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Muskoka Lakes Association
FOR ALL GENERATIONS

# Muskoka Lakes Association 2023 Water Quality Initiative Report

Prepared for: Muskoka Lakes Association
Job #: J210048

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## Final Report

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# Signatures

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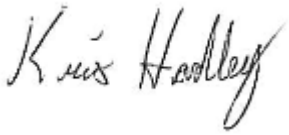

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DISCLAIMER

This report contains the findings of the Muskoka Lakes Association Water Quality Initiative. It is based on the results of samples taken by volunteers that are professionally analyzed by a lab and HESL/our consultants. The report provides only a snapshot in time of the levels of certain indicators and any trends that such indicators may suggest at certain locations within the Muskoka region. The report cannot and shall not be relied upon to define water quality conditions at individual properties nor used for purposes that the program was not designed for. Readers are advised to satisfy themselves regarding water quality at any location and the Muskoka Lakes Association accepts no responsibility or liability for any reliance on the contents of this report.

# Executive Summary

The Muskoka Lakes Association (MLA), Canada's oldest lake association, was founded in 1894 to represent the waterfront residents in the Muskoka Region. It has operated "The MLA Water Quality Initiative" (WQI), a monitoring program focussed on Lakes Rosseau, Joseph and Muskoka and many smaller surrounding lakes, since 2002. The MLA's water quality efforts are concentrated on:

- Protecting and promoting water quality through their monitoring program and
- Promoting responsible land use

The MLA Environment Committee manages over a hundred volunteers to collect annual water quality data and retained Hutchinson Environmental Sciences Limited (HESL) in 2021 to analyze their data and to provide recommendations and program modification/development options. This Water Quality Report presents the most recent data collected in 2023 and compares it to data collected from 2002 to the present.

The MLA and their volunteers monitored 52 areas within 17 lakes and rivers for a total of 534 samples between May and September in 2023. Each sampling area represents a geographic location encompassing a group of WQI monitoring sites, usually focussed on a river, lake or embayment of interest to the MLA. Samples were collected for analysis of total phosphorus (TP) and bacteria (*E. coli* and total coliform), with water and air temperature and Secchi depths recorded at each site.

Changes to the areas and sites monitored by the MLA WQI Program in 2023 were minor. Three additional sites were re-sampled near Willow Beach (WLB) in response to the elevated TP concentrations and long-term increasing trend identified during 2021, to investigate potential sources of phosphorus to WLB-3. No additional nearshore monitoring sites were added in 2023.

Finally, no samples were collected in 2023 at Leonard Lake, East Portage Bay and Browning Island which opted out of the MLA WQI Program.

Detailed summaries of 2023 data for mean Secchi depth, spring and annual average TP and annual geometric mean of *E. coli* and total coliform bacteria counts are included in the Area Reports (Appendix A). Long-term trend analyses for TP concentrations at all monitoring sites were included at sites where more than 5 years of data were available. Significant increasing trends were detected at one site which has been discussed in Section 3.6 and within the area report for Willow Beach. All trend analysis plots have been provided in Appendix B.

Without exception, Secchi depths recorded in 2023 remained within the range of variability of the long-term dataset. We noted that the Secchi depth data analysis methodology currently only includes comparison of the current years data against the long-term range of values collected at a sampling site. Trends in Secchi data were last assessed by HESL in 2017 at a limited number of sampling sites, in 2023 we updated the assessment of the long-term trends in Secchi data. A single significant trend in the Secchi depth data was recorded at Allport Bay (ALL-0) in 2023. We observed a small but statistically significant decline in Secchi depth from 2.5 to 2.0 m. The overall change in clarity at ALL-0 is small and ongoing monitoring will continue to inform this change.

Deep-water phosphorus concentrations at all sampling areas within the Lake Joseph, Lake Muskoka and Lake Rosseau were below the Ministry of the Environment, Conservation and Parks (MECP) Interim Provincial Water Quality Objectives (PWQO) of 10 and 20 µg/L for inland lakes[1], however nearshore phosphorus concentrations were elevated at sites within several sampling areas following rain events. We noted in 2021 that the majority of cases of elevated nearshore phosphorus were the result of samples collected during "Moderate" or "Heavy" storm events which, in some cases, we found storm sampling accounted for three or more of the phosphorus samples collected. Storm sampling can be useful to identify sources of phosphorus and therefore should be collected, however HESL recommended that the number of storm events be limited. In 2022, storm event sampling was generally reduced compared to 2021. In 2023, 53% of the samples were collected during documented rain events. To track consistency in sampling, we have documented the number of samples collected during storm events annually since 2018 and will continue to expand this information moving forward.

Trend assessment of spring phosphorus concentrations found a significant increasing trend at Willow Beach – Lake Muskoka, specifically the WLB-3 station, despite a marked reduction in TP concentration in 2022. Concentrations at this location were the elevated in 2021 and resulted in additional sampling of the creek that discharges near Willow Beach in 2022 and 2023. We found substantially elevated total phosphorus concentrations at WLB-6, in a small watercourse adjacent to a horse farm, and recommend sampling at these locations continue in 2024 to gather additional information. Elevated concentrations of phosphorus near agricultural lands suggest that there may be an opportunity to reduce phosphorus export to the watercourse and ultimately to Willow Beach by working with local stakeholders to implement best management practices of fertilizer use and manure management.

No cyanobacterial blooms were recorded in MLA Program lakes in 2023. Based on data recorded by the Simcoe Muskoka District Health Unit (SMDHU), blooms in the Muskoka region at lakes and embayment's not sampled by the MLA WQI program included Bass Lake (Muskoka), Mary Lake, Leonard Lake, Stewart Lake and Three Mile Lake.

Quality Assurance protocols followed during bacteria sampling in some cases. When bacteria counts exceed 50 cfu/100mL the protocol states that an additional sample is collected. The purpose of this additional sample is to determine if contamination may have been a factor in the high bacteria count. In 2023 bacteria were not properly re-sampled in 14 of the 19 events where counts exceeded 50 cfu/100mL. Maintaining sampling protocols should be a focus of 2024 training and continued vigilance is recommended to ensure anomalous data can be confirmed and to maintain consistency, as much as is possible, between current and historical samples.

Sampling areas where *E. coli* counts were elevated (>50 cfu/100ml) in 2023 include Bala Bay (BAL-2), Beaumaris (BMR-10), Clear Lake (CLR-5 and 8), Gull Lake (GUL-2), Minett (MIN-1, 6 and 9), Muskoka River (MRV-7), Star Lake (STR-1 and 4), Windermere (WIN-5 and 7) and Willow Beach (WLB-3 and 4). The nearshore areas which exceeded a geometric mean of 30 cfu/100mL in 2023 were Beaumaris (BMR-

[1] *To avoid nuisance concentrations of algae in lakes, average total phosphorus concentrations for the ice-free period should not exceed 20 µg/L; A high level of protection against aesthetic deterioration will be provided by a total phosphorus concentration for the ice-free period of 10 µg/L or less. This should apply to all lakes naturally below this value; Excessive plant growth in rivers and streams should be eliminated at a total phosphorus concentration below 30 µg/L.*

10), Cox Bay (COX-7), Minett (MIN-1, 6 and 9), Muskoka River (MRV-7), Windermere (WIN-5) and Willow Beach (WLB-3).

In 2023, 52 areas were sampled, 47 of which were assigned green lights, while four yellow lights and one red light were assigned based on the MLA criteria. Yellow lights at all four sampling areas were the result of elevated bacteria concentrations. No blooms were documented in MLA Program lakes or sampling areas in 2023.

A single red light was assigned in 2023 to Willow Beach (WLB-3), where we identified an ongoing long-term statistically significant increasing trend in phosphorus concentrations. Concentrations at this location were the highest recorded to date in 2023, likely as a result of increased runoff from the local catchment area with increased precipitation.

HESL has formulated several recommendations which we believe will improve the program moving forward. These include:

1. maintaining consistent sampling at long-term sites whenever possible.

2. continued training with volunteers to ensure methodological consistency and long-term data compatibility.

3. Ongoing analysis of water clarity (Secchi data) as part of future annual monitoring assessments and

4. Focussed sampling at Willow Beach, Minett, and Windermere, where elevated levels of bacteria and/or phosphorus were identified in 2023.

# Table of Contents



# List of Figures

# List of Tables



# Appendices

# 1. Introduction

There is a need for high quality, long-term data to support effective science-based management of freshwater resources (Smol 2008). This becomes increasingly important as the magnitude and number of environmental stressors grows (e.g., intensification of human land-use, exotic species' invasions and climate change). A region of particular interest in Canada is the lake-rich Muskoka-Haliburton region of south-central Ontario where, despite its relatively remote location, lakes have been influenced by multiple environmental stressors during the past several decades (Hall and Smol 1996, Paterson et al. 2004, DeSellas et al. 2008, Yan et al. 2008). Although distant from major urban and industrial centres, the Muskoka-Haliburton region is a popular destination for recreational activities, and is home to many cottages, resorts and golf courses. As a result, lakes in the region are susceptible to both regional-scale stressors, such as climate change, as well as local, catchment-scale stressors associated with increased shoreline development.

The Muskoka Lakes Association (MLA), Canada's oldest cottager association, was founded in 1894 to represent the waterfront residents in the Muskoka Region and has operated, since 2002, the MLA Water Quality Initiative (WQI), a monitoring program focussed on Lakes Rosseau, Joseph and Muskoka and many smaller surrounding lakes and rivers. The MLA's water quality efforts are concentrated on:

- Protecting and promoting water quality through their monitoring program, and
- Promoting responsible land use

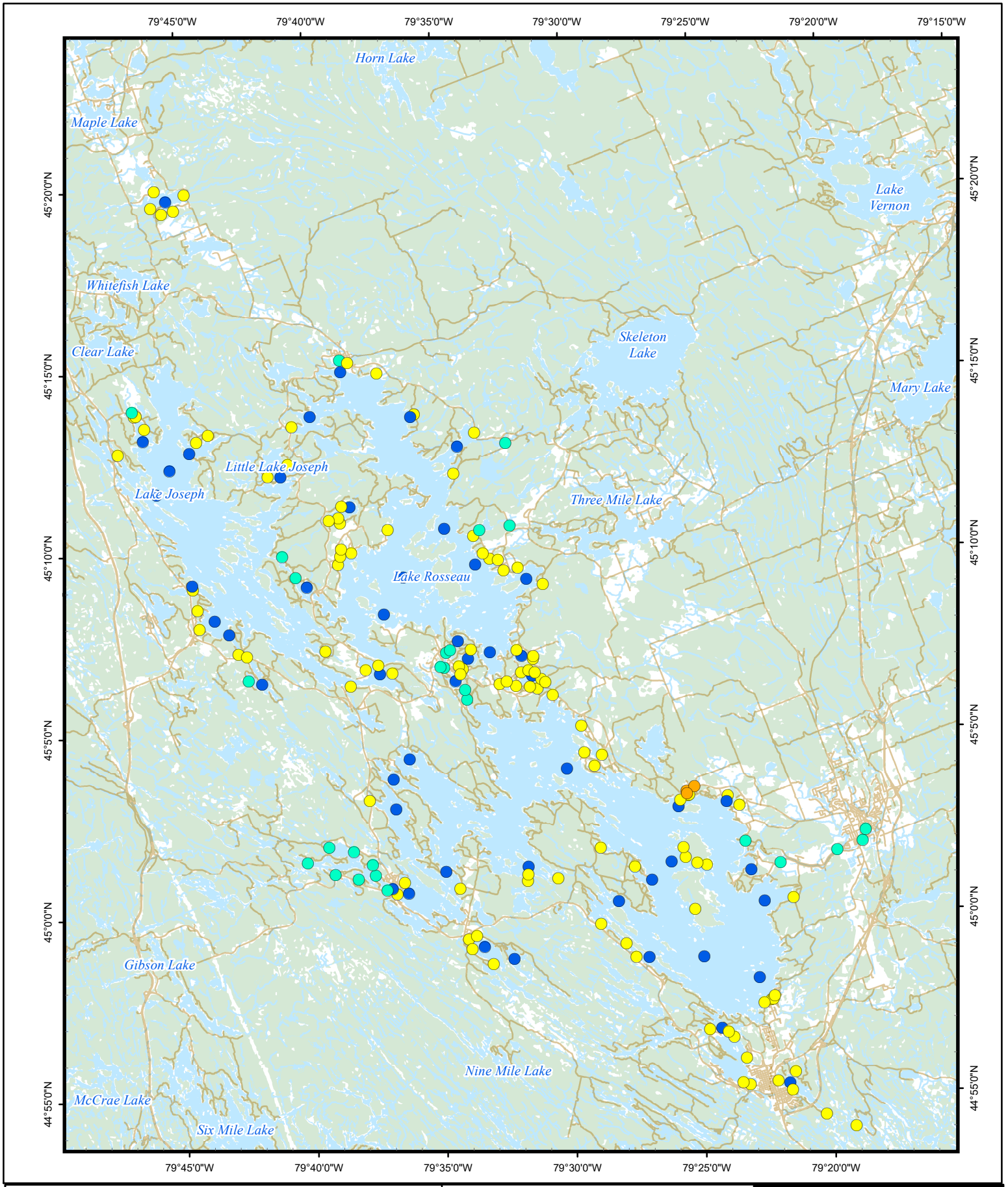
The MLA Environment Committee manages over a hundred volunteers to collect annual water quality data and retained Hutchinson Environmental Sciences Limited (HESL) in 2023 to analyze their data and to provide recommendations and program modification/development options. This Water Quality Report presents the most recent data collected in 2023 and compares it to data collected from 2002 to the present.

# 2. Water Quality Monitoring Program

## 2.1 Regional Setting

The study lakes are located in the Muskoka region of south-central Ontario, Canada, situated on the Precambrian Shield (Figure 1). The Shield is characterized by thin, poorly developed soil with abundant bedrock exposures. Catchments are mainly forested, dominated by sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), yellow birch (*Betula lutea*), red maple (*Acer rubrum*), eastern hemlock (*Tsuga canadensis*), and white and red pine (*Pinus strobus* and *Pinus resinosa*).

A key objective of the MLA program is to determine if the amount, nature and activities associated with shoreline development have altered key water quality indicators: Total Phosphorus (TP), an indicator of lake productivity, water clarity (influenced by algal growth and catchment runoff and measured as Secchi depth) and bacteria as an indicator of potential water borne pathogens (See Section 2.3). Shoreline development varies greatly between and within lakes. Sampling sites have generally been selected based on community concern and are therefore focused on moderately and heavily developed areas which may be influenced by inputs from urban and seasonal recreational (seasonal and year-round residences, resorts, golf course, agricultural) activities.




**Station Type**

- Deep Basin
- Nearshore
- Special Study
- Watercourse

- Roads
- Watercourses
- Waterbodies
- Wooded

0 0.5 1 2 3 4 5 km

**Scale = 1:250,000**

N

| | | | |
|---|---|---|---|
| Project #: | 210048 | Projection: | UTM Zone 17N |
| Drafted: | K. Hadley | Datum: | NAD 1983 |
| Reviewed: | B. Parsons | Date: | Dec 16, 2022 |

# Figure 1

Sampling Stations

### 2.1.1 The Role of Climate

The Muskoka region is situated within the boreal ecozone with a temperate climate. Average monthly air temperature from March to August in 2023 varied between -2.3 and 18.3 °C (Table 1) and monthly precipitation was between 58.8 and 172.3 mm (Table 2). Precipitation in March, and May were below the long-term averages, however total summer precipitation was the highest recorded since 2017 and well above the long-term average. Maximum daily air temperatures in 2023 ranged from 8.4 in March to 30.7 °C in June (Table 3), exceeding the average monthly maxima recorded between 1981 and 2010. Analysis of long-term climate records show high variability in average annual August air temperature since the 1980s but no long-term significant trend despite elevated temperatures since 2015 (Figure 2). Long-term total annual precipitation varied substantially, and no significant long-term trend was noted. (Figure 3).

Spring freshet in 2023 was more similar to typical long-term average conditions than the extreme high-water levels that were noted in 2019, however typical summer lows in water level were not recorded in 2022. Peak water levels at the Beaumaris Water Survey of Canada Station (02EB018) in 2023 (9.99 m), was consistent with levels observed in 2016 and 2017 when precipitation values were higher than during the past 5 years.

**Table 1. Average Temperatures Recorded at the Beatrice Climate Station (6110607).**

| Mean Temperature (°C) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Month** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **1981-2010 Average** |
| March | -1.5 | -5.9 | -3.3 | -6.2 | -0.9 | -1.3 | -3.1 | -2.3 | -3.8 |
| April | 1.6 | 6.3 | -0.2 | 3.3 | 2.7 | 5.9 | 4.3 | 5.3 | 4.4 |
| May | 11.0 | 10.1 | 13.3 | 9.1 | 9.9 | 10.0 | 13.2 | 10.2 | 11.0 |
| June | 15.5 | 15.4 | 15.5 | 14.2 | 16.4 | 17.4 | 16.5 | 16.5 | 15.8 |
| July | 18.6 | 17.9 | 19.5 | 19.3 | 20.5 | 17.6 | 18.6 | 18.3 | 18.2 |
| August | 19.4 | 16.4 | 19.3 | 16.5 | 17.3 | 19.8 | 19.2 | 16.4 | 17.3 |

**Table 2. Total and Average Monthly Rainfall at the Beatrice Climate Station (6110607).**

| Total Monthly Precipitation (mm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Month** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **1981-2010 Average** |
| March | 182.3 | 87.5 | 31 | 62.4 | 98.1 | 43.4 | 44.1 | 70 | 75.2 |
| April | 64.4 | 155.6 | 103.8 | 133.3 | 73.6 | 72.1 | 84.1 | 172.3 | 76.8 |
| May | 56.3 | 130.2 | 27.6 | 100.8 | 68.3 | 14.9 | 50.2 | 58.8 | 97.9 |
| June | 41.3 | 151.6 | 25.5 | 101.1 | 100.9 | 135.9 | 63.9 | 123.5 | 87.7 |
| July | 72.6 | 79.6 | 57 | 23.9 | 81.8 | 136.2 | 51.6 | 140.2 | 94.3 |
| August | 195.5 | 211.2 | 196.1 | 75.3 | 129.4 | 88.2 | 130.9 | 102.8 | 87.7 |
| **Total** | 612.4 | 815.7 | 441 | 496.8 | 552.1 | 490.7 | 293.9 | 667.6 | 519.6 |

**Table 3. Maximum Daily Air Temperatures Recorded at the Beatrice Climate Station (6110607).**

| | Maximum Temperature (°C) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **1981-2010** |
| March | 12.7 | 9.5 | 8.6 | 9.9 | 12.3 | 18.4 | 16.0 | 8.4 | 2.4 |
| April | 22.4 | 27.1 | 17.9 | 18.9 | 15.5 | 24.4 | 22.6 | 28.0 | 10.7 |
| May | 30 | 28.4 | 30.9 | 21.4 | 31.2 | 29.8 | 30.4 | 29.5 | 18.1 |
| June | 29.6 | 27.7 | 30 | 27.7 | 30.3 | 30.3 | 32.2 | 30.7 | 22.6 |
| July | 30 | 28 | 33.9 | 30.6 | 32.4 | 28 | 31.8 | 29.8 | 24.9 |
| August | 33.3 | 27.5 | 30.4 | 27.9 | 29 | 30.1 | 31.8 | 25.2 | 23.8 |

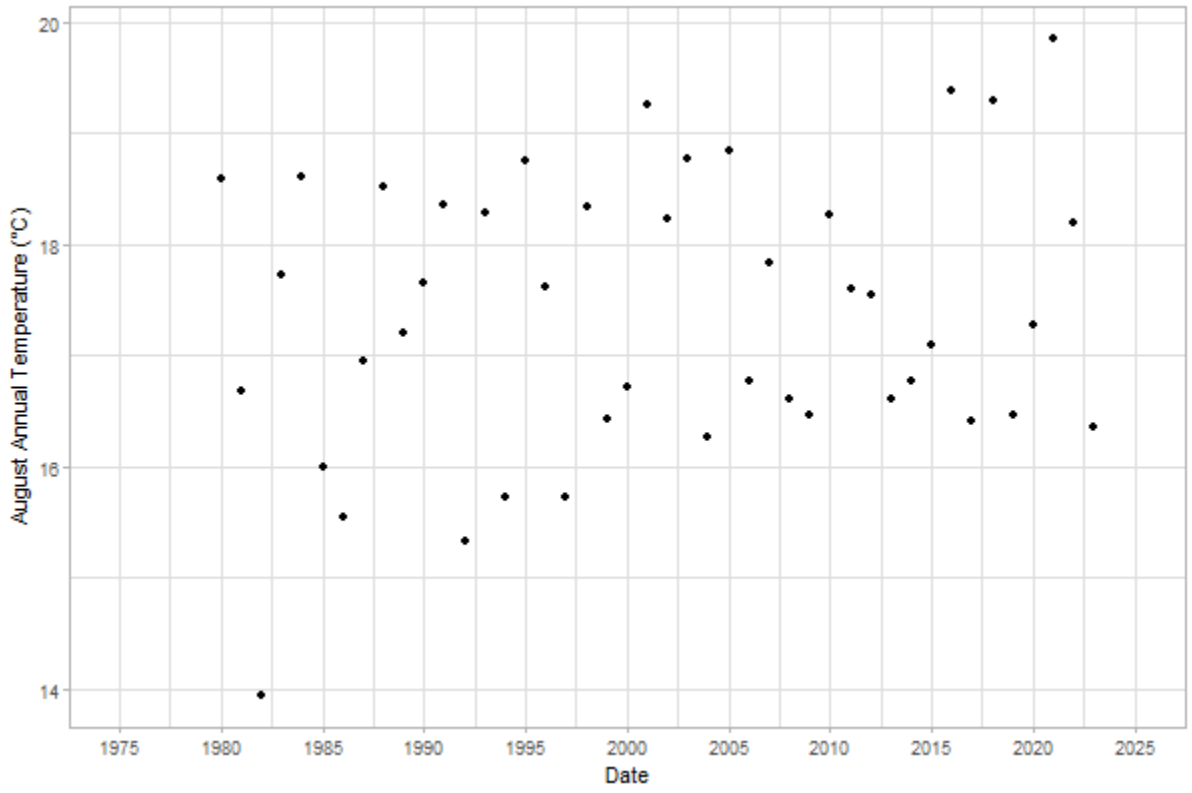



**Figure 2. Long-term Trends in Average Annual Air Temperature at the Beatrice Climate Station (6110607).**

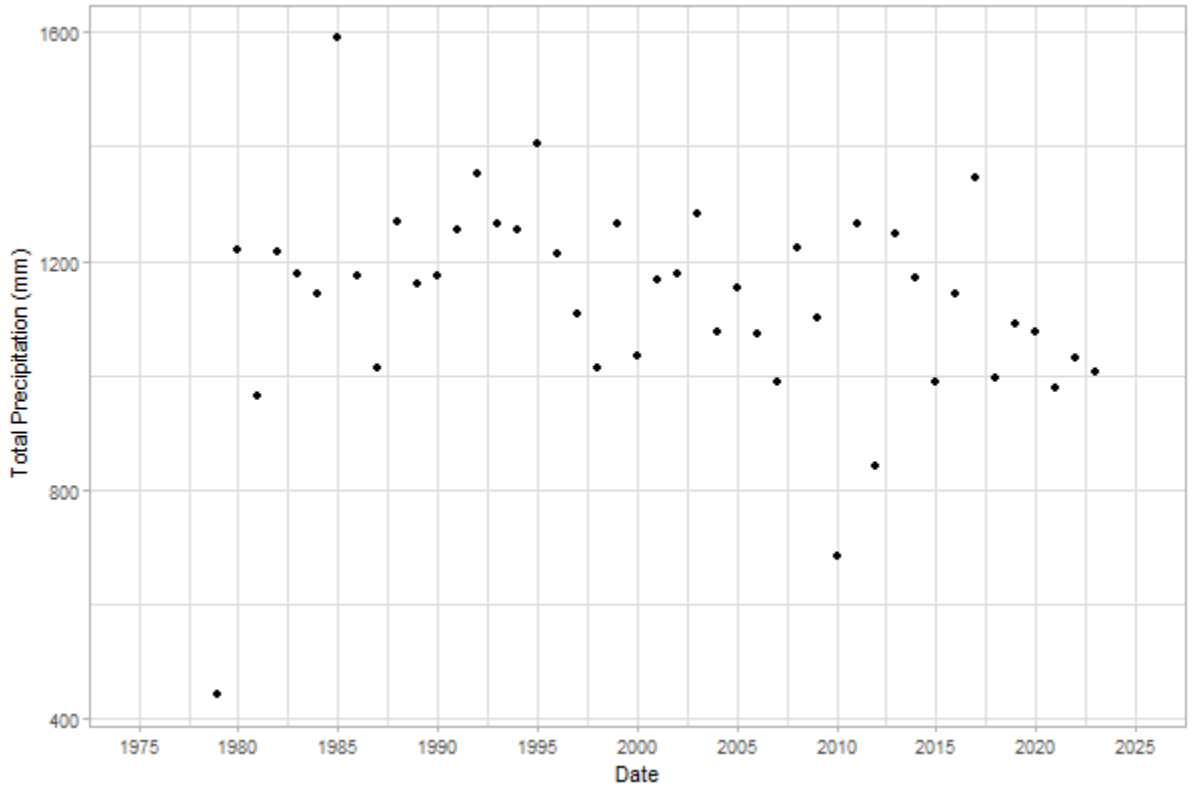



**Figure 3. Long-term Records of Total Annual Precipitation at the Beatrice Climate Station (6110607).**

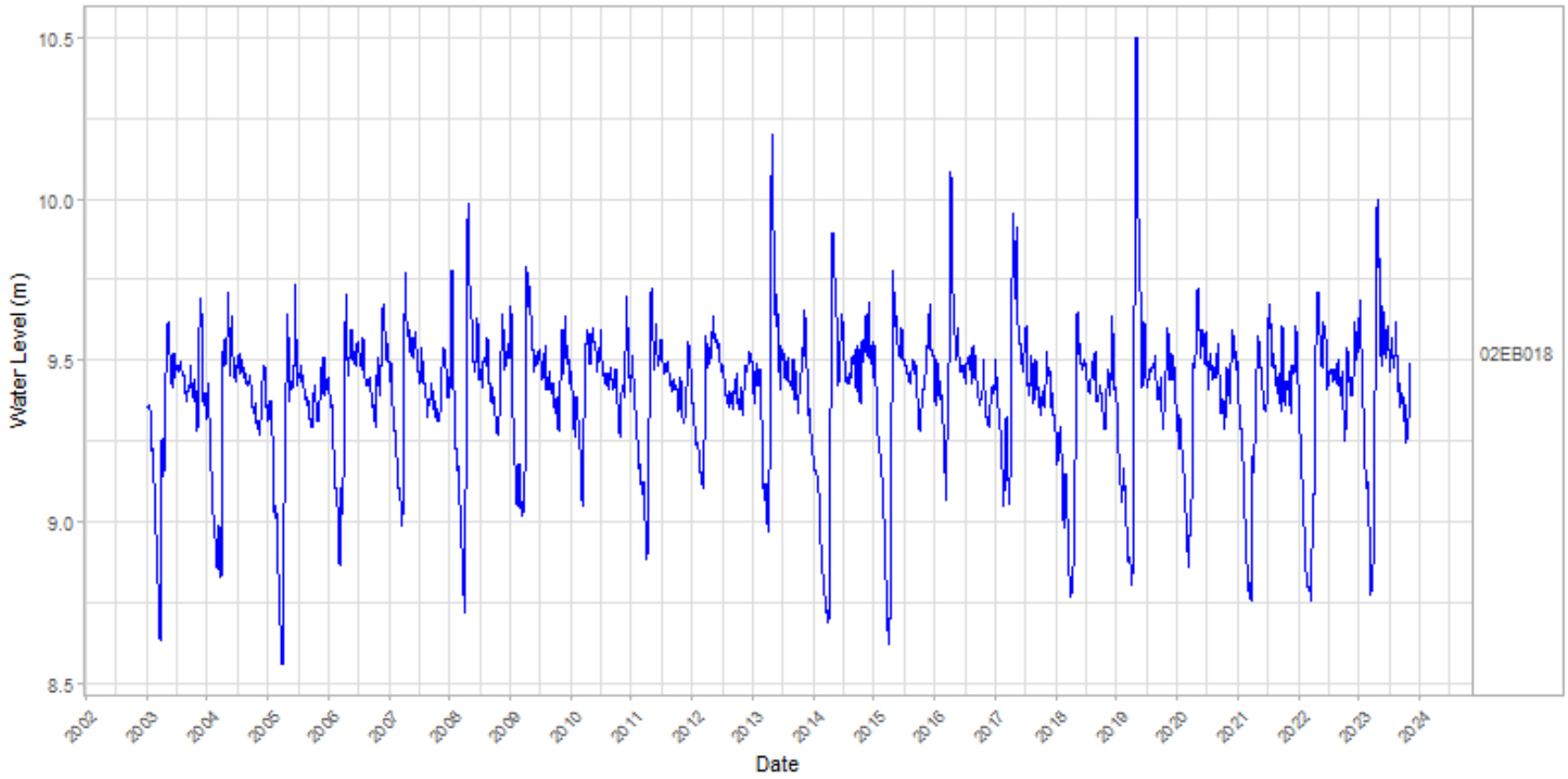



**Figure 4. Long-term Water Level at Beaumaris Water Survey of Canada Station (02EB018).**

## 2.2 Study Areas and General Methods

The MLA WQI monitoring program study area includes Lakes Muskoka, Rosseau, and Joseph and several smaller affiliate lakes and rivers in the Muskoka Region. The study area is divided into targeted sampling areas which include lakes, bays, and rivers. Within each sampling area the MLA maintains several sampling stations, normally this includes a deep-water station (to represent average sampling conditions), one or more nearshore sampling stations and, where applicable, watercourse sampling stations.

Details of the sampling protocols are provided in the MLA Water Quality Initiative Methodology Report (http://www.mla.on.ca) and these standard protocols were followed in 2023.

## 2.3 Water Quality Parameters

The MLA WQI is focussed on TP concentrations, Secchi depth measurements and *E. coli* bacteria sampling. For recreational lakes on the Precambrian Shield water quality concerns are most often associated with nutrient enrichment due to increased human phosphorus sources. Phosphorus is often the primary limiting nutrient in freshwaters in support of macrophyte and algal growth. Phosphorus enters lakes via external loading from the watershed, precipitation and, in certain conditions, through internal loading from sediments at the lake bottom. Effluent from sewage treatment systems and stormwater runoff may have particularly high loadings and as a result phosphorus concentrations are commonly used to assess the impacts of development on water quality. Excessive growth of plants and algae and subsequent decomposition can result in lowering of dissolved oxygen concentrations in deep hypolimnetic waters due to the oxygen requirements of bacteria and this may degrade fish habitat and in extreme cases result in "fish kills", a phenomenon where water temperature near the surface of the lake is too warm and oxygen concentrations of the water near the bottom are too low to support fish needing to take refuge there resulting in a mass die-off.

Secchi disc depth provides a measure of water clarity which is one indication of the productivity of the lake. For Precambrian Shield lakes, Secchi depth is primarily determined by the amount of dissolved organic carbon (DOC) in the water (Dillon et al. 1986), and this is a function of the amount of wetland in the watershed (Dillon and Molot 1997). High algae growth, however, reduces the penetration of light through the water column and reduces the measured Secchi depth beyond that related to DOC. Decreases in Secchi depth over time may therefore be indicative of increased productivity by, for example shoreline disturbance and development activities that increase total suspended solids or phosphorus loading from the watershed.

*E. coli* is a species of fecal coliform bacteria that comes from warm-blooded animals, including humans and are a useful indicator of potential pathogens in the water. They are the primary organism used by Health Canada in determining the safety of recreational waters for swimming and bathing.

In 2022 the MLA began collecting chloride samples in response to concerns that road salt application may be increasing chloride concentrations in lakes in the Muskoka region and posing a threat to aquatic life. Two lakes were sampled in 2022, while sampling expanded in 2023 to include 8 samples, 2 on Lake Joseph and Lake Rosseau, 3 on Lake Muskoka and 1 in the Muskoka River.

## 2.4 Updates in the 2023 Program

Changes to the areas and sites monitored by the MLA WQI Program in 2023 were minor. Additional sites near Willow Beach were sampled for a second consecutive year in response to the elevated total phosphorus concentrations and long-term increasing trend identified during 2021, to investigate potential sources of phosphorus to WLB-3. These sites were:

- WLB-5 – A wetland on the North side of County Road 118 (@ 45° 03' 15" N, 79° 25' 30" W), where water drains through a large culvert prior to discharging into Lake Muskoka @ WLB-3.
- WLB-6 – A small creek entering golf course from East, that drains an adjacent horse farm (@ 45° 03' 27" N, 79° 25' 12" W)
- WLB-7 – The outlet of the golf course pond on the upstream side of the sluice gate (@ 45° 03' 20" N, 79° 25' 31" W), which drains to Lake Muskoka

No additional nearshore monitoring sites were added in 2023.

Finally, no samples were collected at Leonard Lake, Browning Island, and East Portage Bay which opted out of the MLA WQI Program in 2023.

# 3. 2023 Monitoring Methods and Results

## 3.1 Background

The MLA and their volunteers monitored 52 sampling areas within 17 lakes and rivers for a total of 534 samples between May and September in 2023. Each sampling area represents a geographic location encompassing a group of WQI monitoring sites, usually focussed on a watercourse, lake or embayment of interest to the MLA.

Detailed summaries of 2023 data for mean Secchi depth, spring and annual average total phosphorus, as well as annual geometric mean of *E. coli* and total coliform bacteria counts are included in the Area Reports (Appendix A). Long-term trend analyses for total phosphorus concentrations at all monitoring sites were included at sites where more than 5 years of data are available. Significant increasing trends were detected at only one site and is discussed within the area report and Section 3.6. All trend analysis plots have been provided in Appendix B. A visual indication of the overall water quality at each Area is presented by means of a traffic light symbol. The meaning of each symbol is described below:

| Green Light | Yellow Light | Red Light |
|---|---|---|
| Water quality remains consistently good. | Further investigation is recommended to maintain good water quality. | Remedial action is recommended to improve water quality. |

In 2019, the MLA developed new thresholds to align monitoring under the WQI Program with the District Municipality of Muskoka's recently adopted Official Plan amendment - OPA 47 (Table 4). The water quality thresholds defined in DMM Policy C.2.6.3.2 are:

i. A long-term statistically significant ($p<0.1$) increasing trend in total phosphorus concentration demonstrated by at least five (5) spring overturn phosphorus measurements obtained through the District of Muskoka water quality sampling program since 2001.
ii. A long-term total phosphorus concentration of greater than 20 µg/L demonstrated by the average of five (5) most recent spring overturn phosphorus measurements obtained through the District of Muskoka water quality sampling program within the last ten (10) years; and/or
iii. A blue-green algal (cyanobacteria) bloom confirmed and documented by the Province and/or Simcoe-Muskoka District Health Unit.

If conditions (i) or (ii) have been identified in three consecutive monitoring years or condition (iii) has been confirmed to be present, the waterbody is classified as vulnerable and added to Schedule E2. Under the Official Plan, lakes listed under Schedule E2 are subject to a causation study to determine what role, if any, that development has in the measured nutrient enrichment or algae bloom and to recommend management actions. Several of these causation studies have been recently completed and are posted on the District of Muskoka website.

Beginning in 2019, the MLA has assigned a yellow light threshold for phosphorus concentrations that are either:

- >20 µg /L (latest 3-year spring turnover average);
- show an increasing trend in spring measurements over the last 3 years; or
- have an annual average TP that exceeds spring TP.

A red light threshold for phosphorus concentrations is triggered if:

- concentrations exceed 20 µg/L (latest 5-year spring turnover average); or
- a statistically increasing trend in spring measurements over the last 5 years (or longer).

In addition, a red light occurs for study areas where a confirmed cyanobacterial bloom is detected in the current monitoring year, while a yellow light is assigned if a bloom has been confirmed in the past three years or if microcystin concentrations of a current bloom are below 20 µg/L. A green light for Harmful Algae Blooms is assigned in study areas that have never had a blue-green algal bloom, or that have had 3 years since the last bloom.

*E. coli* thresholds were established in 2018 using Health Canada and the Ministry of Health and Long-Term Care Operational Approaches for Recreational Water Guideline (2018) for recreational water use at public beaches and waterfronts and are based on a geometric mean of levels of *E. coli*. Health Canada guidelines deems a site unsuitable for swimming and bathing when *E. coli* counts exceed 200 cfu/100mL, based on a

minimum of five samples per site collected within a one-month period, which is not currently possible under the MLA WQI program. The MLA has, however, adopted their own, lower, thresholds in recognition of the high water quality in Muskoka's lakes, with the green light established for annual means below 30 cfu/100 ml, yellow for counts between 30 and 199 cfu/100 ml and red where annual means exceed the Health Canada threshold of 200 (Table 4). The MLA *E. coli* geometric mean is calculated annually (ideally, 1 sample per month over 4 months). Individual *E. coli* samples that exceed 50 cfu/100ml require volunteers to re-sample the site weekly. Where additional samples are collected, all data were used to calculate the annual geometric mean.

HESL will review traffic light thresholds with the MLA Environment Committee annually. HESL included the Interim Provincial Water Quality Objectives (PWQO) for TP to our comparisons for each Area Report in 2023. These guidelines are generally applied to ice-free average phosphorus concentrations, however we have assessed both spring and, where available, annual data against the guidelines to provide an additional assessment of current water quality. These additional guideline comparisons are not incorporated into the MLA Stoplight Thresholds.

**Table 4. MLA Thresholds for Assigning Traffic Light Limits for Area Summaries.**

| Traffic Light | *E. coli* Yearly Geometric Mean (cfu/100 ml) | Phosphorus Trend Associated with all Sampling Years | Harmful Algae Blooms (HAB's) |
|---|---|---|---|
|  | **0 – 30** | **Flat or decreasing visual trend** | No bloom ever, or 3 years since last bloom |
|  | 31 – 199 | a) >20 µg /L (latest 3-year spring turnover average);<br>b) show an increasing trend in spring measurements over last 3 years; OR<br>c) yearly mean TP exceeds spring TP | Bloom within last 3 years or, if available, bloom in current year with toxic component (microcystins) measured <20 µg /L |
|  | >200 geometric mean for a series of 5 samples per site per month | a) >20 µg/L (latest 5-year spring turnover average); OR<br>b) statistically increasing trend in spring measurements over last 5 years (or longer). | Bloom in current year with toxic component (microcystins) measured >20 µg /L |

## 3.2 Six-year Review of Storm Event Sampling

To assess the long-term sampling protocols of the MLA WQI program, we reviewed the metadata collected on rainfall events during sampling over the past six years of data collection (2018-2023). Where rainfall conditions were recorded, storm-based sampling occurred in a variable number of samples (Table 5), which may result in significant inter-annual variability in both bacteria and total phosphorus concentrations. We will continue to update and track storm sampling in the future to inform the interpretation of data collected by the program. Generally, volunteers are to avoid sampling on days of precipitation but at times it is unavoidable given that the sampling dates are preestablished. Precipitation in July and August was above average in 2023 so it was harder to avoid sampling after a storm event.

**Table 5. Recorded Rainfall Events During MLA WAI Sampling.**

| Year | Total Number of Samples | Number of Samples during Rainfall Events | Number of Samples during Rainfall Events (%) |
|---|---|---|---|
| **2018** | 694 | 347 | 50 |
| **2019** | 644 | 177 | 27 |
| **2020** | NA | NA | NA |
| **2021** | 690 | 343 | 50 |
| **2022** | 671 | 282 | 42 |
| **2023** | 601 | 317 | 53 |

## 3.3 Secchi Disc Depth

Mean Secchi depth measurements at all deep-water stations are provided for each sampling area in the Area Summary Sheets (Appendix A). Without exception, Secchi depths recorded in 2023 remained consistent with the depths reported historically. We noted that the Secchi depth data analysis methodology currently only includes comparison of the current year's data against the long-term range of values collected at a sampling site. Trends in Secchi data were first assessed by HESL in 2017 at a limited number of sampling sites. In 2022, we added long-term analysis of Secchi depth at all stations with sufficient data (> 5 years), these analyses have been updated in 2023. Figures for all trend analyses completed in 2023 have been included in Appendix C. If a significant trend is identified, we will include the trend analysis figure and discussion within the Area Report and in the Technical Report discussion (Section 3.3.2). Secchi depth assessments are not incorporated into the MLA Stoplight Thresholds.

### 3.3.1 Quality Control

Secchi depth measurements are collected as the average of two measurements taken during each field visit. A total of 195 Secchi depth measurements were collected in 2023 across the MLA WQI program sites. Outlier assessment followed methods used for total phosphorus data. Briefly, the Grubb's Test and Dixon Tests were used to identify outliers in Secchi depth data. All outliers, even those identified as potential erroneous measurements, were retained in the long-term data set and will be re-evaluated each year when new data is collected. No samples collected in 2023 were outliers, however QA/QC of past data identified several potentially erroneous values that resulted from data being recorded in feet rather than metres. All such errors were corrected in the database in 2021 and 2022.

### 3.3.2 2023 Secchi Depth Results

A single significant trend in the Secchi depth data was recorded at Allport Bay (ALL-0) in 2023. We observed a small but statistically significant decline in Secchi depth from 2.5 to 2.0 m. The overall change in clarity at ALL-0 is small and ongoing monitoring will continue to inform this change.

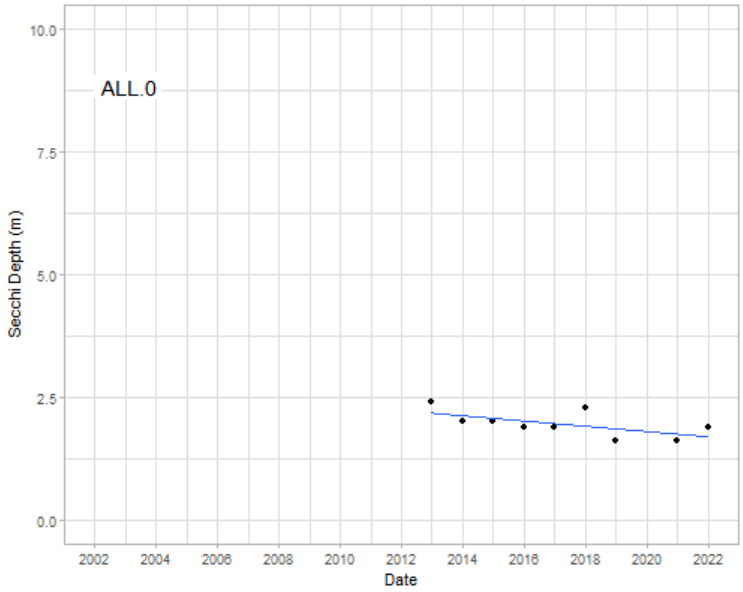



**Figure 5. Long-term trend Assessment of Secchi Depth Data at ALL-0.**

## 3.4 Total Phosphorus Concentrations

Spring total phosphorus concentrations have been collected since monitoring began from the deep-water sampling station within each sampling area and are presented in the Area Summary Reports (Appendix A). In addition, where available, annual average phosphorus data are also presented (e.g., Figure 6). Phosphorus data were compared against the PWQO for Protection Against Aesthetic Deterioration (10 µg/L, Yellow Line) and Prevention Against Nuisance Algal Growth, which coincides with the DMM threshold adopted in OPA 47 (20 µg/L, Red Line), and, where available, previous District of Muskoka Thresholds based on background + 50% (Grey Line). Nearshore phosphorus concentrations were not collected consistently at all nearshore monitoring stations in the MLA WQI Program, in some cases only bacteria were sampled. Where nearshore phosphorus data were collected, we compared spring overturn and annual average nearshore phosphorus concentration against long-term nearshore monitoring data.

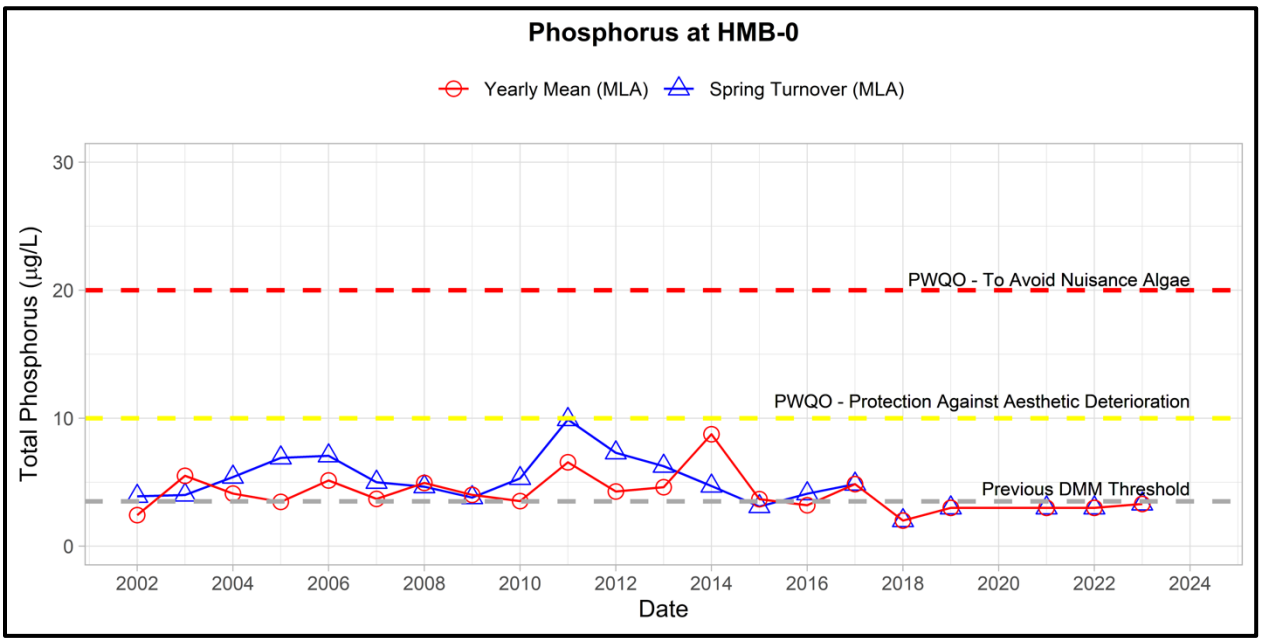



**Figure 6. Example of the Presentation of Long-term Phosphorus Monitoring Figures.**

In 2023, we have continued long-term analysis of total phosphorus concentrations at all deep-water and nearshore stations with sufficient data (> 5 years). Figures for all trend analyses completed in 2023 have been included in Appendix B. When a significant trend is identified, we will include the trend analysis figure and discussion within the Area Report and in the Technical Report discussion (Section 3.3.2). Visual analyses of changes in deep-water and nearshore phosphorus concentrations were also performed to assess the MLA yellow light trigger as described in Section 3.1.

Spring overturn phosphorus concentration from samples collected by the Lake Partner Program and District of Muskoka are available at some sampling stations which are also monitored by the MLA. Based on our understanding with the Environment Committee, these data will be reviewed by HESL and included as a technical memo or addendum to this report when they become publicly available.

### 3.4.1 Quality Control

A total of 44 duplicate phosphorus samples were collected in 2023 and 19 bad splits were identified that were either >30% different or had an absolute difference of >5 µg/L. If a bad split was identified, the higher of the two values was discarded. Outlier assessments followed previous methods using the Grubb's Test and Dixon's Test to identify outliers in the spring and annual average total phosphorus data. Data that were identified as an outlier were retained in the Area summary plots unless it could be clearly identified as contamination. All outliers, even those identified as potential contaminated samples, are retained in the long-term data set, and will be re-evaluated each year when new data is collected. No outliers were identified in samples collected in 2023.

### 3.4.2 2023 Total Phosphorus Results

Deep-water phosphorus concentrations at all sampling areas within Lake Joseph, Lake Muskoka and Lake Rosseau were below PWQO's for inland lakes in 2023 (Figure 7, 8, 9). Nearshore phosphorus

concentrations were elevated at sites within several sampling areas (i.e., BMR, and WIN). Nearshore total phosphorus at Beaumaris (BMR) has historically been elevated. For example, nearshore TP concentrations at BMR-12, where sampling began in 2017, have ranged between 12.0 and 33.1 μg/L and thus the 17.9 μg/L recorded in 2023 is not atypical.

Brandy Lake had spring phosphorus concentrations above the PWQO for Protection Against Aesthetic Deterioration (Figure 10), however, based on long-term data, phosphorus concentrations in Brandy Lake appear naturally elevated and were below the historic District Municipality of Muskoka threshold (28.4 µg/L) in 2023.

Windermere has been flagged as an area of concern since 2021. Nearshore phosphorus concentrations and bacteria at WIN-5 near Parker's Marina were higher in 2023 than those recorded in 2022, but lower than peak values recorded in 2021. Extreme phosphorus values recorded at WIN-5 in 2021 followed a heavy storm event and may not be representative of typical conditions at the site. High precipitation in 2023 did not result in phosphorus concentrations similar to those recorded in 2021. Ongoing monitoring of this area is recommended to maintain the long-term record and continue to assess potential water quality issues.

In 2023, spring phosphorus concentrations a significant increasing trend at Willow Beach on Lake Muskoka was noted at the WLB-3 station (Figure 11). Concentrations at this location were the highest recorded to date in 2023, likely as a result of increased runoff from the local catchment area with increased precipitation. The magnitude of the long-term increasing trend in total phosphorus concentrations at WLB-3 was approximately 0.9 μg/L/year in 2023 up from 0.77 μg/L/year following 2022 sampling. The WLB-3 station is located in a heavily developed area adjacent to two resorts and near the inflow of a creek which drains a golf course and agricultural lands. Sampling of this creek was performed on May 23$^{th}$ and June 25$^{th}$ by the MLA at three locations (WLB-5, 6 and 7; Figure 12). Average phosphorus concentrations at WLB-5 and 6 were elevated (35.0 and 42.9 μg/L, respectively) and above the PWQO for rivers and streams (30 μg/L). At WLB-7, total phosphorus concentrations were below the PWQO for rivers and streams in 2023. We recommend sampling at these locations continue to further inform the range of variability in phosphorus exports from the watercourse to Willow Beach. Elevated concentrations of phosphorus suggest that there may be an opportunity to reduce phosphorus export to the watercourse and ultimately to Willow Beach by working with local stakeholders to implement best management practices of fertilizer use and manure management.

### 3.4.3 River Stations

River sampling stations do not comprise a significant portion of the MLA WQI Program, however long-term records of water quality have been collected from Muskoka River (MRV), Joseph River (JOR), Indian River (IND), Hamer Bay tributary (HMB-8) and Windermere tributary sampling stations (WIN-7 and WIN-8). Phosphorus concentrations within river stations were frequently elevated (Figure 7, 8 and 9) as seasonal changes in flow impact dissolved organic carbon and suspended sediment loads in the water column and thus impact nutrient concentrations. Phosphorus concentrations at these stations were compared against the PWQO for the Elimination of Excessive Plant Growth in Rivers and Streams (30 µg/L) and, where appropriate, are discussed within the Area Reports.

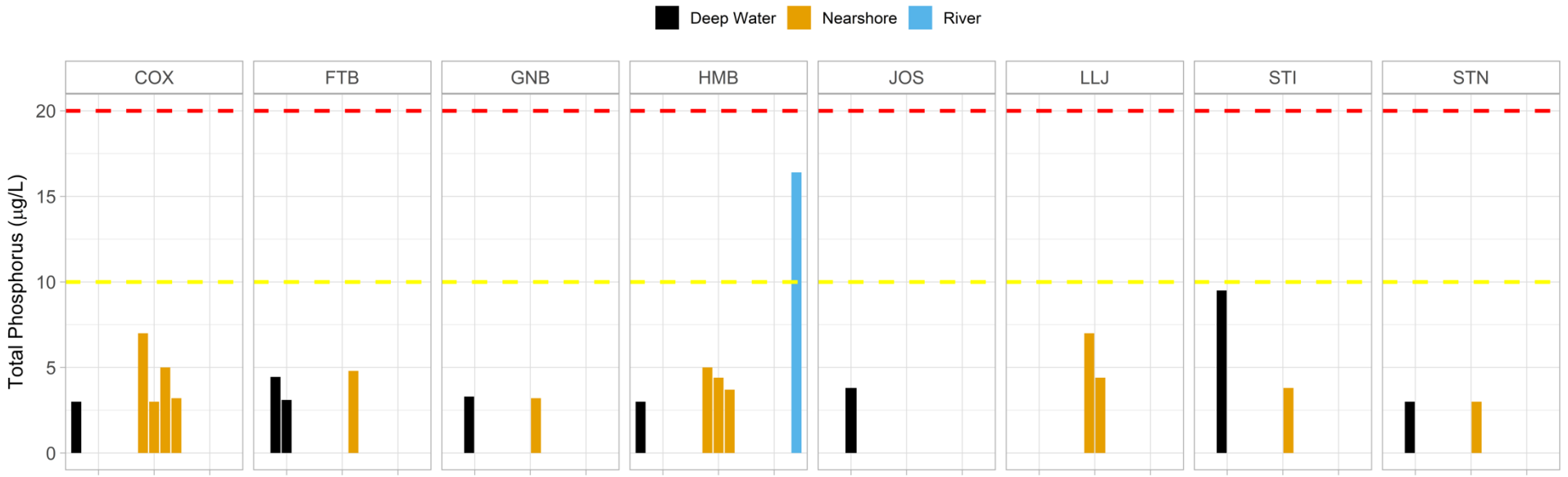



**Figure 7. Summary of the 2023 Spring Total Phosphorus Results from Lake Joseph Sampling Areas.**

Note: COX = Cox Bay; FTB = Foot's Bay; GNB = Gordon Bay; HMB = Hamer Bay; JOS = Lake Joseph; STI = Stills Bay; STN = Stanley Bay.

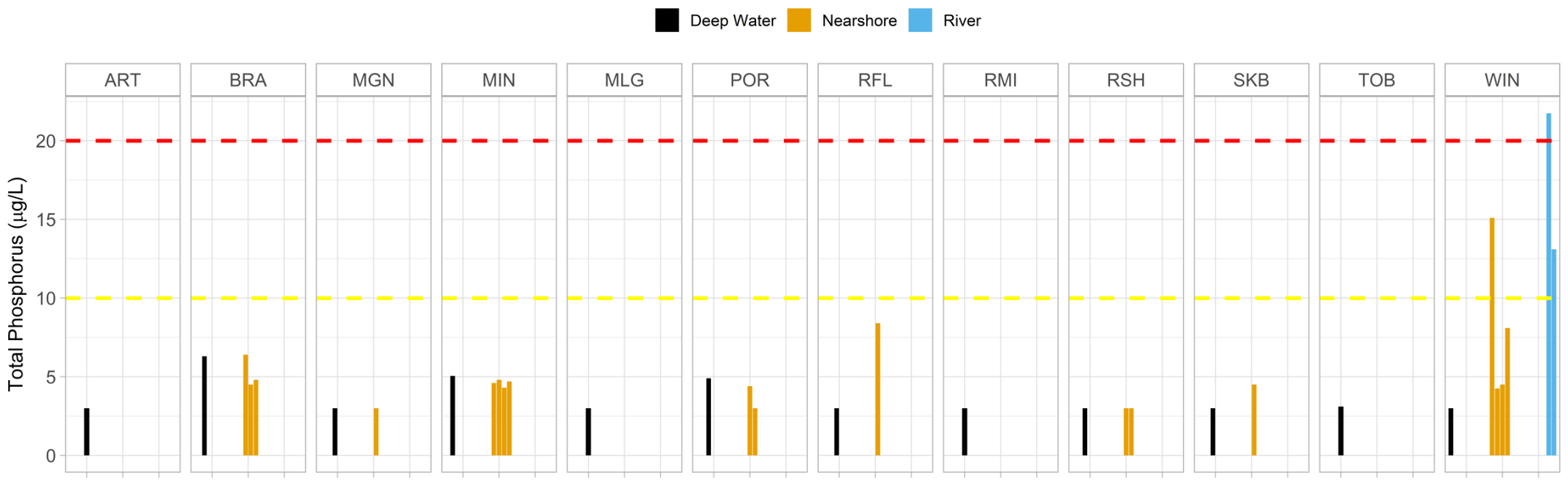



**Figure 8. Summary of the 2023 Spring Total Phosphorus Results from Lake Rosseau Sampling Areas.**

Note: ART = Arthurlie Bay; BRA = Brackenrig Bay; MGN = Morgan Bay; MIN = Minett, MLG = Muskoka Lakes Golf; POR = East Portage Bay; RFL = Rosseau Falls; RMI = Royal Muskoka Island; ROS = Lake Rosseau; RSH = Rosseau North; SKB = Skeleton Bay; TOB = Tobin Island; WIN = Windermere.

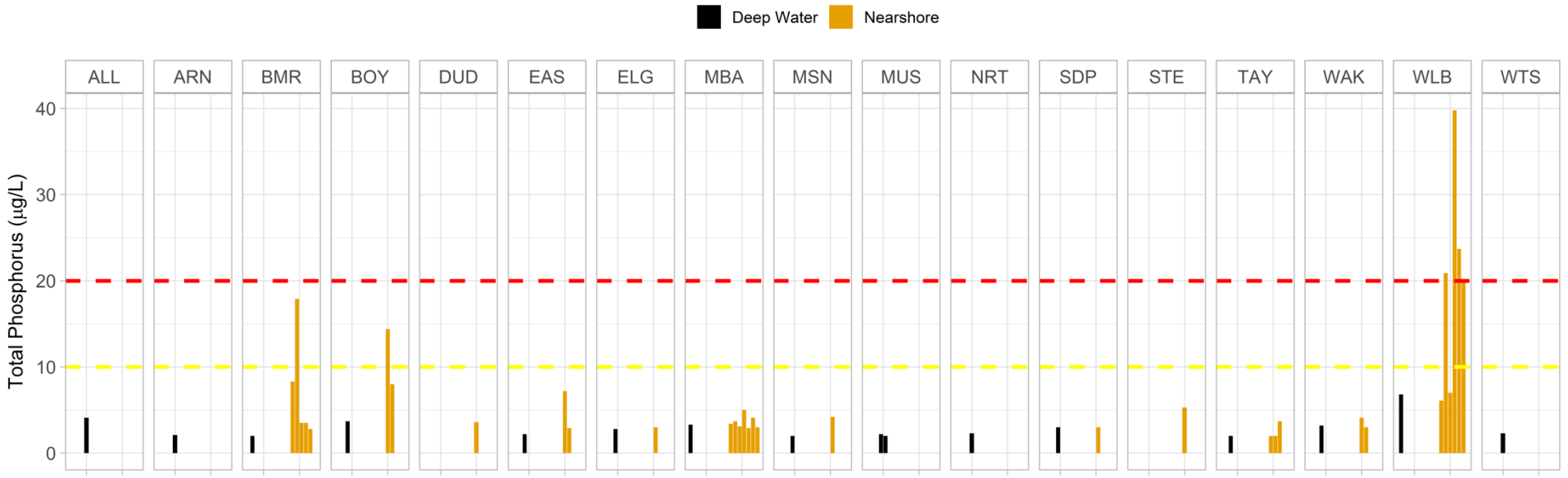



**Figure 9. Summary of the 2023 Total Phosphorus Results from Lake Muskoka Sampling Areas.**

Note: ALL = Alport Bay; ARN = Arundel Lodge; BAL = Bala Bay; BMR = Beaumaris; BOY = Boyd Bay; DUD = Dudley Bay; EAS = East Bay; ELG = Eilean Gowan Island; MBA = Muskoka Bay; MSN = Muskoka Sands; MUS = Lake Muskoka; NRT = North Bay; SDP = Sandy Point; STE = Stephens Bay; TAY = Taylor Island; WAK = Walkers Point; WLB = Willow Beach; WTS = Whiteside Bay.

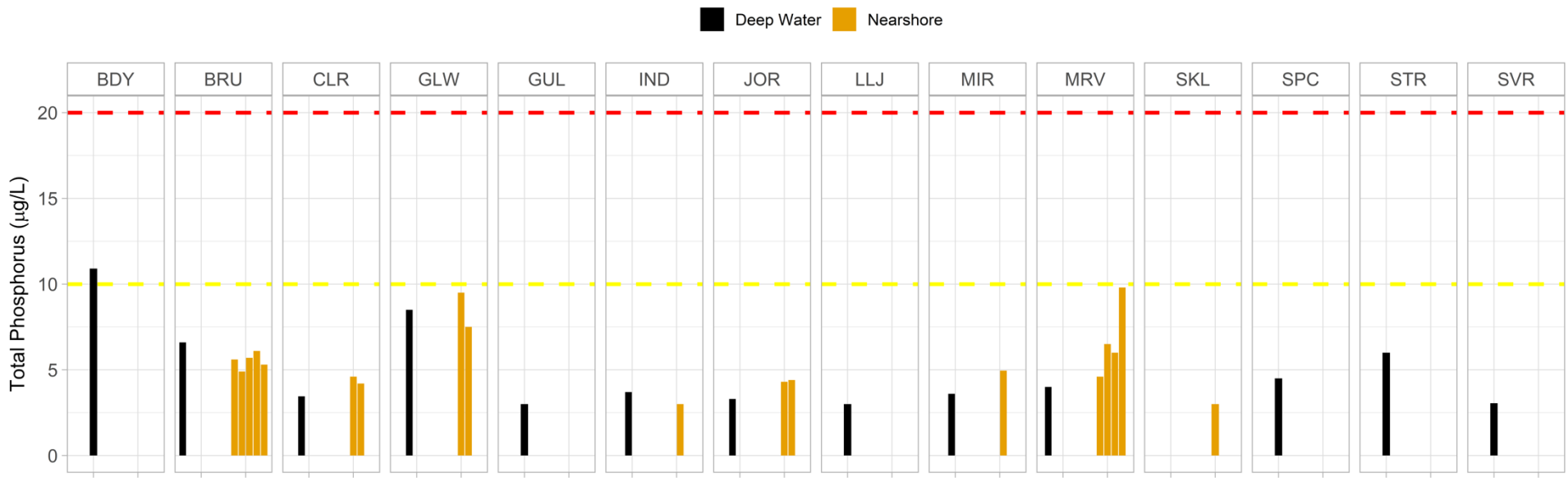
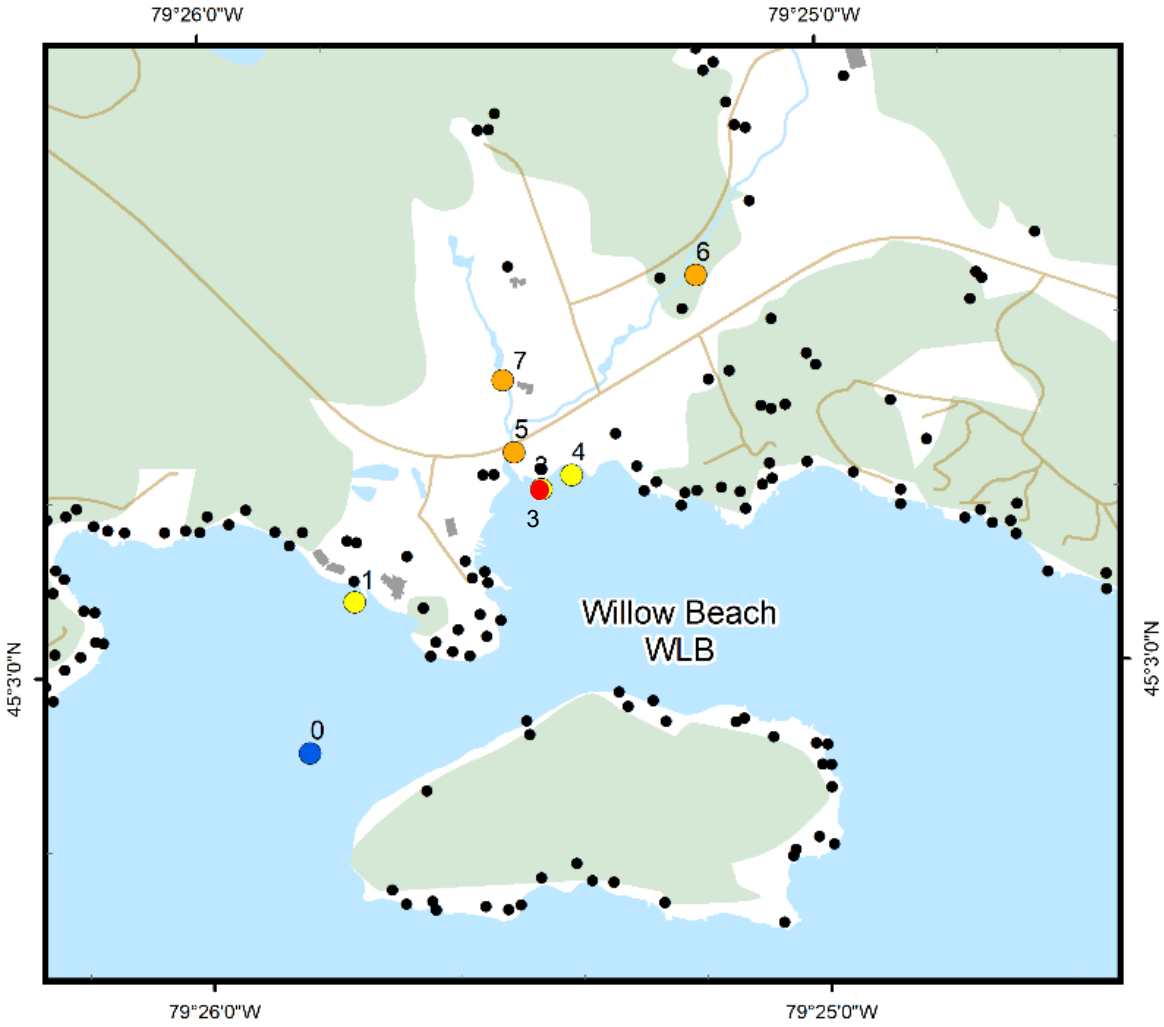



**Figure 10. Summary of the 2023 Spring Total Phosphorus Results from Affiliate Lake and River Sites.**

Note: BDY = Brandy Lake; BRU = Bruce Lake; CLR = Clear Lake; GLW = Gullwing Lake; GUL = Gull Lake; IND = Indian River; JOR = Joseph River; LEO = Leonard Lake; LLJ = Little Lake Joseph; MIR = Mirror Lake; MOO = Moon River; MRV = Muskoka River; SKL = Skeleton Lake; SPC = Silver Lake (Port Carling); STR = Star Lake; SVR = Silver Lake (Gravenhurst).




Note: WLB.3 = Willow Beach Nearshore Site #3.

**Figure 11. Map of Sampling Sites at Willow Beach.**

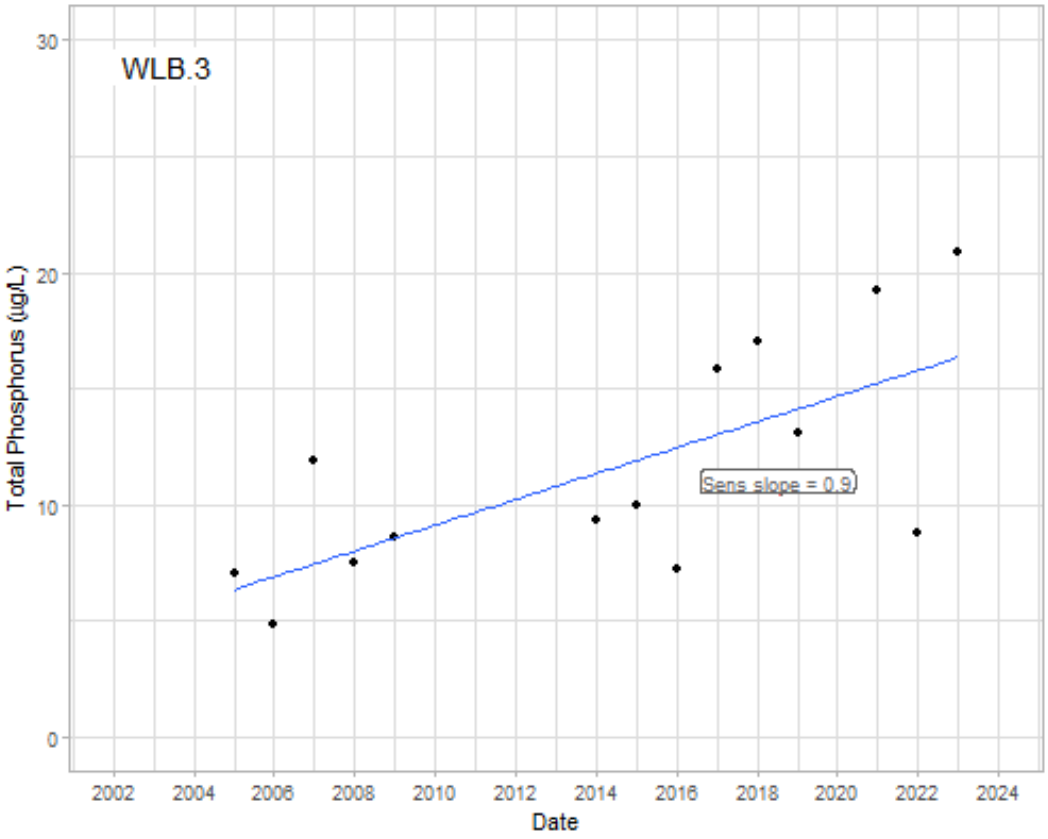



**Figure 12. Trends in Long-term Phosphorus Concentrations at WLB-3.**

## 3.5 Harmful Algal Blooms

Harmful algae blooms are generally characteristic of nutrient enriched lakes but are being reporting with increased frequency in lakes in the Muskoka region and across Ontario (Winter et al. 2011). In the past decade algae blooms in low nutrient lakes have become significantly more prevalent. In 2020-2023 numerous algae blooms have been reported on MLA monitored lakes (Table 6). In the absence of enriched or increasing phosphorus concentrations, the increased blooms are thought to be associated with changes associated with the warming climate, however the specific mechanisms responsible for cyanobacterial blooms in low nutrient lakes are complex and the subject of ongoing scientific research (Pick 2015, Reini et al. 2021). Causation of documented algal blooms is addressed under the Lake System Health Program of the District Municipality of Muskoka.

**Table 6. Summary of Recent Harmful Algae Blooms in MLA and Muskoka Region Monitoring Lakes.**

| 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|
| Bass Lake<br>Brandy Lake<br>Bruce Lake<br>Leonard Lake<br>Muskoka Lake -Weismiller Bay<br>Silver Lake (Port Carling)<br>Three Mile Lake | Three Mile Lake<br>Leonard Lake<br>Bass Lake | Three Mile Lake<br>Leonard Lake | |
| **Outside MLA WQI Program**<br>Fawn Lake<br>Georgian Bay (Southeast)<br>Kahshe Lake<br>Lake St. John<br>Little Lake<br>Mary Lake<br>Menominee Lake<br>Paint Lake<br>Stewart Lake | **Outside MLA WQI Program**<br>Black Lake<br>Cooks Bay (Lake Simcoe)<br>Kahshe Lake<br>Lake of Bays (Ten Mile Bay)<br>Lake St. John<br>Little Lake<br>Little Lake Park<br>Otter Lake<br>Ril Lake<br>Sparrow Lake<br>Stewart Lake | **Outside MLA WQI Program**<br>Bass Lake<br>Farlain Lake<br>Mary Lake<br>Muldrew Lakes<br>Lake St. John<br>Lake St. George<br>Penetang Harbour<br>Smith's Bay | **Outside MLA WQI Program**<br>Bass Lake<br>Leonard Lake<br>Mary Lake<br>Stewart Lake<br>Three Mile Lake |

## 3.6 Bacteria

Under the current MLA WQI Methodology, bacteria (*E. coli* and total coliform) levels were compared to the stop light limits developed by the MLA based on Ministry of Health and Long-Term Care Operational Approaches for Recreational Water Guideline (2018) for recreational water use at public beaches and waterfronts (200 cfu per 100 mL for *E. coli*). In addition, we included the PWQO for *E. coli* is 100 cfu per 100 mL on all Area Report summary figures (e.g., Figure 11).

Total coliform and *E. coli* measurements below the detection limit of 3 cfu/100 mL were assigned a value of 1 cfu/100 mL to calculate geometric means, which were calculated using all available data including any retests.

Total coliform counts from samples collected in 2023 are summarized in the Area Summary Reports. Total coliforms samples collected in 2023 did not exceed the 1000 cfu/100mL guideline at any site, with the exception of the August sampling event at WLB-3, which could be indicative of an impact from the upstream agricultural wildlife. Elevated concentrations were frequently associated with precipitation events described by volunteers in their sampling notes, including the WLB-3 sample in August which was taken during a heavy rainfall event.

As noted in Section 3.1, the MLA WQI field protocols require volunteers to re-sample a site if *E. coli* counts are greater than 50 cfu/100mL. *E. coli* counts exceeded 50 cfu/100 mL at 27 (12%) of 226 sampling events

for *E. coli* in 2023. This frequency was higher than recorded recent years with the exception of 2021 when we noted a disproportionate number of storm samples were collected (8.0% in 2022, 24% in 2021, 4.6% in 2019, 9.2% in 2018, 8.0% in 2017, and 8.7 % in 2016). Re-tests were not completed in 14 of the 19 2023 sampling events that exceeded the 50 cfu/100mL limit.

Sampling areas where *E. coli* counts were elevated (>50 cfu/100ml) in 2023 include Bala Bay (BAL-2), Beaumaris (BMR-10), Clear Lake (CLR-5 and 8), Gull Lake (GUL-2), Minett (MIN-1, 6 and 9), Muskoka River (MRV-7), Star Lake (STR-1 and 4), Windermere (WIN-5 and 7) and Willow Beach (WLB-3 and 4). Despite elevated concentrations during some sampling events some of the sites listed did not exceed the yellow light threshold for *E. coli* in 2023. The nearshore areas which exceeded a geometric mean of 30 cfu/100mL in 2023 were Beaumaris (BMR-10), Cox Bay (COX-7), Minett (MIN-1, 6 and 9), Muskoka River (MRV-7), Windermere (WIN-5) and Willow Beach (WLB-3).

Indian River has been flagged an area of concern due to the MLA yellow light trigger for *E. coli* bacteria being exceeded at three of the six nearshore sampling stations in 2019. The geometric means of bacteria samples collected at IND-2, 3, 4, 7, 8 and 9 in 2023 were below the MLA yellow light threshold. We recommend standard sampling continue at Indian River sites in 2024, however a gradual reduction in sampling effort at these sites could be considered in the future if bacteria counts remain low.

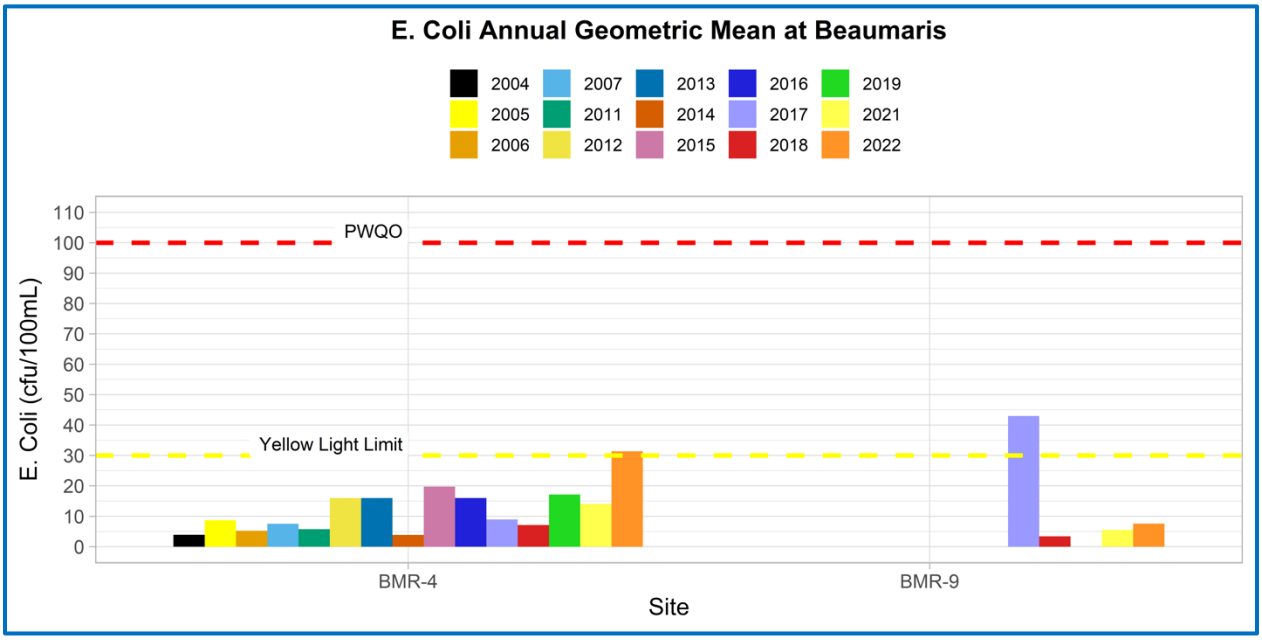



**Figure 13. Example of the Presentation of Long-term *E. coli* Monitoring Figures.**

## 3.7 Chloride

Chloride sampling as part of the Muskoka Lake Association Monitoring Program began in 2022 at two sites and continued in 2023 with 7 total samples collected in Lake Muskoka, Rosseau and Joseph and a single River sample collected in the Muskoka River. All samples collected to date were below the published

guideline for the protection of aquatic life (120 mg/L; Table 7). It is worth noting, however, that the current guideline may not be sufficiently protective of some sensitive organisms.

Recent research suggests that, in low calcium waters, chloride concentrations as low as 10 or 20 mg/L can be harmful to sensitive aquatic life, particularly zooplankton (Arnott et al., 2020). Chloride concentrations Lake Joseph, Muskoka and Rosseau were above 10mg/L, however, average calcium concentrations in the three large Muskoka lakes, based on long-term District of Muskoka data, was above the threshold typically associated with causing stress to zooplankton populations (2.5 mg/L).

**Table 7. Summary of MLA Chloride Concentrations in 2022 and 2023.**

| Year | Area | | Site | Chloride Concentration (mg/L) | Average Calcium Concentrations (mg/L) |
|---|---|---|---|---|---|
| 2022 | Lake Rosseau | Brackenrig Bay | BRA-0 | 8.13 | 3.63 |
| 2022 | Skeleton Lake | - | LIPPA SITE | 7.01 | |
| 2023 | Lake Joseph | Hamer Bay | HMB-0 | 10.80 | 3.94 |
| 2023 | Lake Joseph | Main Basin | JOS-1 | 10.90 | 3.94 |
| 2023 | Lake Muskoka | Muskoka Bay | MBA-0 | 14.70 | 3.92 |
| 2023 | Lake Muskoka | Muskoka Bay | MBA-4 | 18.30 | 3.92 |
| 2023 | Lake Muskoka | Muskoka Sands | MSN-8 | 12.00 | 3.92 |
| 2023 | Lake Rosseau | Brackenrig Bay | BRA-0 | 8.66 | 3.63 |
| 2023 | Lake Rosseau | Rosseau North | RSH-0 | 8.11 | 3.63 |
| 2023 | Muskoka River | - | MRV-2 | 7.91 | |

## 3.8 Summary and Conclusions

The MLA Water Quality Initiative Program assigns stoplights to each sample area based on the annual monitoring and long-term data collected as described in Section 3.1. In 2023, 52 areas were sampled, 47 of which were assigned green lights, while four yellow lights and one red light were assigned based on the MLA criteria (Table 8). Yellow lights at all four sampling areas were the result of elevated bacteria concentrations. No confirmed blooms were documented in MLA Program lakes or sampling areas in 2023.

A single red light was assigned in 2023 to Willow Beach (WLB-3), where we identified a long-term statistically significant increasing trend in phosphorus concentrations. Additional sampling and investigation to assess the sources of phosphorus at this location found that phosphorus concentrations were elevated near the agricultural area upstream of Willow Beach and thus best management practices may provide an opportunity to reduce the export of phosphorus to Lake Muskoka at this location. Fewer yellow lights were recorded in 2023 relative to 2022. Sampling areas upgraded to green in 2023 included Bala Bay, Boyd Bay, Brandy Lake, Bruce Lake and Silver Lake, who have not experienced a cyanobacterial bloom in the past 3 years. Furthermore, Bruce Lake and Indian River had bacteria concentrations below the yellow light threshold in 2023 at all nearshore monitoring stations for the first time since 2019.

**Table 8. Summary of MLA WQI Threshold Exceedances in 2023.**

| Area | Site | *E. coli* | Total Phosphorus | Cyanobacteria Bloom | Stoplight |
|---|---|---|---|---|---|
| Beaumaris | BMR-10 | >30 cfu / 100mL | | | Yellow |
| Minett | MIN-1, MIN-6, MIN-9 | >30 cfu/ 100 mL | | | Yellow |
| Muskoka River | MRV-7 | >30 cfu/ 100 mL | | | Yellow |
| Windermere | WIN-5 | >30 cfu/ 100 mL | | | Yellow |
| Willow Beach | WLB-3 | >30 cfu/ 100 mL | 5-year increase | | Red |

The MLA WQI field protocols require volunteers to re-sample a site if *E. coli* counts are greater than 50 cfu/100mL. Consistency of resampling was poor in 2023. *E. coli* counts exceeded 50 cfu/100 mL at 19 sampling events and retests were not completed in 14 of those events in 2023. In 2022, 13 events warranted re-sampling which was performed in all but four of those events. Maintaining sampling protocols should be an area of focus during training prior to 2024 sampling and continued vigilance is recommended to ensure anomalous data can be confirmed and to maintain consistency, as much as is possible, between current and historical samples.

# 4. Recommendations

HESL has formulated several recommendations based on our work with the MLA on the Water Quality Initiative Program since we began managing the program in 2021, which we believe will improve the program moving forward. These have been discussed within the technical report and are briefly summarized below.

1. Review of the sampling sites by the Environment Committee has been an annual part of the MLA WQI Program and should continue prior to sampling in 2024. We recommend maintaining consistent sampling at long-term sites whenever possible. Trend analyses in 2023 were performed on sites with a minimum of 5 years of data, which represents the absolute minimum number of samples to reasonably draw conclusions on trends over time. Continued monitoring of the existing long-term monitoring stations would increase the number of stations where long-term trend analysis is possible, strengthen the current trend analyses and benefit the program in the future.

2. HESL recommends the MLA continue to undertake sampling during dry weather to the extent possible and maintain good notetaking if antecedent rain occurred. Where rainfall conditions were recorded, storm-based sampling occurred in 27-53% of samples in 2018 - 2023. Continued training with volunteers is recommended to ensure methodological consistency and long-term data compatibility.

3. Retesting of bacteria samples that exceed the MLA Sampling Protocol threshold of 50 cfu/100 mL should be maintained. Sampling protocol compliance in 2023 declined in 2023 as the vast majority of samples exceeding 50 cfu/100mL were not retested. Continued training with volunteers is recommended to ensure methodological consistency.

4. Water clarity (i.e., Secchi Disc depth) data that are currently collected under the WQI Program were highly variable. A thorough review of the Secchi data collected by the MLA to date was begun in 2022 to help identify and eliminate anomalous data if present. HESL will continue to screen and improve the long-term data in 2024.

5. An updated analysis of the long-term trends in Secchi depth was completed in 2023 to assess long-term changes in water clarity and, a single significant change was detected at ALL-0, suggesting ongoing assessment of these data may be a valuable annual addition to the MLA WQI Program.

6. Willow Beach has been identified as an area of concern based on long-term increasing trends in phosphorus since monitoring began. Continued additional monitoring in 2024 within the watershed (e.g., the creek along Ziska Rd.) may be warranted to assess phosphorus sources and mitigation possibilities and to expand our understanding of the inter-annual variability in phosphorus inputs to Willow Beach.

7. Minett continues to be an area of concern due to historically elevated bacteria counts at MIN-1 and yellow stoplight exceedances at MIN-1 and MIN-6 in 2022. We recommend that additional monitoring of bacteria concentrations continue in the MLA WQI program in 2024. Review the need for additional monitoring sites for future development.

8. Indian River has been flagged an area of concern due to the MLA yellow light trigger for *E. coli* bacteria being exceeded at three of the six nearshore sampling stations. Bacteria concentrations remained low in 2023. We recommend standard sampling continue at Indian River sites in 2024, however a gradual reduction in sampling effort at these sites could be considered in the future if bacteria counts remain low.

9. Windermere has been flagged as an area of concern since 2021. Nearshore phosphorus concentrations and bacteria at WIN-5 near Parker's Marina were higher in 2023 than those recorded in 2022, but lower than peak values recorded in 2021. Ongoing monitoring of this area is recommended to maintain the long-term record and continue to assess potential water quality issues.

10. Beaumaris has also been flagged as an area of concern as nearshore phosphorus concentration have been variable since monitoring of BMR-10 and 12 began in 2017 and bacteria collected at

BMR-10 exceeded the yellow light trigger established by the MLA. BMR-10 included four re-tests in July and storm event samples (June and August), however even when removing storm event results E. coli concentrations were still above the yellow light trigger. Bacteria protocols were not followed during all sampling events, e.g., June, when high values should have resulted in re-tests. HESL recommends ongoing sampling to continue to monitor for long-term trends and to further inform on the elevated bacteria concentrations observed at several nearshore sites in 2022 and 2023.

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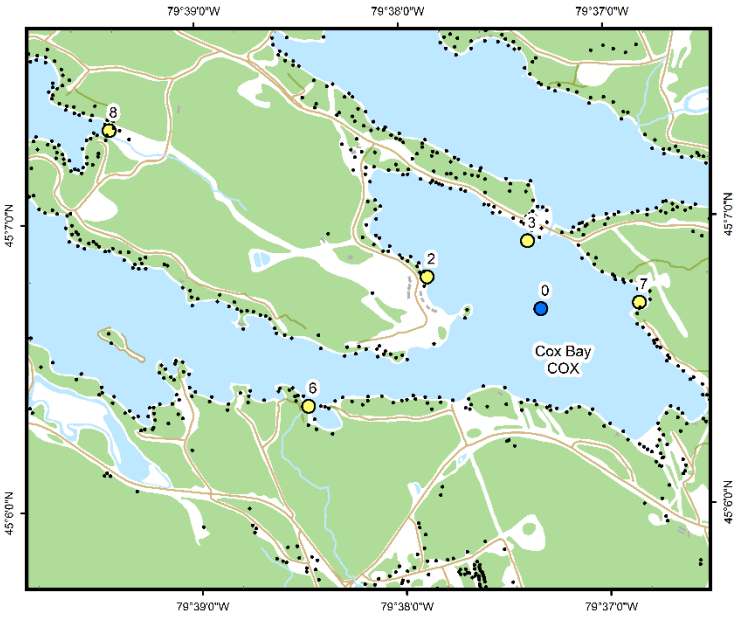
# Appendix A. Area Reports

# Cox Bay (COX)



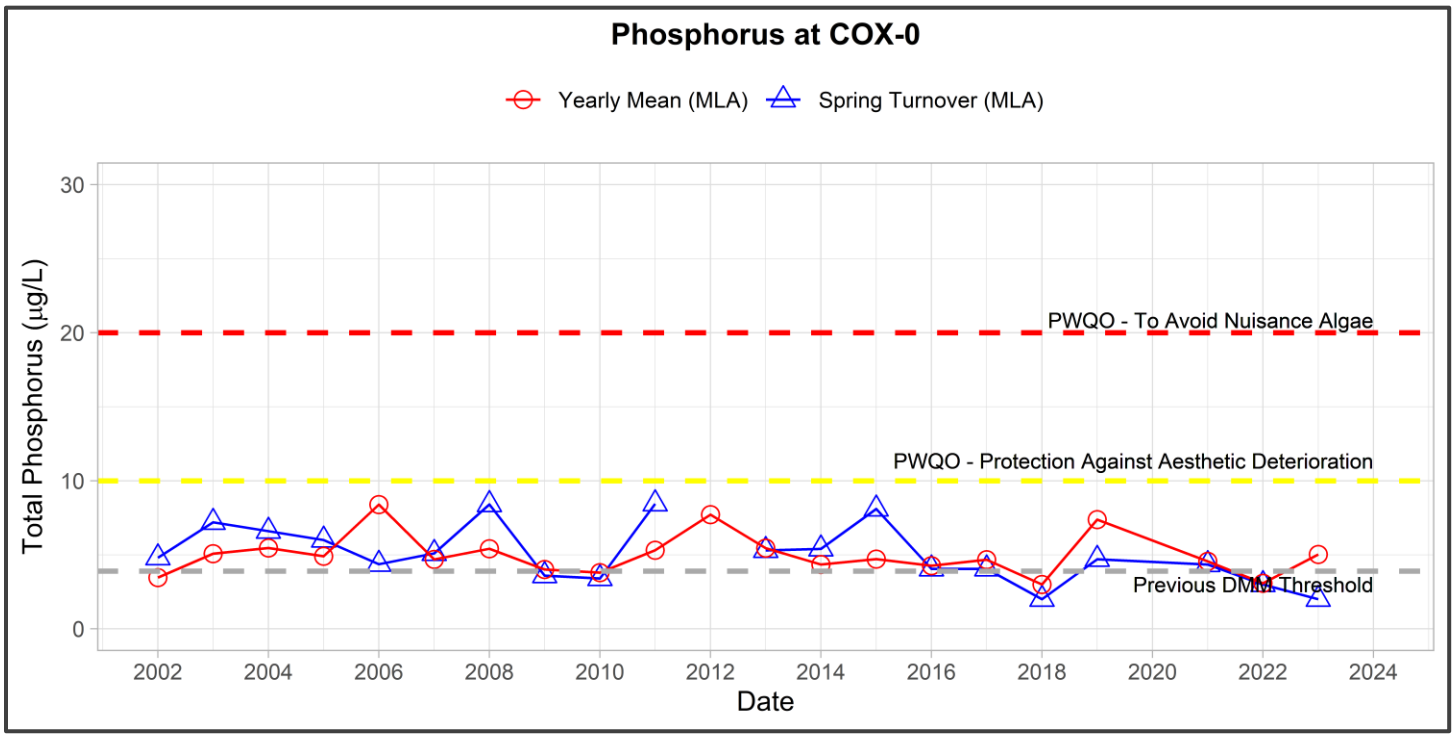

**Area Description:**

Cox Bay is the southernmost bay of Lake Joseph and is home to a large resort and golf course along with a marina and a canal crossing into Lake Rosseau at Port Sandfield. The bay has an area of 1.84 km² and a maximum depth of 12 m. The bay is highly developed with ~15% of the shoreline being open lawn, pavement or landscaping. The Cox Bay Stewardship Initiative group has identified ten permanent watercourses that drain into the bay. Cox Bay is currently classified as moderately sensitive and over-threshold by the DMM. MLA monitoring in Cox Bay began in 2002.

Volunteer Recognition: Liz Lundell, Stuart Golvin, Judy Golvin, and Guy Burry.

2023 Water Quality Results:

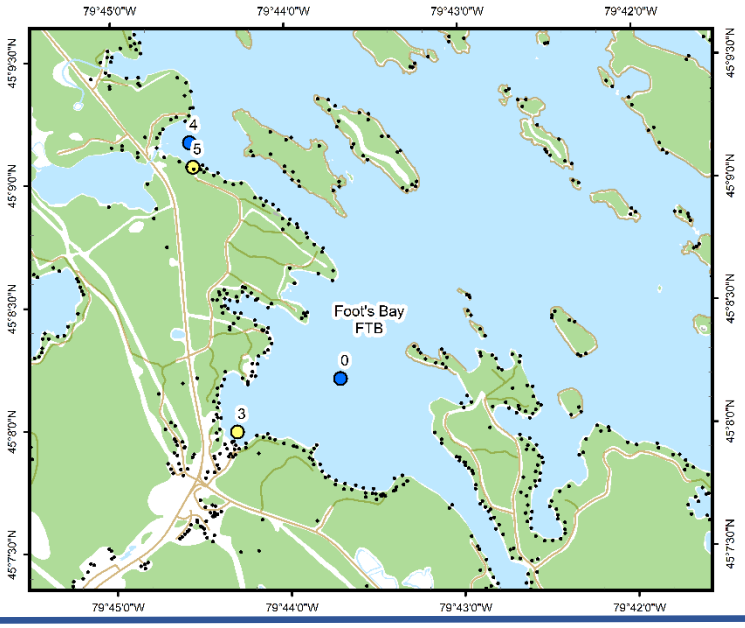
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **COX-0** | 4.1 | 2.0 | 5.0 | | |
| **COX-2** | | 2.0 | | | |
| **COX-3** | | 2.0 | | | |
| **COX-6** | | 2.0 | 4.7 | | |
| **COX-7** | | | | 33 | 51 |
| **COX-8** | | 2.7 | | | |




Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.

Annual average and spring phosphorus concentrations at the deep-water station (COX-0) were above the historic DMM threshold of 3.9 µg/L and the DMM 10-year average (4.4 µg/L) in 2023. All measured phosphorus concentrations were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring phosphorus concentrations at COX-2, 3, 6, 7, and 8 and yearly mean at COX-6 were within the range of variability of previous monitoring years. Average annual Secchi disk depth (4.1 m) was consistent with previous monitoring (3.35 - 8.25 m). NO issues of concern were identified in Cox Bay during 2023 monitoring. **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Foot's Bay (FTB)




**Area Description:**

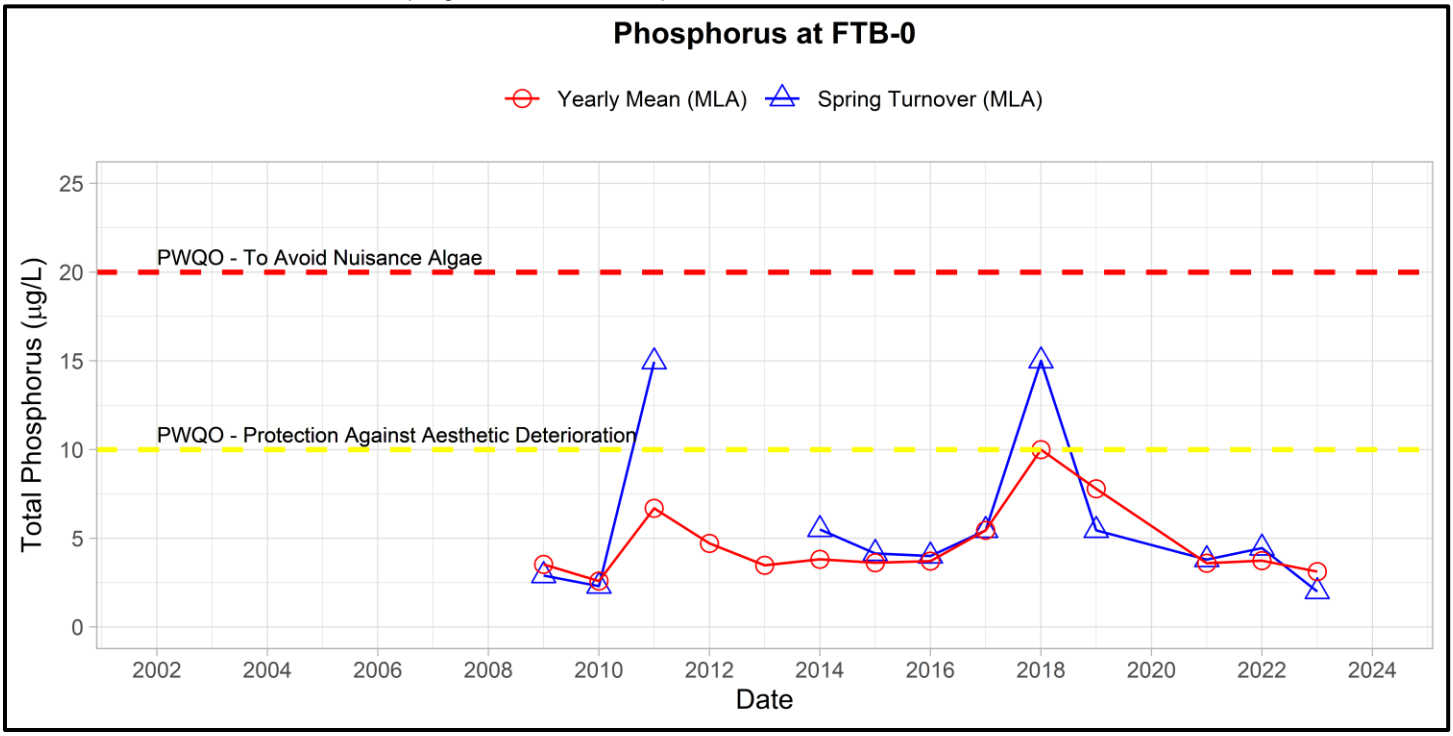
Foot's Bay is located in the south-eastern portion of Lake Joseph. The Bay is highly developed along the southern shore near the marina and adjacent to the highway. Several undeveloped shoreline areas, with mostly intact forests, can be found within the Bay. The main basin of Lake Joseph is currently classified as highly sensitive by the DMM while several bays are classified as moderately sensitive. The DMM does not maintain a monitoring station at Foot's Bay. MLA monitoring of Foot's Bay began in 2009.

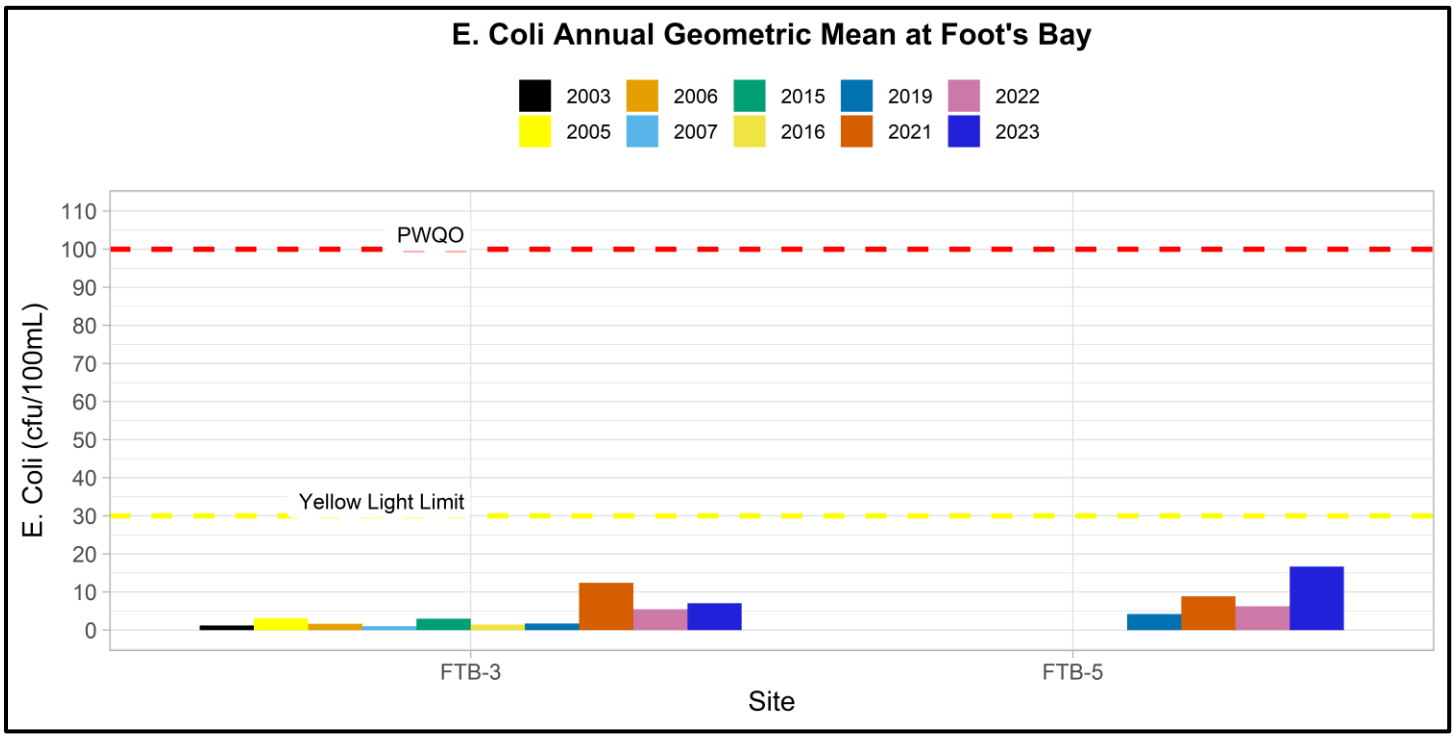
Volunteer Recognition: Dave Clark and Penny Middleton.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **FTB-0** | 4.6 | 2.0 | 3.1 | | |
| **FTB-3** | | | | 7.0 | 49 |
| **FTB-4** | | 2.1 | 3.7 | | |
| **FTB-5** | | 4.8 | | 17 | 40 |
| **FTB-6** | | | 3.6 | | |

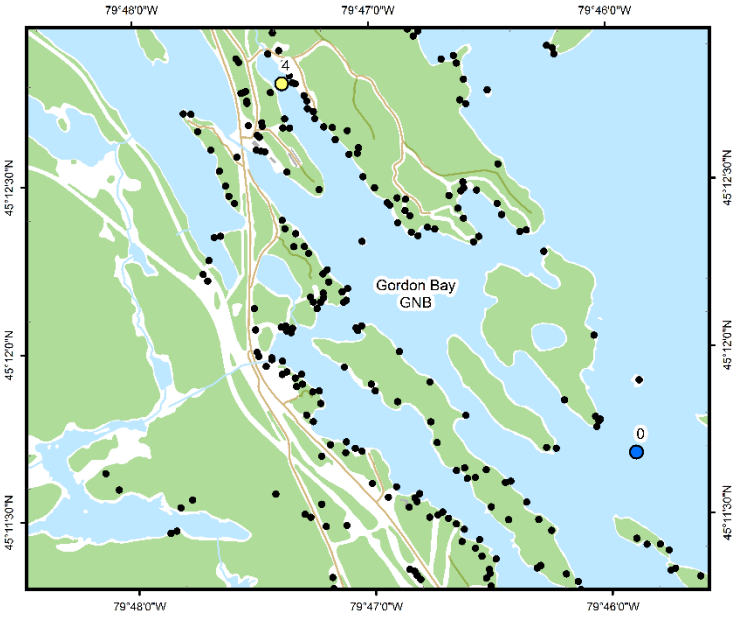
Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.






The marked decline in spring total phosphorus concentrations at FTB-0 noted since 2018 continued in 2023. Total phosphorus concentrations peaked at 15.0 µg/L in both 2011 and 2018 but decreased considerably. In 2023, all measured phosphorus concentrations were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring and annual average phosphorus concentrations at FTB-3 were within the range of variability of previous monitoring years, FTB-6 was newly established in 2022 and phosphorus concentrations at the site remain low. Secchi measurements in 2023 continued to fall within the range of variability measured during the monitoring program (2.5 to 7.2 m). Bacteria concentrations in 2023 were lower than the peak value observed in 2021 but elevated relative to 2022. Bacteria concentration still fell below the established MLA trigger limit, but ongoing monitoring is advised. **HESL recommends sampling continue in Foot's Bay to monitor long-term trends in nutrients and bacteria.**

# Gordon Bay (GNB)




**Area Description:**

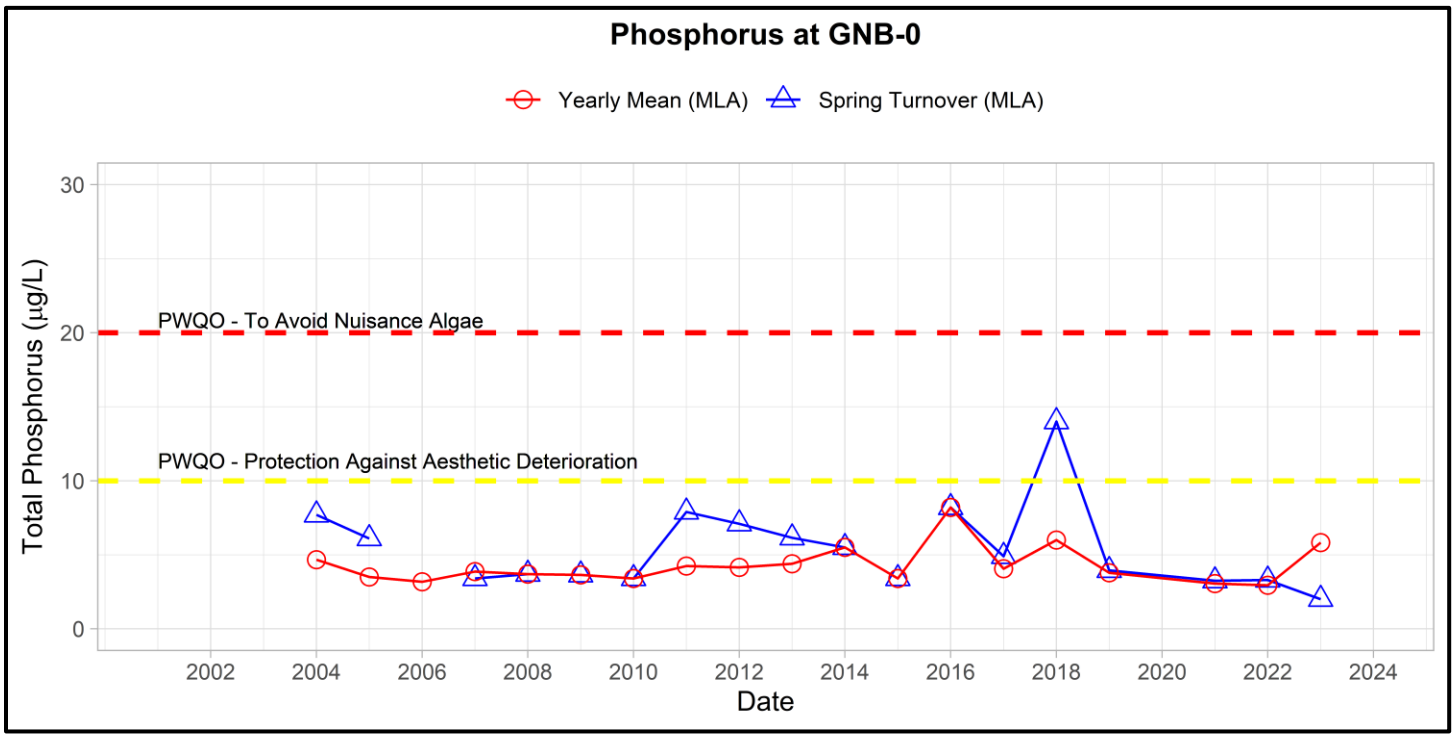
Gordon Bay is a moderately developed region of northwestern Lake Joseph comprised of several smaller bays including Portage Bay, Smith Bay and King Bay. The area includes a large marina in Portage Bay and Lake Joseph Road in the West. MLA monitoring of Gordon Bay began in 2004.

Volunteer Recognition: Alex Magditsch, Cecil Hayhoe.

2023 Water Quality Results:

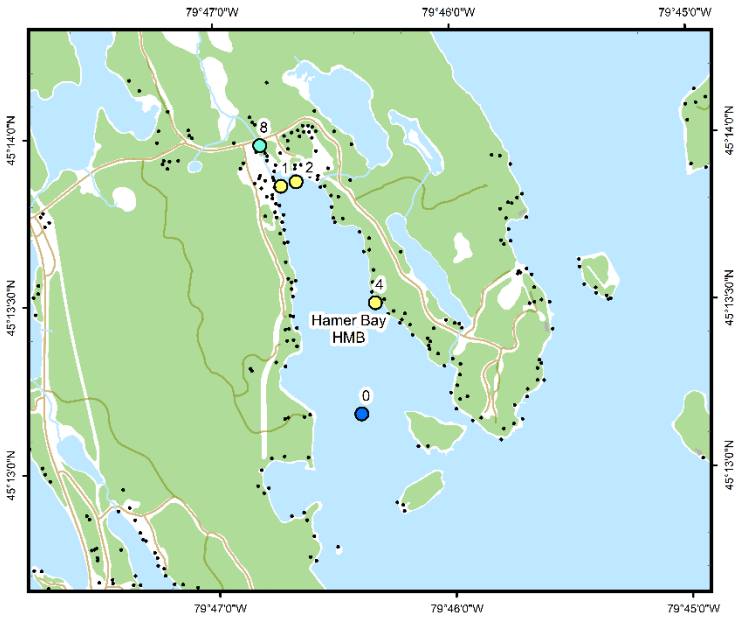
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **GNB-0** | 5.3 | 2.0 | 5.8 | | |
| **GNB-4** | | 2.0 | 3.2 | | |

Note: Grubbs test indicates 2018 spring TP concentration was an outlier.



