Saginaw Bay Monitoring Consortium progress report: Water-years 2024 - 2025

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Introduction

The Saginaw Bay Monitoring Consortium (SBMC) was established to build a coordinated, long-term monitoring program capable of tracking nutrient and sediment inputs from tributaries across the Saginaw Bay watershed. Supported by the Great Lakes Restoration Initiative and additional state and philanthropic partners (Figure 1), the SBMC brings together universities, agencies, and nonprofit organizations to generate high quality data that can inform restoration, management, and policy decisions.

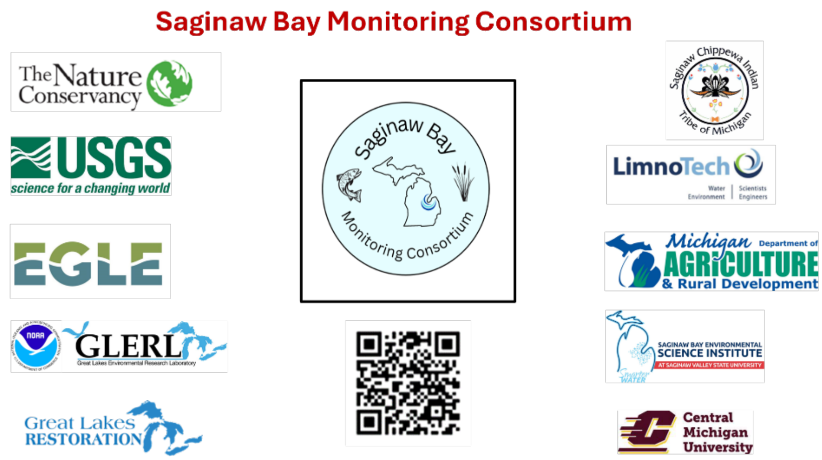

Figure 1. SBMC member organizations. QR code to the online SBMC Storymap and Data Dashboard, also found at www.svsu.edu/sbesi/research/saginawbaymonitoringconsortium/

Saginaw Bay has long faced challenges related to nutrient enrichment, sedimentation, and associated impairments. Understanding how tributaries contribute to these issues, and how those contributions change over time, is essential for effective watershed management. The SBMC's monitoring program is designed to support this need by providing consistent, comparable data across multiple tributaries and multiple years. These data will help inform nutrient reduction targets under Annex 4 of the Great Lakes Water Quality Agreement, provide loading data for Total Maximum Daily Load (TMDL) development, guide watershed groups and municipal stormwater managers, and support adaptive management strategies across the region.

The first two water years of monitoring represent an important milestone for the SBMC. Prior to the SBMC effort, water quality and flow data were sparse for tributaries in the Saginaw Bay Watershed. Furthermore, even those rivers with some water quality data have only been monitored sporadically. While the SBMC dataset is still limited, early results offer valuable insight into spatial patterns of nutrient concentrations and relative loading among tributaries. **At**

this stage, findings should be considered suggestive rather than conclusive. Two years of data do not capture the full range of hydrologic variability (i.e., wet versus dry years), and uneven precipitation across the watershed during this period further complicates interpretation. As a result, it is premature to draw firm conclusions about long-term trends or to make management decisions based solely on the initial dataset.

What these early years do provide is a strong foundation and baseline results for the tributaries. They demonstrate the value of coordinated monitoring by highlighting tributaries and subwatersheds that may warrant closer attention and underscore the importance of continuing this work. The project is currently funded through Water Year 2026 (current funding end date Sep 30, 2026), but additional years of monitoring are essential to establish reliable trends, improve loading estimates, and support sound, data driven management decisions for Saginaw Bay. Data from SBMC's first two years can be found on the SBMC Storymap and Dashboard by using the QR code shown in *Figure 1* or by following the link at www.svsu.edu/sbesi/research/saginawbaymonitoringconsortium.

