Appendix 1

- Water Quality Monitoring QAPP

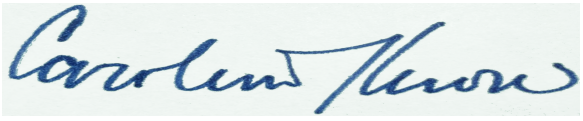
Swan Lake Water Quality
Quality Assurance Project Plan

Swan Lake Watershed Support Project
Tracking Number: #2023-0227
Grantee: Allegan Conservation District

June 3, 2024

Signatures/Approvals:

Prepared By:  Date: 6/3/2024
Brian Talsma, Executive Director, Allegan Conservation District

Reviewed By:  Date: 6/3/2024
Caroline Keson, Monitoring Coordinator, EGLE

For the State:  Date: 6/3/24
Alyssa Riley, Unit Supervisor, EGLE

DISTRIBUTION LIST

- Brian Talsma, Executive Director, Allegan Conservation District
- Bob Sweet, Program Administrator, EGLE
- Caroline Keson, Monitoring Coordinator, EGLE
- Alyssa Riley, Unit Supervisor, EGLE
- Janelle Hohm, Kalamazoo District Contact, EGLE
- Doug McLaughlin, Executive Director, Kalamazoo River Watershed Council

Contact Information provided below:

Brian Talsma Allegan Conservation District 1668 Lincoln Rd Allegan, MI 49010 Phone: (269) 941-6108 Email: brian.talsma@macd.org	Bob Sweet EGLE Nonpoint source program 525 W. Allegan Street Lansing, MI 48909 Phone: (517) 512-9765 Email: sweetr@michigan.gov
Caroline Keson EGLE Nonpoint source program 525 W. Allegan Street Lansing, MI 48909 Phone: (517) 512-0892 Email: kesonc1@michigan.gov	Janelle Hohm EGLE Kalamazoo District Office 7953 Adobe Road Kalamazoo, MI 49009 Phone: (269) 568-2699 Email: hohmj@michigan.gov

Table 1. Personnel and Responsibilities

Organization	**Personnel**	**Responsibilities**
Allegan Conservation District	Brian Talsma Nathan Hilbrands	Project management, field work and data entry
EGLE	Bob Sweet Caroline Keson Janelle Hohm	Technical Assistance

I. Project Description and Summary

With support from the Michigan Department of Environment, Great Lakes and Energy (EGLE), Allegan Conservation District (ACD) will conduct a water quality survey of the Swan Creek watershed (HUC 040500030908) upstream of Swan Lake. Swan Lake has experienced a number of harmful algae blooms (HABs) in recent years, a beach closure due to high E. coli, as well as a high concentration of phosphorus (USGS, 2004). As a shallow and warm lake, it is especially susceptible to eutrophication.

All watersheds in the state of Michigan have been given designated uses and corresponding water quality standards to meet. If a part of a watershed, an AUID, does not meet the water quality standards for a given use, that use is considered to be impaired. The Swan Creek HUC12 watershed is comprised of three AUIDs. This project will take place within MI040500030908-04. The Swan Lake catchment is considered to be impaired for fish consumption. Many of the designated uses have not been assessed for given AUIDs yet; this project will assess the AUID for partial body contact and total body contact recreation. Temperature results from this study can also be compared to cold and warmwater fishery standards. Table 2 shows designated uses not assessed in the watershed. For Other Indigenous Aquatic Life and Wildlife, EGLE plans to monitor both tributaries in 2024 and the results of that study will be added in the WMP addendum. A full table of AUIDs and designated uses can be found in Appendix 5.

Table 2. Swan Creek AUIDs not assessed for designated uses

ASSESSMENT_UNIT_ID	ASSESSMENT_UNIT_NAME	USE_NAME	ATTAINMENT_CODE_NAME
MI040500030908-04	Rivers/Streams in HUC 040500030908	Total Body Contact Recreation	Not Assessed
MI040500030908-04	Rivers/Streams in HUC 040500030908	Warm Water Fishery	Not Assessed
MI040500030908-04	Rivers/Streams in HUC 040500030908	Cold Water Fishery	Not Assessed
MI040500030908-04	Rivers/Streams in HUC 040500030908	Partial Body Contact Recreation	Not Assessed
MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Other Indigenous Aquatic Life and Wildlife	Not Assessed
MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Cold Water Fishery	Not Assessed
MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Warm Water Fishery	Not Assessed
MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Fish Consumption	Not Assessed
MI040500030908-06	SWAN CREEK POND	Total Body Contact Recreation	Not Assessed
MI040500030908-06	SWAN CREEK POND	Cold Water Fishery	Not Assessed
MI040500030908-06	SWAN CREEK POND	Partial Body Contact Recreation	Not Assessed
MI040500030908-06	SWAN CREEK POND	Warm Water Fishery	Not Assessed
MI040500030908-06	SWAN CREEK POND	Fish Consumption	Not Assessed

According to the 2016 National Land Cover Dataset the Swan Lake watershed is around 36% agricultural land and 7% developed land. It is currently unclear what proportion of pollutant contributions originate from each of these land use types. The purpose of the proposed water quality survey is to identify pollutant sources by sampling water quality from lakes and tributaries in the lake's watershed. The data will be examined with respect to the potential pollutant sources and land use characteristics within each tributary's catchment area.

Allegan Conservation District will collect water samples for nutrients, *E. coli*, and optical brighteners, and measure physical stream characteristics at ten stream survey sites. Sites 11 and 12 will be surveyed opportunistically if conditions permit. Nutrient samples will be collected in Swan Lake, Duck Lake, and Eagle Lake from top, middle, and bottom depths at each lake's deepest point. Volunteers with CLMP will collect temperature, dissolved oxygen, chlorophyll a, phosphorus, and Secchi depth data in Swan Lake following MiCorps Cooperative Lake Monitoring Program protocols which are not included in this QAPP.

II. Study Objectives

The purpose of this study is to gather baseline water quality data for the Swan Lake catchment to demonstrate the effects of future BMPs on water quality. The study objectives are:

- Determine pollutant contributions of tributaries entering Swan Lake
- Determine current water quality conditions of Swan Lake
- Relate water quality conditions to upstream land use and HAB timing or intensity
- Determine critical areas of the watershed for preservation and BMPs
- Recommend actions for remediating pollutant sources and HABs

The final results and analysis will be included in an appendix to the Kalamazoo River Watershed Management Plan.

III. Project Timetable and Staff

The project timeframe is January – December 2024. *E. coli* and optical brightener data will be collected weekly during a five-week period during the summer with one additional wet weather sample. Nutrient data and stream characteristics will be collected during dry weather once per month for seven months, as well as opportunistically during three wet weather events. Lake data will be collected once during the summer, and once during the fall.

Table 3. Project timetable and tasks

Task	Jan - Mar			Apr - Jun			Jul - Sep			Oct - Dec			Jan - Mar		
Stream nutrients and measurements					X	X	X	X	X	X	X				
Lake nutrients								X			X				
Stream *E. coli* and optical brighteners							X	X							
Land use and pollutant source analysis									X	X	X	X			
Final report and data submission														X	X

Brian Talsma is the Executive Director of the Allegan Conservation District and former Watershed Technician. Brian has previously worked on updating the Watershed Management Plan for the Gun River Watershed, creating a watershed management plan for Green Lake in the Rabbit River Watershed, and multiple implementation projects reducing erosion and sediment runoff.

Nathan Hilbrands is the current Watershed Technician for the Allegan Conservation District. Nathan has a background in environmental health and conservation and has collected stream characteristics data within the Plaster Creek watershed. Nathan has experience collecting data in the field with Michigan Natural Features Inventory and Calvin University research, and experience working with water quality data with the Lower Grand River Organization of Watersheds.

IV. Collection Procedures

Brian Talsma and Nathan Hilbrands will complete all surveys and calculations with the assistance of volunteers under their supervision. A blank field data sheet is in Appendix 1. A map of the Swan Lake watershed and the survey sites is shown in Figure 1.

Sample collection will include both dry and wet weather events. Wet weather events have over 0.5 inches in the previous 24 hours or 0.25 inches in the previous 12 hours. Dry weather is considered to have less than 0.1 inches over the previous 72 hour period. For stream characteristics and nutrient sampling, seven dry weather events will be sampled over a seven-month period, and three wet weather events will be sampled during that period opportunistically. Weather Underground station KMIGOBLE5 will be used for precipitation data. If this station's data is unavailable, the next nearest station with available data will be used.

