Swan Lake Watershed Management Plan

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EGLE Project No. 2023-0227

Prepared by the Allegan Conservation District

ALLEGAN CONSERVATION DISTRICT

EGLE

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

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CHAPTER 1 - INTRODUCTION AND BACKGROUND

The Swan Lake watershed comprises the headwaters of Swan Creek in southern Allegan County, in southwest Michigan. Swan Creek flows into the Kalamazoo River just downstream of the Lake Allegan impoundment. The watershed is defined as the catchment of Swan Lake, and includes parts of Cheshire, Trowbridge, and Valley Townships in Allegan County, and Bloomingdale Township in Van Buren County. The Swan Lake catchment is 15,297 acres, and includes Duck Lake, Eagle Lake, Muskrat Lake, and Schermerhorn Lake. Figure 1 shows the Swan Lake watershed's location in west Michigan.

The greater Swan Creek watershed includes a large portion of the Allegan State Game area, and two impoundments. The Swan Creek Dam was built in 1937 which created Swan Creek Pond at 118th Ave. The dam is managed by the Michigan Department of Natural Resources (MDNR). Highbanks Dam was built in 1961 in order to create Swan Creek Marsh. Allegan State Game area is managed by the Michigan Department of Natural Resources for recreation and wildlife habitat. Note: this plan references two watersheds with similar names. The Swan Creek Watershed refers to the full HUC12 subwatershed from Muskrat Lake to the Kalamazoo River confluence. Swan Lake Watershed refers to the portion of the Swan Creek Watershed lying upstream of the outlet of Swan Lake, comprising the land draining into Swan Lake. Figure 1A shows the Swan Lake Watershed along with the greater HUC12 watershed.

History

Southwest Michigan has likely been inhabited by humans as early as 7,000-5,000 years ago. This area is home to the Anishinaabe people, and was settled by Europeans in the 1800's. Allegan County was organized in 1835. Cheshire Township was organized in 1851 and opened a post office in 1856. Logging was the main draw for early European settlers, and agriculture quickly followed on the cleared land.

Allegan State Game was created in 1964 by combining the Allegan State Forest, Swan Creek Wildlife Experiment Station, and Fennville State Game Area. The state game area now covers over 50,000 acres including the lower reach of Swan Creek. For more background information, read the Kalamazoo River Watershed Management Plan.

Demographics

The population within the Swan Lake Watershed is concentrated around the shores of Swan Lake, Muskrat Lake, Eagle Lake, and Duck Lake. The watershed is primarily within Cheshire Township in Allegan County, with small sections in Trowbridge and Valley Townships in Allegan County and Bloomingdale Township in Van Buren County. There are no incorporated communities within the watershed. As of the 2020 census, Cheshire Township had a population of 2,211. The 2020 census tract that includes Cheshire Township had a population density of 64 people per square mile, which would give a low-end estimate for the watershed population of around 1,400 residents. The EPA's EJScreen Tool gives an estimated population for the

watershed at 1,669 residents. Allegan County's population growth from 2010 to 2020 of 8.2% was higher than the state average of 1.96%, while Van Buren County's population shrank by 0.9%.

While Allegan County, and West Michigan in general, is growing, the Swan Lake Watershed is likely far enough away from established towns and metropolitan areas that it will not see much of that population growth. Cheshire Township's population has decreased by around 5% since the 2000 census. With around 30% of the watershed being swamp, development opportunities in the future would likely come at the expense of agricultural land.

Harmful Algal Blooms

Over the past few years, Swan Lake has been experiencing Harmful Algal Blooms (HABs). Allegan County Health Department first reported a HAB in Swan Lake in 2021 after cyanotoxins were confirmed by EGLE testing. HABs have been reported every summer since, including blooms on Duck Lake, Muskrat Lake, and Swan Lake in 2024. These blooms impact the health of the lake's ecosystem as well as the residents living on the lake.

Algal blooms can become harmful to human health if they include cyanotoxins. HABs can occur during periods of high temperatures, sunlight, and high nutrient levels. HABs come from cyanobacteria, also known as blue-green algae. They are frequently described as looking like green paint or pea soup, although they can vary in color. Swallowing lake water, or skin contact with HABs can cause adverse effects on human health and pet health. More information about HABs can be found on EGLE's website: https://www.michigan.gov/egle/about/organization/water-resources/glwarm/harmful-algal-blooms. Suspected HABs can be reported by emailing AlgaeBloom@Michigan.gov.

CHAPTER 2 - WATERSHED FEATURES AND CHARACTERISTICS

Topography and Soil

Soils and topography throughout the state of Michigan are heavily influenced by the region's glaciated past. The soils around the Swan Lake Watershed are primarily the remnants of glacial moraines and outwash plains. The higher elevations in the southeastern portion of the watershed are remnants of the Valparaiso moraine. Soils near Swan Lake in the center of the watershed are glaciolacustrine, having been deposited by glacial meltwater in old glacial lakes.

Houghton and Adrian Muck soils are common near Swan Lake and other water bodies throughout the watershed. Fine, loamy soils are found in the Eastern portion of the watershed, while sandy soils are common in the central, flat portion of the watershed. See Figure 6 for a map of hydrologic soil groups in the watershed.

Table 2.1 - Hydrologic Soils in the Swan Lake Watershed

Hydrologic Soil Group	Acres in Watershed	Percent of Watershed
A	4,107	29%
A/D	3,872	27.5%
B	1,194	8.5%
B/D	287	2%
C	1,352	10%
C/D	2,992	21%
D	332	2%
Total	14,136	100%

A - High infiltration rate, low runoff potential. Well-drained to excessively drained sands or gravely sands. High rate of water transmission.
B - Moderate infiltration rate. Moderately well- to well-drained. Moderately fine to medium coarse texture. Moderate rate of water transmission.
C - Slow infiltration rate. Has a layer that impedes downward movement of water. Moderately fine to fine texture. Slow rate of water transmission.
D - Very slow infiltration rate, high runoff potential. Clays with high shrink/swell potential. Permanent high water table. Clay pan or clay layer at or near surface. Shallow over nearly impervious material. Very slow rate of water transmission.
/ = if drained/if natural.

- *The acreage total does not equal the watershed total acreage as areas of open water were not included in hydrologic soil groups.*

Elevation in the watershed ranges from 800 feet above sea level in Bloomingdale Township near Muskrat and Eagle Lakes, to the outlet of Swan Lake at 679 feet above sea level. The area near Swan Lake is relatively flat, while the southern portion of the watershed contains more hills. See Figure 4 for a topographic map of the watershed.

Land Use

The land use within a watershed has a large impact on water quality. Converting native habitats and wetlands to agricultural and residential land impacts hydrology including streamflow, runoff, and groundwater. Land conversion can introduce excess sediments, nutrients, pathogens, thermal pollution, and more to waterbodies.

Prior to widespread European settlement in the 1800's, the dominant vegetation group in the Swan Lake Watershed was beech-sugar maple forest at 42% in the southern and western portion of the watershed, followed by white pine-sugar maple (21%) in the north. The center of the watershed was mostly conifer-hardwood swamp (18%) and a large swath of low hardwood swamp (9%) around Swan Lake. The remaining watershed included open water, tamarack swamp, alder-willow swamp, bogs, and hardwood swamp. Together, wetlands comprised 31% of the watershed. Non-swamp forest covered 63% of the watershed. See Figure 5 for a map of pre-settlement vegetation in the watershed.

Since European settlement of the area, the watershed has gone through a number of changes. 32% of the watershed is now cultivated crops, and 8% is developed land. Cropland in the watershed is mostly corn, soybean, and hay production, with some Christmas tree farms and other produce. Figure 8 shows Prime Farmland within the watershed. Prime Farmland is a United States Department of Agriculture (USDA) definition for land that has the right physical and chemical characteristics for agricultural use. Non-swamp forest cover has decreased to 21%, while total wetland cover has stayed at 31% of the watershed. This indicates that the current agricultural land stems from clearing beech-sugar maple and white pine-sugar maple forests. Current land use statistics can be seen in Table 2.2. See Figure 3 for a map of current land use in the watershed.

Almost all the land within the watershed is privately owned. The Southwest Michigan Land Conservancy owns an 18.8-acre property at the outlet of Swan Lake, and the northernmost section of the watershed includes a small section of Allegan State Game Area. Cheshire Hills Golf Course is a 187-acre, 27 hole public golf course on 102nd Avenue that includes a stretch of creek that drains into Swan Lake from Duck Lake. The watershed contains one permitted Confined Animal Feeding Operation (CAFO), Petro Farms on 102nd Avenue.

Table 2.2 - Land Use in the Swan Lake Watershed

Land Cover	Acreage	Percentage of Watershed
Open Water	774.6	5
Developed, Open Space	781.7	5
Developed, Low Intensity	382.2	2.5
Developed, Medium Intensity	86.9	.57
Developed, High Intensity	13.6	0.08
Barren	7.2	0.04
Deciduous Forest	2952.2	19.3
Evergreen Forest	57.7	0.37
Mixed Forest	247.7	1.6
Shrub/Scrub	20.2	.13
Grassland	194.8	1.3
Pasture	164.4	1
Cultivated Crops	4890.1	31.9
Wooded Wetlands	4613.5	30.2
Emergent Herbaceous Wetlands	110.2	0.72
Total	15,297	100

This data is from the 2021 National Landcover Database.

Hydrology

The Swan Lake catchment includes six lakes larger than 25 acres. The Michigan Department of Natural Resources maintains boat launches on Swan, Duck, and Eagle Lakes. Bloomingdale Township, Van Buren County, maintains a boat launch on Muskrat Lake, and Cheshire Township, Allegan County, maintains a boat launch on Schermerhorn Lake. Emerson Lake does not have public access. Figure 2 shows the lakes and streams of the watershed.

Swan Creek is around 16.5 miles long from the source to the confluence with the Kalamazoo River. Within the Swan Lake catchment, there are approximately 43 miles of designated county drain. Figure 11 shows county drains in the watershed. Downstream from Swan Lake, Swan Creek is a designated Type 1 coldwater stream from 109th St to the Kalamazoo River.

According to the National Wetland Inventory, the Swan Lake Watershed has 3,155 acres of wetland, and 815 acres of lakes. Of the 3,155 acres, 80% of the wetlands are freshwater swamp, with the rest being made up of freshwater emergent wetland, riverine wetland, and small freshwater ponds. The National Wetland Inventory and the National Landcover Database have different methods of determining wetlands, and therefore different values for the Swan Lake Watershed. Figure 7 shows wetlands within the watershed.

Table 2.3 - Lakes in the Swan Lake Watershed

Name	Size	Township	Public Access
Swan Lake	214 acres	Cheshire	Yes, DNR boat launch
Muskrat Lake	143 acres	Cheshire, Bloomingdale	Yes, Bloomingdale Township boat launch
Eagle Lake	225 acres	Cheshire, Bloomingdale	Yes, DNR boat launch
Duck Lake	139 acres	Cheshire	Yes, DNR boat launch
Schermerhorn Lake	76 acres	Cheshire	Yes, Cheshire Township boat launch
Emerson Lake	36 acres	Trowbridge	No

Lake acreage may include areas classified as wetlands and not open water by the National Wetland Inventory and the National Landcover Database.

CHAPTER 3 - METHODOLOGIES

3.1 Introduction

In 2023, Allegan Conservation District (ACD) received a grant from the Michigan Department of Environment Great Lakes and Energy (EGLE) for the Swan Lake Watershed Support project (2023-0227). This project included an agricultural inventory, tributary and lake sampling, and the writing of this appendix for the Kalamazoo River Watershed Management Plan. Restorative Lake Sciences and local volunteers participating in the Cooperative Lakes Monitoring Program also collected data within the Swan Lake Watershed and their methodologies are referenced in this chapter. For full data collection procedures, see Appendix 1.

3.2 Agricultural Inventory

ACD was responsible for conducting windshield surveys and collecting necessary data. All data was collected while driving the watershed during windshield surveys and recorded in FieldMaps. Observations were made from vehicles traveling on accessible roadways.

Fall Tillage Survey

A fall tillage survey was completed to collect information from croplands, specifically: the crop that was last planted, the type of tillage used after harvest of that crop, planting of a winter crop, and the presence or absence of any existing cover crops, filter strips, grassed waterways, or tile risers. This survey was conducted after fall harvest and before spring tilling.

