upper and Lower Jeptha Lakes, and many lakes with little development, including Lake 11, Lake 14, Little Bear Lake, Spring Brook Lake, and others that comprise the headwaters of the Middle Branch. Below are the subwatersheds that stand out as containing more areas of high conservation value. See Appendix G for a complete description and detailed maps.

- 040500020201 (Black River Drain above Beaver Dam Drain)
- 040500020204 (Spring Brook at mouth)
- 040500020205 (North Branch Black River at Spring Brook)
- 040500020206 (Barber Creek at mouth)
- 040500020213 (Black River Extension Drain at mouth)

In addition, with the latest update, SWMPC conducted another GIS analysis and developed a Strategic Land Conservation Plan which identified six areas to concentrate conservation efforts to better protect water quality. The report also includes a list of landowners (see appendix).

Table 28: Subwatershed matrix, BRW

HUC 8	HUC12	Sub-watershed name	Contains impaired segment in 2008 or 2020 Integrated Report?	TMDL developed or pending?	High pollutant loading in L-THIA model*	Significant increase in nutrient/sediment loads & runoff volume in 25% build-out scenario	Hydrologic study: sub-basin yields over fisheries target	Wetland loss	Score	Priority area
04050002	0201	Black River Drain above Beaver Dam Drain	X (Black River Drain, unnamed tributary to Black River Drain, unnamed trib. to Hutchins Lake)					56%	2	2
04050002	0202	Black River Drain at 111th Ave	X (Black River Drain, unnamed tributaries to Black River Drain)					74%	2	2
04050002	0203	North Branch Black River above Middle Branch Black River				X		2.7%%	1	3
04050002	0204	Spring Brook at mouth						-2%	0	3
04050002	0205	North Branch Black River at Spring Brook	X (Melvin Creek)					27%	1	3
04050002	0206	Barber Creek at mouth				X		37%	1.5	2
04050002	0207	Scott Creek Drain at mouth						9%	0	3
04050002	0208	Spicebush Creek at mouth						50%	0.5	3
04050002	0209	Middle Branch Black River at Spicebush Creek						-2%	0	3
04050002	0210	Middle Branch Black River at mouth					X	37%	1	3
04050002	0212	Black River Extension Drain at mouth	X (Lower Jeptha Lake Drain)	x				65%	2	1
04050002	0213	Great Bear Lake Drain at mouth	X (Great Bear Lk Drain, Great Bear Lake)	X (developed)			X	50%	3.5	1

HUC 8	HUC12	Sub-watershed name	Contains impaired segment in 2008 or 2020 Integrated Report?	TMDL developed or pending?	High pollutant loading in L-THIA model*	Significant increase in nutrient/sediment loads & runoff volume in 25% build-out scenario	Hydrologic study: sub-basin yields over fisheries target	Wetland loss	Score	Priority area
04050002	0214	Maple Creek at mouth	X (Cedar Drain)		X		X	61%	4	1
04050002	0215	South Branch Black River at Maple Creek				X		56%	2	2
04050002	0216	South Branch Black River at gauge #04102700			X			58%	2	2
04050002	0217	South Branch Black River at Cedar Creek	X (Cedar Creek, Unnamed trib. to Cedar Creek)				X	64%	3	1
04050002	0218	South Branch Black River at mouth				X	X	56%	2.5	2
04050002	0219	Black River at mouth			X	X	X	61%	3	1

*The top three subwatersheds were chosen for the subwatershed matrix. See Appendix L for the complete report on loading for all subwatersheds.

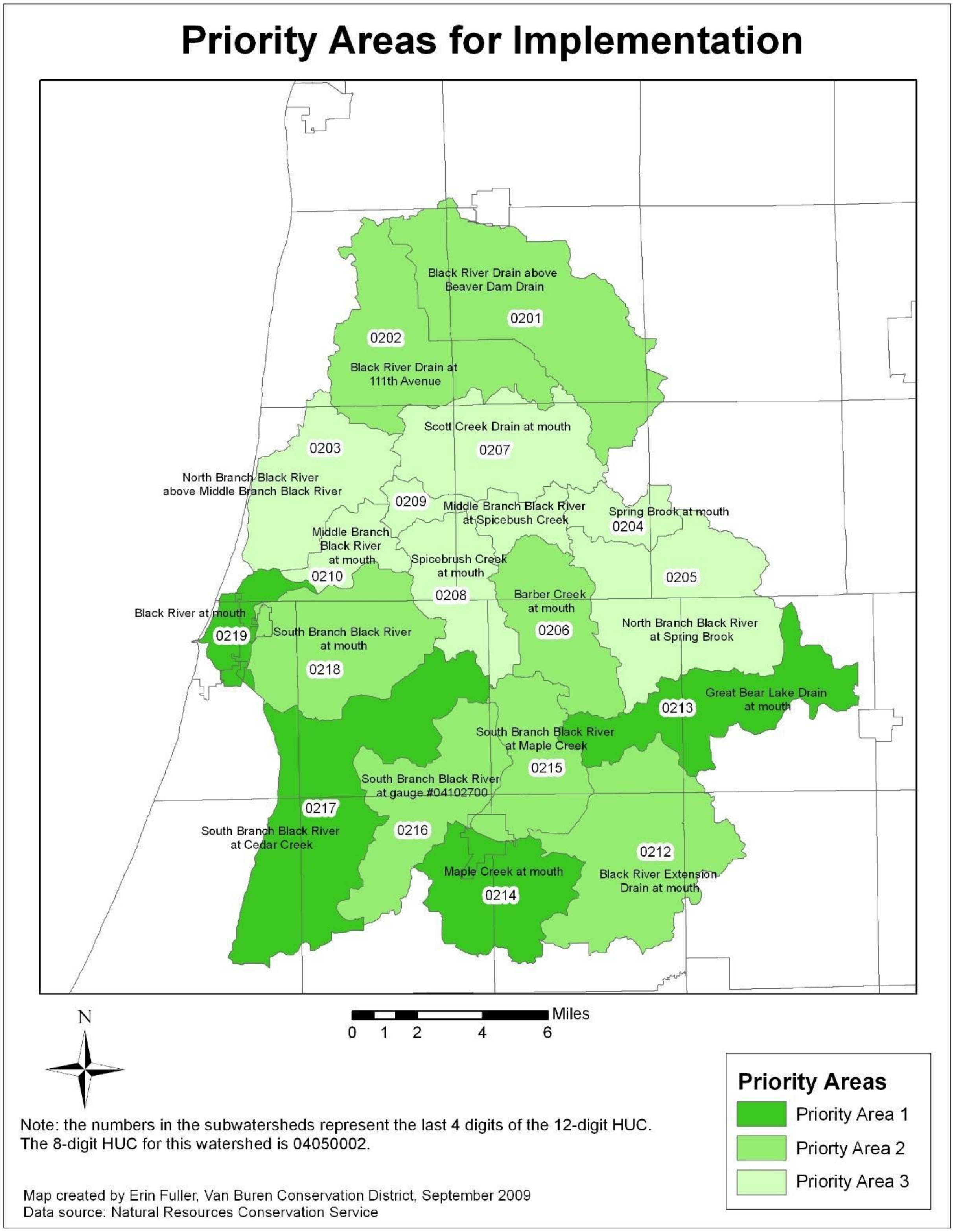


Figure 53: Priority areas for implementation in the BRW, 2009

8 Implementation Strategies

Many of the water quality concerns in the Black River Watershed could be improved through education and land-use planning. Watershed residents need to be educated on how their actions can affect water quality. This education needs to be provided in a variety of formats: workshops for local residents, booths at local fairs and events, and presentations to township boards, lake associations, city and village councils, and other organizations. This education will help provide the foundation for long-range land use planning. Residents will need to understand the importance of master plans and ordinances for the protection of water quality for them to be effective. The themes of education and land-use planning are found throughout the goals and objectives for implementing this plan.