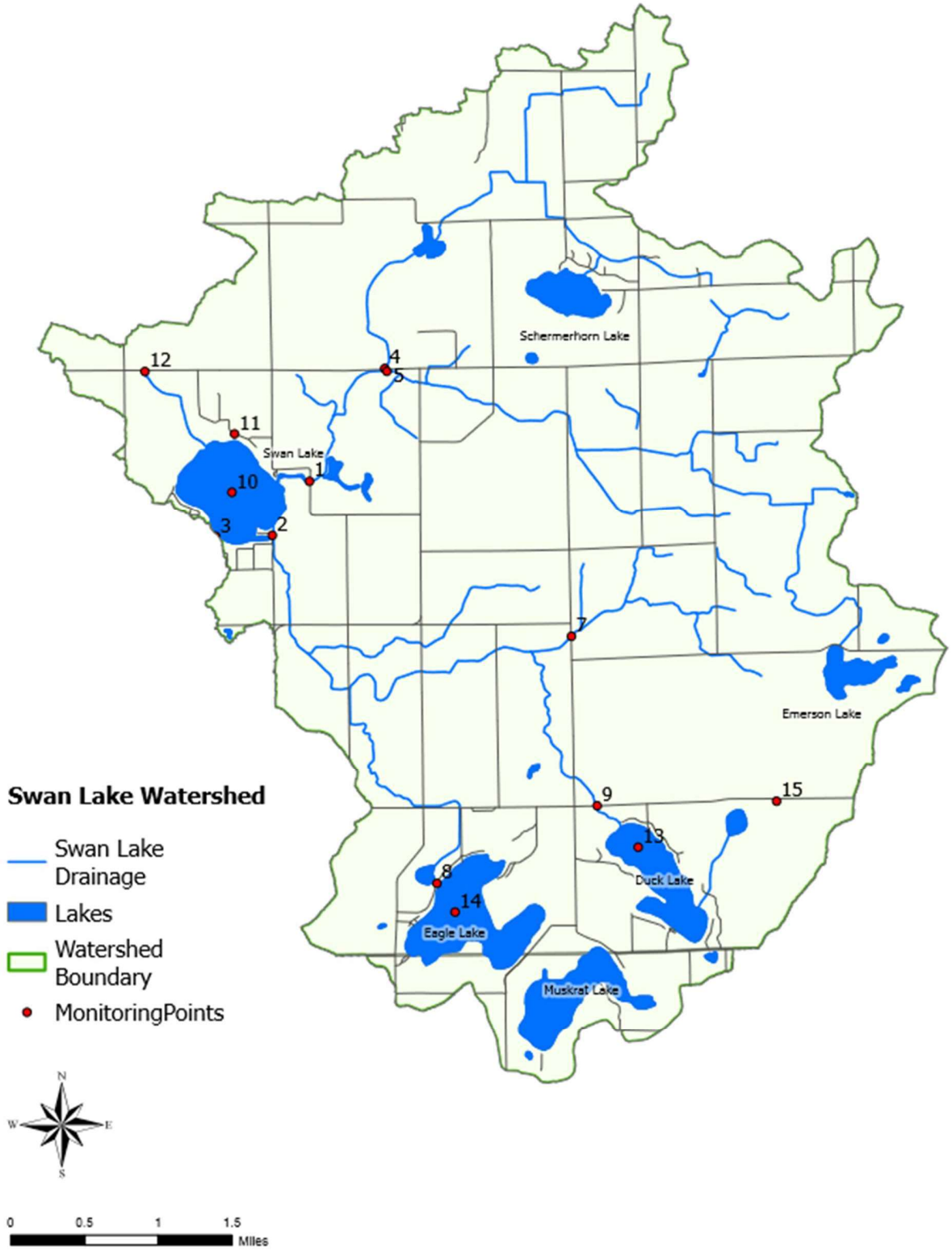


Figure 1. Map of Swan Lake watershed with survey locations. Site 3 is located outside of the watershed at the nearest access to the outlet of Swan Lake. Site 6 has been removed from the study.

E. coli

To compare *E. coli* data to the daily maximum Michigan Water Quality Standards, three samples will be taken weekly at each location during a 30-day period so a geometric mean can be calculated. *E. coli* sampling will be 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 quarters, with samples collected at the 25th, 50th, and 75th quartiles. Water samples will be collected using the grab sample method using lab-provided and washed bottles. Samples will be collected by uncapping and inverting the bottle, keeping an air pocket in the bottle until the required depth (halfway between the surface and bottom of stream). At that time the bottle will be flipped and allowed to fill. *E. coli* samples will be collected at sites 1,2,7,8, 9, and 15.

In addition, the following procedures will be followed:

- Face upstream and stand downstream of where samples will be taken.
- When samples are collected from the creek, care will be taken to ensure that there is sufficient flow, or that flow conditions are within the normal range for that particular stretch of creek. Samples will not be collected if flow is so low that isolated puddles exist.
- Avoid sampling the surface layer of water, which may contain a floating film.
- Avoid disturbing sediment, debris dams, or aquatic vegetation.
- If a river is flowing, avoid targeting stagnant areas of the river to maintain the representativeness of the samples.
- Samples will be immediately placed on ice in a cooler for transportation to the lab.

Optical Brighteners

Optical brighteners are compounds added to laundry detergents and cleaning agents whose fluorescence can be detected with fluorometers. Sample fluorescence is compared to a standard solution with a known concentration of detergent using a laboratory fluorometer. Samples will be taken in conjunction with *E. coli* samples following the same field protocol using lab-provided and washed, foil-wrapped, amber glass bottles. Samples will be stored in a light-proof container in a refrigerator until transported to the lab.

Water Chemistry

Water samples for chemical analysis will be taken at stream and lake sites. Lab-provided sample bottles will be used for all parameters. Label tape will be affixed to all bottles and indelible marker used to write sample site ID and date.

Stream samples will be collected using the grab sample method at stream sites. The bottles will be rinsed three times at the site with water from the stream prior to collecting the sample. Water samples will be collected at mid-stream and mid-depth by uncapping and inverting the bottle, keeping an air pocket in the bottle until halfway between the surface and bottom of stream, flipping over to fill, and capping securely.

Lake samples will be collected at top, middle, and bottom depths at the deepest point of each lake. Depth will be measured using a handheld depth finder. Bottles will be triple rinsed with water from their respective sampling depth. Bottom samples will be collected with a vertical Van Dorn sampler at 1

meter above the measured depth, and middle samples will be collected with a Van Dorn at half the measured depth. Surface samples will be collected with the grab sample method described previously.

Physical Characteristics

Water temperature and dissolved oxygen content will be measured in-situ using a YSI Pro20. Physical measurements with the Pro20 will be made mid-stream and at mid-depth. The Pro20 will be calibrated per user manual instructions prior to each monitoring event. If calibration fails, the unit will be calibrated again and if unsuccessful, YSI technical support will be contacted to resolve the issue. If unable to calibrate with technical support or if there are any other serious issues affecting performance, a second Pro20 is available for use. Field data will be recorded on paper data sheets.

Wetted width, depth, and flow will be measured immediately after water sample collection during all monitoring events at all sites. Wetted width, depth, and flow will be used to estimate stream discharge following these procedures:

1. Select a segment of the stream within the sampling location (Figure 2). This location should be deep enough to float a neutrally buoyant object (object that neither sinks nor floats on top) freely and long enough that it will take between 10 and 30 seconds for the object to travel through the reach undisturbed or obstructed. This distance will be identical for all three floats. Suitable objects include oranges, small sticks, or small sponge rubber balls.
2. Using a stopwatch, determine the time required for the neutrally buoyant object to travel through the entire measured reach. Repeat two times for a total of three observations. The float time may differ between the three floats.
3. Using a measuring tape, measure the stream width at three cross sections located within the float reach (Figure 2): one near the upstream end of the flow reach, one near the middle of the flow reach and one near the lower end of the flow reach. Record the three widths on the “Flow Data Sheet” in the Width row.
4. Using a wading rod or meter stick, measure the stream depth for each of the three cross sections at points approximately equal to the following proportions of the total stream width: 0.1, 0.3, 0.5, 0.7 and 0.9. Record the values. Be sure to include the units (standard or metric) used in collection of these measurements.
5. The mean stream velocity is estimated by calculating the average time it takes for a neutrally buoyant object to flow through a measured length of the channel (step 2). The channel cross-sectional area is calculated from the series of depth measurements along the three channel cross-sections (steps 3 and 4). Discharge is the product of mean velocity and channel cross-sectional area (Figure 2).