Spring Residue Survey

A spring residue survey was also completed to collect data on the planted crop, the percentage of crop residue remaining on fields after planting, and instances of manure application. This survey was conducted after the majority of spring planting was completed, but before crops had grown enough to prevent observers from seeing the ground. Based on Natural Resources Conservation Service (NRCS) guidance, at least 30 percent crop residue is needed on cropland fields in order to reduce erosion to tolerable soil loss levels for crop production. This guidance was used to create categories for observed crop residue remaining on fields: zero percent residue, less than 30 percent residue, greater than 30 percent residue, planted with a no-till method, and not planted yet (if the field has not been planted at the time of the inventory). Data collectors used best professional judgment during windshield surveys to make accurate observations regarding percent residue on cropland fields.

Animal Feeding Operation Survey (AFO)

An AFO survey was conducted in conjunction with each spring residue survey. The type and number of animals were recorded along with any manure or runoff concerns. Additional notes included details of runoff or manure concerns, details regarding hobby farms, and other observations.

3.3 Water Quality Monitoring

Physical characteristics, *E. coli* levels, and nutrient levels were assessed within the watershed in order to estimate loading into Swan Lake and identify critical areas and pollutants. Figure 9 shows monitoring points within the watershed.

E. coli

To compare *E. coli* data to the daily maximum Michigan Water Quality Standards, three samples were taken weekly at each location during a 30-day period so a geometric mean could be calculated. *E. coli* sampling was done with five dry weather events and one wet weather event. In a river or stream, the width of the stream will be divided into quartiles, with samples collected at the 25th, 50th, and 75th quartiles.

Optical Brighteners

Optical brighteners are compounds added to laundry detergents and cleaning agents whose fluorescence can be detected with fluorometers. Samples were collected in conjunction with *E. coli* samples and fluorescence was compared to a standard solution with a known concentration of detergent using a handheld fluorometer in the field.

Water Chemistry

Water samples for chemical analysis were taken at stream and lake sites. Stream samples were collected mid stream and mid depth. Lake samples were collected using a vertical Van Dorn Sampler at top, middle, and bottom depths.

Physical Characteristics

Water temperature and dissolved oxygen content were measured in-situ using a YSI Pro20. Physical measurements with the Pro20 were made mid-stream and at mid-depth. Wetted width, depth, and flow were measured immediately after water sample collection during all monitoring events at all sites. Wetted width, depth, and flow were used to estimate stream discharge.

3.4 Cooperative Lakes Monitoring Program

Allegan Conservation District partnered with the Michigan Clean Water Corps Cooperative Lakes Monitoring Program (CLMP) for additional data collection on Swan Lake. Residents on Duck Lake also enrolled Duck Lake in the program. The CLMP offers a variety of water quality parameters that volunteers measure on their lakes. Volunteers collect data over the summer, and CLMP staff condense the data into yearly reports on every lake in the program. The report includes a Trophic Status Index value, which is an indicator of the level of nutrient enrichment derived from the data collected by the volunteers. For this project, Allegan Conservation District enrolled Swan Lake in the following parameters:

- **Secchi Disk Transparency**: a Secchi disk is lowered into the water until it disappears from view, the depth is taken, and then raised until it comes into view again. Those two depths are averaged.

- **Dissolved Oxygen and Temperature**: a YSI20 Pro probe is lowered at the deepest point of the lake and dissolved oxygen and temperature points are taken every 2.5 to 5 feet.

- **Chlorophyll-a**: a chlorophyll composite sampler is lowered to twice the Secchi disk depth and slowly raised back to the surface to collect a water sample. The water sample is filtered to separate the algae and chlorophyll producing mass out, which is frozen and sent to an EGLE lab for analysis.

- **Summer Phosphorus**: water samples are collected, frozen, and sent to an EGLE lab for analysis.

Phosphorus, Chlorophyll-a, and Secchi disk measurements are combined in an equation to produce a Trophic Status Index (TSI) number for the lake. TSI numbers are grouped into categories that represent the level of nutrient enrichment in the waterbody, from oligotrophic to hypereutrophic. A TSI value and other data collected during the summer is summarized in a yearly report for each lake in the program. From data collected in 2023 Swan Lake was labeled as eutrophic. Secchi Disk Transparency and Summer Phosphorus were both collected on Duck Lake as well. Annual CLMP Summary Reports may be viewed at https://www.micorps.net/lake-monitoring/lake-data-reports/

Full CLMP methods can be found in the CLMP manual at https://www.micorps.net/wp-content/uploads/2021/03/CLMP-Manual-2019update2_2021.pdf

CHAPTER 4 - WATER QUALITY

4.0 Designated Uses and Water Quality Standards

Surface waters of the state are protected under Michigan's Natural Resources and Environmental Protection Act, Act 451 of 1994, as amended (NREPA). The State of Michigan's Part 4 Rules, Water Quality Standards (of Part 31 of the NREPA) specify water quality standards which shall be met in all waters of the state and require that all designated uses of the receiving water be protected. Designated uses include: agriculture, navigation, industrial water supply, public water supply at the point of water intake, warmwater or coldwater fisheries, other indigenous aquatic life and wildlife, fish consumption, partial body contact recreation, and total body contact recreation from May 1 to October 31. The following descriptions of all the designated uses clarify their importance to the Watershed.

- *Agricultural Use* – Surface waters must be a consistent and safe source for irrigation and livestock watering. Livestock producers rely on water that is free of pathogens that could

pose health risks to the livestock.

- *Public Water Supply* – Municipal water supplies must have safe and adequate amounts of surface water. No surface water intakes for municipal water supplies currently exist in the Watershed.
- *Navigation* – Reaches of waterways that are large enough for canoes or kayaks must maintain navigable conditions. Recreational users should be able to enjoy a float down Swan Creek without experiencing excessive log jams, low footbridges, and other obstructions that impede navigation.
- *Warmwater Fishery* – A warmwater fishery is generally considered to have summer temperatures between 60 and 70 degrees Fahrenheit and is capable of supporting warmwater species, such as largemouth and smallmouth bass, on a year-round basis. Warmwater fisheries should maintain a minimum of 5 mg/L of Dissolved Oxygen.
- *Coldwater Fishery* – A coldwater fishery is considered to have summer temperatures below 60 degrees Fahrenheit and to be able to support natural or stocked populations of brook trout. A healthy riparian habitat is essential to provide the needed shade to the streams to maintain lower temperatures. Coldwater fisheries should maintain a minimum of 7 mg/L of Dissolved Oxygen. Swan Creek from 109th Ave downstream to the Kalamazoo River is a designated coldwater fishery, however, there is no designated coldwater fishery within the Swan Lake catchment.
- *Other Indigenous Aquatic Life and Wildlife* – Aquatic plants and animals and other wildlife in the ecosystem should be considered in all management strategies. A stable and healthy habitat supports populations of wildlife that provide outdoor recreational opportunities in the Watershed.
- *Fish consumption* – Waterbodies must be able to provide a fishery for human consumption. Toxic substances should be kept below a level that may become harmful to human health or aquatic life.
- *Partial Body Contact Recreation* – Water quality must meet standards of no more than 1,000 E. *Coli*/100 milliliters (mL) for recreational uses of fishing and boating, where complete submersion in the water is unlikely, to be safe. The popularity of fishing and boating in the Watershed necessitates the prevention of pathogens associated with feces from entering the waterbodies.
- *Total Body Contact Recreation* – Water quality must meet standards of a single day maximum of 300 *E. coli*/100 mL and a geometric mean over 30 days no more than 130 *E. coli* /100 mL for areas to be safe for swimming. Other impediments to total body contact recreation include nuisance aquatic vegetation and algae blooms from excessive nutrient loadings to the Watershed.
- *Industrial Water Supply* – Industrial water supplies must have cool water with low turbidity. No surface water intakes for industrial water supplies currently exist in the Watershed.

EGLE assesses Michigan watersheds on a five-year rotating schedule to determine if waterbodies are attaining specific water quality standards and supporting designated uses. Surface waterbodies are defined as impaired if they do not meet water quality standards and support all applicable designated uses. It is important to mention that waterbodies are not assessed on a regular basis for all designated uses, so the lack of a waterbody being listed as impaired could mean it was not assessed and not that it is meeting water quality standards.

4.1 Impaired Designated Uses

Human activities have impacted water quality in the Swan Lake watershed. Conversion of natural land to agriculture and residential areas can increase runoff and pollution entering the water. The state of Michigan has a statewide TMDL for Polychlorinated biphenyl (PCB) that includes the River/Streams Assessment Unit ID (AUID) in the Swan Lake catchment. This impairment, however, is not covered in detail in this WMP as this pollutant is believed to be caused not by local NPS pollution, but by atmospheric deposition. EGLE's 2024 Integrated Report on Water Quality and Pollution Control listed Swan Lake (MI040500030908-02) as not supporting for Other Indigenous Aquatic Life and Wildlife due to eutrophication. Many of the AUIDs have not been assessed for all designated uses. Figure 15 shows AUIDs in the Swan Lake watershed. None of the waterbodies have been assessed for Partial Body Contact, Total Body Contact, or Warmwater Fishery. *E. coli* data collected by the Allegan Conservation District as part of their watershed support project can help EGLE assess some of the AUIDs for Total and Partial Body Contact. Unassessed Lakes MI040500030908-NAL includes Muskrat Lake, Schermerhorn Lake, and Emerson Lake along with smaller bodies of water in the watershed. Figure 12 shows Impaired AUIDs impacted by NPS pollution in the watershed.

Table 4.1 - Status of Designated Uses in the Swan Lake Watershed

Assessment Unit ID	Designated Use	Assessment
River/Streams MI040500030908-04	Agriculture	Good
River/Streams MI040500030908-04	Fish Consumption	Impaired
River/Streams MI040500030908-04	Navigation	Good
River/Streams MI040500030908-04	Other Indigenous Aquatic Life and Wildlife	Good
River/Streams MI040500030908-04	Partial Body Contact Recreation	Not Assessed
River/Streams MI040500030908-04	Total Body Contact Recreation	Not Assessed
River/Streams MI040500030908-04	Warm Water Fishery	Not Assessed
Swan Lake MI040500030908-02	Agriculture	Good
Swan Lake MI040500030908-02	Fish Consumption	Not Assessed
Swan Lake MI040500030908-02	Navigation	Good
Swan Lake MI040500030908-02	Other Indigenous Aquatic Life and Wildlife	Not Supporting
Swan Lake MI040500030908-02	Partial Body Contact Recreation	Not Assessed
Swan Lake MI040500030908-02	Total Body Contact Recreation	Not Assessed
Swan Lake MI040500030908-02	Warm Water Fishery	Not Assessed
Duck Lake MI040500030908-01	Agriculture	Good
Duck Lake MI040500030908-01	Fish Consumption	Not Assessed
Duck Lake MI040500030908-01	Navigation	Good
Duck Lake MI040500030908-01	Other Indigenous Aquatic Life and Wildlife	Good
Duck Lake MI040500030908-01	Partial Body Contact Recreation	Not Assessed
Duck Lake MI040500030908-01	Total Body Contact Recreation	Not Assessed
Duck Lake MI040500030908-01	Warm Water Fishery	Not Assessed
Eagle Lake MI040500030908-03	Agriculture	Good
Eagle Lake MI040500030908-03	Fish Consumption	Not Assessed
Eagle Lake MI040500030908-03	Navigation	Good
Eagle Lake MI040500030908-03	Other Indigenous Aquatic Life and Wildlife	Good
Eagle Lake MI040500030908-03	Partial Body Contact Recreation	Not Assessed
Eagle Lake MI040500030908-03	Total Body Contact Recreation	Not Assessed
Eagle Lake MI040500030908-03	Warm Water Fishery	Not Assessed
Unassessed Lakes MI040500030908-NAL	Agriculture	Good
Unassessed Lakes MI040500030908-NAL	Fish Consumption	Not Assessed
Unassessed Lakes MI040500030908-NAL	Navigation	Good
Unassessed Lakes MI040500030908-	Other Indigenous Aquatic Life and Wildlife	Not Assessed

NAL		
Unassessed Lakes MI040500030908-NAL	Partial Body Contact Recreation	Not Assessed
Unassessed Lakes MI040500030908-NAL	Total Body Contact Recreation	Not Assessed
Unassessed Lakes MI040500030908-NAL	Warm Water Fishery	Not Assessed

4.3 Previous Water Quality Studies

2004 USGS Survey

In 2004, the United States Geological Survey collected data in Swan Creek Pond. Their survey involved physical characteristics as well as chemical concentrations. Samples were collected on Swan Creek Pond at 118th St. Phosphorus was measured at .047 mg/L. The full report can be downloaded from the USGS Water Data portal here.