The Grubb's test identified the spring 2018 phosphorus data (14.0 μg/L) for GNB-0 as an outlier, it will be maintained in the data set but should be interpreted with caution. In 2023, spring total phosphorus concentrations were were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring phosphorus concentrations at GNB-4 was elevated relative to 2022 but within the range of variability of previous monitoring years. Average annual Secchi disk depth (5.3 m) was consistent with previous monitoring (3.0 - 7.5 m). *E. coli* sampling was discontinued at GNB-4 in 2019. **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Hamer Bay (HMB)



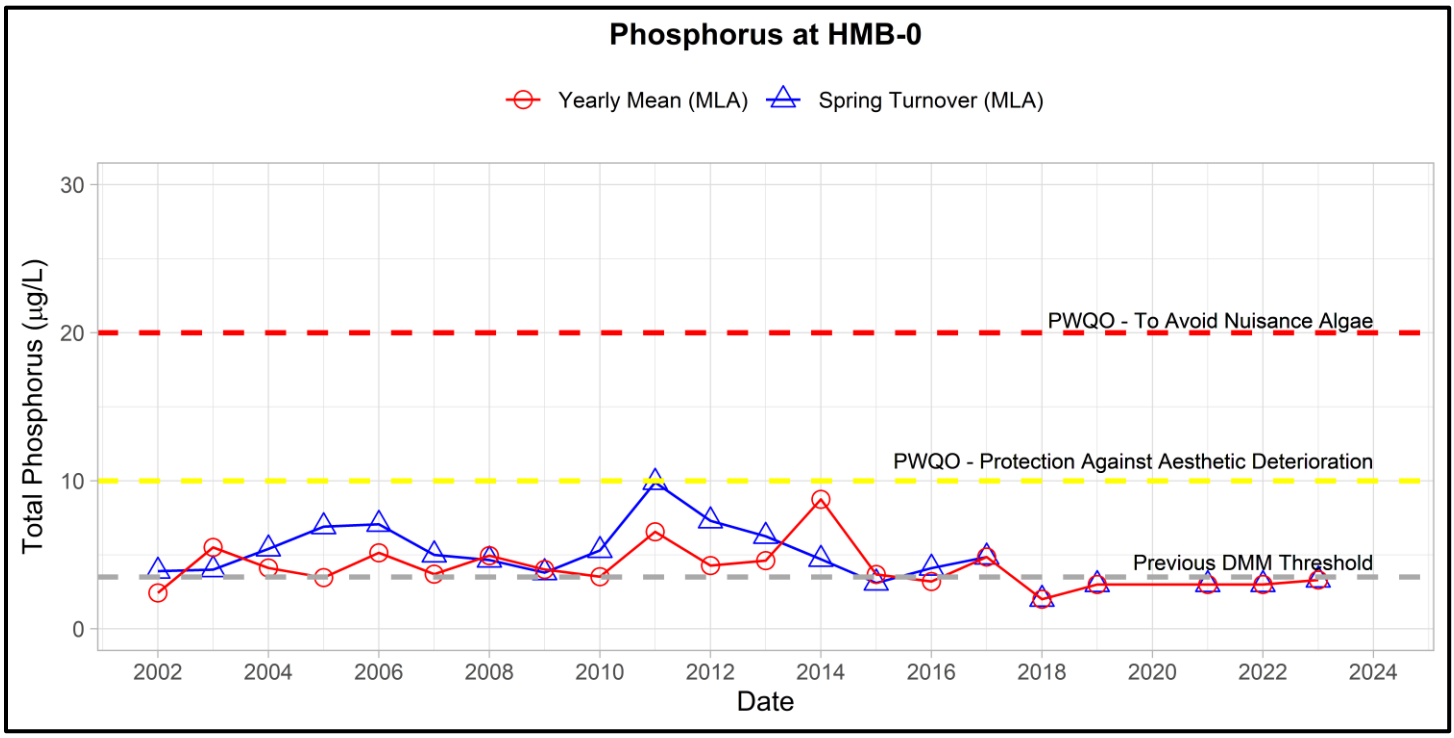

**Area Description:**

Hamer Bay is in the northern region of Lake Joseph. The bay receives drainage from three creeks, one of which flows through a large golf course and wetland in the north, and the others through smaller lakes and wetlands. Hamer Bay is highly developed including a large marina with several parking lots, a resort, and many residential properties along most of the available shoreline. The main basin of Lake Joseph is currently classified as highly sensitive by the DMM. MLA sampling in Hamer Bay began in 2002.

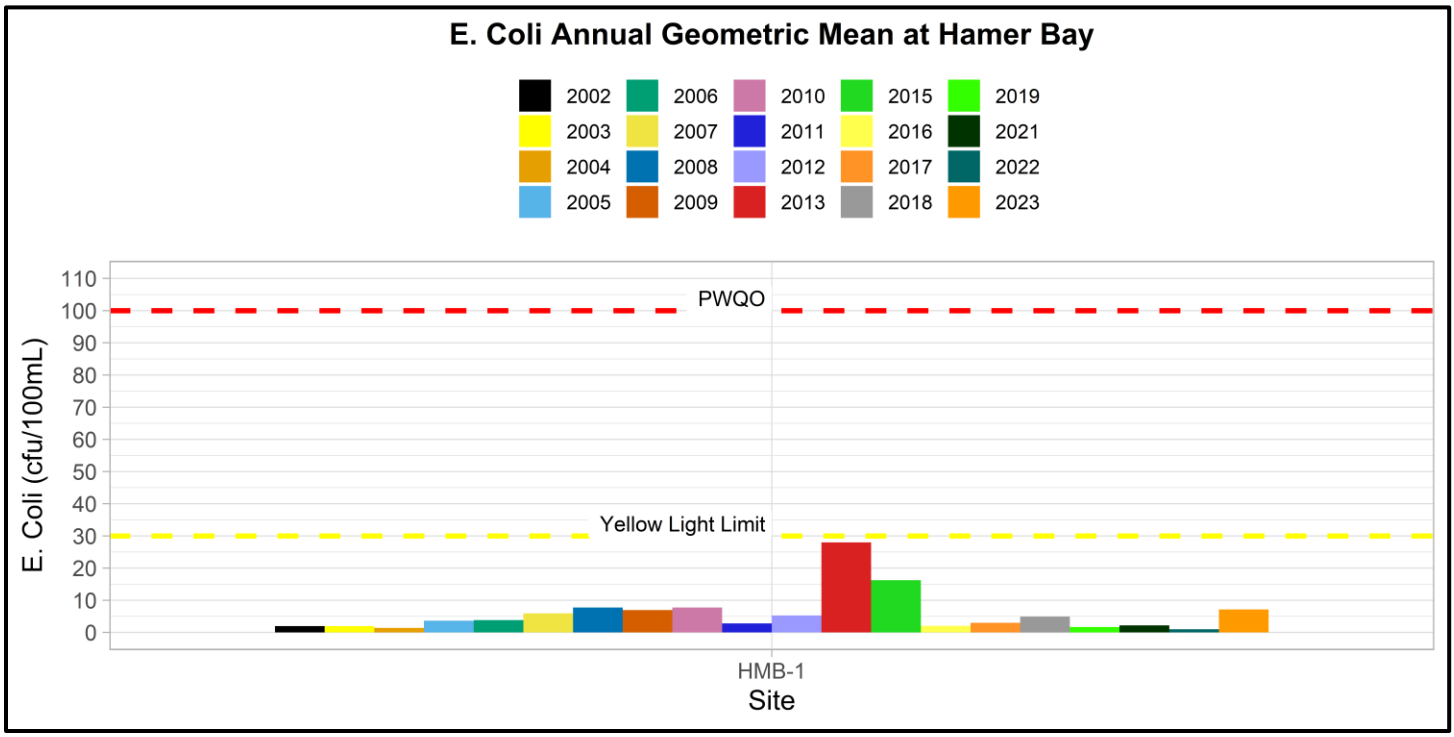
Volunteer Recognition: Alex Magditsch, Cecil Hayhoe.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **HMB-0** | 5.25 | 3.3 | | | 59* |
| **HMB-1** | | 5.6 | 4.9 | 7 | 144 |
| **HMB-2** | | 2.2 | 2.6 | 3* | 94* |
| **HMB-4** | | 2.0 | 2.7 | | |
| **HMB-8** | | 9.5 | 28.2 | 3* | 5* |

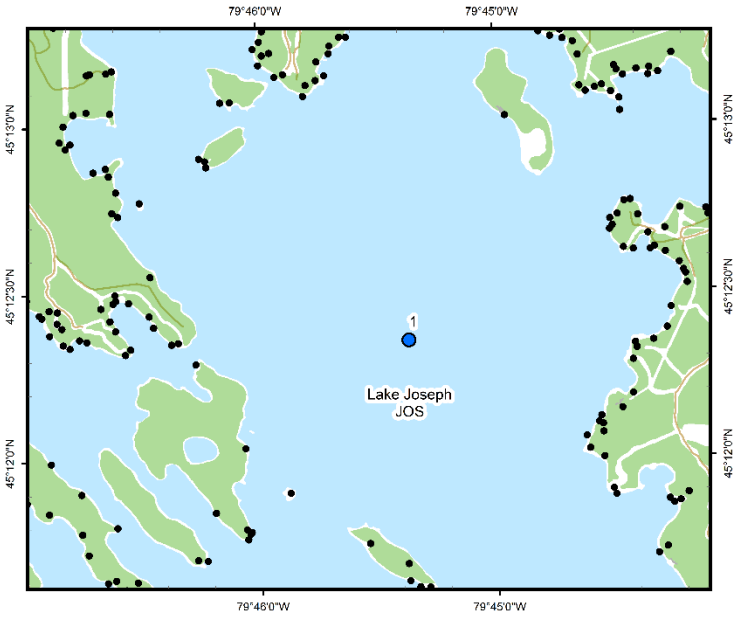



Note: Grubbs test indicates 2014 Annual Total Phosphorus data was an outlier.



In 2023, the spring phosphorus concentration at HMB-0 was below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring and annual average phosphorus concentrations at HMB-1, 2 and 4 were within the range of variability of previous monitoring. Phosphorus concentrations at HMB-8 were below the PWQO guideline for controlling excessive plant growth in rivers and streams (30 µg/L) in three of the four samples collected but were elevated during June sampling (66.7 µg/L) which occurred during a light rainfall event. Bacterial counts of *E. coli* at HMB-1 remain well below the MLA established limits. Elevated total coliforms at HMB-1 in 2023 were heavily influenced by a single sample (559 cfu/100mL) collected during heavy rain. Average annual Secchi disk depth (5.25 m) was within the range of variability (3.25 – 8 m) previously recorded at the site. Sampling at Hamer Bay was frequently performed during rainfall events (3 of 4 samples in 2023), which has the potential to skew results of both TP and bacteria and impact our ability to track long-term changes over time. Future monitoring at the site would benefit from a reduction in storm event sampling consistent with the rest of the monitoring program. **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Lake Joseph (JOS)




**Area Description:**

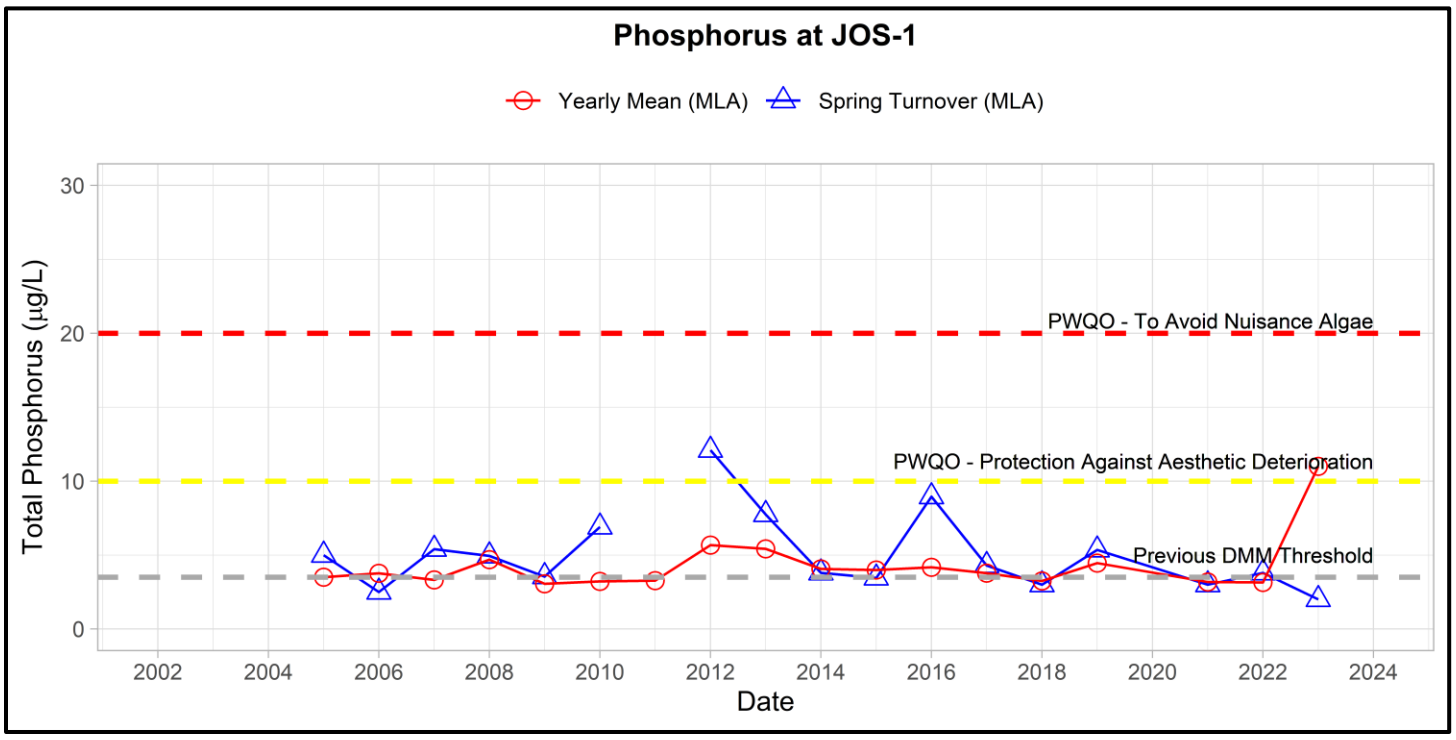
Lake Joseph is a large lake with a surface area of 50.9 km² and a maximum depth of 94 m. The watershed area of Lake Joseph is 55 km² and contains a coldwater fishery. Lake Joseph receives drainage from numerous inflowing streams and rivers and is connected to Lake Rosseau through the narrows at Port Sandfield and the Joseph River. The main basin of the lake is currently classified by the DMM as highly sensitive. MLA monitoring of Lake Joseph's main basin began in 2005.

Volunteer Recognition: Alex Magditsch, Cecil Hayhoe.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **JOS-1** | 5.3 | 2.0 | 11.0 (2.9*) | | |

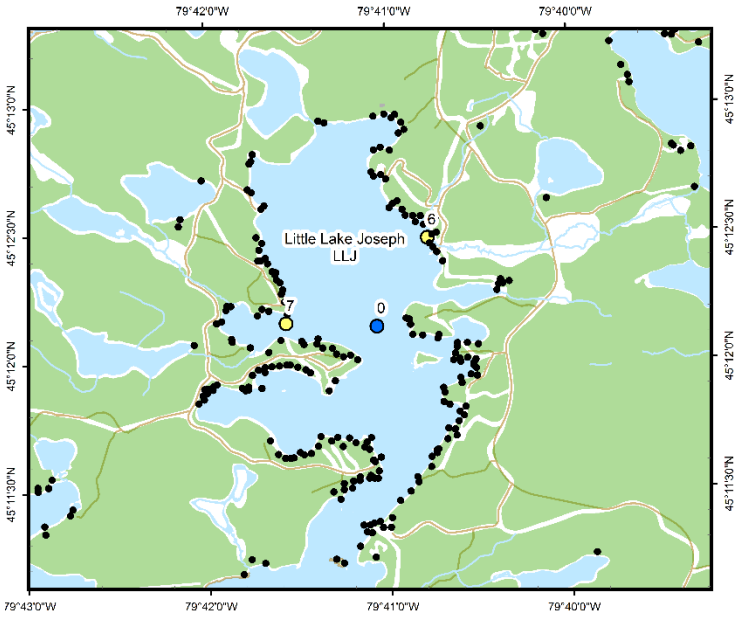
*Indicates the average without the inclusion of extreme value believed to be contamination.




Note: Grubbs test indicates 2012 spring total phosphorus concentrations were an outlier.

In 2023, spring phosphorus concentrations were below the historic DMM threshold of 3.5 μg/L. All measured phosphorus concentrations were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L) with the exception of a single sample collected in July (36.4 μg/L) which substantially increased the annual average above historical results. It is likely that this sample was contaminated during collection and therefore annual results from 2023 should be interpreted with caution. Average annual Secchi disk depth (5.3 m) was consistent with previous monitoring (3.0 – 7.75 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Little Lake Joseph (LLJ)



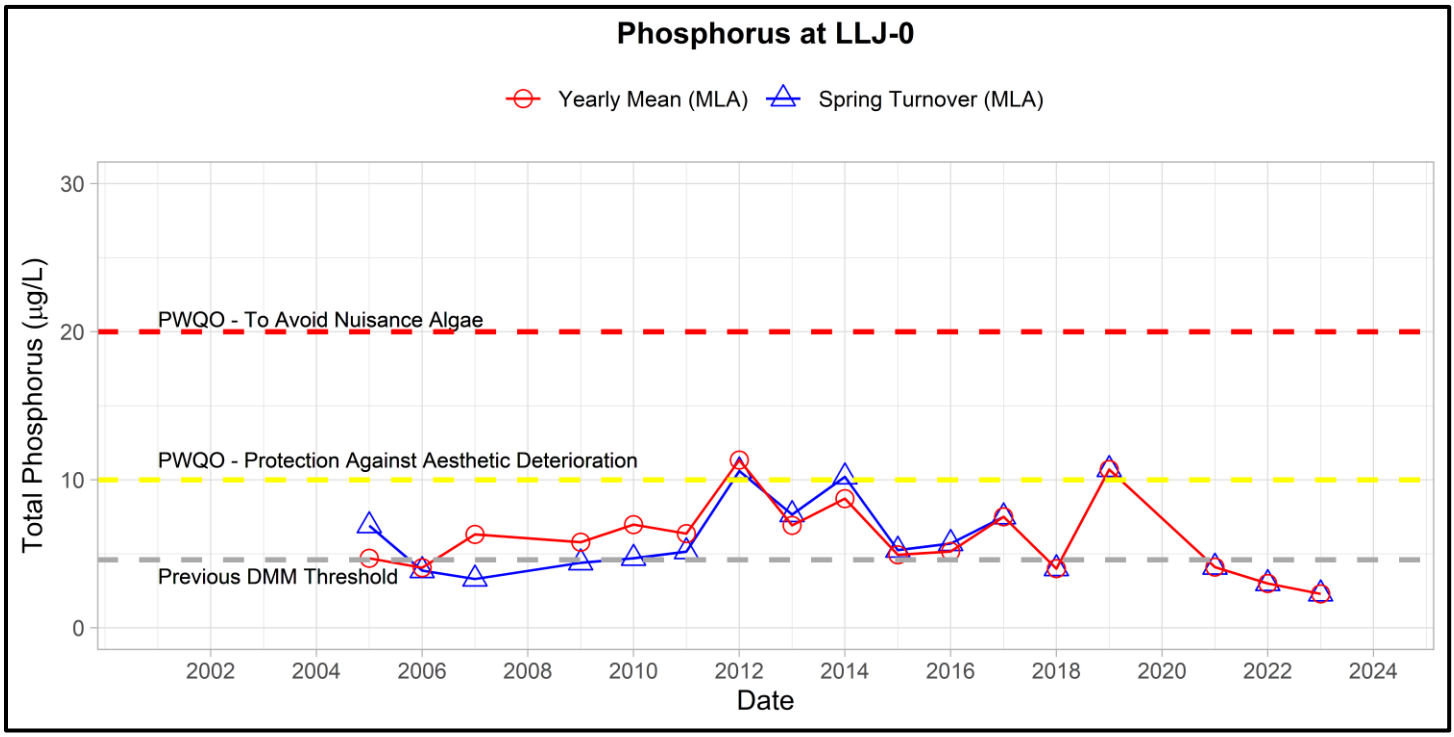

**Area Description:**

Little Lake Joseph is an isolated embayment of Lake Joseph with an area of 2.8 km² with a maximum depth of 40 m. Despite cottage development the shoreline of Little Lake Joseph remains naturalized. The waterbody receives drainage from three small wetlands. Little Lake Joseph is currently classified by the DMM as moderately sensitive. MLA monitoring of Little Lake Joseph began in 2005.

Volunteer Recognition: Dirk Soutendijk and Westley Begg.

2023 Water Quality Results:

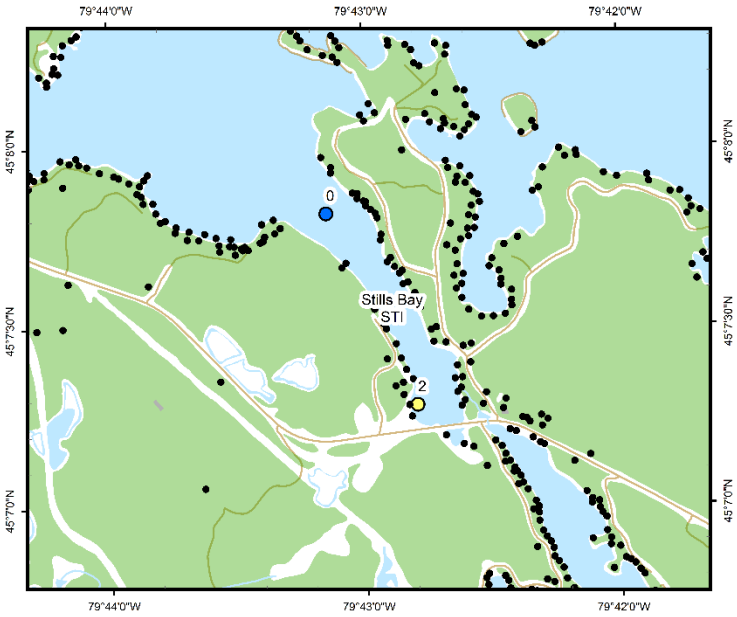
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **LLJ-0** | 4.7 | 2.3 | | | |
| **LLJ-6** | | 3.7 | 4.8 | | |
| **LLJ-7** | | 6.5 | 6.9 | | |




Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.

In 2023, the spring total phosphorus concentration at LLJ-0 was below the historic DMM threshold of 4.6 µg/L. All measured deep-water phosphorus concentrations were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual average phosphorus concentrations at LLJ-6 and 7 were similar, however markedly higher spring phosphorus at LLJ-7 recorded in 2019 and 2021 was no longer detected. This year represents the 8$^{th}$ year with sampling from LLJ-6 and 7, both of which show highly variable spring and annual average phosphorus concentrations and warrant ongoing monitoring. An average annual Secchi disk depth of 4.7 m was recorded in 2023 and is consistent with long-term data at the site (2.5 – 6.5 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Stills Bay (STI)



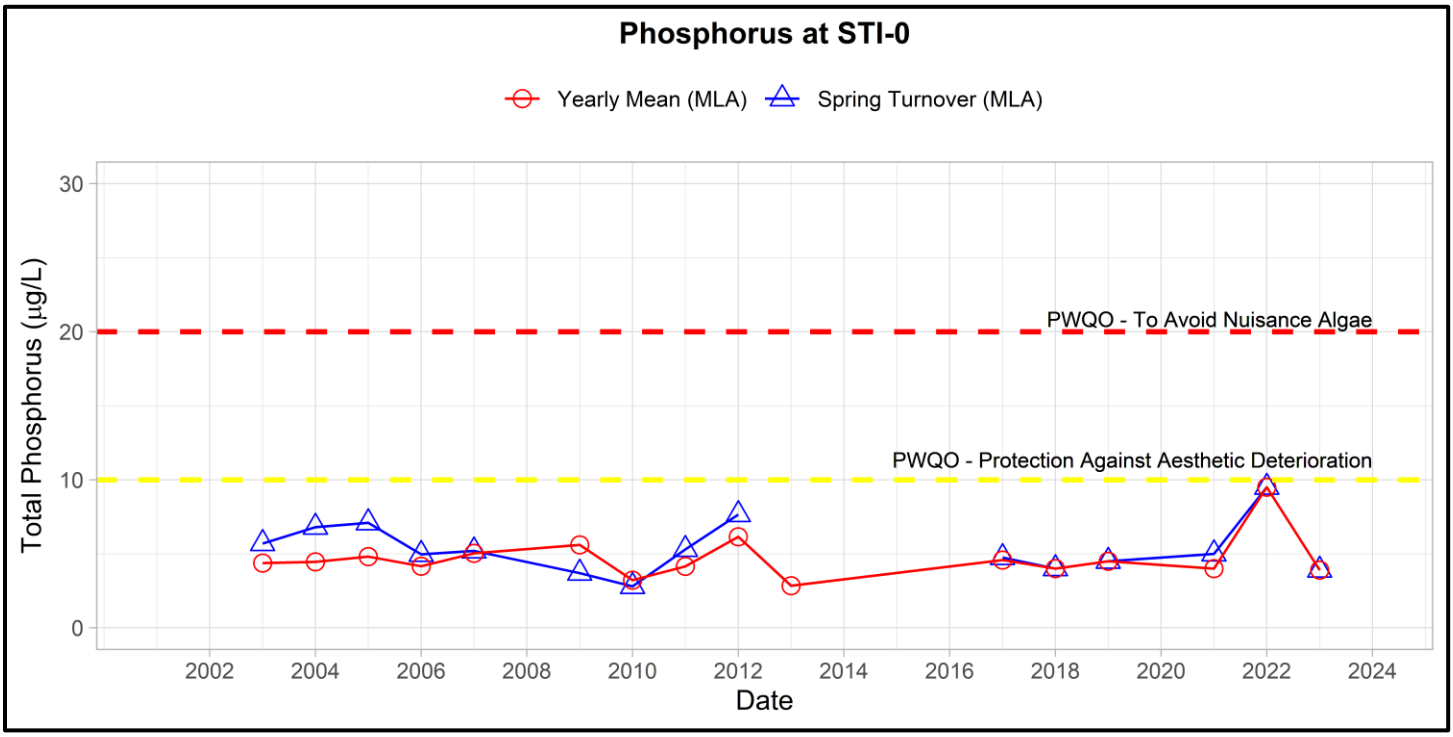

**Area Description:**

Stills Bay is a long, narrow bay in the south-eastern portion of Lake Joseph. The bay is moderately developed. The southern end of the bay is directly adjacent to Highway 169. Stills Bay receives drainage from several watercourses adjacent to a golf course. Several shoreline areas remain undeveloped with mostly intact forests. The main basin of Lake Joseph is currently classified as highly sensitive by the DMM. MLA monitoring of Stills Bay began in 2003.

Volunteer Recognition: Dave Clark and Penny Middleton.

2023 Water Quality Results:

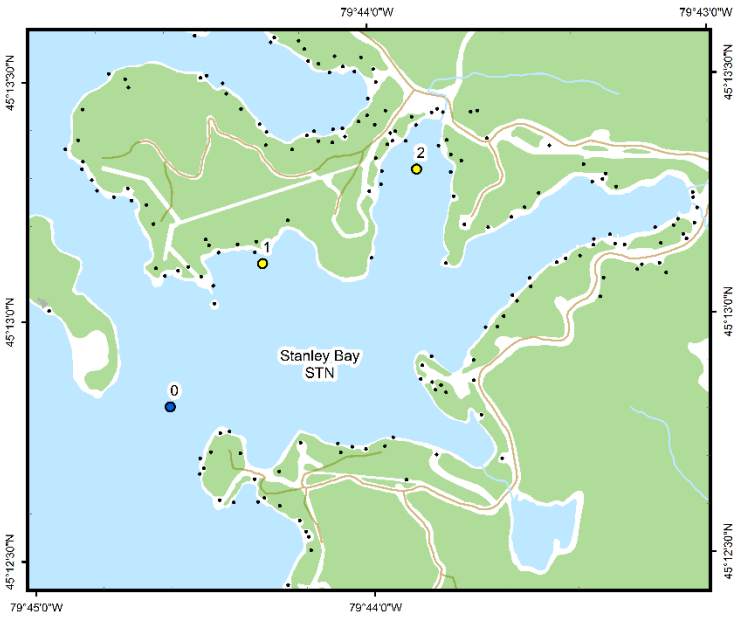
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **STI-0** | 4.8 | 3.9 | | | |
| **STI-2** | | 4.6 | 9.6 | | |




Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.

In 2023, spring turnover phosphorus results returned to values typical for the area after elevated results noted in 2022 which were attributed to a storm event. All measured phosphorus concentrations were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L), with the exception of a single August sample collected at STI-2. The spring phosphorous concentration and yearly mean values at STI-2 in 2023 were within the range of variability of long-term sampling. Average annual Secchi disk depth was within the long-term range of variability at STI-0 (2 – 6.25 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Stanley Bay (STN)



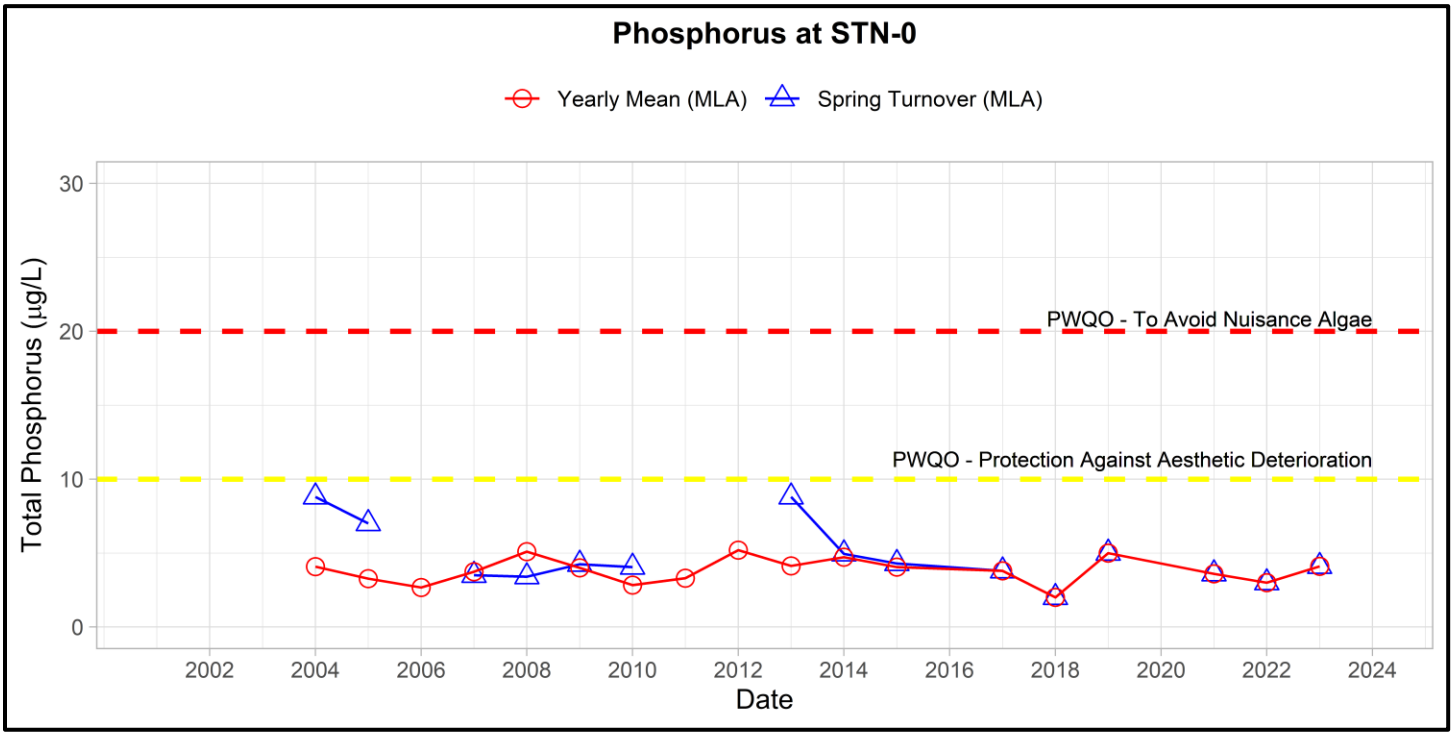

**Area Description:**

Stanley Bay is a deep-water bay on the north-east side of Lake Joseph. The bay is developed with largely intact forest cover along the shoreline. The bay is surrounded by numerous roads and a moderate level of residential development, and agricultural development which could negatively impact water quality.

Volunteer Recognition: Alex Magditsch, Cecil Hayhoe.

2023 Water Quality Results:

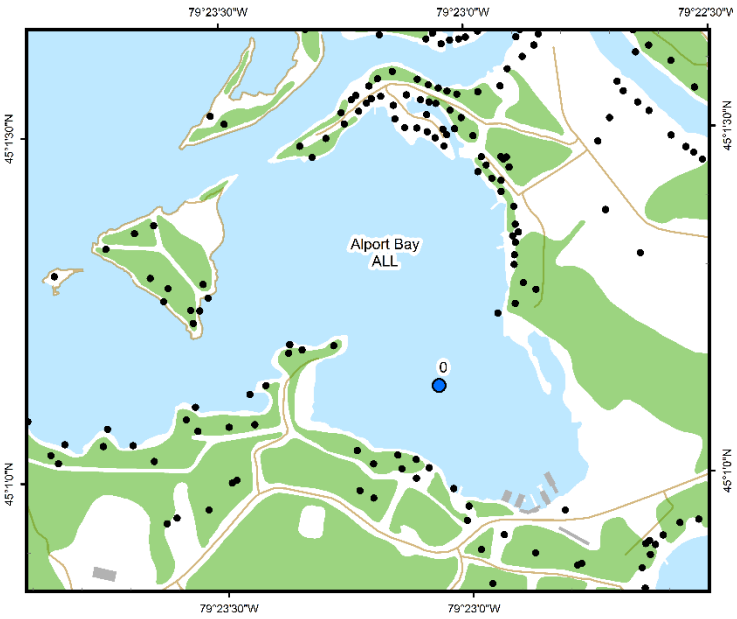
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **STN-0** | 5.0 | 4.1 | | | |
| **STN-2** | | 2.0 | | | |




Note: Grubbs test indicates 2011 data for spring total phosphorus was an outlier.

The spring 2011 phosphorus sample at STN-0 was identified as an outlier (29.1 μg/L) and was significantly higher than any phosphorus measurement recorded historically at the site. This value is suspected to be a result of sample contamination and therefore has been eliminated from the results but retained in the long-term dataset for future consideration as additional data are collected. All measured phosphorus concentrations in 2023 were below the Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Monitoring of spring phosphorus concentrations at STN-2 was within the range of variability of previous monitoring years. Average annual Secchi disk depth (5.0 m) was consistent with previous monitoring (3.75 - 8.0 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Alport Bay (ALL)




**Area Description:**

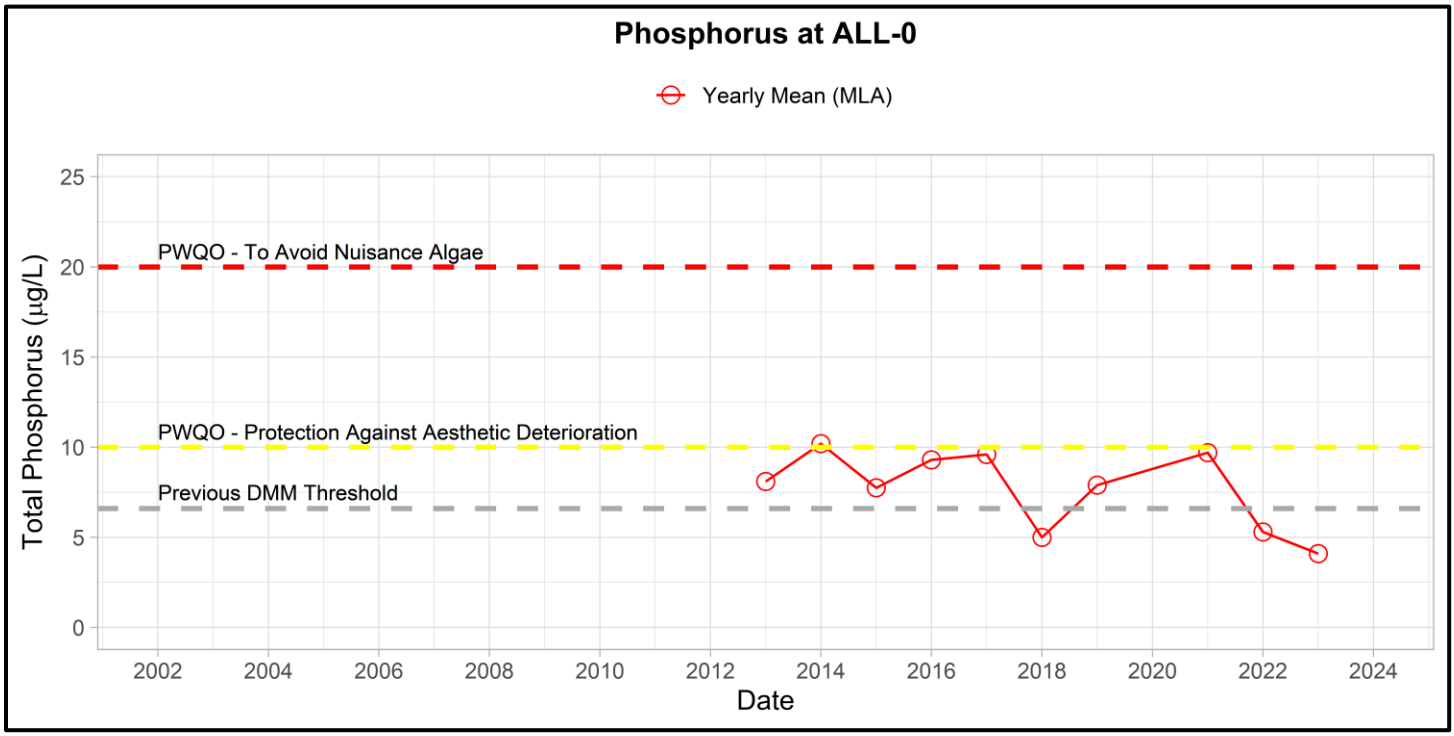
Alport Bay is a small embayment in eastern Lake Muskoka, at the mouth of the Muskoka River. Development in Alport Bay includes a marina in the south and agriculture in the east. Much of the shoreline is developed with a high proportion of the residential properties maintaining manicured lawns and minimal vegetation along the shoreline. MLA monitoring of Alport Bay began in 2013.

Volunteer Recognition: Bill & Jane Caughey, Paul Follis.

2023 Water Quality Results:

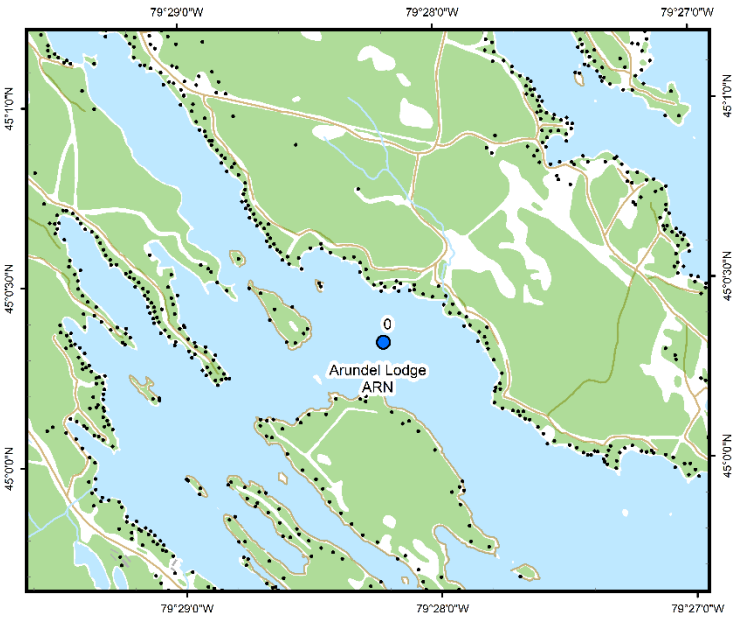
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **ALL-0** | 1.8 | 4.1 | | | |

Note: Grubbs test indicates data collected contained no outliers in 2023.



In 2023, spring total phosphorus concentrations were consistent with the range of variability recorded during monitoring since 2013. All measured phosphorus concentrations in 2023 were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Average annual Secchi disk depth (1.8 m) was consistent with previous monitoring (1.6 – 1.9 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Arundel Lodge (ARN)




**Area Description:**

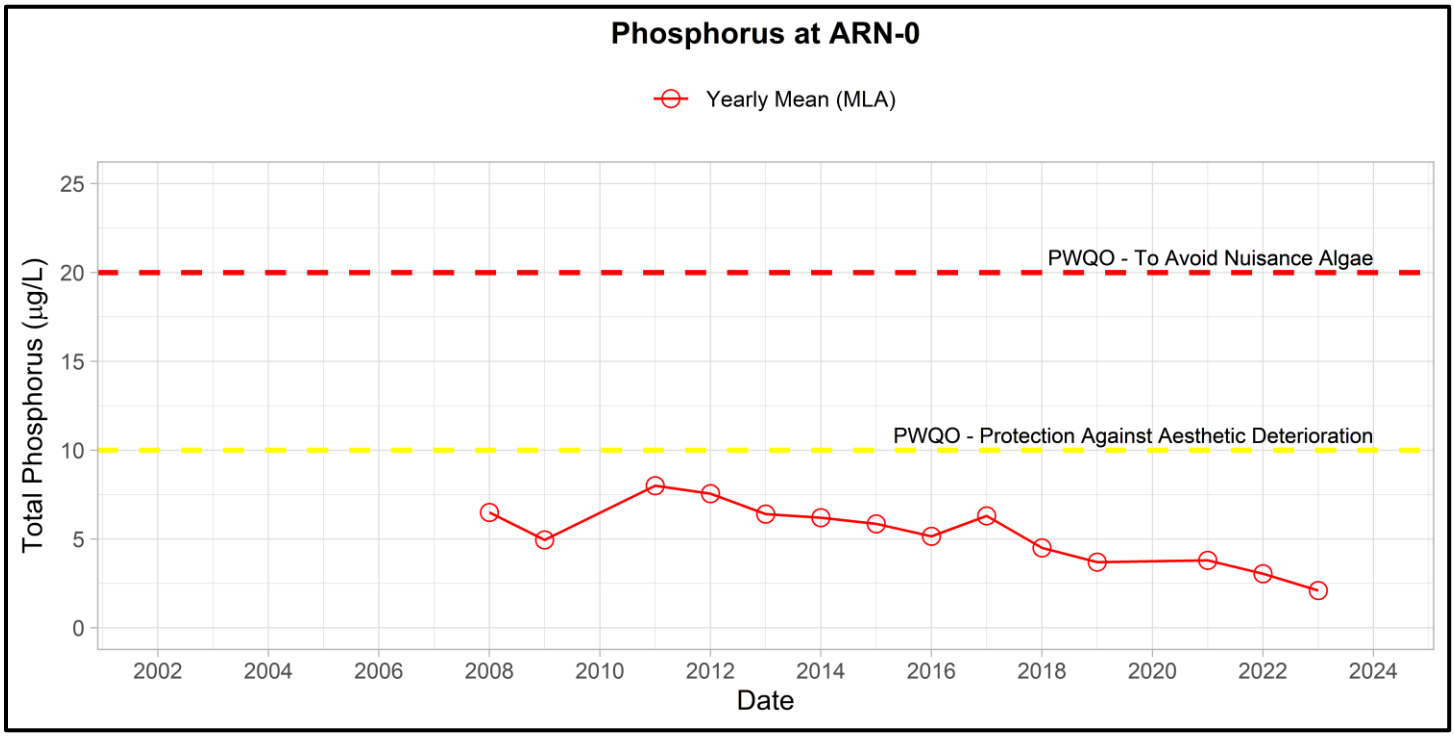
The Arundel Lodge sampling area in south-central Lake Muskoka is east of Hardy Lake Provincial Park and south of Walker's Point. The ARN-0 sampling station is located in Skinner Bay, adjacent to Miller and Firebrand Islands. A small creek, which drains three wetland areas outlets northeast of the ARN-0 site. MLA monitoring at Arundel Lodge began in 2008.

Volunteer Recognition: Carol Hoskins, Sheila Robinson, George Fallis, Stephen Sims, Mark & Sandy Brosch.

2023 Water Quality Results:

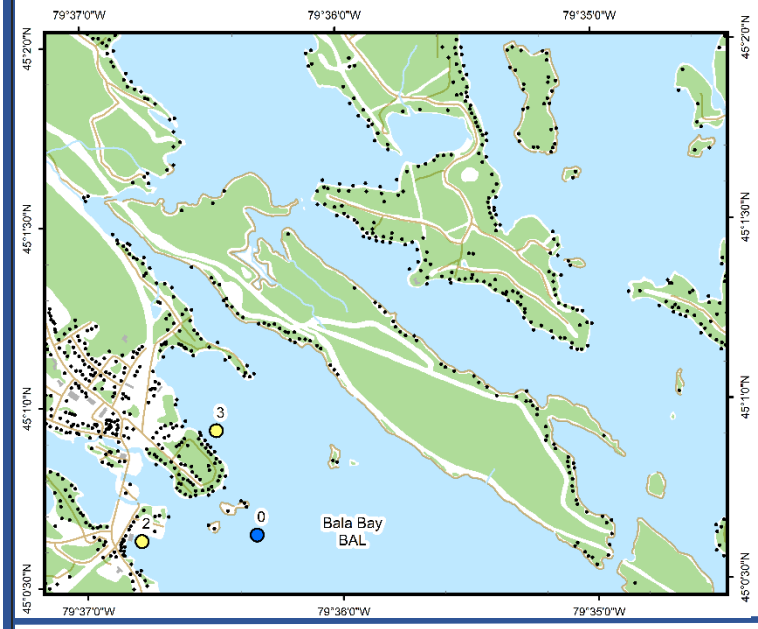
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **ARN-0** | 3.2 | 2.1 | | | |

Note: Grubbs test indicates data collected in 2012 are considered an outlier



In 2023, spring total phosphorus concentrations remained consistent with the range of variability measured since the program began in 2008. All measured phosphorus concentrations were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Average annual Secchi disk depth (3.2 m) was consistent with previous monitoring (2.4 – 3.5 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Bala Bay (BAL)



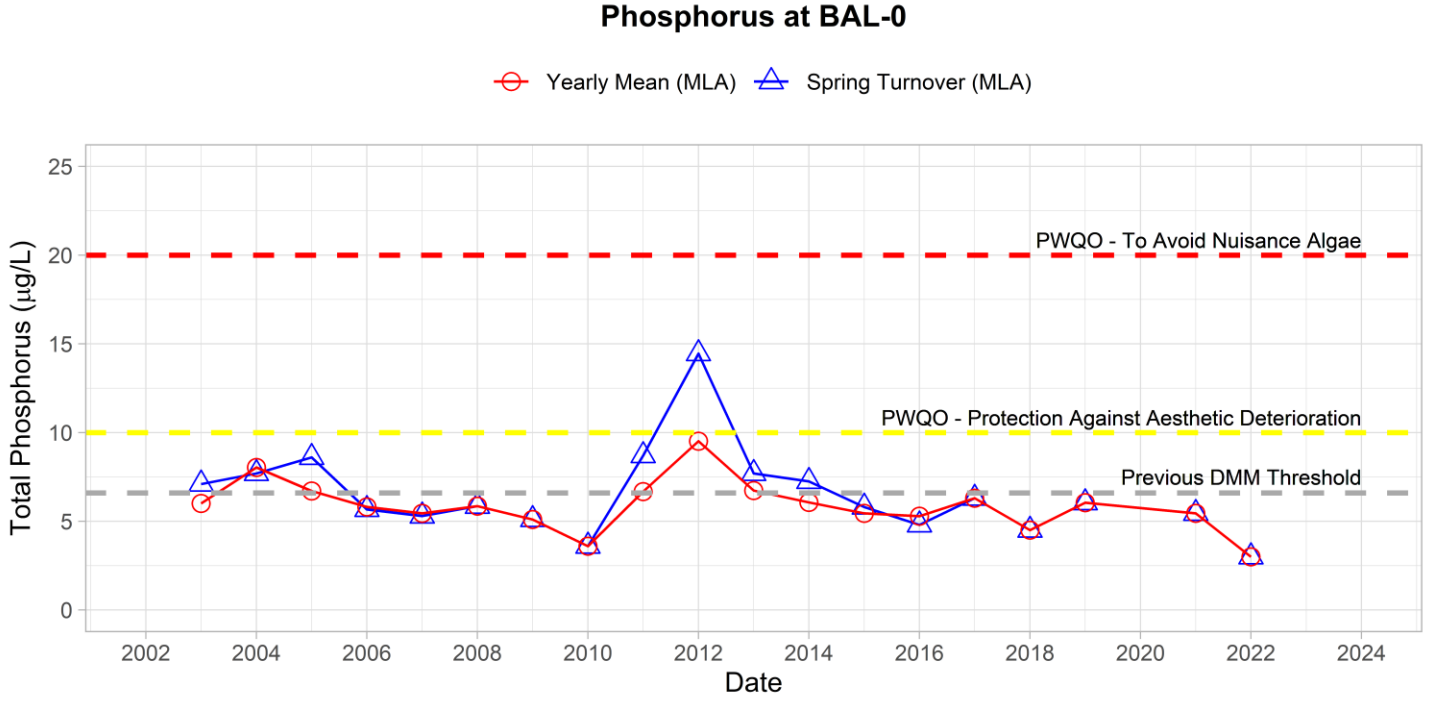

**Area Description:**

Bala Bay is a large bay in the eastern part of Lake Muskoka, which is largely isolated from the rest of the lake by Wanilah and Bala Park Islands. Much of the bay is densely developed however, forest cover remains intact along most shoreline areas. The Village of Bala is located on the western shore of the bay. Bala Bay is the main outflow point of the Muskoka River Watershed which drains through Bala Bay and into the Moon River. There are also two small wetlands that drain into the bay. MLA monitoring of Bala Bay began in 2003.

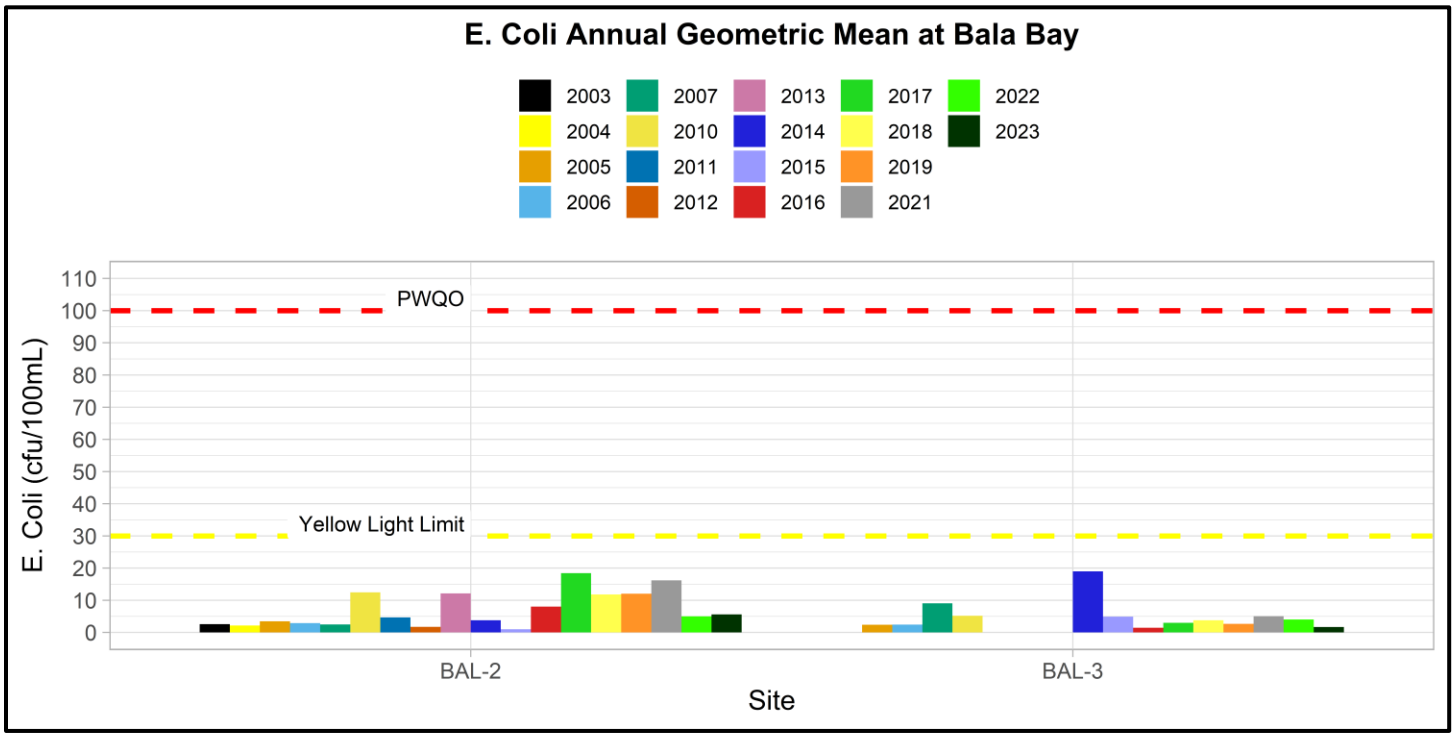
Volunteer Recognition: Peter Joel and Alan Hutton.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| BAL-0 | 3.5 | - | | | |
| BAL-2 | | | | 6 | 7 |
| BAL-3 | | | | 2 | 10 |

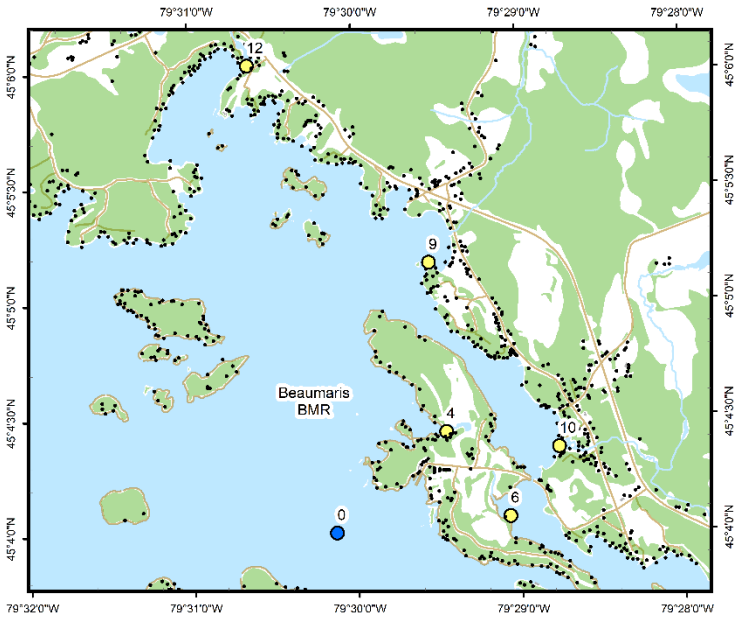



Note: Grubbs test indicates spring total phosphorus data collected in 2012 was considered an outlier.




Spring total phosphorus concentrations were not collected in 2023. Nearshore monitoring of *E. coli* concentrations at BAL-2 and 3 were within the range of variability of previous monitoring years, and below MLA trigger concentrations. Average annual Secchi disk depth (3.5 m) was consistent with previous monitoring (2.5 – 5.3 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Beaumaris (BMR)




**Area Description:**

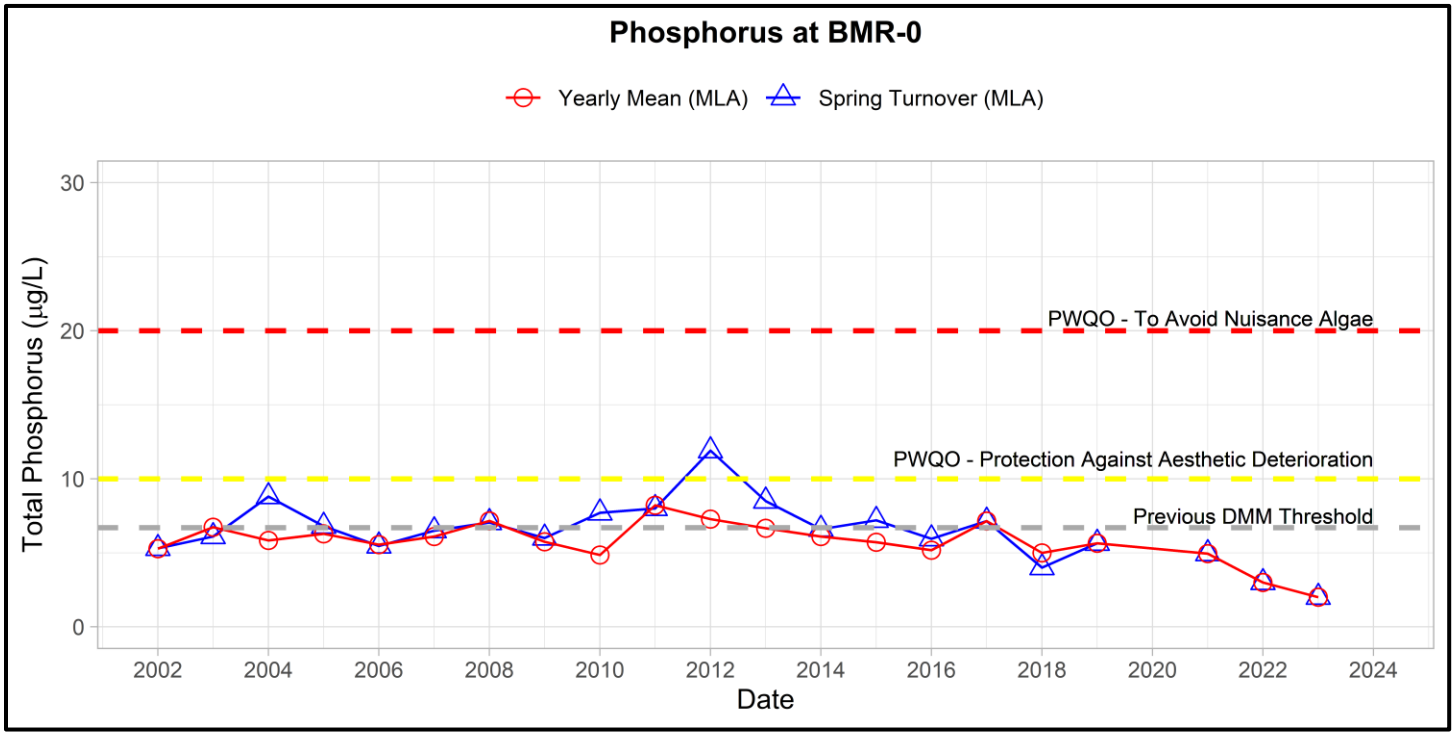
Beaumaris is an island in the Milford Bay region of north-eastern Lake Muskoka and is approximately 132 ha in size. The majority of the island is covered by a golf course with a small private club and marina. Natural shoreline vegetation is largely intact, however large boathouses are common in this area. The watershed includes a wetland to the east where the mainland and the island are linked by a causeway. MLA monitoring at Beaumaris began in 2002.

Volunteer Recognition: Louise Cragg, Don Furniss, Andree Baillargeon, Chris Cragg, Eliza Nevin, Lisa MacLatchy Naprawa, Peter Walsh.

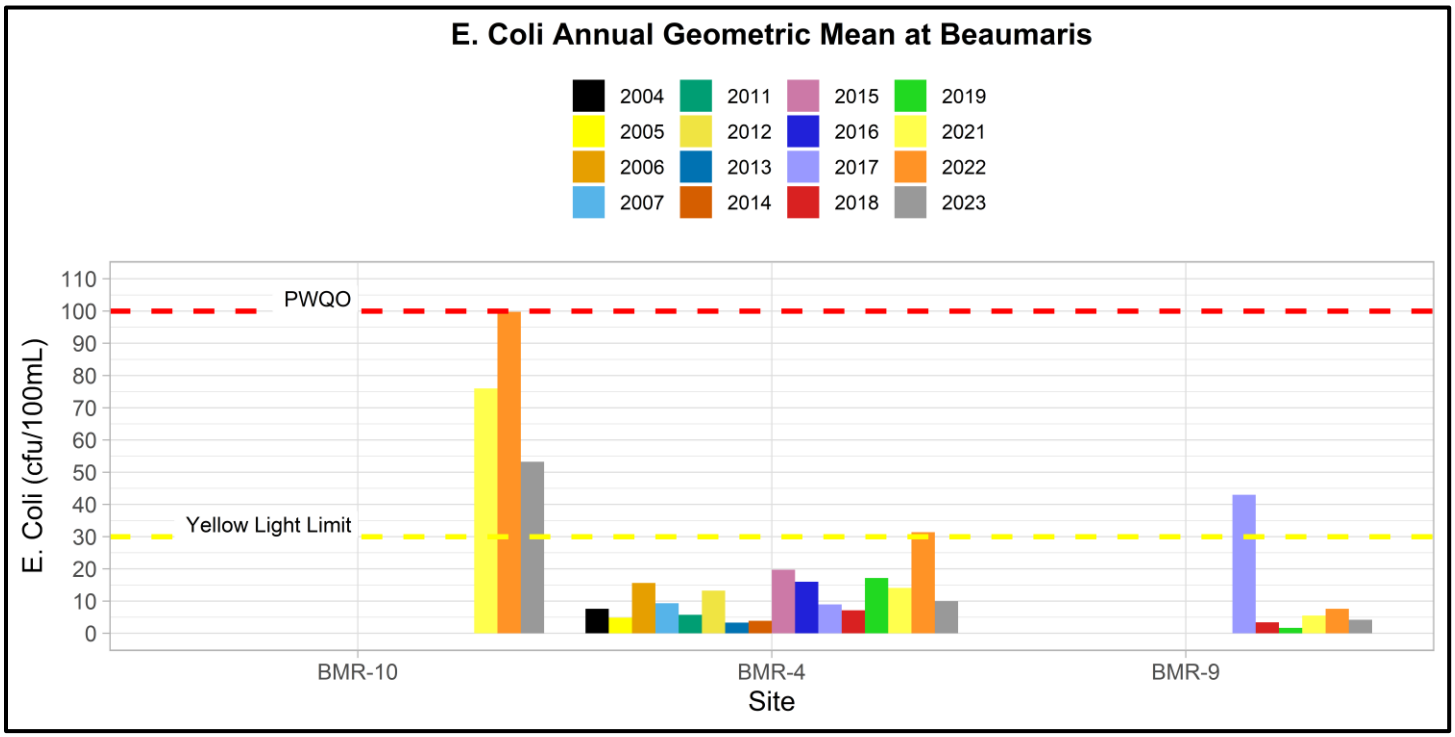
2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **BMR-0** | 2.2 | 2.0 | | | |
| **BMR-4** | | 3.5 | | 15 | 116 |
| **BMR-6** | | 3.5 | | | |
| **BMR-9** | | 2.8 | | 8 | 79 |
| **BMR-10** | | 8.3 | 13.2 | 53 | 849 |
| **BMR-12** | | 17.9 | | | |

Note: Grubbs test indicated that the phosphorus concentration in 2021 at BMR-10 was an outlier.

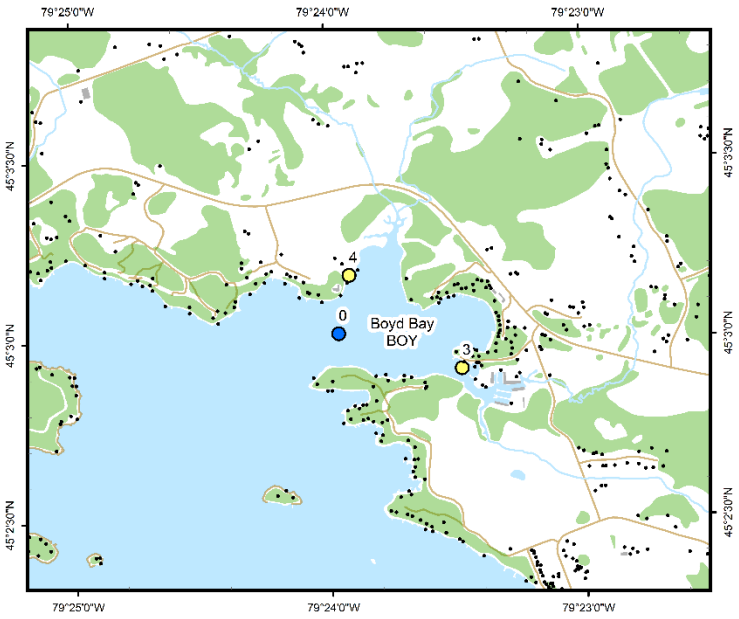



Note: Grubbs test indicates data collected in 2012 are considered an outlier.



Spring phosphorus concentrations at the deep-water station (BMR-0) were below the historic DMM threshold of 6.7 µg/L and the Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L) in 2023. Nearshore monitoring of spring phosphorus concentrations was within the range of variability of previous monitoring years. Nearshore phosphorus concentration have been variable since monitoring of BMR-10 and 12 began in 2017 and therefore ongoing monitoring at these sites is recommended. Average annual Secchi disk depth (2.2 m) was consistent with previous monitoring (2.25 - 4.40 m). The *E. coli* concentrations at BMR-4 and 9 were well below the yellow light limit set by the MLA, bacteria collected at BMR-10 exceeded the yellow light trigger established by the MLA. BMR-10 included four re-tests in July and storm event samples (June and August), however even when removing storm event results *E. coli* concentrations were still above the yellow light trigger. Bacteria protocols were not followed during all sampling events, e.g., June, when high values should have resulted in re-tests. **HESL recommends ongoing sampling to continue to monitor for long-term trends and to further inform on the elevated bacteria concentrations observed at several nearshore sites in 2022 and 2023.**

# Boyd Bay (BOY)




**Area Description:**

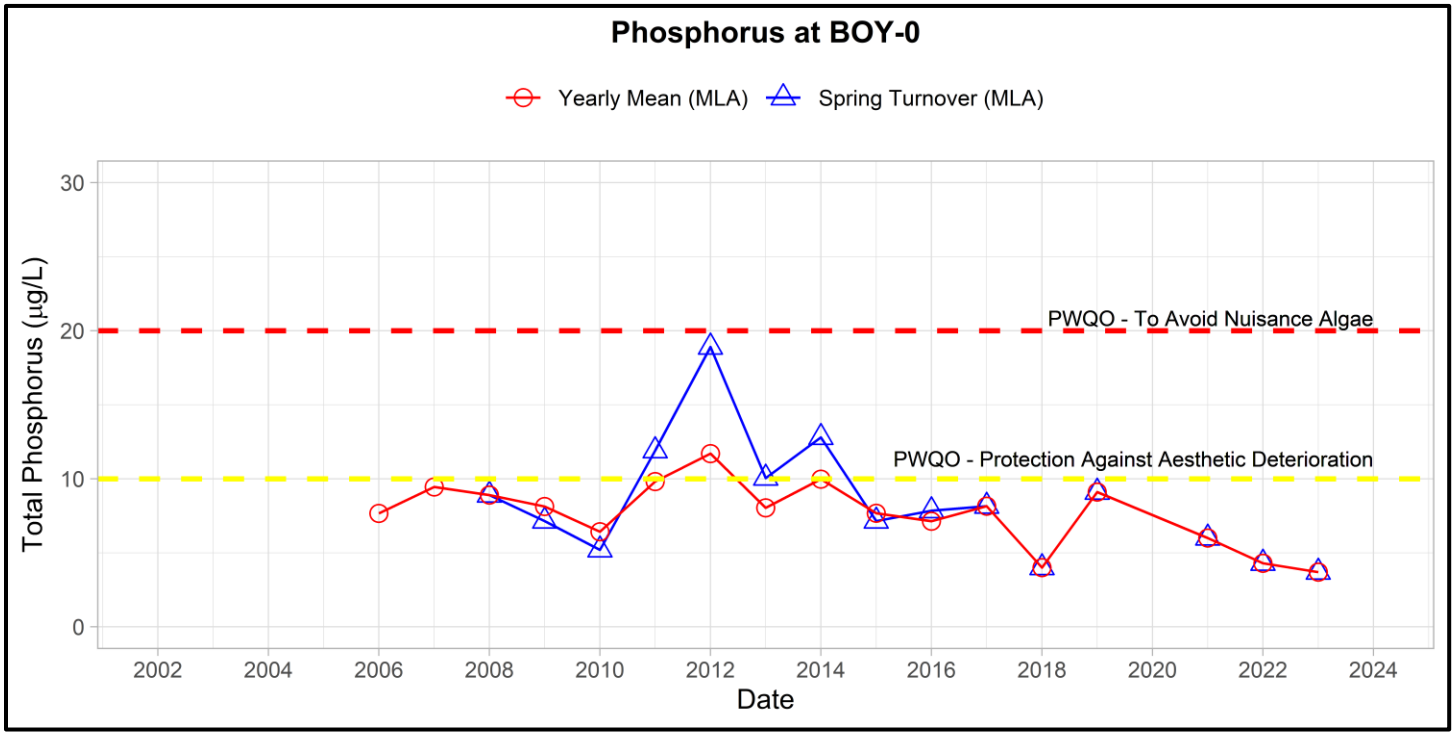
Boyd Bay, in the central part of eastern Lake Muskoka, is a small bay which includes a marina in the southeast, a large wetland in the north, Highway 118 to the east and several inflowing creeks. Inflow from creeks drain agricultural land and therefore may be a source of high nutrient waters. The shoreline of Boyd Bay is highly developed including many residential properties with manicured lawns. MLA monitoring of Boyd Bay began in 2006.

Volunteer Recognition: Bill & Jane Caughey, Paul Follis, Louise Cragg.

2023 Water Quality Results:

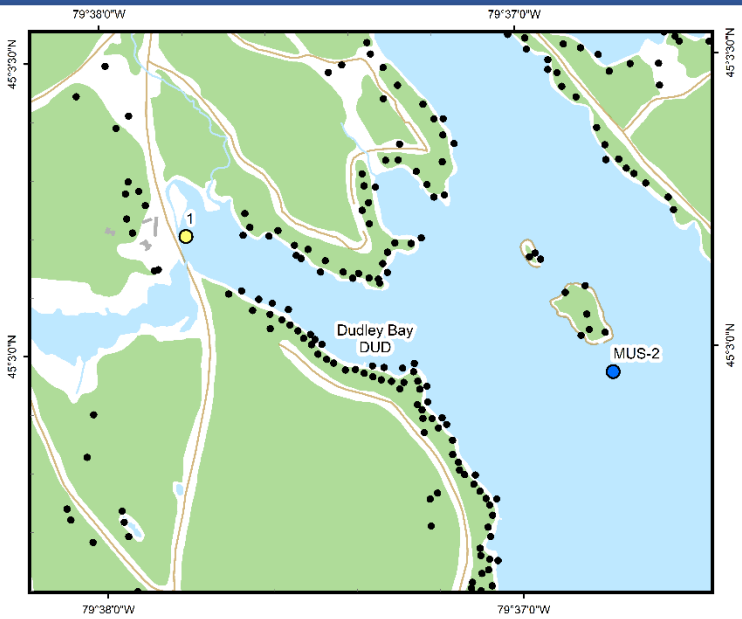
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) Spring Turnover | Total Phosphorus (µg/L) Yearly Mean | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| **BOY-0** | 2.1 | 3.7 | | | |
| **BOY-3** | | 14.4 | 11.8 | | |
| **BOY-4** | | 8.0 | 8.0 | | |

Note: Grubbs test indicates data collected in 2012 are considered an outlier



Spring phosphorus concentrations in 2023 at the deep-water station (BOY-0) were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual average and spring phosphorus concentrations at BOY-3 and 4 were within the range of variability of previous monitoring years. Average annual Secchi disk depth (2.1 m) was consistent with previous monitoring (1.07 – 4.45 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Dudley Bay (DUD-1 and MUS-2)




**Area Description:**

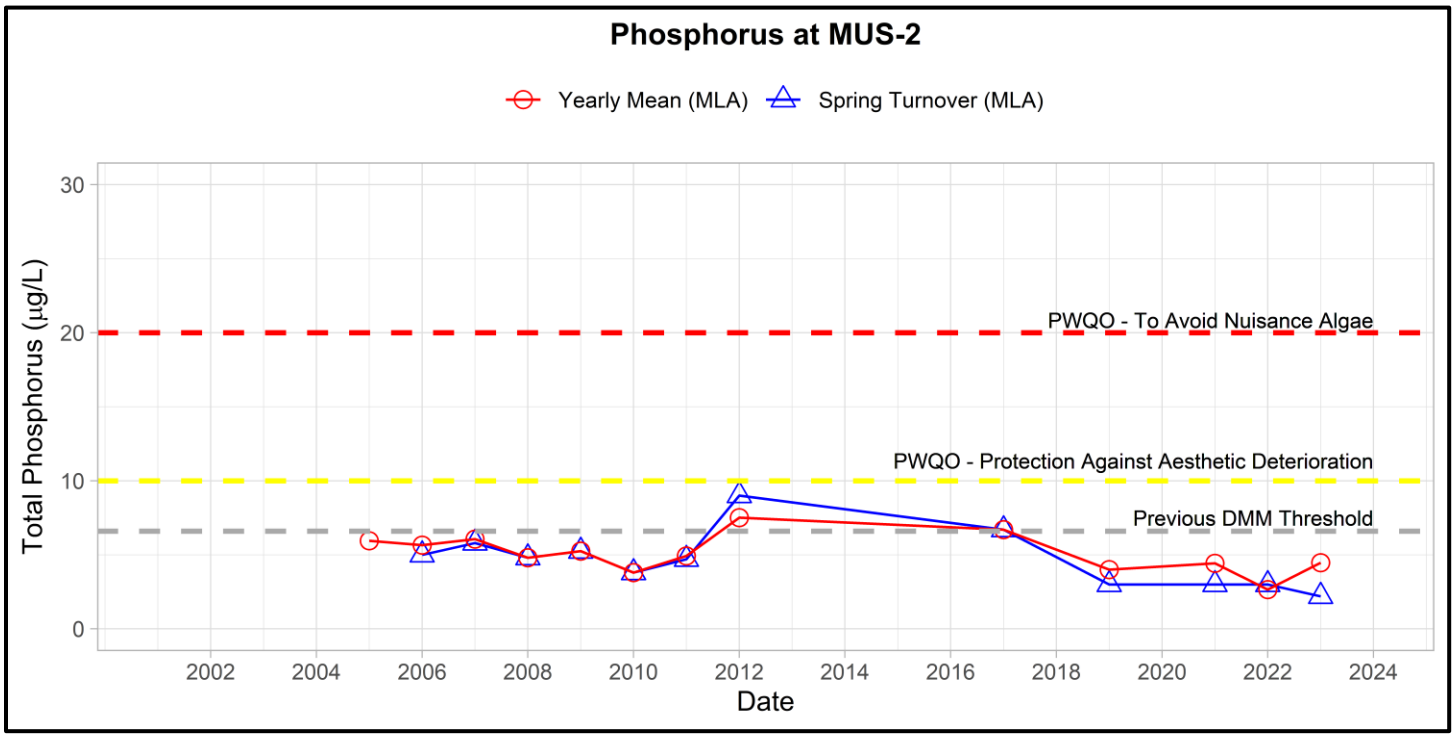
Dudley Bay is a moderately developed area in eastern Lake Muskoka, with a surface area of 3.55 km² and a maximum depth of 20 m. Development in the area includes residential properties, a cranberry farm and Highway 169, which runs in close proximity to the western shoreline. Several creeks and wetlands drain into the bay, including from the cranberry marsh. Dudley Bay was historically classified as moderately sensitive by the DMM. Monitoring started in 2005.

Volunteer Recognition: Eleanor Lewis and Jim Lewis.

2023 Water Quality Results:

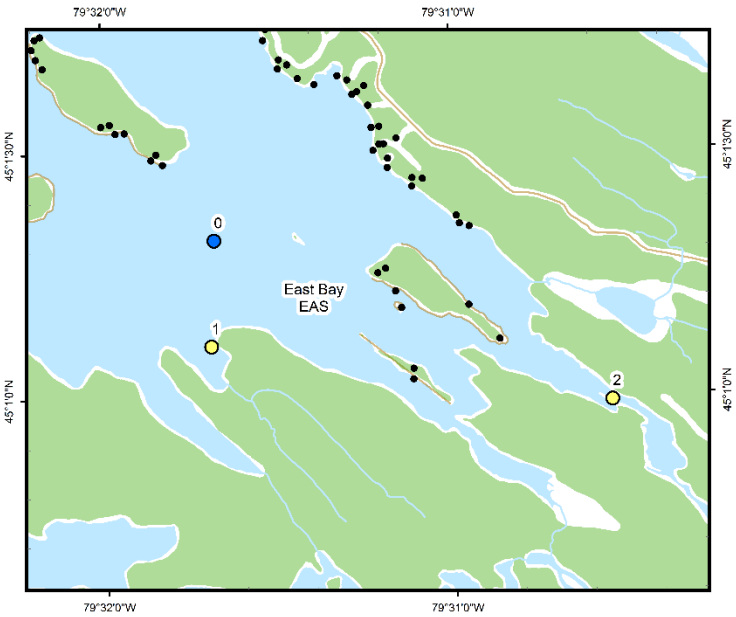
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **DUD-1** | | 3.6 | | | |
| **MUS-2** | 3.0 | 2.2 | 4.5 | | |

Note: Grubbs test indicates no data collected were considered outliers.



Annual average and spring phosphorus concentrations at the deep-water station (MUS-2) were below the historic DMM threshold of 6.6 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring phosphorus concentrations at DUD-1 were within the range of variability observed at the site. Average annual Secchi disk depth (3.0 m) was consistent with previous monitoring (2.5 – 4.75 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# East Bay (EAS)




**Area Description:**

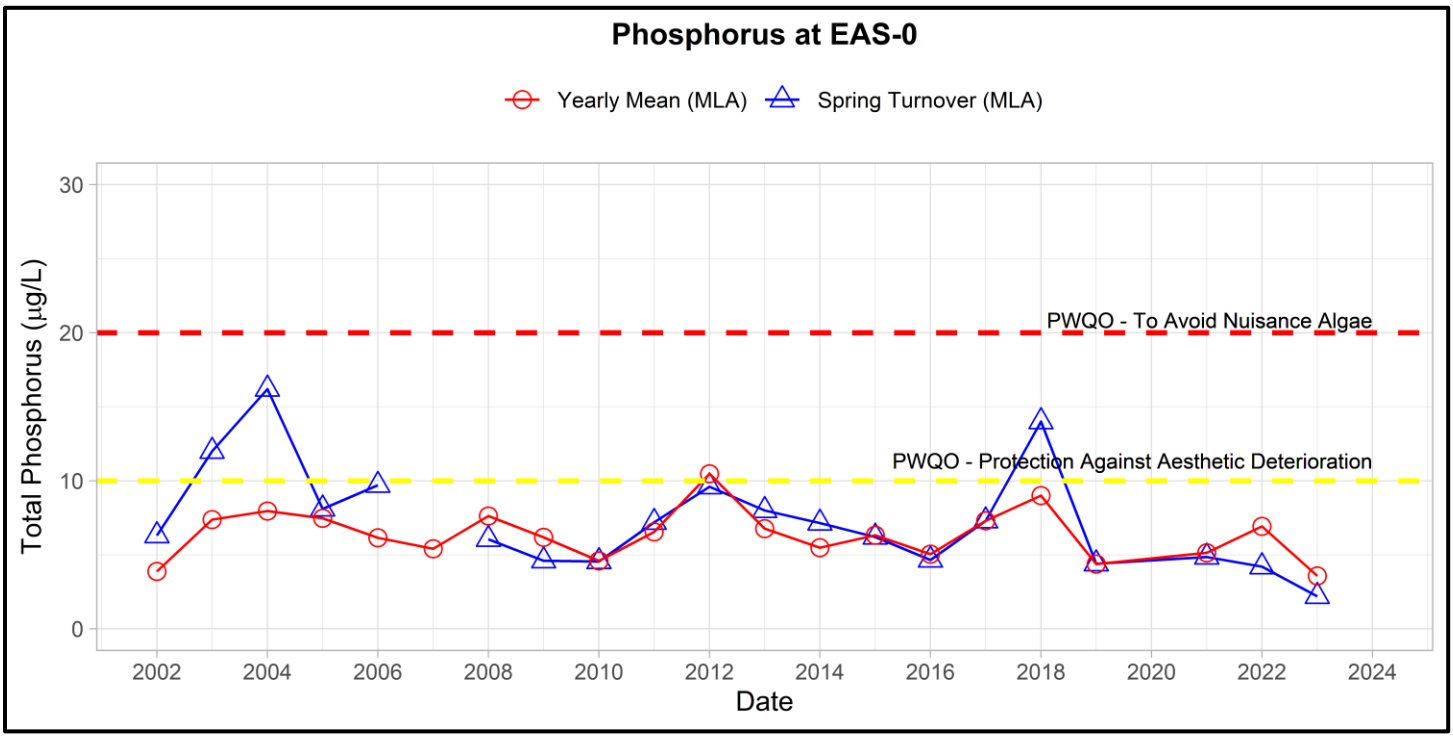
East Bay is part of Hardy Lake Provincial Park located in the western part of Lake Muskoka. Shoreline development in the Bay is low compared to other locations on Lake Muskoka, with few cottages/residences and limited road access. Five creeks flow into the bay through wetland areas of the Provincial Park in the southeast. MLA monitoring of East Bay began in 2002.

Volunteer Recognition: Jan Getson, Jeff Hall, Louise Cragg, Deb Martin-Downs.

2023 Water Quality Results:

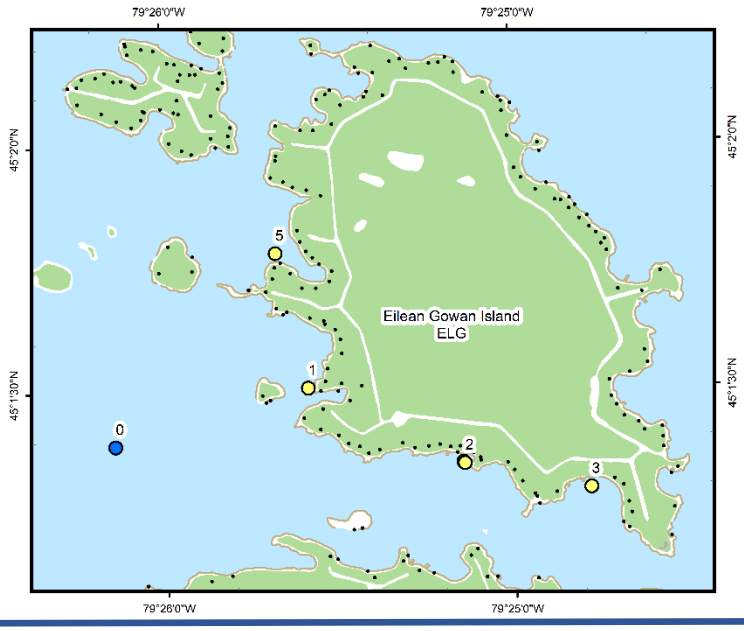
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **EAS-0** | 3.0 | 2.2 | 3.9 | | |
| **EAS-2** | | 7.2 | 7.3 | | |
| **EAS-4** | | 2.9 | 4.6 | | |

Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.



Annual average and spring phosphorus concentrations at the deep-water station (EAS-0) were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual and spring phosphorus concentrations at EAS-2 and 4 were within the range of variability of previous monitoring years. Average annual Secchi disk depth (3.0 m) was consistent with previous monitoring (2.6 – 5.5 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Eilean Gowan Island (ELG)




**Area Description:**

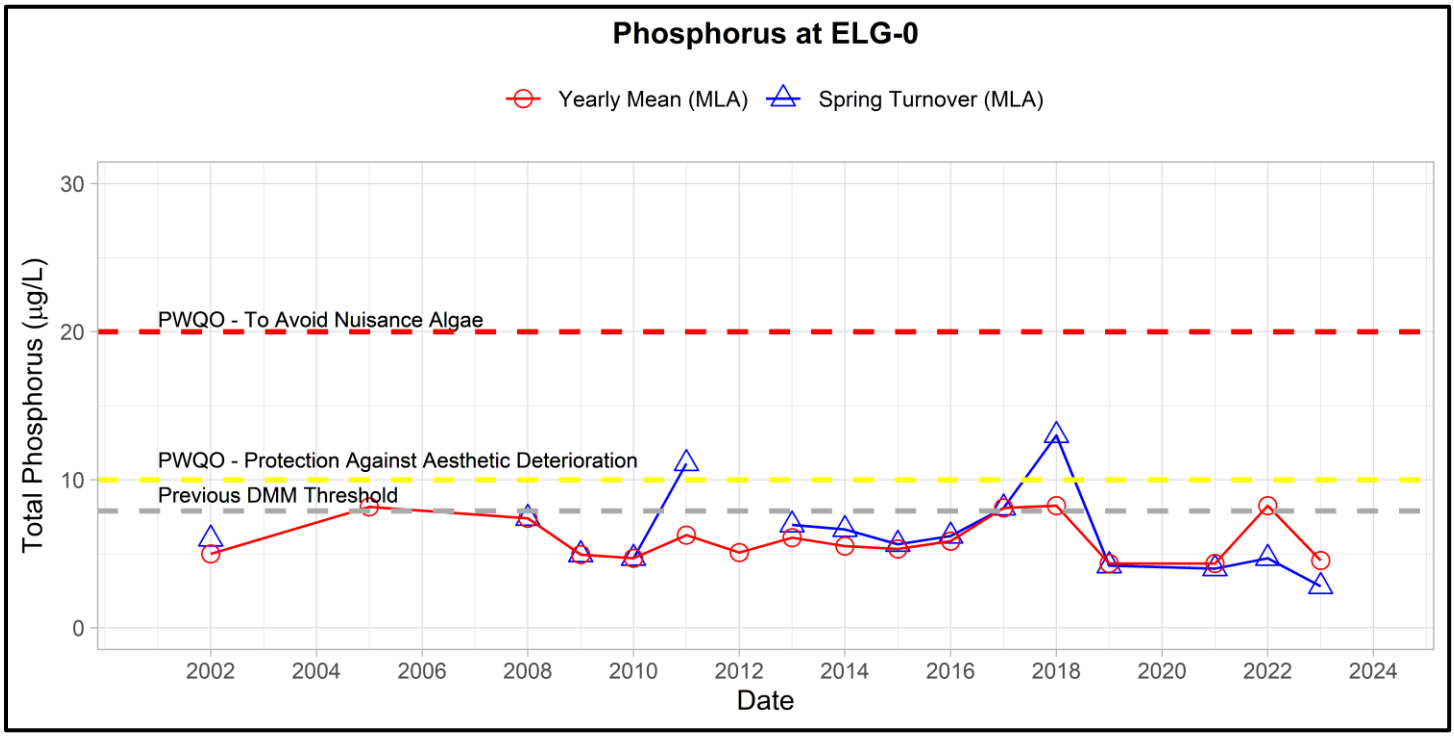
Eilean Gowan Island is located in the eastern part of Lake Muskoka. The island is developed with residential cottages, many of which appear to retain a well-vegetated shoreline. Some manicured lawns and tennis courts are located directly adjacent to the lake. The interior of Eilean Gowan Island is heavily forested and a stream outlets from the upland area to the lake at ELG-1. MLA monitoring of Eilean Gowan Island began in 2002.

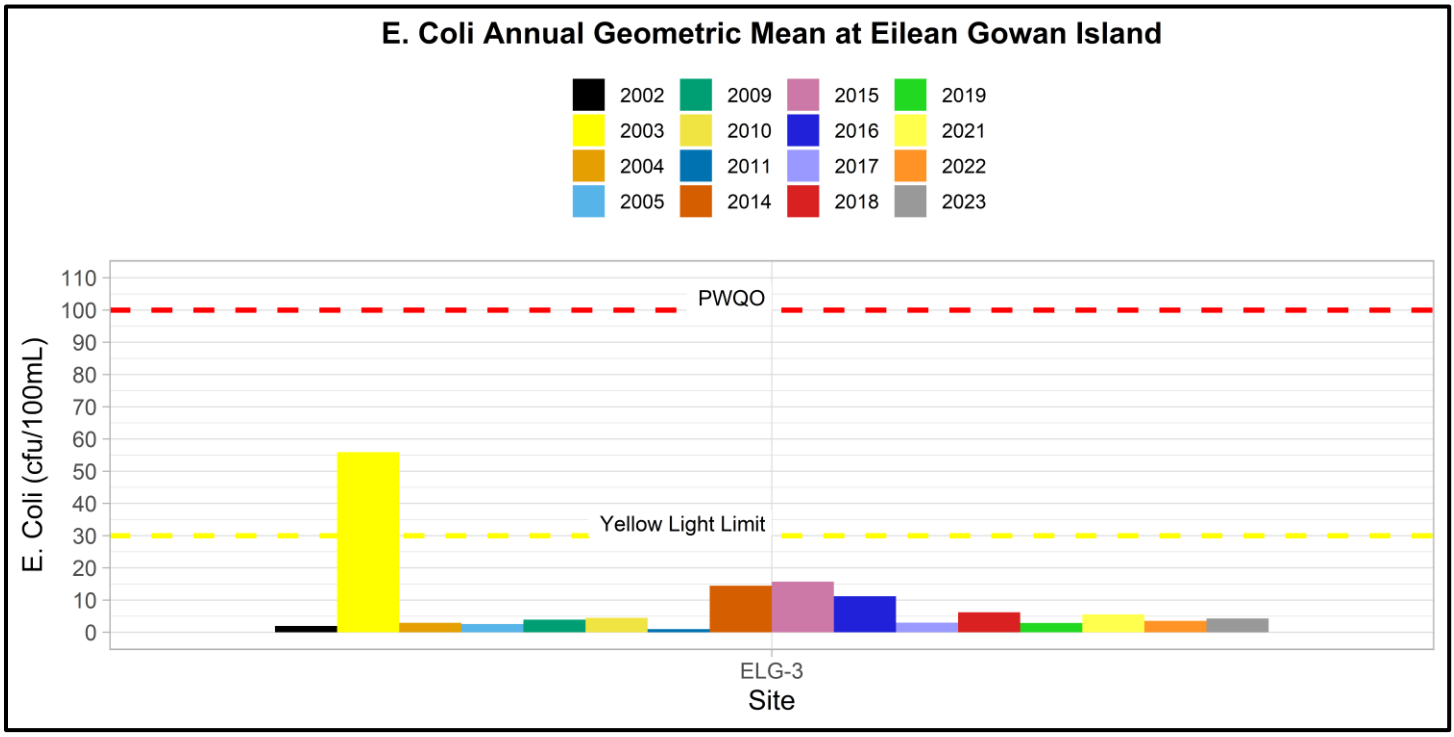
Volunteer Recognition: Doug Tate, Beth Tate, Susan Murphy.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **ELG-0** | 2.5 | 2.8 | 4.6 | | |
| **ELG-3** | | | | 4 | 143 |
| **ELG-5** | | 3.0 | | | |

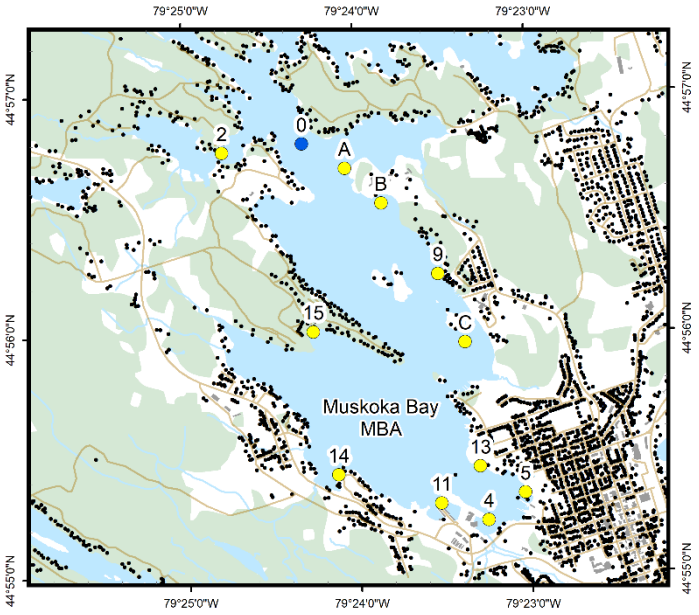
Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.






Spring phosphorus concentrations at the deep-water station (ELG-0) were below the historic DMM threshold of 7.9 µg/L and the Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring phosphorus concentrations at EAS-5 consistent with previous monitoring at the site. Average annual Secchi disk depth (2.5 m) was consistent with previous monitoring (2.0 – 5.25 m). *E. coli* counts in 2023 were well below the MLA trigger threshold of 30 cfu/100mL at ELG-3, elevated total coliforms counts were the result of a single extreme value (418 cfu/100ml) in June. Bacteria data in 2023 should be interpreted with caution as no re-tests were performed during June sampling to confirm the elevated coliform counts and the annual geomean is based on only two samples **HESL recommends ongoing sampling to continue to monitor for long-term trends.**

# Muskoka Bay (MBA)




**Area Description:**

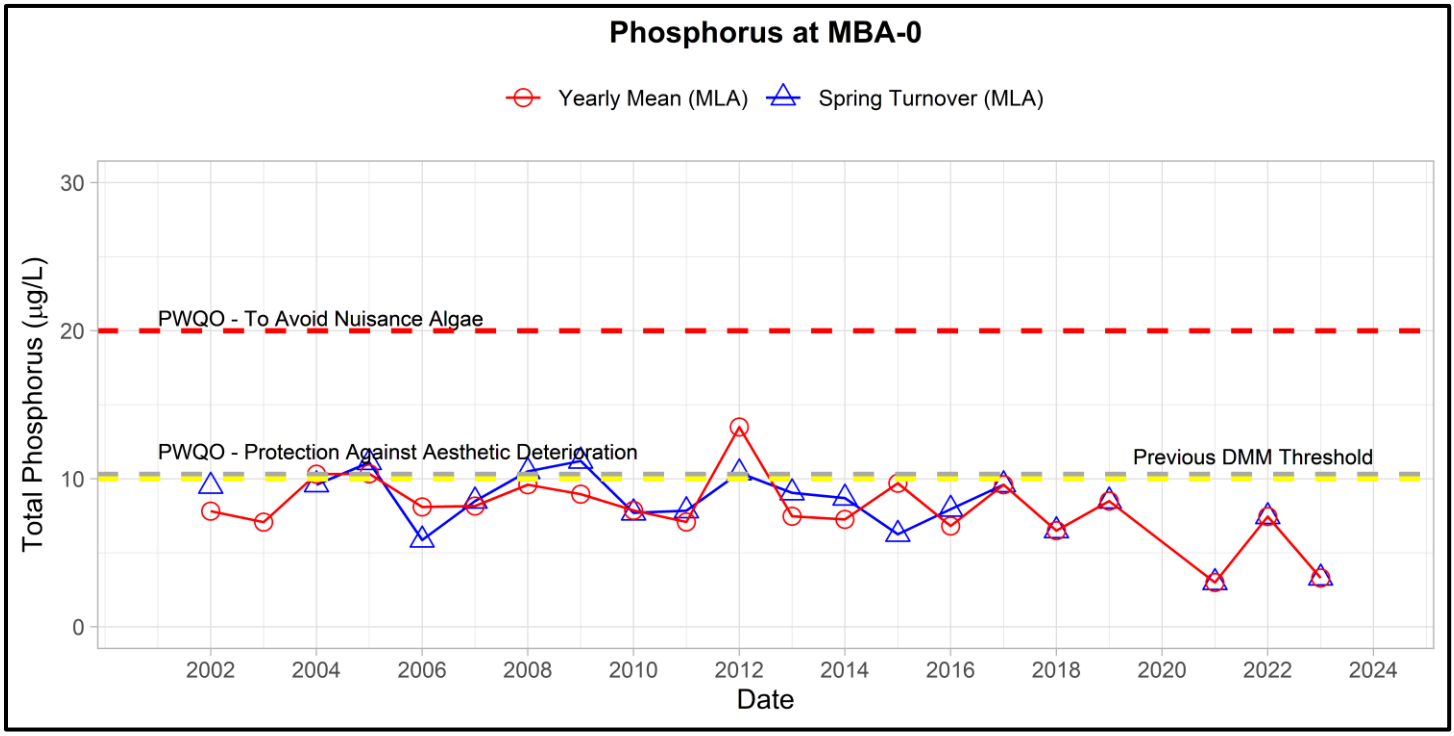
Muskoka Bay is a highly developed bay in southern Lake Muskoka. The highly developed bay has a surface area of 4.03 $km^2$ and a maximum depth of 14 m. Development in the area includes a commercial development and marina in the south, the town of Gravenhurst in the East and cottage development along most of the shoreline. The bay also receives urban stormwater from the town of Gravenhurst. Numerous creeks outlet into Muskoka Bay and wetlands account for 13% of the shoreline area. MLA monitoring of Muskoka Bay began in 2002.

Volunteer Recognition: Karen Abells and Alan Goldenberg.

2023 Water Quality Results:

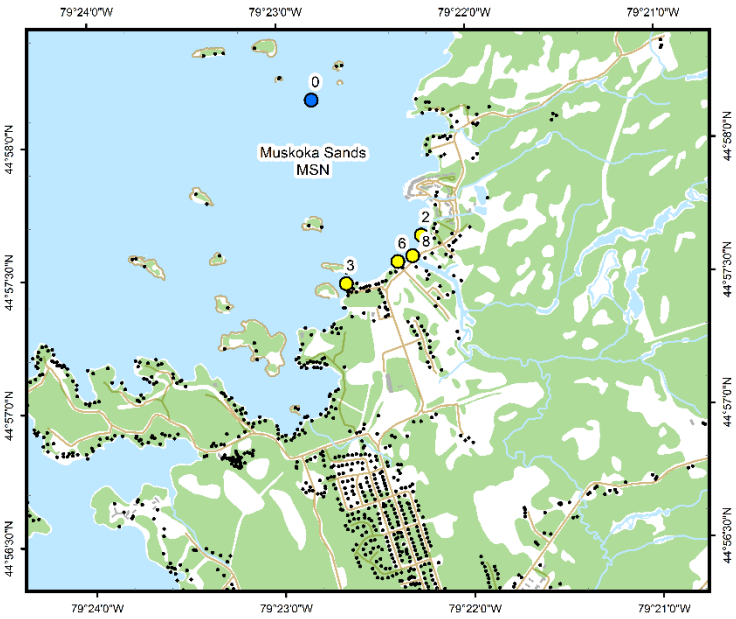
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **MBA-0** | 2.8 | 3.3 | | | |
| **MBA-2** | | 3.7 | | | |
| **MBA-4** | | 3.1 | | | |
| **MBA-5** | | 5.0 | 7.7 | | |
| **MBA-11** | | 3.4 | | | |
| **MBA-A** | 4.4 | 2.9 | 10.0 | | |
| **MBA-B** | | 4.1 | 12.1 | | |
| **MBA-C** | | 3.0 | 7.3 | | |

Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.




The spring phosphorus concentration at the deep-water station (MBA-0) was within the range of long-term variability and was below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring phosphorus concentrations at MBA-2, 4 and 11 were within the range of variability of previous monitoring years. Average annual Secchi disk depth (2.8 m) was consistent with previous monitoring (2.15 – 5.9 m). Additional stations at MBA-A, B and C were first sampled in 2022. Elevated phosphorus concentrations were recorded in August at MBA-B (32.5 µg/L). Two years of sampling is not sufficient to determine the variability in phosphorus concentrations at a site, additional sampling in 2024 and beyond will help determine if these concentrations are cause for concern. **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Muskoka Sands (MSN)



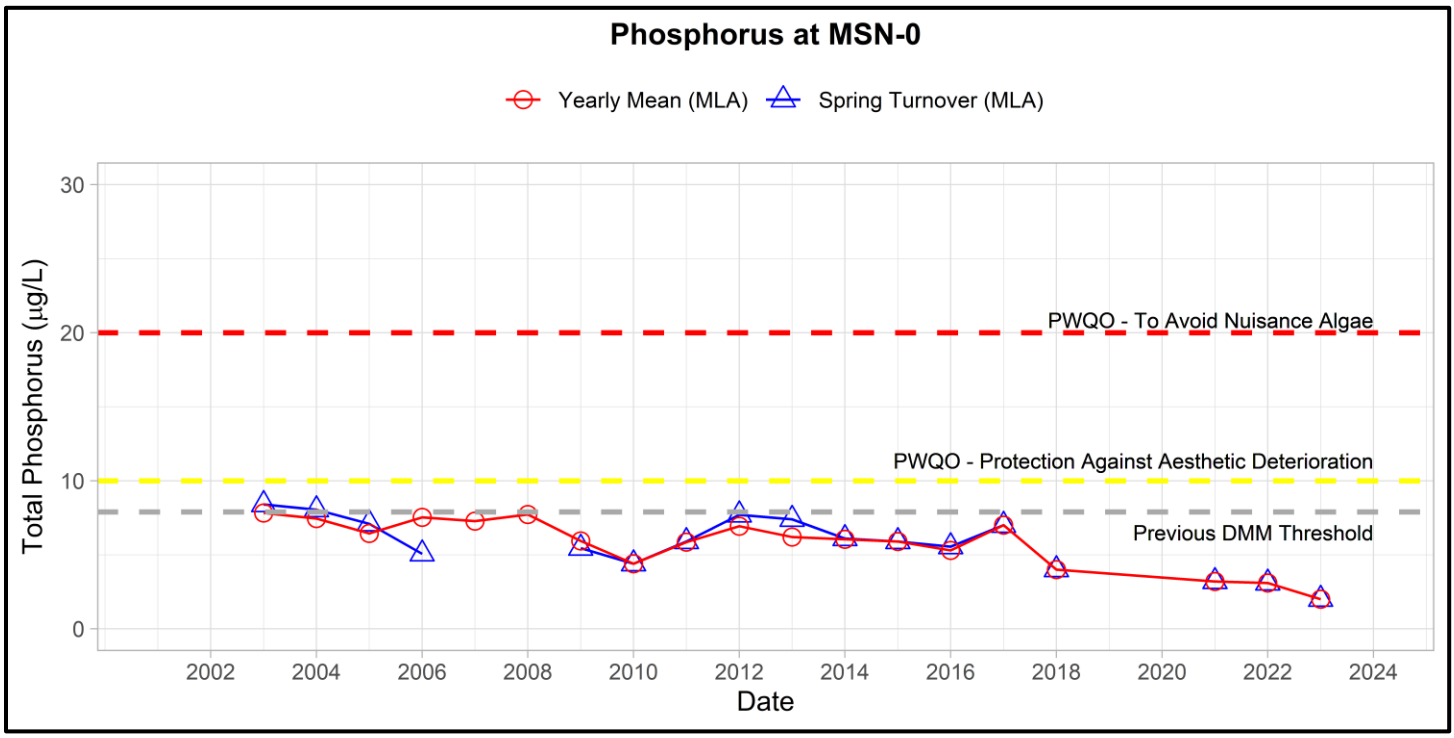

**Area Description:**

The Muskoka Sands sampling area is a highly developed region in southeastern Lake Muskoka at the inflow of the Hoc Roc River. Development within the area includes a large resort and golf course, a substantial number of residential properties and a large road network adjacent to the lake. Land use in the upstream reaches of the Hoc Roc River includes agricultural, industrial, residential, and natural wetland areas. MLA monitoring at Muskoka Sands began in 2003.

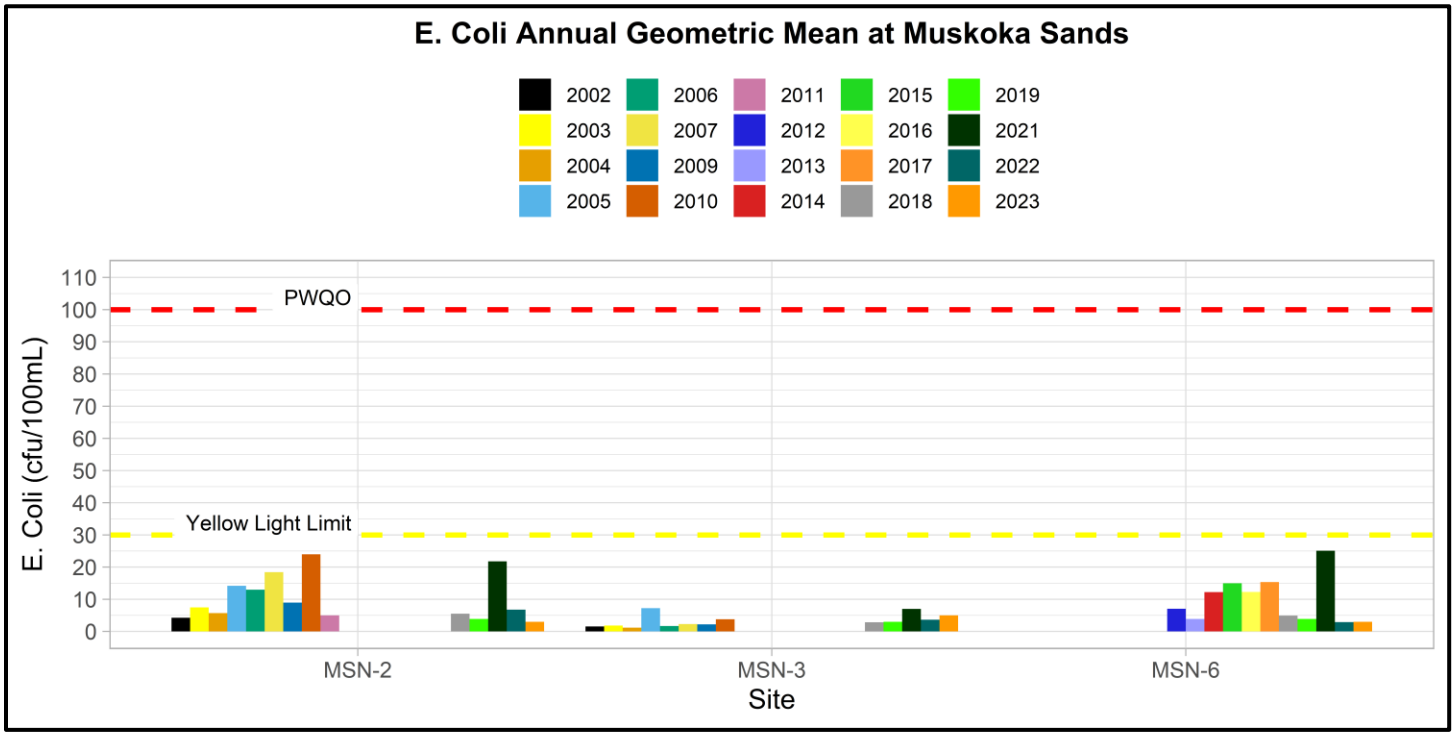
Volunteer Recognition: Sheila Robinson, George Fallis, Stephen Sims.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **MSN-0** | 2.8 | 2.0 | | | |
| **MSN-2** | | | | 3 | 62 |
| **MSN-3** | | | | 5 | 13 |
| **MSN-6** | | | | 3 | 49 |
| **MSN-8** | | 4.2 | 11.3 | | |

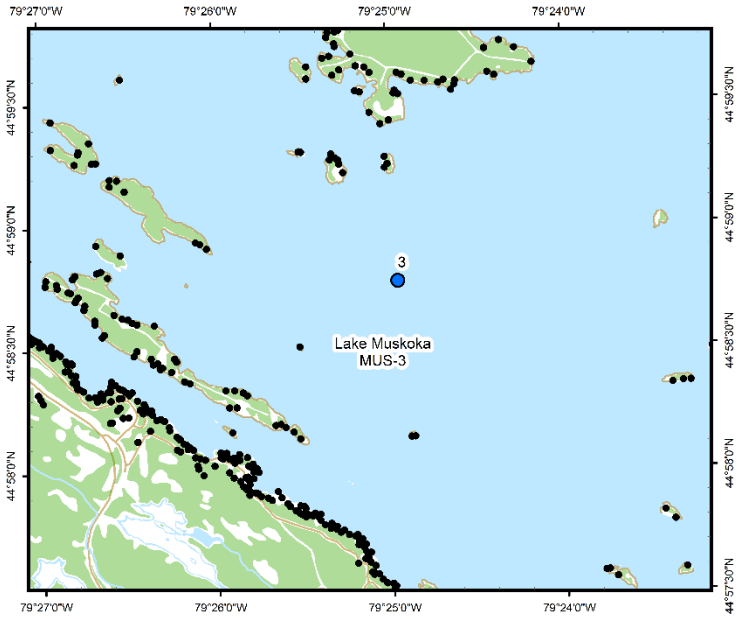



Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.