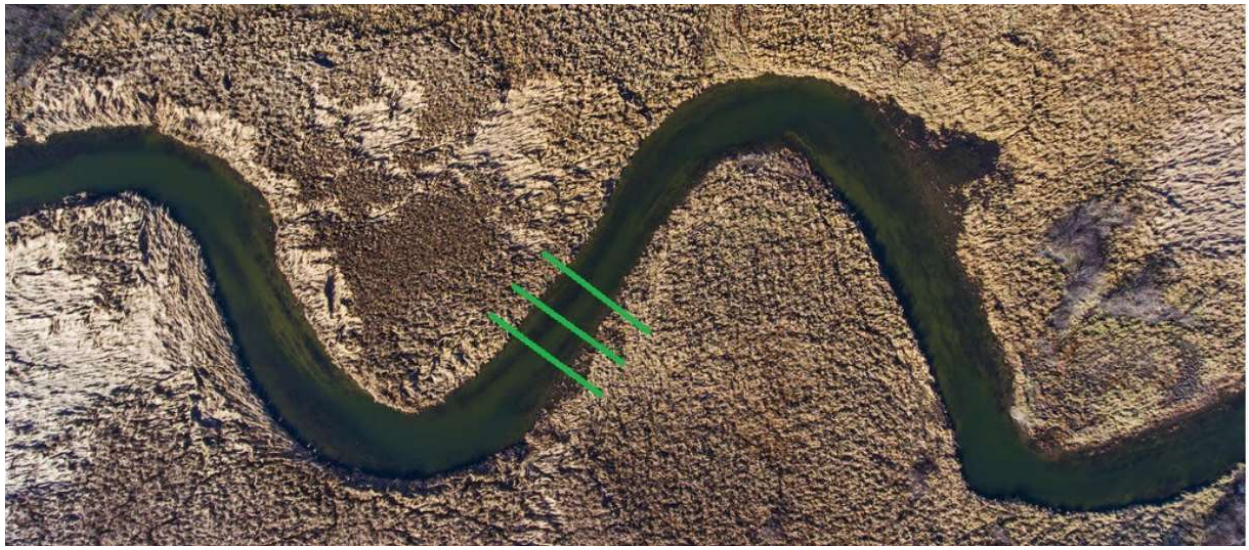


Figure 2. Measure width and depth cross sections at three locations in the stream reach where float time is recorded.

V. Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) guidelines and rules have been established to ensure the reliability and validity of sample collection activities. Compliance with QA/QC is monitored by Brian Talsma. The objectives are to:

- Ensure all procedures are documented, including any changes in administrative and/or technical procedures.
- Ensure all field procedures are conducted according to this QAPP.
- Ensure all data are properly recorded and archived by reviewing data at the end of each day prior to leaving the field.
- Monitor performance of the data collection procedures by a systematic inspection program and provide for corrective action if necessary. If any deviation from the procedures or quality criteria listed in this QAPP is found, data will be flagged for review and reported to EGLE upon submission of the data. If time and resources allow, re-sampling will take place. Outliers will also be flagged for review and will be included or excluded from analysis on a case-by-case basis.

Field Data Quality Objectives will be defined as follows:

- Completeness is ensured by obtaining high-quality data at each site, following the procedures in this QAPP to ensure data does not need to be omitted. All data forms will be checked for completeness prior to leaving each site. At least 95% of the data collected during the inventory will be usable.
- Representativeness is ensured because the design of the study ensures samples represent the entirety of the watershed by selecting locations that receive inputs from diverse land use types. See Figure 3 for the approximate drainage areas of each sampling location.

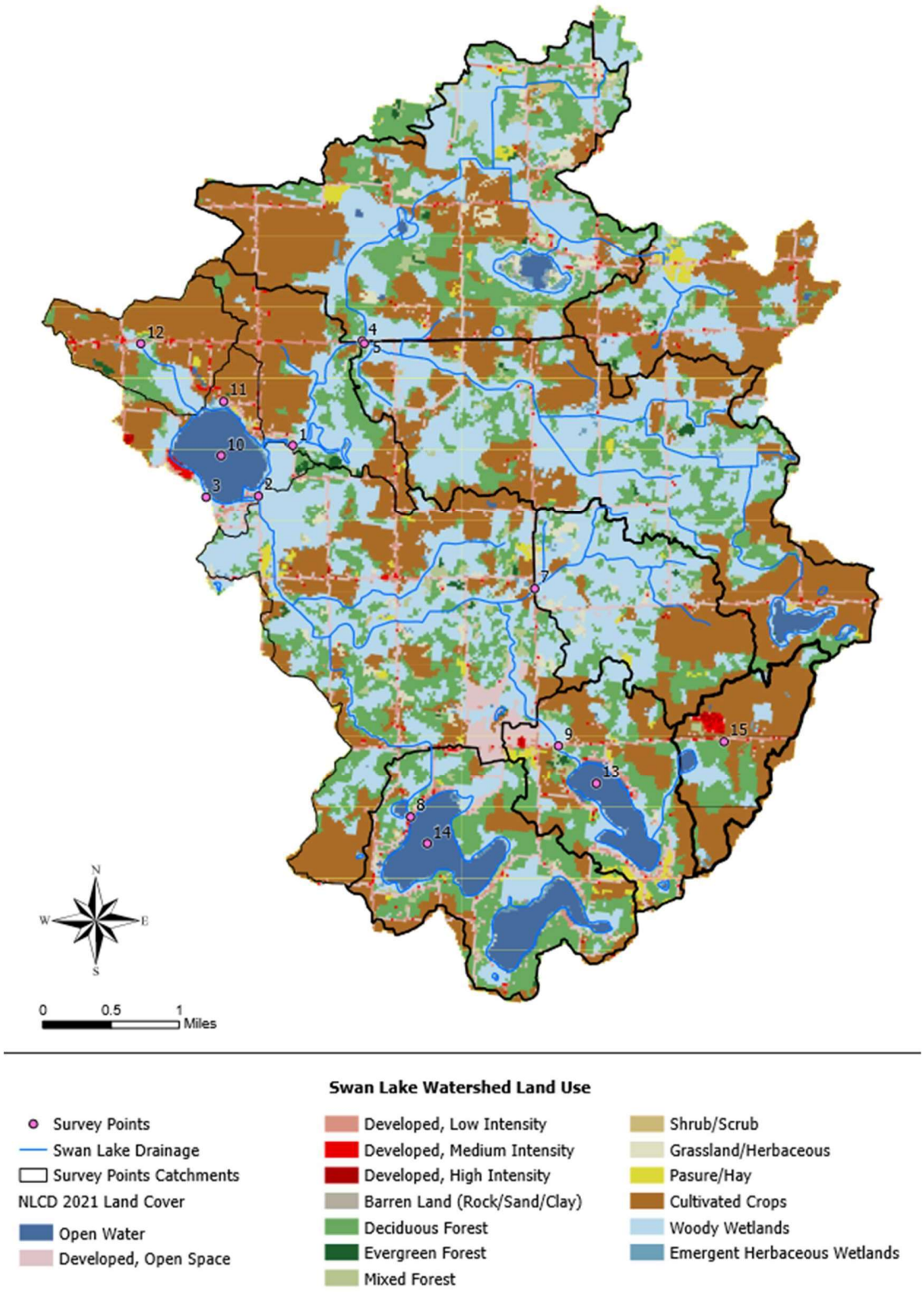


Figure 3: Map of Swan Lake land use and approximate catchment for each sample location.

- Precision will be attained through the collection of field duplicates and replicates for each parameter according to the schedule in table 4. Replicates should have a relative percent difference (RPD) of less than 20%. Duplicates are used for *E. coli* and optical brightener samples and a high RPD will not necessarily be grounds for removal. If the daily geometric mean (DGM) of the duplicates compared to all samples for the site is greater than 50% and the two values do not agree on attainment of the water quality standard, the result will be flagged as having high variability.
- Accuracy will be ensured through the use of trusted laboratories with internal QA/QC procedures, use of equipment and field blanks, and calibration of instruments before sampling. See table 5 for practices for each parameter.
- Comparability external other data sets will be ensured through the use of standard field and lab procedures as detailed in table 5.