Michigan Department of Natural Resources Surveys

The Michigan DNR conducts fish community surveys in lakes and streams across the state. Below are the most recent surveys for each waterbody within the Swan Lake watershed.

Swan Lake, 1993
The fish community was surveyed in Swan Lake in 1993. Twenty different species were caught, with 4,234 total fish caught. Bluegill were the most common fish caught by number and by weight, with black crappie second in number and weight.

Eagle Lake, 2008
The fish community was surveyed in Eagle Lake in 2008. Seventeen different species were caught, with 1,198 total fish caught. Yellow bullhead were the most common fish caught by number and by weight, while bluegill were the second most common by number and weight.

Duck Lake, 2010
The fish community was surveyed in Duck Lake in 2010. Twenty-one species of fish were caught, with 2,663 total fish caught. One state threatened species was caught, the spotted gar, with two species of greatest conservation need caught, the lake chubsucker and tadpole madtom. Bluegill was the most common fish caught, with black crappie in second.

Swan Creek, 2023
The fish community was surveyed in Swan Creek at 118th Ave downstream of Swan Pond Dam, and 116th Ave upstream of the dam. Twelve species of fish were caught at 118th Ave, with 143 total fish caught. Johnny darter were the most common fish caught by number, with white suckers the most common by weight. Brown trout were the second most common by weight, with an average length of 5.9 inches.

Nine species of fish were caught upstream at 116th Ave, with 261 total fish caught. Mottled sculpin was the most common fish caught by number, with brown trout the most common by weight, making up 86% of the total weight. The average brown trout length was 9.8 inches.

Swan Creek is currently being stocked with brown trout and has been stocked since as early as 1928. In 1962, four tons of competing carp were removed upstream of Swan Creek Pond. Swan Creek supports migratory salmon downstream of Swan Creek Pond. All three current stocking locations in the watershed are downstream of Swan Lake. Over 30,000 brown trout were stocked between 1990-2000.

EGLE Macroinvertebrate Surveys

As part of biological surveys of the Kalamazoo River Watershed, two sites in the Swan Creek watershed have been surveyed by EGLE for macroinvertebrates. The first biological survey took place in 2009, with surveys following every five years. The sites were rated for the macroinvertebrate community and habitat.

2009

The first site was in Swan Creek upstream of 110th Ave (42.49151, -86.01357). The site scored Acceptable for macroinvertebrate community and Good for habitat. 25 different taxa were recorded. The second site was in a Swan Lake Drain at 41st Ave (42.46591, -85.94946). The site scored Acceptable, though trending towards Poor, for macroinvertebrate community and Good for habitat. 30 different taxa were recorded, and the site was noted as having been channelized and periodically maintained.

2014

The Swan Creek site upstream of 110th Ave scored Acceptable for macroinvertebrate community and Good for habitat. The dominant taxa was amphipods with mayflies and caddisflies present. The site was noted as having tree stumps along the banks, and cobble and silt in the creek bed. The Swan Lake Drain site at 41st Ave scored Acceptable for macroinvertebrate community and Marginal for habitat. The primary taxa was amphipods with caddisflies and mayflies present. The site was noted as having eroded banks and depositional sandbars in the creek, as well as cleared vegetation for a backyard.

2019

The Swan Creek site upstream of 110th Ave scored Acceptable for macroinvertebrate community and Good for habitat. 22 different taxa were recorded including mayflies and caddisflies. The site was noted as lacking pool variability. The Swan Lake Drain site at 41st Ave scored Acceptable for macroinvertebrate community and Good for habitat, up from Marginal in 2014. 29 different taxa were recorded including mayflies and caddisflies. The site was noted as being very shallow with exposed sand bars.

Table 4.2 - Swan Creek Macroinvertebrate Survey Results

Site	Year	Habitat Score	Macroinvertebrate Community Score
Swan Creek - 110th Ave	2009	Good	Acceptable (2)
	2014	Good	Acceptable (1)
	2019	Good	Acceptable (1)
	2024	Good (122)	Meets Expectations (67)
Swan Lake Drain - 41st Ave	2009	Good	Acceptable (-1)
	2014	Marginal	Acceptable (0)
	2019	Good	Acceptable (0)
	2024	Marginal (93)	Meets Expectations (49)

Habitat and Macroinvertebrate scoring systems changed between 2019 and 2024.

2024

EGLE staff conducted macroinvertebrate surveys in the summer of 2024 at the 110th Ave and 41st Ave sites along with three additional sites in the Swan Creek watershed. The Swan Creek site upstream of 110th Ave scored Meets Expectations for macroinvertebrate community and Good for habitat. The Swan Lake Drain site at 41st Ave scored Meets Expectations for macroinvertebrate community and Marginal for habitat. The species results are summarized in Table 4.3.

Table 4.3 - Swan Creek 2024 macroinvertebrate Survey Results

Name	Location	Date	# Individuals	# Taxa	Dominant Taxa	Dominant taxa count
Swan Creek	110th Ave	8/13/2024	264	24	Baetidae (mayflies)	48
Swan Creek	116th Ave	9/10/2024	325	32	Chironomidae (non-biting midges)	98
Swan Creek	Ds 118th Ave	9/10/2024	286	27	Amphipoda (scuds)	75
Swan Lake Drain	104th Ave	9/10/2024	270	31	Heptageniidae (mayflies)	65
Swan Lake Drain	41st St	8/13/2024	261	31	Corixidae (water boatmen)	89

Restorative Lakes Sciences

Swan Lake residents contracted Restorative Lake Sciences (RLS) to conduct a study of Swan Lake comprising an assessment of physical and chemical water quality parameters, lake sediment, and aquatic communities. RLS classified Swan Lake as hypereutrophic with low Secchi transparency and elevated phosphorus, nitrogen, and chlorophyll-*a*. These results are

similar to those obtained through ACD's water quality assessment conducted during the development of this management plan. RLS identifies failing septic systems, internal loading, and overland runoff from lawns and farm fields as the most likely contributors of nutrients to the lake. Following the study, RLS recommended a number of management options to improve lake health by reducing invasive plants, increasing dissolved oxygen, and reducing tributary and riparian contributions of nutrients.

Duck Lake PLM Lake and Land Management

Residents on Duck Lake collected water samples and had them analyzed by PLM Lake and Land Management. PLM created two full lake reports, one for March and one for August, as well as a variety of phosphorus samples throughout the year. The following tables summarize the PLM findings.

3/13/2024

Table 4.3 - Duck Lake March Temperature and Dissolved Oxygen

Depth (m)	Temperature (degrees C)	Dissolved Oxygen mg/L
0	10.5	16.4
1	8.3	17.3
2	7.9	16.8
3	7.7	16.8
4	7.3	14.7
5	6.9	13.8
6	6.8	13.9
7	6.4	12.2
8	6.3	12.4
9	6.2	12.6
10	6.2	12.6
Secchi Disk Depth: .8 meters		

Table 4.4 - Duck Lake Nutrients

Parameter	Results (March)	Results (August)	Units	Interpretation
E. coli			CFU/ 100mL	NA
Conductivity	229	326	uS/cm	Moderate concentration of dissolved salts
Total Dissolved Solids	206	204	mg/L	
pH	8.8	8.5	S.U.	Water is slightly alkaline
Alkalinity	148	188	mg CaCO3/L	Water is hard
Total Phosphorus	36	378	Ug/L	Phosphorus enriched
Nitrates	430	230	ug/L	Slightly nitrogen enriched

8/27/2024

Table 4.5 - Duck Lake August Temperature and Dissolved Oxygen

Depth (m)	Temperature (degrees C)	Dissolved Oxygen mg/L
0	26.9	8.6
1	26.9	8.5
2	26.8	8.5
3	25.1	8.6
4	23.5	4
5	21.4	0.2
6	14.8	0.1
7	11.7	0.1
8	10.5	0
9	9.2	0
10	8.7	0
Secchi Disk Depth: 2.3 meters		
Thermocline Depth: 3 meters		

Other Sampling Events

Individual water samples were collected and sent to PLM for analysis. Samples taken during December were after significant rain events.

Table 4.6 - Other Duck Lake Sampling Events

Date	Location	Phosphorus
6/29/24	near 154 Peterson Drive	67 ug/L
6/30/24	near 3695 Richardson Drive	< 20 ug/L
6/30/24	near 3599 Baseline Rd	24 ug/L
12/29/24	near 154 Peterson Drive	282 ug/L
12/30/24	Burke Drain	84 ug/L

PLM determined Duck Lake to be highly phosphorus enriched and recommended nutrient abatement.

4.4 Studies Completed as Part of the 2024 EGLE Watershed Council Support Grant

Allegan Conservation District received an EGLE Watershed Council Support Grant in 2023 for $40,000. The project involved water quality monitoring, agricultural surveys, hosting steering committee meetings, and the writing of this watershed management plan.

4.4.1 Water Quality Monitoring

Nutrients

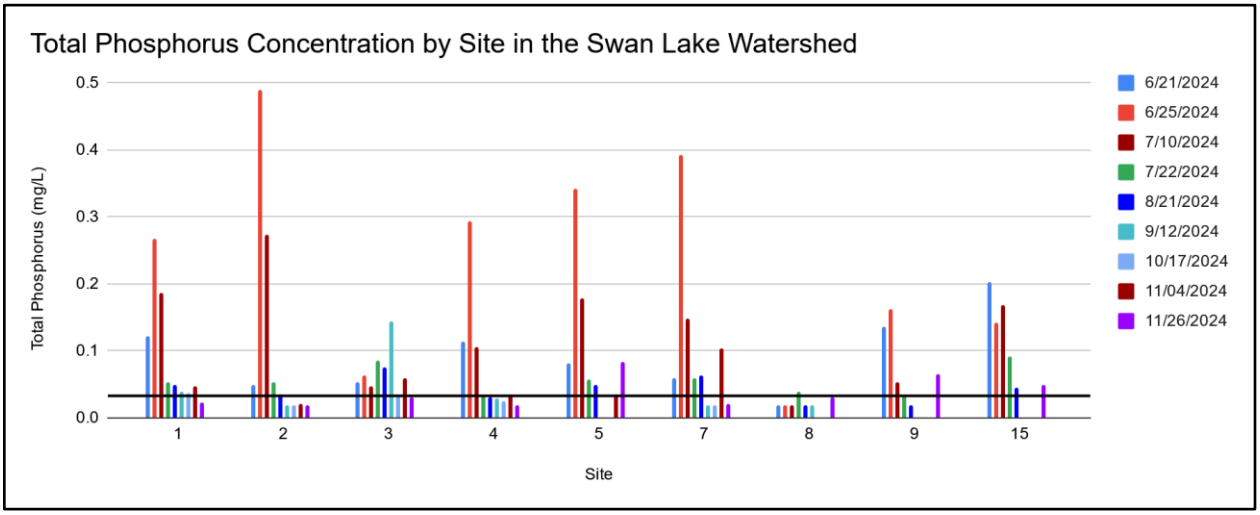
ACD sampled 10 stream sites and 3 lake sites across the watershed. Site locations and parameters are shown in Table 4.7. Stream sites were monitored once a month between June and November, with three wet weather events sampled opportunistically. Water samples were collected and delivered to a lab for nutrient analysis, temperature and dissolved oxygen readings were taken with a YSI Pro20 probe, and stream characteristics such as flow, depth, and wetted width were recorded. Nutrient analysis included measurements of Nitrite, Nitrate, Ammonia, Orthophosphate, Total Phosphorus, Kjeldahl Nitrogen, and Total Suspended Solids. Site 11 was only sampled twice during wet weather events. Figure 9 shows the locations of all monitoring sites within the watershed.