The spring phosphorus concentration at the deep-water station (MSN-0) was below the historic DMM threshold of 7.9 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring phosphorus concentrations at MSN-8 was below 10 µg/L. Bacteria counts were typical of the long-term monitoring record, well below the yellow light trigger established by the MLA. Average annual Secchi disk depth (2.8 m) was consistent with previous monitoring (1.0 - 5.25 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Lake Muskoka (MUS-3)




**Area Description:**

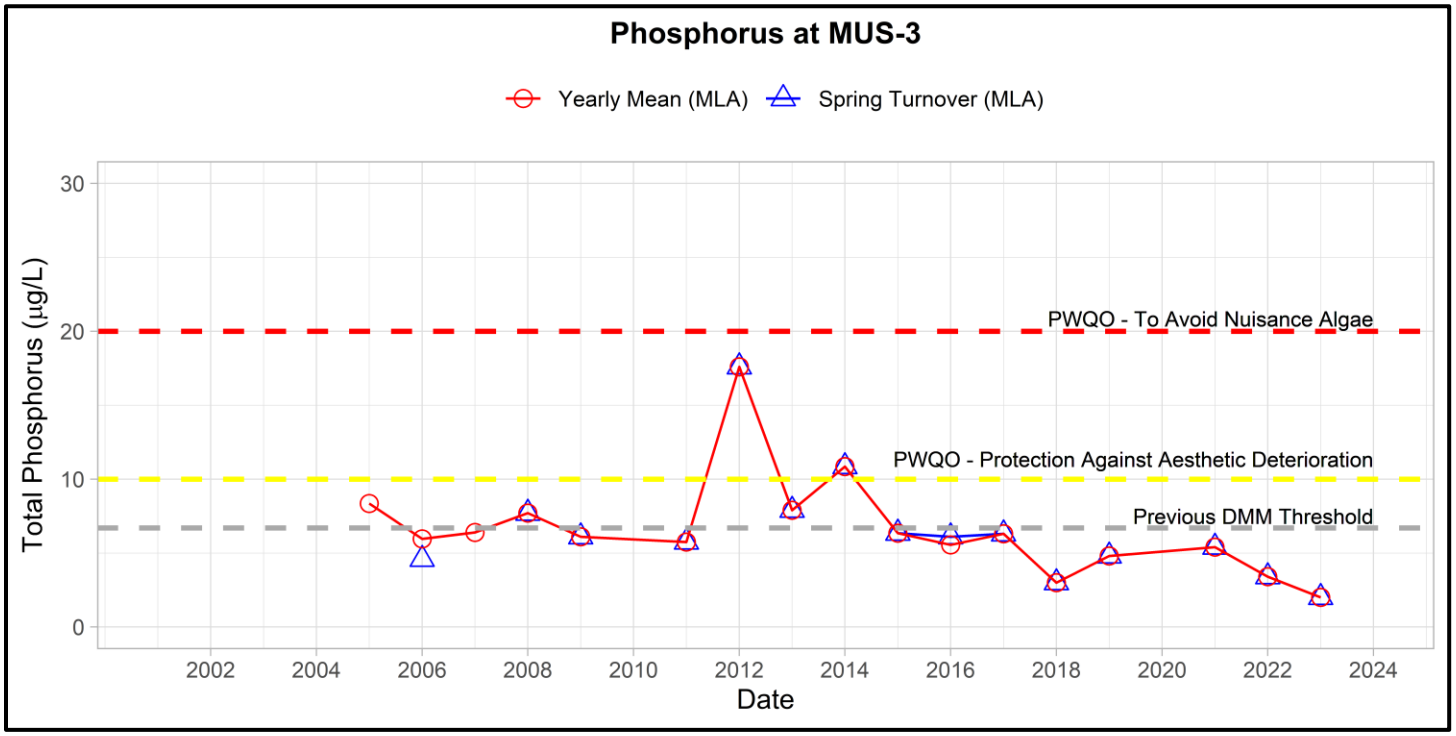
Lake Muskoka is the largest inland lake within the District of Muskoka. The lake has a surface area of 107.55 $km^2$ and maximum water depth of 67 m. The main basin of Lake Muskoka has a watershed area of 130.41 $km^2$ with approximately 6% of the watershed being covered by wetlands. The lakes main outflow is into the Moon River through Bala Bay. MLA monitoring of Lake Muskoka began in 2005.

Volunteer Recognition: Carol Hoskins, Sheila Robinson, George Fallis, Stephen Sims, Mark & Sandy Brosch.

2023 Water Quality Results:

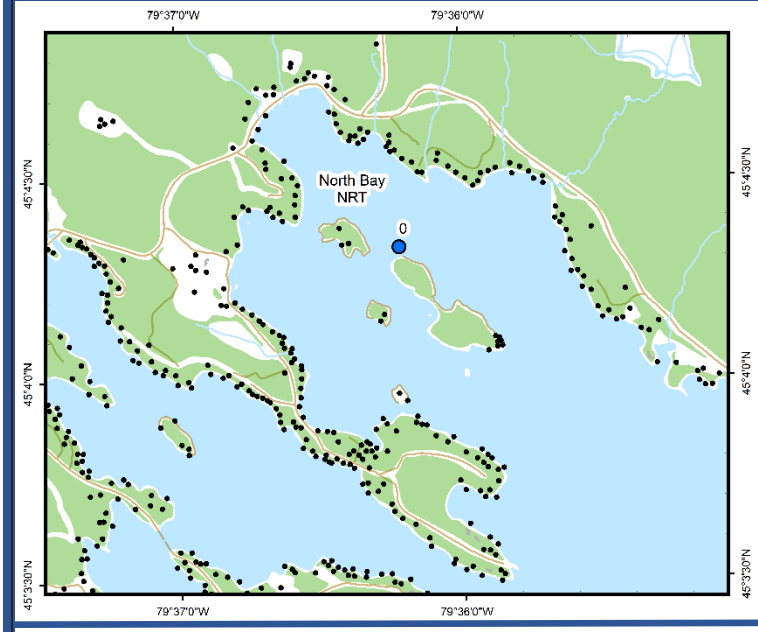
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **MUS-3** | 2.6 | 2.0 | | | |

Note: Grubbs test indicates 2012 spring phosphorus data was considered an outlier.



The spring phosphorus concentration at the deep-water station (MUS-3) was below the historic DMM threshold of 6.7 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Average annual Secchi disk depth (2.6 m) was consistent with previous monitoring (2.4 – 3.95 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# North Bay (NRT)




**Area Description:**

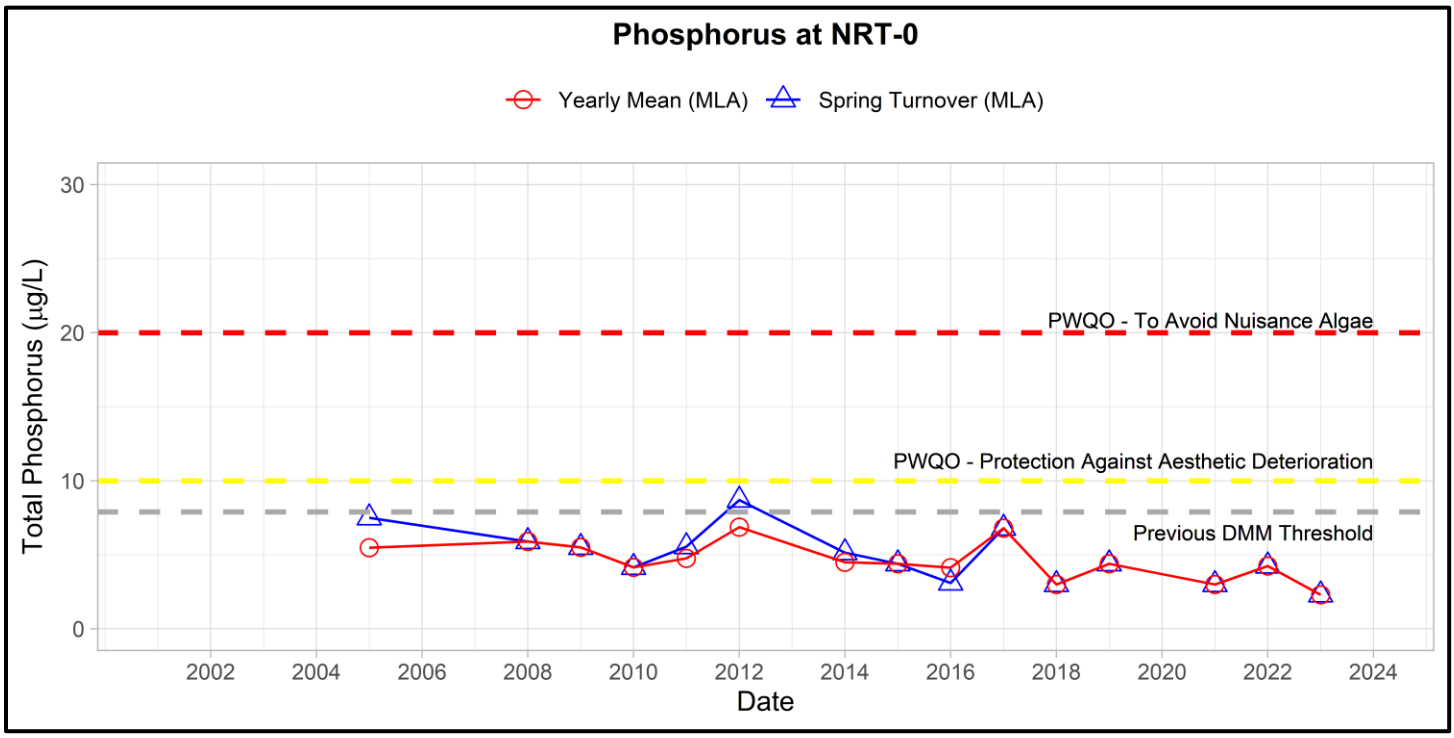
North Bay is a large bay in northwestern Lake Muskoka. Eight creeks outlet into the bay, including one in the North which flows through a District landfill site. North Bay is moderately developed including residential properties and several roads that are in close proximity to the shoreline. Development is focussed on areas adjacent to the lake, and therefore the remainder of the watershed is densely forested

Volunteer Recognition: Eleanor Lewis, Kim Seon and Jim Lewis.

2023 Water Quality Results:

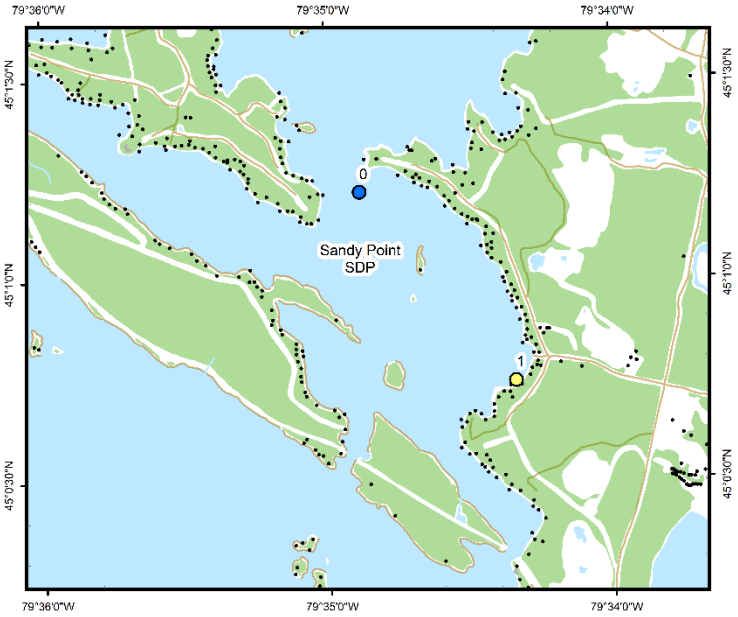
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **NRT-0** | 3.3 | 2.3 | | | |

Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.



The spring phosphorus concentration at the deep-water station (NRT-0) was below the historic DMM threshold of 7.9 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Average annual Secchi disk depth (3.3 m) was consistent with previous monitoring (2.25 – 4.63 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Sandy Point (SDP)




**Area Description:**

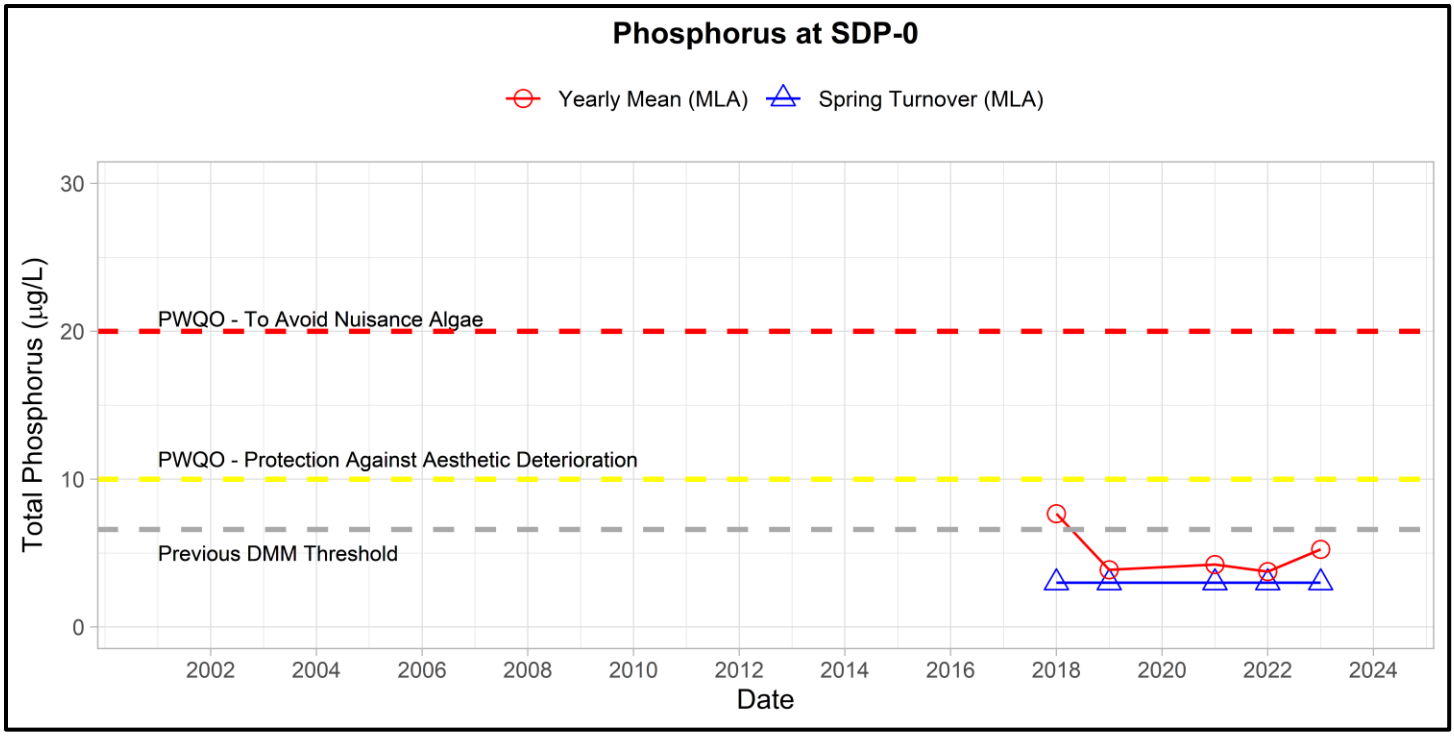
Sandy Point is east of Bala and the Moon River outflow from Lake Muskoka in the western portion of the lake. The Sandy Point stations are northwest of Bala Park Island and Wanilah Island. Three aggregate operations are currently active to the west of the Sandy Point sampling locations. MLA monitoring of Sandy Point began in 2018.

Volunteer Recognition: Mike Schnarr.

2023 Water Quality Results:

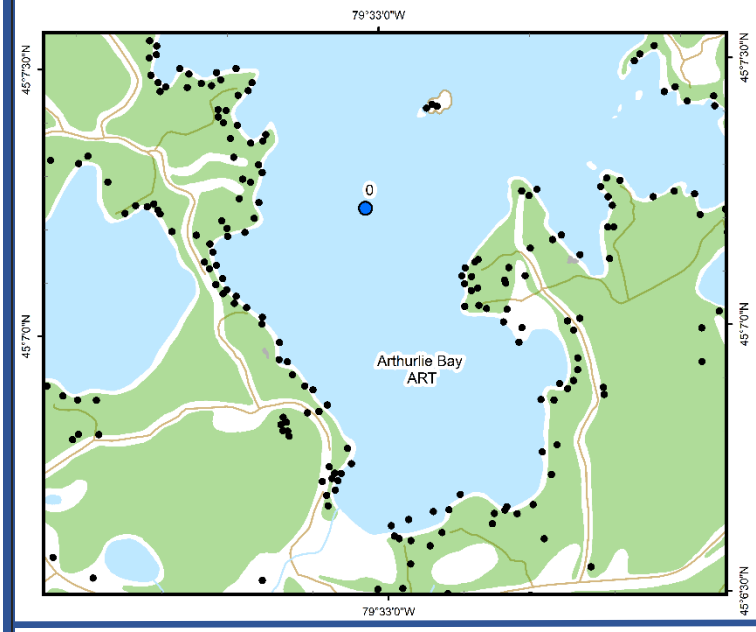
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **SDP-0** | 2.9 | 5.1 | 5.3 | | |
| **SDP-1** | | 5.3 | 4.0 | | |

Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.



Annual average and spring phosphorus concentrations at the deep-water station (SDP-0) were below the historic DMM threshold of 6.6 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring phosphorus concentrations at SDP-1 were within the range of variability of previous monitoring years, though data at this newly established site (2018) are limited. Average annual Secchi disk depth (2.9 m) was consistent with previous monitoring (3.0 - 3.2 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Arthurlie Bay (ART)




**Area Description:**

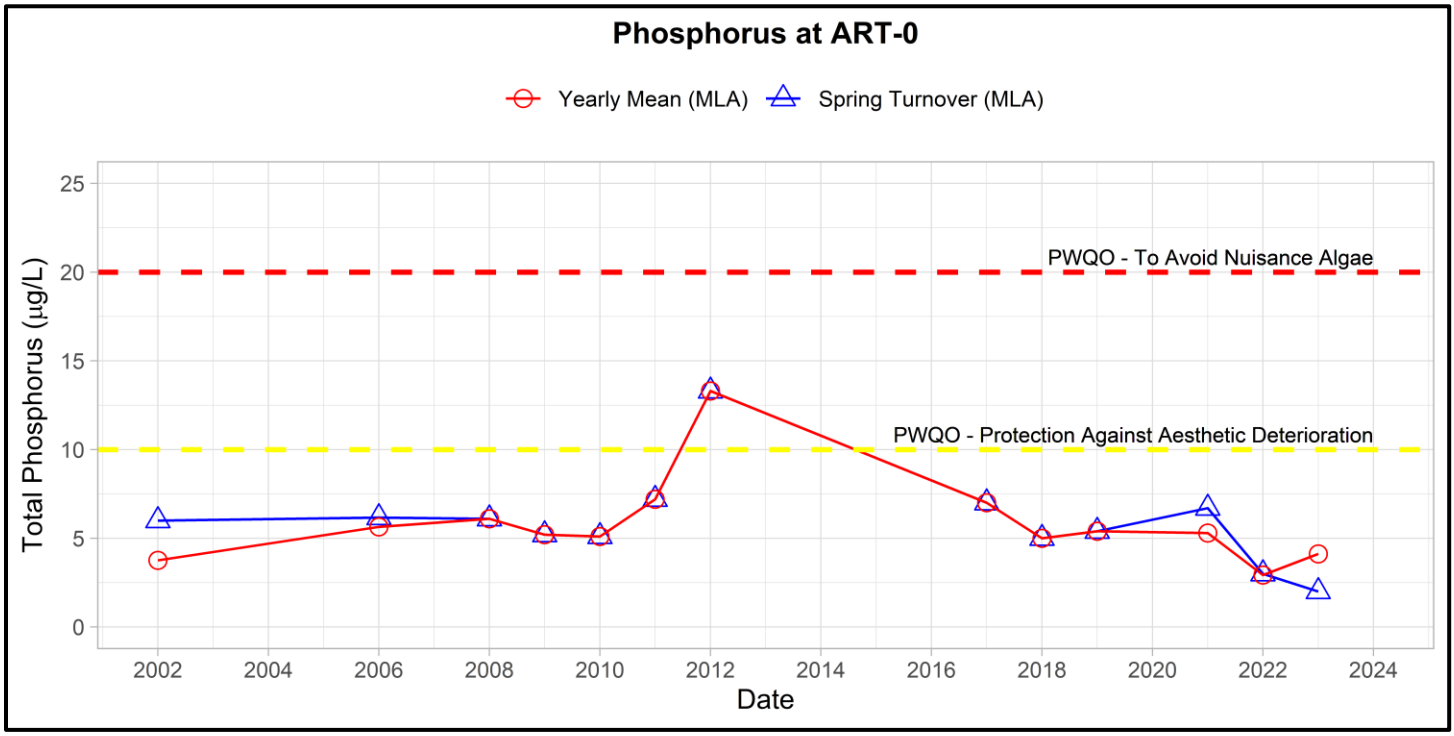
Arthurlie Bay is a shallow bay in the southern basin of Lake Rosseau. Shoreline development is considered moderate to high and includes numerous properties with substantial cleared area. One creek in the south flows through agricultural land prior to entering the southwest corner of the bay. MLA monitoring of Arthurlie Bay began in 2002.

Volunteer Recognition: Mark Tiffin.

2023 Water Quality Results:

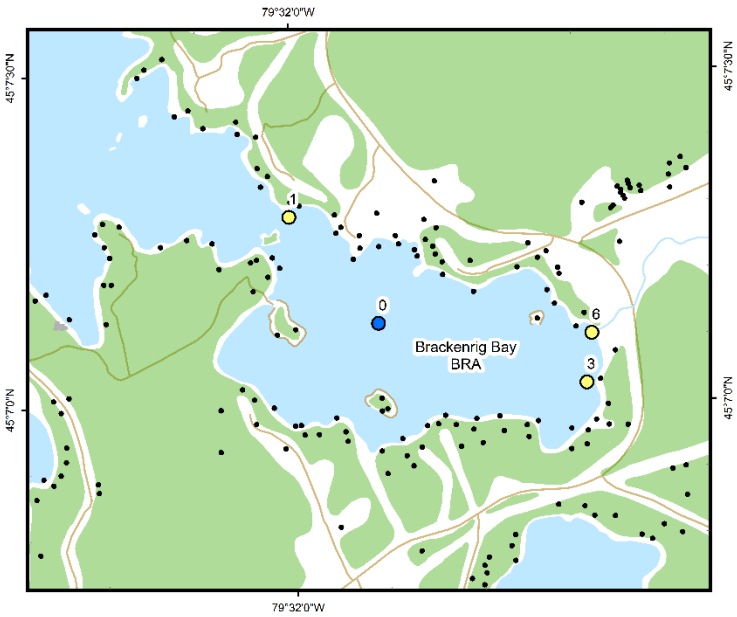
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **ART-0** | 3.6 | 2.0 | 4.1 | | |

Note: Grubbs test indicates spring phosphorus data collected in 2012 are considered an outlier



Annual average and spring phosphorus concentrations at the deep-water station (ART-0) were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Average annual Secchi disk depth (3.6 m) was consistent with the range of previous measurements (3.7 – 4.4 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Brackenrig Bay (BRA)




**Area Description:**

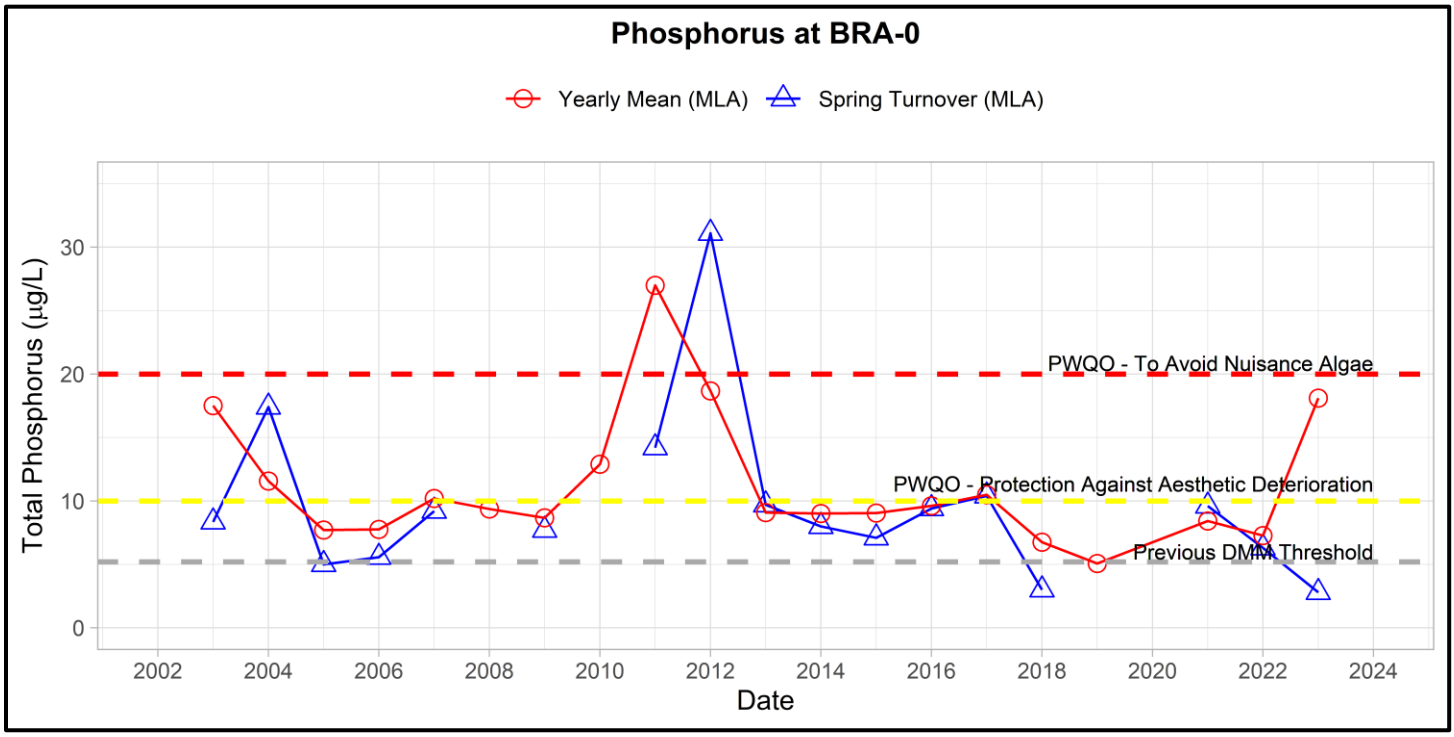
Brackenrig Bay in southern Lake Rosseau, has an area of 0.44 km² and a maximum depth of 3 m. The bay is isolated from Lake Rosseau and is moderately developed with residential properties. Based on District mapping data 18% of the shoreline has been altered with 60% of backlot areas cleared of natural forest. Four creeks drain into the bay, one of which flows through an agricultural area adjacent to a garden center before entering the bay near BRA-6. Brackenrig Bay is not currently listed as sensitive by the DMM. MLA monitoring of Brakenrig Bay began in 2003.

Volunteer Recognition: Judy Stephens-Wells, Ross Wells and Val Fleck.

2023 Water Quality Results:

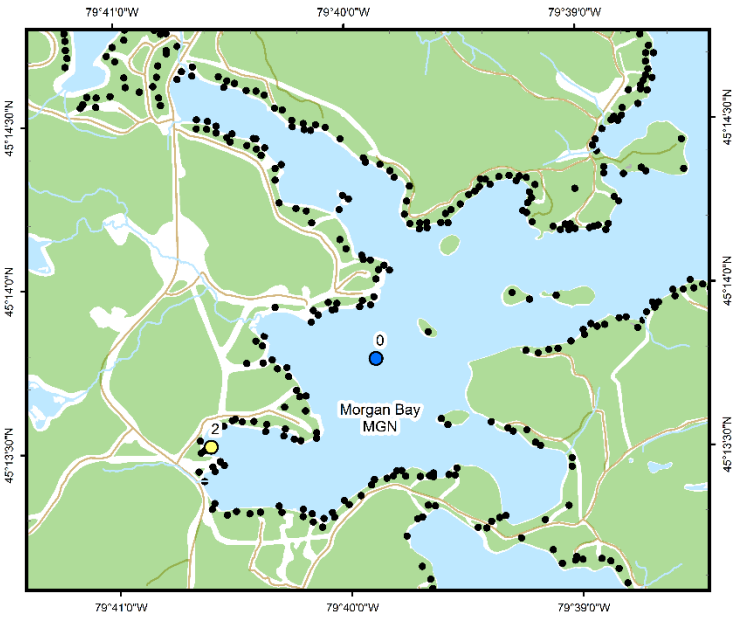
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **BRA-0** | 2.7 | 2.8 | 18.1 (5.9*) | | |
| **BRA-1** | | 2.0 | 4.9 | | |
| **BRA-3** | | 2.3 | 5.7 | | |
| **BRA-6** | | 2.0 | 5.8 | | |

Note: Grubbs test indicates Spring and Annual Total Phosphorus data in 2012 are considered to be outliers.*Phosphorus concentrations are presented both with and without an extreme value recorded in July.




In 2023, spring phosphorus concentrations at the deep-water station (BRA-0) was below the historic DMM threshold of 5.2 µg/L and below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Annual phosphorus concentrations were elevated in 2023 due to a signle extreme value (54.7 µg/L) recorded in July. Nearshore monitoring of phosphorus in July at BRA-1 – 3 was not elevated suggesting that concentrations at BRA-0 may be the result of sample contamination. Nearshore monitoring of annual and spring phosphorus concentrations at BRA-1, 3 and 6 were within the range of variability of previous monitoring. *E. coli* samples at all stations were not collected in 2023. Average annual Secchi disk depth (2.7 m) was consistent with previous monitoring (1.45 – 3.10 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Morgan Bay (MGN)




**Area Description:**

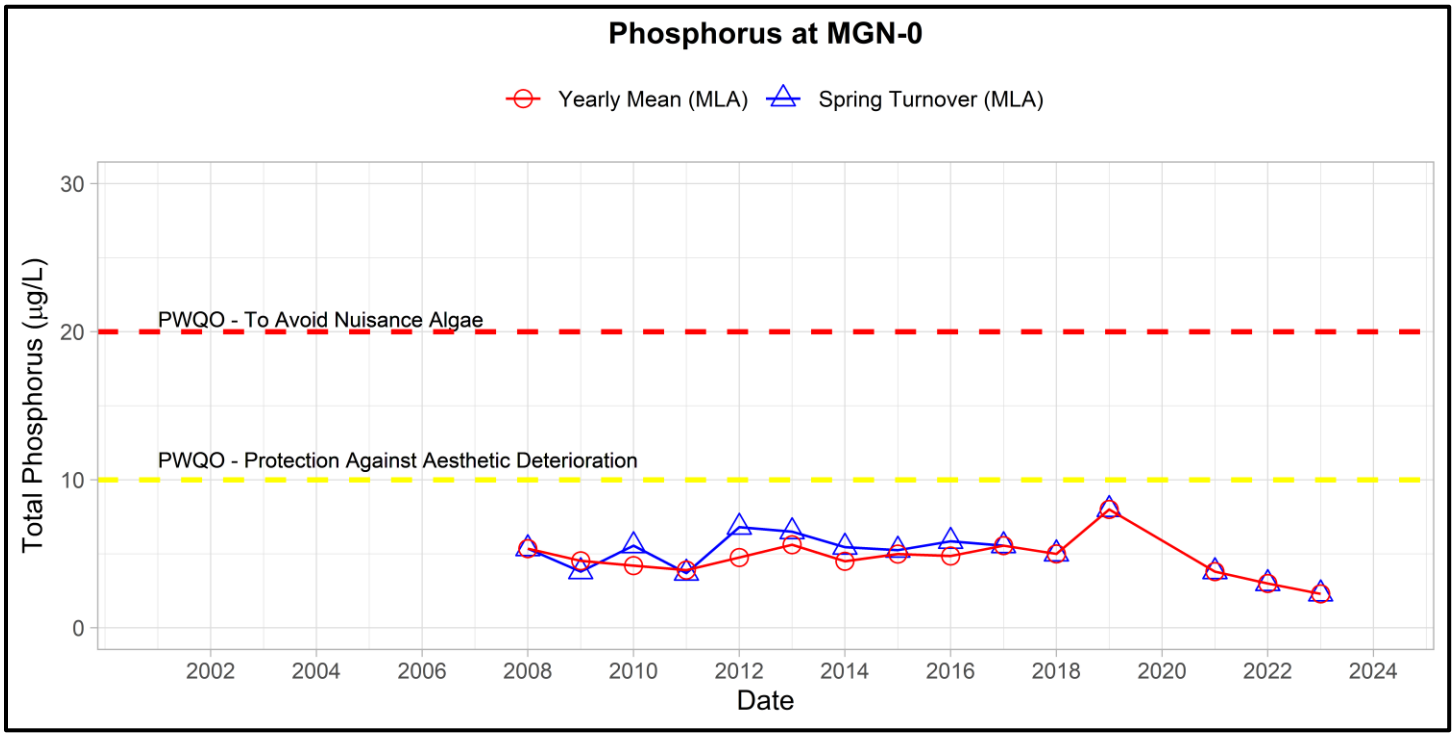
Morgan Bay sampling area is in the northwestern part of Lake Rosseau and includes a series of small bays (i.e., Beechwood Bay, Sucker Bay, Bass Bay). Residential properties have been developed along the majority of the shoreline but many retain natural riparian vegetation. Several creeks flow into Morgan Bay close to the nearshore sampling sites and there is a wetland adjacent to the lake at MGN-3 (last sampled in 2014). Several roads provide access to nearly the entire shoreline area and frequently encroach on the shoreline of the bay. MLA monitoring of Morgan Bay began in 2008.

Volunteer Recognition: Carol Anne Ballantyne.

2023 Water Quality Results:

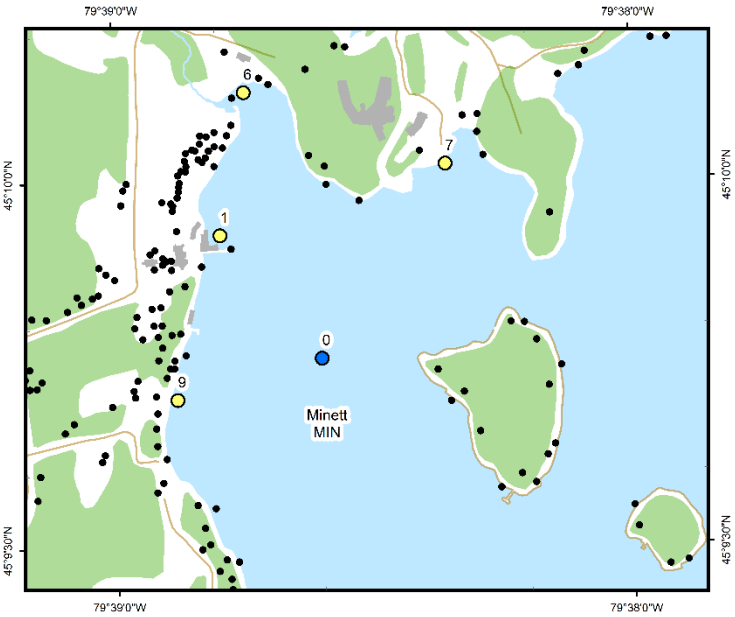
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **MGN-0** | 3.6 | 2.3 | | | |
| **MGN-2** | | 2.1 | 3.4 | | |

Note: Grubbs test indicates data collected in 2012 are considered an outlier



Spring phosphorus concentration at the deep-water station (MGN-0) was below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual average and spring phosphorus concentration at MGN-2 were within the range of variability of previous monitoring years. Average annual Secchi disk depth (3.6 m) was consistent with previous monitoring (1.9 – 5.25 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Minett (MIN)



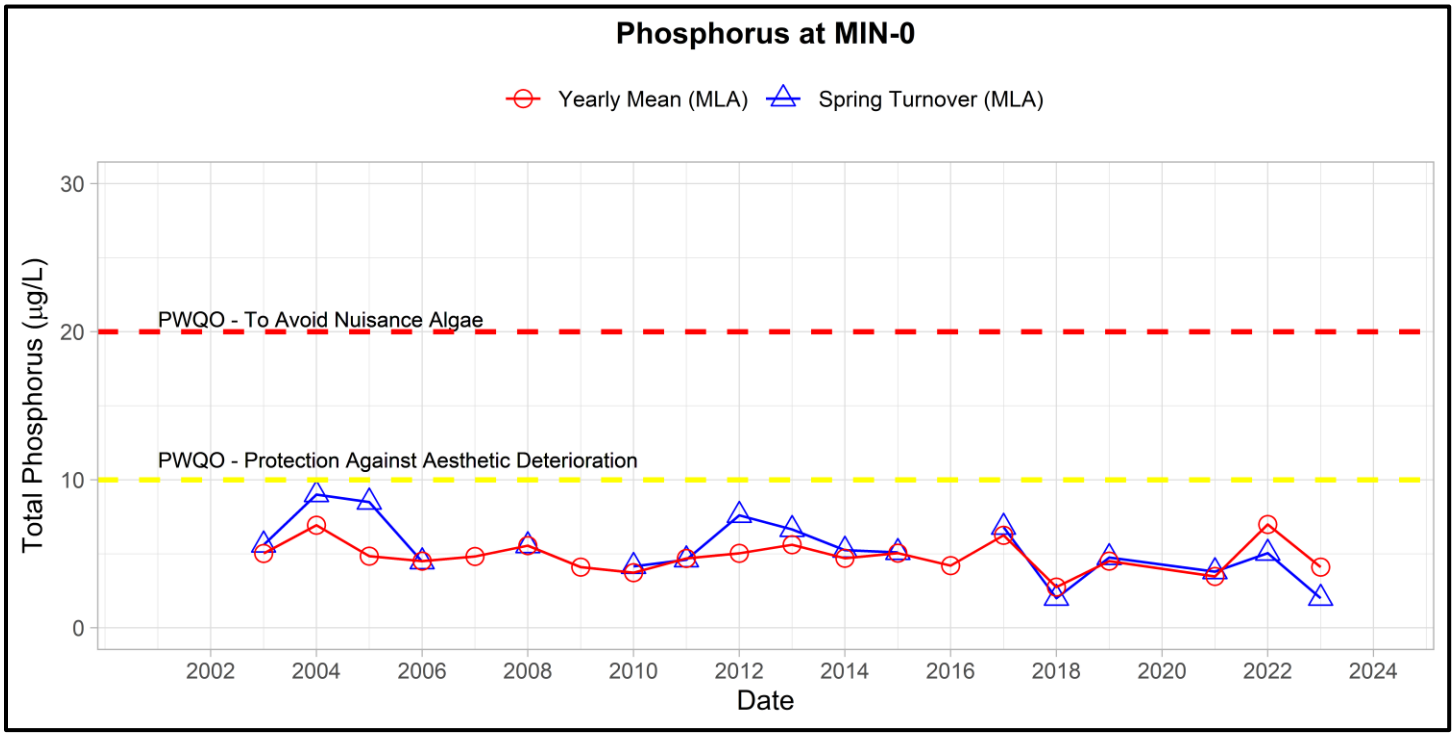

**Area Description:**

The village of Minett is in western Lake Rosseau and includes high intensity development. The sampling area contains two large resorts with golf courses, several roads, a marina, and many private residential properties thus a substantial number of nearshore monitoring locations are included in the MLA sampling program. MLA monitoring in at Minett began with the original program in 2003.

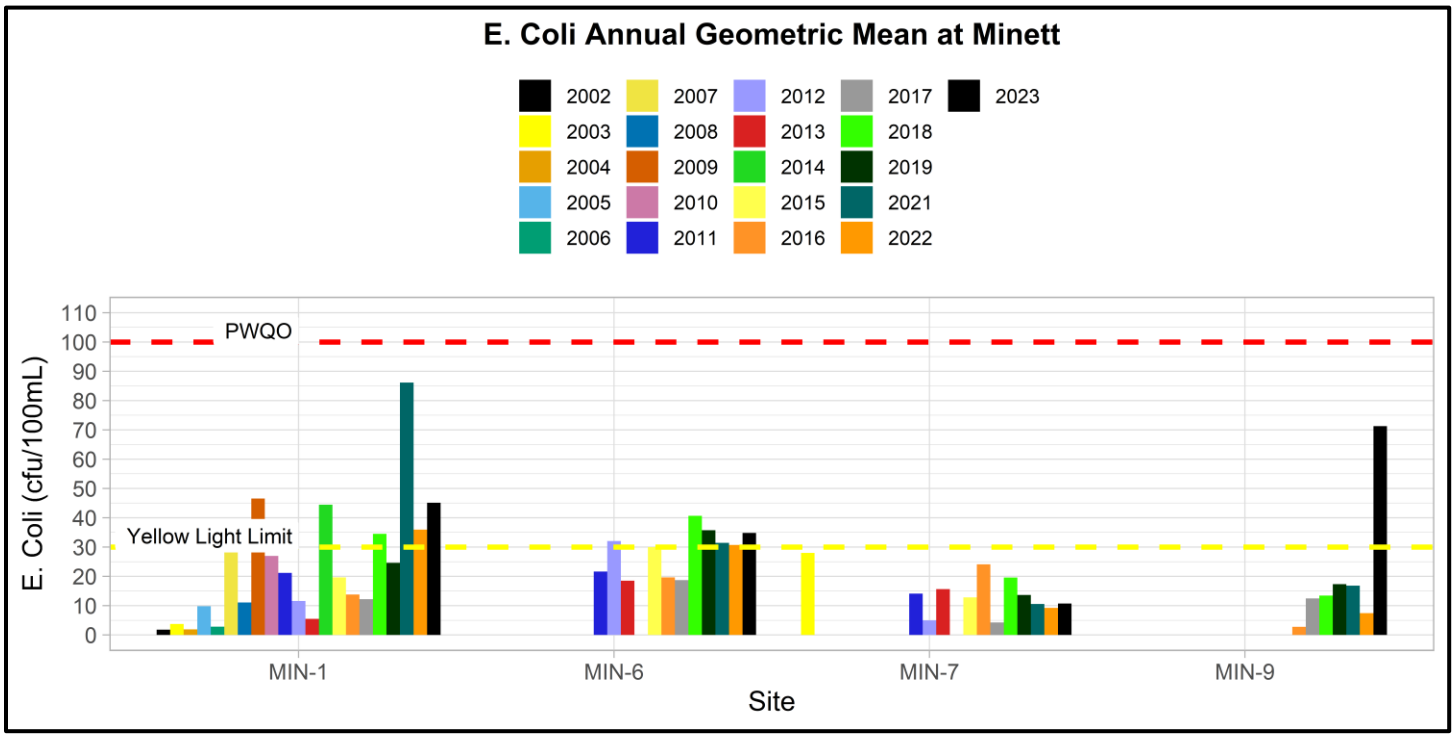
Volunteer Recognition: Laurie Thomson and Greg Thomson.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **MIN-0** | 3.8 | 2.0 | 4.1 | | |
| **MIN-1** | | | 4.7 | 45 | 315 |
| **MIN-6** | | | 10.8 | 34 | 521 |
| **MIN-7** | | | 7.2 | 11 | 92 |
| **MIN-9** | | | 4.1 | 71 | 618 |

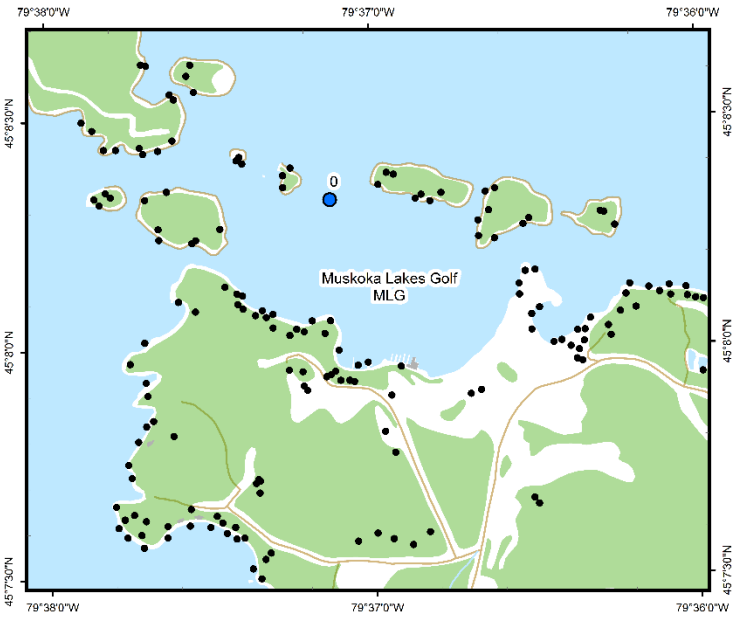



Note: Grubbs test indicates data collected in 2012 are considered an outlier



Annual average and spring phosphorus concentrations at the deep-water station (MIN-0) were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual average and spring phosphorus concentrations at MIN-1, 7 and 9 were within the range of variability of previous monitoring years. Monitoring at MIN-6 again indicated elevated total phosphorus relative to other nearshore stations. *E. coli* counts at stations MIN-1, MIN-6 and MIN-9 were above the MLA stoplight limits, resulting in a yellow stop light for Minett. Average annual Secchi disk depth (3.8 m) was consistent with previous monitoring (1.31 – 5.75 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Muskoka Lakes Golf (MLG)




**Area Description:**

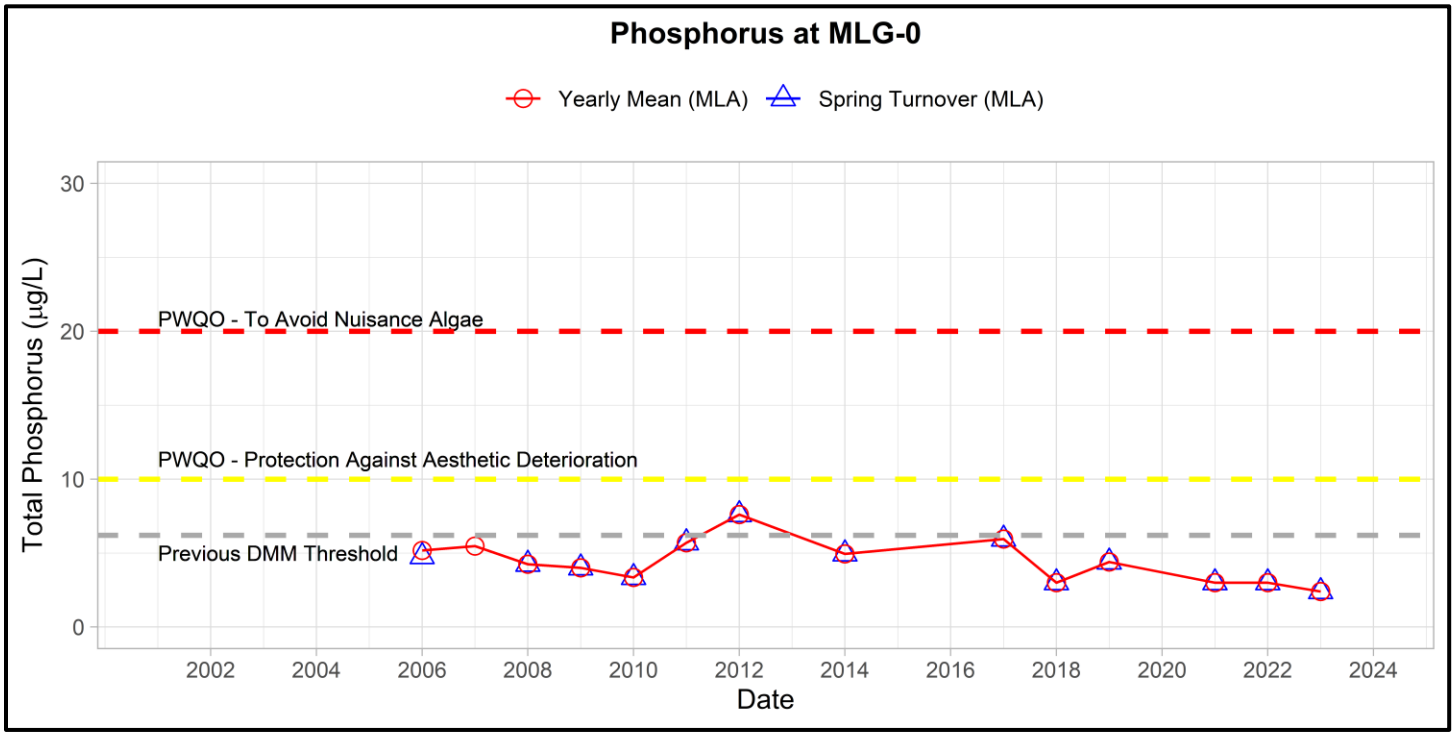
The Muskoka Lakes Golf & Country Club near the Town of Port Carling, along the southern shore of Lake Rosseau's main basin. The bay receives run-off from a golf course area which includes an associated clubhouse and marina. The bay also contains a large wetland that drains into the lake. The northwest winds result in substantial wave action along the southern shoreline of the bay.

Volunteer Recognition: Dianne & Ian Turnbull.

2023 Water Quality Results:

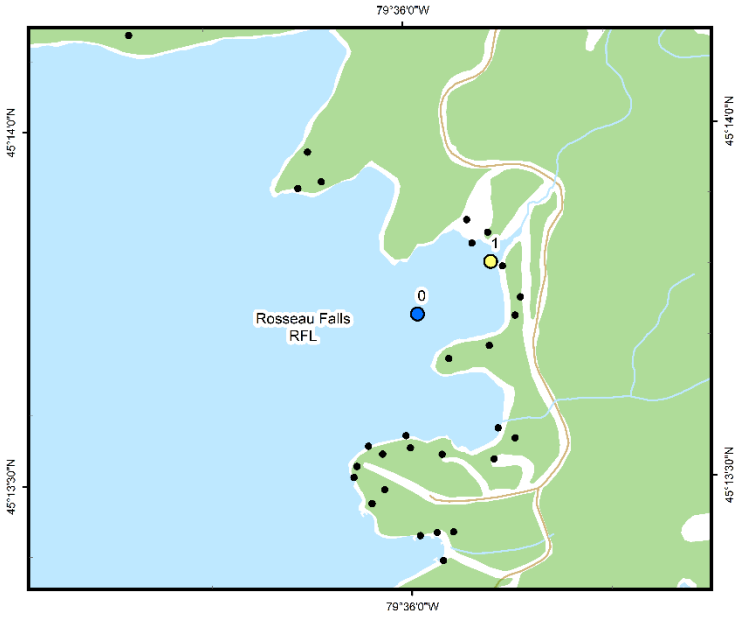
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **MLG-0** | 3.6 | 2.4 | | | |

Note: Grubbs test indicates no Spring and Annual Total Phosphorus data were outliers.



In 2023, the spring phosphorus concentrations at the deep-water station (MLG-0) was below the historic DMM threshold of 6.2 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Average annual Secchi disk depth (3.6 m) was consistent with previous monitoring (3.0 – 5.5 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Rosseau Falls (RFL)




**Area Description:**

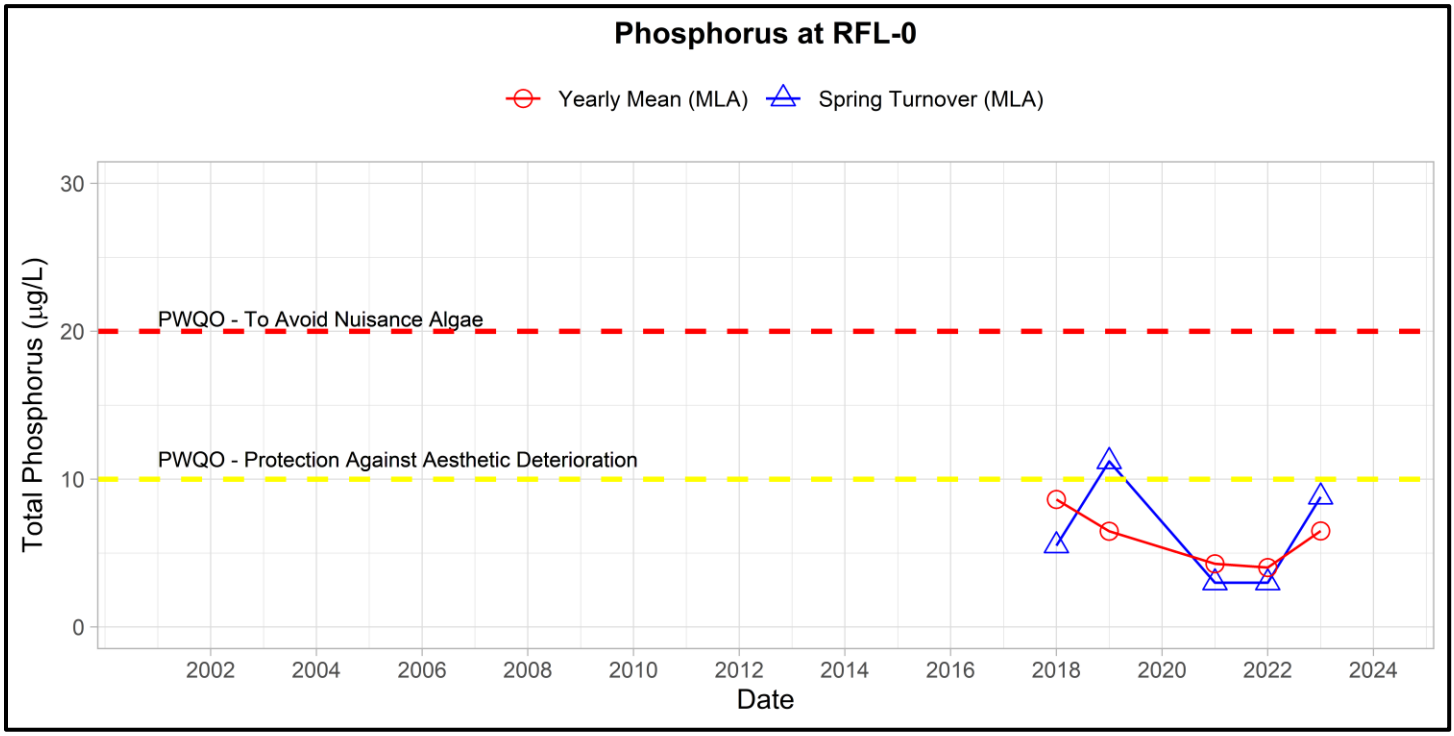
Rosseau Falls is located at the inflow of the Rosseau River to Lake Rosseau. Nearshore sampling at RFL-1 captures inflow from the Rosseau River. The Rosseau River Subwatershed has an area of 130 $km^2$, 98% of which is identified as natural. Cardwell Lake is the only major water body in the subwatershed with a surface area of 2.1 $km^2$ and a maximum depth of 21 m. MLA monitoring of the Rosseau Falls began in 2018.

Volunteer Recognition: John & Sue Wessenger.

2023 Water Quality Results:

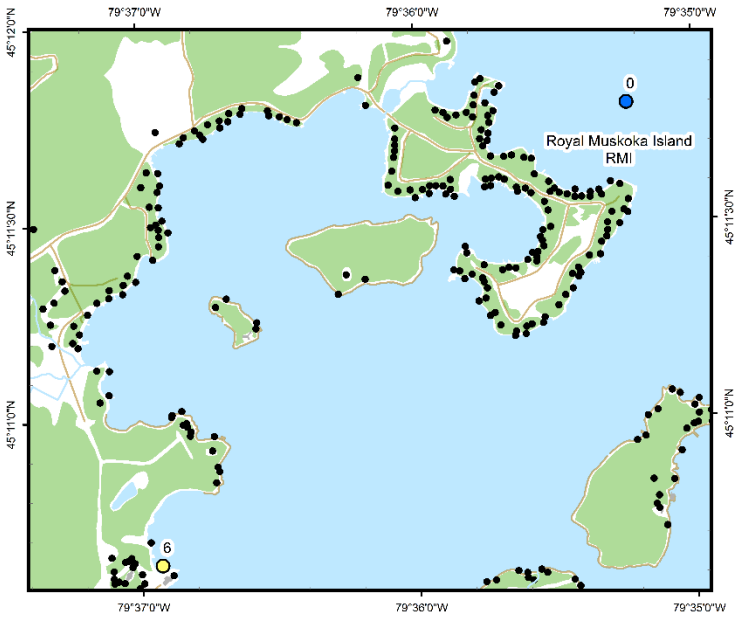
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **RFL-0** | 3.1 | 8.8 | 6.5 | | |
| **RFL-1** | | 11.5 | 6.8 | | |

Note: Grubbs test indicates data no collected in are considered outliers.



In 2023, annual average and spring phosphorus concentrations at the deep-water station (RFL-0) were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Spring total phosphorus concentrations were elevated in 2023 relative to 2022 and 2021 data, but within the range of values recorded since 2018. Nearshore monitoring of annual and spring phosphorus concentrations at RFL-1 were within the range of variability of previous monitoring. Average annual Secchi disk depth (3.1 m) was consistent with the limited previous monitoring (2.9 – 3.5 m). Three out of the four samples collected in 2023 were sampled during rain events. We recommend that sampling be reduced during rain events as over sampling during rainfall if done inconsistently may bias results and eliminate the possibility of meaningful long-term trend analysis results. **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Royal Muskoka Island (RMI)




**Area Description:**

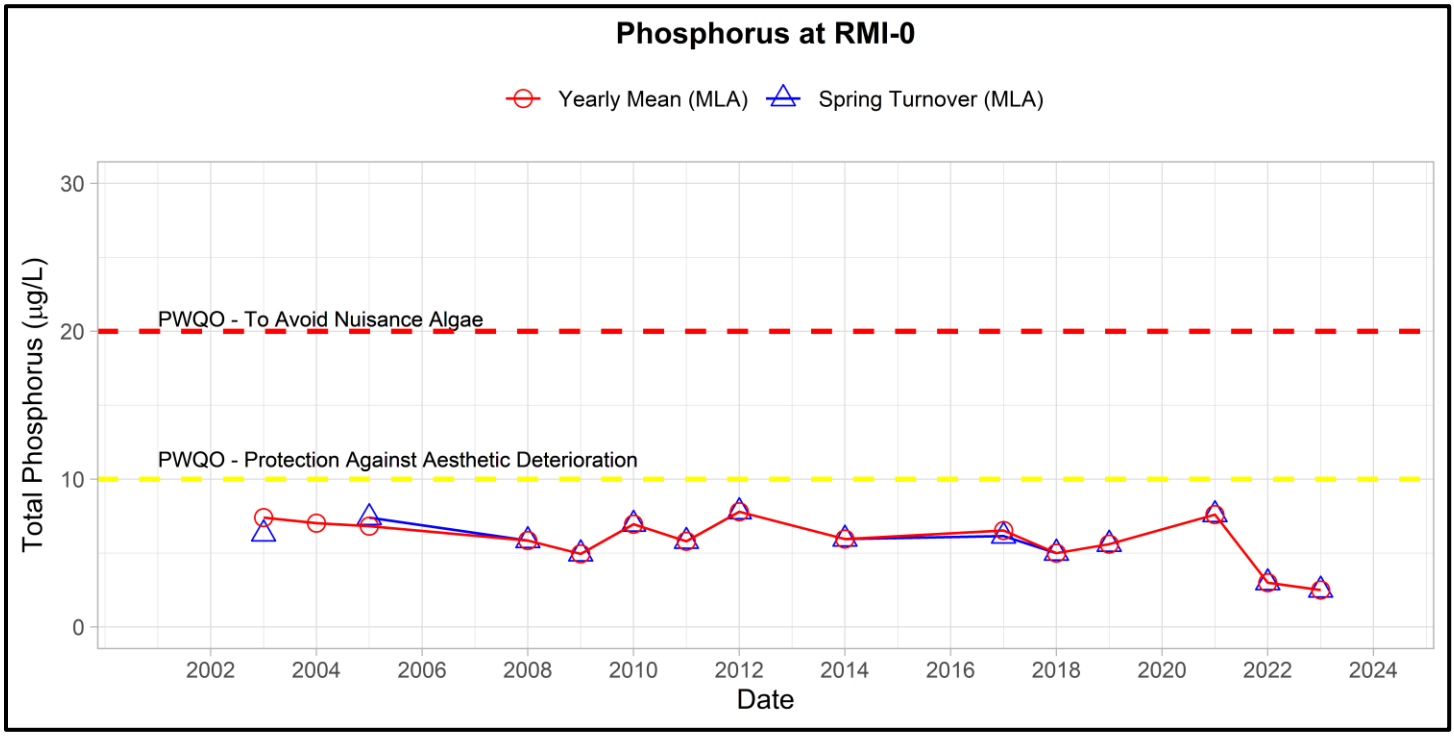
Royal Muskoka Island is a heavily developed residential island in the central portion of Lake Rosseau. A substantial portion of the island's interior has been deforested. Nearshore monitoring extends southwest to include a sampling station adjacent to a summer camp. Northwest winds result in significant wave action near the island. MLA monitoring of Royal Muskoka Island began in 2003.

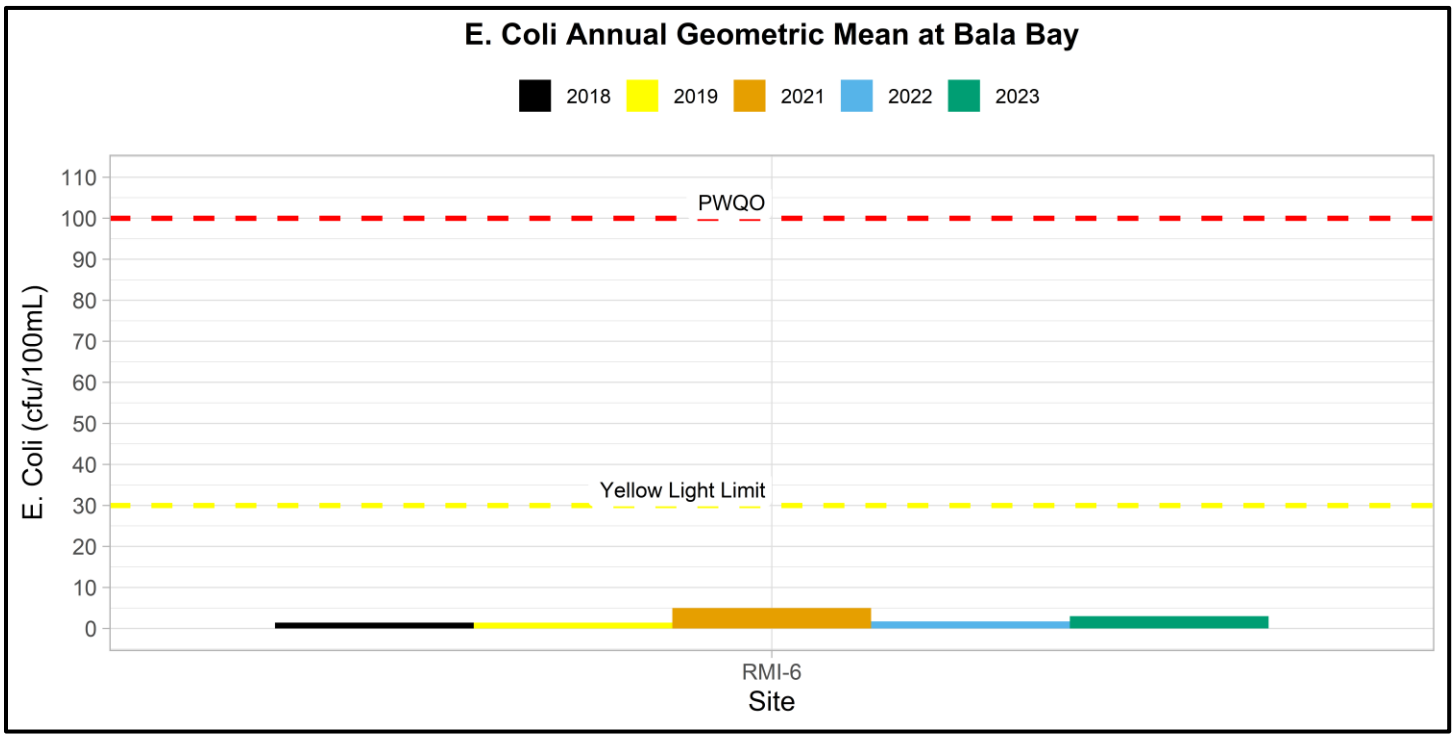
Volunteer Recognition: Mark Tiffin.

2022 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **RMI-0** | 4.4 | 2.5 | | | |
| **RMI-6** | | 2.5 | | 3 | 13 |

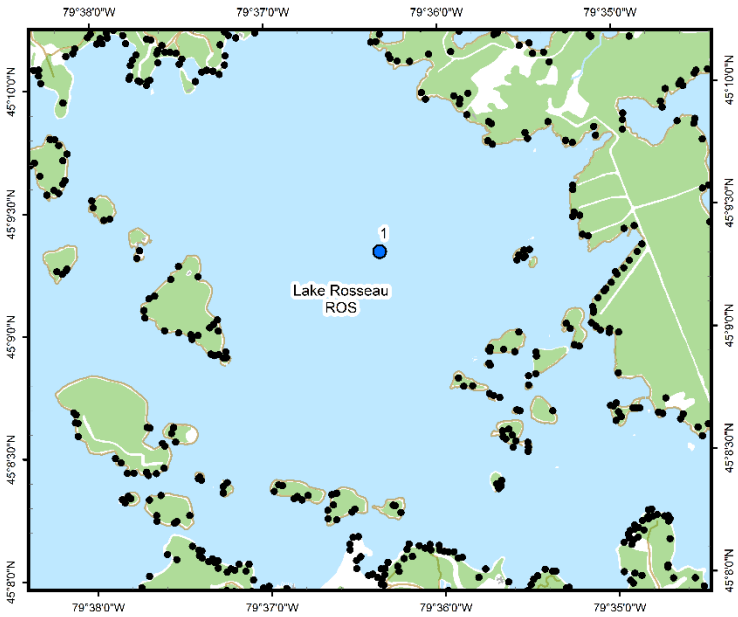
Note: Grubbs test indicates no outliers in spring and annual total phosphorus data.






In 2023, the spring phosphorus concentration at the deep-water station (RMI-0) was below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring phosphorus concentration at RMI-6 was within the range of the long-term data collected by the MLA. *E. coli* counts in 2022 were well below the MLA trigger value. Average annual Secchi disk depth (4.4 m) was consistent with previous monitoring (2.2 – 4.7 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Lake Rosseau (ROS)




**Area Description:**

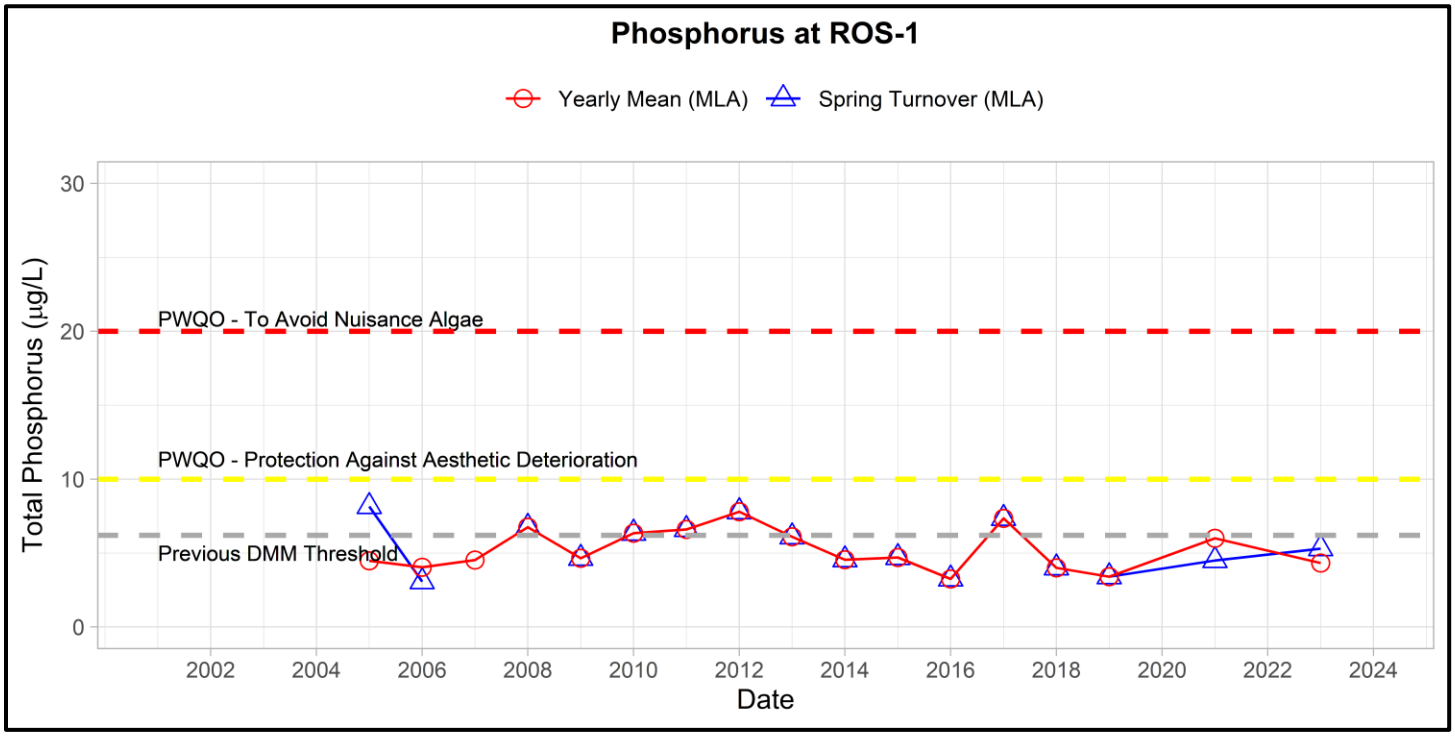
The main basin of Lake Rosseau is 42.22 km² in area with a maximum depth of 60 m. The lake is classified as a coldwater lake and supports a naturally reproducing population of Lake Trout. Wetlands account for ~4% of the watershed. The watershed, excluding the lake itself is 37.13 km². Lake Rosseau is not currently classified as vulnerable by the DMM. MLA monitoring of the main basin of Lake Rosseau began in 2005.

Volunteer Recognition: Christine Gillmore, Bob McCabe.

2023 Water Quality Results:

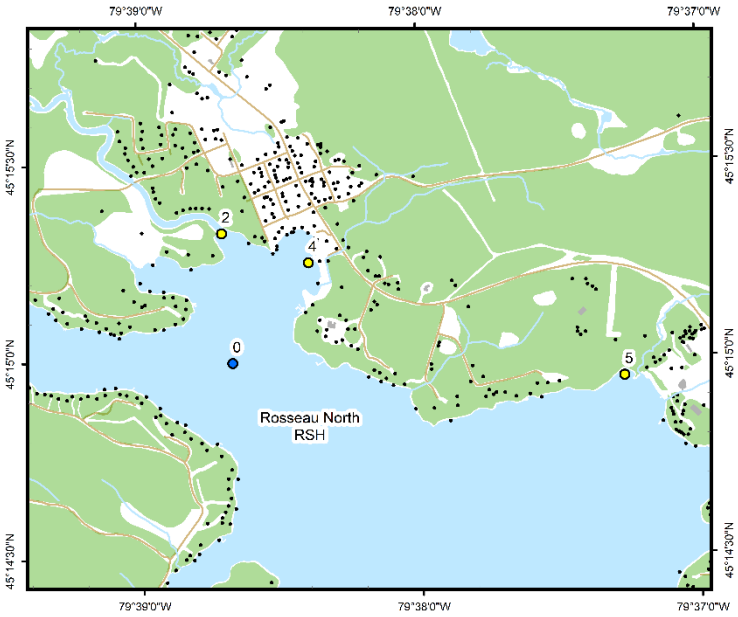
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **ROS-1** | 3.7 | 5.3 | 4.3 | | |

Note: Grubbs test indicates no outliers in the spring and annual total phosphorus data.



In 2023, the spring phosphorus concentrations at the deep-water station (ROS-1) were below the historic DMM threshold of 6.2 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Average annual Secchi disk depth (3.7 m) was consistent with previous monitoring (3.1 – 5.65 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Rosseau North (RSH)




**Area Description:**

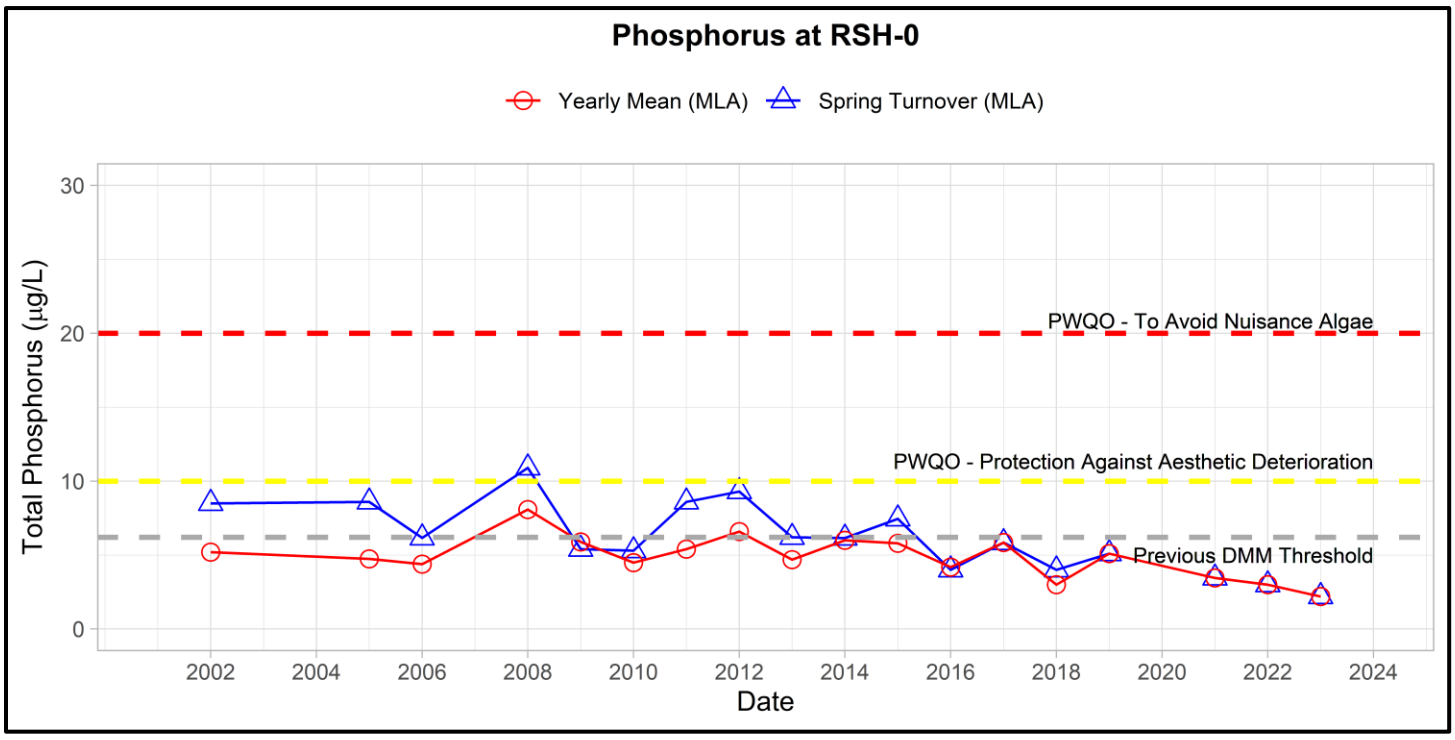
The Rosseau North sampling area includes several small bays (i.e., Rosseau Bay, Beley Bay, and Camerson Bay). The Village of Rosseau at the northern end of Lake Rosseau drains into the lake which also receives drainage from the Shadow River. The watershed is highly developed along the shoreline and upland areas including a marina, residential and agricultural properties. MLA monitoring of Rosseau North began in 2002.

Volunteer Recognition: John & Sue Wessenger.

2023 Water Quality Results:

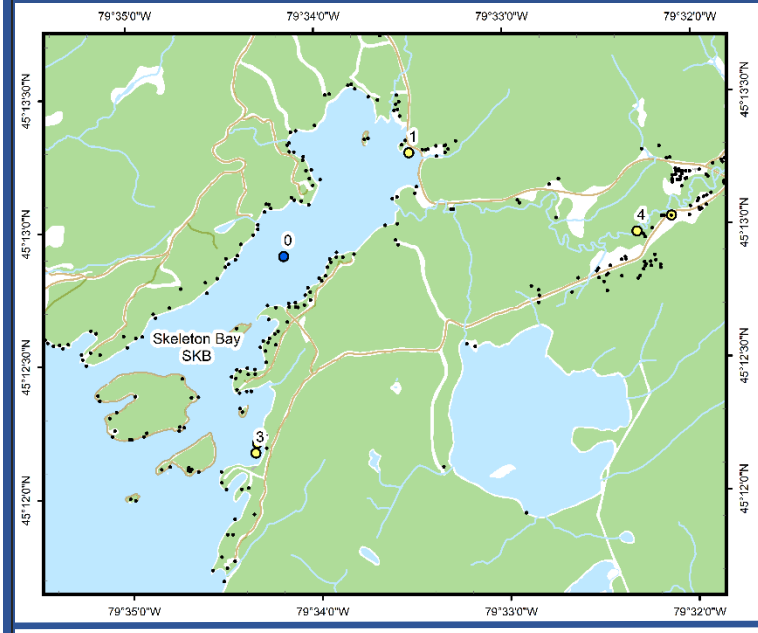
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **RSH-0** | 3.4 | 2.6 | | | |
| **RSH-2** | | 10.2 | 7.5 | | |
| **RSH-4** | | 7.0 | | | |
| **RSH-5** | | 7.0 | | | |

Note: Grubbs test indicates no outliers in spring or annual average total phosphorus data.



In 2023, the spring phosphorus concentrations at the deep-water station (RSH-0) were below the historic DMM threshold of 6.2 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual and spring phosphorus concentrations at RSH-2, 4, and 5 were the within the range of long-term data. *E. coli* samples were not collected in 2023. Average annual Secchi disk depth (3.4 m) was consistent with previous monitoring (1.9 – 5.1 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Skeleton Bay (SKB)




**Area Description:**

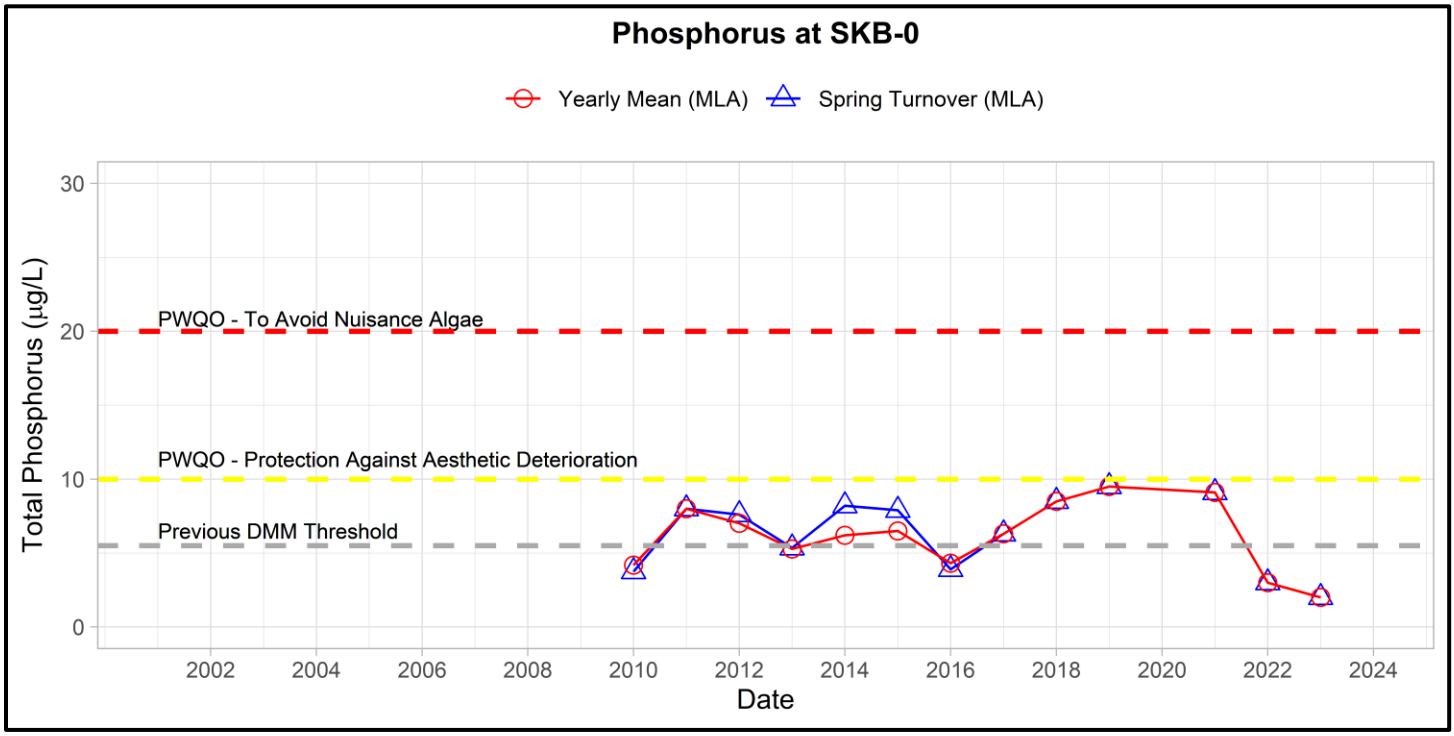
Skeleton Bay is in the eastern portion of Lake Rosseau's north basin. The bay has an area of 1.7 km² and a maximum depth of 20 m. The northeast section of the bay is bordered by Highway 141. This bay receives inflow from six watercourses including the Bent River which drains agricultural lands. Skeleton Bay is not currently listed as vulnerable by the DMM. MLA monitoring of Skeleton Bay began in 2010.

Volunteer Recognition: Jill Levine.

2023 Water Quality Results:

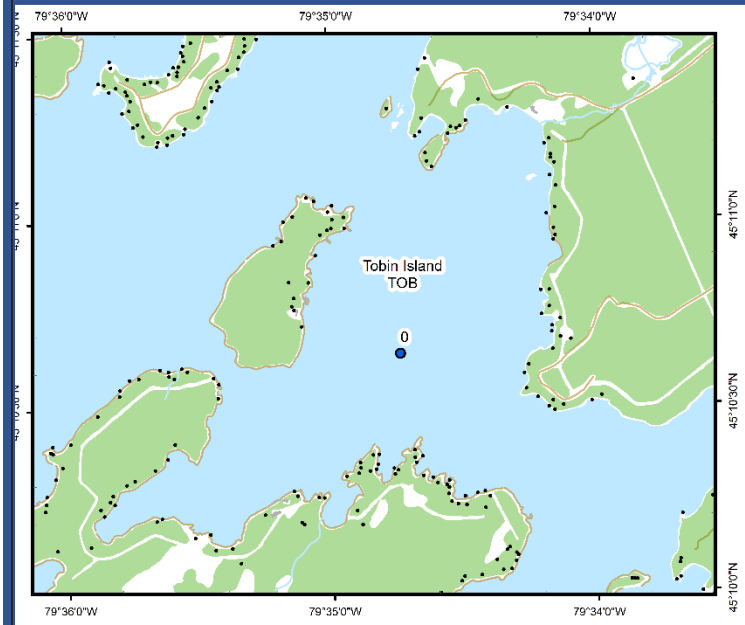
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **SKB-0** | 2.5 | 2.0 | | | |
| **SKB-1** | | 10.2 | 8.3 | | |

Note: Grubbs test indicates data collected in 2012 are considered an outlier



In 2023, the spring phosphorus concentration at the deep-water station (SKB-0) was the lowest recorded in the MLA dataset and was below the historic DMM threshold of 5.5 µg/L as well as Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual and spring phosphorus concentrations at SKB-1 was higher than 2022 results but within the range of variability of previous monitoring. *E. coli* samples were not collected in 2023. Average annual Secchi disk depth (2.5 m) was consistent with previous monitoring (2.13 – 6.13 m). **HESL recommends ongoing sampling to continue to monitor for changes in long-term trends and emerging issues.**

# Tobin Island (TOB)




**Area Description:**

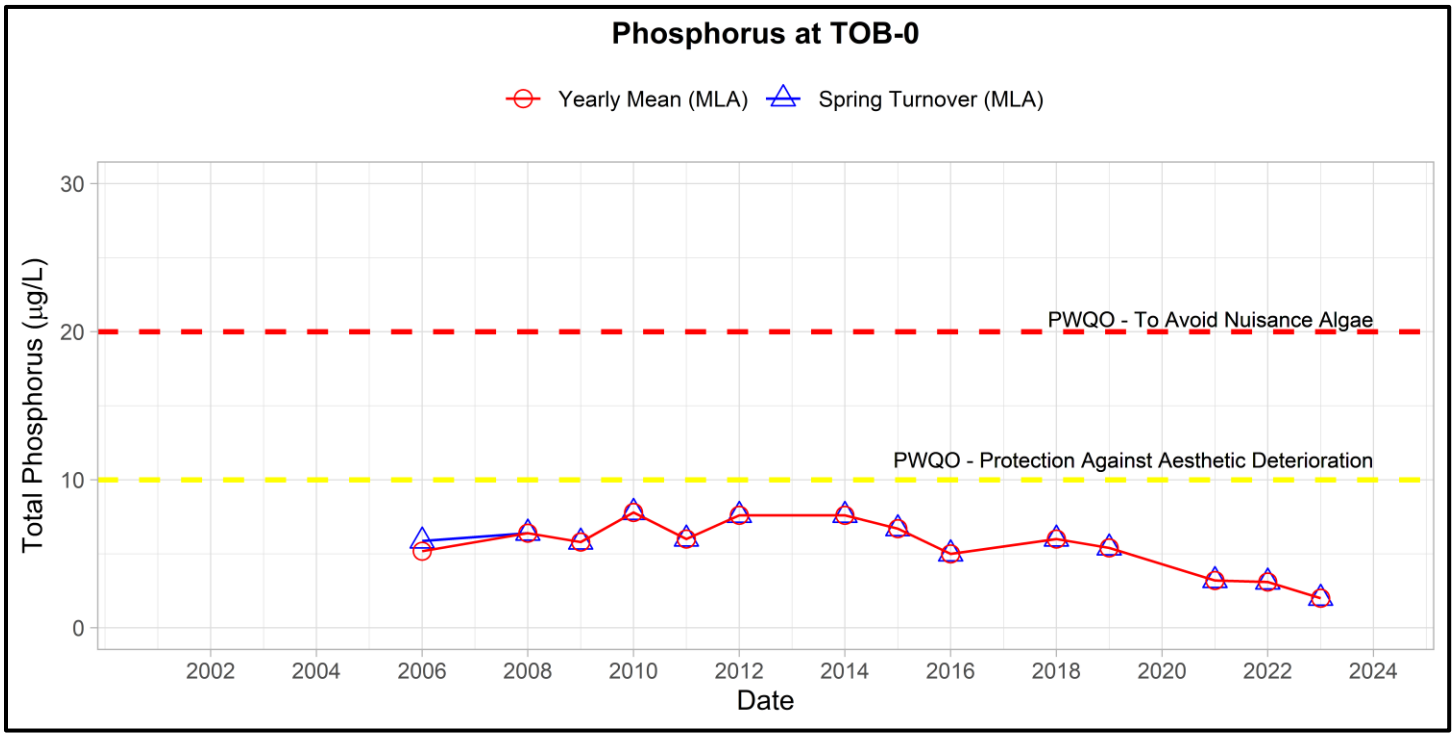
Tobin Island is a moderately developed, open bay in the central part of Lake Rosseau. Development includes cottage/residential properties along the shoreline, however the majority of the inland forest area remains in a natural state. Two creeks from wetland areas flow into the lake within the sampling area. MLA monitoring of Tobin Island began in 2006.

Volunteer Recognition: Mark Tiffin.

2023 Water Quality Results:

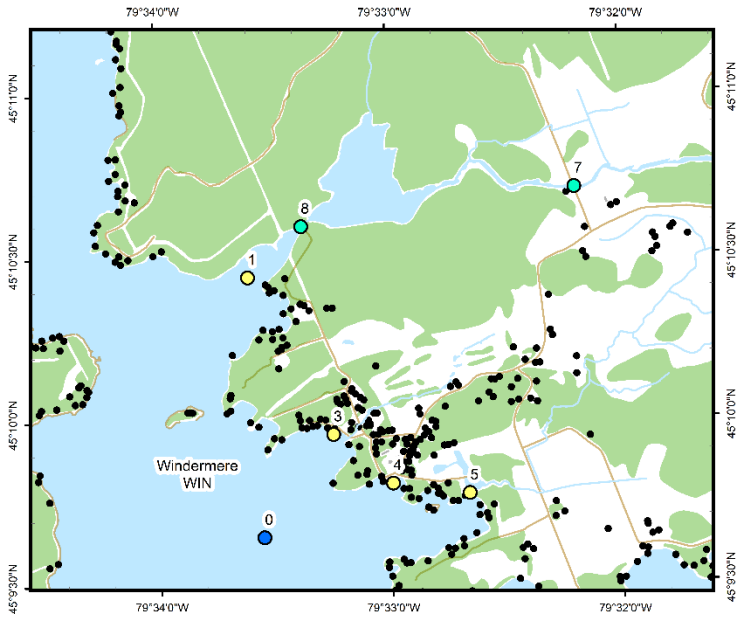
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **TOB-0** | 4.2 | 2.8 | | | |

Note: Grubbs test indicates no data collected in are considered outliers.



In 2023, the spring phosphorus concentration at the deep-water station (TOB-0) was below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Average annual Secchi disk depth (4.2 m) was within the range of variability in the long-term monitoring by the MLA WQI Program (range = 3.0 – 4.3 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Windermere (WIN)



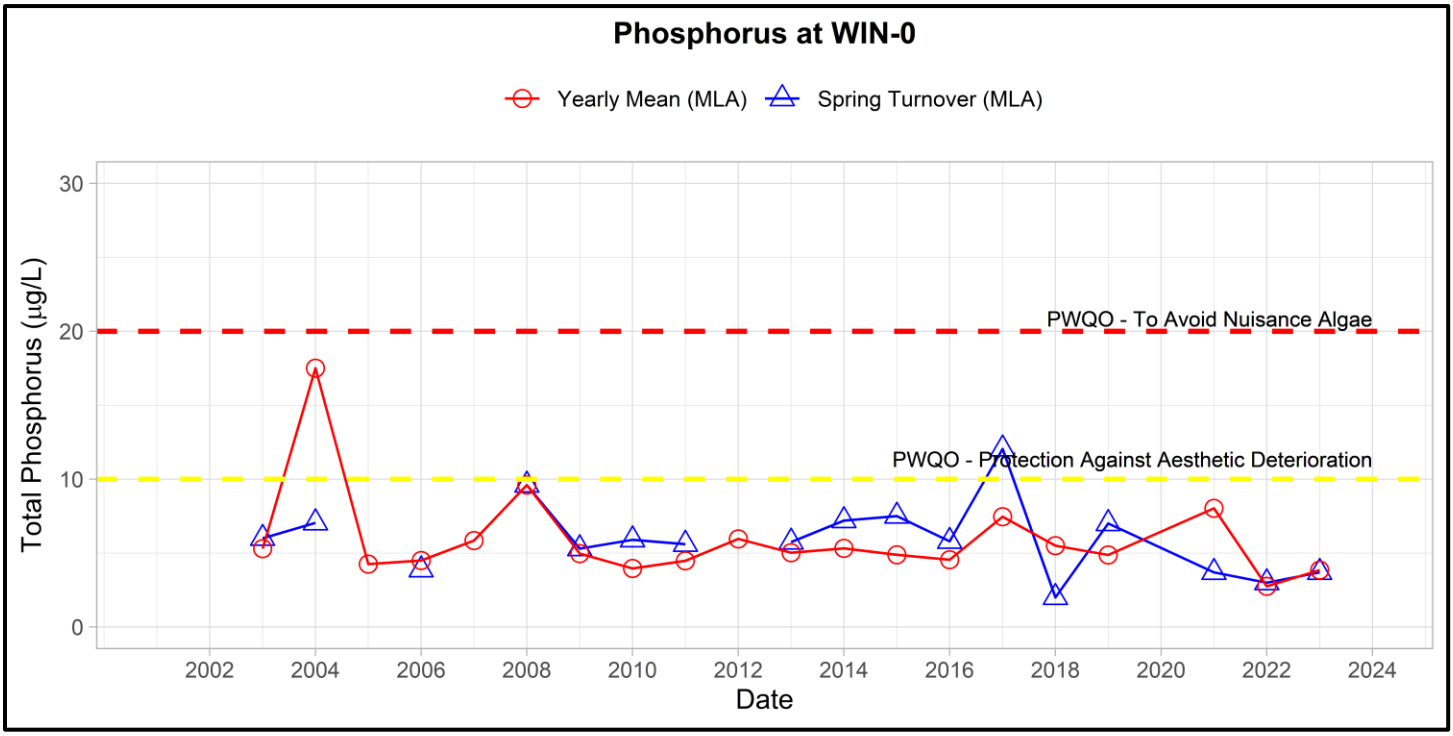

**Area Description:**

The Village of Windermere is in northern Lake Rosseau. The area is heavily developed including a large resort complex, golf course, marina, and numerous residential properties. In addition, there is a substantial agricultural land use within the watershed. Several creeks outlet into this area, including one which flows through agricultural land before discharging to the lake at the marina. MLA monitoring at Windermere began in 2003.

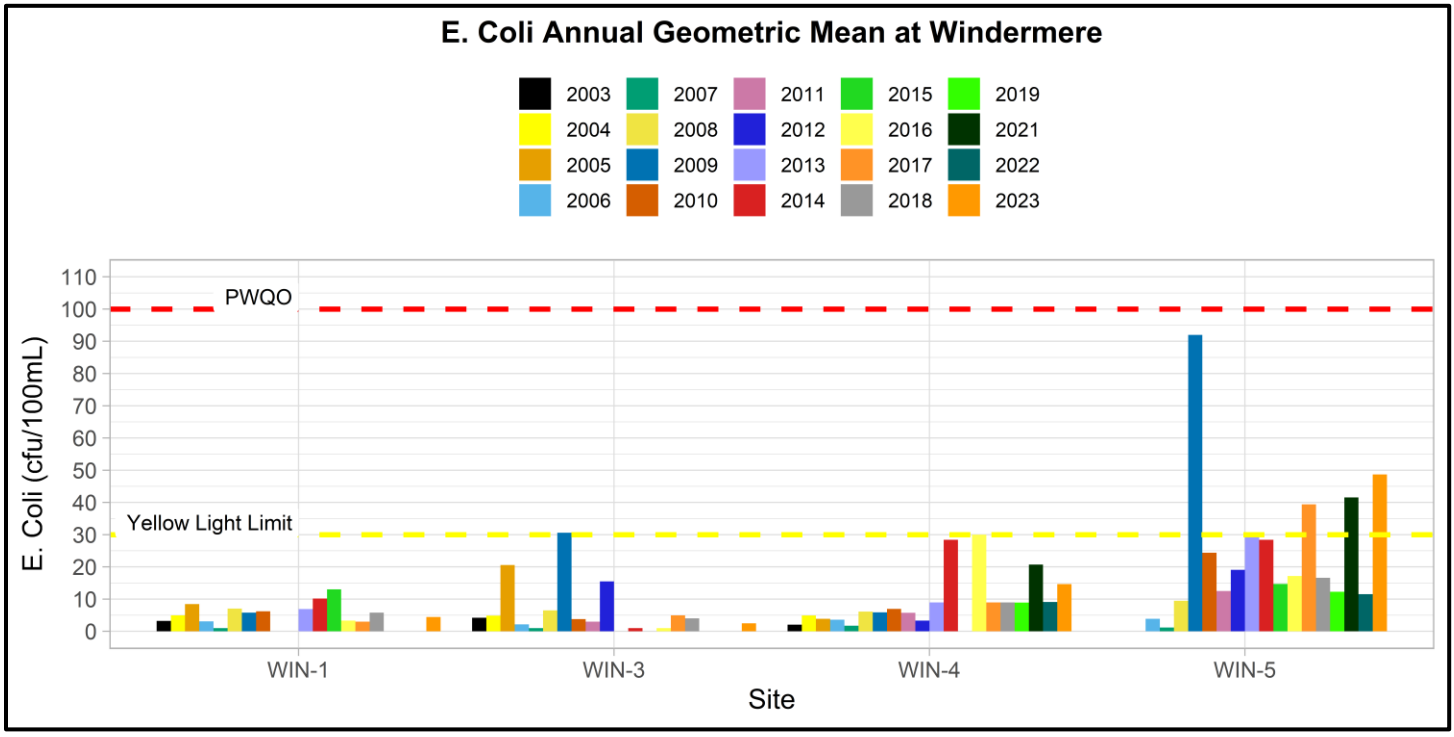
Volunteer Recognition: Bob McCabe and Karen Terry.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **WIN-0** | 3.5 | 3.7 | 3.9 | | |
| **WIN-1** | | 12.5 | 13.0 | 5 | 18 |
| **WIN-3** | | 2.0 | 3.9 | 3 | 10 |
| **WIN-4** | | 2.0 | 3.8 | 15 | 64 |
| **WIN-5** | | 8.4 | 15.7 | 49 | 81 |
| **WIN-7** | | 17.6 | 24.2 | 8 | 63 |
| **WIN-8** | | 17.5 | 18.3 | 6 | 48 |

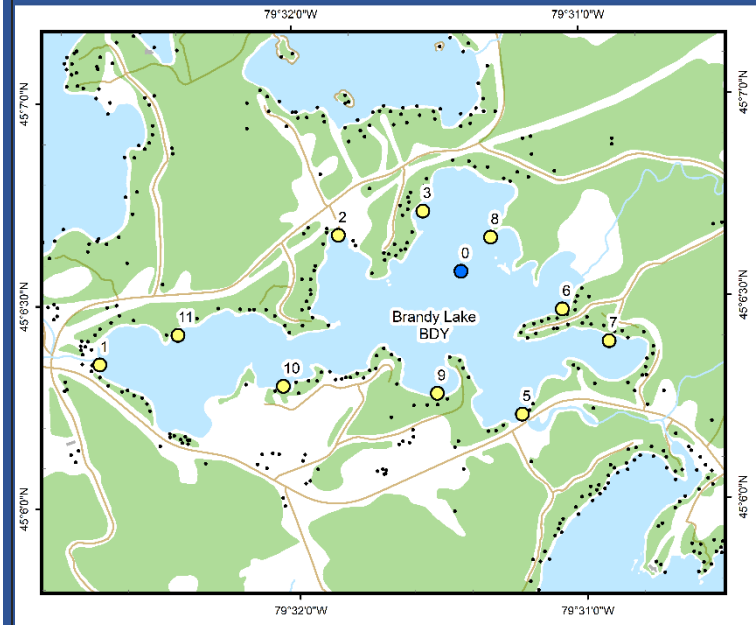



Note: Grubbs test indicates data collected in 2012 are considered an outlier.



In 2023, annual average and spring phosphorus concentrations at the deep-water station (WIN-0) were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual and spring phosphorus concentrations at WIN-1, 3, 4 and 5 were within the range of variability of previous monitoring. At the upstream River station (WIN-7) spring concentrations were the lowest recorded to date since monitoring began in 2014, while downstream at WIN-8 spring and annual total phosphorus concentrations were within the range of variability in the long-term record. *E. coli* counts exceeded the MLA Yellow Light trigger at WIN-5 in 2023. Average annual Secchi disk depth (3.5 m) was consistent with previous monitoring (2.5 and 5.7 m). Windermere has been assigned a yellow light as a result of elevated bacteria concentrations at WIN-5. **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Brandy Lake (BDY)



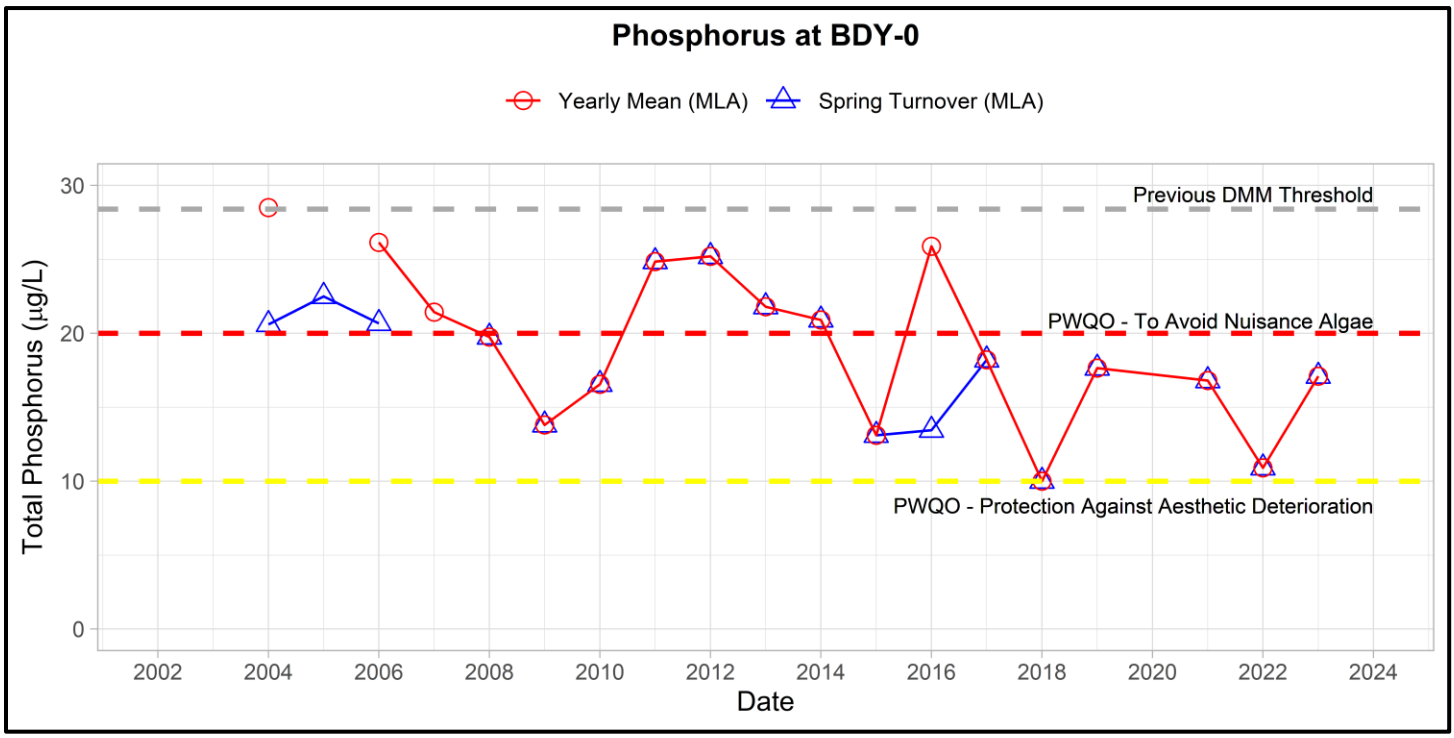

**Area Description:**

Brandy Lake is moderately developed with a surface area of 1.15 km$^2$and a maximum depth of 8 m. Many of the residential properties on Brandy Lake maintain a natural shoreline however, ~ 10% of the shoreline area is estimated to be un-buffered lawn. Wetlands comprise ~40% of the shoreline. Brandy Lake is a dystrophic lake, with naturally elevated dissolved organic carbon. MLA monitoring of Brandy Lake began in 2004.

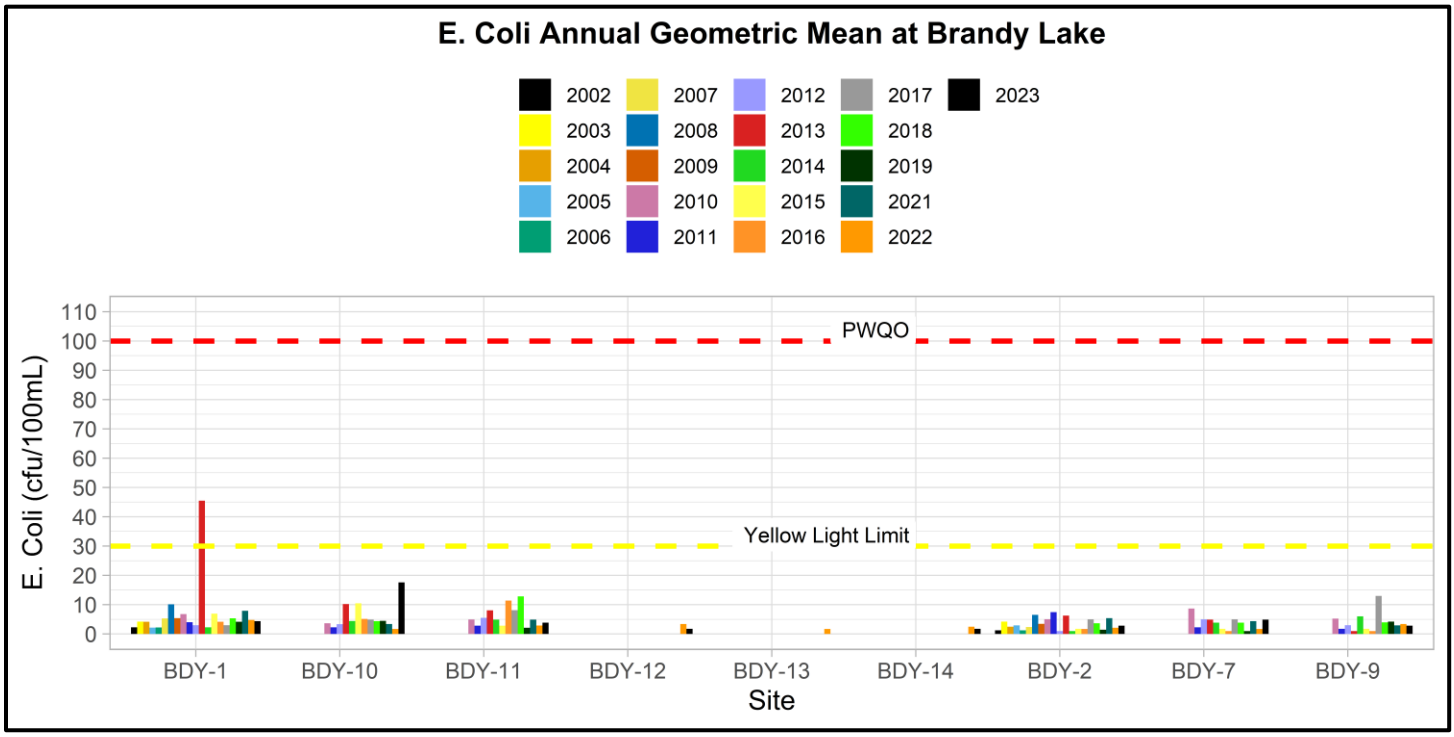
Volunteer Recognition: Kevin Trimble, Andy von Bredow, Derek Stevens.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **BDY-0** | - | 17.1 | | | |
| **BDY-1** | 1.2 | | | 4 | 39 |
| **BDY-2** | 1.1 | | | 3 | 89 |
| **BDY-7** | 1.1 | | | 5 | 112 |
| **BDY-9** | 1.1 | | | 3 | 47 |
| **BDY-10** | 1.1 | | | 18 | 56 |
| **BDY-11** | 1.1 | | | 4 | 68 |
| **BDY-12** | 1.0 | | | 2 | 96 |
| **BDY-13** | 1.0 | | | 1 | 51 |
| **BDY-14** | 0.9 | | | 2 | 48 |

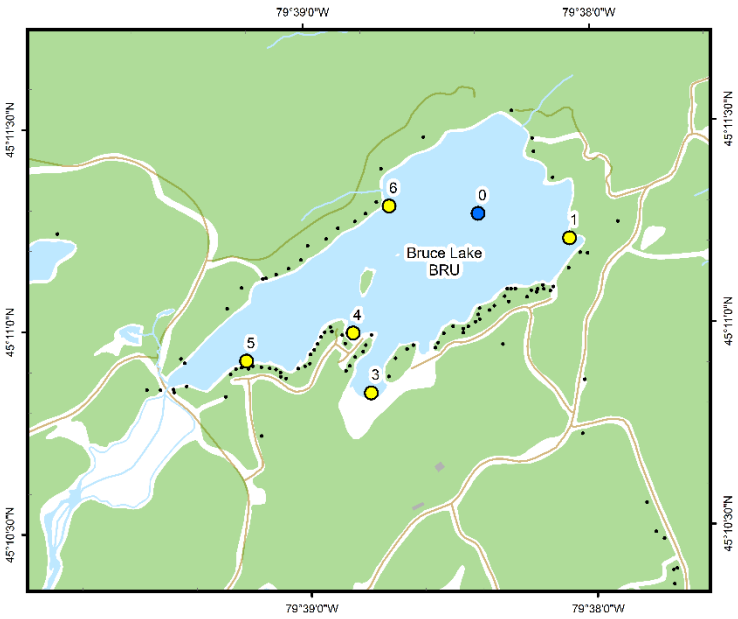



Note: Grubbs test indicates no data collected for spring or annual average total phosphorus concentration are considered an outlier




In 2023, the spring phosphorus concentrations at the deep-water station (BDY-0) increased relative to 2022 but were was below the historic DMM threshold of 28.4 µg/L and the Provincial Water quality Objective (PWQO) for Nuisance Algal Growth (20 µg/L), but above PWQO for Protection Against Aesthetic Deterioration (10 µg/L). *E. coli* counts at all nearshore stations were below the yellow light trigger established by the MLA. Average annual Secchi disk depth at BDY-0 was not measured in 2023. Brandy Lake last experienced a cyanobacteria bloom in 2020 and therefore earned a green light in 2023. **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Bruce Lake (BRU)



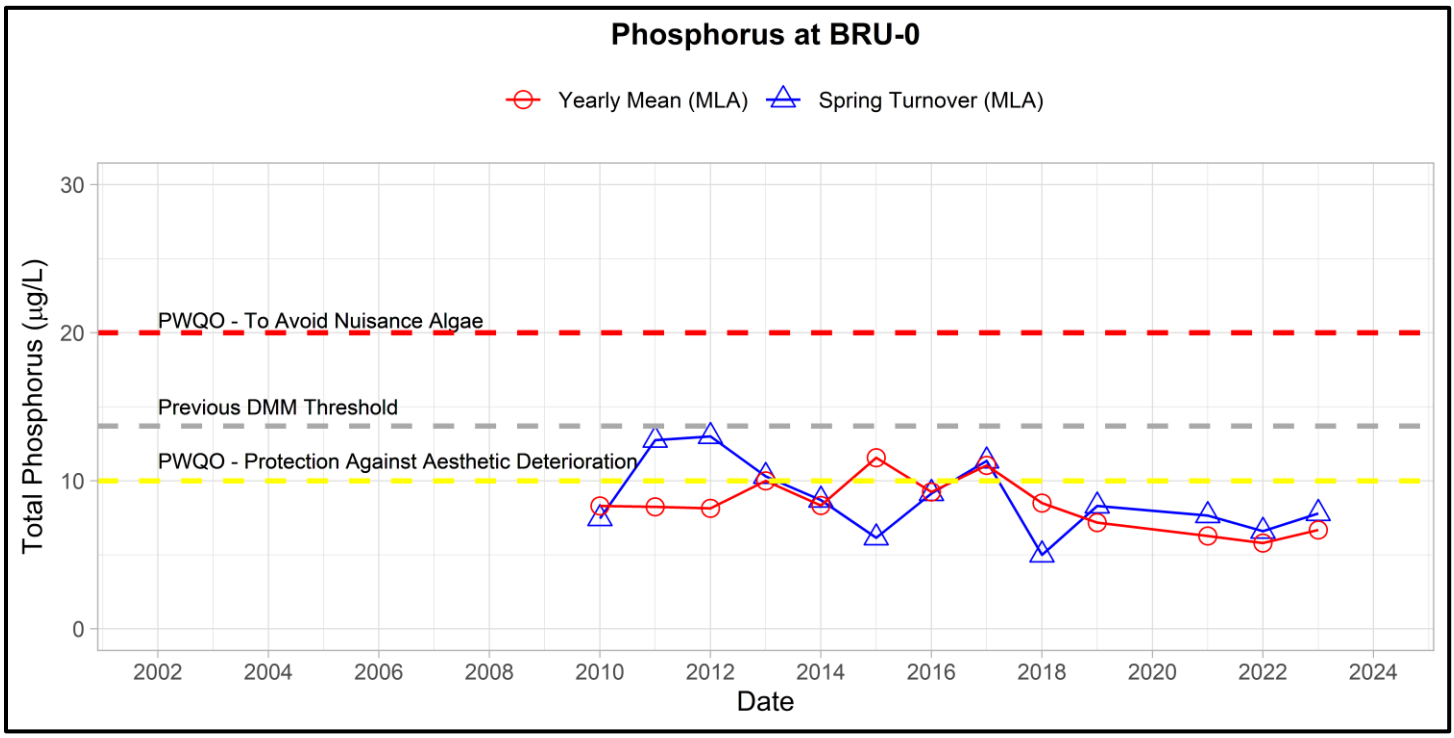

**Area Description:**

Bruce Lake is a small (surface area = 0.98 $km^2$) lake with a maximum depth of 6 m, located east of Highway 632, between Lake Joseph and Lake Rosseau. Based on DMM data ~7% of the catchment area for this lake is comprised of wetlands. Moderate development on the lake includes a golf course located immediately to the south. Bruce Lake is currently listed as vulnerable by the District of Muskoka following an algae bloom in 2020.