8.1 Goals and Objectives for the Black River Watershed

A variety of goals and objectives for the Black River Watershed have been identified through stakeholder meetings and meetings of the Steering, Technical, and Information and Education Committee (Table 26). Some of the objectives will accomplish more than one goal. For example, stabilizing priority streambank erosion sites will help achieve Goal 1, Goal 3 and Goal 4. Additionally, not all problem areas will be targeted for on-the-ground work. Instead, these areas may be addressed through other methods such as landowner education, or by creating ordinances that will address water quality issues. See Appendix R for tasks to help implement each objective.

The overall goals of this watershed management plan fall into four main categories (after Schueler 2004): water quality, hydrological and morphological condition, community concerns and biological diversity.

The action plan that defines how these objectives will be accomplished is displayed in Table 30. Each objective is given a priority of high, medium, or low. Objectives listed as high priority are generally those that would have more of an impact on water quality. If funding is limited, objectives listed as high priority should be undertaken first, and low priority ones last.

Table 29: Goals and objectives, BRW

Goals	Objectives
1. Improve water quality and habitat for fish, indigenous aquatic life and wildlife in the watershed by reducing the amount of nutrients, sediment, and chemical pollutants entering the system	1 A. Stabilize priority streambank erosion sites through the installation of corrective measures
	1 B. Establish a road/stream crossing improvement program to correct identified problems
	1 C. Work to limit or control direct livestock access to the river and tributaries
	1 D. Install corrective measures to reduce runoff at agricultural sites of concern (cover crop, reduced/no tillage, buffer strips)
	1 E. Encourage farmers to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP)
	1 F. Reestablish greenbelts/conservation buffers at sites in critical areas
	1 G. Work with communities to reduce polluted stormwater entering local waterways – utilize low impact development
	1 H. Identify and improve failing septic systems
	1 I. Encourage the creation of local sanitary sewer systems on densely populated inland lakes
2. Continue/increase watershed monitoring efforts and stewardship	2 A. Perform water quality monitoring for potential pollutants to monitor the current quality of the river as well as to monitor changes over time
	2 B. Continue monitoring stream bank erosion
	2 C. Continue geomorphologic assessments of river

	2 D. Perform hydraulic / hydrologic analysis of river
3. Improve the hydrology and morphology of the river	3 A. Reduce volume and rate of runoff using recommendations from hydrologic study (see Appendix N). BMPs include wetland creation, detention, bioretention, buffer strips and infiltration practices
	3 B. Restore river channel to stable condition
4. Provide long-term protection of the Black River Watershed through improved local land use policies and conservation practices	4 A. Assess the current adequacy level of local community planning and zoning controls
	4 B. Develop model ordinances and language for adoption into existing master plans and zoning ordinances
	4 C. Assist local communities in updating master plans and/or adopting ordinances or "smart growth" or low impact development techniques that will protect water quality
	4 D. Permanently protect identified sensitive areas through conservation easements, purchase of development rights, and land purchases
	4 E. Support efforts to protect prime farmland from development
	4 F. Promote Low Impact Development (LID) techniques through regulations or incentives
5. Improve the navigability of the Black River for canoes, kayaks, and other self-propelled watercraft, by reducing sedimentation and reducing excess woody debris	5 A. Remove or cut through downed trees that inhibit navigation by canoes and kayaks and increase bank erosion
	5B. Stabilize priority streambank erosion sites through the installation of corrective measures (see objective 1 A)
	5C. Establish a road/stream crossing improvement program to correct identified problems (see objective 1 B)
	5D. Work to limit or control direct livestock access to the river and tributaries (see objective 1 D)
6. Enhance recreational access sites to prevent the degradation of water quality	6 A. Increase the number of legal access sites
	6 B. Provide educational kiosks and signage at launch sites that educate people about the watershed and good river etiquette
7. Increase knowledge and participation in programs regarding nonpoint source pollution and means of prevention	7 A. Hire staff to implement watershed management plan, including a project manager and a land use planner
	7 B. Implement Information & Education Plan (see Appendix Q)
8. Prevent the introduction of, and minimize the negative impact of, invasive species within the basin.	8 A. Establish or work with existing invasive species control programs to prevent the spread of exotic species in the watershed

Table 30: Black River Watershed Action Plan

(See Appendix R for tasks to help achieve each objective.)

Goal 1: Improve water quality and habitat for fish, indigenous aquatic life and wildlife in the watershed by reducing the amount of nutrients, sediment, and chemical pollutants entering the system										
Priority area 1: subwatersheds -0213, -0214, -0217, -0219 Priority area 2: subwatersheds -0201, -0202, -0206, -0212, -0215, -0216, -0218 [See Figure 45] Priority area 3: subwatersheds -0203, -0204, -0205, -0207, -0208, -0209, -0210										
Objective	Pollutant	Location*	Priority	Coordinating agencies (partners)	Pollutants reduced	Estimated cost	Potential funding or partner programs	Timeline	Milestones (after implementation begins	Proposed evaluation method
1 A. Stabilize priority streambank erosion sites through the installation of corrective measures	Sediment, nutrients	Priority area 1	High	Conservation Districts (Drain Commissioners)	Sediment: 33 tons/yr, P: 32 lbs/yr, N: 63 lbs/yr [there are additional unidentified sites for which pollutant reductions have not been calculated]	$30/linear foot	MEGLE 319, Drain commissioner , Farm Bill	Ongoing	In 5 years 3,000 feet; In 10 years additional 3000 feet; In 15 years additional 3000 feet	Linear feet stabilized; estimate pollutant loading reduction
1 B. Establish a road/stream crossing improvement program to correct identified problems	Sediment, chemicals	Priority areas 1 & 2	Medium	Road commissions, MDOT (Conservation Districts, municipalities)	Potential to reduce sediment & chemical pollutants; not currently quantifiable	Agency staff time $14-$45/hour (varies)	Road commissions, MDOT	Ongoing	In 5 years 25% of problem areas corrected; in 15 years 50%, in 25 years: 100%	Visual survey; before and after photos; estimate pollutant loading reduction
1 C. Work to limit or control direct livestock access to the river and tributaries	Sediment, nutrients, bacteria/ pathogen s	Priority areas 1 & 2	High	NRCS	Sediment: 28 tons/yr, P: 24 lbs/yr, N: 48 lbs/yr	$3/ft for fencing; $6/sq. ft. for stream crossing; staff time	Farm bill	Ongoing	In 5 years 4 sites improved, 8 sites improved In 10 years	Visual survey; document number of sites improved; estimate pollutant loading reduction
1 D: Install corrective measures to reduce runoff at agricultural sites of concern (BMPs include no-till, filter strips, cover crops, fertilizer reduction, etc.)	Sediment, nutrients, bacteria/ pathogen s	Priority areas 1 & 2	Medium	NRCS (Conservation Districts)	Sediment: 2578 tons/yr, P: 3201 lbs/yr, N: 6422 lbs/yr	$350/acre	Farm bill, MEGLE 319	Ongoing	In 10 years, 4595 linear feet of buffers installed, 5500 acres converted to no-till/cover crops By 2028: 10,000 acres converted	Visual survey; before and after photos; track and report acres of corrective measures installed; estimate pollutant loading reduction
1 E. Encourage farms to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP)	Sediment, nutrients, chemicals	All	Medium	Conservation Districts (MDA, NRCS)	Not currently quantifiable	Staff time (varies)	Conservation Districts, MEGLE 319	Ongoing	By 2025: 15 additional farms, by 2030: 20 additional farms,	Number of facilities environmentally assured