Table 4.7 - Monitoring Sites in the Swan Lake Watershed

Site	Latitude	Longitude	Location	Stream Sampling Dry Weather	Stream Sampling Wet Weather	*E. coli* Sampling	Lake Sampling
1	42.465884	-85.949511	41st St	X	X	X	
2	42.45912	-85.954184	42nd St	X	X	X	
3	42.462874	-85.973887	44th St	X	X		
4	42.47698	-85.939509	108th Ave	X	X		
5	42.476694	-85.939231	108th Ave	X	X		
7	42.45057	-85.914797	38th St	X	X	X	
8	42.42628	-85.932667	Mary Rd	X	X	X	
9	42.43387	-85.911427	102nd Ave	X	X	X	
10	42.464813	-85.959796	Deepest point on Swan Lake				X
11	42.470559	-85.959439	Lakeview Dr		X		
13	42.429799	-85.905994	Deepest point on Duck Lake				X
14	42.423468	-85.930274	Deepest point on Eagle Lake				X
15	42.427377	-85.896391	Thelen Dr	X	X	X	

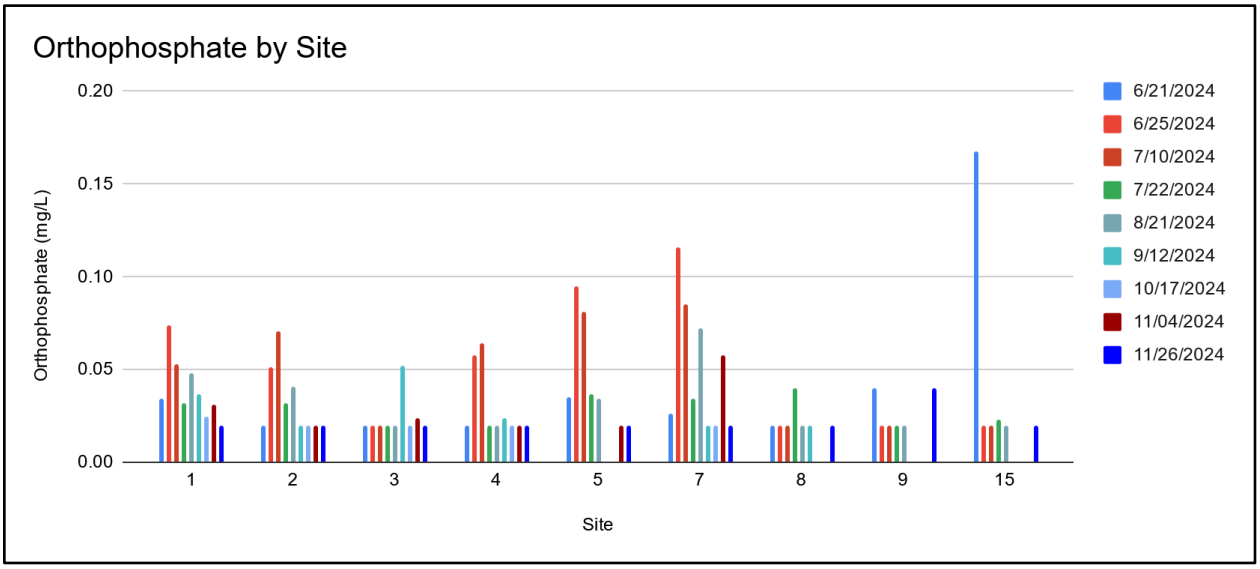
According to the *EPA Ambient Water Quality Criteria Recommendations* document, southern Michigan falls under Ecoregion VII and has a phosphorus reference condition of .033 mg/L for rivers and streams. Of the ten stream sites sampled, 9 of them recorded total phosphorus levels higher than the reference level. Every site except sites 3 and 8 recorded their highest phosphorus concentration during wet weather events.

Chart 4.1 - Total Phosphorus Results in the Swan Lake Watershed



Wet weather events are red and dry weather events are blue and green. Values of .02 represent samples that were below the detection threshold of .02 mg/L. Values of 0 mean no sample was taken that day. The horizontal black line is the reference level of .033 mg/L.

Chart 4.2 - Orthophosphate Results



Wet weather events are red and dry weather events are blue and green. Values of .02 represent samples that were below the detection threshold of .02 mg/L. Values of 0 mean no sample was taken that day.

Nitrogen data was also collected for each site. Values were averaged for summer months (June-August) and fall months (September-November). Nitrite levels were below the detection threshold for every sample, so they were excluded from the graphs. Overall Nitrogen levels were higher in the summer months, and were highest during summer rain events. Ecoregion VII has a Total Nitrogen reference condition of .54 mg/L, which every site sampled surpassed, including sites 4, 5, 7, 9, and 11 by a factor of 10 for wet summer events. Nitrate made up a higher percentage of total nitrogen in the summer than the fall. Nitrogen results were lower in the fall but still exceeded the EPA ecoregion reference level by a wide margin.

Chart 4.3 - Summer Nitrogen Results

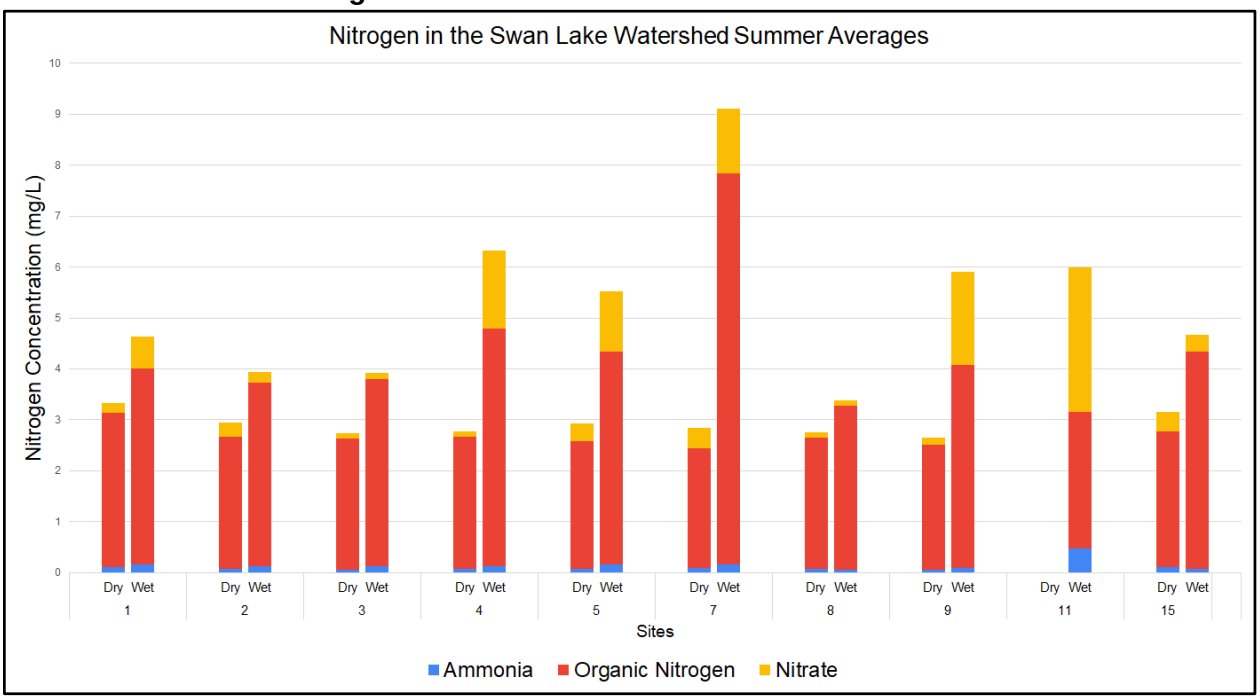
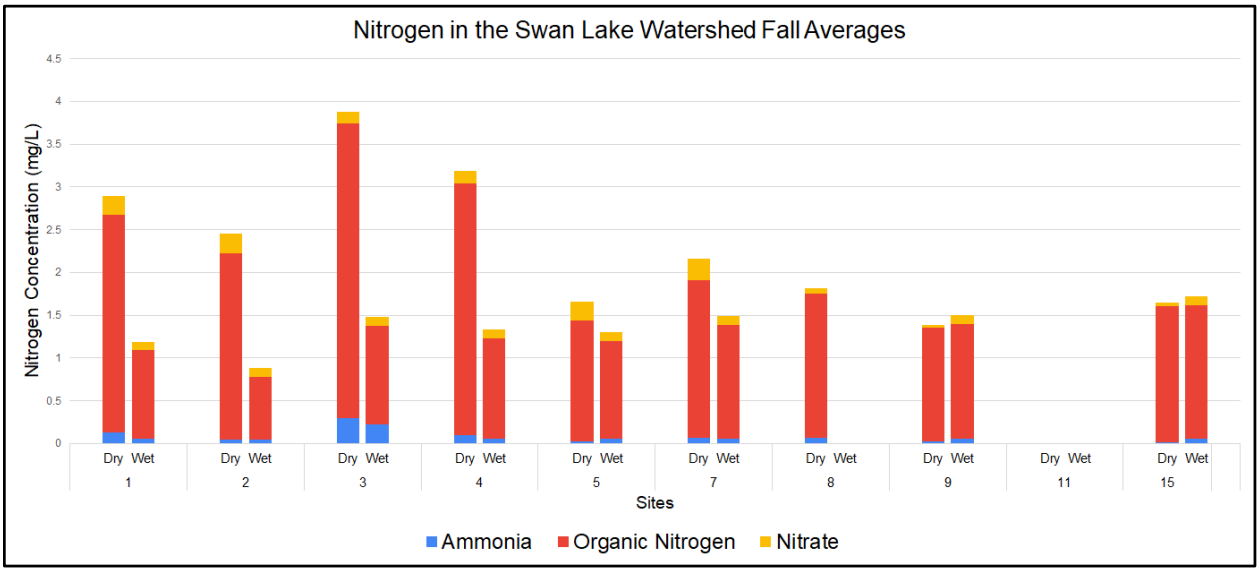


Chart 4.4 - Fall Nitrogen Results



Suspended Solids

Suspended solids data was collected and showed a sharp contrast between wet weather and dry weather sampling. Every site sampled had levels below the detection threshold at least once, and eight of the ten sites sampled had their highest recorded suspended solids on June 25 during a rain event, with the highest recorded value at 236 mg/L. The outlets of Swan, Eagle, and Duck Lake, sites 3,8, and 9 respectively, consistently had lower suspended solids levels than inlets at site 1 and 2.

Flow

Stream flow varied significantly between sites and between sampling dates. Sites 1 and 7 were frequently stagnant even with high water levels, and water levels became too low to sample at sites 5, 8, 9, and 15 during the summer months. Graphs and tables with values of zero for stream sampling events indicate the water level was too low to sample.

Temperature and Dissolved Oxygen

Temperature and dissolved oxygen were measured at each stream sampling site. Dissolved oxygen was consistently low at the outlet of Swan Lake at Site 3. Dissolved oxygen varied between 2.01 mg/L and 11.5 mg/L. The Warmwater Fishery designated use has a minimum Dissolved oxygen standard of 5 mg/L, and sites 3, 7, and 9 recorded values below that value. Table 4.8 shows dissolved oxygen measurements.

The highest water temperature recorded was 30 degrees celsius at Site 8 on 6/21/24. Sites at lake outlets recorded higher average temperatures than sites upstream of lakes, which is shown with Sites 3, 8, and 9 consistently having the highest temperature recorded. The Warmwater Fishery designated use has a monthly temperature maximum which was exceeded three times.

Table 4.8 - Dissolved Oxygen in the Swan Lake Watershed

Site	6/21/2024	6/25/2024	7/10/2024	7/22/2024	8/21/2024	9/12/2024	10/17/2024	11/04/2024	11/26/2024
1	5.38	6.38	6.25	7.2	7.88	7.43	9.88	8.63	9.7
2	7.55	6.93	7.13	8.17	9.4	9.43	11.45	8.51	10.82
3	2.3	4.01	4.28	5.57	4.78	2.01	3.01	3.14	7.58
4	6.87	5.53	5.92	8.17	9.85	10.4	11.55	7.62	10.89
5	6.36	7.1	7.26	8.52	10.08	0	0	5.55	10.08
7	6.49	5.84	5.53	7.08	4.27	0	9.3	3	0
8	10.8	10.01	9.67	9.98	8.94	0	0	0	8.81
9	5.7	5.93	6.48	6.21	7.48	0	0	4.14	10.16
11		6.56	5.01						
15	5.64	6.41	8.19	4.97	8.15	0	0	2.91	10.07

Measurements are in mg/L. The Warmwater Fishery designated use dissolved Oxygen standard is 5 mg/L. Values below the standard are in red.

