Lake Macatawa Water Quality Dashboard

2025

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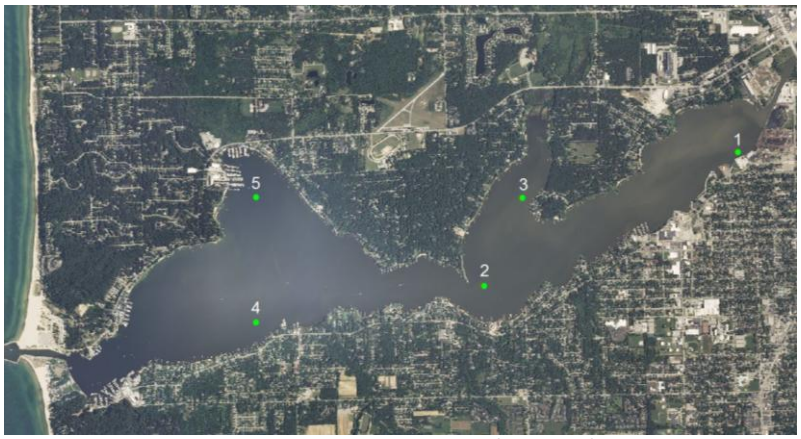
Introduction

As part of Project Clarity, Grand Valley State University's Annis Water Resources Institute (AWRI) established a monitoring program on Lake Macatawa in 2013. The goal of the monitoring program is to evaluate and document the progress toward achieving Project Clarity's goal of improved water quality in Lake Macatawa. The monitoring program involves sampling the lake 3 times per year for a suite of biological, physical, and chemical parameters. Hence, this monitoring does not continuously collect lake-data ~~information is not collected continuously~~ and may either capture or miss episodic, short-term conditions. The value of the dashboard is an assessment of long-term trends, not of short-term events.

Commented [MH1]: Thought this should be updated in lieu of the new continuous monitoring sensor in Lake Mac.

Key water quality indicators were selected from the many parameters that are monitored to create a water quality dashboard for Lake Macatawa (see full annual report for all parameters). The goal of the dashboard is to provide a visual representation of the current status and historical trends in Lake Macatawa water quality, by rating each indicator along a scale from desirable (green) to undesirable (red) conditions. Each scale also includes a category that indicates the water quality goal for the lake is being met (yellow). The indicators that were chosen are commonly used to assess lake health: total phosphorus concentration, chlorophyll *a* concentration, and Secchi disk depth (water clarity). Each indicator is described in more detail below.

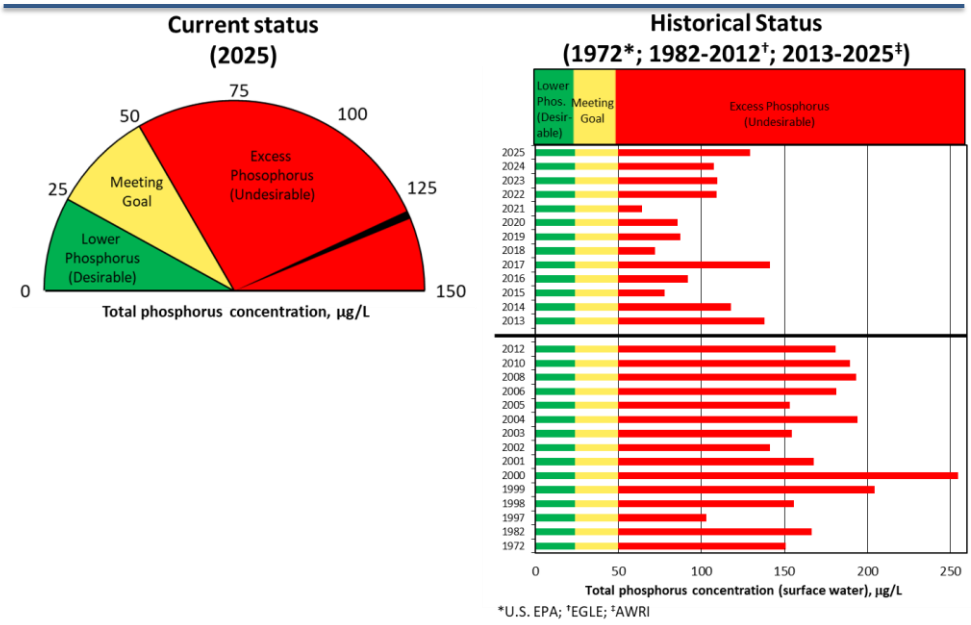
Historical data are included in the dashboard to facilitate comparison of current findings with past status of the selected water quality indicators. Sources for historical data include U.S. EPA (1972; STORET), Michigan Department of Environment, Great Lakes, and Energy (formerly MDEQ; 1982-2012; S. Holden, personal communication), and AWRI (since 2013). All current and historical data shown represent the annual average value of an indicator across Sites 1 (east basin), 2 (central basin), and 4 (west basin; see map below).



