Watershed **H**ealth **A**ssessment of **M**acatawa
(**WHAM!**)

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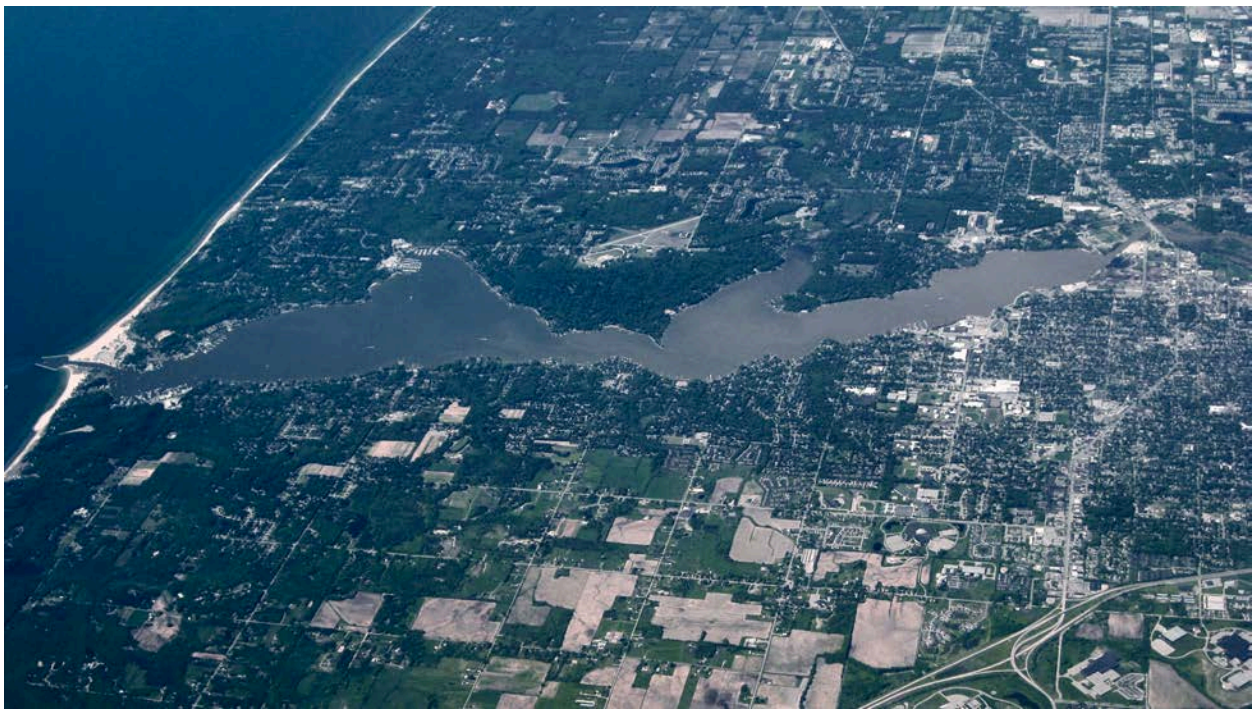


Table of Contents

Background:

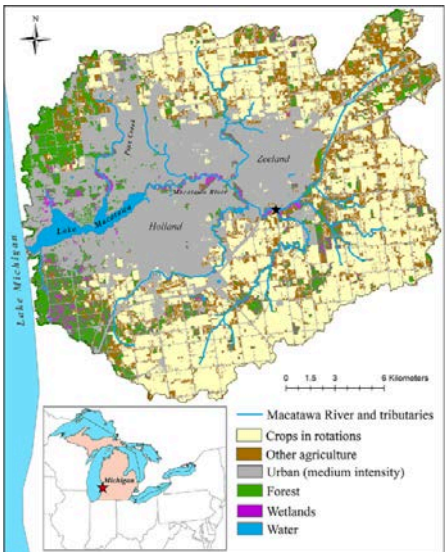
Lake Macatawa is located in Ottawa County in the US state of Michigan. The lake is approximately 6 miles long and 1.2 miles wide. The Lake Macatawa subwatershed covers an area of 175mi^2 near Michigan's western coast and is right next to the town of Holland, Michigan. The town of Holland was founded by Calvinist Dutch immigrants in the mid 19th century. While the community was originally almost ethnically homogenous with the Dutch, as years passed more Americans settled in the area. The Americans and the Dutch worked together to build Holland into the city it is today by establishing industries throughout the 19th and 20th centuries.