1 F. Reestablish greenbelts/ conservation buffers at sites in critical areas	Sediment, nutrients	Priority areas 1 & 2	Medium	Conservation Districts (NRCS, municipalities)	Sediment: 108 tons/yr, P: 91 lbs/yr, N: 183 lbs/yr	$1-$50 per square foot for vegetation + design and labor; staff time	Conservation Districts, MEGLE 319, Farm bill	2022-2032	In 10 years,: 4326 linear feet of greenbelts/ buffers installed	Before and after photos; estimate pollutant loading reduction
1 G. Work with communities to reduce polluted stormwater entering local waterways (BMPs include retention/detention ponds, vegetated swales, raingardens and constructed wetlands, etc.)	Sediment, nutrients, chemicals	Priority areas 1 & 2	Medium	Conservation Districts (municipalities)	Sediment: 304 tons/yr; P: 1,240 lbs/yr; N: 11,713 lbs/yr	Varies by practice, generally $1-$40/sq. ft. Rain garden: $5-40/ sq. ft., Swales: $0.05-$2.50/sq. ft.	MEGLE 319	2022-2032	In 10 years, BMPs installed at 25% coverage rate, in 20 years: BMPs installed at 50% coverage rate	Before-and after survey; track and report reduction of stormwater outlets; estimate pollutant loading reduction
1 H. Identify and improve failing septic systems	Nutrients, bacteria/ pathogens	Priority area 1 & 2	High	Health departments (Conservation Districts)	P: 1lb/year/house	Staff time; educational materials; ≈ $92.50 per inspection	MEGLE 319, Health Departments	2022-2032	In 5 years perform 15 free or discounted septic inspections In ten years: 100 septic inspections	Follow-up surveys to determine if change in practice has occurred; estimate pollutant loading reduction
1 I. Encourage the creation of local sanitary sewer systems on densely populated inland lakes	Nutrients, bacteria/ pathogens	Priority area 1 & 2	Medium	Health departments, Conservation Districts	P: 1lb/year/house	Staff time; homeowner assessments	Lake associations, Conservation districts	2022-2032	In 3 years contact lake associations to assess interest/feasibility; next milestone dependent on level of interest/funding	Before and after knowledge surveys

2. Continue/increase watershed monitoring efforts and stewardship										
Priority area 1: subwatersheds -0213, -0214, -0217, -0219; Priority area 2: subwatersheds -0201, -0202, -0206, -0212, -0215, -0216, -0218; Priority area 3: subwatersheds -0203, -0204, -0205, -0207, -0208, -0209, -0210 [See Figure 45]										
Objective	Pollutant	Location*	Priority	Coordinating agencies (partners)	Pollutants reduced	Estimated cost	Potential funding or partner programs	Timeline	Milestones (after implementation begins	Proposed evaluation method
2 A. Perform water quality monitoring to examine the current quality of the river as well as to monitor changes over time	NA	Priority areas 1, 2 & 3	High	MEGLE, MDNR (Conservation Districts, lake associations, Two Rivers Coalition)	N/A	Variable depending upon study method; staff time	MEGLE 319, Lake associations	On-going	By 2025 have regular monitoring scheme	TMDL goal achieved; Success of studies will be determined in their final reports
2 B. Continue monitoring stream bank erosion	NA	Priority areas 1, 2 & 3	High	MEGLE, MDNR, Black River Watershed Assembly, Two Rivers Coalition	N/A	Staff time; minimal materials costs (≈ $100)	Grants	On-going	By 2025: Assess two sites per year By 2030: Entire watershed assessed	The success of this study will be determined in its final report
2 C. Continue geomorphologic assessments of river	NA	Priority areas 1, 2 & 3	High	MEGLE, MDNR	N/A	Staff time	MDNR, grants	On-going	By 2025: Assess two sites per year By 2030: Have 18 representative reaches assessed	The success of this study will be determined in its final report
2 D. Perform hydraulic/hydrologic analysis of river	NA	Priority areas 1, 2 & 3	Medium	Conservation District (MEGLE, MDNR)	N/A	Staff time; cost of hiring independent contractor ≈ $70,000	MEGLE, grants	On-going	By 2025 Perform hydraulic analysis By 2030: Repeat hydrologic analysis	The success of this study will be determined in its final report

Goal 3: Improve the hydrology and morphology of the river										
Priority area 1: subwatersheds -0213, -0214, -0217, -0219; Priority area 2: subwatersheds -0201, -0202, -0206, -0212, -0215, -0216, -0218 ; Priority area 3: subwatersheds -0203, -0204, -0205, -0207, -0208, -0209, -0210 [See Figure 45]										
Objective	Pollutant	Location*	Priority	Coordinating agencies (partners)	Pollutants reduced	Estimated cost	Potential funding or partner programs	Timeline	Milestones (after implementation begins	Proposed evaluation method
3 A. Reduce volume and rate of runoff using recommendations from hydrologic analysis (see Appendix N). BMPs include wetland creation, detention, bioretention, buffer strips and infiltration practices	Sediment, nutrients, chemicals	Priority areas 1 & 2	High	Conservation Districts (MEGLE, MDNR, Ducks Unlimited)	Not currently quantifiable; these BMPs typically have treatment efficiencies ranging from 30-90%	≈ $20,000 per acre for wetland restoration	MEGLE 319, USFWS	On-going	In ten years 50 acres restored, in 20 years: 100 acres restored, by25 years: 200 acres restored	Acres of wetlands restored or recreated; hydrology study; estimate pollutant loading reduction
3 B. Restore river channel to stable condition	Sediment	Priority areas 1 & 2	Medium	MEGLE, MDNR, Conservation Districts	Not currently quantifiable	Undetermined	MEGLE 319	On-going	In 10 years,10 miles restored, In 15 years:20 miles restored, In 20 years, 50 miles restored	Stream morphology studies; estimate pollutant loading reduction