Table 4.9 - Water temperature in the Swan Lake Watershed

Site	6/21/2024	6/25/2024	7/10/2024	7/22/2024	8/21/2024	9/12/2024	10/17/2024	11/04/2024	11/26/2024
1	21.6	19	19.2	18.2	13.9	15.3	6.7	12.1	5.5
2	20.2	18.7	19.1	18.6	14	14.9	7.2	11.9	6.2
3	27.1	22.5	23.1	24.7	20.8	19.8	8.6	12.4	6.8
4	21.9	21.6	20.8	19.8	15.2	16.8	7.3	12.3	5
5	20.3	19.4	19.2	18.4	14.7			13	5.8
7	18.9	19.5	19.2	17.4	14.3		9	12.5	
8	30	21.7	25.8	27.5	26.1			0	10.3
9	25.6	24.8	23.8	25.6	21.9			13.9	5.5
11		20.2	20.3						
15	23.3	24.9	23.3	23.4	21.1			15.9	5.5

Measurements are in Celsius. The Warmwater Fishery designated use standard is different for each month. Values above the standards are in red.

Nutrient data was also collected on Swan Lake (Site 10), Duck Lake (Site 13), and Eagle Lake (Site 14) twice during the study. Samples were collected with a Van Dorn Sampler at three depths in each lake. Temperature and Dissolved Oxygen were measured following CLMP protocol. Data collected in July helped illustrate the depth of the thermocline within each lake. In July, the Swan Lake thermocline was around 2 meters deep, the Duck Lake thermocline around 3 meters deep, and the Eagle thermocline was around 5 meters deep. Table 4.10 shows high and low Temperature and Dissolved Oxygen values for each lake sampled.

Table 4.10 - Dissolved Oxygen and Temperature Lake Extremes

	Date	**Temperature High (C)**	**Temperature Low (C)**	**DO High (mg/L)**	**DO Low (mg/L)**
Swan	7/24	26.1	13.3	9.55	0.14
	11/25	7.9	7.8	8.85	8.49
Duck	7/24	26.8	11.6	8.73	0.15
	11/25	9.1	9	8.75	8.55
Eagle	7/24	27.2	16.1	9.12	0.56
	11/25	9.9	9.5	8.12	7.71

Table 4.11 - Lake nutrient levels in the Swan Lake Watershed

	Total Nitrogen (mg/L)		Total Phosphorus (mg/L)	
Site	7/24/2024	11/25/2024	7/24/2024	11/25/2024
Swan Top	1.62	2.1	0.02	0.058
Swan Middle	3.48	2.1	0.113	0.048
Swan Bottom	2.5	2.084	0.165	0.04
Duck Top	2.95	4.296	0.02	0.069
Duck Middle	2.03	4.788	0.024	0.063
Duck Top	2.95	4.296	0.02	0.069
Eagle Top	1.61	4.47	0.02	0.02
Eagle Middle	1.58	4.23	0.02	0.02
Eagle Bottom	1.8	3.96	0.02	0.104

E. coli and Optical Brighteners

Along with nutrient data, *E. coli* samples were collected at six sites within the watershed. Five dry weather events were sampled within a 30-day period to obtain a 30-day geometric mean in order to compare to state standards for partial and total body contact. A wet weather event was sampled after the 30-day period. Water levels at sites 9 and 15 became too low to sample towards the end of the 30-day period. Only site 8 had a geometric mean below 130 cfu/100mL, the state standard for total body contact. Five of the six sites also had single day values above the partial body contact standard of 1000 cfu/100mL.

Table 4.12 - *E. coli* results in the Swan Lake Watershed

	Dry Weather	Dry Weather	Dry Weather	Dry Weather	Dry Weather		Wet Weather
Site	8/12/2024	8/20/2024	9/3/2024	9/5/2024	9/11/2024	30-Day Geometric Mean	11/04/2024
1	**1069.69**	896.28	**1925.56**	**1207.36**	**2243.09**	1379.71	935.6
2	704.73	990.58	**1076.64**	476.22	479.14	702.83	788.37
7	292.25	263.58	340.16	266.62	199.33	268.38	**1105.2**
8	11.69	52.76	301.54	104.57	16.64	50.35	31.75
9	260.23	161	241.01	594.99		278.4	**3688.55**
15	246.2	102.59	925.21			285.89	**8000**

Red boxes indicate samples above the total body contact standard of 300 cfu/100mL for a daily maximum, and 130 cfu/100mL for the 30-day geometric mean. Green boxes are within the state standards. Bold values represent samples above the partial body contact standards of 1000 cfu/100ml for a daily maximum.

Optical brightener readings were taken along with *E. coli* sampling as an experimental proxy to indicate contamination from sanitary sewage. Optical brighteners were not measured directly, rather by measuring the fluorescence of a field sample relative to a control with a known concentration of clothes detergent—a primary source of optical brighteners. Measurements were compared to a lab-derived threshold of 10 RFUs that indicates significant detergent contamination. Field readings for optical brighteners were frequently above the 10 RFU threshold, maxing out at 97.8 RFUs. High optical brightener readings were used to flag *E. coli* samples to potentially test for human markers with Microbial Source Tracking (MST).

Optical brighteners were consistently above the 10 RFU threshold at sites 1, 2, and 15. Values at Site 8 were below the threshold for every sampling event. Optical brightener values were compared to their corresponding *E. coli* values in Chart 4.6. With all samples, the R-squared value is relatively low at 0.296. Excluding two outliers significantly strengthens the correlation to 0.609. The outliers were collected on 8/20/2024 at sites 1 and 7 and both show higher fluorescence relative to *E.coli* concentrations. While no abnormalities were noted during this sampling day, there are other fluorescent compounds that may be present in the environment such as dissolved organic matter. While steps were taken to reduce the detection of background fluorescence, high organic matter may nonetheless have elevated fluorescence values.

Chart 4.5 - Optical Brighteners values by Site in the Swan Lake Watershed

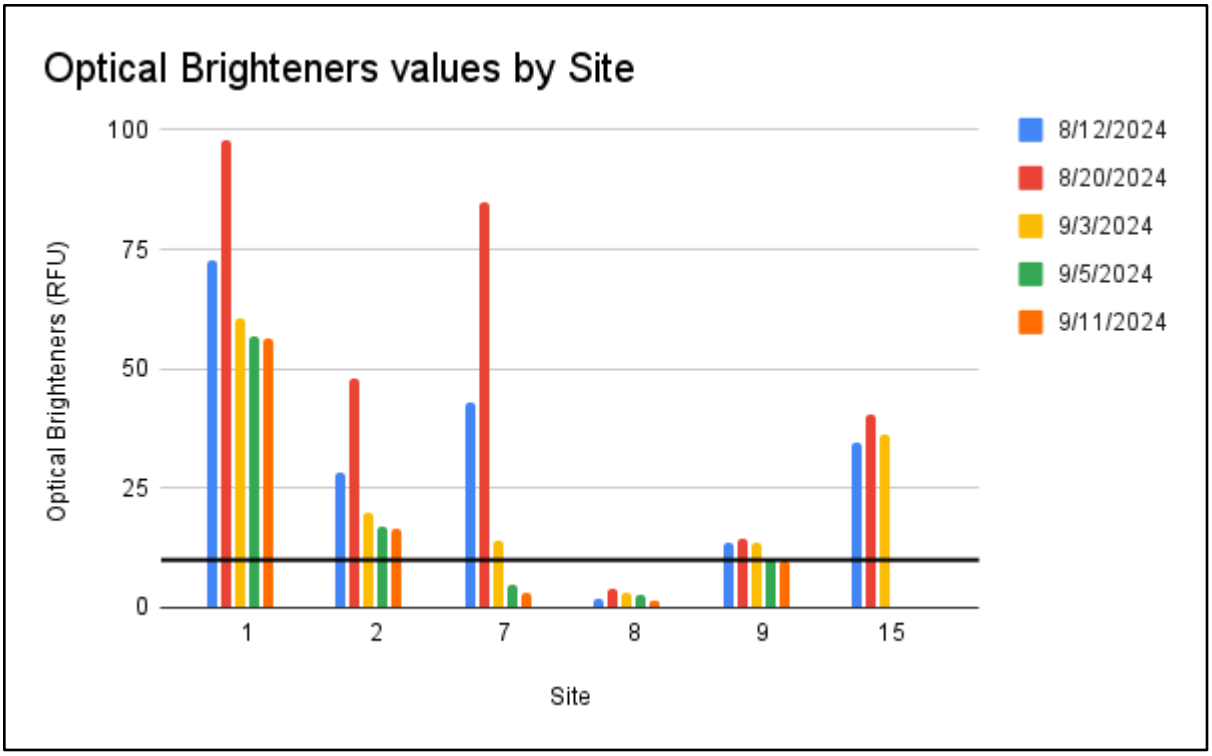
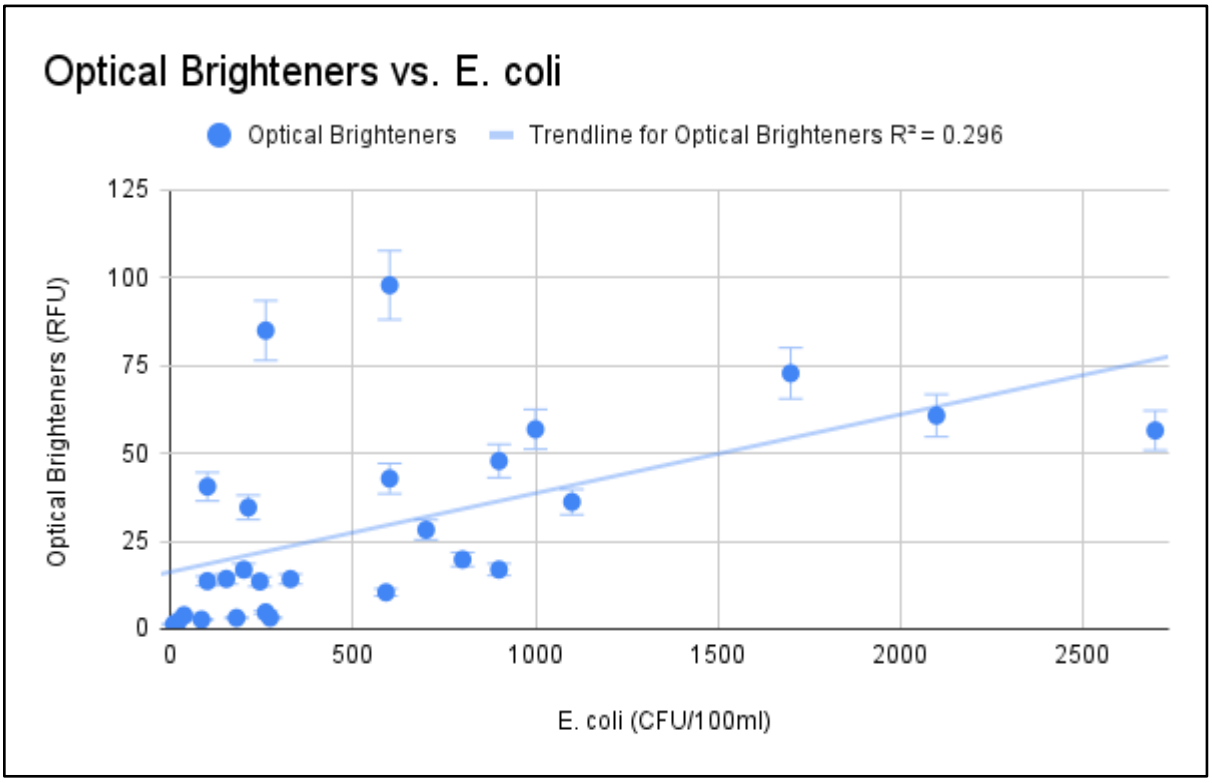


Chart 4.6 - Optical Brighteners values compared to *E. coli* values in the Swan Lake Watershed