Lake Macatawa provides some tourism opportunities as well, with camping, boating and fishing opportunities as well as some beaches. However, the lake has been plagued with surface pollution issues for over 50 years, which has led to beach closures and fishkills.

Mission Statement

WHAM's mission is to continue the trend of improving conditions in the Macatawa Watershed and moving on from the hypereutrophic conditions that have defined the lake's past.

WHAM recognizes the many problems that agricultural runoff brings to Lake Macatawa and aims to educate farmers, tourists, and residents on how they can make a difference by implementing best management practices and conserving water. Also, WHAM wants to shine a spotlight on bioaccumulation of mercury in the fish in the lake to protect the health of people in the watershed.



Geography and Land Use of the Lake Macatawa Watershed

The Lake Macatawa watershed covers 175 square miles on the eastern shore of Lake Michigan and within its boundaries are the towns of Zeeland and Holland, Michigan. The land use of this watershed is mostly agricultural and urban, at 46% and 33% respectively. The areas closest to the lake are mostly medium intensity urban land, while the agricultural land is situated around the middle and edges of the watershed. The lake has historically been considered a hypereutrophic waterway, with phosphorus concentrations greater than 100 micrograms per liter (µg/L).

Governance of the Macatawa Watershed

One of the main organizations involved in the governance of the Lake Macatawa watershed is the Outdoor Discovery Center (ODC) Network, which is a non-profit organization that has been responsible for managing the watershed since 2021. The responsibility of caring for the health of the Lake Macatawa watershed previously belonged to the Macatawa Area Coordinating Council, a metropolitan planning committee made up of several local governments. This passing of ownership over to the ODC marks a huge step for environmental non-profit organizations being able to have a considerable amount of power to make a difference on a large scale. Within the ODC is Project Clarity, which was created to protect and remediate the water of Lake Macatawa and other water bodies within the watershed. Project Clarity partners with the City of Holland, City of Zeeland, Ottawa County Parks and Recreation and other local organizations with the goal of positively benefiting the people living within the Macatawa watershed through environmental protection. Some of the specific goals of Project Clarity relate to economics, and on their website, they state that "When water quality improves, property values rise and tourism flourishes, bringing our community a valued source of business revenue." This goal to support tourism is also something that we would like to touch on in our plan, as we recognize the numerous camping, boating, fishing and beach opportunities that this area provides.

Another important part of governance of the Lake Macatawa watershed is the Total Maximum Daily Load (TMDL) of phosphorus as determined by the United States Environmental Protection Agency in the year 2000. The TMDL for phosphorus in the Lake Macatawa watershed allows for 55,000 pounds of phosphorus per year, which is further divided into 35,000 pounds for nonpoint sources and 20,000 pounds per year for point sources. The TMDL aims to reduce the phosphorus concentrations in Lake Macatawa to 50 micrograms per liter, which has historically been out of reach for the watershed due to the very high levels of phosphorus pollution from surrounding agriculture.

Problems

Problem	**Description**	**Causes**
P1: Phosphorus	High concentrations of phosphorus in Lake Macatawa lead to hypereutrophic conditions, which lead to intense algae blooms that eventually result in eutrophication	• Fertilizers and animal manure from surrounding farmland introduce high levels of phosphorus in bodies of water • Nonpoint source pollution responsible for 91.7% • Stormwater runoff carries nutrients into the

		Lake and its tributaries
P2: Water Clarity	Agriculture and urban development have led to increased erosion of the surrounding landscape, resulting in substantial deposits of sediment in the lake. This impairs water clarity which could jeopardize tourism.	• Runoff of sediment due to increase in impermeable surfaces such as roads and sidewalks • Lack of vegetation to hold sediments in place/slow down runoff
P3: Mercury	Mercury	
	Lake Macatawa and its tributaries have experienced frequent beach closures due to high levels of E. coli, posing a severe health risk to recreational users.	• Malfunctioning and broken septic systems and wastewater plants can release untreated sewage into the watershed • Introduces both phosphorus and E. coli bacteria, compromising the quality of the water

Goals

Reduce phosphorus levels to 50µg/L by 2050

Our goal for phosphorus levels aligns with the goals of the EPA TMDL for phosphorus in Lake Macatawa. At the time of the creation of the TMDL, the annual load of phosphorus entering the lake was estimated to be 138,000 lbs/year, and the TMDL aimed to reduce the amount of phosphorus to help lower the concentration of phosphorus in the water. 91.7% of the phosphorus pollution in the lake comes from nonpoint sources, meaning that they do not originate from a single identifiable point. Nonpoint sources include runoff, which is the main vessel that carries phosphorus into the waterways of the Macatawa watershed. To this day, phosphorus remains a consistent problem in Lake Macatawa.