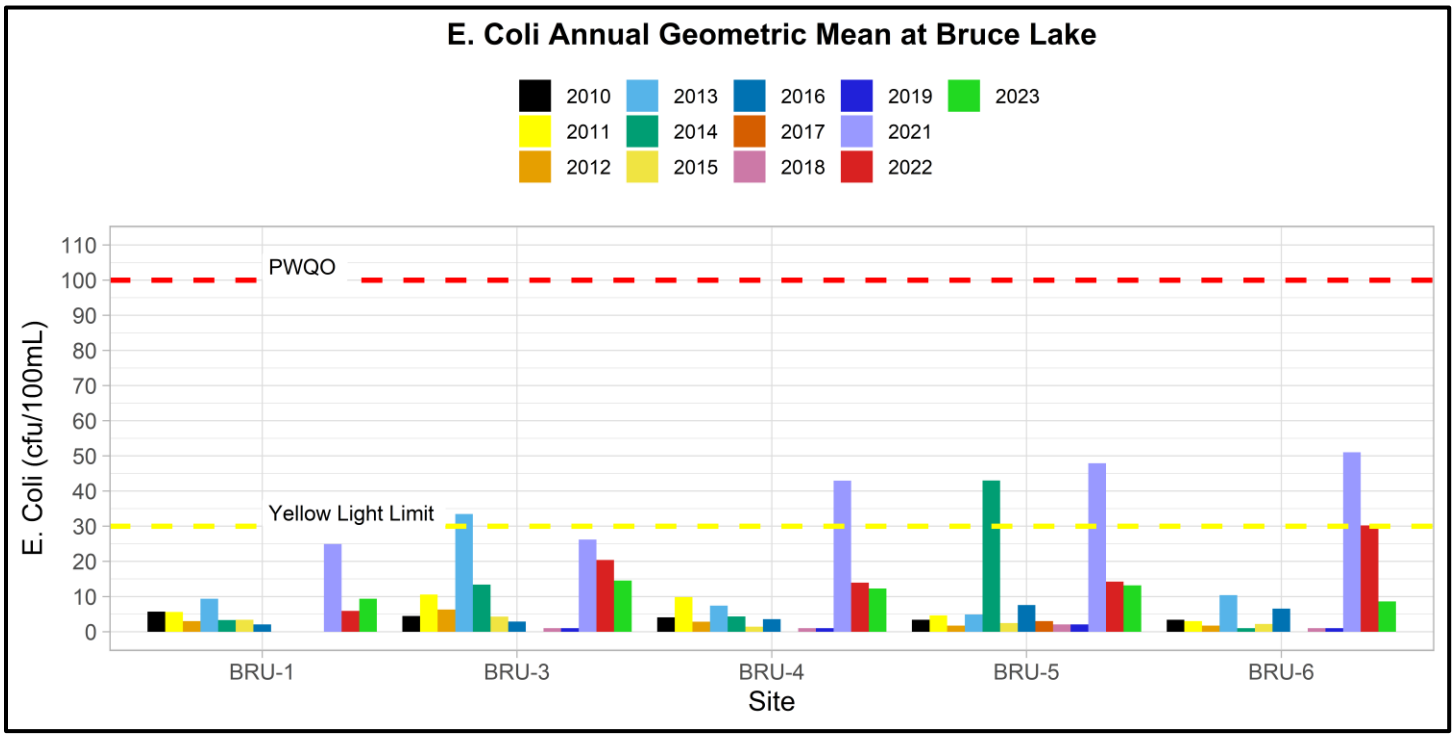
Volunteer Recognition: Andrew Coppola, John Harvey, Paul Hutchinson.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **BRU-0** | 3.1 | 7.8 | 6.7 | | |
| **BRU-1** | | 9.7 | 20.0 (7.4) | 4 | 23 |
| **BRU-3** | | 8.7 | 6.9 | 12 | 40 |
| **BRU-4** | | 8.5 | 6.9 | 10 | 34 |
| **BRU-5** | | 7.9 | 7.9 | 14 | 47 |
| **BRU-6** | | 9.2 | 6.9 | 9 | 29 |

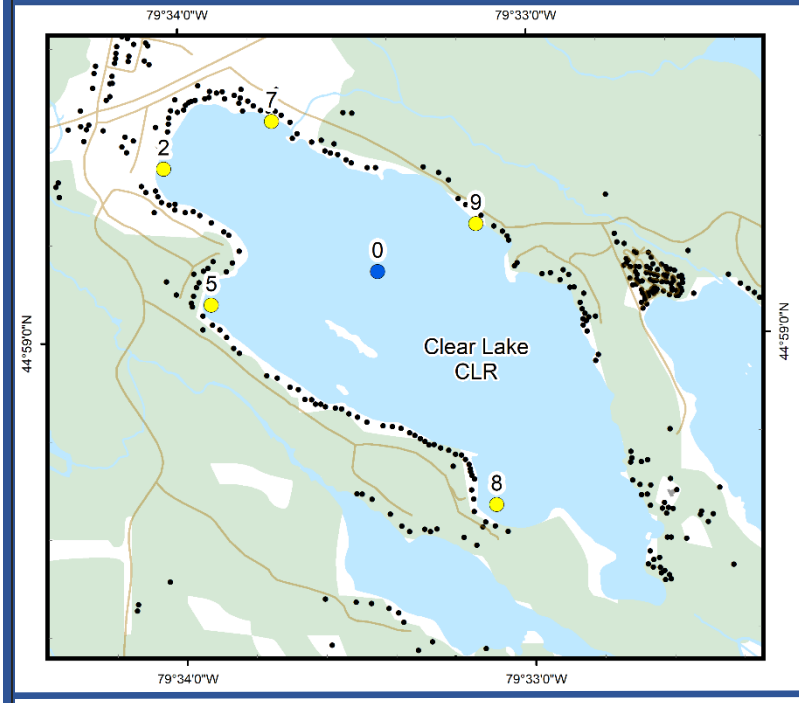



Note: Grubbs test indicates data collected in 2012 are considered an outlier.



In 2023, annual average and spring phosphorus concentrations at the deep-water station (BRU-0) were below the historic DMM threshold of 13.7 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual and spring phosphorus concentrations at BRU-1, 3, 4, 5 and 6 were within the range of variability of previous monitoring. *E. coli* samples at all stations were below the yellow light trigger established by the MLA. Average annual Secchi disk depth (3.1 m) was consistent with previous monitoring (2.4 and 6.5 m). A harmful algae bloom was reported on Bruce Lake in 2020 resulting in a yellow light being maintained for this lake in 2023. **HESL recommends ongoing sampling to monitor for long-term trends and emerging issues.**

# Clear Lake (CLR)



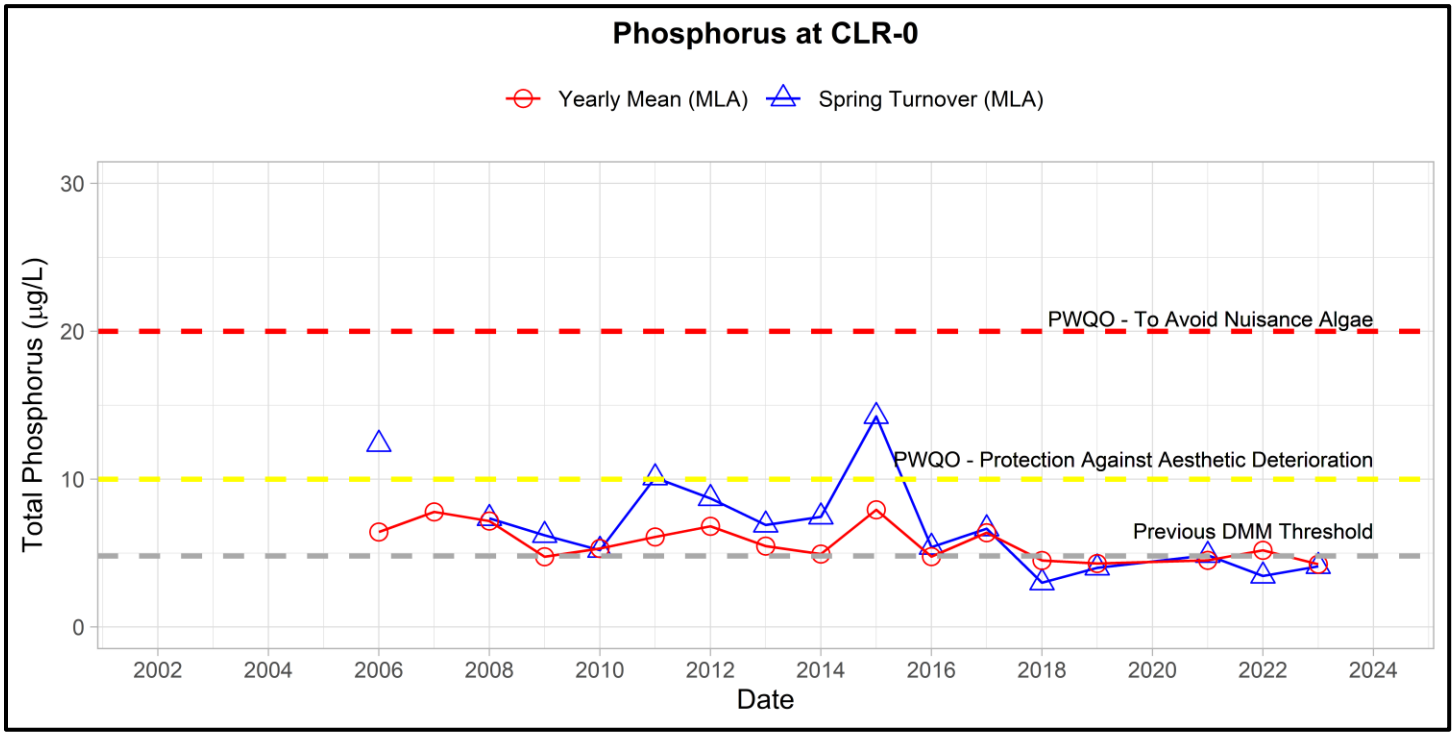

**Area Description:**

Clear Lake, also called Torrance Lake, is a small (surface area = 1.49 km$^2$) lake with a maximum depth of 16 m. The lake is moderately developed with residential lots and is adjacent to
Highway 169. Inflow and outflow of the lake are limited, and surface runoff comes from a small watershed area (0.84 km$^2$). Clear Lake is currently classified as moderately sensitive and over threshold by the DMM. MLA monitoring of Clear Lake began in 2006.

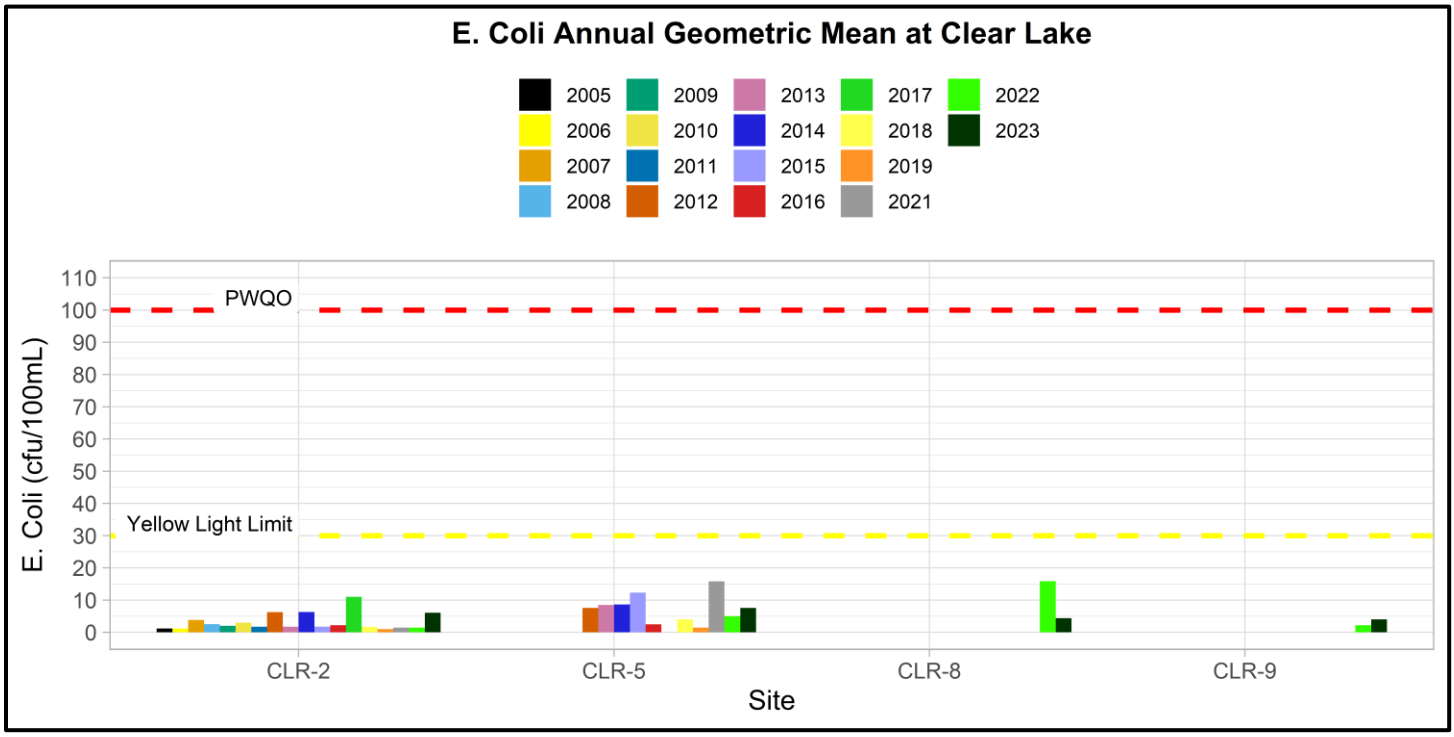
Volunteer Recognition: Bob and Sharon Cleverdon.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **CLR-0** | 6.8 | 4.1 | 4.3 | | |
| **CLR-2** | | 5.0 | 4.9 | 6 | 61 |
| **CLR-5** | | | | 8 | 101 |
| **CLR-8** | | 5.0 | 8.0 | 4 | 62 |
| **CLR-9** | | | | 5 | 88 |

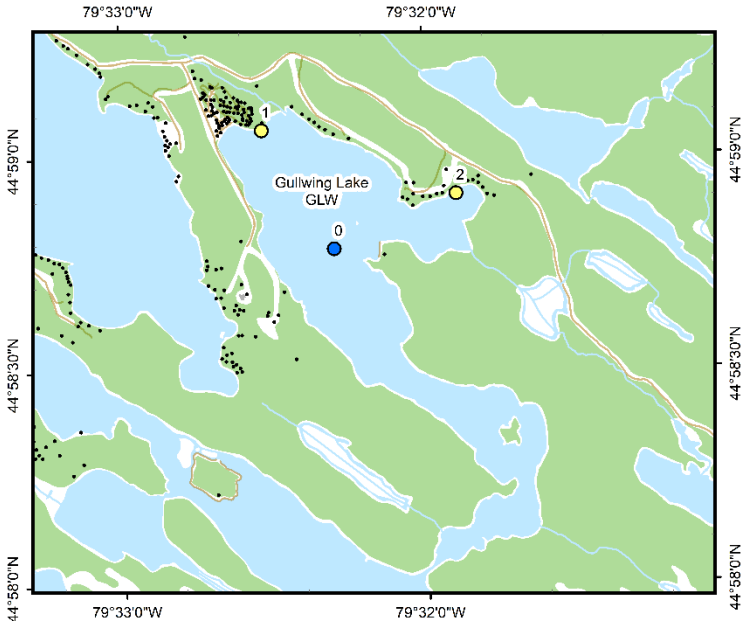



Note: Grubbs test indicates Spring and Annual Total Phosphorus data in 2012 are considered to be outliers.



In 2023, annual average and spring phosphorus concentrations at the deep-water station (CLR-0) were below the historic DMM threshold of 4.8 µg/L and below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual and spring phosphorus concentrations at CLR-2 and 5 were within the range of variability of previous monitoring; 2023 was the second phosphorus sampling year at CLR-8, values were consistent with sampling in 2022 including elevated phosphorus concentrations during August sampling. *E. coli* counts at all stations were below the yellow light trigger established by the MLA. Average annual Secchi disk depth (6.8 m) was consistent with previous monitoring (3.63 and 9.30 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Gullwing Lake (GLW)




**Area Description:**

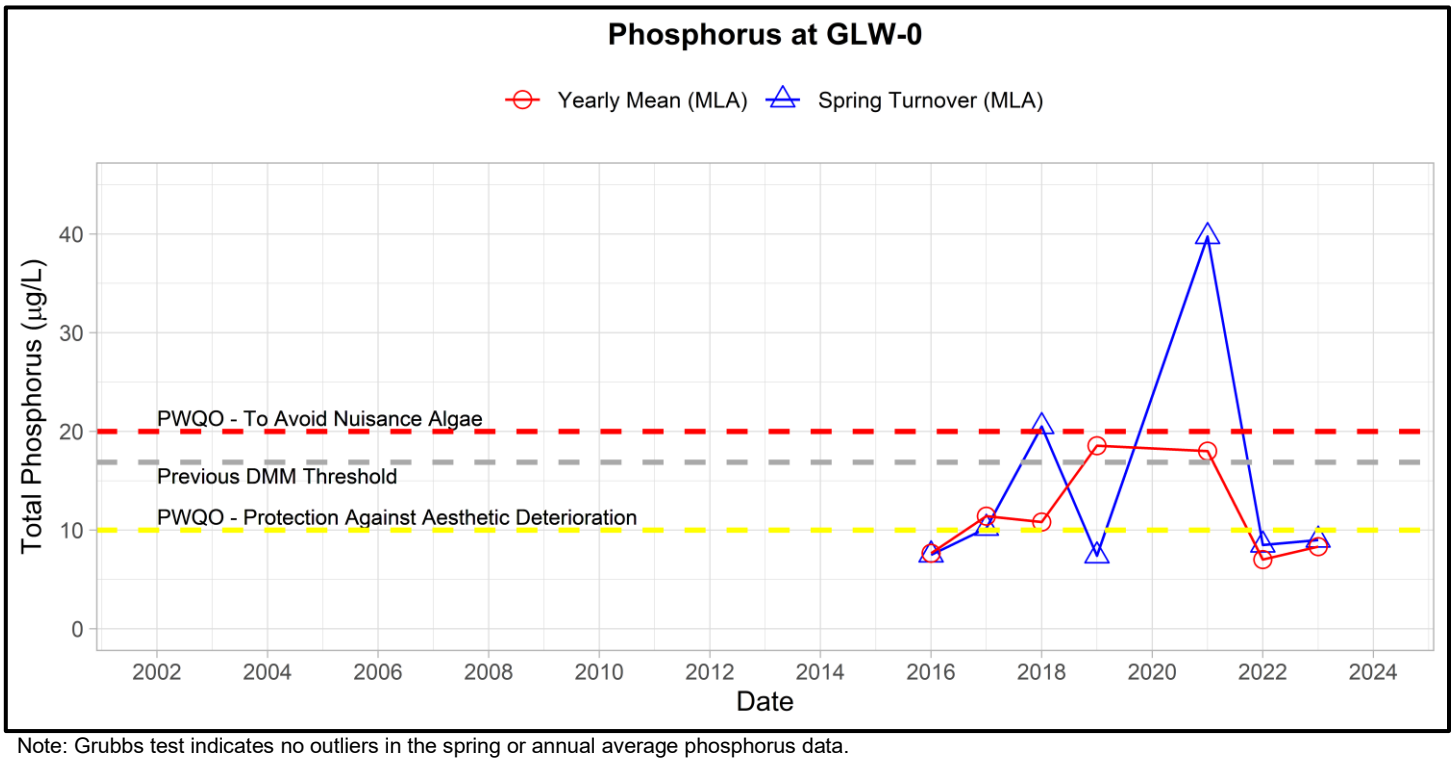
Gullwing Lake is located just south of Torrence and has an area of 0.84km$^2$ and a maximum depth of 9 m. The watershed area of Gullwing Lake is 5.71 km$^2$ includes Crown Land (25%), shoreline residential and a seasonal vacation park located in the northwest. Gullwing Lake is currently listed as moderate sensitivity by the DMM. MLA monitoring of Gullwing Lake began in 2016.

Volunteer Recognition: **Kellie Dobson, Kim Enns,** Donna DiLello, and Jim Dobson.

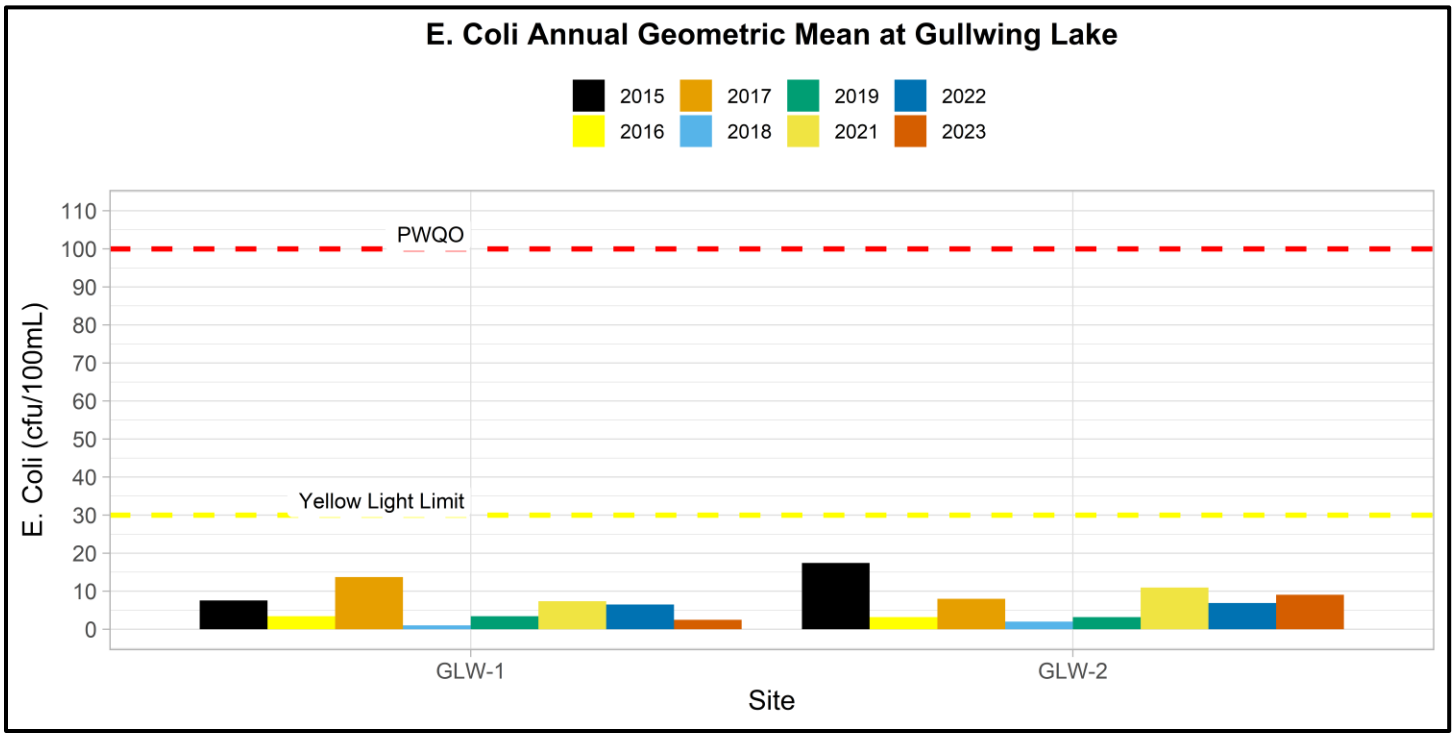
2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **GLW-0** | 2.2 | 9.0 | 8.3 | | 30* |
| **GLW-1** | | 8.4 | 8.5 | 2 | 42 |
| **GLW-2** | | 10.5 | 12.3 | 9 | 28 |

*Based off a single sample.

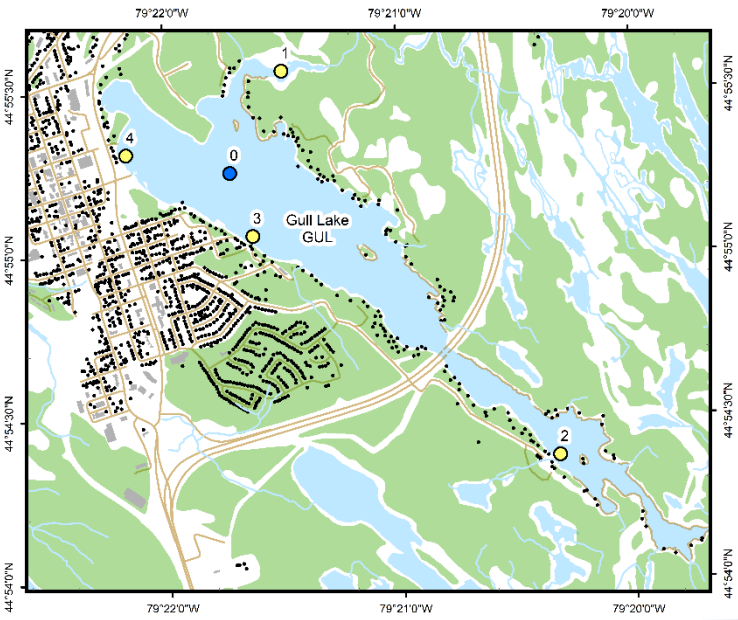



Note: Grubbs test indicates no outliers in the spring or annual average phosphorus data.



In 2023, annual average and spring phosphorus concentrations at the deep-water station (GLW-0) were below the historic DMM threshold of 16.89 µg/L, as well as the Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and the guideline for prevention of Nuisance Algal Growth (20 µg/L). Bsaed on spring 2022 and 2023 data it is likely that the extreme value recorded in spring 2021 was the result of sample contamination. Nearshore monitoring of annual and spring phosphorus concentrations at GLW-1 and 2 were within the range of variability of previous monitoring. *E. coli* counts at all stations were below the yellow light trigger established by the MLA. Average annual Secchi disk depth (2.2 m) was consistent with previous monitoring (1.5 – 3.15 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends.**

# Gull Lake (GUL)



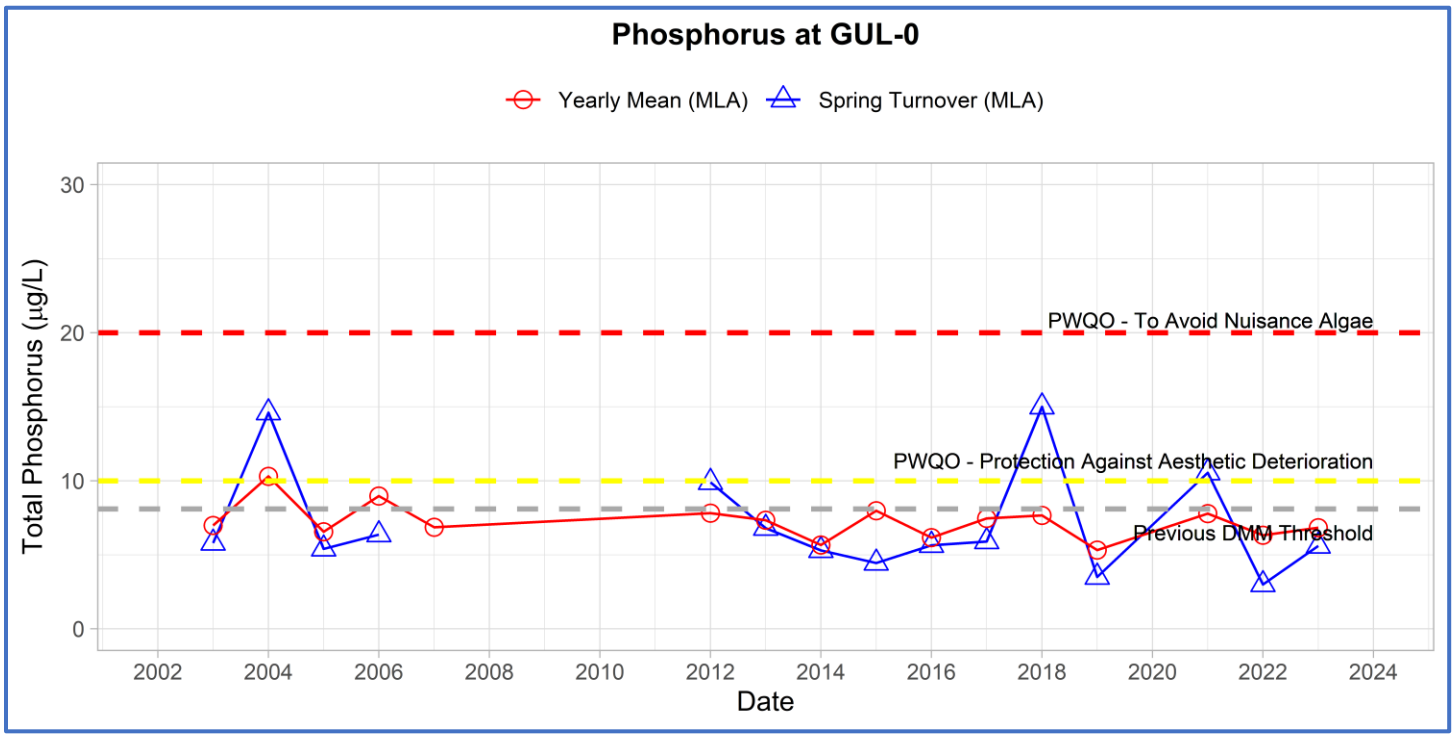

**Area Description:**

Gull Lake is a long, narrow lake with a surface area of 1.33 $km^2$ and a maximum depth of 7 m in the Town of Gravenhurst. Gull Lake receives inflow from Silver Lake at the south end along with nine creeks and overland runoff from the 3.6 $km^2$ watershed. The lake incudes significant residential development from the Town of Gravenhurst, particularly in the northwest and Highway 11 crosses the lake at its midpoint. Gull Lake is not currently listed as vulnerable by the DMM. MLA monitoring of Gull Lake began in 2003.

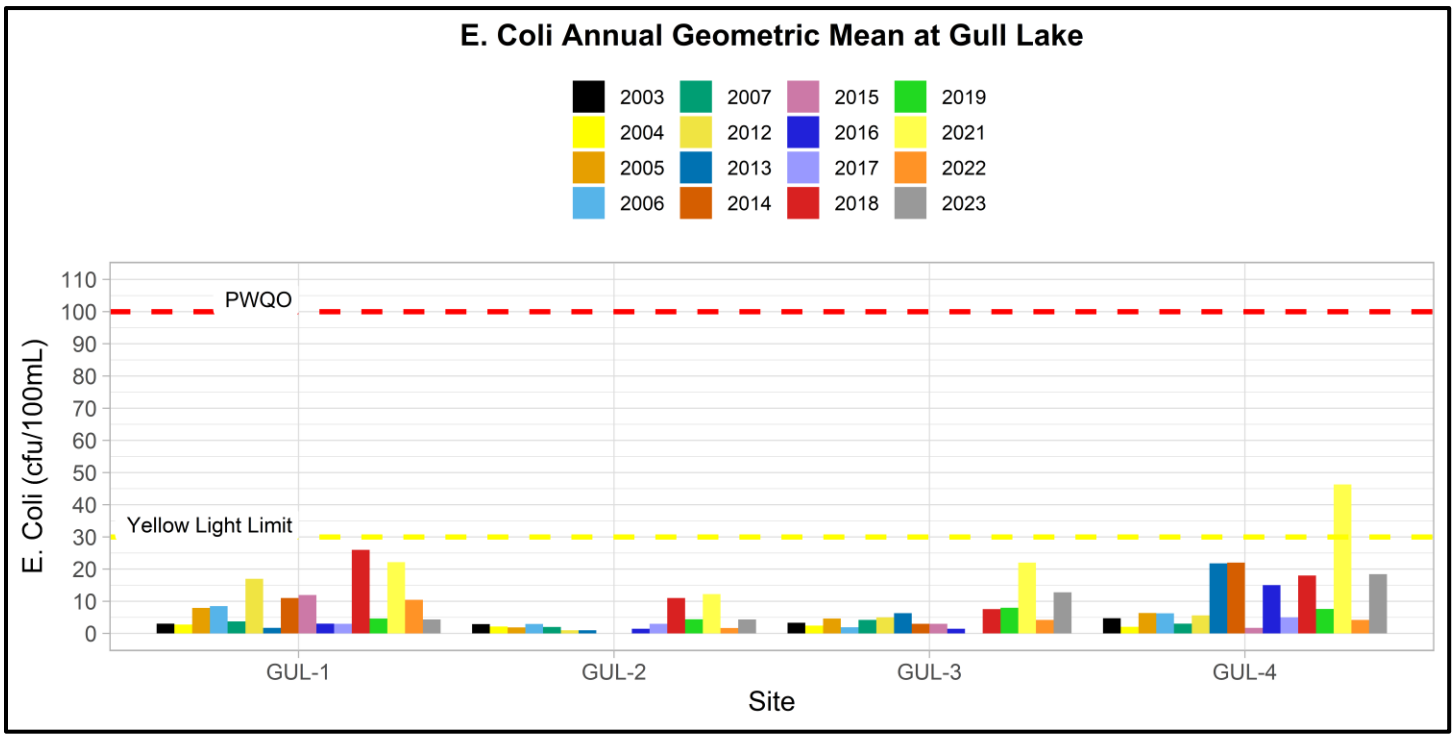
Volunteer Recognition: Bruce & Anne Elliot, Dave & Debbie Stephens, George & Patricia Catleogh.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **GUL-0** | 3.5 | 5.6 | 6.8 | | |
| **GUL-1** | | | | 4 | 94 |
| **GUL-2** | | | | 4 | 152 |
| **GUL-3** | | | | 13 | 120 |
| **GUL-4** | | | | 18 | 140 |

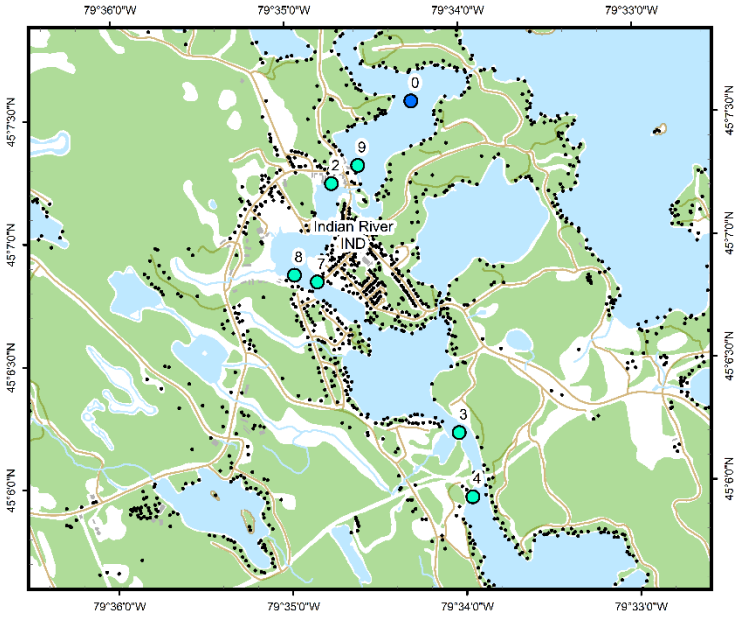



Note: Grubbs test indicates no outliers in Spring or Annual Total Phosphorus data.



The spring phosphorus concentration at the deep-water station (GUL-0) was below the historic DMM threshold of 8.1 µg/L as well as the Provincial Water Quality Monitoring Objectives (PWQO) for Protection Against Aesthetic Deterioration (10 µg/L) and the PWQO for Prevention of Nuisance Algal Growth (20 µg/L). *E. coli* counts at all stations were below the yellow light trigger established by the MLA. Average annual Secchi disk depth (3.5 m) was consistent with previous monitoring (2.5 – 4.8 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Indian River (IND)




**Area Description:**

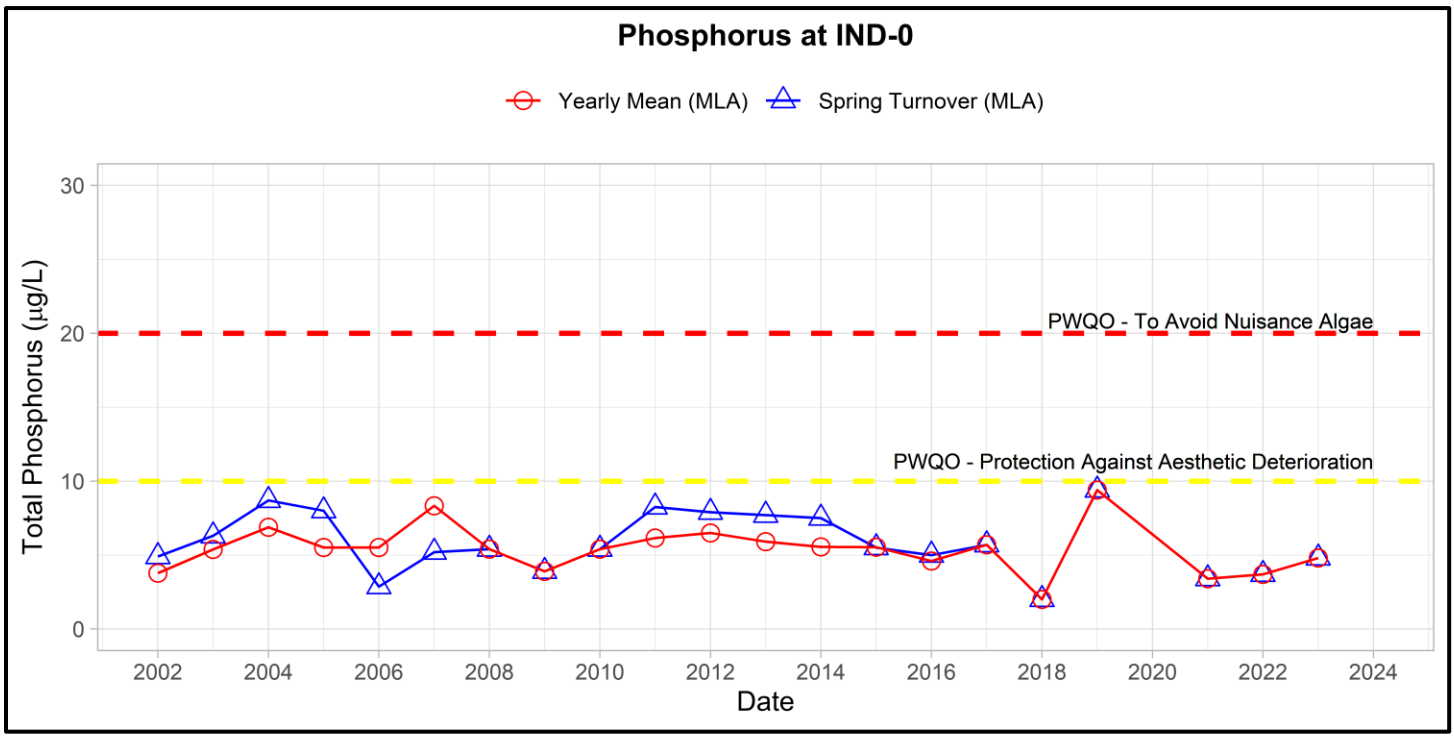
The Indian River connects Lake Rosseau to Mirror Lake and Lake Muskoka. The river flows through and receives stormwater drainage from the urbanized area of Port Carling, which is highly developed. It also has a locks system, several marinas and numerous commercial and residential properties. A large wetland is located adjacent to the river. MLA monitoring of the Indian River began in 2002.

Volunteer Recognition: Jane Armstrong, Susan Carson, Ian Turnbull, Dianne Turnbull, and Chris Vandergrift.

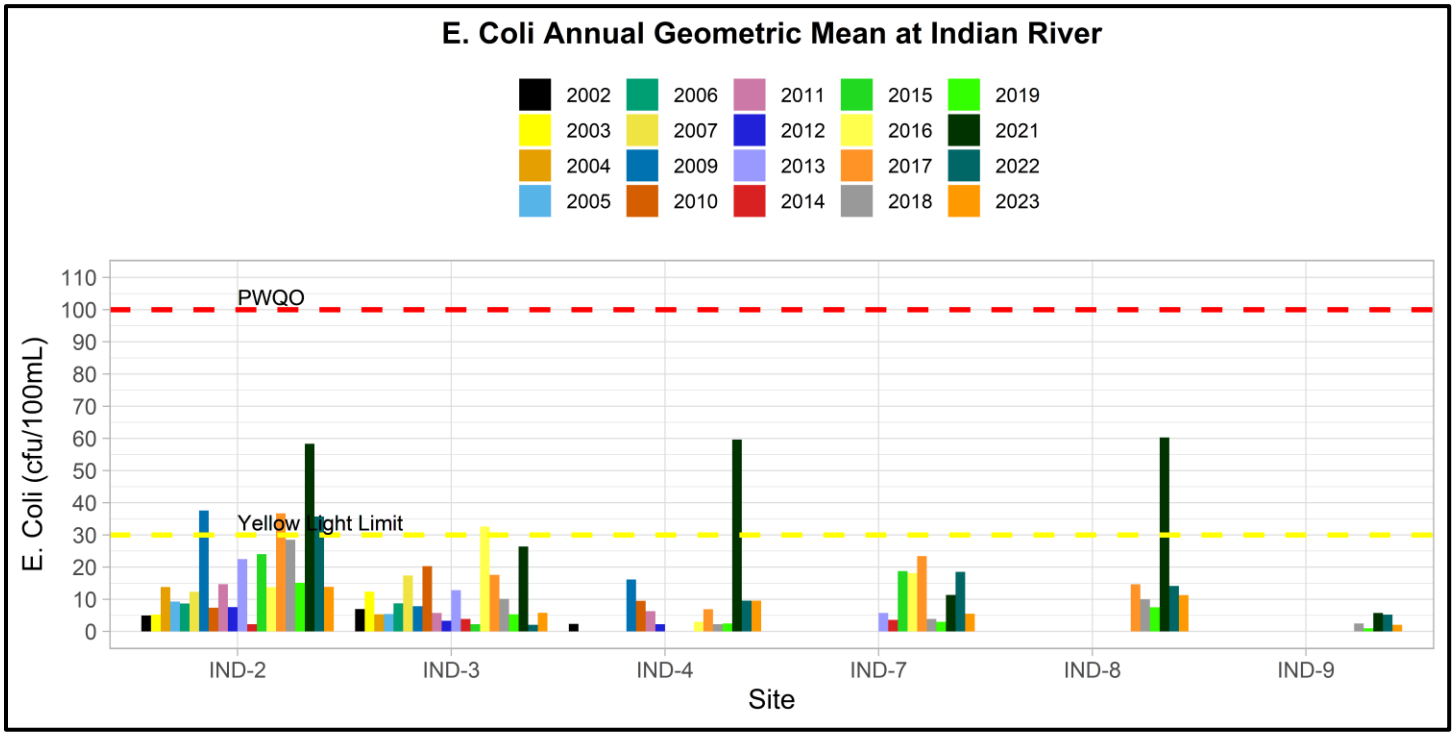
2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **IND-0** | 3.4 | 4.8 | | | |
| **IND-2** | | | | 13 | 125 |
| **IND-3** | | | | 6 | 49 |
| **IND-4** | | | | 10 | 69 |
| **IND-7** | | 4.8 | 10.0(4.6*) | 6 | 16 |
| **IND-8** | | 3.8 | | 11 | 122 |
| **IND-9** | | 2.0 | | 2 | 33 |

*Annual average presented both with and without extreme June 2023 value.

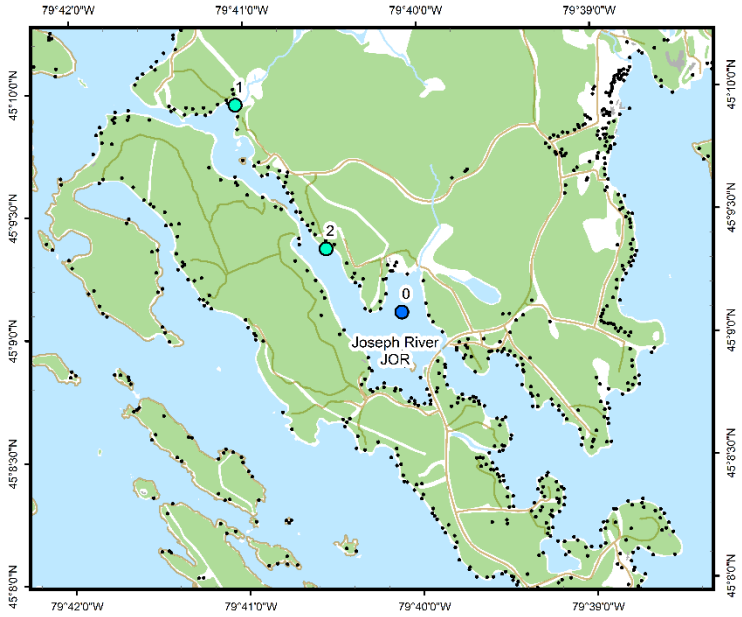



Note: Grubbs test indicates data collected no outliers in the spring or annual average phosphorus data.



In 2023, annual average and spring phosphorus concentrations at the deep-water station (IND-0) were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and prevention of Nuisance Algal Growth (20 µg/L). Nearshore monitoring of spring phosphorus concentrations at IND-7, 8 and 9 were within the range of variability of previous monitoring, annual average total phosphorus concentrations at IND-7 were elevated in 2023 relative to 2022 due to a single sample collected during a precipitation event. *E. coli* counts at all nearshore stations were below the yellow light trigger established by the MLA. Average annual Secchi disk depth (3.4 m) was consistent with previous monitoring (2.0 – 5.6 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Joseph River (JOR)



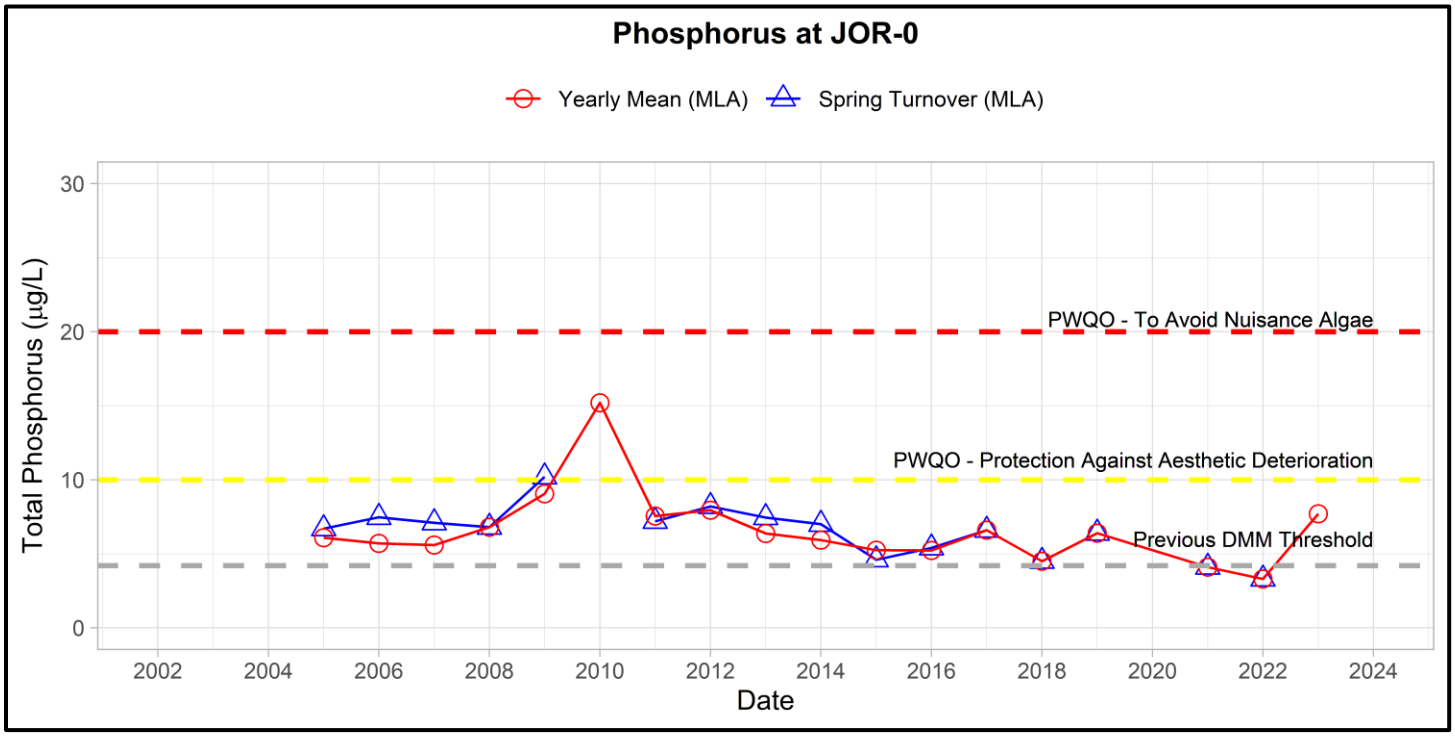

**Area Description:**

The Joseph River is heavily developed watercourse which flows from Lake Joseph to Lake Rosseau. The river is 1.37 km² in surface area and has a maximum depth of 8 m. Development in the watershed includes a marina, and a bridge crossing for Peninsula Road. The river is the primary waterway between Lake Joseph and Lake Rosseau and therefore receives a high level of boat traffic. The Joseph River was historically classified as moderately sensitive by the DMM. MLA monitoring of the Joseph River began in 2005.

Volunteer Recognition: Beth Guy, Laurie Leiser and James Woodruff.

2023 Water Quality Results:

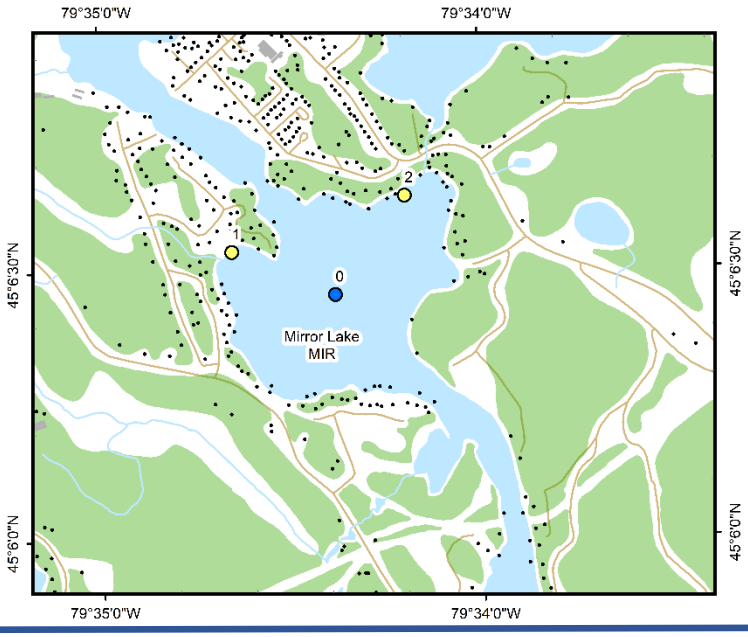
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **JOR-0** | 2.9 | | 7.7 | | |
| **JOR-1** | | | 5.1 | | |




Note: Grubbs test indicated annual average phosphorus data collected in 2010 are considered an outlier as a result or a single measurement which has been removed from the dataset as suspected contamination.

Annual average phosphorus concentrations at the deep-water station (JOR-0) were based on a single sample collected in August which was above the historic DMM threshold of 4.2 µg/L but below the Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual phosphorus concentrations at JOR-1 was within the range of variability of previous monitoring, no spring data were collected in 2023. Average annual Secchi disk depth (2.9 m) was consistent with previous monitoring (2.4 and 5.38 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Mirror Lake (MIR)




**Area Description:**

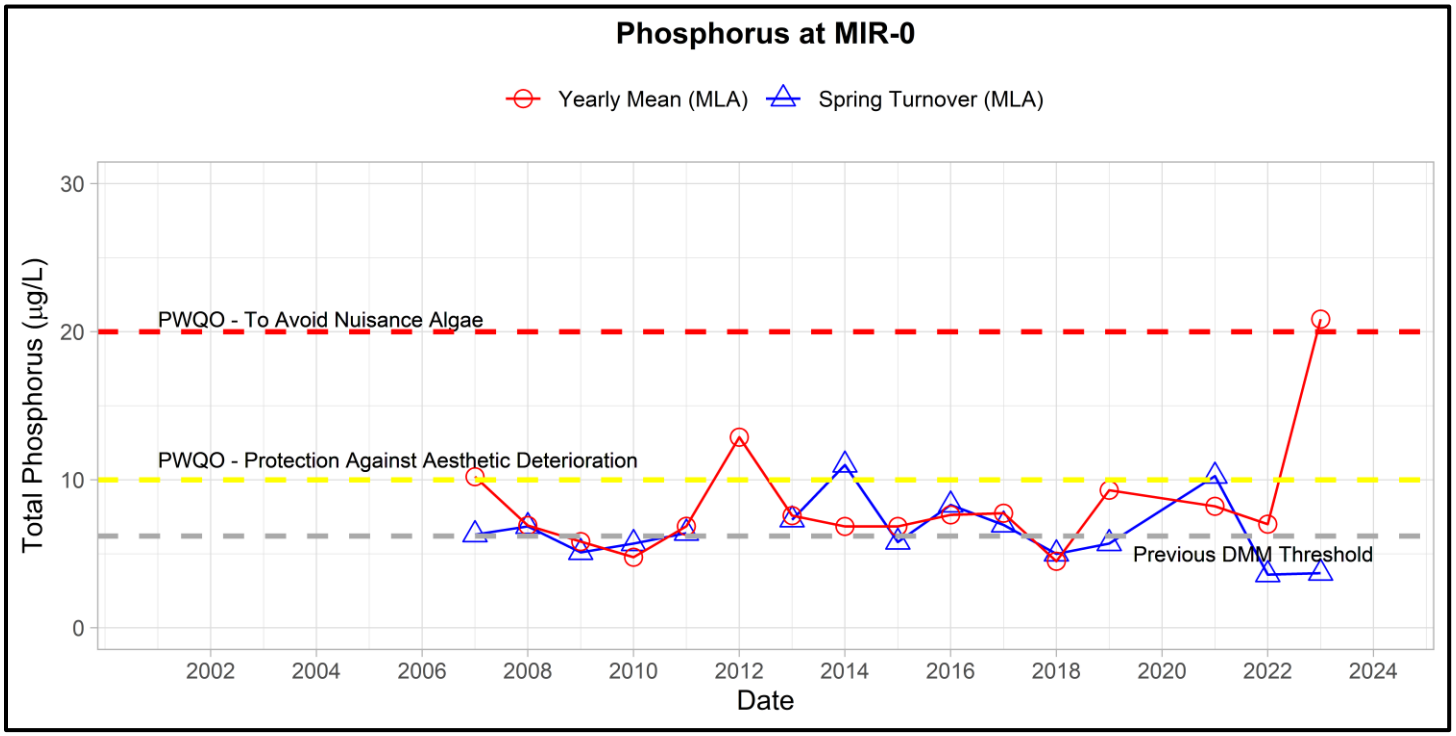
Mirror Lake is a widening of the Indian River south of Port Carling just north of the inflow to Lake Muskoka. The lake has a surface area of 0.46 km² and a maximum depth of 8 m. Two creeks flow into the lake near sampling sites MIR-1 and MIR-2. Development on the lake is high and includes drainage from the urban area of Prot Carling. Mirror Lake has a small watershed, approximately 0.97 km², and is currently classified as moderately sensitive and over-threshold by the DMM. MLA monitoring of Mirror Lake began in 2007.

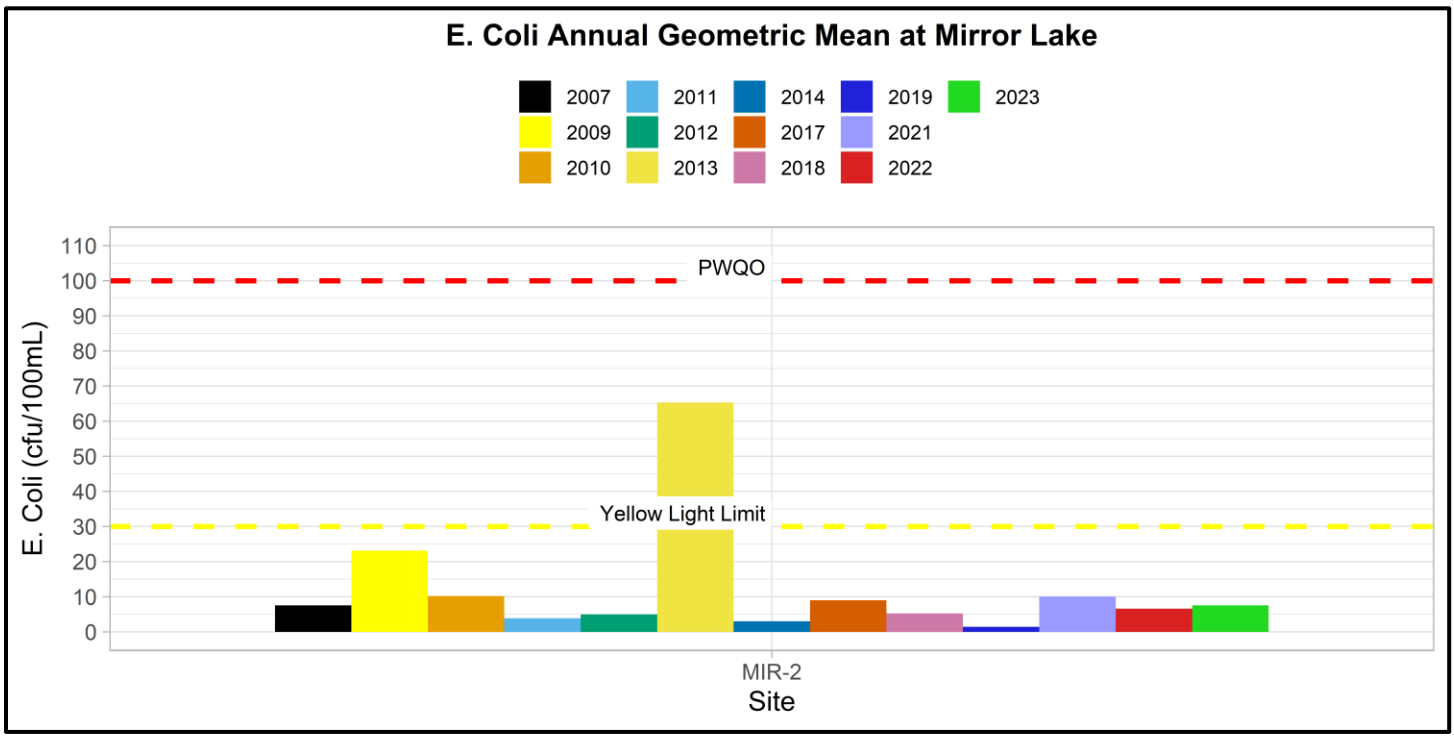
Volunteer Recognition: Susan Carson, Jane Armstrong and Chris Vandergrift

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **MIR-0** | 3.0 | 3.7 | 20.9 | | |
| **MIR-2** | | 4.9 | | 8 | 77 |

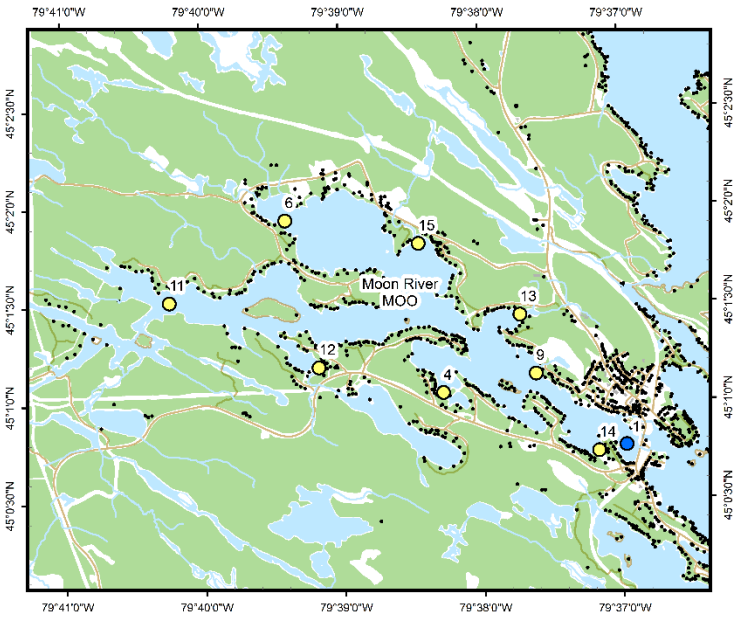
Note: Grubbs test indicates spring phosphorus data collected in 2012 are considered an outlier.






Annual average phosphorus concentrations at the deep-water station (MIR-0) were above the historic DMM threshold of 6.2 µg/L as well as the Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and the PWQO for the Prevention of Nuisance Algal Growth (20 µg/L). Spring phosphorus concentrations in 2023 at MIR-O and MIR-2 were low and within the range of variability of previous monitoring, however June and August TP at MIR-0 were amongst the highest values recorded in the history of the program. Ongoing monitoring in 2024 is recommended to determine if elevated TP at the site is a potentially ongoing issue. *E. coli* counts remained low in 2023 and were below the MLA stoplight limits at MIR-2. Average annual Secchi disk depth (3.0 m) was consistent with previous monitoring (1.95 and 4.45 m). **HESL recommends ongoing sampling to inform on the elevated phosphorus concentrations recorded in 2023, and to continue to monitor for long-term trends and emerging issues.**

# Moon River (MOO)




**Area Description:**

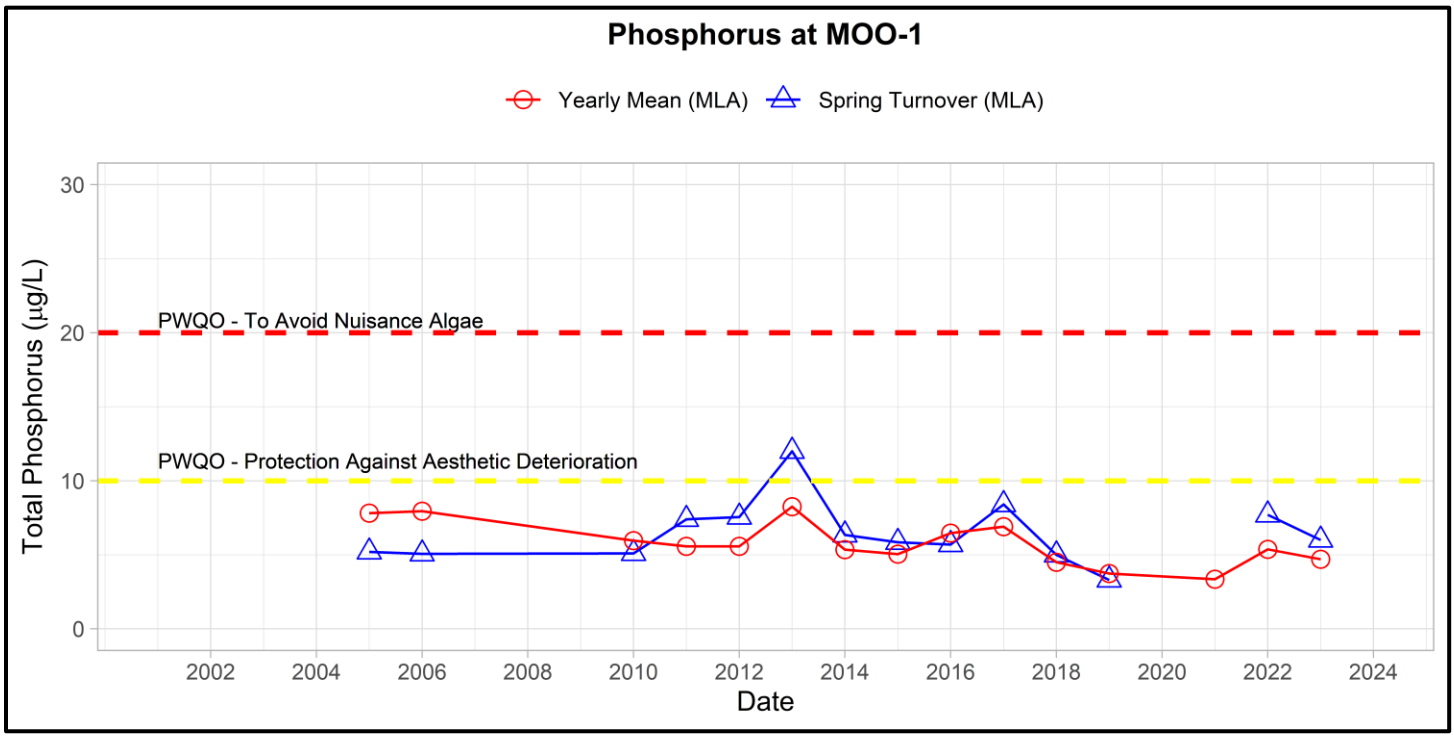
The Moon River is the main outlet of the Muskoka Watershed, flowing from Bala Bay of Lake Muskoka into Georgian Bay. The sampling region is highly developed including the urbanization from the Town of Bala, numerous roads and extensive shoreline development. Numerous small creeks outlet into the sampling area, several of which drain small wetland areas.

Volunteer Recognition: Barry Fisher.

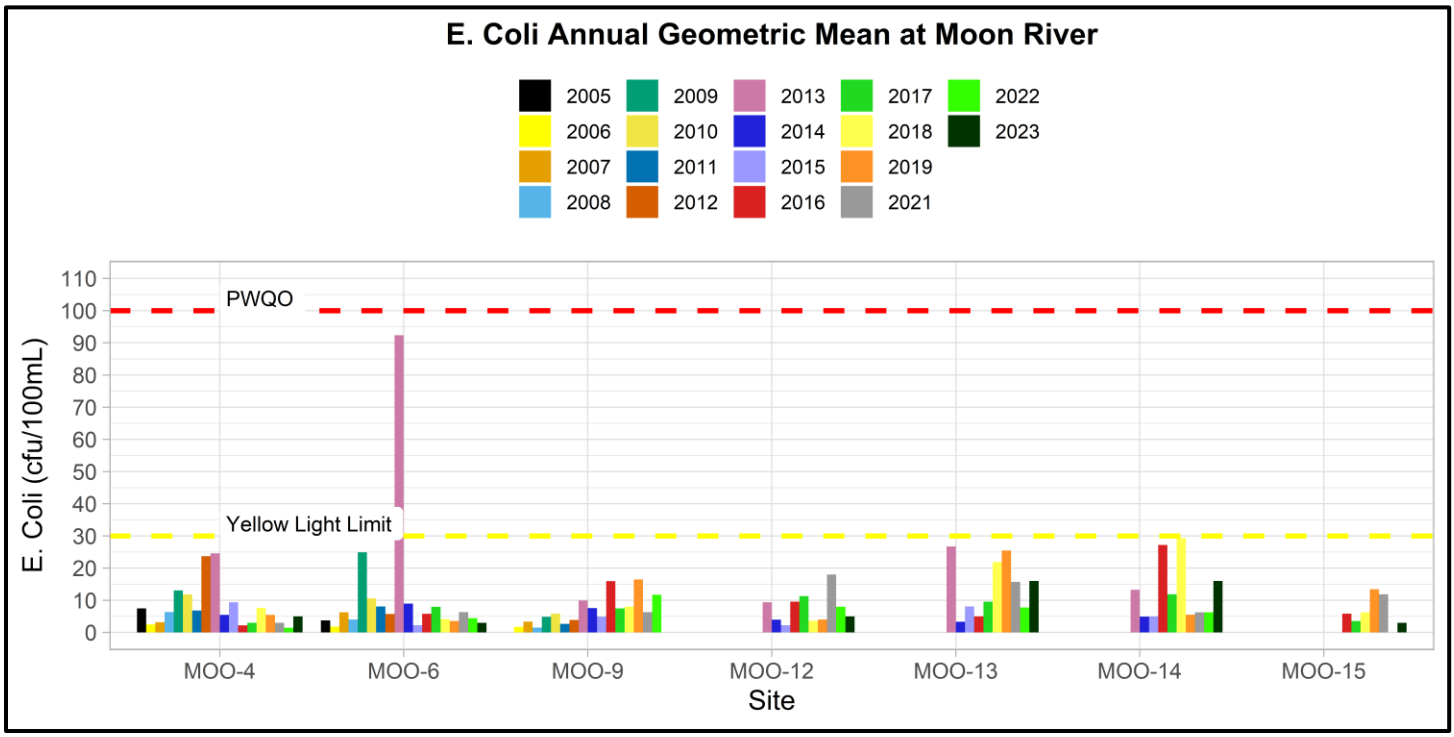
2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **MOO-1** | | 6.0 | 4.7 | | |
| **MOO-4** | | 7.5 | 4.8 | 5 ∓ | 14 |
| **MOO-6** | | 7.7 | 6.9 | 3∓ | 21 |
| **MOO-9** | | 5.3 | 4.5 | | 65 |
| **MOO-11** | 2.8 | 2.0 | 10.3 (3.1*) | | |
| **MOO-12** | | 4.0 | 8.5 (4.0*) | 5 ∓ | 16 |
| **MOO-13** | | 2.8 | 3.9 | 16 ∓ | 40 |
| **MOO-14** | | 2.0 | 3.8 | 16 ∓ | 19 |
| **MOO-15** | | 2.0 | 5.1 | 3∓ | 30 |

Notes: ∓ Result based on a single sample. *Annual average presented both with and without elevated August values included.

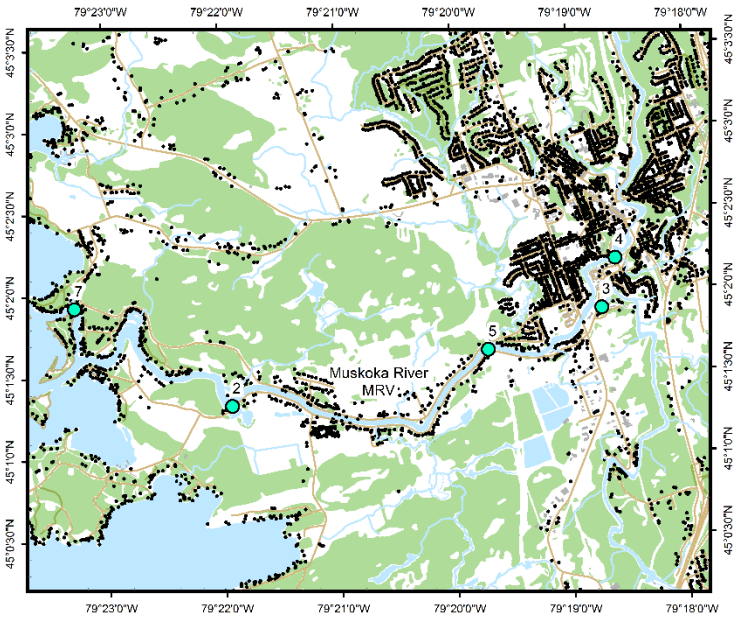



Note: Grubbs test indicates spring phosphorus data collected in 2013 are considered an outlier



Spring and annual average phosphorus concentrations at the deep-water station (MOO-1) were below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual average and spring phosphorus concentrations at MOO-4, 6, 9, 13, 14 and 15 were within the range of variability measured during previous monitoring. Annual average phosphorus concentrations at both MOO-11 and MOO-12 were elevated in 2023 as a result of anomalously high August values, unfortunately local conditions (i.e., rainfall and wave action) were not recorded during this sampling event. Based on the proximity of these two sites and the similarity in phosphorus concentrations, elevated results may be the result localized conditions in the downstream reach of the Moon River sampling area. Further sampling in 2024 will determine if a potentially ongoing issue exists at this location that warrants further investigation or if unique conditions in 2023 resuled in abnormal results. Average annual Secchi disk depth (2.8 m) was consistent with previous monitoring (3.0 and 4.0 m). *E. coli* counts were below the MLA stoplight trigger at all stations. **HESL recommends ongoing sampling to inform the elevated August phosphorus concentrations observed at MOO-11 and 12 and to continue to monitor for long-term trends and emerging issues.**

# Muskoka River (MRV)




**Area Description:**

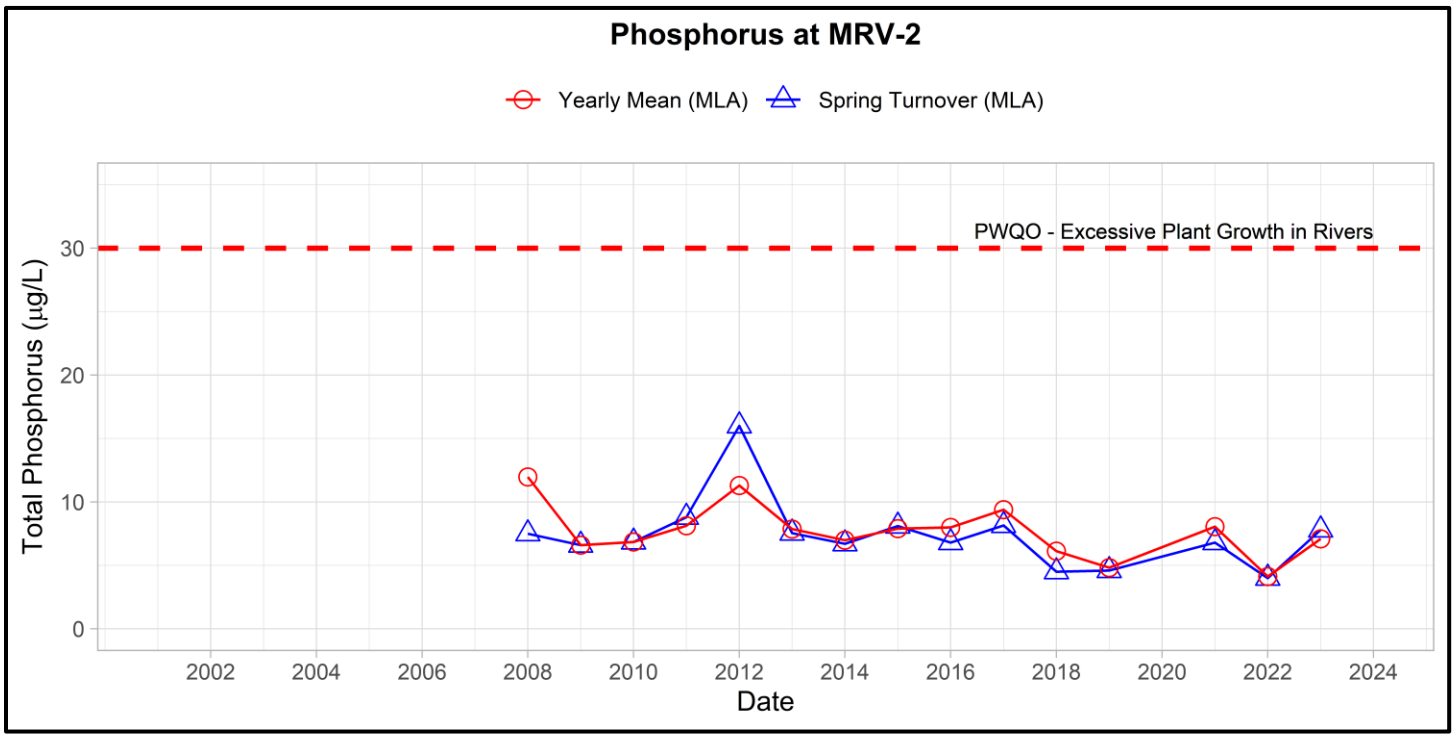
The MLA sample area of the Muskoka River includes the downstream reach from Bracebridge Falls southwest to Alport Bay in Lake Muskoka. The area is highly developed including the urbanized area of Bracebridge, agricultural fields, and extensive residential properties along the entire shoreline. Land clearance and roads are located along both shorelines of the river. MLA monitoring of the Muskoka River began in 2008.

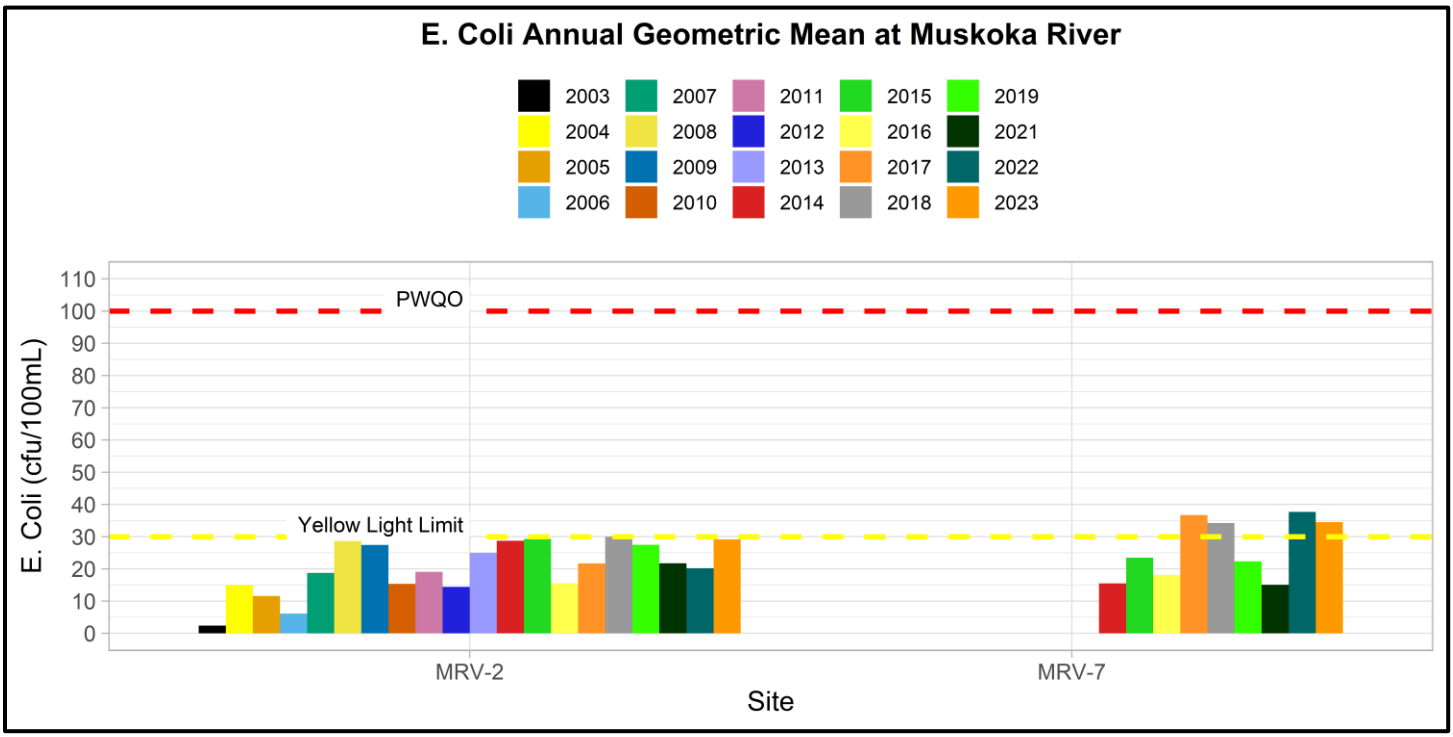
Volunteer Recognition: Mark and Donna Naylor.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **MRV-2** | 2.0 | 7.8 | 7.1 | 29 | 139 |
| **MRV-3** | | 5.6 | | | |
| **MRV-4** | | 7.0 | | | |
| **MRV-5** | | 26.4 | | | |
| **MRV-7** | | | | 34 | 163 |

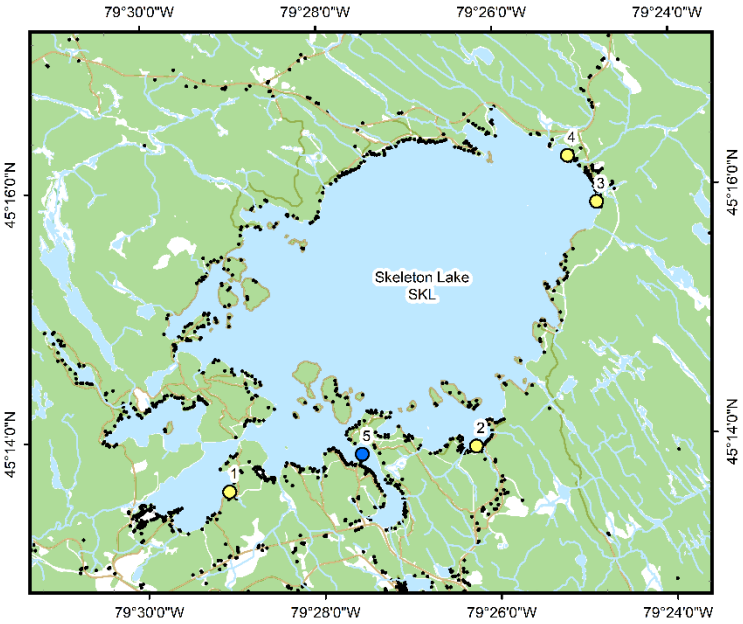
Note: Grubbs test indicates spring phosphorus data collected in 2012 are considered an outlier.




Annual average and spring phosphorus concentrations at the downstream station (MRV--2) were below Provincial Water Quality Monitoring Objectives for the Elimination of Excessive Plant Growth in Rivers and Streams (30 µg/L). Nearshore monitoring of spring phosphorus concentrations at MRV-3, 4, 5 and 7 were within the range of variability of previous monitoring years. The geometric mean of *E coli* samples collected in 2023 at MRV-7 was above the MLA stoplight limit, while MRV-2 was just below (29 CFU/100mL). Average annual Secchi disk depth (2.0 m) was consistent with previous monitoring (1.22 and 10.25 m). **HESL recommends ongoing sampling to assess bacteria concentrations, and to continue to monitor for long-term trends and emerging issues.**

# Skeleton Lake (SKL)



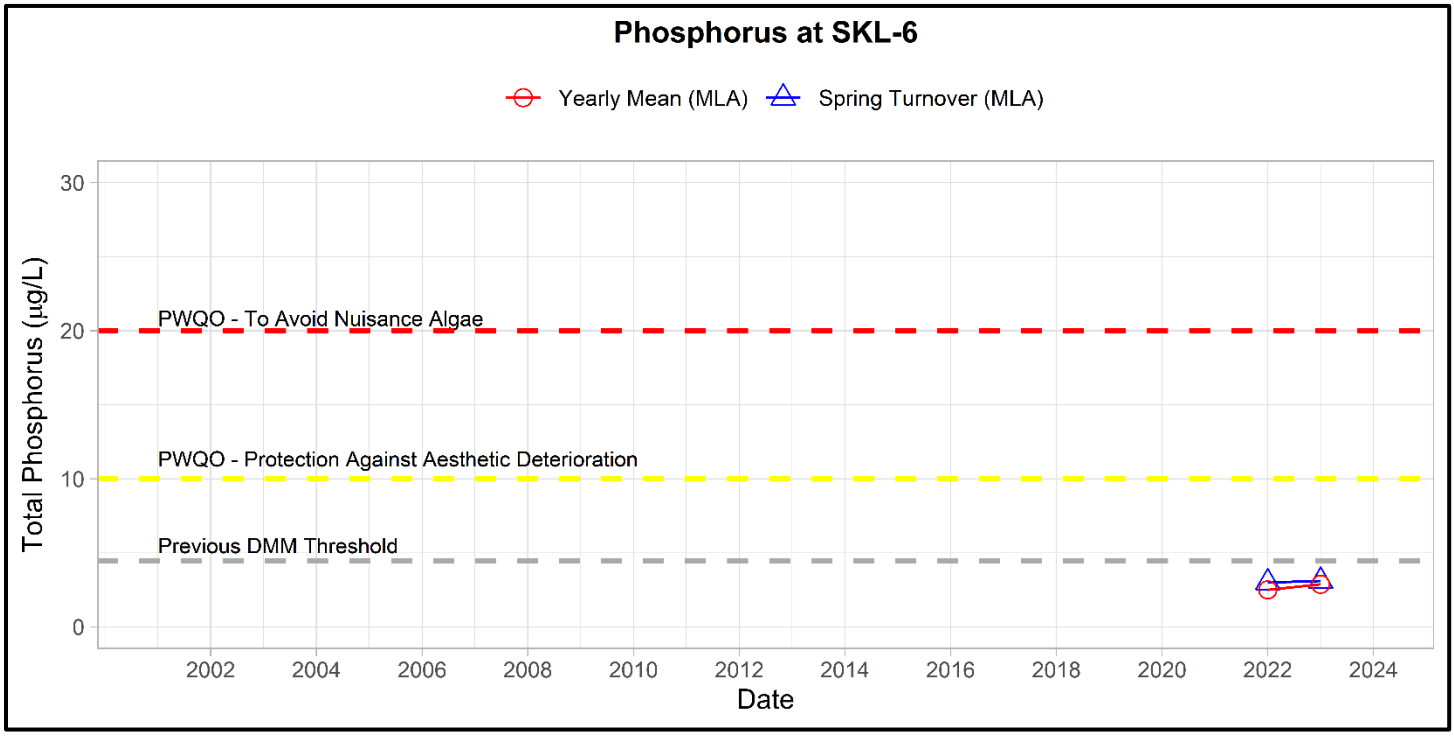

**Area Description:**

Skeleton Lake is large lake located east of Lake Rosseau and North of Three Mile Lake. It has a surface area of 20.54 km² in area and a maximum depth of 60 m. Skeleton Lake receives drainage from a 46.68 km$^2$ watershed. Skeleton Lake is not currently listed as vulnerable by the DMM. MLA monitoring of Skeleton Lake began in 2006 but ended in 2008, sampling resumed in 2021 and is the first sampling event by the MLA since 2008.

Volunteer Recognition: Geoff Ross, Jan Hunter & Tony Shevsky.

2023 Water Quality Results:

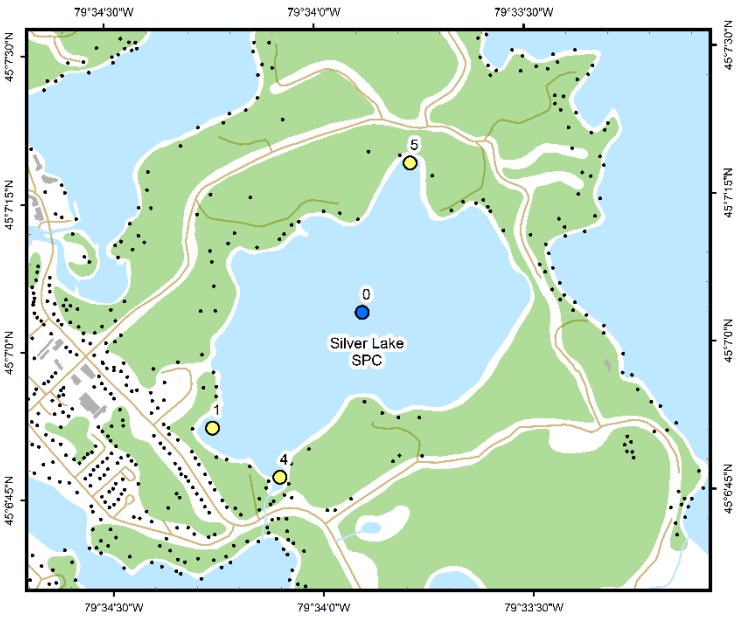
| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **SKL-1** | 4.0 | 6.3 | 3.4 | | |
| **SKL-2** | 4.1 | 4.1 | 3.4 | | |
| **SKL-3** | 4.1 | 3.8 | 3.7 | | |
| **SKL-4** | 4.4 | 4.6 | 4.1 | | |
| **SKL-6** | 4.0 | 3.1 | 2.9 | | |




Note: Grubbs test indicates no spring or annual average phosphorus data collected are considered outliers.

Annual average and spring phosphorus concentrations at the deep-water station (SKL-6) were consistent with results collected in 2022 and below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Nearshore monitoring of annual and spring phosphorus concentrations at SKL-1, 2, 3, and 4 was consistent with long-term monitoring data. *E. coli* samples were not collected in 2023 at Skeleton Lake. **HESL recommends ongoing sampling to enable the assessment of long-term trends and emerging issues.**

# Silver Lake (SPC)



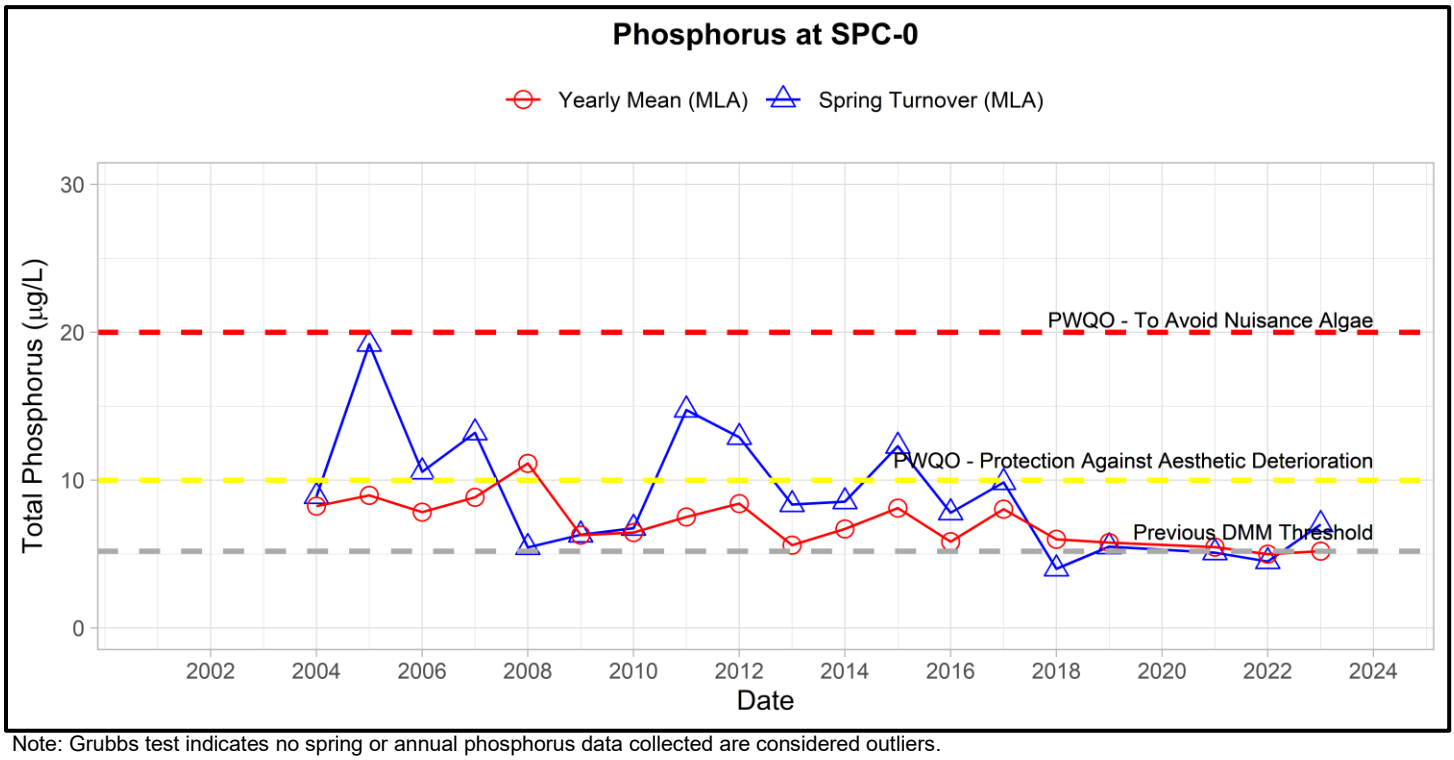

**Area Description:**

Silver Lake is a small lake (surface area = 0.56 km²) with a maximum depth of 14 m just east of Port Carling and west of Arthurlie Bay. The lake has a small watershed area (0.59 km$^2$) and is moderately developed with residential properties. Thinned forest accounts for approximately 50% of the upland area, however 90% of the shoreline is in a natural state. Drainage from Port Carling enters the lake in the southwest and a single outlet drains from the lake in the south. Silver Lake is not currently listed as vulnerable by the DMM.

Volunteer Recognition: Barbara Graydon, Matthew Graydon, Mike Graydon and Johnathan Graydon

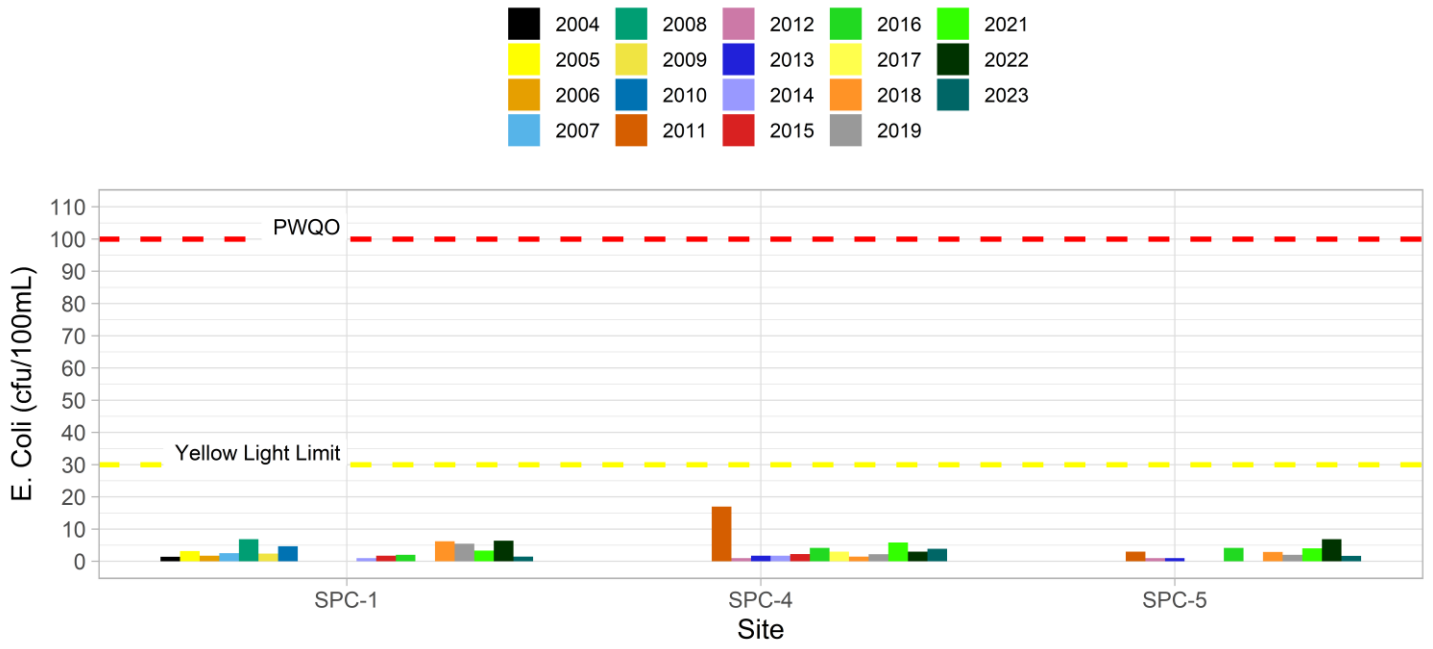
2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **SPC-0** | 5.2 | 7.0 | 5.2 | | |
| **SPC-1** | | | | 1 | 24 |
| **SPC-4** | | | | 4 | 37 |
| **SPC-5** | | | | 2 | 49 |



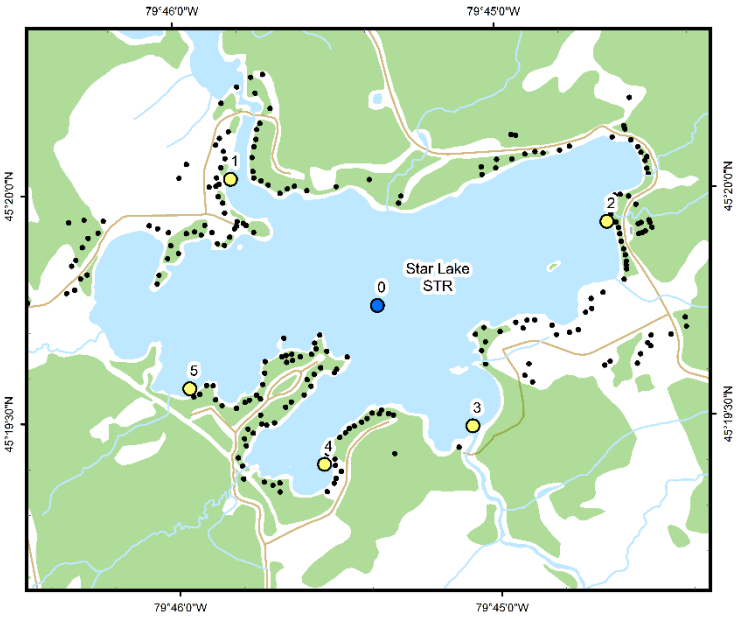

Note: Grubbs test indicates no spring or annual phosphorus data collected are considered outliers.

## E. Coli Annual Geometric Mean at Silver Lake (Port Carling)




Annual average phosphorus concentrations at the deep-water station (SPC-0) were at the historic DMM threshold of 5.2 µg/L but, along with spring phosphorus concentrations, fell below Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). *E. coli* counts were below the MLA stoplight limits at all nearshore sites. Average annual Secchi disk depth (5.2 m) was consistent with previous monitoring (2.0 and 7.5 m). Silver Lake experienced a cyanobacterial bloom in 2020 but as no blooms have occurred in the past 3 year it has been changed to green. **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Star Lake (STR)



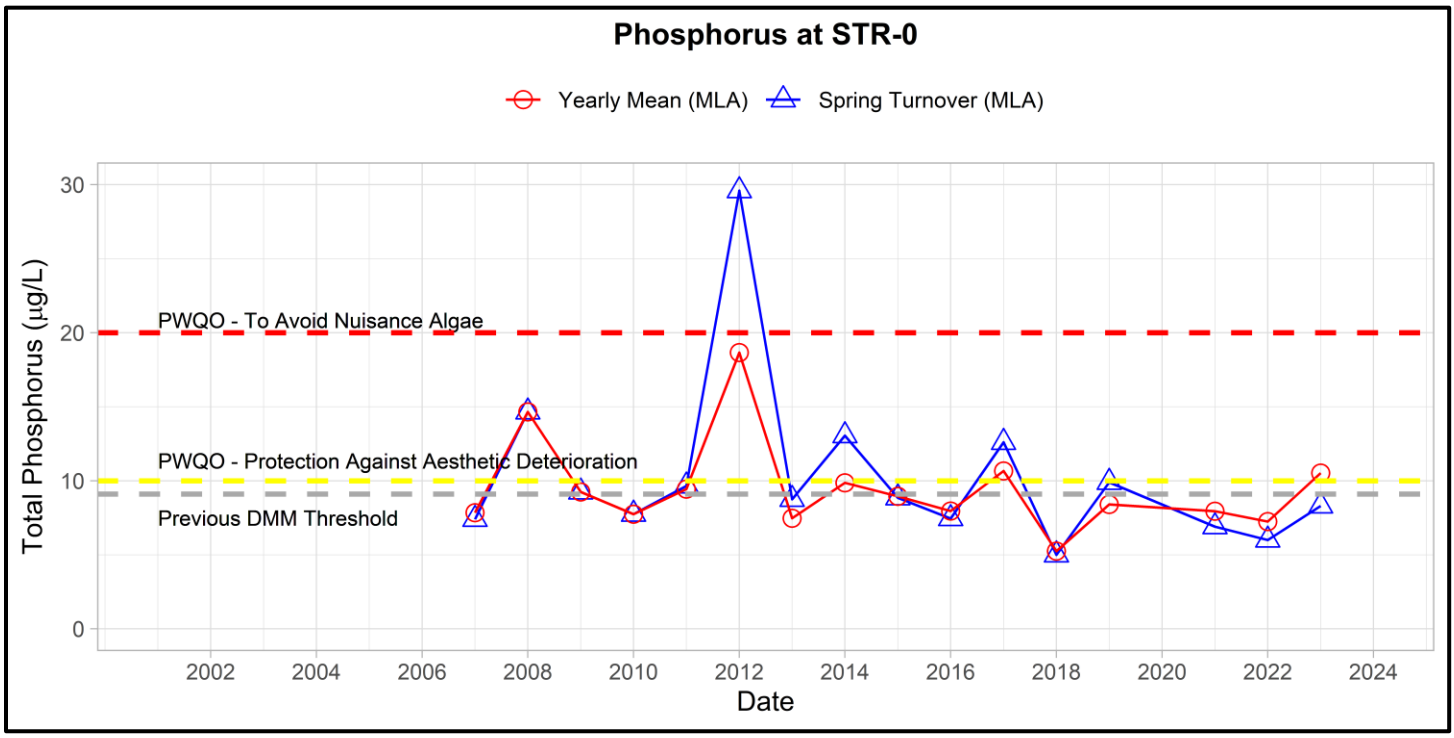

**Area Description:**

Star Lake is a moderately developed lake located within the Township of Seguin. The lake has a surface area of 1.58 km$^2$ and a maximum depth of 23 m. Shoreline development on Star Lake includes residential properties some of which have extensive clearings and lawns, particularly in the East. There is also a substantial agricultural development immediately adjacent to the lake in the northwest. This lake has several inflow and outflow creeks including a connection with Mutton Lake to the North. MLA monitoring of Star Lake began in 2007

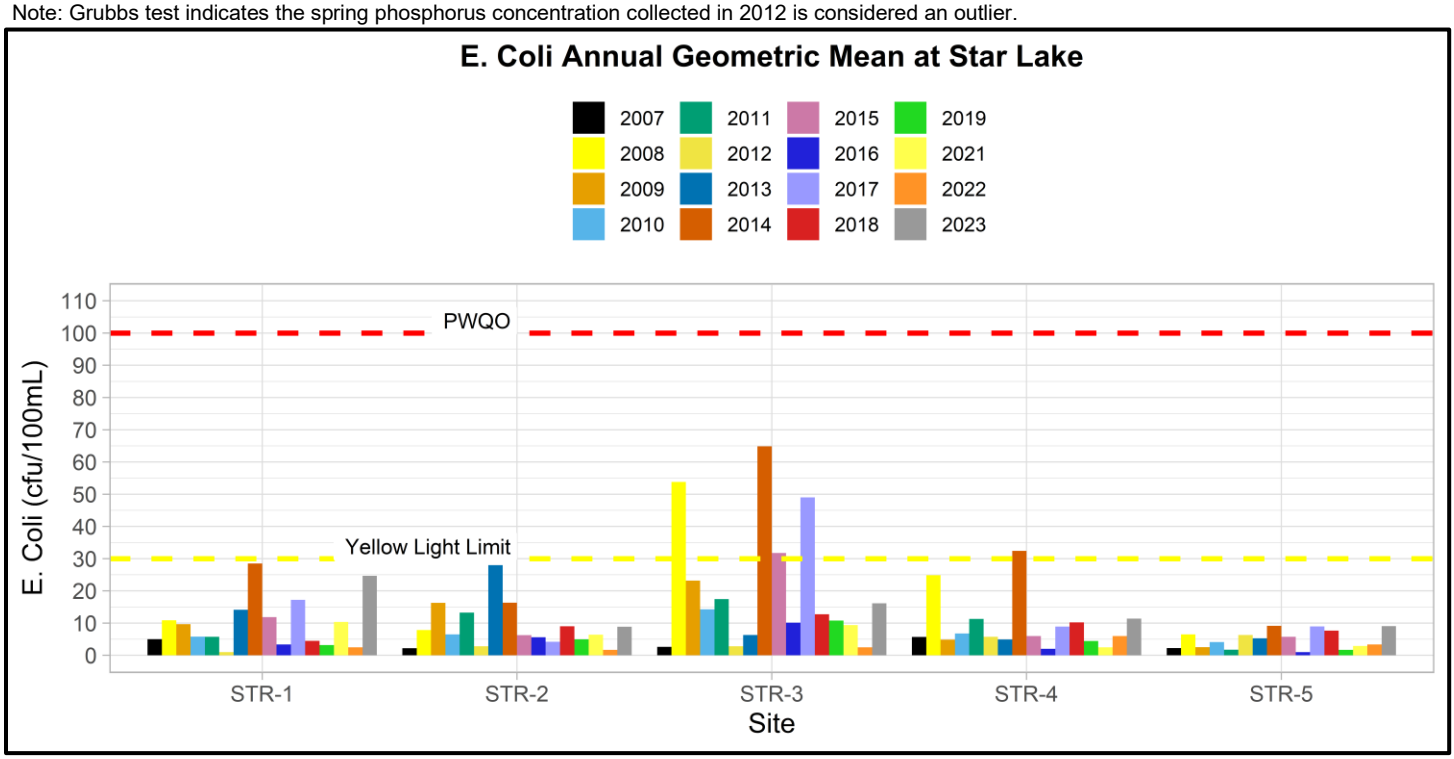
Volunteer Recognition: Karen Gillies, Melaney Kerley, Dawn Sendzik, Kelly Mazza and Jim Kerley.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **STR-0** | 2.5 | 8.3 | 10.5 | | |
| **STR-1** | | | | 25 | 108 |
| **STR-2** | | | | 9 | 49 |
| **STR-3** | | | | 16 | 103 |
| **STR-4** | | | | 11 | 133 |
| **STR-5** | | | | 9 | 81 |

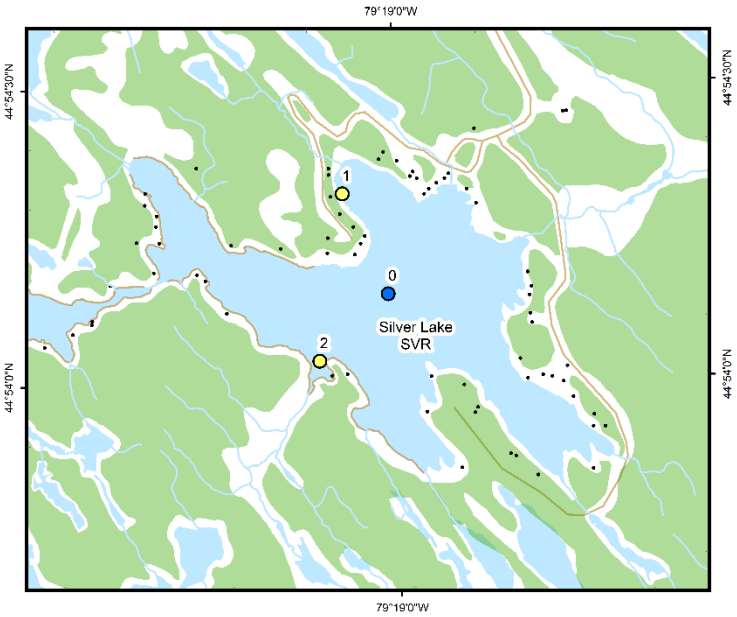



Note: Grubbs test indicates the spring phosphorus concentration collected in 2012 is considered an outlier.