Monitoring Approach

The SBMC's monitoring program is designed to provide consistent, comparable data across the Saginaw Bay watershed. Monitoring began in summer 2023 and includes weekly sampling (when rivers are unfrozen) at 18 tributary sites, each co-located with a U.S. Geological Survey (USGS) gaging station *(Figure 2*). This pairing allows for the calculation of nutrient and sediment loadings using measured concentrations and corresponding discharge. Water quality sampling is conducted on a fixed schedule, rather than targeted for wet weather events. However, this weekly sampling schedule has captured samples from high flow events from most sites over the first two years.

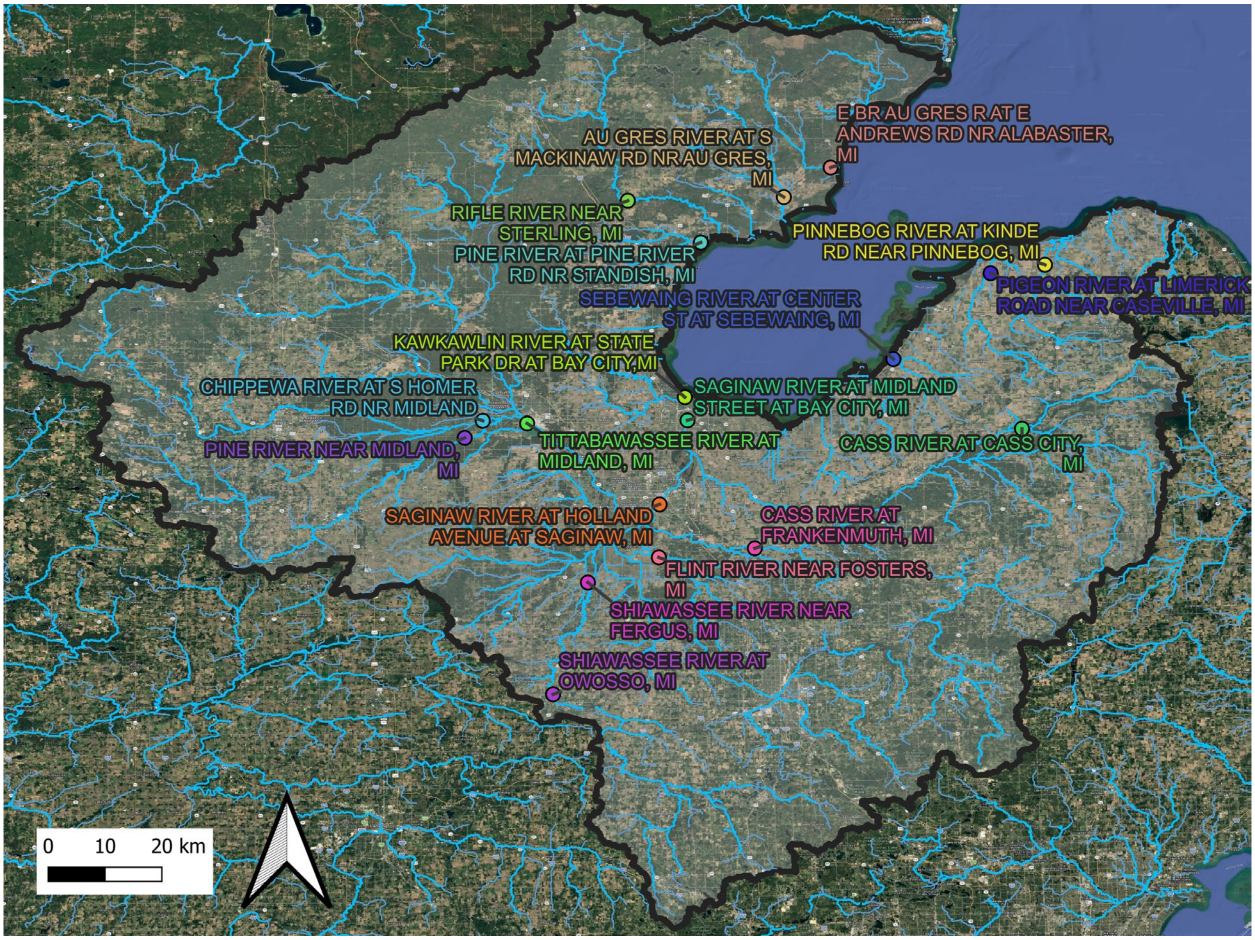

Figure 2. Map of sampling sites. Note that flow data for the Kawkawlin are not available and we therefore cannot estimate loads for this river.