Map of Lake Macatawa showing the 5 sampling locations (green dots) for long-term water quality monitoring. Dashboard indicators were calculated based on data from Sites 1, 2, and 4.

Total Phosphorus

2025 Mean Concentration: 129 µg/L
Target Concentration: 50 µg/L



Phosphorus (P) is an essential element for living organisms. In many freshwater systems, P is the element that limits algal growth. However, when it becomes too abundant, it can help stimulate undesirable algal blooms. Phosphorus comes in many forms; we selected Total Phosphorus (TP) as the dashboard indicator because it includes all the forms of P in the lake (i.e., particulate and dissolved).

Lake Macatawa has a history of extremely high TP concentrations (i.e., > 100 µg/L), placing it in the past in the "hypereutrophic" trophic state. As a result of this nutrient enrichment, the State of Michigan established an interim target TP concentration of 50 µg/L in Lake Macatawa. Thus, the TP dashboard shows the water quality goal as being met when TP concentrations are < 50 µg/L. While attaining this goal would be a significant improvement in water quality from current conditions, Lake Macatawa would still be in an impaired "eutrophic" state, which we define as TP concentration > 24 µg/L. Therefore, the TP dashboard shows the ultimate desired TP concentration as < 24 µg/L.

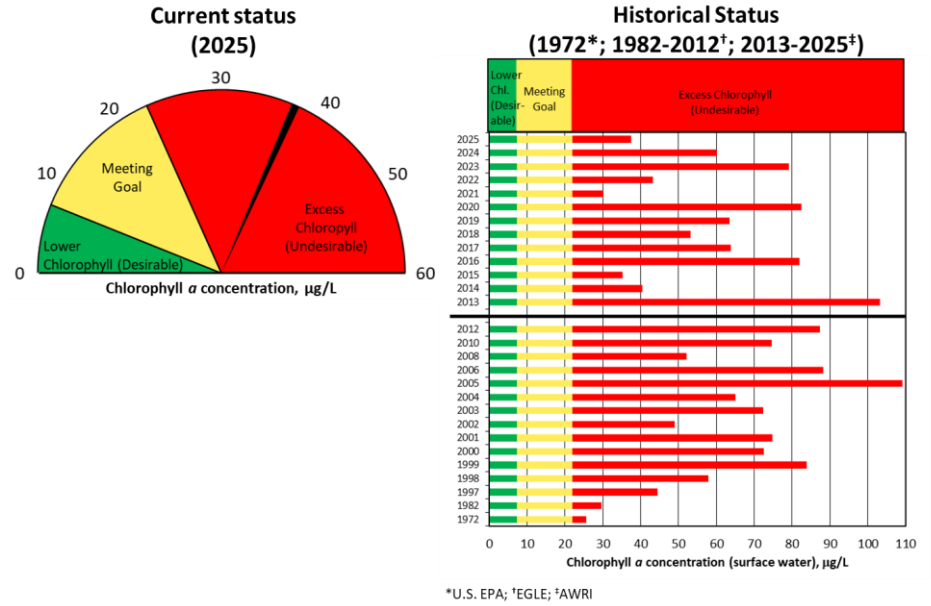
The 2025 status for the total phosphorus indicator remains **Undesirable**, indicating that the average TP concentration in 2025 exceeded the water quality goal. Indeed, 2025 continues a trend of increasing TP since 2021. Part of this trend may be related to Lake Macatawa's proximity to Lake Michigan and its trend of decreasing annual water levels over the same time frame.

Commented [MH2]: Possible example in Lake Mac of Great Lakes coastal wetland drying/rewetting and P release? TP dashboard looks an awful lot like a complementary puzzle piece to Lakes MI-Huron water level dashboard at https://www.glerl.noaa.gov/data/wlevels/dashboard/. I ran a quick regression against Lake MI annual water level data that I already had downloaded thru 2017 vs our dashboard annual TP up to 2017, which had an R2 of 0.31. I could look into this more thoroughly comparing monthly or daily water level against our corresponding sampling data, if that would be of interest.

That said, the highest water level was 2020 and not 2021, so it's not a perfect match for TP, chl, and Secchi trends.