Spring phosphorus concentrations at the deep-water station (STR-0) were below the historic DMM threshold of 9.1 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). Annual phosphorus concentrations in 2023 were above the historic DMM threshold of 9.1 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L), as a result of elevated concentrations during August sampling. August sampling took place during rough conditions and a heavy rainfall event which likely contributed to elevated phosphorus. *E coli* samples collected in 2023 at all stations were below the MLA stoplight limits. Average annual Secchi disk depth (2.5 m) was consistent with previous monitoring (1.40 - 4.45 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

# Silver Lake (SVR)




**Area Description:**

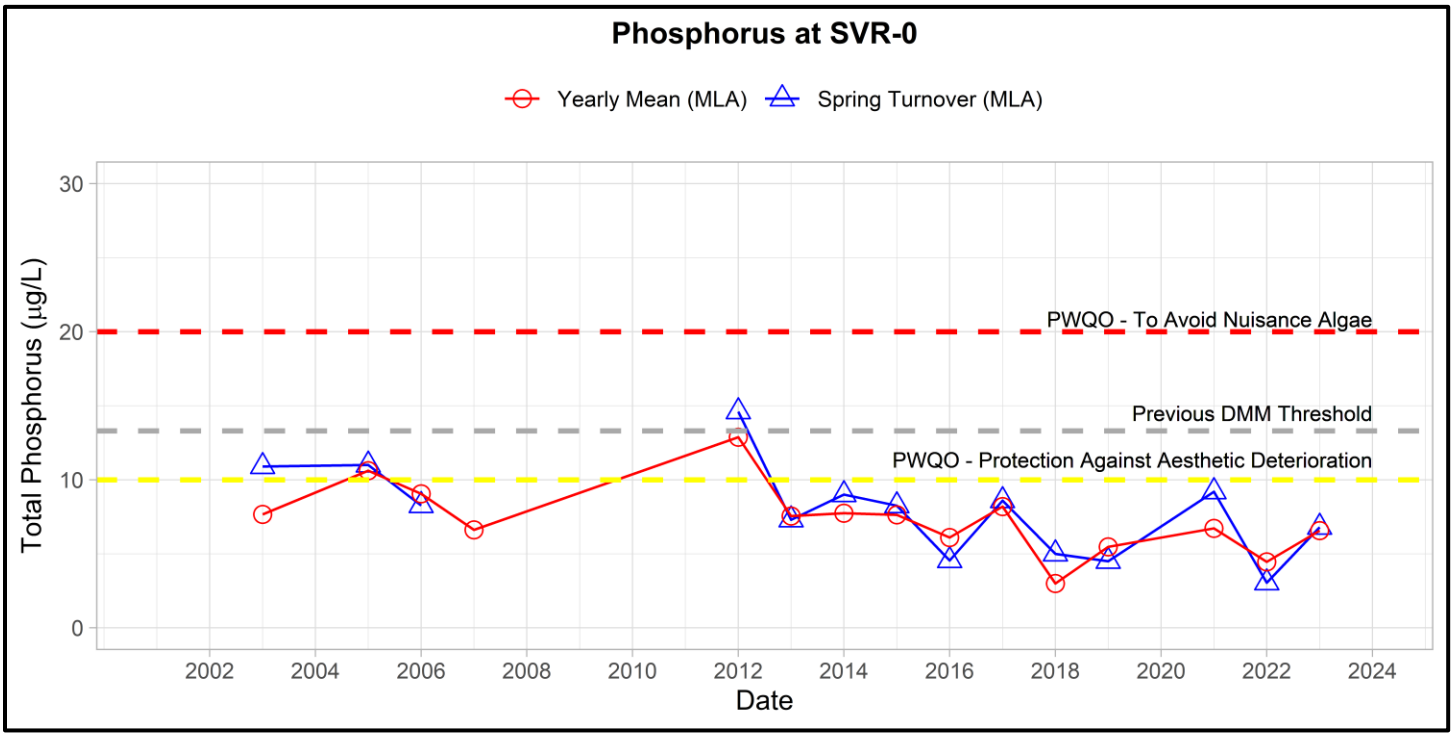
Silver Lake is located at the south end of Gull Lake and has a surface area of 0.58 km² in area and a maximum depth of 14 m. Silver Lake receives drainage from an 8.22 km$^2$ watershed via thirteen rivers and streams. The lake is primarily developed on the north and east shorelines and there is a navigable outlet into Gull Lake in the northwest. Silver Lake is not currently listed as vulnerable by the DMM. MLA monitoring of Silver Lake began in 2003.

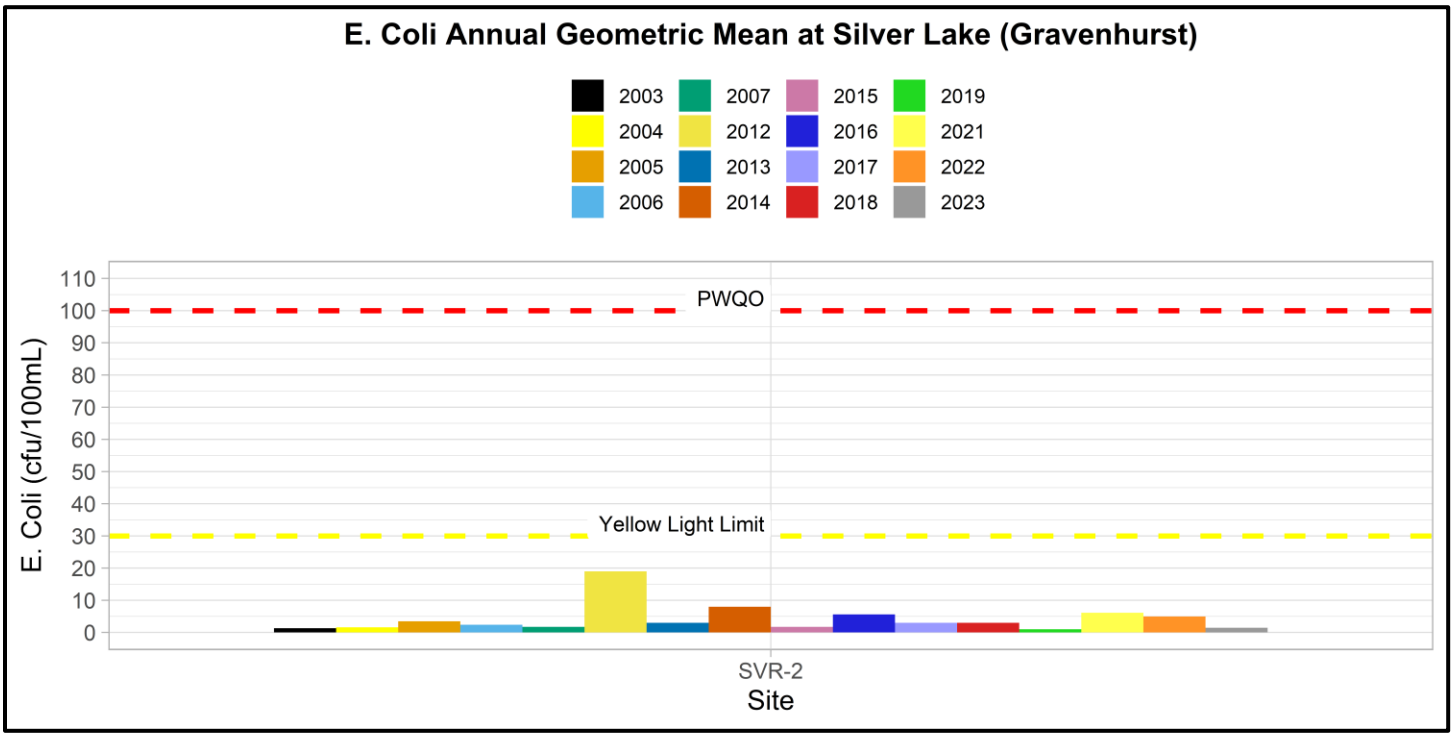
Volunteer Recognition: Bruce & Anne Elliot, Dave & Debbie Stephens, George & Patricia Catleogh.

2023 Water Quality Results:

| | Mean Secchi Disk (m) | Total Phosphorus (µg/L) | | E. coli Yearly Geometric Mean (cfu/100mL) | Total Coliforms Yearly Geometric Mean (cfu/100 mL) |
|---|---|---|---|---|---|
| | | Spring Turnover | Yearly Mean | | |
| **SVR-0** | 2.1 | 6.8 | 6.6 | | |
| **SVR-2** | | | | 1 | 95 |

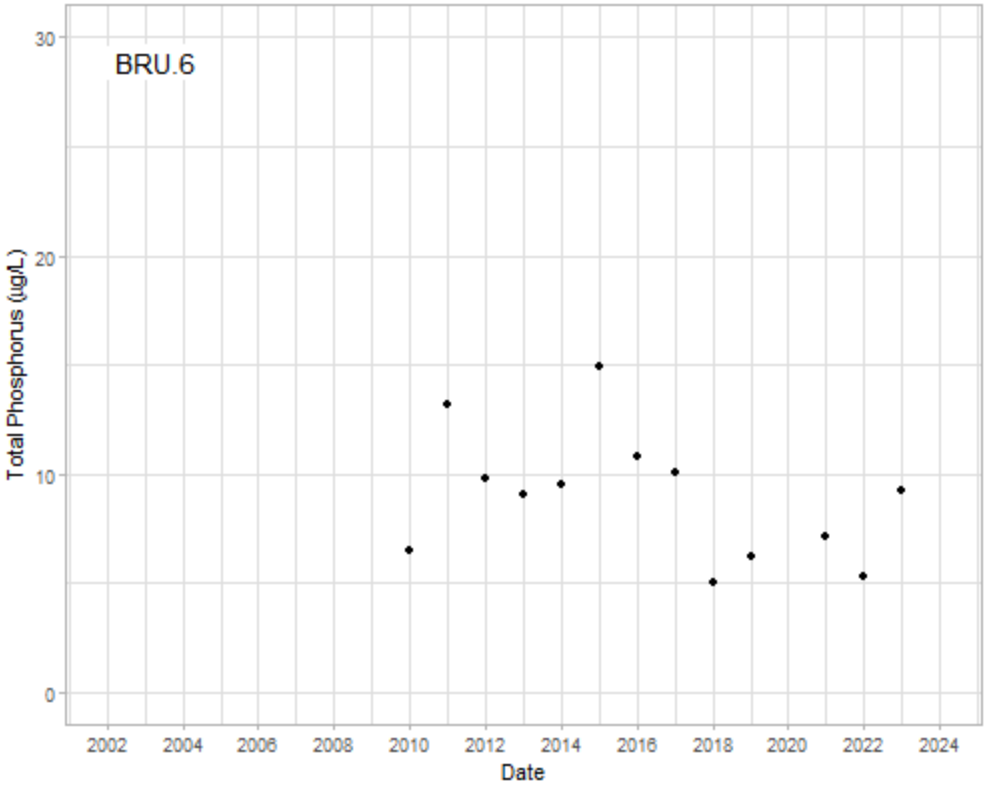
Note: Grubbs test indicates no spring or annual average phosphorus data collected are considered outliers.

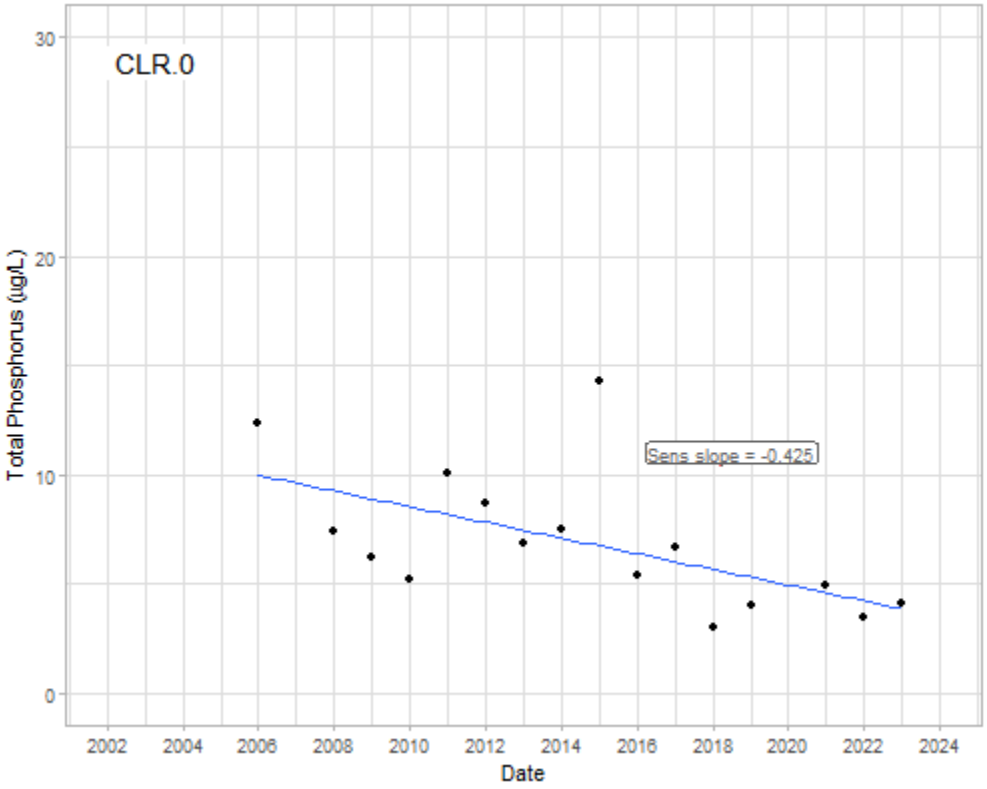


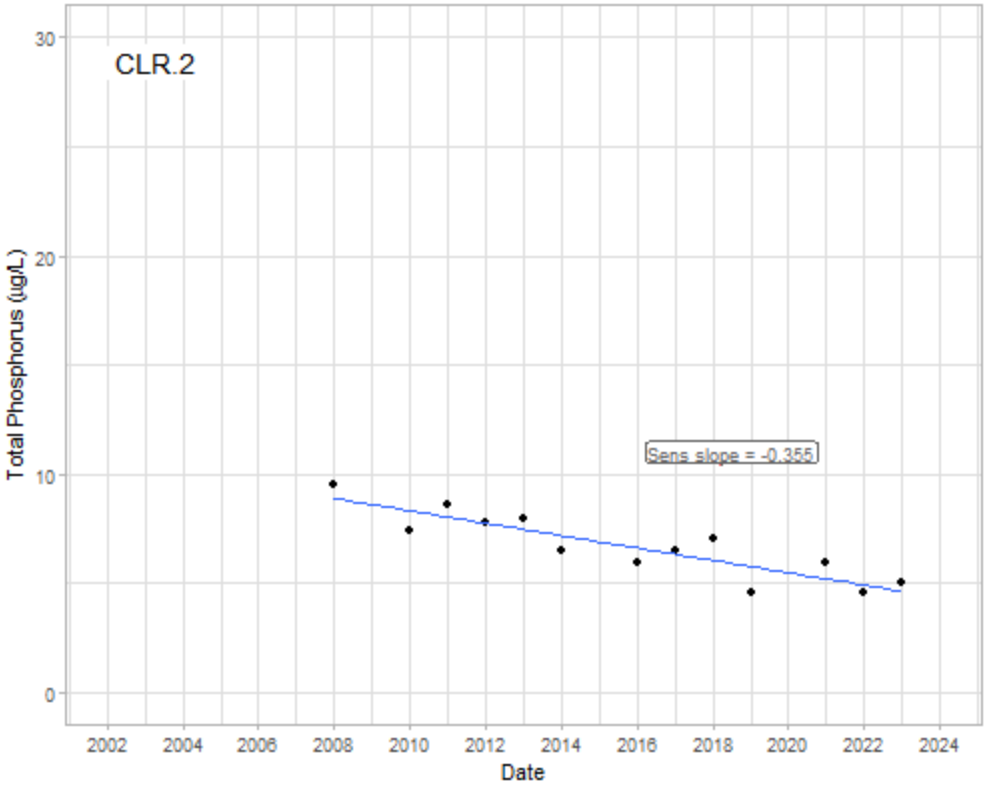


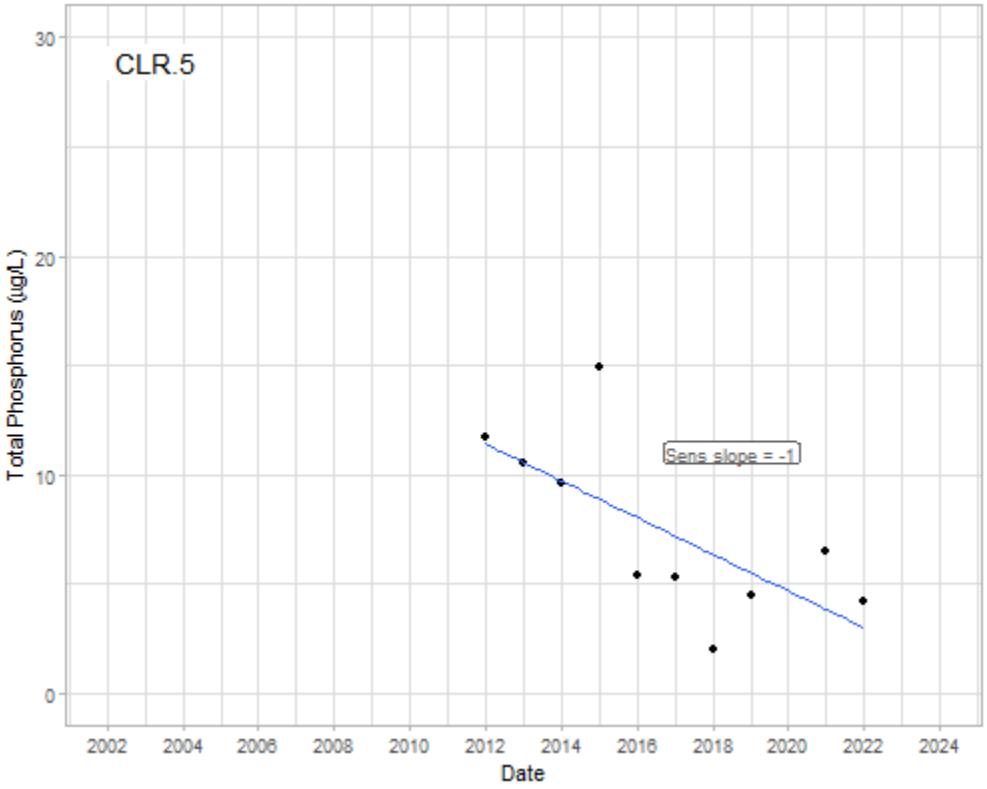

Annual average and spring phosphorus concentrations at the deep-water station (SVR-0) were below the historic DMM threshold of 13.3 µg/L and Provincial Water Quality Monitoring Objectives for Protection Against Aesthetic Deterioration (10 µg/L) and Nuisance Algal Growth (20 µg/L). *E. coli* samples collected in 2023 at SVR-2 were below the MLA stoplight limit. Average annual Secchi disk depth (2.1 m) was consistent with previous monitoring (2.0 and 4.5 m). **HESL recommends ongoing sampling to continue to monitor for long-term trends and emerging issues.**

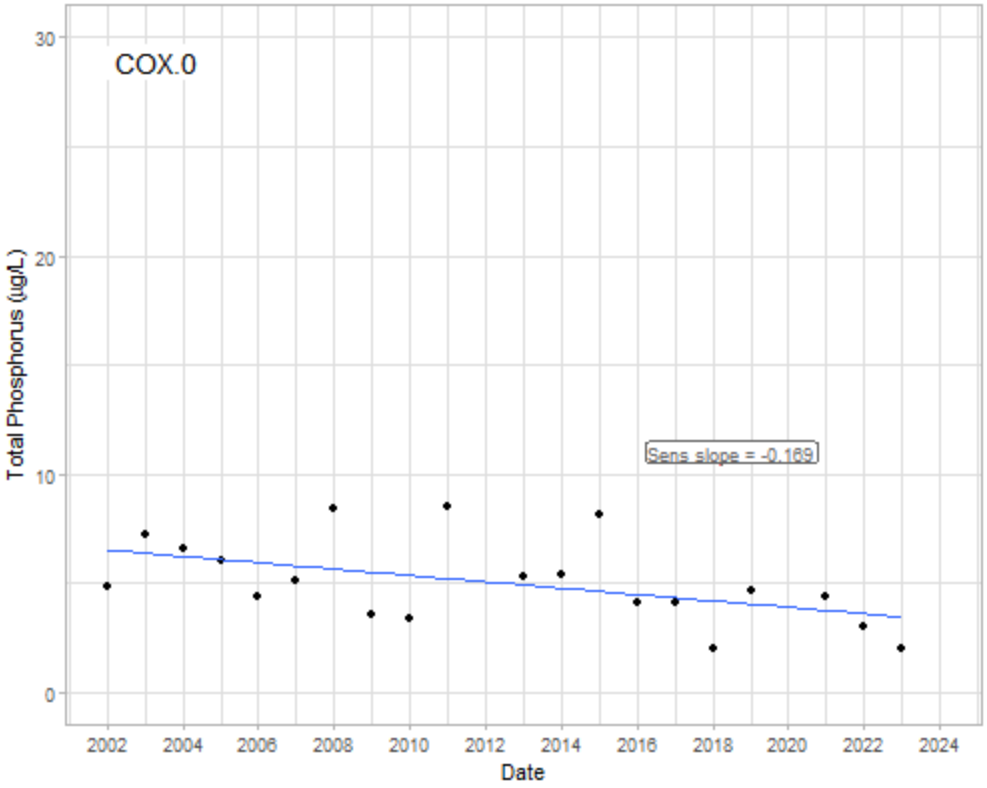
# Appendix B. Long-term Trend Analyses – Total Phosphorus

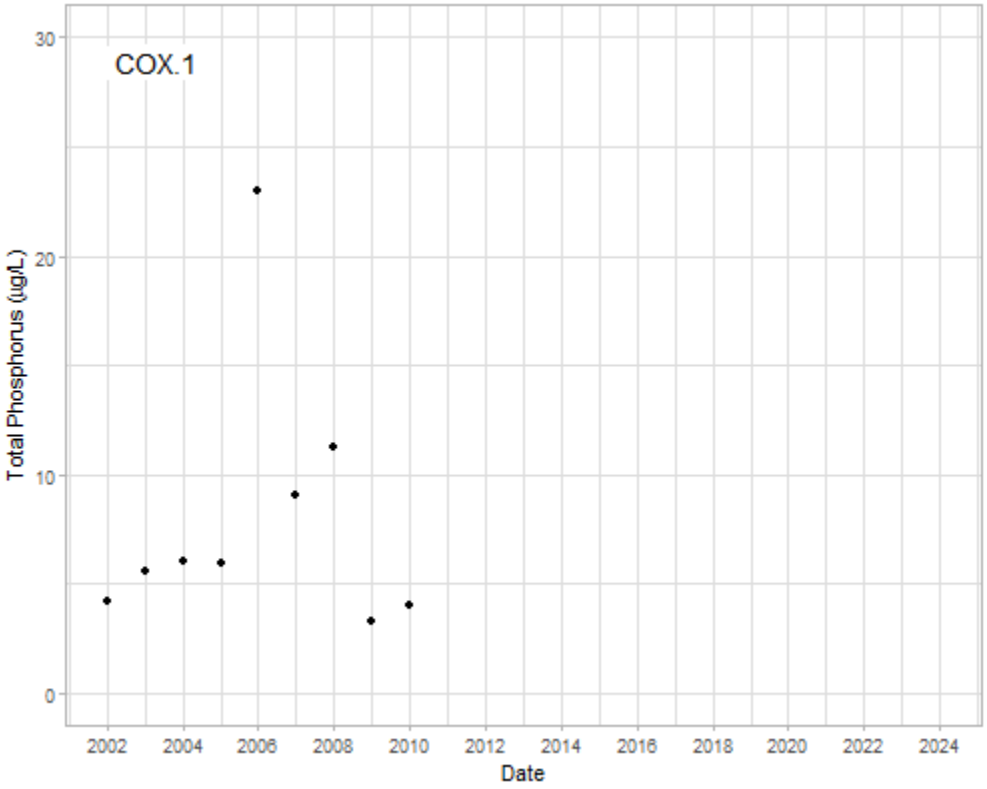

BRU.6
Total Phosphorus (ug/L)
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date

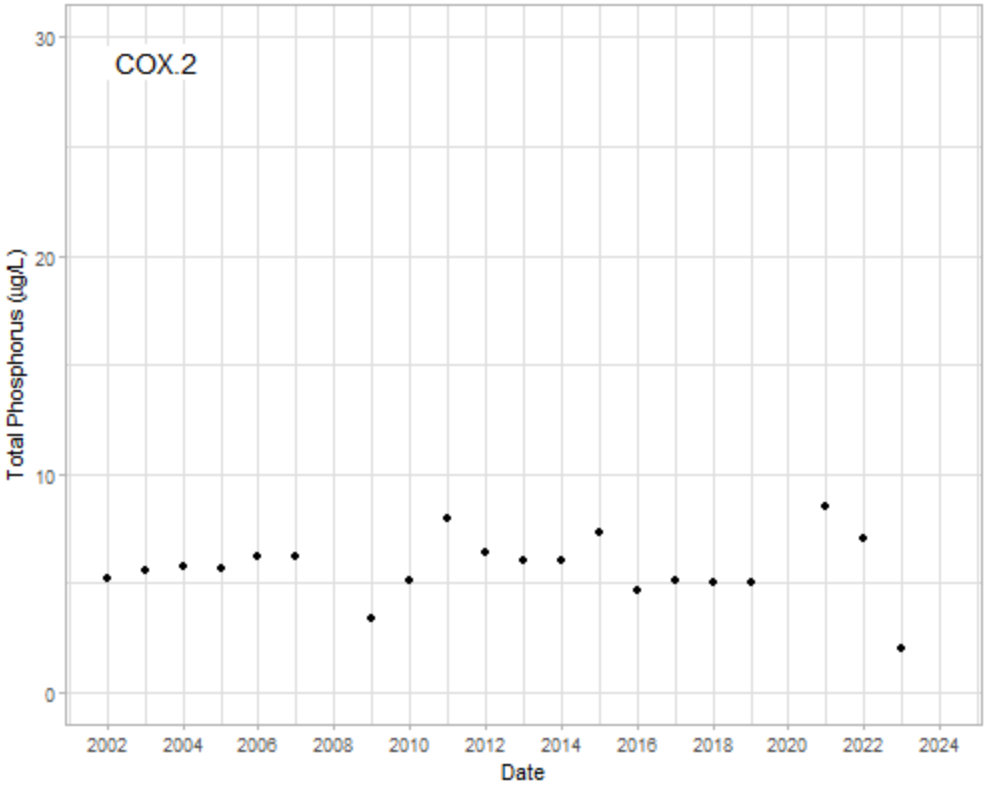

CLR.0
Total Phosphorus (ug/L)
Sens slope = -0.425
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date

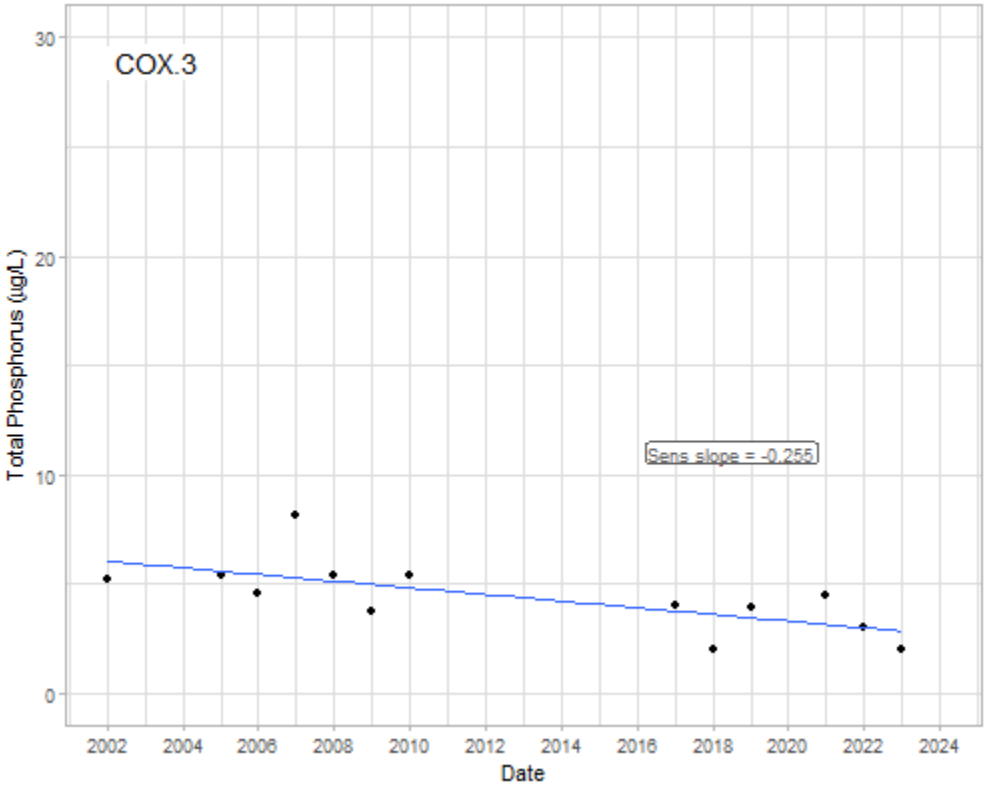

CLR.2
Sens slope = -0.355
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024

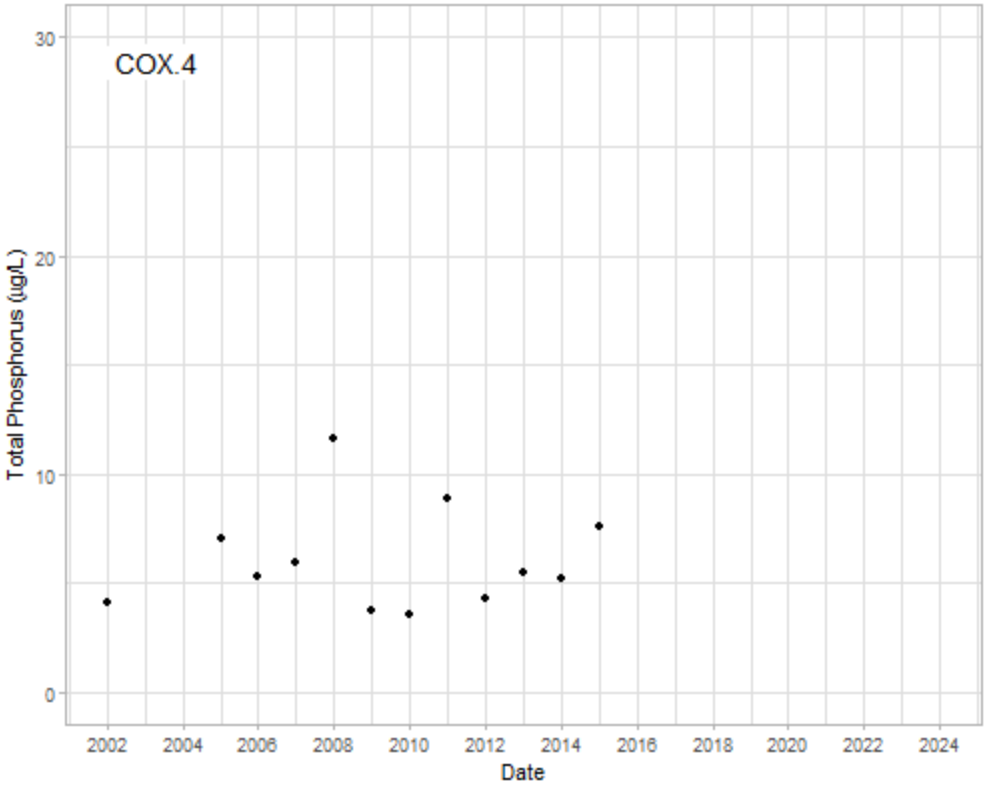

CLR.5
Sens slope = -1
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024

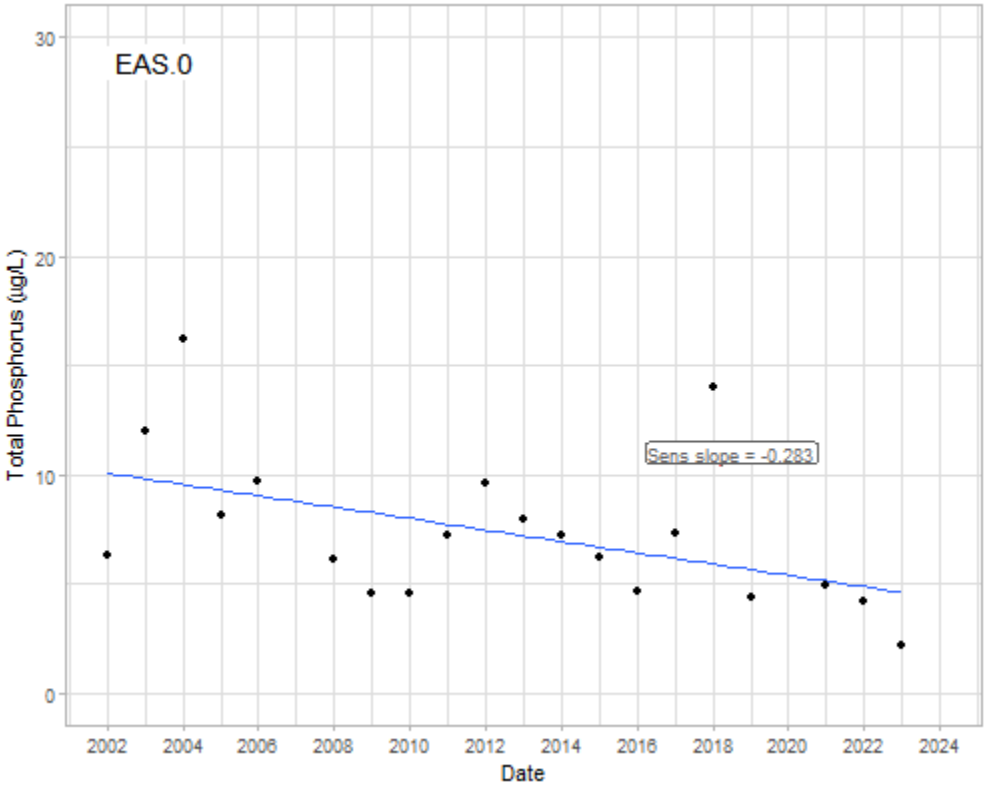

COX.0
Sens slope = -0.169
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024

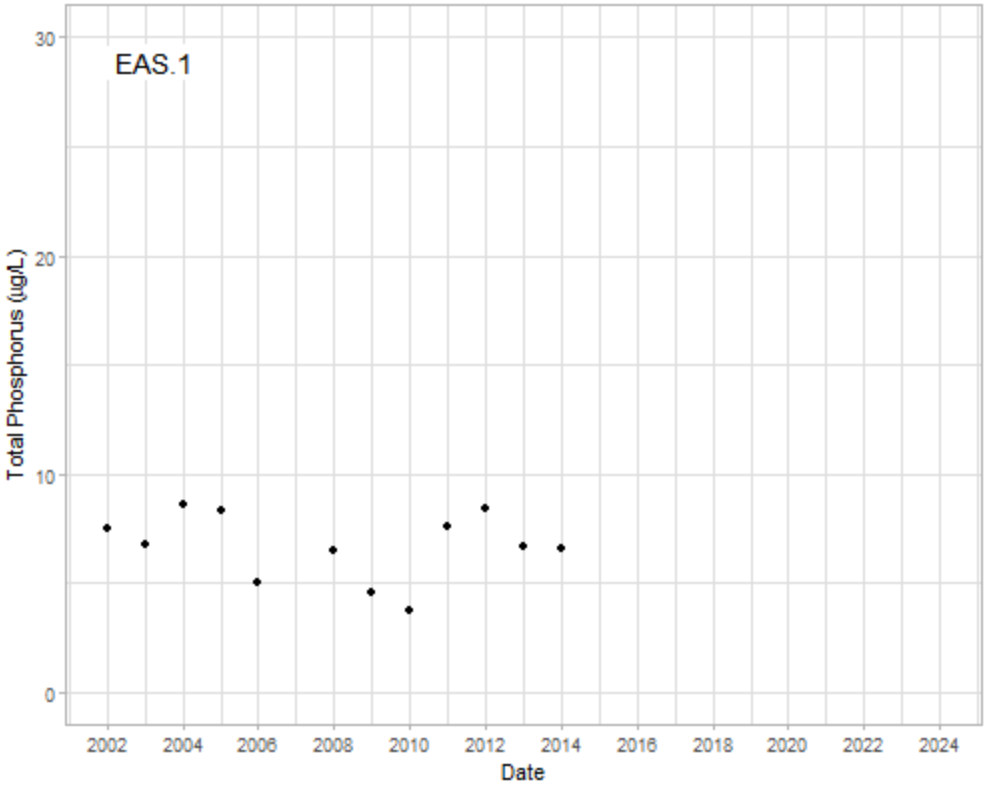

COX.1
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024

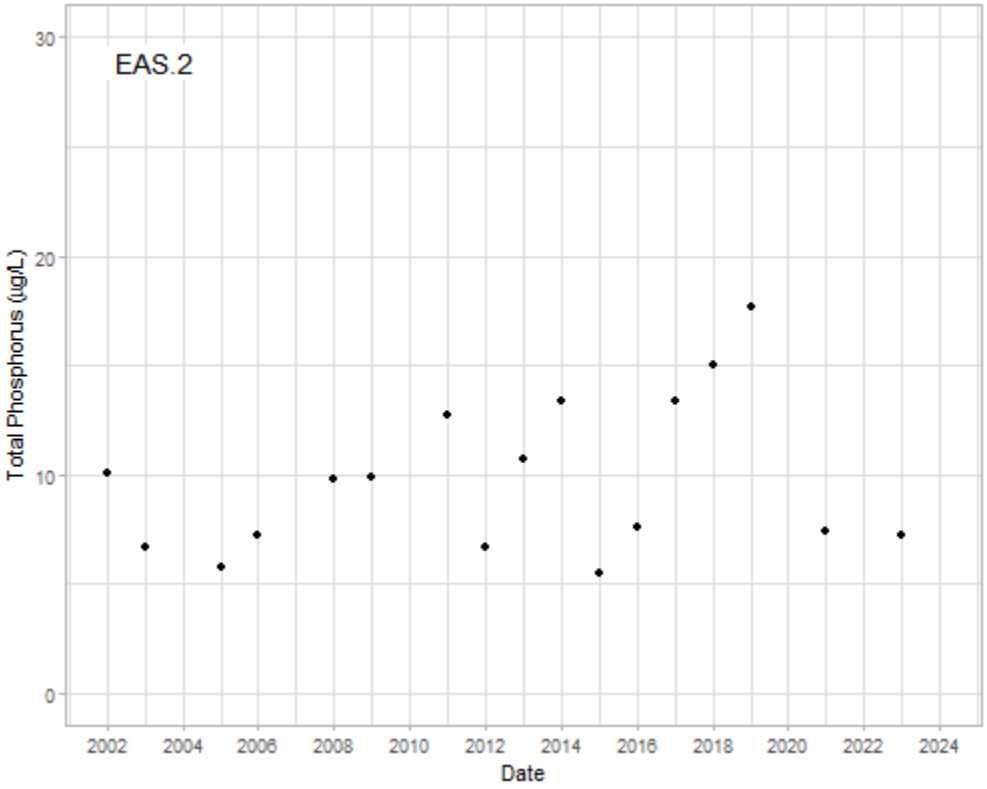

COX.2
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date

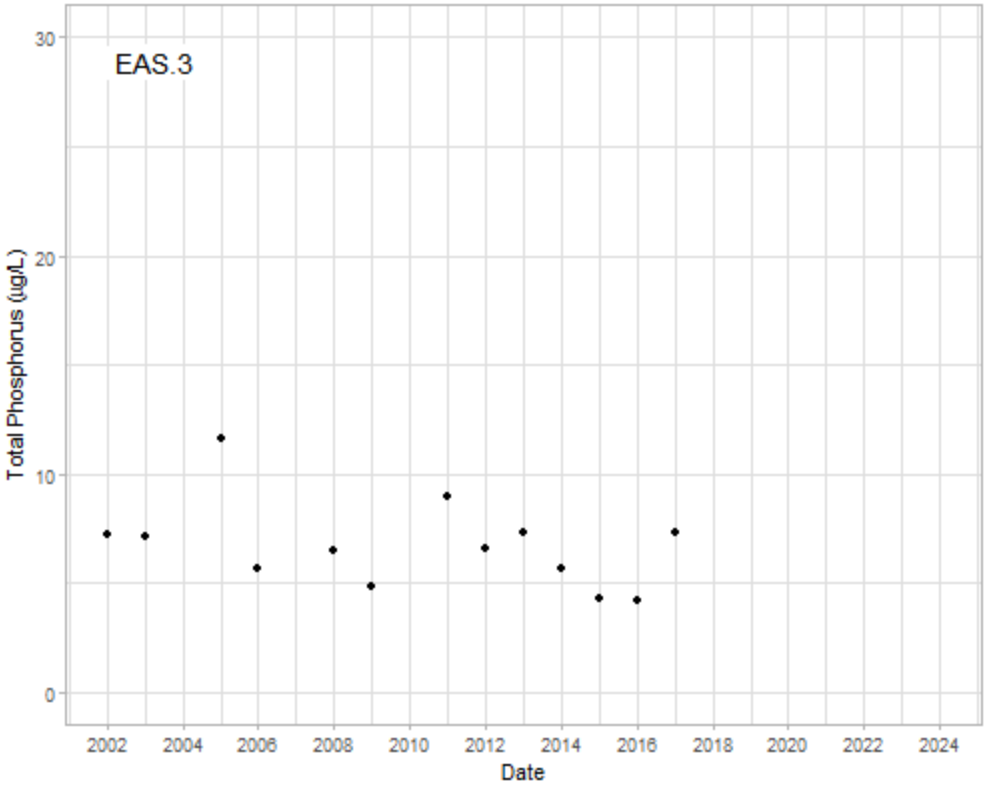

COX.3
Total Phosphorus (ug/L)
30
20
10
0
Sens slope = -0.255
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date

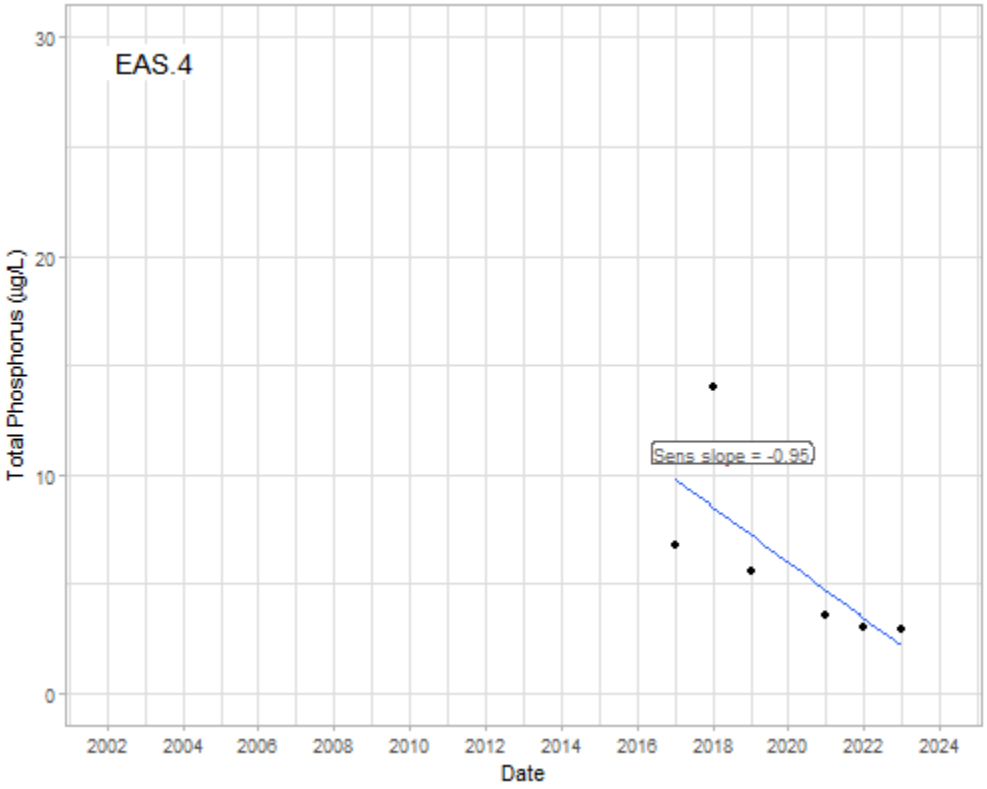

COX.4
Total Phosphorus (ug/L)
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date

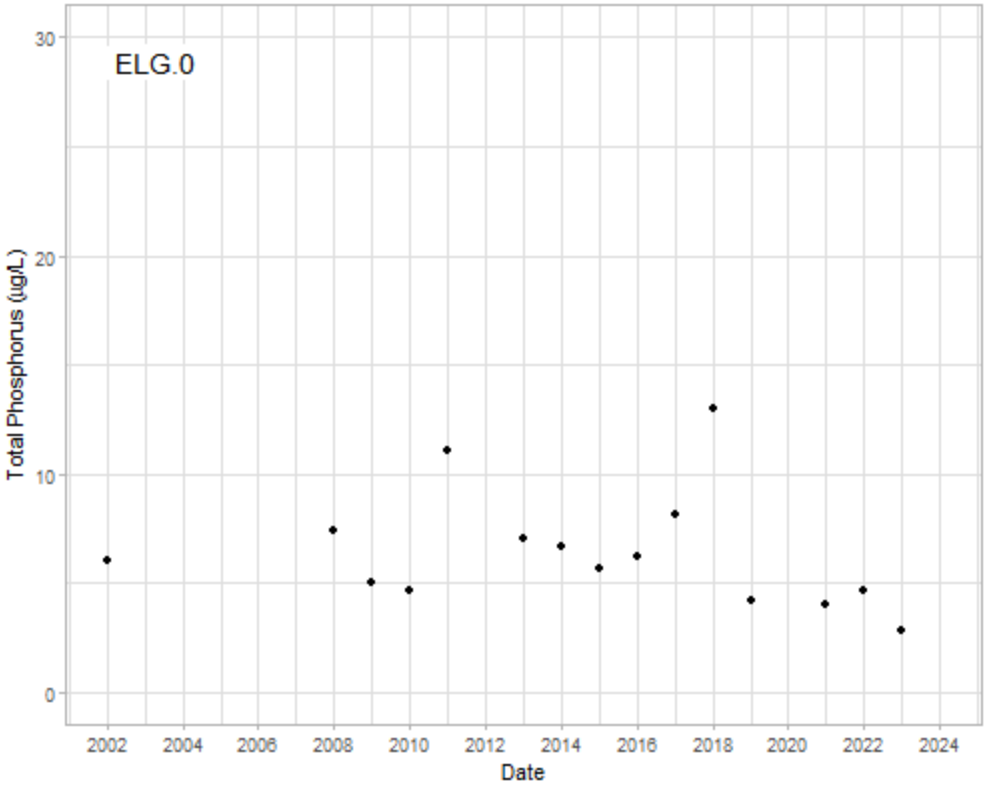

EAS.0
Sens slope = -0.283
Total Phosphorus (ug/L)
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


EAS.1
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


EAS.2
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


EAS.3
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


EAS.4
Total Phosphorus (ug/L)
30
20
10
0
Sens slope = -0.95
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


ELG.0
Total Phosphorus (ug/L)
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2002
2004
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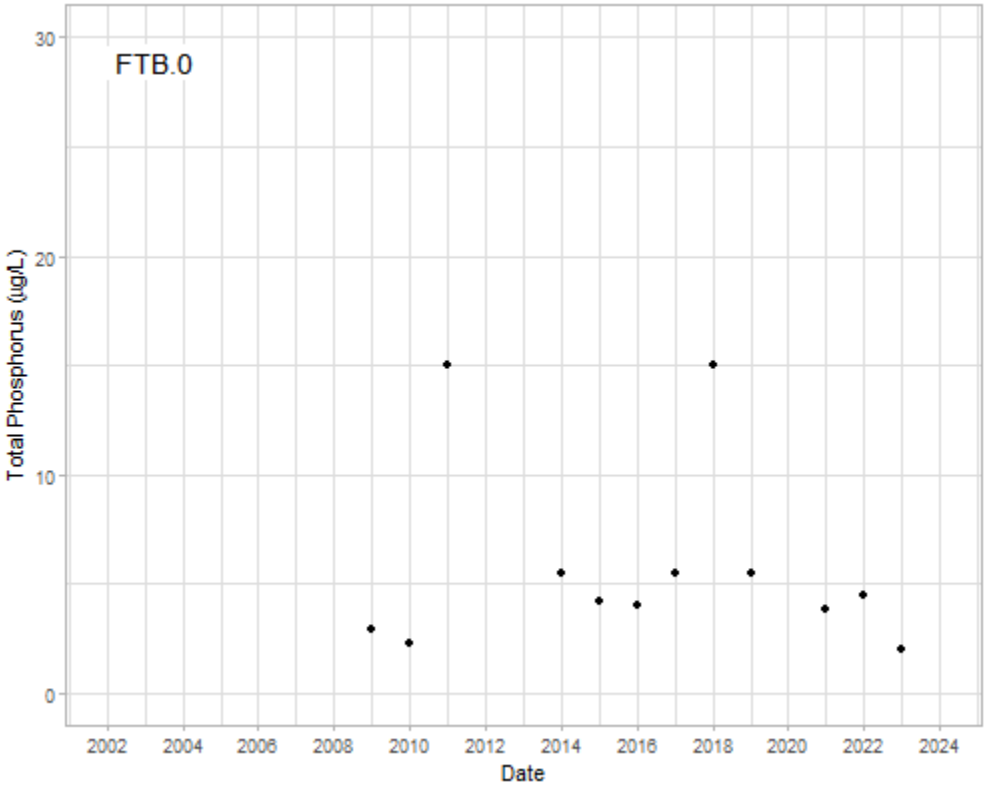
Date


FTB.0
Total Phosphorus (ug/L)
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0
2002
2004
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2008
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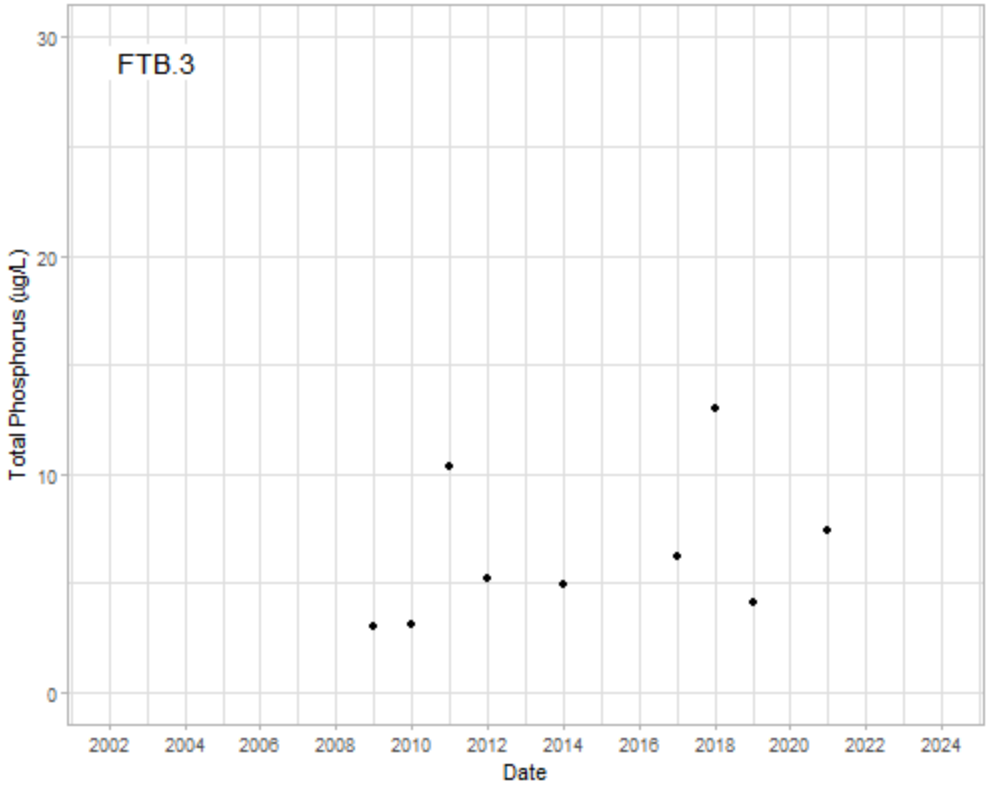
2024
Date


FTB.3
Total Phosphorus (ug/L)
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2002
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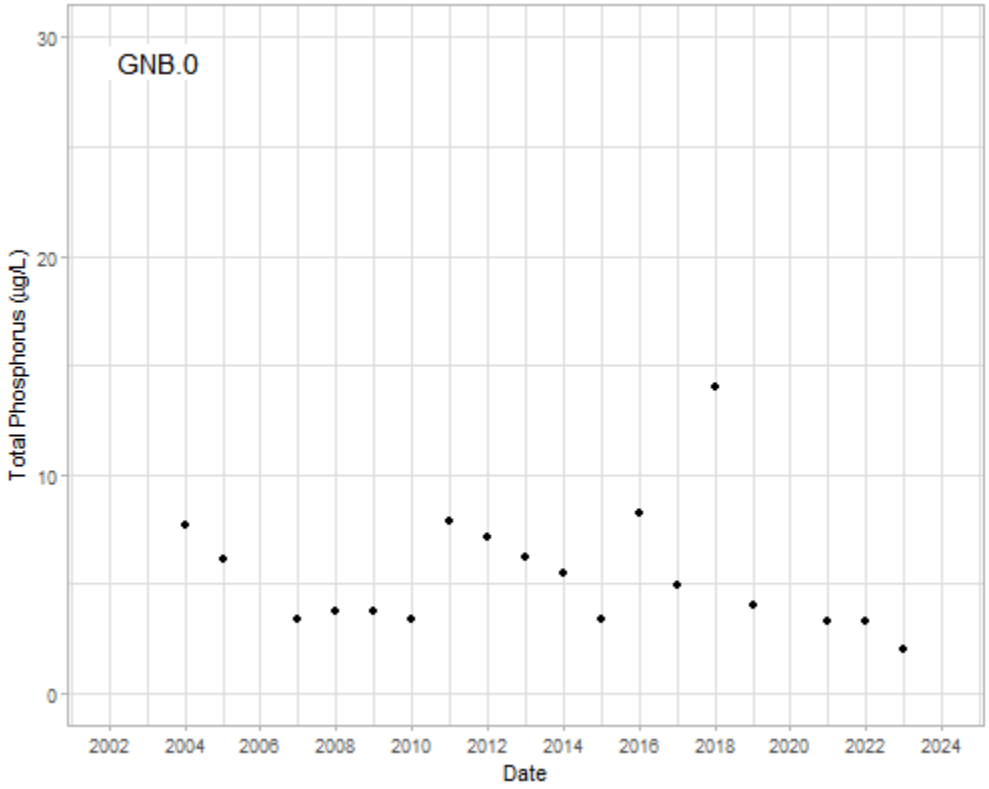
Date


GNB.0
Total Phosphorus (ug/L)
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30
2002
2004
2006
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2022
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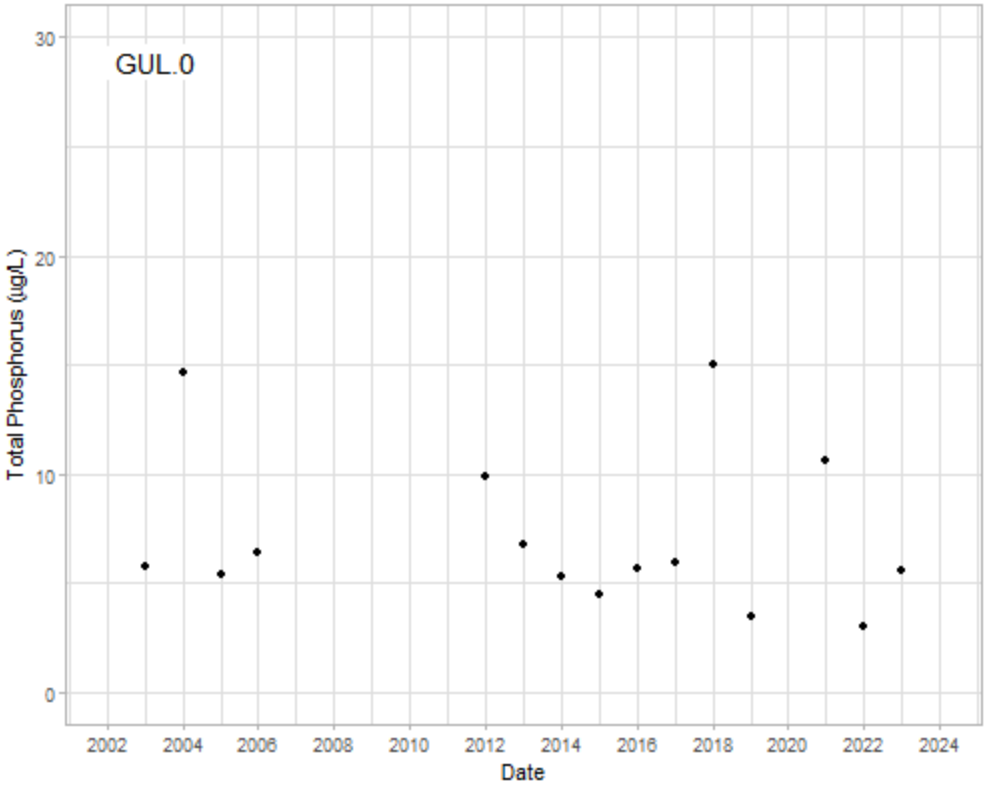
Date


GUL.0
Total Phosphorus (ug/L)
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2002
2004
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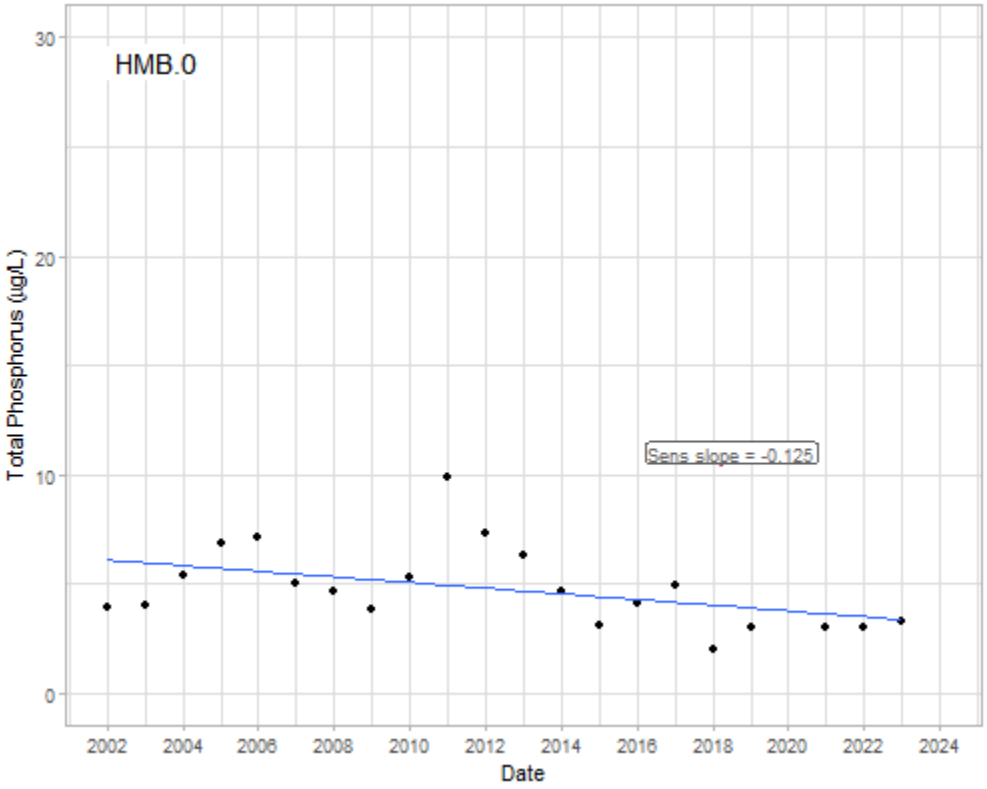
Date


HMB.0
Total Phosphorus (ug/L)
Sens slope = -0.125
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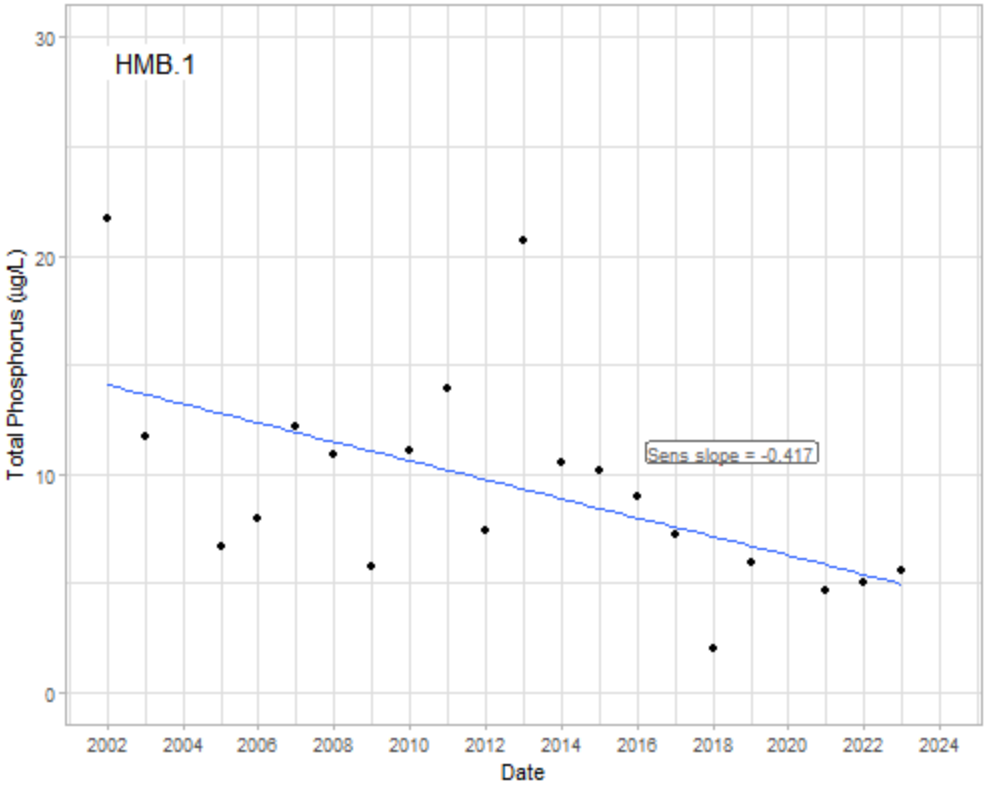
Date


HMB.1
Sens slope = -0.417
Total Phosphorus (ug/L)
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20
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2002
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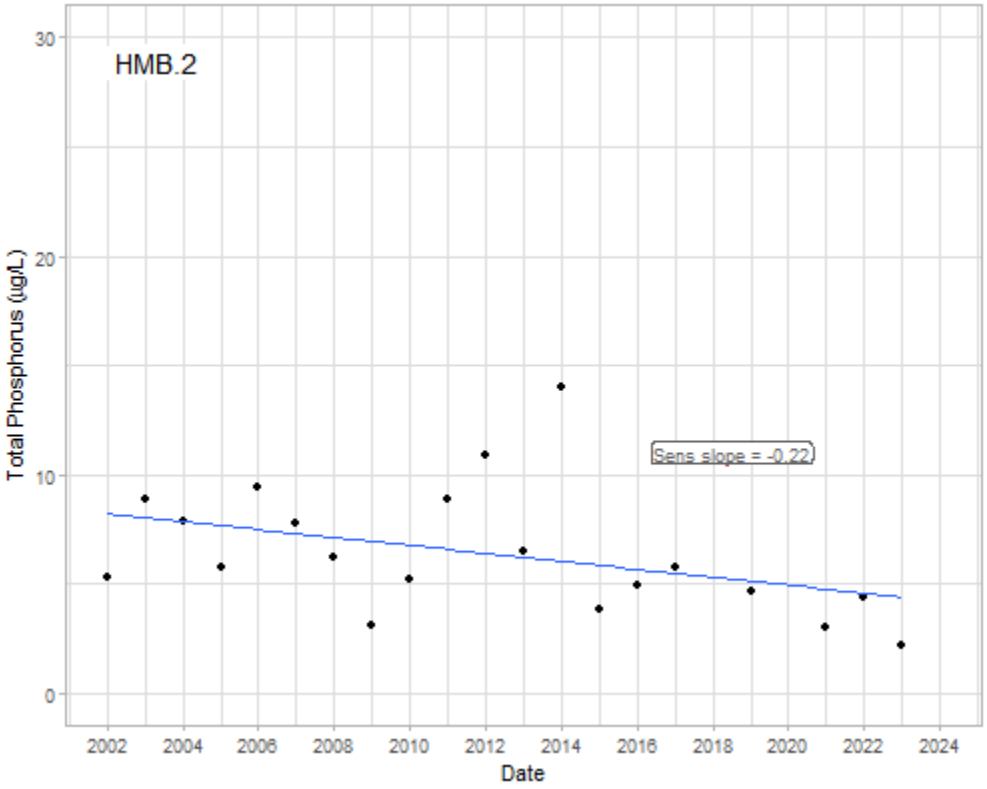
HMB.2
Sens slope = -0.22
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
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2012
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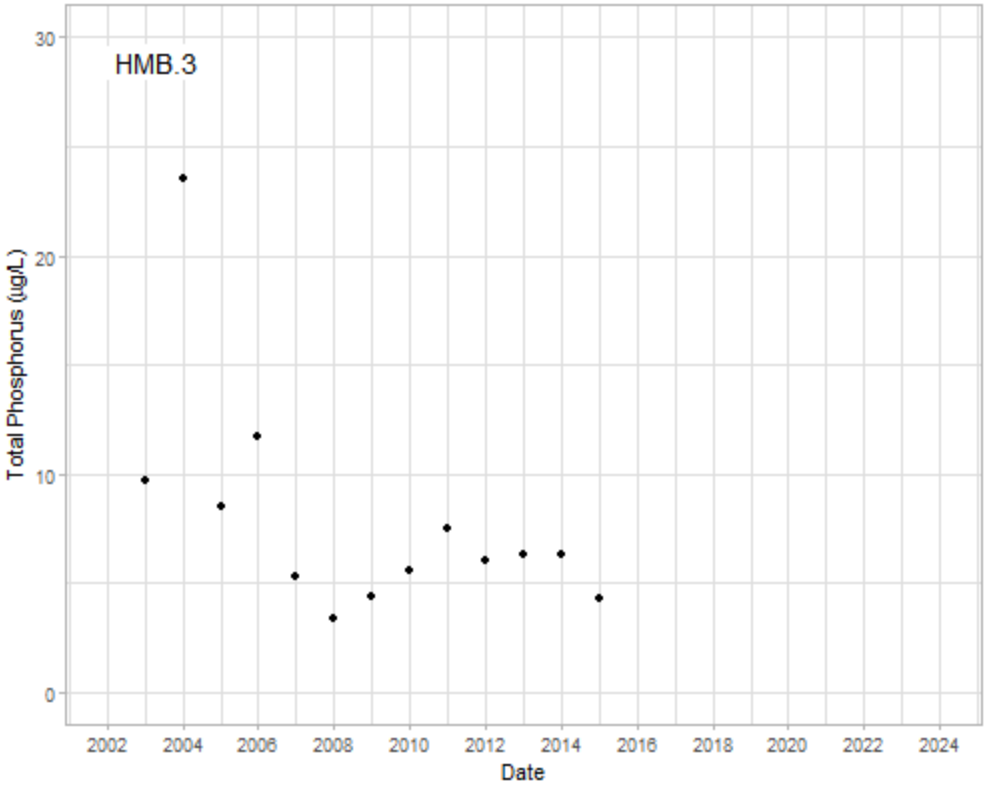
HMB.3
Total Phosphorus (ug/L)
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0
2002
2004
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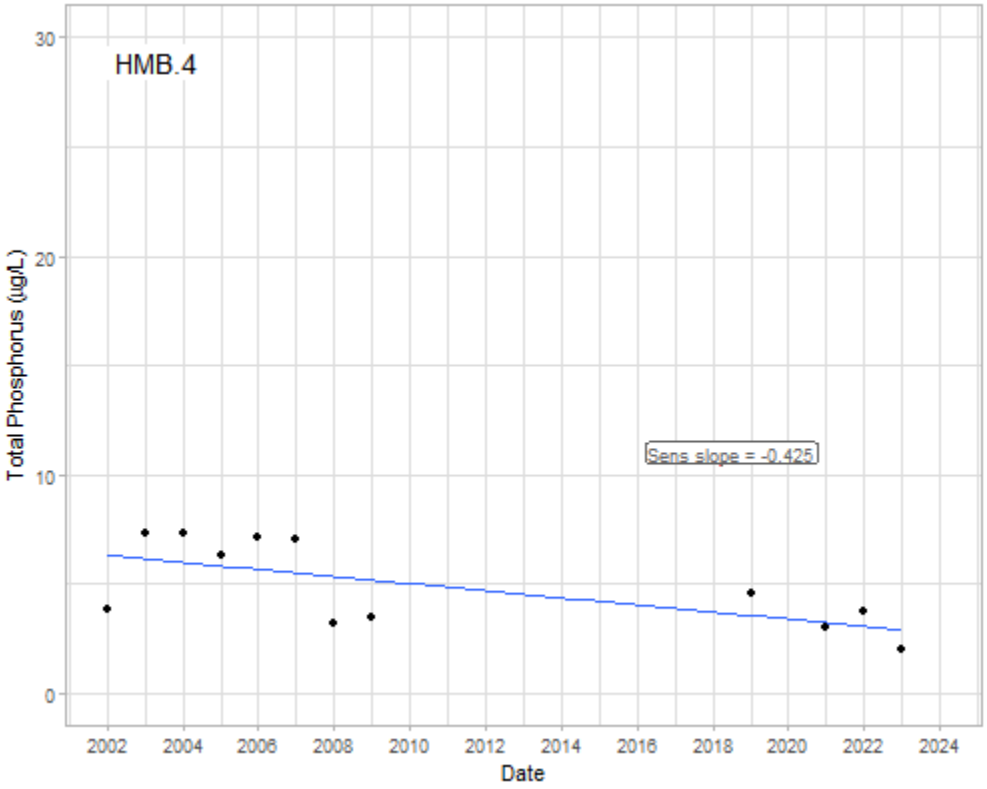
2022
2024
Date


HMB.4
Total Phosphorus (ug/L)
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10
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Sens slope = -0.425
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2022
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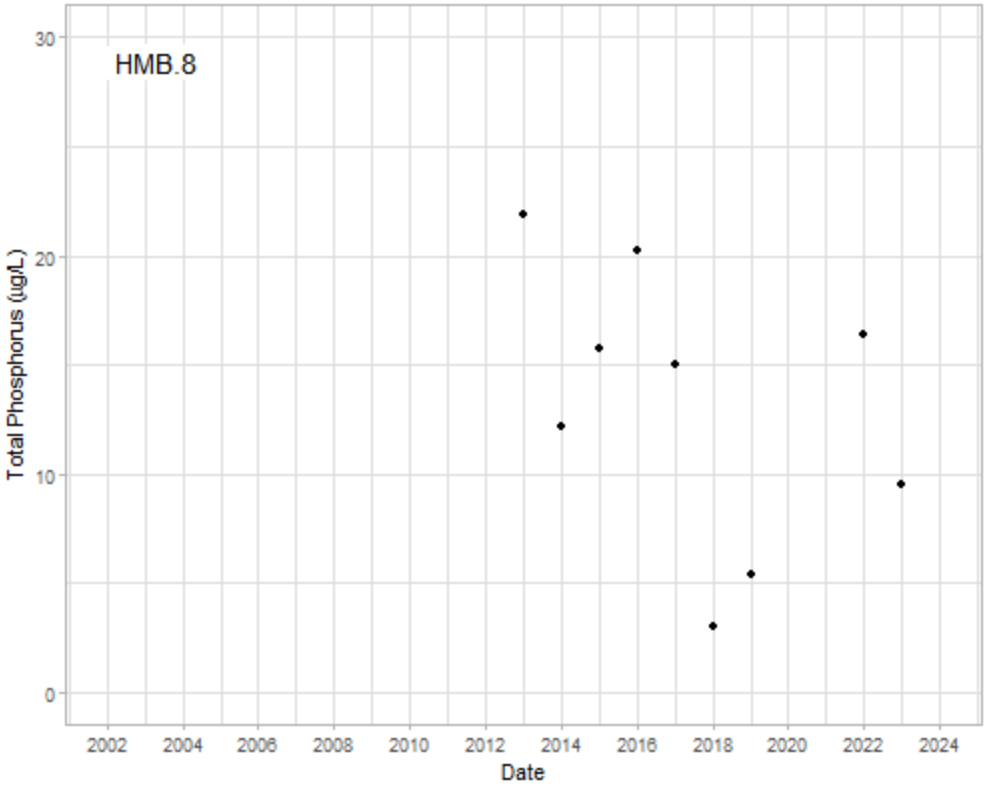
Date


HMB.8
Total Phosphorus (ug/L)
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30
2002
2004
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2012
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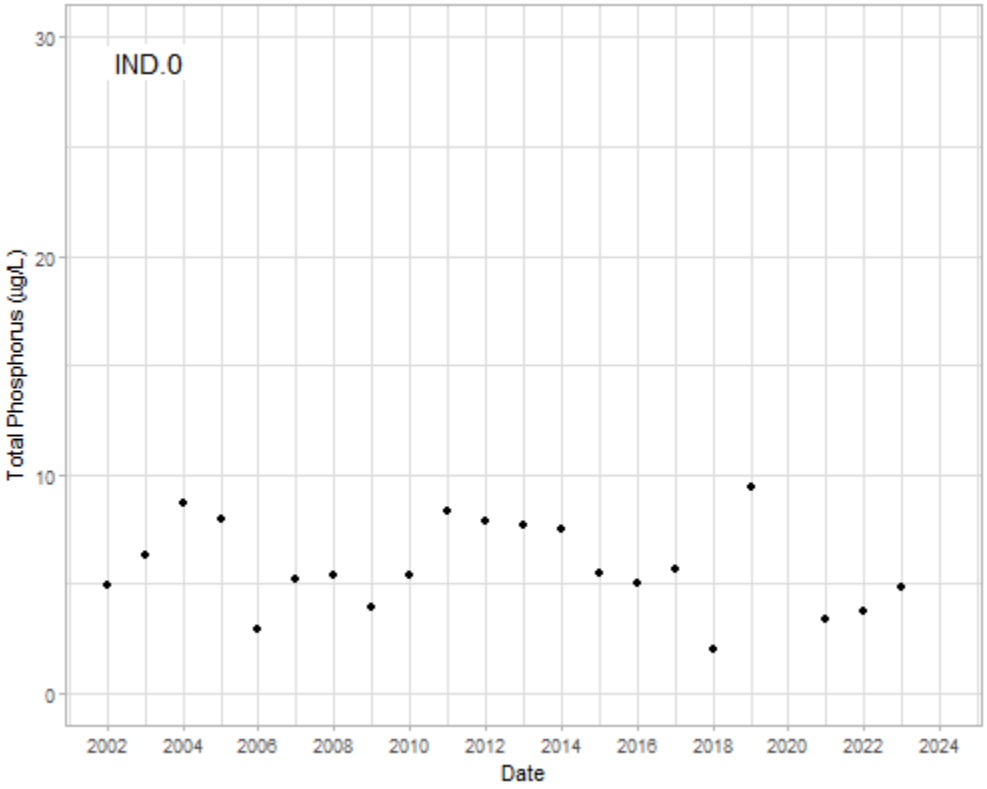
2022
2024
Date


IND.0
Total Phosphorus (ug/L)
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10
20
30
2002
2004
2006
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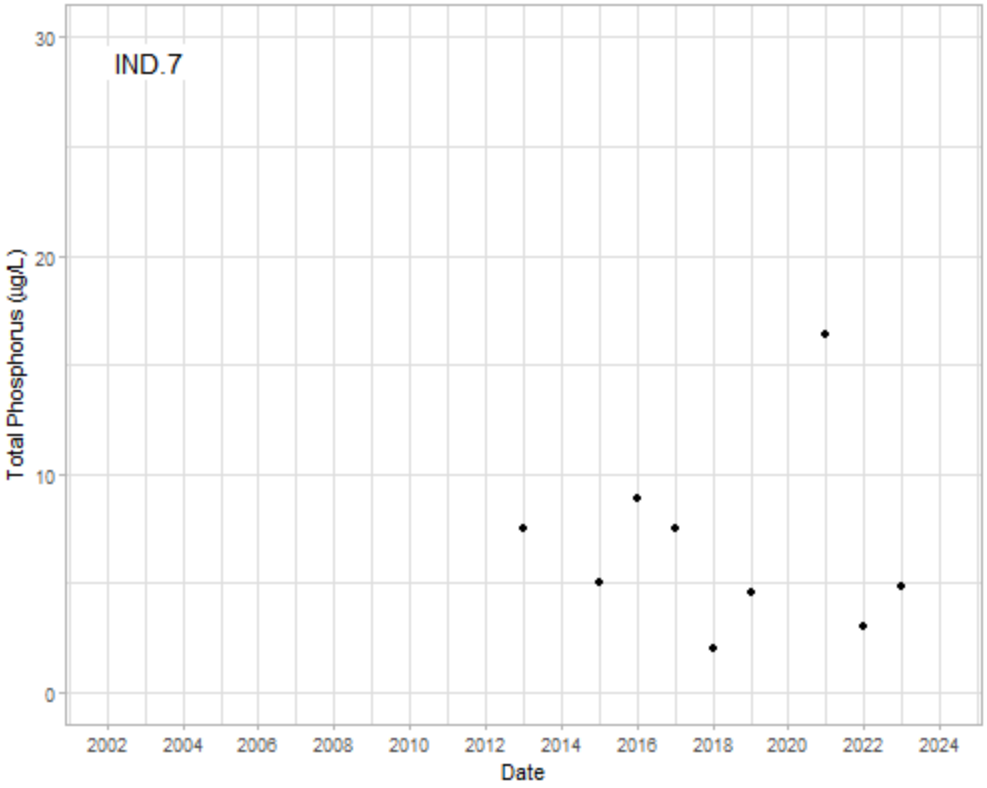
2020
2022
2024
Date


IND.7
Total Phosphorus (ug/L)
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10
0
2002
2004
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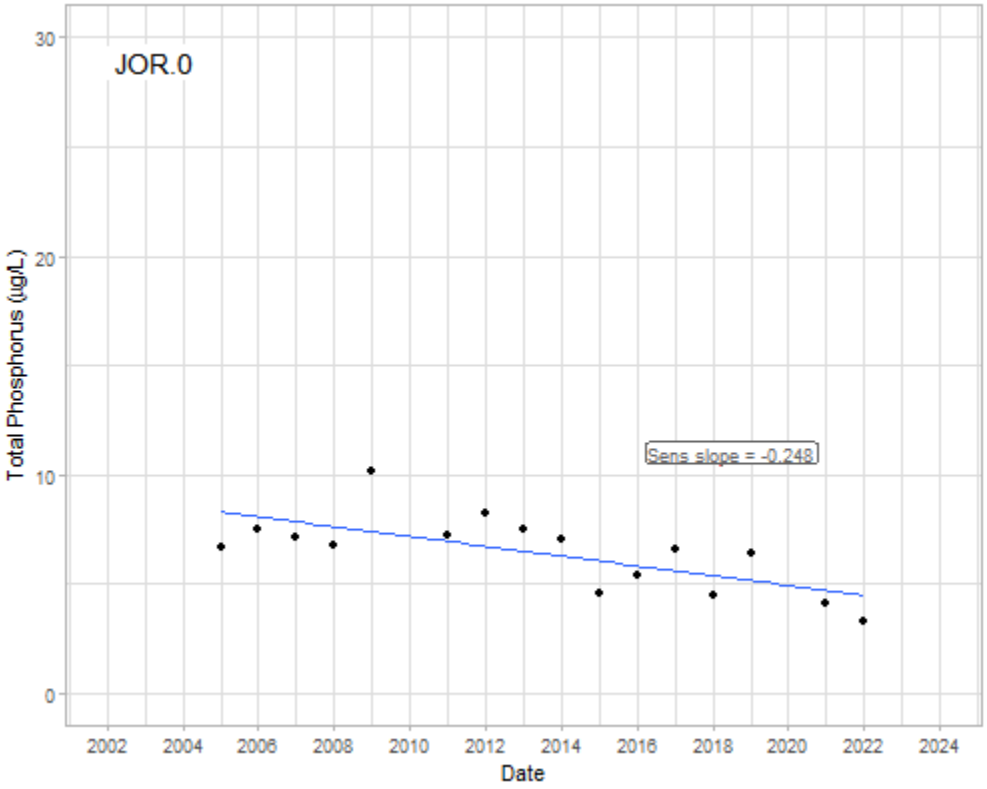
2022
2024
Date


JOR.0
Total Phosphorus (ug/L)
30
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10
0
Sens slope = -0.248
2002
2004
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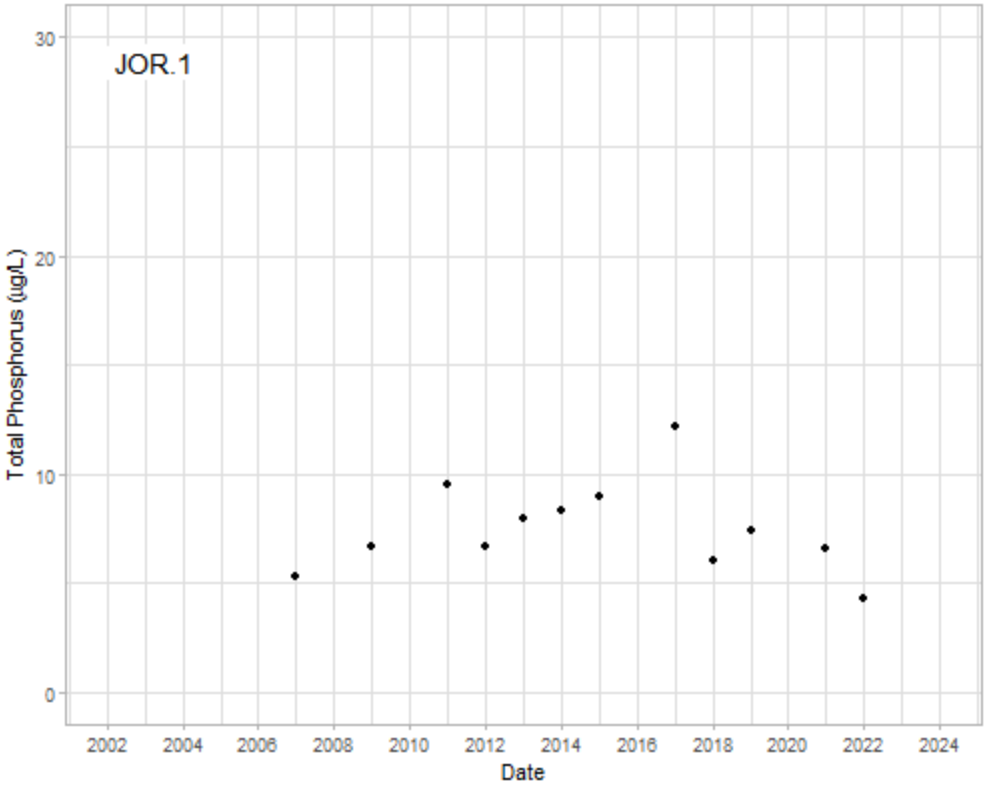
Date


JOR.1
Total Phosphorus (ug/L)
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0
2002
2004
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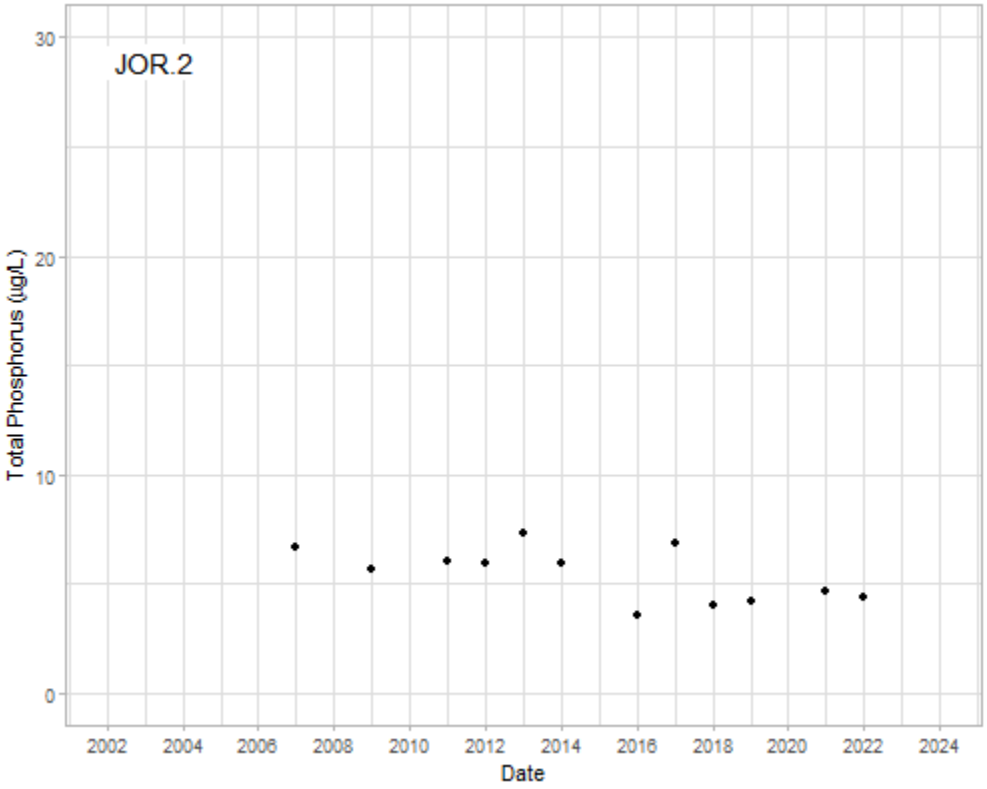
2022
2024
Date


JOR.2
Total Phosphorus (ug/L)
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2002
2004
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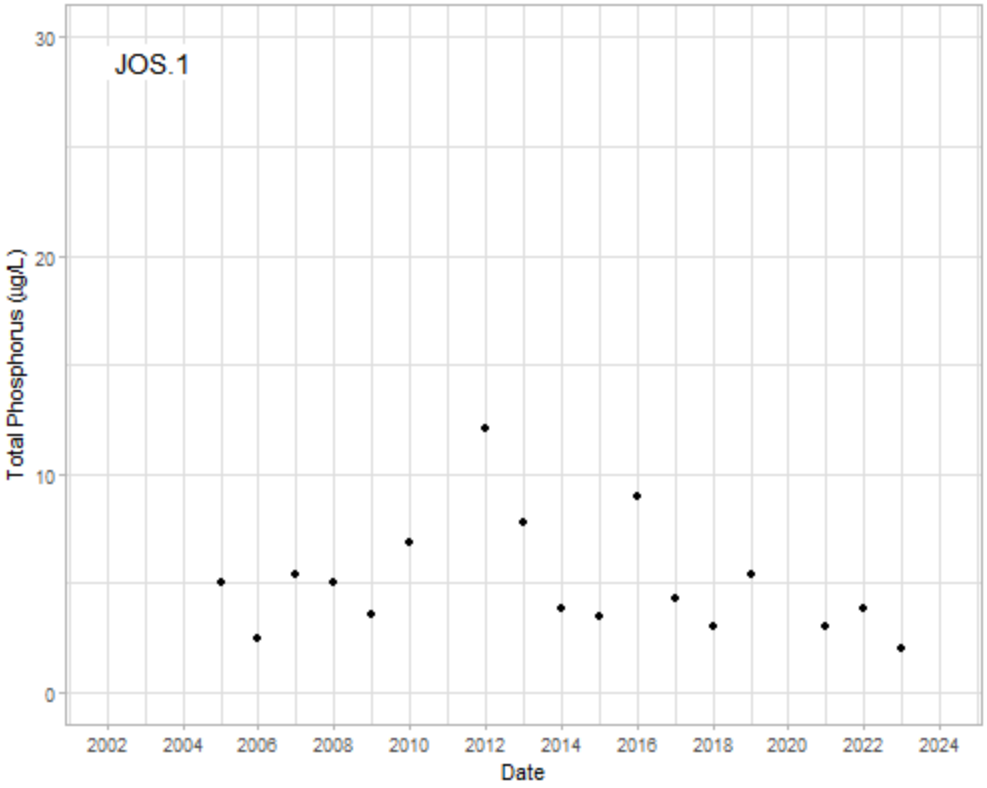
Date


JOS.1
Total Phosphorus (ug/L)
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2002
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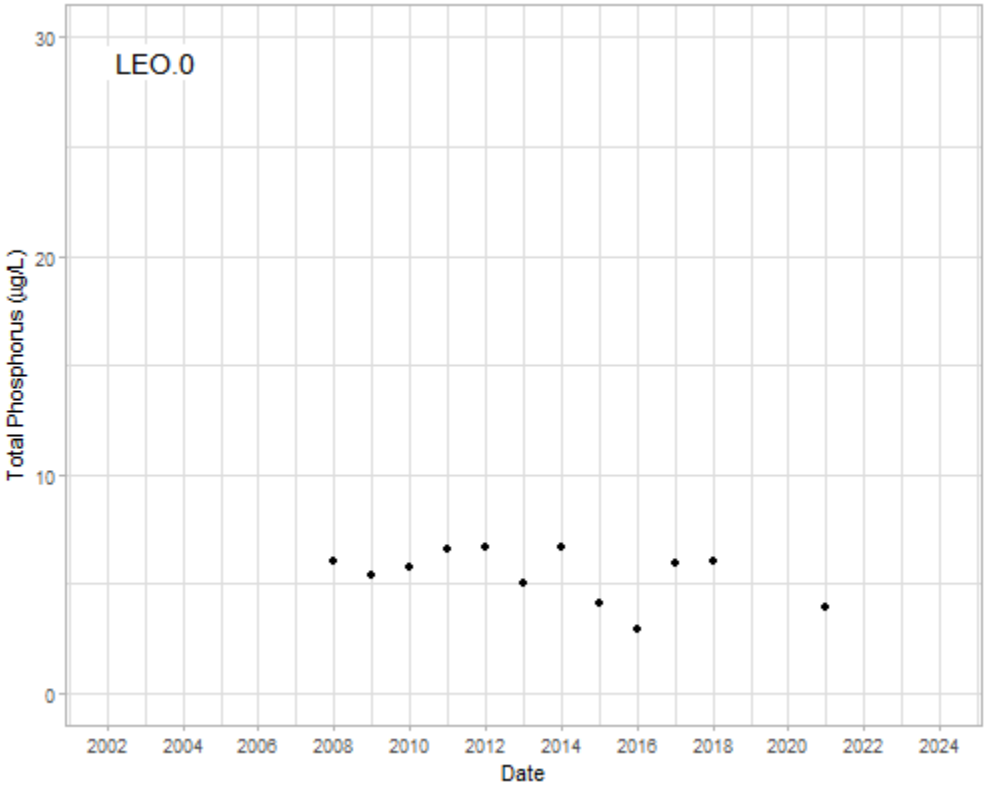
2022
2024
Date


LEO.0
Total Phosphorus (ug/L)
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2002
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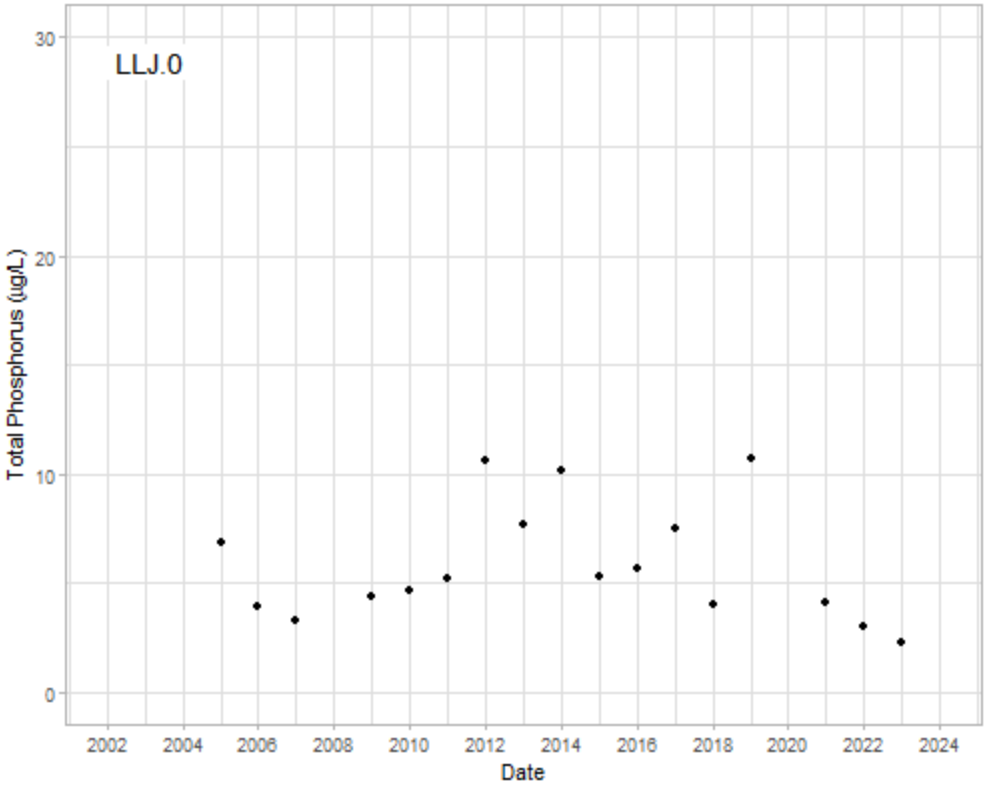
2022
2024
Date


LLJ.0
Total Phosphorus (ug/L)
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0
2002
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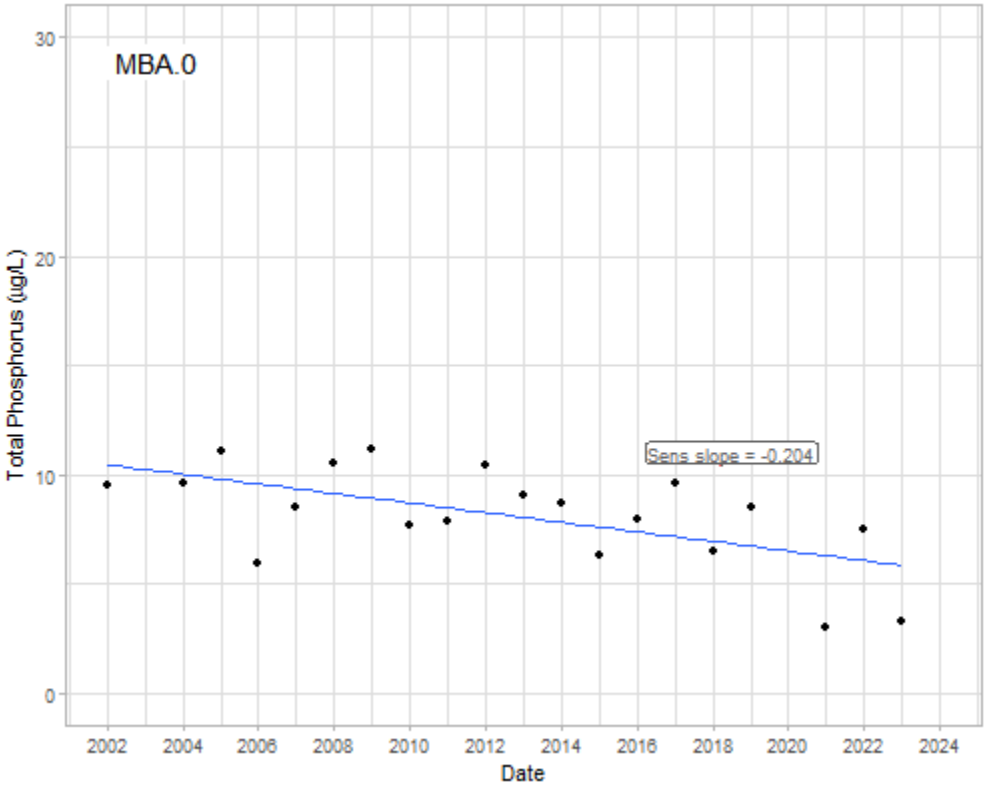
2022
2024
Date


MBA.0
Total Phosphorus (ug/L)
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Sens slope = -0.204
2002
2004
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2022
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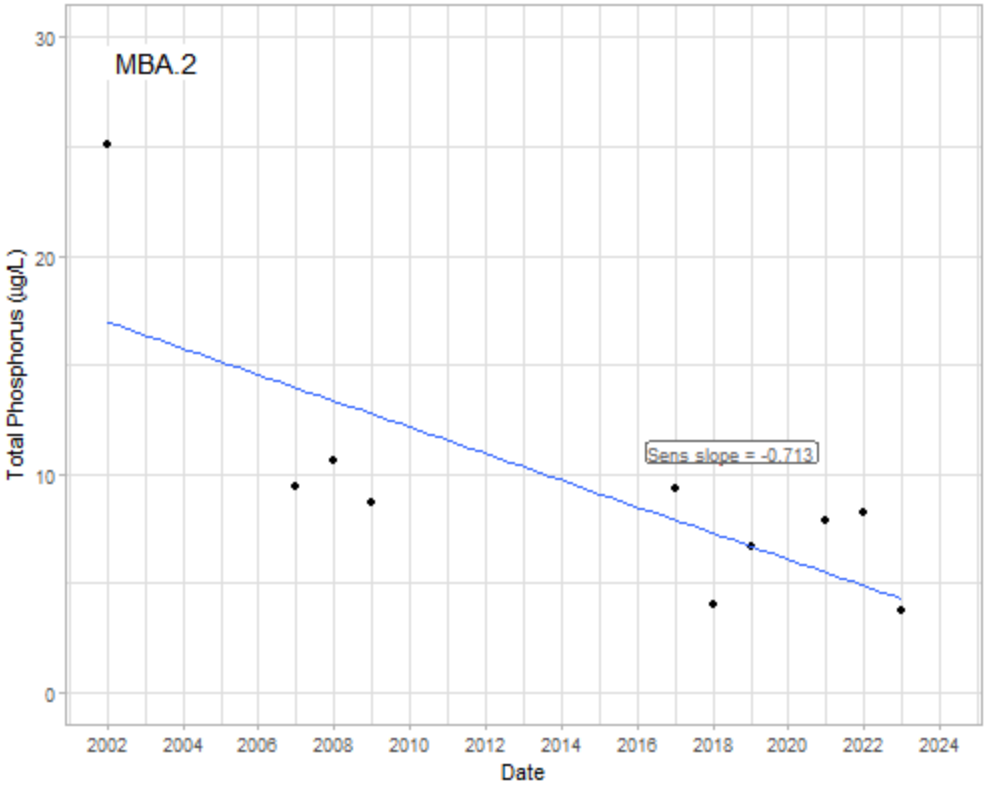
Date


MBA.2
Sens slope = -0.713
Total Phosphorus (ug/L)
Date
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10
20
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2002
2004
2006
2008
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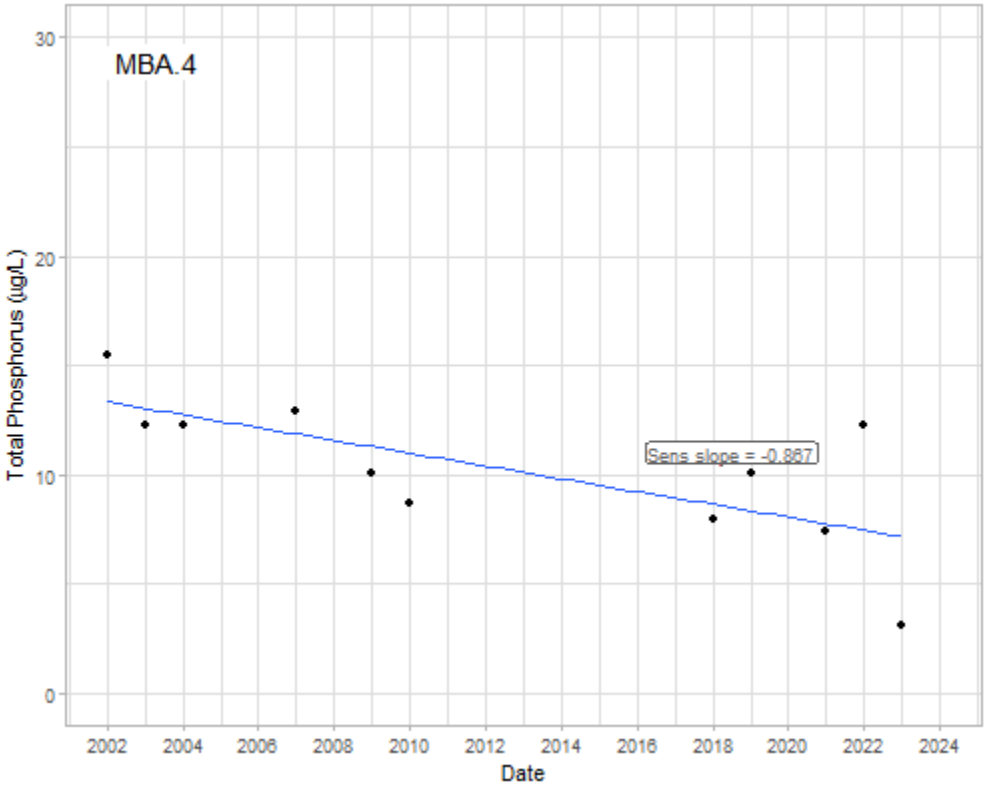
2024


MBA.4
Sens slope = -0.867
Total Phosphorus (ug/L)
Date
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2002
2004
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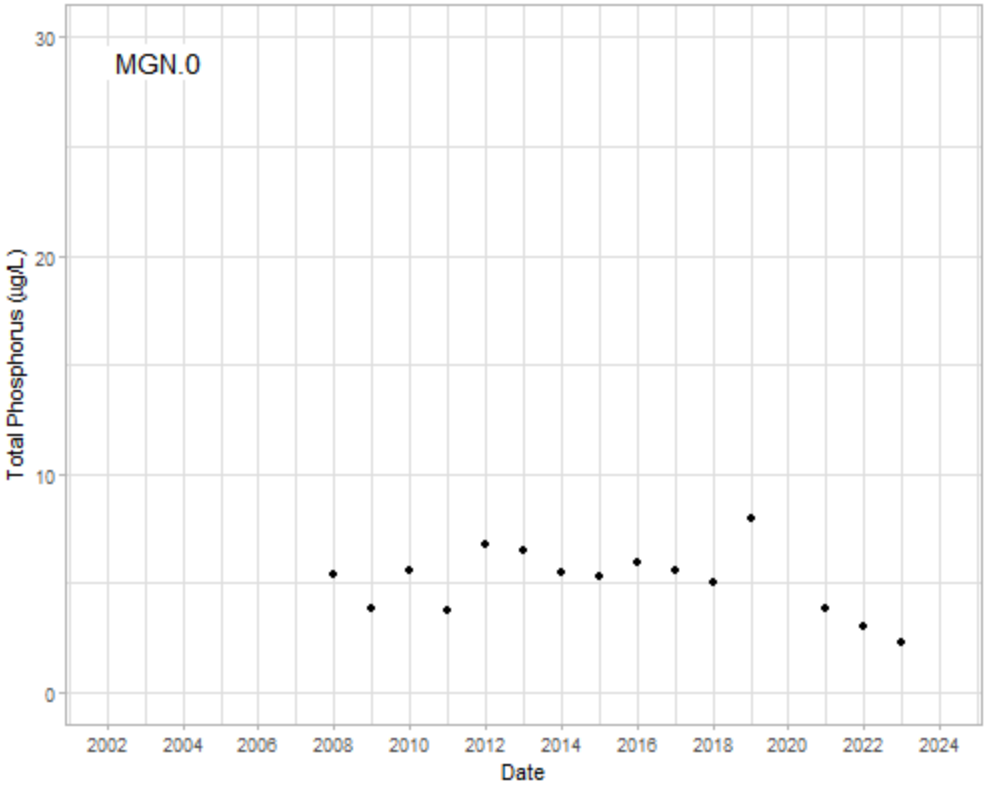
MGN.0
Total Phosphorus (ug/L)
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2002
2004
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2008
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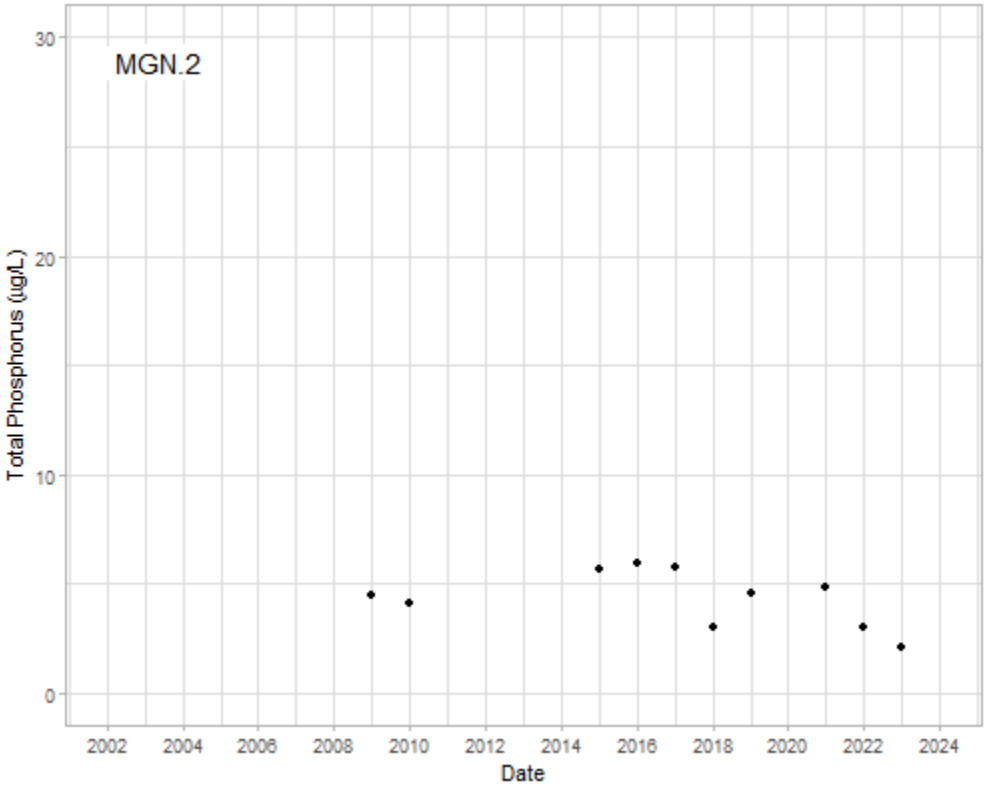
2022
2024
Date