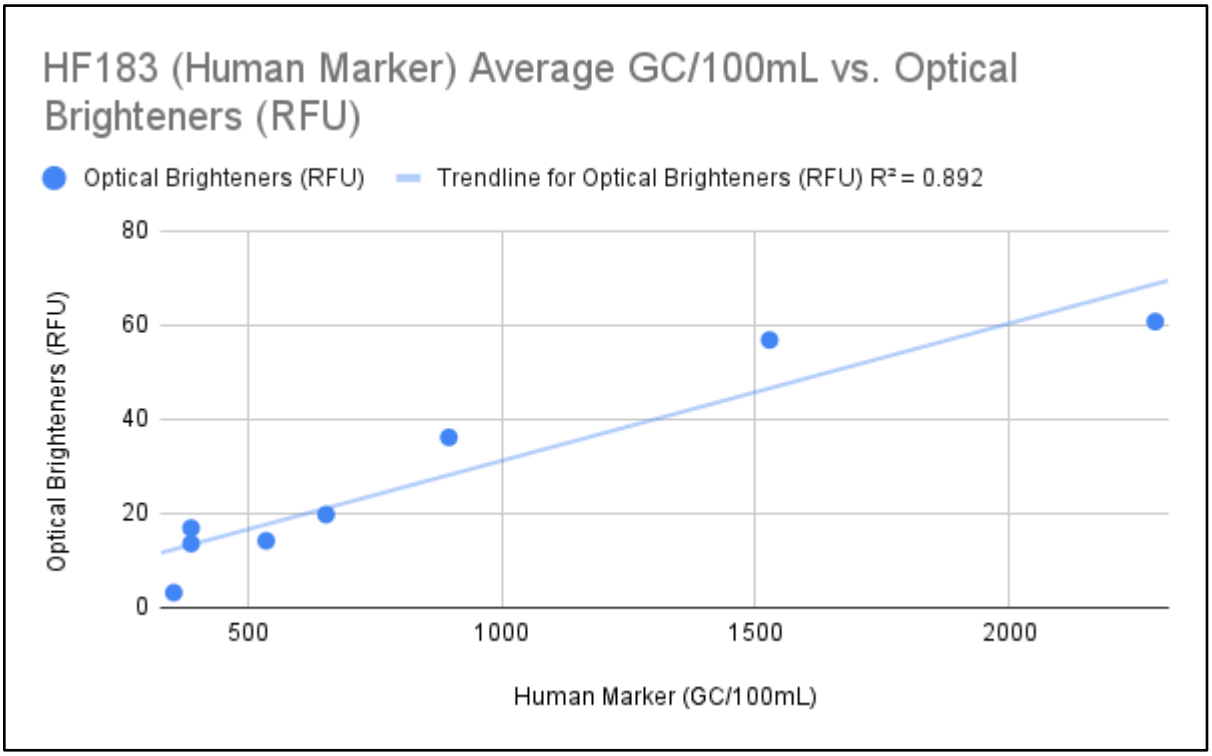
Additionally, samples were sent to the Annis Water Resources Institute at Grand Valley State University for Microbial Source Tracking (MST). Samples were tested for human marker HF183 and cow marker CowM2. Values above the detection threshold of 354 GC/100mL represent detection, with values closer to 354 being lower concentrations. Of our sixteen samples, 12 came back positive for human markers, including two blanks, suggesting some cross contamination during collection or transport during the first two sampling events. No samples came back positive for cow markers. Results of MST are shown in Table 4.13. Graphing optical brightener results against the concentration of human markers in Chart 4.7 gives a much higher correlation, with an R-squared value of .892 compared to the R-squared value of .296 for all *E. coli* samples.

Also worth noting is the accuracy of the lab-derived optical brighteners threshold of 10 RFUs, as every sample tested for human markers with an RFU value above 10 came back positive for human markers. The increased R-squared value between all *E. coli* samples and just samples that were positive for HF183 when compared to optical brightener values points to optical brightener reading in the field being a good proxy for sanitary sewage in this area, and could potentially be used to extrapolate the magnitude of human waste contamination in instances where MST was not conducted.

Table 4.13 - Microbial Source Tracking Results

Collection Date	Site	*E Coli* Geomean CFU/100mL	Optical Brighteners (RFU)	HF183 (Human Marker) Average GC/100mL	CowM2 (Cow Marker) Average GC/100mL
9/3/2024	1	1926	60.72666667	2288	354
9/3/2024	2	1077	19.76	654	354
9/3/2024	7	340	14.2	536	354
9/3/2024	8	302	3.1925	354	354
9/3/2024	9	362	13.6	388	354
9/3/2024	15	925	36.15	896	354
9/5/2024	1	1207	56.82666667	1528	354
9/5/2024	2	1072	16.9	388	354
11/4/2024 (wet weather)	1	936		744	354
11/4/2024 (wet weather)	2	788		354	354
11/4/2024 (wet weather)	7	1105		354	354
11/4/2024 (wet weather)	9	3689		452	354
11/4/2024 (wet weather)	15	>8000		388	354

Chart 4.7 - *E. coli* Human Marker Results Compared to Optical Brighteners values



4.4.2 Agricultural Inventory

Fall Tillage and Spring Residue Surveys

An inventory of all agricultural fields within the watershed was conducted in order to identify what tillage practices are common in the watershed. Between a fall tillage survey and a spring residue survey, tillage practices, cover crop usage, manure presence, and crop type was noted for every field.

There are 4,629 acres of fields in or touching the watershed boundary. Only 6% of the acreage within the watershed was planted with no-till practices, while 38.5% of the acreage was planted with no plant residue visible. For the 2024 growing season, 33.7% of the agricultural fields were planted with corn and 24% with soybeans. Hay was the next largest crop, making up around 21% of the total agricultural acreage in the watershed. The remaining fields were comprised of pastures, small grain fields, fields that were not planted, and other crops. Christmas tree plantings made up a large portion of the 'Other' category, particularly around Silver Lake in the north portion of the watershed. Figure 10 shows agricultural fields in the Swan Lake watershed color-coded by spring residue practices. Figure 14 shows fields color-coded by fall tillage practices.

Table 4.14 - Spring Residue in the Swan Lake Watershed

Spring Residue	Fields	Acres	Percent
Planted no-till	15	290	6%
Greater than 30%	3	70	1.5%
Less than 30%	13	664	14%
No residue	59	1,783	38.5%
N/A	105	1,345	29%
Not Planted	10	106	2%
Skipped	36	368	8%
Total	241	4,629	

Table 4.15 - Agriculture in the Swan Lake Watershed

2024 Crop	Fields	Acres	Percent
Hay	67	956	20.8
Corn Grain	47	1,481	32.2
Corn Silage	4	70	1.5
Soybean	31	1,102	24
Small Grain	2	72	1.6
Pasture	16	134	2.9
Not Planted	10	107	2.3
Skipped	36	369	8
Other	24	307	6.7
Total	237	4,598	

Table 4.16 - Cover Crop use in the Swan Lake Watershed

2024 Cover Crop Status	Fields	Acreage
Yes	15	256
No	102	2,868
N/A	124	1,507

Animal Feeding Operation (AFO) Survey

Based on this survey, there are approximately 30 AFOs within the watershed, most of which are small hobby farms. Six beef operations were surveyed, along with one swine, and one dairy. All but one of the AFOs were estimated to have between 1-60 animals, with the dairy operation being classified as a Confined Animal Feeding Operation and having greater than 500 animals. Six of the AFOs surveyed were noted as potentially having manure storage or erosion control issues. Figure 12 shows AFO locations and priority scores. Prioritization is explained in Chapter 6.

4.5 Pollutants and Concerns

Sediment

The deposition of sediment into waterways harms aquatic habitats by altering streambeds and increasing water turbidity. Sediments decrease habitat for macroinvertebrates and fish spawning and can damage fish gills. High turbidity results in less light penetration and subsequent decrease in DO and water temperatures. Bacteria, nutrients, pesticides, and other pollutants bind to soil

particles and easily enter water bodies with sediment. The input of excess sediment into waterways is often from agriculture, road-stream crossings, altered stream hydrology, and construction/development.

Estimated sediment loss was modeled with EPA's *Pollutant Load Estimation Tool* (PLET) using land cover statistics. PLET models use HUC12 subwatersheds to estimate pollutant loads. The Swan Lake Watershed is a portion of the larger HUC12 Swan Creek subwatershed to which the model was applied. Pollutant load estimates using PLET will therefore be higher than expected loads for just the Swan Lake Watershed. The total sediment load estimated using PLET for Swan Creek and its tributaries is 2199 tons/year, or .073 tons/acre/year.

The most notable observation regarding sediment is a large increase at site 2 during a rain event. This may be due to the fact that preceding this site is a long, straight, shallow drain along an unpaved road. High water velocity may be causing instream erosion with additional sediment contributions from road runoff.

Nutrients

Nutrients are necessary for plant growth, but an overabundance is detrimental to aquatic ecosystems. Nitrogen and phosphorus are often limited resources in an unaltered landscape but can quickly become excessive in developed watersheds. In abundance, these nutrients cause eutrophication in water bodies, impacting ecological communities and recreational opportunities. The growth and subsequent decomposition of excessive algae that flourishes in nutrient-rich water decreases dissolved oxygen, and toxin-producing cyanobacteria thrive in nutrient-rich conditions.

During wet weather events phosphorus, nitrogen, and total suspended solids increased significantly, suggesting that runoff and erosion are significant concerns. The additional increase in nitrates points to fertilizers applied to fields and lawns as primary concerns. As an example, site 11 is a very short drainage path from several farm fields. A significant proportion of the nitrogen from this site is in nitrate form, and elevated nitrates during wet weather are noted across all sites except sites 1-3. Sites 1-3 all notably have upstream wetlands that may be acting to process some of this nitrogen before it enters the lake as organic nitrogen. Farm fields near waterways are the most obvious culprits for this pattern, but fertilized lawns also likely contribute. However, even during dry weather events nutrients remained far above reference conditions. This suggests a continuous source such as failing septic systems that contribute nutrients regardless of weather.

Estimated nutrient loads were modeled with EPA's *Pollutant Load Estimation Tool* (PLET) using land cover statistics. PLET models use HUC12 subwatersheds to estimate pollutant loads. The Swan Lake Watershed is a portion of the larger HUC12 Swan Creek subwatershed to which the model was applied. Pollutant load estimates using PLET will therefore be higher than expected loads for just the Swan Lake Watershed. The total phosphorus load estimated using PLET for Swan Creek and its tributaries is 20,917 pounds/year, or .69 pounds/acre/year. The nitrogen

load estimated using PLET for Swan Creek and its tributaries is 107,218 pounds/year, or 3.54 pounds/acre/year.

E. coli / Pathogens

Bacteria and pathogens enter water bodies from unmaintained and failing septic systems, improper application or storage of manure, barnyards or feedlots, improper disposal of pet waste, and wildlife. High concentrations of bacteria and pathogens in surface waters pose a severe health risk and thus can impair body contact recreation in water bodies. *E. coli* bacteria are often monitored as they are an indicator of pollution from animal and human waste and are often accompanied by other pathogens and disease-carrying organisms.

A number of data points suggest that failing septic systems are significant contributors of pathogens. The most direct evidence is the presence of human-sourced *E.coli* found through MST and the persistently elevated *E.coli* levels throughout the watershed. *E.coli* remained high even though samples were collected during a protracted drought period suggesting a continuous source that doesn't rely on runoff to reach surface water.

These findings do not preclude agricultural sources of coliforms—manure would have been minimally mobile during a drought and fields may not have had manure applied during the sampling window. A number of critical fields were identified that have direct drainage to surface water, and manure applied to those fields has a high risk of entering surface water. In addition, 6 AFOs were observed to have possible manure storage and/or erosion concerns.

Temperature and Oxygen

Swan Creek from 109th Ave downstream to the confluence with the Kalamazoo is a type 1 designated coldwater stream. While much of that stretch of Swan Creek is protected land in the Allegan State Game Area, upstream thermal pollution can have a negative effect. Thermal pollution is frequently caused by increases in impervious surfaces catching and heating rainfall that then runs off into streams and lakes. Dissolved oxygen is closely tied to water temperature with colder water holding more oxygen.