Goal 4: Provide long term protection of the Black River Watershed through improved local land use policies and conservation practices										
Priority area 1: subwatersheds -0213, -0214, -0217, -0219; Priority area 2: subwatersheds -0201, -0202, -0206, -0212, -0215, -0216, -0218; Priority area 3: subwatersheds -0203, -0204, -0205, -0207, -0208, -0209, -0210 [See Figure 45]										
Objective	Pollutant	Location*	Priority	Coordinating agencies (partners)	Pollutants reduced	Estimated cost	Potential funding or partner programs	Timeline	Milestones (after implementation begins	Proposed evaluation method
4 A. Assess the current adequacy level of local community planning and zoning controls	All	Priority areas 1, 2 & 3	High	Conservation Districts (municipalities, county and regional planning agencies, MSU Extension)	N/A	Time & material: $5,997.73 per municipality (SW MI Commission estimate)	MEGLE 319	On-going	In 3 years: 4 communities have been reviewed; in 8 years 10 communities, in 12 years, all communities	Track number of communities reviewed

4 B. Develop model ordinances and language for adoption into existing master plans and zoning ordinances in the following areas: stormwater management, setback provisions, greenbelts, site plan review requirements, lot size, septic systems, funneling/keyholing, wetlands, etc.	All	Priority areas 1, 2 & 3	High	Conservation Districts (municipalities, county and regional planning agencies, MSU Extension)	N/A	Staff time and materials: $9,863.34 per municipality to develop and adopt ordinances (SW MI Commission estimate)	MEGLE 319	On-going	In 3 years: Develop 3 model ordinances In 5 years develop model ordinances for all issues	Track total number of ordinances developed over the life of the project
4 C. Assist local communities in updating master plans and/or adopting ordinances or "smart growth" techniques that will protect water quality	All	Priority areas 1, 2 & 3	High	Conservation Districts (municipalities, county and regional planning agencies, MSU Extension)	N/A	Staff time; workshops ≈ $1,400	MEGLE 319	On-going	In 3 years: Assist 3 communities with master plan/ordinance updates, In 5 years, assist 10 communities In 10 years, repeat review process	Track & report changes; track # of master plans that include water quality provisions/numbe r of water quality ordinances adopted in the watershed; track & report attendance at workshops & training sessions
4 D. Permanently protect sensitive areas through conservation easements, purchase of development rights, and land purchases	All	Parcels in tiers 1 & 2 of land protection priority model in priority subwaters heds in section 7	High	Southwest Michigan Land Conservancy, Conservation Districts, Michigan Nature Association, MDNR, etc.	Not currently quantifiable; Pollutants prevented/preventing future degradation. Once specific parcels are identified, calculations can be made.	$20,000/year for 3 years = $60,000	MEGLE 319	On-going	In 5 years: 100 acres protected, In 10 years: 300 acres protected, In 20 years: 1000 acres protected	Track and report landowner contacts; track and report acreages that have been enrolled in land conservation programs
4 E. Support efforts to protect prime farmland from development	Limits changes in hydrology	All	Medium	Conservation Districts (MSU Extension, County Farm Bureaus, Allegan and Van Buren PDR programs, SWMLC)	Not currently quantifiable; Limits changes in hydrology	Staff time; educational materials	County PDR programs, Conservation Districts	On-going	In 3 years Provide education to municipalities and farmers; In 5 years: educational efforts repeated at least biennially	Acreage enrolled in PDR programs; before and after knowledge surveys

4 F. Promote Low Impact Development (LID) techniques	Potentially all	All	Medium	SW Michigan Planning Commission (Conservation Districts)	N/A	Workshops ≈ $1350; Newsletters ≈ $2500	SW Michigan commission, Conservation Districts	On-going	In 3 years Newsletters distributed, In 5 years at least 2 workshops given; In 7 years, LID techniques installed in 4 communities	Before and after knowledge surveys; track and report LID techniques installed in the watershed
Goal 5: Improve the navigability of the Black River for canoes, kayaks, and other self-propelled watercraft, by reducing sedimentation and reducing excess woody debris										
Priority area 1: subwatersheds -0213, -0214, -0217, -0219; Priority area 2: subwatersheds -0201, -0202, -0206, -0212, -0215, -0216, -0218; Priority area 3: subwatersheds -0203, -0204, -0205, -0207, -0208, -0209, -0210 [See Figure 45]										
Objective	Pollutant	Location*	Priority	Coordinating agencies (partners)	Pollutants reduced	Estimated cost	Potential funding or partner programs	Timeline	Milestones (after implementation begins	Proposed evaluation method
5 A. Remove or cut through downed trees that inhibit navigation by canoes and kayaks [See also: Goal 1, Objectives 1A, 1B and 1D.]	Trash/ debris, sediment	South Branch Black River from Bangor to South Haven/21 river miles	Medium	Van Buren County Convention & Visitors Bureau	N/A	$7,000/year for contractor to do pathway maintenance	Local businesses	Ongoing	Annual maintenance performed.	Document river miles made accessible to canoe/kayak
Goal 6: Enhance recreational access sites to prevent the degradation of water quality										
Priority area 1: subwatersheds -0213, -0214, -0217, -0219; Priority area 2: subwatersheds -0201, -0202, -0206, -0212, -0215, -0216, -0218; Priority area 3: subwatersheds -0203, -0204, -0205, -0207, -0208, -0209, -0210 [See Figure 45]										
Objective	Pollutant	Location*	Priority	Coordinating agencies (partners)	Pollutants reduced	Estimated cost	Potential funding or partner programs	Timeline	Milestones (after implementation begins)	Proposed evaluation method
6 A. Increase the number of legal access sites	Sediment	All	Low	Van Buren County Convention & Visitors Bureau, South Haven Recreational Authority	Not currently quantifiable; well-designed, stable access points will limit informal access points that lead to streambank erosion. Sites still need to be identified.	$100,000 - $500,000/site	MDNR Trust Fund and Land and Water Conservation Fund	On-going	2 new or improved access sites by 2030	Number of legal access sites added or improved

6 B. Provide educational kiosks and signage at launch sites that educate people about the watershed and good river etiquette	All	All	Medium	Van Buren County Convention & Visitors Bureau, South Haven Recreational Authority	Not currently quantifiable; this educational effort is expected to change behaviors in at least some of the targeted audience. This will reduce and prevent pollutants from reaching the Black River.	$1500/sign	Van Buren County Convention & Visitors Bureau, South Haven Recreational Authority	On-going	Install signage at all existing sties by 2025 and new sites as built out.	Track number of kiosks added
Goal 7: Increase knowledge and participation in programs regarding nonpoint source pollution and means of prevention										
Priority area 1: subwatersheds -0213, -0214, -0217, -0219; Priority area 2: subwatersheds -0201, -0202, -0206, -0212, -0215, -0216, -0218; Priority area 3: subwatersheds -0203, -0204, -0205, -0207, -0208, -0209, -0210 [See Figure 45]										
Objective	Pollutant	Location*	Priority	Coordinating agencies (partners)	Pollutants reduced	Estimated cost	Potential funding or partner programs	Timeline	Milestones (after implementation begins)	Proposed evaluation method
7 A. Hire staff to implement watershed management plan, including a project manager and a land use planner	All	All	High	Conservation Districts	N/A	$40,000-$60,000/year	MEGLE 319; Conservation District millage	Ongoing	By 2025: sustainable funding source determined	NA
7 B. Implement Information & Education Plan (see Appendix Q)	All	All	High	Varies (see plan); (Two Rivers Coalition)	Not currently quantifiable; this educational effort is expected to change behaviors in at least some of the targeted audience. This will reduce and prevent pollutants from reaching the Black River.	Varies (see plan)	MEGLE 319	On going	Varies (see plan)	Varies (see plan)