MGN.2
Total Phosphorus (ug/L)
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2002
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2022
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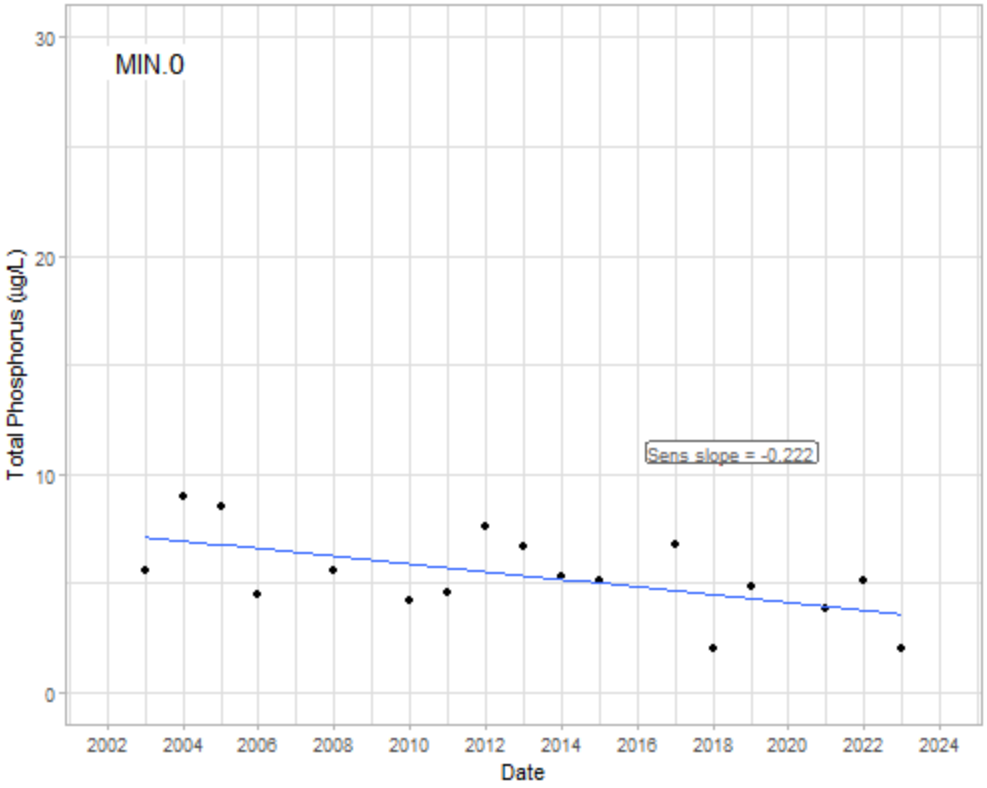
Date


MIN.0
Sens slope = -0.222
Total Phosphorus (ug/L)
Date
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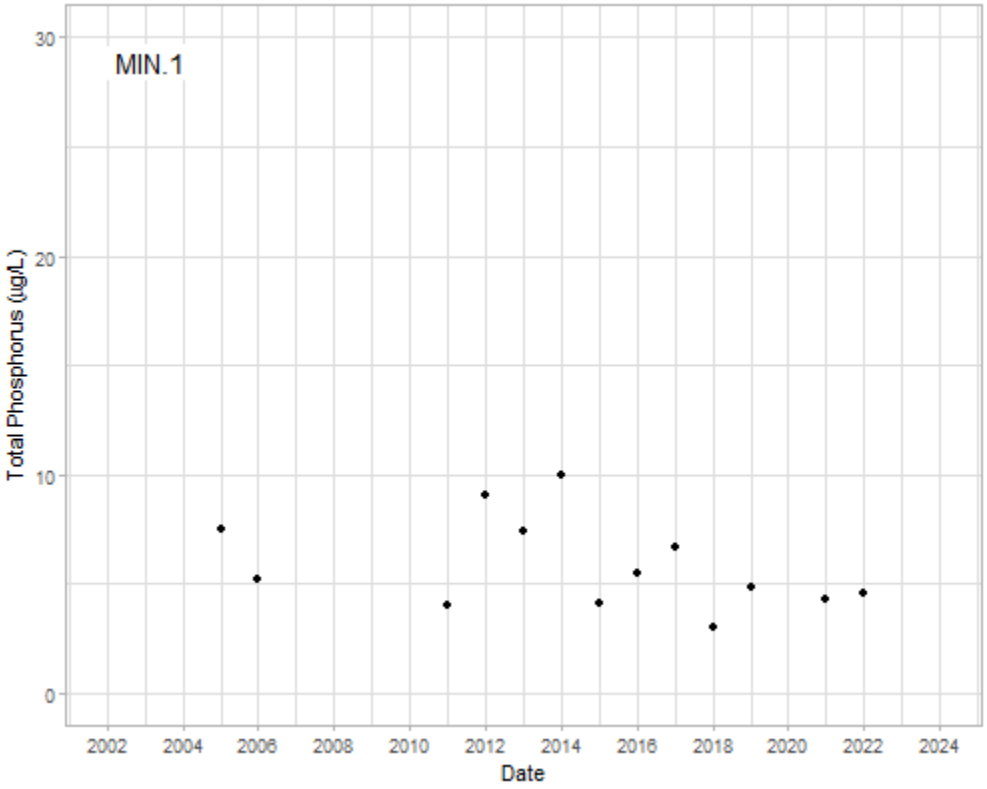
MIN.1
Total Phosphorus (ug/L)
Date
0
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20
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2002
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2006
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2012
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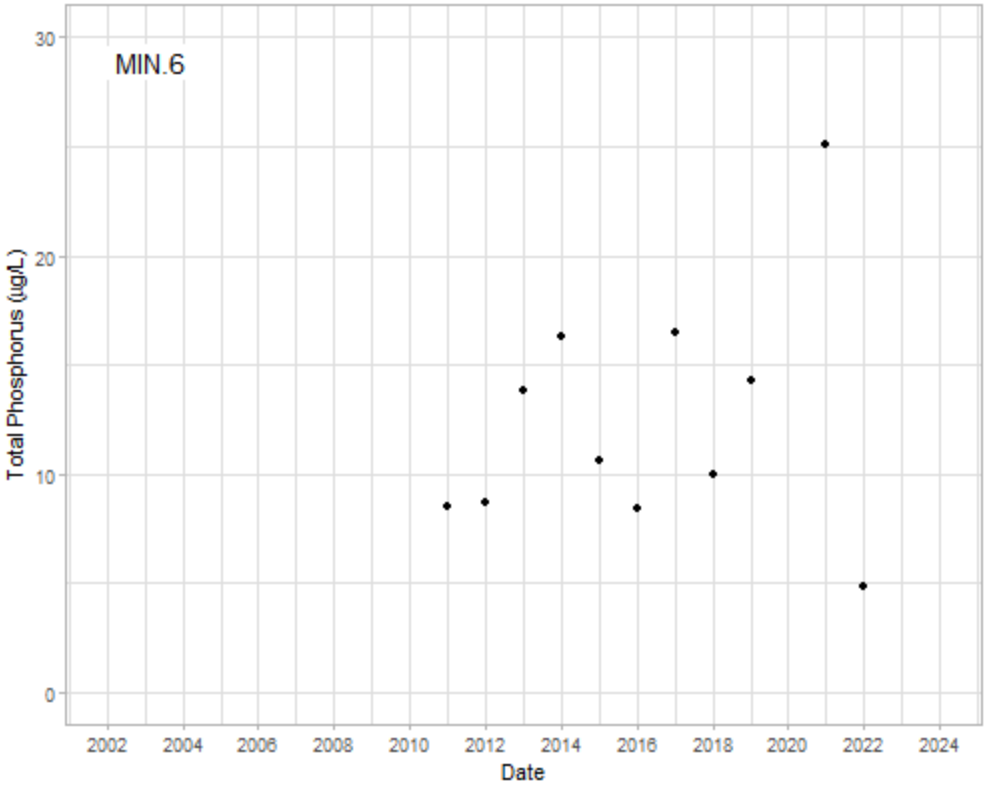
2022
2024


MIN.6
Total Phosphorus (ug/L)
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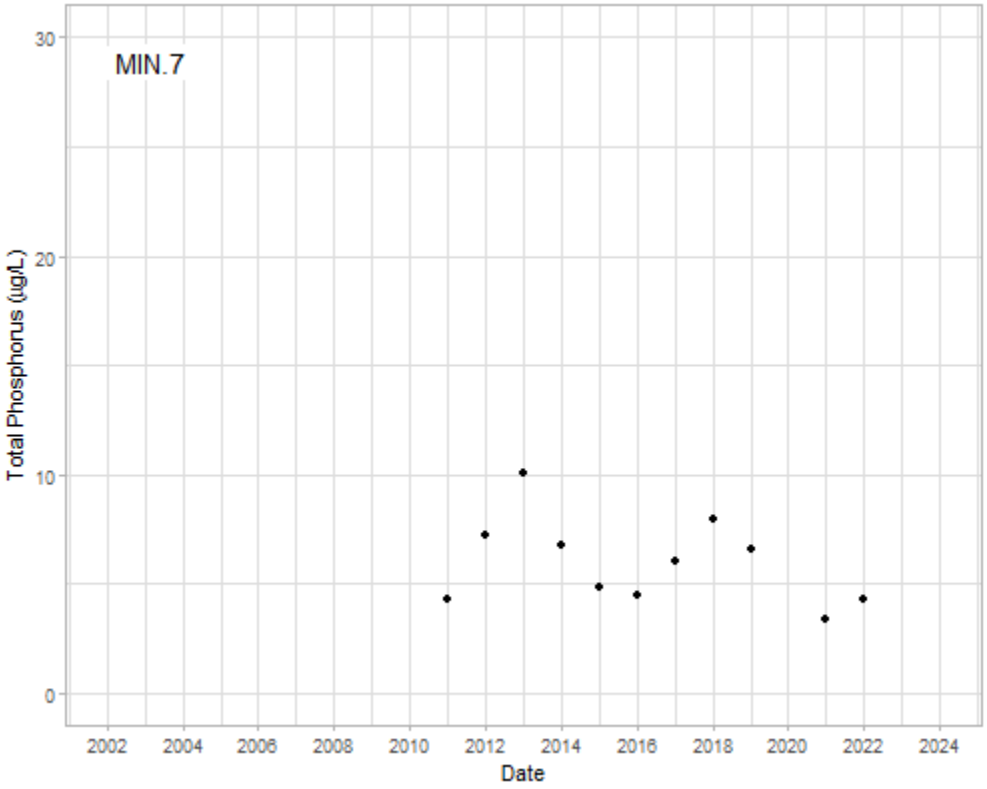
Date


MIN.7
Total Phosphorus (ug/L)
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2002
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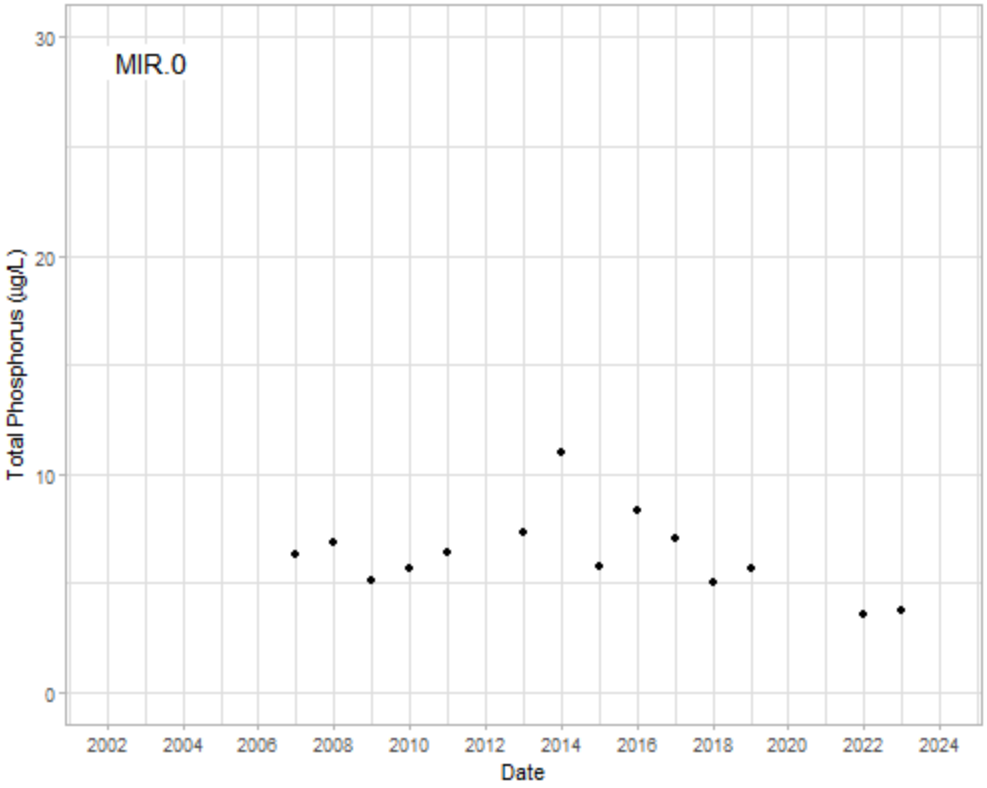
2024
Date


MIR.0
Total Phosphorus (ug/L)
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2002
2004
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2014
2016
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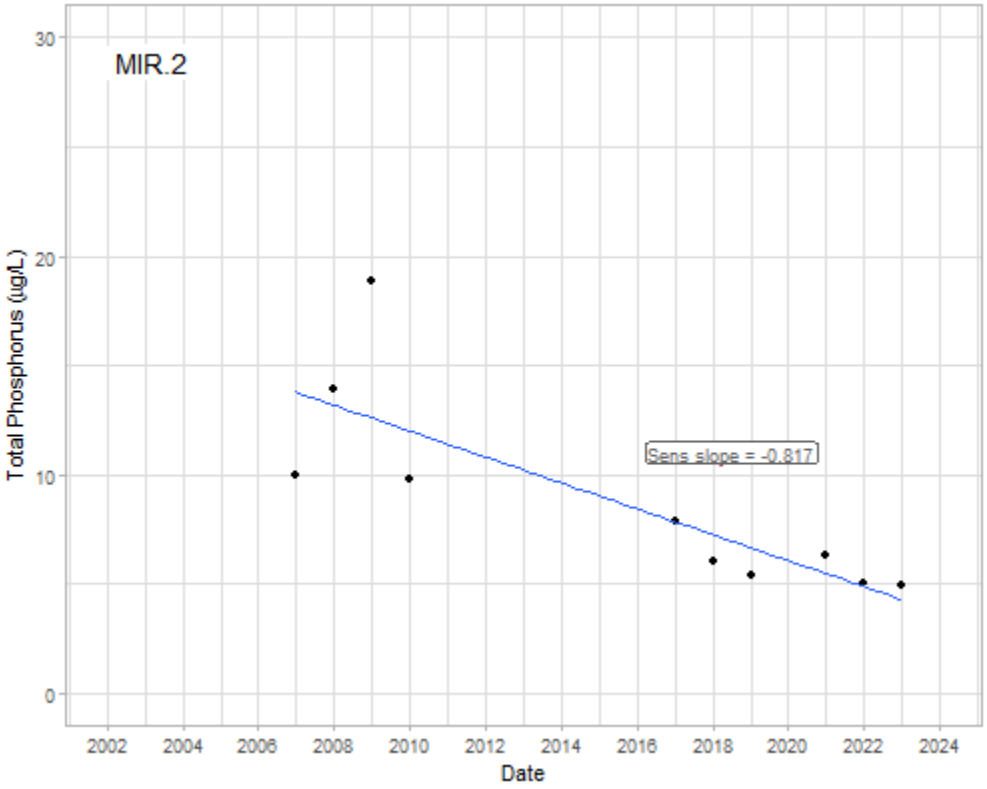
2020
2022
2024
Date


MIR.2
Total Phosphorus (ug/L)
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Sens slope = -0.817
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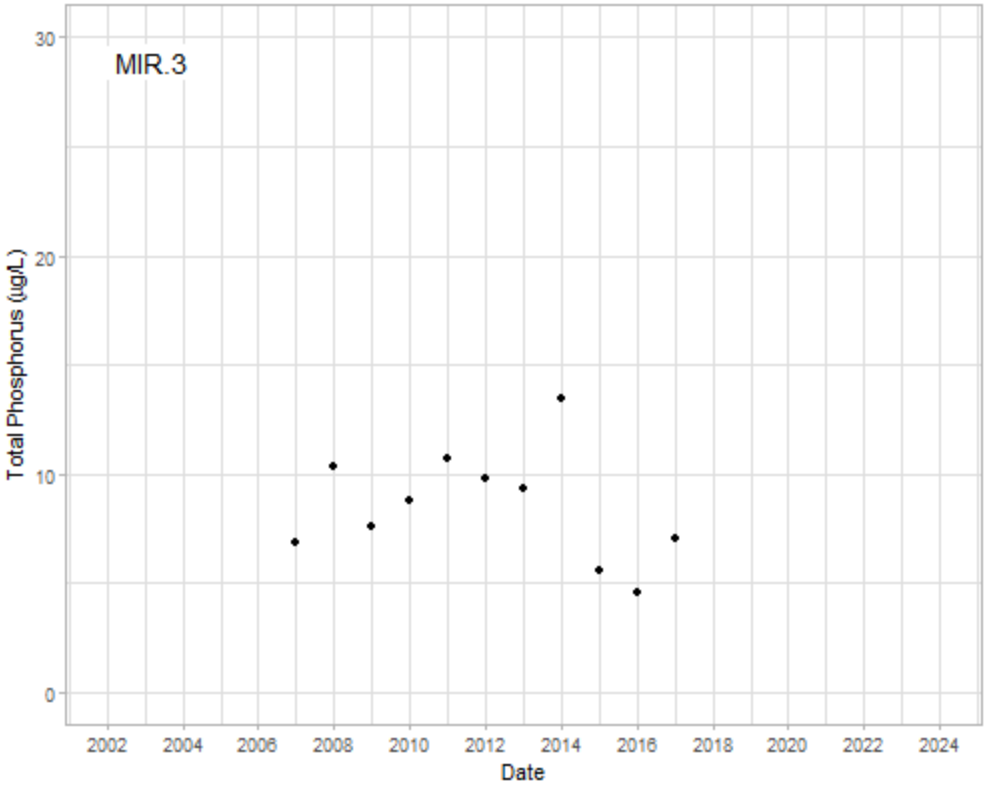
Date


MIR.3
Total Phosphorus (ug/L)
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2002
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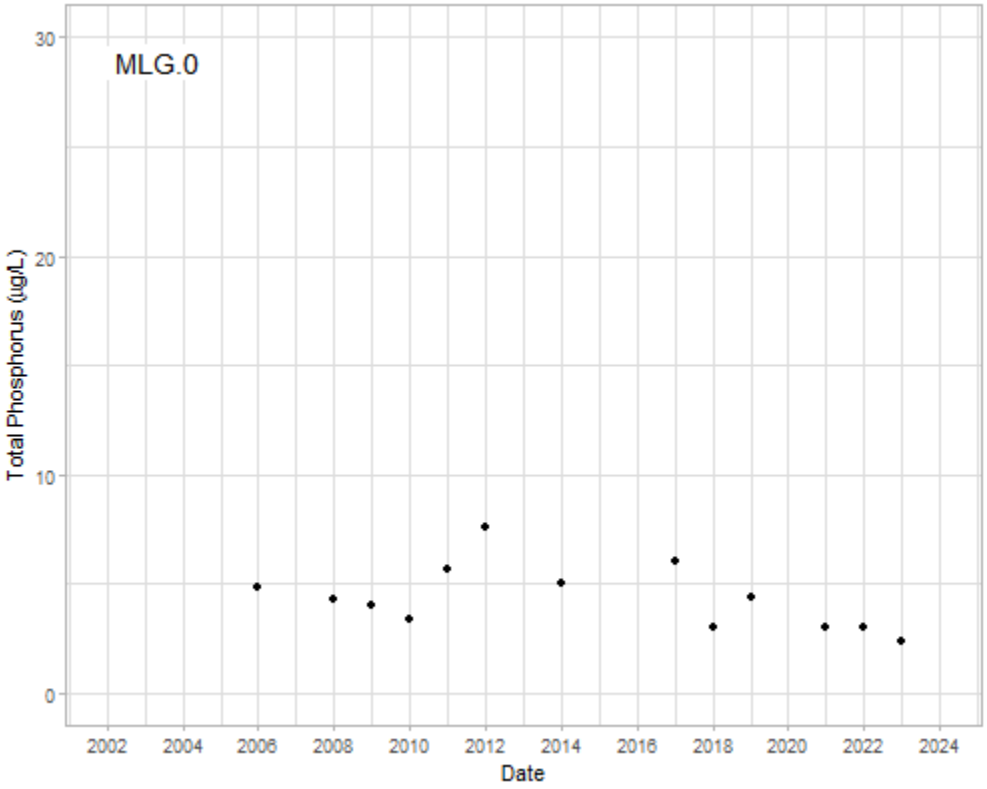
Date


MLG.0
Total Phosphorus (ug/L)
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2002
2004
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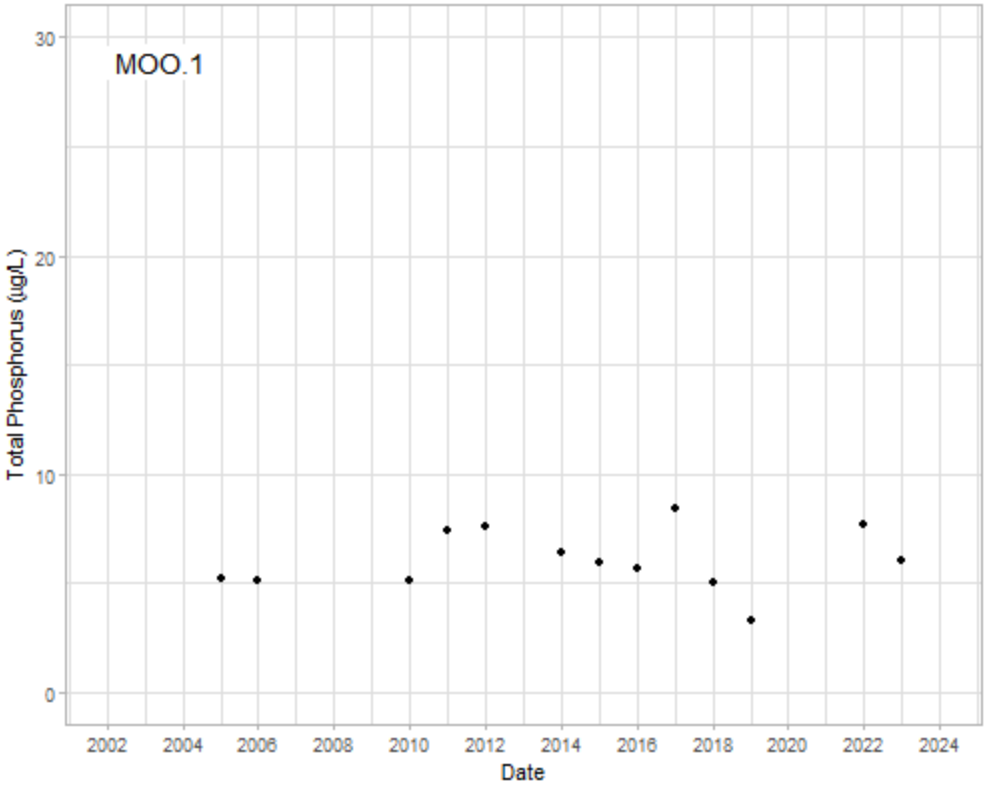
Date


MOO.1
Total Phosphorus (ug/L)
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2002
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2022
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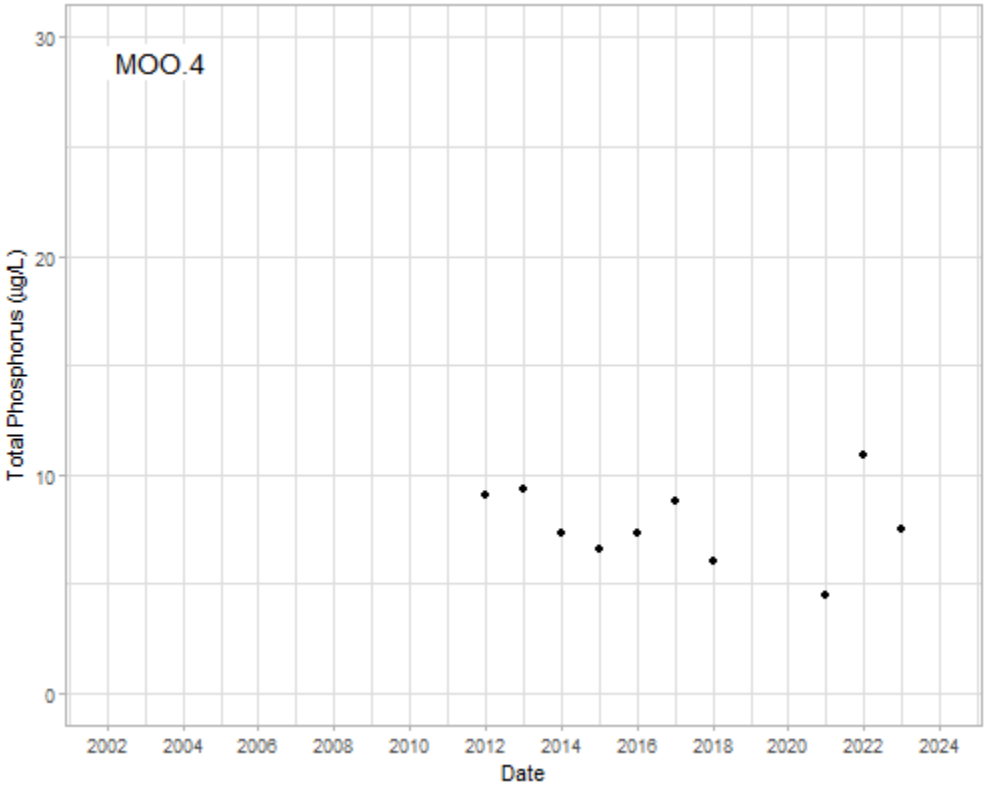
Date


MOO.4
Total Phosphorus (ug/L)
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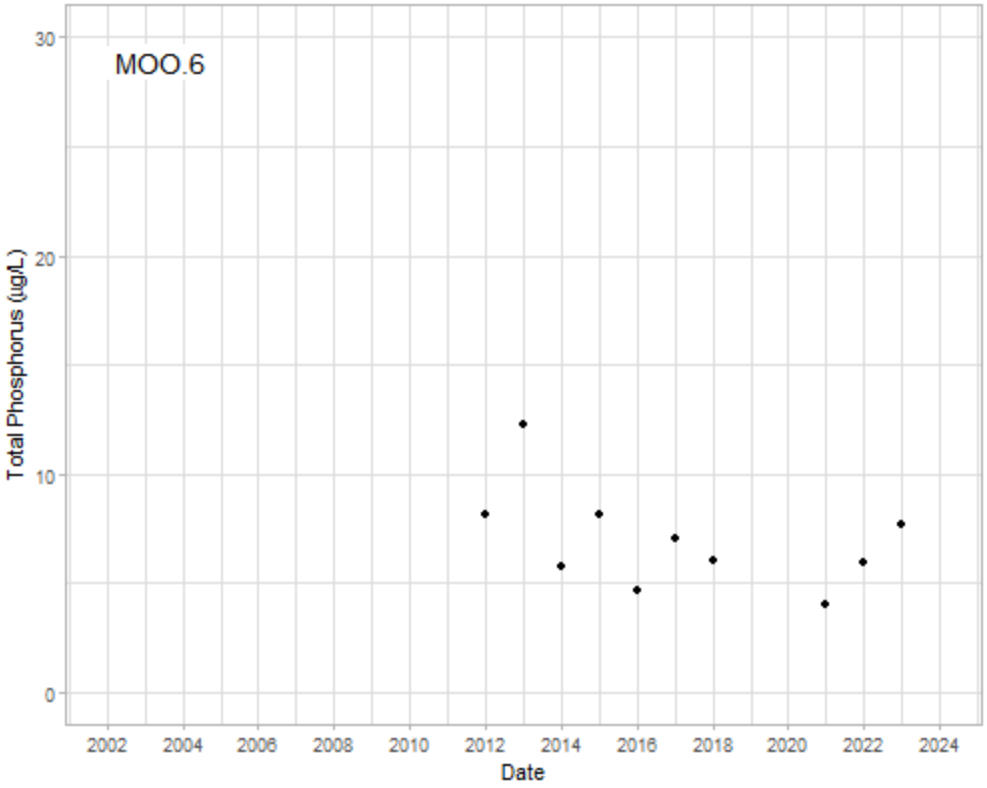
Date


MOO.6
Total Phosphorus (ug/L)
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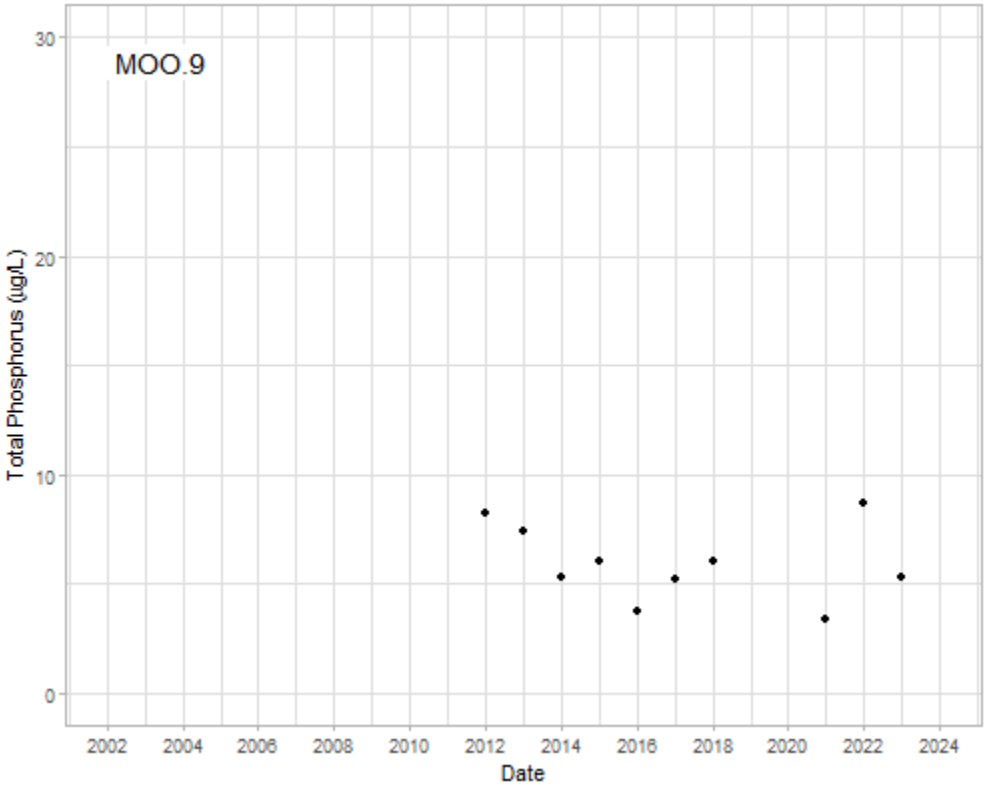
2024
Date


MOO.9
Total Phosphorus (ug/L)
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2020
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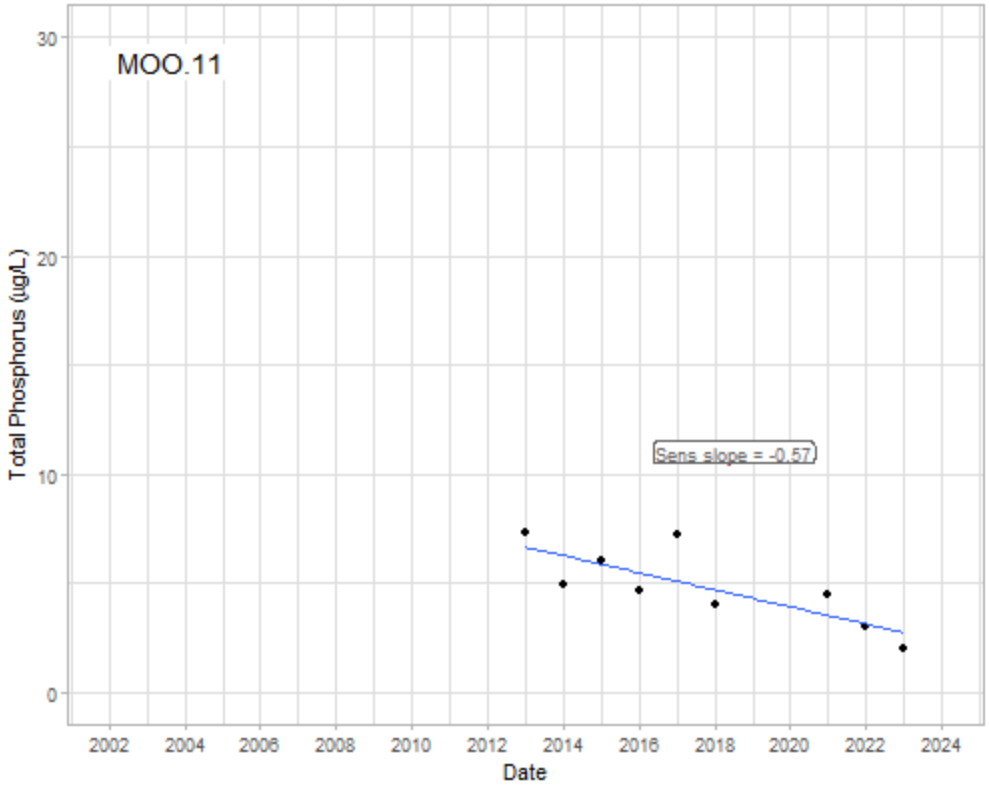
2024
Date


MOO.11
Sens slope = -0.57
Total Phosphorus (ug/L)
Date
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2002
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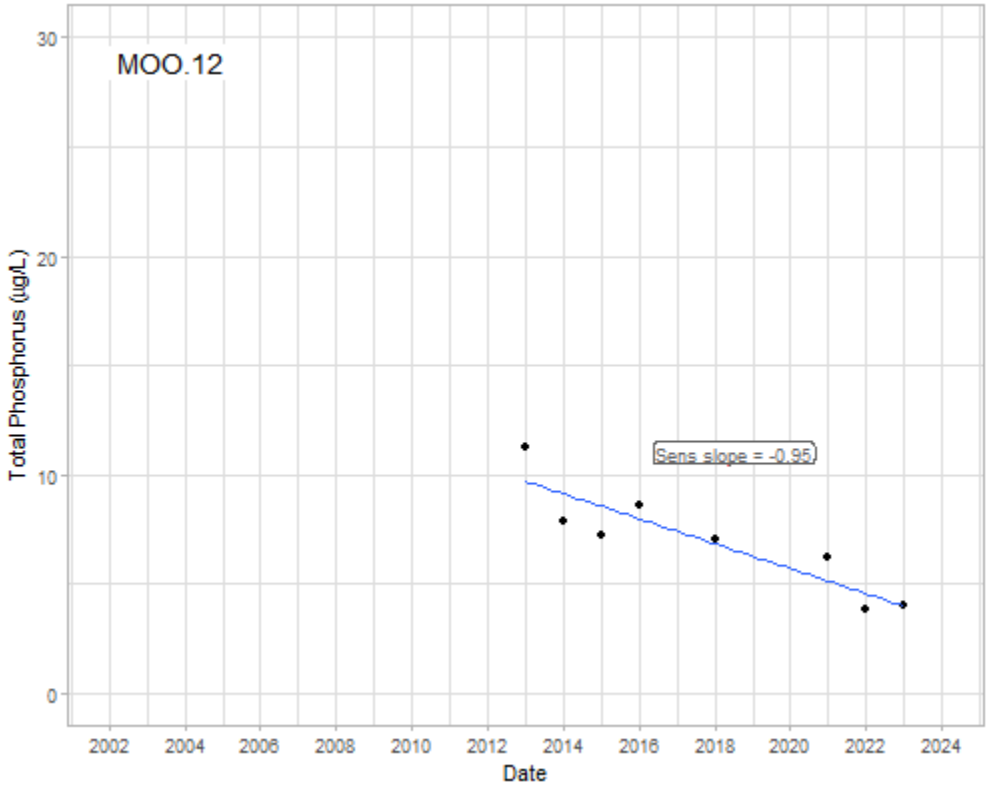
2024


MOO.12
Sens slope = -0.95
Total Phosphorus (ug/L)
Date
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2002
2004
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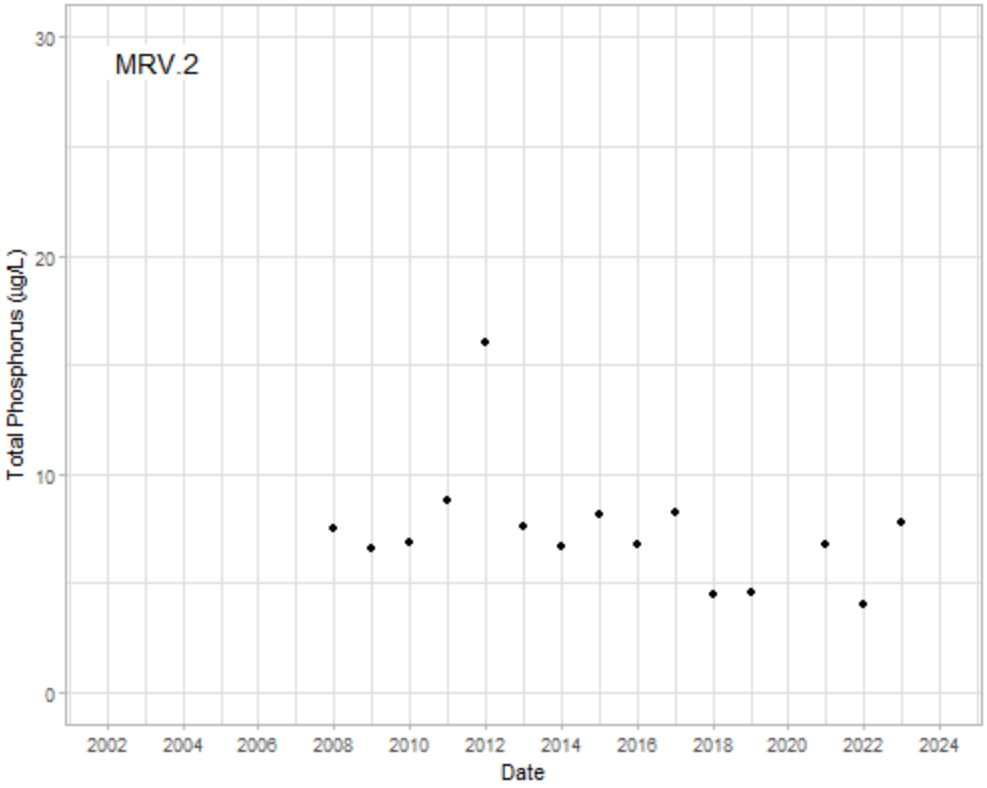
2022
2024


MRV.2
Total Phosphorus (ug/L)
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0
2002
2004
2006
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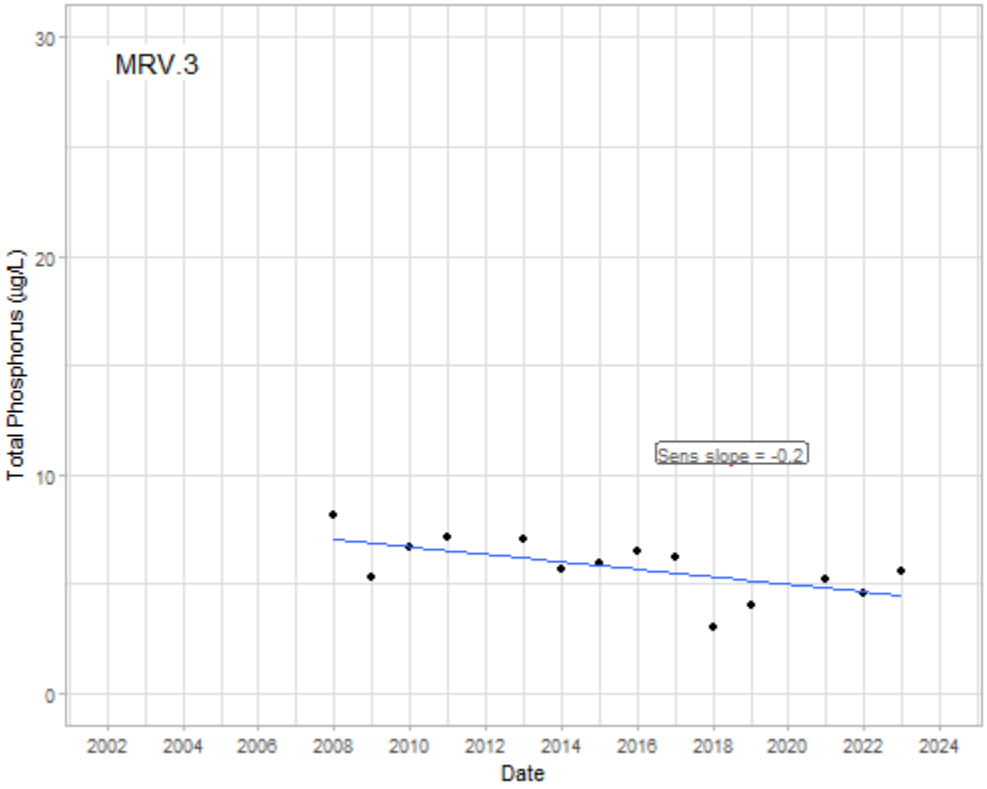
2024
Date


MRV.3
Total Phosphorus (ug/L)
30
20
10
0
Sens slope = -0.2
2002
2004
2006
2008
2010
2012
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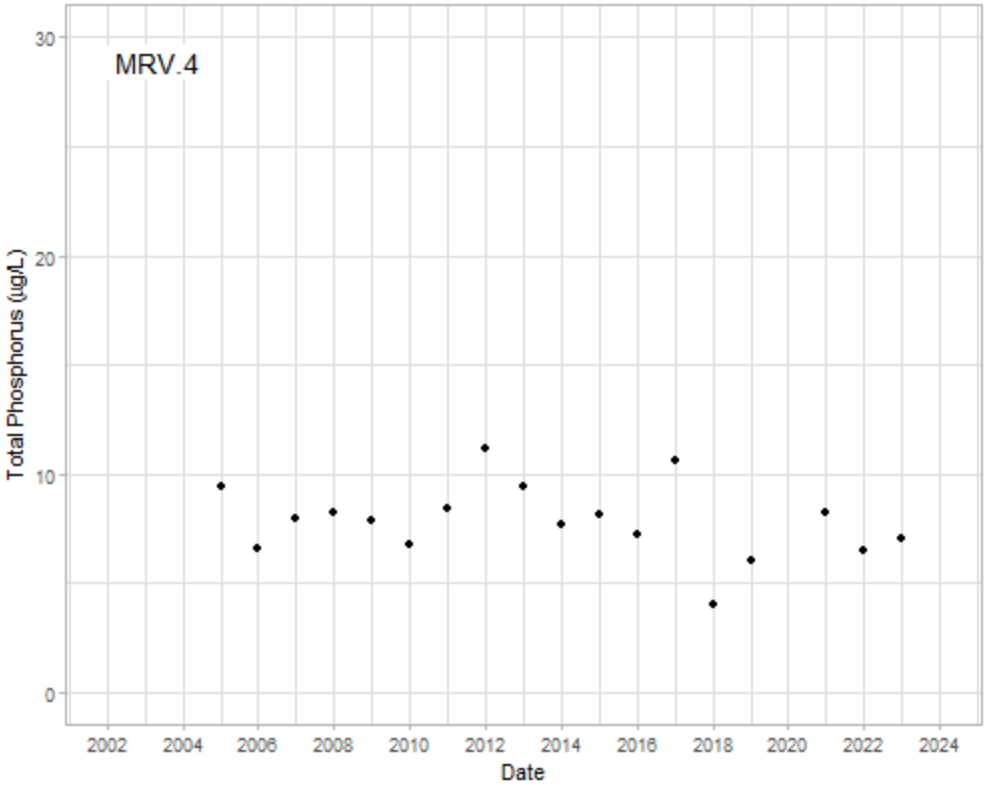
2018
2020
2022
2024
Date


MRV.4
Total Phosphorus (ug/L)
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10
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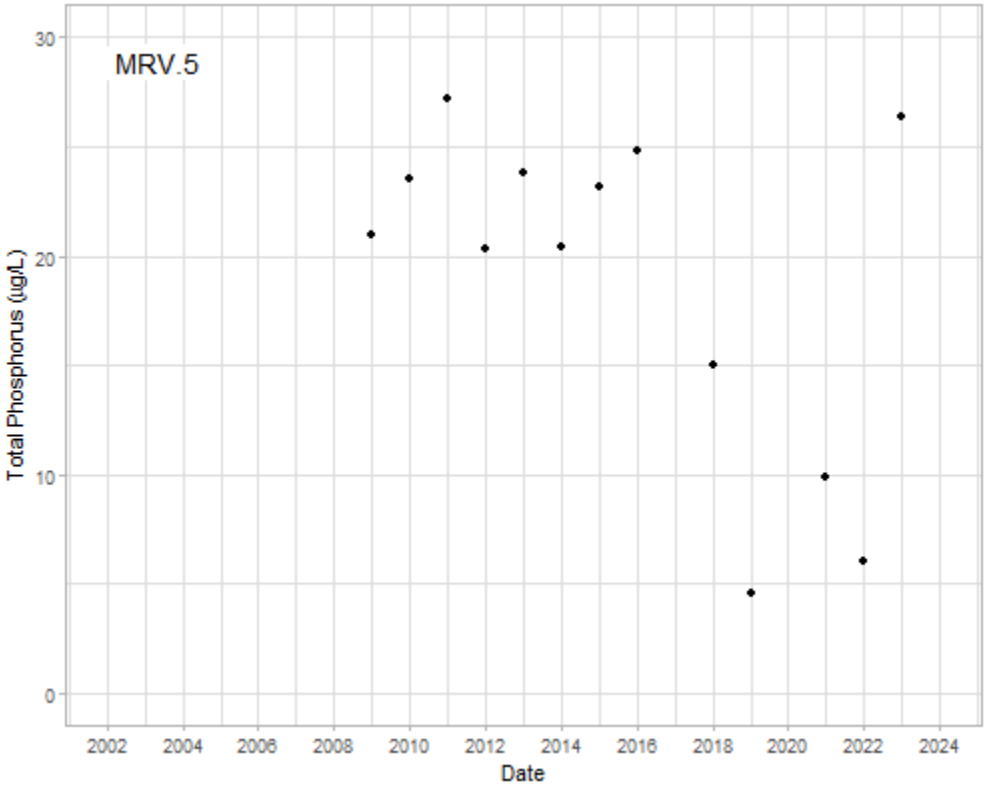
2024
Date


MRV.5
Total Phosphorus (ug/L)
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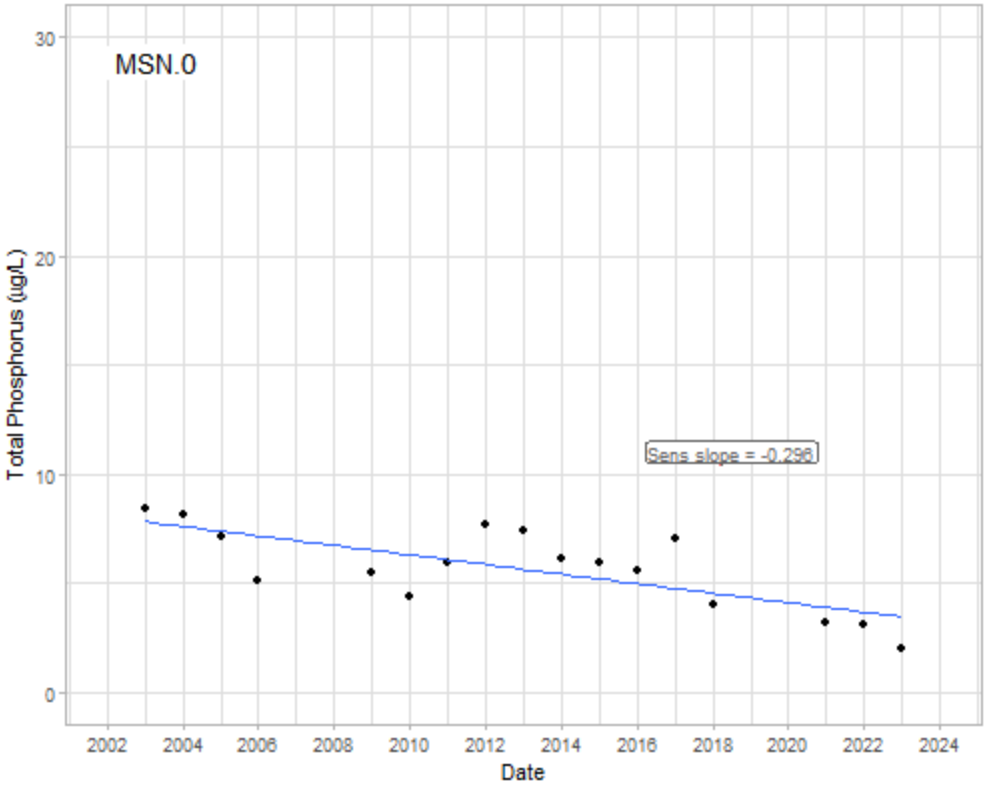
Date


MSN.0
Sens slope = -0.296
Total Phosphorus (ug/L)
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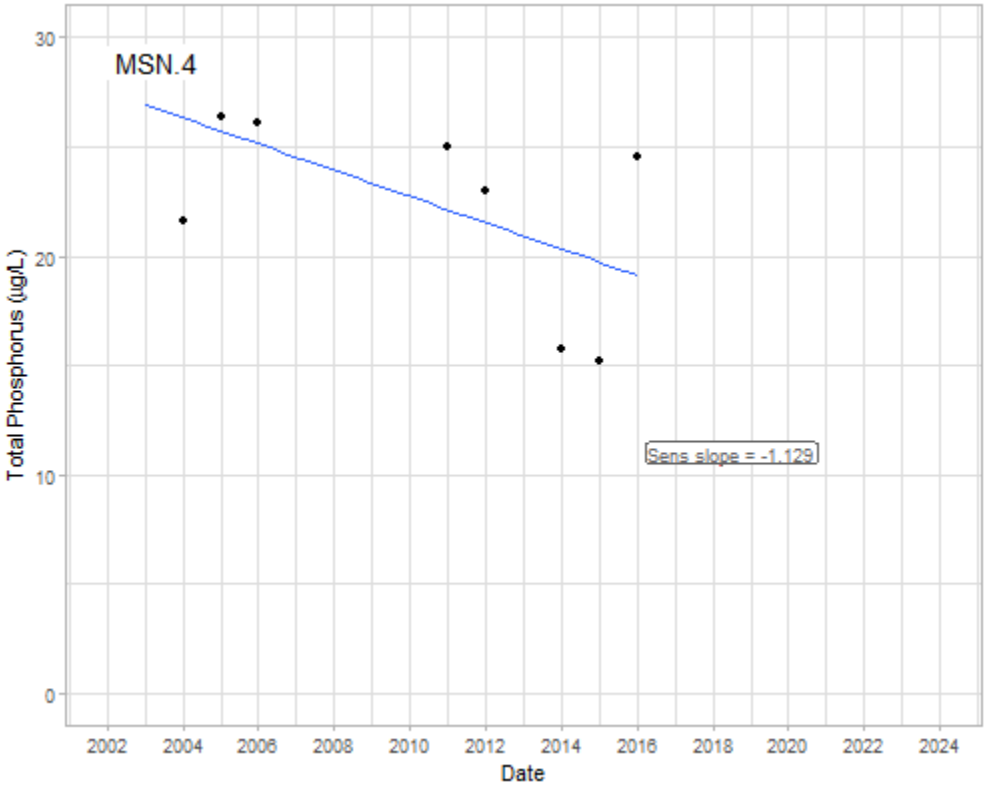
MSN.4
Sens slope = -1.129
Total Phosphorus (ug/L)
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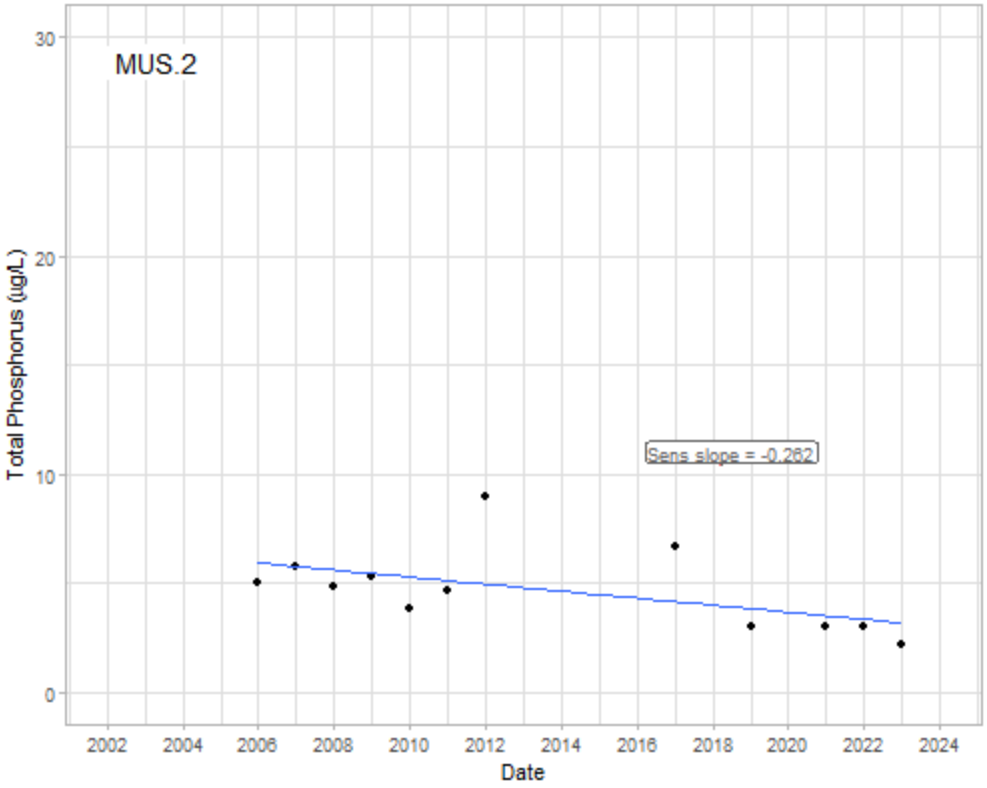
MUS.2
Sens slope = -0.262
Total Phosphorus (ug/L)
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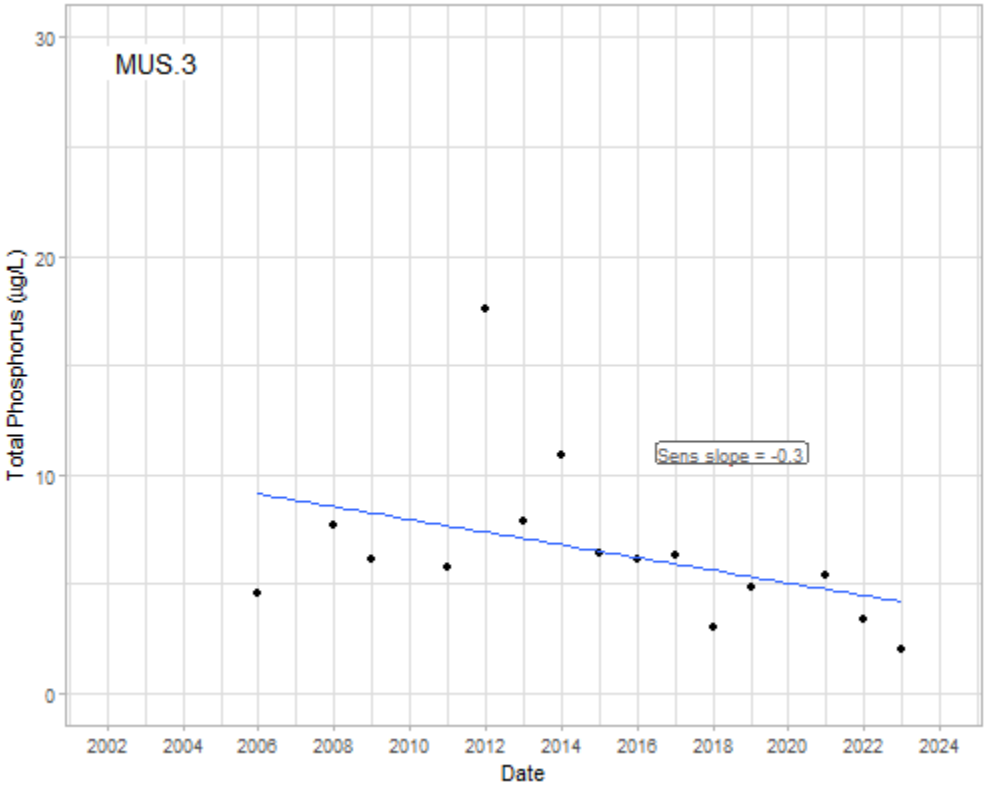
MUS.3
Sens slope = -0.3
Total Phosphorus (ug/L)
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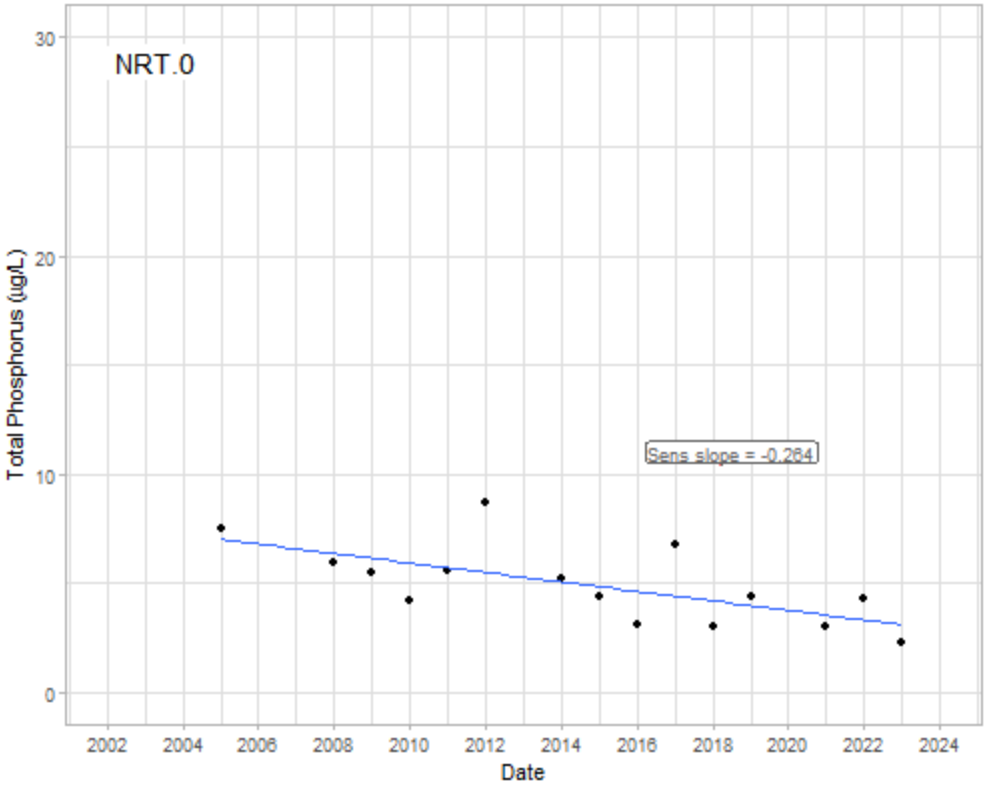
NRT.0
Sens slope = -0.264
Total Phosphorus (ug/L)
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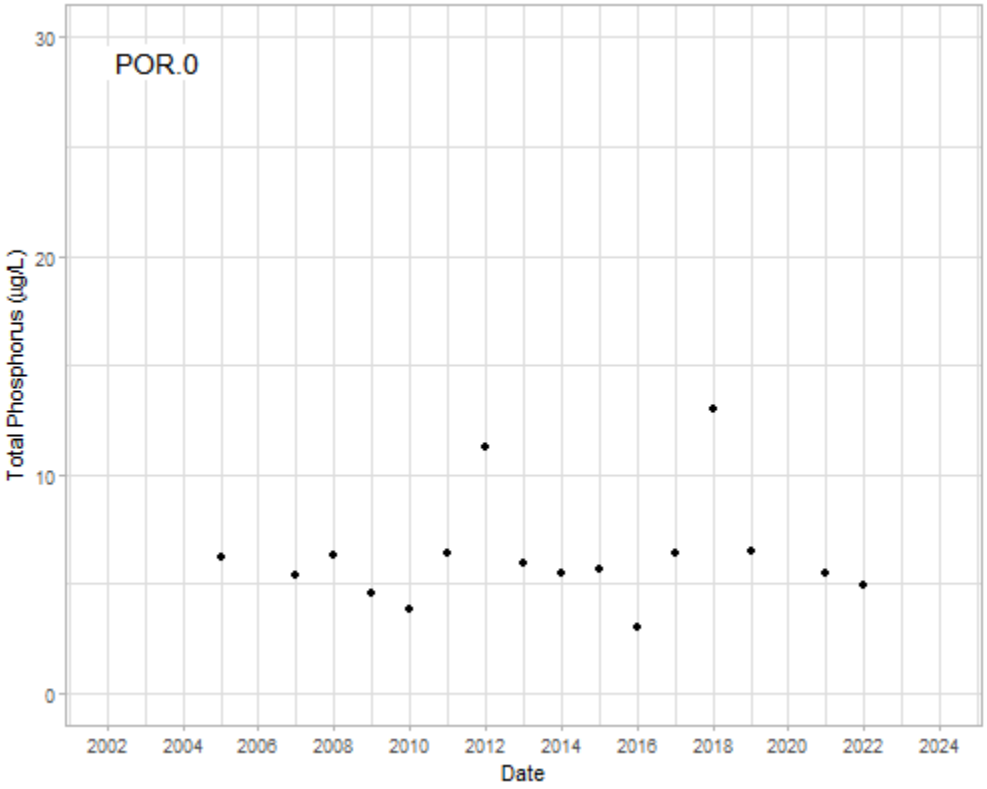
POR.0
Total Phosphorus (ug/L)
Date
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2002
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2022
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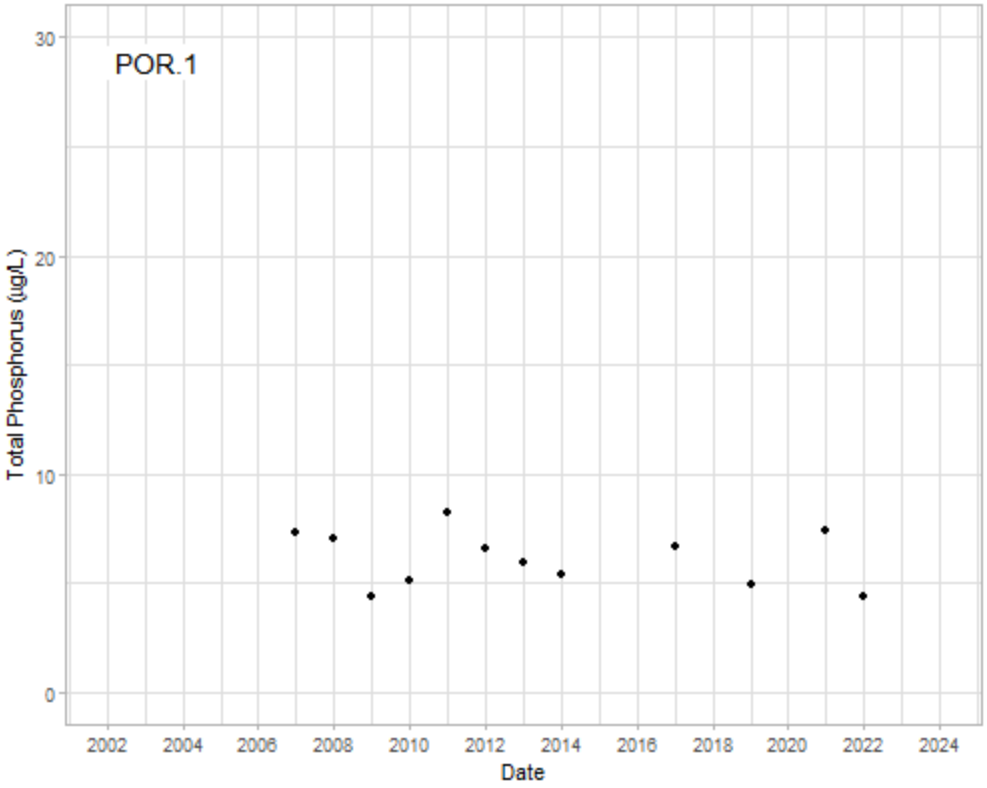
POR.1
Total Phosphorus (ug/L)
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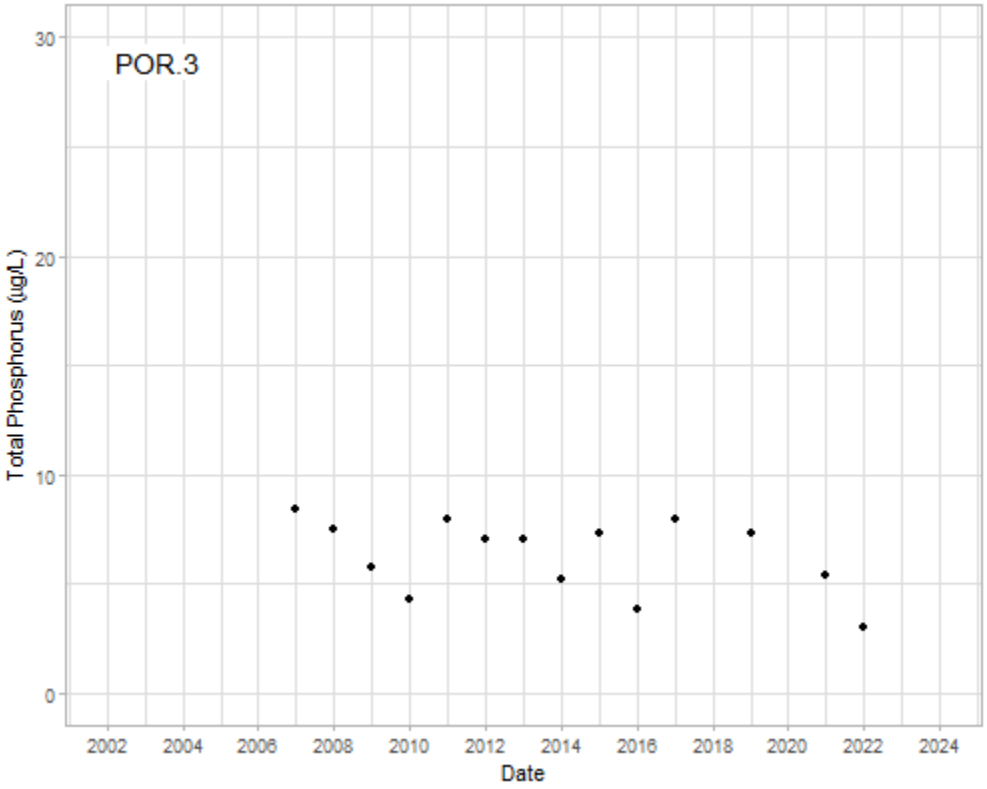
Date


POR.3
Total Phosphorus (ug/L)
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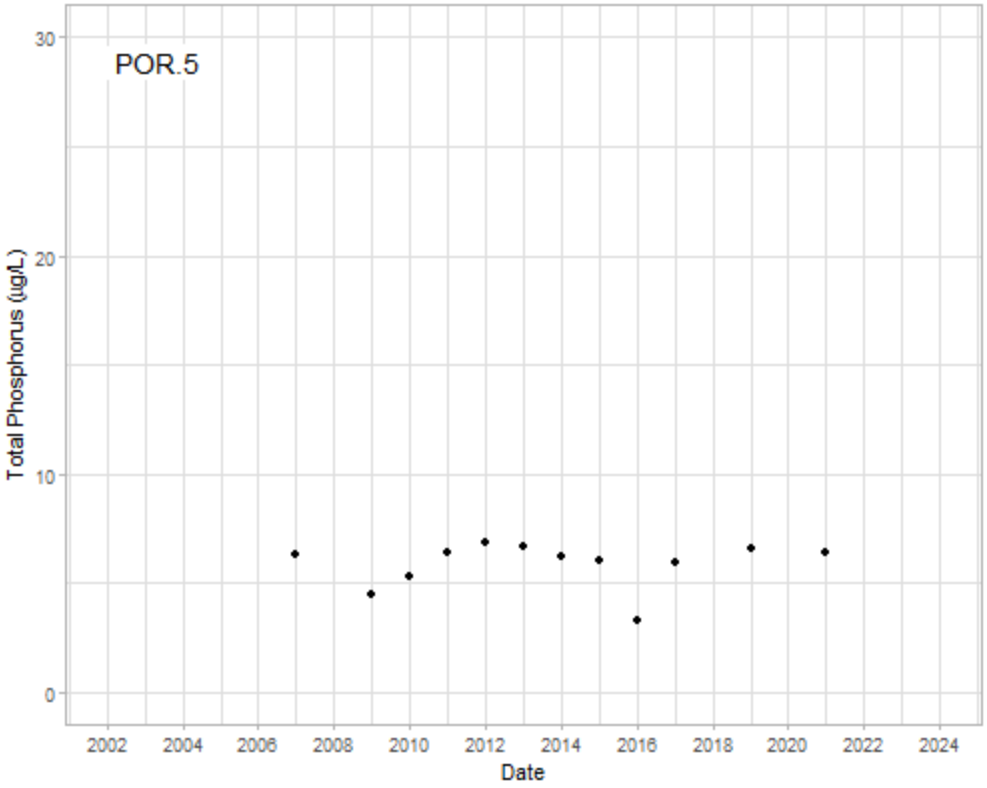
Date


POR.5
Total Phosphorus (ug/L)
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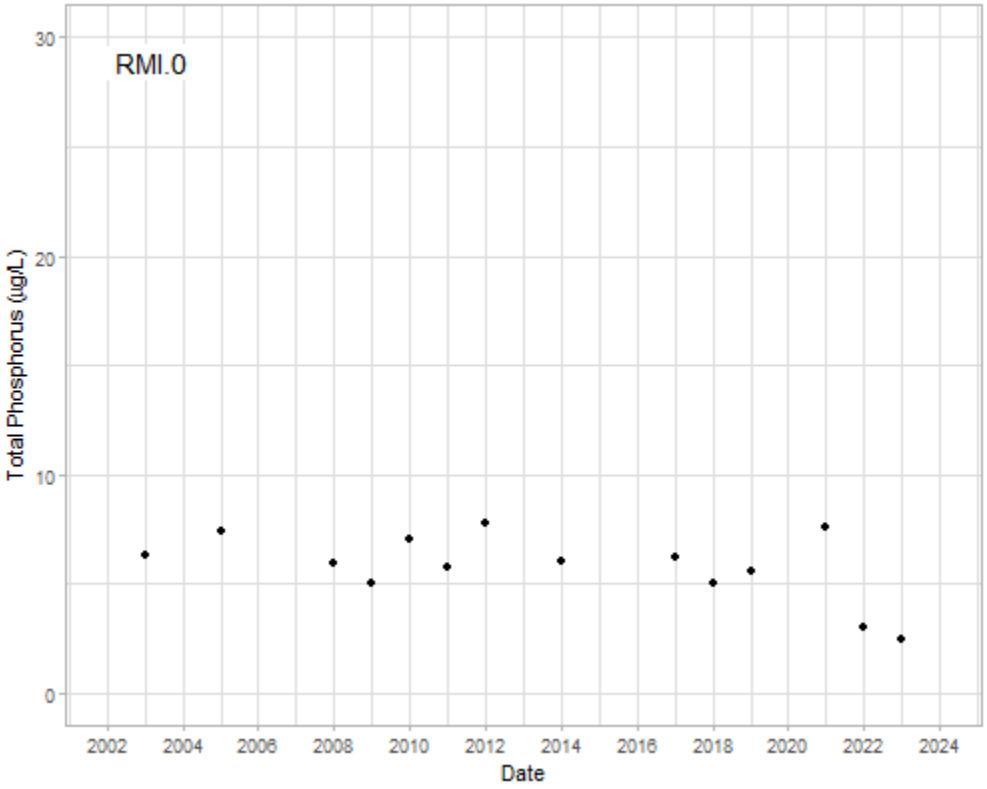
2022
2024
Date


RMI.0
Total Phosphorus (ug/L)
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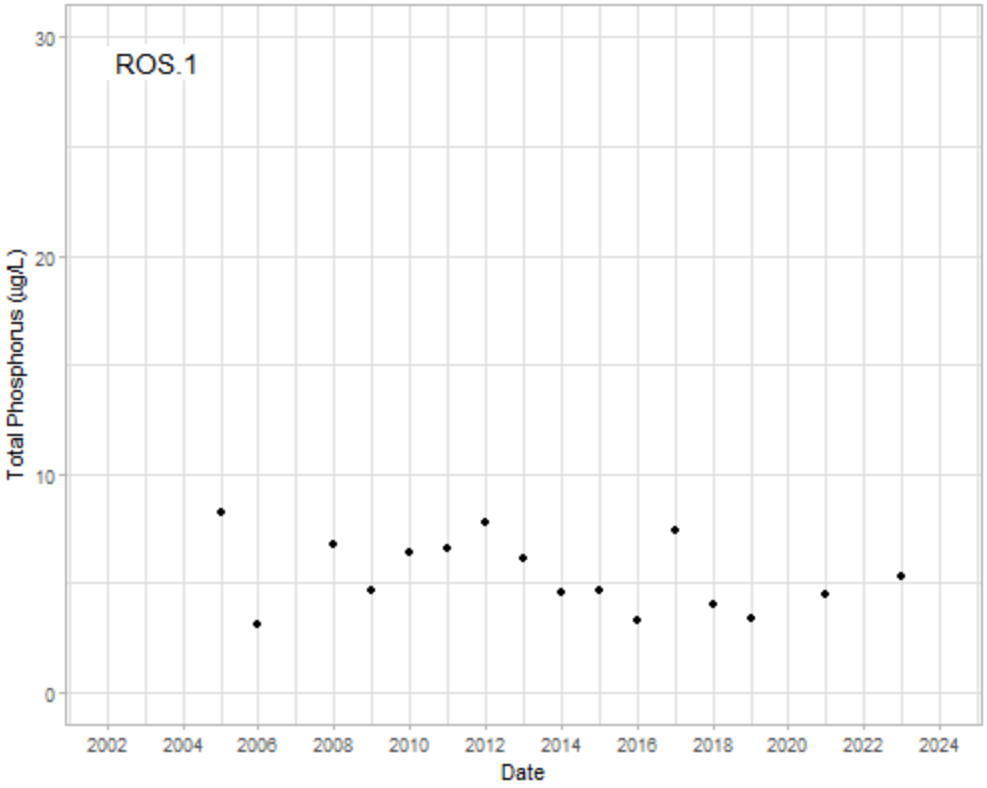
2024
Date


ROS.1
Total Phosphorus (ug/L)
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20
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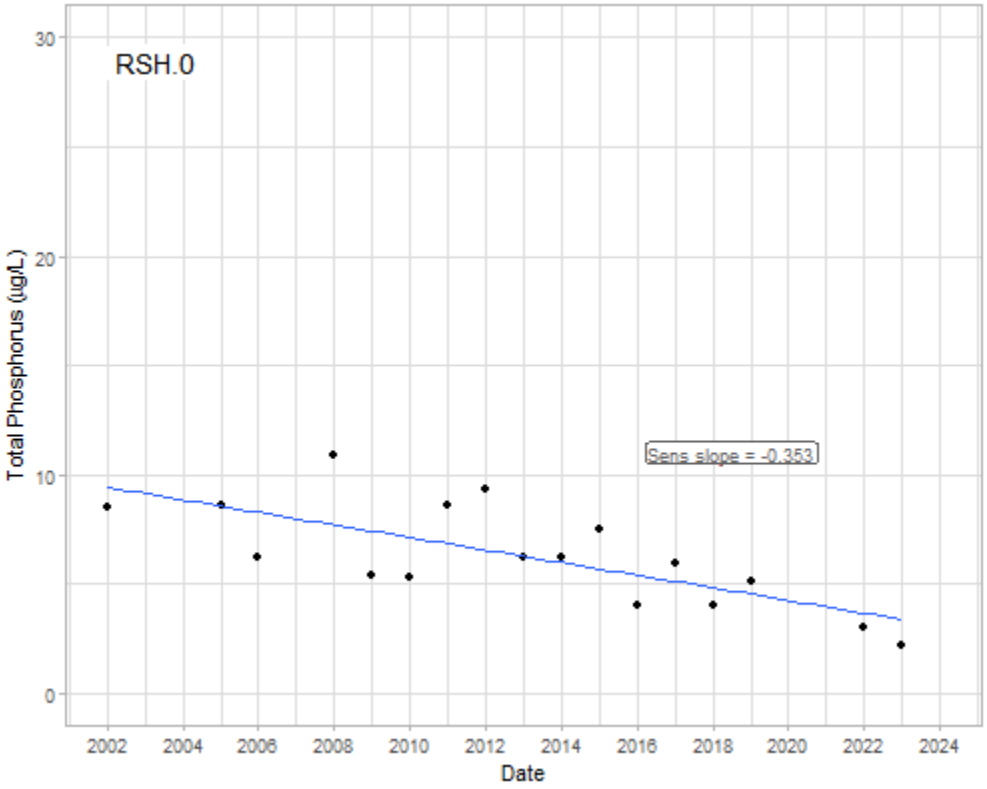
2022
2024
Date


RSH.0
Total Phosphorus (ug/L)
Sens slope = -0.353
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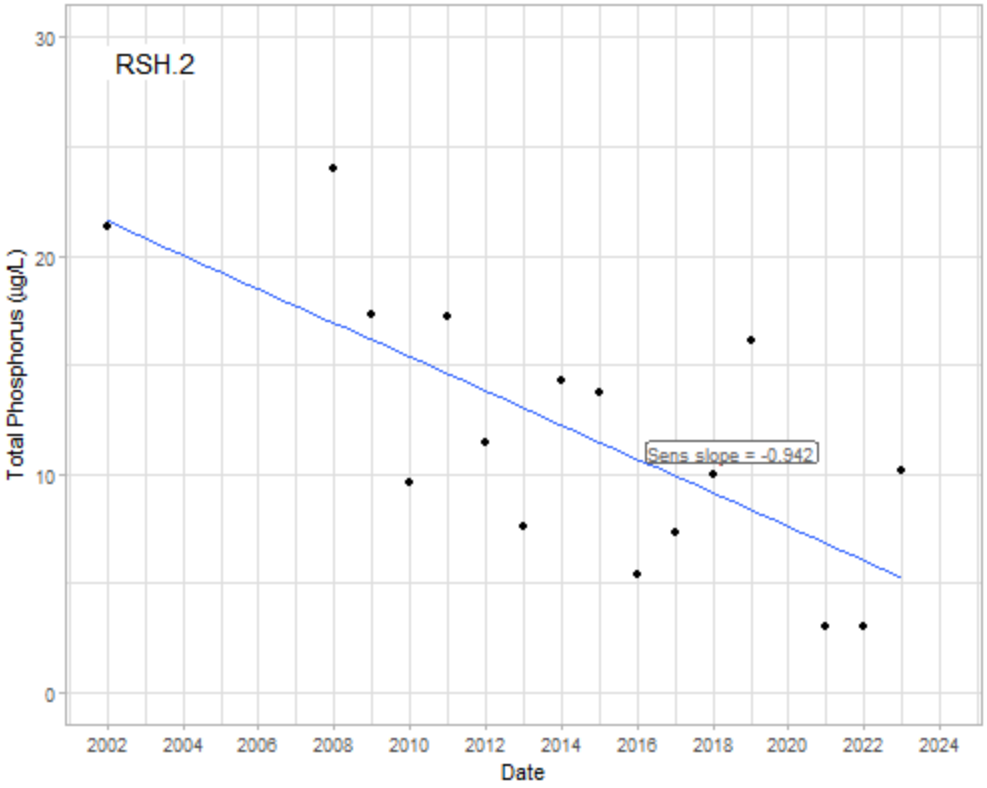
RSH.2
Sens slope = -0.942
Total Phosphorus (ug/L)
Date
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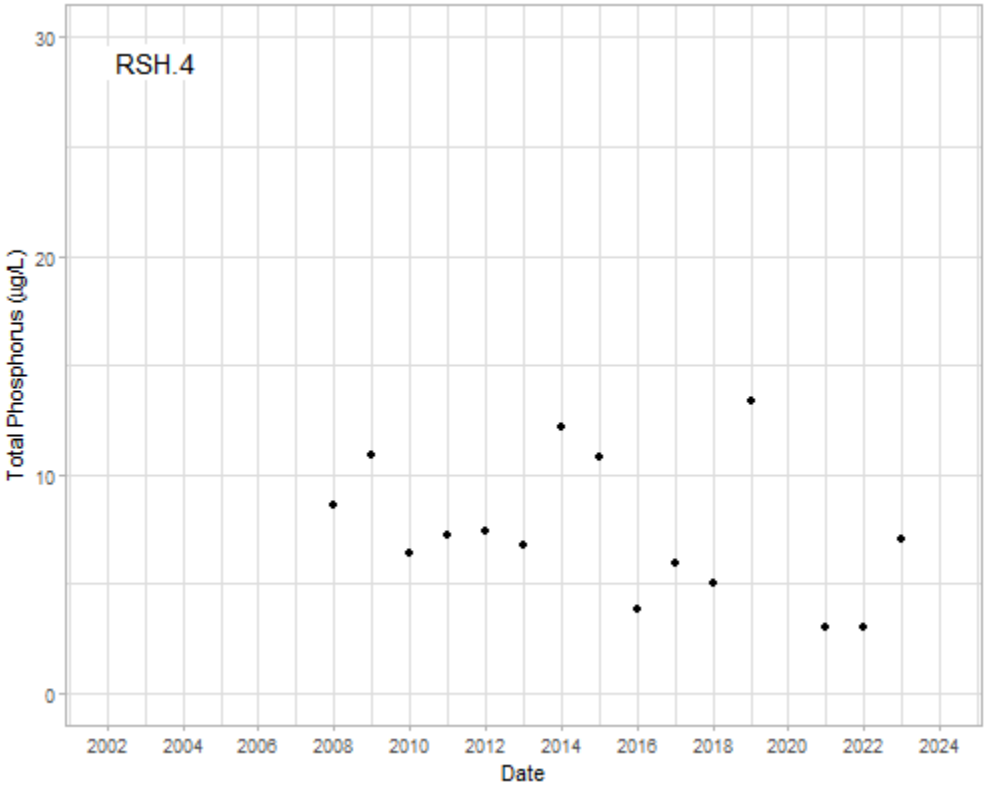
RSH.4
Total Phosphorus (ug/L)
Date
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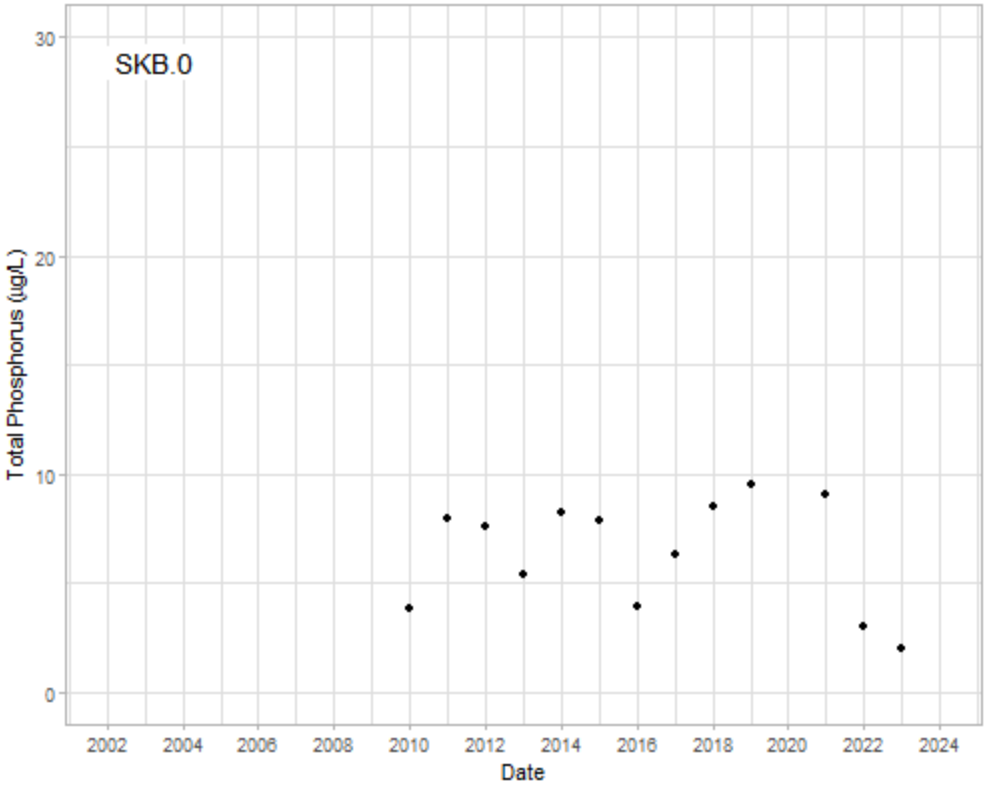
SKB.0
Total Phosphorus (ug/L)
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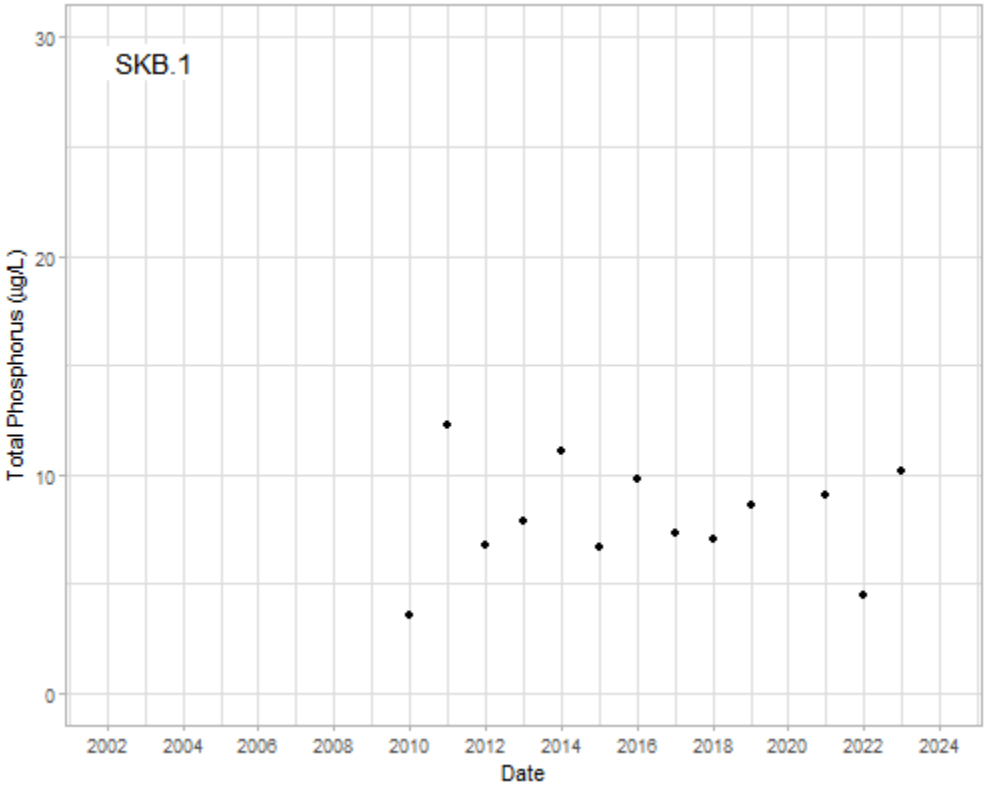
2024
Date


SKB.1
Total Phosphorus (ug/L)
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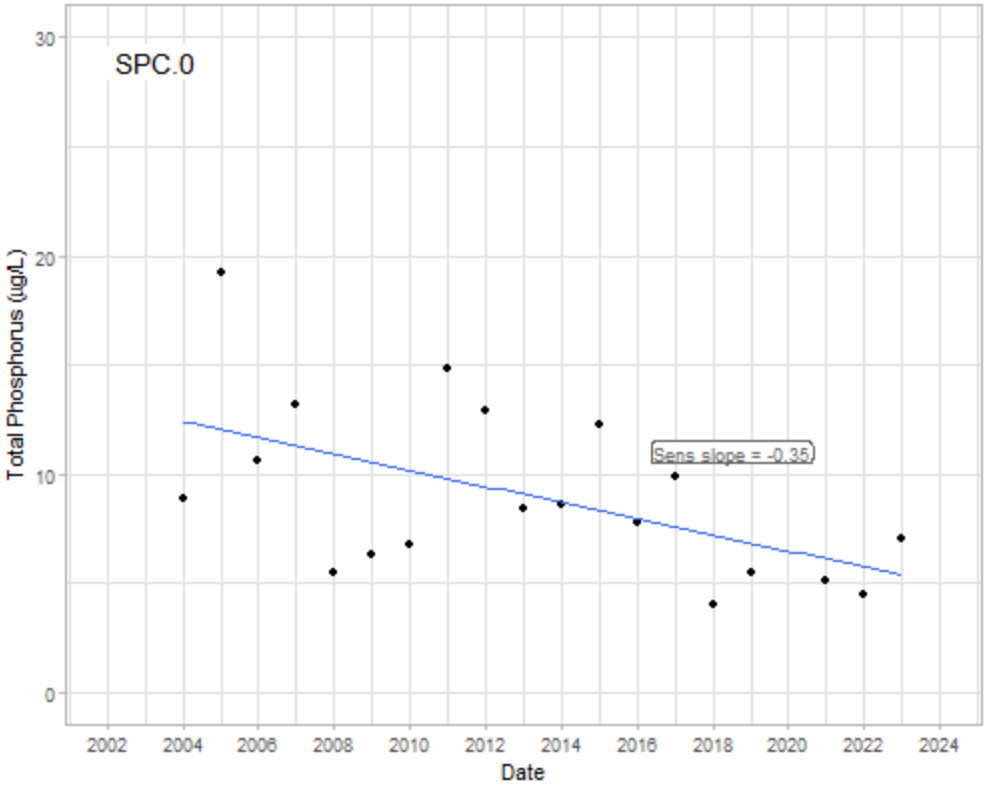
Date


SPC.0
Sens slope = -0.35
Total Phosphorus (ug/L)
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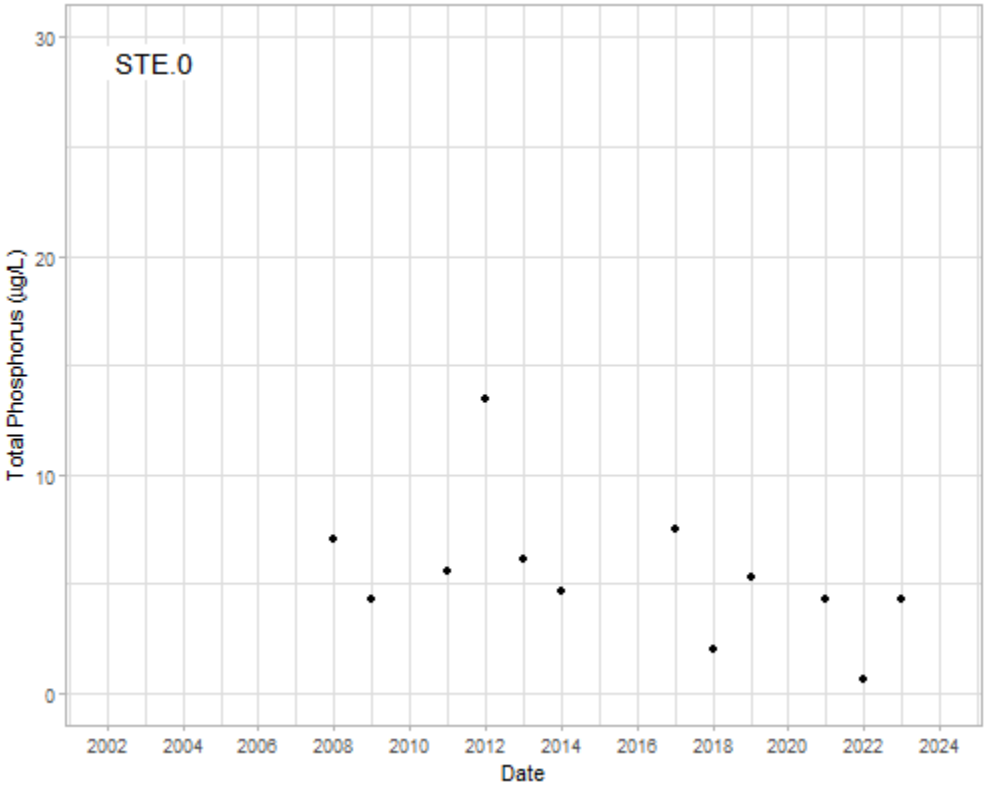
STE.0
Total Phosphorus (ug/L)
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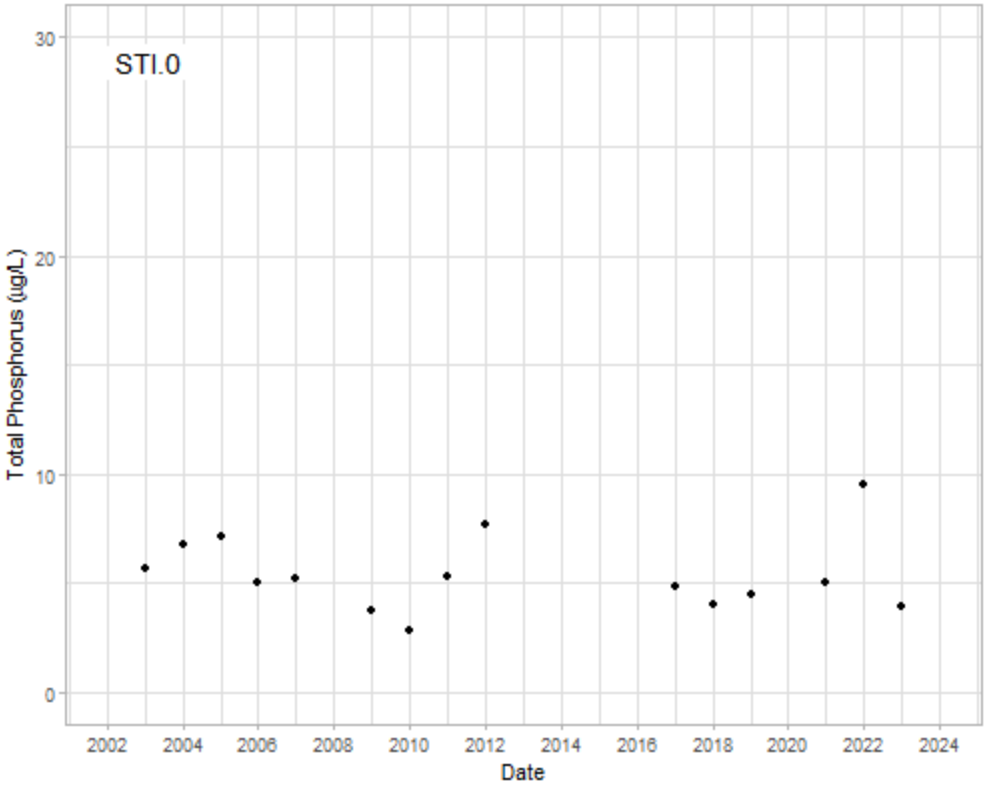
STI.0
Total Phosphorus (ug/L)
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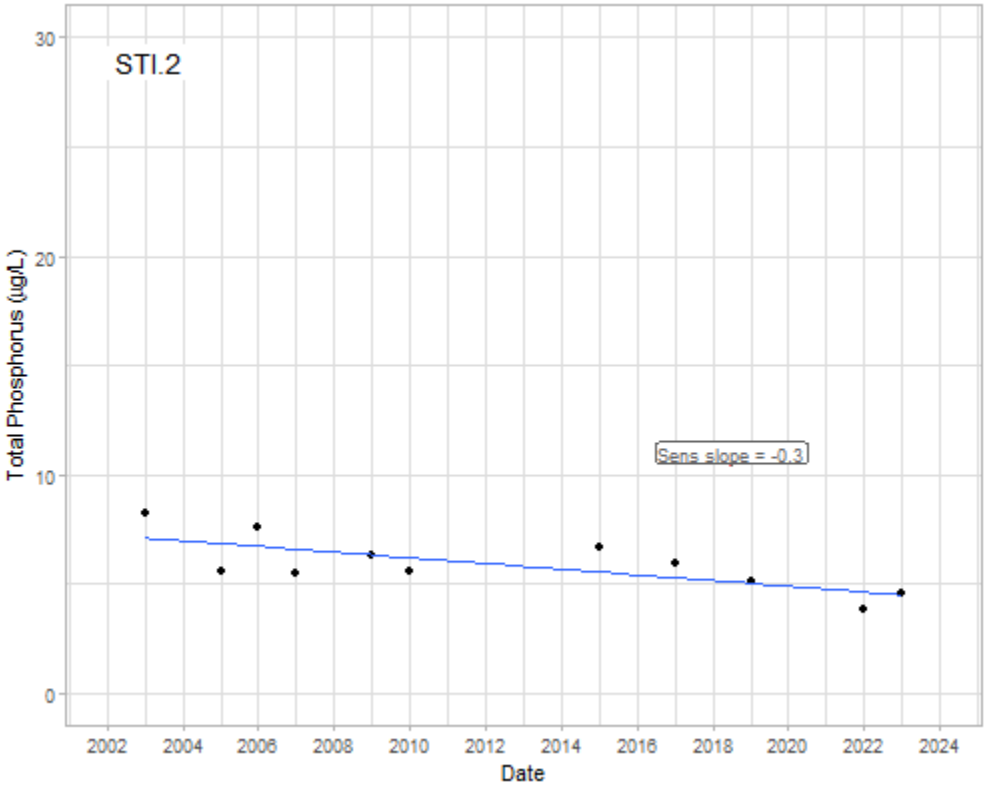
Date


STI.2
Sens slope = -0.3
Total Phosphorus (ug/L)
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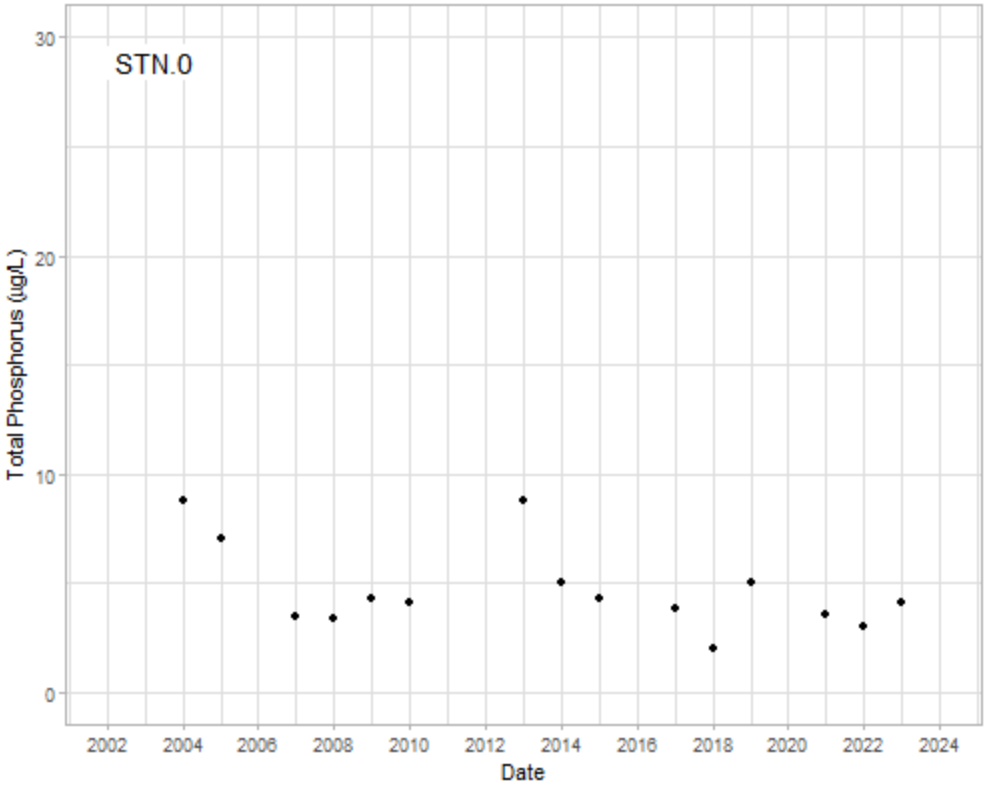
STN.0
Total Phosphorus (ug/L)
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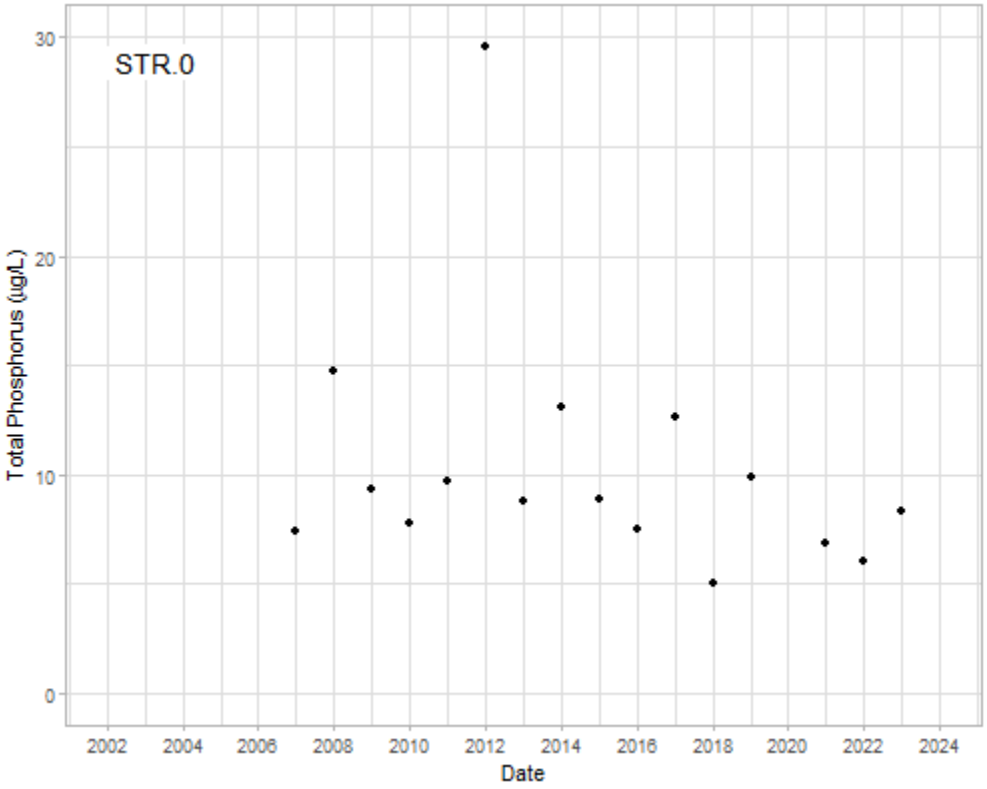
Date


STR.0
Total Phosphorus (ug/L)
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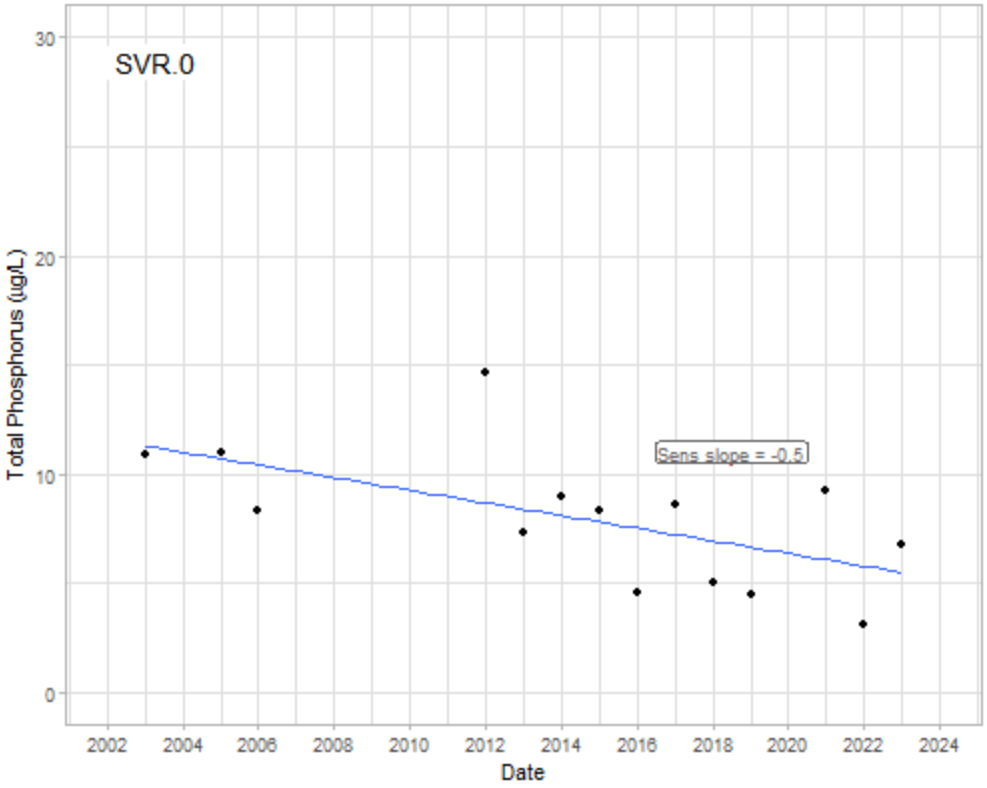
Date