The most notable concern from the 2024 water quality monitoring is the low dissolved oxygen at site 3. Temperature was also higher here, though generally below the WQS. Decomposition of organic matter can elevate water temperature and consume dissolved oxygen, which seems likely in this case because the site is downstream of a wetland with few developed areas nearby. This is likely to improve by lowering upstream nutrients and biological activity.

Increases in average temperatures with climate change will also lead to higher water temperatures regardless of the watershed's land use. Changes in hydrology and the reduction of baseline flow can slow water, allowing it to capture more heat. Loss of riparian habitat and shade can lead to increases in water temperature as well.

CHAPTER 5 - IMPLEMENTATION PLAN

5.1 Goals and Objectives for the Swan Lake Watershed

The implementation of this Watershed Management Plan (WMP) requires a combination of strategies that include community outreach/education, construction/installation of Best Management Practices (BMPs), and supporting local policy. The goals of the watershed community to improve water quality to meet designated uses will not be realized without a multi-faceted approach. This chapter will outline the plan's goals and objectives based on input from stakeholders and existing plans, followed by a summary of the BMPs, policy, and educational efforts necessary to achieve those objectives. Details of critical areas, BMPs, and policies are discussed in Chapter 6. Specific outreach steps, audience, and objectives are presented in Chapter 7. The goals for the watershed and the corresponding objectives are listed below.

1. Minimize pathogen and nutrient pollution from septic systems and residential areas
    a. Increase awareness of proper septic system maintenance among watershed residents.
    b. Identify and remediate failing septic systems.
    c. Implement a centralized wastewater treatment program.
    d. Install native shorelines and fix degraded riparian habitat with native plant species.
    e. Encourage the reduction of fertilizers and pesticides applied to residential areas, especially near waterbodies.
2. Reduce nonpoint source sediment, nutrient, and pathogen loading by stabilizing sediment and minimizing runoff volume and pollutant load.
    a. Prevent wind and water erosion by minimizing soil disturbance, promoting year-round vegetative cover, and strategic planting in critical areas.
    b. Encourage proper timing, rate, and placement of pesticides, fertilizers, and manure.
    c. Encourage proper storage of manure
    d. Increase the use of riparian buffers and vegetation.

5.2 Technical Assistance

All implementation efforts will involve some level of technical assistance which will vary based on practice, site, and cooperator capacity (i.e. the abilities of the person or organization implementing the recommendation). To reflect the range of these costs, technical assistance has been classified into tiers that can serve to guide planning around funding and staff needs for implementation (Table 5.1).

Table 5.1 - Technical Assistance Tiers

Tier	Description	Example Actions
Tier 1	No specialized assistance needed. Staff with basic natural resources education can reasonably be expected to plan implementation with the help of existing tools.	Basic education, program applications, use of basic planning tools
Tier 2	Some specialized assistance needed. Staff should have a relevant certification or substantial experience to plan implementation.	Prepare construction specifications (non-engineered), interpret soil test results
Tier 3	Significant specialized assistance needed. Most planning and implementation assistance should be done by specialized staff.	Engineering, surveying, legal or legislative work
Tier 4	A team of specialized staff is required.	Large infrastructure projects

There are numerous organizations which can provide technical assistance. Agricultural practices may be supported by conservation districts, Michigan Department of Agriculture and Rural Development, Natural Resources Conservation Service, Michigan State University Extension, Pheasants Forever, and agronomy consultants. Assistance for policy and planning practices may come from conservation districts, local planning officials, county health departments, and outside legal services. Because costs can vary dramatically from project to project, technical assistance organizations should be contacted for cost information before seeking funding for a project.

5.3 Implementation Costs and Financial Assistance

Estimates of implementation costs are taken from a number of sources. Where available, costs were taken from the 2024 Environmental Quality Incentives Program payment schedule and multiplied by 1.33 to account for landowner contributions (this program estimates 75% of the cost will be covered with the remaining 25% contributed by the landowner). These costs are only for establishment of the practice and do not account for incentives such as land rental or foregone income payments. The other practices were estimated using a variety of outside sources, or barring that, professional best judgment based on similar projects.

Yearly Operation and Maintenance (O&M) costs for multi-year practices are site specific. For the purpose of high-level budgeting and planning, practices are estimated to have an annual maintenance cost calculated by dividing the installation costs by the practice lifespan and multiplying by 2%.

Annual O&M = Installation cost ÷ practice lifespan * .02

More detailed O&M plans should be developed during the planning and site selection phase of project development. These plans should consider the value and amount of labor, fuel costs, equipment usage costs, and the lifespan and replacement costs of physical components.

A variety of local, federal, and state programs can be leveraged to provide financial assistance for the recommendations. The Farm Bill, Clean Water Act, Clean Michigan Initiative, Great Lakes Restoration Initiative, Michigan’s State Revolving Fund, and local millages are all sources of funding that can either be applied directly or obtained through a grant application.

Conservation district staff are well versed in the variety of funding mechanisms available and should be consulted for assistance.

Table 5.2 - Recommended BMPs

Recommendation	Pollutant	Technical Assistance	Unit Cost Estimate	Amount	Total Cost (O&M Cost)	Estimated Pollutant Load Reduction
Cover Crops	Sediment, Nutrients, *E. coli*	Tier 1	$83/Ac/Yr	2,868 acres	$238,044	N: 2299 lbs/yr P: 247 lbs/yr TSS: 114 tons/yr
No-till or Strip Till	Sediment, Nutrients, *E. coli*	Tier 1	$37/Ac/Yr	2,447 acres	$90,539	N: 3525 lbs/yr P: 1842 lbs/yr TSS: 766 tons/yr
Nutrient Management	Nutrients, *E. coli*	Tier 2	$38	4,629 acres	$175,902	N: 2341 lbs/yr P: 1109 lbs/yr
Grassed Waterways	Sediment, Nutrients, *E. coli*	Tier 2	$9/Ft	2,400 feet	$21,600 ($.018/Ft/yr)	N: 126 lbs/yr P: 34 lbs/yr TSS: 14.61 tons/yr
Natural Shoreline Design	Sediment, Nutrients, *E. coli*	Tier 2	$15/Ft	2000 feet	$30,000	
Septic Policy	Nutrients, *E. coli*	Tier 3	$2,000/ Township	3 townships	$6,000	
Septic System Repairs	Nutrients, *E. coli*	Tier 3	Costs should be estimated by the relevant professionals			
Centralized Wastewater Treatment	Nutrients, *E. coli*	Tier 4				
Waste Storage Facilities	Nutrients, *E. coli*	Tier 3	$3.43/Cu Ft	19,500 Cu Ft*	$66,885 ($.0046/Cu Ft/yr)	
Critical Area Planting	Sediment, Nutrients, *E. coli*	Tier 1	$0.15/Sq Ft	4,000 Sq Ft	$600 ($.003/Sq Ft/yr)	
Risk Assessment and Planning through the MAEAP	Sediment, Nutrients, *E. coli*	Tier 2	$2500/Farm	30 farms	$75,000	
Enrollment in CLMP		Tier 1	$210/Lake	5 lakes	$1,050	
Total					**$705,620**	

** For waste storage calculations, beef operations were assumed to have 30 cows, and Hobby farms were assumed to have 5 horses.*

5.4 Implementation Schedule

Implementing recommended BMPs requires funding that will likely come from grants. As of the writing of this watershed management plan, no implementation grants have been secured. Short term recommendations are actions feasible with no direct implementation grant, while mid- and long-term actions assume funding has been secured.

Table 5.3 - Implementation Timeline

Short Term 2025-2026	● Enroll Muskrat Lake, Eagle Lake, and Schermerhorn Lake in the Cooperative Lakes Monitoring Program ● Develop and distribute educational materials concerning septic system repair and replacement options ● Contact producers eligible for MAEAP ● Seek funding for agricultural BMP implementation
Mid Term 2027-2030	● Implementation of new cover crops and no-till practices on 1,000 acres ● Match existing agricultural BMPs to encourage continued implementation ● Continue *E. coli* and nutrient monitoring efforts ● Develop model septic policies ● Implement grassed waterways ● Provide financial support for septic system repairs ● Implement native shoreline installation on lakefront properties
Long Term 2031-2035	● Conduct a sewer/wastewater feasibility study ● Implementation of cover crops and no-till practices on remaining acres ● Follow up with previous implementations ● Implement AFO recommendations such as manure storage and access control ● Discuss septic policies with local planning officials

CHAPTER 6 - CRITICAL AREAS AND MANAGEMENT RECOMMENDATIONS

6.1 Critical Areas

After identifying major sources of pollution or impairments in the Swan Lake watershed, the Steering Committee's focus was narrowed to the areas that contribute the majority of those pollutants. Focusing on these Critical Areas prioritizes concerns and results in the greatest improvements for the time and money invested into the project. These critical areas are where the implementation of Best Management Practices (BMPs) will be prioritized. Implementation work under this plan should still occur in lower priority areas. For example, low impact stormwater practices like household rain gardens are beneficial in all residential areas and widespread implementation helps to normalize these practices so that voluntary implementation becomes more likely. However, limited funds should first be directed to implementation in priority areas.

Based on the complex variety of land uses on diverse topography with many unique ecological features, no single remediation plan can cover all contingencies encountered in the Watershed. As a result, the critical areas are classified into Agricultural and Residential Critical Areas. Details of the BMPs for each area can be found in Section 6.2.

Agricultural Critical Areas

The agricultural critical areas within the watershed can be split into two groups that have a separate set of pollutant risks and associated BMPs– crop fields and animal feeding operations (AFOs).

The major source of concern in crop fields is runoff which results in excess amounts of sediment and nutrient loading. Fields were prioritized based on proximity to waterways, observed discharge to a waterway, without preventative practices, and slope steepness. BMPs will focus on practices that mitigate erosion and increase infiltration. Figure 13 shows prioritized agricultural fields in the watershed.

The second set of agriculture critical areas are animal feeding operations. The 30 AFOs in the watershed range in size from hobby farms with one or two horses, up to a large CAFO with thousands of cows. Manure storage and animal access to surface water are the highest priority concern for these areas. Improper storage and direct livestock access cause significant contributions of pathogens and nutrients. BMPs will focus on siting, manure storage, livestock access control, and grazing management. Figure 12 shows prioritized AFOs in the watershed.

Residential Critical Areas

The second critical area category is residential riparian zones. The area encompassing all residential areas within 200 feet from lake shorelines and the top of all streambanks and drainage ditches are included into this critical area. Residential areas are also a large contributor of nutrients and are suspected to be a significant source of *E. coli* and other pathogens—failing or inadequate septic systems are the main concerns. Drain fields located in the water table can carry nutrients and *E. coli* directly into surface water, and systems at full capacity can leach pollutants into the ground or surface water.

Secondary concerns associated with residential areas are impervious surface runoff, yard waste, and habitat destruction. High runoff volumes and velocities from impervious surfaces or areas with insubstantial vegetation contribute to unstable hydrology. Reducing impervious surfaces in residential areas prevents sporadic flows, and runoff from roads and driveways may also contain hydrocarbons and heavy metals. Runoff from rooftops and parking lots not only contains contaminants, but it has also been warmed by the sun and contributes to thermal pollution. Construction sites need to have management practices that prevent erosion and sediment from entering streams and drains. Yard waste piled on lake shorelines or on streambanks can blow, wash, or be carried by high water into the water adding nutrients and pesticide contaminants. Nuisance populations of geese can quickly create a problem in the summer months when they feed in lawns and gardens. Goose feces, up to four pounds per goose per day, wash into lakes and streams and contribute to nutrient and pathogen impairments.

Nutrients, hydrology, pathogens, hydrocarbons, exotic species, and habitat fragmentation are all contributed by residential areas. BMPs in residential critical areas will focus on public education,

native plantings, stormwater management, and proper waste treatment.

Kalamazoo River Watershed Land Conservation Plan

In 2014, an analysis of priority land for conservation done by the Kalamazoo River Watershed Council found the Swan Lake HUC12 to include the most high priority parcels for conservation in the Kalamazoo watershed. Parcels were assigned values in six conservation criteria which were weighted by importance to water quality: Wetlands, Land Cover, Hydrology Buffer, Proximity to Conserved Land, Trout Streams, and Threatened and Endangered Species in that order.