Goal 8: Prevent the introduction of, and minimize the negative impact of, invasive species within the basin.										
Priority area 1: subwatersheds -0213, -0214, -0217, -0219; Priority area 2: subwatersheds -0201, -0202, -0206, -0212, -0215, -0216, -0218 ; Priority area 3: subwatersheds -0203, -0204, -0205, -0207, -0208, -0209, -0210 [See Figure 45]										
Objective	Pollutant	Location*	Priority	Coordinating agencies (partners)	Pollutants reduced	Estimated cost	Potential funding or partner programs	Timeline	Milestones (after implementation begins)	Proposed evaluation method
8 A. Establish or work with existing invasive species control programs to prevent the spread of exotic species in the watershed	Invasive species	Priority areas 1 & 2	Medium	CISMAs, Conservation Districts (The Stewardship Network, MDNR, Southwest Michigan Land Conservancy, MSU Extension	N/A	Staff time; materials; workshops $40,000/year	CISMAs, Conservation District, GLRI, MDNR, EGLE, Conservation Districts, The Stewardship Network, lake associations	On-going		Number of populations located, number of populations treated, number of populations eliminated; Ratio of put ins with/without signage, number of wash stations

* Individual sites are identified by priority area in Appendix M.

8.2 Recommendations for Implementation

The ultimate vision of this project is to better help people understand their impact on water quality and learn what they can do to improve and protect water quality. Many of the problems associated with current water quality are related to a lack of understanding about nonpoint source pollution and basic river morphology and hydrology. The problems that exist are primarily not ones that can be easily fixed with 'band-aid' Best Management Practices (BMPs). Instead, the focus should be on improved land use planning and a wide-ranging information and education plan. We will work with existing programs (through organizations such as the Natural Resources Conservation Service) to implement BMPs in some critical locations. We plan to also implement a few well-placed BMPs in critical areas that will be very visible to the public (e.g. in public parks in the watershed), and thus help enforce the educational goals of the project.

Due to limitations in the planning grant, additional studies will be needed to determine the best locations and scope of many of the recommendations contained within this plan. Objectives of this management plan are organized by area below.

8.2.1 Recommendations for Priority Area 1

- 1 A. Stabilize priority streambank erosion sites through the installation of corrective measures
- 1 B. Establish a road/stream crossing improvement program to correct identified problems
- 1 C. Work to limit or control direct livestock access to the river and tributaries
- 1 D. Install corrective measures to reduce runoff at agricultural sites of concern
- 1 E. Encourage farms to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP)
- 1 F. Reestablish greenbelts/conservation buffers at sites in critical areas
- 1 G. Work with communities to reduce polluted stormwater entering local waterways
- 1 H. Identify and improve failing septic systems
- 1I. Encourage the creation of local sanitary sewer systems on densely populated inland lakes
- 2 A. Perform water quality monitoring for potential pollutants to monitor the current quality of the river as well as to monitor changes over time
- 2 B. Continue monitoring stream bank erosion
- 2 C. Continue geomorphologic assessments of river
- 2 D. Perform hydraulic / hydrologic analysis of river
- 3 A. Reduce volume and rate of runoff using recommendations from hydrologic analysis
- 3 B. Restore river channel to stable condition
- 4 A. Assess the current adequacy level of local community planning and zoning controls
- 4 B. Develop model ordinances and language for adoption into existing master plans and zoning ordinances
- 4 C. Assist local communities in updating master plans and/or adopting ordinances or "smart growth" techniques that will protect water quality
- 4 D. Permanently protect identified sensitive areas through conservation easements, purchase of development rights, and land purchases
- 4 E. Support efforts to protect prime farmland from development
- 4 F. Promote Low Impact Development (LID) techniques
- 5 A. Remove or cut through downed trees that inhibit navigation by canoes and kayaks
- 6 A. Increase the number of legal access sites
- 6 B. Provide educational kiosks and signage at launch sites that educate people about the watershed and good river etiquette
- 7 A. Hire staff to implement watershed management plan, including a project manager and a land use planner
- 7 B. Implement Information & Education Plan (Appendix Q)
- 8 A. Establish or work with existing invasive species control programs to prevent the spread of exotic species in the watershed

8.2.2 Recommendations for Priority Area 2

- 1 B. Establish a road/stream crossing improvement program to correct identified problems
- 1 C. Work to limit or control direct livestock access to the river and tributaries
- 1 D. Install corrective measures to reduce runoff at agricultural sites of concern
- 1 E. Encourage farms to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP)

- 1 F. Reestablish greenbelts/conservation buffers at sites in critical areas
- 1 G. Work with communities to reduce polluted stormwater entering local waterways
- 1 H. Identify and improve failing septic systems
- 1I. Encourage the creation of local sanitary sewer systems on densely populated inland lakes
- 2 A. Perform water quality monitoring for potential pollutants to monitor the current quality of the river as well as to monitor changes over time
- 2 B. Continue monitoring stream bank erosion
- 2 C. Continue geomorphologic assessments of river
- 2 D. Perform hydraulic / hydrologic analysis of river
- 3 A. Reduce volume and rate of runoff using recommendations from hydrologic analysis
- 3 B. Restore river channel to stable condition
- 4 A. Assess the current adequacy level of local community planning and zoning controls
- 4 B. Develop model ordinances and language for adoption into existing master plans and zoning ordinances
- 4 C. Assist local communities in updating master plans and/or adopting ordinances or "smart growth" techniques that will protect water quality
- 4 D. Permanently protect identified sensitive areas through conservation easements, purchase of development rights, and land purchases
- 4 E. Support efforts to protect prime farmland from development
- 4 F. Promote Low Impact Development (LID) techniques
- 5 A. Remove or cut through downed trees that inhibit navigation by canoes and kayaks
- 6 A. Increase the number of legal access sites
- 6 B. Provide educational kiosks and signage at launch sites that educate people about the watershed and good river etiquette
- 7 A. Hire staff to implement watershed management plan, including a project manager and a land use planner
- 7 B. Implement Information & Education Plan (Appendix Q)
- 8 A. Establish or work with existing invasive species control programs to prevent the spread of exotic species in the watershed