Table 4. Data quality objectives for sample analysis

Parameter	Accuracy	Precision
***E.coli* and optical brightener analysis**	1 field blank per sample day (1 per 18 samples)	Collect and analyze field duplicates at one site per day.
Nutrient analysis	1 equipment blank per sample day using Van Dorn (1 per 9 samples)	Collect and analyze field replicates for 1 per 21 samples.
Oxygen and temperature	Calibrate meter according to instructions (Appendix 2)	A second person will recalibrate and conduct replicate measurements at 1 site per sampling day (minimum 1 in 10); DQO = RPD of ≤ 20%

Table 5. Laboratory, methods, detection limits, and sample holding times.

Parameter	Laboratory or Instrument	Method	Detection Limit	Holding Time
Total Phosphorus	Prein and Newhoff	SM4500-P-E-2011	0.02 mg/L	48 hours
Orthophosphates	Prein and Newhoff	SM4500-P-E-2011	0.02 mg/L	48 hours
Total Kjeldal Nitrogen	Prein and Newhoff	SM4500-N-2011	0.5 mg/L	48 hours
Nitrate	Prein and Newhoff	EPA 300.0	0.1 mg/L	48 hours
Nitrite	Prein and Newhoff	EPA 300.0	0.1 mg/L	48 hours
Ammonia	Prein and Newhoff	SM4500-NH3-D-2011	0.03 mg/L	48 hours
Total Suspended Solids	Prein and Newhoff	SM2540D-2015	4 mg/L	48 hours
E. coli count	Prein and Newhoff	Hach 10029 with 10x dilution	10 CFU/100mL	6 hours
Optical brighteners	Grand Valley State University - Annis Water Resources Institute	Burres 2011 (based on Cao et al. 2009), see Appendix 2	5 µL/L Tide equivalent	28 days
Dissolved oxygen	YSI Pro20	Described in QAPP	0 – 50 mg/L, see Appendix 3	N/A
Temperature	YSI Pro20	Described in QAPP	0 – 45 °C, see Appendix 3	N/A

VIII. Data Management

Water samples will be tracked through chain of custody forms from collection to laboratory delivery (Appendix 4).

Data will be stored both physically and digitally. Data sheets will be digitized at the end of each sampling day and then stored with other grant files for a minimum of 7 years. Laboratory results will be received digitally and stored indefinitely with other project data on ACD's Google Drive. Project data will be formatted to fit the STORET template and sent to EGLE with the final report.

Related Data

Two other data collection initiatives will occur concurrently with this study under other QAPPs. The data from these initiatives will be collected digitally and utilized in this analysis. Copies of these data will be stored in the same manner as those generated by this project. The first initiative is through the MiCorps Cooperative Lakes Monitoring Program. Volunteers will follow CLMP protocols to collect temperature, dissolved oxygen, chlorophyll a, phosphorus, and Secchi depth data from Swan and Duck Lakes. The second initiative is weekly sampling for *E. coli* at the Swan Lake boat launch conducted by the Allegan County Health Department.

IX. Assessments and Response Actions/Reports

Brian Talsma will be responsible for oversight of the inventory work, as well as the review and approval of all deliverables. The information collected during this project will be discussed by the project Steering Committee and analyzed and summarized in the Watershed Management Plan by Nathan Hilbrands. Progress will be reported to EGLE during quarterly reports, and data, calculations, and will be submitted with the final report. All water quality data will be recorded and submitted to EGLE on the STORET template.

X. Data Validation and Usability

Review will take place during the entry of each day's data, on a quarterly basis during the period of data collection, and upon final analysis of field data. If errors are suspected or detected, data will be discarded and the site in question will be resurveyed.

XI. Data Analysis and Interpretation

Comparison to Existing Standards and Recommendations

To determine the status of designated uses in the watershed, results will be compared to applicable standards or recommendations. Where a standard or recommendation does not exist, the Steering Committee will recommend a local standard.

Three samples for *E. coli* testing will be collected at each site to calculate daily and 30-day geometric means and compared to Michigan's Part 4 Water Quality Standards Rule 62. Daily geometric means at each site will be compared to the daily maximum of 300 CFU/100mL for total body contact recreation and 1000cfu/ml for partial body contact recreation. 30-day geometric means will be compared to the partial body contact standard of 130cfu/ml.

Michigan law does not set a specific standard for nutrient concentrations. It does state "nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the surface waters of the state." Total Nitrogen and Total Phosphorus values will be compared to

EPA Ecoregion VII Ambient Water Quality Recommendations. The recommendation for total Nitrogen is 0.54 mg/L and the recommendation for total Phosphorus is 33 µg/L.

Temperature and dissolved oxygen have standards defined in Part 4. Swan Creek downstream of 109th Ave. is a designated type 4 trout stream and is therefore protected as a coldwater fishery, and therefore measurements at the outflow of Swan Lake should meet the minimum standards for coldwater fisheries. The dissolved oxygen standard is 7 mg/L. Tributaries upstream of Swan Lake are protected as warmwater fisheries and should meet the dissolved oxygen standard of 5mg/L. Temperatures in each reach (upstream and downstream of Swan Lake) should meet monthly average temperature standards shown in table 6. While this study will not collect enough data to evaluate possible temperature impairments, the data collected will be used by the Steering Committee to determine whether further investigation is warranted.

Table 6. Temperature standards in degrees Fahrenheit for coldwater fisheries (downstream Swan Lake) and warmwater fisheries (upstream Swan Lake)

Month	J	F	M	A	M	J	J	A	S	O	N	D
Upstream Swan Lake	41	40	50	63	76	84	85	85	79	68	55	43
Downstream Swan Lake	38	38	41	56	70	80	83	81	74	64	49	39

Michigan does not currently have water quality standards for Suspended Solids, and standards vary for other states, between 30mg/L to 158mg/L by state. The EPA has a standard in terms of light reduction, stating solids “should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life."

Pollutant Contribution Calculations

Nutrient and sediment contributions to Swan Lake and downstream to the Kalamazoo River will be estimated using the collected data. Instantaneous loading will be calculated by multiplying the pollutant concentration by the flow. Where previous data exists, trends will be analyzed for significant changes (an R-squared value of 0.70 or more).

Identification of Critical Areas and Pollutant Sources

The data gained through this study will primarily serve to help the Steering Committee identify the highest priority actions and locations for reducing pollutant loading. Areas showing high pollutant contributions will be examined to determine likely pollutant sources through an analysis of available data including septic records and land cover, observations from Steering Committee members, and data obtained through an agriculture inventory described in another QAPP.

All field data and interpretation of findings will be shared with watershed planning partners to identify and prioritize locations and options for future nonpoint source remedial activities, as well as develop a watershed management plan. Data from the tributary study will be used to identify sub-watersheds that contribute disproportionately high loads of nutrients or high pollutant concentrations. Sub-watersheds found to be exceeding Michigan water quality standards will be prioritized. If no sub-watersheds exceed

water quality standards, sub-watersheds with the highest nutrient concentrations will be prioritized. This information, coupled with agriculture inventory and other readily available data, will be used to determine critical areas for the watershed management plan and in turn, develop recommendations for addressing specific non-point source pollution problems.

Appendix 1 - Field Data Sheets

Site ID	Date and Time	Surveyor Names	Wetted Width (m)		Depth (stream percentile, measured in meters)					Float Time (seconds)	Discharge (m^3/s)	Temp (Celsius)	DO (mg/L)	Precipitation (inches)		Grab Samples Collected	Notes (weather conditions)
					0.1	0.3	0.5	0.7	0.9					24 hours	72 hours		
			Upstream														
			Middle														
			Downstream														
			Upstream														
			Middle														
			Downstream														
			Upstream														
			Middle														
			Downstream														
			Upstream														
			Middle														
			Downstream														
			Upstream														
			Middle														
			Downstream														
			Upstream														
			Middle														
			Downstream														
			Upstream														
			Middle														
			Downstream														

Site ID	Date and Time	Surveyor Names	Collection Depth (m)			Samples Collected	Notes (weather conditions)
			Top	Middle	Bottom		

Appendix 2 – Optical Brightener Standard Operating Procedure

Standard Operating Procedure (SOP) 3.4.1.4

By Erick Burres **Updated 3/2011**

Measuring Optic Brighteners in Ambient Water Samples Using a Fluorometer

Introduction

Using Optic Brighteners as Indicators of Wastewater?