Chlorophyll *a*

2025 Mean Concentration: 38 µg/L
Target Concentration: 22 µg/L



*U.S. EPA; †EGLE; ‡AWRI

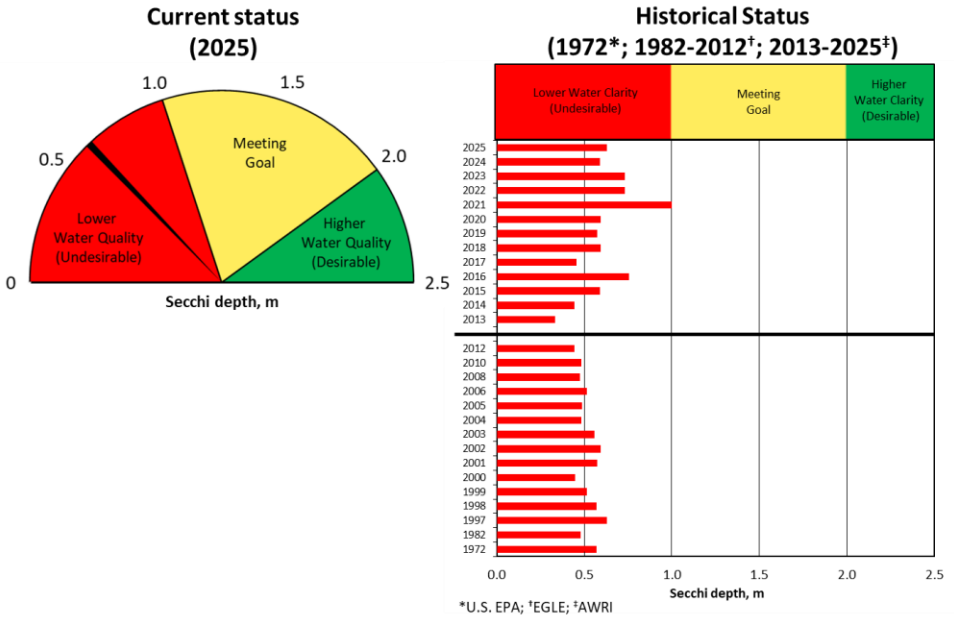
Chlorophyll *a* is the green pigment found in photosynthetic plants and algae. Measuring chlorophyll *a* is a relatively simple way to estimate the amount of algal biomass present in lake water, although it has some limitations. First, chlorophyll *a* does not provide information on whether or not the algae present produce toxins. Second, chlorophyll concentrations can change depending upon environmental conditions, such as light or nutrient level. Finally, chlorophyll *a* concentrations may be low due to very active predation by grazers (zooplankton), so the measurement may give an underestimate of how much algal biomass would otherwise be present.

Lake Macatawa has a history of excess algal biomass and high chlorophyll *a* concentrations, typically exceeding the "hypereutrophic" threshold commonly used by EGLE (22 µg/L) in its assessments of the lake. The chlorophyll *a* dashboard shows that the concentration will meet the water quality goal once it is < 22 µg/L. Although meeting the chlorophyll *a* goal would be a significant improvement in water quality, Lake Macatawa would still be categorized as "eutrophic" (i.e., > 7 µg/L chlorophyll *a*). Thus, the chlorophyll *a* dashboard shows that the ultimate desired chlorophyll *a* concentration is < 7 µg/L.

The current status for the chlorophyll *a* indicator is **Undesirable** although one of the lower chlorophyll concentrations observed in the range of Project Clarity monitoring. Indeed, it is encouraging to see the strong decline of ~20 µg/L per year since 2023. The 2025 mean concentration was strongly influenced by a low spring mean of 5 µg/L, compared to the much higher summer and fall means of 41-66 µg/L.

Secchi Disk Depth (Water Clarity)

2025 Mean Depth: 0.63 m (~2.1 ft)
Target Depth: 1 m (~3.3 ft)



Secchi disk depth is an estimate of water clarity. It is measured using a standard black and white disk, named after the Italian priest Angelo Secchi, who first used an all-white disk for marine waters in 1865. Lake ecologists modified it to black and white in the late 1800s. The Secchi disk is a simple and easy way to measure water clarity, although if waters are cloudy, the disk depth tells you nothing about why the lake is turbid (e.g., is it due to suspended algae or suspended sediment?).

Along with excess phosphorus and chlorophyll *a* concentrations, Secchi depths have historically reflected impaired conditions in Lake Macatawa. Oligotrophic lakes, such as Lake Tahoe, have Secchi disk depths down to 21 m (~70 ft) or deeper. Conversely, hypereutrophic lakes, such as Lake Macatawa, typically have Secchi depths shallower than 1 m (~3 ft). The water clarity goal for Lake Macatawa is modest, with a Secchi depth > 1 m. Because Secchi depths between 1 and 2 m are indicative of a eutrophic state, a desirable Secchi depth is > 2 m.

The current status for the Secchi depth indicator is **Undesirable**, and in fact, the average Secchi depth has been in decline (become more shallow) since 2021 and currently does not meet the criteria of the water quality goal.