To help alleviate the phosphorus concentrations in Lake Macatawa, WHAM aims to communicate with farmers and other agricultural stakeholders in the area and encourage the adoption of best management practices (BMPs) that would lessen the load of phosphorus that runs off in the watershed. For example, we would like to encourage farmers to reduce the surface application of fertilizers, especially before rainfall events. Also, we would like to encourage soil testing for smaller farms to identify areas that already have sufficient levels of phosphorus which

would further discourage the widespread application of these fertilizers. These practices would require more effort but would also save money, as less fertilizer would be used.

Another solution for the phosphorus problem would be planting native plants in the littoral zone of the lake. These plants would slow down runoff going into the lake and capture sediment that may contain phosphorus.

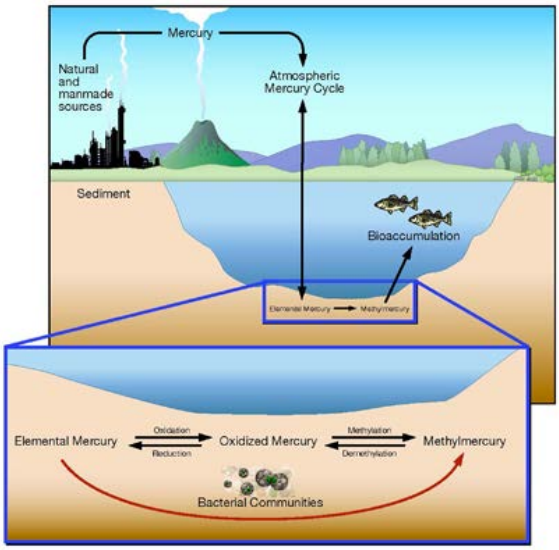
Improve Water Clarity and aim for a Secchi disk depth of 2m by 2050

The measurement of water clarity that has been reported for Lake Macatawa in the past is the Secchi disk depth. A Secchi disk is a black and white disk (pictured to the right) that is lowered into water, and the depth measurement is taken at the point where the disk is no longer visible. Historical Secchi disk data shows that the depth rarely goes above 0.5m, with a depth of 1m measured in 2021 being higher than previous years. Our goal is to improve the Secchi disk depth to 2m by 2050, which would indicate good water quality.

While the reasons for poor water clarity are pretty much the same as the reasons for high phosphorus levels, we wanted to designate the water clarity as a separate problem so that we could more easily connect to lake goers and tourists. Poor water clarity is something that is very easy to notice if you're at a beach, and can sometimes be off-putting. WHAM wants to improve the water clarity, as this will lead to greater aesthetic appeal to beachgoers and other sportsmen who frequent the lake. The improvements in the lake's aesthetics could be a benefit to the local tourism economy, which could then lead to more people coming to the area to visit and enjoy the camping sites, beaches and fishing opportunities that the lake provides.

While the towns surrounding the lake aren't responsible for the pollution coming from agricultural sources, we still want to use the issue of water clarity as an opportunity to educate the general public on the impaired status of Lake Macatawa. WHAM would like to include people in the efforts in reducing runoff by providing some simple things the individual can do to reduce impact, even if it doesn't make a difference in the grand scheme of things. For example, those living in the suburban areas around the lake can water their lawn less or sweep their driveway instead of hosing it down. This will not only save the individual money, but it will reduce urban runoff and help connect people to protecting their waterways.

Maintain the Decrease in Mercury levels through 2050



Excess amounts of mercury in a water body can pose a threat to humans when aquatic bacteria mixes with mercury and converts it into **methylmercury (CH_3Hg),** a highly toxic substance that is incredibly dangerous to humans. This process is referred to as methylation, and is a common process by which a 'methyl group' molecule consisting of 1 Carbon atom and 3 Hydrogen atoms are bonded to another molecule and alter its gene expression. In this case, increasing the toxicity of mercury.The mercury being converted to methylmercury typically exists in fish, either via those fish eating smaller prey that contain mercury (plankton, etc.) or via those fish existing for a long period of time in water afflicted with mercury. Humans who then consume these fish will be exposed to an incredibly dangerous and potentially fatal chemical.