Optical brighteners (also known as OBs or OBAs), or fluorescent whitening agents (FWAs in the detergent industry), are compounds that are excited (activated) by wavelengths of light in the near-ultraviolet (UV) range (360 to 365 nm) and then emit light in the blue range (400 to 440 nm). Electrons in fluorescent molecules are excited into a higher energy state by absorption of light and then emit a small amount of heat plus fluorescence as the electrons return to their ground state. Usually, the fluorescence from the second excited state is measured as this can be accomplished with a variety of different pieces of equipment called fluorometers.

Optical brighteners are primarily added to laundry soaps, detergents, and cleaning agents for the purpose of brightening fabrics and/or surfaces. Optical brighteners are dyes that are added to essentially all laundry detergents. These brighteners are adsorbed by fabric and brighten clothing.

Laundry wastewater is the largest contributor of optical brighteners to wastewater systems because it retains a large portion of dissolved optical brighteners. Laundry effluent is predominantly associated with sanitary wastewater. Toilet papers contain fluorescent whitening agents. As toilet paper breaks down, fluorescent whitening agents are released into water. Since optical brighteners decompose relatively slowly except through photo-decay, they serve as ideal indicators (surrogates) of illicit discharges in storm drains, leaking pipes from community wastewater treatment systems, and/or failing septic tanks.

Using optical brighteners as indicators (surrogates) for detecting wastewater has several advantages. Detection is nearly instantaneous, the equipment used is relatively inexpensive, no formal training is needed, and large numbers of samples can be analyzed in a short period of time. It is even possible to conduct “laboratory” operations “in the field”. Where fecal contamination is known or is suspected to occur, the detection of optical brighteners can assist in pollution screening and source identification.

Preparations and Procedures:

Supplies:

Sample Bottles
Foil
Disposable polymethacrylate cuvettes
Permanent marker
Fluorometer (such as an Aquaflor)
UV Lamp (300-400nm excitation & 436nm emission filters; (6W, 365 nm typically used)
UV-proof safety glasses
Stopwatch
Calculator
DI Water
Laboratory Notepad/Datasheets
Calibration standard solution
    Equipment necessary to prepare a calibration solution
        OB Agent (Tide 2X Original Scent is suggested. Since at least March 2011, all Tide detergents are 2X)
        Pipette (Piston type)
        Pipette Tip(s)
        DI Water
        1 liter Erlenmeyer flask & aluminum foil or a 1 liter amber bottle
        Falcon tube (50ml) or equivalent
        Tissue -optic brightener free (This can be checked by placing the tissue under the UV lamp and checking for florescence.)
Secondary Standard (optional)
Computer & software: Internal data logging & downloading to a spreadsheet (optional)

Sample Storage:

Fig. 1 Sample wrapped in foil.

The sample must be stored at room temperature and in a lightproof container. An amber bottle or a sample bottle covered with foil can be used (Figure 1).

Always protect the sample from light exposure. Optic brighteners photodecay.

Positioning the Sample (Labeling and Marking the Curvette):

The curvette (Figure 2) needs to be placed in the sample compartment with the same orientation for each measurement taken. Mark the curvette at the top on one side so that the curvette can be placed into the sample compartment the same way each time (Figure 3).

Fig. 2 Disposable polymethacrylate cuvette

Fig. 3 Curvette labeled for positioning

Sample Handling:

Use a clean (new) curvette for each sample. The curvette must be dry on the outside. If it is not possible to use a new curvette for each sample, after cleaning the curvette fill it with a blank solution (DI water) and take a measurement to check for contamination. If the curvette is contaminated do not use it again.

Do not take a measurement if there are air bubbles in the curvette. Remove any bubbles present by lightly tapping on the outside of the curvette wall with your finger, or slightly tilt the curvette to dissipate the bubbles.

Calibration:

Read and follow the instructions for your fluorometer. It is suggested that you use an optic brightener (OB) calibration solution. If this is not available, one can be prepared using a clothes washing detergent such as Tide. If you are using a fluorometer provided on loan by the Clean Water Team, a preset adjustable secondary standard will be provided which will allow the operator to quickly and easily check the fluorometer's calibration stability. If the meter's reading is more that +/-10% of the secondary standard's value, the fluorometer should be recalibrated. Be sure that the calibration value for the 50ppm standard is set to 100 relative fluorescence units (RFU) such as 2 RFU relative to 1ppm of calibration solution (Tide 2x or equivalent).

Preparing a 50ppm OB calibration solution using a clothes washing detergent:

As it can be very difficult to made a 50ppm calibration solution directly, because it requires adding 5ul of detergent (Tide 2X) into 100ml DI it is recommended that a two step serial dilution process be used..

- Prepare a 1 liter Erlenmeyer flask covered with aluminum foil to make it light-proof or a 1 liter amber bottle with 100 ml of DI water.

- Using a piston style pipette, draw 0.5ml of OB agent (Tide 2X Original Scent is suggested). Wipe off excess OB agent that might have coated the pipette tip. Dispense the OB agent into the 1 liter vessel of DI water, cap and mix thoroughly. Allow foam to settle before next step*. (This solution is 500ppm Tide 2X and can be reserved as stock for further use.)

- To then make the actual calibration solution (50.0ppm Tide 2X), add 5.0ml of the stock solution to 45ml of DI water in a foil wrapped Falcon tube. Cap the tube and mix thoroughly. Allow foam to settle before use*.

- It may take quite a long time for foam to settle

Fig. 4 Fluorometer

Fig. 5 Secondary Standard

Label 3 disposable polymethacrylate cuvettes per sample (Analyze triplicates for each sample).

Load 3mls of sample into each curvette (protect the sample from light as much as possible during loading). If 3mls of sample is not available be sure that at least 2ml of sample is used (1/2 of the curvette is full).

Assigning a Calibration Standard Value (Aquafluor):
1. Press the <STD VAL> button.
2. Use the - and + arrow buttons to set the standard value. Holding down either arrow button down will allow you to change the value using fast scrolling.
3. When finished, Press the <ENT> or <ESC> button to accept the value and to return to the Home screen.

Performing the Calibration (Aquafluor):
1. Press the <CAL> button.
2. Press <ENT> to start the calibration.
3. Insert your blank sample and press <ENT>. The Aquafluor will average the reading for 10 seconds and set the blanking zero point.
4. Insert the standard sample and press <ENT>. The reading is averaged for 10 seconds and the Standard Calibration value is set.
5. Press <ENT> when the calibration is complete to accept the calibration. If <ENT> is not pressed within 10 seconds, you will be asked if you want to abort the calibration. Aquafluor™ User's Manual 12 Press the ↑ or ↓ arrow button to abort or accept the calibration respectively. If at anytime during steps 1-4 you want to stop the calibration, press <ESC>. This will return you to the Home screen and will default the instrument to the previous calibration.

Sample Preparation:
Label 3 disposable polymethacrylate cuvettes per sample (Analyze triplicates for each sample).

Load 3mls of sample into each cuvette (protect the sample from light as much as possible during loading). If 3mls of sample is not available be sure that at least 2ml of sample is used (1/2 of the cuvette is full).

Sample Analysis:

Turn the fluorometer on.

Insert the sample.

Press the <READ> button.

The reading result will appear on the top line of the Home screen.

Once the word "WAIT" disappears from the Home screen another reading can be made. During each reading the sample is warmed.

Be sure that you wait for each sample to equilibrate to room temperature before each reading is made.

Analytical Procedure:

As the analytical procedure is followed, ensure that all sample information and data is recorded as it relates to the analytical decision process (Table 1). Examples of laboratory data sheets can be found in Appendix A and B.

Step 1.
Measure initial fluorescence using Aquafluor (or equivalent)

If the sample measures <5ppm conclude that the sample is negative for optical brighteners.

If the sample measures higher than >5ppm, continue to step 2.

Step 2.
Expose samples directly to UV light for 5minutes and then measure fluorescence again. Calculate the percentage of reduction in fluorescence after 5min compared to before UV exposure

If % reduction < 8%, conclude the sample is negative for optical brighteners.

If % reduction ≥30%, conclude the sample is positive for optical brighteners.

If % reduction <30% and >8%, continue to Step 3.

Step 3.
Expose samples under UV for another 5min (i.e. accumulatively 10min), measure fluorescence, calculate the ratio of % reduction in fluorescence after 10min UV exposure over % reduction after 5min UV exposure

If the ratio is no less than (equal to or greater than) 1.5, conclude that the sample is negative for optical brighteners.

If the ratio is less than 1.5, conclude that the sample is positive for optical brighteners.

Step 4.
Out of the 3 replicates

If all three are positive → conclude that the sample is positive for optical brighteners.