Field teams collect onsite measurements of dissolved oxygen, temperature, pH, conductivity, and turbidity. They also collect grab samples which are returned to the laboratory at Saginaw Valley State University. Laboratory analyses include soluble reactive phosphorus (SRP), total phosphorus (TP), total suspended solids (TSS), nitrate+nitrite, nitrite, and ammonium. All sampling and analytical procedures follow an approved Quality Assurance Project Plan (QAPP) to ensure data consistency and reliability.

Preliminary loading values presented in this report are **estimated** annual loads, calculated by interpolating daily concentration data between measurements, multiplying each by corresponding daily discharge, and summing over the year. There is substantial uncertainty in these estimates from a variety of factors but primarily due to interpolating concentration data between weekly (or less frequent) sampling. These values support relative comparisons among sites and years but should not be interpreted as accurate annual mass loads. In addition to tributary monitoring, National Oceanic and Atmospheric Administration Great Lakes Environmental Research Laboratory (NOAA GLERL) conducts open water sampling at 10 sites in Saginaw Bay, providing complementary information on bay conditions and trends. Monitoring in the Bay includes TP, SRP, nitrogen fractions, chlorophyll a, and microcystin. Results from the open water sites are expected to be available on the SBMC dashboard in the future.

Preliminary Observations

Although the dataset is still limited, early observations from Water Years 2024 and 2025 provide insight into spatial patterns of nutrient concentrations and relative loading across the watershed. A water year begins on Oct 1 and extends through Sep 30 of the following year (e.g. water year 2024 is from Oct 1, 2023 – Sep 30, 2024). These findings should be interpreted cautiously and viewed as early indicators, not definitive trends.

Nitrate + Nitrite Patterns

- Higher concentrations are observed in several agriculturally dominated subwatersheds. Concentrations are available on the SBMC Data Dashboard.
- Larger tributaries, such as the Saginaw River, contribute the greatest total loads due to higher discharge (Figure 3).
- Loading per unit area is higher in subwatersheds with a high percentage of agricultural land (e.g., Pigeon, Pinnebog, and Cass Rivers) (Figure 4).
- Year-to-year differences may be due to variability in precipitation (WY25 was drier and therefore had lower discharge than WY24). WY25 loads at some locations are underestimated due to periods of ice during which discharge data are not available.