Current gaseous mercury levels in Lake Michigan are estimated at 1.65 ± 0.61 ng/m3, according to a 2021 report. EPA data suggests the median concentration of mercury in Lake Michigan fish fluctuates, but remains below 0.5 µg/g, the current regional guideline standard. Our goal would be to sustain decreased levels of mercury, which the EPA has reported has fluctuated over time. We would target the mercury issue from two fronts: the Bioaccumulation and Human Disposal angles. For bioaccumulation, monitoring is the only measure we'd recommend against the natural phenomenon. Remaining aware of the natural rate of mercury deposition, while not something that can be regulated, does give us an important benchmark for comparison when measuring man-polluted mercury.

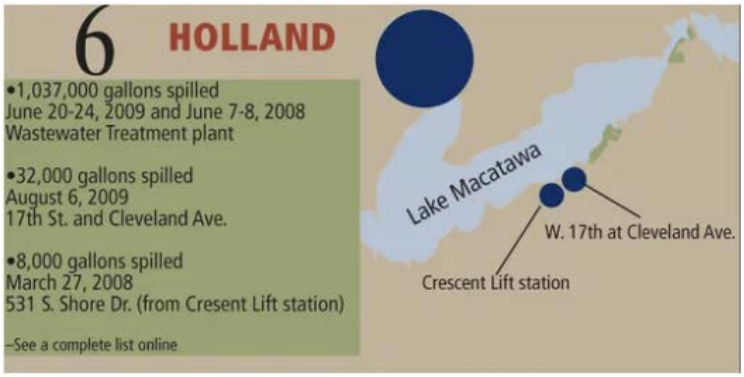
Awareness of proper disposal methods, promotion of mercury-free alternative products, increased regulations, and the usage of activated carbon filters to clean currently contaminated water, are all measures we recommend to decrease the current levels of mercury in the Macatawa area. Specifically, sending EPA agents to local farms to check for proper disposal of bulbs/batteries/old thermometers into waste dumps and EPA safe distance from a water body, raising awareness of mercury free alternatives (non mercury dental fillings, thermometers, and

non fluorescent lights aka LEDs), and sustaining prior increased regulations vis a vi banning coal fired power plants.

Reduce E. coli levels to 85 CFU per 100 mL by 2050

E. coli presents the most costly problem to the Lake Macatawa Watershed. Many of the processes to remove the bacteria from the watershed require costly tools, chief among these would be the deployment of vast arrays of UV lighting to sterilize the water, purging microorganisms. Other methods, such as osmosis filters and chlorine treatment are just as costly, and planning and executing these treatment operations on such a vast scale pose a significant challenge, but also allow for a very substantial victory.

The main source of E. coli contamination is from malfunctioning septic systems and wastewater treatment plants releasing untreated or partially treated sewage into the watershed. This region of Michigan is infamous for its poorly maintained septic infrastructure, and many of its users hail from regions relying on city-owned sewage systems. When these people come to Holland, often to vacation during the warmer months, they are uneducated about how the septic system works, often creating a massive strain on it. This stress causes leakages into surrounding groundwater, which eventually makes its way into the greater watershed.



Data on Wastewater Discharges in Holland, per *The Holland Sentinel*

WHAM would like to attack this problem head on utilizing many different strategies, with the goal of reducing E. coli levels below 85 colony forming units (CFU) per 100 mL by 2050. It should be noted that the Environmental Protection Agency's suggestion for swimming beaches is that E. coli levels should not exceed 88 CFU per 100 mL, but WHAM believes that its goal of <85 CFU per 100 mL is a very achievable one. WHAM suggests a three-pronged approach to tackling this problem. The first step would be committing to restoring natural wetland by planting native vegetation, building buffer strips along numerous waterways, and the utilization of cover crops to limit bacterial movement. In addition to this, WHAM plans to upgrade or replace aging septic systems in city-owned buildings near or within the watershed while expanding the City of Holland's stormwater treatment infrastructure. WHAM would also give tax-cuts/subsidies to private citizens who upgrade their own household septic systems. To reinforce these actions, WHAM will launch educational programs in the local community about the best ways for individuals to reduce E. coli contamination. In order to evaluate our progress, WHAM will conduct frequent water testing, not only to identify pollution hotspots but to also keep track of overall E. coli pollution in Lake Macatawa and surrounding waterways

Conclusion:

Currently, Lake Macatawa and other streams within the watershed are still impaired. However, the watershed has seen steady progress over the last 50 years. Phosphorus and sediment levels, while still not ideal, have begun to slowly move towards desirable conditions. WHAM hopes to continue this progress by involving agricultural and residential stakeholders from the area and educating them on best management practices and other ways to be more sustainable. Together, we will make great progress in the next 25 years in achieving a cleaner Macatawa.

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