8.2.3 Recommendations for Priority Area 3

- 1 E. Encourage farmers to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP)
- 2 A. Perform water quality monitoring for potential pollutants to monitor the current quality of the river as well as to monitor changes over time
- 2 B. Continue monitoring stream bank erosion
- 2 C. Continue geomorphologic assessments of river
- 2 D. Perform hydraulic / hydrologic analysis of river
- 4 A. Assess the current adequacy level of local community planning and zoning controls
- 4 B. Develop model ordinances and language for adoption into existing master plans and zoning ordinances
- 4 C. Assist local communities in updating master plans and/or adopting ordinances or "smart growth" techniques that will protect water quality
- 4 D. Permanently protect identified sensitive areas through conservation easements, purchase of development rights, and land purchases
- 4 E. Support efforts to protect prime farmland from development
- 4 F. Promote Low Impact Development (LID) techniques
- 6 A. Increase the number of legal access sites
- 6 B. Provide educational kiosks and signage at launch sites that educate people about the watershed and good river etiquette
- 7 A. Hire staff to implement watershed management plan, including a project manager and a land use planner
- 7 B. Implement Information & Education Plan (Appendix Q)

8.2.4 Lakes

Many of the lakes in the watershed are facing (or will face in the future) cultural eutrophication, or aging that is caused by excessive nutrient input from human activities. Several steps can be taken to limit or slow this cultural eutrophication process. We recommend that lake associations promote techniques for landscaping for water quality, including improving shoreline buffers and limiting fertilizer use near lakes. We also recommend that lake residents have their septic systems inspected and pumped regularly. Lake residents should also attempt to maintain as much existing around lakes as possible, as wetlands act as natural filters of pollutants like sediment and nutrients.

8.2.5 Septic Systems

Septic systems may contribute a great deal of nutrient pollution to our surface waters. It is likely that more residents of the watershed utilize septic systems than public sewers, due to the rural nature of the watershed. However, it is difficult to determine how much pollution septics may contribute to the watershed, or how many septic systems may be failing in the watershed. Therefore, it is recommended that septic systems be inspected every three to five years and be pumped regularly. Some municipalities have (or are considering) ordinances that require septic systems to be inspected periodically (when a home is sold, e.g.). In addition, if hookup to a public sewer system is a feasible alternative, this should be given serious consideration, especially in lakefront communities.

8.2.6 Riparian Corridor

We recommend that efforts be made to maintain or restore forests along waterways in the Black River Watershed. Forests dominated the land cover of the watershed prior to European settlement, and much of the river corridor remains in a forested, natural state. This corridor serves to protect and improve water quality by filtering out pollutants, stabilizing streambanks, and providing habitat for a variety of species. A forested corridor keeps river temperatures cool, which benefits the fishery. Natural debris that falls into the river from overhanging trees provides food and habitat for aquatic organisms. Forest buffers help prevent nonpoint source pollution from reaching waterways, and forested streams are better able to process the pollutants that do reach them than deforested streams (Sweeney et al. 2004). Deforested stream corridors also often have increased temperatures and less beneficial woody debris (Sweeney et al. 2004).

This forested corridor is a key feature to protecting the water quality on the Black River. Any activities which would diminish or fragment this corridor should be discouraged. The generally shallow depth of the river and amount of natural debris has served to limit use of the river to self-propelled watercraft. This has maintained the tranquil and rural nature of the river, as well as protecting the banks from erosion caused by boat wakes.

8.2.7 Stormwater Management

Given the rural nature of the watershed, stormwater pollution is likely not a great contributor to nonpoint source pollution. However, the small cities still certainly have some impact. The cities also have the potential to grow into larger cities with more complex stormwater pollution issues. Thus, we recommend that the cities and villages take a proactive approach to stormwater pollution. One method is to replace storm drains with ones that are imprinted with the message "Don't dump—drains to stream." As the municipalities replace old storm drains, these could be inserted. These are minimally more expensive than the traditional storm drains, and the cost could be considered local match for the Black River Watershed Project.

8.2.8 Wetland Protection

We feel that every effort should be made to protect the remaining wetland areas in the watershed. In addition, any effort to create additional wetland acreage would be encouraged. Wetlands provide a wide variety of benefits, from filtering pollutants to mitigating flooding effects. Much wetland acreage has been lost in the watershed. Though it is not feasible that all of the original wetland areas in the watershed will be restored, any increased wetland acreage will benefit water quality in the Black River and its lakes and tributaries. Non-regulated wetlands should be of particular focus for protection efforts.

8.2.9 Low Impact Development

Low Impact Development (LID) is an innovative approach to land use planning. LID techniques focus on managing stormwater on-site to keep it from running off impermeable surfaces and carrying pollutants into nearby waterways. LID techniques can be used very effectively with new developments to reduce their impact on water quality. In addition, existing developments can use LID techniques during renovations, or to retrofit existing infrastructure. We recommend that these techniques be used whenever possible. Development will continue to occur in the watershed but use of LID techniques will protect water quality. LID techniques include: rain gardens, porous pavement, green roofs, vegetative filter strips, and others.

8.2.10 Information and Education

Many water quality issues are traceable to a lack of education about water quality issues. For this reason, we hope to initiate a variety of water quality education programs. These programs will consist of classroom visits as well as workshops for adults. In addition, a variety of brochures and letters will be distributed targeting specific groups (see Appendix Q). A watershed newsletter will be sent to stakeholders to keep them informed and updated on the progress of the project. A website will also be maintained that will contain a variety of information about the project, including upcoming events, past successes, and ideas to help watershed residents protect water quality.

We recommend that informational packets be distributed to newcomers to the watershed. These packets would welcome residents to the watershed and would contain information about such things as riparian buffers, stormwater management, septic systems, etc. This would help not only educate new residents but would encourage buy-in to the Black River Watershed project. These packets could be distributed through local realtors or through the county assessor's office when the affidavit of property transfer is distributed. Local Newcomer's Clubs could also be enlisted to help with this effort.

8.2.11 Long Term Land Use Planning

The importance of land-use planning cannot be overestimated. Many land use plans are outdated, or do not contain information relevant to protection of water quality. We hope that with the implementation of this plan, support can be provided to municipalities to undertake improvements to their master plans and/or zoning ordinances that will help improve water quality in the future.

9 Evaluation

9.1 Evaluation of Planning Phase

Evaluations forms were passed out at several public meetings and workshops during the planning phase. Responses on these forms were typically very positive. Attendees overwhelmingly felt that the meetings or workshops were useful, and many noted that they learned things that will change their behavior in the future.

A number of individuals and organizations have been crucial to the creation of this watershed management plan (Table 28). Many committed local match to the project and gave project support above and beyond expectations.

Not included in the following list are agencies and their staff that did not provide a written commitment of local match but nonetheless provided significant assistance to this project. These include: the Natural Resources Conservation Service (Jeff Douglas, Stacy Kimble and Jean Brokish), the Michigan Department of Natural Resources (Jay Wesley, Chris Freiburger, Kregg Smith, Brian Gunderman), and the Michigan Department of Environmental Quality (now Department of Environment, Great Lakes and Energy) (Julia Kirkwood, Chris Bauer, Joe Rathbun, Pete Vincent, Dave Fongers, Matt Hanauer). Patricia Bizoukas, Amy Lockhart, Erin Fuller and Colleen Forestieri of the Van Buren Conservation District and Nancy Carpenter of the Berrien Conservation District were also crucial members of the planning process.