SVR.0
Sens slope = -0.5
Total Phosphorus (ug/L)
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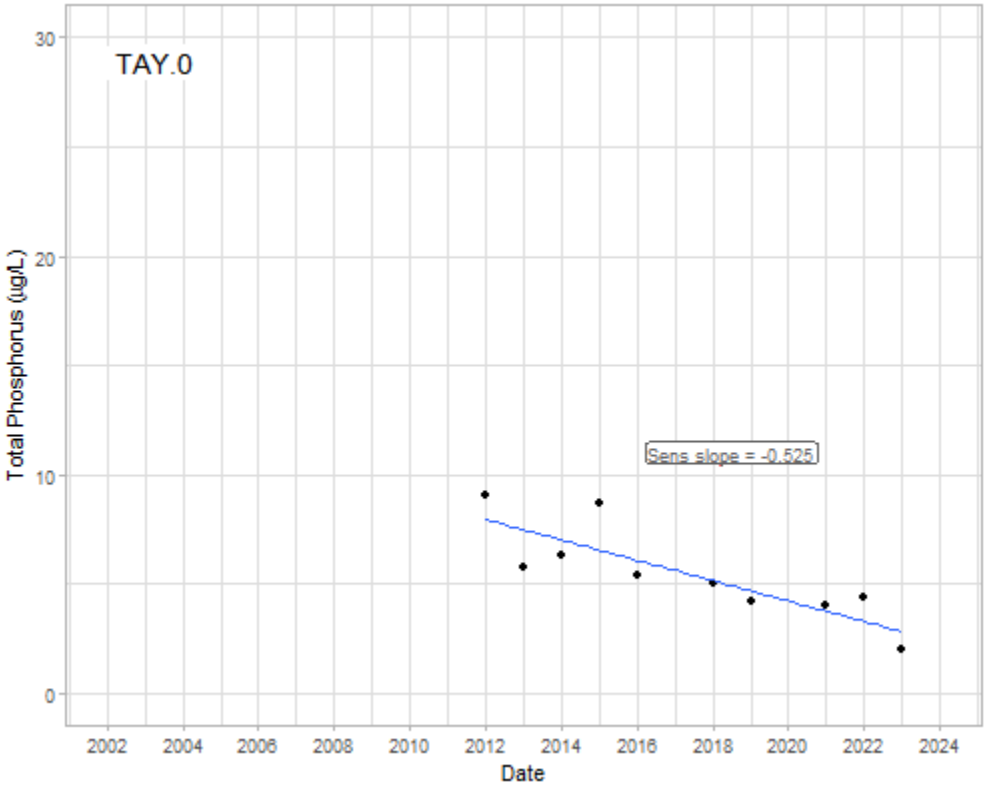
TAY.0
Sens slope = -0.525
Total Phosphorus (ug/L)
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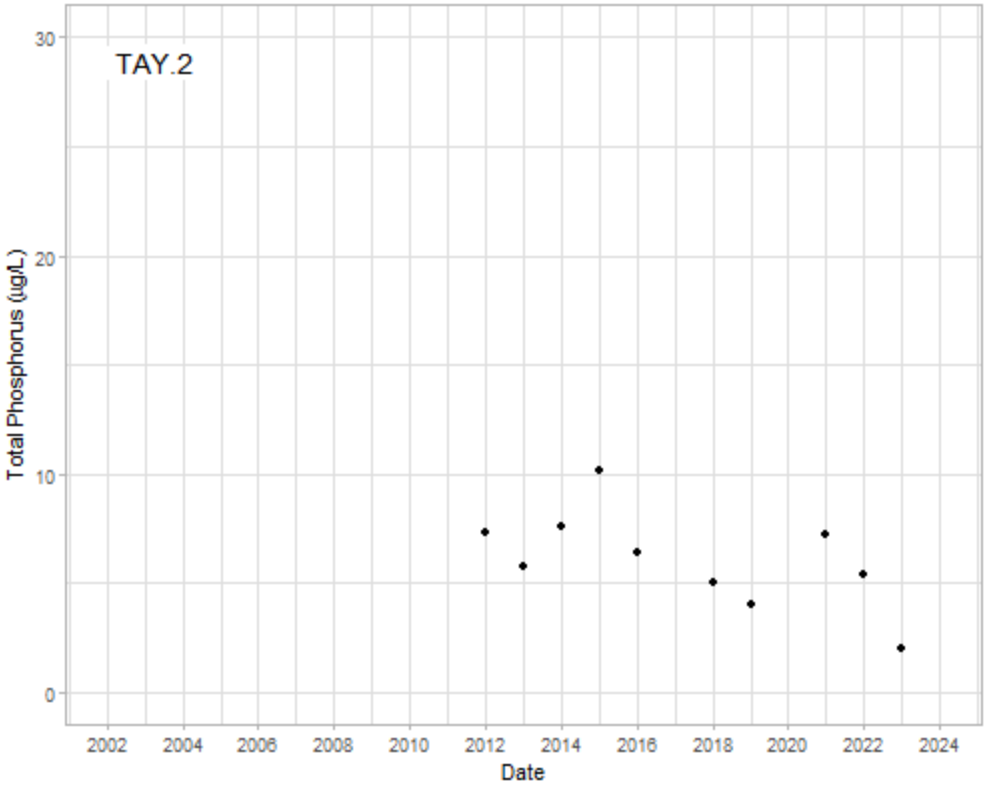
TAY.2
Total Phosphorus (ug/L)
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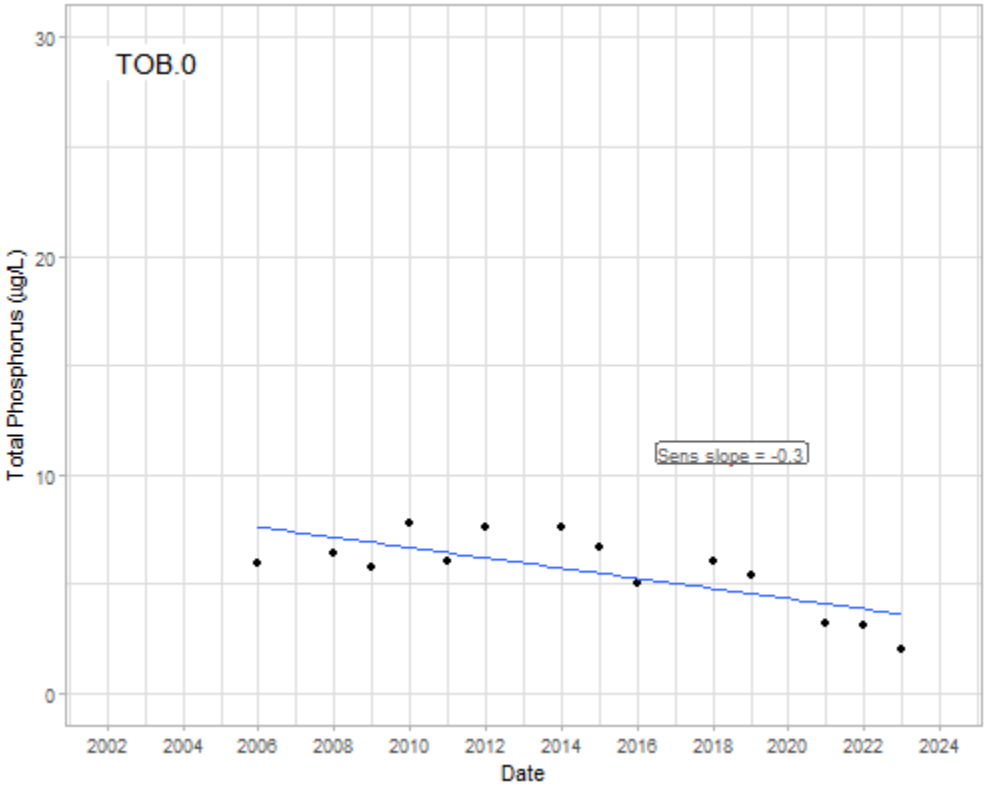
Date


TOB.0
Total Phosphorus (ug/L)
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Sens slope = -0.3
2002
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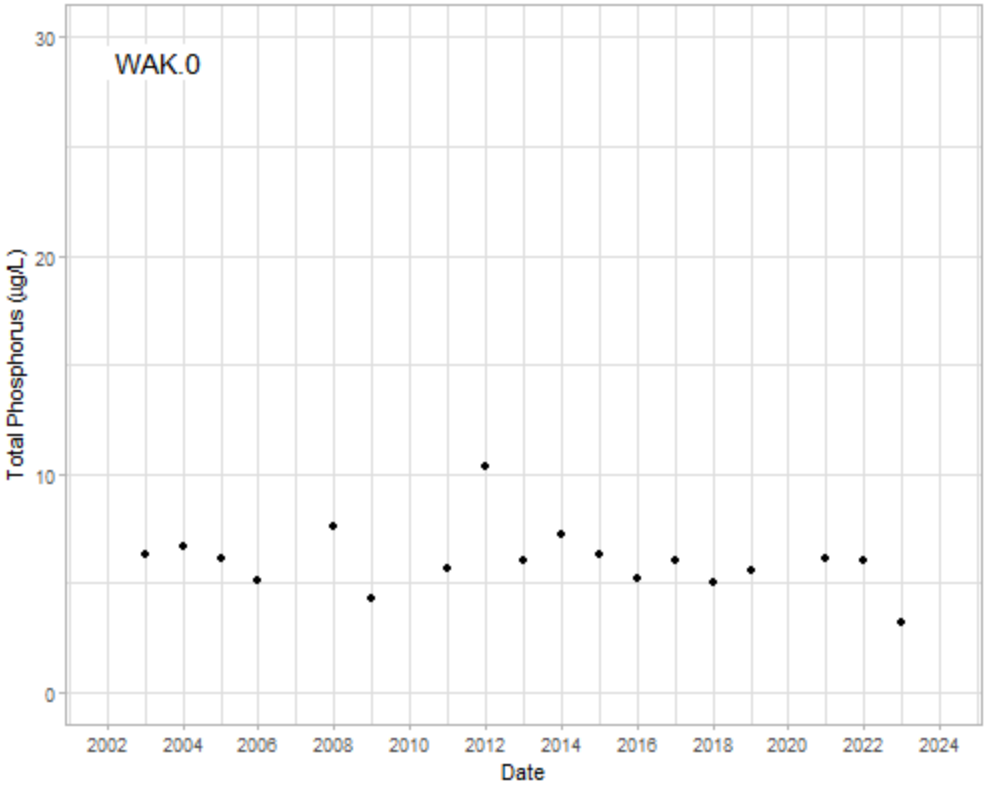
Date


WAK.0
Total Phosphorus (ug/L)
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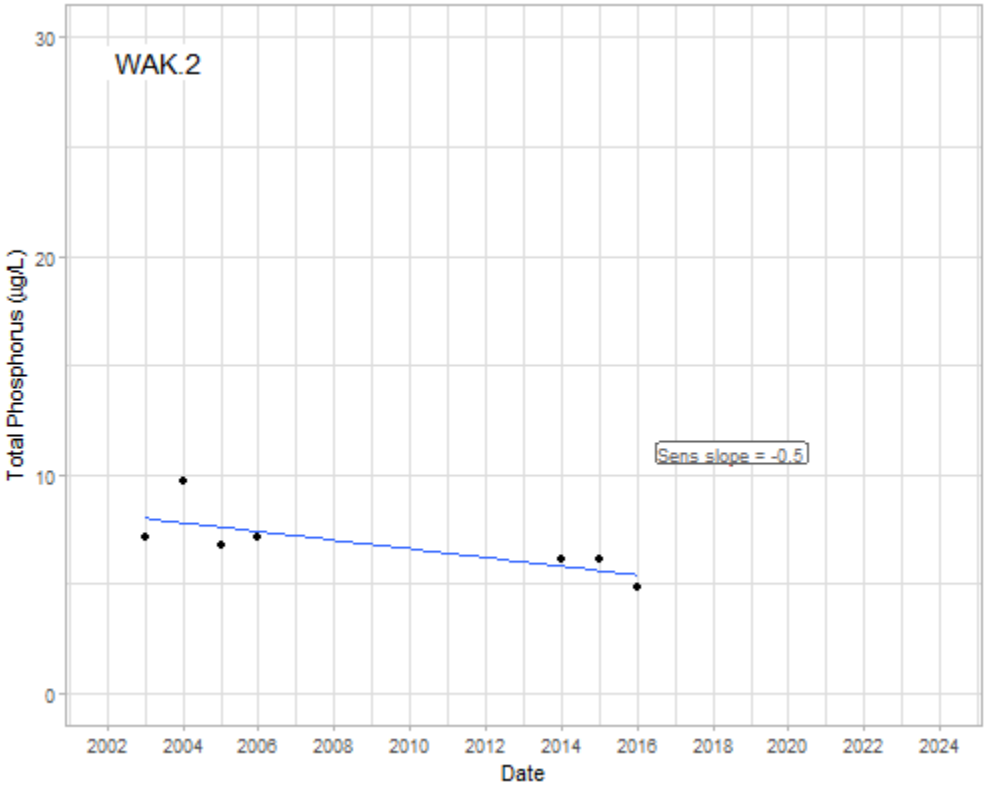
Date


WAK.2
Total Phosphorus (ug/L)
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Sens slope = -0.5
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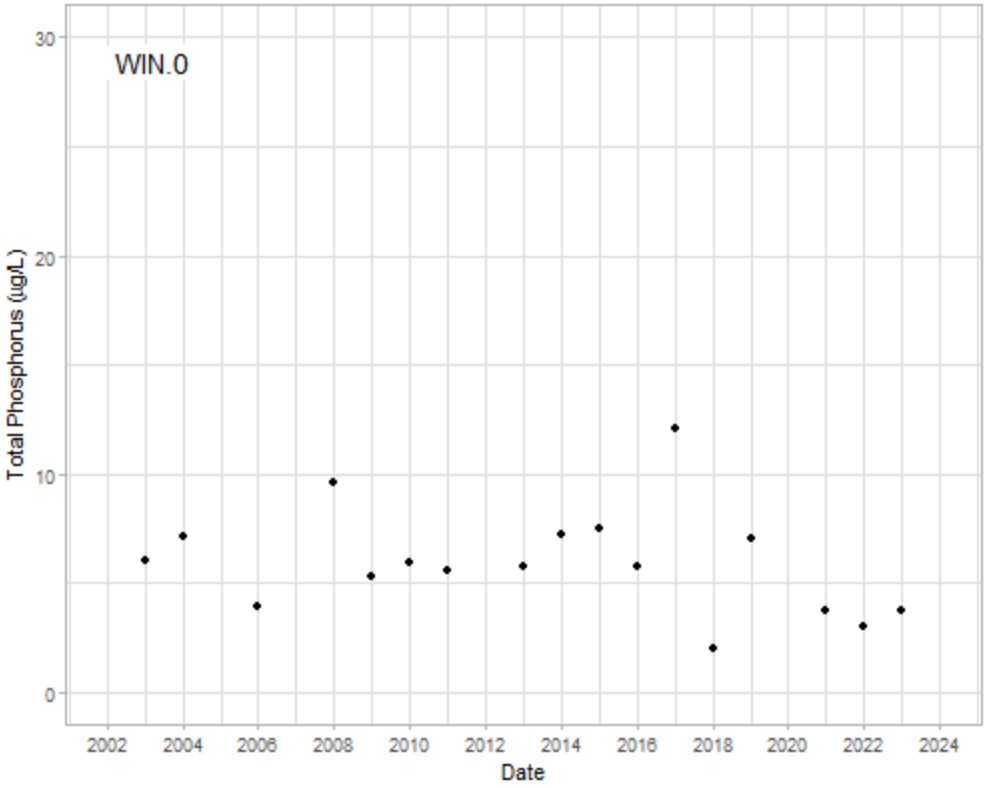
2022
2024
Date


WIN.0
Total Phosphorus (ug/L)
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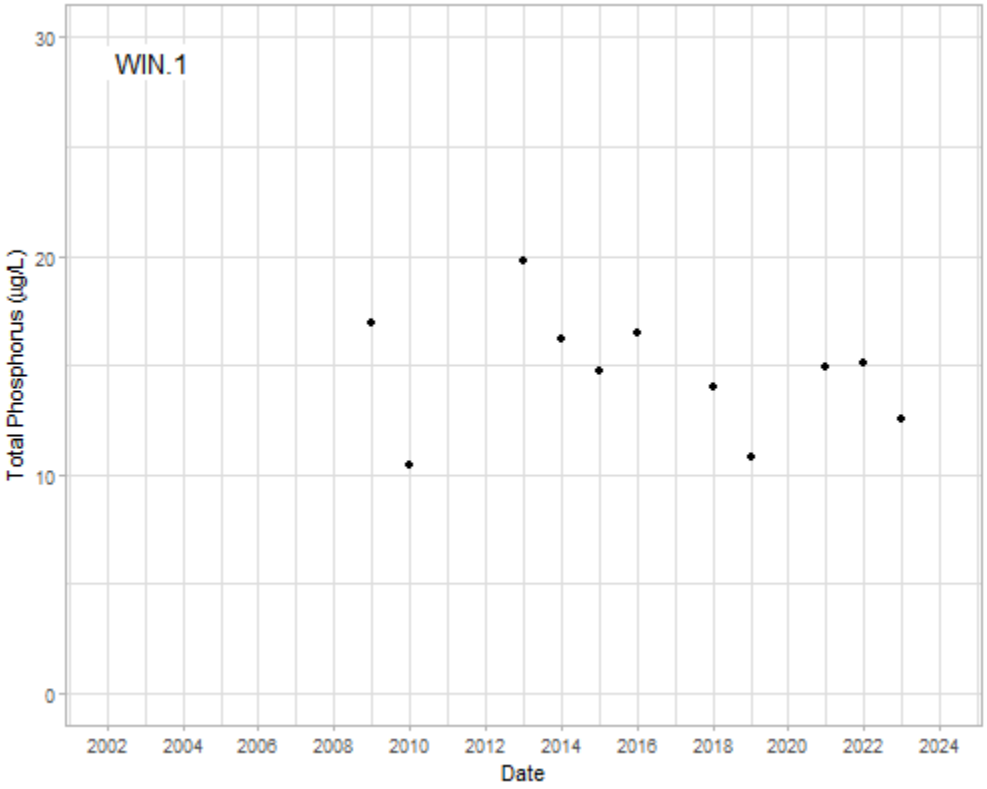
2024
Date


WIN.1
Total Phosphorus (ug/L)
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2002
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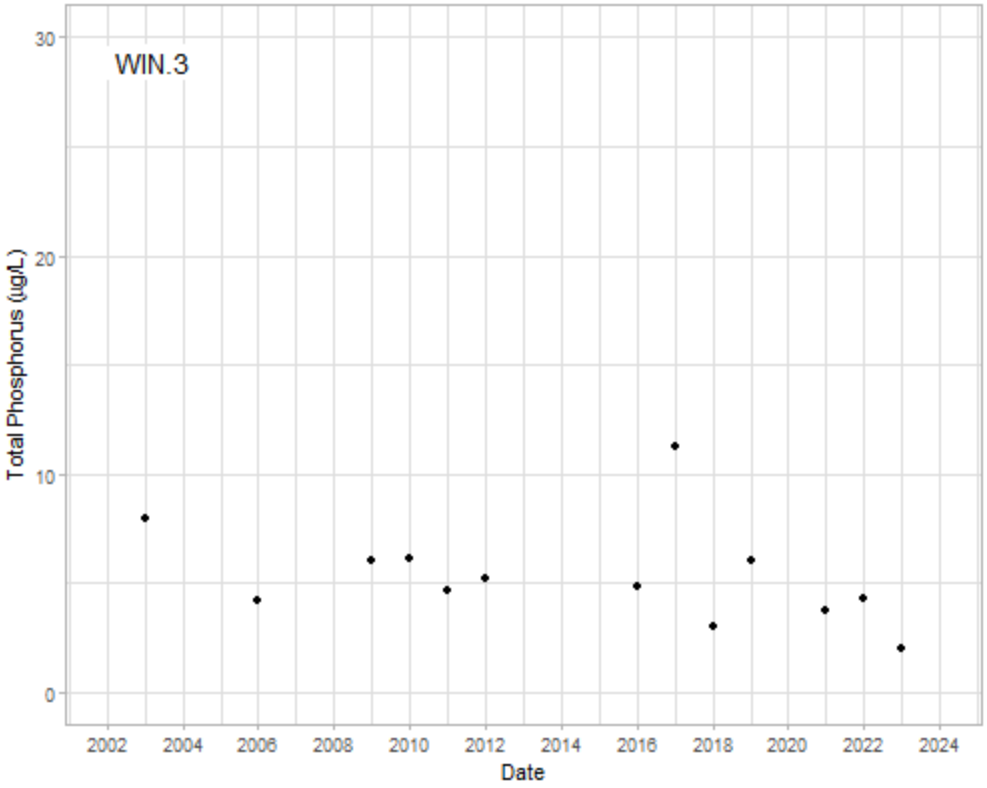
Date


WIN.3
Total Phosphorus (ug/L)
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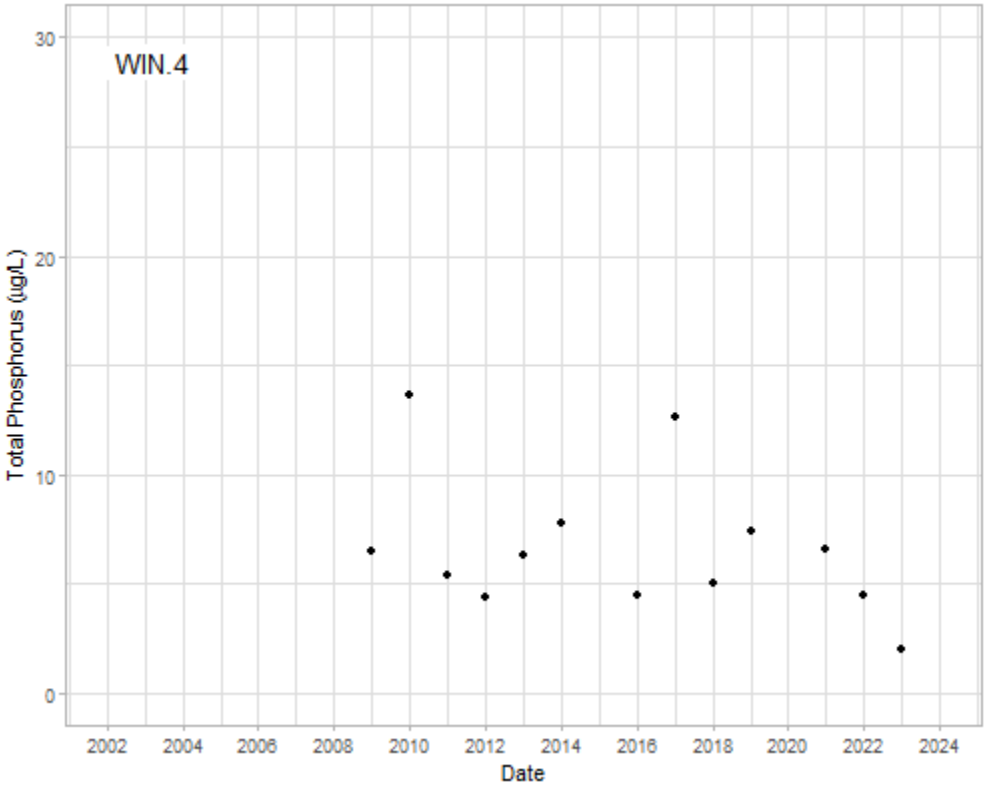
2024
Date


WIN.4
Total Phosphorus (ug/L)
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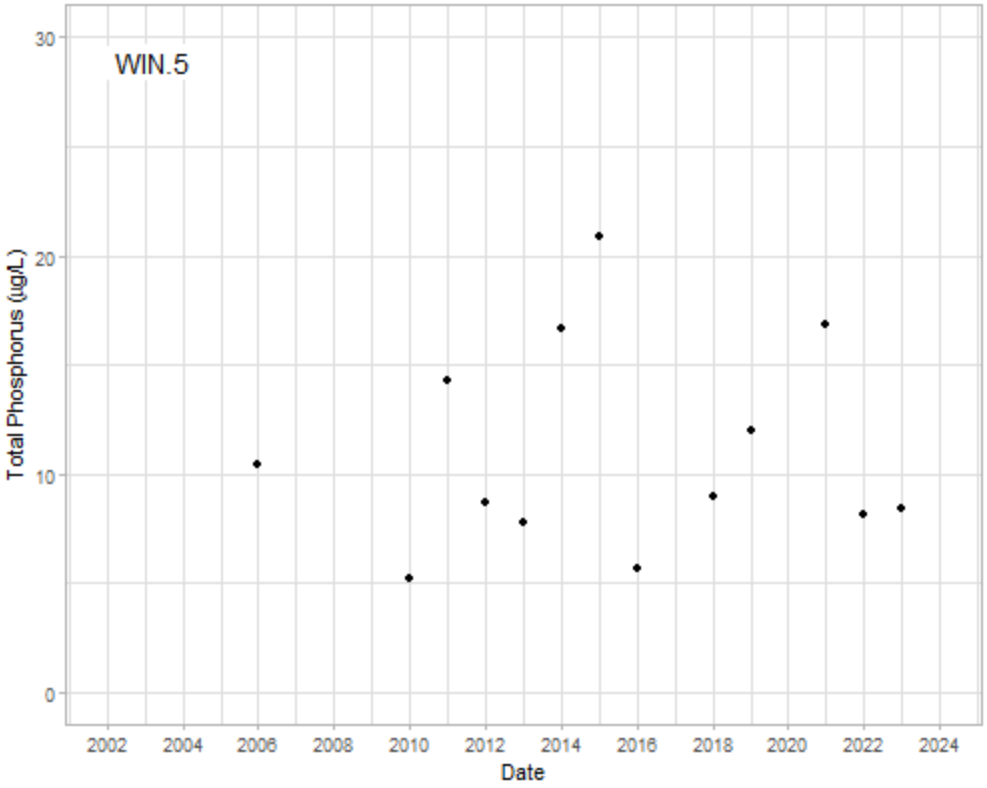
Date


WIN.5
Total Phosphorus (ug/L)
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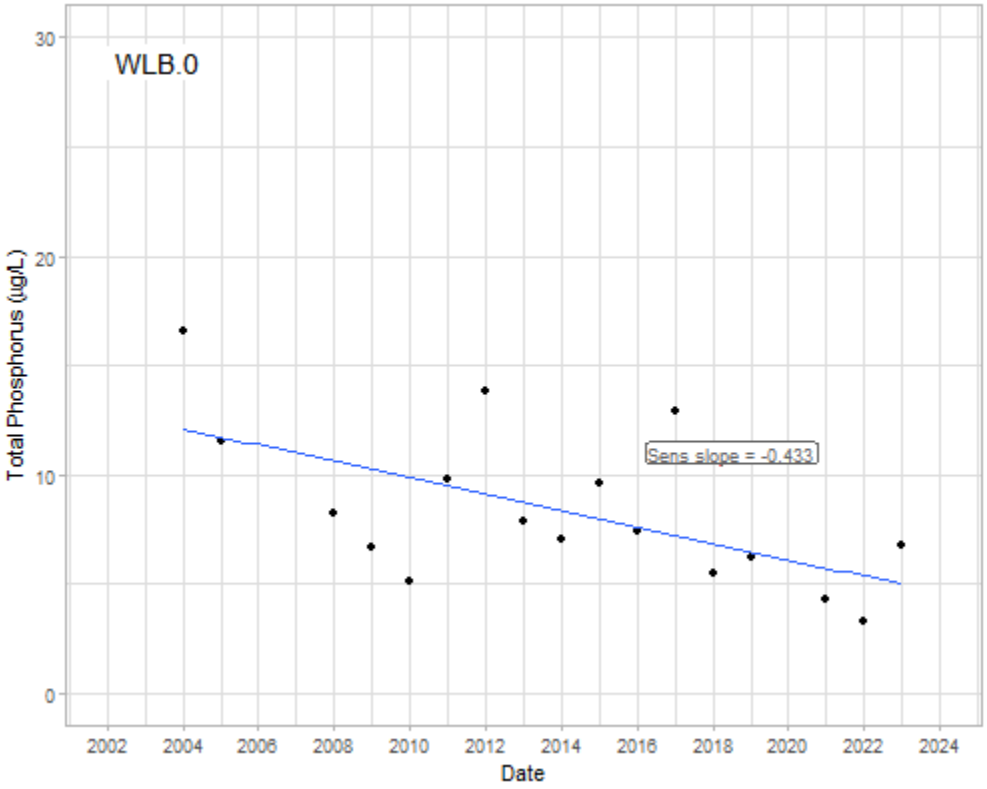
2024
Date


WLB.0
Total Phosphorus (ug/L)
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Sens slope = -0.433
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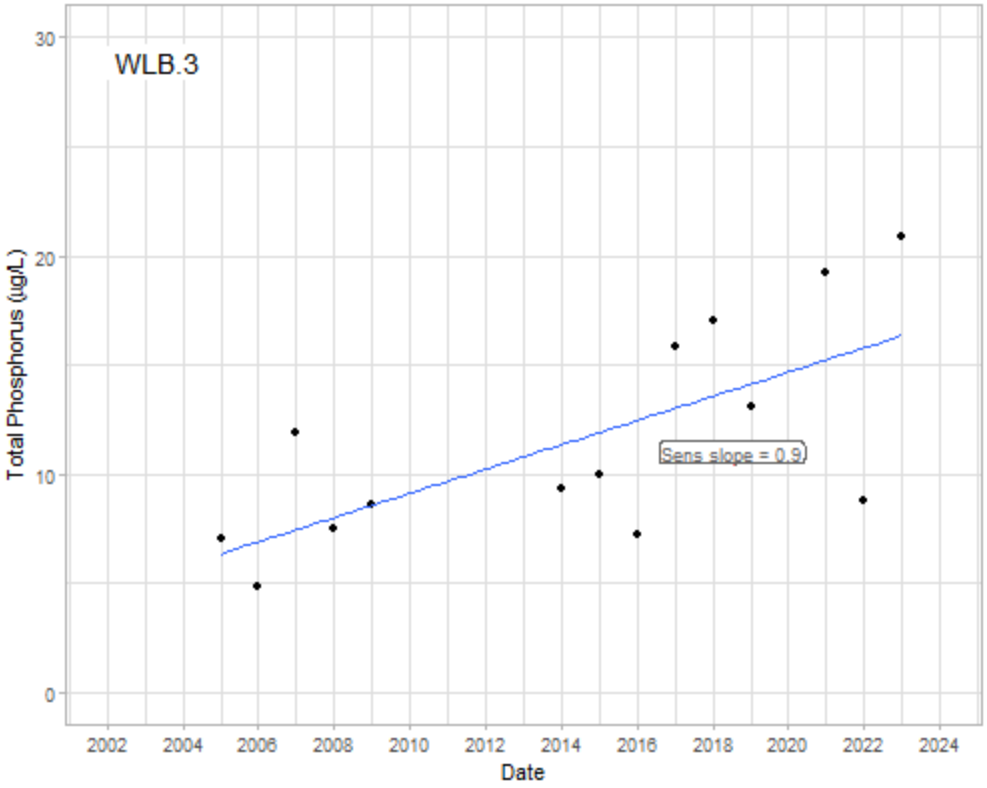
Date


WLB.3
Sens slope = 0.9
Total Phosphorus (ug/L)
Date
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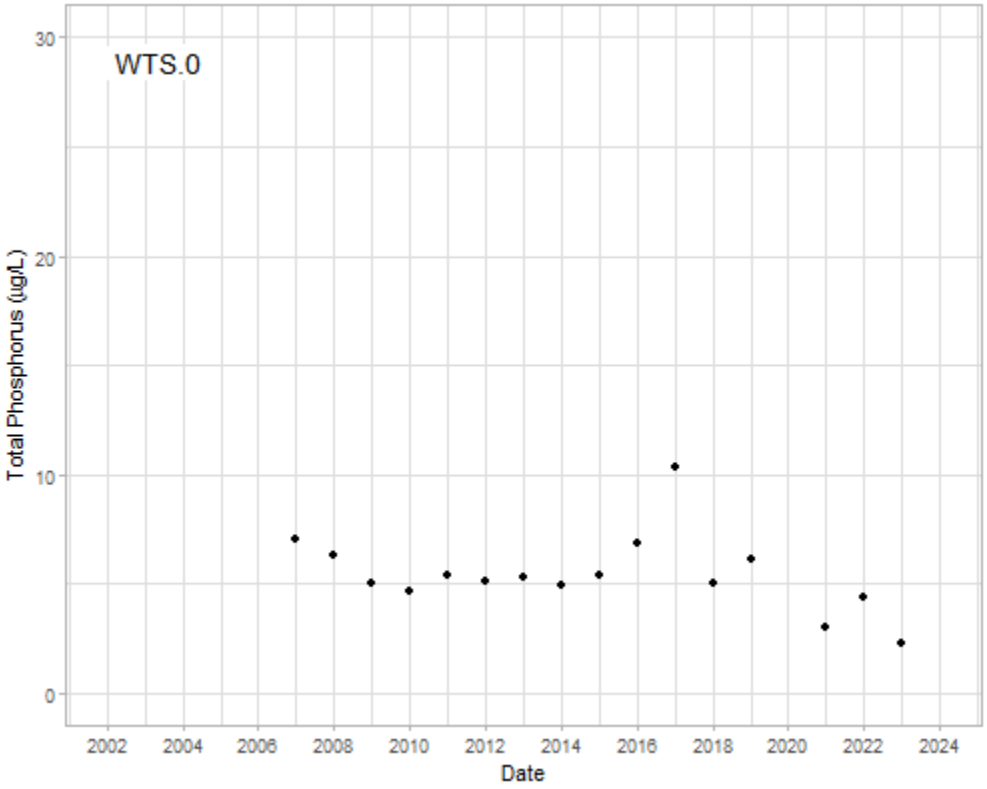
WTS.0
Total Phosphorus (ug/L)
Date
0
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2002
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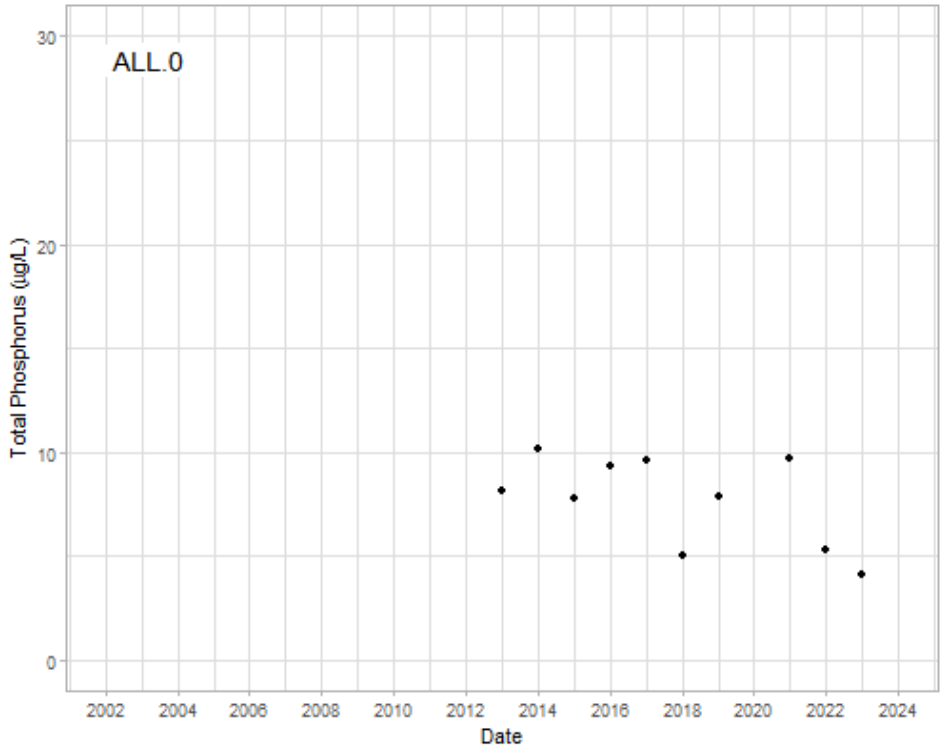
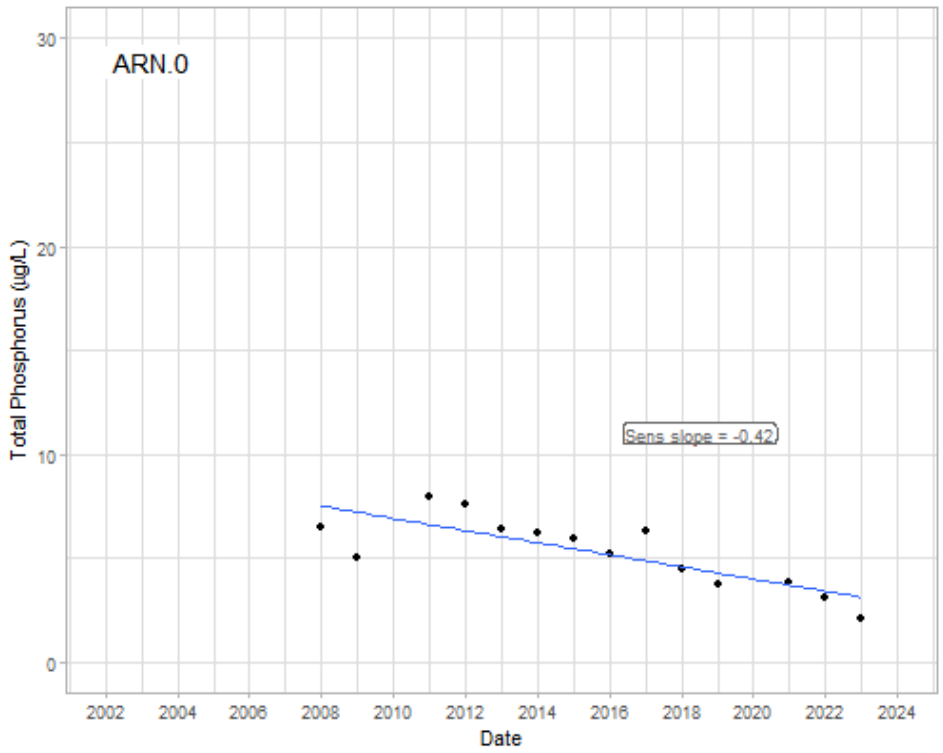
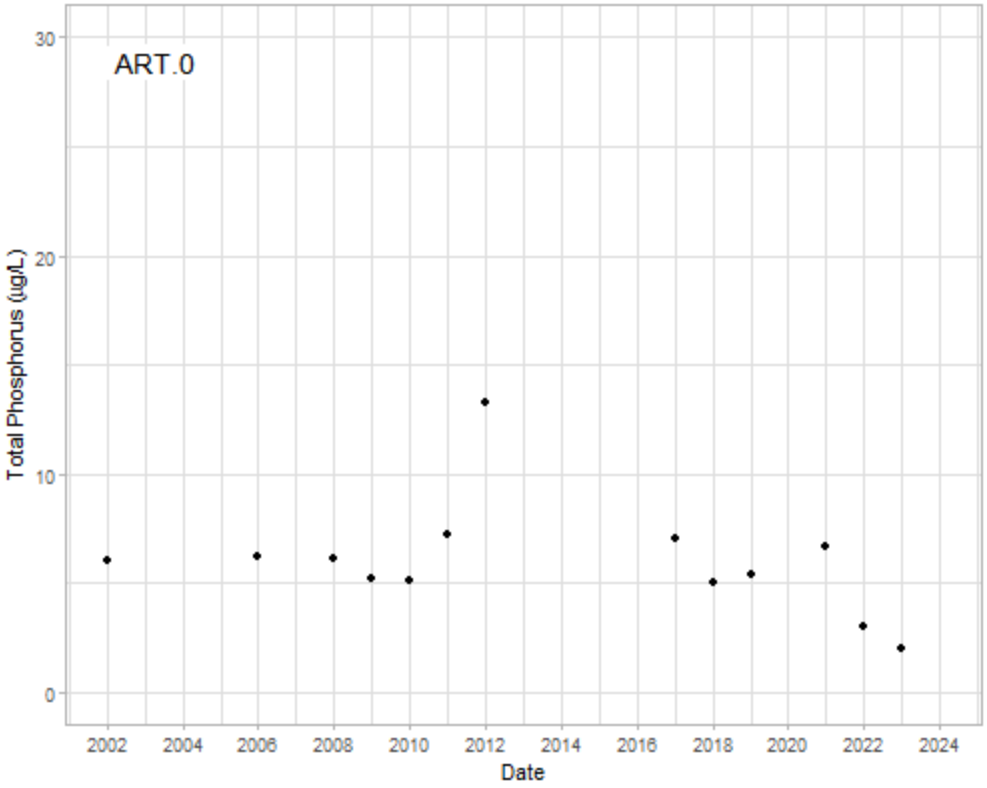
2024

Spring Total Phosphorus Long-term Trends




ART.0
Total Phosphorus (ug/L)
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0
2002
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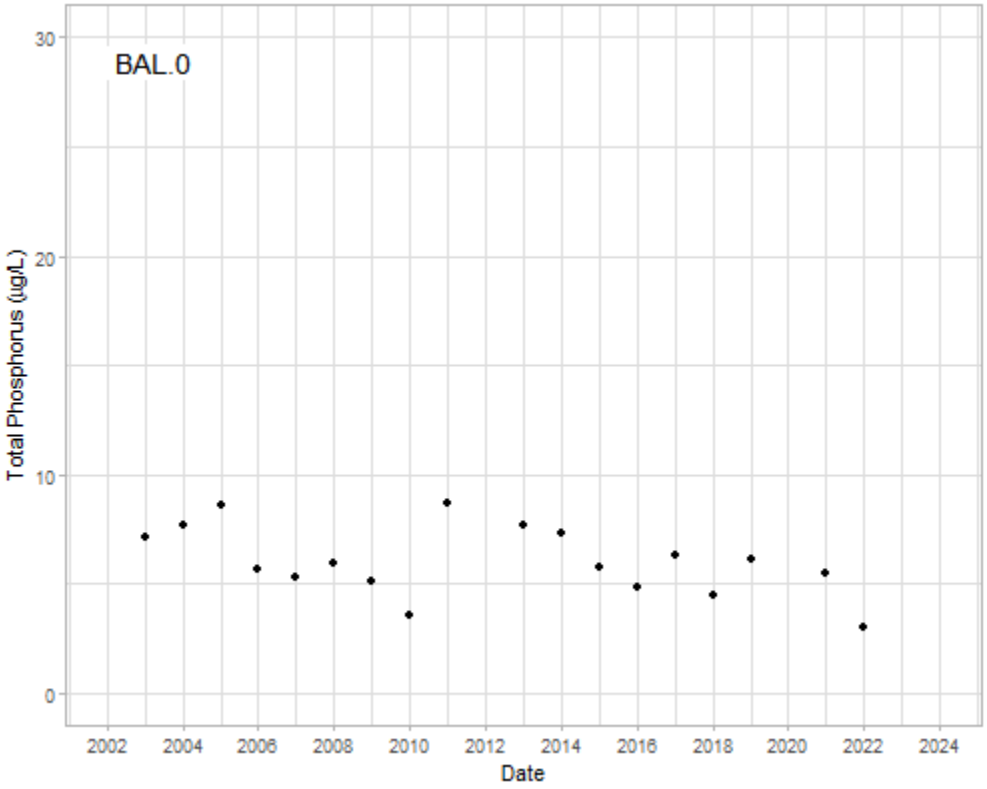
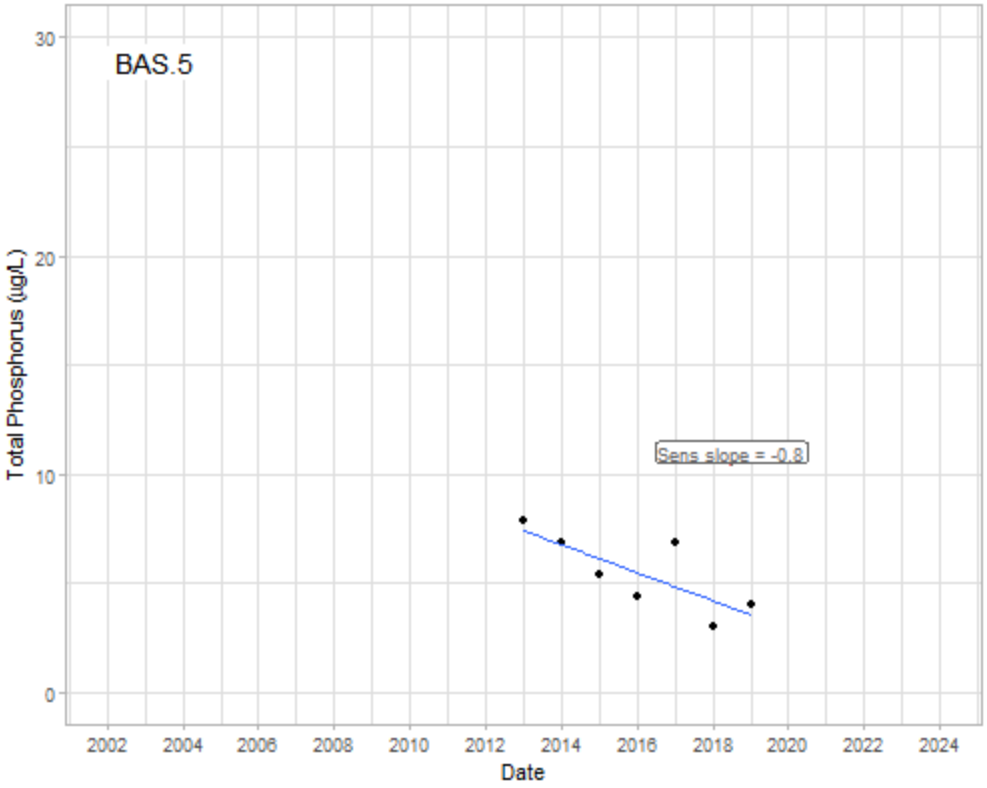
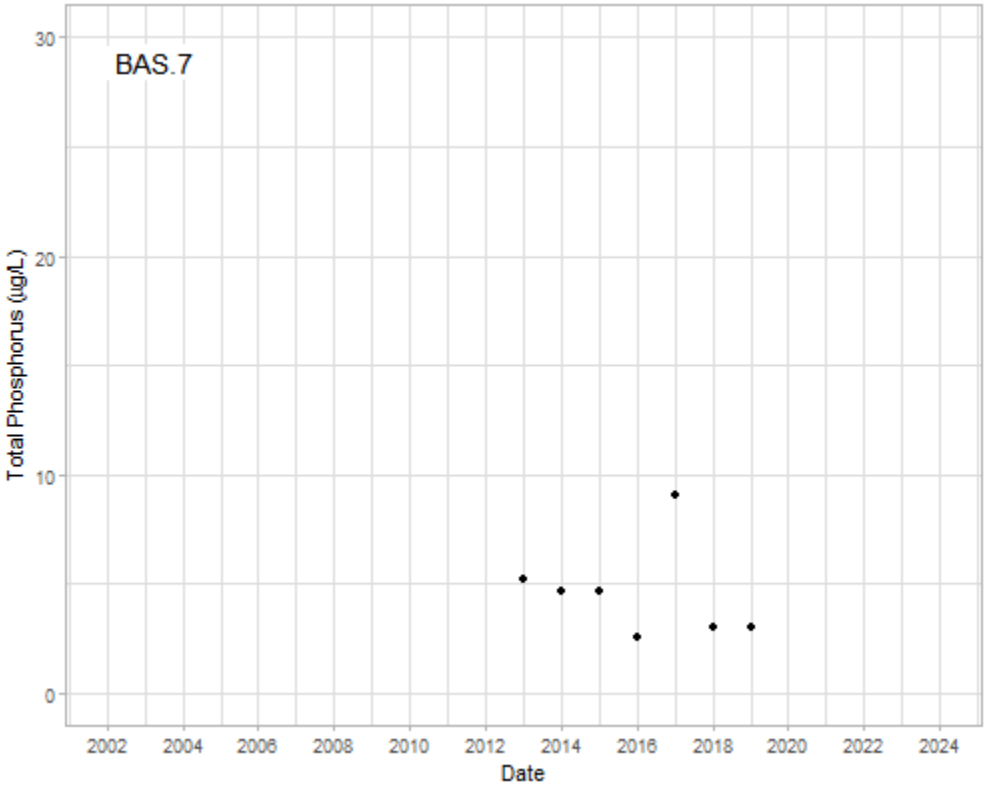
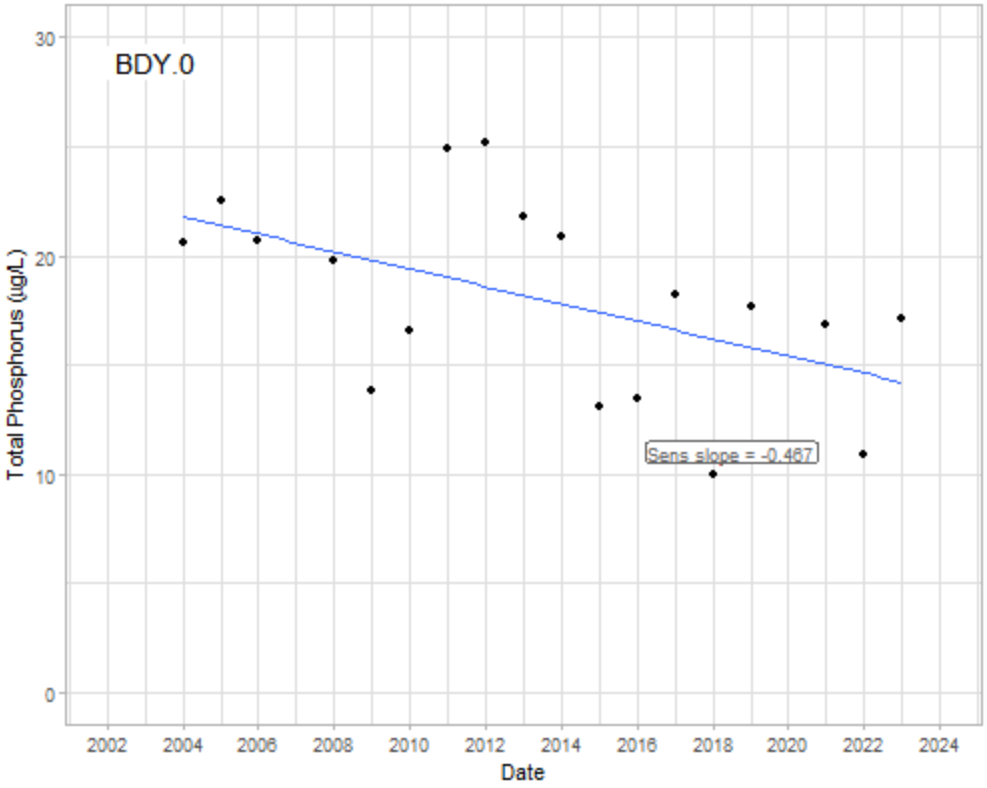
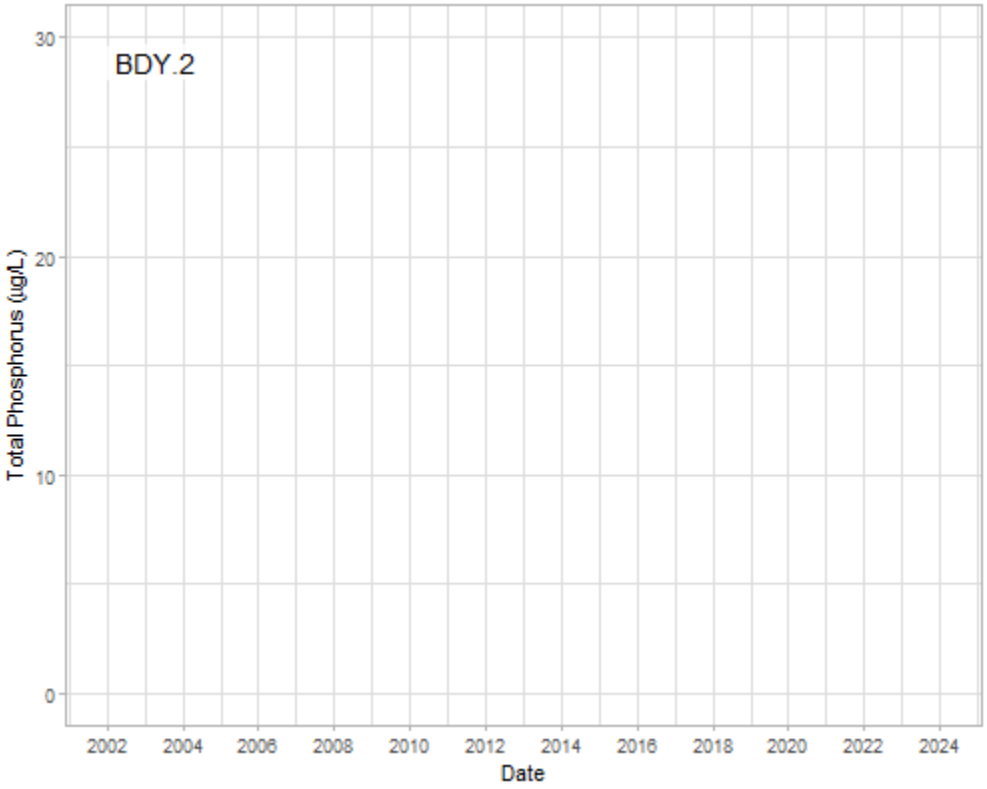
2022
2024
Date


BAL.0
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


BAS.5
Sens slope = -0.8
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


BAS.7
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


BDY.0
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date
Sens slope = -0.467


BDY.2
Total Phosphorus (ug/L)
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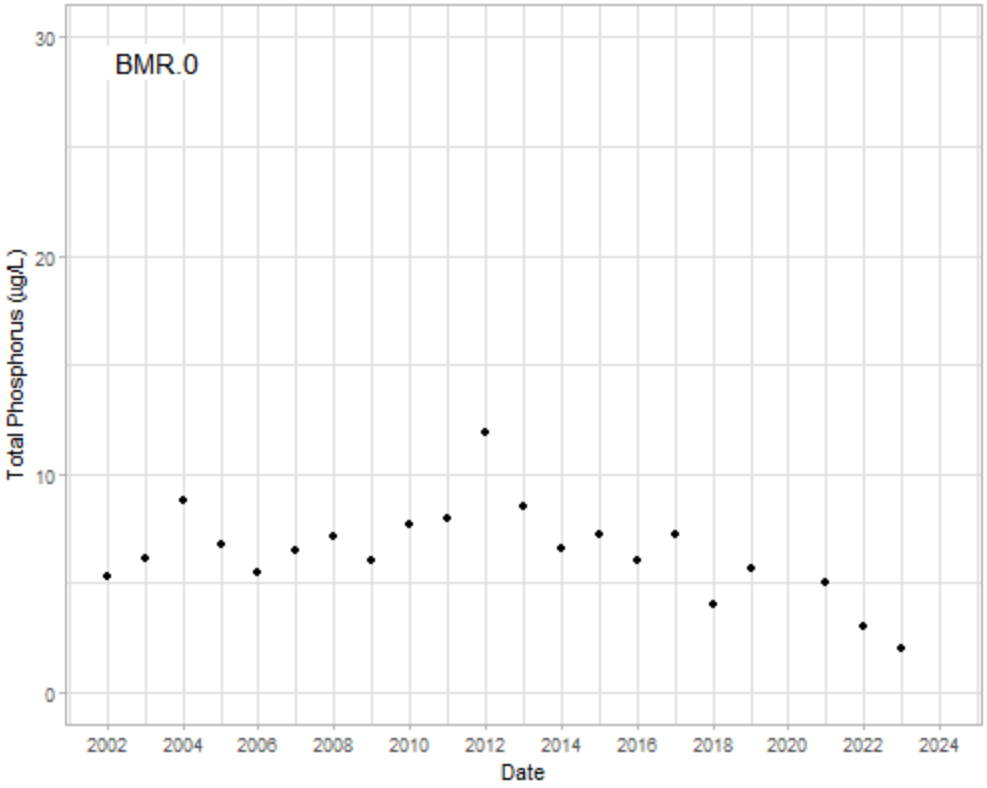
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


BMR.0
Total Phosphorus (ug/L)
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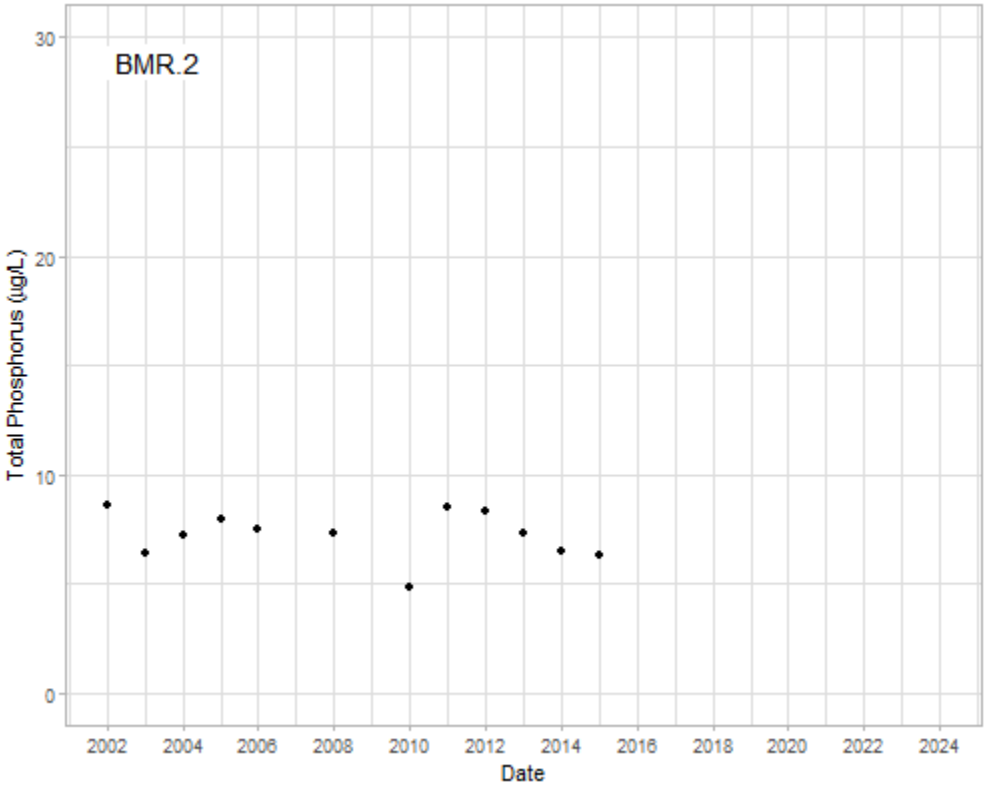
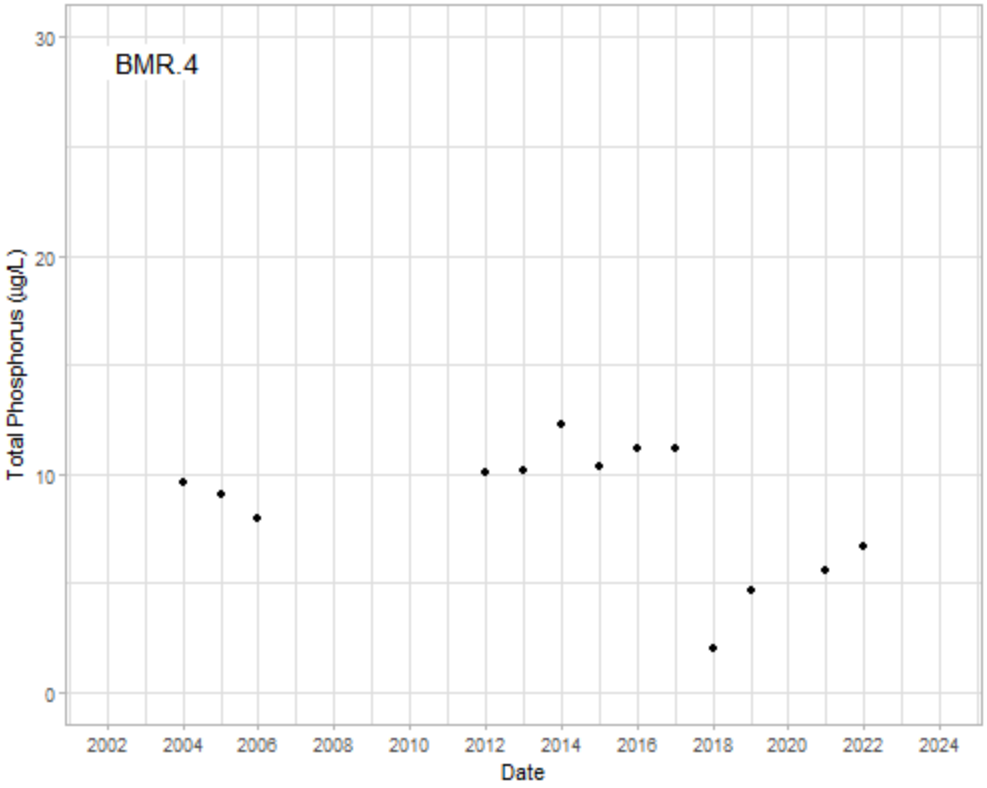
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


BMR.2
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


BMR.4
Total Phosphorus (ug/L)
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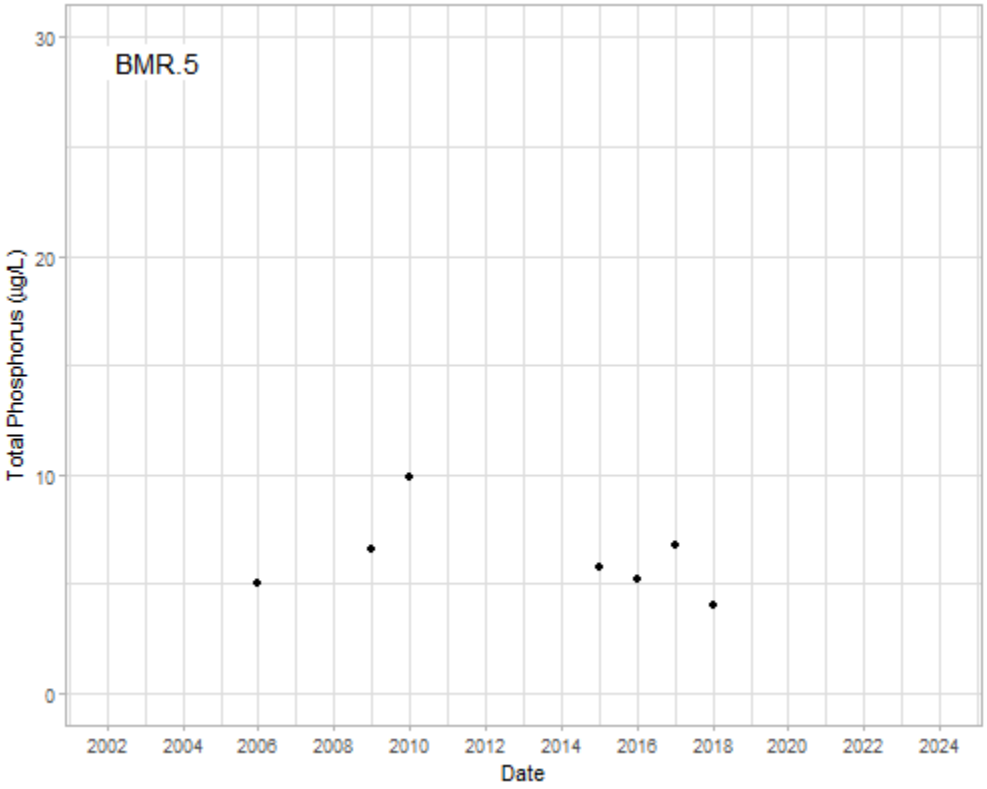
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


BMR.5
Total Phosphorus (ug/L)
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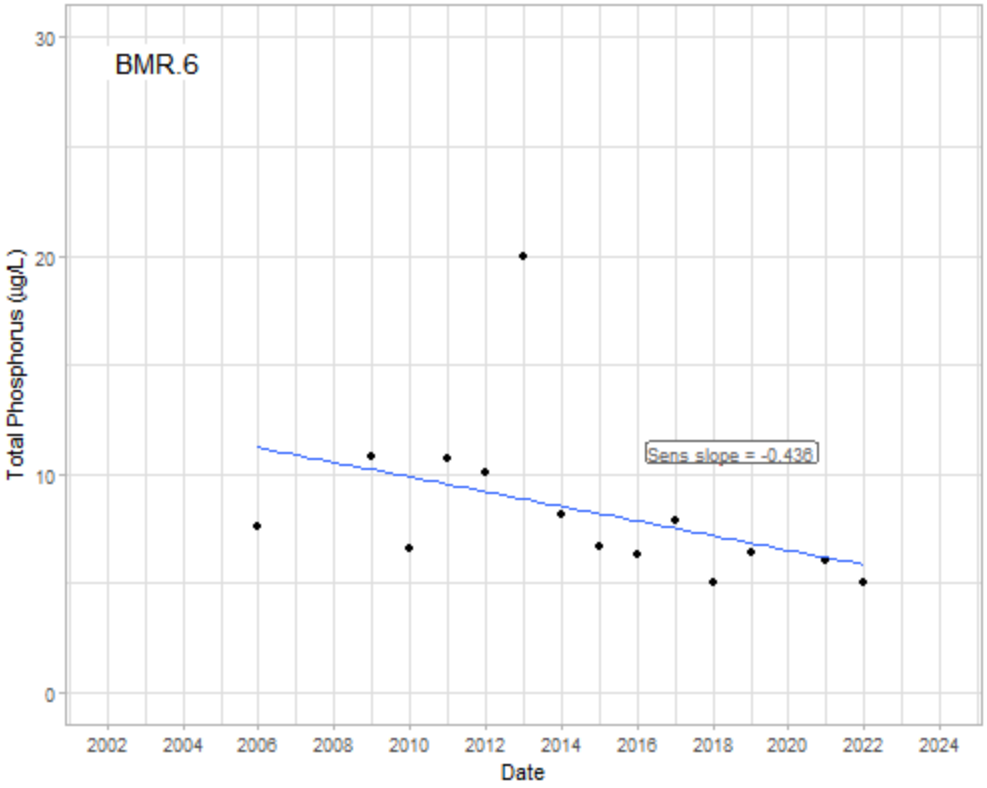
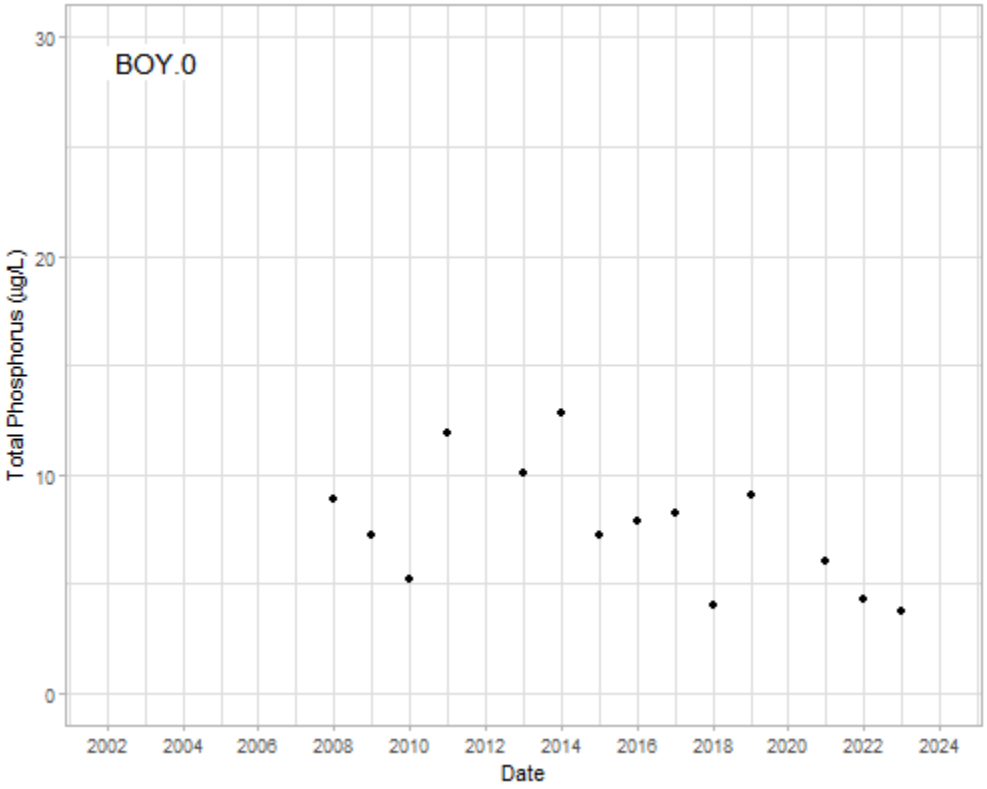
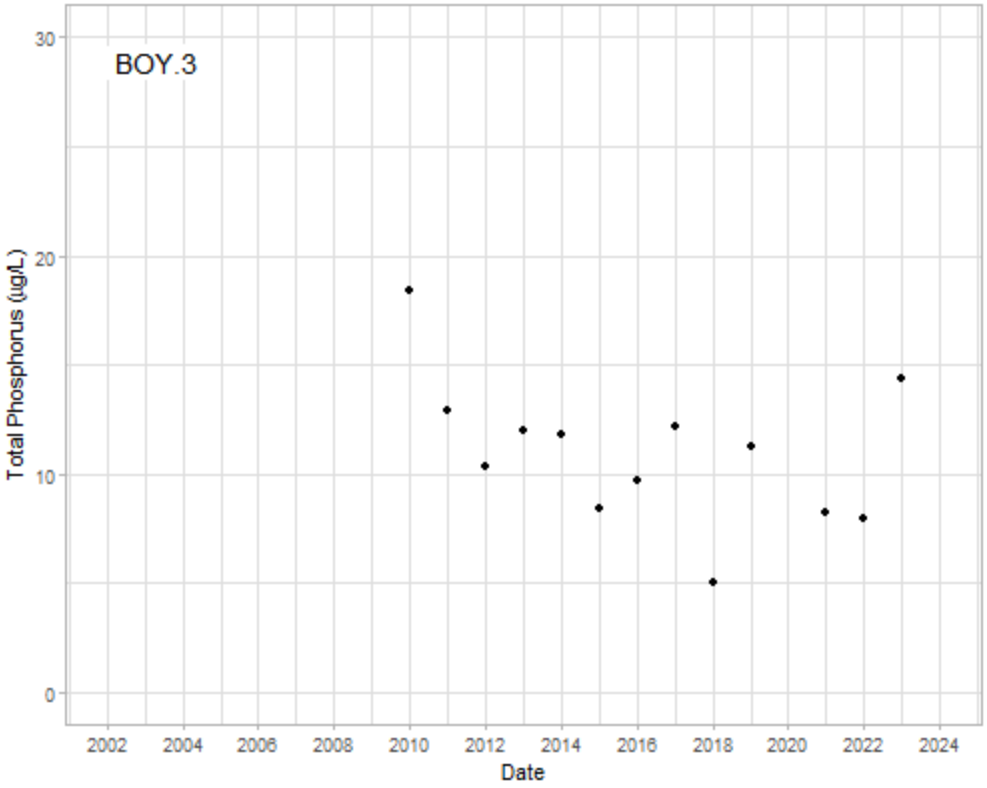
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


BMR.6
Sens slope = -0.436
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


BOY.0
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


BOY.3
Total Phosphorus (ug/L)
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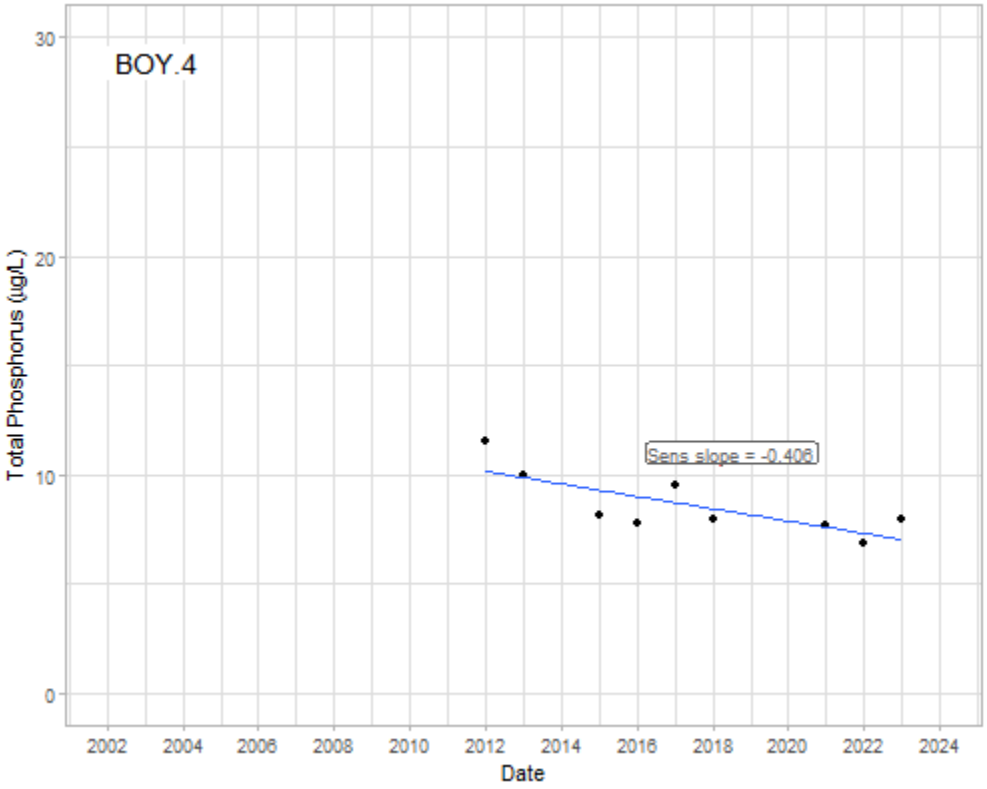
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


BOY.4
Total Phosphorus (ug/L)
Sens slope = -0.406
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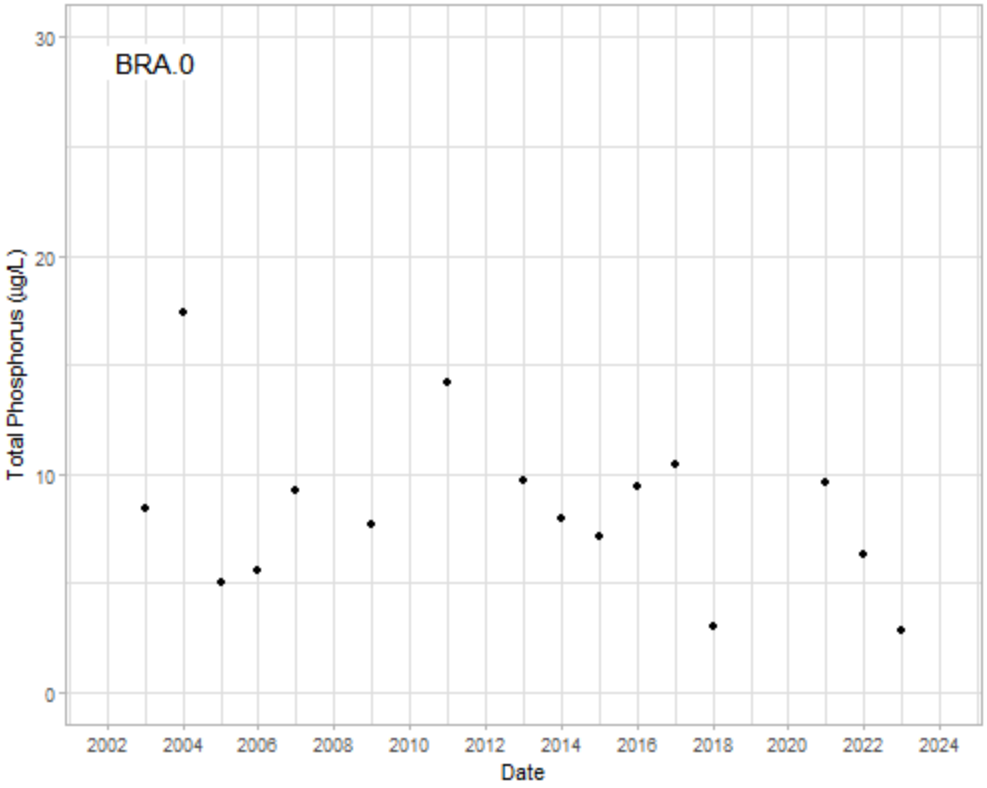
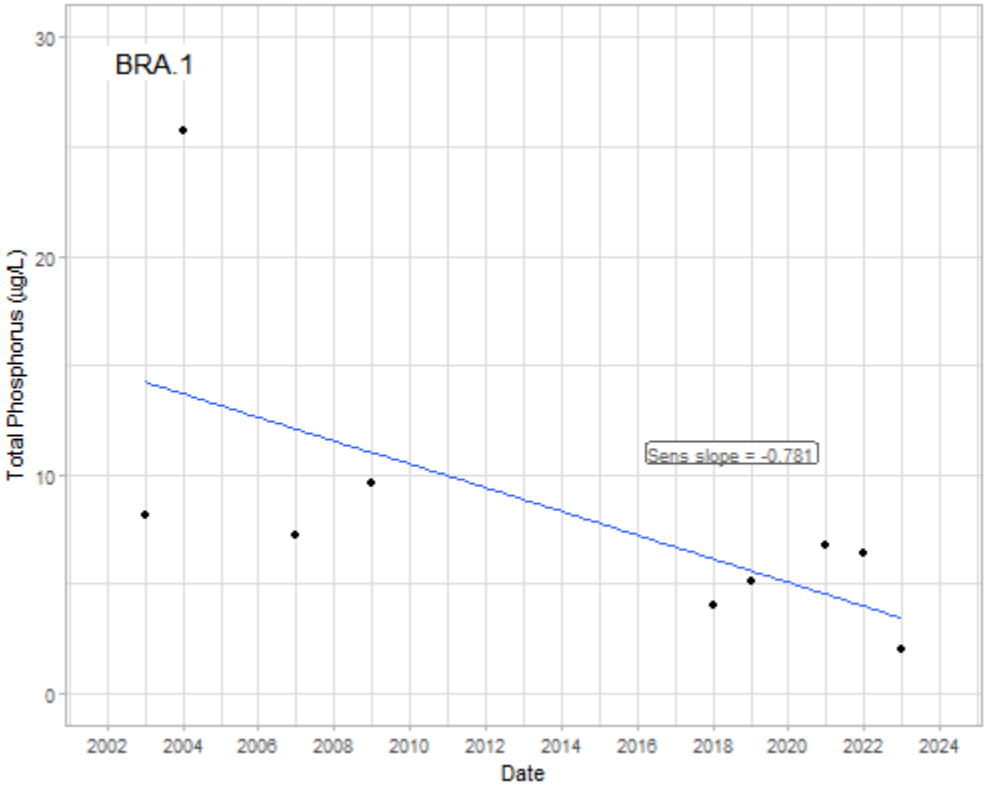
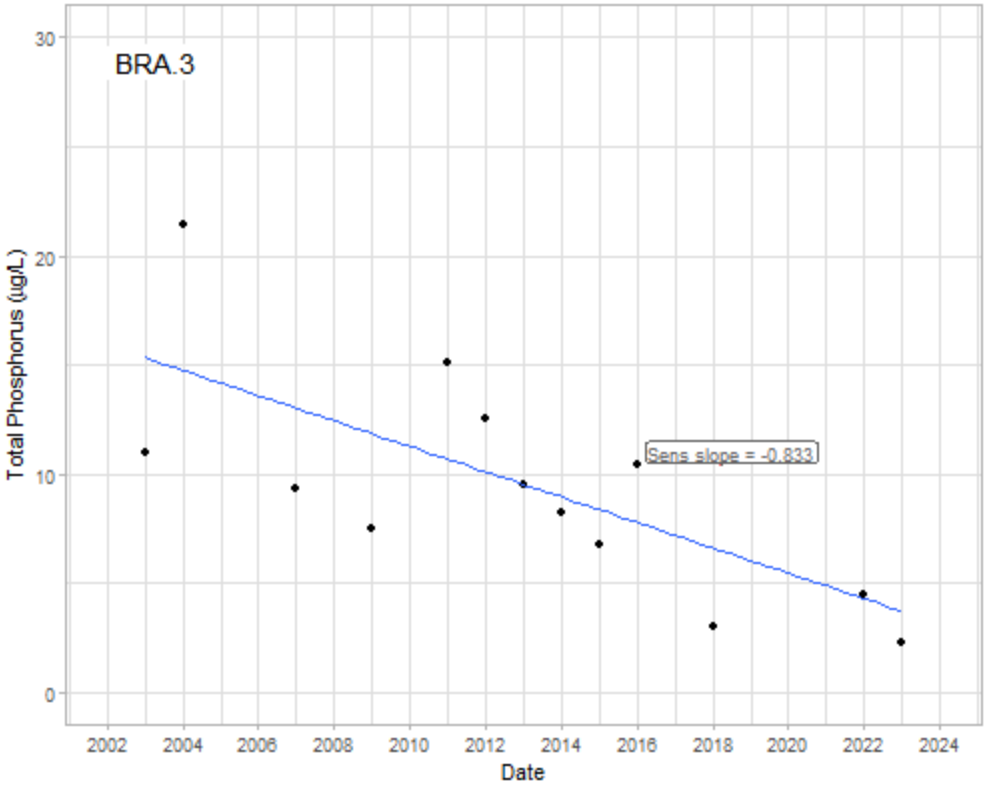
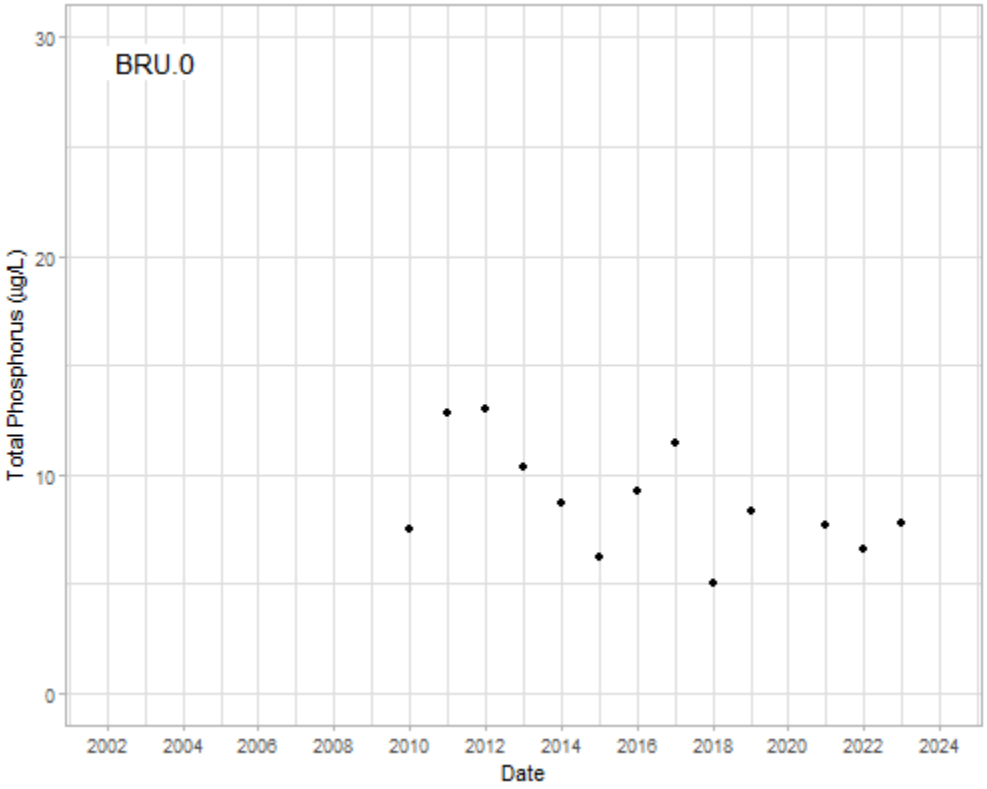
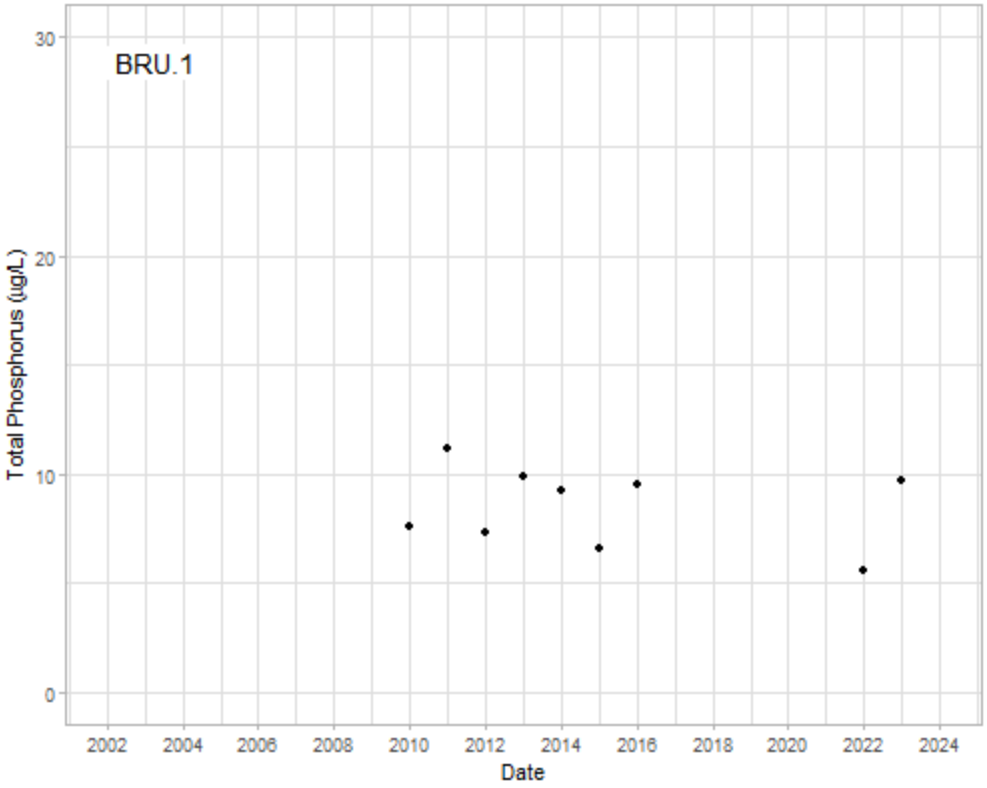
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date

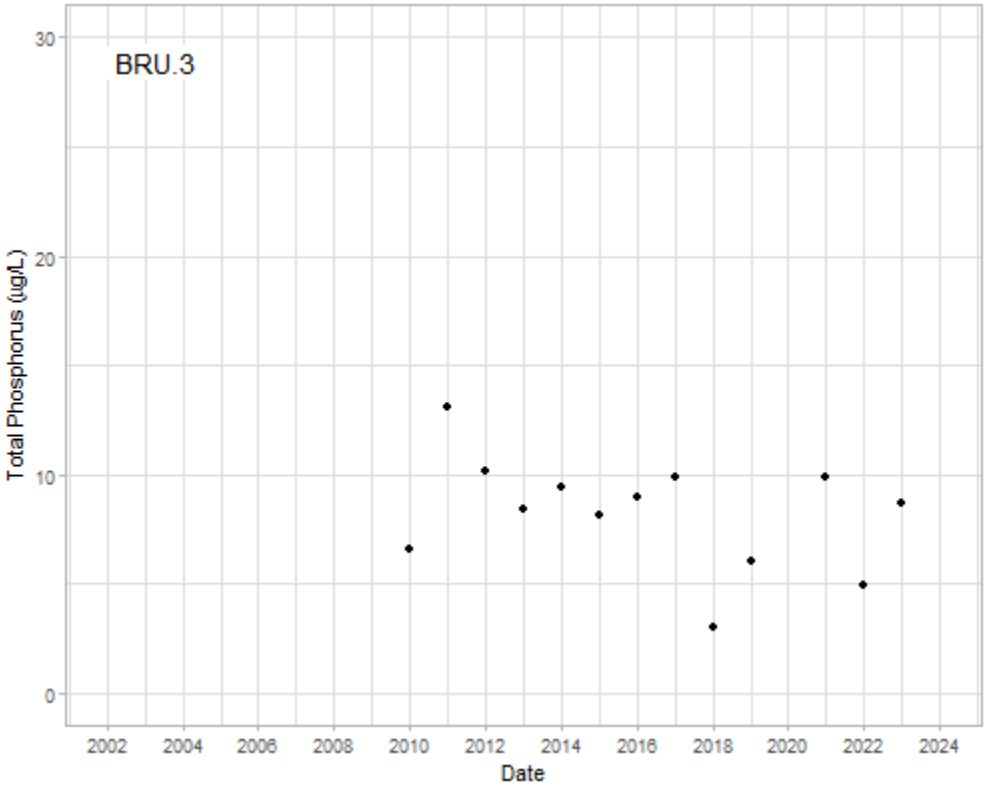

BRA.0
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date

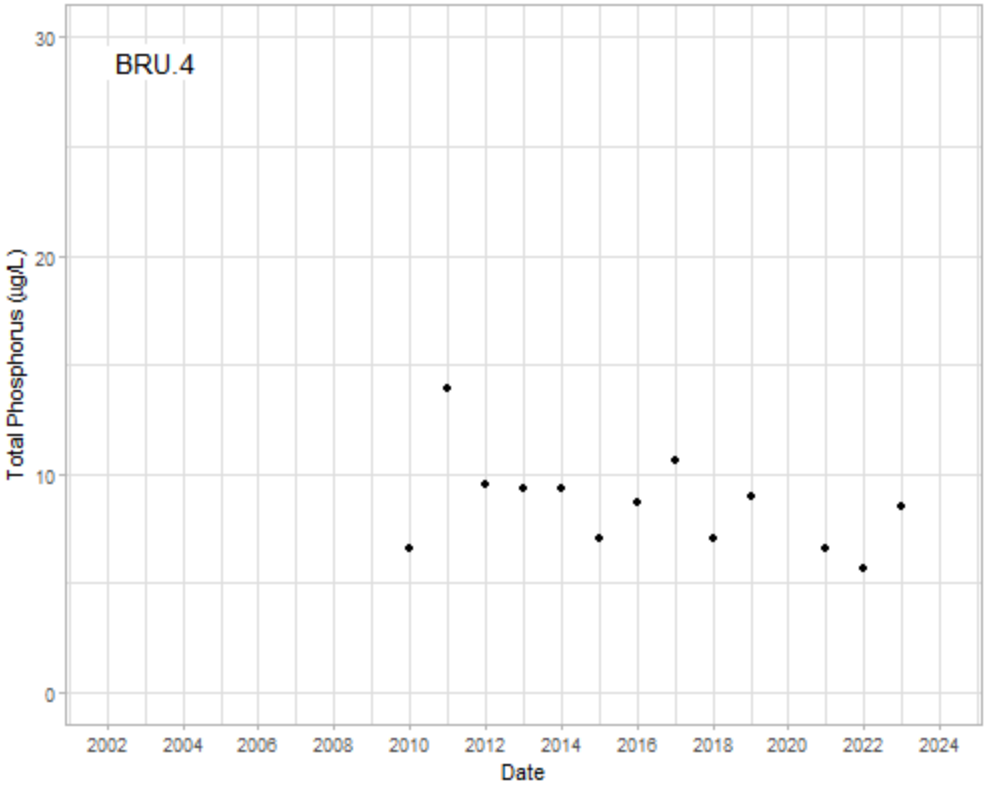

BRA.1
Total Phosphorus (ug/L)
30
20
10
0
Sens slope = -0.781
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


BRA.3
Sens slope = -0.833
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


BRU.0
Total Phosphorus (ug/L)
Date
0
10
20
30
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


BRU.1
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


BRU.3
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date


BRU.4
Total Phosphorus (ug/L)
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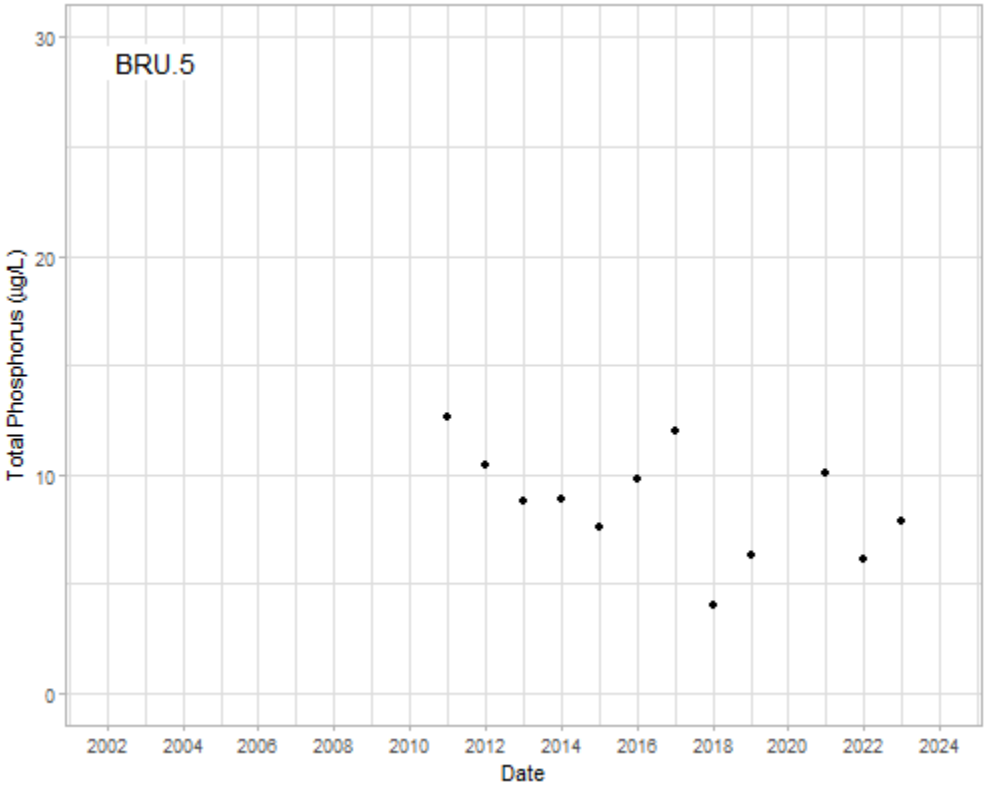
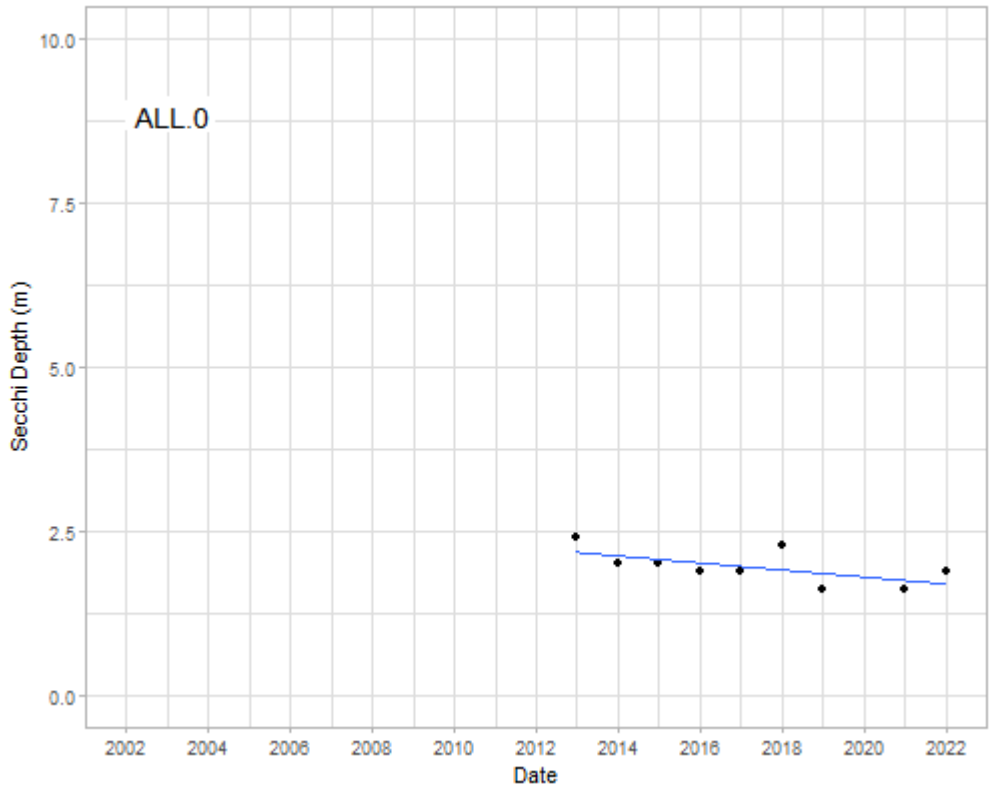
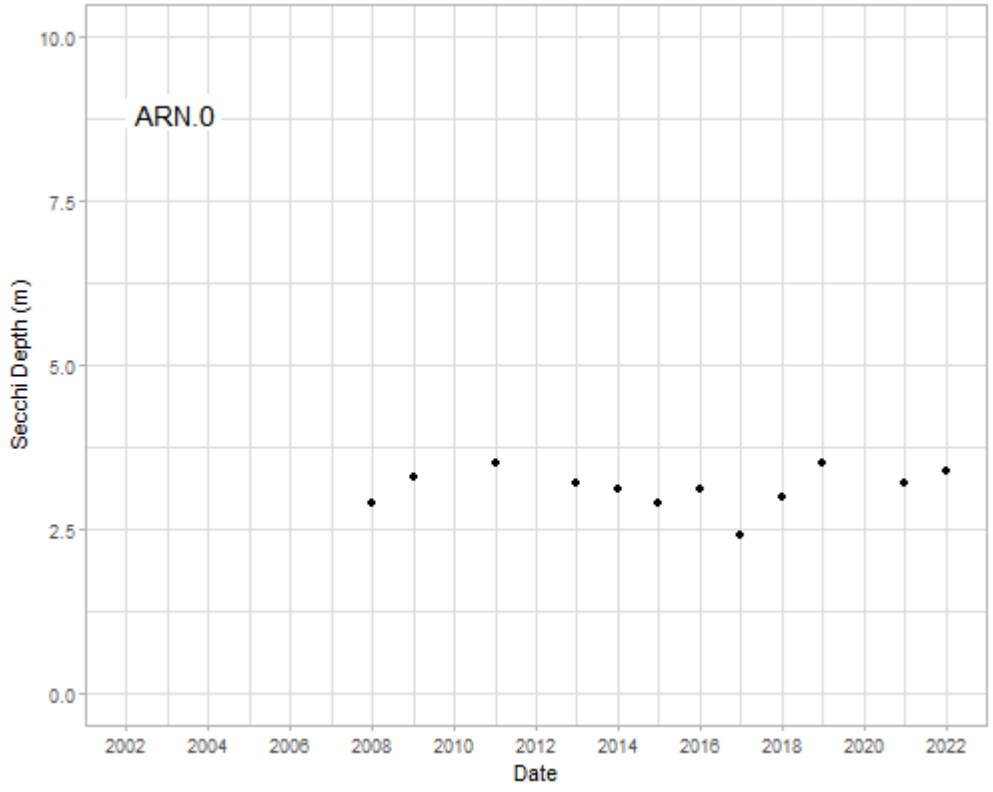
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date

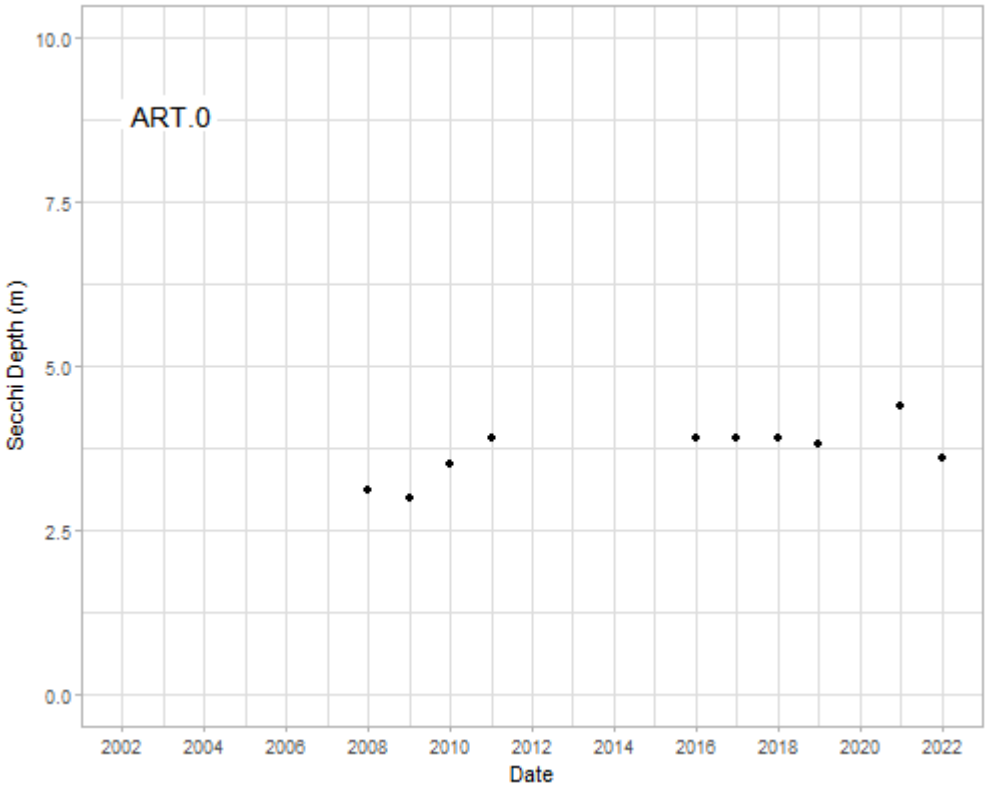

BRU.5
Total Phosphorus (ug/L)
30
20
10
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Date

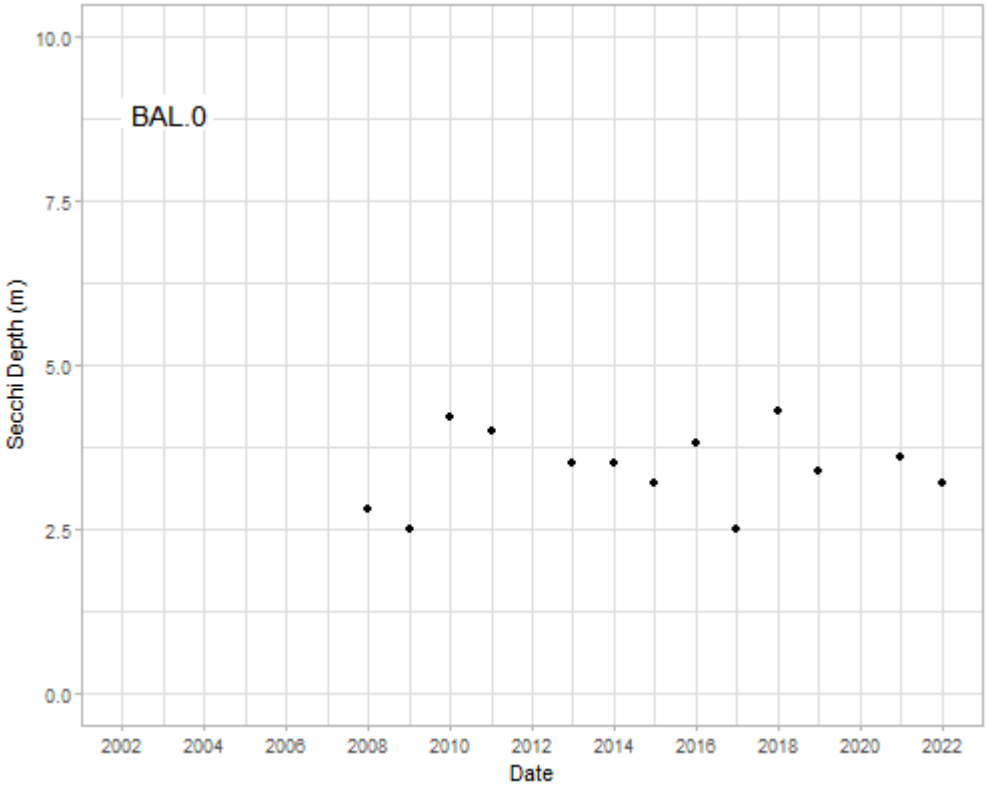
# Appendix C. Long-term Trend Analyses – Secchi Depth

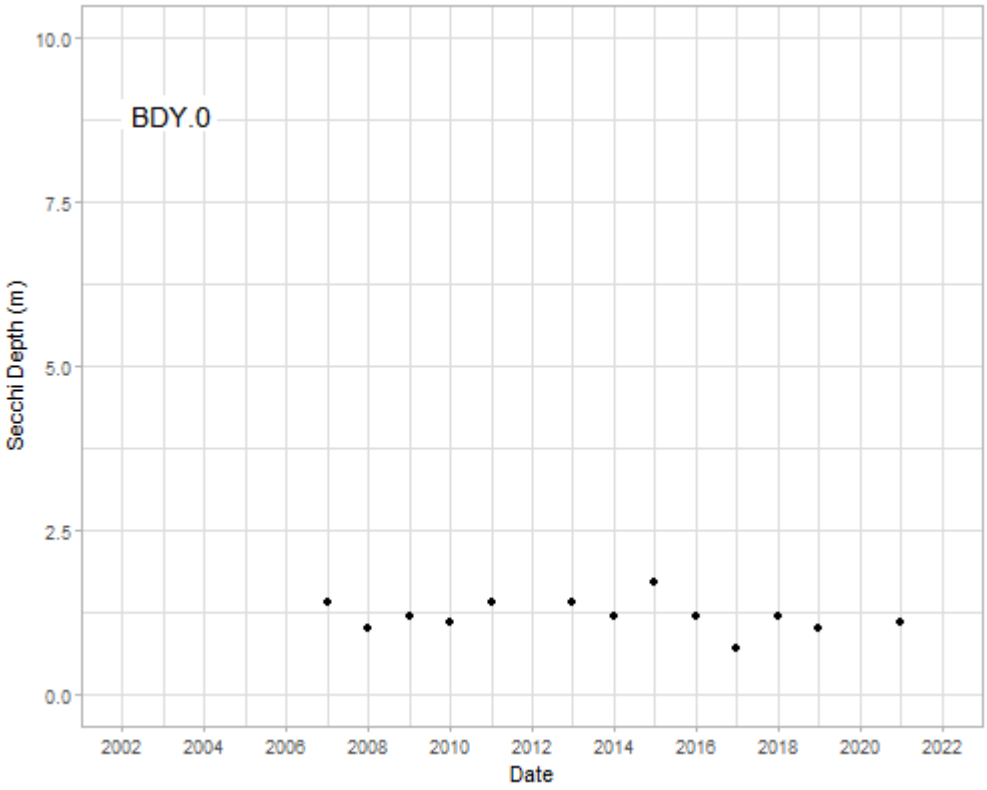
Seechi Depth Long-term Trends




ART.0
Secchi Depth (m)
10.0
7.5
5.0
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


BAL.0
Secchi Depth (m)
10.0
7.5
5.0
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


BDY.0
Secchi Depth (m)
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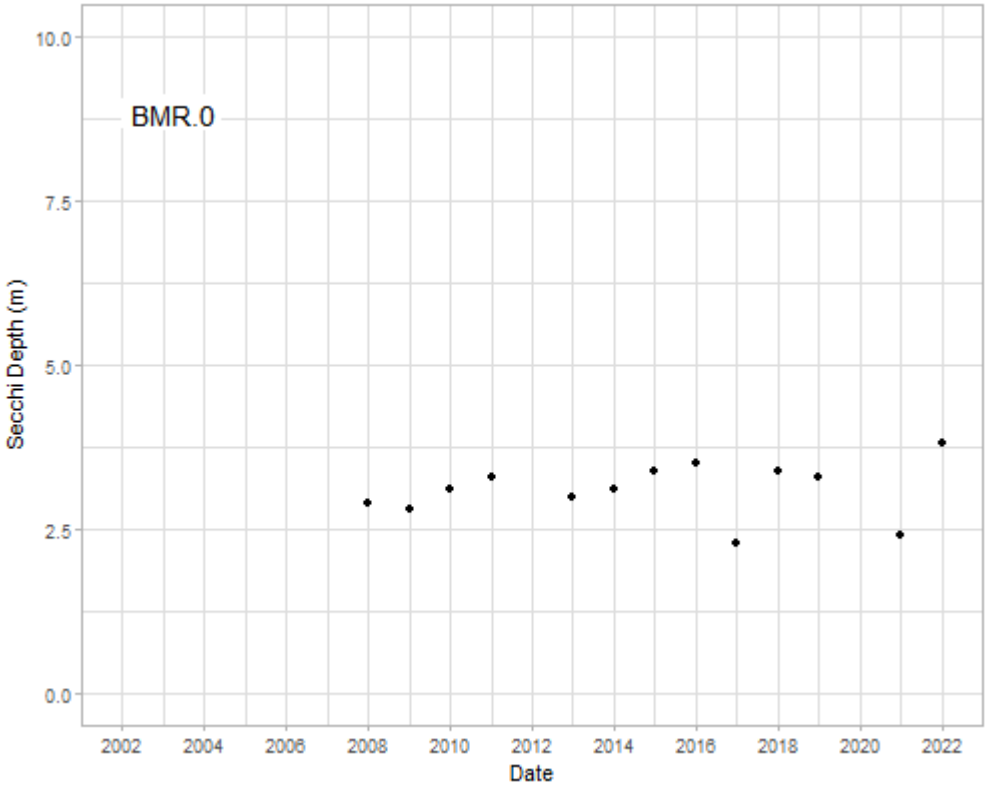
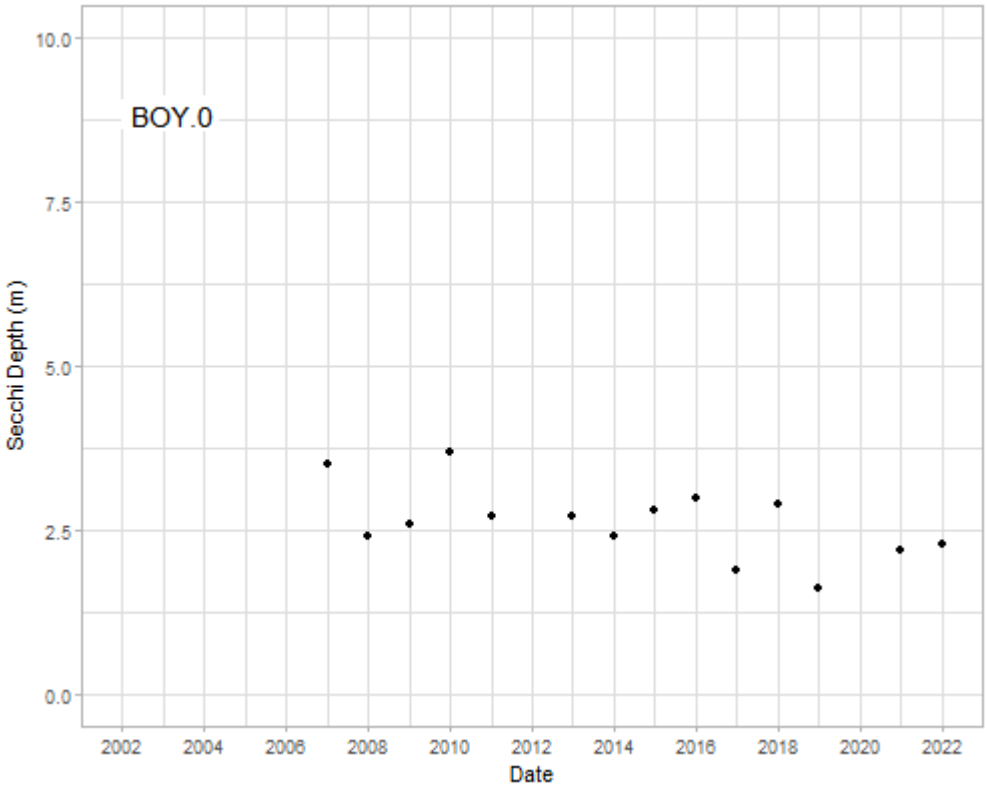
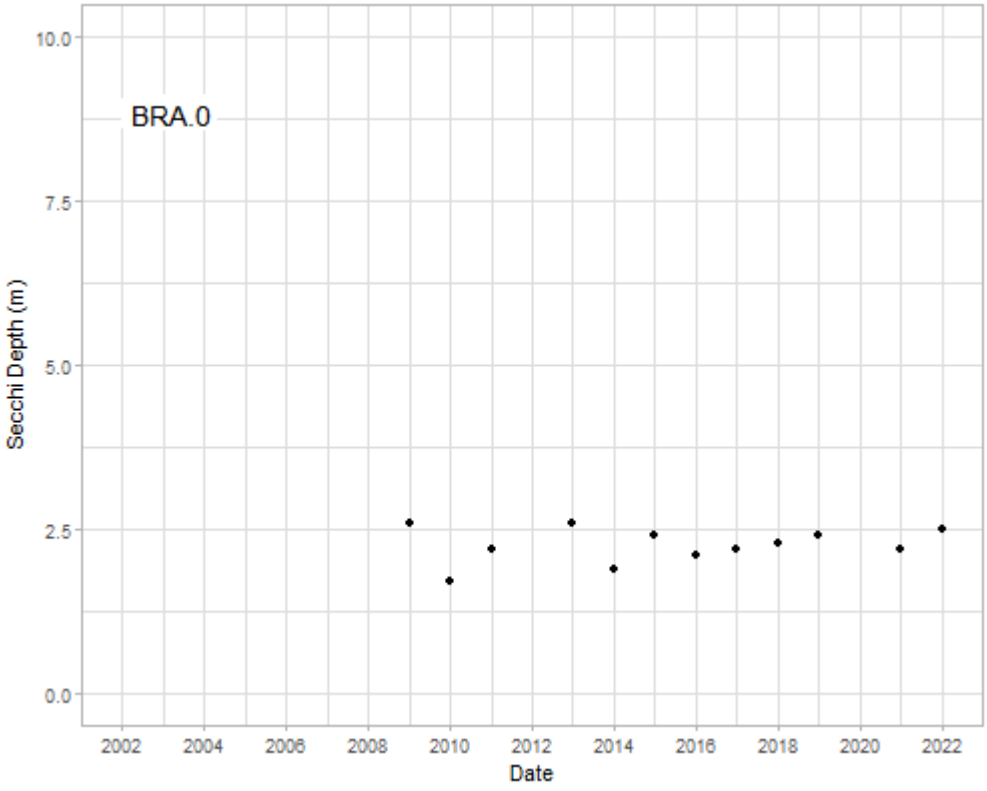
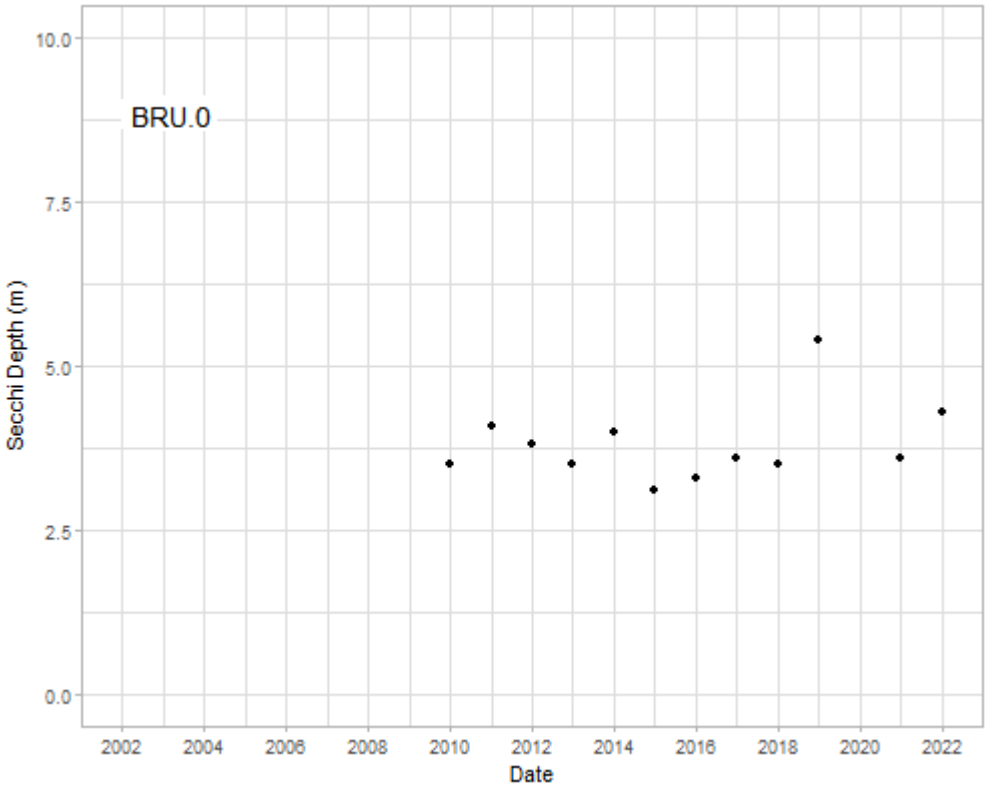
7.5
5.0
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