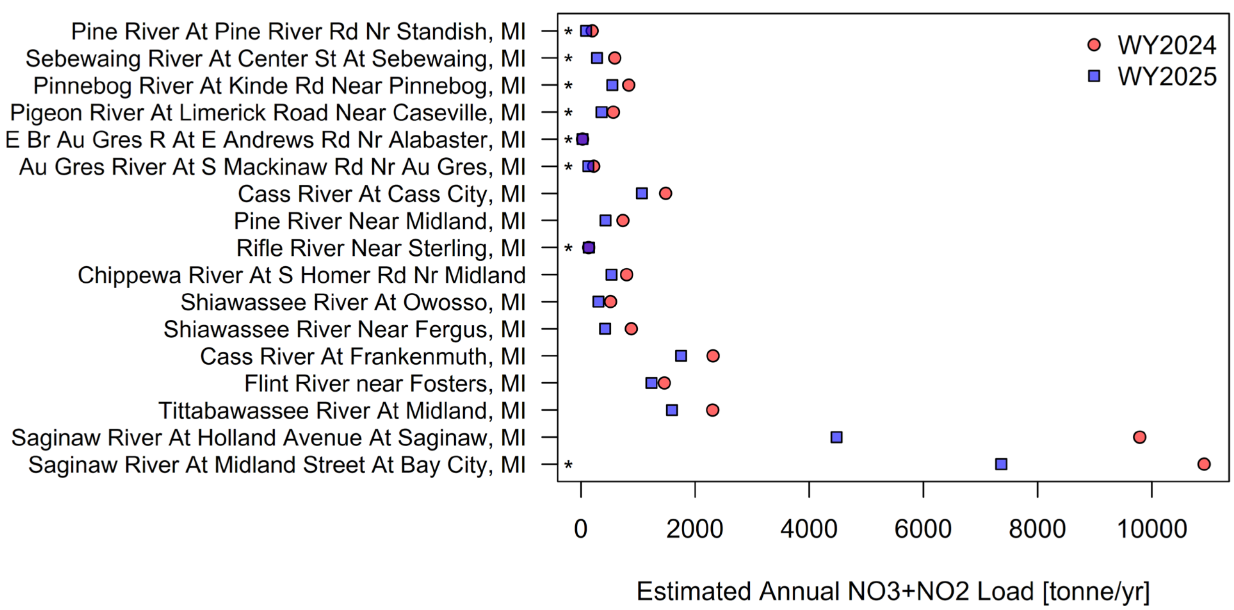

Figure 3. Estimated Nitrate+Nitrite loads (metric tonne/yr) by monitoring site. Sites are from lowest average flow (top) to highest (bottom). *Denotes sites that drain directly into Saginaw Bay.

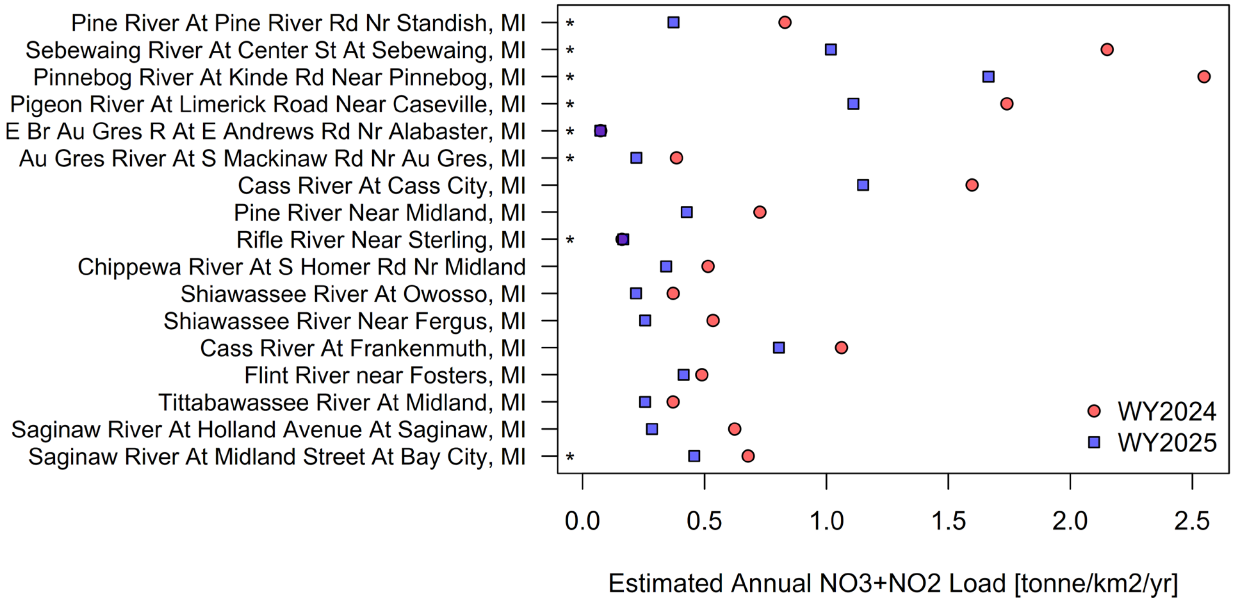

Figure 4. Estimated Nitrate+Nitrite loading per unit land area. Sites are from lowest average flow (top) to highest (bottom). *Denotes sites that drain directly into Saginaw Bay.