If two out of three positive → conclude that the presence of optical brighteners within the sample is undetermined.

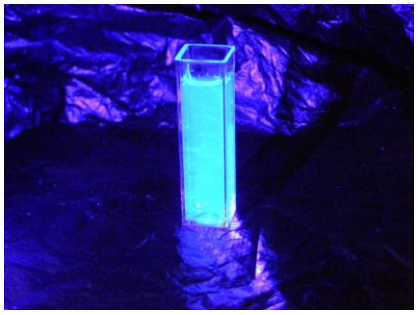


Fig. 6 Prepared (spiked) sample under UV light exposure

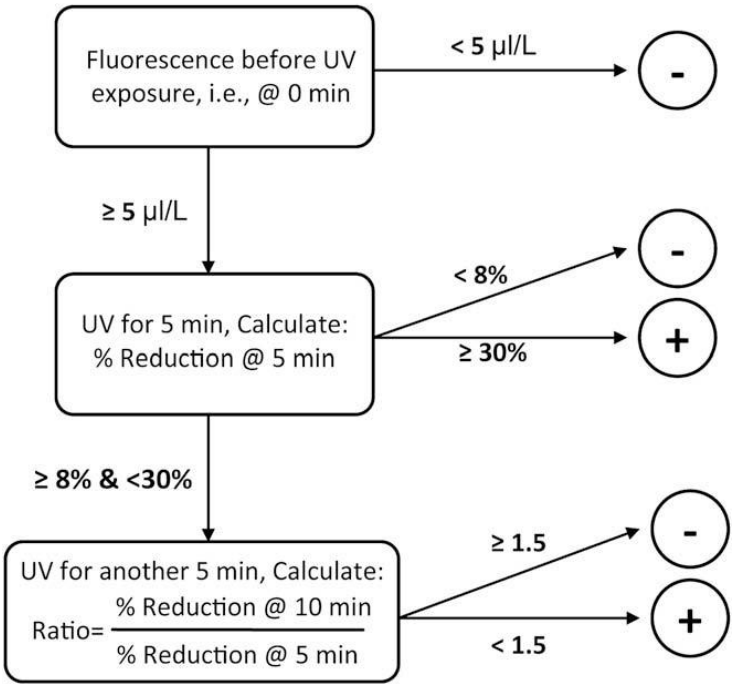


Diagram 1. Analytical Procedure Decision Tree (Cao, 2008)

Sample ID	Date	Replicate	Fluoresc. at 0 min	Step1	Fluoresc. at 5 min	%Reduction in fluoresc. at 5 min	Step2	Fluoresc. at 10 min	%Reduction in fluoresc. at 10 min	Ratio of %reduction at 10min to that at 5min	Step3	OB Result	Notes	QA-1	QA-2	Sample ID	Date	Avg. Initial fluorescence (RFU)	Presence or Absence of OB
Example	3/17/09	1	30	UV	15	50	Positive		n/a	n/a	n/a	Positive		1	1	Example	3/17/2009	21.33	Undetermined
		2	25	UV	20	20	UV	18	28.0	1.4	Positive	Positive		1	1				
		3	9	Negative		n/a	n/a		n/a	n/a	n/a	Negative		0	0				
Legend																			
	Cells that will be filled during the measurement																		
	Cells that give results (Positive, Negative) or instruction (UV) for next step																		
	Lab results on OB detection (Positive, Negative)																		
	Final results to report																		
QA-1,QA-2	QA: the two columns should completely agree with each other																		

Table 1. Example of a Laboratory Data Sheet

OPTIONAL
Internal Data Logging and Data Downloading to a Spreadsheet (Example using software for the Aquafluor):

Activate internal data logging:

Press the <DATA> button 2 times.
Press the <ENT> button to toggle between logging and stop status.
Press the <ESC> button when finished to return to the Home Screen.

Download data:

Connect the fluorometer to the serial port of your computer.
Open the software (Spreadsheet Interface Software- SIS for 380).
< Follow manufacturer instructions to install software.>

Press the <DATA> button 3 times.

Press the <ENT> button 5 times to start the data download.
Press the <ESC> button when finished to return to the Home Screen.

Erase data:

Press the <DATA> button 4 times.
Press the <ENT> button 5 times to erase all logged data.
Press the <ESC> button when finished to return to the Home Screen.

Deactivate internal data logging:

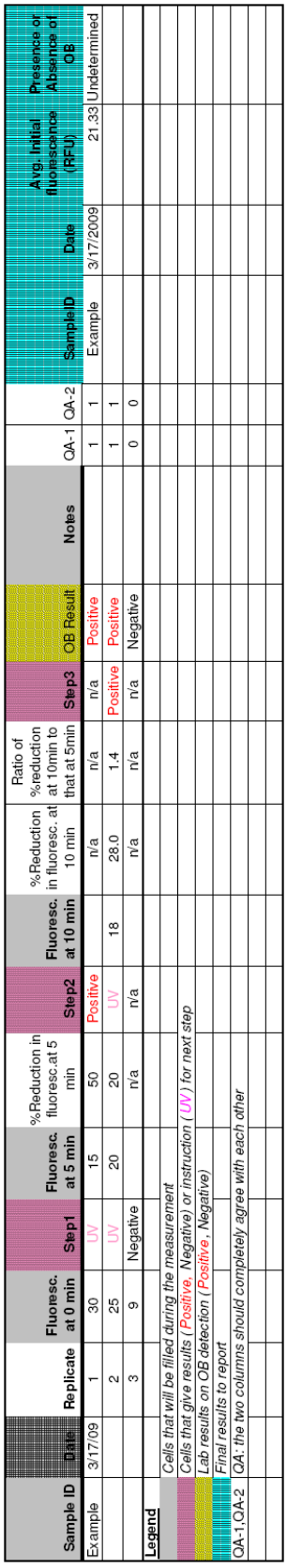
Press the <DATA> button 2 times.
Press the <ENT> button to toggle between logging and stop status.

Fig. 7 Software and data cable

Appendix A Example of a Laboratory Data Sheet (Cao 2009)

Sample ID	**Date**	**Initial fluorescence (RFU)**	**Presence or Absence of OB**

Appendix B Laboratory Data Sheet Example From Table 1 (Cao 2009)



Sample ID	Date	Replicate	Fluoresc. at 0 min	Step1	Fluoresc. at 5 min	%Reduction in fluoresc.at 5 min	Step2	Fluoresc. at 10 min	%Reduction in fluoresc. at 10 min	Ratio of %reduction at 10min to that at 5min	Step3	OB Result	Notes	QA-1	QA-2	SampleID	Date	Avg. Initial fluorescence (RFU)	Presence or Absence of OB
Example	3/17/09	1	30	UV	15	50	Positive		n/a	n/a	n/a	Positive		1	1	Example	3/17/2009	21.33	Undetermined
		2	25	UV	20	20	UV	18	28.0	1.4	Positive	Positive		1	1				
		3	9	Negative		n/a	n/a		n/a	n/a	n/a	Negative		0	0				

Legend

Cells that will be filled during the measurement

Cells that give results (Positive, Negative) or instruction (UV) for next step

Lab results on OB detection (Positive , Negative)

Final results to report

QA-1,QA-2 *QA: the two columns should completely agree with each other*

References

Cao, Yiping and John F. Griffith, Stephen B. Weisberg. 2009. Evaluation of optical brightener photodecay characteristics for detection of human fecal contamination. Water Research http://www.elsevier.com/locate/watres

Ciba Specialty Chemicals, Inc. 2004. Human and environmental risk assessment on ingredients of European household cleaning products: Fluorescent Brightener FWA-1. http://www.heraproject.com/RiskAssessment.cfm

Ciba Specialty Chemicals, Inc. 2004. Human and environmental risk assessment on ingredients of European household cleaning products: Fluorescent Brightener FWA-5. http://www.heraproject.com/RiskAssessment.cfm

Close, M. E., L. R. Hodgson, and G. Todd. 1989. Field evaluation of fluorescent whitening agents and sodium tripolyphosphate as indicators of septic tank contamination in domestic wells. New Zealand Journal of Marine and Freshwater Research 23:563-568.

Gilpin, B. J., and D. Saunders. 2005. Fluorescent whiteners as indicators of human effluent. Environmental Detection News 2:1-2 and 6-7.