BMR.0
Secchi Depth (m)
10.0
7.5
5.0
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


BOY.0
Secchi Depth (m)
10.0
7.5
5.0
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


BRA.0
Secchi Depth (m)
10.0
7.5
5.0
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


BRU.0
Secchi Depth (m)
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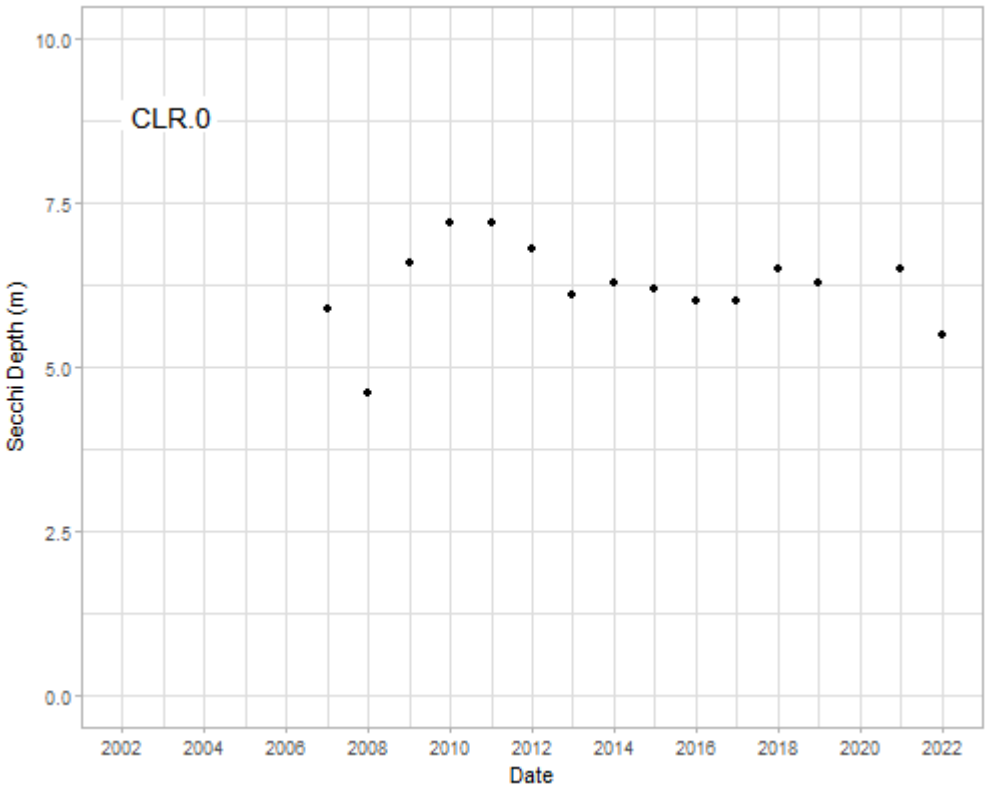
5.0
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


CLR.0
Secchi Depth (m)
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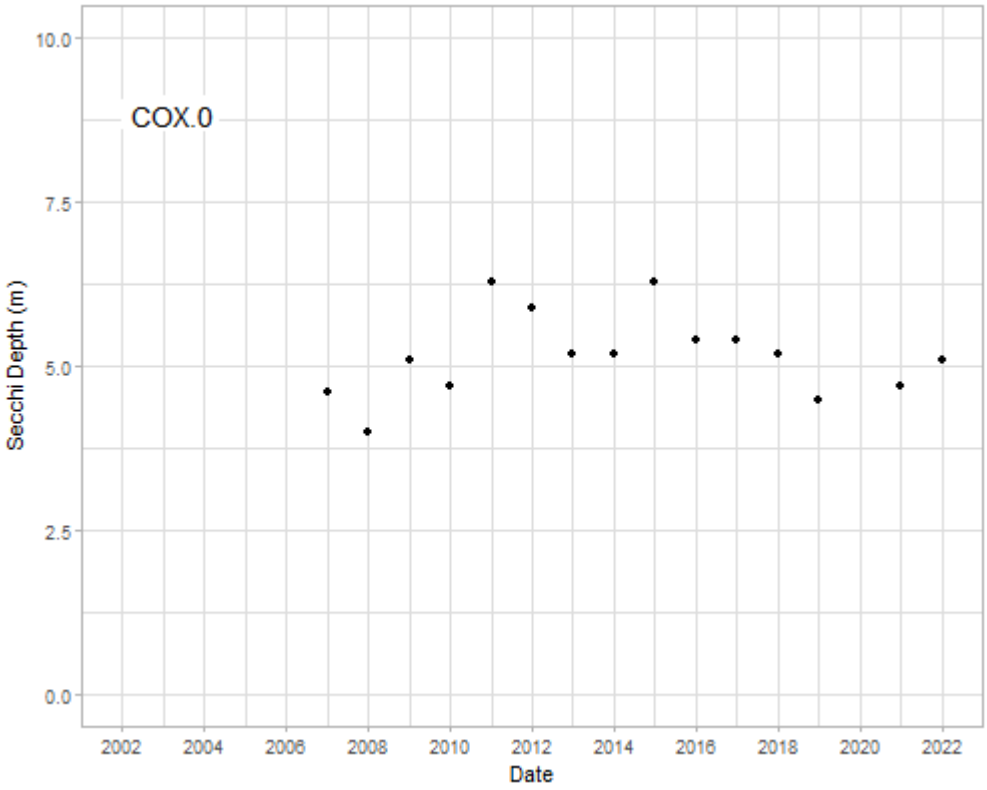
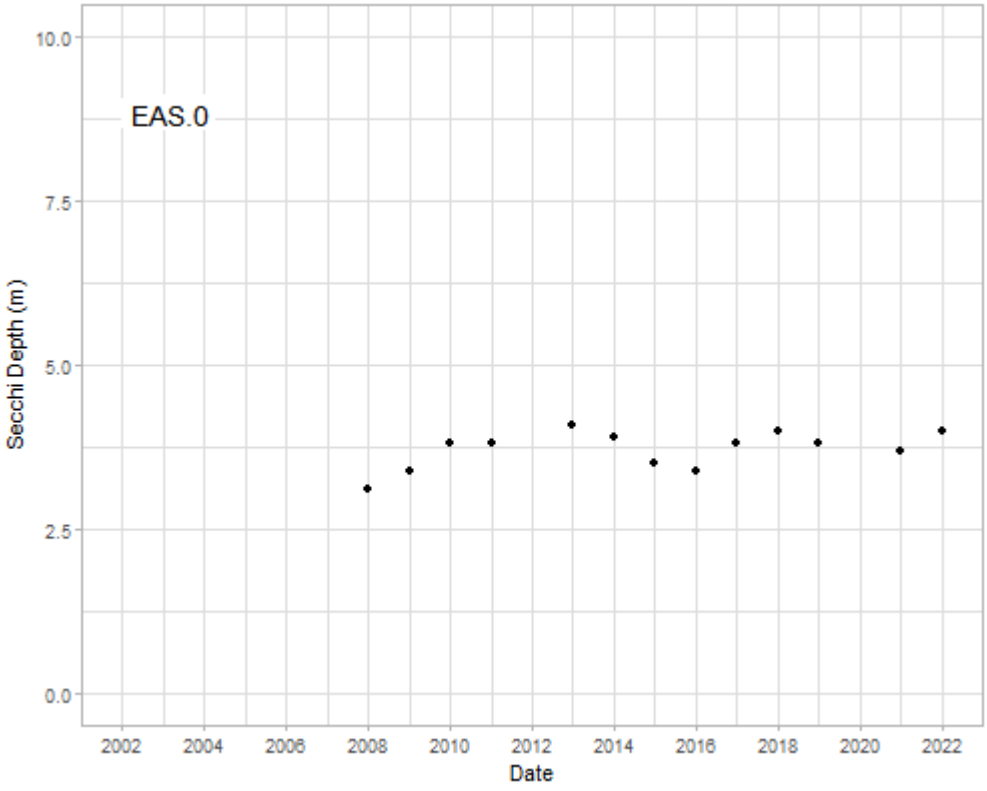
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


COX.0
Secchi Depth (m)
10.0
7.5
5.0
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


EAS.0
Secchi Depth (m)
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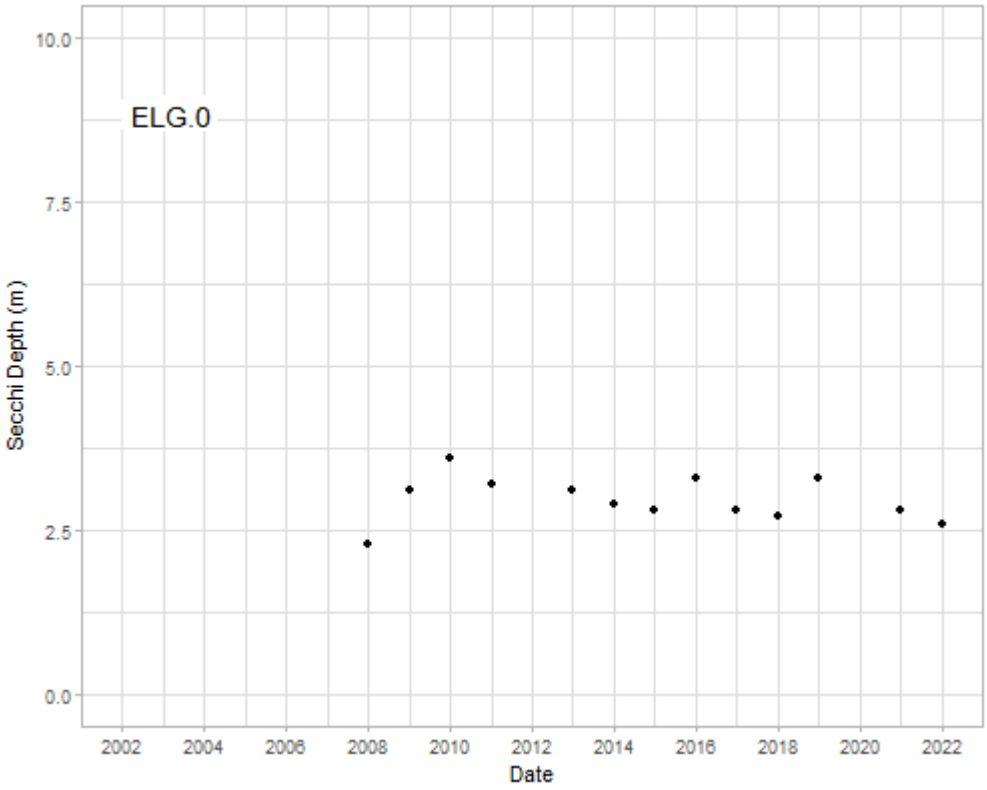
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


ELG.0
Secchi Depth (m)
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2.5
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2006
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2012
2014
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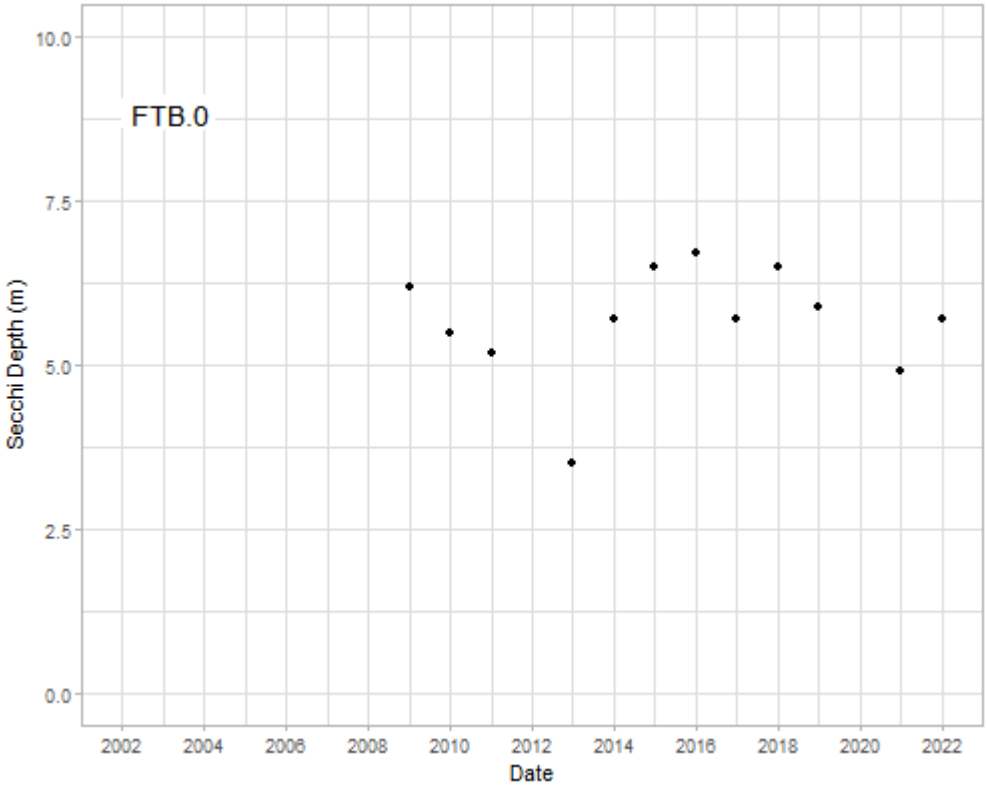
2020
2022
Date


FTB.0
Secchi Depth (m)
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2.5
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2002
2004
2006
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2010
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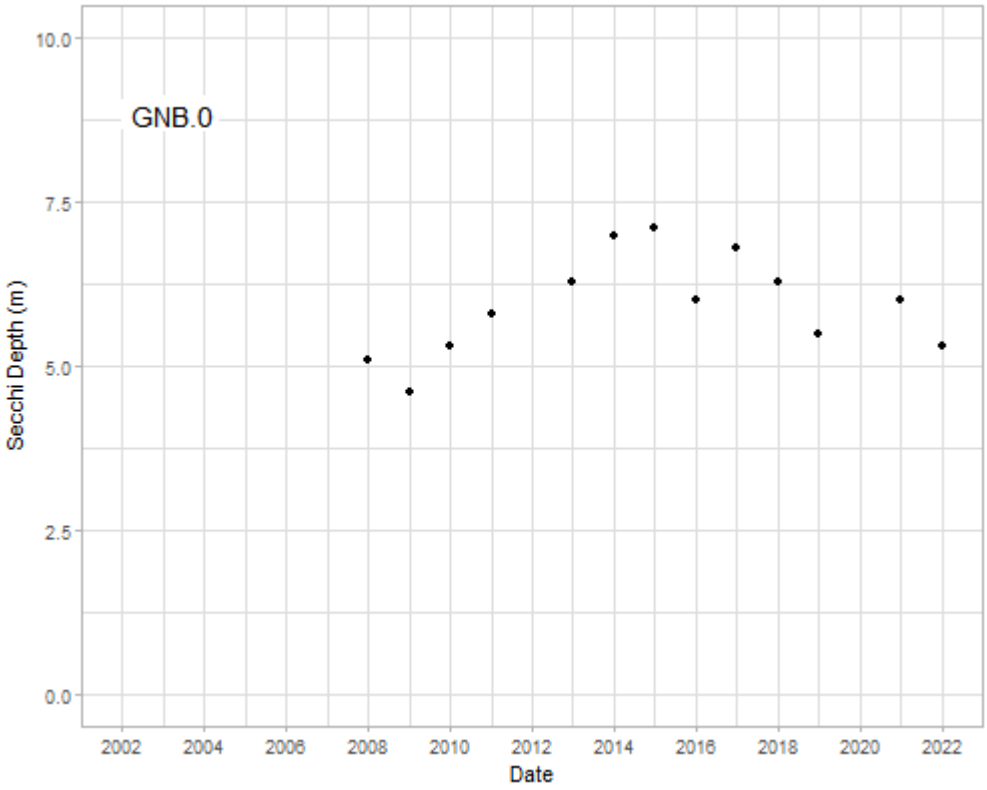
2018
2020
2022
Date


GNB.0
Secchi Depth (m)
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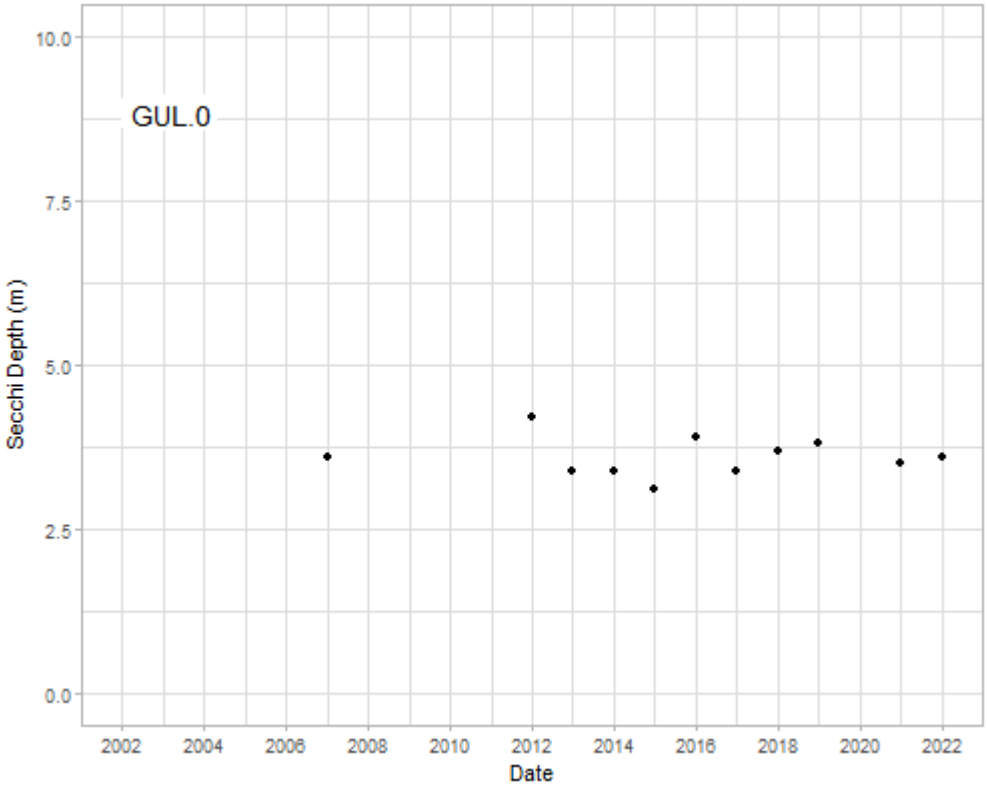
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


GUL.0
Secchi Depth (m)
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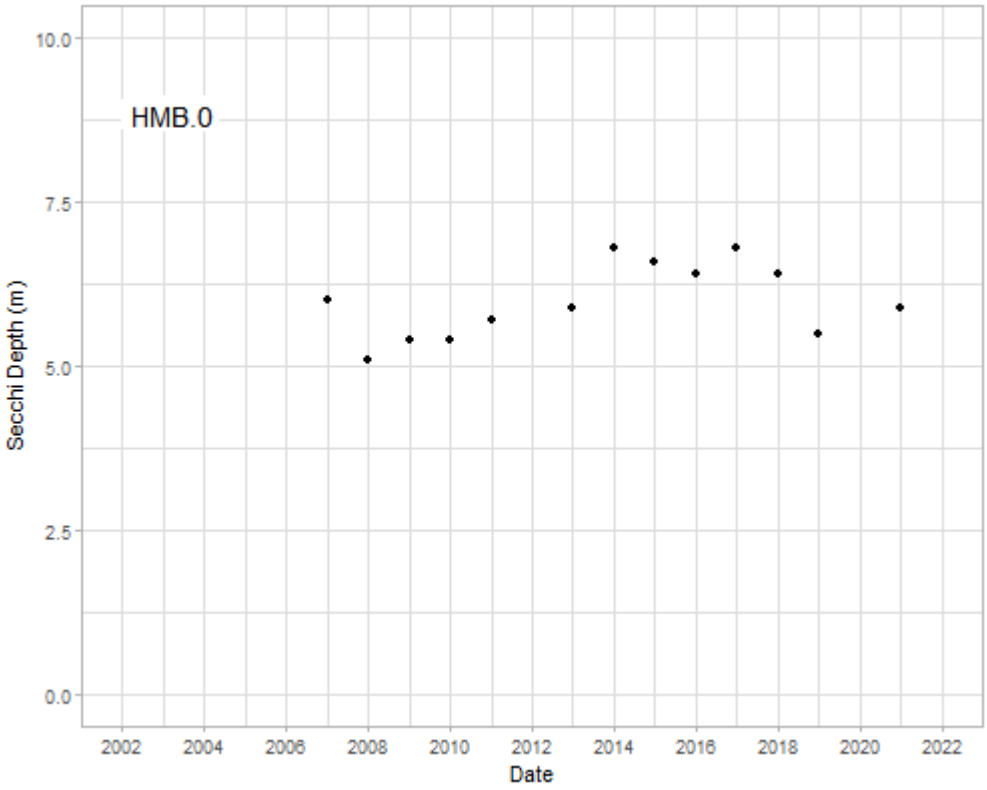
2018
2020
2022
Date


HMB.0
Secchi Depth (m)
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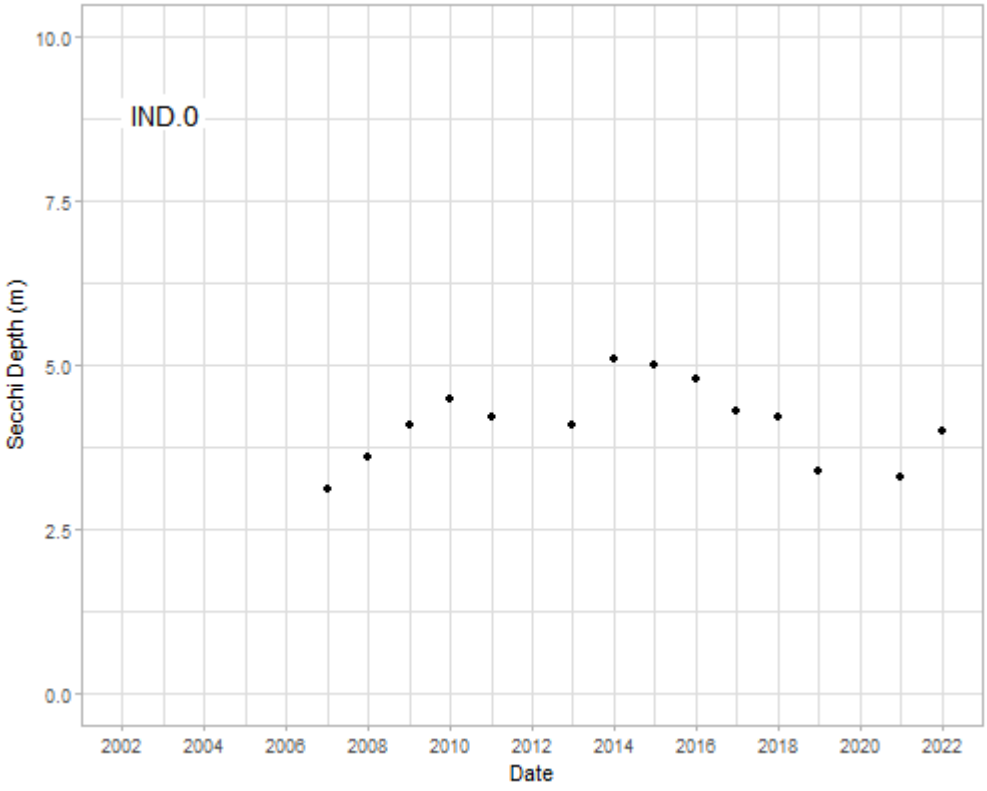
2.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Date


IND.0
Secchi Depth (m)
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2.5
0.0
2002
2004
2006
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2010
2012
2014
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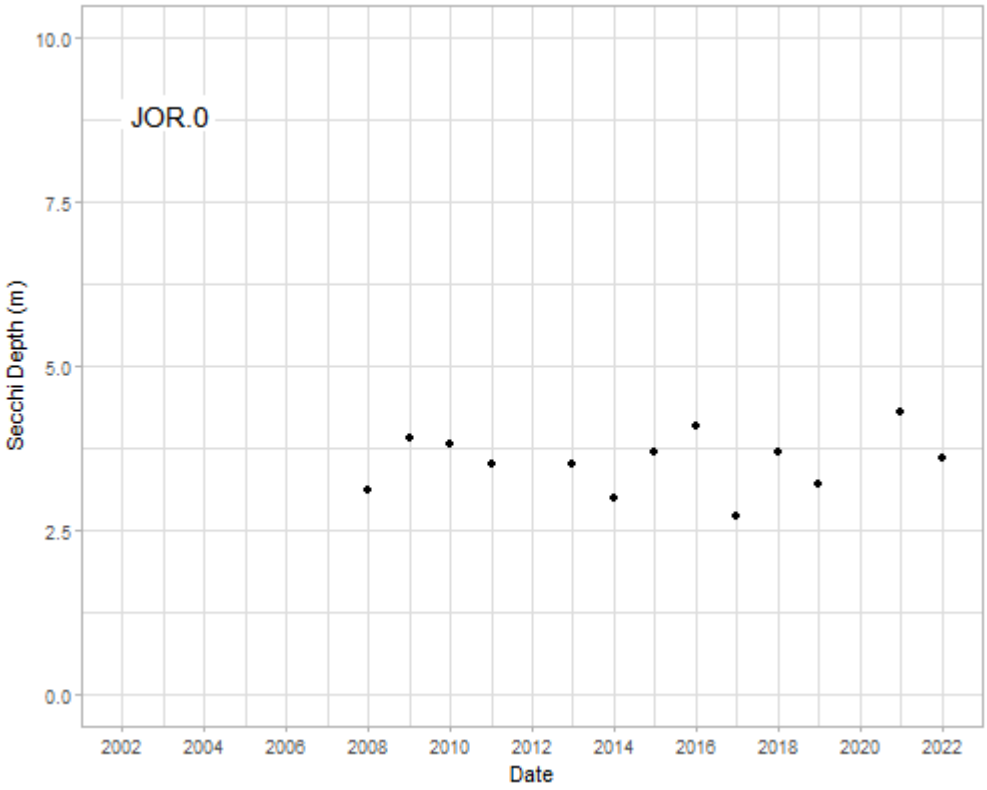
2018
2020
2022
Date


JOR.0
Secchi Depth (m)
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2.5
0.0
2002
2004
2006
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2010
2012
2014
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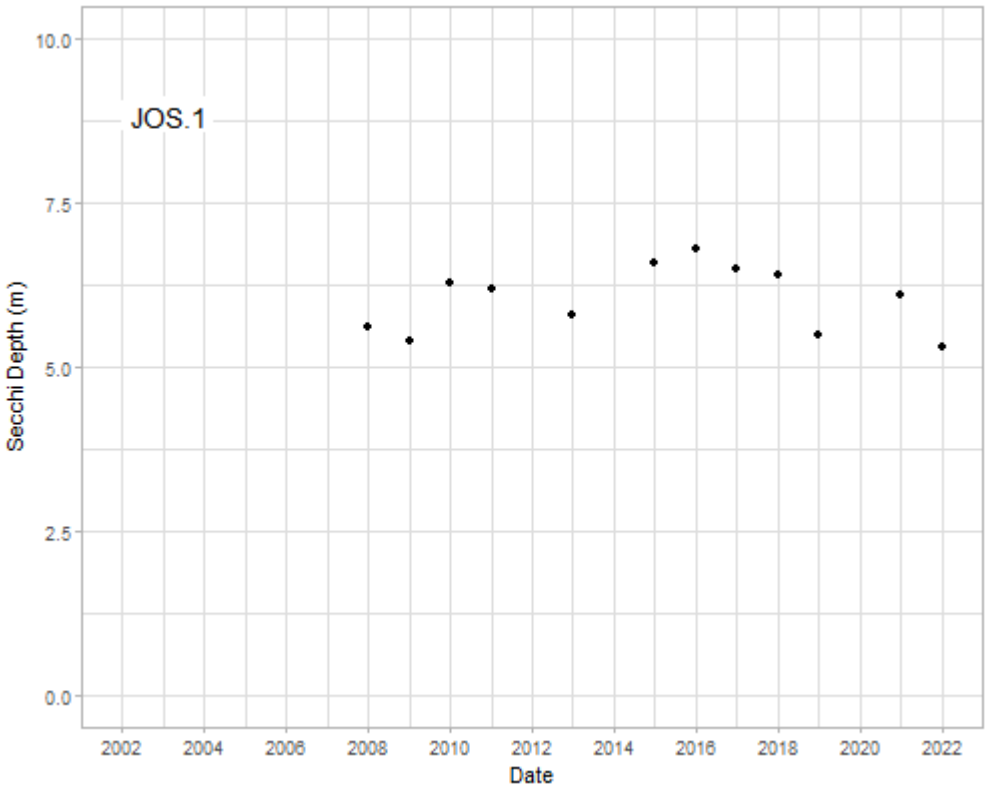
2018
2020
2022
Date


JOS.1
Secchi Depth (m)
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5.0
2.5
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2002
2004
2006
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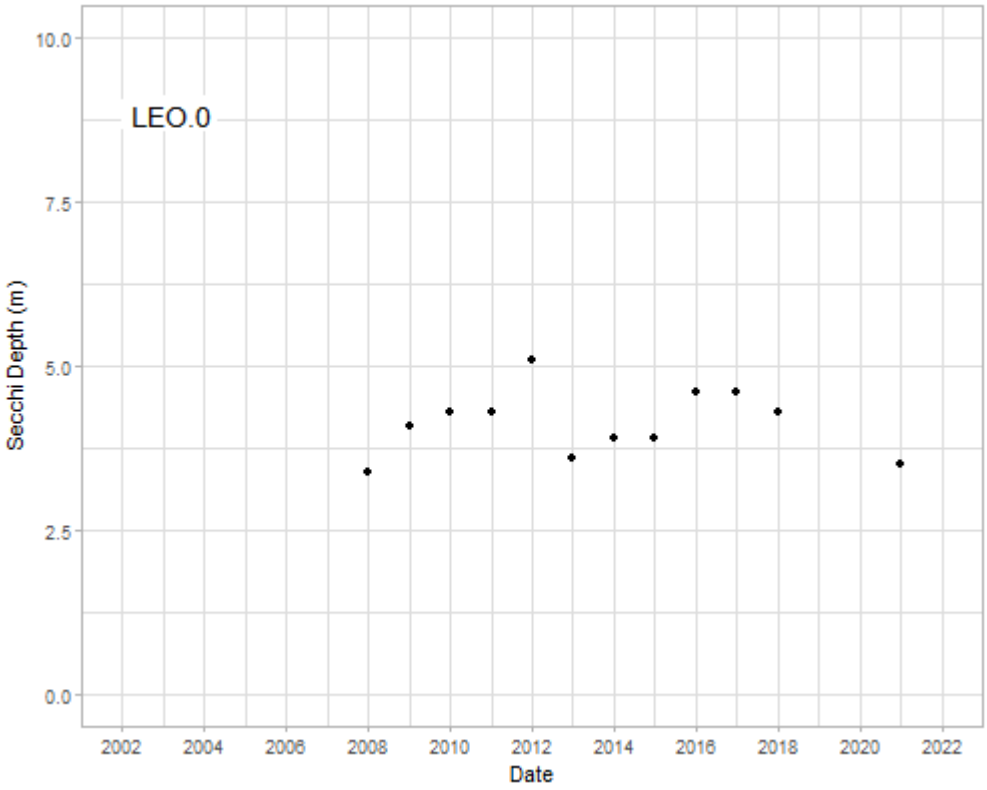
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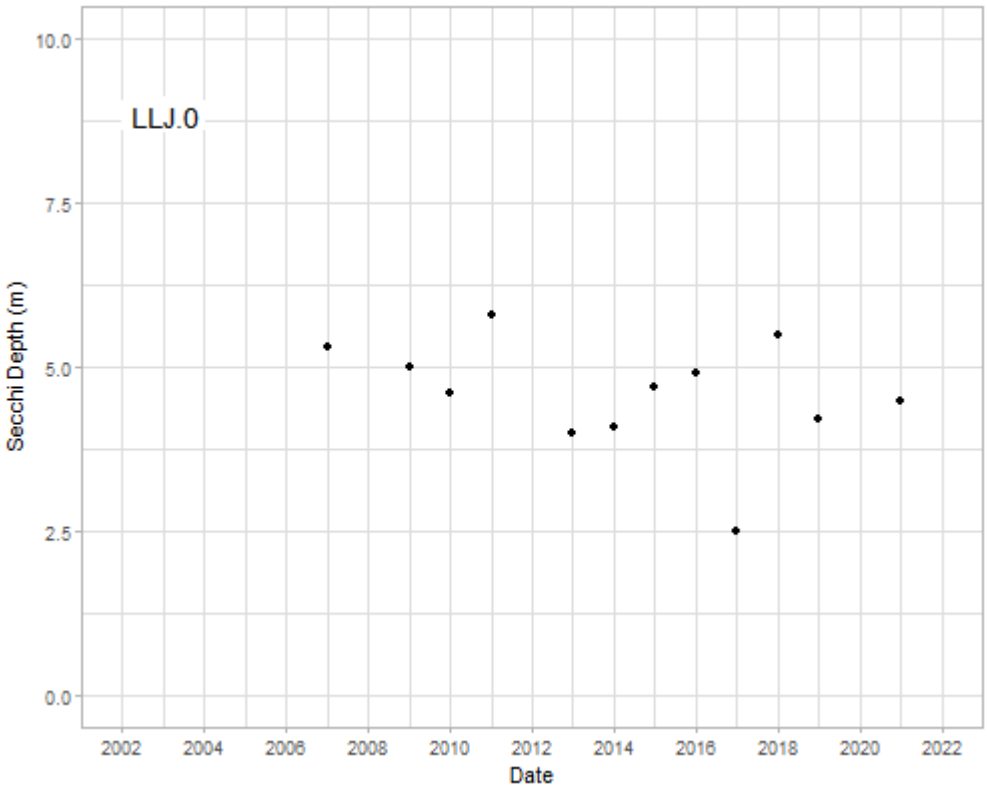
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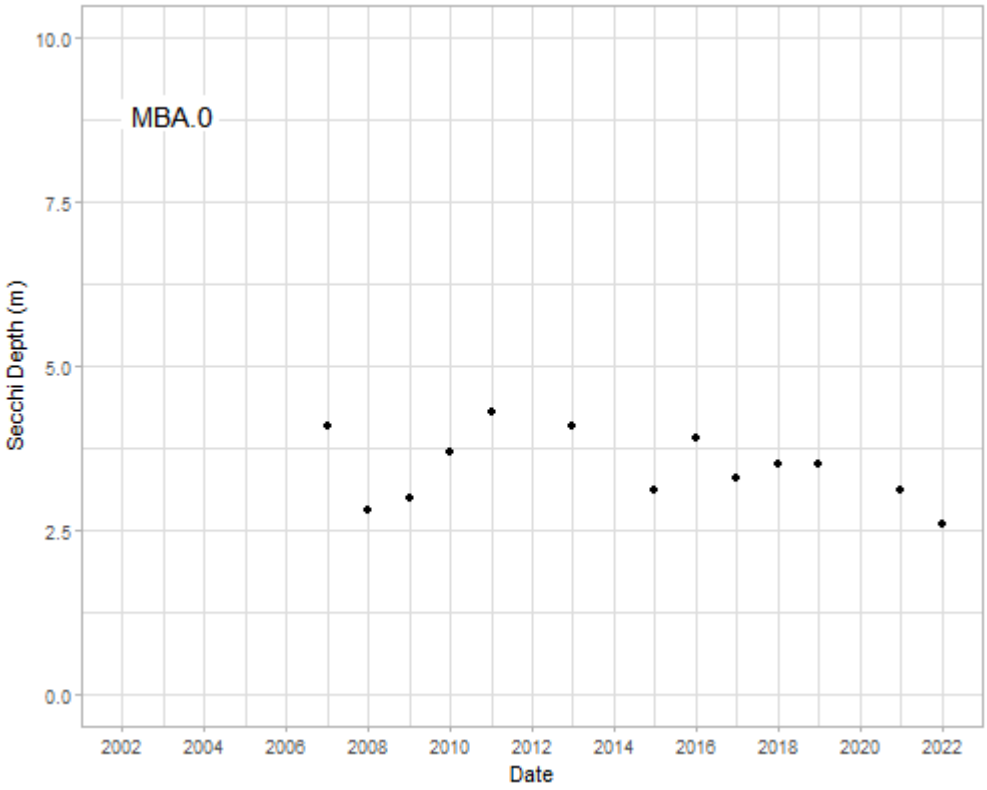
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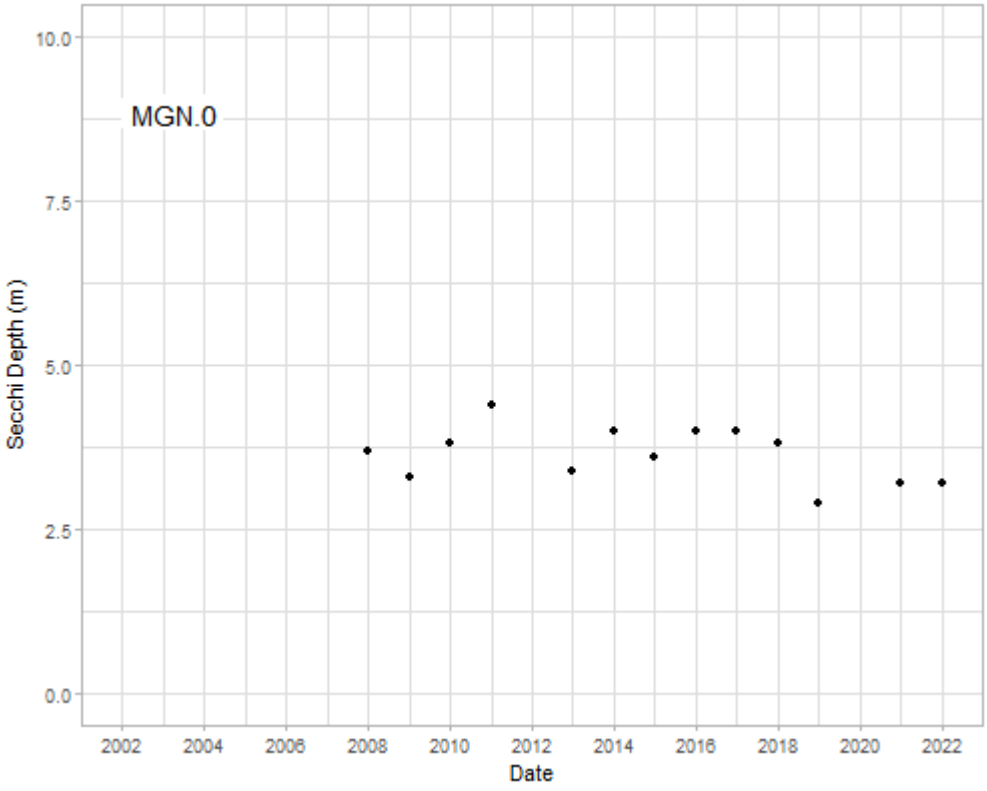
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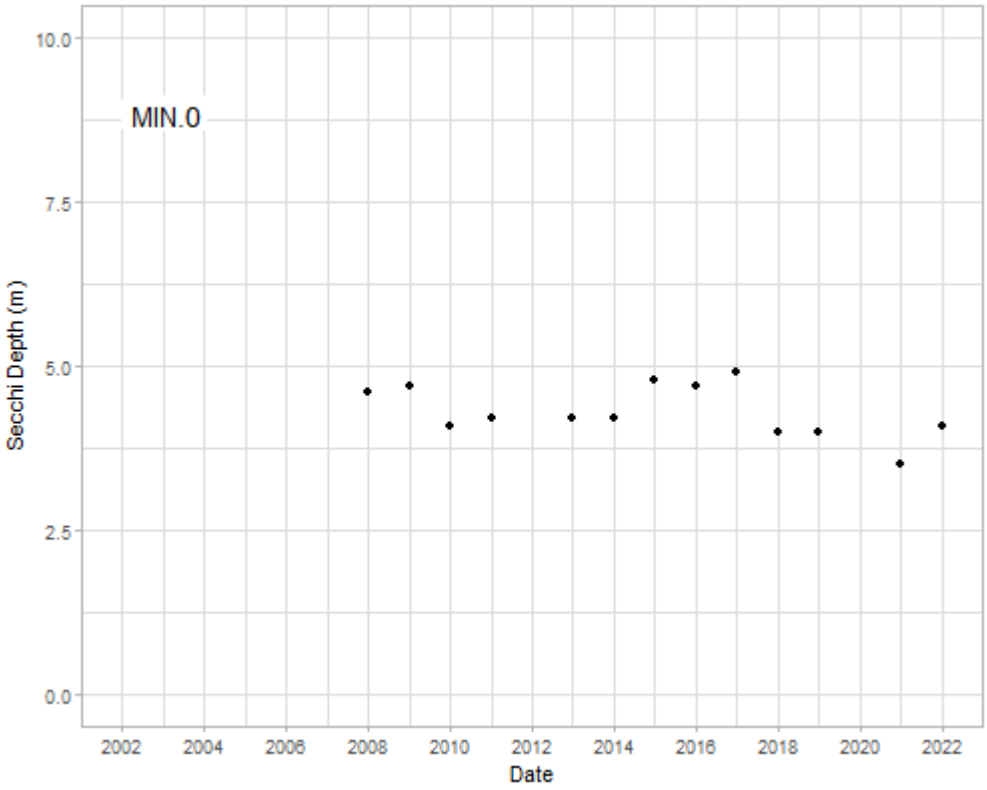
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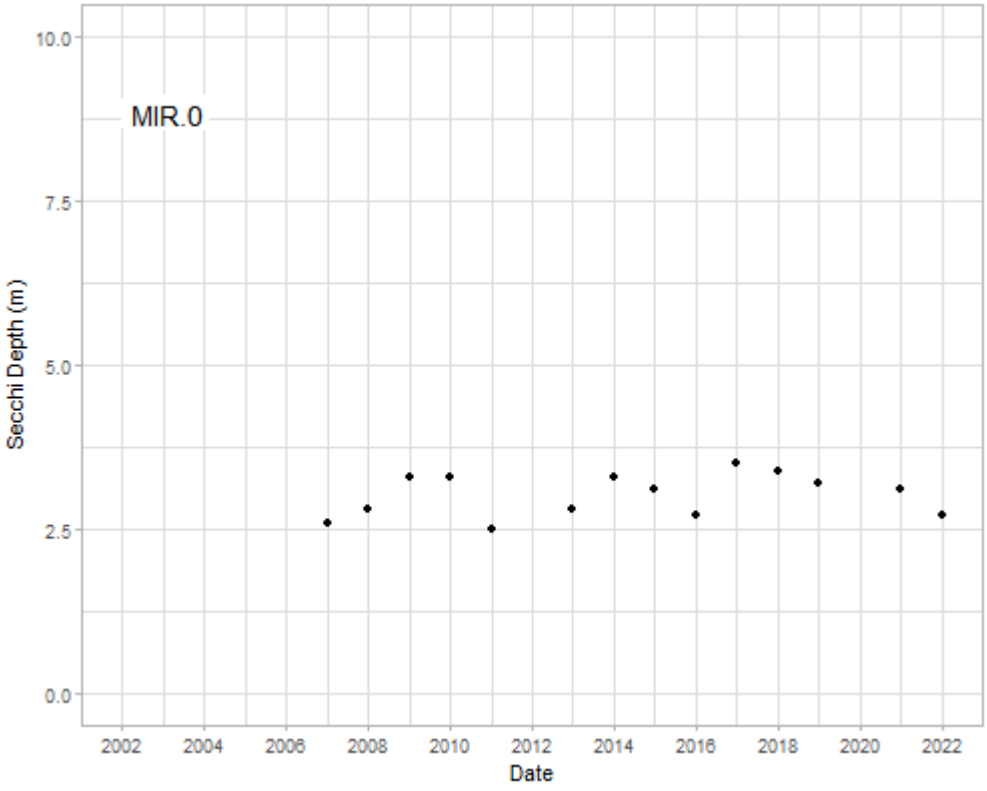
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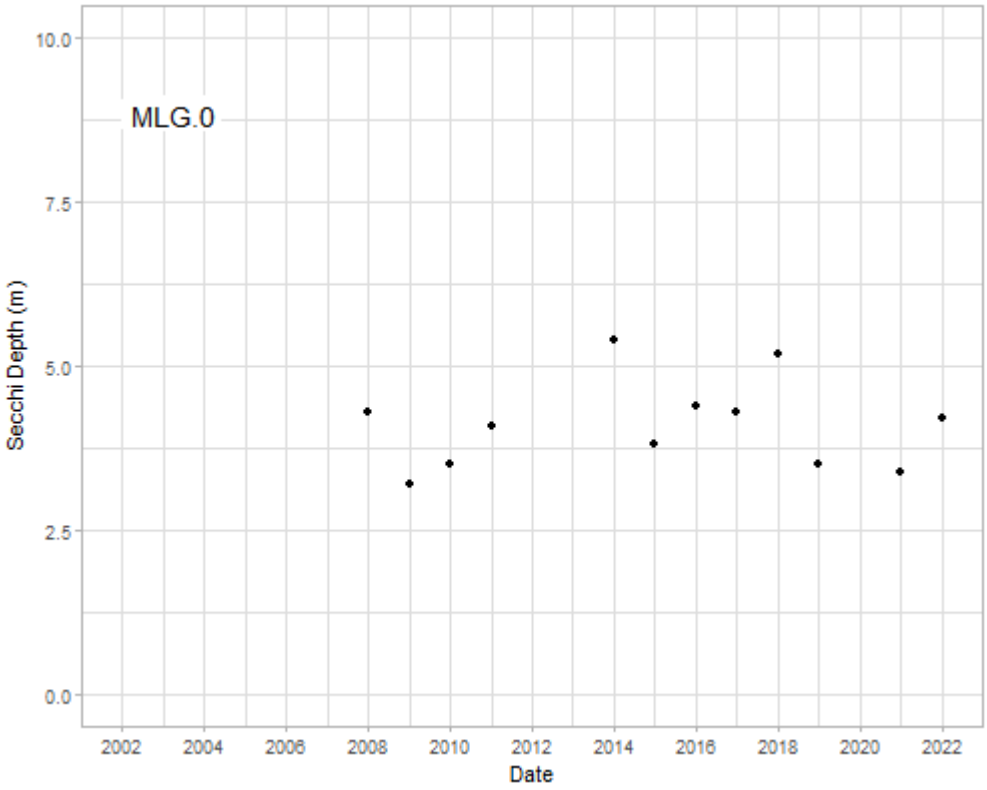
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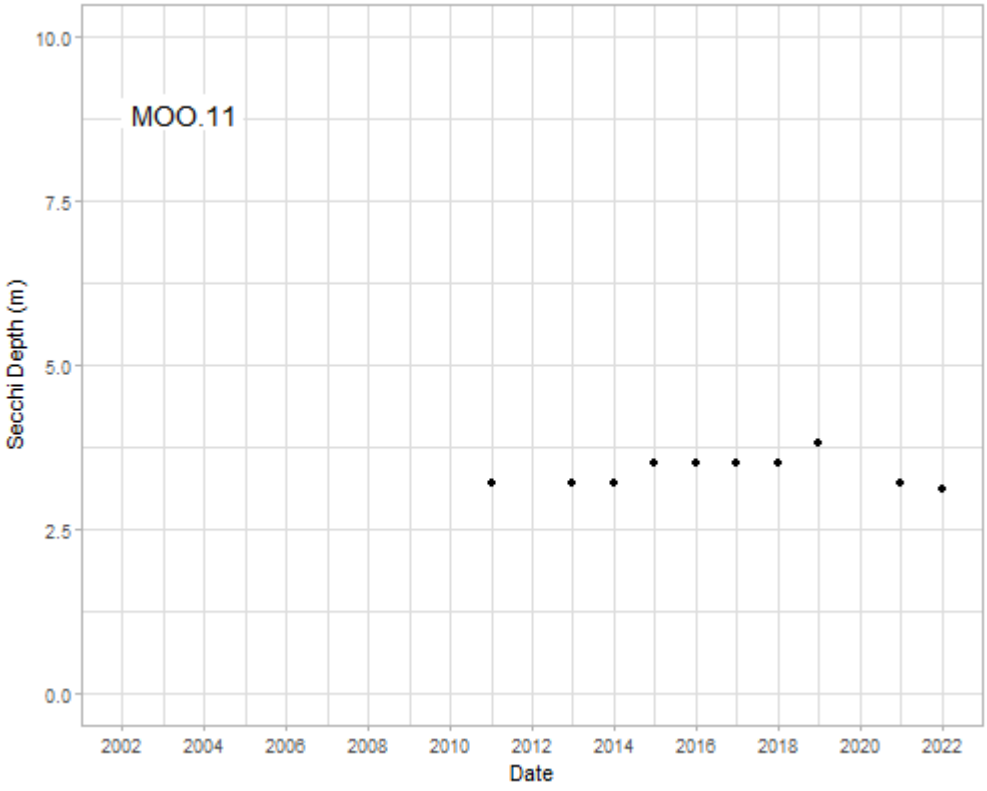
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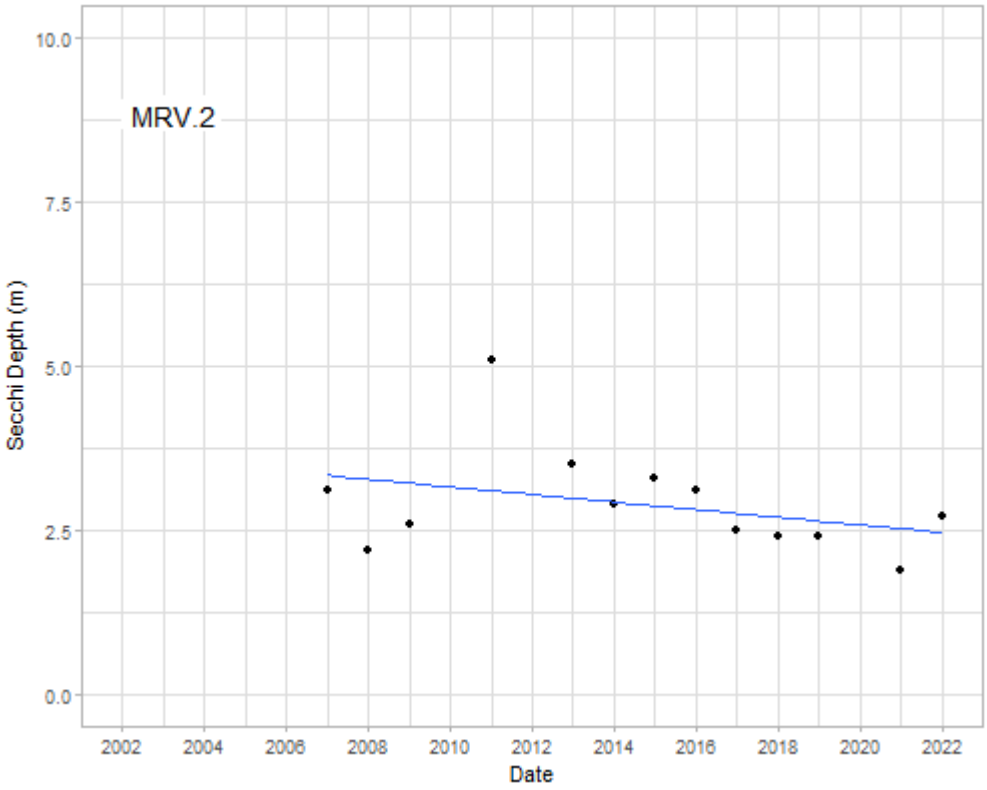
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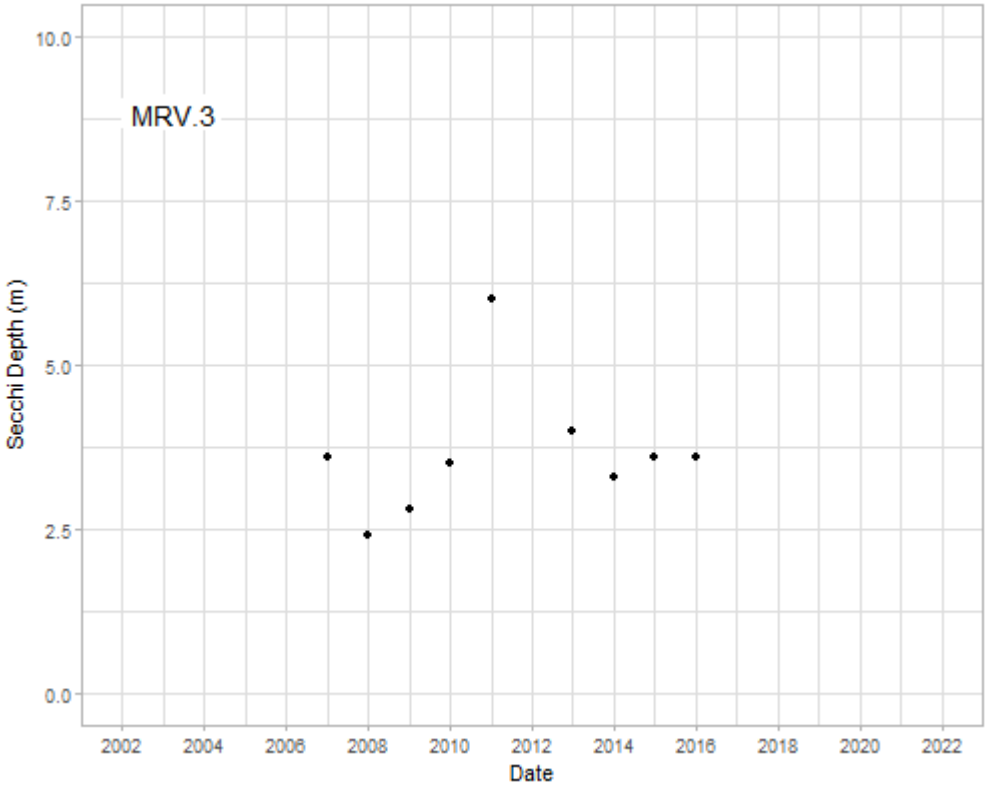
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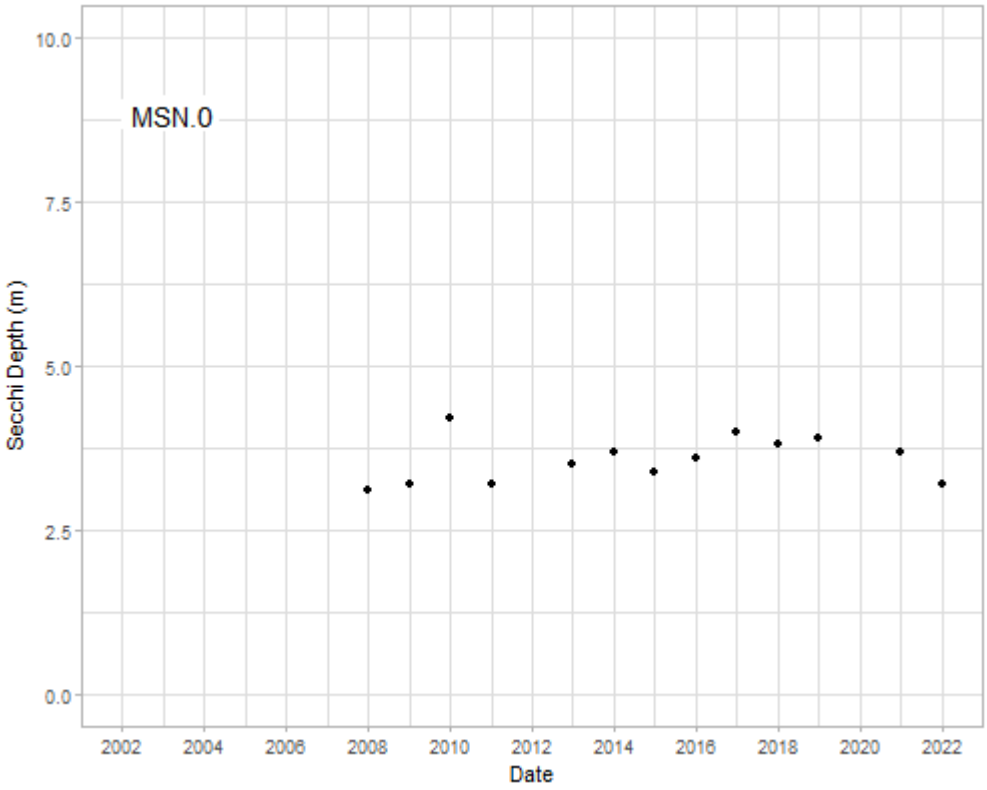
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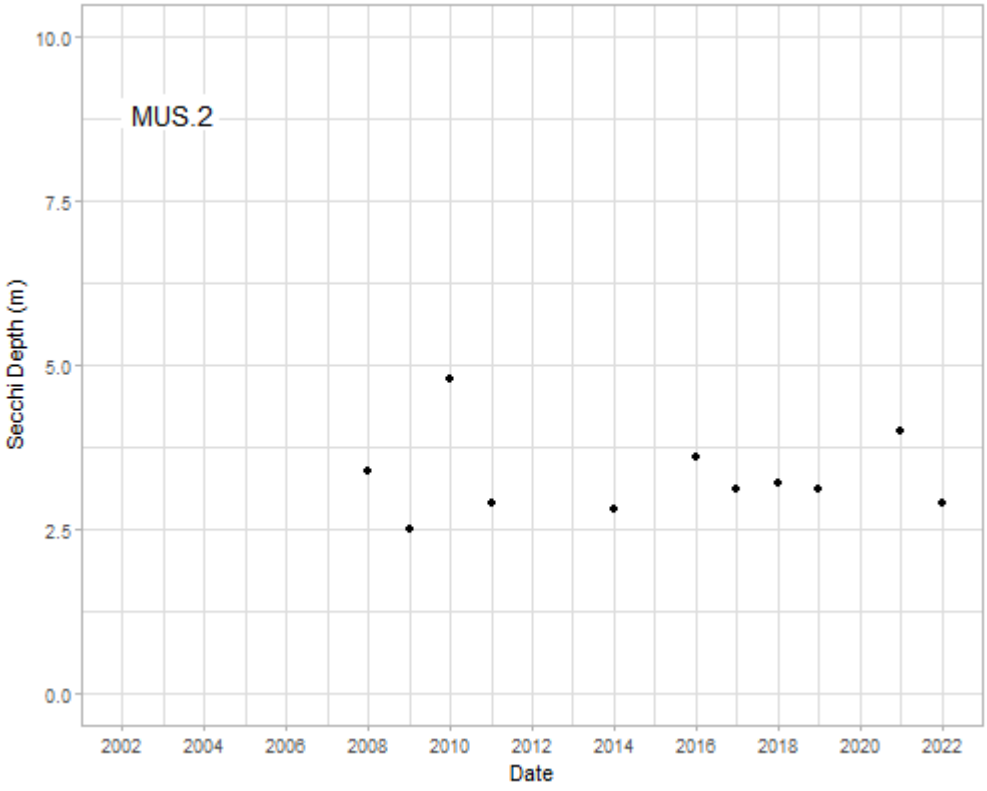
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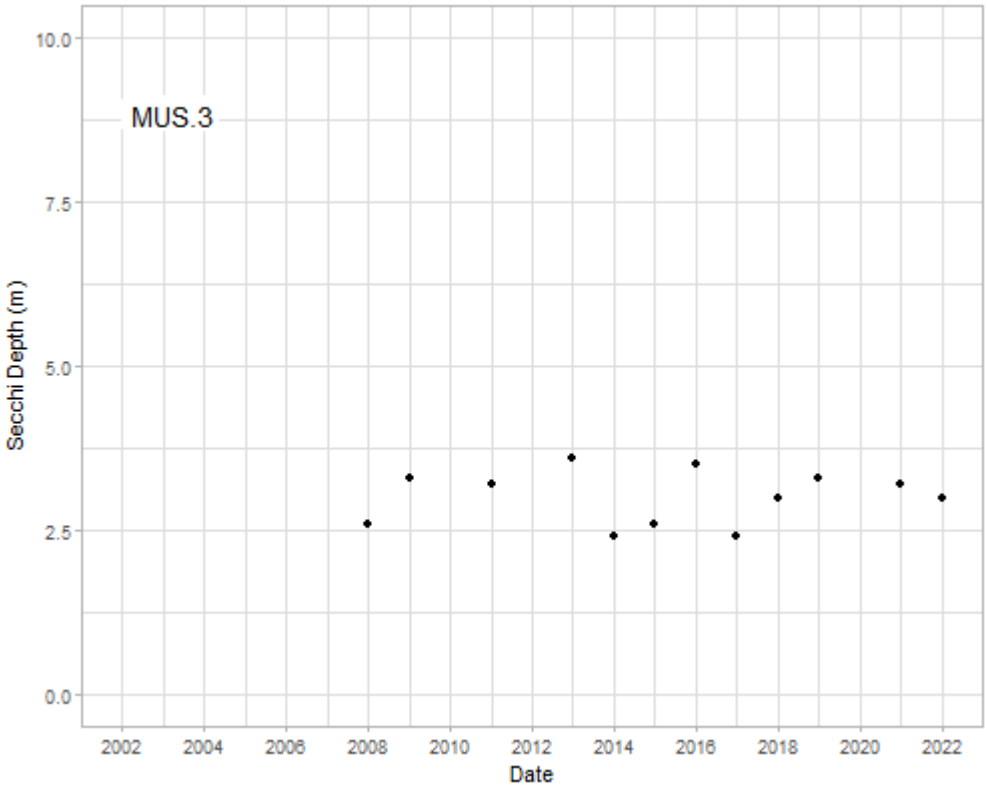
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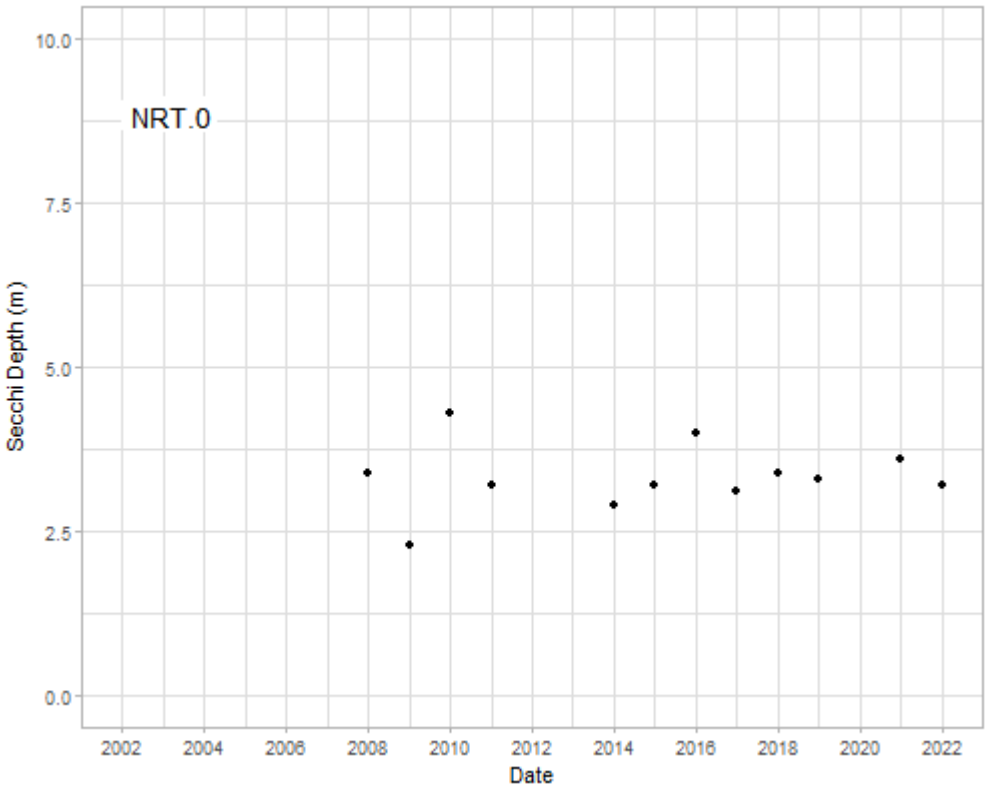
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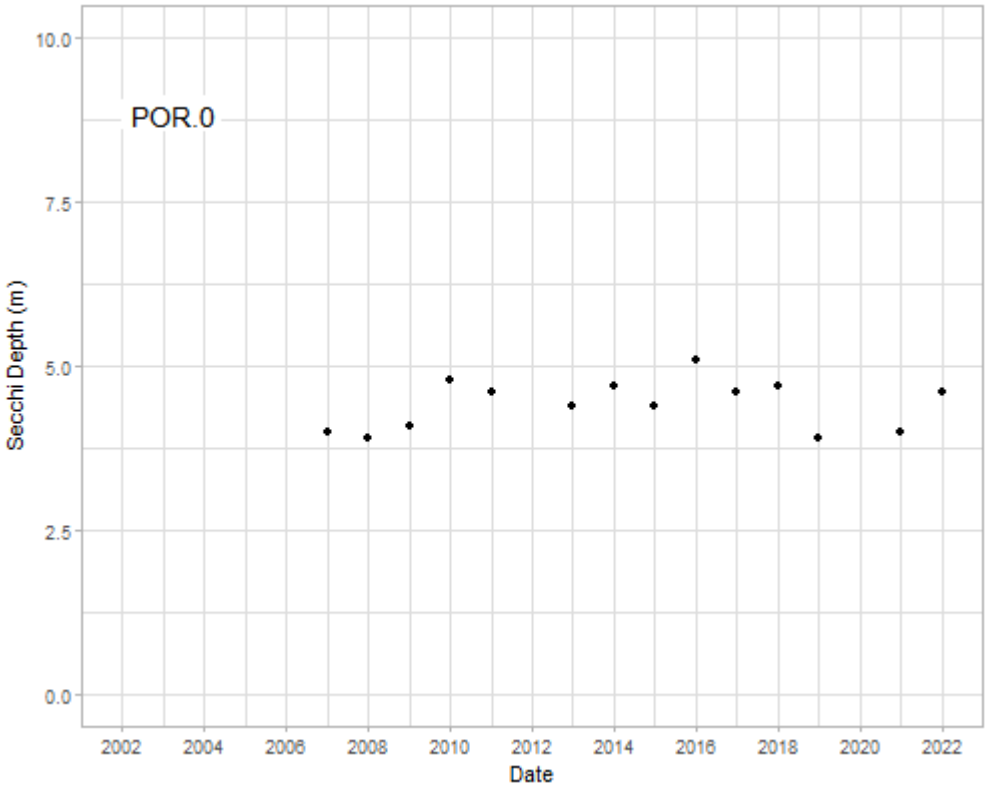
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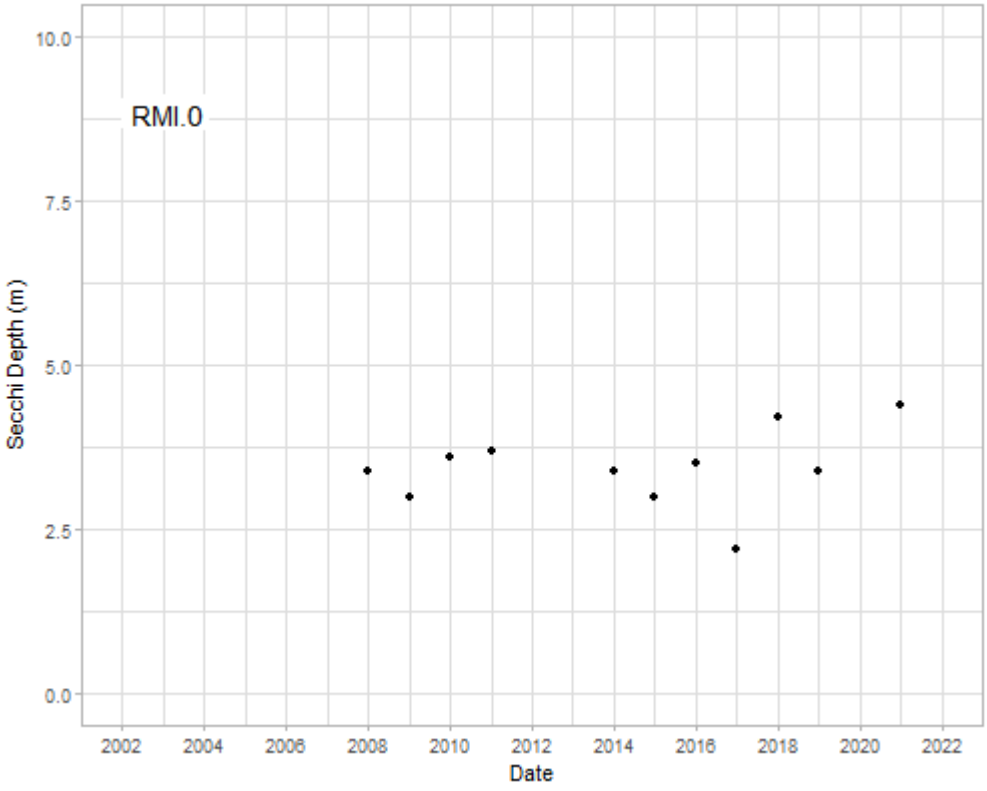
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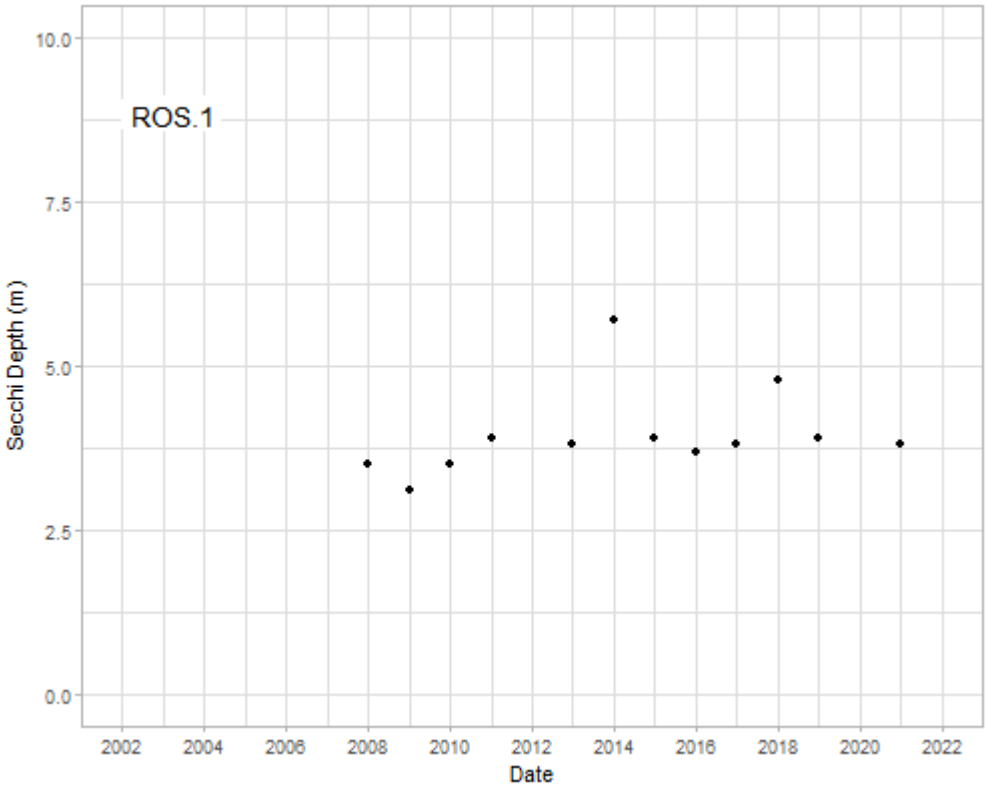
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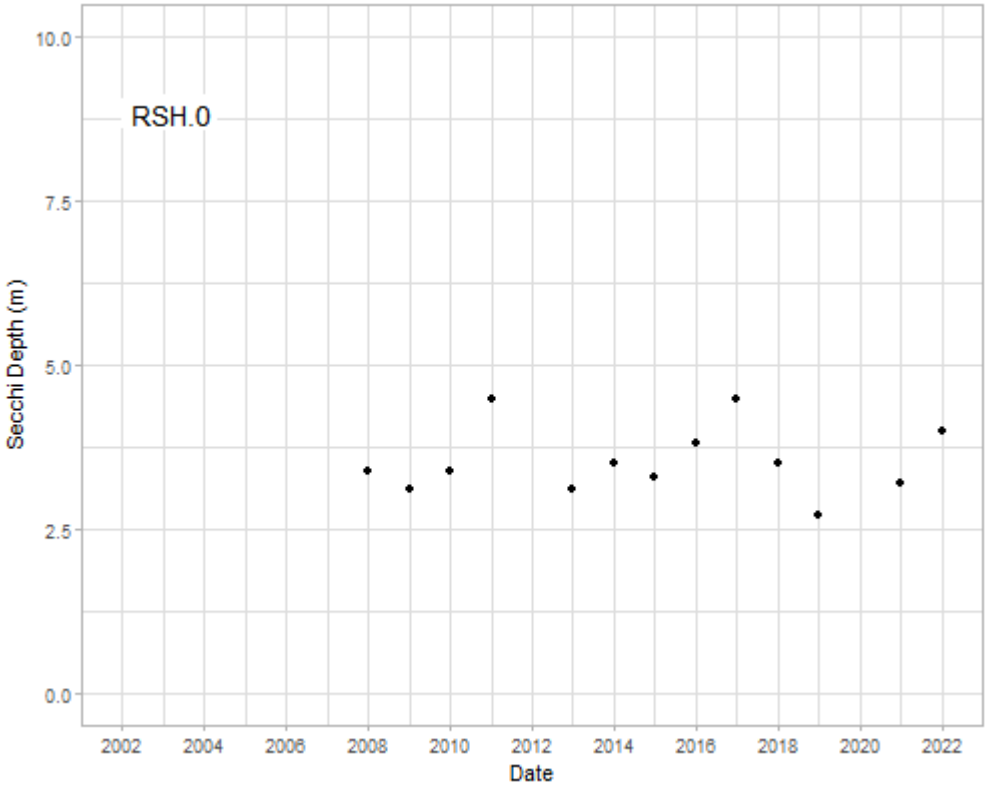
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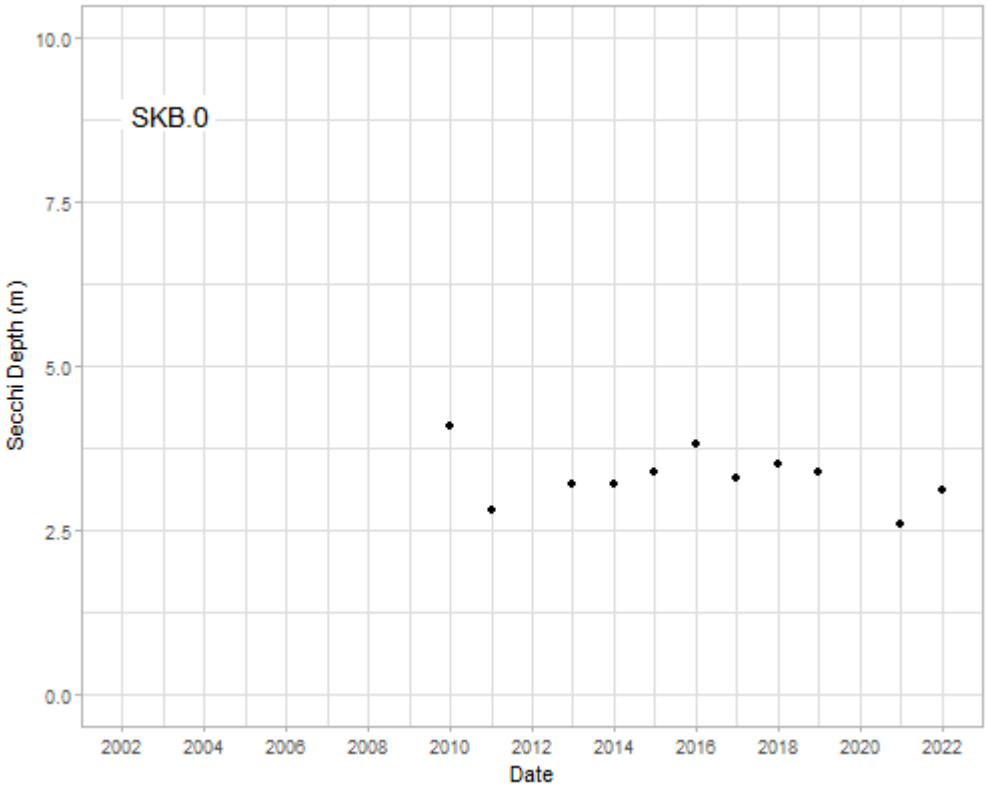
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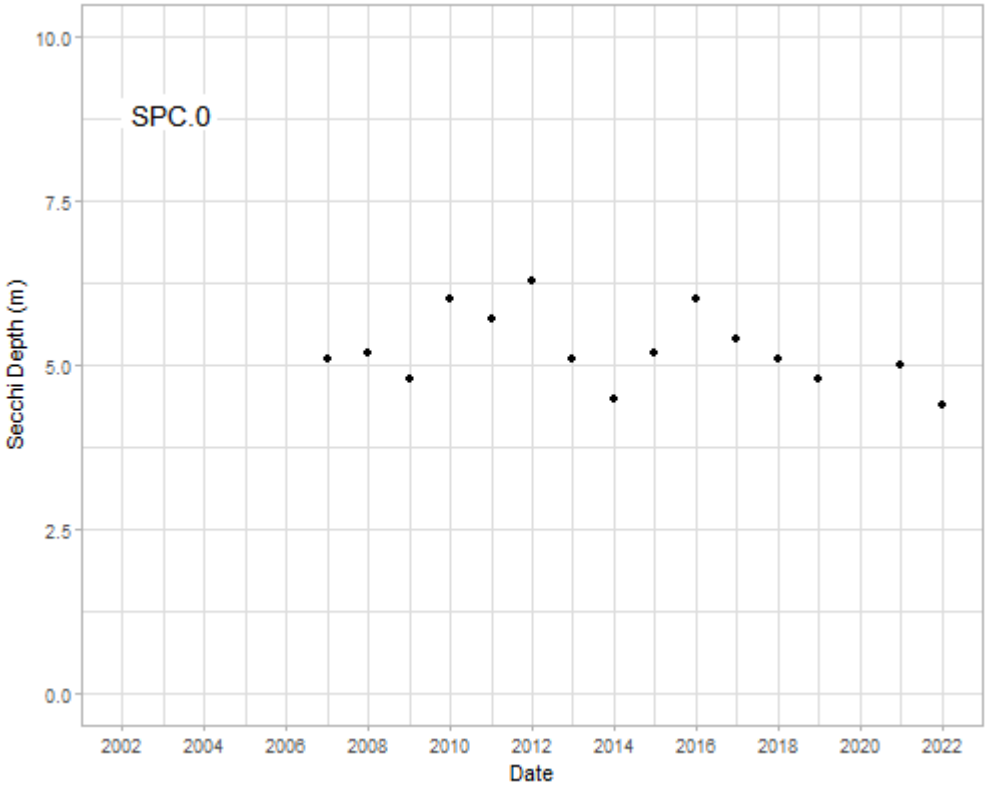
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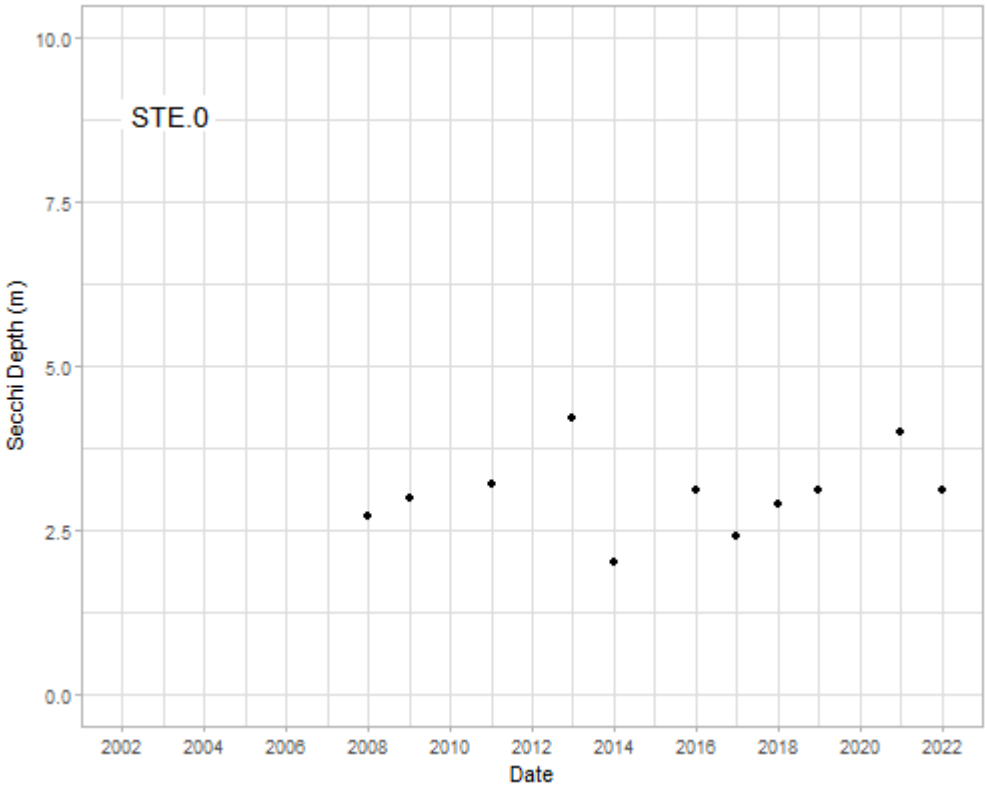
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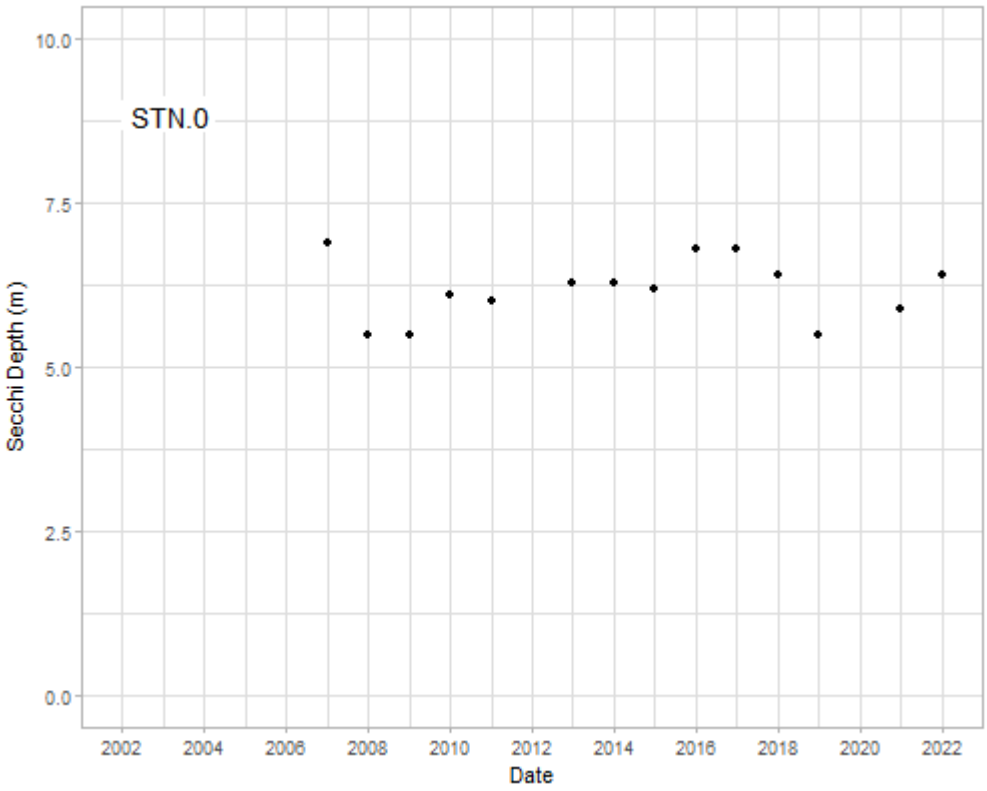
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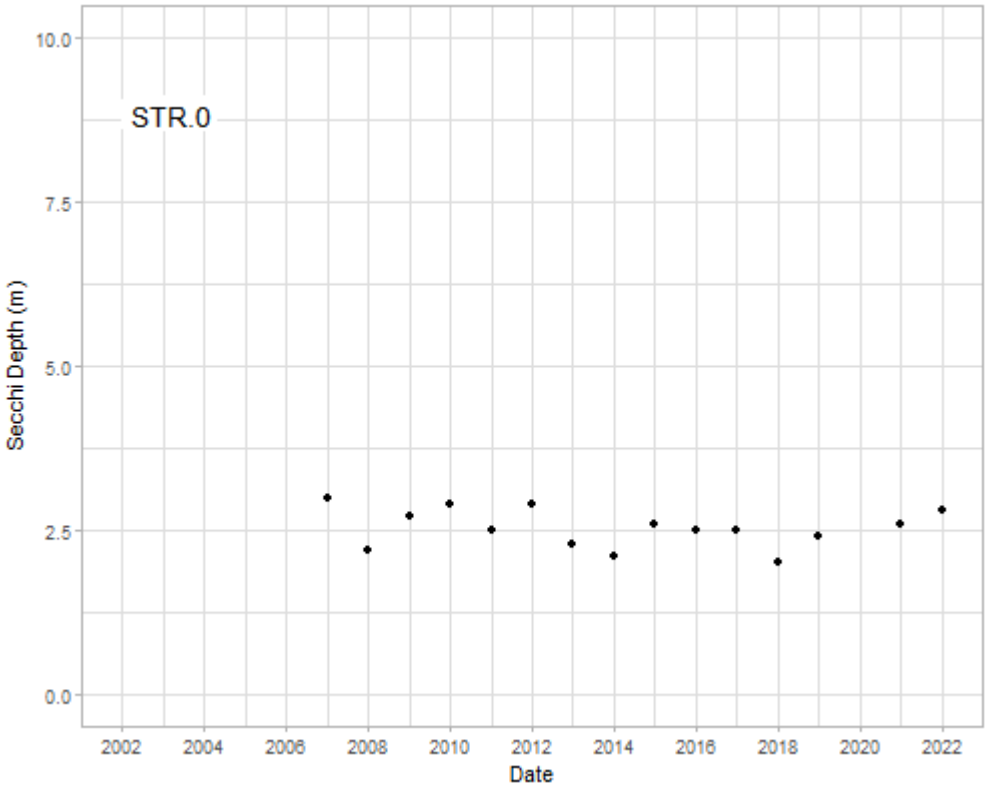
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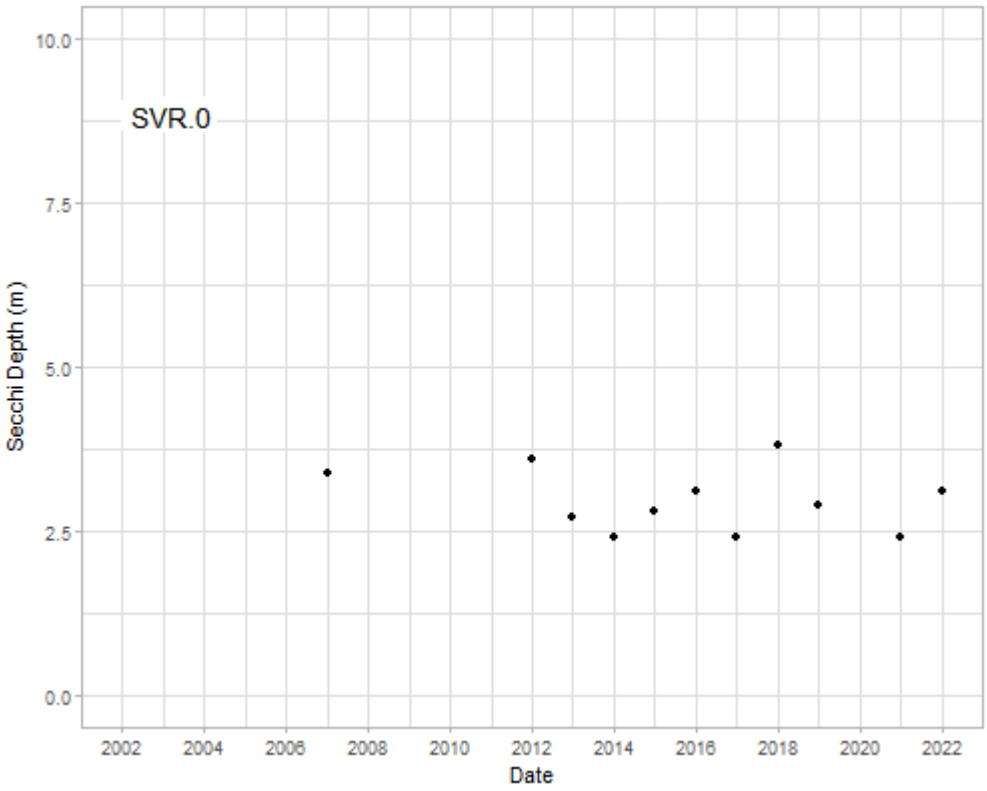
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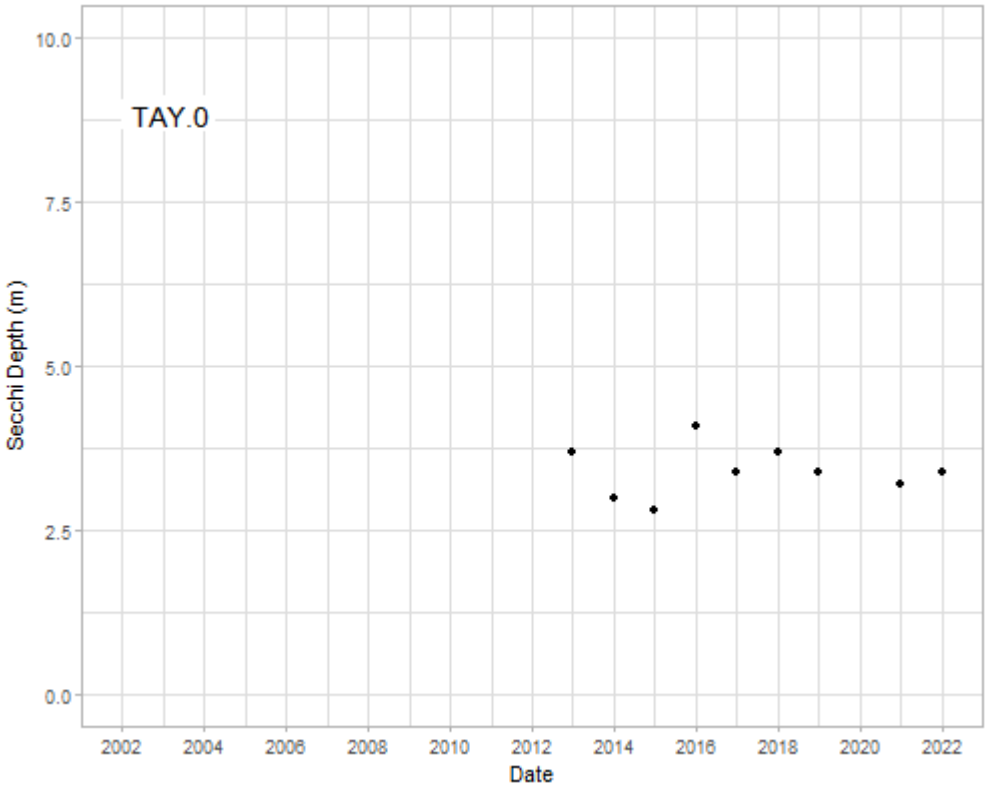
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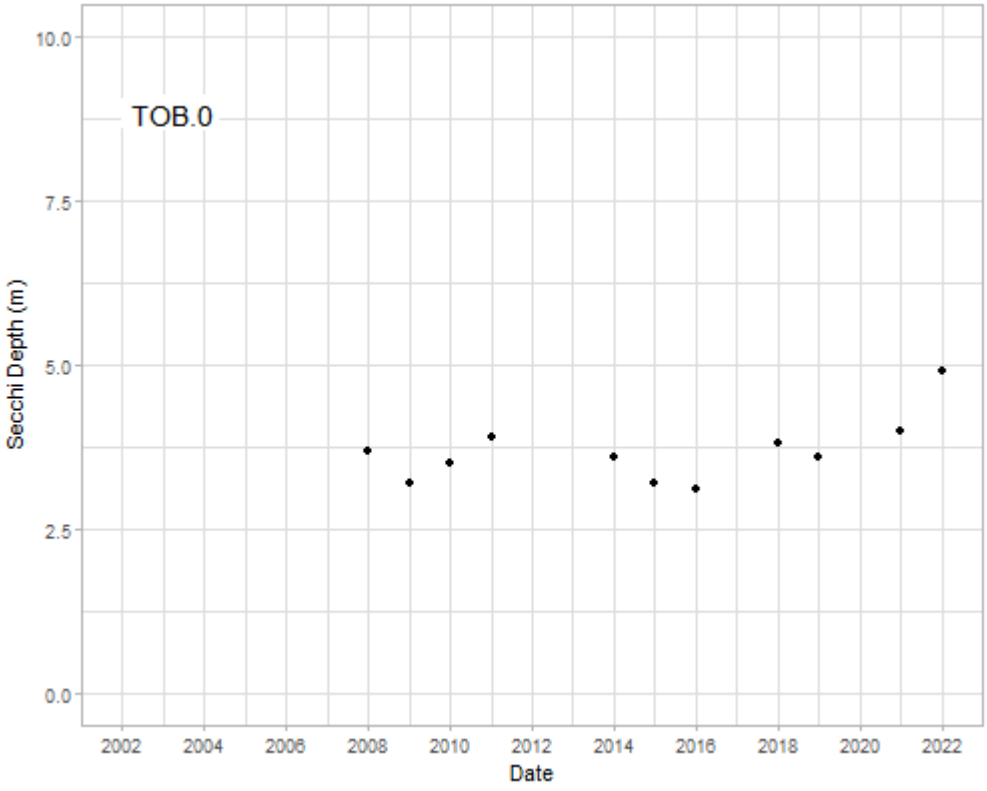
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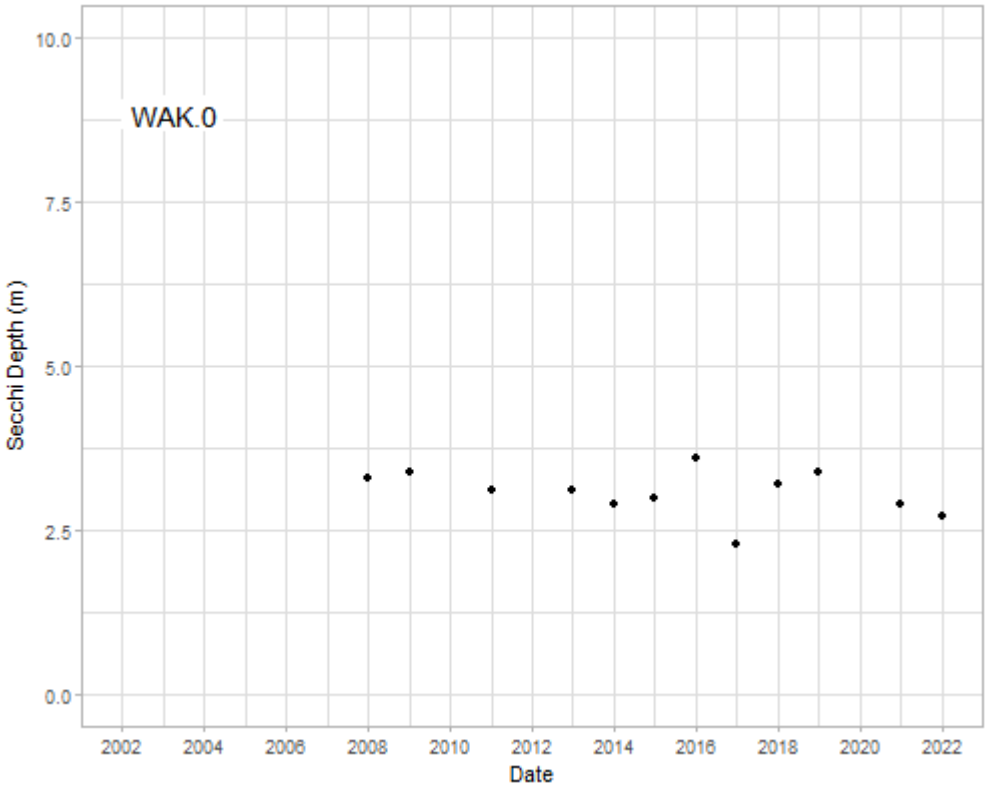
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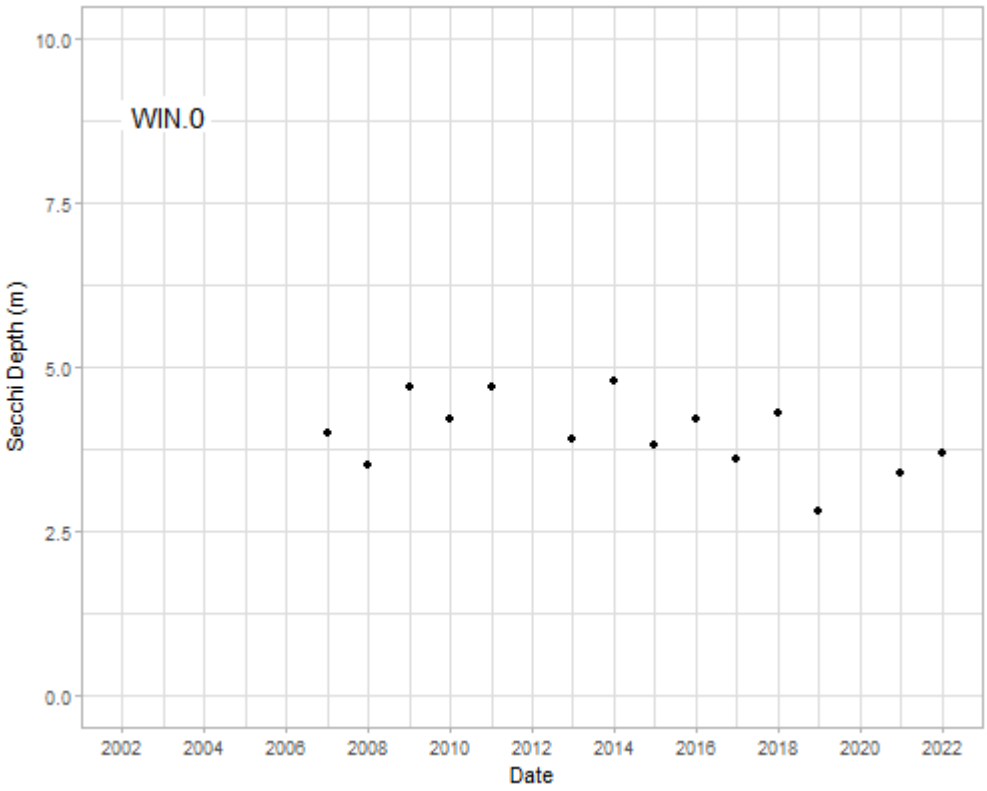
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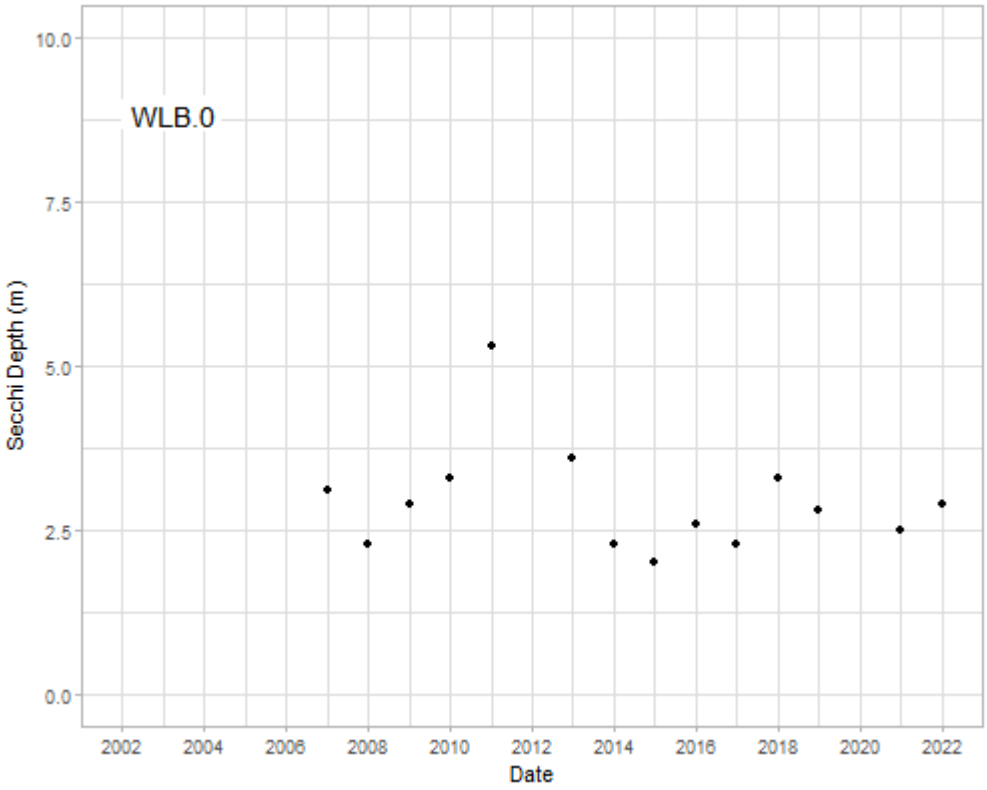
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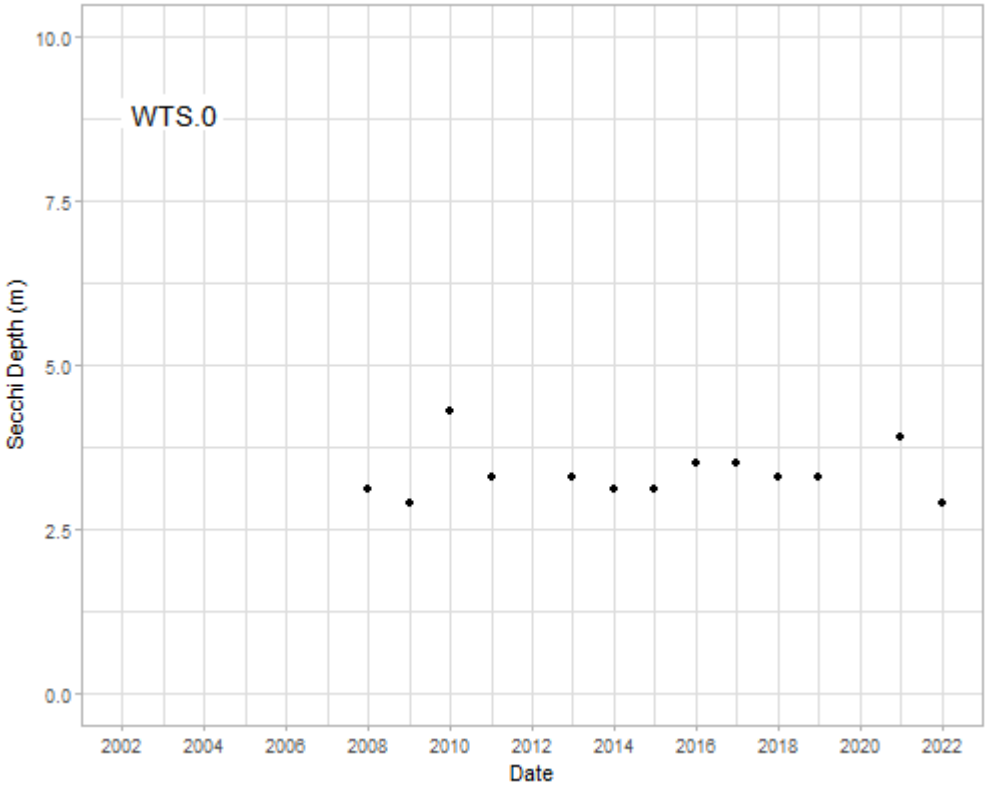
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