Total Phosphorus Patterns

- Elevated concentrations occur in some of the same agricultural regions as observed for nitrate+nitrite, but the Flint subwatershed also stands out with particularly high values. Concentrations are available on the SBMC Data Dashboard.
- Larger tributaries, such as the Saginaw River, contribute the greatest total loads due to higher discharge (Figure 5).
- Loading per unit area is not higher in agricultural subwatersheds, but it is comparatively high in the Flint subwatershed (Figure 6).
- The presence of major point sources (e.g., wastewater treatment plants) may influence phosphorus patterns in certain tributaries such as the Flint River.

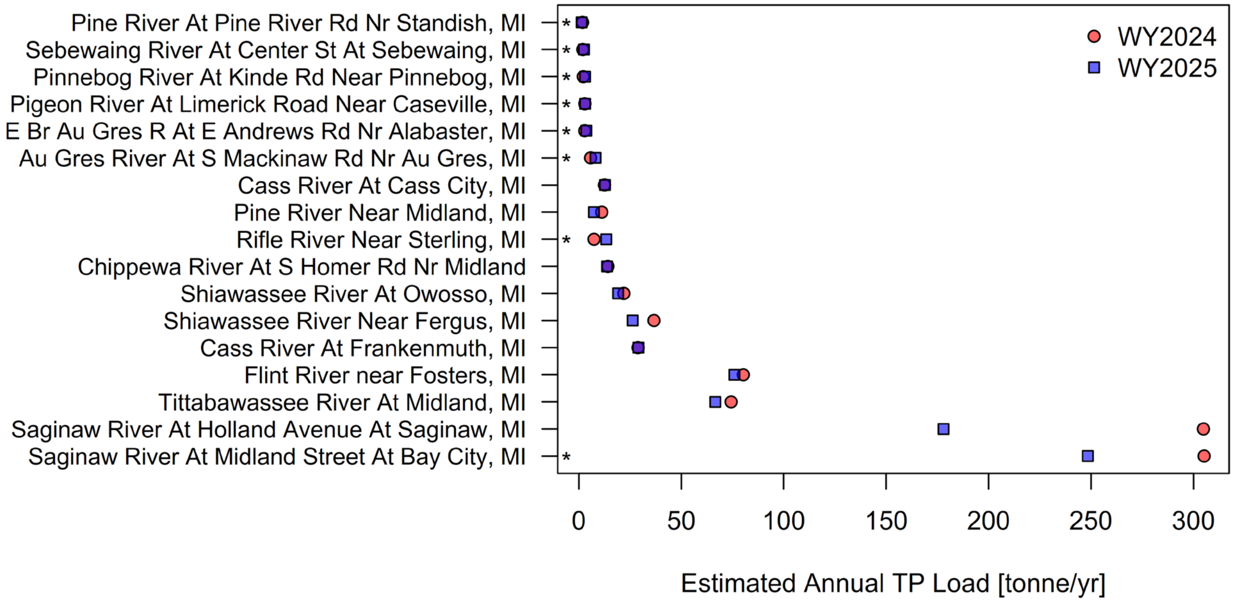

Figure 5. Estimated total phosphorus loading (metric tonne/yr) by monitoring site. Sites are from lowest average flow (top) to highest (bottom). *Denotes sites that drain directly into Saginaw Bay.