Table 31: Local partners, BRW

Name/Organization	Tasks
VBCD Directors	Attended monthly VBCD board meetings; general grant administration; read and commented on watershed management plan
Sauk Trails RC&D Council	Participated in committee meetings; gave grant for purchase of Information & Education (I & E) materials
Allegan Co. Road Commission	Participated in Steering and Technical Committee meetings
Allegan Co. Drain Commission	Participated in Steering Committee and Stakeholder meetings
MSUE - Allegan County	Participated in meetings
Allegan Conservation District	Participated in Steering Committee and Stakeholder meetings
Columbia Township	Provided meeting space; participated in meetings
MSUE - Van Buren County	Staff participated in I & E Committee meetings; attended Stakeholder meetings; donated prizes for photo contests; wrote articles for newsletter; printed newsletter
Two Rivers Coalition	Provided volunteers for inventory efforts, provided feedback for plan updates, provided data from studies on E.coli and macro invertebrates
Berrien Conservation District	Coordinated the agricultural inventory
Watershed Assembly Members*	
Casco Township Hall	Provided meeting space
City of Bangor	Staff participated in I & E committee, Steering Committee, and Technical Committee meetings; attended Stakeholder meetings; wrote articles for newsletter; attended trainings for water quality monitoring; participated in bank erosion study; provided publicity for the project
Bangor City Hall	Provided meeting space
Lee Township Hall	Provided meeting space
Michigan Lake and Stream Associations	Participated in Stakeholder and Steering Committee meetings; contributed to management plan
Van Buren Co. Land Management Dept.	Provided data for project Geographical Information System (GIS)
Volunteers	Helped with bank erosion study; created project website; helped create project GIS; data entry; office help
Steering Committee	Participated in Steering committee meetings
I&E Committee	Participated in I & E committee meetings; donated prizes for photo contests; wrote articles for newsletter

Technical Committee	Participated in Technical committee meetings
Watershed Assembly (general public)	Attended public meetings; participated in committee meetings; provided meeting space; wrote articles for newsletter; donated prizes for photo contests; donated stream survey kit

* The Watershed Assembly was a catch-all category for groups that did not commit specific amounts of local match but gave a great deal of time and support to this project.

9.2 Implementation Phase Evaluation

An evaluation process will determine if the implementation of this management plan is effective and if improvements in water quality are being achieved. Evaluation of a watershed can be a difficult and expensive endeavor. The level of evaluation and the methods utilized will largely depend on a sustainable watershed organization being able to carry out the evaluation methods, as well as on the availability of funding.

As this plan is implemented, we anticipate a variety of benefits to water quality. Tangible evidence of water quality improvements include: reduced need for dredging in South Haven Harbor, reduced need for dredging Great Bear Lake sediment trap, reduced algae blooms in inland lakes, the drafting and implementation of ordinances that are protective of water quality, and the establishment of a sustainable, non-profit group to advocate for continued improvement of water quality in the Black River Watershed. In addition, we anticipate that the fishery of the Black River will be improved. Furthermore, the goal from the Great Bear Lake TMDL of a spring overturn concentration of 0.030 mg/L of phosphorus will be obtained in Great Bear Lake.

Changes in water quality can also be documented through a variety of water quality monitoring methods. Periodic assessments of water quality in the watershed are conducted as part of federal and state water quality monitoring programs. Local efforts to monitor water quality include those of lake associations and drain commissioners. Goal 2 of this watershed management plan proposes to "continue/increase watershed monitoring and stewardship efforts." This goal includes continuing to monitor stream bank erosion, continuing geomorphologic assessments of the river and performing hydraulic/hydrologic analysis of river.

A method of monitoring stream bank erosion is the Bank Erosion Hazard Index (BEHI), which can be conducted at road stream crossings in priority area. A baseline BEHI could be conducted and then repeated every 5 years to assess changes in the watershed. A geomorphologic study could be repeated in the Bloomingdale and Bangor areas to assess improvements in the river channel over time. This could be repeated every 10 years. A hydrologic study could be repeated for the entire watershed every 10 years (or when new land use data is available). Phosphorus monitoring should be continued in the Great Bear Lake area to assess the implementation of the TMDL. This phosphorus monitoring should be repeated at least every 3 years (see Appendix S for previous study). Thermal monitoring is of importance for the coldwater streams in the watershed. Monitoring of temperature regimes will help evaluate if these coldwater streams are being protected. MDNR Fisheries sometimes conducts thermal monitoring. *E. coli* monitoring could be undertaken in heavily used swimming lakes as well as waterbodies running through the Todd Farm Unit of the Allegan State Game Area (where there is a known large concentration of waterfowl).

Evaluation methods for on-site improvements will include pollutant load reduction calculations, photographic documentation, visual surveys, bank erosion measurements, stream morphology studies, macroinvertebrate surveys, and embeddedness measurements. Table 30 contains a column listing the proposed evaluation method for each objective.

The progress of the Information and Education (I & E) campaign can be gauged through knowledge surveys, follow-up surveys (to determine if a change in practice has occurred), tracking production and distribution of I & E materials, tracking number of contacts generated by publicity in local media outlets, tracking number of students reached through classroom visits, and tracking attendance at meetings, workshops and training sessions. The proposed evaluation method for each activity in the Information and Education Plan is included in Appendix Q.

This implementation process should be reviewed at a minimum of every two years to determine if progress is being made on the objectives listed in Table 30, and to ensure that the pollutant load reductions listed in that table are being achieved.

9.3 Estimating Pollutant Load Reductions

A pollutant loading is 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. Pollutant loading calculations are best used at specific sites where structural BMPs are installed and detailed data about the reduction of pollutants can be gathered. Specific pollutant load reduction calculations should be completed for structural BMPs when they are proposed and installed. It is hoped that with the implementation of this management plan, all of the pollutants affecting the Black River will be reduced. Sedimentation and nutrients were considered to be the two pollutants that have the greatest impact on the water quality of the Black River, so these pollutants will have the greatest reductions. Many objectives in this management plan deal with hydrological modifications or are proactive and preventative measures. Estimating pollutant loads and load reductions for these types of practices is not feasible.

Pollutant load reduction estimates have been made for many of the objectives shown in section 8.1. These estimates were derived from methods described in the Pollutants Controlled Calculation and Documentation for Section 319 Watersheds (MDEQ 1999). To address impaired/threatened designated uses (warmwater fishery, coldwater fishery, and other indigenous aquatic life and wildlife) in the rural and agricultural areas of the priority subwatersheds, a reduction of an estimated 3,348 lbs/year of total phosphorus, 6,716 lbs/year of total nitrogen, and 2,747 tons/year in total suspended solids need to be recognized in the watershed. This will achieve the goal of a 29% reduction in phosphorus needed to achieve the TMDL for Great Bear Lake. These loading reductions were calculated for objectives 1A, 1C, 1D and 1F in Table 30. Loading reductions for agricultural BMPs were estimated from applying the BMPs at a 50% coverage on the cropland in the four priority subwatersheds. However, it must be emphasized that these pollutant reductions are estimates. Nonpoint source pollution is, by definition, difficult to quantify. These estimates were based on a rough field survey, aerial photographs, and map layers in a Geographic Information System. Note that pollutant reduction estimates are reported to the nearest whole number, per guidance from the Michigan Department of Environmental Quality (MDEQ 1999). Further load reductions will also come from tasks in which reductions are not currently quantifiable, such as land use planning, enrolling farms in the MAEAP program, conservation easements, etc.