The Swan Creek Watershed had 128 parcels scoring in the top 20% for conservation value, equaling 5,548 acres. These properties should be the focus of land conservation efforts within the watershed. This can include conservation easements, drafting forestry management plans, or donating land to a land conservancy. More information can be found in the Kalamazoo River Watershed Land Conservation Plan.

6.2 Management recommendations

Management recommendations have been developed for each pollutant source. Practices are prioritized differently for each pollutant source and a description of the methodology can be found in the respective sections. A summary table of the recommendations can be found in Chapter 5, in Table 5.2.

6.2.1 Agricultural Fields and AFOs

For all field practices, fields were given a prioritization score based on proximity to waterbodies and current tillage and cover crop practices (Figure 13). Fields with more intensive tillage practices and less frequent cover crop use received higher priority because they are more susceptible to erosion. All practices on a given field are prioritized based on the field's composite score since the combination of multiple practices is desirable. A full list of fields and priority scoring is available in Appendix 3 with higher values indicating higher priority.

Limiting or eliminating tillage through **no-till or strip till** is recommended for all crop fields. Reducing tillage prevents erosion, improves soil structure to increase moisture and carbon storage, improves soil biotic diversity, and increases organic matter. These benefits help to reduce sediment and nutrient runoff, and pathogen runoff if manure is applied correctly on the field. Costs are lower to farmers who use this method since less fuel is used in farm operations, and the reduction in erosion reduces the need for nutrient inputs. In worst case scenarios, additional pesticides may be necessary to prevent weeds, fungus, and disease. In this case, a farmer could expect a slight cost increase for implementing no-till practices. To maximize the benefits of no-till, it should be implemented along with cover crops and controlled traffic farming. In fine-textured soils, no-till can cause the creation of macropores that speed water drainage into a tile system. In this case, broadcast fertilizer can quickly be

delivered to surface water. Because this risk relies on a number of variables (soil type, fertilizer application type and method, tillage methods, etc.), planners should carefully evaluate mitigation strategies on a case-by-case basis. For more information, Michigan State University Extension has a number of research publications discussing this issue and how to address it.

Cover crops are recommended for all crop fields to reduce sediment, nutrient, and pathogen loads. Numerous studies have shown that incorporating cover crops into corn and soy rotations can add significant value through production increases and input savings. Cover crops decrease reliance on fertilizers and herbicides, build soil structure and organic matter, retain soil moisture, moderate soil temperatures, sequester carbon, increase habitat for beneficial insects and birds, and can directly add additional revenue if the farmer decides to harvest the cover crop to sell or for their own use. This practice is very flexible due to the number of cover crop options and can be suitable even for specialty operations like Christmas tree production. Fields with drain tile need to be intentional in selecting plant types to prevent damage to the drainage system.

Nutrient management plans (NMP) or comprehensive nutrient management plans (CNMP) are recommended for all crop fields. These plans outline the type, timing, amount, and location of nutrient applications on fields. Soil test results inform these plans in order to ensure that the appropriate nutrients are available for crops, and that nutrients are not being unnecessarily applied. CNMPs contain additional information for livestock operations regarding the utilization of manure and other management considerations. These practices reduce nutrient and pathogen runoff.

Grassed waterways are drainage paths within a field that are stabilized with permanent vegetation to prevent gully erosion. The vegetation reduces sediment and nutrient loading by slowing water velocity, trapping sediment, and consuming nutrients in the runoff. The roots of the vegetation stabilize the soil and promote water infiltration.

For all practices, AFOs were given a prioritization score based on observed erosion/manure issues and proximity to water bodies and wetlands. AFOs without noted issues with erosion or manure storage are considered to have the lowest priority. The proximity score is given to facilities within 500 feet of water bodies and wetlands due to the increased chance contaminated runoff enters surface water directly. Facilities with both an observed issue and proximity to water bodies were given the highest priority.

Waste storage facilities are engineered facilities for the storage of manure. An exposed manure stockpile or undersized storage poses a significant risk of nutrient and pathogen pollution, and manure storage should be prioritized at these operations. Proper siting away from wells, surface water, and flood zones is critical, and existing manure facilities that pose a risk to surface or groundwater should be replaced at an appropriate location. This practice can result in considerable nutrient and pathogen reductions.

Risk reduction through the **Michigan Agriculture Environmental Assurance Program (MAEAP)** can result in pollutant reduction through response planning and siting work. MAEAP technicians conduct a comprehensive assessment of each operation to identify risks to surface and groundwater. Participants who complete the program have not only directly addressed structural issues like well isolation distances and proper chemical containment, they are also equipped to handle emergencies like accidental manure spills. These preventative measures help to minimize nutrient, pathogen, and chemical pollution. In addition, this program frequently serves as a starting point for contacting producers about implementing other practices that may fit well on their operation.

6.2.2 Residential Areas

Improving wastewater treatment through **improved septic health** and/or utilizing **centralized wastewater treatment** is critical to improving watershed health. Soils in the watershed are not conducive to wastewater treatment, and so special care must be taken to ensure that septics are functioning properly. Both educational efforts and significant public engagement will be necessary to implement these recommendations.

Natural shoreline design is a landscaping technique incorporating bioengineered features and native plantings to prevent shoreline erosion while maintaining aquatic habitat and recreational uses. These designs vary greatly based on site conditions but provide similar benefits when well designed. In addition to habitat benefits, natural vegetation slows runoff and captures sediment similar to filter strips. This directly reduces sediment load, and also reduces pathogen and nutrient loading from animal waste or fertilizer found on lawns. Natural buffers have the added benefit of dissuading geese from loitering in the area.

Along with restoring natural shorelines, reducing fertilizer use on lawns near waterbodies is an important part of reducing nutrient runoff. Replacing lawn with native plants reduces the nutrients and water needs of residential landscapes. Native vegetation also provides more habitat for local wildlife, especially pollinators and insects.

Local policy is necessary to enhance oversight of septic systems through the implementation of a **septic testing ordinance** and a review of septic standards for new or replacement septic systems. Septic maintenance is a critical and often overlooked responsibility of homeowners—an estimated 25% of septic systems in Michigan are failing. This not only contributes to impairments in surface water quality; it impacts drinking water since most households rely on private groundwater wells. Increasing the frequency of septic testing will help to ensure that homeowners are aware of when action is needed. EGLE has implemented a new statewide loan program for replacing failing septic systems.

Other Recommendations
Other recommendations for boaters and riparian landowners:

- Remove all signs of vegetation from boats and trailers before leaving access areas.
- Thoroughly wash boats and trailers before moving to another water body or drain and

leave boats dry docked for 7 to 10 days.
- Do not feed geese or other waterfowl.
- Remove pet or waterfowl waste from lawns.
- Be knowledgeable and aware of exotic species transport to prevent further spread throughout the watershed.

CHAPTER 7 - INFORMATION AND EDUCATION

Communication and collaboration are key to successfully implementing positive change. In order to achieve goals established in this watershed management plan, working with state agencies and local organizations will be necessary. Education efforts will focus on three main areas: septic systems, natural shorelines, and agricultural BMPs.

7.1 Septic Systems

Educating homeowners about the importance of proper septic system care is one of the most important steps towards better water quality in the Swan Lake watershed. There are plenty of existing septic system educational materials available, so the focus would be on distribution and not creating new materials.

Materials:
- SepticSmart Week webinars
- Michigan Septic Replacement Loan Program
- Community Action of Allegan County Well and Septic Repair Program

Audience:
- Riparian homeowners
- Residents
- Local Officials

Potential Partners:
- EGLE
- Allegan County Health Department
- Community Action of Allegan County
- Local Government

7.2 Natural Shorelines

Natural shorelines and plantings are the most comprehensive way to reduce the impact of residential properties. This practice is broadly beneficial and cost-effective, but needs to be normalized in order to become widespread. Encouraging early adopters and creating a demonstration site are key to widespread shoreline restoration.

Materials:

- Michigan Shoreland Stewards Program Guide
- Outdoor Discovery Center (ODC) Network rainscaping resources
- Michigan Shoreland Stewards Ambassador Training
- Landscaping for Water Quality

Audience:

- Riparian homeowners
- Lake Associations

Potential Partners:

- Lake Associations
- Michigan Natural Shoreland Partnership
- MiCorps
- Local native plant nurseries
- MDNR

7.3 Agricultural BMPs

Because of the prevalence of agriculture in the watershed, producers are a critical audience. The majority of recommendations contained in this plan are relevant to producers, and a firm understanding of what practices to implement and how to do so effectively will be necessary for the success of this work. Broad awareness of the agricultural recommendations will serve to create networks of support where producers can help one another troubleshoot specific issues when implementing a practice.

Materials:

- Midwest Cover Crops Field Guide - Midwest Cover Crops Council
- No-till Cover Crops Handbook - Nature Conservancy

Audience:

- Producers
- Hobby farmers
- Residents

Potential Partners:

- Farm Service Agency (FSA)
- Natural Resources Conservation Service (NRCS)
- MDARD
- EGLE
- Local Governments

CHAPTER 8 - MILESTONES AND EVALUATION

Evaluation of the implementation of the Watershed Management Plan (WMP) will provide the Steering Committee an opportunity to assess the effectiveness of activities that have been implemented to achieve the goals set forth in the plan. This chapter will describe the set of criteria and milestones that will be used to determine if pollutant reductions are being achieved over time and if substantial progress is being made toward attaining water quality standards. If implementation work does not result in the expected water quality improvements, this WMP should be revised to address any shortfalls.

This chapter will also discuss interim milestones that will demonstrate progress towards success. While attainment of water quality standards is the measure of complete success, the milestones are indicators of progress that don't require significant data collection. Progress towards milestones can easily and inexpensively be reported to stakeholders. If milestones are not being met in a timely manner, stakeholders should meet to identify and address the barriers to progress.

8.1 Evaluation Criteria and Monitoring

The monitoring plan and success criteria are derived from the water quality standards relevant to the listed impairments or suspected impairments.

Other Indigenous Aquatic Life and Wildlife - A biological survey of the macroinvertebrate community is used to assess this designated use. Sites should receive a rating of "Acceptable" indicating a score of -4 to +4 for the macroinvertebrate community. Because sites in the lower Swan Creek currently have acceptable or higher ratings, these sites should show an increase in their score.

Total and Partial Body Contact Recreation - *E. coli* samples are used to assess this designated use. Five summer sampling events in a 30-day period, each event consisting of three samples, are used to calculate a geometric mean. The geometric mean should be less than 130 *E. coli* per 100 milliliters for the 30-day period or 300 *E. coli* per 100 milliliters on any single day for total body contact, and 1000 *E. coli* per 100 milliliters on any single day for partial body contact. The standard for total body contact applies from May 1st through October 1st, while the standard for partial body contact applies to the whole year.

8.2 Monitoring Plan

Future monitoring efforts should focus on surveying the same locations ACD sampled in 2024 in order to obtain comparable data and show changes over time. Nutrients, physical characteristics, and *E. coli* data should be collected to compare to 2024 values. Before and after data collection connected to the implementation of BMPs is crucial to demonstrate the impact on water quality.

Cooperative Lakes Monitoring Program (CLMP)

An important part of future monitoring efforts is getting the lakes within the watershed enrolled in CLMP. Swan Lake and Duck Lake were enrolled as part of the ACD grant, and continual data collection on those lakes should be supported. Eagle Lake has been enrolled in the past, and should be re-enrolled for future data collection. Muskrat and Schermerhorn Lakes should both be enrolled as well. Most CLMP volunteers are riparian homeowners on the lake they collect data for. Connecting with homeowners and sharing information about the program is the best way to get lakes enrolled. March 1st is the earliest deadline for enrolling a lake in CLMP.

EGLE Watershed Monitoring Program

EGLE conducts regular monitoring for macroinvertebrates and habitat on a 5-year rotation. Follow-up *E.coli* monitoring should be conducted after significant BMP implementation in order to evaluate progress towards attainment.

Residents

There are a number of very active lake residents who have continually worked alongside the development of this management plan to make their own observations and collect their own data. Lake residents regularly employ private companies to collect water quality data in and around their lakes. The Allegan Conservation District will continue to engage with these residents through data sharing and formal stakeholder meetings. This data can be used to determine when another major monitoring effort should be initiated to more fully evaluate watershed health.