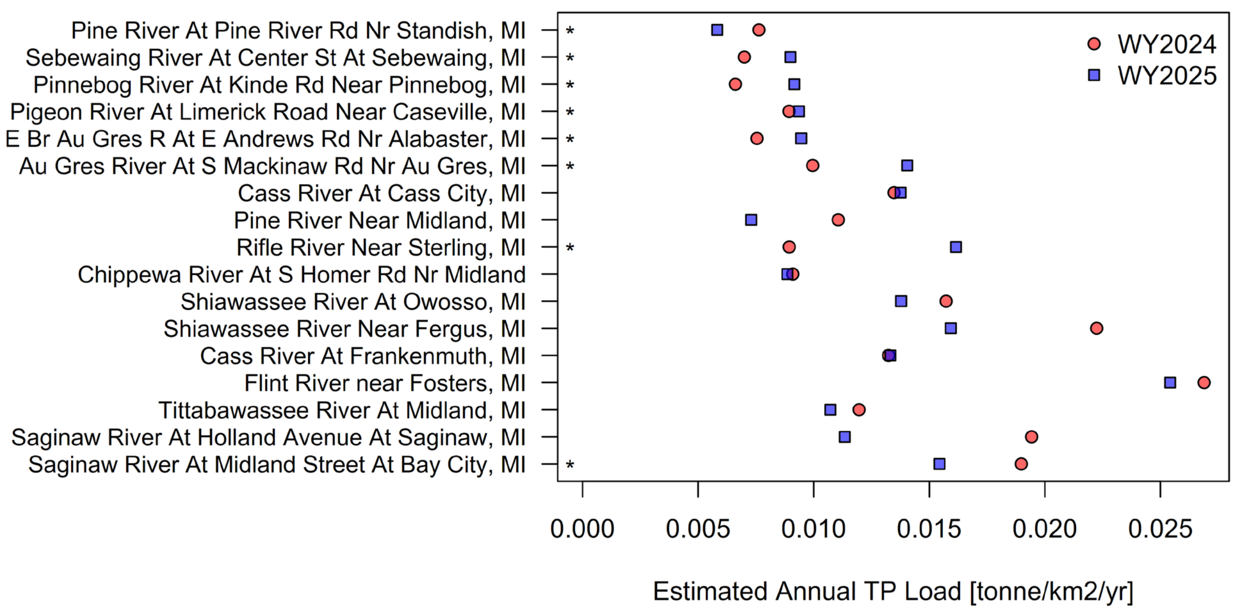

Figure 6. Estimated total phosphorus loading per unit land area. Sites are from lowest average flow (top) to highest (bottom). *Denotes sites that drain directly into Saginaw Bay.

Precipitation Variability

Precipitation during WY24 and WY25 was uneven across the watershed. *Figure 7* compares average river flow in WY24 and WY25 with long-term average flows from eight SBMC sampling sites. A value greater than 1 indicates the year had higher flows than average. A value less than 1 indicates the year had lower flows than average. Many of the southern sites had higher flows than average during WY24. During WY25, all sites had flows at or below average. Precipitation analysis (*Figure 8*) shows similar trends, with WY24 being wet in the southern half and dry in the northern half of the watershed. WY25 was very dry almost everywhere. These differences complicate interpretation of nutrient loading, as hydrologic conditions strongly influence nutrient transport.