Gilpin, B. J., J. E. Gregor, and M. G. Savill. 2002. Identification of the source of fecal pollution in contaminated rivers. Water Science and Technology 46:9-15.
Poiger, T., J. A. Field, T. M. Field, H. Siegrist, and W. Giger. 1998. Behavior of fluorescent whitening agents during sewage treatment. Water Research 32:1939-1947.

Hagedorn, C., R. B. Reneau, Jr., M. Saluta, and A. Chapman. 2003. Impact of onsite wastewater systems on water quality in coastal regions. 23pp. Final Project Report to the Virginia Department of Health and the Virginia Department of Conservation and Recreation, Richmond, VA. Project No. 50312-01-13-PT.

Hagedorn, C., R. B. Reneau, Jr., M. Saluta, and A. Hassall. 2005.Fluorometric Detection of Optical Brighteners as an Indicator of Human Sources of Water Pollution. Part I. Description and Detection of Optical Brighteners. Crop and Soil Environmental News, November 2005

Hagedorn, C., R. B. Reneau, Jr., M. Saluta, and A. Hassall. 2005.Fluorometric Detection of Optical Brighteners as an Indicator of Human Sources of Water Pollution. Part II Development as a Source Tracking Methodology in Open Waters Crop and Soil Environmental News, November 2005

Hayashi, Y., S. Managaki, and H. Takada. 2002. Fluorescent whitening agents in Tokyo Bay and adjacent rivers: Their application as anthropogenic molecular markers in coastal environments. Environmental Science and Technology 36:3556-3563.

Iyer ,Seshadri, M. Barbachem S. McLaughlin, and W. Johnston. 2006. Monitoring Optical Brighteners Helps Track Watershed Pollution. Water World, December 2006 http://w w .pennnet.com/display_article/280471/41/ARTCL/none/none/1/Monitoring-Optical-Brighteners-Helps-Track-Watershed-Pollution

Sargent, D., and W. Castonguay. 1998. Water quality sampling: An optical brightener handbook. http://www.naturecompass.org/8tb/sampling/

Sinton, L.W., R. K. Finlay, and D. J. Hannah. 1998. Distinguishing human from animal faecal contamination in water: a review. New Zealand Journal of Marine and Freshwater Research 32:323-348.

Turner Designs. 2004. Aquafluor: Handheld Fluorometer and Turbidimeter-A User's Manuel. P/N 998-0851

Ullmans Encyclopedia of Industrial Chemistry. 2001 Electronic release, 6th Edition. Wiley-VCH Interscience. http://www.wiley-vch.de/contents/ullmann/ull_10518.html

URS Corporation. 2004. Optical brightener study, Lynnhaven Bay Watershed. 87pp. Draft Report to the City of Virginia Beach, Department of Public Works, Virginia Beach, VA. Project No. 11655695.

Waye, D. 2003. Detecting sewage leaks with optical brightener monitoring. Volunteer Monitor 15:16-17.

Appendix 3 – YSI Pro20 Specifications and Calibration

YSI Pro20 PORTABLE DISSOLVED OXYGEN METER

SPECIFICATIONS W2-03

Pro20 System Specifications (Instrument, Probe, and Cable)		
Temperature	Range Resolution Accuracy	–5 to 55°C (0 to 45°C; DO compensation range for mg/L) 0.1°C ±0.3°C
Dissolved Oxygen % Saturation (galvanic or polarographic)	Range Resolution Accuracy	0 to 500% 0.1% or 1% air saturation (user selectable) 0 to 200% air saturation, ±2% of the reading or ±2% air saturation, whichever is greater; 200 to 500% air saturation, ±6% of the reading
Dissolved Oxygen mg/L (galvanic or polarographic)	Range Resolution Accuracy	0 to 50 mg/L 0.01 or 0.1 mg/L (user selectable) 0 to 20 mg/L, ±2% of the reading or ±0.2 mg/L, whichever is greater; 20 to 50 mg/L, ±6% of the reading
Barometer	Range Resolution Accuracy	400 to 999.9 mmHg 0.1 mmHg ±5 mmHg within ±5°C temperature range from calibration point

Pro20 Handheld Specifications	
Size	8.3 cm width x 21.6 cm length x 5.7 cm depth
Weight with Batteries	475 grams
Power	2 alkaline C–cells providing 400 hours of battery life; low battery indicator
Cables	1– 4– 10– 20– 30– and 100–m lengths with military-spec connectors for handheld compatibility (special order up to 100–m)
Warranty	3–year instrument; 2–year cable; 1–year Polarographic sensors; 6–months Galvanic sensors
Salinity Input Range	0–70 ppt; manual (automatically compensates for manual input value)
Data Memory	50 data sets
Languages	English, Spanish, German, French
Certifications	RoHS, CE, WEEE, IP67 waterproof, 1–meter drop test

YSI, a Xylem brand
1725 Brannum Lane
Yellow Springs, OH 45387

+1.937.767.7241
info@ysi.com
YSI.com

WE KNOW D.O.™

YSI.com/Pro20

Pro20 / **Pro**20i Quick Start Guide

Item #605645

This Pocket Guide is meant to serve as a quick reference in calibrating and operating the Pro20/Pro20i. It is not intended to replace the information found in the User Manual.

Installing the DO Membrane

1. Prepare the O_2 probe solution according to the instructions on the bottle. After mixing, allow the solution to sit for 1 hour. This will help prevent air bubbles from later developing under the membrane.
2. Remove, and discard the red protective cap or used membrane from the sensor.
3. Thoroughly rinse the sensor tip with distilled or deionized water.
4. Fill a new membrane cap with probe solution. Avoid touching the membrane portion of the cap.
5. Thread the membrane cap onto the sensor, moderately tight. A small amount of electrolyte will overflow.
6. Screw the probe sensor guard on moderately tight.

Setting Sensor & Membrane Type

The instrument's Sensor Type must be configured for the sensor installed. Failure to do this may result in damage not covered under warranty.

The instrument will step you through an initial configuration when powered on for the first time. This allows you to set the language, sensor, and membrane options. Use the up or down arrow keys to highlight the appropriate language, sensor, and membrane, then press enter to confirm. To change the sensor or membrane type after the initial configuration, press the **Menu** key.

Barometer Calibration

The barometer reading must be accurate to ensure accurate DO% calibrations and DO readings.

If your barometer requires an adjustment:

1. Determine your local barometric pressure (BP) in mmHg from a mercury barometer, an independent laboratory, or from a local weather service. If the BP reading has been corrected to sea level, use the following equation to determine the true BP in mmHg for your altitude.
   True BP = (Corrected BP in mmHg) – {2.5 * (Local Altitude in feet/100)}

2. From the run screen, use the up or down arrow keys to highlight the barometer box then press enter.
3. Use the up or down arrow keys to adjust the barometer reading to the **local, true barometric pressure**.
4. Press enter to confirm and save the barometer adjustment.

DO Calibration

The Pro20/Pro20i can be calibrated in % saturation, mg/L, or ppm. Calibration of any option (%, mg/L, or ppm) will automatically calibrate the others. The Pro20/Pro20i can be calibrated with the press of one key when One Touch Cal is enabled in the System Setup menu.

The following procedure outlines the % saturation calibration option with and without One Touch Cal enabled.

1. Moisten the sponge in the cal/transport sleeve with a small amount of water and install it on the probe. The cal/transport sleeve ensures venting to the atmosphere. **Make sure the DO and temperature sensors are <u>not</u> immersed in the water.**
2. Turn the instrument on. If using a polarographic sensor, wait 10 minutes for the DO sensor to stabilize. Galvanic sensors do not require a warm up time.
3. Ensure the barometer reading and salinity correction values along the bottom of the screen are accurate.
4. Press and hold the **Cal** key for three seconds.
5. If One Touch Cal is enabled, the instrument will indicate **Calibrating %DO** on the display and automatically calibrate the sensor to the barometer reading and salinity correction value.
6. If One Touch Cal is not enabled, highlight **%** or **%Local** and press **Enter**. The Pro20/Pro20i will display the current DO% and temperature readings along with the % calibration value. Wait at least 3 seconds, then, once the DO% and temperature readings are stable, press **Enter** to complete the calibration.
7. **Calibration Successful** will display for a few seconds to indicate a successful calibration and then the instrument will return to the run screen.
8. If the calibration is unsuccessful, an error message will display on the screen. Press the **Cal** key to exit the error message and return to the run screen.

Salinity Compensation Calibration

The Pro20/Pro20i uses an inputted salinity value in ppt (parts per thousand) to compensate dissolved oxygen mg/L values.

To adjust the salinity compensation value:.