A build-out analysis utilizing the Long-term Hydrologic Impact Assessment model (L-THIA) was utilized to estimate load reductions in the urban portions of the watershed for sediment and nutrients with the installation of urban stormwater BMPs (including grass swale, extended dry detention basin, wet retention pond, rain garden and constructed wetlands). Among the five BMPs examined, the most cost effective for phosphorus is a wet retention pond and the most cost-effective for nitrogen is a dry detention basin. The most cost-effective BMP for total suspended solids are extended dry detention basins and wet retention basins.

To address impaired/threatened designated uses (warmwater fishery, coldwater fishery, and other indigenous aquatic life and wildlife) in the priority subwatersheds, urban stormwater BMPs should be implemented on urban lands at a 50% treatment coverage for grass swales, extended detention basins and wet retention basins (on all urban land uses, including low-density residential, high-density residential, commercial, industrial and roads/parking lots), 10% coverage for rain gardens (on low-density residential, high-density residential, commercial and industrial land uses) and 50% coverage for constructed wetlands (on low-density residential, high-density residential, commercial and industrial land uses). With those BMP implementation rates on urban lands, an estimated 1,240 lbs/year reduction in total phosphorus, 11,713 lbs/year reduction in total nitrogen, and 304 tons/year reduction in total suspended solids need to be recognized in the watershed. These reduction estimates were calculated by averaging the load reductions for each of the five urban stormwater BMPs modeled for the urban acreage of the watershed. For more information on this model, see Appendix L. This model also demonstrated that though agriculture is the largest non-point source of pollutants in the watershed, urban land uses contribute over 25% of the pollutant load even though they occupy only 5% of the land area. Thus, it will be crucial to focus on urban BMPs in the future, as build-out occurs.

9.4 Feasibility of Management Plan Goals and Objectives

The goals and objectives of this plan have been written with their feasibility in mind. The objectives that will likely be the most difficult to undertake are those that require significant outlays of resources or will involve much research. For example, the goal of improving the hydrology and morphology of the river by decreasing incision and restoring wetlands will be a significant and costly undertaking, and one that will require a good deal of research before any work occurs. However, with meaningful participation from agencies like county drain commissions, the Michigan Department of Environment, Great Lakes and Energy and the Michigan Department of Natural Resources, this goal could be achieved.

A major concern of any watershed stakeholder is that of the economics of watershed protection. However, a variety of studies have shown that despite the investment required in watershed protection efforts, there can be an overall net gain in terms of improved water quality, increased recreational outlets, higher quality of life, and even an increase in property values (Schueler 2000). In addition, a variety of grant programs are available to provide at least some of the funding necessary to undertake many of the proposed actions.

Resistance to planning and zoning in this region is significant and may be a real barrier to implementing portions of this watershed management plan. Some municipalities may be more willing than others to implement progressive planning and zoning measures. If these efforts are successful and well-received, other municipalities may be more willing to attempt them. Furthermore, new grant opportunities may encourage advancements in local planning and zoning initiatives (Partnerships for Change grant, e.g.). Regional planning agencies are also active in this watershed and will help facilitate this goal. The importance of education in implementing new planning and zoning techniques should not be overlooked.

Overall, the feasibility of implementing this plan depends on the ability of local stakeholders to truly collaborate and work for these goals. This will require strong leadership and significant time commitments.

10 Sustainability

The Black River Watershed Project has a long history. As long as twenty years ago, residents had concerns with water quality and began investigating solutions. Many entities have applied for grants to improve water quality and have continued to work for improved water quality even when those grants were not awarded. This tenacity speaks to the ability for this project to succeed in the future. In the past, a group of citizens known as the Black River Watershed Assembly, came together to try to keep the watershed management plan moving forward even when no funding was immediately available for an implementation phase. More recently a citizen-based group, the Two Rivers Coalition, has been formed with a mission of working to protect the health of the Black River and Paw Paw River Watersheds through conservation, education, and advocacy. This group arose out of visioning sessions for watershed project sustainability and as of 2009 has already successfully undertaken several water quality projects, fundraising efforts, and has received several grants to assist with their efforts. In addition, organizations like the Southwest Michigan Planning Commission, the Van Buren Conservation District, and the Southwest Michigan Land Conservancy will continue their efforts in this watershed. The educational aspects of this project will build the capacity of interested citizens to continue to advocate for water quality improvements in the Black River Watershed.

One aim of this watershed management plan is to provide information for stakeholders to take steps on their own to improve water quality. Municipalities and other groups interested in protecting the Black River will be able to use this plan to leverage funding for local projects.

This plan should be reviewed and updated as needed. This will ensure that as conditions in the watershed change, the plan will continue to be useful. At a minimum, review should include updating the following:

- Section 3.5, Land Cover – every 10 years
- Section 5, Community Profile – every 10 years
- Section 6, Water Quality in the Black River Watershed – every 2 years
- Section 7, Priority Areas – every 5 years
- Section 8.1, Goals and Objectives – every 5-10 years
- Education Plan (Appendix Q) – every 5 years
- Additionally, the TMDL for Great Bear Lake will be re-evaluated regularly. MEGLE will conduct annual monitoring, and assessments will continue until results from two consecutive years demonstrate attainment of the 0.030 mg/L spring overturn goal.

10.1 Other Projects and Programs

A variety of agencies have cooperated with and provided input to the Black River Watershed Project thus far, and it is our hope that they will continue to do so. These agencies include: Michigan State University Extension, Natural Resources Conservation Service, Conservation Districts, regional planning agencies, Southwest Michigan Land Conservancy, Michigan Association of Conservation Districts, county road commissions, county drain commissions, county health departments, the Michigan Department of Environment, Great Lakes and Energy, the Michigan Department of Natural Resources, the Allegan County Math & Science Center, and municipalities within the watershed. In addition, we hope to work more in the future with the Michigan Department of Transportation, county Purchase of Development Rights programs, Intermediate School Districts, and the Michigan Groundwater Stewardship Program. All attempts should be made in the future to continue to build relationships with these and other organizations.

There are a wide variety of grant programs that may also be tapped into by local communities and organizations to support water quality protection efforts. This watershed management plan will provide background and support for other grant application efforts.

10.2 Long Term Project Goals

Certainly, the overarching goal of this project is to improve water quality in the Black River Watershed. Furthermore, we hope to approach this task holistically, rather than relying on short-term “band-aid” solutions. Thus, the most emphasis is placed on long-term land use planning and education. On-the-ground restoration efforts will be implemented at a few highly visible public sites. Other best management practices will be implemented through coordination with existing programs, such as those offered through the Natural Resources Conservation Services.

Bibliography

Glossary of Acronyms

Appendices (page)