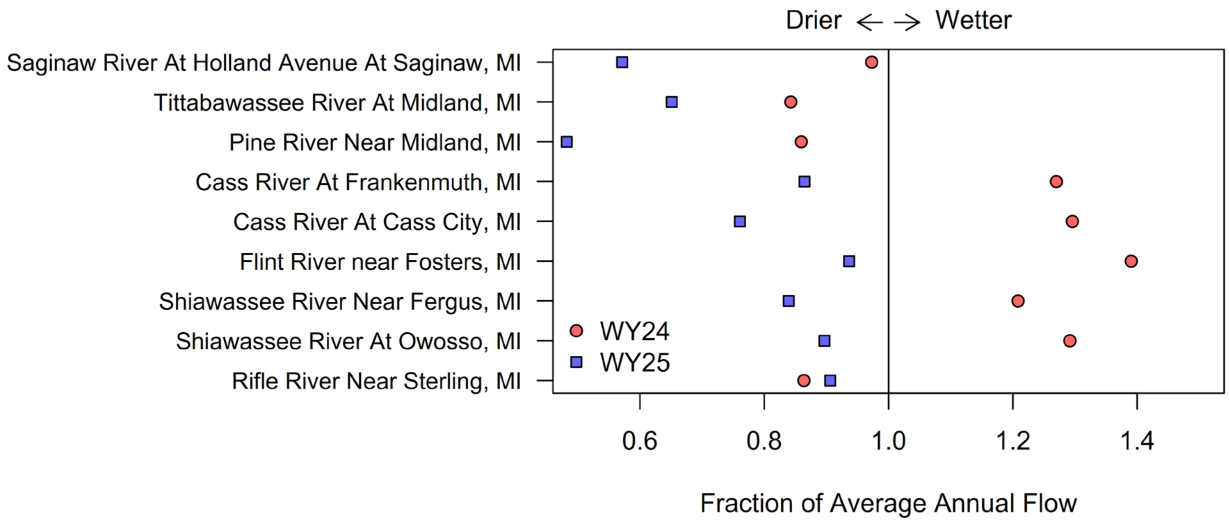

Figure 7. Comparison of average annual river flow (discharge) to the long-term average for eight SBMC sampling sites where USGS gage stations pre-date this project. Values <1 indicate drier than average conditions. Values >1 indicate wetter than average conditions.