1. Use the up or down arrow keys to highlight the salinity box on the run screen, then press enter.
2. Use the up or down arrow keys to adjust the salinity compensation value to the salinity of the water you are testing.
3. Press enter to confirm and to save the new salinity compensation value.

Taking Measurements

The Pro20/Pro20i can be calibrated in **%** saturation, **mg/L**, or **ppm**. Calibration of any option (%, mg/L, or ppm) will automatically calibrate the others. The Pro20/Pro20i can be calibrated with the press of one key when One Touch Cal is enabled in the System Setup menu.

The following procedure outlines the % saturation calibration option with and without One Touch Cal enabled.

1. Turn the instrument on and wait 5-15 minutes if using a polarographic sensor.
2. To take readings, insert the probe into the sample. Move the probe in the sample at a rate of at least 6 inches per second until the readings stabilize.
3. Highlight **Save** and press **Enter** to store the reading. The instrument will confirm that the reading was successfully saved.

Contact Information

a xylem brand

1725 Brannum Lane
Yellow Springs, OH 45387
(800) 765-4974, (937) 767-7241
info@ysi.com

Visit **YSI.com/Pro20** or **YSI.com/Pro20i** to find the User Manual, specs, and accessories.

Item# 605645 Dwg# 605645
January 2020 Rev E

This page is intentionally left blank.

Appendix 4 – Chain of Custody Form

Prein&Newhof
Engineers▪Surveyors▪Environmental▪Laboratory

3260 Evergreen Drive, NE
Grand Rapids, MI 49525
t. 616-364-7600
f. 616-364-4222

Client:
Billing Address:
Phone Number:
Project Name:
Project Number:
Email Results To:
Sampling Personnel:

Wastewater	W
Drinking Water	D
Groundwater	G
Soil	S
Sludge	L
Other	X

CHAIN OF CUSTODY

Lab Use	Sample Information			MATRIX	Preservative						Analysis Requested
Lab Sample ID #	Date Collected	Time Collected	Sample Description and Location (e.g. MW-1)		None	H2SO4	HNO3	HCL	NaOH	Other	

Comments:

Relinquished By: (Signature)	Date	Time		Received By: (Signature)	Date	Time	
Relinquished By: (Signature)	Date	Time		Received By: (Signature)	Date	Time	
Received for Laboratory By:	Date	Time		Data Package Relinquished By:	Date	Time	

Appendix 5 – Swan Lake 2024 Integrated Report

Appendix 5. Swan Lake 2024 Integrated Report 303d Listings

HUC12	ASSESSMENT_UNIT_ID	ASSESSMENT_UNIT_NAME	LOCATION_DESCRIPTION	WATER_TYPE_NAME	WATER_SIZ	USE_NAME	ATTAINMENT_CODE_NAME
40500030908	MI040500030908-04	Rivers/Streams in HUC 040500030908	Includes: Swan Creek and tributaries from Swan Creek Pond upstream to headwaters.	RIVER	54.3373	Other Indigenous Aquatic Life and Wildlife	Fully Supporting
40500030908	MI040500030908-04	Rivers/Streams in HUC 040500030908	Includes: Swan Creek and tributaries from Swan Creek Pond upstream to headwaters.	RIVER	54.3373	Fish Consumption	Not Supporting
40500030908	MI040500030908-04	Rivers/Streams in HUC 040500030908	Includes: Swan Creek and tributaries from Swan Creek Pond upstream to headwaters.	RIVER	54.3373	Total Body Contact Recreation	Not Assessed
40500030908	MI040500030908-04	Rivers/Streams in HUC 040500030908	Includes: Swan Creek and tributaries from Swan Creek Pond upstream to headwaters.	RIVER	54.3373	Warm Water Fishery	Not Assessed
40500030908	MI040500030908-04	Rivers/Streams in HUC 040500030908	Includes: Swan Creek and tributaries from Swan Creek Pond upstream to headwaters.	RIVER	54.3373	Navigation	Fully Supporting
40500030908	MI040500030908-04	Rivers/Streams in HUC 040500030908	Includes: Swan Creek and tributaries from Swan Creek Pond upstream to headwaters.	RIVER	54.3373	Cold Water Fishery	Not Assessed
40500030908	MI040500030908-04	Rivers/Streams in HUC 040500030908	Includes: Swan Creek and tributaries from Swan Creek Pond upstream to headwaters.	RIVER	54.3373	Agriculture	Fully Supporting
40500030908	MI040500030908-04	Rivers/Streams in HUC 040500030908	Includes: Swan Creek and tributaries from Swan Creek Pond upstream to headwaters.	RIVER	54.3373	Partial Body Contact Recreation	Not Assessed
40500030908	MI040500030908-04	Rivers/Streams in HUC 040500030908	Includes: Swan Creek and tributaries from Swan Creek Pond upstream to headwaters.	RIVER	54.3373	Industrial Water Supply	Fully Supporting
40500030908	MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Swan Creek Pond, Valley Township	INLAND LAKE SHORELINE	0.2	Industrial Water Supply	Fully Supporting
40500030908	MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Swan Creek Pond, Valley Township	INLAND LAKE SHORELINE	0.2	Other Indigenous Aquatic Life and Wildlife	Not Assessed
40500030908	MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Swan Creek Pond, Valley Township	INLAND LAKE SHORELINE	0.2	Agriculture	Fully Supporting
40500030908	MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Swan Creek Pond, Valley Township	INLAND LAKE SHORELINE	0.2	Cold Water Fishery	Not Assessed
40500030908	MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Swan Creek Pond, Valley Township	INLAND LAKE SHORELINE	0.2	Total Body Contact Recreation	Fully Supporting
40500030908	MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Swan Creek Pond, Valley Township	INLAND LAKE SHORELINE	0.2	Navigation	Fully Supporting
40500030908	MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Swan Creek Pond, Valley Township	INLAND LAKE SHORELINE	0.2	Partial Body Contact Recreation	Fully Supporting
40500030908	MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Swan Creek Pond, Valley Township	INLAND LAKE SHORELINE	0.2	Warm Water Fishery	Not Assessed
40500030908	MI040500030908-05	SWAN CREEK POND PINE POINT CAMPGROUND BEACH	Swan Creek Pond, Valley Township	INLAND LAKE SHORELINE	0.2	Fish Consumption	Not Assessed
40500030908	MI040500030908-06	SWAN CREEK POND	Impoundment of Swan Creek west of Allegan and u/s of 118th Avenue .	RESERVOIR	60.4139	Other Indigenous Aquatic Life and Wildlife	Fully Supporting
40500030908	MI040500030908-06	SWAN CREEK POND	Impoundment of Swan Creek west of Allegan and u/s of 118th Avenue .	RESERVOIR	60.4139	Total Body Contact Recreation	Not Assessed
40500030908	MI040500030908-06	SWAN CREEK POND	Impoundment of Swan Creek west of Allegan and u/s of 118th Avenue .	RESERVOIR	60.4139	Navigation	Fully Supporting
40500030908	MI040500030908-06	SWAN CREEK POND	Impoundment of Swan Creek west of Allegan and u/s of 118th Avenue .	RESERVOIR	60.4139	Cold Water Fishery	Not Assessed
40500030908	MI040500030908-06	SWAN CREEK POND	Impoundment of Swan Creek west of Allegan and u/s of 118th Avenue .	RESERVOIR	60.4139	Industrial Water Supply	Fully Supporting
40500030908	MI040500030908-06	SWAN CREEK POND	Impoundment of Swan Creek west of Allegan and u/s of 118th Avenue .	RESERVOIR	60.4139	Partial Body Contact Recreation	Not Assessed
40500030908	MI040500030908-06	SWAN CREEK POND	Impoundment of Swan Creek west of Allegan and u/s of 118th Avenue .	RESERVOIR	60.4139	Agriculture	Fully Supporting
40500030908	MI040500030908-06	SWAN CREEK POND	Impoundment of Swan Creek west of Allegan and u/s of 118th Avenue .	RESERVOIR	60.4139	Warm Water Fishery	Not Assessed
40500030908	MI040500030908-06	SWAN CREEK POND	Impoundment of Swan Creek west of Allegan and u/s of 118th Avenue .	RESERVOIR	60.4139	Fish Consumption	Not Assessed

Appendix 2

- Table of Field Priority Scores and Agricultural Inventory Results

- **Appendix 1 is a .csv document. To request a copy, contact Allegan Conservation District at allegan.admin@macd.org**