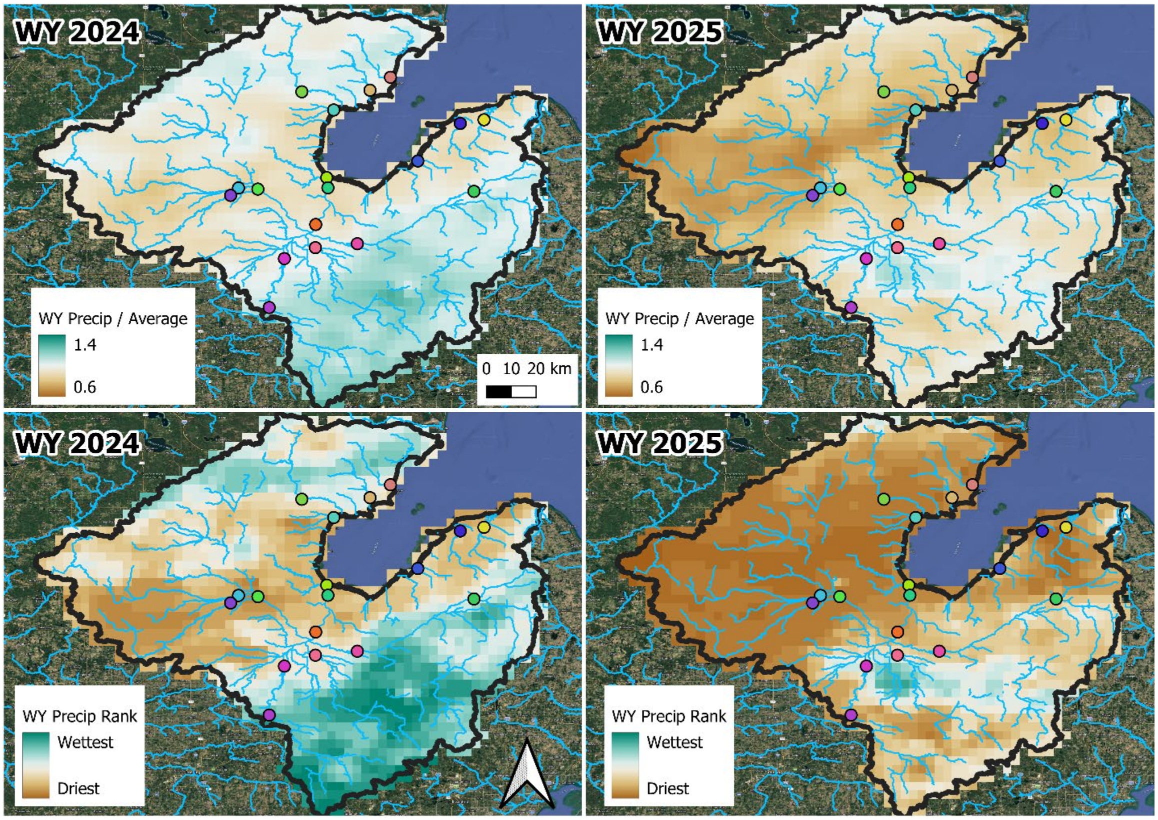

Figure 8. Comparison of annual precipitation (from PRISM dataset) for WY24 and WY25 with the 30-year average across the Saginaw Bay Watershed. The top maps compare WY total precipitation with the 30-year average (>1 = wetter, <1 = drier). The bottom maps are the same data but shown as a rank (1=driest, 30=wettest) for the 30-year period. For all maps, darker blue indicates wetter and darker brown indicates drier. Colored points are sampling site locations (see Figure 2).

Challenges & Lessons Learned

Limited Dataset for Trend Detection

Two years of monitoring offer a useful starting point, but they are not enough to establish long-term trends or to evaluate progress toward nutrient-reduction goals. A longer record is needed to capture the full range of hydrologic conditions (wet, dry, and average years) and to produce more reliable estimates of average annual nutrient loads to Saginaw Bay.

Extending monitoring beyond two years also reduces the influence of random year-to-year variability. For example, increasing the monitoring period from two years to five years can reduce uncertainty in load estimates by as much as 37%. This reduction is based on the relationship between sample size and variance (and thus uncertainty), calculated as $\sqrt{2} \div \sqrt{5}$.

Complexity of Nutrient Sources

Early patterns suggest that nitrate loading is closely tied to agricultural land use, while phosphorus loading reflects a more complex mix of point and non-point sources. Distinguishing these contributions will require additional data and modeling.

Value of Collaboration
Strong coordination among universities, agencies, and nonprofit partners has been essential to the success of the monitoring program. Continued collaboration will support data interpretation, modeling, and management applications.

Next Steps & Future Direction

Continue Multi-Year Monitoring
Additional years of data are essential to improve loading estimates, confirm early patterns, and support robust trend analysis. The project is funded through Water Year 2026, but at least two more years are needed to achieve reliable conclusions.

Expand the SBMC Storymap and Dashboard
As Saginaw Bay monitoring data become available from NOAA GLERL's 10 open water sites, the SBMC Storymap and Dashboard can be expanded thereby allowing coordinated tributary and bay monitoring results to be evaluated together.

Integrate Data into Watershed and Bay Models
SBMC partners will work with state, federal, and academic collaborators to seek funding to incorporate monitoring data into watershed and bay models. These tools will help evaluate management scenarios and identify the most effective strategies for reducing nutrient and sediment inputs.

Identify Conservation Opportunities
Monitoring and modeling results will be used to prioritize subwatersheds to assess where conservation practices could most effectively reduce nutrient and sediment loading, with attention to both agricultural and point source influences.

Refine Loading Targets as Needed
As the dataset grows, existing nutrient reduction targets can be evaluated and refined as warranted based on improved understanding of watershed processes.

Maintain Stakeholder Engagement
Ongoing communication with watershed groups, agricultural partners, municipalities, and community stakeholders will remain a priority to ensure that monitoring data support informed, collaborative decision making.

Acknowledgments
The Saginaw Bay Monitoring Consortium extends its appreciation to the many partners, funders, and community members who have supported this work. The success of the monitoring program depends on the collaboration and commitment of organizations across the region.

Funding Acknowledgment
The SBMC gratefully acknowledges the generous support of:

- U.S. Environmental Protection Agency's Great Lakes Restoration Initiative
- Michigan Department of Environment, Great Lakes, and Energy
- The Cook Family Foundation
- The Jury Foundation

Their investment has made it possible to build a comprehensive, long-term monitoring program that will inform restoration and management decisions for years to come.